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STATIC GEOCHEMICAL CHARACTERISATION OF POTENTIAL TSF CONSTRUCTION MATERIAL

Vasse TSF Expansion

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REPORT



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1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) has been engaged by Fortescue Metals Group Ltd (FMG) to provide engineering support for the design of the extension to the Vasse Tailings Storage Facility (TSF) located at the Christmas Creek iron ore mine site (Christmas Creek). Included in our scope of work is a preliminary assessment of the potential for acid and metalliferous drainage (AMD) from the waste rock that will be used to construct the Vasse TSF embankment.

This report presents the results and interpretation of static geochemical testwork carried out on samples of waste rock provided by FMG. A list of abbreviations and a glossary of terms used in this report is provided as Appendix A.

2.0 OBJECTIVES

The objective of this study is to assess the AMD potential of waste rock currently stockpiled at Christmas Creek that may be used as construction material for the Vasse TSF embankment.

3.0 SCOPE OF WORK

The following scope of work for the geochemical characterisation study has been completed:

- Review of relevant geochemical data provided by FMG
- Screening-level characterisation of representative samples by the following laboratory tests:
 - Acid base accounting (ABA)
 - Net acid generation (NAG) testing
 - Paste pH and surface rinse pH/EC testing
 - Short term leach testing utilising a modified synthetic precipitation leaching procedure (SPLP)
 - Total elemental analysis
 - Mineralogical analysis.
- Static geochemical characterisation report including:
 - Laboratory results and interpretation of results for the screening level characterisation
 - Recommendations for AMD management and further work if necessary.

4.0 PROJECT BACKGROUND

4.1 General

FMG was formed in 2003 and is developing the Pilbara Iron Ore and Infrastructure Project, made up of a series of iron ore mines in the Pilbara region, as well as rail and port infrastructure for ore export through Port Hedland (Figure 1). The current series of mines includes the Christmas Creek iron ore project area and the Cloudbreak iron ore project area (Cloudbreak). The Vasse TSF, part of the Christmas Creek project area, contains deposited tailings produced by the existing ore processing facility (OPF). The Vasse TSF is to be expanded by constructing an embankment and depositing further tailings on the pre-deposited tailings within the Vasse Pit and therefore forming an above ground Vasse TSF.

Mining operations at the Christmas Creek site commenced in Quarter 1 2006 and are expected to extend over the projected mine life of approximately 25 years. Over this period it is expected that 997 million tonnes (M tonnes) of iron ore will be mined. At Christmas Creek, mining is conducted using an open-cut method, employing surface miners to extract the iron ore. The ore comprises flat-lying deposits, located close to the ground surface. To date, mining at Christmas Creek has been conducted in the Flinders, Mokare, Vasse, and Windich pits (Figure 2).



The Christmas Creek mine produces three ore products: High Grade Lump, High Grade Fines and Rocket Fines. The High Grade Lump and High Grade Fines products only require crushing and screening prior to dispatch. The low grade or Rocket Fines, however, require an additional processing step (de-sanding) to reduce the high levels of naturally occurring silica and alumina in the product (Coffey 2010a).

4.2 Current Operations

Christmas Creek currently processes all run-of-mine (ROM) ore through a dry facility, where the ore is initially conveyed to a 'dry' crushing and screening plant to screen and reduce the oversized portions. Low grade ore material is further treated in a de-sand plant (wet process) which assists in reducing the high levels of unwanted silica and alumina in the ROM ore (Coffey 2011). Currently, ore mined from Christmas Creek is processed at the existing OPF. The new OPF currently under construction at the Christmas Creek site will employ a de-sanding process similar to the process that is currently utilised at the existing OPF. The economic product and tailings generated from the new OPF is expected to be similar to that which is currently produced at the existing OPF.

Existing facilities at the Christmas Creek mine site include: the Vasse TSF, an OPF, and a second OPF under construction. The Vasse TSF is currently in its first operational stage. The Vasse above-ground TSF expansion will be designed to accommodate five years of tailings production (approximately 12 000 000 m³ at 1.5 t/m³) from the existing OPF, requiring up to 1 600 000 m³ of embankment construction material (based on a downstream embankment construction method).

4.3 Vasse TSF Extension Plans

The Vasse TSF will be constructed on top of the existing Vasse in-pit tailings storage facility (IPTSF). The tailings will be contained by the existing pit walls and a perimeter embankment built around three sides of the IPTSF. The perimeter embankment will comprise a starter embankment approximately 7 m high with two subsequent wall raises (each of 7 m) to achieve a maximum embankment height of 21 m. The dimensions of the two wall raises (Stage 2 and Stage 3) will be verified during operation of Stage 1 by conducting *in situ* monitoring and material testing to validate design assumptions made. If necessary, the Stage 2 and Stage 3 raise design will be modified to suit *in situ* conditions. The eastern and western embankments of the TSF will be raised in a downstream direction primarily because of the availability of waste material that will allow a robust closure design. The southern embankment will be raised in an upstream direction because of downstream space limitations. The starter embankment and wall raises will be constructed using compacted tailings excavated from the IPTSF and waste rock from the mining activities and waste stockpiles (Golder 2012a).

5.0 REVIEW OF RELEVANT INFORMATION

5.1 Available Information

The following information was reviewed and is considered relevant to the static geochemical characterisation report:

- Windich IPTSF - Waste Rock and Tailings Static Geochemical Characterisation (Golder 2012b)
- Christmas Creek geochemical desktop study (Coffey 2010b)
- Meteorological data
- Geological information
- Hydrogeological/hydrological information.

A summary of the data reviewed for the above areas is provided in the following sections. Limited geochemical data for the waste rock stockpiled at Christmas Creek were available for review.



5.2 Golder Windich IPTSF Geochemical Characterisation Report

The static AMD assessment program was conducted to evaluate the environmental stability of waste rock for potential use in constructing the Windich IPTSF embankment and tailings material collected from the existing OPF. The focus of the program was on the acid generating potential and metalliferous leaching potential of the waste rock and tailings.

Similar to the Vasse TSF extension, waste stockpiles were identified for use as candidate sources of construction material for the IPTSF embankment. Waste material within stockpiles was been observed to be highly variable in colour, particle size, degree of weathering and consistency.

The preliminary static geochemical characterisation program included 18 waste rock samples, 3 tailings solids samples and 2 tailings supernatant samples. The testing program included the following components: ABA and NAG testing, short term leach tests, chemical composition of solids (total elemental), mineralogical analysis and water quality testing (on tailings supernatant).

Conclusions were as follows:

- waste rock samples are classified as non-acid forming (NAF) or uncertain (UC)
- tailings samples are classified as NAF
- due to the low acid neutralising capacity (ANC) measured and the uncertain classifications, further testing is required
- five elements were measured in tailings and waste rock samples at concentrations greater than three times the average crustal abundance: antimony, arsenic, iron, manganese and silver
- selenium was measured at the limit of reporting (2 µg/L) in the SPLP extract of one of the 18 waste rock samples tested. The amount of selenium measured for this sample is below the ANZECC/ARMCANZ assessment criteria at the 95% protection level.

A kinetic testing program is in progress that includes three waste rock humidity cells and three tailings humidity cells. The aim of the kinetic program is to clarify the uncertainties from the static program and to assist with prediction of drainage water quality for the Windich IPTSF.

Selenium and boron have been identified by FMG to naturally occur at elevated concentrations at both the Christmas Creek and Cloudbreak mine sites (FMG 2007). Selenium was reported in total elemental analysis results at concentrations greater than three times the average crustal abundance in waste rock samples but was not measured above the limit of reporting (LOR) for the tailings samples. Boron was reported at a concentration equal to three times the average crustal abundance in one waste rock sample, but boron concentration in the remaining waste rock and tailings samples was reported at below the LOR.

Selenium was not measured in any of the leachates above the LOR, which was below the ANZECC/ARMCANZ criterion of 11 µg/L. Selenium was also not measured above the LOR for the tailings supernatant, but the LOR (20 µg/L) was above the ANZECC/ARMCANZ criterion.

The average reported boron concentration for the waste rock and tailings solids leachates was 62 µg/L, which is significantly below the ANZECC/ARMCANZ criterion of 370 µg/L. The boron concentration in tailings supernatant was 400 µg/L of boron, which may indicate that boron is present at concentrations greater than the ANZECC/ARMCANZ criterion in the water sourced for process water. Boron was not measured in the SPLP leachates at concentrations above 100 µg/L

5.3 Coffey Geochemical Desktop Study

Coffey Mining (Coffey) completed a desktop assessment of existing geochemical data on mine waste at the Christmas Creek mine (Coffey 2010b). Geochemical data provided included analyses results for sulfur, CaO, MgO and loss on ignition. Coffey concluded that no assessment of potential AMD was possible based



on the available geochemical data. Coffey recommended further analysis on fresh samples to assess the sulfide sulfur content of the waste material.

5.4 Climate

Christmas Creek is located in the Pilbara region, which is situated in the north of Western Australia. The area has an arid climate with annual mean evaporation rates significantly greater than rainfall. High rainfall can occur between January and March, coinciding with the development of tropical cyclones.

The following Bureau of Meteorology (BOM) weather stations and climatic data are relevant to the mine site:

- Average annual rainfall of 319 mm rainfall (as measured at Bonney Downs - BOM 4006)
- Average annual evaporation of 3158 mm (as measured at Wittenoom - BOM 5026)
- The 1 in 100 year average recurrence interval (ARI), 72 hour storm event for the mine area is approximately 4.7 mm/hr (BOM website).

Rainfall data recorded at the Bonney Downs climate station (BoM station 4006) between 1907 and 2011 are considered to be valid for the Vasse TSF. Mean monthly rainfall data show that the wettest months are from December to March, with the wettest being January and February.

Evaporation data have been recorded at the Wittenoom climate station (BoM 5026) between 1949 and 2011 and are considered appropriate for the Vasse TSF. Evaporation is highest in the months from October to March.

5.5 Regional Geology and Landforms

The topography of the eastern Pilbara is dominated by the Hamersley Plateau in the south and the Chichester Ranges in the north. These two features are divided by the Fortescue Valley. The main drainage path is the region in the Fortescue River, which flows north-west through Roy Hill Station and into the Fortescue Marshes. The pre-mining topography of the project area was described as hilly to undulating terrain, sloping south south-west towards the Fortescue River Valley (FMG 2006). The elevation of the project area at Christmas Creek ranges between RL 440 m and RL 500 m.

The project area is situated within the Hamersley Basin, an area where the granitoid rocks of the Pilbara Craton are overlain by Archaean sedimentary rocks. The lowest of the sedimentary group is known as the Fortescue Group, which is overlain, in parts, by the Hamersley Group. These sedimentary formations were originally formed in horizontal layers. Over time, however, tectonic movement has resulted in folding of the rocks and several major geological faults have developed. Bedrock iron ore mineralisation is hosted along the Chichester Range (i.e. at Christmas Creek and Cloudbreak) by the Nammuldi Member contained within the Marra Mamba Iron Formation, which itself forms part of the Hamersley Group. The Nammuldi Member is underlain by the Roy Hill Shale Member of the Jeerinah Formation, which is the uppermost geological unit of the Fortescue Group. To the south of the Chichester Range, the Nammuldi Member is concealed beneath mixed layers of sand, clays and gravels (alluvium and colluvium) of Tertiary age, referred to locally as Tertiary Detritals (FMG 2006).

5.6 Local Geology and Landforms

The geology of the Christmas creek area is typically composed of tertiary alluvial and detritals overlying shales and banded iron formations. A 'hardcap' is often encountered below the tertiary deposits, and marks the start of the mineralised zones. The stratigraphy is gently folded, with north-south or north-east - south-west trending fold hinges that plunge gently to the south or south-west.

FMG has undertaken exploration drilling around the Vasse pit area. This drilling indicated the Tertiary Detritals material extends from ground level to depths between 0.5 m below ground level (m bgl) to 20 m bgl.



5.7 Hydrogeology

Christmas Creek is situated on the mid to lower slopes of the Chichester Range along the northern edge of the Fortescue Marsh. The area is characterised by the presence of three main groups of aquifers: unconsolidated sedimentary (Tertiary Detrital); chemically deposited (mineralised formation - Calcrete); and fractured rock (Dolomite and Banded Iron Formation (BIF)). The soil and rock hydraulic conductivities have been estimated from bore pumps tests carried out in the Christmas Creek area. Values range between approximately 6×10^{-5} m/s and 4.5×10^{-3} m/s. Lower values were found for the Tertiary Detritals and the fractured rock Marra Mamba Formation units, while higher values were found for the mineralised Marra Mamba Formation (FMG 2011).

Mining conducted at Christmas Creek uses an open-cut method of mining, employing surface miners to extract the iron ore, which is composed of flat-lying deposits located close to the ground surface. The shallow pit surface mining approach being implemented has resulted in an average pit depth of approximately 20 m bgl for the Vasse pit (now Vasse IPTSF). This relatively shallow pit depth means that the pit shell is limited to the uppermost of the three hydrogeological layers described above: the unconsolidated sedimentary (Tertiary Detritals) layer.

5.8 Surface Water

Christmas Creek is located on the southern edge of the Chichester Plateau, to the north of the Fortescue Marshes. The Fortescue Marshes are an extensive intermittent wetlands located along the upper reaches of the Fortescue River, which occupy an area approximately 100 km long by 10 km wide. Numerous intermittent creeks flow into the Fortescue Marshes from the southern and northern flanks of the Fortescue Valley with one such creek located approximately 250 m east of the Vasse TSF footprint. Encroachment into the floodway of the adjacent creek was identified as a siting constraint by FMG and as such the Vasse TSF has been situated so as not to impede seasonal flow of the creek. Christmas Creek is situated well above any potential flood level in the Fortescue Marshes (Coffey, 2010b). Bunding around the pit perimeter was constructed to prevent external surface water from entering the Pit, and subsequently surface water will be diverted away from the Vasse TSF embankments.

5.9 Groundwater

Groundwater levels are a subdued reflection of the topography of the region. In the project area maximum groundwater levels are recorded along the topographic highs associated with rocks of the Hamersley and Fortescue Groups, whilst groundwater levels are lowest in low-lying areas associated with creeks of the Fortescue River system and the Fortescue Marshes. Groundwater beneath the Marshes and their surrounding areas is saline, while closer to the Chichester Ranges the groundwater is fresher (Coffey 2010c).

URS Australia Pty Ltd (URS) have summarised the groundwater conditions at the Christmas Creek Mine Site (URS, 2012, incorporating findings from FMG, 2010 as follows:

Christmas Creek is situated on an area of the Chichester Range that drains in a southerly direction towards the Fortescue Marsh. Typically, arid Pilbara conditions control the hydrological regime at the site with sporadic but intense wet season rainfall events (thunderstorms and tropical cyclones) resulting in ephemeral surface water flows and regional groundwater recharge. Significant storm flows that drain to the Fortescue Marsh cause it to periodically flood and are of lower salinity than stored water and baseflow.

Rates of evaporation significantly exceed annual rainfall and the cycles of flood and evaporation across the Fortescue Marsh basin have developed a hypersaline body of groundwater beneath the Fortescue Marsh area. The hypersaline groundwater extends north towards the Chichester Range and interacts with less dense brackish water, draining from the range, in a transition zone at the north edge of the basin.

The mineralised Marra Mamba Formation (MMF) ore body being mined at Christmas Creek is an important hydrogeological feature within the region, exhibiting high permeability and being the most significant brackish aquifer in the area of the mine. The MMF aquifer is overlain by generally lower permeability Tertiary Detritals (TD) consisting of colluvial, alluvial and chemical sediments; although a zone of silcrete and calcrete (known



as the Oakover Formation) is the exception to this and represents a shallow aquifer, which is naturally saline south of the mine site due to its interaction with marsh basin groundwater.

Although the overlying TD units generally exhibit lower permeability, they do represent a significant brackish groundwater body and in many areas have shown direct connectivity with the deeper MMF. Dewatering of the MMF does result in drawdown of groundwater levels in nearby TD units. The majority of mining operations to date have involved extraction of above-water-table mineralized MMF. Based on information provided by FMG it is understood that from 2012, mining rates will increase and mining will proceed below the water table, which will involve a considerable increase in groundwater abstraction, management and re-injection.

Based on the URS report, the groundwater elevation at Christmas Creek varies in the range of RL 411 m to RL 421 m. In the vicinity of the Vasse pit the groundwater elevation is at the higher end of this range. The minimum elevation of the Vasse pit floor varies from approximately RL 427 to RL 431 m and the top elevation of the tailings that fill the pit in that area is approximately RL 449 m. This means that the base of the Vasse IPTSF is entirely above the natural groundwater table. Additionally, the groundwater elevation at Christmas Creek will be drawn down as part of the dewatering program developed to make accessible ore located below the pre-mining groundwater level.

6.0 GEOCHEMICAL CHARACTERISATION METHODS

The static AMD assessment program was conducted to evaluate the environmental stability of waste rock for potential use in constructing the Vasse TSF embankment. The focus of the program was on the acid generating potential and metalliferous leaching potential of the waste rock.

6.1 Sample Details

A total of 36 waste rock samples from 37 different locations were logged and collected by Tetra Tech between 13 and 15 June 2012 (Tetra Tech 2012). Sampling locations from several stockpiles and three test pits surrounding the Vasse TSF were selected by Golder as part of the concurrent geotechnical studies from which geochemical samples were also collected. Figure 3 - Sampling Locations, presents the locations of the various waste rock stockpiles and the three test pits sampled. Waste rock stockpiles selected have been identified for use as candidate sources of construction material for the Vasse TSF embankment.

A total of 36 waste rock samples were submitted for static geochemical testing. The sample number was based on Table 8.2 of "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials" (Price 2009) and an estimated waste rock volume of 1.6 M tonne required for the Vasse TSF embankment.

From the 36 waste rock samples, a sub-group of 14 were selected for further detailed testing including mineralogical analysis, total elemental analysis and leaching tests. The sub-group was selected by taking into account logging sheets provided by Tetra Tech and preliminary ABA and NAG testing results.

Logging sheets produced by Tetra Tech show that mostly, material was logged as red brown fill with three locations logged as natural alluvium. Most of the material encountered was logged as containing variable amounts of goethite, hematite, martite and shale. No material origin details were provided for the waste rock stockpiles and it is unclear what pit the waste was mined from. Tetra Tech logs are presented as Appendix B.

Sample details are provided in Table 1.

A brief sampling protocol was provided to FMG personnel for the previous Windich geochemical characterisation assessment. Golder instructed FMG to follow the same procedure for collection of samples for geochemical analysis. Samples were delivered to the Golder laboratory in Osborne Park where sub-samples were then prepared by Golder personnel for laboratory testing. The residual material was then stored at the Golder laboratory for possible further testing, if required.



6.2 Laboratory Testing and Analysis

All samples were submitted to SGS Environmental (SGS) in Newburn, Western Australia. Mineralogical analysis was subcontracted by SGS to Microanalysis, Victoria Park, Western Australia. A summary of the laboratory methods that were used is provided in Appendix C.

The testing program included the following components:

- Semi-quantitative mineralogical analysis using x-ray diffraction (XRD)
- Chemical composition of solids (total elemental analysis)
- ABA, paste pH and surface rinse pH/EC testing
- NAG testing
- Short term leaching tests.

6.3 Mineralogical Analysis

Mineralogical analysis was used to identify minerals of potential environmental importance, in particular potentially acid generating minerals (e.g. sulfides), acid neutralising minerals (primarily carbonates and some silicates), and readily-soluble minerals (e.g. sulfates). Samples were submitted by SGS to Microanalysis for semi-quantitative XRD analysis.

XRD results are reported as %w/w and have a corresponding International Centre for Diffraction Data (ICDD) match probability. The ICDD match probability is reported (as an indication only) as to how well the peak positions and relative intensities for the sample matched those in the published literature for that particular compound.

A 'good' match will match the positions and intensity ratios of all peaks. A 'medium' match may have slight differences in peak intensity, width and position or obscuration of the peaks by the background that can be explained by preferred orientation, fluorescence, extinction, crystallite size and strain within the crystal lattice. A 'low' match is either the best match to the experimental pattern that still has unexplained differences, or describes a pattern which has only one peak to match.

6.4 Total Elemental Analysis

The results of solid-phase chemical analysis are a potential indication of the presence of elements of potential environmental concern in higher than typical concentrations. It is emphasised that a high solid concentration of a particular element does not necessarily imply that the element will be mobilised at a concentration harmful to the environment.

Samples were digested with strong acid and the filtered solution analysed by inductively coupled plasma mass spectrometry (ICP-MS) or inductively coupled plasma optical emission spectrometry (ICP-OES) for a suite of metals and metalloids.

6.5 Acid-Base Accounting plus pH/EC Testing

ABA was used to assist with evaluation of acid generation characteristics through estimation of the acid neutralising capacity (ANC) and the maximum potential acidity (MPA). Paste pH and surface rinse pH/EC tests are not standard ABA tests but aid the interpretation of the other tests and analyses as ancillary data. ABA analysis included measurement of the following:

- **Total sulfur (%):** Total sulfur content is measured by heating a sample in a LECO furnace to ~1650°C and measuring the sulfur dioxide production.
- **Acid soluble sulfur (%):** This method measures the soluble sulfate (SO_4^{2-} -S) content by extraction with hydrochloric acid. Sulfides are not as reactive as sulfates and are excluded from the dissolution. Sulfur



in the extract is measured by ICP. Sulfide sulfur is calculated by subtracting sulfate sulfur from total sulfur.

- **MPA (%S):** This is an estimate of the maximum possible acid production of a sample. MPA is a function of the sulfide (S) content, based on the stoichiometric assumption that the maximum acidity produced by a sample containing 1% of S as pyrite is 30.6 kg H₂SO₄/t. MPA is calculated using total or sulfidic sulfur as follows:

MPA (kg H₂SO₄/t) = wt% Total Sulfur (or Sulfidic Sulfur) × 30.6

- **ANC (kg H₂SO₄/t):** This titration method measures the amount of acid that a sample can neutralise. The test estimates the buffering capacity of a sample due to dissolution/weathering of other minerals in the sample that consumed acid formed from pyrite oxidation. The ANC was reported in kg of H₂SO₄ consumption per tonne of waste (kg H₂SO₄/t).

Samples are initially evaluated to measure the strength of titration reagents needed using a fizz test. Samples were subjected to an excess of hydrochloric acid followed by alkaline back titration to pH 7. Results were expressed in kg H₂SO₄/t or kg CaCO₃/t after correction for moisture content, if applicable.

- **Paste pH:** The paste pH procedure is designed to more closely approximate the water to solid ratio of pore water in wastes as compared to other pH test procedures. A 1:2 solid to water ratio was used and the sample was prepared by crushing/pulverising.
- **Surface rinse pH/EC:** The surface rinse pH/EC procedure involved testing a whole sample with a 1:5 solid to water ratio.

6.6 Net Acid Generation Tests

The NAG procedure uses a strong oxidant (hydrogen peroxide) to rapidly oxidise predominantly available sulfide minerals in a crushed sample of the entire rock (AMIRA 2002). The ANC of the sample can then be directly challenged by the acidity generated by rapidly oxidising sulfides. If the sample has sufficient available ANC, the alkalinity of the whole rock will not be entirely depleted, and the system is expected to have the capacity to remain circum-neutral.

The NAG pH and NAG capacity are the key parameters obtained from NAG test results. If there is inadequate available ANC, then the NAG pH of the test solution will fall below 4.5 and the NAG capacity will be positive (AMIRA 2002),¹ indicating net acidity rather than net alkalinity. If the NAG pH is less than 4.5 and the NAG capacity is <5 kg H₂SO₄/t, then the sample is still considered potentially acid generating, but with low capacity. Values >5 kg H₂SO₄/t indicate a high capacity for acid generation.

6.7 Short Term Leaching Tests

The short-term nature of these leaching tests provides an indication of a material's potential to leach constituents of concern in the material's current condition. Test results depend entirely on the current geochemical condition of the sample (e.g. un-oxidised vs. oxidised; oxidation products present vs. absent). For reactive rocks, the mechanisms that lead to changes in solution chemistry during water-rock interaction often develop over periods of time are much greater than can be represented in a short-term leach test (e.g. sulfide oxidation). If a material is relatively "fresh" and un-oxidised, further long term testing is often required to assess the changes that may occur through the oxidation process.

Modified synthetic precipitation leaching procedure (SPLP; USEPA Method 1312) testing was conducted on air-dried samples at a 1:10 soil to water ratio and a pH 5.0 lixiviant. The leachates were analysed for pH, major ions and elemental composition using a range of analytical techniques as summarised in Appendix C. A list of analytes is included as Appendix C.

¹ The NAG criteria of pH 4.5 and NAG capacity above 5 kg H₂SO₄/tonne is an estimate and will vary from site to site.



6.8 Acid Forming Potential Classification

Guidelines for evaluating acid forming potential of mine wastes presented by AMIRA International (AMIRA) and the Mine Environment Neutral Drainage Program (MEND) are summarised in Table 4. The AMIRA 2002 guidelines are commonly used in Western Australia for the evaluation of ABA and NAG results: these guidelines were adopted for this static geochemical characterisation program. However, consideration was also given to the MEND (Price 2009) classification scheme when classifying the materials.

The following categories are used in the AMIRA classification system:

- Non-acid forming (NAF)
- Potentially acid forming (PAF)
- Uncertain.

7.0 RESULTS

This section presents the results of the static geochemical characterisation for the waste rock samples. An overall assessment of the AMD potential of the waste rock samples based on the collective interpretation of all test results is provided in Section 8.0. SGS and Microanalysis laboratory certificates for the results are provided in Appendix D. For statistical calculations, values reported as below the LOR were conservatively considered equal to the LOR.

7.1 Mineralogical Analysis

Mineralogical data for the 14 samples tested are presented in Table 2. The principal mineral phase identified in eight of the waste rock samples was the iron oxy-hydroxide goethite and on average comprised approximately 40% by weight (w/w) of the sample analysed. Hematite (iron oxide), quartz (silicate) and kaolinite (aluminium silicate) were the next most abundant minerals identified with average contents for the samples tested of 19%w/w, 18%w/w and 15%w/w, respectively.

Three sulfide minerals were identified in five waste rock samples. Arsenopyrite was interpreted to be present in three samples within the range of 5.5%w/w and 13.2%w/w; however, the probability match reported by Microanalysis was low for the maximum value and medium for the remaining two arsenopyrite detections. Pentlandite was interpreted to be present in two samples at concentrations of 0.9%w/w and 2.1%w/w; the probability match for pentlandite was also reported as low and medium probability. Chalcocite, which is non-acid producing, was identified in one sample at 5.3%w/w and reported as low probability. The identification of sulfides from XRD analysis will be discussed further in Section 7.3 in concert with ABA and NAG results.

The acid neutralising carbonate mineral calcite was identified in waste rock collected from location #4 with content of 2.4%w/w. No other carbonate minerals were identified.

Other minerals identified in minor amounts were the oxide magnesio-ferrite and silicates halloysite, sodium magnesium silicate and chamosite.

7.2 Total Elemental Analysis

Table 3 presents total elemental analysis results and the average, minimum, and maximum concentrations of each element for both the waste rock samples and the tailings samples. For comparison, the table also provides the average crustal abundance and three times the average crustal abundance for each element (Mason and Moore 1982).

Figure 4 compares the concentration of each element in all samples to three times the average crustal abundance and highlights the elements measured at concentrations greater than three times the average crustal abundance.

Seven elements were measured at concentrations greater than three times the average crustal abundance in one or more samples: antimony, arsenic, boron, iron, manganese, selenium and sulfur. These parameters



may be of environmental concern if these higher concentrations can be mobilised; this should be further evaluated through leach testing, such as the short term leach testing described in Section 7.4.

Iron concentrations are between 6 to 12 times greater than the average crustal abundance (50 000 ppm). The high iron content observed in total elemental concentration results is consistent with the type of ore deposit. The majority of samples had sulfur concentrations between 12 and 24 times greater than the average crustal abundance (26 ppm). The iron and sulfur results could suggest the presence of potentially acid generating iron sulfides or secondary iron sulfate phases.

Arsenic was elevated with respect to the average crustal abundance (1.8 ppm) in all waste rock samples. Of the 14 samples, 12 had total arsenic concentrations between 12 and 48 times the average crustal abundance. Arsenic and the remaining elements antimony, boron, manganese and selenium are all considered to be ecotoxic elements of concern (ANZECC & ARMCANZ 2000). While the arsenic is generally elevated in the samples, elevated concentrations of arsenic do not correlate with the arsenopyrite potentially detected by XRD (Section 7.1). This inconsistency may indicate that arsenic is present in forms other than arsenopyrite, such as sorbed or co-precipitated with an iron phase. Given the uncertainty as to form, the mobility of arsenic is assessed based on the results of the leach testing presented in Section 7.4.

Selenium concentrations in the waste rock samples were below the LOR in 10 of the 14 samples, but calculated averages consider values below the LOR to be equal to the LOR. As the LOR for selenium (1 ppm) is greater than three times the average crustal abundance value of 0.05 ppm, the minimum concentration and calculated average is plotted in Figure 4 as greater than three times the average crustal abundance.

7.3 Acid Base Accounting plus pH/EC Testing

The results of ABA, pH/EC tests and NAG testing are presented in Table 5.

7.3.1 Total Sulfur and Sulfate Sulfur

The total sulfur concentrations for the 36 waste rock samples were between <0.005% by weight (w/w) and 0.160%w/w with an average value of 0.025%w/w. Sulfate sulfur concentrations were below the LOR (0.05%w/w) in all but one waste rock sample; the sulfate sulfur concentration measured in material collected from location 28 was equal to 0.05%w/w indicating the sulfur measured is in the oxidised form. Sulfate sulfur concentrations equal to the LOR for the remainder of the samples may indicate that the limited sulfur measured in the samples is in the reduced form and not the oxidised form; however, because the LOR for sulfate is 10 times greater than the LOR for total sulfur this is not conclusive.

Total sulfur concentrations were below the limit of reporting in four of five samples identified as sulfide bearing by XRD analysis and 0.021%w/w in the fifth sulfide bearing sample. These total sulfur concentrations contradict XRD results, for example, an arsenopyrite composition of 13.2%w/w in sample collected from location #26 is equivalent to a total sulfur concentration of 2.6%w/w, should arsenopyrite be the only source of sulfur within the sample.

Assessing NAG test results with ANC concentrations in section 7.3.6 will assist clarification of the contradiction between total sulfur concentration and XRD results.

7.3.2 Maximum Potential Acidity

Typically, to minimise overestimation of the acid producing potential of the samples, sulfide sulfur concentrations are calculated by subtracting concentrations of measured sulfate sulfur from the total sulfur concentration as sulfate sulfur does not contribute to acidity concentrations. Due to the absence of sulfate sulfur detected in the waste rock samples, total sulfur concentrations have been used in maximum potential acidity (MPA) calculations.

MPA concentrations calculated for the waste rock samples are between <0.2 and 4.9 kg of H₂SO₄ generated per tonne of waste (kg H₂SO₄/t).



7.3.3 Acid Neutralising Capacity

The minimum ANC of the selected samples was below the detection limit (<1.0 kg of H_2SO_4 neutralised per tonne of waste), and the maximum was 25 kg $\text{H}_2\text{SO}_4/\text{t}$. ANC concentrations for three samples were above 10 kg $\text{H}_2\text{SO}_4/\text{t}$ (sample locations #4, #7, #19).

These data show that in the majority of samples collected, measured concentrations of ANC are fairly low indicating minimal capacity to neutralise any acidity that is potentially generated. This is consistent with the results from the mineralogical analysis which identified limited mineral with buffering capacity. The carbonate mineral calcite was only identified in one sample which also had the highest ANC concentration.

7.3.4 Net Acid Producing Potential

Net acid producing potential (NAPP) is calculated as the difference between MPA and ANC. A negative NAPP concentration indicates that a sample probably has sufficient ANC to prevent acid generation and conversely, if MPA exceeds ANC, the material may be acid generating. The minimum NAPP calculated for the 36 samples was -24.8 kg $\text{H}_2\text{SO}_4/\text{t}$ and the maximum NAPP calculated was -0.3 kg $\text{H}_2\text{SO}_4/\text{t}$.

Figure 5 shows MPA concentration versus NAPP for all samples and shows that the samples with the highest MPA concentration also have the highest calculated NAPP values, as expected.

7.3.5 Paste pH and Surface Rinse pH/EC

Paste pH is a qualitative measurement of the current acid-base characteristics of a sample. The paste pH reflects the balance of readily-soluble acid generating and acid neutralising components within the sample. All except three samples had circum-neutral paste pH readings (6.5-8.0). Two samples recorded slightly acidic paste pH readings (sample locations #2 and #34; paste pH's of 6.4 and 6.2, respectively) and one sample was slightly alkaline (sample location #4; paste pH of 8.2).

Figure 6 presents paste pH values versus MPA and ANC concentrations. No significant trends were observed between the paste pH and MPA concentration which is not surprising considering the maximum MPA concentration was 4.9 kg $\text{H}_2\text{SO}_4/\text{t}$. Paste pH versus ANC concentration is comparable to the paste pH versus MPA concentration. Predictably, the sample with the highest paste pH (collected from location #4) also had the highest ANC concentration.

Values for the surface rinse pH test were very similar to the results from the paste pH test and were within the range 6.2-8.5 as shown in Table 5. The surface rinse EC results (Table 5) generally indicated low salinity potential with all samples within the range of 7 to 1100 $\mu\text{S}/\text{cm}$.

7.3.6 Net Acid Generation Testing

The NAG pH may be indicative of potential long-term conditions because it accounts for the oxidation of available sulfides and subsequent neutralisation by available neutralisation potential. The minimum NAG pH value for the waste rock samples was 5.5, the maximum NAG pH value was 8.9 and the average NAG pH value was 6.7 (neutral). As shown in Table 5, a total of 17 samples had slightly acidic NAG pH values (5.5-6.5), three samples had slightly alkaline pH values (8.0-8.9) and the remaining samples had neutral NAG pH values (6.5-8.0). Generally, the NAG pH values were comparable to the paste pH values indicating that the available acidity is proportional to the total acid generating potential for the waste rock samples.

Figure 5 shows the relationship between NAG pH and MPA concentration for all samples. No identifiable trend is observed which can be expected as the MPA concentration range is very narrow. Also shown on Figure 5 is that no NAG pH values were measured below 4.5 which is typically used as "cut-off" value when using the AMIRA (2002) acid generating classification.

The NAG capacity is a direct measurement of the net amount of acid generated by a sample as opposed to the NAPP which is a calculated value. The minimum NAG capacity of the samples was <0.5 kg $\text{H}_2\text{SO}_4/\text{t}$ and the maximum NAG capacity was 1 kg $\text{H}_2\text{SO}_4/\text{t}$ (Table 5). A total of 12 samples recorded NAG capacity values above the LOR and were all between the LOR and 1.0 kg $\text{H}_2\text{SO}_4/\text{t}$. These values are considered



relatively low (e.g. Miller et al. 1997). In addition, the 24 waste rock samples with NAG capacity values below the LOR are in agreement with the calculated NAPP concentrations.

7.3.7 Acid Forming Potential

An acid forming potential classification was assigned to each sample based on the AMIRA classification presented in Table 4. Figure 7 shows that all waste rock samples tested plot within the NAF field as NAG pH is below 4.5 and NAPP concentrations are negative in all samples.

Table 5 also presents the ANC/MPA ratio which is equivalent to the neutralisation potential ratio (NPR) used in the MEND classification system presented in Table 4. As illustrated in Figure 7, all except five samples would be classified as NAF according to the MEND classification system as the ANC/MPA ratio is above 2. The remaining five samples would be classified as uncertain (UC) with ratios between 1 and 2.

The uncertain classification arises as the samples could possibly be PAF if the ANC is insufficiently reactive or it is depleted at a faster rate than any sulfides present. However, a total of 24 waste rock samples had ANC/MPA ratios above 5 indicating it is likely that there is sufficient acid neutralising material to account for the five uncertain samples.

7.4 Short Term Leaching Tests

Results for the modified SPLP tests are presented in Table 6. Baseline groundwater data can be used to develop site specific trigger values when evaluating potential leachate contaminants (ANZECC & ARMCANZ 2000). At the time of reporting, baseline groundwater data are not available to develop site values that would indicate contaminants of concern. For this reason the SPLP results were compared to the 95% environmental protection criteria of the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ) guidelines for freshwater quality (ANZECC & ARMCANZ 2000). Direct comparison of the results to standards is not appropriate as numerous factors between the laboratory and field can affect results (e.g. water to rock ratio); however, a comparison to standards does provide a reference point.

Values above or outside the ANZECC/ARMCANZ 95% protection criteria (referred to as 'assessment criteria' from here within) are highlighted in Table 6.

7.4.1 Major Parameters

All leachate pH values measured were within the range of 6.4 and 8.6 indicating circum-neutral to slightly alkaline conditions under test conditions. Electrical conductivity values indicate fresh water conditions and were within the range of 49 to 670 $\mu\text{S}/\text{cm}$.

Measured nitrate concentrations in all samples were above the assessment criterion of 1 mg/L and were within the range of 1.3 and 26 mg/L. The median nitrate concentration was 4 mg/L. The elevated nitrogen concentrations were fairly consistent with nitrate concentrations measured in leachate from static leach testing of waste rock material characterised for the Windich IPTSF embankment (Figure 2). In this case, the nitrate concentrations from the 18 waste rock samples were within the range of 1.0 to 8.4 mg/L.

It is possible that nitrate could be naturally elevated within the Christmas Creek area; however, without background groundwater quality data this is difficult to confirm. The elevated nitrate concentrations may also be indicative of blasting residues as geological sources of nitrates are rare given their high solubility. The current Windich IPTSF kinetic testing program which includes waste rock material will assist in assessing the long term leaching potential for nitrate.

7.4.2 Metals and Metalloids

The limit of reporting (LOR) for several metals and metalloids were above the assessment criteria, this is addressed in Section 7.4.3.

Boron, cadmium, chromium, copper and zinc were all leached in waste rock samples at concentrations above the assessment criteria as described below.



- Boron was leached at concentrations within the range of <0.2 and 0.7 mg/L and was above the assessment criterion of 0.37 mg/L in eight samples.
- Cadmium leached from six waste rock samples above the assessment criterion of 0.0002 mg/L. The minimum and maximum cadmium concentrations were <0.001 and 0.002 mg/L, respectively.
- Chromium concentrations were above the assessment criterion of 0.001 mg/L in three waste rock samples. The minimum chromium concentrations measured in the leachate was <0.005 mg/L and the maximum concentrations was 0.013 mg/L.
- The minimum copper concentration reported was <0.005 mg/L and the maximum concentration was 0.36 mg/L. Copper leach concentrations in eight samples collected were above the assessment criterion of 0.0014 mg/L.
- Zinc was leached at concentrations above the assessment criteria of 0.008 mg/L in all samples except one waste rock sample collected from location #38, which was below the LOR (<0.01 mg/L). Zinc concentrations were within the range of <0.01 mg/L to 0.26 mg/L; all samples with reported zinc concentration above the LOR were greater than an order of magnitude above the assessment criteria.

Of the six metals/metalloids (antimony, arsenic, boron, iron, manganese and selenium) reported as being enriched relative to three times the average crustal abundance in the waste rock samples, only boron was reported at concentrations greater than the assessment criteria in the short term leachates. Antimony, arsenic and selenium were not leached above the limit of reporting from any waste rock sample.

7.4.3 Quality Assurance/Quality Control

The limit of reporting for several elements was higher than expected for the leachate analysis. As a result of elevated laboratory limit of reporting levels, the limit of reporting for several metals/metalloids is above the assessment criteria. These are; antimony, beryllium, cadmium, chromium, copper, lead, selenium, silver and zinc.

Although the majority of these elements were not observed above the limit of reporting in many leachates, as the limit of reporting is above the assessment criteria we cannot categorically dismiss these metals/metalloids as potential contaminants.

Laboratory QA/QC reports are provided as Appendix D.

8.0 CONCLUSIONS

Golder interprets the waste rock samples tested as having a low potential to produce acidity. The drainage generated from the Vasse TSF embankment, should it be constructed out of the tested material, is expected to be circum-neutral. However, the drainage may still contain elevated nitrate concentrations and elevated concentrations of some trace metals (e.g. boron, cadmium, chromium, copper and zinc).

The above conclusions with respect to acid generation potential were made based on the following:

- the average NAG pH and paste pH values were neutral (6.7 and 7.2, respectively) and all NAG pH values were above 5.5
- the average short term leachate was neutral and all leachates were within the range of 6.4 and 8.6
- all NAPP concentrations were negative
- all waste rock samples were classified as NAF under the AMIRA classification system by ABA testing
- the majority of samples (85%) were classified as NAF under the MEND classification system and no samples were classified as PAF by ABA testing
- sulfides were identified through mineralogical analysis in 5 of the 14 samples analysed, although the match probability was noted as medium to low by the laboratory. These results are inconsistent with the ABA and NAG results which indicated lower sulfide content and little acid generation potential.



With respect to leaching of metals, metalloids, and other constituents, Golder offers the following observations:

- nitrate, boron, cadmium, chromium, copper and zinc were leached above the assessment criteria from waste rock samples in short term leach tests
- selenium, which has been identified along with boron by FMG to naturally occur at elevated concentrations, was not measured in any of the leachates above the LOR
- while antimony, arsenic, boron, iron, manganese and selenium were identified as elevated in the solid phase relative to crustal abundance, only boron was measured at concentrations greater than the assessment criteria in the short term leachates.

In the absence of background groundwater quality data that may allow the development of site specific trigger values, management of runoff and seepage from the Vasse embankment material may be required.

8.1 Assessment Criteria

It is important to recognise that the leachates were assessed relative to the ANZECC/ARMCANZ 95% environmental protection criteria (ANZECC & ARMCANZ 2000). Direct comparison of the results to standards is not appropriate as numerous factors between the laboratory and field can affect results (e.g. water to rock ratio); however, a comparison to standards does provide a reference point. Ideally, site specific trigger values would be generated based on background groundwater quality data to avoid relying on generic guideline trigger values. In the vicinity of an ore body, geological material will have elevated metals and metalloids concentrations; therefore, surrounding groundwater may also have naturally occurring high levels of metals and metalloids.

Therefore, to avoid ongoing and potentially unnecessary management of the Vasse TSF embankment drainage for constituents that could include nitrate, boron, cadmium, chromium, copper and zinc, site specific trigger values should be created.

9.0 RECOMMENDATIONS

Golder recommends that FMG:

- develop site specific trigger values for monitoring at Christmas Creek that could be applied to both the Vasse TSF and the Windich IPTSF to avoid potentially unnecessary drainage management
- include appropriate management of nitrate, boron, cadmium, chromium, copper and zinc in the absence of site specific trigger values, drainage management for the Vasse embankment
- submit a limited amount of waste rock samples for long term kinetic tests to further assess the metalliferous drainage potential of the material to be used in the construction of the Vasse TSF embankment
- conduct additional mineralogical testing to evaluate the discrepancy with respect to sulfide content observed between ABA and XRD analyses

10.0 CONCLUDING REMARKS

We trust that this report is adequate for your current requirements. Please contact Josh Pearce if you wish to discuss the conclusions or if we can be of further assistance.

11.0 LIMITATIONS

Your attention is drawn to the document "Limitations", which is included as Appendix E to this report. This document is intended to assist you in ensuring that your expectations of this report are realistic, and that you understand the inherent limitations of a report of this nature. If you are uncertain as to whether this report is appropriate for any particular purpose please discuss this issue with us.



Report Signature Page

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Sample Lab ID	Sample Location	Date Collected	From Depth (m)	To Depth (m)	Sample Interval (m)	Sample Type	Easting	Northing
PE069061.001	TP1	15-Jun-12	0.00	2.30	2.30	Composite	7525674.8	780534.3
PE069061.002	TP9+TP6							
	TP6	15-Jun-12	0.00	1.00	1.00	Composite	7525305.8	781063.5
	TP9	15-Jun-12	0.00	3.00	3.00	Composite	7525399.7	781301.1
PE069061.003	#1	12-Jun-12	0.00	0.50	0.50	Composite	7526056.0	780247.1
PE069061.004	#2	14-Jun-12	0.00	3.00	3.00	Composite	7525515.2	780093.7
PE069061.005	#3	13-Jun-12	0.00	3.00	3.00	Composite	7526175.1	780351.1
PE069061.006	#4	13-Jun-12	0.00	3.00	3.00	Composite	7526165.9	780508.2
PE069061.007	#5	13-Jun-12	0.00	3.00	3.00	Composite	7526226.0	780639.2
PE069061.008	#6	13-Jun-12	0.00	3.00	3.00	Composite	7526356.2	780707.0
PE069061.009	#7	14-Jun-12	0.00	3.00	3.00	Composite	7526455.8	780837.6
PE069061.010	#8	13-Jun-12	0.00	3.00	3.00	Composite	7526525.8	780706.2
PE069061.011	#9	13-Jun-12	0.00	3.00	3.00	Composite	7526435.2	780591.1
PE069061.012	#10	13-Jun-12	0.00	3.00	3.00	Composite	7526323.7	780502.5
PE069061.013	#11	12-Jun-12	0.00	0.50	0.50	Composite	7526345.1	780299.2
PE069061.014	#12	13-Jun-12	0.00	3.00	3.00	Composite	7526563.2	780484.2
PE069061.015	#13	13-Jun-12	0.00	3.00	3.00	Composite	7526550.7	780583.0
PE069061A.016	#14	12-Jun-12	0.00	0.50	0.50	Composite	7526666.0	780314.6
PE069061A.017	#15	13-Jun-12	0.00	3.00	3.00	Composite	7526689.0	780503.2
PE069061.018	#16	14-Jun-12	0.00	3.00	3.00	Composite	7526580.4	780786.3
PE069061.020	#19	13-Jun-12	0.00	3.00	3.00	Composite	7525897.8	780596.1
PE069061.021	#20	13-Jun-12	0.00	3.00	3.00	Composite	7525708.4	780636.3
PE069061.022	#21	14-Jun-12	0.00	3.00	3.00	Composite	7525445.6	780592.3
PE069061.023	#22	14-Jun-12	0.00	1.00	1.00	Composite	7525254.7	780719.1
PE069061.024	#25	14-Jun-12	0.00	3.00	3.00	Composite	7524945.3	780321.6
PE069061.025	#26	14-Jun-12	0.00	3.00	3.00	Composite	7525317.1	780282.0
PE069061.026	#27	12-Jun-12	0.00	0.50	0.50	Composite	7525279.2	780404.8
PE069061.027	#28	14-Jun-12	0.00	3.00	3.00	Composite	7525252.8	780154.7
PE069061.028	#29	14-Jun-12	0.00	3.00	3.00	Composite	7525180.7	780273.4
PE069061.029	#30	14-Jun-12	0.00	3.00	3.00	Composite	7525023.8	780184.1
PE069061.030	#31	14-Jun-12	0.00	3.00	3.00	Composite	7525142.2	780068.4
PE069061.031	#32	14-Jun-12	0.00	3.00	3.00	Composite	7525248.4	781011.4
PE069061.032	#33	14-Jun-12	0.00	2.00	2.00	Composite	7525244.8	781204.4
PE069061.033	#34	14-Jun-12	0.00	2.00	2.00	Composite	7525241.3	781371.1
PE069061.034	#35	14-Jun-12	0.00	3.00	3.00	Composite	7525534.2	781363.5
PE069061.035	#36	13-Jun-12	0.00	3.00	3.00	Composite	7525779.4	781523.0
PE069061.036	#38	14-Jun-12	0.00	3.00	3.00	Composite	7526285.8	781471.7
PE069061.037	#18	13-Jun-12	0.00	3.00	3.00	Composite	7526027.6	780618.8

All samples were submitted for ABA, NAG and pH/EC testing

Highlighted samples were submitted for mineralogical analysis , total elemental analysis and leaching tests.

Mineral Group		Iron Oxy-hydroxide	Iron Oxide		Carbonates	Sulfides			Silicates					
Mineral		Goethite	Hematite	Magnesio-ferrite, syn	Calcite, magnesium, syn	Pentlandite	Arsenopyrite	Chalcocite, syn	Kaolinite	Halloysite	Chamosite	Sodium Magnesium Silicate	Quartz	Total
Sample Lab ID	Sample Location													
		%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w	%w/w
PE069061.004	#2	6.1	14.1						11.5		14.0		54.4	100.1
PE069061.005	#3	47.4	33.7						7.1				11.8	100.0
PE069061.006	#4	24.6	5.2		2.4						6.3		61.5	100.0
PE069061.012	#10	58.5	24.7						16.8					100.0
PE069061.014	#12	68.7	17.0										14.3	100.0
PE069061.020	#19	53.5	24.5			2.1					14.5		5.5	100.1
PE069061.024	#25	75.9				0.9	8.1				15.2			100.1
PE069061.025	#26	31.6	30.6				13.2				14.6		10.0	100.0
PE069061.026	#27	24.0	3.3	4.5					25.8				42.4	100.0
PE069061.030	#31	10.8	35.5						33.4	15.7			4.6	100.0
PE069061.032	#33	17.5	29.2					5.3	24.4				23.6	100.0
PE069061.034	#35	45.5	13.9						24.5				16.1	100.0
PE069061.035	#36	54.0	15.6						21.1				9.4	100.1
PE069061.036	#38	37.8	17.5				5.5		39.2					100.0

Mineral Group	Iron Oxy-hydroxide	Iron Oxide		Carbonates	Sulfides			Silicates				
Mineral	Goethite	Hematite	Magensio-ferrite, syn	Calcite, magnesium, syn	Pentlandite	Arsenopyrite	Chalcocite, syn	Kaolinite	Halloysite-14A	Chamosite	Sodium Magnesium Silicate	Quartz
Formula												
Count	14	14	14	14	14	14	14	14	14	14	14	14
Average (%w/w)	39.7	18.9	0.3	0.2	0.2	1.9	0.4	14.6	1.1	3.6	1.0	18.1
Max (%w/w)	75.9	35.5	4.5	2.4	2.1	13.2	5.3	39.2	15.7	15.2	14.0	61.5
Min (%w/w)	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MINERAL	MINERAL GROUP	FORMULA
Goethite	Iron Oxy-hydroxides	Fe ⁺³ O(OH)
Goethite, aluminian, syn	Iron Oxy-hydroxides	Fe _{0.93} Al _{0.07} O(OH)
Hematite	Iron Oxides	Fe ₂ O ₃
Hematite, syn	Iron Oxides	Fe _{1.957} O ₃
Magnesio-ferrite, syn	Iron Oxides	Mg _{1.06} Fe _{1.94} O _{3.97}
Calcite, magnesium, syn	Carbonates	(Mg _{0.03} Ca _{0.97})CO ₃
Pentlandite	Sulfides	Fe ₄ Ni ₅ S ₈
Arsenopyrite	Sulfides	FeAsS
Chalcocite, syn	Sulfides	Cu ₂ S
Kaolinite-1A	Silicates	Al ₂ Si ₂ O ₅ (OH) ₄
Kaolinite-1T	Silicates	Al ₂ Si ₂ O ₅ (OH) ₄
Halloysite-14A	Silicates	Al ₂ Si ₂ O ₅ (OH) ₄
Chamosite	Silicates	Fe ₃ Si ₂ O ₅ (OH) ₄
Sodium Magnesium Silicate	Silicates	Na _{1.8} Mg _{0.9} Si _{1.1} O ₄
Quartz	Silicates	SiO ₂

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature for that particular compound.

ICDD Match Probability
HIGH
MEDIUM
LOW

TABLE 3 - Total Elemental Analysis

Element		Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	Tl	V	Zn
Units		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
LOR		0.1	100	1	20	1	0.1	40	0.1	0.1	10	2	100	0.001	100	20	1	0.1	50	1	20	1	20	0.1	1	0.42	0.3	1	10	0.2	1	2
Lab ID	Sample Location																															
PE069061B.004	#2	<0.1	53000	51	20	130	0.6	770	0.2	9.7	190	40	390000	<0.001	3500	740	1600	2.7	500	36	540	27	280	3.7	<1	12	2.5	17	3700	0.3	220	50
PE069061B.005	#3	<0.1	23000	25	<20	60	0.4	600	0.1	11	60	36	570000	<0.001	350	1000	3800	1.6	500	28	560	18	510	3.1	<1	4	1.0	5	1300	<0.2	57	64
PE069061B.006	#4	<0.1	13000	11	<20	26	0.3	8400	<0.1	8.3	30	18	360000	<0.001	270	2200	1300	1.3	300	18	400	7	230	0.7	<1	17	0.4	9	460	<0.2	32	33
PE069061B.012	#10	<0.1	34000	28	<20	160	0.4	630	0.2	10	70	26	520000	<0.001	210	460	2400	1.1	200	24	280	27	590	2.7	<1	4.7	1.8	9	2100	<0.2	84	43
PE069061B.014	#12	<0.1	23000	17	<20	110	0.3	600	<0.1	9.1	30	21	540000	<0.001	420	640	1700	1.0	400	21	330	16	570	2.2	<1	5.8	0.8	8	1100	<0.2	39	35
PE069061B.020	#19	0.1	31000	24	30	180	0.4	5000	<0.1	8.7	80	32	530000	<0.001	430	1200	1600	0.8	300	20	270	16	550	1.8	<1	4.8	1.0	14	1300	<0.2	69	28
PE069061B.024	#25	<0.1	59000	32	30	240	0.6	1100	0.2	19	80	54	440000	<0.001	510	2000	5300	1.3	1000	30	180	35	390	3.2	<1	5.8	1.2	22	1900	0.2	75	30
PE069061B.025	#26	<0.1	41000	57	<20	260	0.5	1000	0.1	8	100	24	500000	<0.001	750	700	3800	1.7	300	21	260	22	550	2.3	<1	5.8	1.5	14	2100	0.2	100	32
PE069061B.026	#27	<0.1	68000	34	<20	26	0.6	460	0.2	12	90	23	300000	<0.001	170	1100	1700	1.9	900	38	380	19	860	5.2	<1	14	1.9	14	3500	<0.2	110	37
PE069061B.030	#31	<0.1	78000	39	30	120	0.3	1900	0.1	3.5	170	40	330000	<0.001	820	800	160	1.5	500	34	180	31	610	3.8	2	12	3.3	31	4500	<0.2	160	48
PE069061B.032	#33	0.2	64000	62	<20	88	1.2	480	0.2	10	180	62	410000	<0.001	1600	550	450	3.1	200	51	280	25	340	4.2	3	7.5	2.6	10	3600	0.2	200	92
PE069061B.034	#35	0.1	43000	34	<20	190	0.6	460	0.1	6.5	140	43	440000	<0.001	930	470	1000	2.1	200	33	240	19	440	3.0	2	6.5	1.7	6	2300	<0.2	120	44
PE069061B.035	#36	<0.1	51000	46	<20	290	0.5	670	0.2	5.8	150	35	440000	<0.001	500	490	1500	1.6	300	19	190	22	830	3.7	<1	7.8	2.0	21	2700	<0.2	120	39
PE069061B.036	#38	<0.1	48000	24	<20	66	0.3	960	0.1	6.1	120	58	480000	<0.001	390	590	380	1.5	600	21	260	29	600	2.2	2	5.4	2.0	13	2500	<0.2	96	91
MIN		<0.1	13000	11	20	26	0.3	460	<0.1	4	30	18	300000	<0.001	170	460	160	0.8	200	18	180	7	230	0.7	<1	4	0.4	5	460	<0.2	32	28
AVERAGE		0.1	44928.6	35	27.5	139	0.5	1645	0.2	9	106	37	446429	<0.001	775	924	1906	1.7	443	28	311	22	525	3.0	1	8.07857	1.7	14	2361	0.2	106	48
MAX		0.2	78000	62	30	290	1.2	8400	0.2	19	190	62	570000	<0.001	3500	2200	5300	3.1	1000	51	560	35	860	5.2	3	17	3.3	31	4500	0.3	220	92
Average Crustal Abundance		0.07	81300	1.8	10	425	2.8	36300	0.2	25	100	55	50000	0.08	25900	20900	950	1.5	28300	75	1050	13	26	0.2	0.05	27.7	2	375	4400	0.5	135	210
Average Crustal Abundance (x3)		0.21	243900	5.4	30	1275	8.4	108900	0.6	75	300	165	150000	0.24	77700	62700	2850	4.5	84900	225	3150	39	78	0.6	0.15	83.2	6	1125	13200	1.5	405	630

Greater than 3 times average crustal abundance

- Limit of reporting values were used to calculate average values, i.e. <20 = 20

- Average crustal abundances were sourced from: Mason, B. and Moore, C. B. 1982. Principles of Geochemistry, 4th ed., Wiley, New York.

AMIRA 2002*		
Sample potential	Criteria	Comments
PAF	NAPP > 0	A sample classified as PAF always has a significant sulfur content, the acid generating potential of which exceeds the inherent acid neutralising capacity of the material
	NAG pH < 4.5	
NAF	NAPP < 0	A sample classified as NAF may, or may not, have a significant sulfur content but the availability of ANC within the sample is more than adequate to neutralise all the acid that theoretically could be produced by any contained sulfide minerals
	NAG pH ≥ 4.5	
UC	NAPP > 0	An uncertain classification is used when there is an apparent conflict between the NAPP and NAG results. Uncertain samples are generally given a tentative classification that is shown in brackets e.g. UC(NAF).
	NAG pH ≥ 4.5	
UC	NAPP < 0	
	NAG pH < 4.5	

*Adapted from: *Test Handbook - Prediction and Kinetic Control of Acid Mine Drainage* (AMIRA 2002)

Price 2009 [#]		
Sample potential	Criteria	Comments
PAF	NPR < 1	Potentially acid generating material, unless sulfide minerals are non-reactive, or NP is preferentially exposed on surfaces.
UC	1 < NPR < 2	Possibly PAF if NP is insufficiently reactive or is depleted at a faster rate than sulfides
NAF	NPR > 2	Non-potentially acid generation material, unless NP is insufficiently reactive, extremely reactive sulfides are present, or preferential exposure of sulfides is found in the material.

[#]Adapted from: *"Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials"*, published by MEND, to convert North American terminology to Australian terminology for equivalent parameters (Price 2009)

PAF	Potentially acid forming
NAF	Non-acid forming
UC	Uncertain
NAPP	Net acid producing potential
NAG	Net acid generating
NPR	Neutralisation potential ratio (equivalent to ANC/MPA ratio)

TABLE 5 - ABA, pH/EC and NAG Results

Parameter		Paste pH	Surface Rinse pH	Surface Rinse EC	Total S	Sulfate Sulfur	Sulfide Sulfur	MPA	ANC	NAPP	ANC/MPA	NAG pH	NAG EC	NAG (to pH 7)	Acid Generating Potential
LOR		0.1	0.1	2	0.005	0.05	0.005	0.5	1.0	0.5	1.0	0.1	1	0.5	
Sample Lab ID	Sample Location	No Units	No Units	µS/cm	%	%	%	kg H ₂ SO ₄ /t	kg H ₂ SO ₄ /t	kg H ₂ SO ₄ /t	No Units	No Units	µS/cm	kg H ₂ SO ₄ /t	
PE069061.001	TP1	7.7	7.5	170	0.094	<0.05	0.094	2.9	4.6	-1.7	1.6	7.1	41	<0.5	NAF
PE069061.002	TP9+TP6	6.8	6.6	73	0.012	<0.05	0.012	0.4	2.4	-2.0	6.5	5.8	39	0.8	NAF
PE069061.003	#1	6.9	6.6	130	0.008	<0.05	0.008	0.2	2.2	-2.0	9.0	5.5	30	0.8	NAF
PE069061.004	#2	6.4	6.4	120	<0.005	<0.05	<0.005	<0.2	<1.0	-0.8	6.5	6.6	41	<0.5	NAF
PE069061.005	#3	7.0	6.8	450	0.013	<0.05	0.013	0.4	2.9	-2.5	7.3	6.4	59	<0.5	NAF
PE069061.006	#4	8.2	8.4	210	0.005	<0.05	0.005	0.2	25.0	-24.8	163.4	8.2	110	<0.5	NAF
PE069061.007	#5	7.7	8.0	410	0.032	<0.05	0.032	1.0	3.8	-2.8	3.9	7.7	57	<0.5	NAF
PE069061.008	#6	7.8	7.9	170	<0.005	<0.05	<0.005	<0.2	3.1	-2.9	20.3	7.0	35	<0.5	NAF
PE069061.009	#7	7.6	7.9	390	<0.005	<0.05	<0.005	<0.2	18.0	-17.8	117.6	8.9	120	<0.5	NAF
PE069061.010	#8	7.6	7.7	190	<0.005	<0.05	<0.005	<0.2	2.9	-2.7	19.0	6.9	38	<0.5	NAF
PE069061.011	#9	7.4	7.4	120	0.012	<0.05	0.012	0.4	2.2	-1.8	6.0	5.9	34	0.6	NAF
PE069061.012	#10	7.2	7.1	140	0.045	<0.05	0.045	1.4	2.4	-1.0	1.7	5.9	36	1.0	NAF
PE069061.013	#11	7.1	7.1	64	0.010	<0.05	0.010	0.3	2.6	-2.3	8.5	6.2	28	0.6	NAF
PE069061.014	#12	6.9	6.9	280	0.160	<0.05	0.160	4.9	5.3	-0.4	1.1	6.4	47	<0.5	NAF
PE069061.015	#13	6.9	6.9	100	0.019	<0.05	0.019	0.6	2.6	-2.0	4.5	5.8	33	0.6	NAF
PE069061A.016	#14	6.6	6.7	160	0.040	<0.50*	0.040	1.2	2.9	-1.7	2.4	6.7	43	<0.5	NAF
PE069061A.017	#15	7.4	7.6	380	<0.005	<0.50*	<0.005	<0.2	5.7	-5.5	37.3	7.8	62	<0.5	NAF
PE069061.018	#16	6.5	6.6	260	0.029	<0.05	0.029	0.9	2.6	-1.7	2.9	6.0	38	0.6	NAF
PE069061.020	#19	7.6	7.9	200	<0.005	<0.05	<0.005	<0.2	14.0	-13.8	91.5	8.3	150	<0.5	NAF
PE069061.021	#20	7.4	7.6	280	0.052	<0.05	0.052	1.6	4.4	-2.8	2.8	6.6	54	<0.5	NAF
PE069061.022	#21	7.5	7.7	150	0.034	<0.05	0.034	1.0	2.6	-1.6	2.5	7.1	58	<0.5	NAF
PE069061.023	#22	6.9	7.2	860	0.009	<0.05	0.009	0.3	1.6	-1.3	5.8	6.0	39	0.8	NAF
PE069061.024	#25	7.1	7.2	260	<0.005	<0.05	<0.005	<0.2	3.7	-3.5	24.2	7.2	92	<0.5	NAF
PE069061.025	#26	7.5	7.5	270	<0.005	<0.05	<0.005	<0.2	4.2	-4.0	27.5	7.0	46	<0.5	NAF
PE069061.026	#27	7.2	7.5	1100	0.060	<0.05	0.060	1.8	3.7	-1.9	2.0	6.9	110	<0.5	NAF
PE069061.027	#28	6.9	7.2	400	0.046	0.05	0.000	<0.2	3.0	-2.8	15.0	6.7	65	<0.5	NAF
PE069061.028	#29	7.6	8.0	680	<0.005	<0.05	<0.005	<0.2	4.7	-4.5	30.7	8.0	79	<0.5	NAF
PE069061.029	#30	7.2	7.6	410	0.015	<0.05	0.015	0.5	2.3	-1.8	5.0	6.4	51	0.6	NAF
PE069061.030	#31	7.7	7.9	210	<0.005	<0.05	<0.005	<0.2	5.6	-5.4	36.6	7.5	51	<0.5	NAF
PE069061.031	#32	6.6	8.5	7	0.015	<0.05	0.015	0.5	3.0	-2.5	6.5	5.5	28	1.0	NAF
PE069061.032	#33	6.6	6.7	61	<0.005	<0.05	<0.005	<0.2	3.0	-2.8	19.6	6.1	27	<0.5	NAF
PE069061.033	#34	6.2	6.2	66	0.044	<0.05	0.044	1.3	2.6	-1.3	1.9	5.5	32	1.0	NAF
PE069061.034	#35	6.7	6.7	72	<0.005	<0.05	<0.005	<0.2	2.6	-2.4	17.0	6.1	28	<0.5	NAF
PE069061.035	#36	6.6	6.7	120	0.074	<0.05	0.074	2.3	2.6	-0.3	1.1	5.8	33	0.6	NAF
PE069061.036	#38	7.4	7.1	340	0.021	<0.05	0.021	0.6	3.3	-2.7	5.1	6.8	48	<0.5	NAF
PE069061.037	#18	7.1	8.2	120	<0.005	<0.05	<0.005	<0.2	3.0	-2.8	19.6	6.4	36	<0.5	NAF
MIN		6.2	6.2	7	<0.005	<0.05	0.000	<0.2	<1.0	-24.8	1.1	5.5	27.0	<0.5	
MEDIAN		7.2	7.3	195	0.012	0.05	0.011	0.3	3.0	-2.5	6.5	6.6	42.0	0.5	
MAX		8.2	8.5	1100	0.160	0.05	0.160	4.9	25.0	-0.3	163.4	8.9	150.0	1.0	
Average		7.2	7.3	262	0.025	0.05	0.024	0.8	4.5	-3.8	20.4	6.7	53.3	0.6	
Standard Deviation		0.5	0.6	228	0.032	0.00	0.032	1.0	4.7	4.9	34.5	0.9	29.2	0.2	

*LOR for samples was raised to <0.50

Sulfide sulfur = total sulfur - sulfate sulfur

MPA calculated from total sulfur

For statistical and calculation purposes (MPA, NAPP, ANC/MPA) all values reported below the limit of reporting were treated as the limit of reporting (i.e. <0.025 = 0.025)

TABLE 6 - Short-term Leaching Test Results

Parameter		Mass of Sample Used	pH	EC	TDS	Alkalinity (as HCO3)	Alkalinity (as CO3)	Total Alkalinity (as CaCO3)	Acidity (to pH 8.3)	Cl ⁻	F ⁻	SO ₄ ²⁻	FRP	NO ₃ ⁻ ³ (as NO)	Ca	K	Mg	Na	Ag	Al	As	B	Ba	Be
Units		g	pH Units	µS/cm	mg/L	mg/L	mg/L	mg/L	mg CaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR		1	0	2	10	5	1	5	5	1	0.1	1	0.002	0.05	0.2	0.1	0.1	0.5	0.005	0.02	0.02	0.2	0.01	0.005
Lab ID	Sample Location																							
PE069061C.004	#2	101	6.4	73	140	7	<1	6	26	3	<0.1	6	<0.002	17.0	5.2	6.9	1.5	5.2	<0.005	<0.02	<0.02	0.5	0.64	<0.005
PE069061C.005	#3	101	7.0	250	196	27	<1	22	9	40	1.2	47	<0.002	6.6	14.0	1.6	6.4	25	<0.005	<0.02	<0.02	0.4	0.60	<0.005
PE069061C.006	#4	102	8.6	160	136	60	<1	49	6	11	1.6	15	<0.002	2.4	16.0	1.3	2.0	16	<0.005	<0.02	<0.02	0.3	0.48	<0.005
PE069061C.012	#10	101	7.2	110	108	35	<1	29	8	7	0.6	16	0.012	2.5	10.0	0.8	2.6	8.8	<0.005	0.03	<0.02	0.4	0.65	<0.005
PE069061C.014	#12	100	7.1	170	136	20	<1	16	9	19	0.3	33	<0.002	4.1	8.8	2.0	3.7	20	<0.005	<0.02	<0.02	0.3	0.54	<0.005
PE069061C.020	#19	100	8.4	200	156	61	<1	50	7	8	1.4	27	0.023	6.1	24.0	2.2	3.4	8.7	<0.005	0.03	<0.02	0.3	0.50	<0.005
PE069061C.024	#25	100	7.9	510	288	33	<1	27	10	84	0.6	59	<0.002	26.0	16.0	3.7	12	56	<0.005	0.02	<0.02	0.4	0.53	<0.005
PE069061C.025	#26	100	7.7	190	136	60	<1	49	7	12	0.4	21	<0.002	4.7	21.0	2.2	3.9	10	<0.005	0.03	<0.02	0.3	0.48	<0.005
PE069061C.026	#27	101	7.5	670	372	5	<1	<5	9	100	1.1	120	<0.002	11.0	21.0	5.0	23	66	<0.005	<0.02	<0.02	0.7	0.53	<0.005
PE069061C.030	#31	102	8.1	170	128	88	<1	72	<5	6	0.8	8	0.007	3.6	20.0	2.8	4.5	8.4	<0.005	0.05	<0.02	0.4	0.55	<0.005
PE069061C.032	#33	99	6.9	49	60	9	<1	7	7	5	0.1	5	<0.002	1.3	2.9	2.4	0.7	5.1	<0.005	0.04	<0.02	0.4	0.48	<0.005
PE069061C.034	#35	100	7.0	54	96	9	<1	7	7	2	0.2	12	<0.002	1.3	4.5	1.7	1.1	4.3	<0.005	0.04	<0.02	0.3	0.44	<0.005
PE069061C.035	#36	100	6.8	79	88	6	<1	5	7	8	0.2	12	0.007	4.1	3.7	1.3	1.7	8.3	<0.005	0.04	<0.02	0.4	0.48	<0.005
PE069061C.036	#38	100	7.6	220	172	34	<1	28	12	21	0.6	40	<0.002	8.4	10.0	3.3	3.8	28	<0.005	<0.02	<0.02	<0.2	0.05	<0.005
		MIN	6.4	49	60	5	<1	<5	<5	2	<0.1	5	<0.002	1.3	2.9	0.8	0.7	4.3	<0.005	<0.02	<0.02	0.3	0.05	<0.005
		AVERAGE	7.4	208	158	32	<1	28	10	23	0.7	30	0.005	7.1	13	2.7	5.0	19	<0.005	0.03	<0.02	0.4	0.50	<0.005
		MAX	8.6	670	372	88	<1	72	26	100	1.6	120	0.023	26	24	6.9	23	66	<0.005	0.05	<0.02	0.7	0.65	<0.005
ANZECC/ARMCANZ 95% Protection Criteria (2000)			6.5-8.0	120-300 / 300-1500 ^a										1.0					0.00005	0.055	0.013 ^b , 0.024 ^c	0.37		0.004 ^d

Parameter		Mass of Sample Used	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	P	Pb	S	Sb	Se	Si	Sn	Sr	Ti	V	Zn	Hg	Tl
Units		g	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
LOR		1	0.001	0.01	0.005	0.005	0.02	0.005	0.01	0.005	0.05	0.005	0.1	0.05	0.02	0.02	0.05	0.005	0.005	0.02	0.01	0.0005	1
Lab ID	Sample Location																						
PE069061C.004	#2	101	<0.001	<0.01	<0.005	<0.005	<0.02	0.490	<0.01	<0.005	<0.05	<0.005	2.8	<0.05	<0.02	10	<0.05	0.037	<0.005	<0.02	0.25	<0.0005	<1
PE069061C.005	#3	101	0.001	<0.01	<0.005	0.360	0.02	<0.005	<0.01	<0.005	<0.05	<0.005	13.0	<0.05	<0.02	6.7	<0.05	0.110	<0.005	<0.02	0.24	<0.0005	<1
PE069061C.006	#4	102	<0.001	<0.01	<0.005	<0.005	0.11	<0.005	<0.01	<0.005	0.06	<0.005	4.9	<0.05	<0.02	4.9	<0.05	0.069	<0.005	<0.02	0.09	<0.0005	<1
PE069061C.012	#10	101	0.001	<0.01	<0.005	0.120	0.05	0.011	<0.01	<0.005	<0.05	<0.005	5.1	<0.05	<0.02	6.1	<0.05	0.066	<0.005	<0.02	0.19	<0.0005	<1
PE069061C.014	#12	100	0.002	<0.01	<0.005	0.006	0.05	0.017	<0.01	<0.005	0.05	<0.005	10.0	<0.05	<0.02	5.7	<0.05	0.070	<0.005	<0.02	0.20	<0.0005	<1
PE069061C.020	#19	100	0.001	<0.01	0.008	0.120	0.02	<0.005	<0.01	<0.005	<0.05	<0.005	8.6	<0.05	<0.02	4.7	<0.05	0.130	<0.005	<0.02	0.14	<0.0005	<1
PE069061C.024	#25	100	<0.001	<0.01	<0.005	<0.005	0.07	0.090	<0.01	<0.005	<0.05	<0.005	18.0	<0.05	<0.02	9.7	<0.05	0.140	<0.005	<0.02	0.21	<0.0005	<1
PE069061C.025	#26	100	0.001	<0.01	<0.005	0.066	0.05	0.043	<0.01	<0.005	<0.05	<0.005	7.3	<0.05	<0.02	5.0	<0.05	0.100	<0.005	<0.02	0.22	<0.0005	<1
PE069061C.026	#27	101	0.002	<0.01	<0.005	<0.005	<0.02	0.016	<0.01	<0.005	<0.05	<0.005	44.0	<0.05	<0.02	1.1	<0.05	0.390	<0.005	<0.02	0.23	<0.0005	<1
PE069061C.030	#31	102	<0.001	<0.01	0.009	0.013	0.03	<0.005	<0.01	<0.005	<0.05	<0.005	2.7	<0.05	<0.02	6.0	<0.05	0.120	<0.005	0.02	0.12	<0.0005	<1
PE069061C.032	#33	99	<0.001	<0.01	<0.005	0.026	0.03	0.240	<0.01	<0.005	<0.05	<0.005	1.9	<0.05	<0.02	6.5	<0.05	0.030	<0.005	<0.02	0.26	<0.0005	<1
PE069061C.034	#35	100	<0.001	<0.01	<0.005	0.007	0.04	0.100	<0.01	<0.005	<0.05	<0.005	3.9	<0.05	<0.02	5.3	<0.05	0.034	<0.005	<0.02	0.13	<0.0005	<1
PE069061C.035	#36	100	<0.001	<0.01	<0.005	<0.005	0.05	0.015	<0.01	<0.005	<0.05	<0.005	4.1	<0.05	<0.02	6.9	<0.05	0.047	<0.005	<0.02	0.11	<0.0005	<1
PE069061C.036	#38	100	<0.001	<0.01	0.013	<0.005	0.04	<0.005	<0.01	<0.005	<0.05	<0.005	12.0	<0.05	<0.02	7.8	<0.05	0.069	<0.005	<0.02	<0.01	<0.0005	<1
		MIN	<0.001	<0.01	<0.005	<0.005	<0.02	<0.005	<0.01	<0.005	<0.05	<0.005	1.9	<0.05	<0.02	1.1	<0.05	0.030	<0.005	<0.02	<0.01	<0.0005	<1
		AVERAGE	0.001	<0.01	0.006	0.053	0.05	0.075	<0.01	<0.005	0.05	<0.005	10	<0.05	<0.02	6.2	<0.05	0.101	<0.005	0.02	0.18	<0.0005	<1
		MAX	0.002	<0.01	0.013	0.360	0.11	0.490	<0.01	<0.005	0.06	<0.005	44	<0.05	<0.02	10	<0.05	0.390	<0.005	0.02	0.26	<0.0005	<1
ANZECC/ARMCANZ 95% Protection Criteria (2000)			0.0002		0.001 ^e	0.0014	0.3 ^f	1.9		0.011		0.0034		0.03 ^d	0.011						0.008	0.006	4 ^d

Extraction Solution Used = Fluid #2 (pH5.0)	
Volume of ExtractionSolution Used = 1000 ml	

^a The range is for upland and lowland rivers in South-west Australia.

^b as arsenic V

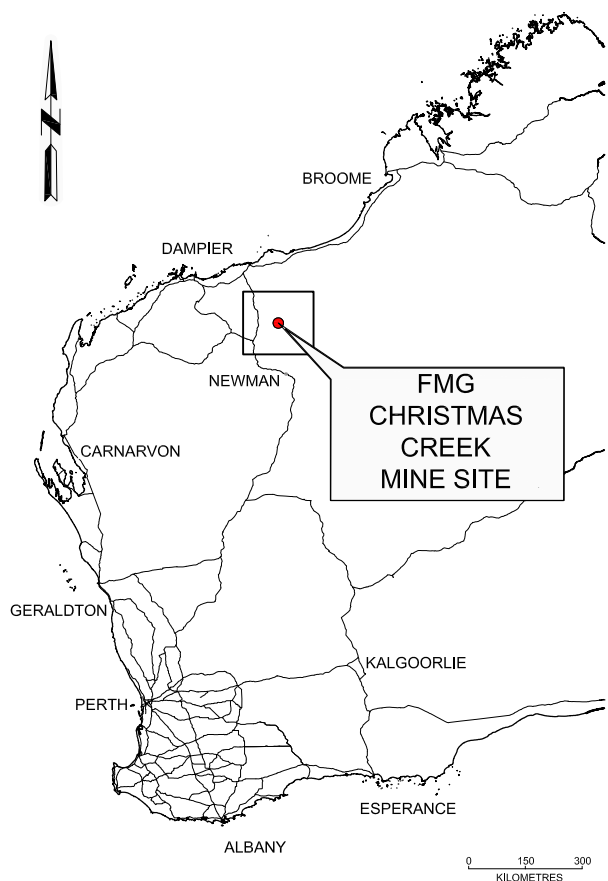
^c as arsenic III

^d Australian Water Quality Guidelines for Freshwater and Marine Waters. National Water Quality Management Strategy, 1992

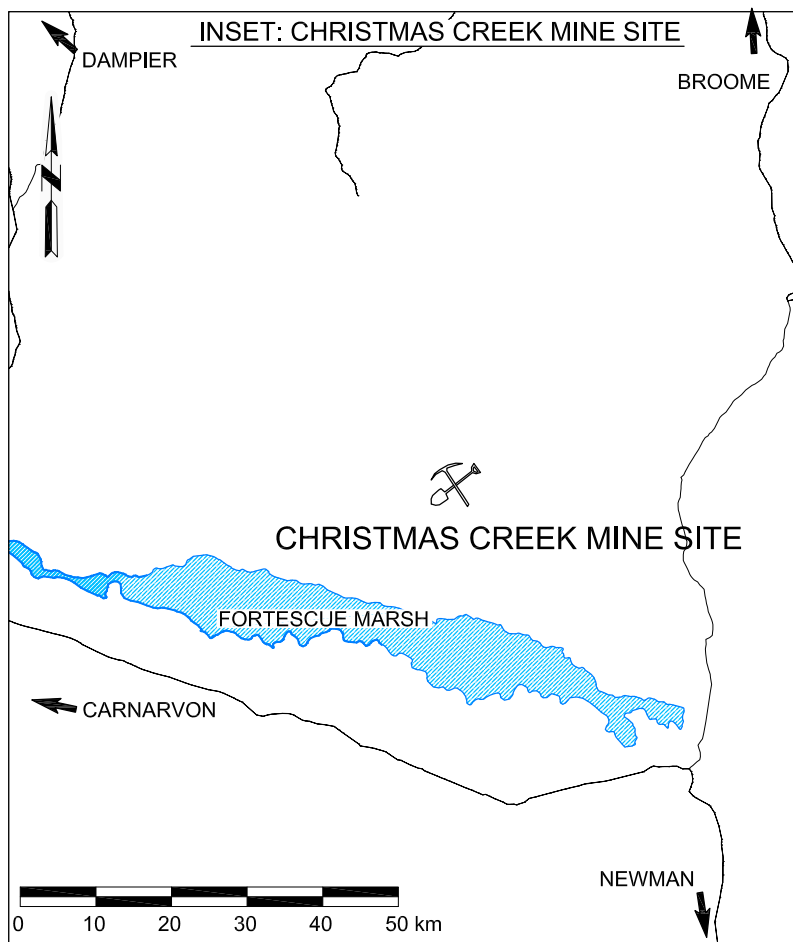
^e as chromium VI

^f 95% interim guideline value

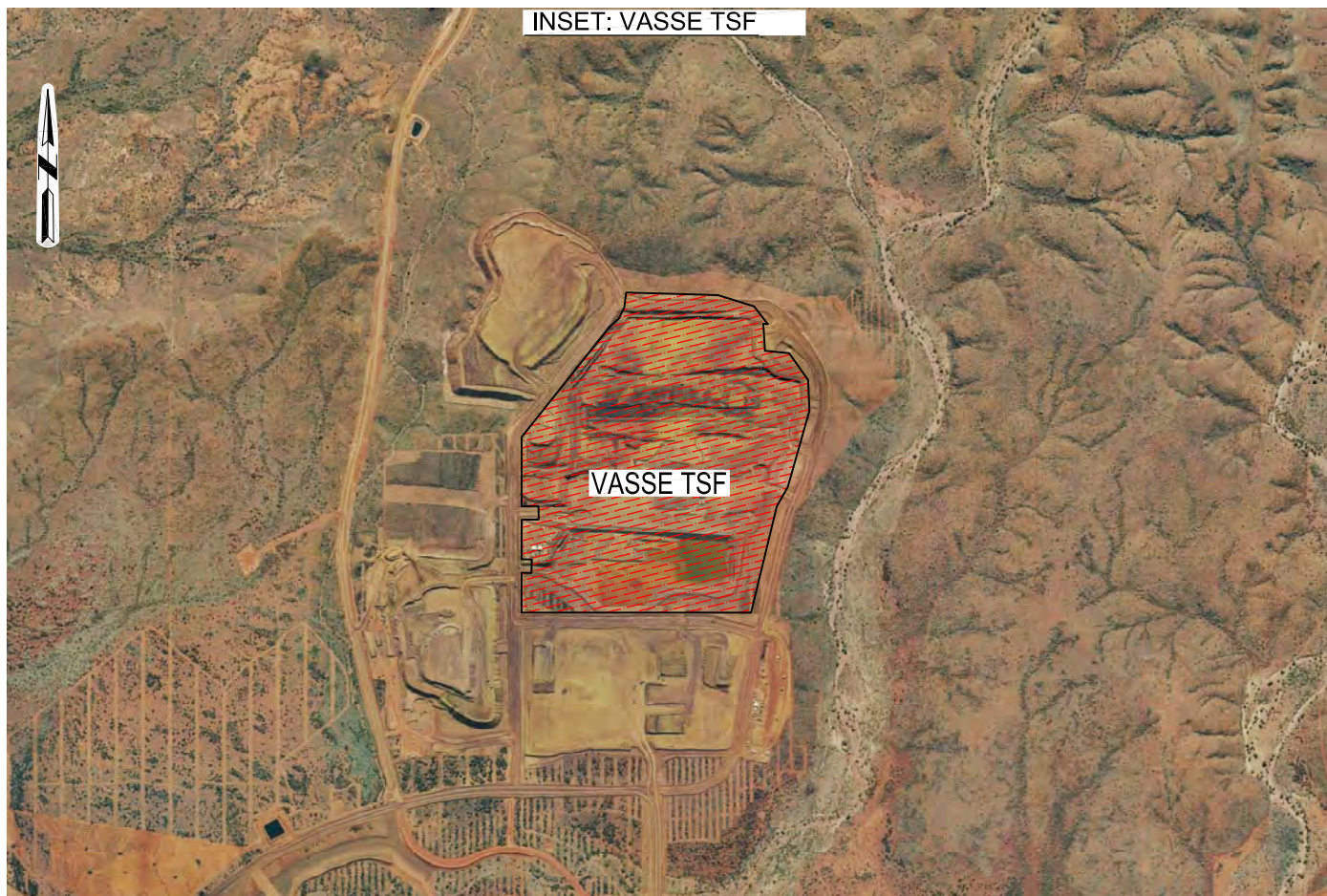
INSET: WESTERN AUSTRALIA



INSET: CHRISTMAS CREEK MINE SITE



INSET: VASSE TSF



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CLIENT
Fortescue Metals Group LTD

DRAWN BY
R.WERDER-BIGHAM / DH

DATE
29.08.2012

CHECKED BY
JP

DATE
29.08.2012

SCALE
AS SHOWN

SHEET SIZE
A4

PROJECT

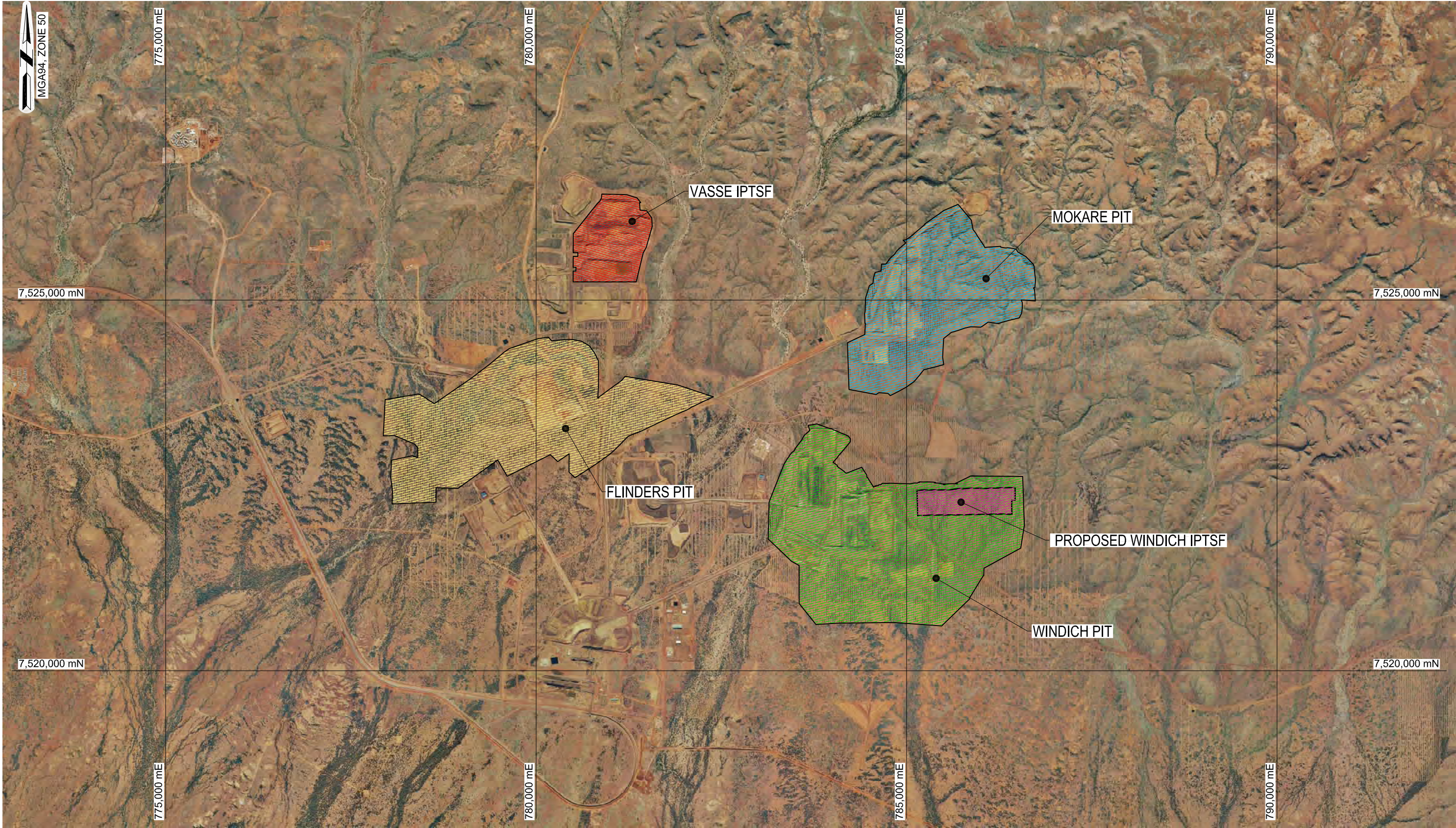
Vasse TSF

DRAWING TITLE

FMG CHRISTMAS CREEK MINE SITE
LOCALITY PLAN






PROJECT No 127645023	DOC No 012	DOC TYPE R	FIGURE No F001	REVISION 0	FIGURE 1
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SITE PLAN
SCALE 1:50,000

LEGEND

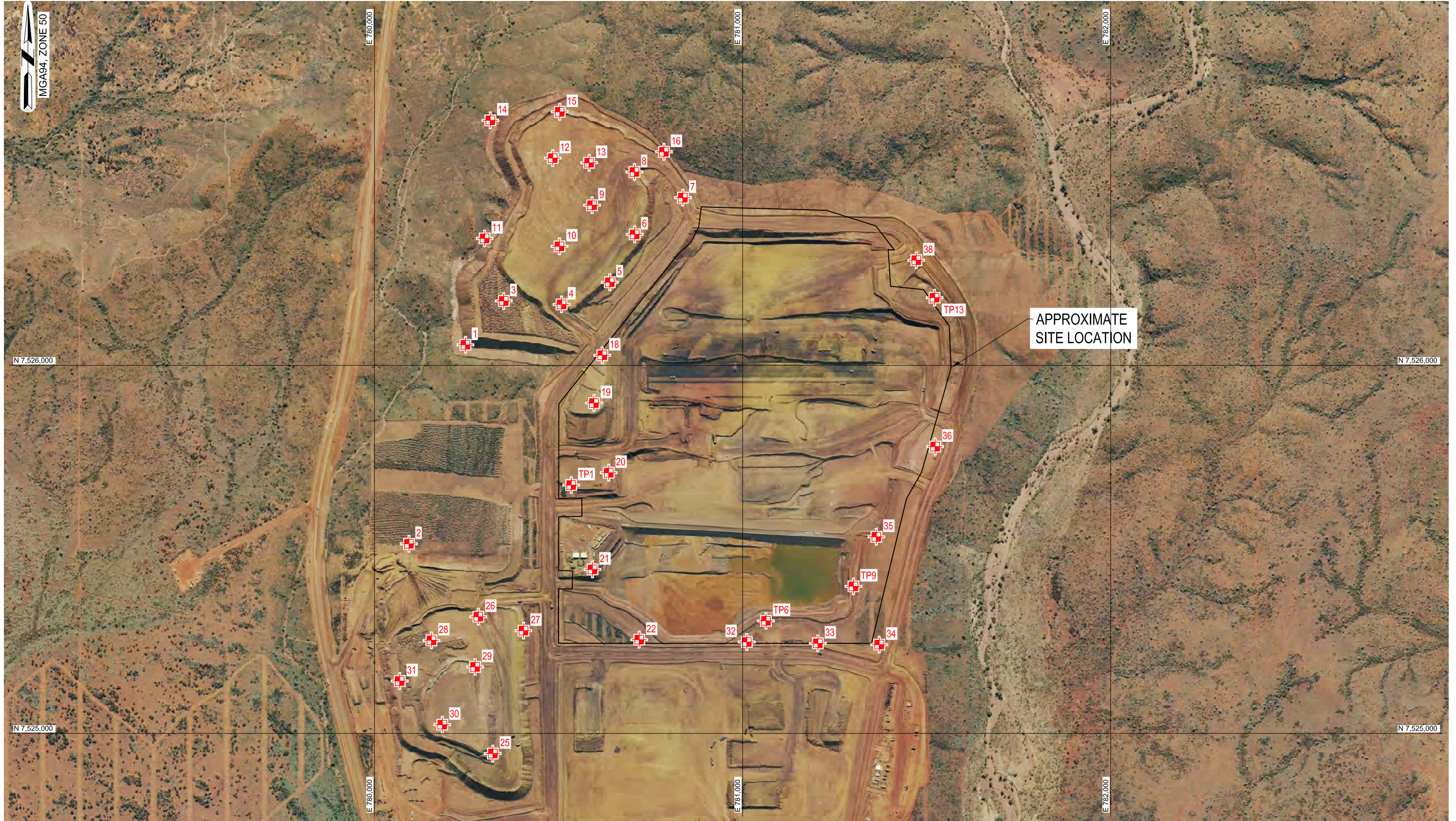
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	FLINDERS PIT		WINDICH PIT		



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GOLDER ASSOCIATES PTY. LTD.

CLIENT Fortescue Metals Group LTD			PROJECT Vasse TSF								
DRAWN BY R.WERDER-BIGHAM / DH		DATE 29.08.2012		DRAWING TITLE FMG CHRISTMAS CREEK GENERAL VICINITY SITE PLAN							
CHECKED BY JP		DATE 29.08.2012									
SCALE SCALE:1:50,000			SHEET SIZE A3	PROJECT No 127645023		DOC No 012	DOC TYPE R	FIGURE No F002	REVISION 0	FIGURE 2	

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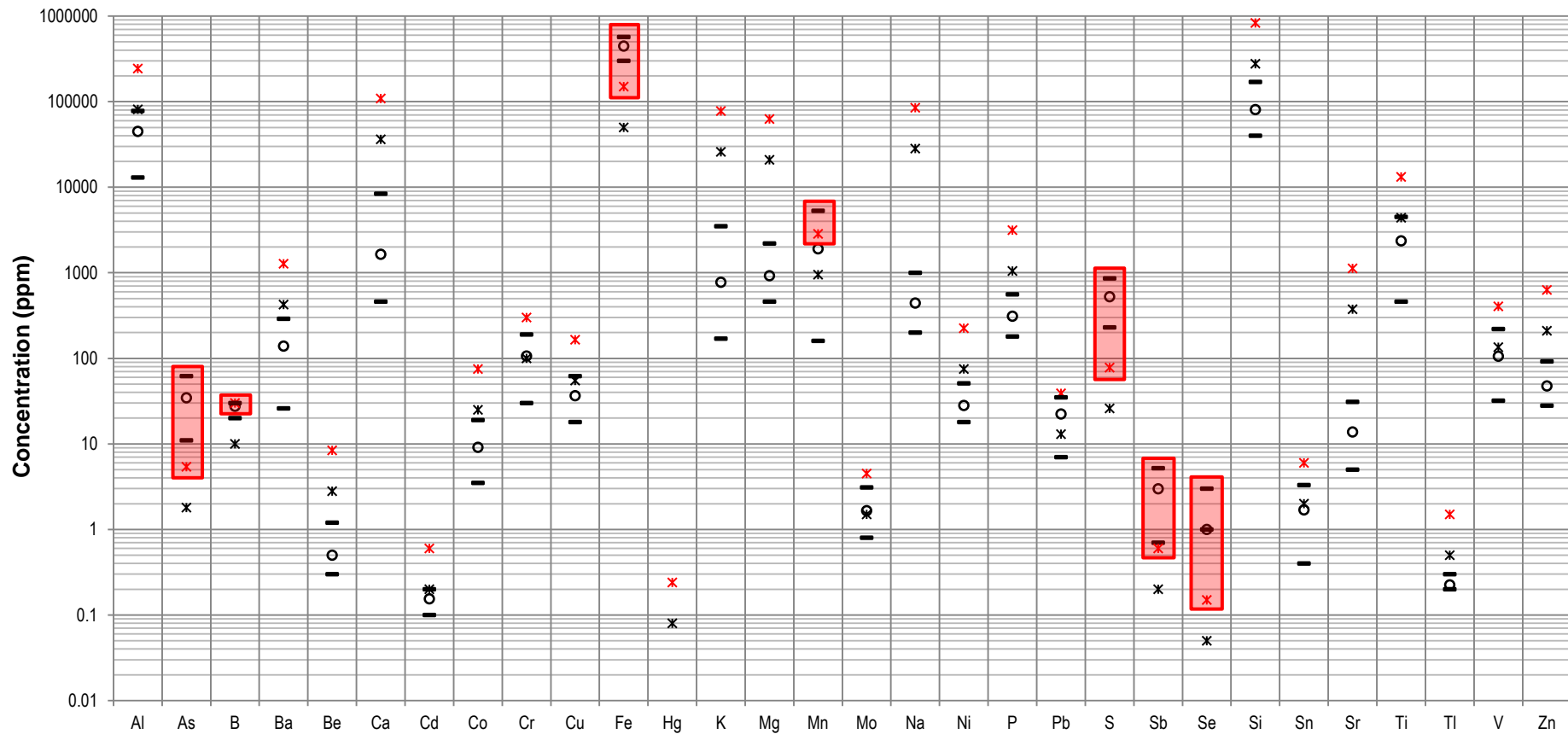
TP1 TEST PIT LOCATION



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CLIENT Fortescue Metals Group LTD		PROJECT Vasse TSF			
DRAWN BY R.WERDER-BIGHAM / DH	DATE 29.08.2012	DRAWING TITLE SAMPLING LOCATIONS			
CHECKED BY JP	DATE 29.08.2012				
SCALE SCALE:1:10,000	SHEET SIZE A3	PROJECT No 127645023	DOC No 012	DOC TYPE R	FIGURE No F003
		REVISION 0	FIGURE 3		

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FMG Vasse TSF

TITLE

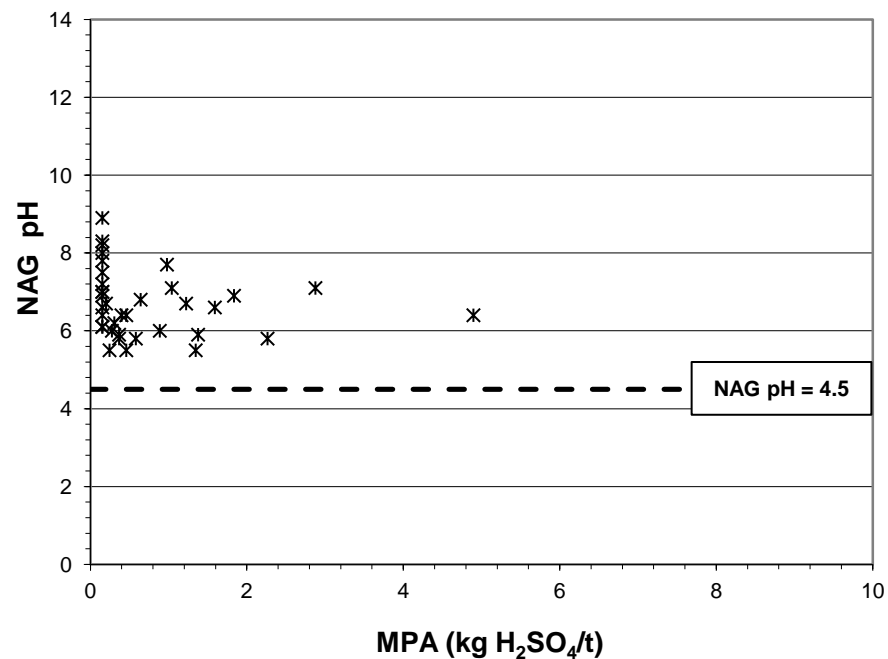
Total Elemental Concentrations

DRAWN JP
CHECKED JSW
REVIEWED JSW

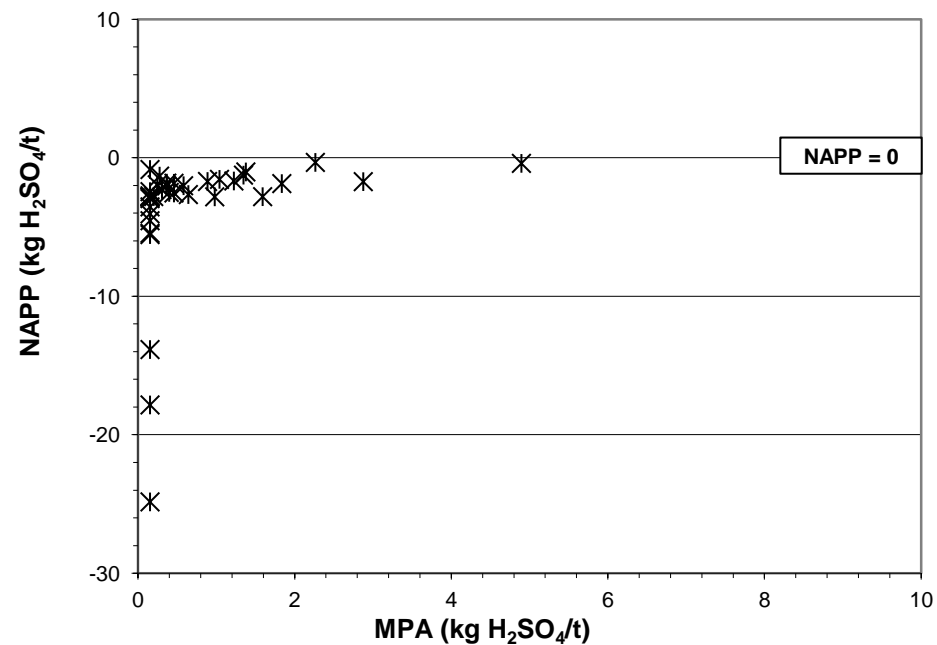
DATE OCTOBER 2012
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JOB NO. 127645023
DWG. NO.
FIGURE NO. 4

MPA vs. NAG pH



MPA vs. NAPP

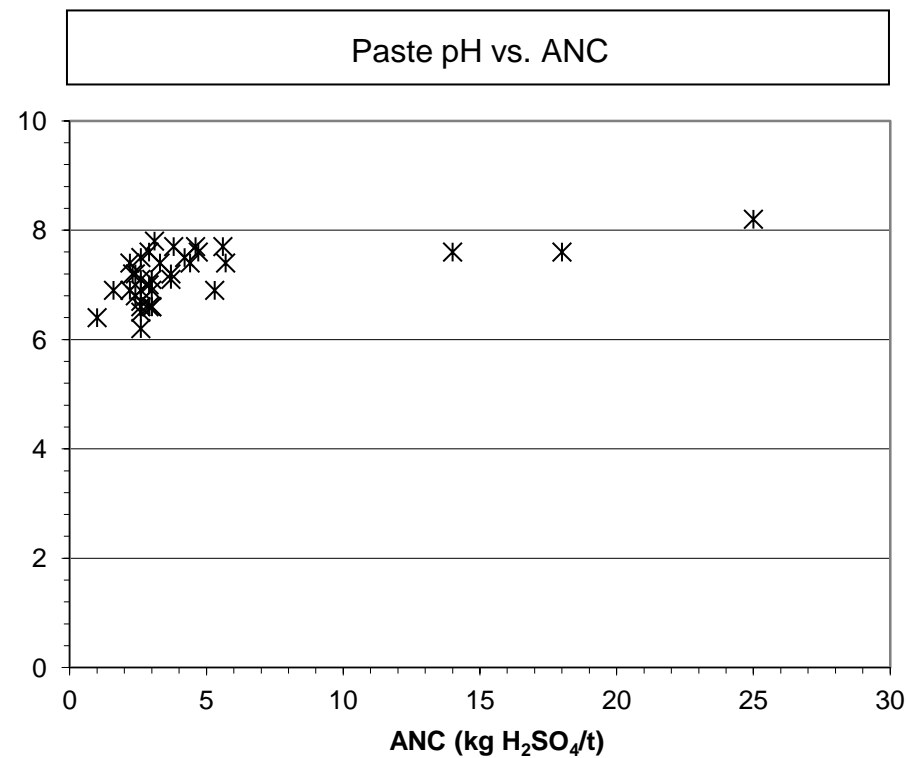
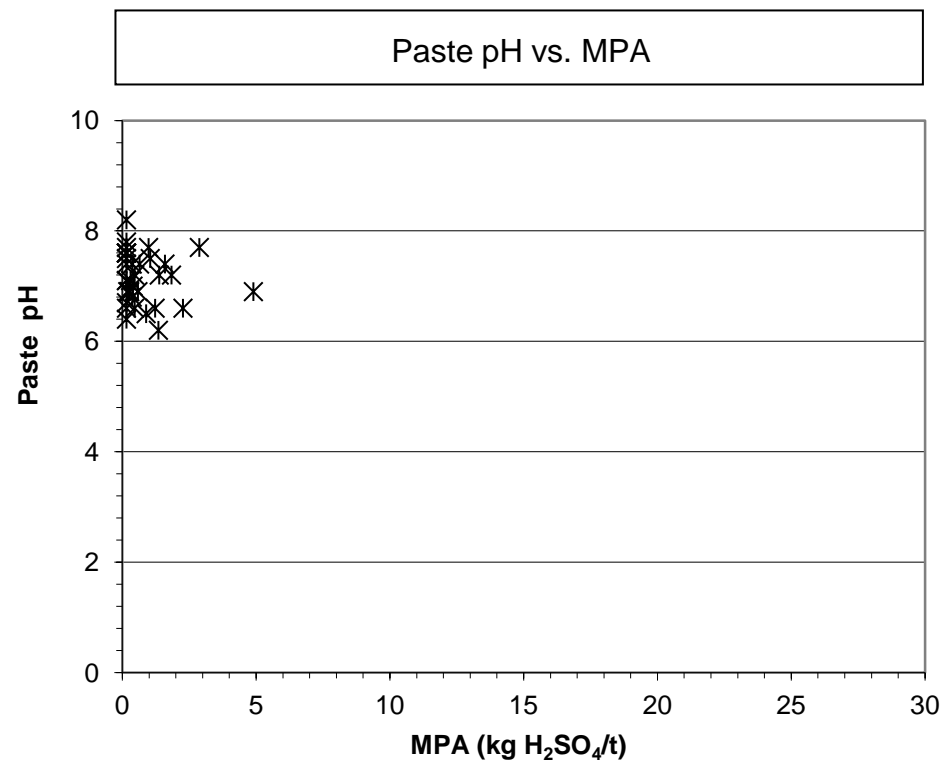


FMG Vasse TSF

TITLE

ABA Results - MPA vs. NAG pH and NAPP

DRAWN	JP	DATE	OCTOBER 2012	JOB NO.	127645023
CHECKED	JSW	SCALE	N/A	DWG. NO.	
REVIEWED	JSW	FILE NO.	FMG Vasse TSF	FIGURE NO.	5



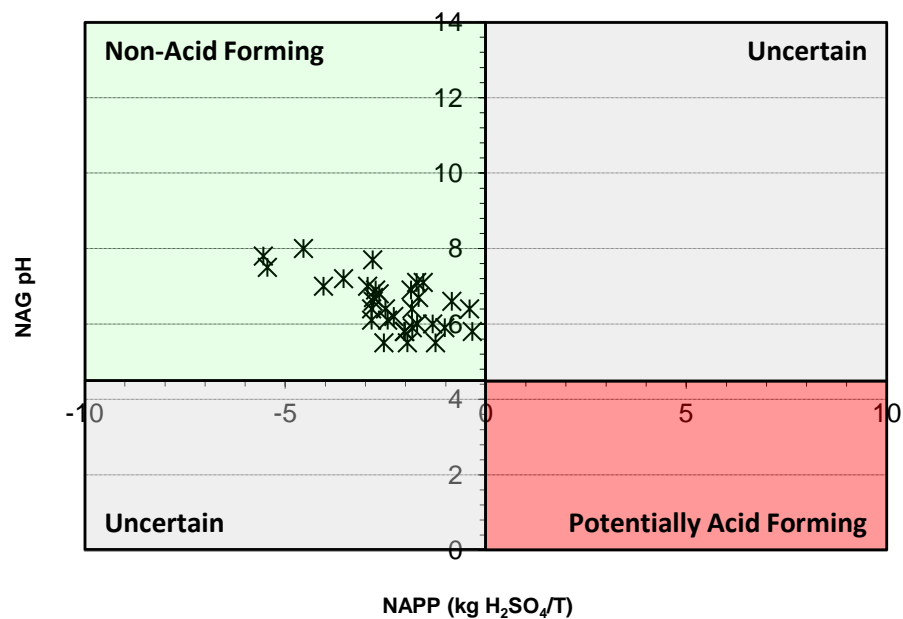
FMG Vasse TSF

TITLE

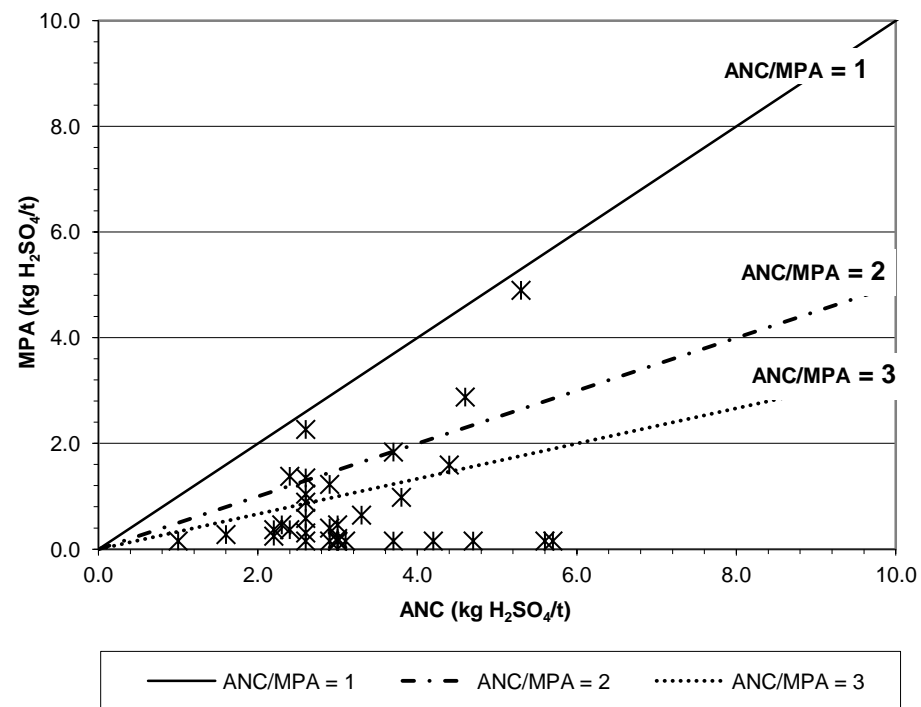
ABA Results - Paste pH vs. MPA and ANC

DRAWN	JP	DATE	OCTOBER 2012	JOB NO.	127645023
CHECKED	JSW	SCALE	N/A	DWG. NO.	
REVIEWED	JSW	FILE NO.	FMG Vasse TSF	FIGURE NO.	6

Adapted from AMIRA 2002



Adapted from PRICE 2009



Note: Non-detect values plotted at the detection limit.



FMG Vasse TSF

TITLE

Acid Generating Classification Figures

DRAWN	JP	DATE	OCTOBER 2012	JOB NO.	127645023
CHECKED	JSW	SCALE	N/A	DWG. NO.	
REVIEWED	JSW	FILE NO.	FMG Vasse TSF	FIGURE NO.	7



APPENDIX A

List of Abbreviations and Glossary of Terms



APPENDIX A

Glossary and Abbreviations

The following glossary of terms includes definitions and abbreviations of common geochemical terms used in the main text and associated appendices. A table of symbols for metals, compounds and parameters used in laboratory analysis have also been included to assist understanding of laboratory analysis.

Definitions have been sourced from Managing Acid and Metalliferous Drainage (DoITR 2007), ARD Test Handbook (AMIRA 2002) and Prediction Manual for Drainage Chemistry from Sulfidic Geologic Materials (Price 2009).

ABBREVIATIONS

ABBREVIATIONS	DEFINITION
ABA	Acid base account
AMD	Acid and metalliferous drainage
AMIRA	AMIRA International
ANC	Acid neutralising capacity
BOM	Bureau of Meteorology
FMG	Fortescue Metals Group Ltd
ICP-MS	Inductively coupled plasma mass spectrometry
ICP-OES	Inductively coupled optical emission spectrometry
IPTSF	In-Pit tailings storage facility
MEND	Mine Environment Neutral Drainage
MPA	Maximum potential acidity
NAF	Non-acid forming
NAG	Net acid generating
NAPP	Net acid producing potential
PAF	Potentially acid forming
SPLP	Synthetic precipitation leaching procedure
TDS	Total dissolved solids
TSF	Tailings storage facility
XRD	X-ray diffraction



APPENDIX A

Glossary and Abbreviations

SYMBOLS USED IN LAB ANALYSIS

Ag	Silver	Cr	Chromium	Pb	Lead
Al	Aluminium	F	Fluorine	S	Sulfur
As	Arsenic	Hg	Mercury	Sb	Antimony
Au	Gold	K	Potassium	Se	Selenium
B	Boron	Mg	Magnesium	Si	Silicon
Ba	Barium	Mn	Manganese	Sr	Strontium
Ca	Calcium	Mo	Molybdenum	Tl	Thallium
Cd	Cadmium	Na	Sodium	U	Uranium
Co	Cobalt	Ni	Nickel	V	Vanadium
Cu	Copper	P	Phosphorous	Zn	Zinc

NH₄⁺	Ammonium ion	Ca²⁺	Calcium ion	SO₄²⁻	Sulfate ion
Na⁺	Sodium ion	Cl⁻	Chloride ion	S²⁻	Sulfide ion
K⁺	Potassium ion	NO₃⁻	Nitrate ion	EC	Electrical conductivity
Mg²⁺	Magnesium ion	F⁻	Fluoride ion	TDS	Total dissolved solids

GEOCHEMICAL TERMS

Acid - A measure of hydrogen ion (H⁺) concentration; generally expressed as pH. Acid is not equivalent to acidity.

Acid Base Account - An Acid Base Account (ABA) evaluates the balance between acid generation processes (oxidation of sulfide minerals) and acid neutralising processes. It can involve determination of the maximum potential acidity (APP) and the inherent acid neutralising capacity (ANC).

Acid Drainage - A form of Acid and Metalliferous Drainage (AMD), characterised by low pH, elevated toxic metal concentrations, high sulfate concentrations and high salinity.

Acidity - A measure of hydrogen ion (H⁺) concentration and mineral (latent) acidity; generally expressed as mg/L CaCO₃ equivalent. Measured by titration in a laboratory or estimated from pH and water quality data.

Alkalinity - A measure of the capacity of a solution to neutralise an acid.

Acid and Metalliferous Drainage (AMD) - AMD includes both acid drainage typically caused from the oxidation of exposed sulfides, and metalliferous drainage resulting from elevated levels of toxic metals and salinity.

Acid Neutralising Capacity (ANC) - expressed as kg H₂SO₄ equivalent per tonne. This is a measure of the *in situ* neutralising potential of a particular sample.

Kinetic Test - Procedure used to measure the magnitude and/or effects of dynamic processes, including reaction rates (such as sulfide oxidation and acid generation), material alteration and drainage chemistry and loadings that result from weathering. Unlike static tests, kinetic tests measure the behaviour of a sample over time.

Lithology - A soil or rock type defined by a distinct set of physical and mineralogical characteristics.

Maximum Potential Acidity (MPA) - A measure of acid production and is calculated from total measured sulfur.

Metalliferous Drainage - A form of Acid and Metalliferous Drainage (AMD), characterised by near-neutral pH, elevated heavy metal concentrations, high sulfate salinity.



APPENDIX A

Glossary and Abbreviations

Net Acid Generation (NAG) Test - also referred to as 'single addition NAG test'. Peroxide is used to oxidise any sulfides in a sample, then any acid generated during oxidation may be partially or completely consumed by neutralising components in the sample. Any remaining acidity is expressed as kg H₂SO₄ per tonne. A 'sequential NAG test' involves a series of NAG tests on a sample. This may be required if a sample cannot be fully oxidised using the conventional NAG test.

Net Acid Producing Potential (NAPP) - expressed as kg H₂SO₄ per tonne. Calculated by subtracting acid neutralising capacity (ANC) from acid producing potential (APP).

pH - the negative logarithm of the hydrogen ion concentration in solution. Scale of 0-14; pH of 7 = neutral solution.

Precautionary Principle - This principle states that, where the scientific evidence is uncertain, decision-makers should take action to limit continued environmental damage and should err on the side of caution when evaluating proposals that may have a serious or irreversible impact on the environment.

Redox Potential (Eh) - A measure of the affinity of a substance for electrons and therefore the potential to be reduced. Usually measured in volts.

Saline Drainage - A product of Acid and Metalliferous Drainage (AMD), characterised by high sulfate salinity but near-neutral pH and low concentrations of heavy metals.

Static Test - Procedure for characterising the physical or chemical status of a geological sample at one point in time. Static tests include measurements of mineral and chemical composition and the analyses required for Acid Base Accounts.

Tailings - Finely ground materials from which the desired mineral values have been largely extracted. Approximately 98% of the material mined for processing is discharged as tailings. At coal mines, tailings represent the coarse and fine rejects from the coal washery.

Tailings Storage Facility - Facility designed for the storage of unsaturated tailings material produced during ore processing. These facilities, unlike tailings dams, are not suitable for storage of supernatant water.

Waste Rock - Material such as soils, barren or uneconomic mineralised rock, that surrounds a mineral or coal orebody and must be removed in order to mine the ore. This is generally referred to as waste rock in metalliferous mines or overburden, interburden, interseam or spoil in coal mines.



APPENDIX B

Tetra Tech Test Pit Logs

TETRA TECH TEST PIT LOGGING SHEET	
TP No: TP01	
Project No: 1296580100	
Sheet 1 of 1	

Client: Fortescue Metal Group Christmas Creek	Date Started: 15 June 2012
---	----------------------------

Project Title: FMG Christmas Creek Vasse Waste Rock Dump Geotechnical Investigation	Dated Completed: 15 June 2012
---	-------------------------------

Project Name: PMS Christmas Creek, Vasse Waste Rock Dump Geotechnical Investigation	Project Completed: 25 June 2022
---	---------------------------------

Location: Vasse WRD, Christmas Creek		Logged By: S Berry

EASTING	NORTHING	RL(m)
---------	----------	-------

[illegible]
$$RL(m)$$

General Comments

[illegible]

TETRA TECH TEST PIT LOGGING SHEET	
TP No: TP09	
Project No: 1296580100	
Sheet 1 of 1	

Client: Fortescue Metal Group Christmas Creek	Date Started: 15 June 2012
---	----------------------------

Project Title: FMG Christmas Creek Vasse Waste Rock Dump Geotechnical Investigation	Dated Completed: 15 June 2012
---	-------------------------------

Project Name: PMS Christmas Creek, Vasse Waste Rock Dump Geotechnical Investigation	Project Completed: 25 June 2022
---	---------------------------------

Location: Vasse WRD, Christmas Creek		Logged By: S Berry

EASTING	NORTHING	RL(m)
---------	----------	-------

[illegible]
$$RL(m)$$

General Comments

From

2.8

2.8

2.8

3.0

EOP 3.0m, Too Dense To Advance (Bedrock)

TETRA TECH TEST PIT LOGGING SHEET	
TP No: TP13	
Project No: 1296580100	
Sheet 1 of 1	

Client: Fortescue Metal Group Christmas Creek	Date Started: 15 June 2012
---	----------------------------

Project Title: FMG Christmas Creek Vasse Waste Rock Dump Geotechnical Investigation	Dated Completed: 15 June 2012
---	-------------------------------

Project Name: PMS Christmas Creek, Vasse Waste Rock Dump Geotechnical Investigation	Project Completed: 25 June 2022
---	---------------------------------

Location: Vasse WRD, Christmas Creek		Logged By: S Berry

EASTING	NORTHING	RL(m)
---------	----------	-------

[illegible]
$$RL(m)$$

General Comments

Blows/100mm

To

0.6

GoE

2.4

mot



APPENDIX C

Summary of Laboratory Methods



All analysis except mineralogical analysis was completed by SGS Environmental Newburn. Microanalysis in Victoria Park completed all XRD mineralogical analysis.

Mineralogical Analysis

Mineralogical analysis is important to identify minerals of potential environmental importance, in particular potentially acid generating minerals (i.e. sulfides), acid neutralising minerals (primarily carbonates and selected silicates), and readily-soluble minerals (e.g. sulfates).

The x-ray diffractograms were analyzed using the search match software Eva. The x-ray source was copper radiation. The concentrations were calculated using the peak area integration method where the area of the 100% peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum.

Total Elemental Analysis

The results from solid-phase chemical analysis can be used to make an inference regarding elements of potential environmental concern, although it should be understood that a high concentration of a particular element does not necessarily imply that this element will indeed be mobilised in concentrations that may lead to environmental impacts.

Samples are digested to release elements from the mineral phase into a phase in which they can be analysed (e.g. liquid solution or glass disk) (Price 2005). Samples were acid digested either by modified aqua regia digest, the four acid digest or peroxide fusion. The resulting liquids were then analysed by inductively coupled plasma mass spectrometry (ICP-MS) or inductively coupled plasma optical emission spectrometry (ICP-OES).

Table C1 lists the elements analysed.

Acid Base Accounting (ABA) plus Paste pH

Acid base accounting (ABA) is conducted to predict the acid generation characteristics of a material through determination of the acid neutralising capacity (ANC) and maximum potential acidity (MPA).

ABA analysis included determination of the following:

- **Total Sulfur (%):** measured by heating sample in a LECO furnace to ~1650°C and measuring the sulfur dioxide production.
- **Acid Soluble Sulfur (%):** this method is for the determination of soluble sulfate (SO_4^{2-} -S) by extraction with hydrochloric acid. Sulfides should not react and would normally be expelled. Sulfur is determined by ICP. Can then calculate sulfide sulfur by subtracting sulfate sulfur from total sulfur.
- **MPA (%S):** is a measure of acid production. MPA is a function of the sulfide (S) content, making the assumption that the maximum acidity produced by a sample containing 1% of S as pyrite is 30.6 kg H_2SO_4 /tonne. MPA can be calculated using total or sulfidic sulfur as follows:
$$\text{MPA (kg H}_2\text{SO}_4\text{/tonne)} = \text{wt\% Total Sulfur} \times 30.6$$
- **ANC (kg H_2SO_4 /tonne):** measures the amount of acid the sample can neutralise. The tests establish the buffering capacity of a sample due to dissolution/weathering of other minerals in the sample that consume acid formed from oxidation of pyrite. The ANC is reported in kg of H_2SO_4 consumption per tonne of waste (kg H_2SO_4 /tonne).

Samples are initially evaluated to determine the strength of reagents needed using a fizz test. Samples are then subjected to an excess of hydrochloric acid followed by alkaline back titration to pH 7. Results are expressed in kg H_2SO_4 /tonne or kg CaCO_3 /tonne after correction for moisture content if applicable.

- **Paste pH:** the paste pH procedure is designed to more closely resemble the water to solid ratio of pore water in wastes than other pH analysis procedures. The solid to water ratio used is 1:2.



The ANC of a mine waste is determined by treating the sample with a known excess of hydrochloric acid, and back-titrating the amount of unconsumed acid with sodium hydroxide. The principal neutralising minerals in most geological materials are calcium and magnesium carbonates. Additional neutralising minerals accounted for in the determination of ANC include basic silicates such as calcic feldspars, olivine, amphiboles, and biotite. However, due to their generally slower dissolution rates, their contribution to the overall ANC is generally considered to be small under ambient conditions. Felsic silicates, such as sodic and potassic feldspars, muscovite, most clay minerals, and quartz, do not contribute significantly to the ANC. In addition, carbonate minerals that contain iron and/or manganese do not report to the ANC measurement. The ANC is reported in kilogram of sulfuric acid consumption per tonne of waste ($\text{kg H}_2\text{SO}_4/\text{tonne}$). It is also expressed in units of kilogram of calcium carbonate equivalent per tonne of material ($\text{kg CaCO}_3/\text{t}$), representing the capacity of the solids to neutralise acid, but not necessarily implying that calcite (CaCO_3) is present.

Paste pH is a qualitative outcome of the ANC, and provides additional information on the neutralising capabilities of a material. It is determined by mixing the solid with a fixed amount of distilled water, and measuring the pH of the resulting slurry. The paste pH reflects the balance of readily-soluble acid generating and acid neutralising components within a sample. The ratio used is a 1:2, solid to water ratio.

The MPA of a material is derived from a sulfur determination. The most environmentally conservative approach to calculate MPA is to make the assumption that all sulfur in a sample is potentially reactive and therefore capable of generating acid. However, this ignores the fact that not all sulfur will contribute acidity (e.g., sulfur in gypsum, barite or chalcocite). For this study, MPA was calculated using total sulfur as the quantity of acid soluble sulfur (sulfate sulfur) measured was insignificant. As for ANC, the MPA is expressed in $\text{kg H}_2\text{SO}_4/\text{t}$. By convention in ABA studies, one assumes that the sulfur is present entirely as pyrite (FeS_2), and the stoichiometry of pyrite oxidation is used to calculate a theoretical amount of sulfuric acid that could be generated, then requiring neutralisation by a corresponding quantity of hypothetical CaCO_3 .

Net Acid Generation (NAG) Testing

The test is based on a principle that a strong oxidising agent (hydrogen peroxide) accelerates oxidation of any sulfide minerals. During the test both acid generation and neutralisation occurs at the same time. If the sample has sufficient available ANC, the alkalinity of the whole rock will not be entirely depleted, and the system is expected to have the capacity to remain circum-neutral. If there is inadequate available ANC, then the pH of the test solution will fall below 4.5 and there will be net acidity rather than net alkalinity. A pH of less than 4.5 after reaction indicates that sample has a potential for acid generation.

Pulverised sub-sample of a waste rock or an as received sample of filter cake, soil or sludge is subjected to an oxidising digest with hydrogen peroxide. The pH and EC of the NAG suspension is recorded at various stages in the digest. The acid produced (if any) is titrated using standardised NaOH to pH 7.0. NAG results are reported to $0.5 \text{ kg H}_2\text{SO}_4/\text{tonne}$.

Net Acid Producing Potential (NAPP)

Net acid producing potential (NAPP) is defined as the difference between the capacity of a sample to generate acid (MPA) and its capacity to neutralise acid (ANC):

$$\blacksquare \quad \text{NAPP (kg H}_2\text{SO}_4/\text{tonne)} = \text{MPA} - \text{ANC (kg H}_2\text{SO}_4/\text{tonne)}$$

Negative NAPP indicates that a sample has sufficient ANC to prevent acid generation. Conversely, if MPA exceeds ANC, the material may be acid generating.



APPENDIX C

Summary of Laboratory Methods

Modified Synthetic Precipitation Leaching Procedure (SPLP)

The U.S. Environmental Protection Agency's (EPA) Synthetic Precipitation Leaching Procedure (SPLP) (EPA Method 1312) was developed to assess the environmental stability of a waste material following contact with meteoric water. The test, designed for sites in the United States, stipulates a lixiviant with a pH of 4.2 or 5.0 for sites located east or west of the Mississippi River, respectively. The former lixiviant is considered representative of "acid rain" generated in industrialised areas, whereas the latter lixiviant is considered representative of more rural environments. The target pH is attained by addition of a dilute 60% sulfuric/40% nitric acid solution. The standard SPLP protocol considers a sample particle size of minus-9.5 mm, a solution to solid ratio of 20:1 by weight, and a reaction time of 18 hours.

The short-term nature of the SPLP test provides a snapshot in time of a material's environmental stability. Test results depend entirely on the present disposition of the sample (e.g. unoxidised vs. oxidised; oxidation products present vs. absent, etc). For reactive materials, the mechanisms that lead to changes in solution chemistry during water-rock interaction often develop over periods of time that are much greater than can be represented in an 18 hour extraction test (e.g. sulfide oxidation).

The resulting leachates were then analysed for metals and cations by inductively coupled plasma optical emission spectrometry (ICP-OES) and atomic absorption spectroscopy (AAS).

A modified SPLP test was performed using a solution to solids ratio of 10:1 and a pH 5.0 lixiviant rather than the standard 20:1 ratio. Parameters analysed for are listed in Table C1.

Table C1: SPLP and Total Elemental Parameters

Ag	Cd	Mg	S	Tl	*Alkalinity
Al	Co	Mn	Sb	V	*Sulfate
As	Cr	Mo	Se	Zn	*Chloride
B	Cu	Na	Si	*pH	*Fluoride
Ba	Fe	Ni	Sn	*EC	*Nitrate
Be	Hg	P	Sr	*Acidity	*Reactive P
Ca	K	Pb	Ti	*TDS	

Note:*SPLP only.



APPENDIX D

Laboratory Certificates

**SGS Environmental Services**

10 Reid Road,
Perth International Airport,
Newburn WA 6105
Tel: 08 9373 3500 Fax: 08 9373
3668

ATTN: HEIDE MIELKE
Email: Heide.Mielke@sgs.com

CHAIN OF CUSTODY & ANALYSIS REQUEST

Lab ID Number: 127645023 – Vasse TSF (please quote on all correspondence)
PE069061

Company Name: GOLDER ASSOCIATES

Project Name/No: 127645023

Address: Level 3, 1 Havelock Street

Purchase Order No: 26027

WEST PERTH 6005

Results Required Date:

Contact Name:

Josh Pearce
Justin Willis

Telephone: 0409 882 823

Fax:

Email Results to:

jpearce@golder.com.au
jwillis@golder.com.au

Laboratory Quotation No: ENV113242

ANALYSIS REQUESTED. SPECIFY & TICK AS APPROPRIATE

Notes/Guidelines/LOR/
Special instructions

SGS ID Client Sample ID
Sampling Date/Time
(field record sheet number)

Tick as
Appropriate

Solid Sample
Liquid Sample
Gas/Air Sample
PRESERVATIVE
NO. OF ITEMS

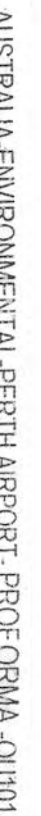
1	TP1	11-15/06/2012	X				1
2	TP9+TP6	11-15/06/2012	X				1
3	#1	11-15/06/2012	X				1
4	#2	11-15/06/2012	X				1
5	#3	11-15/06/2012	X				1
6	#4	11-15/06/2012	X				1
7	#5	11-15/06/2012	X				1
8	#6	11-15/06/2012	X				1
9	#7	11-15/06/2012	X				1
10	#8	11-15/06/2012	X				1
11	#9	11-15/06/2012	X				1
12	#10	11-15/06/2012	X				1
13	#11	11-15/06/2012	X				1
14	#12	11-15/06/2012	X				1
15	#13	11-15/06/2012	X				1

PLEASE SUBMIT ALL 36 SAMPLES FOR THE FOLLOWING TESTS as per ENV113242:

- Acid base accounting (AMIRA). ✓
- NAG (single addition). ✓
- Paste pH (1:2 - MEND). ✓
- Surface Rinse pH/EC (1:5 - MEND). ✓

PLEASE HOLD SAMPLES FOR ADDITIONAL TESTING ON
SELECTED SAMPLES ONLY (including total elemental, modified
SPLP and XRD). Samples for additional testing will be selected at
a later date.

16	#14	11-15/06/2012	X						1	
17	#15	11-15/06/2012	X						1	
18	#16	11-15/06/2012	X						1	
19	#18	11-15/06/2012	X						1	
20	#19	11-15/06/2012	X						1	
21	#20	11-15/06/2012	X						1	
22	#21	11-15/06/2012	X						1	
23	#22	11-15/06/2012	X						1	
24	#25	11-15/06/2012	X						1	
25	#26	11-15/06/2012	X						1	
26	#27	11-15/06/2012	X						1	
27	#28	11-15/06/2012	X						1	
28	#29	11-15/06/2012	X						1	
29	#30	11-15/06/2012	X						1	
30	#31	11-15/06/2012	X						1	
31	#32	11-15/06/2012	X						1	
32	#33	11-15/06/2012	X						1	
33	#34	11-15/06/2012	X						1	
34	#35	11-15/06/2012	X						1	
35	#36	11-15/06/2012	X						1	
36	#38	11-15/06/2012	X						1	
Relinquished By: Stephen Abbey		Date/Time: 12/07/2012 PM	Received By: <i>DS</i>							Date/Time: 13/7/12 1400
Relinquished By:		Date/Time:	Received By:							Date/Time:
Samples Intact: Yes / No		Temperature: Ambient	Sample Security Sealed: Yes / No							Quarantine: Yes / No
Comments / Subcontracting details: i.e. samples subcontracted to SGS Sydney due to TAT requested										Hazards: e.g. may contain Asbestos



APPROVED BY: R. MA

Action Taken:

Client IDs #14, #15 + #18 not booked in as per client instructions.

- #15 + #18 not received.
- 2 x dissimilar bags received for #14.

Registered By:

DB 17/7/12

Job Number:

69061

of Eskies:

1 pallet

IB / ICE / None

Temp: 20°C

Tray Numbers:

S-284-294



QUOTATION ENV113242

Date: 29/11/2011
Organisation: Golder Associates Perth
Contact Name: Josh Pearce
Phone: +61 8 9213 8226
Email: jpearce@golder.com.au
Valid Until: 27/05/2012
Sample Type: Soil
Approximate Number of Samples: 900
Expected Commencement: 16/12/2011
Duration: 1 Month
Primary Laboratory: Perth
Secondary Laboratory: Other

Dear Josh,

Thank you for allowing SGS to quote on your project, please see the following pages for details regarding pricing and additional services for the selected analytes. SGS looks forward to providing you more than just a testing service for your project. We are able to assist with many aspects of your project including but not limited to logistics, sampling containers and specific testing advice.

SGS offers a typical **1 Month Turn Around Time** for the analyses in this project.

Please ensure this quotation is accurate based on your project requirements. To commence your project with SGS please confirm your acceptance by email and advise me if you require the relevant sampling containers.

If you have any questions please do not hesitate to contact me on the below details.

Yours Sincerely,

Heide Mielke
Environmental Services
Client Services Officer

SGS Australia Pty Ltd
10 Reid Road
Newburn, WA 6105
Phone: +61 (0)8 9373 3632
Fax: +61 (0)8 9373 3668
E-mail: heide.mielke@sgs.com



Pricing

ANALYSIS		METHOD	LOI (mg/kg)	CONTAINERS PER SAMPLE	UNIT COST	UNITS	TOTAL (AUD)
Soil							
Sample Preparation	Crush & Pulverise <2kg (\$1/kg for samples >2kg)	-	-	11	900	\$	9,900.00
Acid Mine Drainage	Net Acid Generation pHox	AS4969	Calculation 0.1pH unit	20	900	\$	\$18,000.00
Acid Base Accounting	Net Acid Producing Potential Maximum Potential for Acidity Sulphate SHCl Total Sulphur (by LECO) TOS Tot S - SO4 ANC	ABA can be presented in accordance with AMIRA or MEND (client to specify) MEND analysis can be Sobek, Modified Sobek or Siderite Corrected (ANC only)	Calculation 0.005% 0.005% 0.005% 0.06% CaCO ₃	Whit-Paks/Bags	65	900	\$58,500.00
Other Charges							
Administration Fee (per job)				30	1	\$	30.00
Disposal Fee				1	900	\$	900.00
VWA Utility Premium				1	900	\$	900.00
TOTAL PRICE							\$88,230.00



ANALYTICAL REPORT



CLIENT DETAILS

Contact Josh Pearce
Client Golder Associates Pty Ltd
Address PO Box 1914
(1 Havelock Street, West Perth WA 6005)
WEST PERTH WA 6872

Telephone 08 9213 7600
Facsimile 08 9328 8433
Email jpearce@golder.com.au

Project **127645023**
Order Number **26027**
Samples 34

LABORATORY DETAILS

Manager Ros Ma
Laboratory SGS Newburn Environmental
Address 10 Reid Rd
Newburn WA 6105

Telephone (08) 9373 3500
Facsimile (08) 9373 3556
Email au.environmental.perth@sgs.com

SGS Reference **PE069061 R0**
Report Number 0000043596
Date Reported 30 Jul 2012
Date Received 13 Jul 2012

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Corey Williams
National Operations Manager

Hue Thanh Ly
Spectroscopy Chemist

Michael McKay
Inorganic Team Leader - Waters

Sonam Tashi



ANALYTICAL REPORT

PE069061 R0

Parameter	Units	LOR	Sample Number	PE069061.001	PE069061.002	PE069061.003	PE069061.004	PE069061.005
			Sample Matrix Sample Name	Soil TP1	Soil TP9+TP6	Soil #1	Soil #2	Soil #3

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	7.7	6.8	6.9	6.4	7.0
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	7.5	6.6	6.6	6.4	6.8
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	170	73	130	120	450
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	170	73	130	120	450

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.094	0.012	0.008	<0.005	0.013
Maximum Potential Acidity*	kg H2SO4/T	0.5	2.9	<0.5	<0.5	<0.5	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	4	3	4	3	5
Acid Soluble Sulphur (SHCI)	%w/w	0.05	<0.050	<0.050	<0.050	<0.050	<0.050

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL	NIL	NIL	NIL
Titration - Green Colouration?*	No unit	-	No	No	No	No	No
Titration - Precipitate Formed?*	No unit	-	YES	YES	YES	YES	YES
Initial Effervescence*	No unit	-	No	No	No	No	No
Effervescence on Warming*	No unit	-	No	No	No	No	No
ANC as % CaCO ₃	% CaCO ₃	0.1	0.5	0.2	0.2	<0.1	0.3
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.5	0.3	0.2	0.1	0.3
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	4.7	2.5	2.2	<1	2.9
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H2SO4/T	1	4.6	2.4	2.2	<1	2.9
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	4.7	2.5	2.2	<1	2.9
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H2SO4/T	1	4.6	2.4	2.2	<1	2.9

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H2SO4/T	0.25	2.5	<0.25	<0.25	<0.25	<0.25
Net Acid Production Potential	kg H2SO4/T	-400	-2	-2	-2	-1	-3
Total Oxidisable Sulphur	%w/w	0.005	0.083	0.006	<0.005	<0.005	<0.005



ANALYTICAL REPORT

PE069061 R0

	Sample Number	PE069061.001	PE069061.002	PE069061.003	PE069061.004	PE069061.005
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Name	TP1	TP9+TP6	#1	#2	#3
Parameter	Units	LOR				

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	41	39	30	41	59
pHox (NAG pH)	No unit	-	7.1	5.8	5.5	6.6	6.4
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	0.8	0.8	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	0.8	0.8	<0.5	<0.5

	Sample Number	PE069061.006	PE069061.007	PE069061.008	PE069061.009	PE069061.010
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Name	#4	#5	#6	#7	#8
Parameter	Units	LOR				

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	8.2	7.7	7.8	7.6	7.6
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	8.4	8.0	7.9	7.9	7.7
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	210	410	170	390	190
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	210	410	170	390	190

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.005	0.032	<0.005	<0.005	<0.005
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.5	<0.5	1.0	<0.5	<0.5	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	3	5	4	6	4
Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	<0.050	<0.050	<0.050



ANALYTICAL REPORT

PE069061 R0

Parameter	Sample Number		PE069061.006	PE069061.007	PE069061.008	PE069061.009	PE069061.010
	Sample Matrix		Soil	Soil	Soil	Soil	Soil
	Sample Name		#4	#5	#6	#7	#8
Units	LOR						

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	Moderate	NIL	NIL	Moderate	NIL
Titration - Green Colouration?*	No unit	-	No	No	No	No	No
Titration - Precipitate Formed?*	No unit	-	YES	YES	YES	YES	YES
Initial Effervescence*	No unit	-	No	No	No	No	No
Effervescence on Warming*	No unit	-	No	No	No	No	No
ANC as % CaCO ₃	% CaCO ₃	0.1	2.6	0.4	0.3	1.8	0.3
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	2.8	0.4	0.3	2.0	0.3
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	26	3.9	3.2	18	2.9
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	25	3.8	3.1	18	2.9
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	26	3.9	3.2	18	2.9
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	25	3.8	3.1	18	2.9

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	<0.25	0.45	<0.25	<0.25	<0.25
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-25	-3	-3	-19	-3
Total Oxidisable Sulphur	%w/w	0.005	<0.005	0.015	<0.005	<0.005	<0.005

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	μS/cm	1	110	57	35	120	38
pHox (NAG pH)	No unit	-	8.2	7.7	7.0	8.9	6.9
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Parameter	Sample Number		PE069061.011	PE069061.012	PE069061.013	PE069061.014	PE069061.015
	Sample Matrix		Soil	Soil	Soil	Soil	Soil
	Sample Name		#9	#10	#11	#12	#13
Units	LOR						

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	7.4	7.2	7.1	6.9	6.9
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ANALYTICAL REPORT

PE069061 R0

Sample Number	PE069061.011	PE069061.012	PE069061.013	PE069061.014	PE069061.015
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Name	#9	#10	#11	#12	#13
Parameter	Units	LOR			

pH in soil (1:5) Method: AN101

pH	pH Units	0.1	7.4	7.1	7.1	6.9	6.9
----	----------	-----	------------	------------	------------	------------	------------

Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	120	140	64	280	100
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	120	140	64	280	100

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.012	0.045	0.010	0.16	0.019
Maximum Potential Acidity*	kg H2SO4/T	0.5	<0.5	1.4	<0.5	4.9	0.6

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	4	4	3	5	4
Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	<0.050	<0.050	<0.050

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL	NIL	NIL	NIL
Titration - Green Colouration?*	No unit	-	No	No	No	No	No
Titration - Precipitate Formed?*	No unit	-	YES	YES	YES	YES	YES
Initial Effervescence*	No unit	-	No	No	No	No	No
Effervescence on Warming*	No unit	-	No	No	No	No	No
ANC as % CaCO ₃	% CaCO ₃	0.1	0.2	0.2	0.3	0.5	0.3
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.2	0.3	0.3	0.6	0.3
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	2.2	2.5	2.7	5.4	2.7
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	2.2	2.4	2.6	5.3	2.6
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	2.2	2.5	2.7	5.4	2.7
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	2.2	2.4	2.6	5.3	2.6

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	<0.25	0.99	<0.25	4.4	0.33
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-2	-1	-3	-1	-2
Total Oxidisable Sulphur	%w/w	0.005	<0.005	0.032	<0.005	0.15	0.011

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	34	36	28	47	33
pHox (NAG pH)	No unit	-	5.9	5.9	6.2	6.4	5.8
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	0.6	1.0	0.6	<0.5	0.6
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	0.6	1.0	0.6	<0.5	0.6



ANALYTICAL REPORT

PE069061 R0

Parameter	Sample Number		PE069061.018	PE069061.020
	Sample Matrix		Soil	Soil
	Sample Name		#16	#19
Parameter	Units	LOR		

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	6.5	7.6
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	6.6	7.9
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	260	200
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	260	200

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.029	<0.005
Maximum Potential Acidity*	kg H2SO4/T	0.5	0.9	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	3	4
Acid Soluble Sulphur (SHCI)	%w/w	0.05	<0.050	<0.050

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	Slight
Titration - Green Colouration?*	No unit	-	No	No
Titration - Precipitate Formed?*	No unit	-	YES	YES
Initial Effervescence*	No unit	-	No	No
Effervescence on Warming*	No unit	-	No	No
ANC as % CaCO ₃	% CaCO ₃	0.1	0.3	1.5
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.3	1.6
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	2.7	15
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H2SO4/T	1	2.6	14
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	2.7	15
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H2SO4/T	1	2.6	14

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H2SO4/T	0.25	0.67	<0.25
Net Acid Production Potential	kg H2SO4/T	-400	-2	-15
Total Oxidisable Sulphur	%w/w	0.005	0.022	<0.005



ANALYTICAL REPORT

PE069061 R0

Parameter	Sample Number		PE069061.018	PE069061.020
	Sample Matrix		Soil	Soil
	Sample Name		#16	#19
Parameter	Units	LOR		

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	38	150
pHox (NAG pH)	No unit	-	6.0	8.3
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	0.6	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	0.6	<0.5

Parameter	Sample Number		PE069061.021	PE069061.022	PE069061.023	PE069061.024	PE069061.025
	Sample Matrix		Soil	Soil	Soil	Soil	Soil
	Sample Name		#20	#21	#22	#25	#26
Parameter	Units	LOR					

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	7.4	7.5	6.9	7.1	7.5
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	7.6	7.7	7.2	7.2	7.5
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	280	150	860	260	270
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	280	150	860	260	270

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.052	0.034	0.009	<0.005	<0.005
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.5	1.6	1.0	<0.5	<0.5	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	7	4	2	4	3
Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	<0.050	<0.050	<0.050



ANALYTICAL REPORT

PE069061 R0

Parameter	Sample Number		PE069061.021	PE069061.022	PE069061.023	PE069061.024	PE069061.025
	Sample Matrix		Soil	Soil	Soil	Soil	Soil
	Sample Name		#20	#21	#22	#25	#26
Units	LOR						

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL	NIL	NIL	NIL
Titration - Green Colouration?*	No unit	-	NO	NO	NO	NO	NO
Titration - Precipitate Formed?*	No unit	-	Yes	Yes	Yes	Yes	Yes
Initial Effervescence*	No unit	-	NO	NO	NO	NO	NO
Effervescence on Warming*	No unit	-	NO	NO	NO	NO	NO
ANC as % CaCO ₃	% CaCO ₃	0.1	0.5	0.3	0.2	0.4	0.4
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.5	0.3	0.2	0.4	0.5
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	4.5	2.6	1.7	3.8	4.3
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	4.4	2.6	1.6	3.7	4.2
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	4.5	2.6	1.7	3.8	4.3
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	4.4	2.6	1.6	3.7	4.2

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	0.73	0.51	<0.25	<0.25	<0.25
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-4	-2	-2	-4	-5
Total Oxidisable Sulphur	%w/w	0.005	0.024	0.017	<0.005	<0.005	<0.005

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	54	58	39	92	46
pHox (NAG pH)	No unit	-	6.6	7.1	6.0	7.2	7.0
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	0.8	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	0.8	<0.5	<0.5

Parameter	Sample Number		PE069061.026	PE069061.027	PE069061.028	PE069061.029	PE069061.030
	Sample Matrix		Soil	Soil	Soil	Soil	Soil
	Sample Name		#27	#28	#29	#30	#31
Units	LOR						

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	7.2	6.9	7.6	7.2	7.7
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ANALYTICAL REPORT

PE069061 R0

Parameter	Units	LOR	Sample Number	PE069061.026	PE069061.027	PE069061.028	PE069061.029	PE069061.030
			Sample Matrix	Soil	Soil	Soil	Soil	Soil
			Sample Name	#27	#28	#29	#30	#31

pH in soil (1:5) Method: AN101

pH	pH Units	0.1	7.5	7.2	8.0	7.6	7.9
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	1100	400	680	410	210
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	1100	400	680	410	210

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.060	0.046	<0.005	0.015	<0.005
Maximum Potential Acidity*	kg H2SO4/T	0.5	1.8	1.4	<0.5	<0.5	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	11	6	6	5	2
Acid Soluble Sulphur (SHCl)	%w/w	0.05	0.050	<0.050	<0.050	<0.050	<0.050

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL	NIL	NIL	NIL
Titration - Green Colouration?*	No unit	-	NO	NO	NO	NO	NO
Titration - Precipitate Formed?*	No unit	-	Yes	Yes	Yes	Yes	Yes
Initial Effervescence*	No unit	-	NO	NO	NO	NO	NO
Effervescence on Warming*	No unit	-	NO	NO	NO	NO	NO
ANC as % CaCO ₃	% CaCO ₃	0.1	0.4	0.3	0.5	0.2	0.6
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.4	0.3	0.5	0.3	0.6
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	3.8	3.1	4.8	2.4	5.7
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	3.7	3.0	4.7	2.3	5.6
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	3.8	3.1	4.8	2.4	5.7
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	3.7	3.0	4.7	2.3	5.6

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	0.30	0.70	<0.25	<0.25	<0.25
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-3	-2	-5	-2	-6
Total Oxidisable Sulphur	%w/w	0.005	0.010	0.023	<0.005	<0.005	<0.005

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	110	65	79	51	51
pHox (NAG pH)	No unit	-	6.9	6.7	8.0	6.4	7.5
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	0.6	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	0.6	<0.5



ANALYTICAL REPORT

PE069061 R0

Parameter	Units	LOR	Sample Number	PE069061.031	PE069061.032	PE069061.033	PE069061.034	PE069061.035
			Sample Matrix	Soil	Soil	Soil	Soil	Soil
			Sample Name	#32	#33	#34	#35	#36

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	6.6	6.6	6.2	6.7	6.6
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	8.5	6.7	6.2	6.7	6.7
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	7	61	66	72	120
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	7	61	66	72	120

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.015	<0.005	0.044	<0.005	0.074
Maximum Potential Acidity*	kg H2SO4/T	0.5	<0.5	<0.5	1.3	<0.5	2.3

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	2	2	5	2	4
Acid Soluble Sulphur (SHCI)	%w/w	0.05	<0.050	<0.050	<0.050	<0.050	<0.050

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL	NIL	NIL	NIL
Titration - Green Colouration?*	No unit	-	NO	NO	NO	NO	NO
Titration - Precipitate Formed?*	No unit	-	Yes	Yes	Yes	Yes	Yes
Initial Effervescence*	No unit	-	NO	NO	NO	NO	NO
Effervescence on Warming*	No unit	-	NO	NO	NO	NO	NO
ANC as % CaCO ₃	% CaCO ₃	0.1	0.3	0.3	0.3	0.3	0.3
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.3	0.3	0.3	0.3	0.3
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	3.1	3.1	2.6	2.6	2.6
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	3.0	3.0	2.6	2.6	2.6
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	3.1	3.1	2.6	2.6	2.6
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	3.0	3.0	2.6	2.6	2.6

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	0.29	<0.25	0.78	<0.25	1.8
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-3	-3	-2	-3	-1
Total Oxidisable Sulphur	%w/w	0.005	0.009	<0.005	0.026	<0.005	0.059



ANALYTICAL REPORT

PE069061 R0

Sample Number	PE069061.031	PE069061.032	PE069061.033	PE069061.034	PE069061.035
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Name	#32	#33	#34	#35	#36
Parameter	Units	LOR			

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	28	27	32	28	33
pHox (NAG pH)	No unit	-	5.5	6.1	5.5	6.1	5.8
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	1.0	<0.5	1.0	<0.5	0.6
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	1.0	<0.5	1.0	<0.5	0.6

Sample Number	PE069061.036	PE069061.037
Sample Matrix	Soil	Soil
Sample Name	#38	#18
Parameter	Units	LOR

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	7.4	7.1
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	7.1	8.2
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	340	120
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	340	120

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.021	<0.005
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.5	0.6	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	4	4
Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050



ANALYTICAL REPORT

PE069061 R0

		Sample Number	PE069061.036	PE069061.037
		Sample Matrix	Soil	Soil
		Sample Name	#38	#18
Parameter	Units	LOR		

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL
Titration - Green Colouration?*	No unit	-	NO	NO
Titration - Precipitate Formed?*	No unit	-	Yes	NO
Initial Effervescence*	No unit	-	NO	NO
Effervescence on Warming*	No unit	-	NO	NO
ANC as % CaCO ₃	% CaCO ₃	0.1	0.3	0.3
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.4	0.3
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	3.3	3.1
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	3.3	3.0
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	3.3	3.1
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	3.3	3.0

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	0.26	<0.25
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-3	-3
Total Oxidisable Sulphur	%w/w	0.005	0.008	<0.005

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	48	36
pHox (NAG pH)	No unit	-	6.8	6.4
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: ME-(AU)-[ENV]AN212

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Fizz Rating Reaction*	LB045226	No unit	-	NIL		
	LB045228	No unit	-	NIL		
	LB045695	No unit	-	NIL		
Titration - Green Colouration?*	LB045226	No unit	-	No		
	LB045228	No unit	-	NO		
	LB045695	No unit	-	NO		
Titration - Precipitate Formed?*	LB045226	No unit	-	No		
	LB045228	No unit	-	NO		
	LB045695	No unit	-	NO		
Initial Effervescence*	LB045226	No unit	-	No		
	LB045228	No unit	-	NO		
	LB045695	No unit	-	NO		
Effervescence on Warming*	LB045226	No unit	-	No		
	LB045228	No unit	-	NO		
	LB045695	No unit	-	NO		
ANC as % CaCO ₃	LB045226	% CaCO ₃	0.1	<0.1		
	LB045228	% CaCO ₃	0.1	<0.1		
	LB045695	% CaCO ₃	0.1	<0.1		
ANC as % CaMg(CO ₃) ₂	LB045226	%w/w	0.1	<0.1		
	LB045228	%w/w	0.1	<0.1		
	LB045695	%w/w	0.1	<0.1		
Acid Neutralisation Capacity/Neutralisation Potential	LB045226	kg CaCO ₃ /T	1	<1	0 - 9%	NA
	LB045228	kg CaCO ₃ /T	1	<1	0 - 7%	NA
	LB045695	kg CaCO ₃ /T	1	<1	7%	NA
Acid Neutralisation Capacity/Neutralisation Potential kg H ₂ SO ₄ /t	LB045226	kg H ₂ SO ₄ /T	1	<1	0 - 9%	NA
	LB045228	kg H ₂ SO ₄ /T	1	<1	0 - 7%	NA
	LB045695	kg H ₂ SO ₄ /T	1	<1	7%	NA

Conductivity and TDS by Calculation - Soil Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity of Extract (1:5 as received)	LB045246	µS/cm	2	<2	0%	102 - 103%
	LB045400	µS/cm	2	<2		101%
Conductivity of Extract (1:5 dry sample basis)	LB045246	µS/cm	2	<2	0%	NA
	LB045400	µS/cm	2	<2		NA

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

HCl Extractable S, Ca and Mg in Soil ICP OES Method: ME-(AU)-[ENV]AN014

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Acid Soluble Sulphur (SHCl)	LB045223	%w/w	0.05	<0.050	0%	NA
	LB045225	%w/w	0.05	<0.050	0%	NA
	LB045698	%w/w	0.05	<0.050	0%	NA

pH in soil (1:2) Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH (1:2) aged	LB045481	pH Units	0.1	5.5 - 5.7	0%	NA

pH in soil (1:5) Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH	LB045245	pH Units	0.1	0%	100%
	LB045399	pH Units	0.1		100%

Single Addition Net Acid Generation (NAG) Method: ME-(AU)-[ENV]AN216

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
ECox (NAG Conductivity)	LB045229	µS/cm	1	25		
	LB045230	µS/cm	1	22		
	LB045697	µS/cm	1	22		
pHox (NAG pH)	LB045229	No unit	-	5.2	1 - 5%	90%
	LB045230	No unit	-	5.4	0 - 1%	93%
	LB045697	No unit	-	5.5	1%	91%
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	LB045229	kg H ₂ SO ₄ /T	0.5	<0.5	0%	116%
	LB045230	kg H ₂ SO ₄ /T	0.5	<0.5	0%	119%
	LB045697	kg H ₂ SO ₄ /T	0.5	<0.5	0%	116%
NAG as kg H ₂ SO ₄ /tonne to pH 7	LB045229	kg H ₂ SO ₄ /T	0.5	<0.5	0%	113%
	LB045230	kg H ₂ SO ₄ /T	0.5	<0.5	0%	116%
	LB045697	kg H ₂ SO ₄ /T	0.5	<0.5	0%	116%
NAG as kg CaCO ₃ /tonne to pH 4.5	LB045229	kg CaCO ₃ /T	0.5	<0.5	0%	116%
	LB045230	kg CaCO ₃ /T	0.5	<0.5	0%	119%
	LB045697	kg CaCO ₃ /T	0.5	<0.5	0%	116%
NAG as kg CaCO ₃ /tonne to pH 7	LB045229	kg CaCO ₃ /T	0.5	<0.5	0%	113%
	LB045230	kg CaCO ₃ /T	0.5	<0.5	0%	116%
	LB045697	kg CaCO ₃ /T	0.5	<0.5	0%	116%



QC SUMMARY

PE069061 R0

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total Sulfur by LECO Furnace Method: ME-(AU)-[ENV]AN202

Parameter	QC	Units	LOR	MB	DUP %RPD	LCS
	Reference					%Recovery
Total Sulfur*	LB045239	%w/w	0.005	<0.005	0 - 18%	106 - 111%
	LB045539	%w/w	0.005	<0.005	0%	111%
Maximum Potential Acidity*	LB045539	kg H2SO4/T	0.5	<0.5		

METHOD

METHODOLOGY SUMMARY

AN002	Into a glass bottle or plastic jar weigh 20g of air-dried or as received sample, and add 100mL distilled water. If suspensions are prepared on different sample weights, ensure that the 1:5 soil to water ratio is maintained.
AN014	This method is for the determination of soluble sulphate (SO ₄ -S) by extraction with hydrochloric acid. Sulphides should not react and would normally be expelled. Sulphur is determined by ICP.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water (or 0.01M CaCl ₂) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as μmhos/cm or μS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2520 B.
AN202	The sulphur is oxidised to sulphur dioxide gas in a tube furnace using oxygen to aid the oxidation process. The evolved sulphur dioxide is measure by an infra red cell. The infra red cell output is calibrated against the value of a known standard sample to provide the total sulphur value of the unknown sample.
AN202	Maximum Potential Acidity of the sample is a calculation that expresses the total sulphur result as kg of H ₂ SO ₄ /tonne.
AN212	Samples are initially evaluated to determine the strength of reagents needed using a 'fizz' test. Samples are then subjected to an excess of hydrochloric acid followed by alkaline back titration to pH 7. Results are expressed in kg H ₂ SO ₄ /tonne or Kg CaCO ₃ /tonne after correction for moisture content if applicable.
AN215	This is purely a calculation based on results obtained from Total Sulphur, Sulphate Method, and Acid Neutralisation Capacity Method (ME-(AU)-[ENV]AN212).
AN216	Pulverised sub-sample of a waste rock or an as received sample of filter cake, soil or sludge is subjected to an oxidising digest with hydrogen peroxide. The pH and EC of the NAG suspension is recorded at various stages in the digest. The acid produced (if any) is titrated using standardised NaOH to pH 7.0. NAG results are reported to 0.5 kg H ₂ SO ₄ /tonne.



FOOTNOTES

IS	Insufficient sample for analysis.	QFH	QC result is above the upper tolerance
LNR	Sample listed, but not received.	QFL	QC result is below the lower tolerance
*	This analysis is not covered by the scope of accreditation.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated
LOR	Limit of Reporting		
↑↓	Raised or Lowered Limit of Reporting		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf>

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STATEMENT OF QA/QC PERFORMANCE

PE069061 R0

CLIENT DETAILS

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Project **127645023**
Order Number **26027**
Samples 34

LABORATORY DETAILS

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SGS Reference PE069061 R0
Report Number 0000043597
Date Reported 30 Jul 2012

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client. This QA/QC Statement must be read in conjunction with the referenced Analytical Report. The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Analysis Date	pH in soil (1:2)	34 items
	pH in soil (1:5)	33 items

SAMPLE SUMMARY

Sample counts by matrix	33 Soil	Type of documentation received	COC
Date documentation received	13/7/2012	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	20°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	1 Pallet

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP)

Method: ME-(AU)-ENVJAN212

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
TP9+TP6	PE069061.002	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#1	PE069061.003	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#2	PE069061.004	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#3	PE069061.005	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#4	PE069061.006	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#5	PE069061.007	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#6	PE069061.008	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#7	PE069061.009	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#8	PE069061.010	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#9	PE069061.011	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#10	PE069061.012	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#11	PE069061.013	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#12	PE069061.014	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#13	PE069061.015	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#16	PE069061.018	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#19	PE069061.020	LB045226	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#20	PE069061.021	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#21	PE069061.022	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#22	PE069061.023	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#25	PE069061.024	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#26	PE069061.025	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#27	PE069061.026	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#28	PE069061.027	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#29	PE069061.028	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#30	PE069061.029	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#31	PE069061.030	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#32	PE069061.031	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#33	PE069061.032	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#34	PE069061.033	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#35	PE069061.034	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#36	PE069061.035	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#38	PE069061.036	LB045228	-	13 Jul 2012	-	18 Jul 2012	-	25 Jul 2012
#18	PE069061.037	LB045695	-	13 Jul 2012	-	25 Jul 2012	-	27 Jul 2012

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-ENVJAN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
TP9+TP6	PE069061.002	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#1	PE069061.003	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#2	PE069061.004	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#3	PE069061.005	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#4	PE069061.006	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#5	PE069061.007	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#6	PE069061.008	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#7	PE069061.009	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#8	PE069061.010	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#9	PE069061.011	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#10	PE069061.012	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#11	PE069061.013	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#12	PE069061.014	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#13	PE069061.015	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#16	PE069061.018	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#19	PE069061.020	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#20	PE069061.021	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#21	PE069061.022	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#22	PE069061.023	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#25	PE069061.024	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#26	PE069061.025	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#27	PE069061.026	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Conductivity and TDS by Calculation - Soil (continued)

Method: ME-(AU)-ENVJAN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#28	PE069061.027	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#29	PE069061.028	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#30	PE069061.029	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#31	PE069061.030	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#32	PE069061.031	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#33	PE069061.032	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#34	PE069061.033	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#35	PE069061.034	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#36	PE069061.035	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#38	PE069061.036	LB045246	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012
#18	PE069061.037	LB045400	-	13 Jul 2012	-	20 Jul 2012	-	20 Jul 2012

HCl Extractable S, Ca and Mg in Soil ICP OES

Method: ME-(AU)-ENVJAN014

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
TP9+TP6	PE069061.002	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#1	PE069061.003	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#2	PE069061.004	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#3	PE069061.005	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#4	PE069061.006	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#5	PE069061.007	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#6	PE069061.008	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#7	PE069061.009	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#8	PE069061.010	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#9	PE069061.011	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#10	PE069061.012	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#11	PE069061.013	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#12	PE069061.014	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#13	PE069061.015	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#16	PE069061.018	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#19	PE069061.020	LB045223	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#20	PE069061.021	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#21	PE069061.022	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#22	PE069061.023	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#25	PE069061.024	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#26	PE069061.025	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#27	PE069061.026	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#28	PE069061.027	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#29	PE069061.028	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#30	PE069061.029	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#31	PE069061.030	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#32	PE069061.031	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#33	PE069061.032	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#34	PE069061.033	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#35	PE069061.034	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#36	PE069061.035	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#38	PE069061.036	LB045225	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#18	PE069061.037	LB045698	-	13 Jul 2012	-	25 Jul 2012	-	27 Jul 2012

pH in soil (1:2)

Method: ME-(AU)-ENVJAN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
TP9+TP6	PE069061.002	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#1	PE069061.003	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#2	PE069061.004	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#3	PE069061.005	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#4	PE069061.006	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#5	PE069061.007	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#6	PE069061.008	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#7	PE069061.009	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#8	PE069061.010	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†



HOLDING TIME SUMMARY

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SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

pH in soil (1:2) (continued)

Method: ME-(AU)-ENVJAN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#9	PE069061.011	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#10	PE069061.012	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#11	PE069061.013	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#12	PE069061.014	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#13	PE069061.015	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#16	PE069061.018	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#19	PE069061.020	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#20	PE069061.021	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#21	PE069061.022	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#22	PE069061.023	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#25	PE069061.024	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#26	PE069061.025	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#27	PE069061.026	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#28	PE069061.027	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#29	PE069061.028	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#30	PE069061.029	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#31	PE069061.030	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#32	PE069061.031	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#33	PE069061.032	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#34	PE069061.033	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#35	PE069061.034	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#36	PE069061.035	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#38	PE069061.036	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†
#18	PE069061.037	LB045481	-	13 Jul 2012	-	23 Jul 2012	-	26 Jul 2012†

pH in soil (1:5)

Method: ME-(AU)-ENVJAN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
TP9+TP6	PE069061.002	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#1	PE069061.003	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#2	PE069061.004	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#3	PE069061.005	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#4	PE069061.006	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#5	PE069061.007	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#6	PE069061.008	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#7	PE069061.009	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#8	PE069061.010	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#9	PE069061.011	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#10	PE069061.012	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#11	PE069061.013	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#12	PE069061.014	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#13	PE069061.015	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#16	PE069061.018	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#19	PE069061.020	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#20	PE069061.021	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#21	PE069061.022	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#22	PE069061.023	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#25	PE069061.024	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#26	PE069061.025	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#27	PE069061.026	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#28	PE069061.027	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#29	PE069061.028	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#30	PE069061.029	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#31	PE069061.030	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#32	PE069061.031	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#33	PE069061.032	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#34	PE069061.033	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#35	PE069061.034	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#36	PE069061.035	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†
#38	PE069061.036	LB045245	-	13 Jul 2012	-	18 Jul 2012	-	26 Jul 2012†



HOLDING TIME SUMMARY

PE069061 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

pH in soil (1:5) (continued)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#18	PE069061.037	LB045399	-	13 Jul 2012	-	20 Jul 2012	-	20 Jul 2012

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-[ENV]AN216

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
TP9+TP6	PE069061.002	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#1	PE069061.003	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#2	PE069061.004	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#3	PE069061.005	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#4	PE069061.006	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#5	PE069061.007	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#6	PE069061.008	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#7	PE069061.009	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#8	PE069061.010	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#9	PE069061.011	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#10	PE069061.012	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#11	PE069061.013	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#12	PE069061.014	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#13	PE069061.015	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#16	PE069061.018	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#19	PE069061.020	LB045229	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#20	PE069061.021	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#21	PE069061.022	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#22	PE069061.023	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#25	PE069061.024	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#26	PE069061.025	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#27	PE069061.026	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#28	PE069061.027	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#29	PE069061.028	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#30	PE069061.029	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#31	PE069061.030	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#32	PE069061.031	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#33	PE069061.032	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#34	PE069061.033	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#35	PE069061.034	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#36	PE069061.035	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#38	PE069061.036	LB045230	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#18	PE069061.037	LB045697	-	13 Jul 2012	-	25 Jul 2012	-	27 Jul 2012

Total Sulfur by LECO Furnace

Method: ME-(AU)-[ENV]AN202

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
TP1	PE069061.001	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
TP9+TP6	PE069061.002	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#1	PE069061.003	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#2	PE069061.004	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#3	PE069061.005	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#4	PE069061.006	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#5	PE069061.007	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#6	PE069061.008	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#7	PE069061.009	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#8	PE069061.010	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#9	PE069061.011	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#10	PE069061.012	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#11	PE069061.013	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#12	PE069061.014	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#13	PE069061.015	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#16	PE069061.018	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#19	PE069061.020	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#20	PE069061.021	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#21	PE069061.022	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#22	PE069061.023	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012



HOLDING TIME SUMMARY

PE069061 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total Sulfur by LECO Furnace (continued)

Method: ME-(AU)-ENVJAN202

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#25	PE069061.024	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#26	PE069061.025	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#27	PE069061.026	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#28	PE069061.027	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#29	PE069061.028	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#30	PE069061.029	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#31	PE069061.030	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#32	PE069061.031	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#33	PE069061.032	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#34	PE069061.033	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#35	PE069061.034	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#36	PE069061.035	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#38	PE069061.036	LB045239	-	13 Jul 2012	-	18 Jul 2012	-	27 Jul 2012
#18	PE069061.037	LB045539	-	13 Jul 2012	-	23 Jul 2012	-	24 Jul 2012



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.



METHOD BLANKS

PE069061 R0

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-ENVJAN106

Sample Number	Parameter	Units	LOR	Result
LB045246.001	Conductivity of Extract (1:5 as received)	µS/cm	2	<2
LB045246.024	Conductivity of Extract (1:5 as received)	µS/cm	2	<2
LB045400.001	Conductivity of Extract (1:5 as received)	µS/cm	2	<2

pH In soil (1:2)

Method: ME-(AU)-ENVJAN101

Sample Number	Parameter	Units	LOR	Result
LB045481.001	pH (1:2) aged	pH Units	0.1	5.7
LB045481.022	pH (1:2) aged	pH Units	0.1	5.5

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-ENVJAN216

Sample Number	Parameter	Units	LOR	Result
LB045229.001	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5
LB045230.001	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5
LB045697.001	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5

Total Sulfur by LECO Furnace

Method: ME-(AU)-ENVJAN202

Sample Number	Parameter	Units	LOR	Result
LB045239.001	Total Sulfur*	%w/w	0.005	<0.005
LB045239.025	Total Sulfur*	%w/w	0.005	<0.005
LB045539.001	Total Sulfur*	%w/w	0.005	<0.005

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP)

Method: ME-(AU)-ENVJAN212

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.010	LB045226.013	Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	2.9	2.7	65	9
		Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	2.9	2.6	66	9
PE069061.020	LB045226.024	Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	15	15	37	0
		Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	14	14	37	0
PE069061.030	LB045228.013	Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	5.7	5.7	47	0
		Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	5.6	5.6	48	0
PE069061.036	LB045228.020	Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	3.3	3.6	59	7
		Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	3.3	3.5	59	7
PE069061.037	LB045695.004	Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	3.1	3.3	61	7
		Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	3.0	3.3	62	7

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-ENVJAN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.001	LB045246.003	Conductivity of Extract (1:5 as received)	µS/cm	2	170	170	31	0
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	170	170	31	0
PE069061.011	LB045246.014	Conductivity of Extract (1:5 as received)	µS/cm	2	120	120	32	0
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	120	120	32	0
PE069061.021	LB045246.027	Conductivity of Extract (1:5 as received)	µS/cm	2	280	280	31	0
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	280	280	31	0
PE069061.031	LB045246.038	Conductivity of Extract (1:5 as received)	µS/cm	2	7	7	59	0
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	7	7	59	0

HCl Extractable S, Ca and Mg in Soil ICP OES

Method: ME-(AU)-ENVJAN014

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.010	LB045223.013	Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	73	0
PE069061.020	LB045223.024	Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	68	0
PE069061.030	LB045225.013	Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	101	0
PE069061.036	LB045225.020	Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	71	0
PE069061.037	LB045698.004	Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.050	<0.050	64	0

pH in soil (1:2)

Method: ME-(AU)-ENVJAN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.001	LB045481.004	pH (1:2) aged	pH Units	0.1	7.7	7.7	31	0
PE069061.011	LB045481.015	pH (1:2) aged	pH Units	0.1	7.4	7.4	31	0
PE069061.021	LB045481.024	pH (1:2) aged	pH Units	0.1	7.4	7.5	31	0
PE069061.031	LB045481.035	pH (1:2) aged	pH Units	0.1	6.6	6.5	32	0

pH in soil (1:5)

Method: ME-(AU)-ENVJAN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.001	LB045245.003	pH	pH Units	0.1	7.5	7.5	31	0
PE069061.011	LB045245.015	pH	pH Units	0.1	7.4	7.4	31	0
PE069061.021	LB045245.028	pH	pH Units	0.1	7.6	7.6	31	0
PE069061.031	LB045245.040	pH	pH Units	0.1	8.5	8.5	31	0

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-ENVJAN216

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.010	LB045229.013	pHox (NAG pH)	No unit	-	6.9	6.5	10	5
		NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
PE069061.020	LB045229.024	pHox (NAG pH)	No unit	-	8.3	8.4	10	1
		NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
PE069061.030	LB045230.013	pHox (NAG pH)	No unit	-	7.5	7.6	10	0
		NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
PE069061.036	LB045230.020	pHox (NAG pH)	No unit	-	6.8	6.7	10	1
		NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0



DUPLICATES

PE069061 R0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Single Addition Net Acid Generation (NAG) (continued)

Method: ME-(AU)-ENVJAN216

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.036	LB045230.020	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
PE069061.037	LB045697.004	pHox (NAG pH)	No unit	-	6.4	6.4	10	1
		NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	161	0
		NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	159	0

Total Sulfur by LECO Furnace

Method: ME-(AU)-ENVJAN202

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061.004	LB045239.007	Total Sulfur*	%w/w	0.005	<0.005	<0.005	200	0
PE069061.028	LB045239.036	Total Sulfur*	%w/w	0.005	<0.005	<0.005	200	0
PE069061.031	LB045239.040	Total Sulfur*	%w/w	0.005	0.015	0.018	60	18
PE069061.037	LB045539.005	Total Sulfur*	%w/w	0.005	<0.005	<0.005	200	0



LABORATORY CONTROL SAMPLES

PE069061 R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB045246.023	Conductivity of Extract (1:5 as received)	µS/cm	2	310	303	95 - 105	102
LB045246.044	Conductivity of Extract (1:5 as received)	µS/cm	2	310	303	95 - 105	103
LB045400.004	Conductivity of Extract (1:5 as received)	µS/cm	2	310	303	95 - 105	101

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB045481.002	pH (1:2) aged	pH Units	0.1	7.0	0	NA	NA

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB045245.001	pH	pH Units	0.1	7.0	7	98 - 102	100
LB045245.024	pH	pH Units	0.1	7.0	7	98 - 102	100
LB045399.001	pH	pH Units	0.1	7.0	7	98 - 102	100

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-[ENV]AN216

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB045229.002	pHox (NAG pH)	No unit	-	2.3	2.5	90 - 110	90
	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	22	18.69	80 - 120	116
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	28	24.65	80 - 120	113
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	22	19.07	80 - 120	116
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	28	25.16	80 - 120	113
LB045230.002	pHox (NAG pH)	No unit	-	2.3	2.5	90 - 110	93
	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	22	18.69	80 - 120	119
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	28	24.65	80 - 120	116
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	23	19.07	80 - 120	119
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	29	25.16	80 - 120	116
LB045697.002	pHox (NAG pH)	No unit	-	2.3	2.5	90 - 110	91
	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	22	18.69	80 - 120	116
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	28	24.65	80 - 120	116
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	22	19.07	80 - 120	116
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	29	25.16	80 - 120	116

Total Sulfur by LECO Furnace

Method: ME-(AU)-[ENV]AN202

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB045239.002	Total Sulfur*	%w/w	0.005	0.086	0.081	80 - 120	106
LB045239.027	Total Sulfur*	%w/w	0.005	0.090	0.081	80 - 120	111
LB045539.002	Total Sulfur*	%w/w	0.005	0.090	0.081	80 - 120	111



Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.



Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.



Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
<http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf>

- * Non-accredited analysis.
- Sample not analysed for this analyte.
- ^ Analysis performed by external laboratory.

- IS Insufficient sample for analysis.
- LNR Sample listed, but not received.
- LOR Limit of reporting.
- QFH QC result is above the upper tolerance.
- QFL QC result is below the lower tolerance.

- ① At least 2 of 3 surrogates are within acceptance criteria.
- ② RPD failed acceptance criteria due to sample heterogeneity.
- ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
- ④ Recovery failed acceptance criteria due to matrix interference.
- ⑤ Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
- ⑥ LOR was raised due to sample matrix interference.
- ⑦ LOR was raised due to dilution of significantly high concentration of analyte in sample.
- ⑧ Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
- ⑨ Low surrogate recovery due to the sample emulsifying during extraction.
- † Refer to Analytical Report comments for further information.

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Project **127645023**
 Order Number **26027**
 Samples 2

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SGS Reference **PE069061A R0**
 Report Number 0000044197
 Date Reported 09 Aug 2012
 Date Received 27 Jul 2012

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES



Hue Thanh Ly
Spectroscopy Chemist



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Inorganic Team Leader - Waters



Ros Ma
Laboratory Assistant Manager



Sonam Tashi



ANALYTICAL REPORT

PE069061A R0

Parameter	Sample Number		PE069061A.016	PE069061A.017
	Sample Matrix		Soil	Soil
	Sample Name		#14	#15
	Units	LOR		

pH in soil (1:2) Method: AN101

pH (1:2) aged	pH Units	0.1	6.6	7.4
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pH in soil (1:5) Method: AN101

pH	pH Units	0.1	6.7	7.6
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Conductivity and TDS by Calculation - Soil Method: AN106

Conductivity of Extract (1:5 as received)	µS/cm	2	160	380
Conductivity of Extract (1:5 dry sample basis)	µS/cm	2	160	380

Total Sulfur by LECO Furnace Method: AN202

Total Sulfur*	%w/w	0.005	0.040	<0.005
Maximum Potential Acidity*	kg H ₂ SO ₄ /T	0.5	1.2	<0.5

HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014

Acid Extractable Sulphate as S	mg/L	-	4	5
Acid Soluble Sulphur (SHCl)	%w/w	0.05	<0.50 †	<0.50 †

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: AN212

Fizz Rating Reaction*	No unit	-	NIL	NIL
Titration - Green Colouration?*	No unit	-	No	No
Titration - Precipitate Formed?*	No unit	-	YES	YES
Initial Effervescence*	No unit	-	No	No
Effervescence on Warming*	No unit	-	No	No
ANC as % CaCO ₃	% CaCO ₃	0.1	0.3	0.6
ANC as % CaMg(CO ₃) ₂	%w/w	0.1	0.3	0.6
Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	2.9	5.8
Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	2.9	5.7
ANC/NP Siderite Corrected	kg CaCO ₃ /T	1	2.9	5.8
ANC/NP kg H ₂ SO ₄ /t Siderite Corrected	kg H ₂ SO ₄ /T	1	2.9	5.7

Net Acid Generation Potential (NAGP) Method: AN215

Total Oxidisable Sulphur	kg H ₂ SO ₄ /T	0.25	0.88	<0.25
Net Acid Production Potential	kg H ₂ SO ₄ /T	-400	-2	-6
Total Oxidisable Sulphur	%w/w	0.005	0.029	<0.005

Single Addition Net Acid Generation (NAG) Method: AN216

ECox (NAG Conductivity)	µS/cm	1	43	62
pHox (NAG pH)	No unit	-	6.7	7.8
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5
NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5
NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP) Method: ME-(AU)-[ENV]AN212

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Fizz Rating Reaction*	LB046155	No unit	-	NIL		
Titration - Green Colouration?*	LB046155	No unit	-	No		
Titration - Precipitate Formed?*	LB046155	No unit	-	No		
Initial Effervescence*	LB046155	No unit	-	No		
Effervescence on Warming*	LB046155	No unit	-	No		
ANC as % CaCO ₃	LB046155	% CaCO ₃	0.1	<0.1		
ANC as % CaMg(CO ₃) ₂	LB046155	%w/w	0.1	<0.1		
Acid Neutralisation Capacity/Neutralisation Potential	LB046155	kg CaCO ₃ /T	1	<1.0	0%	NA
Acid Neutralisation Capacity/Neutralisation Potential kg H ₂ SO ₄ /t	LB046155	kg H ₂ SO ₄ /T	1	<1.0	0%	NA

Conductivity and TDS by Calculation - Soil Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Conductivity of Extract (1:5 as received)	LB046148	µS/cm	2	<2	100%
Conductivity of Extract (1:5 dry sample basis)	LB046148	µS/cm	2	<2	NA

HCl Extractable S, Ca and Mg in Soil ICP OES Method: ME-(AU)-[ENV]AN014

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Acid Extractable Sulphate as S	LB046157	mg/L	-		3%	11%
Acid Soluble Sulphur (SHCl)	LB046157	%w/w	0.05	<0.050	3%	11%

pH in soil (1:2) Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
pH (1:2) aged	LB046151	pH Units	0.1	5.6	NA

pH in soil (1:5) Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	LCS %Recovery
pH	LB046147	pH Units	0.1	100%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Single Addition Net Acid Generation (NAG) Method: ME-(AU)-[ENV]AN216

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
ECox (NAG Conductivity)	LB046156	µS/cm	1	27		
pHox (NAG pH)	LB046156	No unit	-	5.9	0%	98%
NAG as kg H ₂ SO ₄ /tonne to pH 4.5	LB046156	kg H ₂ SO ₄ /T	0.5	<0.5	0%	103%
NAG as kg H ₂ SO ₄ /tonne to pH 7	LB046156	kg H ₂ SO ₄ /T	0.5	<0.5	0%	105%
NAG as kg CaCO ₃ /tonne to pH 4.5	LB046156	kg CaCO ₃ /T	0.5	<0.5	0%	103%
NAG as kg CaCO ₃ /tonne to pH 7	LB046156	kg CaCO ₃ /T	0.5	<0.5	0%	105%

Total Sulfur by LECO Furnace Method: ME-(AU)-[ENV]AN202

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Sulfur*	LB046183	%w/w	0.005	<0.005	4%	111%

METHOD

METHODOLOGY SUMMARY

AN002	Into a glass bottle or plastic jar weigh 20g of air-dried or as received sample, and add 100mL distilled water. If suspensions are prepared on different sample weights, ensure that the 1:5 soil to water ratio is maintained.
AN014	This method is for the determination of soluble sulphate (SO ₄ -S) by extraction with hydrochloric acid. Sulphides should not react and would normally be expelled. Sulphur is determined by ICP.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water (or 0.01M CaCl ₂) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2520 B.
AN202	The sulphur is oxidised to sulphur dioxide gas in a tube furnace using oxygen to aid the oxidation process. The evolved sulphur dioxide is measure by an infra red cell. The infra red cell output is calibrated against the value of a known standard sample to provide the total sulphur value of the unknown sample.
AN202	Maximum Potential Acidity of the sample is a calculation that expresses the total sulphur result as kg of H ₂ SO ₄ /tonne.
AN212	Samples are initially evaluated to determine the strength of reagents needed using a 'fizz' test. Samples are then subjected to an excess of hydrochloric acid followed by alkaline back titration to pH 7. Results are expressed in kg H ₂ SO ₄ /tonne or Kg CaCO ₃ /tonne after correction for moisture content if applicable.
AN215	This is purely a calculation based on results obtained from Total Sulphur, Sulphate Method, and Acid Neutralisation Capacity Method (ME-(AU)-[ENV]AN212).
AN216	Pulverised sub-sample of a waste rock or an as received sample of filter cake, soil or sludge is subjected to an oxidising digest with hydrogen peroxide. The pH and EC of the NAG suspension is recorded at various stages in the digest. The acid produced (if any) is titrated using standardised NaOH to pH 7.0. NAG results are reported to 0.5 kg H ₂ SO ₄ /tonne.



FOOTNOTES

IS	Insufficient sample for analysis.	QFH	QC result is above the upper tolerance
LNR	Sample listed, but not received.	QFL	QC result is below the lower tolerance
*	This analysis is not covered by the scope of accreditation.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated
LOR	Limit of Reporting		
↑↓	Raised or Lowered Limit of Reporting		

Samples analysed as received.

Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf>

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STATEMENT OF QA/QC PERFORMANCE

PE069061A R0

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Project **127645023**
Order Number **26027**
Samples 2

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SGS Reference PE069061A R0
Report Number 0000044198
Date Reported 09 Aug 2012

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client. This QA/QC Statement must be read in conjunction with the referenced Analytical Report. The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Analysis Date	pH in soil (1:2)	2 items
	pH in soil (1:5)	2 items
LCS	HCl Extractable S, Ca and Mg in Soil ICP OES	2 items

SAMPLE SUMMARY

Sample counts by matrix	2 Soil	Type of documentation received	COC
Date documentation received	27/7/2012	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	20°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	1 Box

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP)

Method: ME-(AU)-[ENV]AN212

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046155	-	27 Jul 2012	-	01 Aug 2012	-	03 Aug 2012
#15	PE069061A.017	LB046155	-	27 Jul 2012	-	01 Aug 2012	-	03 Aug 2012

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046148	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012
#15	PE069061A.017	LB046148	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012

HCl Extractable S, Ca and Mg in Soil ICP OES

Method: ME-(AU)-[ENV]AN014

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046157	-	27 Jul 2012	-	01 Aug 2012	-	09 Aug 2012
#15	PE069061A.017	LB046157	-	27 Jul 2012	-	01 Aug 2012	-	09 Aug 2012

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046151	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012†
#15	PE069061A.017	LB046151	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012†

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046147	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012†
#15	PE069061A.017	LB046147	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012†

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-[ENV]AN216

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046156	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012
#15	PE069061A.017	LB046156	-	27 Jul 2012	-	01 Aug 2012	-	08 Aug 2012

Total Sulfur by LECO Furnace

Method: ME-(AU)-[ENV]AN202

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#14	PE069061A.016	LB046183	-	27 Jul 2012	-	01 Aug 2012	-	03 Aug 2012
#15	PE069061A.017	LB046183	-	27 Jul 2012	-	01 Aug 2012	-	03 Aug 2012



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.



METHOD BLANKS

PE069061A R0

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB046148.001	Conductivity of Extract (1:5 as received)	µS/cm	2	<2

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result
LB046151.001	pH (1:2) aged	pH Units	0.1	5.6

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-[ENV]AN216

Sample Number	Parameter	Units	LOR	Result
LB046156.001	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5

Total Sulfur by LECO Furnace

Method: ME-(AU)-[ENV]AN202

Sample Number	Parameter	Units	LOR	Result
LB046183.001	Total Sulfur*	%w/w	0.005	<0.005

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Acid Neutralising Capacity or Neutralisation Potential(ANC/NP)

Method: ME-(AU)-[ENV]AN212

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069341.002	LB046155.009	Acid Neutralisation Capacity/Neutralisation Potential	kg CaCO ₃ /T	1	19.252635139	19.276433310	31	0
		Acid Neutralisation Capacity/Neutralisation Potential kg	kg H ₂ SO ₄ /T	1	16.867582436	16.890904643	31	0

HCl Extractable S, Ca and Mg in Soil ICP OES

Method: ME-(AU)-[ENV]AN014

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069341.002	LB046157.007	Acid Extractable Sulphate as S	mg/L	-	13.591	13.238	30	3
		Acid Soluble Sulphur (SHCl)	%w/w	0.05	0.062	0.0601442786	38	3

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-[ENV]AN216

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061A.017	LB046156.005	pHox (NAG pH)	No unit	-	7.8	7.8	10	0
		NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0
		NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	<0.5	<0.5	200	0

Total Sulfur by LECO Furnace

Method: ME-(AU)-[ENV]AN202

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061A.016	LB046183.004	Total Sulfur*	%w/w	0.005	0.040	0.039	43	4



LABORATORY CONTROL SAMPLES

PE069061A R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]JAN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046148.005	Conductivity of Extract (1:5 as received)	µS/cm	2	300	303	95 - 105	100

HCl Extractable S, Ca and Mg in Soil ICP OES

Method: ME-(AU)-[ENV]JAN014

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046157.002	Acid Extractable Sulphate as S	mg/L	-	NA	50	80 - 120	11
	Acid Soluble Sulphur (SHCl)	%w/w	0.05	0.27	0.2497	80 - 120	11

pH in soil (1:2)

Method: ME-(AU)-[ENV]JAN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046151.002	pH (1:2) aged	pH Units	0.1	7.0	0	NA	NA

pH in soil (1:5)

Method: ME-(AU)-[ENV]JAN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046147.001	pH	pH Units	0.1	7.0	7	98 - 102	100

Single Addition Net Acid Generation (NAG)

Method: ME-(AU)-[ENV]JAN216

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046156.002	pHox (NAG pH)	No unit	-	2.4	2.5	90 - 110	98
	NAG as kg H ₂ SO ₄ /tonne to pH 4.5	kg H ₂ SO ₄ /T	0.5	19	18.69	80 - 120	103
	NAG as kg H ₂ SO ₄ /tonne to pH 7	kg H ₂ SO ₄ /T	0.5	26	24.65	80 - 120	105
	NAG as kg CaCO ₃ /tonne to pH 4.5	kg CaCO ₃ /T	0.5	20	19.07	80 - 120	103
	NAG as kg CaCO ₃ /tonne to pH 7	kg CaCO ₃ /T	0.5	26	25.16	80 - 120	105

Total Sulfur by LECO Furnace

Method: ME-(AU)-[ENV]JAN202

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046183.002	Total Sulfur*	%w/w	0.005	0.090	0.081	80 - 120	111



Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.



Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.



Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
<http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf>

- * Non-accredited analysis.
- Sample not analysed for this analyte.
- ^ Analysis performed by external laboratory.

- IS Insufficient sample for analysis.
- LNR Sample listed, but not received.
- LOR Limit of reporting.
- QFH QC result is above the upper tolerance.
- QFL QC result is below the lower tolerance.

- ① At least 2 of 3 surrogates are within acceptance criteria.
- ② RPD failed acceptance criteria due to sample heterogeneity.
- ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
- ④ Recovery failed acceptance criteria due to matrix interference.
- ⑤ Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
- ⑥ LOR was raised due to sample matrix interference.
- ⑦ LOR was raised due to dilution of significantly high concentration of analyte in sample.
- ⑧ Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
- ⑨ Low surrogate recovery due to the sample emulsifying during extraction.
- † Refer to Analytical Report comments for further information.

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ANALYTICAL REPORT



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Order Number **26027**
Samples 14

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SGS Reference **PE069061B R0**
Report Number 0000045574
Date Reported 31 Aug 2012
Date Received 02 Aug 2012

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

Four Acid Digest Metals subcontracted to SGS Perth Minerals, 10 Reid Rd Newburn WA, NATA Accreditation Number 1936, WM143874.

XRD subcontracted to Microanalysis, Reports appended.

SIGNATORIES

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ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.004	PE069061B.005
	Sample Matrix	Soil	Soil
	Sample Name	#2	#3
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	53000	23000
Calcium, Ca*	ppm	40	770	600
Chromium, Cr*	ppm	10	190	60
Iron, Fe*	ppm	100	390000	570000
Potassium, K*	ppm	100	3500	350
Magnesium, Mg*	ppm	20	740	1000
Sodium, Na*	ppm	50	500	500
Phosphorus, P*	ppm	20	540	560
Sulphur, S*	ppm	20	280	510
Strontium, Sr*	ppm	1	17	5
Titanium, Ti*	ppm	10	3700	1300
Vanadium, V*	ppm	1	220	57

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	<0.1	<0.1
Arsenic, As*	ppm	1	51	25
Barium, Ba*	ppm	1	130	60
Beryllium, Be*	ppm	0.1	0.6	0.4
Cadmium, Cd*	ppm	0.1	0.2	0.1
Cobalt, Co*	ppm	0.1	9.7	11
Copper, Cu*	ppm	2	40	36
Manganese, Mn*	ppm	1	1600	3800
Molybdenum, Mo*	ppm	0.1	2.7	1.6
Nickel, Ni*	ppm	1	36	28
Lead, Pb*	ppm	1	27	18
Antimony, Sb*	ppm	0.1	3.7	3.1
Selenium, Se*	ppm	1	<1	<1
Tin, Sn*	ppm	0.3	2.5	1.0
Thallium, Tl*	ppm	0.2	0.3	<0.2
Zinc, Zn*	ppm	2	50	64



ANALYTICAL REPORT

PE069061B R0

Parameter	Sample Number		PE069061B.004	PE069061B.005
	Sample Matrix		Soil	Soil
	Sample Name		#2	#3
	Units	LOR		

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	20	<20
Silicon, Si*	%	0.42	12	4.0

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50	50
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	6.4	7.0
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	42	150

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	72	96
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	<5	15
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	<5	12

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	5	6
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ANALYTICAL REPORT

PE069061B R0

Parameter	Sample Number		PE069061B.004	PE069061B.005
	Sample Matrix		Soil	Soil
	Sample Name		#2	#3
	Units	LOR		

Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	2	18
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.1	0.8
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	3	22
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	8.3	3.3
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02	<0.02
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.19	0.22
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	<0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001	<0.001
Calcium, Ca	mg/L	0.2	2.2	8.0
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	<0.005
Iron, Fe	mg/L	0.02	0.03	<0.02
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	0.5	3.7
Manganese, Mn	mg/L	0.005	0.062	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	5.1	0.9
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	9.2	5.9
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	1.5	14
Strontium, Sr	mg/L	0.005	0.014	0.064
Sulphur, S	mg/L	0.1	1.0	7.6
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.05	0.03



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.004	PE069061B.005
			Sample Matrix	Soil	Soil
			Sample Name	#2	#3
Parameter	Units	LOR			

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.006
		Sample Matrix	Soil
		Sample Name	#4
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	13000
Calcium, Ca*	ppm	40	8400
Chromium, Cr*	ppm	10	30
Iron, Fe*	ppm	100	360000
Potassium, K*	ppm	100	270
Magnesium, Mg*	ppm	20	2200
Sodium, Na*	ppm	50	300
Phosphorus, P*	ppm	20	400
Sulphur, S*	ppm	20	230
Strontium, Sr*	ppm	1	9
Titanium, Ti*	ppm	10	460
Vanadium, V*	ppm	1	32

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	<0.1
Arsenic, As*	ppm	1	11
Barium, Ba*	ppm	1	26
Beryllium, Be*	ppm	0.1	0.3
Cadmium, Cd*	ppm	0.1	<0.1
Cobalt, Co*	ppm	0.1	8.3
Copper, Cu*	ppm	2	18
Manganese, Mn*	ppm	1	1300
Molybdenum, Mo*	ppm	0.1	1.3
Nickel, Ni*	ppm	1	18
Lead, Pb*	ppm	1	7
Antimony, Sb*	ppm	0.1	0.7
Selenium, Se*	ppm	1	<1
Tin, Sn*	ppm	0.3	0.4
Thallium, Tl*	ppm	0.2	<0.2
Zinc, Zn*	ppm	2	33



ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.006
		Sample Matrix	Soil
		Sample Name	#4
Parameter	Units	LOR	

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	<20
Silicon, Si*	%	0.42	17

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50
Volume of Extraction Solution Used*	mL	-	1000
pH SPLP after 18 hours*	pH Units	-	8.8
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	100

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	64
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	40
Carbonate Alkalinity as CO ₃	mg/L	1	<1
Total Alkalinity as CaCO ₃	mg/L	5	32

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	<5
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	5
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ANALYTICAL REPORT

PE069061B R0

Parameter	Sample Number	PE069061B.006	
	Sample Matrix	Soil	
	Sample Name	#4	
	Units	LOR	

Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.8
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	7
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	0.91
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.02
Antimony, Sb	mg/L	0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020
Barium, Ba	mg/L	0.01	0.15
Beryllium, Be	mg/L	0.005	<0.005
Boron, B	mg/L	0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001
Calcium, Ca	mg/L	0.2	11
Cobalt, Co	mg/L	0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005
Iron, Fe	mg/L	0.02	0.02
Lead, Pb	mg/L	0.005	<0.005
Magnesium, Mg	mg/L	0.1	0.9
Manganese, Mn	mg/L	0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05
Potassium, K	mg/L	0.1	0.7
Selenium, Se	mg/L	0.02	<0.020
Silicon, Si	mg/L	0.02	4.1
Silver, Ag	mg/L	0.005	<0.005
Sodium, Na	mg/L	0.5	7.0
Strontium, Sr	mg/L	0.005	0.036
Sulphur, S	mg/L	0.1	2.1
Tin, Sn	mg/L	0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02
Zinc, Zn	mg/L	0.01	<0.01



ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.006
		Sample Matrix	Soil
		Sample Name	#4
Parameter	Units	LOR	

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1
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ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.012	PE069061B.014
	Sample Matrix	Soil	Soil
	Sample Name	#10	#12
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	34000	23000
Calcium, Ca*	ppm	40	630	600
Chromium, Cr*	ppm	10	70	30
Iron, Fe*	ppm	100	520000	540000
Potassium, K*	ppm	100	210	420
Magnesium, Mg*	ppm	20	460	640
Sodium, Na*	ppm	50	200	400
Phosphorus, P*	ppm	20	280	330
Sulphur, S*	ppm	20	590	570
Strontium, Sr*	ppm	1	9	8
Titanium, Ti*	ppm	10	2100	1100
Vanadium, V*	ppm	1	84	39

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	<0.1	<0.1
Arsenic, As*	ppm	1	28	17
Barium, Ba*	ppm	1	160	110
Beryllium, Be*	ppm	0.1	0.4	0.3
Cadmium, Cd*	ppm	0.1	0.2	<0.1
Cobalt, Co*	ppm	0.1	10	9.1
Copper, Cu*	ppm	2	26	21
Manganese, Mn*	ppm	1	2400	1700
Molybdenum, Mo*	ppm	0.1	1.1	1.0
Nickel, Ni*	ppm	1	24	21
Lead, Pb*	ppm	1	27	16
Antimony, Sb*	ppm	0.1	2.7	2.2
Selenium, Se*	ppm	1	<1	<1
Tin, Sn*	ppm	0.3	1.8	0.8
Thallium, Tl*	ppm	0.2	<0.2	<0.2
Zinc, Zn*	ppm	2	43	35



ANALYTICAL REPORT

PE069061B R0

Parameter	Sample Number		PE069061B.012	PE069061B.014
	Sample Matrix		Soil	Soil
	Sample Name		#10	#12
	Units	LOR		

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	<20	<20
Silicon, Si*	%	0.42	4.7	5.8

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50	50
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	6.9	6.8
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	63	100

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	56	56
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	14	11
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	11	9

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	<5	<5
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ANALYTICAL REPORT

PE069061B R0

Parameter	Sample Number		PE069061B.012	PE069061B.014
	Sample Matrix		Soil	Soil
	Sample Name		#10	#12
Parameter	Units	LOR		

Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	3	10
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.5	0.3
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	10	19
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	1.0	2.1
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02	<0.02
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.30	0.24
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	<0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001	<0.001
Calcium, Ca	mg/L	0.2	5.5	4.7
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	<0.005
Iron, Fe	mg/L	0.02	0.05	<0.02
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	1.4	2.0
Manganese, Mn	mg/L	0.005	<0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	0.3	1.0
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	4.9	4.8
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	4.1	10
Strontium, Sr	mg/L	0.005	0.037	0.040
Sulphur, S	mg/L	0.1	2.9	6.1
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.03	0.04



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.012	PE069061B.014
			Sample Matrix	Soil	Soil
			Sample Name	#10	#12
Parameter	Units	LOR			

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.020
		Sample Matrix	Soil
		Sample Name	#19
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	31000
Calcium, Ca*	ppm	40	5000
Chromium, Cr*	ppm	10	80
Iron, Fe*	ppm	100	530000
Potassium, K*	ppm	100	430
Magnesium, Mg*	ppm	20	1200
Sodium, Na*	ppm	50	300
Phosphorus, P*	ppm	20	270
Sulphur, S*	ppm	20	550
Strontium, Sr*	ppm	1	14
Titanium, Ti*	ppm	10	1300
Vanadium, V*	ppm	1	69

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	0.1
Arsenic, As*	ppm	1	24
Barium, Ba*	ppm	1	180
Beryllium, Be*	ppm	0.1	0.4
Cadmium, Cd*	ppm	0.1	<0.1
Cobalt, Co*	ppm	0.1	8.7
Copper, Cu*	ppm	2	32
Manganese, Mn*	ppm	1	1600
Molybdenum, Mo*	ppm	0.1	0.8
Nickel, Ni*	ppm	1	20
Lead, Pb*	ppm	1	16
Antimony, Sb*	ppm	0.1	1.8
Selenium, Se*	ppm	1	<1
Tin, Sn*	ppm	0.3	1.0
Thallium, Tl*	ppm	0.2	<0.2
Zinc, Zn*	ppm	2	28



ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.020
		Sample Matrix	Soil
		Sample Name	#19
Parameter	Units	LOR	

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	30
Silicon, Si*	%	0.42	4.8

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50
Volume of Extraction Solution Used*	mL	-	1000
pH SPLP after 18 hours*	pH Units	-	8.2
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	120

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	76
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	42
Carbonate Alkalinity as CO ₃	mg/L	1	<1
Total Alkalinity as CaCO ₃	mg/L	5	34

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	<5
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	4
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ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.020
		Sample Matrix	Soil
		Sample Name	#19
Parameter	Units	LOR	

Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	1.0
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	14
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	3.3
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.18
Antimony, Sb	mg/L	0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020
Barium, Ba	mg/L	0.01	0.24
Beryllium, Be	mg/L	0.005	<0.005
Boron, B	mg/L	0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001
Calcium, Ca	mg/L	0.2	15
Cobalt, Co	mg/L	0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005
Iron, Fe	mg/L	0.02	0.40
Lead, Pb	mg/L	0.005	<0.005
Magnesium, Mg	mg/L	0.1	1.7
Manganese, Mn	mg/L	0.005	0.007
Molybdenum, Mo	mg/L	0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05
Potassium, K	mg/L	0.1	1.2
Selenium, Se	mg/L	0.02	<0.020
Silicon, Si	mg/L	0.02	4.1
Silver, Ag	mg/L	0.005	<0.005
Sodium, Na	mg/L	0.5	3.7
Strontium, Sr	mg/L	0.005	0.079
Sulphur, S	mg/L	0.1	4.5
Tin, Sn	mg/L	0.05	<0.05
Titanium, Ti*	mg/L	0.005	0.005
Vanadium, V	mg/L	0.02	<0.02
Zinc, Zn	mg/L	0.01	0.01



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.020
			Sample Matrix	Soil
			Sample Name	#19
Parameter	Units	LOR		

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1
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ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.024	PE069061B.025
	Sample Matrix	Soil	Soil
	Sample Name	#25	#26
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	59000	41000
Calcium, Ca*	ppm	40	1100	1000
Chromium, Cr*	ppm	10	80	100
Iron, Fe*	ppm	100	440000	500000
Potassium, K*	ppm	100	510	750
Magnesium, Mg*	ppm	20	2000	700
Sodium, Na*	ppm	50	1000	300
Phosphorus, P*	ppm	20	180	260
Sulphur, S*	ppm	20	390	550
Strontium, Sr*	ppm	1	22	14
Titanium, Ti*	ppm	10	1900	2100
Vanadium, V*	ppm	1	75	100

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	<0.1	<0.1
Arsenic, As*	ppm	1	32	57
Barium, Ba*	ppm	1	240	260
Beryllium, Be*	ppm	0.1	0.6	0.5
Cadmium, Cd*	ppm	0.1	0.2	0.1
Cobalt, Co*	ppm	0.1	19	8.0
Copper, Cu*	ppm	2	54	24
Manganese, Mn*	ppm	1	5300	3800
Molybdenum, Mo*	ppm	0.1	1.3	1.7
Nickel, Ni*	ppm	1	30	21
Lead, Pb*	ppm	1	35	22
Antimony, Sb*	ppm	0.1	3.2	2.3
Selenium, Se*	ppm	1	<1	<1
Tin, Sn*	ppm	0.3	1.2	1.5
Thallium, Tl*	ppm	0.2	0.2	0.2
Zinc, Zn*	ppm	2	30	32



ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.024	PE069061B.025
	Sample Matrix	Soil	Soil
	Sample Name	#25	#26
Parameter	Units	LOR	

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	30	<20
Silicon, Si*	%	0.42	5.8	5.8

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50	50
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	7.6	7.3
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	280	110

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	172	64
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	16	34
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	13	28

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	5	<5
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ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.024	PE069061B.025
	Sample Matrix	Soil	Soil
	Sample Name	#25	#26
Parameter	Units	LOR	

Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	42	6
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.5	0.4
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	26	13
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	14	2.1
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.04	0.06
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.17	0.27
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	<0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001	<0.001
Calcium, Ca	mg/L	0.2	8.3	11
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	<0.005
Iron, Fe	mg/L	0.02	0.14	0.10
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	5.9	1.9
Manganese, Mn	mg/L	0.005	<0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	2.2	1.4
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	8.3	4.4
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	31	4.7
Strontium, Sr	mg/L	0.005	0.067	0.055
Sulphur, S	mg/L	0.1	10	4.0
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.03	0.03



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.024	PE069061B.025
			Sample Matrix	Soil	Soil
			Sample Name	#25	#26
Parameter	Units	LOR			

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.026	PE069061B.030
		Sample Matrix	Soil	Soil
		Sample Name	#27	#31
Parameter	Units	LOR		

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	68000	78000
Calcium, Ca*	ppm	40	460	1900
Chromium, Cr*	ppm	10	90	170
Iron, Fe*	ppm	100	300000	330000
Potassium, K*	ppm	100	170	820
Magnesium, Mg*	ppm	20	1100	800
Sodium, Na*	ppm	50	900	500
Phosphorus, P*	ppm	20	380	180
Sulphur, S*	ppm	20	860	610
Strontium, Sr*	ppm	1	14	31
Titanium, Ti*	ppm	10	3500	4500
Vanadium, V*	ppm	1	110	160

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	<0.1	<0.1
Arsenic, As*	ppm	1	34	39
Barium, Ba*	ppm	1	26	120
Beryllium, Be*	ppm	0.1	0.6	0.3
Cadmium, Cd*	ppm	0.1	0.2	0.1
Cobalt, Co*	ppm	0.1	12	3.5
Copper, Cu*	ppm	2	23	40
Manganese, Mn*	ppm	1	1700	160
Molybdenum, Mo*	ppm	0.1	1.9	1.5
Nickel, Ni*	ppm	1	38	34
Lead, Pb*	ppm	1	19	31
Antimony, Sb*	ppm	0.1	5.2	3.8
Selenium, Se*	ppm	1	<1	2
Tin, Sn*	ppm	0.3	1.9	3.3
Thallium, Tl*	ppm	0.2	<0.2	<0.2
Zinc, Zn*	ppm	2	37	48



ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.026	PE069061B.030
	Sample Matrix	Soil	Soil
	Sample Name	#27	#31
Parameter	Units	LOR	

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	<20	30
Silicon, Si*	%	0.42	14	12

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50	50
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	6.8	8.3
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	360	110

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	196	68
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	<5	56
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	<5	46

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	<5	<5
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ANALYTICAL REPORT

PE069061B R0

	Sample Number	PE069061B.026	PE069061B.030
	Sample Matrix	Soil	Soil
	Sample Name	#27	#31
Parameter	Units	LOR	

Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	52	3
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	1.0	0.6
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	69	4
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	6.1	1.5
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02	0.07
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.16	0.24
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001	<0.001
Calcium, Ca	mg/L	0.2	11	14
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	<0.005
Iron, Fe	mg/L	0.02	<0.02	0.04
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	12	2.5
Manganese, Mn	mg/L	0.005	<0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	2.5	1.8
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	0.89	5.2
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	33	3.9
Strontium, Sr	mg/L	0.005	0.20	0.070
Sulphur, S	mg/L	0.1	24	1.4
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.03	0.02



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.026	PE069061B.030
			Sample Matrix	Soil	Soil
			Sample Name	#27	#31
Parameter	Units	LOR			

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061B R0

Sample Number	PE069061B.032	PE069061B.034	PE069061B.035
Sample Matrix	Soil	Soil	Soil
Sample Name	#33	#35	#36
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	64000	43000	51000
Calcium, Ca*	ppm	40	480	460	670
Chromium, Cr*	ppm	10	180	140	150
Iron, Fe*	ppm	100	410000	440000	440000
Potassium, K*	ppm	100	1600	930	500
Magnesium, Mg*	ppm	20	550	470	490
Sodium, Na*	ppm	50	200	200	300
Phosphorus, P*	ppm	20	280	240	190
Sulphur, S*	ppm	20	340	440	830
Strontium, Sr*	ppm	1	10	6	21
Titanium, Ti*	ppm	10	3600	2300	2700
Vanadium, V*	ppm	1	200	120	120

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	0.2	0.1	<0.1
Arsenic, As*	ppm	1	62	34	46
Barium, Ba*	ppm	1	88	190	290
Beryllium, Be*	ppm	0.1	1.2	0.6	0.5
Cadmium, Cd*	ppm	0.1	0.2	0.1	0.2
Cobalt, Co*	ppm	0.1	10	6.5	5.8
Copper, Cu*	ppm	2	62	43	35
Manganese, Mn*	ppm	1	450	1000	1500
Molybdenum, Mo*	ppm	0.1	3.1	2.1	1.6
Nickel, Ni*	ppm	1	51	33	19
Lead, Pb*	ppm	1	25	19	22
Antimony, Sb*	ppm	0.1	4.2	3.0	3.7
Selenium, Se*	ppm	1	3	2	<1
Tin, Sn*	ppm	0.3	2.6	1.7	2.0
Thallium, Tl*	ppm	0.2	0.2	<0.2	<0.2
Zinc, Zn*	ppm	2	92	44	39



ANALYTICAL REPORT

PE069061B R0

Parameter	Units	LOR	Sample Number	PE069061B.032	PE069061B.034	PE069061B.035
			Sample Matrix	Soil	Soil	Soil
			Sample Name	#33	#35	#36

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001	<0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	<20	<20	<20
Silicon, Si*	%	0.42	7.5	6.5	7.8

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50	50	50
Volume of Extraction Solution Used*	mL	-	1000	1000	1000
pH SPLP after 18 hours*	pH Units	-	6.4	6.6	6.6
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	26	32	48

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	36	20	36
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	<5	<5	<5
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	<5	<5	<5

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	<5	<5	<5
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	3	1	4
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ANALYTICAL REPORT

PE069061B R0

Sample Number	PE069061B.032	PE069061B.034	PE069061B.035
Sample Matrix	Soil	Soil	Soil
Sample Name	#33	#35	#36
Parameter	Units	LOR	

Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.1	0.2	0.2
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	3	8	10
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	0.42	0.34	1.8
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.18	0.06	0.03
Antimony, Sb	mg/L	0.05	<0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.14	0.24	0.29
Beryllium, Be	mg/L	0.005	<0.005	<0.005	<0.005
Boron, B	mg/L	0.2	<0.2	<0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001	<0.001	<0.001
Calcium, Ca	mg/L	0.2	1.1	2.2	2.0
Cobalt, Co	mg/L	0.01	<0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	<0.005	<0.005
Iron, Fe	mg/L	0.02	0.15	0.08	0.04
Lead, Pb	mg/L	0.005	<0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	0.3	0.6	0.9
Manganese, Mn	mg/L	0.005	0.011	<0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	1.7	1.3	0.7
Selenium, Se	mg/L	0.02	<0.020	<0.020	<0.020
Silicon, Si	mg/L	0.02	5.7	4.7	5.6
Silver, Ag	mg/L	0.005	<0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	2.1	1.8	4.3
Strontium, Sr	mg/L	0.005	0.010	0.018	0.027
Sulphur, S	mg/L	0.1	0.9	2.3	2.6
Tin, Sn	mg/L	0.05	<0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.03	0.03	0.03



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.032	PE069061B.034	PE069061B.035
			Sample Matrix	Soil	Soil	Soil
			Sample Name	#33	#35	#36
Parameter	Units	LOR				

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1	<1
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ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.036
		Sample Matrix	Soil
		Sample Name	#38
Parameter	Units	LOR	

ICPAES after Four Acid Digest Digest Method: ICP40Q

Aluminium, Al*	ppm	100	48000
Calcium, Ca*	ppm	40	960
Chromium, Cr*	ppm	10	120
Iron, Fe*	ppm	100	480000
Potassium, K*	ppm	100	390
Magnesium, Mg*	ppm	20	590
Sodium, Na*	ppm	50	600
Phosphorus, P*	ppm	20	260
Sulphur, S*	ppm	20	600
Strontium, Sr*	ppm	1	13
Titanium, Ti*	ppm	10	2500
Vanadium, V*	ppm	1	96

Metals in soil by Four Acid digest, ICPMS Method: IMS40Q

Silver, Ag*	ppm	0.1	<0.1
Arsenic, As*	ppm	1	24
Barium, Ba*	ppm	1	66
Beryllium, Be*	ppm	0.1	0.3
Cadmium, Cd*	ppm	0.1	0.1
Cobalt, Co*	ppm	0.1	6.1
Copper, Cu*	ppm	2	58
Manganese, Mn*	ppm	1	380
Molybdenum, Mo*	ppm	0.1	1.5
Nickel, Ni*	ppm	1	21
Lead, Pb*	ppm	1	29
Antimony, Sb*	ppm	0.1	2.2
Selenium, Se*	ppm	1	2
Tin, Sn*	ppm	0.3	2.0
Thallium, Tl*	ppm	0.2	<0.2
Zinc, Zn*	ppm	2	91



ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.036
		Sample Matrix	Soil
		Sample Name	#38
Parameter	Units	LOR	

Rare Earth Metals in soil by ICPMS Method: IMS12S

Mercury, Hg*	ppm	0.001	<0.001
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Metals in Soils from Alkali Fusion ICP AES Method: ICP90Q

Boron, B*	ppm	20	<20
Silicon, Si*	%	0.42	5.4

Sample Subcontracted Method:

Sample Subcontracted*	No unit	-	-
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	50
Volume of Extraction Solution Used*	mL	-	1000
pH SPLP after 18 hours*	pH Units	-	7.5
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	120

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	48
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Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	17
Carbonate Alkalinity as CO ₃	mg/L	1	<1
Total Alkalinity as CaCO ₃	mg/L	5	14

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	<5
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	9
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ANALYTICAL REPORT

PE069061B R0

		Sample Number	PE069061B.036
		Sample Matrix	Soil
		Sample Name	#38
Parameter	Units	LOR	

Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.4
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	19
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	4.2
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.05
Antimony, Sb	mg/L	0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020
Barium, Ba	mg/L	0.01	0.20
Beryllium, Be	mg/L	0.005	<0.005
Boron, B	mg/L	0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001
Calcium, Ca	mg/L	0.2	4.6
Cobalt, Co	mg/L	0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005
Iron, Fe	mg/L	0.02	0.28
Lead, Pb	mg/L	0.005	<0.005
Magnesium, Mg	mg/L	0.1	1.7
Manganese, Mn	mg/L	0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05
Potassium, K	mg/L	0.1	1.7
Selenium, Se	mg/L	0.02	<0.020
Silicon, Si	mg/L	0.02	6.3
Silver, Ag	mg/L	0.005	<0.005
Sodium, Na	mg/L	0.5	14
Strontium, Sr	mg/L	0.005	0.029
Sulphur, S	mg/L	0.1	6.1
Tin, Sn	mg/L	0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02
Zinc, Zn	mg/L	0.01	0.03



ANALYTICAL REPORT

PE069061B R0

			Sample Number	PE069061B.036
			Sample Matrix	Soil
			Sample Name	#38
Parameter	Units	LOR		

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1
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QC SUMMARY

PE069061B R0

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Acidity of SPLP Extract Method: ME-(AU)-[ENV]AN140

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Acidity to pH 8.3	LB047323	mg CaCO ₃ /L	5	<5	0%

Alkalinity in SPLP Extract Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Bicarbonate Alkalinity as HCO ₃	LB046790	mg/L	5	<5	2%
Carbonate Alkalinity as CO ₃	LB046790	mg/L	1	<1	
Total Alkalinity as CaCO ₃	LB046790	mg/L	5	<5	

Chloride by Discrete Analyser in SPLP Extract Method: ME-(AU)-[ENV]AN274

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Chloride	LB046878	mg/L	1	<1	0%

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Filterable Reactive Phosphorus	LB047332	mg/L	0.002	<0.002	0%

Fluoride by Ion Selective Electrode in SPLP Leachate Method: ME-(AU)-[ENV]AN141

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Fluoride by ISE	LB047043	mg/L	0.1	<0.1	2%	94%

Mercury in Soil by SPLP Extract Method: ME-(AU)-[ENV]AN311/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Mercury	LB046781	mg/L	0.0005	<0.0005	0%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water (SPLP) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Aluminium, Al	LB046784	mg/L	0.02	<0.02	1%
Antimony, Sb	LB046784	mg/L	0.05	<0.05	0%
Arsenic, As	LB046784	mg/L	0.02	<0.020	0%
Barium, Ba	LB046784	mg/L	0.01	<0.01	0%
Beryllium, Be	LB046784	mg/L	0.005	<0.005	0%
Boron, B	LB046784	mg/L	0.2	<0.2	0%
Cadmium, Cd	LB046784	mg/L	0.001	<0.001	0%
Calcium, Ca	LB046784	mg/L	0.2	<0.2	0%
Cobalt, Co	LB046784	mg/L	0.01	<0.01	0%
Chromium, Cr	LB046784	mg/L	0.005	<0.005	0%
Copper, Cu	LB046784	mg/L	0.005	<0.005	0%
Iron, Fe	LB046784	mg/L	0.02	<0.02	3%
Lead, Pb	LB046784	mg/L	0.005	<0.005	0%
Magnesium, Mg	LB046784	mg/L	0.1	<0.1	0%
Manganese, Mn	LB046784	mg/L	0.005	<0.005	0%
Molybdenum, Mo	LB046784	mg/L	0.01	<0.01	0%
Nickel, Ni	LB046784	mg/L	0.005	<0.005	0%
Phosphorus, P	LB046784	mg/L	0.05	<0.05	0%
Potassium, K	LB046784	mg/L	0.1	<0.1	0%
Selenium, Se	LB046784	mg/L	0.02	<0.020	0%
Silicon, Si	LB046784	mg/L	0.02	<0.02	0%
Silver, Ag	LB046784	mg/L	0.005	<0.005	0%
Sodium, Na	LB046784	mg/L	0.5	<0.5	0%
Strontium, Sr	LB046784	mg/L	0.005	<0.005	0%
Sulphur, S	LB046784	mg/L	0.1	<0.1	1%
Tin, Sn	LB046784	mg/L	0.05	<0.05	0%
Titanium, Ti*	LB046784	mg/L	0.005	<0.005	0%
Vanadium, V	LB046784	mg/L	0.02	<0.02	0%
Zinc, Zn	LB046784	mg/L	0.01	<0.01	2%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: ME-(AU)-[ENV]AN258

Parameter	QC Reference	Units	LOR	MB
Nitrate, NO ₃ as NO ₃	LB047199	mg/L	0.05	<0.05

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

SPLP (Synthetic Precipitaion Leaching Procedure) Method: USEPA 1312

Parameter	QC Reference	Units	LOR	DUP %RPD
Mass of Sample Used*	LB046619	g	-	0%
Volume of ExtractionSolution Used*	LB046619	mL	-	0%
pH SPLP after 18 hours*	LB046619	pH Units	-	2%
Conductivity @ 25 C SPLP after 18 hours*	LB046619	µS/cm	2	1%

Sulphate in SPLP Extract Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Sulphate, SO4	LB046878	mg/L	1	<1	1%

Total Dissolved Solids (TDS) in SPLP Extract Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 180°C*	LB046763	mg/L	10	<10	6%	103%

Trace Metals in SPLP Extract by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Thallium, Tl	LB046913	µg/L	1	<1	0%

METHOD

METHODOLOGY SUMMARY

AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN140	Acidity by Titration: The water sample/extract is titrated with sodium hydroxide to designated pH end point. In a sample containing only carbon dioxide, bicarbonates and carbonates, titration to pH 8.3 at 25°C corresponds to stoichiometric neutralisation of carbonic acid to bicarbonate. Method reference APHA 2310 B.
AN141	Determination of Fluoride by ISE: A fluoride ion selective electrode and reference electrode combination, in the presence of a pH/complexation buffer, is used to determine the fluoride concentration on the soil water extract. The electrode millivolt response is measured logarithmically against fluoride concentration. Reference APHA F- C.
AN258	Nitrate and Nitrite by FIA: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Without the cadmium reduction only the original nitrite is determined. Reference APHA 4500-NO3- F.
AN274	Chloride by Aquakem DA following SPLP extraction: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-
AN275	Sulphate by Aquakem DA from SPLP Extract: Sulphate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulphate concentration in the sample. Reference APHA 4500-SO42-. Internal reference AN275.
AN278	Reactive Phosphorus by Discrete Analyser: Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
USEPA 1312	Soil or waste solids are extracted 1:20w/w in an extraction Fluid (# 1 pH 4.2±0.05 and #2 pH 5.0±0.05) for 18±2hrs followed by filtration for elemental analysis as required.
USEPA 1312	Extraction fluid #1: This fluid is made by adding the 60/40 weight percent mixture of sulfuric and nitric acids (or a suitable dilution) to reagent water until the pH is 4.20 + 0.05. Extraction fluid #2: This fluid is made by adding the 60/40 weight percent mixture of sulfuric and nitric acids (or a suitable dilution) to reagent water until the pH is 5.00 + 0.05.



FOOTNOTES

IS	Insufficient sample for analysis.	QFH	QC result is above the upper tolerance
LNR	Sample listed, but not received.	QFL	QC result is below the lower tolerance
*	This analysis is not covered by the scope of accreditation.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated
LOR	Limit of Reporting		
↑↓	Raised or Lowered Limit of Reporting		

Samples analysed as received.

Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au.pv.sgs.v3/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.au.sgs.com/terms_and_conditions_au. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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STATEMENT OF QA/QC PERFORMANCE

PE069061B R0

CLIENT DETAILS

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Project **127645023**
Order Number **26027**
Samples 14

LABORATORY DETAILS

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SGS Reference PE069061B R0
Report Number 0000045576
Date Reported 31 Aug 2012

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client. This QA/QC Statement must be read in conjunction with the referenced Analytical Report. The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met.

SAMPLE SUMMARY

Sample counts by matrix	14 Soil	Type of documentation received	COC
Date documentation received	2/8/2012	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	20°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	1 Pallet

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Acidity of SPLP Extract

Method: ME-(AU)-[ENV]AN140

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#3	PE069061B.005	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#4	PE069061B.006	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#10	PE069061B.012	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#12	PE069061B.014	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#19	PE069061B.020	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#25	PE069061B.024	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#26	PE069061B.025	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#27	PE069061B.026	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#31	PE069061B.030	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#33	PE069061B.032	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#35	PE069061B.034	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#36	PE069061B.035	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#38	PE069061B.036	LB047323	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012

Alkalinity in SPLP Extract

Method: ME-(AU)-[ENV]AN135

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#3	PE069061B.005	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#4	PE069061B.006	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#10	PE069061B.012	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#12	PE069061B.014	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#19	PE069061B.020	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#25	PE069061B.024	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#26	PE069061B.025	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#27	PE069061B.026	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#31	PE069061B.030	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#33	PE069061B.032	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#35	PE069061B.034	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#36	PE069061B.035	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#38	PE069061B.036	LB046790	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012

Chloride by Discrete Analyser in SPLP Extract

Method: ME-(AU)-[ENV]AN274

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#3	PE069061B.005	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#4	PE069061B.006	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#10	PE069061B.012	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#12	PE069061B.014	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#19	PE069061B.020	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#25	PE069061B.024	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#26	PE069061B.025	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#27	PE069061B.026	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#31	PE069061B.030	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#33	PE069061B.032	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#35	PE069061B.034	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#36	PE069061B.035	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#38	PE069061B.036	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser

Method: ME-(AU)-[ENV]AN278

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#3	PE069061B.005	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#4	PE069061B.006	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#10	PE069061B.012	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#12	PE069061B.014	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#19	PE069061B.020	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#25	PE069061B.024	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#26	PE069061B.025	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#27	PE069061B.026	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#31	PE069061B.030	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser (continued)

Method: ME-(AU)-[ENV]AN278

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#33	PE069061B.032	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#35	PE069061B.034	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#36	PE069061B.035	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012
#38	PE069061B.036	LB047332	-	02 Aug 2012	-	16 Aug 2012	-	16 Aug 2012

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-[ENV]AN141

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#3	PE069061B.005	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#4	PE069061B.006	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#10	PE069061B.012	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#12	PE069061B.014	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#19	PE069061B.020	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#25	PE069061B.024	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#26	PE069061B.025	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#27	PE069061B.026	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#31	PE069061B.030	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#33	PE069061B.032	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#35	PE069061B.034	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#36	PE069061B.035	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012
#38	PE069061B.036	LB047043	-	02 Aug 2012	-	13 Aug 2012	-	14 Aug 2012

Mercury in Soil by SPLP Extract

Method: ME-(AU)-[ENV]AN311/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#3	PE069061B.005	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#4	PE069061B.006	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#10	PE069061B.012	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#12	PE069061B.014	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#19	PE069061B.020	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#25	PE069061B.024	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#26	PE069061B.025	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#27	PE069061B.026	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#31	PE069061B.030	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#33	PE069061B.032	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#35	PE069061B.034	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#36	PE069061B.035	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#38	PE069061B.036	LB046781	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012

Metals in Water (SPLP) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#3	PE069061B.005	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#4	PE069061B.006	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#10	PE069061B.012	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#12	PE069061B.014	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#19	PE069061B.020	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#25	PE069061B.024	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#26	PE069061B.025	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#27	PE069061B.026	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#31	PE069061B.030	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#33	PE069061B.032	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#35	PE069061B.034	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#36	PE069061B.035	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012
#38	PE069061B.036	LB046784	-	02 Aug 2012	-	09 Aug 2012	-	10 Aug 2012

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract

Method: ME-(AU)-[ENV]AN258

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#3	PE069061B.005	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#4	PE069061B.006	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#10	PE069061B.012	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract (continued)

Method: ME-(AU)-[ENV]AN258

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#12	PE069061B.014	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#19	PE069061B.020	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#25	PE069061B.024	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#26	PE069061B.025	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#27	PE069061B.026	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#31	PE069061B.030	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#33	PE069061B.032	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#35	PE069061B.034	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#36	PE069061B.035	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012
#38	PE069061B.036	LB047199	-	02 Aug 2012	-	15 Aug 2012	-	15 Aug 2012

SPLP (Synthetic Precipitation Leaching Procedure)

Method: USEPA 1312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#3	PE069061B.005	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#4	PE069061B.006	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#10	PE069061B.012	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#12	PE069061B.014	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#19	PE069061B.020	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#25	PE069061B.024	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#26	PE069061B.025	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#27	PE069061B.026	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#31	PE069061B.030	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#33	PE069061B.032	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#35	PE069061B.034	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#36	PE069061B.035	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012
#38	PE069061B.036	LB046619	-	02 Aug 2012	-	08 Aug 2012	-	08 Aug 2012

Sulphate in SPLP Extract

Method: ME-(AU)-[ENV]AN275

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#3	PE069061B.005	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#4	PE069061B.006	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#10	PE069061B.012	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#12	PE069061B.014	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#19	PE069061B.020	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#25	PE069061B.024	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#26	PE069061B.025	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#27	PE069061B.026	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#31	PE069061B.030	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#33	PE069061B.032	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#35	PE069061B.034	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#36	PE069061B.035	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012
#38	PE069061B.036	LB046878	-	02 Aug 2012	-	10 Aug 2012	-	10 Aug 2012

Total Dissolved Solids (TDS) in SPLP Extract

Method: ME-(AU)-[ENV]AN113

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#3	PE069061B.005	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#4	PE069061B.006	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#10	PE069061B.012	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#12	PE069061B.014	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#19	PE069061B.020	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#25	PE069061B.024	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#26	PE069061B.025	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#27	PE069061B.026	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#31	PE069061B.030	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#33	PE069061B.032	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#35	PE069061B.034	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#36	PE069061B.035	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012
#38	PE069061B.036	LB046763	-	02 Aug 2012	-	09 Aug 2012	-	09 Aug 2012



HOLDING TIME SUMMARY

PE069061B R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Trace Metals in SPLP Extract by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061B.004	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#3	PE069061B.005	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#4	PE069061B.006	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#10	PE069061B.012	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#12	PE069061B.014	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#19	PE069061B.020	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#25	PE069061B.024	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#26	PE069061B.025	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#27	PE069061B.026	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#31	PE069061B.030	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#33	PE069061B.032	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#35	PE069061B.034	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#36	PE069061B.035	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012
#38	PE069061B.036	LB046913	-	02 Aug 2012	-	10 Aug 2012	-	13 Aug 2012



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.



METHOD BLANKS

PE069061B R0

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soil by SPLP Extract

Method: ME-(AU)-[ENV]AN311/AN312

Sample Number	Parameter	Units	LOR	Result
LB046781.001	Mercury	mg/L	0.0005	<0.0005

Metals in Water (SPLP) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result
LB046784.001	Aluminium, Al	mg/L	0.02	<0.02
	Antimony, Sb	mg/L	0.05	<0.05
	Arsenic, As	mg/L	0.02	<0.020
	Barium, Ba	mg/L	0.01	<0.01
	Beryllium, Be	mg/L	0.005	<0.005
	Boron, B	mg/L	0.2	<0.2
	Cadmium, Cd	mg/L	0.001	<0.001
	Calcium, Ca	mg/L	0.2	<0.2
	Cobalt, Co	mg/L	0.01	<0.01
	Chromium, Cr	mg/L	0.005	<0.005
	Copper, Cu	mg/L	0.005	<0.005
	Iron, Fe	mg/L	0.02	<0.02
	Lead, Pb	mg/L	0.005	<0.005
	Magnesium, Mg	mg/L	0.1	<0.1
	Manganese, Mn	mg/L	0.005	<0.005
	Molybdenum, Mo	mg/L	0.01	<0.01
	Nickel, Ni	mg/L	0.005	<0.005
	Phosphorus, P	mg/L	0.05	<0.05
	Potassium, K	mg/L	0.1	<0.1
	Selenium, Se	mg/L	0.02	<0.020
	Silicon, Si	mg/L	0.02	<0.02
	Silver, Ag	mg/L	0.005	<0.005
	Sodium, Na	mg/L	0.5	<0.5
	Strontium, Sr	mg/L	0.005	<0.005
	Sulphur, S	mg/L	0.1	<0.1
	Tin, Sn	mg/L	0.05	<0.05
	Titanium, Ti*	mg/L	0.005	<0.005
	Vanadium, V	mg/L	0.02	<0.02
	Zinc, Zn	mg/L	0.01	<0.01

Trace Metals in SPLP Extract by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB046913.001	Thallium, Tl	µg/L	1	<1

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Acidity of SPLP Extract

Method: ME-(AU)-[ENV]AN140

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB047323.012	Acidity to pH 8.3	mg CaCO ₃ /L	5	<5	<5	153	0

Alkalinity in SPLP Extract

Method: ME-(AU)-[ENV]AN135

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046790.012	Total Alkalinity as CaCO ₃	mg/L	5	46	47	26	2

Chloride by Discrete Analyser in SPLP Extract

Method: ME-(AU)-[ENV]AN274

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046878.012	Chloride	mg/L	1	3	3	53	0

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser

Method: ME-(AU)-[ENV]AN278

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB047332.012	Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002	200	0

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-[ENV]AN141

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB047043.015	Fluoride by ISE	mg/L	0.1	0.6	0.6	33	2

Mercury in Soil by SPLP Extract

Method: ME-(AU)-[ENV]AN311/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046781.012	Mercury	µg/L	0.0005	<0.0005	<0.0005	200	0

Metals in Water (SPLP) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046784.012	Aluminium, Al	mg/L	0.02	0.07	0.07	44	1
		Antimony, Sb	mg/L	0.05	<0.05	<0.05	200	0
		Arsenic, As	mg/L	0.02	<0.020	<0.020	200	0
		Barium, Ba	mg/L	0.01	0.24	0.24	19	0
		Beryllium, Be	mg/L	0.005	<0.005	<0.005	200	0
		Boron, B	mg/L	0.2	<0.2	<0.2	200	0
		Cadmium, Cd	mg/L	0.001	<0.001	<0.001	200	0
		Calcium, Ca	mg/L	0.2	14	14	16	0
		Cobalt, Co	mg/L	0.01	<0.01	<0.01	200	0
		Chromium, Cr	mg/L	0.005	<0.005	<0.005	200	0
		Copper, Cu	mg/L	0.005	<0.005	<0.005	200	0
		Iron, Fe	mg/L	0.02	0.04	0.04	61	3
		Lead, Pb	mg/L	0.005	<0.005	<0.005	200	0
		Magnesium, Mg	mg/L	0.1	2.5	2.5	19	0
		Manganese, Mn	mg/L	0.005	<0.005	<0.005	200	0
		Molybdenum, Mo	mg/L	0.01	<0.01	<0.01	200	0
		Nickel, Ni	mg/L	0.005	<0.005	<0.005	200	0
		Phosphorus, P	mg/L	0.05	<0.05	<0.05	200	0
		Potassium, K	mg/L	0.1	1.8	1.8	21	0
		Selenium, Se	mg/L	0.02	<0.020	<0.020	200	0
		Silicon, Si	mg/L	0.02	5.2	5.2	15	0
		Silver, Ag	mg/L	0.005	<0.005	<0.005	200	0
		Sodium, Na	mg/L	0.5	3.9	3.9	28	0
		Strontium, Sr	mg/L	0.005	0.070	0.070	22	0
		Sulphur, S	mg/L	0.1	1.4	1.3	22	1

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Metals in Water (SPLP) by ICPOES (continued)

Method: ME-(AU)-[ENV]AN320/AN321

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046784.012	Tin, Sn	mg/L	0.05	<0.05	<0.05	200	0
		Titanium, Ti*	mg/L	0.005	<0.005	<0.005	200	0
		Vanadium, V	mg/L	0.02	<0.02	<0.02	200	0
		Zinc, Zn	mg/L	0.01	0.02	0.01	81	2

SPLP (Synthetic Precipitation Leaching Procedure)

Method: USEPA 1312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046619.012	Mass of Sample Used*	g	-	50	50	12	0
		Volume of Extraction Solution Used*	mL	-	1000	1000	10	0
		pH SPLP after 18 hours*	pH Units	-	8.3	8.1	15	2
		Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	110	110	17	1

Sulphate in SPLP Extract

Method: ME-(AU)-[ENV]AN275

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046878.012	Sulphate, SO ₄	mg/L	1	4	4	38	1

Total Dissolved Solids (TDS) in SPLP Extract

Method: ME-(AU)-[ENV]AN113

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046763.013	Total Dissolved Solids Dried at 180°C*	mg/L	10	68	72	29	6

Trace Metals in SPLP Extract by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061B.030	LB046913.012	Thallium, Tl	µg/L	1	<1	<1	200	0



LABORATORY CONTROL SAMPLES

PE069061B R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-[ENV]AN141

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB047043.003	Fluoride by ISE	mg/L	0.1	1.9	2	80 - 120	94

Total Dissolved Solids (TDS) in SPLP Extract

Method: ME-(AU)-[ENV]AN113

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB046763.002	Total Dissolved Solids Dried at 180°C*	mg/L	10	308	300	80 - 120	103



Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.



MATRIX SPIKE DUPLICATES

PE069061B R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.



Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
<http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf>

- * Non-accredited analysis.
- Sample not analysed for this analyte.
- ^ Analysis performed by external laboratory.

- IS Insufficient sample for analysis.
- LNR Sample listed, but not received.
- LOR Limit of reporting.
- QFH QC result is above the upper tolerance.
- QFL QC result is below the lower tolerance.

- ① At least 2 of 3 surrogates are within acceptance criteria.
- ② RPD failed acceptance criteria due to sample heterogeneity.
- ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
- ④ Recovery failed acceptance criteria due to matrix interference.
- ⑤ Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
- ⑥ LOR was raised due to sample matrix interference.
- ⑦ LOR was raised due to dilution of significantly high concentration of analyte in sample.
- ⑧ Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
- ⑨ Low surrogate recovery due to the sample emulsifying during extraction.
- † Refer to Analytical Report comments for further information.

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Order Number **26027**
Samples 14

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SGS Reference **PE069061C R0**
Report Number 0000045407
Date Reported 29 Aug 2012
Date Received 21 Aug 2012

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

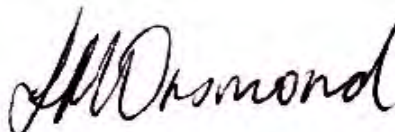
SPLP Ba, B, Na, and Zn replicate RPD for sample "#31" was outside acceptance criteria due to sample heterogeneity.

TDS by Evaporation for "#2" and "#4" may bias high compared to TDS by calculation due to sample matrix.

SIGNATORIES



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Laboratory Assistant Manager



ANALYTICAL REPORT

PE069061C R0

Parameter	Sample Number	PE069061C.004		PE069061C.005
	Sample Matrix	Soil		Soil
	Sample Name	#2		#3
	Units	LOR		

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	140	196
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	101	101
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	6.4	7.0
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	73	250

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	7	27
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	6	22

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	26	9
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	3	40
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	<0.1	1.2
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	6	47
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002
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ANALYTICAL REPORT

PE069061C R0

Parameter	Sample Number		PE069061C.004	PE069061C.005
	Sample Matrix		Soil	Soil
	Sample Name		#2	#3
	Units	LOR		

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	17	6.6
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02	<0.02
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.64	0.60
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	0.5	0.4
Cadmium, Cd	mg/L	0.001	<0.001	0.001
Calcium, Ca	mg/L	0.2	5.2	14
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	0.36
Iron, Fe	mg/L	0.02	<0.02	0.02
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	1.5	6.4
Manganese, Mn	mg/L	0.005	0.49	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	6.9	1.6
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	10	6.7
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	5.2	25
Strontium, Sr	mg/L	0.005	0.037	0.11
Sulphur, S	mg/L	0.1	2.8	13
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.25	0.24

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.006
		Sample Matrix	Soil
		Sample Name	#4
Parameter	Units	LOR	

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	136
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	102
Volume of Extraction Solution Used*	mL	-	1000
pH SPLP after 18 hours*	pH Units	-	8.6
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	160

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	60
Carbonate Alkalinity as CO ₃	mg/L	1	<1
Total Alkalinity as CaCO ₃	mg/L	5	49

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	6
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	11
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	1.6
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	15
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	2.4
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.006
		Sample Matrix	Soil
		Sample Name	#4
Parameter	Units	LOR	

Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02
Antimony, Sb	mg/L	0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020
Barium, Ba	mg/L	0.01	0.48
Beryllium, Be	mg/L	0.005	<0.005
Boron, B	mg/L	0.2	0.3
Cadmium, Cd	mg/L	0.001	<0.001
Calcium, Ca	mg/L	0.2	16
Cobalt, Co	mg/L	0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005
Iron, Fe	mg/L	0.02	0.11
Lead, Pb	mg/L	0.005	<0.005
Magnesium, Mg	mg/L	0.1	2.0
Manganese, Mn	mg/L	0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005
Phosphorus, P	mg/L	0.05	0.06
Potassium, K	mg/L	0.1	1.3
Selenium, Se	mg/L	0.02	<0.020
Silicon, Si	mg/L	0.02	4.9
Silver, Ag	mg/L	0.005	<0.005
Sodium, Na	mg/L	0.5	16
Strontium, Sr	mg/L	0.005	0.069
Sulphur, S	mg/L	0.1	4.9
Tin, Sn	mg/L	0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02
Zinc, Zn	mg/L	0.01	0.09

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.006
		Sample Matrix	Soil
		Sample Name	#4
Parameter	Units	LOR	

Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.012	PE069061C.014
		Sample Matrix	Soil	Soil
		Sample Name	#10	#12
Parameter	Units	LOR		

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	108	136
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	101	100
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	7.2	7.1
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	110	170

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	35	20
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	29	16

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	8	9
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	7	19
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.6	0.3
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	16	33
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	0.012	<0.002
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ANALYTICAL REPORT

PE069061C R0

Parameter	Sample Number		PE069061C.012	PE069061C.014
	Sample Matrix		Soil	Soil
	Sample Name		#10	#12
	Units	LOR		

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	2.5	4.1
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.03	<0.02
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.65	0.54
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	0.4	0.3
Cadmium, Cd	mg/L	0.001	0.001	0.002
Calcium, Ca	mg/L	0.2	10	8.8
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	0.12	0.006
Iron, Fe	mg/L	0.02	0.05	0.05
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	2.6	3.7
Manganese, Mn	mg/L	0.005	0.011	0.017
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	0.05
Potassium, K	mg/L	0.1	0.8	2.0
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	6.1	5.7
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	8.8	20
Strontium, Sr	mg/L	0.005	0.066	0.070
Sulphur, S	mg/L	0.1	5.1	10
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.19	0.20

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.020
		Sample Matrix	Soil
		Sample Name	#19
Parameter	Units	LOR	

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	156
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	100
Volume of Extraction Solution Used*	mL	-	1000
pH SPLP after 18 hours*	pH Units	-	8.4
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	200

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	61
Carbonate Alkalinity as CO ₃	mg/L	1	<1
Total Alkalinity as CaCO ₃	mg/L	5	50

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	7
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	8
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	1.4
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	27
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	0.023
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	6.1
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.020
		Sample Matrix	Soil
		Sample Name	#19
Parameter	Units	LOR	

Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.03
Antimony, Sb	mg/L	0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020
Barium, Ba	mg/L	0.01	0.50
Beryllium, Be	mg/L	0.005	<0.005
Boron, B	mg/L	0.2	0.3
Cadmium, Cd	mg/L	0.001	0.001
Calcium, Ca	mg/L	0.2	24
Cobalt, Co	mg/L	0.01	<0.01
Chromium, Cr	mg/L	0.005	0.008
Copper, Cu	mg/L	0.005	0.12
Iron, Fe	mg/L	0.02	0.02
Lead, Pb	mg/L	0.005	<0.005
Magnesium, Mg	mg/L	0.1	3.4
Manganese, Mn	mg/L	0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05
Potassium, K	mg/L	0.1	2.2
Selenium, Se	mg/L	0.02	<0.020
Silicon, Si	mg/L	0.02	4.7
Silver, Ag	mg/L	0.005	<0.005
Sodium, Na	mg/L	0.5	8.7
Strontium, Sr	mg/L	0.005	0.13
Sulphur, S	mg/L	0.1	8.6
Tin, Sn	mg/L	0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02
Zinc, Zn	mg/L	0.01	0.14

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005
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ANALYTICAL REPORT

PE069061C R0

			Sample Number	PE069061C.020
			Sample Matrix	Soil
			Sample Name	#19
Parameter	Units	LOR		

Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.024	PE069061C.025
		Sample Matrix	Soil	Soil
		Sample Name	#25	#26
Parameter	Units	LOR		

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	288	136
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	100	100
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	7.9	7.7
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	510	190

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	33	60
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	27	49

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	10	7
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	84	12
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.6	0.4
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	59	21
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002
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ANALYTICAL REPORT

PE069061C R0

	Sample Number	PE069061C.024	PE069061C.025
	Sample Matrix	Soil	Soil
	Sample Name	#25	#26
Parameter	Units	LOR	

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	26	4.7
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.02	0.03
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.53	0.48
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	0.4	0.3
Cadmium, Cd	mg/L	0.001	<0.001	0.001
Calcium, Ca	mg/L	0.2	16	21
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	<0.005	0.066
Iron, Fe	mg/L	0.02	0.07	0.05
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	12	3.9
Manganese, Mn	mg/L	0.005	0.090	0.043
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	3.7	2.2
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	9.7	5.0
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	56	10
Strontium, Sr	mg/L	0.005	0.14	0.10
Sulphur, S	mg/L	0.1	18	7.3
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.21	0.22

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.026	PE069061C.030
		Sample Matrix	Soil	Soil
		Sample Name	#27	#31
Parameter	Units	LOR		

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	372	128
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	101	102
Volume of Extraction Solution Used*	mL	-	1000	1000
pH SPLP after 18 hours*	pH Units	-	7.5	8.1
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	670	170

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	5	88
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	<5	72

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	9	<5
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	100	6
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	1.1	0.8
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	120	8
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	0.007
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ANALYTICAL REPORT

PE069061C R0

	Sample Number	PE069061C.026	PE069061C.030
	Sample Matrix	Soil	Soil
	Sample Name	#27	#31
Parameter	Units	LOR	

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	11	3.6
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02	0.05
Antimony, Sb	mg/L	0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.53	0.55
Beryllium, Be	mg/L	0.005	<0.005	<0.005
Boron, B	mg/L	0.2	0.7	0.4
Cadmium, Cd	mg/L	0.001	0.002	<0.001
Calcium, Ca	mg/L	0.2	21	20
Cobalt, Co	mg/L	0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	0.009
Copper, Cu	mg/L	0.005	<0.005	0.013
Iron, Fe	mg/L	0.02	<0.02	0.03
Lead, Pb	mg/L	0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	23	4.5
Manganese, Mn	mg/L	0.005	0.016	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	5.0	2.8
Selenium, Se	mg/L	0.02	<0.020	<0.020
Silicon, Si	mg/L	0.02	1.1	6.0
Silver, Ag	mg/L	0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	66	8.4
Strontium, Sr	mg/L	0.005	0.39	0.12
Sulphur, S	mg/L	0.1	44	2.7
Tin, Sn	mg/L	0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	0.02
Zinc, Zn	mg/L	0.01	0.23	0.12

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1
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ANALYTICAL REPORT

PE069061C R0

Parameter	Units	LOR	Sample Number	PE069061C.032	PE069061C.034	PE069061C.035
			Sample Matrix	Soil	Soil	Soil
			Sample Name	#33	#35	#36

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	60	96	88
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	99	100	100
Volume of ExtractionSolution Used*	mL	-	1000	1000	1000
pH SPLP after 18 hours*	pH Units	-	6.9	7.0	6.8
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	49	54	79

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	9	9	6
Carbonate Alkalinity as CO ₃	mg/L	1	<1	<1	<1
Total Alkalinity as CaCO ₃	mg/L	5	7	7	5

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	7	7	7
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	5	2	8
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.1	0.2	0.2
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	5	12	12
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002	0.007
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ANALYTICAL REPORT

PE069061C R0

Parameter	Units	LOR	Sample Number Sample Matrix Sample Name	PE069061C.032 Soil #33	PE069061C.034 Soil #35	PE069061C.035 Soil #36
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Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	1.3	1.3	4.1
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Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	0.04	0.04	0.04
Antimony, Sb	mg/L	0.05	<0.05	<0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020	<0.020	<0.020
Barium, Ba	mg/L	0.01	0.48	0.44	0.48
Beryllium, Be	mg/L	0.005	<0.005	<0.005	<0.005
Boron, B	mg/L	0.2	0.4	0.3	0.4
Cadmium, Cd	mg/L	0.001	<0.001	<0.001	<0.001
Calcium, Ca	mg/L	0.2	2.9	4.5	3.7
Cobalt, Co	mg/L	0.01	<0.01	<0.01	<0.01
Chromium, Cr	mg/L	0.005	<0.005	<0.005	<0.005
Copper, Cu	mg/L	0.005	0.026	0.007	<0.005
Iron, Fe	mg/L	0.02	0.03	0.04	0.05
Lead, Pb	mg/L	0.005	<0.005	<0.005	<0.005
Magnesium, Mg	mg/L	0.1	0.7	1.1	1.7
Manganese, Mn	mg/L	0.005	0.24	0.10	0.015
Molybdenum, Mo	mg/L	0.01	<0.01	<0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005	<0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05	<0.05	<0.05
Potassium, K	mg/L	0.1	2.4	1.7	1.3
Selenium, Se	mg/L	0.02	<0.020	<0.020	<0.020
Silicon, Si	mg/L	0.02	6.5	5.3	6.9
Silver, Ag	mg/L	0.005	<0.005	<0.005	<0.005
Sodium, Na	mg/L	0.5	5.1	4.3	8.3
Strontium, Sr	mg/L	0.005	0.030	0.034	0.047
Sulphur, S	mg/L	0.1	1.9	3.9	4.1
Tin, Sn	mg/L	0.05	<0.05	<0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005	<0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02	<0.02	<0.02
Zinc, Zn	mg/L	0.01	0.26	0.13	0.11

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005	<0.0005	<0.0005
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Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1	<1	<1
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ANALYTICAL REPORT

PE069061C R0

Parameter	Sample Number	PE069061C.036	
	Sample Matrix	Soil	
	Sample Name	#38	
	Units	LOR	

Total Dissolved Solids (TDS) in SPLP Extract Method: AN113

Total Dissolved Solids Dried at 180°C*	mg/L	10	172
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SPLP (Synthetic Precipitation Leaching Procedure) Method: USEPA 1312

Extraction Solution Used*	No unit	-	Fluid #2 (pH5.0)
Mass of Sample Used*	g	-	100
Volume of Extraction Solution Used*	mL	-	1000
pH SPLP after 18 hours*	pH Units	-	7.6
Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	220

Alkalinity in SPLP Extract Method: AN135

Bicarbonate Alkalinity as HCO ₃	mg/L	5	34
Carbonate Alkalinity as CO ₃	mg/L	1	<1
Total Alkalinity as CaCO ₃	mg/L	5	28

Acidity of SPLP Extract Method: AN140

Acidity to pH 8.3	mg CaCO ₃ /L	5	12
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Chloride by Discrete Analyser in SPLP Extract Method: AN274

Chloride	mg/L	1	21
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Fluoride by Ion Selective Electrode in SPLP Leachate Method: AN141

Fluoride by ISE	mg/L	0.1	0.6
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Sulphate in SPLP Extract Method: AN275

Sulphate, SO ₄	mg/L	1	40
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Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: AN278

Filterable Reactive Phosphorus	mg/L	0.002	<0.002
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Nitrate Nitrogen and Nitrite Nitrogen (NO_x) by FIA in SPLP Extract Method: AN258

Nitrate, NO ₃ as NO ₃	mg/L	0.05	8.4
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ANALYTICAL REPORT

PE069061C R0

		Sample Number	PE069061C.036
		Sample Matrix	Soil
		Sample Name	#38
Parameter	Units	LOR	

Metals in Water (SPLP) by ICPOES Method: AN320/AN321

Aluminium, Al	mg/L	0.02	<0.02
Antimony, Sb	mg/L	0.05	<0.05
Arsenic, As	mg/L	0.02	<0.020
Barium, Ba	mg/L	0.01	0.05
Beryllium, Be	mg/L	0.005	<0.005
Boron, B	mg/L	0.2	<0.2
Cadmium, Cd	mg/L	0.001	<0.001
Calcium, Ca	mg/L	0.2	10
Cobalt, Co	mg/L	0.01	<0.01
Chromium, Cr	mg/L	0.005	0.013
Copper, Cu	mg/L	0.005	<0.005
Iron, Fe	mg/L	0.02	0.04
Lead, Pb	mg/L	0.005	<0.005
Magnesium, Mg	mg/L	0.1	3.8
Manganese, Mn	mg/L	0.005	<0.005
Molybdenum, Mo	mg/L	0.01	<0.01
Nickel, Ni	mg/L	0.005	<0.005
Phosphorus, P	mg/L	0.05	<0.05
Potassium, K	mg/L	0.1	3.3
Selenium, Se	mg/L	0.02	<0.020
Silicon, Si	mg/L	0.02	7.8
Silver, Ag	mg/L	0.005	<0.005
Sodium, Na	mg/L	0.5	28
Strontium, Sr	mg/L	0.005	0.069
Sulphur, S	mg/L	0.1	12
Tin, Sn	mg/L	0.05	<0.05
Titanium, Ti*	mg/L	0.005	<0.005
Vanadium, V	mg/L	0.02	<0.02
Zinc, Zn	mg/L	0.01	<0.01

Mercury in Soil by SPLP Extract Method: AN311/AN312

Mercury	mg/L	0.0005	<0.0005
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ANALYTICAL REPORT

PE069061C R0

			Sample Number	PE069061C.036
			Sample Matrix	Soil
			Sample Name	#38
Parameter	Units	LOR		

Trace Metals in SPLP Extract by ICPMS Method: AN318

Thallium, Tl	µg/L	1	<1
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QC SUMMARY

PE069061C R0

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Acidity of SPLP Extract Method: ME-(AU)-[ENV]AN140

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Acidity to pH 8.3	LB047845	mg CaCO ₃ /L	5	8	1 - 50%

Alkalinity in SPLP Extract Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Bicarbonate Alkalinity as HCO ₃	LB047844	mg/L	5	<5	3 - 8%
Carbonate Alkalinity as CO ₃	LB047844	mg/L	1	<1	
Total Alkalinity as CaCO ₃	LB047844	mg/L	5	<5	

Chloride by Discrete Analyser in SPLP Extract Method: ME-(AU)-[ENV]AN274

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Chloride	LB048086	mg/L	1	<1	11 - 13%

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Filterable Reactive Phosphorus	LB048091	mg/L	0.002	0.022	0 - 101%

Fluoride by Ion Selective Electrode in SPLP Leachate Method: ME-(AU)-[ENV]AN141

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Fluoride by ISE	LB048122	mg/L	0.1	<0.1	2%	91%

Mercury in Soil by SPLP Extract Method: ME-(AU)-[ENV]AN311/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Mercury	LB047787	mg/L	0.0005	<0.0005	0%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water (SPLP) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Aluminium, Al	LB047788	mg/L	0.02	<0.02	0 - 1%
Antimony, Sb	LB047788	mg/L	0.05	<0.05	0%
Arsenic, As	LB047788	mg/L	0.02	<0.020	0%
Barium, Ba	LB047788	mg/L	0.01	<0.01	4 - 105%
Beryllium, Be	LB047788	mg/L	0.005	<0.005	0%
Boron, B	LB047788	mg/L	0.2	<0.2	0 - 65%
Cadmium, Cd	LB047788	mg/L	0.001	<0.001	0%
Calcium, Ca	LB047788	mg/L	0.2	<0.2	1 - 6%
Cobalt, Co	LB047788	mg/L	0.01	<0.01	0%
Chromium, Cr	LB047788	mg/L	0.005	<0.005	1 - 2%
Copper, Cu	LB047788	mg/L	0.005	<0.005	0 - 53%
Iron, Fe	LB047788	mg/L	0.02	<0.02	11 - 19%
Lead, Pb	LB047788	mg/L	0.005	<0.005	0%
Magnesium, Mg	LB047788	mg/L	0.1	<0.1	2 - 7%
Manganese, Mn	LB047788	mg/L	0.005	<0.005	0%
Molybdenum, Mo	LB047788	mg/L	0.01	<0.01	0%
Nickel, Ni	LB047788	mg/L	0.005	<0.005	0%
Phosphorus, P	LB047788	mg/L	0.05	<0.05	0%
Potassium, K	LB047788	mg/L	0.1	<0.1	6 - 17%
Selenium, Se	LB047788	mg/L	0.02	<0.020	0%
Silicon, Si	LB047788	mg/L	0.02	<0.02	0 - 5%
Silver, Ag	LB047788	mg/L	0.005	<0.005	0%
Sodium, Na	LB047788	mg/L	0.5	<0.5	12 - 26%
Strontium, Sr	LB047788	mg/L	0.005	<0.005	5 - 16%
Sulphur, S	LB047788	mg/L	0.1	<0.1	1 - 6%
Tin, Sn	LB047788	mg/L	0.05	<0.05	0%
Titanium, Ti*	LB047788	mg/L	0.005	<0.005	0%
Vanadium, V	LB047788	mg/L	0.02	<0.02	0 - 4%
Zinc, Zn	LB047788	mg/L	0.01	<0.01	0 - 76%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract Method: ME-(AU)-[ENV]AN258

Parameter	QC Reference	Units	LOR	MB
Nitrate, NO ₃ as NO ₃	LB047984	mg/L	0.05	<0.05

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

SPLP (Synthetic Precipitaion Leaching Procedure) Method: USEPA 1312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Extraction Solution Used*	LB047716	No unit	-	Fluid #2 (pH5.	
Mass of Sample Used*	LB047716	g	-	100	1%
Volume of ExtractionSolution Used*	LB047716	mL	-	1000	0%
pH SPLP after 18 hours*	LB047716	pH Units	-	4.8	0 - 1%
Conductivity @ 25 C SPLP after 18 hours*	LB047716	µS/cm	2	6	0 - 2%

Sulphate in SPLP Extract Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Sulphate, SO4	LB048086	mg/L	1	<1	2 - 9%	93%

Total Dissolved Solids (TDS) in SPLP Extract Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 180°C*	LB047906	mg/L	10	<10	10%	NA

Trace Metals in SPLP Extract by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Thallium, Tl	LB047789	µg/L	1	<1	0%

METHOD

METHODOLOGY SUMMARY

AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN140	Acidity by Titration: The water sample/extract is titrated with sodium hydroxide to designated pH end point. In a sample containing only carbon dioxide, bicarbonates and carbonates, titration to pH 8.3 at 25°C corresponds to stoichiometric neutralisation of carbonic acid to bicarbonate. Method reference APHA 2310 B.
AN141	Determination of Fluoride by ISE: A fluoride ion selective electrode and reference electrode combination, in the presence of a pH/complexation buffer, is used to determine the fluoride concentration on the soil water extract. The electrode millivolt response is measured logarithmically against fluoride concentration. Reference APHA F- C.
AN258	Nitrate and Nitrite by FIA: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Without the cadmium reduction only the original nitrite is determined. Reference APHA 4500-NO ₃ - F.
AN274	Chloride by Aquakem DA following SPLP extraction: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-
AN275	Sulphate by Aquakem DA from SPLP Extract: Sulphate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulphate concentration in the sample. Reference APHA 4500-SO ₄ 2-. Internal reference AN275.
AN278	Reactive Phosphorus by Discrete Analyser: Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
USEPA 1312	Soil or waste solids are extracted 1:20w/w in an extraction Fluid (# 1 pH 4.2±0.05 and #2 pH 5.0±0.05) for 18±2hrs followed by filtration for elemental analysis as required.
USEPA 1312	Extraction fluid #1: This fluid is made by adding the 60/40 weight percent mixture of sulfuric and nitric acids (or a suitable dilution) to reagent water until the pH is 4.20 + 0.05. Extraction fluid #2: This fluid is made by adding the 60/40 weight percent mixture of sulfuric and nitric acids (or a suitable dilution) to reagent water until the pH is 5.00 + 0.05.



FOOTNOTES

IS	Insufficient sample for analysis.	QFH	QC result is above the upper tolerance
LNR	Sample listed, but not received.	QFL	QC result is below the lower tolerance
*	This analysis is not covered by the scope of accreditation.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated
LOR	Limit of Reporting		
↑↓	Raised or Lowered Limit of Reporting		

Samples analysed as received.

Solid samples expressed on a dry weight basis.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
<http://www.sgs.com.au.pv.sgs.v3/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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STATEMENT OF QA/QC PERFORMANCE

PE069061C R0

CLIENT DETAILS

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Project **127645023**
Order Number **26027**
Samples 14

LABORATORY DETAILS

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SGS Reference PE069061C R0
Report Number 0000045408
Date Reported 29 Aug 2012

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS Environmental Services' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document and was supplied by the Client. This QA/QC Statement must be read in conjunction with the referenced Analytical Report. The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Duplicate	Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser	1 item
	Metals in Water (SPLP) by ICPOES	3 items

SAMPLE SUMMARY

Sample counts by matrix	14 Soil	Type of documentation received	COC
Date documentation received	2/8/2012	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	20°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	1 Pallet

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Acidity of SPLP Extract

Method: ME-(AU)-[ENV]AN140

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#3	PE069061C.005	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#4	PE069061C.006	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#10	PE069061C.012	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#12	PE069061C.014	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#19	PE069061C.020	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#25	PE069061C.024	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#26	PE069061C.025	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#27	PE069061C.026	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#31	PE069061C.030	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#33	PE069061C.032	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#35	PE069061C.034	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#36	PE069061C.035	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#38	PE069061C.036	LB047845	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012

Alkalinity in SPLP Extract

Method: ME-(AU)-[ENV]AN135

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#3	PE069061C.005	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#4	PE069061C.006	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#10	PE069061C.012	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#12	PE069061C.014	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#19	PE069061C.020	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#25	PE069061C.024	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#26	PE069061C.025	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#27	PE069061C.026	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#31	PE069061C.030	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#33	PE069061C.032	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#35	PE069061C.034	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#36	PE069061C.035	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012
#38	PE069061C.036	LB047844	-	21 Aug 2012	-	23 Aug 2012	-	23 Aug 2012

Chloride by Discrete Analyser in SPLP Extract

Method: ME-(AU)-[ENV]AN274

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#3	PE069061C.005	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#4	PE069061C.006	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#10	PE069061C.012	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#12	PE069061C.014	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#19	PE069061C.020	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#25	PE069061C.024	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#26	PE069061C.025	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#27	PE069061C.026	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#31	PE069061C.030	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#33	PE069061C.032	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#35	PE069061C.034	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#36	PE069061C.035	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#38	PE069061C.036	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser

Method: ME-(AU)-[ENV]AN278

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#3	PE069061C.005	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#4	PE069061C.006	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#10	PE069061C.012	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#12	PE069061C.014	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#19	PE069061C.020	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#25	PE069061C.024	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#26	PE069061C.025	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#27	PE069061C.026	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#31	PE069061C.030	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser (continued)

Method: ME-(AU)-ENVJAN278

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#33	PE069061C.032	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#35	PE069061C.034	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#36	PE069061C.035	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#38	PE069061C.036	LB048091	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-ENVJAN141

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#3	PE069061C.005	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#4	PE069061C.006	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#10	PE069061C.012	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#12	PE069061C.014	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#19	PE069061C.020	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#25	PE069061C.024	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#26	PE069061C.025	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#27	PE069061C.026	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#31	PE069061C.030	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#33	PE069061C.032	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#35	PE069061C.034	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#36	PE069061C.035	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#38	PE069061C.036	LB048122	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012

Mercury in Soil by SPLP Extract

Method: ME-(AU)-ENVJAN311/AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#3	PE069061C.005	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#4	PE069061C.006	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#10	PE069061C.012	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#12	PE069061C.014	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#19	PE069061C.020	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#25	PE069061C.024	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#26	PE069061C.025	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#27	PE069061C.026	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#31	PE069061C.030	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#33	PE069061C.032	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#35	PE069061C.034	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#36	PE069061C.035	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012
#38	PE069061C.036	LB047787	-	21 Aug 2012	-	22 Aug 2012	-	23 Aug 2012

Metals in Water (SPLP) by ICPOES

Method: ME-(AU)-ENVJAN320/AN321

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#3	PE069061C.005	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#4	PE069061C.006	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#10	PE069061C.012	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#12	PE069061C.014	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#19	PE069061C.020	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#25	PE069061C.024	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#26	PE069061C.025	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#27	PE069061C.026	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#31	PE069061C.030	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#33	PE069061C.032	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#35	PE069061C.034	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#36	PE069061C.035	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012
#38	PE069061C.036	LB047788	-	21 Aug 2012	-	22 Aug 2012	-	28 Aug 2012

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract

Method: ME-(AU)-ENVJAN258

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#3	PE069061C.005	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#4	PE069061C.006	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#10	PE069061C.012	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA in SPLP Extract (continued)

Method: ME-(AU)-ENVJAN258

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#12	PE069061C.014	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#19	PE069061C.020	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#25	PE069061C.024	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#26	PE069061C.025	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#27	PE069061C.026	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#31	PE069061C.030	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#33	PE069061C.032	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#35	PE069061C.034	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#36	PE069061C.035	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012
#38	PE069061C.036	LB047984	-	21 Aug 2012	-	24 Aug 2012	-	27 Aug 2012

SPLP (Synthetic Precipitation Leaching Procedure)

Method: USEPA 1312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#3	PE069061C.005	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#4	PE069061C.006	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#10	PE069061C.012	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#12	PE069061C.014	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#19	PE069061C.020	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#25	PE069061C.024	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#26	PE069061C.025	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#27	PE069061C.026	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#31	PE069061C.030	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#33	PE069061C.032	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#35	PE069061C.034	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#36	PE069061C.035	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012
#38	PE069061C.036	LB047716	-	21 Aug 2012	-	21 Aug 2012	-	21 Aug 2012

Sulphate in SPLP Extract

Method: ME-(AU)-ENVJAN275

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#3	PE069061C.005	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#4	PE069061C.006	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#10	PE069061C.012	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#12	PE069061C.014	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#19	PE069061C.020	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#25	PE069061C.024	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012
#26	PE069061C.025	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#27	PE069061C.026	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#31	PE069061C.030	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#33	PE069061C.032	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#35	PE069061C.034	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#36	PE069061C.035	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	28 Aug 2012
#38	PE069061C.036	LB048086	-	21 Aug 2012	-	27 Aug 2012	-	27 Aug 2012

Total Dissolved Solids (TDS) in SPLP Extract

Method: ME-(AU)-ENVJAN113

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#3	PE069061C.005	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#4	PE069061C.006	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#10	PE069061C.012	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#12	PE069061C.014	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#19	PE069061C.020	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#25	PE069061C.024	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#26	PE069061C.025	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#27	PE069061C.026	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#31	PE069061C.030	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#33	PE069061C.032	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#35	PE069061C.034	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#36	PE069061C.035	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012
#38	PE069061C.036	LB047906	-	21 Aug 2012	-	24 Aug 2012	-	24 Aug 2012



HOLDING TIME SUMMARY

PE069061C R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Trace Metals in SPLP Extract by ICPMS

Method: ME-(AU)-ENVJAN318

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
#2	PE069061C.004	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#3	PE069061C.005	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#4	PE069061C.006	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#10	PE069061C.012	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#12	PE069061C.014	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#19	PE069061C.020	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#25	PE069061C.024	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#26	PE069061C.025	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#27	PE069061C.026	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#31	PE069061C.030	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#33	PE069061C.032	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#35	PE069061C.034	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#36	PE069061C.035	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012
#38	PE069061C.036	LB047789	-	21 Aug 2012	-	22 Aug 2012	-	27 Aug 2012



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.



METHOD BLANKS

PE069061C R0

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-[ENV]AN141

Sample Number	Parameter	Units	LOR	Result
LB048122.001	Fluoride by ISE	mg/L	0.1	<0.1

Mercury in Soil by SPLP Extract

Method: ME-(AU)-[ENV]AN311/AN312

Sample Number	Parameter	Units	LOR	Result
LB047787.001	Mercury	mg/L	0.0005	<0.0005

Metals in Water (SPLP) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Sample Number	Parameter	Units	LOR	Result
LB047788.001	Aluminium, Al	mg/L	0.02	<0.02
	Antimony, Sb	mg/L	0.05	<0.05
	Arsenic, As	mg/L	0.02	<0.020
	Barium, Ba	mg/L	0.01	<0.01
	Beryllium, Be	mg/L	0.005	<0.005
	Boron, B	mg/L	0.2	<0.2
	Cadmium, Cd	mg/L	0.001	<0.001
	Calcium, Ca	mg/L	0.2	<0.2
	Cobalt, Co	mg/L	0.01	<0.01
	Chromium, Cr	mg/L	0.005	<0.005
	Copper, Cu	mg/L	0.005	<0.005
	Iron, Fe	mg/L	0.02	<0.02
	Lead, Pb	mg/L	0.005	<0.005
	Magnesium, Mg	mg/L	0.1	<0.1
	Manganese, Mn	mg/L	0.005	<0.005
	Molybdenum, Mo	mg/L	0.01	<0.01
	Nickel, Ni	mg/L	0.005	<0.005
	Phosphorus, P	mg/L	0.05	<0.05
	Potassium, K	mg/L	0.1	<0.1
	Selenium, Se	mg/L	0.02	<0.020
	Silicon, Si	mg/L	0.02	<0.02
	Silver, Ag	mg/L	0.005	<0.005
	Sodium, Na	mg/L	0.5	<0.5
	Strontium, Sr	mg/L	0.005	<0.005
	Sulphur, S	mg/L	0.1	<0.1
	Tin, Sn	mg/L	0.05	<0.05
	Titanium, Ti*	mg/L	0.005	<0.005
	Vanadium, V	mg/L	0.02	<0.02
	Zinc, Zn	mg/L	0.01	<0.01

Trace Metals in SPLP Extract by ICPMS

Method: ME-(AU)-[ENV]AN318

Sample Number	Parameter	Units	LOR	Result
LB047789.001	Thallium, Tl	µg/L	1	<1

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Acidity of SPLP Extract

Method: ME-(AU)-[ENV]AN140

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047845.012	Acidity to pH 8.3	mg CaCO ₃ /L	5	<5	5	121	1
PE069061C.036	LB047845.017	Acidity to pH 8.3	mg CaCO ₃ /L	5	12	7	67	50

Alkalinity in SPLP Extract

Method: ME-(AU)-[ENV]AN135

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047844.012	Total Alkalinity as CaCO ₃	mg/L	5	72	74	22	3
PE069061C.036	LB047844.017	Total Alkalinity as CaCO ₃	mg/L	5	28	30	32	8

Chloride by Discrete Analyser in SPLP Extract

Method: ME-(AU)-[ENV]AN274

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB048086.007	Chloride	mg/L	1	6	5	34	11
PE069061C.036	LB048086.012	Chloride	mg/L	1	21	18	20	13

Filterable Reactive Phosphorus (FRP) in SPLP Extract by Discrete Analyser

Method: ME-(AU)-[ENV]AN278

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB048091.007	Filterable Reactive Phosphorus	mg/L	0.002	0.007	0.002	60	101 @
PE069061C.036	LB048091.012	Filterable Reactive Phosphorus	mg/L	0.002	<0.002	<0.002	200	0

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-[ENV]AN141

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.020	LB048122.010	Fluoride by ISE	mg/L	0.1	1.4	1.4	22	2

Mercury in Soil by SPLP Extract

Method: ME-(AU)-[ENV]AN311/AN312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047787.012	Mercury	µg/L	0.0005	<0.0005	<0.0005	200	0
PE069061C.036	LB047787.017	Mercury	µg/L	0.0005	<0.0005	<0.0005	200	0

Metals in Water (SPLP) by ICPOES

Method: ME-(AU)-[ENV]AN320/AN321

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047788.012	Aluminium, Al	mg/L	0.02	0.05	0.05	56	1
		Antimony, Sb	mg/L	0.05	<0.05	<0.05	200	0
		Arsenic, As	mg/L	0.02	<0.020	<0.020	200	0
		Barium, Ba	mg/L	0.01	0.55	0.17	18	105 @
		Beryllium, Be	mg/L	0.005	<0.005	<0.005	200	0
		Boron, B	mg/L	0.2	0.4	<0.2	97	65
		Cadmium, Cd	mg/L	0.001	<0.001	<0.001	200	0
		Calcium, Ca	mg/L	0.2	20	20	16	1
		Cobalt, Co	mg/L	0.01	<0.01	<0.01	200	0
		Chromium, Cr	mg/L	0.005	0.009	0.010	68	2
		Copper, Cu	mg/L	0.005	0.013	0.007	65	53
		Iron, Fe	mg/L	0.02	0.03	0.02	92	19
		Lead, Pb	mg/L	0.005	<0.005	<0.005	200	0
		Magnesium, Mg	mg/L	0.1	4.5	4.4	17	2
		Manganese, Mn	mg/L	0.005	<0.005	<0.005	200	0
		Molybdenum, Mo	mg/L	0.01	<0.01	<0.01	200	0
		Nickel, Ni	mg/L	0.005	<0.005	<0.005	200	0
		Phosphorus, P	mg/L	0.05	<0.05	<0.05	200	0
		Potassium, K	mg/L	0.1	2.8	3.3	18	17
		Selenium, Se	mg/L	0.02	<0.020	<0.020	200	0
		Silicon, Si	mg/L	0.02	6.0	6.3	15	5
		Silver, Ag	mg/L	0.005	<0.005	<0.005	200	0
		Sodium, Na	mg/L	0.5	8.4	6.5	22	26 @
		Strontium, Sr	mg/L	0.005	0.12	0.11	19	5
		Sulphur, S	mg/L	0.1	2.7	2.5	19	6

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Metals in Water (SPLP) by ICPOES (continued)

Method: ME-(AU)-[ENV]AN320/AN321

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047788.012	Tin, Sn	mg/L	0.05	<0.05	<0.05	200	0
		Titanium, Ti*	mg/L	0.005	<0.005	<0.005	200	0
		Vanadium, V	mg/L	0.02	0.02	0.03	95	4
		Zinc, Zn	mg/L	0.01	0.12	0.06	26	76 @
PE069061C.036	LB047788.017	Aluminium, Al	mg/L	0.02	<0.02	<0.02	151	0
		Antimony, Sb	mg/L	0.05	<0.05	<0.05	200	0
		Arsenic, As	mg/L	0.02	<0.020	<0.020	200	0
		Barium, Ba	mg/L	0.01	0.05	0.05	34	4
		Beryllium, Be	mg/L	0.005	<0.005	<0.005	200	0
		Boron, B	mg/L	0.2	<0.2	<0.2	200	0
		Cadmium, Cd	mg/L	0.001	<0.001	<0.001	200	0
		Calcium, Ca	mg/L	0.2	10	9.8	17	6
		Cobalt, Co	mg/L	0.01	<0.01	<0.01	200	0
		Chromium, Cr	mg/L	0.005	0.013	0.013	53	1
		Copper, Cu	mg/L	0.005	<0.005	<0.005	200	0
		Iron, Fe	mg/L	0.02	0.04	0.05	59	11
		Lead, Pb	mg/L	0.005	<0.005	<0.005	200	0
		Magnesium, Mg	mg/L	0.1	3.8	3.6	18	7
		Manganese, Mn	mg/L	0.005	<0.005	<0.005	200	0
		Molybdenum, Mo	mg/L	0.01	<0.01	<0.01	200	0
		Nickel, Ni	mg/L	0.005	<0.005	<0.005	200	0
		Phosphorus, P	mg/L	0.05	<0.05	<0.05	200	0
		Potassium, K	mg/L	0.1	3.3	3.5	18	6
		Selenium, Se	mg/L	0.02	<0.020	<0.020	200	0
		Silicon, Si	mg/L	0.02	7.8	7.7	15	0
		Silver, Ag	mg/L	0.005	<0.005	<0.005	200	0
		Sodium, Na	mg/L	0.5	28	25	17	12
		Strontium, Sr	mg/L	0.005	0.069	0.059	23	16
		Sulphur, S	mg/L	0.1	12	12	16	1
		Tin, Sn	mg/L	0.05	<0.05	<0.05	200	0
		Titanium, Ti*	mg/L	0.005	<0.005	<0.005	200	0
		Vanadium, V	mg/L	0.02	<0.02	<0.02	200	0
		Zinc, Zn	mg/L	0.01	<0.01	<0.01	200	0

SPLP (Synthetic Precipitation Leaching Procedure)

Method: USEPA 1312

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047716.012	Mass of Sample Used*	g	-	102	100	11	1
		Volume of Extraction Solution Used*	mL	-	1000	1000	10	0
		pH SPLP after 18 hours*	pH Units	-	8.1	8.2	15	1
		Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	170	180	16	2
PE069061C.036	LB047716.017	Mass of Sample Used*	g	-	100	101	11	1
		Volume of Extraction Solution Used*	mL	-	1000	1000	10	0
		pH SPLP after 18 hours*	pH Units	-	7.6	7.6	15	0
		Conductivity @ 25 C SPLP after 18 hours*	µS/cm	2	220	220	16	0

Sulphate in SPLP Extract

Method: ME-(AU)-[ENV]AN275

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB048086.009	Sulphate, SO4	mg/L	1	8	7	29	9
PE069061C.036	LB048086.014	Sulphate, SO4	mg/L	1	40	40	18	2

Total Dissolved Solids (TDS) in SPLP Extract

Method: ME-(AU)-[ENV]AN113

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047906.013	Total Dissolved Solids Dried at 180°C*	mg/L	10	128	116	23	10
PE069061C.036	LB047906.018	Total Dissolved Solids Dried at 180°C*	mg/L	10	172	156	21	10

Trace Metals in SPLP Extract by ICPMS

Method: ME-(AU)-[ENV]AN318

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
PE069061C.030	LB047789.012	Thallium, Tl	µg/L	1	<1	<1	200	0
PE069061C.036	LB047789.017	Thallium, Tl	µg/L	1	<1	<1	200	0



LABORATORY CONTROL SAMPLES

PE069061C R0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Fluoride by Ion Selective Electrode in SPLP Leachate

Method: ME-(AU)-[ENV]AN141

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB048122.002	Fluoride by ISE	mg/L	0.1	1.8	2	80 - 120	91

Sulphate in SPLP Extract

Method: ME-(AU)-[ENV]AN275

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB048086.002	Sulphate, SO4	mg/L	1	93	100	80 - 120	93



MATRIX SPIKES

PE069061C R0

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.



Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: $RPD = | \text{OriginalResult} - \text{ReplicateResult} | \times 100 / \text{Mean}$

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: $MAD = 100 \times \text{SDL} / \text{Mean} + \text{LR}$

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.



Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here:
<http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-11.pdf>

- * Non-accredited analysis.
- Sample not analysed for this analyte.
- ^ Analysis performed by external laboratory.

- IS Insufficient sample for analysis.
- LNR Sample listed, but not received.
- LOR Limit of reporting.
- QFH QC result is above the upper tolerance.
- QFL QC result is below the lower tolerance.

- ① At least 2 of 3 surrogates are within acceptance criteria.
- ② RPD failed acceptance criteria due to sample heterogeneity.
- ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
- ④ Recovery failed acceptance criteria due to matrix interference.
- ⑤ Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
- ⑥ LOR was raised due to sample matrix interference.
- ⑦ LOR was raised due to dilution of significantly high concentration of analyte in sample.
- ⑧ Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
- ⑨ Low surrogate recovery due to the sample emulsifying during extraction.
- † Refer to Analytical Report comments for further information.

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This test report shall not be reproduced, except in full.

Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_01
Client ID: PE069061B-004
Date: 23/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

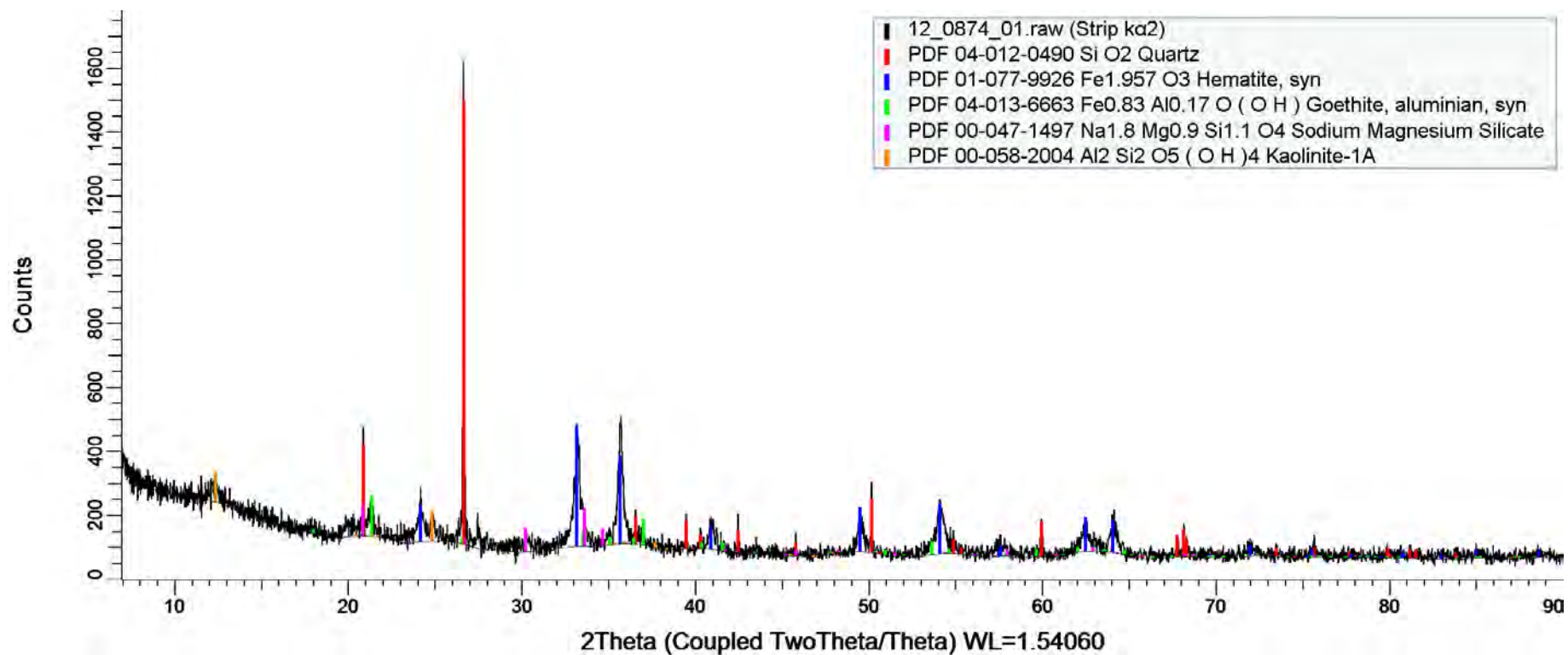
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Quartz (Si O ₂)	54.4	good
Hematite, syn (Fe _{1.957} O ₃)	14.1	good
Sodium Magnesium Silicate (Na _{1.8} Mg _{0.9} Si _{1.1} O ₄)	14.0	medium
Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	11.5	medium
Goethite, aluminian, syn (Fe _{0.83} Al _{0.17} O (O H))	6.1	low

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_02
Client ID: PE069061B-005
Date: 23/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

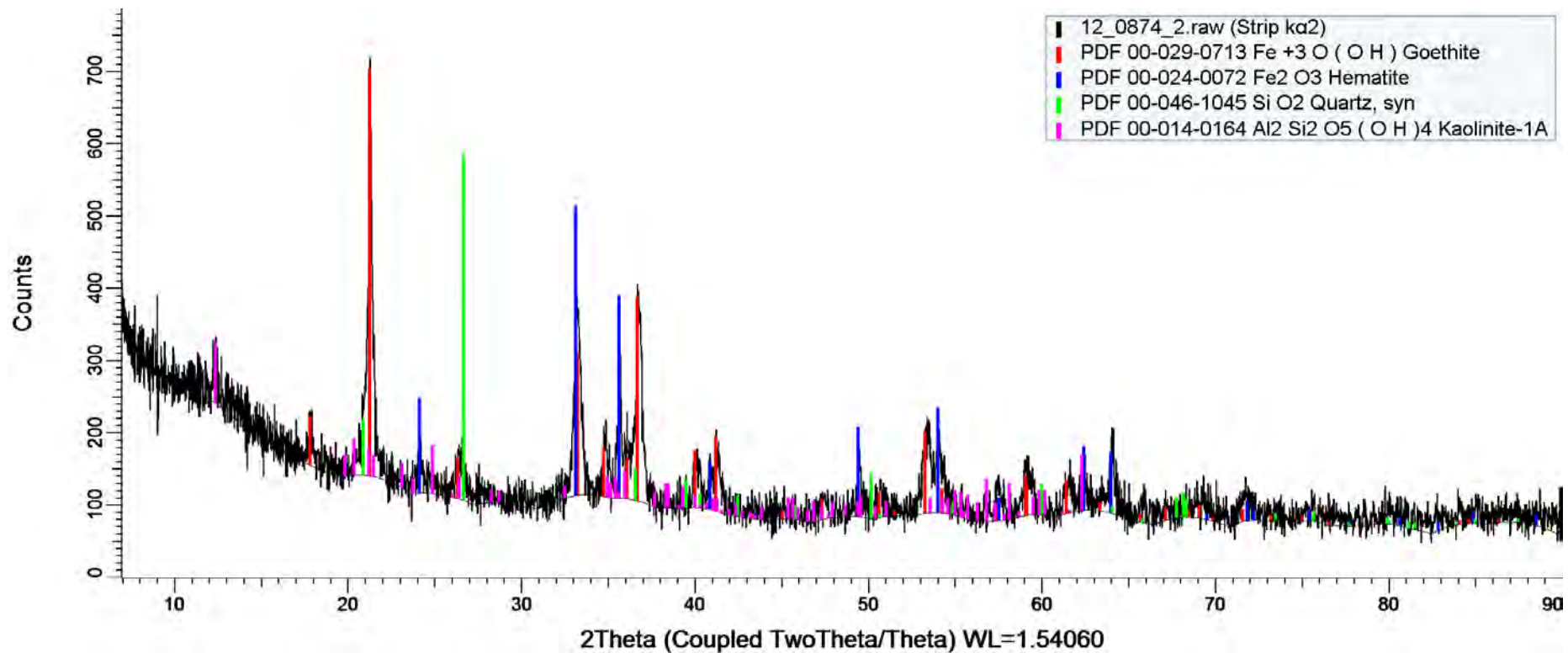
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	47.4	good
Hematite (Fe2 O3)	33.7	good
Quartz, syn (Si O2)	11.8	good
Kaolinite-1A (Al2 Si2 O5 (O H)4)	7.1	medium

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_03
Client ID: PE069061B-006
Date: 23/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

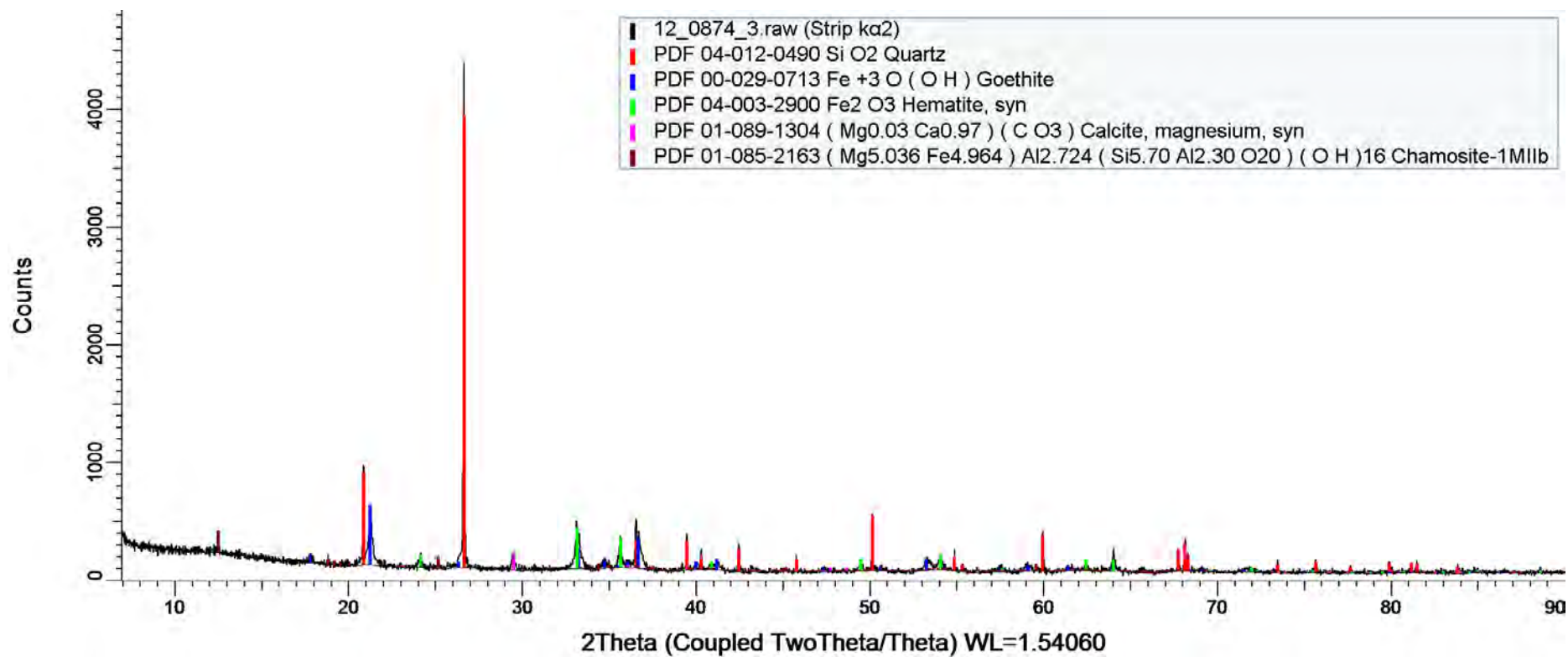
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Quartz (Si O ₂)	61.5	good
Goethite (Fe +3 O (O H))	24.6	good
Chamosite-1MIIb ((Mg _{5.036} Fe _{4.964}) Al _{2.724} (Si _{5.70} Al _{2.30} O ₂₀) (O H) ₁₆)	6.3	good
Hematite, syn (Fe ₂ O ₃)	5.2	good
Calcite, magnesium, syn ((Mg _{0.03} Ca _{0.97}) (C O ₃))	2.4	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_04
Client ID: PE069061B-012
Date: 23/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

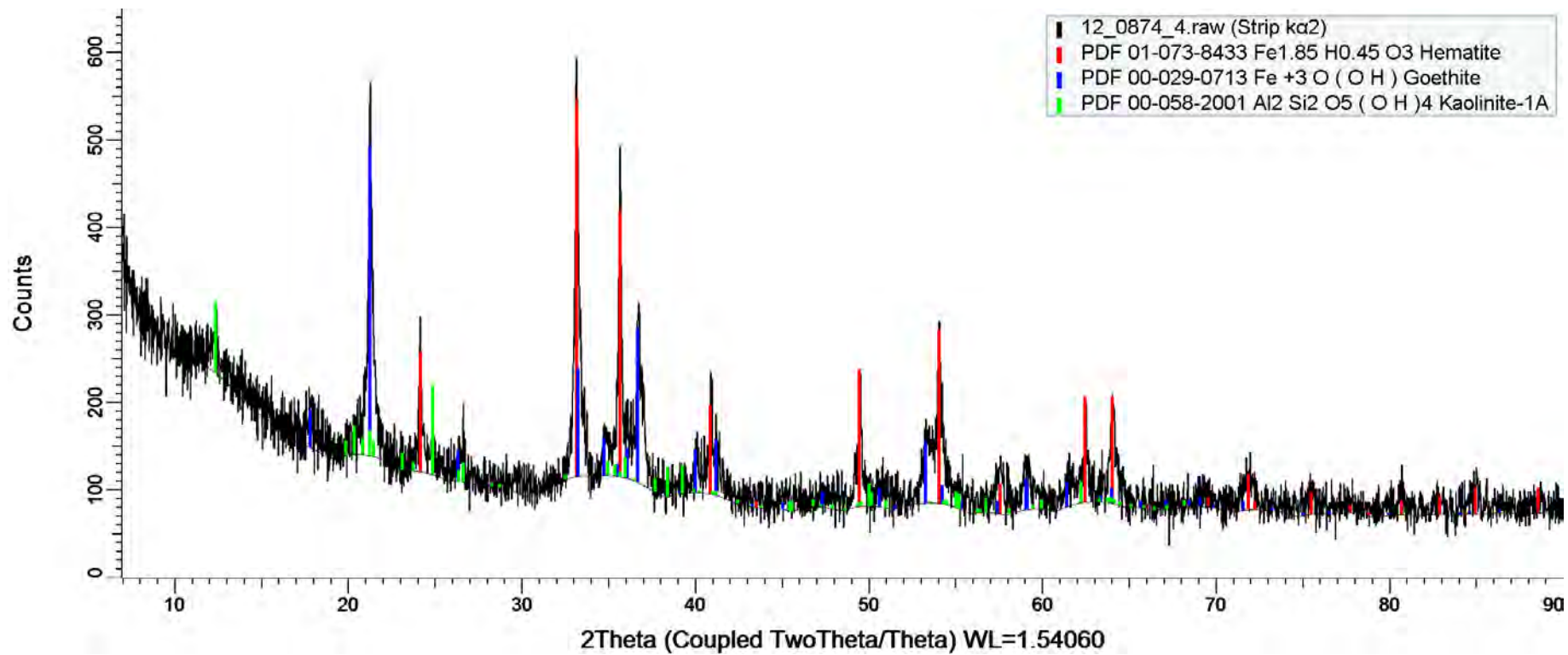
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	58.5	good
Hematite (Fe1.85 H0.45 O3)	24.7	good
Kaolinite-1A (Al2 Si2 O5 (O H)4)	16.8	medium

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_05
Client ID: PE069061B-014
Date: 29/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

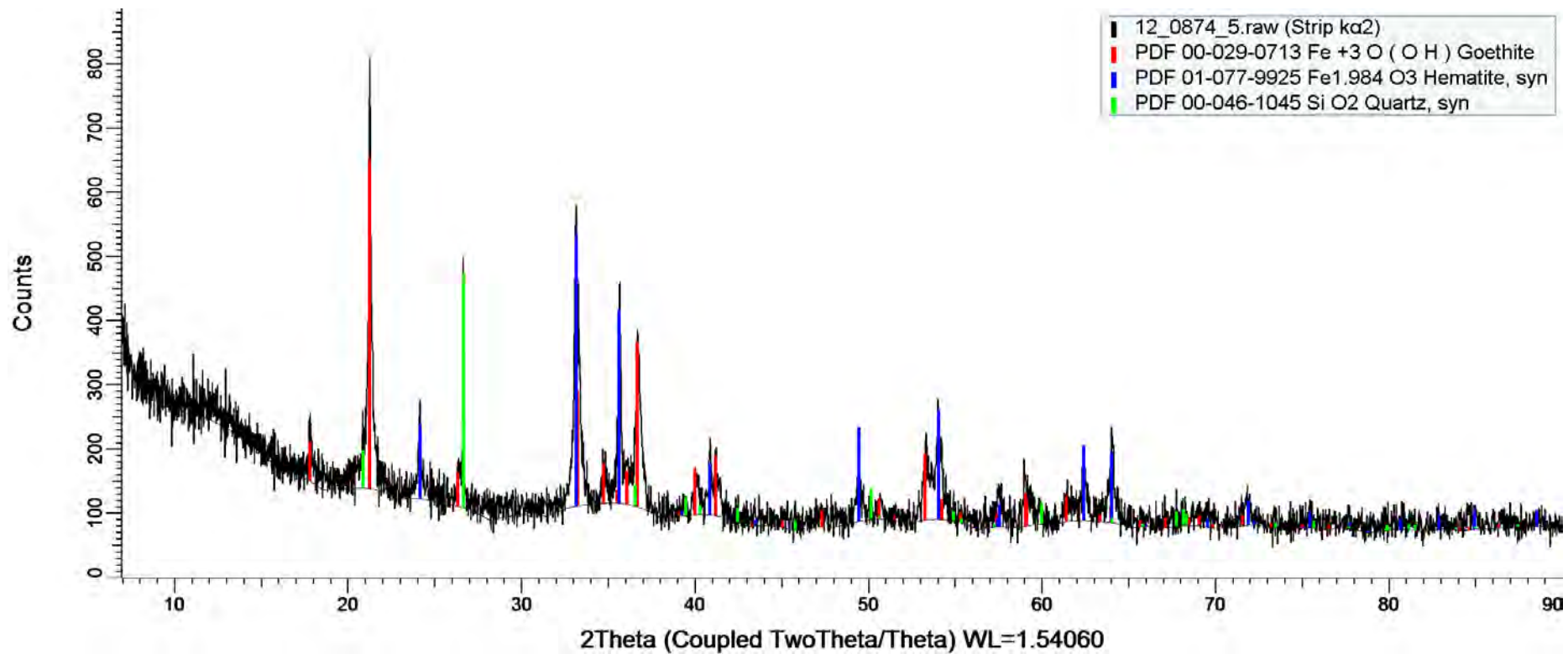
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	68.7	good
Hematite, syn (Fe1.984 O3)	17.0	good
Quartz, syn (Si O2)	14.3	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_06
Client ID: PE069061B-020
Date: 29/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

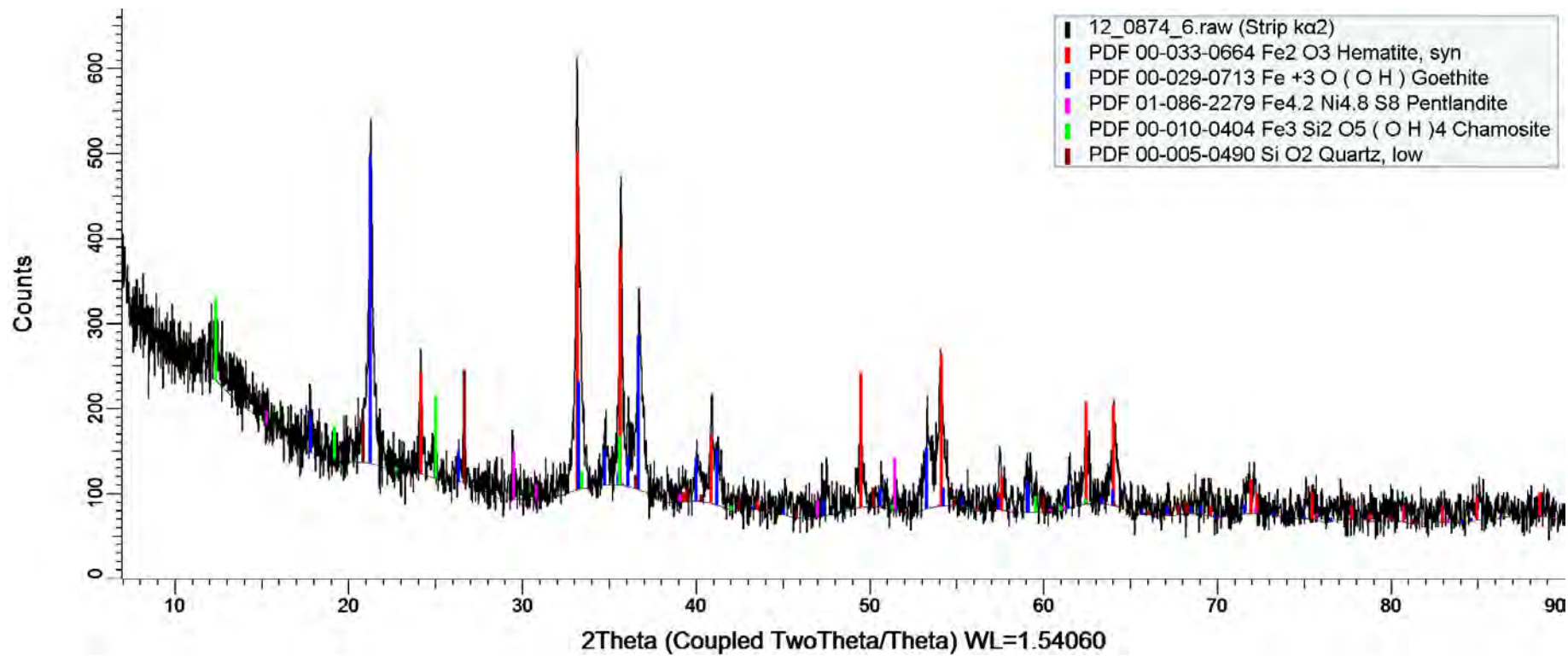
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	53.5	good
Hematite, syn (Fe2 O3)	24.5	good
Chamosite (Fe3 Si2 O5 (O H)4)	14.5	medium
Quartz, low (Si O2)	5.5	good
Pentlandite (Fe4.2 Ni4.8 S8)	2.1	medium

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_07
Client ID: PE069061B-024
Date: 29/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

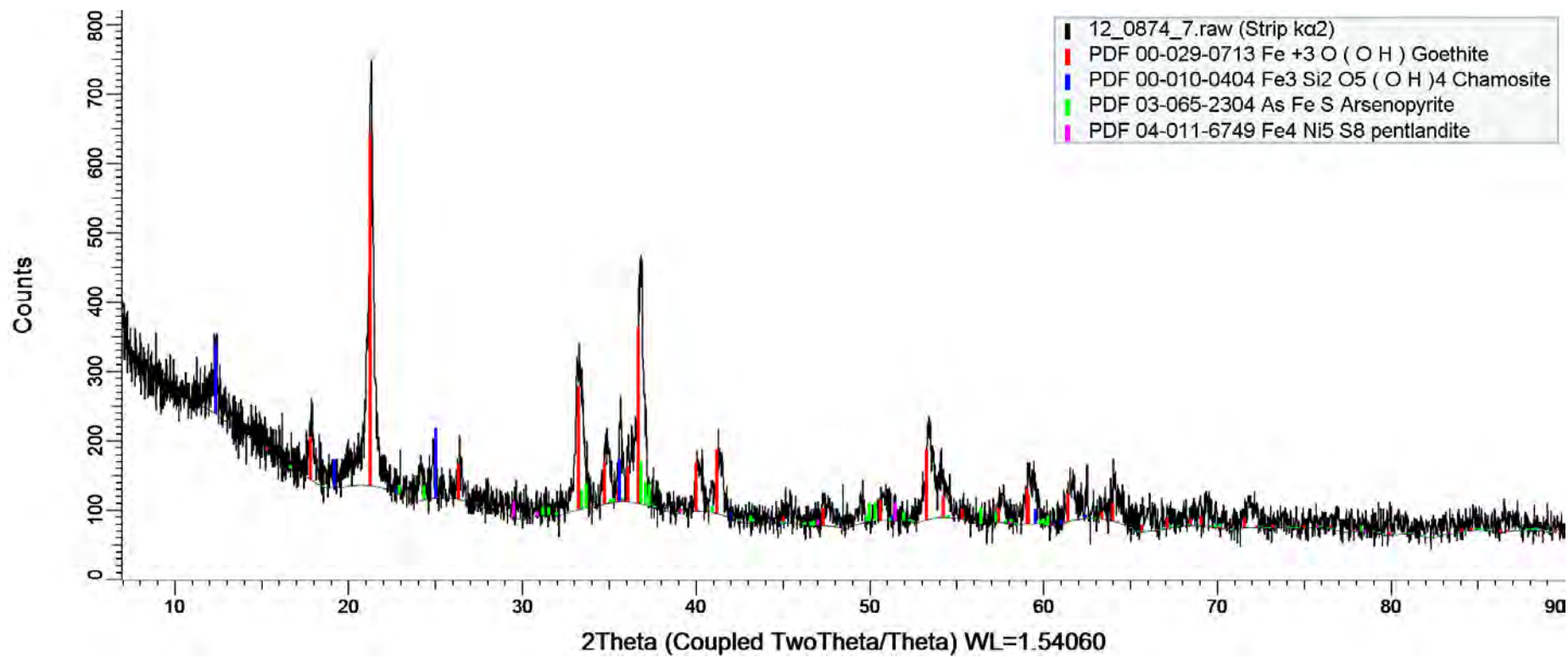
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	75.9	good
Chamosite (Fe3 Si2 O5 (O H)4)	15.2	good
Arsenopyrite (As Fe S)	8.1	medium
pentlandite (Fe4 Ni5 S8)	0.9	low

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_08
Client ID: PE069061B-025
Date: 29/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

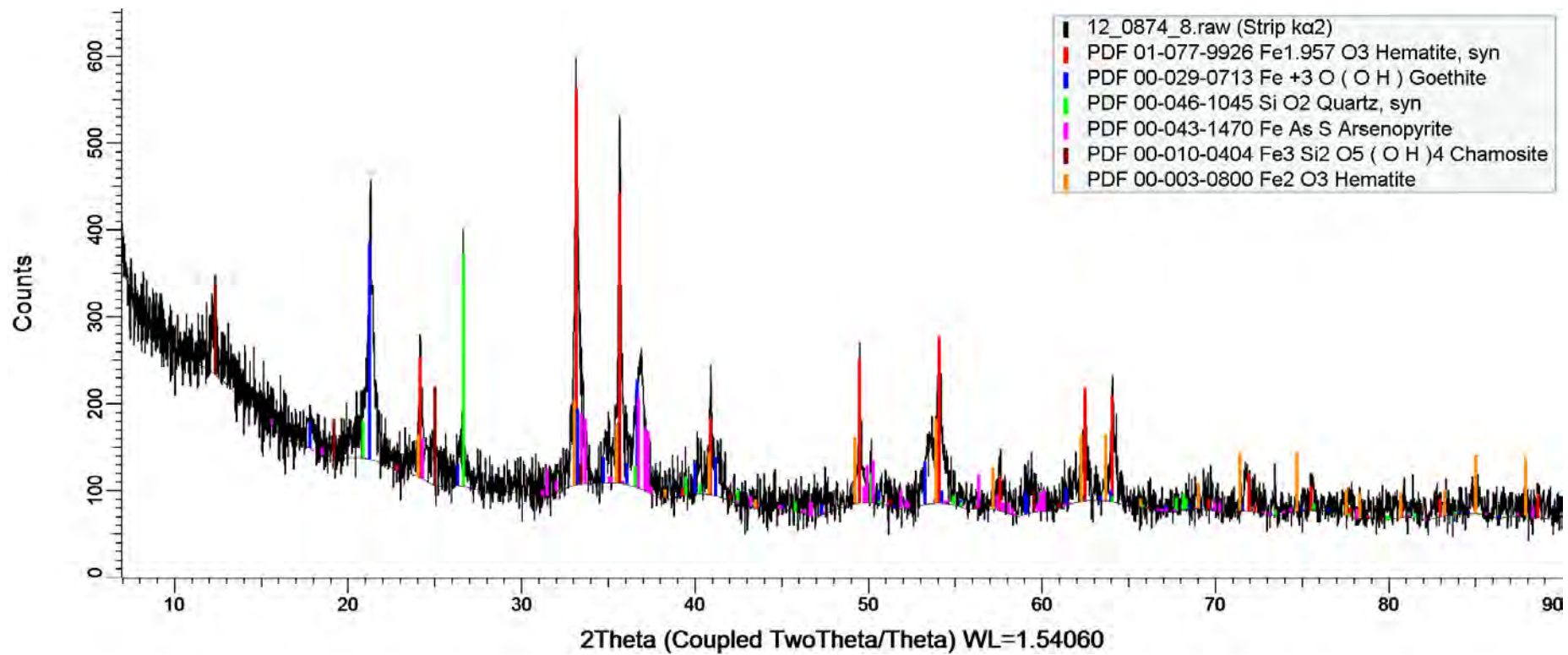
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	31.6	good
Hematite, syn (Fe1.957 O3)	18.3	good
Chamosite (Fe3 Si2 O5 (O H)4)	14.6	medium
Arsenopyrite (Fe As S)	13.2	low
Hematite (Fe2 O3)	12.3	good
Quartz, syn (Si O2)	10.0	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_09
Client ID: PE069061B-026
Date: 31/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

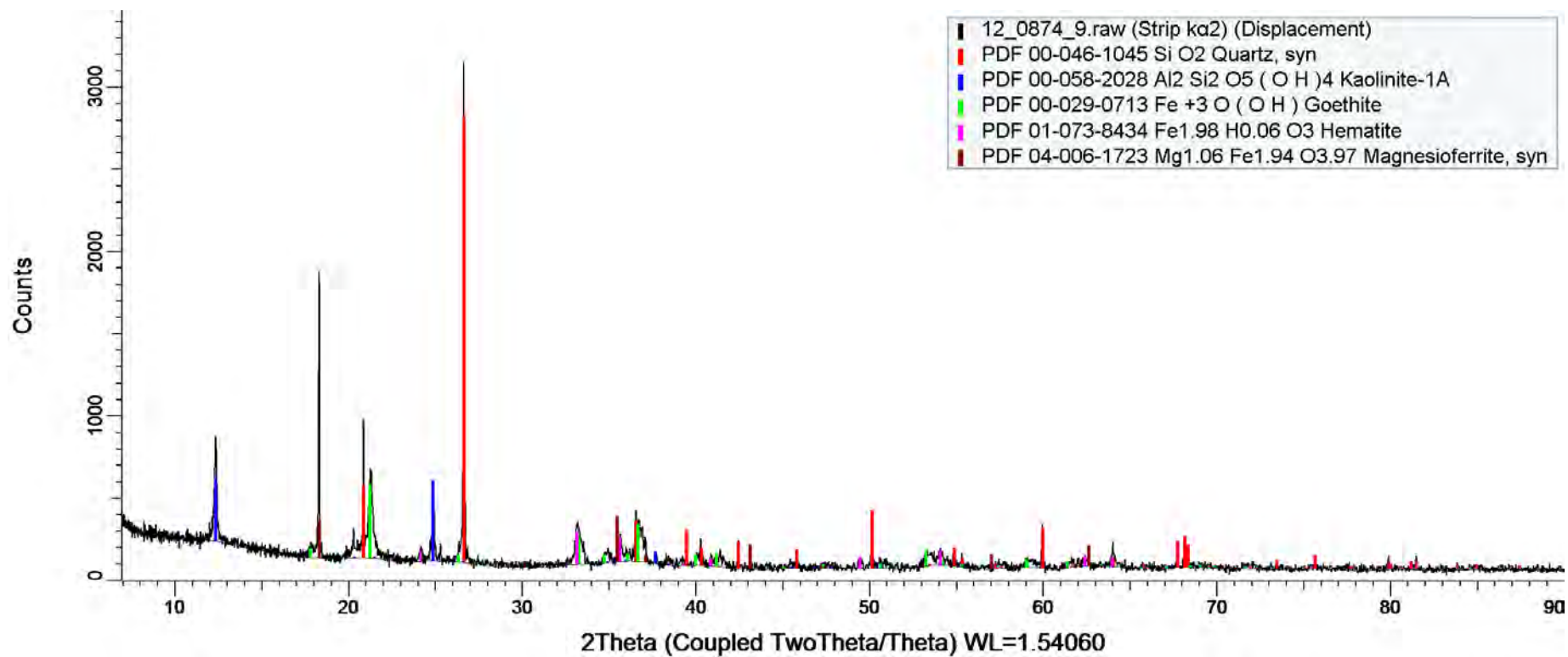
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Quartz, syn (Si O ₂)	42.4	good
Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	25.8	good
Goethite (Fe +3 O (O H))	24.0	good
Magnesioferrite, syn (Mg _{1.06} Fe _{1.94} O _{3.97})	4.5	low
Hematite (Fe _{1.98} H _{0.06} O ₃)	3.3	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_10
Client ID: PE069061B-030
Date: 30/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

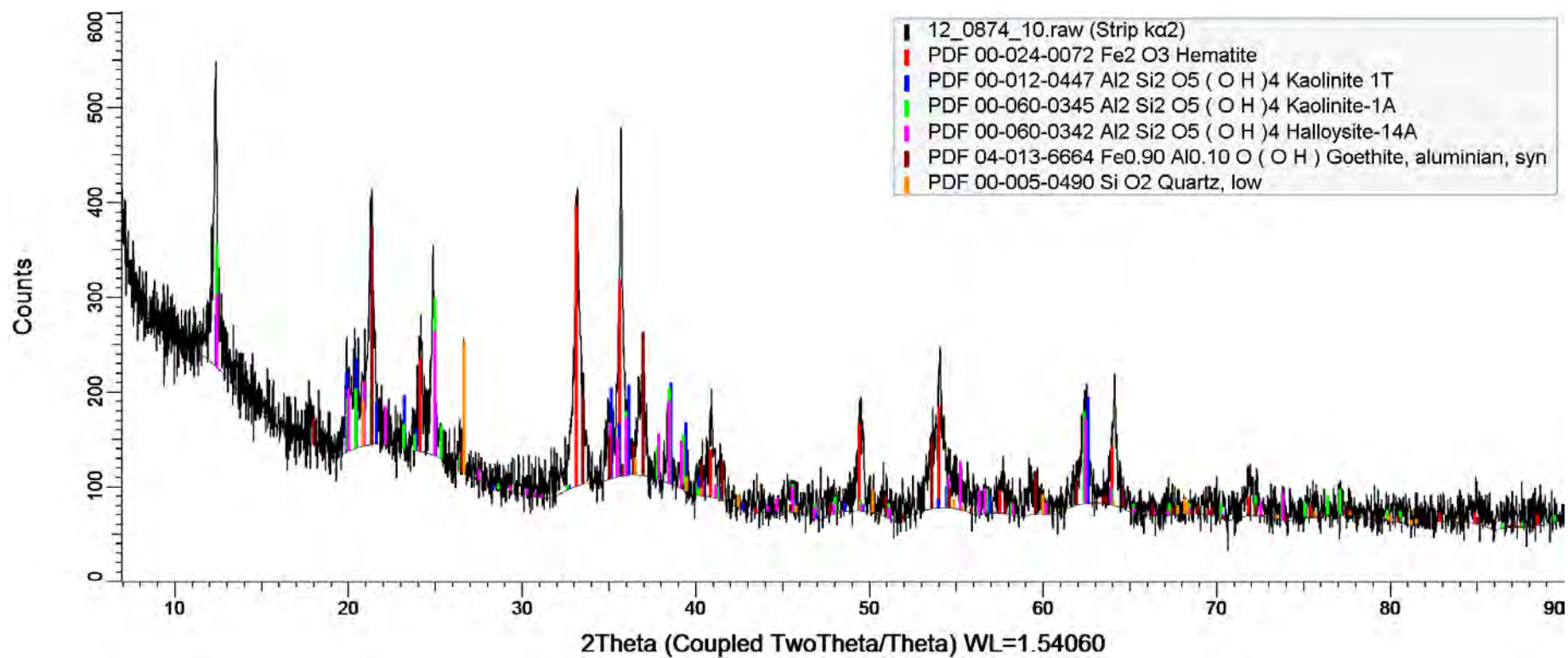
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Hematite (Fe ₂ O ₃)	35.5	good
Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	19.9	medium
Halloysite-14A (Al ₂ Si ₂ O ₅ (O H) ₄)	15.7	low
Kaolinite 1T (Al ₂ Si ₂ O ₅ (O H) ₄)	13.5	medium
Goethite, aluminian, syn (Fe _{0.90} Al _{0.10} O (O H))	10.8	medium
Quartz, low (Si O ₂)	4.6	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_11
Client ID: PE069061B-032
Date: 30/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

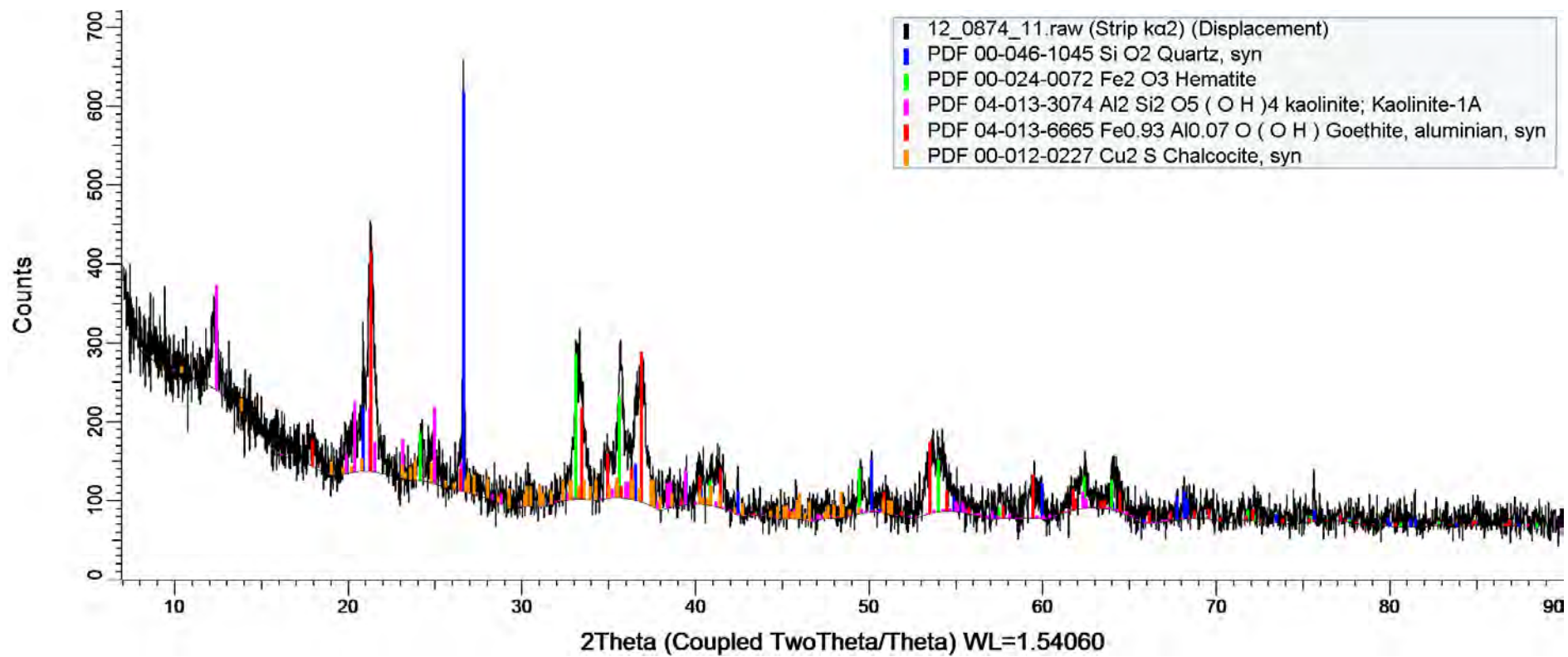
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Hematite (Fe ₂ O ₃)	29.2	good
kaolinite; Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	24.4	medium
Quartz, syn (Si O ₂)	23.6	good
Goethite, aluminian, syn (Fe _{0.93} Al _{0.07} O (O H))	17.5	medium
Chalcocite, syn (Cu ₂ S)	5.3	low

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_12
Client ID: PE069061B-034
Date: 30/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

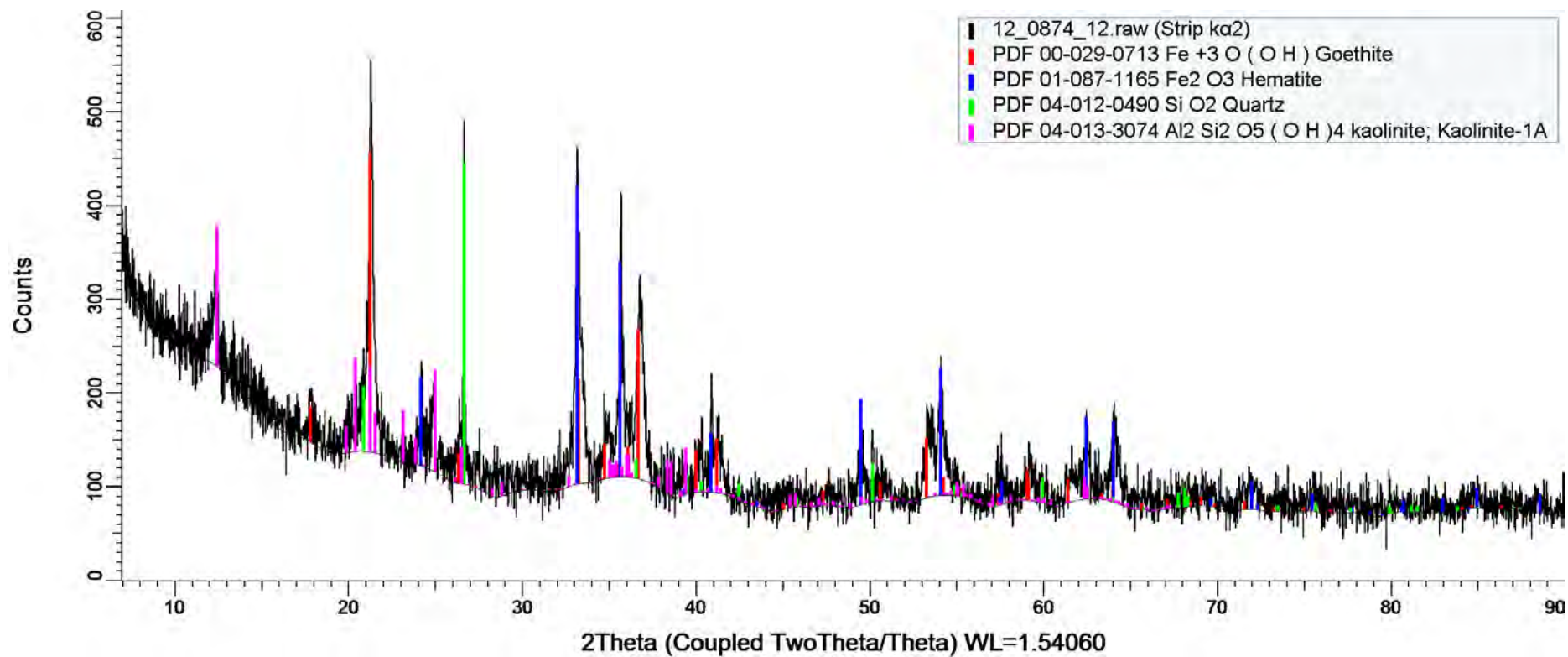
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	45.5	good
kaolinite; Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	24.5	good
Quartz (Si O ₂)	16.1	good
Hematite (Fe ₂ O ₃)	13.9	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_13
Client ID: PE069061B-035
Date: 30/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

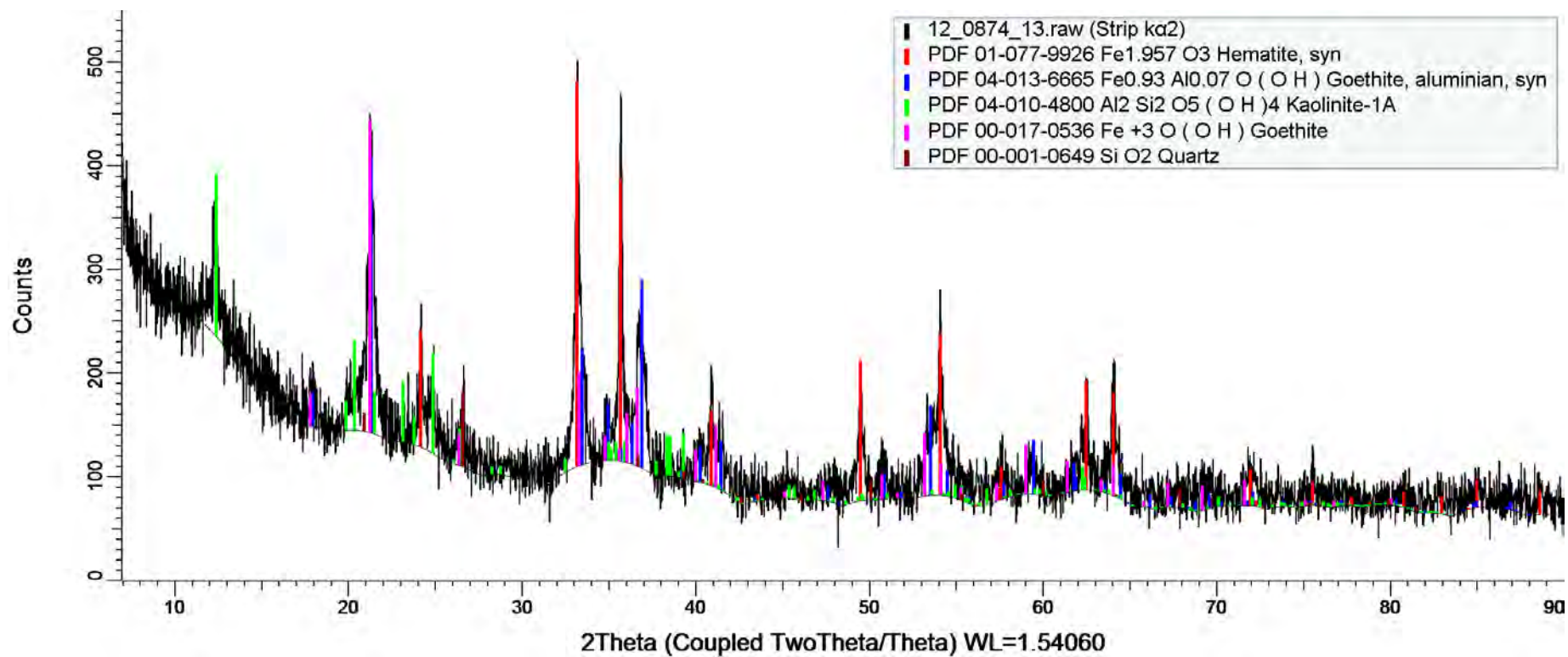
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Goethite (Fe +3 O (O H))	40.0	good
Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	21.1	good
Hematite, syn (Fe _{1.957} O ₃)	15.6	good
Goethite, aluminian, syn (Fe _{0.93} Al _{0.07} O (O H))	14.0	good
Quartz (Si O ₂)	9.4	good

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.



Client: SGS Australia
Job number: 12_0874
Sample: 12_0874_14
Client ID: PE069061B-036
Date: 30/08/12
Analysis: Semi-quantitative mineralogical analysis by x-ray diffraction (XRD)

Sample Preparation

The sample was supplied to Microanalysis Australia as a pulped sample in a paper bag. A representative sub – sample was removed and lightly ground such that 90% was passing 20 µm. Grinding to this size helps eliminate preferred orientation.

Analysis

Only crystalline material present in the sample will give peaks in the XRD scan. Amorphous (non crystalline) material will add to the background. The search match software used was Eva2.1. An up to date ICDD card set was used. The x-ray source was copper radiation.

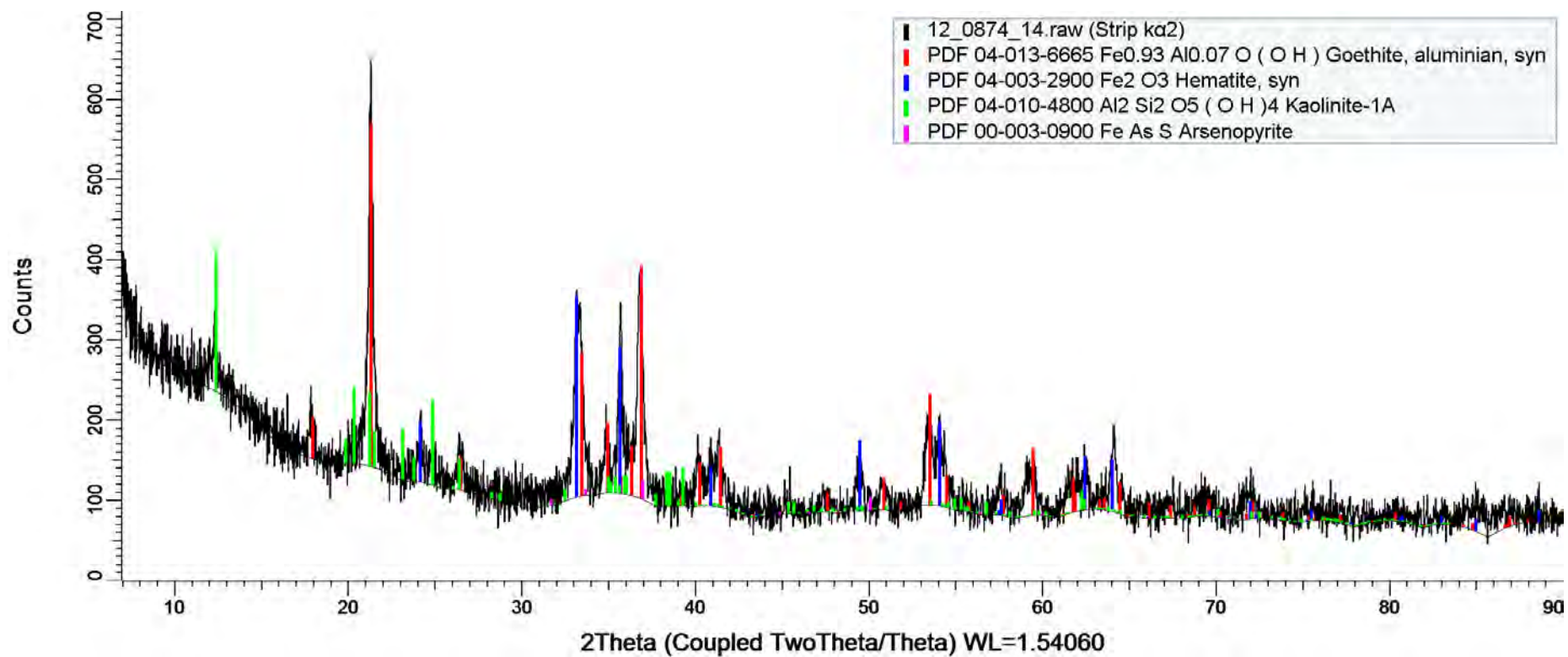
No standards were used in the quantification process. The concentrations were calculated using the peak area integration method where the area of the 100 % peak for each mineral phase is summed and the relative percentages of each phase calculated based on the relative contribution to the sum. This method allows for some attention to be paid to preferred orientation but is limited in considering substitution and lattice strain.

Summary

The phases are listed in order of interpreted concentration:

Mineral phase	Concentration (%w/w)	ICDD match probability
Kaolinite-1A (Al ₂ Si ₂ O ₅ (O H) ₄)	39.2	good
Goethite, aluminian, syn (Fe _{0.93} Al _{0.07} O (O H))	37.8	good
Hematite, syn (Fe ₂ O ₃)	17.5	good
Arsenopyrite (Fe As S)	5.5	medium

The ICDD match probability is reported as an indication as to how well the peak positions and relative intensities for the sample matched those in the published literature (www.icdd.org) for that particular compound.





APPENDIX E

Limitations



LIMITATIONS

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