THUNDERBIRD MINERAL SANDS PROJECT
MINE WASTE CHARACTERISATION

PREPARED FOR:

SHEFFIELD RESOURCES LIMITED

Sheffield Resources LIMITED

OCTOBER 2016

PREPARED BY:

Martinick Bosch Sell Pty Ltd
4 Cook Street
West Perth WA 6005
Ph: (08) 9226 3166
Fax: (08) 9226 3177
Email: info@mbsenvironmental.com.au
Web: www.mbsenvironmental.com.au

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Distribution List:

Company	Contact name	Copies	Date
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1. INTRODUCTION

1.1 PROJECT BACKGROUND

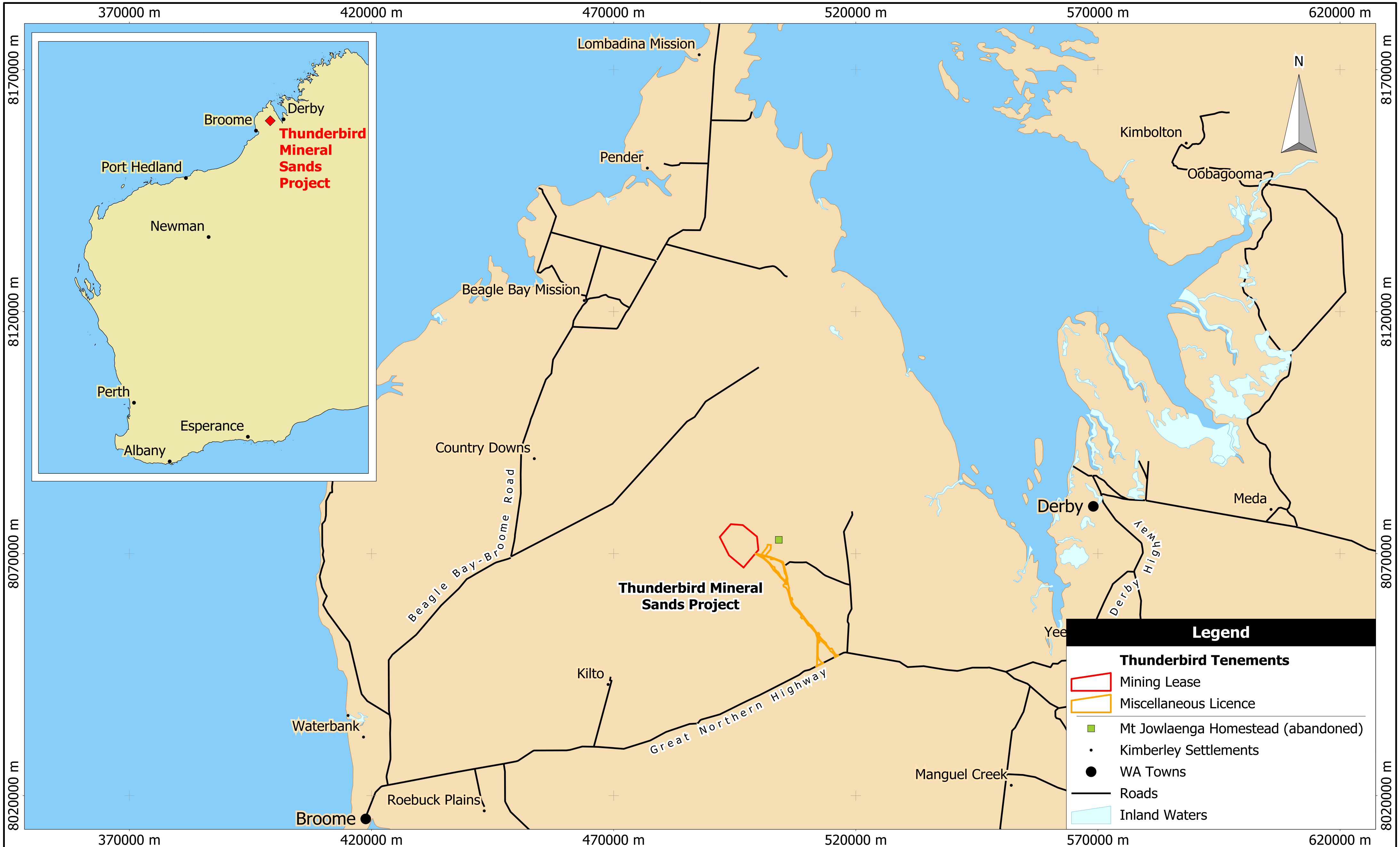
Sheffield Resources Limited (Sheffield Resources) is proposing to develop the Thunderbird Mineral Sands Project (the project), located on the Dampier Peninsula within the west Kimberley region of Western Australia (Figure 1). The project will involve the mining of heavy mineral sands to produce a number of products (ilmenite, zircon, and HiTi88 leucoxene) and subsequent export to overseas markets from Derby Port.

Sheffield Resources is investigating development options for the project and commissioned MBS Environmental (MBS) to undertake geochemical characterisation of mine and process waste streams likely to be generated. The outcomes of these studies will be used to support project planning and environmental impact assessment processes. This report details the methodology, processes and results of the assessment and provides recommendations for the management and storage of the project's mine wastes.

1.2 OBJECTIVE AND SCOPE OF WORK

The objective of the study was to determine the potential for acid and metalliferous drainage (AMD), neutral or saline drainage to occur from mined waste materials and if these materials are likely to pose a significant risk to the environment and suitability for rehabilitation of the site. The scope of work involved the following:

- Liaise with Sheffield Resources personnel to obtain representative mine waste samples from recent exploration and resource definition drilling programs.
- Liaise with relevant geochemical and environmental testing laboratories to ensure use of appropriate methods of testwork for mineral sand mine waste characterisation.
- Classify mine wastes based on their potential to generate AMD according to the established procedures published by the Federal Department of Industry, Tourism and Resources (DITR, 2007) and the International Network for Acid Prevention (INAP).
- Determine by analysis those metals and metalloids of environmental significance which are enriched in mine wastes relative to natural levels and the relative environmental significance of this enrichment.
- Determine by analysis of water and dilute acid leachates, the potential for seepage from mine waste and ore stockpiles to contaminate local surface and groundwater resources and identify general strategies for mitigation of risk as required.
- Assess the potential for any clay rich material to be dispersive and hence pose any possible physical instability and runoff contamination risks from constructed landforms with such materials.
- Preparation of a geochemical characterisation report with respect to the mine wastes predicted to be produced at the project, outlining to Sheffield Resources the predicted properties and any potential significant environmental risks to the environment posed by these materials.



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Thunderbird Mineral Sands Project

Figure 1

Project Location

4 Cook St
West Perth WA 6005
Ph: (08) 9226 3166
Fax: (08) 9226 3177
info@mbsenvironmental.com.au
www.mbsenvironmental.com.au

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W:\Sheffield Resources\PER\Drawings\PER Location Plan.map 15/06/2016 F1 Project Location Layout

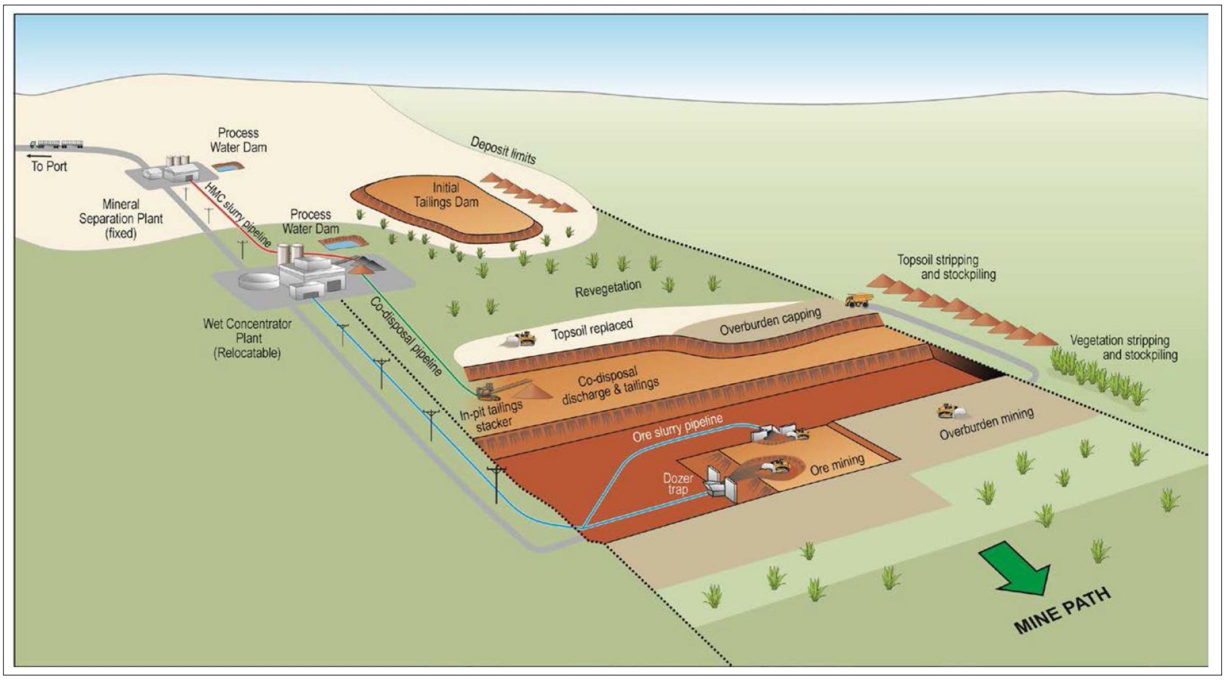
2. PROJECT DESCRIPTION

The project is located approximately 95 km northeast of Broome and 75 km west of Derby at the southeast edge of the Dampier Peninsula in Western Australia. It is located within Pastoral Lease H910623 (Mt Jowlaenga) held by Yeeda Pastoral Company Pty Ltd (used for cattle grazing). The project will be accessed via the Great Northern Highway and then via a proposed 30 km long site access road. The project includes:

- Progressive mining of heavy mineral sands over a 47 year period from the Thunderbird deposit. The initial rate of mining will allow for excavation of 7.5 Mtpa (nominal) to year 5 and then increasing to 15 Mtpa for the remainder of the project life with progressive backfilling and rehabilitation of mined pits.
- Onsite primary and secondary processing of ore to produce a range of saleable mineral products (ilmenite, zircon, and HiTi88 Leucoxene). Construction of processing facilities will be staged to match mining rates as above.
- Abstraction and injection of groundwater from the Broome Aquifer to allow mining and supply ore processing needs.
- Supporting infrastructure including an accommodation village, power generation, waste storage and disposal facilities, communications infrastructure and internal roadways.
- Upgrade and extension of the existing pastoral track (Mt Jowlaenga Road) from the Great Northern Highway to form a 30 km site access road.
- Transport of mineral products from the Mine Site via the Site Access Road and Great Northern Highway to Derby Port for storage prior to export via King Sound. As required packaged mineral product from Broome Port to international customers.

The project will comprise mining of heavy mineral sands from the Thunderbird deposit over a 47 year mine life, processing onsite and transportation of final concentrates (ilmenite, zircon, and HiTi88 leucoxene) by road to Derby Port for storage and subsequent export to overseas markets. Sheffield Resources proposes to extract mineral products using conventional mineral sand mining techniques. Mining will be undertaken progressively, with approximately 200 ha of the proposed 1,510 ha pit disturbance open at any one time. Mined areas will undergo progressive backfilling and rehabilitation. A summary of the proposed mining, ore processing and export operations is detailed below and shown in Figure 2.

Figure 2: Proposed Mining Schematic for Thunderbird



2.1 MINING

Sheffield Resources proposes to use standard mineral sands mining with progressive backfilling and rehabilitation. The large, relatively thick and sheet-like characteristics of the host sand unit allow for bulk mining techniques employing heavy earthmoving equipment to achieve the proposed processing rate of 7.5 Mtpa (years 1 – 5) and 15 Mtpa (year 5 onwards). Mining will commence in the northern section of the pit area and will progressively expand southwards.

The top of mineralisation starts at the surface in the northernmost section of the pit and dips towards the south. The overburden is weakly mineralised and includes intermittent zones of induration (minor ferricrete and calcrete areas) relating to a lateritic weathering profile of older Cretaceous sediments. These are thin enough to enable free digging with standard heavy earthmoving equipment, although some dozer ripping may be required with the more competent overburden. The majority of overburden will be removed using scrapers and/or excavators and dump trucks and immediately returned to mined sections of the pit. Approximately 34% of the Thunderbird ore deposit occurs above the water table, 37% in the transitional zone, and 29% below.

Dozers will be used to push ore into dozer traps where the sand will be screened of coarse oversize material and the remaining undersize material slurried and pumped for further scrubbing and screening prior to wet concentration and processing.

3. ENVIRONMENTAL SETTING

3.1 CLIMATE

The project is located on the Dampier Peninsula within the west Kimberley region of Western Australia. Most rainfall occurs during the wet season between November and April. Areal potential evapotranspiration is very high, averaging 1,980 mm per year and varies moderately across seasons. It generally remains higher than average rainfall even in the wet season, resulting in water limited conditions for vegetation (CSIRO 2009).

Weather data has been collected from an automatic weather station at the project site since November 2014. Maximum and minimum temperatures and mean relative humidity are shown in Chart 1. Maximum temperatures are generally between 35 and 45°C. Minimum temperature rarely drops below 15°C. Average relative humidity is around 40% in the dry season and approaches 80% in the wet season. Days with maximum relative humidity over 90% were observed in all months.

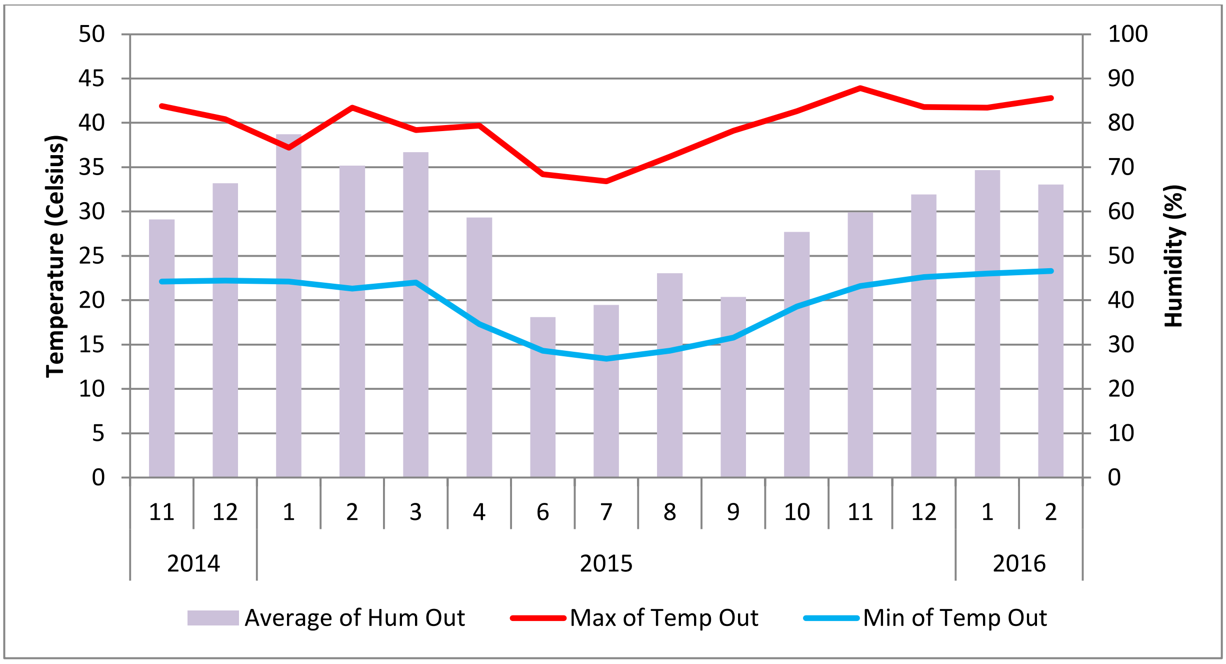


Chart 1: Temperature and Humidity at Thunderbird

Spatially extrapolated rainfall data is available for the project location from the SILO Data Drill data set. This data is calculated by extrapolation from all available BoM data including the closest BoM sites (Thunderbird, Mount Jowlaenga, Country Downs, Beagle Bay, Yeeda and Derby Aero) to give a continuous estimated record for a specific location. Comparison with local stations shows that, the Data Drill closely matches Mount Jowlaenga rainfall records when they were available, and is similar to Country Downs and other nearby stations at other times.

Monthly rainfall statistics for the Thunderbird project area based on the Data Drill dataset from 1889 to 2015 are shown in Table 1 and Chart 2. The annual figures presented are based on a rainfall year from September to August. Mean annual rainfall is 694 mm. Rainfall is very variable with the lowest annual rainfall of 153 mm and maximum of 1,503 mm. Median annual rainfall is 675 mm. Median monthly rainfall is 1.2 mm or less during the dry season from May to October. Zero or very low rainfall may occur in any month.

Table 1: Rainfall Statistics (mm) for Thunderbird Project Site 1889 to 2015 (Data Drill)

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Annual
Mean	1.0	3.9	17.8	92.4	193.1	181.0	128.9	29.9	23.4	14.9	6.5	3.5	695.3
Highest	48.5	53.9	229.1	668.5	1031.8	556.9	535.1	261.7	308.4	159.4	157.6	56.1	1502.7
90th percentile	1.1	12.0	44.3	181.4	365.3	334.9	288.1	73.5	80.6	53.7	19.8	5.9	1003.6
Median	0.0	0.3	8.4	66.1	156.6	164.7	96.7	12.4	0.9	0.3	0.0	1.2	675.2
10th percentile	0.0	0.0	0.3	10.8	54.7	47.0	26.0	0.0	0.0	0.0	0.0	0.7	401.2
Lowest	0.0	0.0	0.0	1.1	21.0	12.7	1.8	0.0	0.0	0.0	0.0	0.5	152.6

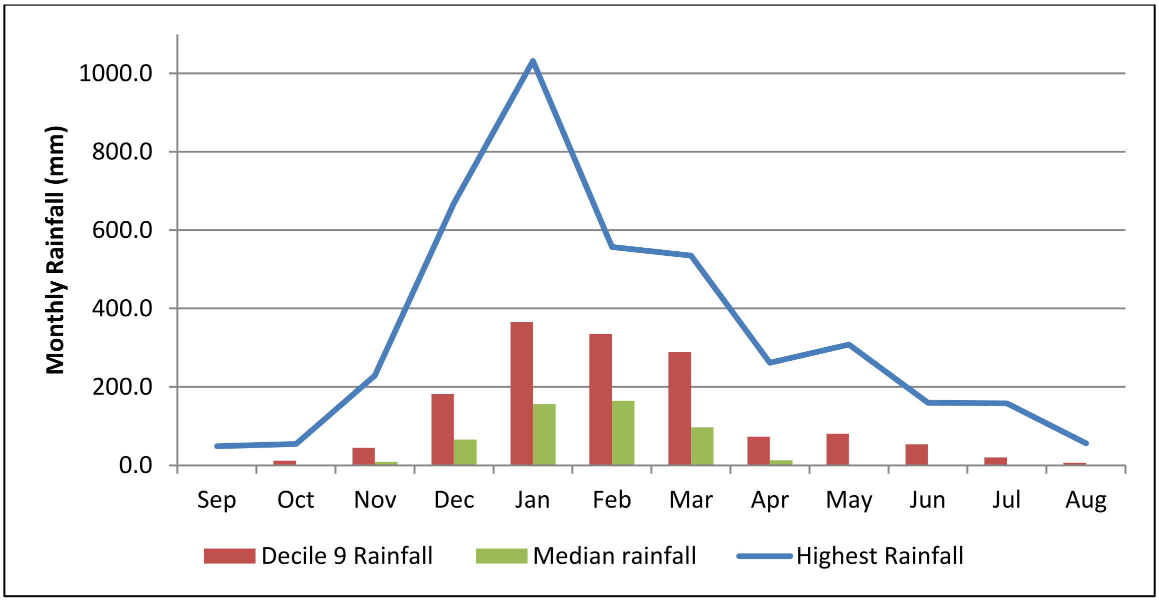


Chart 2: Monthly Rainfall Statistics for Thunderbird

3.2 GEOLOGY

3.2.1 Regional Geology

The project is located in the west Kimberley region of Western Australia within the Phanerozoic Canning Basin, an intracratonic basin covering 640,000 km^2 with a dominant onshore area of 530,000 km^2. The Canning Basin contains a sequence of folded and faulted sediments approximately 18 km thick.

The Canning Basin is subdivided into a number of north-westerly trending tectonic elements identified predominantly from seismic and other geophysical data. Structural element boundaries, typically fault zones, were active at various times during deposition. The structural elements include two elongate series of major depocentres, separated by mid-basinal platforms and flanking shelves or terraces. The northern depocentres comprise the Fitzroy Trough (northwest) and Gregory sub-basin (southeast), which are separated by the Jones Arch. These depocentres contain about 15 km of strata, the thickest being of Devonian to Permian age. Pre-Devonian strata are assumed at depth, but have not been reached by drilling.

Stratigraphic units present within or adjacent to the project comprise sand units of the Upper Jurassic to the Lower Cretaceous, including the Jarlemai Siltstone, the Broome Sandstone and the Melligo Sandstone (Table 2). These formations dip at a shallow angle of less than 5° to the southwest.

Table 2: Stratigraphic Units

Unit Name	Description
Jarlemai Siltstone	• Dated as Upper Jurassic but may extend up to the Early Cretaceous (Crowe et al. 1978). • Deposited at the height of the Jurassic-Cretaceous marine transgression in the Canning Basin. • Lithology varies from siltstone to claystone and sandstone and is glauconitic to ferruginous in part (Towner and Gibson 1983).
Broome Sandstone	• Originally defined to cover sandstone cropping out along the west coast of the Dampier Peninsula near Broome and overlying the Jarlemai Siltstone (Brunnschweiler 1957). • Contains a wide variety of sandstone lithologies and sedimentary structures, consistent with deposition in a shallow-marine (tidal) environment as the Early Cretaceous sea regressed (Towner and Gibson 1980). • Lithology varies from a fine to very coarse sandstone to a mudstone with e minor conglomerate. • Sedimentary features such as ripple-marks, cross-bedding and bioturbation can be observed. • The topmost part contains well rounded heavy minerals (Towner and Gibson 1983).
Melligo Sandstone	• Conformably to disconformably overlies the Broome Sandstone. • High silicified unit but unsilicified Melligo Sandstone has been recognised in the Mount Jowlaenga area on the basis of sedimentary structures and fabric (Brunnschweiler 1957, McWhae et al. 1958, Towner and Gibson 1980). • Good sorting and rounding of the constituent grains, which include heavy minerals, coupled with thin bedding, flat to low-angle cross bedding and parting lineation indicate that it is a beach deposit, laid down as the sea in which the Broome Sandstone was deposited regressed. • Lithology of the Melligo Sandstone is fine to medium, well-sorted, thin-bedded to laminated sandstone that is pebbly in places. • Contains heavy minerals (Towner and Gibson 1983). • Considered by Sheffield Resources geologists to be an equivalent unit to the Broome Sandstone and therefore the primary target lithology for heavy mineral concentrations.

3.2.2 Project Geology

The Thunderbird deposit is a heavy mineral sands deposit containing valuable heavy minerals ilmenite, zircon, leucoxene and rutile. The Thunderbird deposit is hosted by deeply weathered Cretaceous-aged formations. Mineralisation is in a thick, broad anticlinal sheet-like body striking northwest. The areal extent, width, grade, geological continuity and grain size of the Thunderbird deposit are interpreted to indicate an off-shore sub-wave base depositional environment.

Five stratigraphic units have been defined by Sheffield Resources geologists via a combination of surface mapping and drillhole lithological logs. These are locally referred to as the Fraser Beds, Reeves, Melligo, Thunderbird and Jowlaenga Formations. Of these, the Thunderbird Formation is the main mineralised unit with the Fraser Beds acting as a distinct marker unit toward the base of the Thunderbird Formation.

The Thunderbird Formation is a medium to dark brown/orange, fine to very fine sand unit. The Formation has a thickness of up to 90 m (average of 38 m) and is very rich in heavy minerals (up to 40%). The Formation has been modelled to be at least 8.5 km along strike and more than 2.5 to 5.5 km wide. The following features are present within the Formation:

- Layers of siliceous and iron cemented sandstone. The layers are interpreted to have been formed by post-deposition chemical processes of ferruginisation from ancient water table movements with iron oxides leached from the sand (e.g. from ilmenite). These cemented mineralised layers occur throughout the formation in a patchy nature, with extents rarely continuous between holes at 60 and 250 m spacing. This cemented mineralised sandstone is estimated to comprise no more than 10% of the deposit.
- Continuous, very high grade heavy mineral (greater than 7.5%) zone named the GT Zone. The GT Zone is up to 29 m thick (average 15 m) over an area of at least 7 km by 3.5 km, striking approximately north-south, open along strike and following the dip of the Thunderbird Formation. The high grade of heavy minerals in the GT Zone is interpreted to result from deposition in off-shore higher wave energy shoals.

Mined material will consist of removing overburden material and extracting the mineralised sand unit (GT Zone) of the Thunderbird Formation.

3.3 LANDFORM AND SOILS

Project landforms and soils were the subject of a separate baseline report (MBS Environmental 2016b) which has additional information and mapping relevant to the project area.

The project is located within four land systems (Payne and Schoknecht 2011):

- The Fraser land system - characterised by sandplains and dunes. Relief less than nine metres.
- The Reeves land system - characterised by sandplains, scattered hills and minor plateaus. Relief to 60 metres.
- The Waganut land system - characterised by low-lying sandplains and dunefields with through-going drainage. Relief less than nine metres.
- The Yeeda land system - characterised by sandplains and occasional dunes with little organised drainage.

The four main soil types (Bettenay et al. 1967) within the land systems described above and located within the project area are as follows:

- Red earthy sands with associated hummocks of siliceous sands.
- Red earthy sands associated with soils on the plains, with dunes and hummocks of red sands. Some soils in lower sites often have a heavy surface layer of ferruginous gravel.
- Neutral red earths and sandy neutral red soils on plains with minor sandstone residuals on which there is extensive rocky outcrops.
- Neutral red earths and red earthy sands within sand plains with irregular dunes/active drainage systems.

3.4 SURFACE WATER DRAINAGE AND QUALITY

The project lies within the upper catchments of Fraser River (including Fraser River South) and Logue River (including Little Logue River). While the Fraser River enters King Sound from the west, the Logue River discharges to King Sound at Jarrananga Plain, immediately adjacent to the Fitzroy River. The Fitzroy River Basin is a much larger river basin extending approximately 500 km inland and representing the primary surface water inflow to King Sound.

Other than pastoral dams, there are no permanent water bodies at or near the project. A small depression is located approximately 3 km southeast of the Thunderbird deposit and a number of small drainage lines exist within the development envelope. However, these features contain water only during the wet season. No surface water quality monitoring data is available for the mine site development envelope or elsewhere on the Dampier Peninsula. Given the lack of industry and other sources of potential contamination, surface runoff is expected to be of good quality, suitable for livestock and agricultural use.

3.5 REGIONAL HYDROGEOLOGY AND WATER QUALITY

Five distinctive hydrogeological units have been identified within the project area:

- Superficial sediments 'Pindan'.
- Broome upper aquifer.
- Heavy mineral sands (HMS) ore zone.
- Broome lower aquifer.
- Jarlemai Siltstone.

Ground level elevations within the mining area range from 89 m AHD in the south to 119 m AHD in the north, while the water table ranges from 66 m AHD in the south to 75 m AHD in the north (Rockwater 2016). The resulting depth to water is between 44 m BGL on elevated ground and 23 m BGL in local areas adjacent to drainage lines. The hydraulic gradient in the project region is approximately 1.6 m per km and decreases in the southwest to about 0.7 m per km. The steeper groundwater gradient near the project area is the result of lower permeability material where the ore occurs and at the base of the Broome aquifer.

A numerical groundwater model has been used to estimate the volume of dewatering required to ensure suitable working conditions in the base of the pits. The conceptual mining schedule and pit shell definition (developed from the resource block model) were used in groundwater modelling assessments (Rockwater 2016).

The water supply borefield will provide about 10.7 GL/yr for the first 15 years (12.2 GL/yr in Year 1) of mining. Mine dewatering will be required after Year 15. Dewatering volumes are predicted to increase gradually over the next 17 years as mining depths increase. Pumping from the water supply borefield will be scaled back as mine dewatering takes on an increasing role in supply the ore processing facilities' requirements. From mining Year 32 to mining Year 47, excess mine water will be injected into the Broome aquifer at a rate of up to 7 GL/yr initially and up to 22 GL/yr during the last four years of mining.

Groundwater salinity in the Broome aquifer ranges from less than 100 to more than 30 000 mg/L TDS (GSWA 1991). It is generally low in elevated landscapes, including the project area, with saline groundwater only recorded towards discharge areas along the coast and Roebuck Plains above the saltwater wedge. Groundwater in the Broome aquifer is essentially a sodium chloride type, with occasional high levels of bicarbonate.

An intermittent soak is situated about 3 km to the southeast of the mine. This feature exhibits groundwater levels in the Broome aquifer of about 20 m below land surface and is therefore unlikely to be connected to the regional Broome aquifer and is more likely related to local perched water (Rockwater 2016).

4. DESCRIPTION OF SAMPLES

A total of 57 mine waste samples were selected from 16 drill holes for geochemical characterisation. The samples comprised overburden and Thunderbird Formation sands. Table 3 summarises the sample type/resource position and location relative to the natural groundwater table of the superficial aquifer for each sample. The 16 drill hole locations are shown in Figure 3. Full details of all samples assessed are provided in Table A1-1 of Appendix 1.

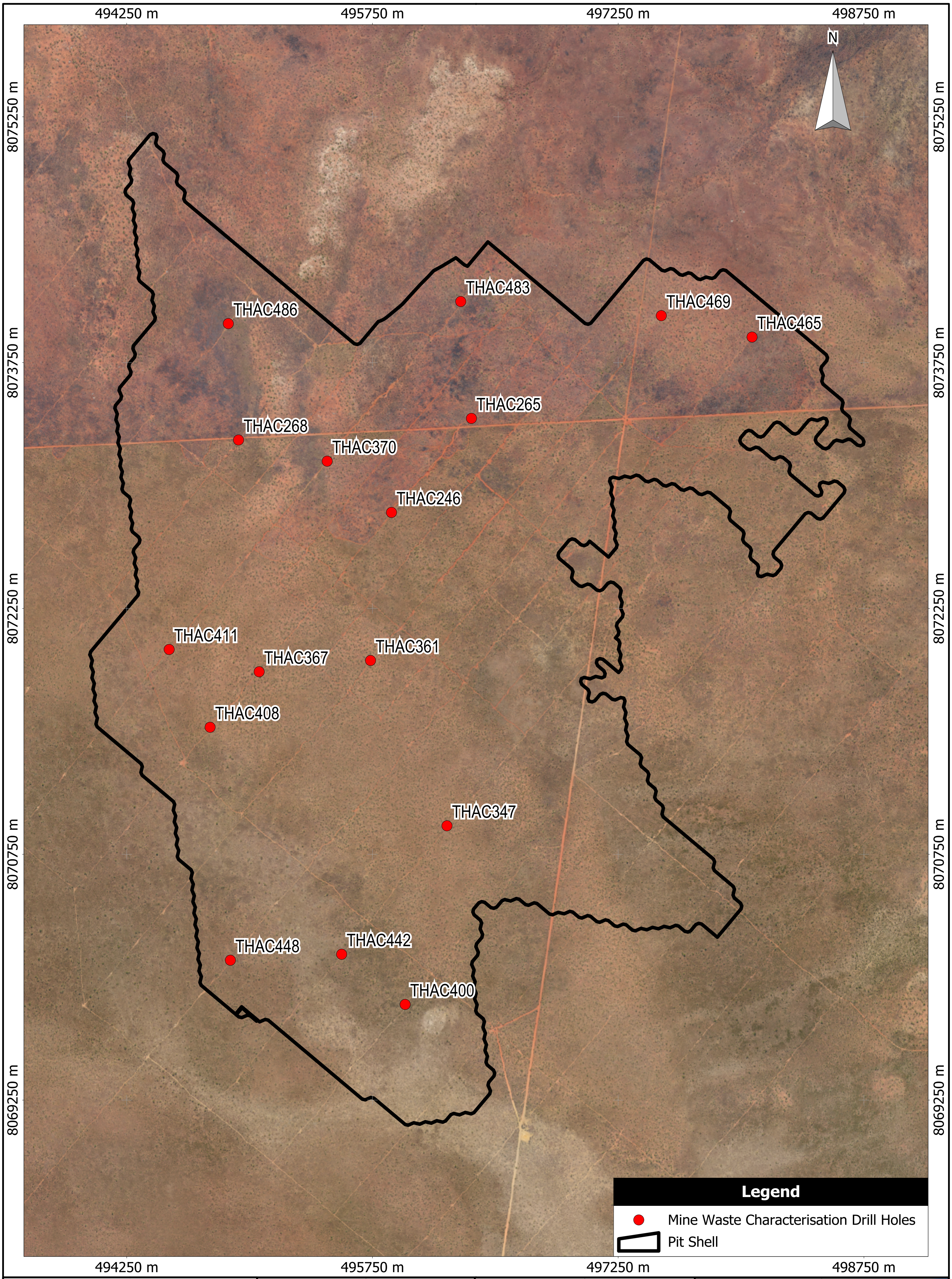
Table 3: Summary of Sheffield Mine Waste Samples

Sample Type/Resource Position	Position Relative to Groundwater Table	# Samples
Overburden	More than 5 m above	7
Overburden	Within 5 m of water table	6
Mineralised Waste Above Orebody	More than 5 m above	4
Mineralised Waste Above Orebody	Within 5 m of water table	9
Mineralised Waste Above Orebody	More than 5 m below water table	2
Orebody	More than 5 m above	4
Orebody	Within 5 m of water table	5
Orebody	More than 5 m below water table	3
Mineralised Waste Below Orebody	More than 5 m above	5
Mineralised Waste Below Orebody	Within 5 m of water table	5
Mineralised Waste Below Orebody	More than 5 m below water table	4
Basement	More than 5 m below water table	3
Total		**57**

Sample selection for geochemical characterisation was chosen on the basis of the following:

- The 16 drill hole locations were chosen to provide a representative spread across the defined resource and proposed mining area for the full life of mine. The distribution of drill hole locations is shown in Figure 3.
- Samples other than overburden and basement represented the same fine sand lithology and sample classification was instead made by resource position (overburden, mineralised waste above the orebody, orebody material, mineralised waste below the orebody and basement material below the limit of excavation). The number of samples from each sample type was designed to be consistent with its relative contribution to the currently defined resource model.
- Potential presence of sulfides at or below the water table with consideration for sampling above, at and below the natural water table. More intensive sampling was conducted within five metres of the water table on this basis.
- Sampling was to a depth below the proposed maximum depth of the pit.

Of the 57 samples, 13 comprised overburden, 15 comprised mineralised waste above the orebody, 12 comprised orebody sands, 14 comprised mineralised waste sands below the orebody and three comprised basement regolith. These samples were selected by Sheffield Resources project geologists following discussion with MBS geochemists. All samples represented either 1.5 or 3 m depth intervals as indicated in Table A1-1 of Appendix 1.



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Air Photo Date: October 2015
Grid: Australia MGA94 (51)
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Thunderbird Mineral Sands Project

Figure 3

Location of Drill Holes Used for Mine Waste Assessment

Martinick Bosch Sell Pty Ltd
4 Cook St
West Perth WA 6005
Ph: (08) 9226 3166
Fax: (08) 9226 3177
info@mbsenvironmental.com.au
www.mbsenvironmental.com.au

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5. GEOCHEMICAL CHARACTERISATION METHODS

5.1 ACID BASE ACCOUNTING CLASSIFICATION BACKGROUND

The aim of quantitative laboratory testing for acid base accounting (ABA) is to estimate the net potential for acid formation if the waste material is disturbed and any oxidisable sulfur species (sulfides) present allowed to oxidise by exposure to atmospheric oxygen to generate sulfuric acid. Pyrite (FeS_2) forms naturally under reduced oxygen (anaerobic) conditions in soils and sediment from biological reduction of sulfate to sulfide by sulfate reducing bacteria (SRB). Anaerobic conditions for the generation of pyrite in acid sulfate soils (ASS) occur in areas of waterlogging and organic rich soils and sediments such as swamps and wetlands. Pyrite and other potentially acid forming sulfides can also be present as primary minerals in rocks formed by volcanic activity and typically associated with hard rock mining. When exposed by physical disturbance or a lowering of the water table, pyrite reacts with oxygen and water to produce acidity (H^+) according to the chemical equation:

$$4FeS_2 + 15O_2 + 14H_2O \rightarrow 4Fe(OH)_3 + 16H^+ + 8SO_4^{2-}$$

Oxidation of one mole of pyrite will produce two moles of sulfuric acid or alternatively, 30.6 kg of sulfuric acid will be produced by oxidation of one tonne of ASS containing 1% by weight sulfur. This potential acidity will be in addition to any existing acidity already present, but can also be counteracted by any acid neutralising capacity (ANC) present.

There is no simple method to define whether mine waste containing small quantities of sulfides will produce sulfuric acid. For AMD, a combination of approaches is often applied to more accurately classify mine waste. These approaches are listed below in order of increasing data requirements (and therefore increased reliability):

- The "Analysis Concept", which only requires data for total sulfur content. Its adoption is based on long term experience of wastes from Western Australian mine sites in arid and semi-arid conditions. Experience has shown that hard rock waste containing low sulfur contents (less than 0.2 to 0.3%), rarely produces significant amounts of acidic seepage. In the case of potential ASS material however, a more suitable conservative screening criteria for total sulfur is 0.05% (DMP - Department of Mines and Petroleum 2016). ASS methods are a modified form of acid base accounting as used in AMD procedures for hard rock mine waste, but are tailored specifically for soils where the concentrations of sulfides are normally lower, significant levels of organic materials are often present, ANC is often low and other forms of acidity (collectively called retained acidity) are more common.
- The "Ratio Concept", which compares the relative proportions of acid neutralising minerals (measured by the ANC) to acid generating minerals (measured by the Acid Production Potential (AP)). The risk of generating acidic seepage is generally low when this ratio (the Neutralisation Potential Ratio – NPR) is above a value of two.
- Acid-Base Accounting, in which the calculated value for Nett Acid Producing Potential (NAPP) is used to classify the acid generating potential of mine waste. NAPP is equal to the AP minus the ANC.
- Procedures recommended by AMIRA (2002), which take into consideration measured values provided by the Nett Acid Generation (NAG) test and calculated NAPP values.
- Use of chromium-reducible sulfur (CRS or S_{CR}) as a direct measure of oxidisable sulfur, as a preferred alternative to indirect measurement of oxidisable sulfur by AMIRA (2002) methodology.
- Kinetic leaching column test data, which provides information for the relative rates of acid generation under controlled laboratory conditions, intended to simulate those within a waste material stockpile or TSF.

A sound knowledge of geological and geochemical processes must also be employed in the application of the above methods.

Classification of wastes in this report follows the Australian Government's Guidelines on Managing Acidic and Metalliferous Drainage (DITR 2007) and AMIRA (2002) and is based on NAPP and NAG pH results. However selection of samples for full ABA parameters (ANC, NAG, AP and NAPP) and CRS was also based on the ASS criteria of 0.05% total sulfur (DMP 2016, DER 2015) in order to cover any potential for such material at or below the groundwater table. The adopted methodology therefore included the following assessments:

- Analysis for total sulfur (Tot_S) on all samples.
- Analysis for ANC (quoted in kg H_2SO_4/t), NAG (quoted in kg H_2SO_4/t), NAGpH and CRS if total sulfur was greater than 0.05%.
- Calculation of AP based on total sulfur and sulfate sulfur = [(Tot_S – SO_4_S) * 30.6] kg H_2SO_4/t.
- Secondary check calculation of AP based on chromium reducible sulfur = [(CRS) * 30.6] kg H_2SO_4/t.
- Calculation of NAPP = [AP – ANC] kg H_2SO_4/t.
- Calculation of NPR = ANC/AP.

When assessing data for AP and NAPP, it must be noted that both parameters are based on the assumption that all sulfur contained in the sample is acid producing (sourced from pyrite and other iron sulfide minerals). However, this represents a worst case scenario as not all minerals containing sulfur will result in acid production. Conversely, the NAPP calculation also assumes that the acid neutralising material measured in ANC is rapid-acting. In practice, some neutralising capacity is supplied by silicate and aluminosilicate minerals which can be much slower to react. Further still, iron carbonate minerals such as siderite ($FeCO_3$) have limited or no capacity to neutralise acidity due to acid producing reactions resulting from oxidation of the dissolved ferrous iron component. Despite these assumptions, NAPP remains a suitable conservative prediction of potential acid generation when used in conjunction with mineralogical data.

A combined acid generation classification scheme based on NAPP and NAG determinations is presented in Table 4.

Table 4: ABA Classification Criteria

Primary Geochemical Waste Type Class	NAPP Value kg H_2SO_4/t	NAGpH
Barren	Very low (< 2) based on total sulfur <0.05%	-
Potentially Acid Forming (PAF)	≥10	< 4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	< 4.5
Uncertain (UC)	0 to 5	> 4.5
Uncertain (UC)	-10 to 0	< 4.5
Non Acid Forming (NAF)	-100 to 0	> 4.5
Acid Consuming (AC)	< -100	> 4.5

Table 4 is based on the Australian Government's Guidelines on Managing Acidic and Metalliferous Drainage (DITR 2007) and is in turn based on an earlier classification system included within the AMIRA ARD Test Handbook (AMIRA 2002), which is advocated by the Global Acid Rock Drainage Guidelines (GARD) published by the International Network for Acid Prevention (INAP 2009). This classification system, based on static acid base accounting procedures and used in conjunction with geological, geochemical and mineralogical analysis can still leave materials classified as 'uncertain' where there is conflicting NAGpH and NAPP results. Uncertain materials demonstrating a NAG pH above 4.5 may be tentatively assigned as potentially NAF and those below pH 4.5 as potentially PAF – however in such cases, further assessment, such as the use of kinetic leaching columns may be required to provide a definitive classification. Classification criteria for pH of potentially ASS material is normally based on an oxidised pH (pH_{FOX} equivalent to NAGpH) of less than 3.0 (DER 2012, DER 2015) so a classification criteria of pH 4.5 for NAGpH is therefore more conservative for acid generation.

5.2 ACID BASE ACCOUNTING METHODOLOGY

Sample analysis was performed by a NATA accredited laboratory (Intertek Genalysis). Preliminary analysis was conducted for total sulfur measured by combustion and infra-red analysis. Samples with greater than or equal to 0.05% total sulfur were selected for further analysis of CRS, ANC and NAG.

5.3 ELEMENTAL COMPOSITION AND GAI

A range of major and trace metals and metalloids were measured on selected samples by inductively coupled plasma (ICP) spectrometry following digestion of a finely ground sample with a four acid (HF, HCl, HNO_3 and $HClO_4$) mixture, which is considered to be a near total determination for the elements measured.

Digest solutions were analysed for a general suite of potential toxicants determined by ICP optical emission spectroscopy (ICP-OES) or ICP mass spectroscopy (ICP-MS). Samples were analysed for aluminium (Al), arsenic (As), barium (Ba), calcium (Ca), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), molybdenum (Mo), sodium (Na), nickel (Ni), lead (Pb), antimony (Sb), selenium (Se), tin (Sn), thorium (Th), uranium (U), vanadium (V) and zinc (Zn).

From this data, the global abundance index (GAI) for each element was calculated by comparison to the average earth crustal abundance (Bowen 1979 and AIMM 2001). The main purpose of the GAI is to provide an indication of any elemental enrichment that could be of environmental significance. The GAI (based on a log-2 scale) is expressed in integer increments from zero to six (GARD Guide). A GAI of zero indicates that the content of the element is less than or up to three times the average crustal abundance; a GAI of one corresponds to a three to six fold enrichment; a GAI of two corresponds to a six to 12 fold enrichment and so forth, up to a GAI of six which corresponds to a 96-fold, or greater, enrichment above average crustal abundances. A GAI of more than three is considered significant and may warrant further investigation.

5.4 WATER LEACHATE CHARACTERISATION METHODOLOGY

The use of a tumbled water extract of a finely ground sample allows the laboratory water extraction test to mimic weathering conditions that may be expected in a temperate, semi-arid environment over a period of several years. It is not suitable for predicting long term release rates.

Observed concentrations of major ions, metals and metalloids in the extract may not represent maximum potential concentrations. This test method can be limited by the rates of dissolution, desorption and solubility (especially for sparingly soluble minerals such as gypsum ($CaSO_4.2H_2O$), barite ($BaSO_4$) and fluorite (CaF_2)). Hence an understanding of mineral phases present is important when interpreting the results.

Samples examined during this investigation were subject to a water leach according to the Australian Standards Leaching Procedure (ASLP) 4439.3 Class 1 specification with 1:20 weight/weight, sample to water. Analytical finish was via ICP-OES or ICP-MS, as necessary. Samples were analysed for Al, As, boron (B), Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Th, U, V and Zn. Water extracts of samples were simultaneously tested for Electrical Conductivity (EC), pH, alkalinity (bicarbonate, carbonate and hydroxide forms), sulfate and chloride. Fluoride concentrations were measured by Ion Selective Electrode (ISE).

5.5 DILUTE ACID LEACHATE CHARACTERISATION METHODOLOGY

Samples were leached by tumbling using dilute acetic acid as the leaching fluid (initial pH 2.9) according to ASLP 4439.3 specification. Analytical finish of the filtered (0.45 µm) extract was via ICP-OES or ICP-MS finish, as necessary, for the same metals and metalloids as performed for the water leachable fraction. Analysis of this leachate can provide:

- An indication of the relative abundance of acid-consuming minerals. High concentrations of calcium (and magnesium) in conjunction with higher ANC values would indicate the presence of calcite ($CaCO_3$). High concentrations of soluble silicon and/or aluminium would indicate reactive silicates and/or aluminosilicates are responsible for ANC.
- An indication of the amount of non-acid forming sulfate sulfur present in the sample.
- Heavy metals and metalloids that may be leachable over extended periods if acidic conditions were to prevail.

5.6 EXCHANGEABLE CATIONS

Exchangeable cations (calcium, magnesium, sodium and potassium) were extracted from selected samples using 1 M ammonium chloride solution at pH 7 as the cation displacing solution, followed by measurement using ICP-OES.

5.7 PARTICLE SIZE ANALYSIS

Particle size analysis on nine selected samples was performed by light (laser) scattering using a Beckman Coulter Particle Size Analyser by Intertek Genalysis Laboratory Services. Results are provided in Appendix 2.

6. RESULTS AND DISCUSSION

6.1 ACID BASE ACCOUNTING

Laboratory results for total sulfur, natural pH (1:5) and ABA parameters on samples with greater than or equal to 0.05% total sulfur are collated in Table A1-2 of Appendix 1.

6.1.1 Sulfur Assay and Forms

Based on the data in Table A1-2 of Appendix 1, the following are noted as key points for the 57 mine waste samples:

- Total sulfur concentrations were very low (0.03% or less) in all samples except two. The two higher sulfur samples (SB006113 with 0.22% sulfur and SB012707 with 0.96% sulfur) were also the two deepest of all samples taken from 88.5 and 96 m below surface respectively (more than 50 m below the water table).
- Further analysis of these two samples indicated the presence of oxidisable sulfur species (likely pyrite/marcasite) with CRS results of 0.13% (SB006113) and 0.64% (SB012707) respectively.
- Two samples with 0.03% sulfur (next highest sulfur content) from drill hole THAC465 were relatively shallow in depth (SB013517, 4.5 m and SB013522, 12 m) and significantly above the water table. This is consistent with a small pocket of residual sulfate or organic sulfur at this location, rather than oxidisable sulfur.
- As a result of the very low sulfur concentrations of most samples, calculated AP values were low (<0.3 to 1 kg H_2SO_4/t) for 55 of the 57 samples (96%). Calculated AP (from CRS results) of the two higher sulfur samples SB006113 and SB012707 were 3.9 and 19.7 kg H_2SO_4/t respectively.

A frequency histogram of total sulfur content by sample type is given in Chart 3 below, showing the very low concentrations of sulfur in most samples.

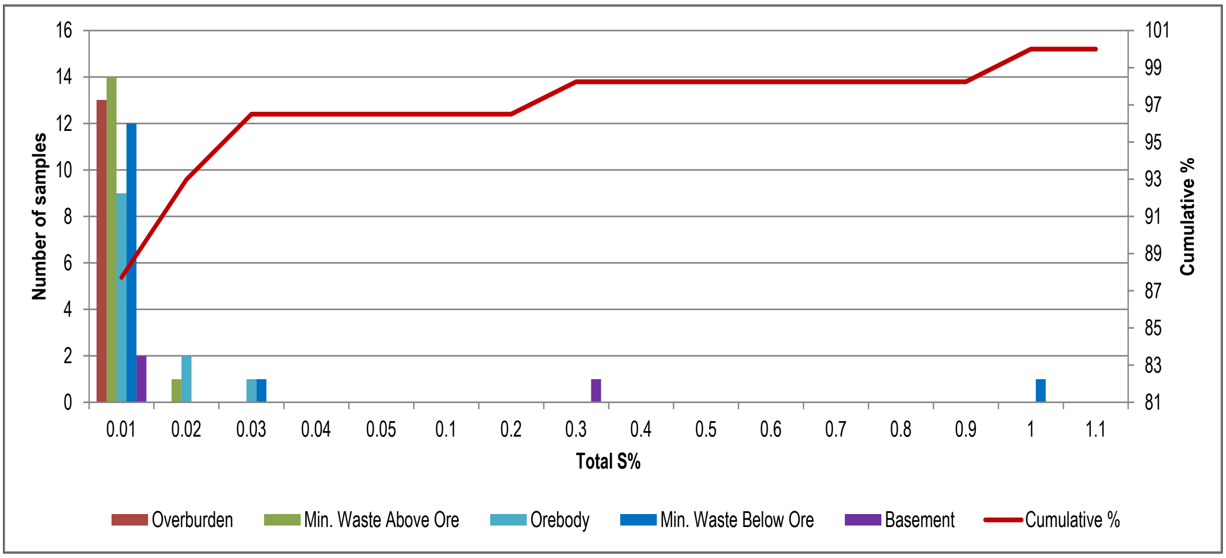

Chart 3: Frequency Plot of Total Sulfur Concentrations for Sheffield Mine Waste

6.1.2 Acid Drainage Classification

Based upon measured total sulfur, pH, CRS and ABA parameters, the following aspects were evident for mine waste samples:

- The natural pH of samples (1:5 extract) was circum-neutral to acidic for almost all samples (range 5.1 to 7.2). Such values are typical of highly weathered and leached soils such as the Pindan soils of the project.
- The natural pH values and measured soluble alkalinity (Section 6.3.1) of all samples indicate very low to zero available ANC.
- As a result of the low levels of potentially oxidisable sulfur and ANC, all but two of the samples assessed are classified as NAF and given a sub-classification of 'Barren', having neither acid producing nor acid neutralisation potential.
- Five samples reported total sulfur values of 0.03% or less but the pH values for these five samples were consistent with samples having less than 0.01% total sulfur (circum-neutral to mildly acidic) — this confirms a lack of risk associated with such low levels of sulfur and that 0.05% total sulfur was an appropriate screening value.
- Samples SB006113 (basement from 88.5 m) and SB012707 (mineralised waste below orebody from 96 m) were classified as PAF, with the pH of 3.1 for both samples as received indicating acid formation in these samples had already commenced during core storage prior to sampling and analysis. Oxidised pH values (NAGpH) for SB006113 and SB012707 samples were pH 3.3 and 2.5. Both of these samples occur below the ore zone.

A plot of AMD classification for Thunderbird mine waste samples by type/resource position is given in Chart 4. The four quadrants are labelled as NAF, PAF and two UC (uncertain). All but two samples in Chart 4 have less than or equal to 1 kg H_2SO_4/t NAPP and are 'Barren'.

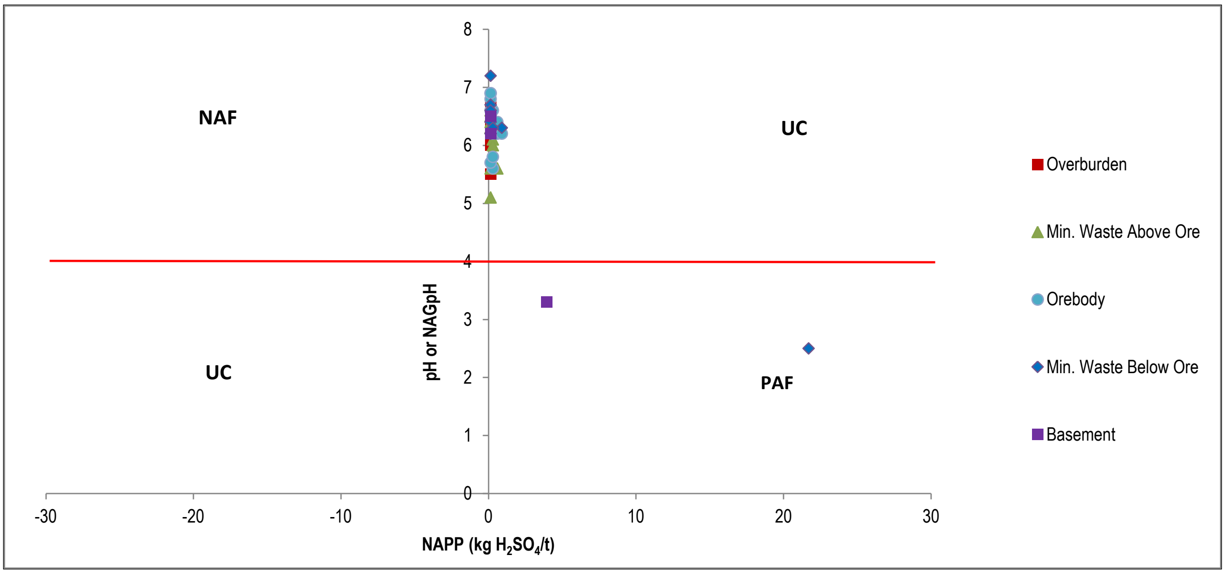

Chart 4: AMD Classification of Mine Waste Calculated NAPP Versus NAGpH or pH

It is important to note the following regarding the spatial distribution of the two PAF classified samples within the defined project resource:

- Sample SB006113 (basement from 88.5 m) is the second deepest sample assessed and represents a marker bed some 18 m below the intended pit floor of defined 'ore' at this location.

- Sample SB0012707 (mineralised waste below orebody from 96 m) also represents material below the intended lower level of excavation as it is low grade material not defined as 'ore' and will only potentially be encountered at the end of the proposed 47 year mine life.

Table 5 illustrates the relationship between the distance to water table/ground level and presence of sulfides, with only samples 53.5 m or more below the water table (highlighted yellow indicating presence of sulfides and being classified as PAF.

Table 5: Summary of Total S and CRS for the Deepest Nine Samples

Sample	Type	Depth (m)	Depth Below Water Table (m)*	Depth Below Ground (m)**	Total S (%)	CRS (%)
SB012707	Min. Waste Below Ore	96 -97.5	-68	103	0.96	0.644
SB006113	Basement	88.5-90	-53.5	88.5	0.22	0.129
SB012894	Orebody	76.5-78	-48.5	83.5	0.02	
SB006100	Min. Waste Above Ore	69-70.5	-34	69	<0.01	
SB004268	Basement	69-72	-33	68	<0.01	
SB012878	Min. Waste Above Ore	52.5-54	-24.5	59.5	<0.01	
SB003694	Basement	63-64.5	-21	56	<0.01	
SB006091	Orebody	55.5-57	-20.5	55.5	0.02	
SB004261	Min. Waste Below Ore	48-51	-12	47	<0.01	

** Positive values above water table, negative below +/- 3m accuracy (maximum sample width)*

*** Based on average depth to natural water table of 35 m*

6.2 ELEMENTAL COMPOSITION

Laboratory results for analysis of total metals and metalloids by four acid digestion for nine selected mine waste samples are collated in Table A1-3 of Appendix 1. Calculated GAI values, as outlined in Section 5.3, are presented in Table A1-4 of Appendix 1.

Mineral deposits by their nature are anticipated to have some elements present in concentrations above the average crustal abundance. The GAI does, however, provide a useful screening tool for identifying elements requiring further assessment by more specific test methods. Examination of the total element concentrations and the corresponding GAI values for project samples indicates the following:

- All samples were found to have low concentrations of all elements tested with the minor exception of selenium and thorium in the orebody and one of the four mineralised waste samples, consistent with a composition of highly leached quartz sand and clays and some unreactive heavy minerals in the resource zone.
- As expected for a mineral sand placer deposit, samples from the orebody and mineralised waste (SB014433) from below the orebody were enriched in thorium – which is often associated with the mineral monazite ((Ce, La, Nd, Th)PO_4). Thorium concentrations in these samples ranged from 110 to 160 mg/kg (GAI 3) versus a crustal abundance of 10 mg/kg, with the other mineralised waste sample below the orebody (SB014431) having 82 mg/kg thorium (GAI 2). All other samples had less than 30 mg/kg thorium.
- The same orebody and mineralised waste samples below the orebody (SB003679, SB003681 and SB014433) were slightly enriched in selenium (2.6 to 3.8 mg/kg, GAI 3 to 4) versus the average soil concentration of 0.2 mg/kg. Sample SB014431, mineralised waste below the orebody, also had a selenium concentration of 1.4 mg/kg (GAI 2). Selenium concentrations in other samples were less than or equal to 0.9 mg/kg.
- The distribution of uranium concentrations (maximum 16 mg/kg, GAI 2 in orebody SB003679) mirrored those of thorium within the orebody and mineralised waste, but were insufficient to be considered significantly enriched versus the global abundance of 2.7 mg/kg. Lead concentrations mirrored the distribution of uranium (as lead is a radioactive decay product of uranium), but lead concentrations were insufficient to be considered enriched (maximum lead concentration was 40 mg/kg).
- Concentrations of all other environmentally relevant metals and metalloids tested were low to very low and did not significantly exceed average crustal abundances.

6.3 WATER LEACHATE CHARACTERISATION

6.3.1 pH, Salinity and Soluble Alkalinity

Results for pH, EC (1:5 extracts) and soluble alkalinity (selected samples 1:20 water extracts) are given in Table A1-5 of Appendix 1. Results indicate:

- The samples generated circum-neutral to slightly acidic leachates (pH values ranging from 5.1 to 7.2) for all but the two PAF samples (pH 3.1) in the un-oxidised state. A pH distribution histogram by sample type is presented in Chart 5 below. The presence of partially soluble iron and aluminium complexes is considered the major controlling influence of pH in water extracts, rather than buffering from acid-soluble carbonate minerals.
- All of the nine leachates measured contained very low concentrations of soluble alkalinity (maximum 6 mg/L as $CaCO_3$).
- EC of most samples ranged from 9 to 49 µS/cm indicating extremely low soluble salt concentrations. The two PAF samples (SB0006113 and SB012707), which were partially oxidised during core storage, had higher EC values of 584 µS/cm and 1,138 µS/cm respectively attributed to acid formation.

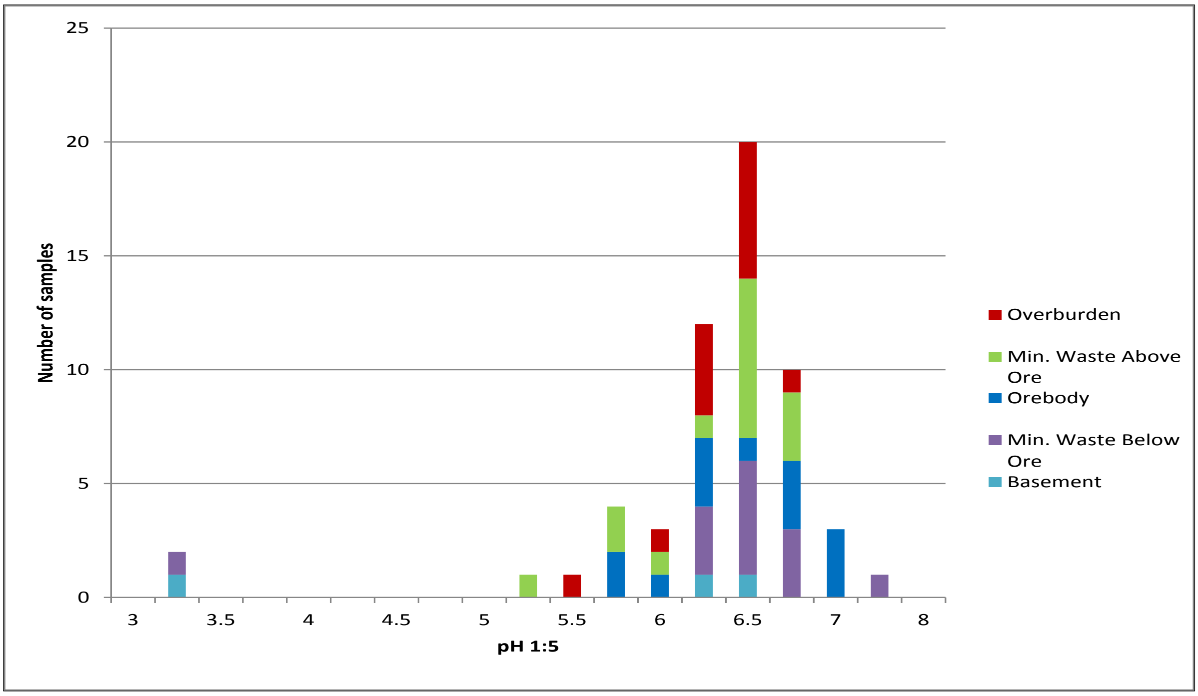

Chart 5: Mine Waste Initial pH Distribution

6.3.2 Soluble Major Ions

Results of analysis for major ions and the calculated sodium absorption ratio (SAR) on a 1:5 extract of the nine selected samples are presented in Table A1-6 of Appendix 1. SAR is a measure of the tendency of water to cause replacement of the calcium and magnesium ions attached to soil clay minerals with sodium ions. Sodium dominant (sodic) clays have poor structure (are subject to dispersion) and develop permeability problems. Highly sodic wastes are more likely to be dispersive (prone to water erosion by suspension of clays), than non-sodic wastes. Issues of sodicity are exacerbated in the presence of high alkalinity which increases the formation of insoluble calcium and magnesium carbonates.

Examination of the results for major ions and SAR in Table A1-6 of Appendix 1 indicates:

- Extracts, although of very low salinity were sodium chloride dominant with lesser amounts of magnesium and sulfate.
- Comparison of the leachate SAR values to EC (Chart 6 below) indicate all samples analysed are classified as dispersive (CSIRO 1999). The orange and red lines in Chart 6 signify approximate boundaries between flocculated, potentially dispersive and dispersive soil/weathered mine waste types.
- Fluoride concentrations were at or below the reporting (0.1 mg/L) and well below the livestock drinking water guideline of 2 mg/L (ANZECC 2000).

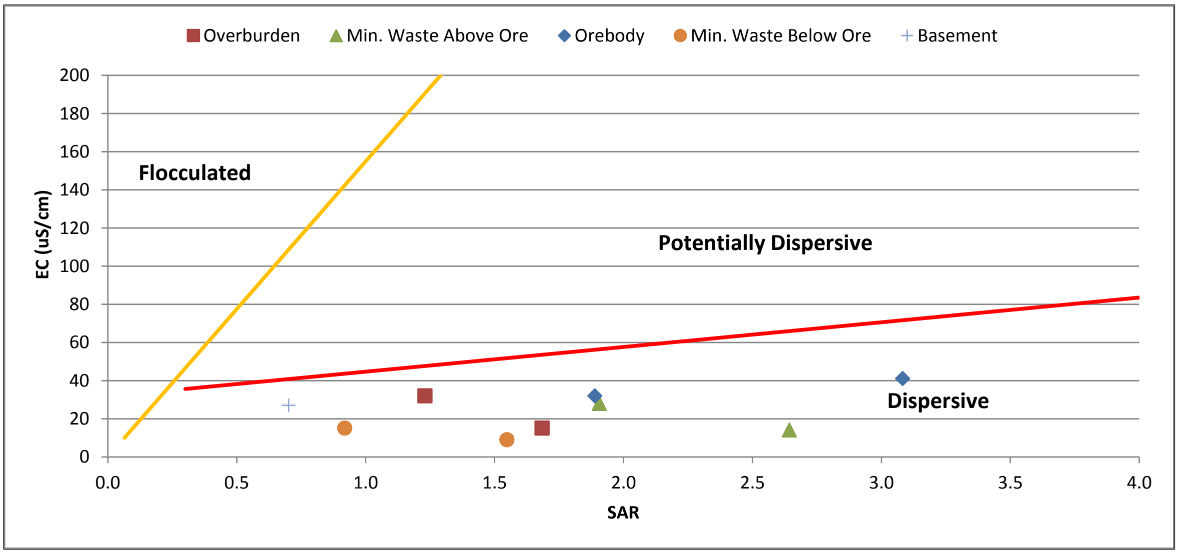

Chart 6: Calculated SAR Values Versus EC

Overall, results of major ions analysis suggest that seepage from Thunderbird mine waste will have extremely low levels of salinity, but that the clay sized fraction has the potential to be dispersive due to low EC and being sodium dominant. This aspect is examined further in Section 6.5.

6.3.3 Soluble Metals and Metalloids

Results for water soluble metals and metalloids in the 1:20 ASLP extracts are given in Table A1-7 of Appendix 1. ANZECC livestock drinking water guidelines (cattle), ANZECC/DEC freshwater guidelines, and Human Drinking Water Guidelines (NHMRC 2011) are provided for comparison. The primary use of groundwater in the regional area is drinking water for cattle. Key observations for soluble metals and metalloids data are summarised below.

- Metals and metalloid concentrations in water leachates for all mine waste samples were generally at or below laboratory limits of reporting and all were below corresponding ANZECC livestock drinking water guidelines. This indicates a low risk of material adversely impacting groundwater quality by a process of leaching from rainfall or in contact with groundwater/process water.
- The aluminium concentration in three of the nine samples was equal to or above human aesthetic drinking water guideline of 0.2 mg/L, with a maximum of 2.12 mg/L (SB012859, overburden). While these results may be caused by presence of extremely fine suspended aluminium material/complexes passing through the filter, the effect of some soluble aluminium (and iron) complexes from portions of disturbed waste material at these concentrations in the project environment is considered of no environmental significance in the project area and surrounds. Available analysis of project groundwater (Pennington Scott 2014), indicates representative concentrations between 0.02 and 1.2 mg/L aluminium at pH values of 5.8 to 6.3.

Overall, water soluble concentrations of all metals and metalloids assessed were very low to non-detectable for all elements of environmental significance. This indicates there is a very low risk of circum-neutral leachates generated from project mine waste impacting the surrounding environment.

6.4 DILUTE ACID LEACHATE CHARACTERISATION

Dilute acid leachate results for all samples are presented in Tables A1-8 of Appendix 1.

Under the acidic conditions (pH 2.9) of this test, the following properties were identified:

- Metal and metalloid concentrations in the acetic acid leachates of all samples were below the corresponding ANZECC livestock drinking water guidelines except for aluminium in sample SB012859 (overburden, 25.5 m depth, 6.25 mg/L aluminium versus guideline 5 mg/L). Overall, this indicates a low risk of material adversely impacting groundwater quality even if localised acid conditions were to prevail from exposure of PAF material.

- Aluminium, iron, magnesium, calcium and sodium were the major species released with presence of acetic acid. Concentrations of calcium and magnesium however were still low, indicating very little available buffering capacity in the form of calcium or magnesium carbonates. Aluminium and iron oxides are considered to provide the majority of acid buffering/neutralising capacity.
- Sample SB0125859 was indicated to MBS as being approximately 4 m above the water table (Table A1-1, Appendix 1) and was found to have the highest proportion of dilute acid soluble iron, aluminium and manganese versus the total metal concentrations (e.g. 9.5% of total iron solubilised). Analysis results for this sample are therefore consistent with a bed of groundwater precipitated iron hydroxides (ferricrete) and aluminium just above the normal groundwater table which is then re-solubilised in contact with dilute acetic acid. Other samples outside of this zone had significantly less dilute acid soluble iron, aluminium and manganese in proportion to the total metal concentration. These soluble concentrations under worst case acidic conditions are not considered of environmental significance in the overall project.
- Despite geochemical enrichment in selenium and thorium, no soluble selenium was detected in acid extracts of orebody or mineralised waste samples and concentrations of thorium were very low (maximum 5.4 µg/L). Uranium concentrations (maximum 4.7 µg/L), were of similar magnitude to thorium and below the human and livestock drinking water guidelines of 17 and 200 µg /L, respectively.

6.5 PARTICLE SIZE ANALYSIS AND POTENTIAL FOR DISPERSION

Particle size distribution results for selected mine waste samples are provided in Appendix 2. Summary statistics of particle sizing are presented in Table 6. These results can also be combined with calculated effective cation exchange capacity (ECEC) and exchangeable sodium percentage (ESP) presented in Table A1-9 of Appendix 1 to give an indication of the potential for dispersion of the mine waste materials. An ESP of less than 6% is considered non-sodic, 6 to 15% is considered moderately sodic and more than 15% highly sodic for Australian soils (Northcote and Skene 1972, CSIRO 1999). Key points are summarised as follows:

- The particle size distribution of all sample types by resource position was fairly consistent with approximately 10% being clay sized material (< 2 µm) (Table 6). The overburden material had a slightly higher proportion of silt fraction (<20 µm) with 50% of material being in the silt or clay fraction. This clay content classifies all mined waste materials as clayey sand to sandy loam in texture.
- Calculated ECEC values were very low (0.2 to 0.5 cmol(+)/kg), which is unusual for weathered regolith containing substantial proportions of clay sized material (< 2 µm). This observation suggests that clay-sized material contains very little clay minerals (such as kaolinite, illite and smectite), but very fine particles of quartz and iron oxides. Although mine waste containing these materials are unlikely to behave as swelling clays, they are expected to have very little physical wet strength and a high potential to disperse in water.
- Examination of results for ECEC and ESP indicates the sodicity of the clay material in project mine waste is variable. Overburden samples SB012859 and SB012861 were non sodic to slightly sodic and hence at less risk of being dispersive. Almost all mineralised mine waste samples from other positions within the resource were moderately sodic, with the exception of sample SB003679, which was highly sodic (Table 6).
- These results are consistent with finding from analysis of tailings residues (MBS 2016a) and indicate that mined waste (in particular the slimes from orebody processing) have potential to be dispersive. In practice this means slurries of mined materials placed back into the initial TSF or mine void have the potential to result in the supernatant water remaining highly turbid with suspended clay, limiting options for discharge of any excess mine water during high rainfall events. In practice, it is understood this will be managed by addition of flocculent to the process water which in turn will assist in settling of the clay/silt material in the

mine void/initial TSF and lowering the turbidity of water which is mostly re-circulated into the plant for use in processing.

- Covering the rehabilitated mined areas/TSF with low sodicity overburden and soil materials (MBS 2016b) in an essentially flat terrain will then prevent any long term turbid water runoff from mined areas.

Table 6: Summary of Particle Size Analysis Results (µm) and ESP

Sample	Type	10th Percentile	50th Percentile (Median)	90th Percentile	ECEC (cmol (+)/kg)	ESP (%)
SB003679	Orebody	1.61	26.98	102.4	0.2	10.9
SB003681	Orebody	1.69	25.34	100.2	0.2	26.8
SB004268	Basement	1.75	21.30	94.49	0.2	9.9
SB005597	Min. Waste Above Ore	2.06	25.21	114.2	0.3	14.5
SB006078	Min. Waste Above Ore	1.94	21.80	104.1	0.2	10.9
SB012859	Overburden	1.86	16.19	65.02	0.5	4.3
SB012861	Overburden	2.03	17.98	78.82	03	6.6
SB014431	Min. Waste Below Ore	1.90	28.11	103.9	0.2	9.9
SB014433	Min. Waste Below Ore	1.73	26.22	100.2	0.2	10.6

7. CONCLUSIONS

A total of 57 mine waste samples were selected from 16 drill holes for geochemical characterisation. The samples comprised overburden (13), mineralised waste above the orebody (15), Thunderbird Formation orebody sands (12), mineralised waste below the orebody (14) and basement/marker bed samples (3). Geochemical assessment of these 57 mine waste samples for the project indicated the following properties:

- The vast majority (55 of 57 samples, 96%) of samples contained very low concentrations of total sulfur or ANC and were all classified as NAF-Barren, having neither acid forming nor acid neutralising capacity.
- The two deepest samples assessed (SB006113 and SB012707) at or below 53.5 m below the natural water table (approximately 88.5 m below surface) were found to contain 0.22% and 0.96% sulfur respectively and were classified as PAF. These samples were identified basement material or mineralised waste below the orebody and are not intended for excavation.
- Natural pH values for samples other than the two PAF samples described above were circum-neutral to slightly acidic (pH 5.1 to 7.2) and very low in soluble salts and soluble alkalinity. Overall this indicates seepage from non-sulfidic project mine waste by rainfall or interaction with groundwater is expected to have very low levels of soluble salts/salinity and be slightly acidic (pH 6 to 6.5) which is very consistent with natural groundwater from the site (pH 5.8 to 6.3). The two sulfidic PAF samples (SB006113 and SB012707) were already partially oxidised upon receipt and had elevated salinity/EC values resulting from acid sulfate formation.
- Thorium was the most significantly enriched element associated with orebody samples and mineralised waste samples below the orebody. Thorium concentrations in these samples ranged from 110 to 160 mg/kg (GAI 3) versus a crustal abundance of 10 mg/kg. Thorium enrichment is considered to be associated with naturally elevated concentrations of monazite present in the Thunderbird deposit. Both water and dilute acid leachate testing indicated these total concentrations will not be mobilised under any expected mining conditions.
- Minor enrichment in selenium in orebody and mineralised waste samples below the orebody was also noted (2.6 to 3.8 mg/kg, GAI 3 to 4) versus the average soil concentration of 0.2 mg/kg. Both water and dilute acid leachate testing indicated these total concentrations will not be mobilised under any expected mining conditions.
- Concentrations of all other environmentally significant metals and metalloids tested were low to very low indicating a low risk to the environment.
- Concentrations of water soluble elements of environmental significance in mine waste samples were generally very low to non-detectable and below ANZECC livestock drinking water guidelines for all samples selected which is the only current beneficial use of groundwater. Overall, results indicate there is an extremely low risk of mine waste leachates from circum-neutral waters adversely impacting the surrounding environment by rainfall or groundwater interaction.
- Dilute acid leach results confirmed negligible levels of calcium and magnesium carbonates were available for buffering capacity/acid neutralisation. Low levels of aluminium and iron were the primary elements solubilised, which is consistent with a natural presence of hydrated aluminium and iron oxides from weathering and groundwater interactions. A sample (SB012859) of overburden in a ferricrete zone 4 m above the natural groundwater table released the highest concentrations of aluminium and iron upon contact with acid, with aluminium (6.25 mg/L), marginally above the ANZECC livestock drinking water guideline of 5 mg/L under these artificially acid conditions. Concentrations of all other environmentally significant metals and metalloids (including geochemically enriched thorium and selenium) were very low in all samples and below corresponding ANZECC livestock drinking water guidelines.
- Particle size analysis indicated all samples had approximately 10% clay content with clay and silt fractions (<20 µm) together combining for approximately 50% by weight of material. Cation exchange capacity measurements indicated samples of overburden were non-sodic to marginally sodic with a lower risk of dispersion. Remaining sample types were moderately to highly sodic with orebody samples being highest

in sodicity (ESP values of 10.9 to 26.8%) and higher risk of dispersion. These mine waste materials are therefore expected to have a dispersive tendency and make water turbid by remaining suspended in the low salinity water of the project. As processing involves the use of flocculants, slurries of these materials should still reasonably settle upon placement in the mine void or initial TSF.

Overall, results indicate that mine waste at depths less than 48.5 m below the natural water table (approximately 83.5 m below surface) will be NAF and Barren with essentially no capacity for acid generation or acid neutralisation. Levels of soluble salts, metals and metalloids in any seepage from these materials will be extremely low, even under mildly acidic conditions.

An apparent demarcation of sulfidic, PAF material was found to occur at depths between 48.5 m (non-sulfidic) and 53.5 m (sulfidic) below the natural water table (refer Table 5). Consistent with a staged approach to ASS investigation (DER 2015), further confirmation of the exact depth and extent of this sulfidic material intercept by additional, more intensive regolith sampling and analysis ahead of mining would be required before any disturbance of material at this depth occurs. Subsequent development of an appropriate mining strategy and ASS management plan (refer DER 2015 and 2015b) including groundwater monitoring should be implemented before any possible disturbance of material at this depth occurs. This includes consideration of the cone of depression resulting from mine dewatering.

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9. GLOSSARY OF TECHNICAL TERMS

Term	Explanation
Acid fizz test	A field test used to test for the presence of carbonate minerals in soil and sediment. Dilute hydrochloric acid is added to the sample and an effervescent reaction indicates the presence of carbonate minerals.
ACM	Acid consuming material.
Action criteria	The critical net acidity values (expressed as % pyrite sulfur or the equivalent moles H^+/t) for different soil texture groups and sizes of soil disturbance that trigger the need for ASS management.
Actual acidity	The soluble and exchangeable acidity already present in the soil, often as a result of previous oxidation of sulfides. It is measured in the laboratory using the TAA method but does not include the less soluble acidity (i.e. residual acidity) held in minerals such as alunite and jarosite.
alunite	A hydrated aluminium potassium sulfate mineral, formula $KAl_3(SO_4)_2(OH)_6$. It is an analogue of jarosite where aluminium has replaced iron and can hydrate to aluminium hydroxide and release soluble free acidity. It is thus a source of stored or 'retained' acidity.
ANC	Acid Neutralising Capacity. A process where a sample is reacted with excess 0.5 m HCl at a pH of about 1.5, for 2-3 hours at 80-90ºC followed by back-titration to pH=7 with sodium hydroxide. This determines the acid consumed by soluble materials in the sample.
ANC_E	Acid Neutralising Capacity (Excess). Found in soils with acid neutralising capacity in excess of that needed to neutralise acid generation from sulfides. Measured by titration with alkali to pH 6.5 after oxidation of the sample with peroxide. If ANC_E of a soil is positive then the TPA is zero and vice versa.
AP	Acid Potential. Similar to MPA, but only is based on the amount of sulfide-sulfur (calculated at the difference between total sulfur and sulfate-sulfur (SO_4-S)) rather than total sulfur. AP (kg H_2SO_4/t) = (Total S – SO_4-S) x 30.6
ASS	Acid Sulfate Soils.
calcite	Calcium carbonate $CaCO_3$
CEC	Cation Exchange Capacity of a soil is defined as the total sum of exchangeable cations that it can adsorb at a specific pH. Cation exchange of exchangeable cations in reversible chemical reactions is a quality important in terms of soil fertility, erosion and plant nutritional studies.
Chromium suite	The approach of calculating net acidity using the chromium reducible sulfur method to determine potential sulfidic acidity. It is combined with a decision process based on pH_{KCl} to determine the other components of acid-base accounting (TAA, ANC).
Circum-neutral pH	pH value near 7.
CRS	Chromium Reducible Sulfur (S_{CR}). A measurement of reactive sulfide sulfur normally applied to acid sulfate soils using reaction with metallic chromium and hydrochloric acid to liberate hydrogen sulfide gas, which is trapped and then measured by iodometric titration.
Dolomite	Calcium magnesium carbonate $CaMg(CO_3)_2$
EC	Electrical conductivity. A measurement of solution salinity. Conversion: 1,000 µS/cm = 1 dS/m = 1 mS/cm
Effective NAPP	NAPP calculated using CarbNP rather than traditional ANC. Effective NAPP (kg H_2SO_4/t) = AP – CarbNP
ENV	Effective neutralising value of a liming product (normally calcite) which takes into account

	the chemical purity of the lime, particle size and solubility in its ability to neutralise acid.
Existing or Exchangeable acidity	The acidity already present in soils, usually as a result of oxidation of sulfides, but which can also be from organic material or ions which release acid upon hydrolysis (Fe and Al). Existing acidity is the sum of actual acidity and retained acidity.
Fineness factor	A factor applied to the amount of acid neutralising material required to neutralise the acid potential due to the poor reactivity of coarser carbonate or other acid neutralising material. The minimum factor is 1.5 for finely divided pure agricultural lime (calcium carbonate), but may be as high as 3.0 for coarser shell material.
Fulvic acid	A complex mixture of small organic molecules derived from biological breakdown of plant matter (humus). They are organic acids (carboxyl and phenolate groups) which remain soluble in water below pH 2 (compare with Humic acid).
Humic acid	A complex mixture of large (high molecular weight) organic molecules derived from biological breakdown of plant matter (humus). They are organic acids (carboxyl and phenolate groups) which are insoluble in water below pH 2.
Ilmenite	Iron Titanium Oxide ($FeTiO_3$). It can be processed (removal of iron) to produce synthetic rutile (TiO_2).
Jarosite	A hydrated iron potassium sulfate mineral, formula $KFe_3(SO_4)_2(OH)_6$. It can hydrate to iron (III) hydroxide and release soluble free acidity. It is thus a source of stored or 'retained' acidity. Jarosite is often distinguished by its yellow colouration among dark sediments exposed to oxygen. A sodium form is known as natrojarosite.
Laterite	Highly weathered soils/subsoils developed by extensive leaching of iron and aluminium rich parent rocks in tropical climates to leave soils rich in hydrous iron and aluminium oxides.
Leucoxene	An industry applied name (not an official mineral name) to describe highly weathered ilmenite where the iron has been leached to leave a higher titanium content ilmenite (70 to 93% titanium dioxide content).
Monazite	A normally highly insoluble mineral of $(Ce, La)PO_4$ which also contains thorium (approximately 5%) and uranium (0.3 to 0.5%) and is a naturally occurring radioactive material (NORM). It can be 'cracked' by high temperature sulfuric acid and dissolved leaving behind the insoluble minerals zircon (ZrO_2), rutile (TiO_2) and $ZrSiO_4$
MPA	Maximum Potential Acidity. A calculation where the total sulfur in the sample is assumed to all be present as pyrite. This value is multiplied by 30.6 to produce a value known as the Maximum Potential Acidity reported in units of kg H_2SO_4/t. MPA should include only the non-sulfate sulfur to avoid over-estimation of acid production in which case it may be referred to as AP.
NAF	Non Acid Forming
NAG	Net Acid Generation. A process where a sample is reacted with 15% hydrogen peroxide solution at pH = 4.5 to oxidise all sulfides and then time allowed for the solution to react with acid soluble materials. This is a direct measure of the acid generating capacity of the sample but can be affected by the presence of organic materials.
NAGpH	Net Acid Generation pH. The pH of the NAG test solution after oxidation.
NAPP	Net Acid Producing Potential. NAPP (kg H_2SO_4/t) = AP – ANC
Net acidity	Result obtained after accounting for all forms of soil acidity and neutralising capacity. Net acidity = Potential acidity + Existing acidity – (ANC/Fineness Factor)
PAF	Potentially Acid Forming.
PAF-HC	Potentially Acid Forming – High Capacity. Classification for samples with NAPP values greater than 10 kg H_2SO_4/t.
PAF-LC	Potentially Acid Forming – Low Capacity. Classification for samples with NAPP values less

	than or equal to 10 kg H_2SO_4/t.
pH_F	pH field of a 1:2 soil:water paste
pH_{FOX}	pH field after addition of a few drops of strong oxidant (hydrogen peroxide).
pH_{KCl}	pH in a 1M potassium chloride solution (laboratory measured).
pH_{OX}	pH in a peroxide oxidised suspension as per the SPOCAS method (laboratory measured).
Potential acidity	The latent acidity in ASS that can be generated if the sulfide minerals present are fully oxidised to generate sulfuric acid. It is estimated by measurement of S_{POS} (SPOCAS Suite) or SCR (Chromium Suite).
pyrite	Iron (II) sulfide, FeS_2. Pyrite is the most common sulfide mineral and the major acid forming mineral oxidising to produce sulfuric acid
Retained acidity	The less available fraction of existing acidity which is not measured as part of TAA and is due to hydrolysis of relatively insoluble minerals such alunite and jarosite.
Rutile	Titanium dioxide (TiO_2)
SAR	Sodium Absorption Ratio.
S_{CR}	The symbol often given to the result for sulfur measured by the chromium reducible sulfur method i.e. CRS.
TAA	Titratable actual acidity. Used in both the SCR and SPOCAS suites; it determines the present soil acidity by titration with sodium hydroxide after extraction in potassium chloride up to pH 6.5.
Zircon	Zirconium dioxide (ZrO_2). Often used to also describe zirconium silicate ($ZrSiO_4$)

APPENDICES

APPENDIX 1: COLLATED DATA

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Table A1-1: Sample Descriptions

Sample ID	Drill Hole	Depth (m)	Sample Type	Distance to Water Table (m)*
SB003694	THAC268	63 - 64.5	Unmineralised Basement	-21
SB003663	THAC268	17 – 18.5	Mineralised Waste Above Orebody	26.5
SB003685	THAC268	49.5 - 51	Mineralised Waste Below Orebody	-7.5
SB003658	THAC268	9.5 – 11	Overburden	34
SB003679	THAC268	40.5 - 42	Orebody	3
SB003681	THAC268	43.5 – 45	Orebody	-1.5
SB003680	THAC268	42 - 43.5	Orebody	0
SB001970	THAC347	18 – 21	Mineralised Waste Above Orebody	18
SB001978	THAC347	42 – 45	Mineralised Waste Below Orebody	-9
SB001965	THAC347	3 – 6	Overburden	33
SB001974	THAC347	30 – 33	Orebody	6
SB001976	THAC347	36 – 39	Orebody	-3
SB001975	THAC347	33 – 36	Orebody	0
SB004268	THAC361	69 – 72	Basement	-33
SB004250	THAC361	15 – 18	Mineralised Waste Above Orebody	24
SB004261	THAC361	48 – 51	Mineralised Waste Below Orebody	-12
SB004247	THAC361	6 - 9	Overburden	33
SB004389	THAC367	12 - 15	Overburden	27
SB004962	THAC370	36 – 39	Mineralised Waste Below Orebody	6
SB004964	THAC370	42 – 45	Mineralised Waste Below Orebody	1.5
SB004963	THAC370	39 – 42	Mineralised Waste Below Orebody	0
SB004951	THAC370	3 – 6	Overburden	39
SB005597	THAC400	23 – 24.5	Mineralised Waste Above Orebody	1.5
SB005599	THAC400	26 – 27.5	Mineralised Waste Above Orebody	-3
SB005598	THAC400	24.5 – 26	Mineralised Waste Above Orebody	0
SB006113	THAC408	88.5 – 90	Basement	-53.5
SB006076	THAC408	33.5 – 35	Mineralised Waste Above Orebody	3
SB006078	THAC408	36.5 – 38	Mineralised Waste Above Orebody	-1.5
SB006077	THAC408	35 – 36.5	Mineralised Waste Above Orebody	0
SB006100	THAC408	69 – 70.5	Mineralised Waste Above Orebody	-34
SB006061	THAC408	11 – 12.5	Overburden	25.5
SB006091	THAC408	55.5 – 57	Orebody	-20.5
SB006238	THAC411	37 – 38.5	Mineralised Waste Above Orebody	1.5
SB006240	THAC411	40 – 41.5	Mineralised Waste Above Orebody	-3
SB006239	THAC411	38.5 – 40	Mineralised Waste Above Orebody	0
SB008549	THAC442	25.5 – 27	Overburden	1.5
SB008551	THAC442	28.5 – 30	Overburden	-3
SB008550	THAC442	27 – 28.5	Overburden	0
SB012878	THAC448	52.5 – 54	Mineralised Waste Above Orebody	-24.5
SB012707	THAC448	96 – 97.5	Mineralised Waste Below Orebody	-68
SB012859	THAC448	25.5 – 27	Overburden	4
SB012861	THAC448	29.5 – 30.5	Overburden	-1

Sample ID	Drill Hole	Depth (m)	Sample Type	Distance to Water Table (m)*
SB012860	THAC448	27 – 29.5	Overburden	0
SB012894	THAC448	76.5 - 78	Orebody	-48.5
SB013522	THAC465	12 – 13.5	Mineralised Waste Below Orebody	24
SB013517	THAC465	4.5 – 6	Orebody	31.5
SB013628	THAC469	15 – 16.5	Mineralised Waste Below Orebody	16.5
SB013622	THAC469	6 – 7.5	Orebody	25.5
SB014304	THAC483	0 – 1.5	Mineralised Waste Above Orebody	38
SB014313	THAC483	13.5 – 15	Mineralised Waste Below Orebody	24.5
SB014431	THAC486	40.5 - 42	Mineralised Waste Below Orebody	1.5
SB014433	THAC486	43.5 – 45	Mineralised Waste Below Orebody	-1.5
SB014432	THAC486	42 – 43.5	Mineralised Waste Below Orebody	0
SB014408	THAC486	6 – 7.5	Overburden	37.5
SB014422	THAC486	27 – 28.5	Orebody	16.5
SB001977	THAC347	39 – 42	Orebody	-6
SB002728	THAC246	27 -28.5	Mineralised Waste Below Orebody	10.5

** Positive values above water table, negative below +/- 3m accuracy (maximum sample width)*

Table A1-2: Acid Base Accounting

Sample	Sample Type	Distance to WT (m)	Total S %	CRS %	pH (1:5)	ANC	AP (MPA)	NAPP	NAG pH	NAG to pH 4.5 kg H_2SO_4/t	NAG to pH 7 kg H_2SO_4/t	Classification
					pH units	kg H_2SO_4/t			pH units	kg H_2SO_4/t		
SB003694	Basement	-21	<0.01		6.5							Barren
SB003663	Min. Waste Above Ore	26.5	<0.01		6.3							Barren
SB003685	Min. Waste Below Ore	-7.5	0.01		6.3							Barren
SB003658	Overburden	34	<0.01		6.4							Barren
SB003679	Orebody	3	0.01		5.6							Barren
SB003681	Orebody	-1.5	<0.01		5.7							Barren
SB003680	Orebody	0	0.01		6.2							Barren
SB001970	Min. Waste Above Ore	18	<0.01		6.5							Barren
SB001978	Min. Waste Below Ore	-9	<0.01		6.7							Barren
SB001965	Overburden	33	<0.01		5.5							Barren
SB001974	Orebody	6	<0.01		6.9							Barren
SB001976	Orebody	-3	<0.01		6.8							Barren
SB001975	Orebody	0	<0.01		6.9							Barren
SB004268	Basement	-33	<0.01		6.2							Barren
SB004250	Min. Waste Above Ore	24	<0.01		6.5							Barren
SB004261	Min. Waste Below Ore	-12	<0.01		6.4							Barren
SB004247	Overburden	33	<0.01		6.1							Barren
SB004389	Overburden	27	<0.01		6.1							Barren
SB004962	Min. Waste Below Ore	6	<0.01		6.2							Barren
SB004964	Min. Waste Below Ore	1.5	<0.01		6.6							Barren
SB004963	Min. Waste Below Ore	0	<0.01		6.6							Barren
SB004951	Overburden	39	<0.01		6.0							Barren
SB005597	Min. Waste Above Ore	1.5	<0.01		6.6							Barren
SB005599	Min. Waste Above Ore	-3	<0.01		6.7							Barren
SB005598	Min. Waste Above Ore	0	<0.01		6.5							Barren

Sample	Sample Type	Distance to WT (m)	Total S %	CRS %	pH (1:5)	ANC	AP (MPA)	NAPP	NAG pH	NAG to pH 4.5 kg H_2SO_4/t	NAG to pH 7 kg H_2SO_4/t	Classification
					pH units	kg H_2SO_4/t			pH units	kg H_2SO_4/t		
SB006113	Basement	-53.5	0.22	0.129	3.1	0	3.9	3.9	3.3	3	7	PAF-LC
SB006076	Min. Waste Above Ore	3	<0.01		5.6							Barren
SB006078	Min. Waste Above Ore	-1.5	<0.01		6.3							Barren
SB006077	Min. Waste Above Ore	0	<0.01		5.1							Barren
SB006100	Min. Waste Above Ore	-34	<0.01		6.4							Barren
SB006061	Overburden	25.5	<0.01		6.1							Barren
SB006091	Orebody	-20.5	0.02		6.4							Barren
SB006238	Min. Waste Above Ore	1.5	0.01		6.1							Barren
SB006240	Min. Waste Above Ore	-3	0.02		5.6							Barren
SB006239	Min. Waste Above Ore	0	0.01		6							Barren
SB008549	Overburden	1.5	0.01		6.4							Barren
SB008551	Overburden	-3	<0.01		6.5							Barren
SB008550	Overburden	0	<0.01		6.4							Barren
SB012878	Min. Waste Above Ore	-24.5	<0.01		6.3							Barren
SB012707	Min. Waste Below Ore	-68	0.96	0.644	3.1	-2	19.7	22	2.5	19	25	PAF-HC
SB012859	Overburden	4	<0.01		6.2							Barren
SB012861	Overburden	-1	<0.01		6.5							Barren
SB012860	Overburden	0	<0.01		6.7							Barren
SB012894	Orebody	-48.5	0.02		6.2							Barren
SB013522	Min. Waste Below Ore	24	0.03		6.3							Barren
SB013517	Orebody	31.5	0.03		6.2							Barren
SB013628	Min. Waste Below Ore	16.5	<0.01		6.4							Barren
SB013622	Orebody	25.5	0.01		5.8							Barren
SB014304	Min. Waste Above Ore	38	0.01		6.7							Barren
SB014313	Min. Waste Below Ore	24.5	<0.01		7.2							Barren
SB014431	Min. Waste Below Ore	1.5	<0.01		6.2							Barren
SB014433	Min. Waste Below Ore	-1.5	<0.01		6.2							Barren

Sample	Sample Type	Distance to WT (m)	Total S %	CRS %	pH (1:5)	ANC	AP (MPA)	NAPP	NAG pH	NAG to pH 4.5 kg H_2SO_4/t	NAG to pH 7 kg H_2SO_4/t	Classification
					pH units	kg H_2SO_4/t			pH units	kg H_2SO_4/t		
SB014432	Min. Waste Below Ore	0	0.01		6.3							Barren
SB014408	Overburden	37.5	<0.01		6.3							Barren
SB014422	Orebody	16.5	0.01		6.6							Barren
SB001977	Orebody	-6	<0.01		6.6							Barren
SB002728	Min. Waste Below Ore	10.5	<0.01		6.7							Barren

Table A1-3: Elemental Analysis Mine Waste Samples

Sample Number	Sample Type	Al	As	Ba	Ca	Cd	Cr	Cu	Fe	K	Mg	Mn
		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg
SB003679	Orebody	2.23	29	51	100	0.06	147	4	10.1	460	240	920
SB003681	Orebody	2.25	24	56	81	0.05	110	<1	7.39	450	180	490
SB004268	Basement	3.03	25	85	104	<0.02	47	18	2.71	1,050	180	56
SB005597	Min. Waste Above Ore	1.69	11	47	59	<0.02	57	5	1.42	360	120	79
SB006078	Min. Waste Above Ore	1.55	6.5	52	72	<0.02	60	2	0.86	260	120	160
SB012859	Overburden	1.15	2.4	37	61	<0.02	88	13	0.54	330	130	24
SB012861	Overburden	0.95	7.3	34	58	<0.02	47	3	0.92	300	92	25
SB014431	Min. Waste Below Ore	2.62	14	62	81	<0.02	86	<1	4.24	530	150	350
SB014433	Min. Waste Below Ore	2.42	20	71	84	<0.02	96	<1	7.04	540	160	450

Table A1-3: Elemental Analysis , continued

Sample Number	Sample Type	Mo	Na	Ni	Pb	Sb	Se	Sn	Th	U	V	Zn
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SB003679	Orebody	2.2	98	17	36	0.37	3.8	3.4	160	16	300	95
SB003681	Orebody	1.6	93	14	29	0.30	2.6	2.5	110	11	220	63
SB004268	Basement	0.7	92	3	33	0.24	0.9	1.4	25	2.8	190	25
SB005597	Min. Waste Above Ore	0.3	63	5	14	0.18	<0.5	0.8	17	2.4	91	25
SB006078	Min. Waste Above Ore	0.3	73	3	11	0.18	<0.5	1.2	28	2.5	83	13
SB012859	Overburden	0.5	64	5	5.0	0.14	<0.5	0.5	3.5	0.42	15	11
SB012861	Overburden	0.3	43	2	5.4	0.18	<0.5	0.3	3.1	0.56	25	8
SB014431	Min. Waste Below Ore	0.5	71	7	21	0.21	1.4	1.9	82	7.2	190	45
SB014433	Min. Waste Below Ore	0.6	64	10	40	0.21	3.1	2.4	140	12	220	55

All units of measure are mg/kg unless otherwise specified

Table A1-4: Global Abundance Index Classification

Sample Number	Sample Type	Al	As	Ba	Ca	Cd	Cr	Cu	Fe	K	Mg	Mn
SB003679	Orebody	0	0	0	0	0	0	0	1	0	0	0
SB003681	Orebody	0	0	0	0	0	0	0	0	0	0	0
SB004268	Basement	0	0	0	0	0	0	0	0	0	0	0
SB005597	Min. Waste Above Ore	0	0	0	0	0	0	0	0	0	0	0
SB006078	Min. Waste Above Ore	0	0	0	0	0	0	0	0	0	0	0
SB012859	Overburden	0	0	0	0	0	0	0	0	0	0	0
SB012861	Overburden	0	0	0	0	0	0	0	0	0	0	0
SB014431	Min. Waste Below Ore	0	0	0	0	0	0	0	0	0	0	0
SB014433	Min. Waste Below Ore	0	0	0	0	0	0	0	0	0	0	0
Average Crustal/Soil Abundance (mg/kg)		**82000**	**25**	**500**	**41000**	**0.11**	**100**	**50**	**4.1**	**21000**	**23000**	**950**

Table A1-4: Global Abundance Index Classification, continued

Sample Number	Lithology	Mo	Na	Ni	Pb	Sb	Se	Sn	Th	U	V	Zn
SB003679	Orebody	0	0	0	1	0	4	0	3	2	0	0
SB003681	Orebody	0	0	0	0	0	3	0	3	1	0	0
SB004268	Basement	0	0	0	1	0	2	0	1	0	0	0
SB005597	Min. Waste Above Ore	0	0	0	0	0	0	0	0	0	0	0
SB006078	Min. Waste Above Ore	0	0	0	0	0	0	0	1	0	0	0
SB012859	Overburden	0	0	0	0	0	0	0	0	0	0	0
SB012861	Overburden	0	0	0	0	0	0	0	0	0	0	0
SB014431	Min. Waste Below Ore	0	0	0	0	0	2	0	2	1	0	0
SB014433	Min. Waste Below Ore	0	0	0	1	0	3	0	3	2	0	0
Average Crustal/Soil Abundance (mg/kg)		**1.5**	**23000**	**80**	**14**	**0.2**	**0.2**	**2**	**10**	**2.7**	**160**	**75**

Table A1-5: pH, EC (1:5 Extract) and Alkalinity (1:20 Extract) Mine Waste Samples

Sample Number	Sample Type	pH pH units	EC µS/cm	Alkalinity			
				HCO_3	CO_3	OH	Total
				mg $CaCO_3$/L			
SB003694	Basement	6.5	24	nm	nm	nm	nm
SB003663	Min. Waste Above Ore	6.3	19	nm	nm	nm	nm
SB003685	Min. Waste Below Ore	6.3	55	nm	nm	nm	nm
SB003658	Overburden	6.4	15	nm	nm	nm	nm
SB003679	Orebody	5.6	32	<5	<5	<1	<5
SB003681	Orebody	5.7	41	<5	<5	<1	<5
SB003680	Orebody	6.2	58	nm	nm	nm	nm
SB001970	Min. Waste Above Ore	6.5	19	nm	nm	nm	nm
SB001978	Min. Waste Below Ore	6.7	23	nm	nm	nm	nm
SB001965	Overburden	5.5	15	nm	nm	nm	nm
SB001974	Orebody	6.9	17	nm	nm	nm	nm
SB001976	Orebody	6.8	24	nm	nm	nm	nm
SB001975	Orebody	6.9	22	nm	nm	nm	nm
SB004268	Basement	6.2	27	5	<5	<1	5
SB004250	Min. Waste Above Ore	6.5	18	nm	nm	nm	nm
SB004261	Min. Waste Below Ore	6.4	24	nm	nm	nm	nm
SB004247	Overburden	6.1	23	nm	nm	nm	nm
SB004389	Overburden	6.1	12	nm	nm	nm	nm
SB004962	Min. Waste Below Ore	6.2	28	nm	nm	nm	nm
SB004964	Min. Waste Below Ore	6.6	19	nm	nm	nm	nm
SB004963	Min. Waste Below Ore	6.6	47	nm	nm	nm	nm
SB004951	Overburden	6.0	13	nm	nm	nm	nm
SB005597	Min. Waste Above Ore	6.6	14	5	<5	<1	5
SB005599	Min. Waste Above Ore	6.7	15	nm	nm	nm	nm
SB005598	Min. Waste Above Ore	6.5	14	nm	nm	nm	nm
SB006113	Basement	3.1	584	nm	nm	nm	nm
SB006076	Min. Waste Above Ore	5.6	14	nm	nm	nm	nm
SB006078	Min. Waste Above Ore	6.3	28	5	<5	<1	5
SB006077	Min. Waste Above Ore	5.1	30	nm	nm	nm	nm
SB006100	Min. Waste Above Ore	6.4	29	nm	nm	nm	nm
SB006061	Overburden	6.1	19	nm	nm	nm	nm
SB006091	Orebody	6.4	52	nm	nm	nm	nm
SB006238	Min. Waste Above Ore	6.1	40	nm	nm	nm	nm
SB006240	Min. Waste Above Ore	5.6	25	nm	nm	nm	nm
SB009239	Min. Waste Above Ore	6.0	27	nm	nm	nm	nm
SB008549	Overburden	6.4	16	nm	nm	nm	nm
SB008551	Overburden	6.5	13	nm	nm	nm	nm

Sample Number	Sample Type	pH pH units	EC µS/cm	Alkalinity			
				HCO_3	CO_3	OH	Total
				mg $CaCO_3$/L			
SB008550	Overburden	6.4	27	nm	nm	nm	nm
SB012878	Min. Waste Above Ore	6.3	14	nm	nm	nm	nm
SB012707	Min. Waste Below Ore	3.1	1,138	nm	nm	nm	nm
SB012859	Overburden	6.2	32	<5	<5	<1	<5
SB012861	Overburden	6.5	15	6	<5	<1	6
SB012860	Overburden	6.7	49	nm	nm	nm	nm
SB012894	Orebody	6.2	23	nm	nm	nm	nm
SB013522	Min. Waste Below Ore	6.3	8	nm	nm	nm	nm
SB013517	Orebody	6.2	43	nm	nm	nm	nm
SB013628	Min. Waste Below Ore	6.4	9	nm	nm	nm	nm
SB013622	Orebody	5.8	12	nm	nm	nm	nm
SB014304	Min. Waste Above Ore	6.7	25	nm	nm	nm	nm
SB014313	Min. Waste Below Ore	7.2	125	nm	nm	nm	nm
SB014431	Min. Waste Below Ore	6.2	9	<5	<5	<1	<5
SB014433	Min. Waste Below Ore	6.2	15	5	<5	<1	5
SB014432	Min. Waste Below Ore	6.3	10	nm	nm	nm	nm
SB014408	Overburden	6.3	18	nm	nm	nm	nm
SB014422	Orebody	6.6	25	nm	nm	nm	nm
SB001977	Orebody	6.6	31	nm	nm	nm	nm
SB002728	Min. Waste Below Ore	6.7	18	nm	nm	nm	nm

nm = not measured

Table A1-6: Major Ions Mine Waste Samples (1:20 Extract)

Sample Number	Sample Type	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO_4 mg/L	F mg/L	SAR
SB003679	Orebody	0.04	0.18	4.0	0.6	5	2.82	<0.1	1.9
SB003681	Orebody	0.07	0.16	6.5	0.7	6	4.48	<0.1	3.1
SB004268	Basement	0.29	0.55	2.8	1.2	4	0.67	<0.1	0.7
SB005597	Min. Waste Above Ore	0.01	0.02	2.0	0.4	6	0.30	0.1	2.6
SB006078	Min. Waste Above Ore	0.07	0.12	3.6	1.0	4	3.68	0.1	1.9
SB012859	Overburden	0.18	0.50	4.5	0.8	7	1.46	<0.1	1.2
SB012861	Overburden	0.05	0.07	2.5	0.5	3	0.66	0.1	1.7
SB014431	Min. Waste Below Ore	0.02	0.02	1.3	0.4	2	<0.03	<0.1	1.5
SB014433	Min. Waste Below Ore	0.09	0.14	1.9	0.6	3	<0.03	<0.1	0.9

Table A1-7: Water Soluble Metals and Metalloids Mine Waste Samples (1:20 Extract)

Sample Number	Sample Type	Al	As	B	Ba	Cd	Cr	Cu	Fe	Mn	Mo
SB003679	Orebody	0.05	<0.0001	<0.01	0.00335	<0.0002	<0.01	<0.01	0.06	0.007	<0.00005
SB003681	Orebody	0.05	<0.0001	<0.01	0.00114	<0.0002	<0.01	<0.01	0.07	0.002	<0.00005
SB004268	Basement	0.11	<0.0001	<0.01	0.01305	<0.0002	<0.01	<0.01	0.01	0.007	<0.00005
SB005597	Min. Waste Above Ore	0.1	0.0007	<0.01	0.00076	<0.0002	<0.01	<0.01	0.01	<0.001	0.00013
SB006078	Min. Waste Above Ore	1.07	0.0004	<0.01	0.00326	<0.0002	<0.01	<0.01	0.05	0.002	0.00024
SB012859	Overburden	2.12	0.0004	<0.01	0.01311	<0.0002	<0.01	<0.01	0.61	0.012	0.00014
SB012861	Overburden	0.13	0.0012	<0.01	0.00109	<0.0002	<0.01	<0.01	0.04	<0.001	0.00065
SB014431	Min. Waste Below Ore	0.1	0.0001	<0.01	0.00092	<0.0002	<0.01	<0.01	0.08	<0.001	<0.00005
SB014433	Min. Waste Below Ore	0.2	0.0005	<0.01	0.00292	<0.0002	<0.01	<0.01	0.37	0.001	<0.00005
Freshwater		**0.055**	**0.024**	**0.37**	**N/G**	**0.0002**	**N/G**	**0.0014**	**N/G**	**1.9**	**N/G**
Livestock Drinking Water*		**5**	**0.5**	**5**	**N/G**	**0.01**	**1**	**1***	**N/G**	**N/G**	**0.15**
Human Drinking Water		**0.2**	**0.01**	**4**	**2**	**0.002**	**0.05 (Cr(VI))**	**2**	**N/G**	**0.5**	**0.05**

Table A1-7: Water Soluble Metals and Metalloids Mine Waste Samples (1:20 Extract), continued

Sample Number	Sample Type	Ni	Pb	Sb	Se	Sn	Th (µg/L)	U (µg/L)	V	Zn
SB003679	Orebody	<0.01	<0.0005	<0.0001	<0.0005	<0.0001	0.047	0.007	<0.01	<0.01
SB003681	Orebody	<0.01	<0.0005	<0.0001	<0.0005	<0.0001	0.023	<0.005	<0.01	<0.01
SB004268	Basement	<0.01	<0.0005	0.00006	<0.0005	<0.0001	0.045	0.013	<0.01	0.07
SB005597	Min. Waste Above Ore	<0.01	<0.0005	0.00011	<0.0005	<0.0001	0.01	0.026	<0.01	<0.01
SB006078	Min. Waste Above Ore	<0.01	<0.0005	0.00012	<0.0005	<0.0001	0.203	0.038	<0.01	0.02
SB012859	Overburden	<0.01	<0.0005	0.00009	<0.0005	<0.0001	0.272	0.031	<0.01	<0.01
SB012861	Overburden	<0.01	<0.0005	0.00029	<0.0005	<0.0001	0.035	0.023	<0.01	<0.01
SB014431	Min. Waste Below Ore	<0.01	<0.0005	<0.0001	<0.0005	<0.0001	0.03	<0.005	<0.01	<0.01
SB014433	Min. Waste Below Ore	<0.01	<0.0005	0.00005	<0.0005	<0.0001	0.145	0.01	<0.01	<0.01
Freshwater		**0.011**	**0.0034**	**N/G**	**0.005**	**N/G**	**N/G**	**N/G**	**N/G**	**0.008**
Livestock Drinking Water		**1**	**0.1**	**N/G**	**0.02**	**N/G**	**N/G**	**200**	**N/G**	**20**
Human Drinking Water		**0.02**	**0.01**	**N/G**	**0.01**	**N/G**	**N/G**	**17**	**N/G**	**3**

**Beef cattle value used for copper guideline comparison.*

All units of measure are mg/L unless specified

Table A1-8: Dilute Acetic Acid ASLP Extract, Metals and Metalloids (1:20)

Sample Number	Sample Type	Al	As	B	Ba	Ca	Cd	Cr	Cu	Fe	K	Mg	Mn
SB003679	Orebody	1.25	<0.0001	<0.01	0.049	0.27	<0.0002	<0.01	0.05	0.43	0.2	0.88	0.054
SB003681	Orebody	0.90	<0.0001	<0.01	0.035	0.48	<0.0002	<0.01	0.03	0.32	0.4	0.85	0.035
SB004268	Basement	0.32	<0.0001	<0.01	0.127	0.90	<0.0002	<0.01	<0.01	0.21	0.5	1.25	0.036
SB005597	Min. Waste Above Ore	4.78	<0.0001	<0.01	0.138	0.43	<0.0002	0.01	<0.01	0.49	0.5	1.33	0.013
SB006078	Min. Waste Above Ore	3.47	0.0003	<0.01	0.110	0.66	<0.0002	<0.01	<0.01	0.61	0.6	0.71	0.033
SB012859	Overburden	6.25	0.0003	<0.01	0.172	1.06	<0.0002	0.04	0.09	2.56	0.7	2.17	0.078
SB012861	Overburden	2.36	0.0001	<0.01	0.082	1.12	<0.0002	0.01	<0.01	0.94	0.5	1.45	0.020
SB014431	Min. Waste Below Ore	2.03	<0.0001	<0.01	0.101	0.82	<0.0002	<0.01	<0.01	0.15	0.3	0.96	0.048
SB014433	Min. Waste Below Ore	1.64	<0.0001	<0.01	0.084	0.65	<0.0002	<0.01	<0.01	0.34	0.3	0.8	0.016

All units of measure are mg/L unless specified

Table A1-8: Dilute Acetic Acid ASLP Extract, Metals and Metalloids, continued

Sample Number	Sample Type	Mo	Na	Ni	Pb	S	Sb	Se	Sn	Th (µg/L)	U (µg/L)	V	Zn
SB003679	Orebody	<0.00005	1.1	<0.01	<0.0005	0.07	<0.0001	<0.0005	<0.0001	5.39	4.69	<0.01	0.06
SB003681	Orebody	<0.00005	1.7	<0.01	<0.0005	<0.05	<0.0001	<0.0005	<0.0001	3.48	3.99	<0.01	0.04
SB004268	Basement	<0.00005	0.8	<0.01	<0.0005	0.07	<0.0001	<0.0005	<0.0001	0.56	3.12	<0.01	0.45
SB005597	Min. Waste Above Ore	<0.00005	0.8	<0.01	<0.0005	<0.05	<0.0001	<0.0005	<0.0001	1.05	2.21	<0.01	0.02
SB006078	Min. Waste Above Ore	<0.00005	1.1	<0.01	<0.0005	0.17	<0.0001	<0.0005	<0.0001	2.52	1.42	<0.01	0.27
SB012859	Overburden	<0.00005	1.4	<0.01	<0.0005	<0.05	<0.0001	<0.0005	<0.0001	0.83	1.30	<0.01	0.08
SB012861	Overburden	0.00005	0.8	<0.01	<0.0005	<0.05	<0.0001	<0.0005	<0.0001	1.07	1.19	<0.01	0.15
SB014431	Min. Waste Below Ore	<0.00005	0.4	<0.01	<0.0005	<0.05	<0.0001	<0.0005	<0.0001	0.81	3.69	<0.01	0.04
SB014433	Min. Waste Below Ore	<0.00005	0.6	<0.01	<0.0005	<0.05	<0.0001	<0.0005	<0.0001	4.83	3.51	<0.01	0.16

All units of measure are mg/L unless specified

Table A1-9: Exchangeable Cations, Mine Waste Samples

Sample Number	Sample Type	Ca	Mg	Na	K	ECEC	ESP
		centimoles (+)/kg					%
SB003679	Orebody	0.07	0.08	0.02	0.03	0.2	10.9
SB003681	Orebody	0.07	0.08	0.07	0.03	0.2	26.8
SB004268	Basement	0.09	0.08	0.02	0.03	0.2	9.9
SB005597	Min. Waste Above Ore	0.06	0.20	0.05	0.03	0.3	14.5
SB006078	Min. Waste Above Ore	0.07	0.08	0.02	0.03	0.2	10.9
SB012859	Overburden	0.11	0.32	0.02	0.06	0.5	4.3
SB012861	Overburden	0.10	0.18	0.02	0.03	0.3	6.6
SB014431	Min. Waste Below Ore	0.09	0.08	0.02	0.03	0.2	9.9
SB014433	Min. Waste Below Ore	0.07	0.08	0.02	0.03	0.2	10.6

APPENDIX 2: PARTICLE SIZE DISTRIBUTION RESULTS

Intertek GENALYSIS LABORATORY SERVICES

ANALYTICAL REPORT

SHEFFIELD RESOURCES LTD
PO Box 205
WEST PERTH, W.A. 6872
AUSTRALIA

JOB INFORMATION

JOB CODE	:	1628.0/1605060
No. of SAMPLES	:	57
No. of ELEMENTS	:	40
CLIENT O/N	:	SRWAS (Job 1 of 0)
SAMPLE SUBMISSION No.	:	
PROJECT	:	THUNDERBIRD MINERAL SANDS PR(
STATE	:	Rock
DATE RECEIVED	:	19/04/2016
DATE COMPLETED	:	20/06/2016
DATE PRINTED	:	20/06/2016
ANALYSING LABORATORY	:	Intertek Genalysis Perth

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

MAIN OFFICE AND LABORATORY

15 Davison Street, Maddington 6109, Western Australia
PO Box 144, Gosnells 6990, Western Australia
Tel: +61 8 9251 8100 Fax: +61 8 9251 8110
Email: genalysis@intertek.com
Web Page: www.genalysis.com.au

KALGOORLIE SAMPLE PREPARATION DIVISION

12 Keogh Way, Kalgoorlie 6430, Western Australia
Tel: +61 8 9021 6057 Fax: +61 8 9021 3476

ADELAIDE LABORATORY

11 Senna Road, Wingfield, 5013, South Australia
Tel: +61 8 8162 9714 Fax: +61 8 8349 7444

JOHANNESBURG LABORATORY

43 Malcolm Moodie Crescent,
Jet Park, Gauteng, South Africa 1459
Tel: +27 11 552 8149 Fax: +27 11 552 8248

TOWNSVILLE LABORATORY

9-23 Kelli Street, Mt St John, Bohle, Queensland, Australia 4818
Tel: +61 7 4774 3655 Fax: +61 7 4774 4692

Results are not intended for commercial settlement purposes

SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work http://www.intertek.com/terms/

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

The results provided are not intended for commercial settlement purposes.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $4.00 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $150.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

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

ANALYSIS

ELEMENTS	Al	Al	Al	ANC	As	As
UNITS	ppm	mg/l	mg/l	kgH2SO4/t	ppm	ug/l
DETECTION LIMIT	50	0.01	0.01	1	0.5	0.1
DIGEST	4A/	Ws/	ASLP/	ANCx/	4A/	Ws/
ANALYTICAL FINISH	OE	OE	OE	VOL	MS	MS
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	2.23%	0.05	1.25		28.9	X
0004 SB003680						
0005 SB003681	2.25%	0.05	0.90		23.5	X
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	3.03%	0.11	0.32		25.3	X
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707				-2		
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	2.62%	0.10	2.03		14.1	0.1
0032 SB014432						
0033 SB014433	2.42%	0.20	1.64		19.8	0.5
0034 SB004964						
0035 SB005597	1.69%	0.10	4.78		10.6	0.7
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Ba
UNITS	ug/l	mg/l	mg/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.1	0.01	0.01	0.1	0.05	0.05
DIGEST	ASLP/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	OE	OE	MS	MS	MS
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	X	X	X	51.1	3.35	49.05
0004 SB003680						
0005 SB003681	X	X	X	55.8	1.14	34.74
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	X	X	X	84.8	13.05	126.86
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	X	X	X	62.0	0.92	100.87
0032 SB014432						
0033 SB014433	X	X	X	70.7	2.92	84.43
0034 SB004964						
0035 SB005597	X	X	X	46.9	0.76	138.28
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	CO3	Ca	Ca	Ca	Ca	Cd
UNITS	mgCaCO3/L	ppm	mg/Kg	mg/l	mg/l	ppm
DETECTION LIMIT	1	50	10	0.01	0.01	0.02
DIGEST	Ws/	4A/	AmCl7/	Ws/	ASLP/	4A/
ANALYTICAL FINISH	VOL	OE	OE	OE	OE	MS
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	X	100	14	0.04	0.27	0.06
0004 SB003680						
0005 SB003681	X	81	14	0.07	0.48	0.05
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	X	104	18	0.29	0.90	X
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	X	81	18	0.02	0.82	X
0032 SB014432						
0033 SB014433	X	84	15	0.09	0.65	X
0034 SB004964						
0035 SB005597	X	59	12	0.01	0.43	X
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Cd	Cd	Cl	ColourChange	Cr	Cr
UNITS	ug/l	ug/l	mg/L	NONE	ppm	mg/l
DETECTION LIMIT	0.02	0.02	2	0	5	0.01
DIGEST	Ws/	ASLP/	Ws/	ANCx/	4A/	Ws/
ANALYTICAL FINISH	MS	MS	VOL	QUAL	OE	OE
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	X	X	5		147	X
0004 SB003680						
0005 SB003681	X	X	6		110	X
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	X	X	4		47	X
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707				No		
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	X	X	2		86	X
0032 SB014432						
0033 SB014433	X	X	3		96	X
0034 SB004964						
0035 SB005597	X	X	6		57	X
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Cr	Cu	Cu	Cu	EC	F
UNITS	mg/l	ppm	mg/l	mg/l	uS/cm	mg/L
DETECTION LIMIT	0.01	1	0.01	0.01	5	0.1
DIGEST	ASLP/	4A/	Ws/	ASLP/	Ws/	Ws/
ANALYTICAL FINISH	OE	OE	OE	OE	MTR	SIE
SAMPLE NUMBERS						
0001 SB003658					15	
0002 SB003663					19	
0003 SB003679	X	4	X	0.05	32	X
0004 SB003680					58	
0005 SB003681	X	X	X	0.03	41	X
0006 SB003685					55	
0007 SB003694					24	
0008 SB001965					15	
0009 SB001970					19	
0010 SB001974					17	
0011 SB001975					22	
0012 SB001976					24	
0013 SB001978					23	
0014 SB004247					23	
0015 SB004250					18	
0016 SB004261					24	
0017 SB004268	X	18	X	X	27	X
0018 SB004389					12	
0019 SB004951					13	
0020 SB004962					28	
0021 SB004963					47	
0022 SB012707					1138	
0023 SB013517					43	
0024 SB013522					8	
0025 SB013622					12	
0026 SB013628					9	
0027 SB014304					25	
0028 SB014313					125	
0029 SB014408					18	
0030 SB014422					25	
0031 SB014431	X	X	X	X	9	X
0032 SB014432					10	
0033 SB014433	X	X	X	X	15	X
0034 SB004964					19	
0035 SB005597	0.01	5	X	X	14	0.1
0036 SB005598					14	
0037 SB005599					15	
0038 SB006061					19	
0039 SB006076					14	
0040 SB006077					30	

ANALYSIS

ELEMENTS	Fe	Fe	Fe	Final-pH	Final-pH	Fizz-Rate
UNITS	%	mg/l	mg/l	NONE	NONE	NONE
DETECTION LIMIT	0.01	0.01	0.01	0.1	0.1	0
DIGEST	4A/	Ws/	ASLP/	ASLP/	ANCx/	ANCx/
ANALYTICAL FINISH	OE	OE	OE	MTR	MTR	QUAL
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	10.12	0.06	0.43	2.9		
0004 SB003680						
0005 SB003681	7.39	0.07	0.32	2.9		
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	2.71	0.01	0.21	2.9		
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707					1.6	0.0000000
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	4.24	0.08	0.15	3.0		
0032 SB014432						
0033 SB014433	7.04	0.37	0.34	2.9		
0034 SB004964						
0035 SB005597	1.42	0.01	0.49	3.0		
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	HCO3	K	K	K	K	Mg
UNITS	mgCaCO3/L	ppm	mg/Kg	mg/l	mg/l	ppm
DETECTION LIMIT	5	20	20	0.1	0.1	20
DIGEST	Ws/	4A/	AmCl7/	Ws/	ASLP/	4A/
ANALYTICAL FINISH	VOL	OE	OE	OE	OE	OE
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	X	462	X	0.6	0.2	236
0004 SB003680						
0005 SB003681	X	449	X	0.7	0.4	177
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	5	1055	X	1.2	0.5	181
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	X	530	X	0.4	0.3	153
0032 SB014432						
0033 SB014433	5	543	X	0.6	0.3	160
0034 SB004964						
0035 SB005597	5	360	X	0.4	0.5	121
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Mg	Mg	Mg	Mn	Mn	Mn
UNITS	mg/Kg	mg/l	mg/l	ppm	mg/l	mg/l
DETECTION LIMIT	20	0.01	0.01	1	0.001	0.001
DIGEST	AmCl7/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	OE	OE	OE	OE	OE	OE
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	X	0.18	0.88	915	0.007	0.054
0004 SB003680						
0005 SB003681	X	0.16	0.85	493	0.002	0.035
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	X	0.55	1.25	56	0.007	0.036
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	X	0.02	0.96	348	X	0.048
0032 SB014432						
0033 SB014433	X	0.14	0.80	449	0.001	0.016
0034 SB004964						
0035 SB005597	24	0.02	1.33	79	X	0.013
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Mo	Mo	Mo	Na	Na	Na
UNITS	ppm	ug/l	ug/l	ppm	mg/Kg	mg/l
DETECTION LIMIT	0.1	0.05	0.05	20	10	0.1
DIGEST	4A/	Ws/	ASLP/	4A/	AmCl7/	Ws/
ANALYTICAL FINISH	MS	MS	MS	OE	OE	OE
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	2.2	X	X	98	X	4.0
0004 SB003680						
0005 SB003681	1.6	X	X	93	15	6.5
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	0.7	X	X	92	X	2.8
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	0.5	X	X	71	X	1.3
0032 SB014432						
0033 SB014433	0.6	X	X	64	X	1.9
0034 SB004964						
0035 SB005597	0.3	0.13	X	63	11	2.0
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Na	NAG	NAGpH	NAG(4.5)	Ni	Ni
UNITS	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	ppm	mg/l
DETECTION LIMIT	0.1	1	0.1	1	1	0.01
DIGEST	ASLP/	NAGx/	NAGx/	NAGx/	4A/	Ws/
ANALYTICAL FINISH	OE	VOL	MTR	VOL	OE	OE
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	1.1				17	X
0004 SB003680						
0005 SB003681	1.7				14	X
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	0.8				3	X
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707		25	2.5	19		
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	0.4				7	X
0032 SB014432						
0033 SB014433	0.6				10	X
0034 SB004964						
0035 SB005597	0.8				5	X
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Ni	OH	Pb	Pb	Pb	pH
UNITS	mg/l	mgCaCO3/L	ppm	ug/l	ug/l	NONE
DETECTION LIMIT	0.01	1	0.5	0.5	0.5	0.1
DIGEST	ASLP/	Ws/	4A/	Ws/	ASLP/	Ws/
ANALYTICAL FINISH	OE	VOL	MS	MS	MS	MTR
SAMPLE NUMBERS						
0001 SB003658						6.4
0002 SB003663						6.3
0003 SB003679	X	X	35.8	X	0.8	5.6
0004 SB003680						6.2
0005 SB003681	X	X	28.8	X	0.5	5.7
0006 SB003685						6.3
0007 SB003694						6.5
0008 SB001965						5.5
0009 SB001970						6.5
0010 SB001974						6.9
0011 SB001975						6.9
0012 SB001976						6.8
0013 SB001978						6.7
0014 SB004247						6.1
0015 SB004250						6.5
0016 SB004261						6.4
0017 SB004268	X	X	33.1	X	X	6.2
0018 SB004389						6.1
0019 SB004951						6.0
0020 SB004962						6.2
0021 SB004963						6.6
0022 SB012707						3.1
0023 SB013517						6.2
0024 SB013522						6.3
0025 SB013622						5.8
0026 SB013628						6.4
0027 SB014304						6.7
0028 SB014313						7.2
0029 SB014408						6.3
0030 SB014422						6.6
0031 SB014431	X	X	21.4	X	X	6.2
0032 SB014432						6.3
0033 SB014433	X	X	40.5	X	X	6.2
0034 SB004964						6.6
0035 SB005597	X	X	14.0	X	X	6.6
0036 SB005598						6.5
0037 SB005599						6.7
0038 SB006061						6.1
0039 SB006076						5.6
0040 SB006077						5.1

Results are not intended for commercial settlement purposes

ANALYSIS

ELEMENTS	S	S	S	S	S	SO4
UNITS	%	ppm	mg/l	mg/l	%	%
DETECTION LIMIT	0.01	50	0.05	0.05	0.005	0.03
DIGEST		4A/	Ws/	ASLP/	SCR/	
ANALYTICAL FINISH	/CSA	OE	OE	OE	VOL	/CALC
SAMPLE NUMBERS						
0001 SB003658	X					
0002 SB003663	X					
0003 SB003679	0.01	74	0.94	0.07		2.82
0004 SB003680	0.01					
0005 SB003681	X	54	1.49	X		4.48
0006 SB003685	0.01					
0007 SB003694	X					
0008 SB001965	X					
0009 SB001970	X					
0010 SB001974	X					
0011 SB001975	X					
0012 SB001976	X					
0013 SB001978	X					
0014 SB004247	X					
0015 SB004250	X					
0016 SB004261	X					
0017 SB004268	X	53	0.22	0.07		0.67
0018 SB004389	X					
0019 SB004951	X					
0020 SB004962	X					
0021 SB004963	X					
0022 SB012707	0.96				0.644	
0023 SB013517	0.03					
0024 SB013522	0.03					
0025 SB013622	0.01					
0026 SB013628	X					
0027 SB014304	0.01					
0028 SB014313	X					
0029 SB014408	X					
0030 SB014422	0.01					
0031 SB014431	X	X	X	X		X
0032 SB014432	0.01					
0033 SB014433	X	X	X	X		X
0034 SB004964	X					
0035 SB005597	X	X	0.10	X		0.30
0036 SB005598	X					
0037 SB005599	X					
0038 SB006061	X					
0039 SB006076	X					
0040 SB006077	X					

ANALYSIS

ELEMENTS	Sb	Sb	Sb	Se	Se	Se
UNITS	ppm	ug/l	ug/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.05	0.01	0.01	0.5	0.5	0.5
DIGEST	4A/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	0.37	X	X	3.8	X	X
0004 SB003680						
0005 SB003681	0.30	X	X	2.6	X	X
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	0.24	0.06	X	0.9	X	X
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	0.21	X	X	1.4	X	X
0032 SB014432						
0033 SB014433	0.22	0.05	X	3.1	X	X
0034 SB004964						
0035 SB005597	0.18	0.11	X	X	X	X
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	Sn	Sn	Sn	Th	Th	Th
UNITS	ppm	ug/l	ug/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.1	0.1	0.1	0.01	0.005	0.005
DIGEST	4A/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	3.4	X	X	159.58	0.047	5.389
0004 SB003680						
0005 SB003681	2.5	X	X	114.76	0.023	3.484
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	1.4	X	X	24.86	0.045	0.562
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	1.9	X	X	82.30	0.030	0.810
0032 SB014432						
0033 SB014433	2.4	X	X	138.17	0.145	4.825
0034 SB004964						
0035 SB005597	0.8	X	X	16.55	0.010	1.048
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

ANALYSIS

ELEMENTS	TotAlk	U	U	U	V	V
UNITS	mgCaCO3/L	ppm	ug/l	ug/l	ppm	mg/l
DETECTION LIMIT	5	0.01	0.005	0.005	1	0.01
DIGEST		4A/	Ws/	ASLP/	4A/	Ws/
ANALYTICAL FINISH	/CALC	MS	MS	MS	OE	OE
SAMPLE NUMBERS						
0001 SB003658						
0002 SB003663						
0003 SB003679	X	16.45	0.007	4.687	305	X
0004 SB003680						
0005 SB003681	X	10.61	X	3.994	221	X
0006 SB003685						
0007 SB003694						
0008 SB001965						
0009 SB001970						
0010 SB001974						
0011 SB001975						
0012 SB001976						
0013 SB001978						
0014 SB004247						
0015 SB004250						
0016 SB004261						
0017 SB004268	5	2.79	0.013	3.122	186	X
0018 SB004389						
0019 SB004951						
0020 SB004962						
0021 SB004963						
0022 SB012707						
0023 SB013517						
0024 SB013522						
0025 SB013622						
0026 SB013628						
0027 SB014304						
0028 SB014313						
0029 SB014408						
0030 SB014422						
0031 SB014431	X	7.18	X	3.687	191	X
0032 SB014432						
0033 SB014433	5	11.82	0.010	3.512	223	X
0034 SB004964						
0035 SB005597	5	2.38	0.026	2.210	91	X
0036 SB005598						
0037 SB005599						
0038 SB006061						
0039 SB006076						
0040 SB006077						

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ANALYSIS

ELEMENTS	V	Zn	Zn	Zn
UNITS	mg/l	ppm	mg/l	mg/l
DETECTION LIMIT	0.01	1	0.01	0.01
DIGEST	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	OE	OE	OE	OE
SAMPLE NUMBERS				
0001 SB003658				
0002 SB003663				
0003 SB003679	X	95	X	0.06
0004 SB003680				
0005 SB003681	X	63	X	0.04
0006 SB003685				
0007 SB003694				
0008 SB001965				
0009 SB001970				
0010 SB001974				
0011 SB001975				
0012 SB001976				
0013 SB001978				
0014 SB004247				
0015 SB004250				
0016 SB004261				
0017 SB004268	X	25	0.07	0.45
0018 SB004389				
0019 SB004951				
0020 SB004962				
0021 SB004963				
0022 SB012707				
0023 SB013517				
0024 SB013522				
0025 SB013622				
0026 SB013628				
0027 SB014304				
0028 SB014313				
0029 SB014408				
0030 SB014422				
0031 SB014431	X	45	X	0.04
0032 SB014432				
0033 SB014433	X	55	X	0.16
0034 SB004964				
0035 SB005597	X	25	X	0.02
0036 SB005598				
0037 SB005599				
0038 SB006061				
0039 SB006076				
0040 SB006077				

ANALYSIS

ELEMENTS	Al	Al	Al	ANC	As	As
UNITS	ppm	mg/l	mg/l	kgH2SO4/t	ppm	ug/l
DETECTION LIMIT	50	0.01	0.01	1	0.5	0.1
DIGEST	4A/	Ws/	ASLP/	ANCx/	4A/	Ws/
ANALYTICAL FINISH	OE	OE	OE	VOL	MS	MS
SAMPLE NUMBERS						
0041 SB006078	1.55%	1.07	3.47		6.5	0.4
0042 SB006091						
0043 SB006100						
0044 SB006113				0		
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	1.15%	2.12	6.25		2.4	0.4
0052 SB012860						
0053 SB012861	9489	0.13	2.36		7.3	1.2
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						

CHECKS						
0001 SB004268	3.04%				25.1	
0002 SB004268			0.36			
0003 SB004268						
0004 SB003694						
0005 SB008550						

STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925	7.38%				9.9	
0004 UNI 1			25.15			
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1				97		

BLANKS						
0001 Control Blank	X				X	
0002 Control Blank			X			
0003 Control Blank						
0004 Control Blank		X				X
0005 Control Blank		X				X

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Ba
UNITS	ug/l	mg/l	mg/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.1	0.01	0.01	0.1	0.05	0.05
DIGEST	ASLP/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	OE	OE	MS	MS	MS
SAMPLE NUMBERS						
0041 SB006078	0.3	X	X	52.2	3.26	110.43
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	0.3	X	X	36.6	13.11	171.67
0052 SB012860						
0053 SB012861	0.1	X	X	34.3	1.09	82.28
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268				82.5		
0002 SB004268	X		X			123.15
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925				423.4		
0004 UNI 1			5.09			
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank				X		
0002 Control Blank	X		X			X
0003 Control Blank						
0004 Control Blank		X			X	
0005 Control Blank		X			0.15	

ANALYSIS

ELEMENTS	CO3	Ca	Ca	Ca	Ca	Cd
UNITS	mgCaCO3/L	ppm	mg/Kg	mg/l	mg/l	ppm
DETECTION LIMIT	1	50	10	0.01	0.01	0.02
DIGEST	Ws/	4A/	AmCl7/	Ws/	ASLP/	4A/
ANALYTICAL FINISH	VOL	OE	OE	OE	OE	MS
SAMPLE NUMBERS						
0041 SB006078	X	72	14	0.07	0.66	X
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	X	61	22	0.18	1.06	X
0052 SB012860						
0053 SB012861	X	58	20	0.05	1.12	X
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268		83				X
0002 SB004268					0.88	
0003 SB004268			21			
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2			2631			
0002 OREAS 45e						
0003 OREAS 925		4524				0.52
0004 UNI 1					25.50	
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank		X				X
0002 Control Blank					0.01	
0003 Control Blank			X			
0004 Control Blank	X			X		
0005 Control Blank				X		

ANALYSIS

ELEMENTS	Cd	Cd	Cl	ColourChange	Cr	Cr
UNITS	ug/l	ug/l	mg/L	NONE	ppm	mg/l
DETECTION LIMIT	0.02	0.02	2	0	5	0.01
DIGEST	Ws/	ASLP/	Ws/	ANCx/	4A/	Ws/
ANALYTICAL FINISH	MS	MS	VOL	QUAL	OE	OE
SAMPLE NUMBERS						
0041 SB006078	X	X	4		60	X
0042 SB006091						
0043 SB006100						
0044 SB006113				No		
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	X	X	7		88	X
0052 SB012860						
0053 SB012861	X	X	3		47	X
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268					53	
0002 SB004268		X				
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925					69	
0004 UNI 1						
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank					X	
0002 Control Blank		X				
0003 Control Blank						
0004 Control Blank	X		X			X
0005 Control Blank	X		X			X

ANALYSIS

ELEMENTS	Cr	Cu	Cu	Cu	EC	F
UNITS	mg/l	ppm	mg/l	mg/l	uS/cm	mg/L
DETECTION LIMIT	0.01	1	0.01	0.01	5	0.1
DIGEST	ASLP/	4A/	Ws/	ASLP/	Ws/	Ws/
ANALYTICAL FINISH	OE	OE	OE	OE	MTR	SIE
SAMPLE NUMBERS						
0041 SB006078	X	2	X	X	28	0.1
0042 SB006091					52	
0043 SB006100					29	
0044 SB006113					584	
0045 SB006238					40	
0046 SB009239					27	
0047 SB006240					25	
0048 SB008549					16	
0049 SB008550					27	
0050 SB008551					13	
0051 SB012859	0.04	13	X	0.09	32	X
0052 SB012860					49	
0053 SB012861	0.01	3	X	X	15	0.1
0054 SB012878					14	
0055 SB012894					23	
0056 SB001977					31	
0057 SB002728					18	
CHECKS						
0001 SB004268		17				
0002 SB004268	X			X		
0003 SB004268						
0004 SB003694					26	
0005 SB008550					26	
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925		6193				
0004 UNI 1	24.80			10.11		
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank		X				
0002 Control Blank	X			X		
0003 Control Blank						
0004 Control Blank			X		X	X
0005 Control Blank			X		X	X

ANALYSIS

ELEMENTS	Fe	Fe	Fe	Final-pH	Final-pH	Fizz-Rate
UNITS	%	mg/l	mg/l	NONE	NONE	NONE
DETECTION LIMIT	0.01	0.01	0.01	0.1	0.1	0
DIGEST	4A/	Ws/	ASLP/	ASLP/	ANCx/	ANCx/
ANALYTICAL FINISH	OE	OE	OE	MTR	MTR	QUAL
SAMPLE NUMBERS						
0041 SB006078	0.86	0.05	0.61	3.0		
0042 SB006091						
0043 SB006100						
0044 SB006113					1.6	0.0000000
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	0.54	0.61	2.56	3.0		
0052 SB012860						
0053 SB012861	0.92	0.04	0.94	3.0		
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268	2.72					
0002 SB004268			0.27	2.9		
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925	6.99					
0004 UNI 1			247.77			
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1					1.8	
BLANKS						
0001 Control Blank	X					
0002 Control Blank			X	2.9		
0003 Control Blank						
0004 Control Blank		X				
0005 Control Blank		X				

ANALYSIS

ELEMENTS	HCO3	K	K	K	K	Mg
UNITS	mgCaCO3/L	ppm	mg/Kg	mg/l	mg/l	ppm
DETECTION LIMIT	5	20	20	0.1	0.1	20
DIGEST	Ws/	4A/	AmCl7/	Ws/	ASLP/	4A/
ANALYTICAL FINISH	VOL	OE	OE	OE	OE	OE
SAMPLE NUMBERS						
0041 SB006078	5	264	X	1.0	0.6	118
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	X	331	22	0.8	0.7	134
0052 SB012860						
0053 SB012861	6	300	X	0.5	0.5	92
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268		1059				161
0002 SB004268					0.5	
0003 SB004268			X			
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2			142			
0002 OREAS 45e						
0003 OREAS 925		2.49%				1.81%
0004 UNI 1					24.5	
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank		X				X
0002 Control Blank					X	
0003 Control Blank			X			
0004 Control Blank	X			X		
0005 Control Blank				0.1		

ANALYSIS

ELEMENTS	Mg	Mg	Mg	Mn	Mn	Mn
UNITS	mg/Kg	mg/l	mg/l	ppm	mg/l	mg/l
DETECTION LIMIT	20	0.01	0.01	1	0.001	0.001
DIGEST	AmCl7/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	OE	OE	OE	OE	OE	OE
SAMPLE NUMBERS						
0041 SB006078	X	0.12	0.71	159	0.002	0.033
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	39	0.50	2.17	24	0.012	0.078
0052 SB012860						
0053 SB012861	22	0.07	1.45	25	X	0.020
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268				55		
0002 SB004268			1.19			0.030
0003 SB004268	25					
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2	1047					
0002 OREAS 45e						
0003 OREAS 925				990		
0004 UNI 1			24.90			9.977
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank				10		
0002 Control Blank			X			X
0003 Control Blank	X					
0004 Control Blank		X			X	
0005 Control Blank		X			X	

ANALYSIS

ELEMENTS	Mo	Mo	Mo	Na	Na	Na
UNITS	ppm	ug/l	ug/l	ppm	mg/Kg	mg/l
DETECTION LIMIT	0.1	0.05	0.05	20	10	0.1
DIGEST	4A/	Ws/	ASLP/	4A/	AmCl7/	Ws/
ANALYTICAL FINISH	MS	MS	MS	OE	OE	OE
SAMPLE NUMBERS						
0041 SB006078	0.3	0.24	X	73	X	3.6
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	0.5	0.14	X	64	X	4.5
0052 SB012860						
0053 SB012861	0.3	0.65	0.05	43	X	2.5
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						

CHECKS						
0001 SB004268	0.7			87		
0002 SB004268			X			
0003 SB004268					X	
0004 SB003694						
0005 SB008550						

STANDARDS						
0001 ASS1511-2					183	
0002 OREAS 45e						
0003 OREAS 925	0.9			2868		
0004 UNI 1						
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						

BLANKS						
0001 Control Blank	X			X		
0002 Control Blank			X			
0003 Control Blank					X	
0004 Control Blank		X				X
0005 Control Blank		X				X

ANALYSIS

ELEMENTS	Na	NAG	NAGpH	NAG(4.5)	Ni	Ni
UNITS	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	ppm	mg/l
DETECTION LIMIT	0.1	1	0.1	1	1	0.01
DIGEST	ASLP/	NAGx/	NAGx/	NAGx/	4A/	Ws/
ANALYTICAL FINISH	OE	VOL	MTR	VOL	OE	OE
SAMPLE NUMBERS						
0041 SB006078	1.1				3	X
0042 SB006091						
0043 SB006100						
0044 SB006113		7	3.3	3		
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	1.4				5	X
0052 SB012860						
0053 SB012861	0.8				2	X
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268					3	
0002 SB004268	0.7					
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925					35	
0004 UNI 1	25.6					
0005 OREAS 24b						
0006 NAG Std 3		23	2.5	20		
0007 ANC-1						
BLANKS						
0001 Control Blank					X	
0002 Control Blank	X					
0003 Control Blank						
0004 Control Blank						X
0005 Control Blank						X

ANALYSIS

ELEMENTS	Ni	OH	Pb	Pb	Pb	pH
UNITS	mg/l	mgCaCO3/L	ppm	ug/l	ug/l	NONE
DETECTION LIMIT	0.01	1	0.5	0.5	0.5	0.1
DIGEST	ASLP/	Ws/	4A/	Ws/	ASLP/	Ws/
ANALYTICAL FINISH	OE	VOL	MS	MS	MS	MTR
SAMPLE NUMBERS						
0041 SB006078	X	X	11.3	X	X	6.3
0042 SB006091						6.4
0043 SB006100						6.4
0044 SB006113						3.1
0045 SB006238						6.1
0046 SB009239						6.0
0047 SB006240						5.6
0048 SB008549						6.4
0049 SB008550						6.4
0050 SB008551						6.5
0051 SB012859	0.02	X	5.0	X	2.7	6.2
0052 SB012860						6.7
0053 SB012861	X	X	5.4	X	X	6.5
0054 SB012878						6.3
0055 SB012894						6.2
0056 SB001977						6.6
0057 SB002728						6.7
CHECKS						
0001 SB004268			33.6			
0002 SB004268	X				X	
0003 SB004268						
0004 SB003694						6.5
0005 SB008550						6.5
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925			116.3			
0004 UNI 1	9.95					
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank			X			
0002 Control Blank	X				X	
0003 Control Blank						
0004 Control Blank		X		X		
0005 Control Blank		X		X		

ANALYSIS

ELEMENTS	S	S	S	S	S	SO4
UNITS	%	ppm	mg/l	mg/l	%	%
DETECTION LIMIT	0.01	50	0.05	0.05	0.005	0.03
DIGEST		4A/	Ws/	ASLP/	SCR/	
ANALYTICAL FINISH	/CSA	OE	OE	OE	VOL	/CALC
SAMPLE NUMBERS						
0041 SB006078	X	X	1.23	0.17		3.68
0042 SB006091	0.02					
0043 SB006100	X					
0044 SB006113	0.22				0.129	
0045 SB006238	0.01					
0046 SB009239	0.01					
0047 SB006240	0.02					
0048 SB008549	0.01					
0049 SB008550	X					
0050 SB008551	X					
0051 SB012859	X	X	0.49	X		1.46
0052 SB012860	X					
0053 SB012861	X	X	0.22	X		0.66
0054 SB012878	X					
0055 SB012894	0.02					
0056 SB001977	X					
0057 SB002728	X					
CHECKS						
0001 SB004268		52				
0002 SB004268	0.01			X		
0003 SB004268						
0004 SB003694						
0005 SB008550	X					
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e	0.04					
0003 OREAS 925		9685				
0004 UNI 1				24.79		
0005 OREAS 24b	0.20					
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank	X	X				X
0002 Control Blank				X		
0003 Control Blank						
0004 Control Blank			X			X
0005 Control Blank	X		X			X

ANALYSIS

ELEMENTS	Sb	Sb	Sb	Se	Se	Se
UNITS	ppm	ug/l	ug/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.05	0.01	0.01	0.5	0.5	0.5
DIGEST	4A/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0041 SB006078	0.18	0.12	X	X	X	X
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	0.14	0.09	X	X	X	X
0052 SB012860						
0053 SB012861	0.18	0.29	X	X	X	X
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268	0.23			0.9		
0002 SB004268			X			X
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925	1.33			9.5		
0004 UNI 1						
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank	0.08			X		
0002 Control Blank			X			X
0003 Control Blank						
0004 Control Blank		X			X	
0005 Control Blank		X			X	

ANALYSIS

ELEMENTS	Sn	Sn	Sn	Th	Th	Th
UNITS	ppm	ug/l	ug/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.1	0.1	0.1	0.01	0.005	0.005
DIGEST	4A/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0041 SB006078	1.2	X	X	28.34	0.203	2.516
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	0.5	X	X	3.54	0.272	0.825
0052 SB012860						
0053 SB012861	0.3	X	X	3.08	0.035	1.074
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268	1.6			24.84		
0002 SB004268			X			0.625
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925	14.9			15.84		
0004 UNI 1						
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank	X			0.01		
0002 Control Blank			X			X
0003 Control Blank						
0004 Control Blank		X			X	
0005 Control Blank		X			X	

ANALYSIS

ELEMENTS	TotAlk	U	U	U	V	V
UNITS	mgCaCO3/L	ppm	ug/l	ug/l	ppm	mg/l
DETECTION LIMIT	5	0.01	0.005	0.005	1	0.01
DIGEST		4A/	Ws/	ASLP/	4A/	Ws/
ANALYTICAL FINISH	/CALC	MS	MS	MS	OE	OE
SAMPLE NUMBERS						
0041 SB006078	5	2.49	0.038	1.424	83	X
0042 SB006091						
0043 SB006100						
0044 SB006113						
0045 SB006238						
0046 SB009239						
0047 SB006240						
0048 SB008549						
0049 SB008550						
0050 SB008551						
0051 SB012859	X	0.42	0.031	1.295	15	X
0052 SB012860						
0053 SB012861	6	0.56	0.023	1.192	25	X
0054 SB012878						
0055 SB012894						
0056 SB001977						
0057 SB002728						
CHECKS						
0001 SB004268		2.70			187	
0002 SB004268				2.929		
0003 SB004268						
0004 SB003694						
0005 SB008550						
STANDARDS						
0001 ASS1511-2						
0002 OREAS 45e						
0003 OREAS 925		3.04			89	
0004 UNI 1						
0005 OREAS 24b						
0006 NAG Std 3						
0007 ANC-1						
BLANKS						
0001 Control Blank		X			X	
0002 Control Blank				X		
0003 Control Blank						
0004 Control Blank	X		X			X
0005 Control Blank			X			X

ANALYSIS

ELEMENTS	V	Zn	Zn	Zn
UNITS	mg/l	ppm	mg/l	mg/l
DETECTION LIMIT	0.01	1	0.01	0.01
DIGEST	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	OE	OE	OE	OE
SAMPLE NUMBERS				
0041 SB006078	X	13	0.02	0.27
0042 SB006091				
0043 SB006100				
0044 SB006113				
0045 SB006238				
0046 SB009239				
0047 SB006240				
0048 SB008549				
0049 SB008550				
0050 SB008551				
0051 SB012859	X	11	X	0.08
0052 SB012860				
0053 SB012861	X	8	X	0.15
0054 SB012878				
0055 SB012894				
0056 SB001977				
0057 SB002728				
CHECKS				
0001 SB004268		23		
0002 SB004268	X			0.46
0003 SB004268				
0004 SB003694				
0005 SB008550				
STANDARDS				
0001 ASS1511-2				
0002 OREAS 45e				
0003 OREAS 925		443		
0004 UNI 1	9.96			9.95
0005 OREAS 24b				
0006 NAG Std 3				
0007 ANC-1				
BLANKS				
0001 Control Blank		X		
0002 Control Blank	X			X
0003 Control Blank				
0004 Control Blank			X	
0005 Control Blank			X	

ANALYSIS

ELEMENTS	Al	Al	Al	ANC	As	As
UNITS	ppm	mg/l	mg/l	kgH2SO4/t	ppm	ug/l
DETECTION LIMIT	50	0.01	0.01	1	0.5	0.1
DIGEST	4A/	Ws/	ASLP/	ANCx/	4A/	Ws/
ANALYTICAL FINISH	OE	OE	OE	VOL	MS	MS
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Ba
UNITS	ug/l	mg/l	mg/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.1	0.01	0.01	0.1	0.05	0.05
DIGEST	ASLP/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	OE	OE	MS	MS	MS
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	CO3	Ca	Ca	Ca	Ca	Cd
UNITS	mgCaCO3/L	ppm	mg/Kg	mg/l	mg/l	ppm
DETECTION LIMIT	1	50	10	0.01	0.01	0.02
DIGEST	Ws/	4A/	AmCl7/	Ws/	ASLP/	4A/
ANALYTICAL FINISH	VOL	OE	OE	OE	OE	MS
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Cd	Cd	Cl	ColourChange	Cr	Cr
UNITS	ug/l	ug/l	mg/L	NONE	ppm	mg/l
DETECTION LIMIT	0.02	0.02	2	0	5	0.01
DIGEST	Ws/	ASLP/	Ws/	ANCx/	4A/	Ws/
ANALYTICAL FINISH	MS	MS	VOL	QUAL	OE	OE
BLANKS						
0006 Control Blank			X			

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Cr	Cu	Cu	Cu	EC	F
UNITS	mg/l	ppm	mg/l	mg/l	uS/cm	mg/L
DETECTION LIMIT	0.01	1	0.01	0.01	5	0.1
DIGEST	ASLP/	4A/	Ws/	ASLP/	Ws/	Ws/
ANALYTICAL FINISH	OE	OE	OE	OE	MTR	SIE
BLANKS						
0006 Control Blank					X	

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Fe	Fe	Fe	Final-pH	Final-pH	Fizz-Rate
UNITS	%	mg/l	mg/l	NONE	NONE	NONE
DETECTION LIMIT	0.01	0.01	0.01	0.1	0.1	0
DIGEST	4A/	Ws/	ASLP/	ASLP/	ANCx/	ANCx/
ANALYTICAL FINISH	OE	OE	OE	MTR	MTR	QUAL
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	HCO3	K	K	K	K	Mg
UNITS	mgCaCO3/L	ppm	mg/Kg	mg/l	mg/l	ppm
DETECTION LIMIT	5	20	20	0.1	0.1	20
DIGEST	Ws/	4A/	AmCl7/	Ws/	ASLP/	4A/
ANALYTICAL FINISH	VOL	OE	OE	OE	OE	OE
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Mg	Mg	Mg	Mn	Mn	Mn
UNITS	mg/Kg	mg/l	mg/l	ppm	mg/l	mg/l
DETECTION LIMIT	20	0.01	0.01	1	0.001	0.001
DIGEST	AmCl7/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	OE	OE	OE	OE	OE	OE
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Mo	Mo	Mo	Na	Na	Na
UNITS	ppm	ug/l	ug/l	ppm	mg/Kg	mg/l
DETECTION LIMIT	0.1	0.05	0.05	20	10	0.1
DIGEST	4A/	Ws/	ASLP/	4A/	AmCl7/	Ws/
ANALYTICAL FINISH	MS	MS	MS	OE	OE	OE
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Na	NAG	NAGpH	NAG(4.5)	Ni	Ni
UNITS	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	ppm	mg/l
DETECTION LIMIT	0.1	1	0.1	1	1	0.01
DIGEST	ASLP/	NAGx/	NAGx/	NAGx/	4A/	Ws/
ANALYTICAL FINISH	OE	VOL	MTR	VOL	OE	OE
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Ni	OH	Pb	Pb	Pb	pH
UNITS	mg/l	mgCaCO3/L	ppm	ug/l	ug/l	NONE
DETECTION LIMIT	0.01	1	0.5	0.5	0.5	0.1
DIGEST	ASLP/	Ws/	4A/	Ws/	ASLP/	Ws/
ANALYTICAL FINISH	OE	VOL	MS	MS	MS	MTR
BLANKS						
0006 Control Blank		X				

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	S	S	S	S	S	SO4
UNITS	%	ppm	mg/l	mg/l	%	%
DETECTION LIMIT	0.01	50	0.05	0.05	0.005	0.03
DIGEST		4A/	Ws/	ASLP/	SCR/	
ANALYTICAL FINISH	/CSA	OE	OE	OE	VOL	/CALC
BLANKS						
0006 Control Blank	X					

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Sb	Sb	Sb	Se	Se	Se
UNITS	ppm	ug/l	ug/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.05	0.01	0.01	0.5	0.5	0.5
DIGEST	4A/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	Sn	Sn	Sn	Th	Th	Th
UNITS	ppm	ug/l	ug/l	ppm	ug/l	ug/l
DETECTION LIMIT	0.1	0.1	0.1	0.01	0.005	0.005
DIGEST	4A/	Ws/	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	TotAlk	U	U	U	V	V
UNITS	mgCaCO3/L	ppm	ug/l	ug/l	ppm	mg/l
DETECTION LIMIT	5	0.01	0.005	0.005	1	0.01
DIGEST		4A/	Ws/	ASLP/	4A/	Ws/
ANALYTICAL FINISH	/CALC	MS	MS	MS	OE	OE
BLANKS						
0006 Control Blank						

MISSING SAMPLES: SB003510

ANALYSIS

ELEMENTS	V	Zn	Zn	Zn
UNITS	mg/l	ppm	mg/l	mg/l
DETECTION LIMIT	0.01	1	0.01	0.01
DIGEST	ASLP/	4A/	Ws/	ASLP/
ANALYTICAL FINISH	OE	OE	OE	OE
BLANKS				
0006 Control Blank				

MISSING SAMPLES: SB003510

METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
/CALC	Intertek Genalysis Perth **3244 3237**	
No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.		
/CSA	Intertek Genalysis Perth **3244 3237**	**MPL_W043, CSA : MPL_W043**
Induction Furnace Analysed by Infrared Spectrometry		
4A/MS	Intertek Genalysis Perth **3244 3237**	**4A/ : MPL_W002, MS : ICP_W003**
Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.		
4A/OE	Intertek Genalysis Perth **3244 3237**	**4A/ : MPL_W002, OE : ICP_W004**
Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.		
AmCl7/OE	Intertek Genalysis Perth **3244 3237**	
Extraction with 1M NH4Cl. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.		
ANCx/MTR	Intertek Genalysis Perth **3244 3237**	
Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement		
ANCx/QUAL	Intertek Genalysis Perth **3244 3237**	
Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection		
ANCx/VOL	Intertek Genalysis Perth **3244 3237**	
Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.		
ASLP/MS	Intertek Genalysis Perth **3244 3237**	**ASLP/ : ENV_W037, MS : ICP_W003**
AS4439.3-1997: Australian Standard Leachates Protocol for Wastes, Sediments & Contaminated Soils. Analysed by Inductively Coupled Plasma Mass Spectrometry.		
ASLP/MTR	Intertek Genalysis Perth **3244 3237**	
AS4439.3-1997: Australian Standard Leachates Protocol for Wastes, Sediments & Contaminated Soils. Analysed with Electronic Meter Measurement		
ASLP/OE	Intertek Genalysis Perth **3244 3237**	**ASLP/ : ENV_W037, OE : ICP_W004**
AS4439.3-1997: Australian Standard Leachates Protocol for Wastes, Sediments & Contaminated Soils. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.		
NAGx/MTR	Intertek Genalysis Perth **3244 3237**	
Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement		

METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
NAGx/VOL	Intertek Genalysis Perth **3244 3237**	

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

SCR/VOL	Intertek Genalysis Perth **3244 3237**	

Chromium Reducible Suplhur Analysed by Volumetric Technique.

Ws/MS	Intertek Genalysis Perth **3244 3237**	

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed by Inductively Coupled Plasma Mass Spectrometry.

Ws/MTR	Intertek Genalysis Perth **3244 3237**	

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed with Electronic Meter Measurement

Ws/OE	Intertek Genalysis Perth **3244 3237**	

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

Ws/SIE	Intertek Genalysis Perth **3244 3237**	

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed by Specific Ion Electrode.

Ws/VOL	Intertek Genalysis Perth **3244 3237**	

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed by Volumetric Technique.

Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:17

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_05_01.$ls 1628.01605060_05_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB003679
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:23 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_05_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 41.67 µm
Median: 26.98 µm

d_{10}: 1.606 µm d_{50}: 26.98 µm d_{90}: 102.4 µm

<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
61.7%	68.8%	73.8%	82.6%	88.7%	91.7%	99.9%

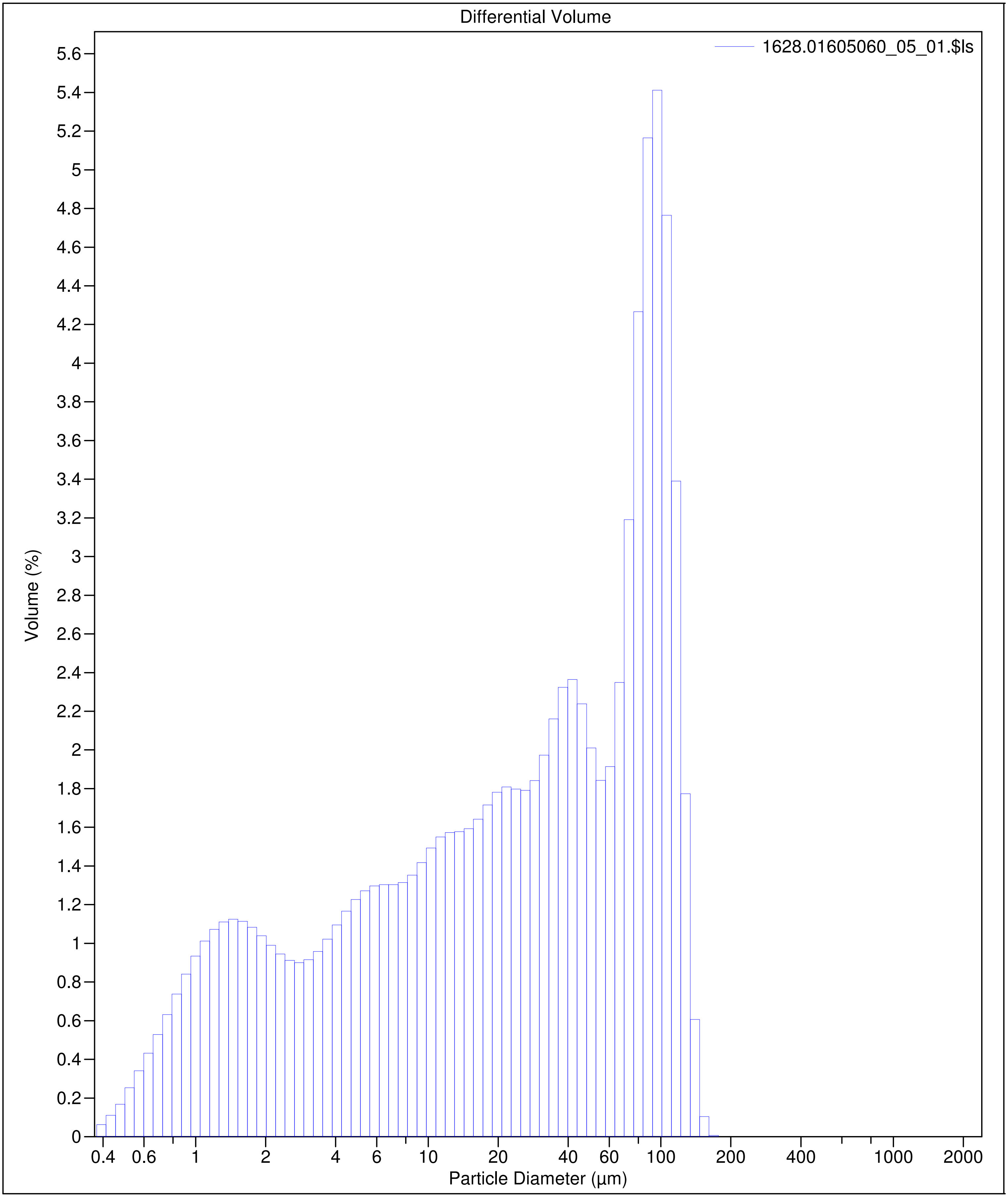
>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
38.3%	31.2%	26.2%	17.4%	11.3%	8.28%	0.087%

Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:17

1628.0/1605060



Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:11

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_06_01.$ls 1628.01605060_06_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB003681
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:28 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_06_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 40.41 µm
Median: 25.34 µm

d_{10}: 1.687 µm d_{50}: 25.34 µm d_{90}: 100.2 µm

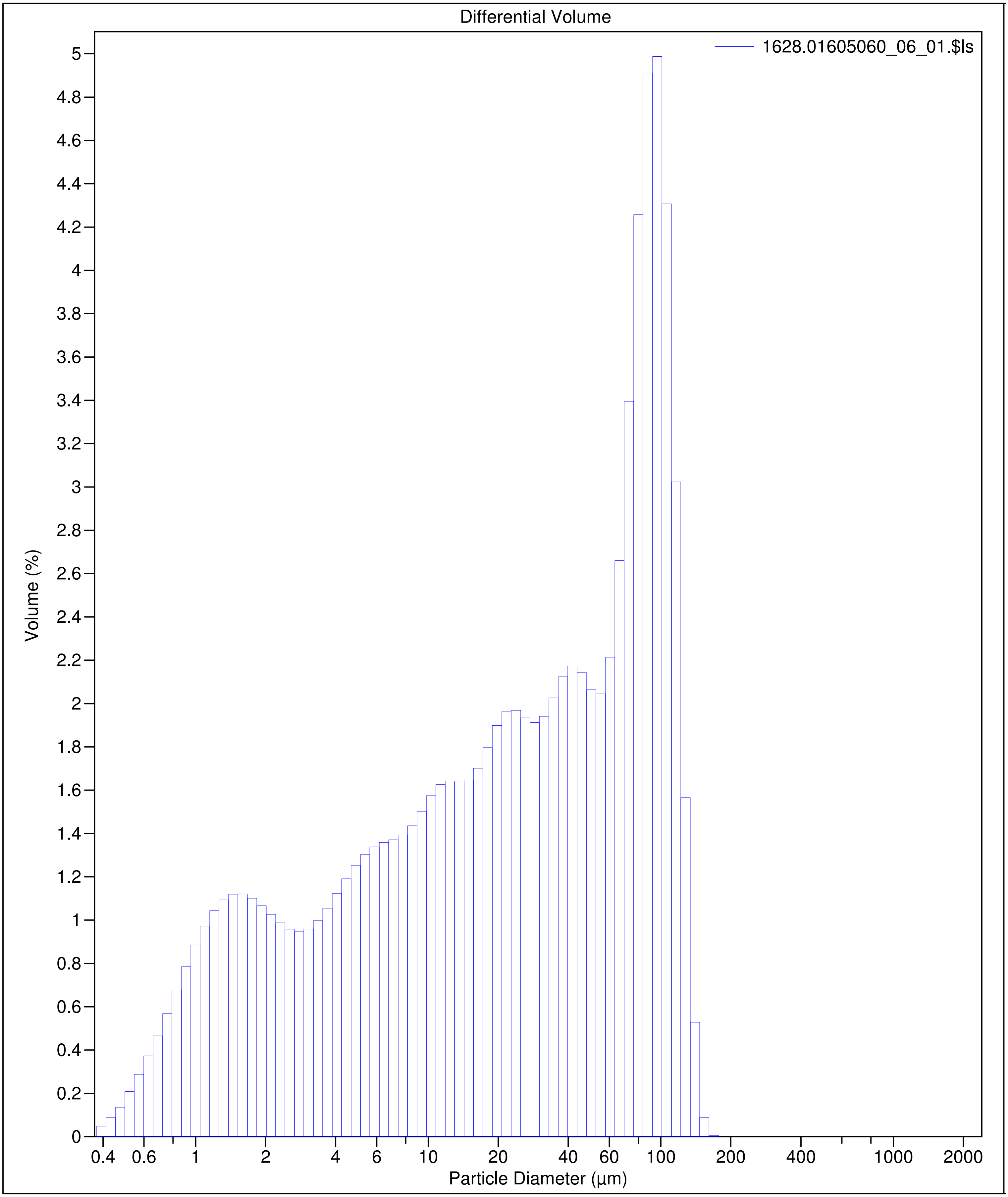
<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
62.5%	70.1%	75.6%	84.2%	89.9%	92.6%	99.9%

>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
37.5%	29.9%	24.4%	15.8%	10.1%	7.38%	0.075%

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:11

1628.0/1605060



Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:18

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_07_01.$ls 1628.01605060_07_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB004268
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:32 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_07_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 35.90 µm
Median: 21.30 µm

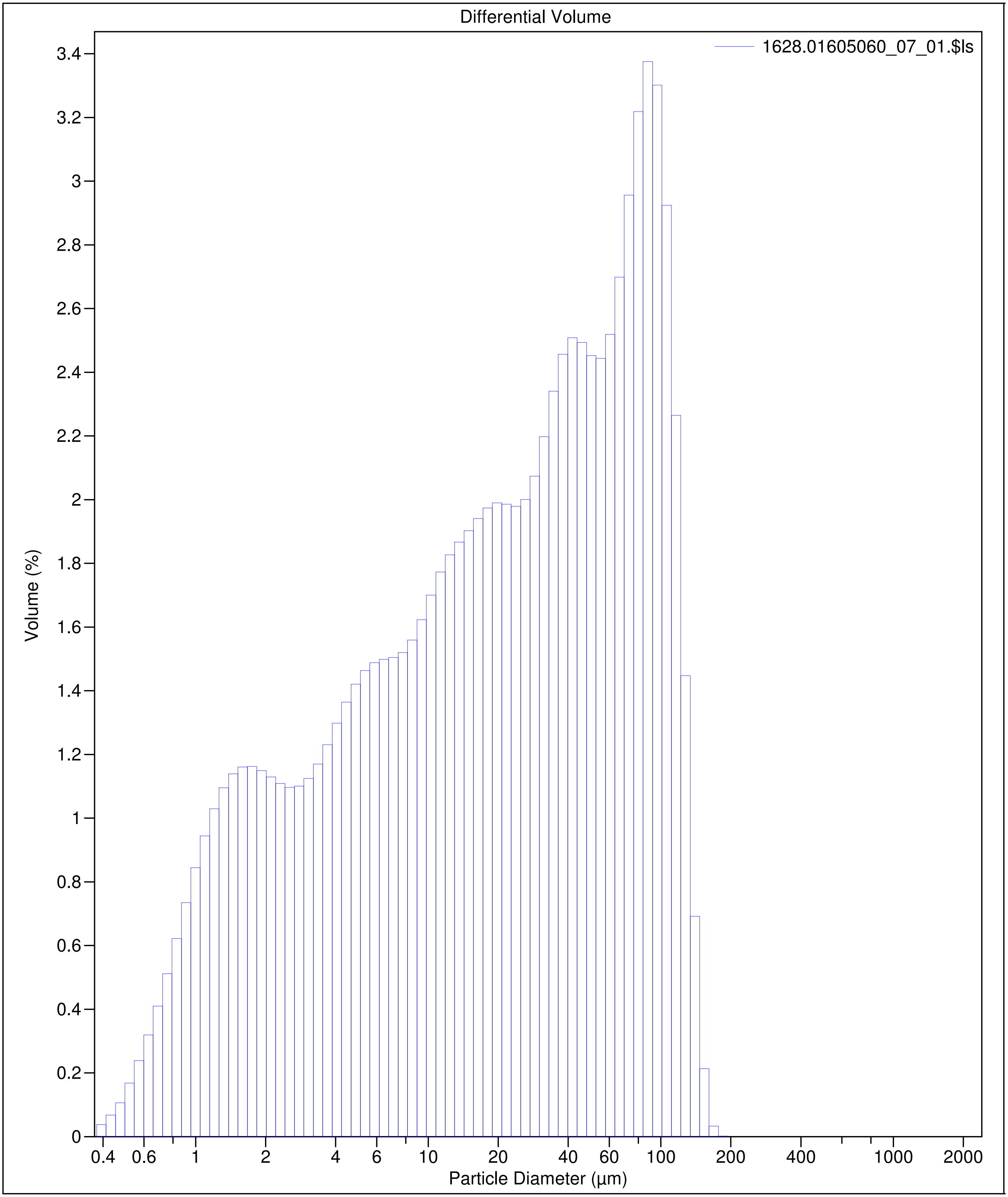
d_{10}: 1.748 µm d_{50}: 21.30 µm d_{90}: 94.49 µm

<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
67.7%	76.7%	81.9%	88.3%	92.0%	93.9%	99.8%
>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
32.3%	23.3%	18.1%	11.7%	7.98%	6.13%	0.20%

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:18

1628.0/1605060



Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:13

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_11_01.$ls 1628.01605060_11_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB005597
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:53 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_11_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 43.71 µm
Median: 25.21 µm

d_{10}: 2.060 µm d_{50}: 25.21 µm d_{90}: 114.2 µm

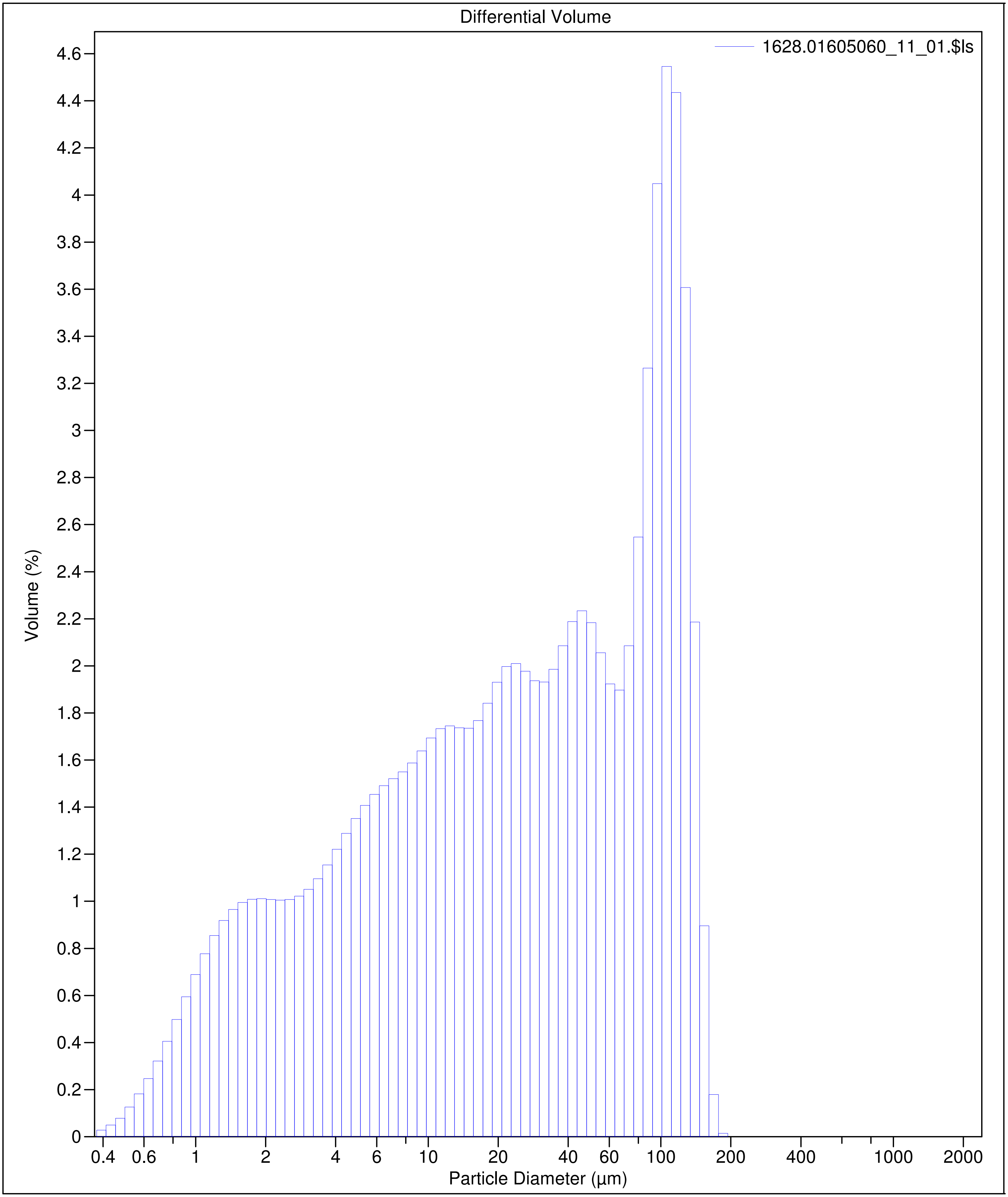
<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
62.6%	70.2%	73.8%	79.3%	83.6%	86.4%	99.1%
>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
37.4%	29.8%	26.2%	20.7%	16.4%	13.6%	0.89%

Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:13

1628.0/1605060



Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:21

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_12_01.$ls 1628.01605060_12_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB006078
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:57 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_12_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 38.26 µm
Median: 21.80 µm

d_{10}: 1.936 µm d_{50}: 21.80 µm d_{90}: 104.1 µm

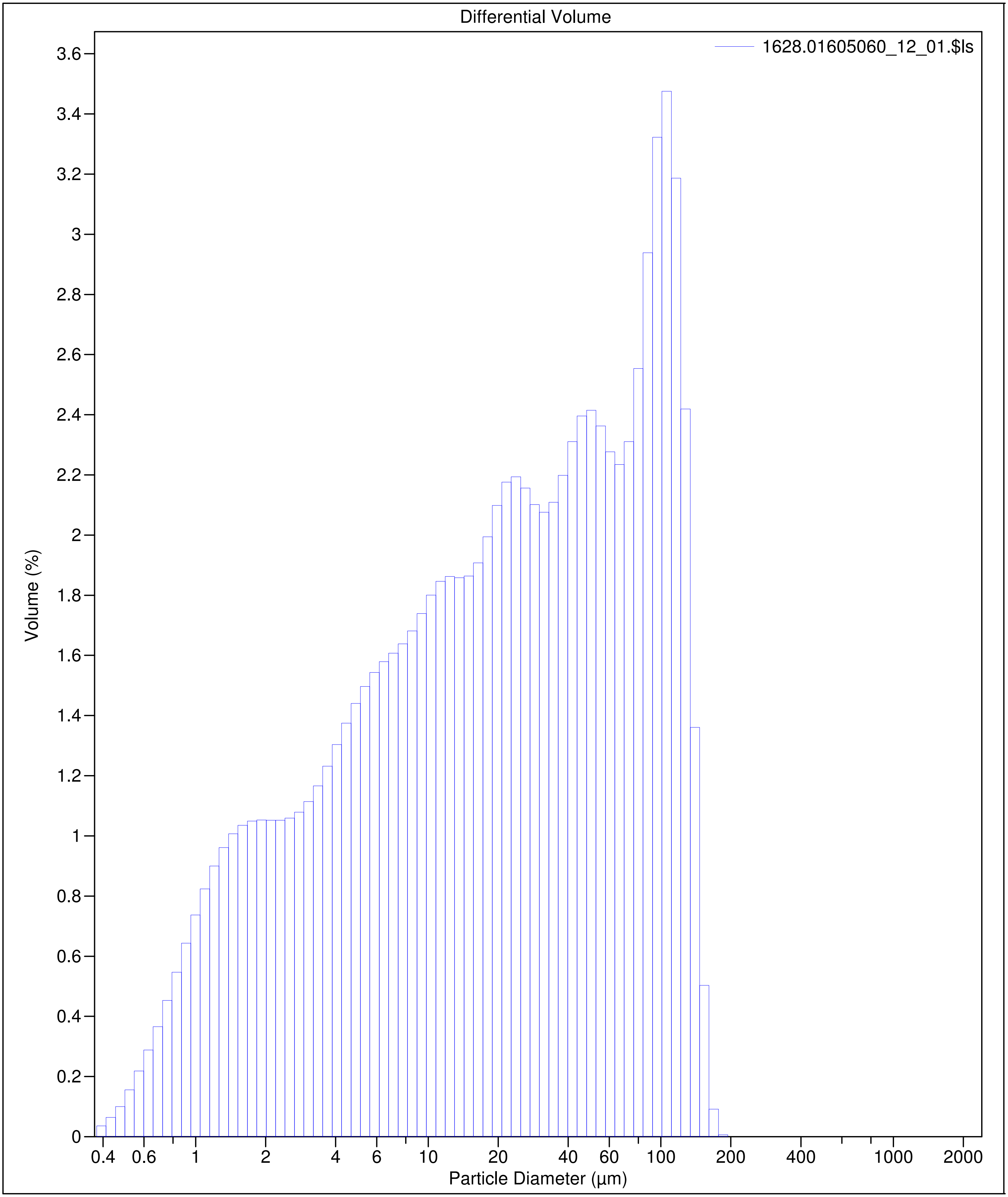
<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
66.9%	75.4%	79.7%	84.9%	88.6%	90.7%	99.5%
>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
33.1%	24.6%	20.3%	15.1%	11.4%	9.32%	0.49%

Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:21

1628.0/1605060



Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:21

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_13_01.$ls 1628.01605060_13_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB012859
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	15:02 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_13_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 25.82 µm
Median: 16.19 µm

d_{10}: 1.862 µm d_{50}: 16.19 µm d_{90}: 65.02 µm

<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
78.7%	89.1%	93.6%	97.1%	98.5%	99.0%	99.998%

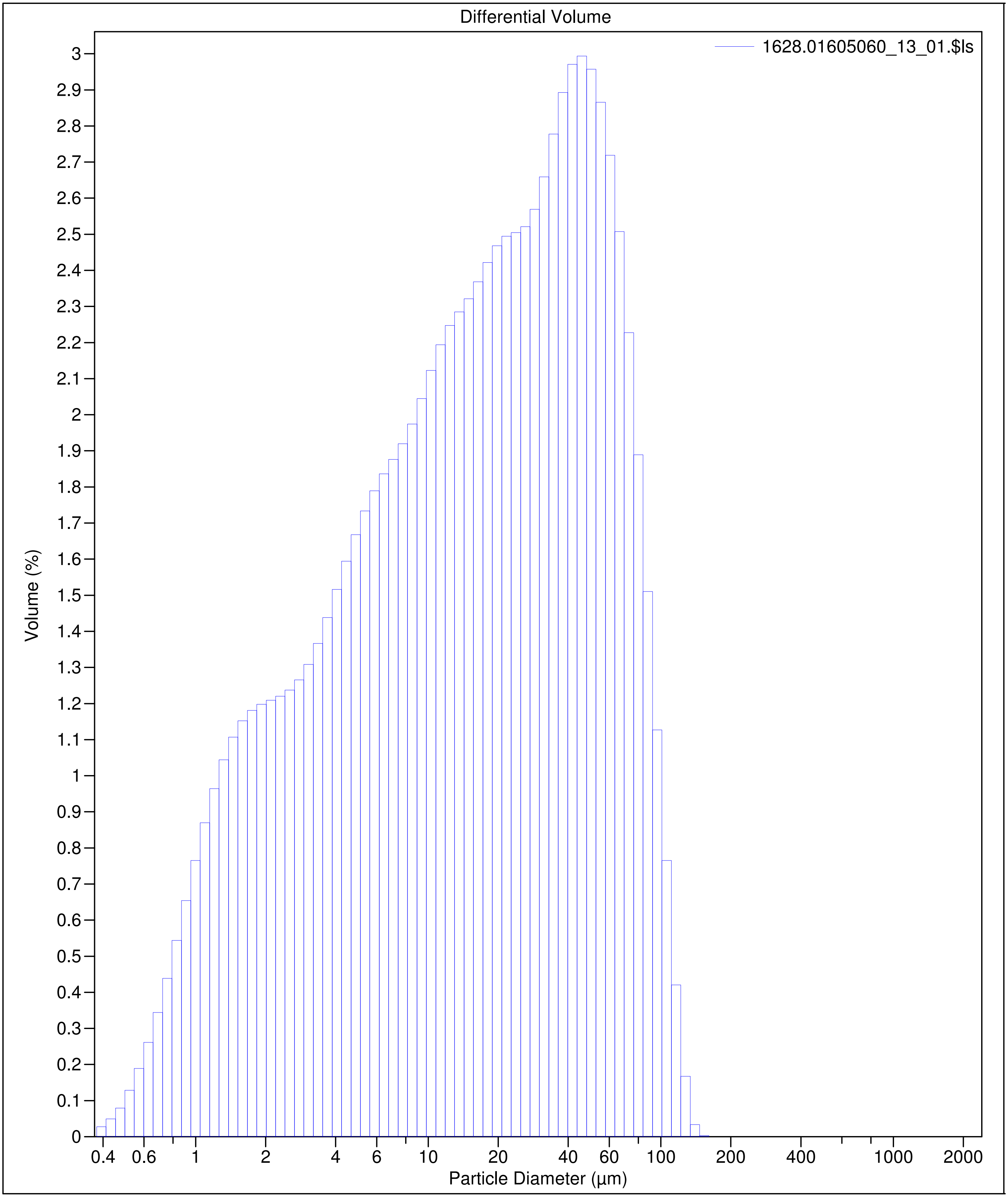
>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
21.3%	10.9%	6.38%	2.90%	1.53%	1.01%	0.0023%

Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:21

1628.0/1605060



Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:22

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_14_01.$ls 1628.01605060_14_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB012861
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	15:08 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_14_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 29.97 µm
Median: 17.98 µm

d_{10}: 2.031 µm d_{50}: 17.98 µm d_{90}: 78.82 µm

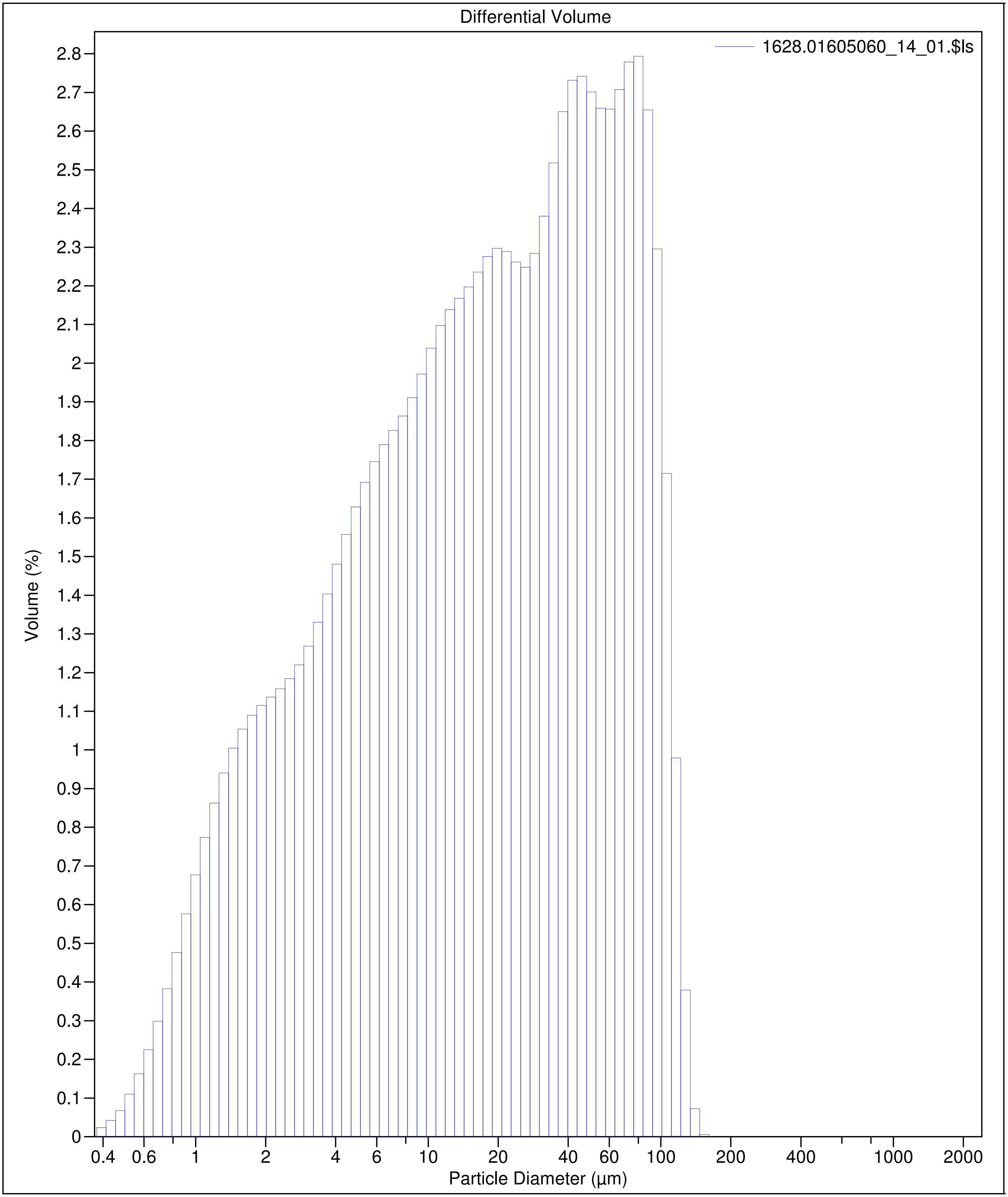
<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
73.7%	83.4%	88.5%	93.9%	96.6%	97.7%	99.996%

>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
26.3%	16.6%	11.5%	6.12%	3.43%	2.30%	0.0043%

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:22

1628.0/1605060



Intertek

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:18

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_08_01.$ls 1628.01605060_08_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB014431
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:37 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_08_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 42.44 µm
Median: 28.11 µm

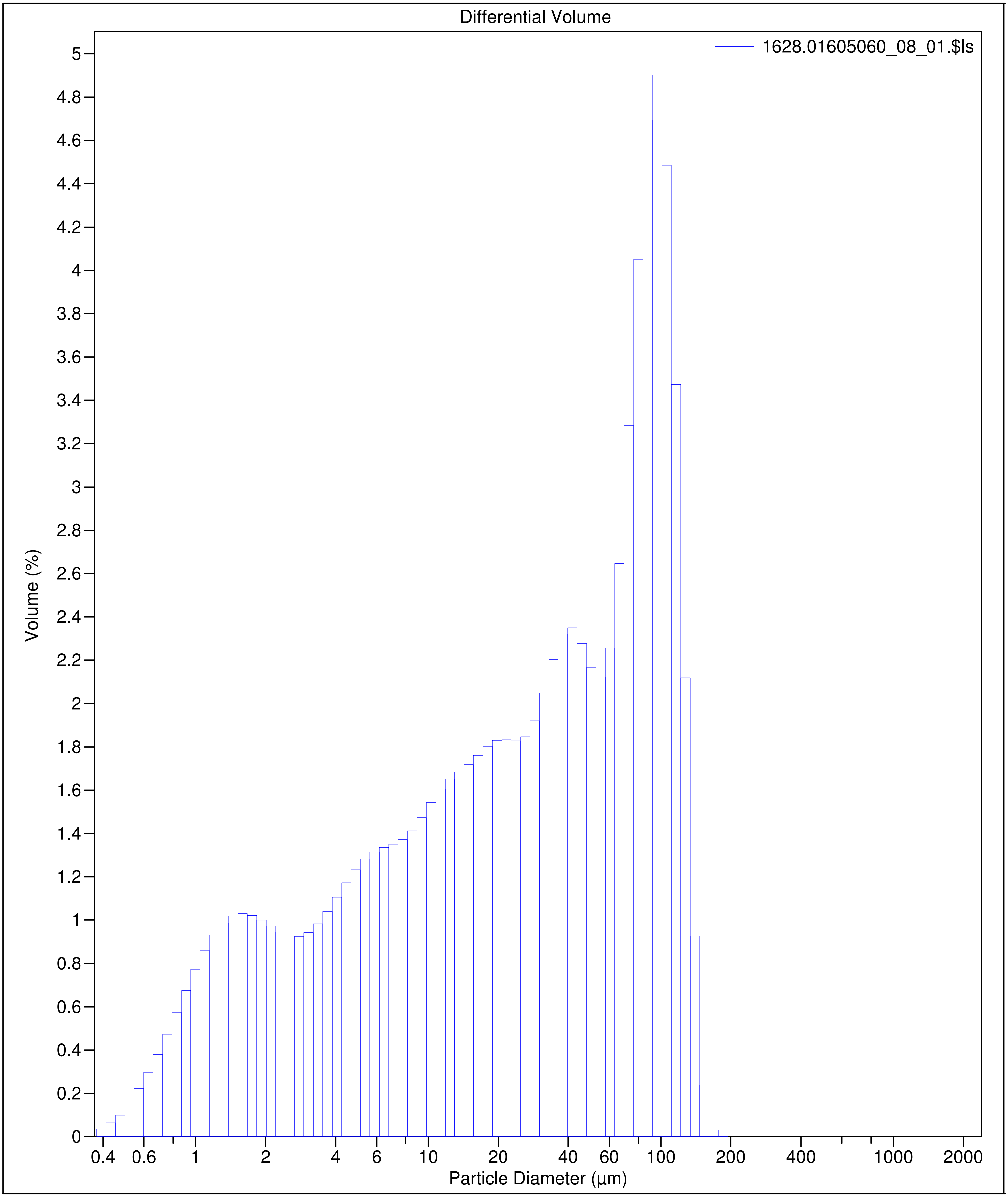
d_{10}: 1.904 µm d_{50}: 28.11 µm d_{90}: 103.9 µm

<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
61.0%	69.0%	74.4%	82.6%	88.1%	91.0%	99.8%
>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
39.0%	31.0%	25.6%	17.4%	11.9%	9.05%	0.22%

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:18

1628.0/1605060



Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:19

1628.0/1605060

File name:	C:\LS13320\Samples\1628.01605060_09_01.$ls 1628.01605060_09_01.$ls
File ID:	1628.0/1605060
Sample ID:	SB014433
Comment 1:	HAZEL
Optical model:	RI18PS100.rf780z
Start time:	14:42 20 May 2016

Volume Statistics (Arithmetic) 1628.01605060_09_01.$ls

Calculations from 0.375 µm to 2000 µm

Volume: 100%
Mean: 40.45 µm
Median: 26.22 µm

d_{10}: 1.727 µm d_{50}: 26.22 µm d_{90}: 100.2 µm

<45 µm	<63 µm	<75 µm	<90 µm	<100 µm	<106 µm	<150 µm
62.4%	70.7%	76.3%	84.6%	89.9%	92.5%	99.9%

>45 µm	>63 µm	>75 µm	>90 µm	>100 µm	>106 µm	>150 µm
37.6%	29.3%	23.7%	15.4%	10.1%	7.49%	0.094%

Beckman Coulter LS Particle Size Analyzer

23 May 2016 8:19

1628.0/1605060