Appendix M
Geochemistry Assessment

WINCHESTER SOUTH PROJECT
Environmental Impact Statement

WHITEHAVEN COAL

Resource Strategies

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Geochemical Assessment of Potential Waste Rock and Coal Reject Materials

WINCHESTER SOUTH PROJECT

Final

Prepared for:

Whitehaven WS Pty Ltd

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EXECUTIVE SUMMARY

Terrenus Earth Sciences (Terrenus) has completed a geochemical assessment of potential mineral waste (sub-soil and rock) from the proposed Winchester South Project (the Project) – a proposed coal mining project in the Bowen Basin in Central Queensland. The project is being developed by Whitehaven WS Pty Ltd, a subsidiary of Whitehaven Coal Ltd (Whitehaven).

The geochemical assessment has been undertaken for mine planning purposes, with respect to the environmental considerations of potential mineral waste materials associated with the Project, and how these mineral waste materials may need to be managed to minimise their potential environmental impacts.

The Project would comprise the extraction of coal by open-cut mining methods from several coal seams within the Rangal and Fort Cooper Coal Measures. Run-of-mine (ROM) coal would be processed on site at the coal handling and preparation plant (CHPP) and coal reject would be emplaced on site.

Terrenus has geochemically assessed potential overburden and interburden (collectively called potential waste rock), potential coarse reject (obtained from the coal quality test-work program) and potential ROM coal. The geochemical characteristics of potential coarse reject and ROM coal are broadly representative of the expected environmental geochemical characteristics of coal reject.

Geochemical data was derived from existing data (EGi, 2012) compiled by the previous tenement owners, combined with new data from exploration samples collected in 2019 by Whitehaven geologists. All samples (2012 and 2019) were obtained from drill-holes within the Project area.

The environmental geochemical characteristics and proposed management of potential waste rock and coal reject is summarised in the following sub-sections. In considering these characteristics and management measures, it should be noted that coal reject is expected to comprise approximately four percent (%) of all mineral waste generated at the Project.

Geochemical Characteristics of Potential Waste Rock

- Waste rock, as a bulk material, is expected to generate pH-neutral to alkaline, low- to moderate-salinity surface water run-off and seepage following surface exposure. Weathered waste rock should have similar soil pH to unweathered waste rock, however weathered waste rock is generally expected to be more saline than unweathered waste rock.

- The total sulfur (S) concentration of potential waste rock is very low, with over 99% of samples having a total S concentration below 0.2%. As such, greater than 99% of potential waste rock samples are classified as non-acid forming (NAF) with 92% of samples further classified as ‘barren’ with respect to sulfur concentrations (*ie*. S ≤0.05%). One sample (out of 277 samples) was classified as potentially acid forming (PAF) with low acid-generating capacity (PAF-LC).

- Total metal and metalloid concentrations in potential waste rock samples are very low compared to average element abundance in soil in the earth’s crust. One sample (out of 33

potential waste rock samples) was enriched in arsenic (As) and four samples were enriched in beryllium (Be) with respect to average crustal abundance in soil.

- Soluble multi-element results indicate that some waste rock *may* produce leachate containing slightly elevated concentrations of some soluble elements (such as aluminium [Al], As, copper [Cu], selenium [Se] and zinc [Zn]) compared to applied water quality guideline values for slightly to moderately disturbed freshwater aquatic ecosystems (95% species protection) (ANZECC & ARMCANZ, 2000). The concentrations of all elements tested are less than the water quality guideline values for livestock drinking water.

  It is important to note that the results presented in this report represent an 'assumed worst case' scenario as the samples were either 'aged' for 16 hours in the 1:2 weight:volume (w:v) solution prior to leaching or were pulverised (to less than 75 µm in diameter) prior to a 1:5 (w:v) leach. Therefore, samples had a long equilibration period or had a very high surface area compared to likely materials in the field. Individual materials would also be well mixed at storage locations. The results therefore suggest that the concentration of metal/metalloids in the samples represent initial pore water chemistry and surface water run-off and seepage from waste rock (in the field) would be expected to be less than the recorded laboratory water extract concentrations of potential waste rock samples.

  The applied guideline values are provided for context and are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to total and soluble metals/metalloids in waste rock. Due to a number of factors in the field (compared to the laboratory), including scale-up and dilution, any direct comparison of soluble multi-element concentrations in laboratory leachate is strictly not valid and should be used with caution.

- Potential waste rock samples have a wide range of cation exchange capacity (CEC) values and, generally, have high to very high exchangeable sodium percentage (ESP) values. As such, bulk waste rock is expected to be 'strongly sodic'. About half of the samples tested, regardless of lithology or degree of weathering, have some potential to be dispersive. As such, it is reasonable to expect that a significant proportion of waste rock (regardless of lithology and weathering) may be erosive and dispersive to varying degrees.

Geochemical Characteristics of Potential Coarse Reject

- Potential coarse reject is expected to generate pH-neutral to alkaline, low-salinity surface water run-off and seepage following initial surface exposure.

- Over two-thirds of the potential coarse reject samples were classified as NAF and four samples were classified as PAF-LC. The remaining five samples were classified as Uncertain, primarily due to uncertainty around the availability of sufficient neutralising material. However, despite some uncertainty surrounding the acid classification of five samples, all have relatively low sulfur concentration and, at worst, would have a low capacity to generate significant acidity (*ie*. be conservatively classified as PAF-LC).

- Overall, the sulfur (and sulfide) concentration in potential coarse reject is generally low, with a 90th percentile sulfide concentration of 0.4% (90th percentile total S = 0.59%). Coarse reject (as a bulk material) is regarded as posing a low unmitigated risk of acid generation and a low to moderate unmitigated risk of sulfate generation.

- Total metal and metalloid concentrations in potential coarse reject samples are low compared to average element abundance in soil in the earth's crust. One potential coarse reject sample is enriched in S with respect to average crustal abundance in soil.
- The soluble multi-element concentrations in potential coarse reject samples are below applied water quality guideline values for slightly to moderately disturbed freshwater aquatic ecosystems (95% species protection) and livestock drinking water guideline values (ANZECC & ARMCANZ, 2000) and, in most cases, are below the laboratory limit of reporting (LOR).

Geochemical Characteristics of Potential ROM Coal

- Based on the results of coal seam samples, potential ROM coal is expected to generate pH-neutral to alkaline, low- to moderate salinity surface water run-off and seepage following initial surface exposure.
- Over 98% of the coal seam samples (59 out of 60 samples) are classified as NAF, and 82% of samples are further classified as NAF-Barren or NAF-Low S due to their very low total S concentration. One sample has an Uncertain classification, but has negligible capacity to generate acid. Therefore, ROM coal (as a bulk material) represented by these coal seam samples is regarded as posing a low risk of acid and/or sulfate generation.
- Only one coal seam sample (from the 2012 program) underwent analysis for total and soluble element concentrations. The total element concentrations are low compared to average element abundance in soil in the earth's crust. The sample has slightly elevated concentrations of soluble Al and As compared to applied water quality guideline values for slightly to moderately disturbed freshwater aquatic ecosystems (95% species protection) (ANZECC & ARMCANZ, 2000). The concentrations of all elements tested are lower than the water quality guideline values for livestock drinking water.

Management and Mitigation of Waste Rock Piles

Overburden and interburden would be used to develop out-of-pit waste rock emplacements during the operation of the Project, before being used to progressively backfill the open cut pits, once space becomes available.

Waste rock is overwhelmingly NAF with excess ANC and has a negligible risk of developing acid conditions. Furthermore, waste rock is expected to generate relatively low to moderate salinity surface water run-off and seepage with relatively low soluble metal/metalloid concentrations. However, waste rock is expected to be sodic with some potential for dispersion and erosion (to varying degrees).

Where highly sodic and/or dispersive waste rock is identified it should, wherever practicable, not report to final landform surfaces and should not be used in construction activities. Tertiary waste rock has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program, 2004 and 2019).

It may not be practical to selectively handle and preferentially emplace highly sodic and dispersive waste rock during operation of the Project, however Whitehaven should take reasonable measures to identify and selectively place (or alternately manage) highly sodic and

dispersive waste rock. Therefore, in the absence of such selective handling, waste rock landforms would need to be constructed with short and low (shallow) slopes and progressively rehabilitated to minimise erosion. Where practical, and where competent rock is available, armouring of slopes should be considered.

Where waste rock is used for construction activities, this should be limited (as far as practical) to unweathered Permian sandstone, as this material is widely accepted to be more suitable for construction and for use as embankment covering on final landform surfaces. Regardless of the waste rock type, especially where engineering or geotechnical stability is required, laboratory testing and rehabilitation field trials should be undertaken by Whitehaven to determine the propensity for dispersion and erosion of waste rock landforms.

Surface water run-off and seepage from waste rock emplacements, including any rehabilitated areas, should be monitored for 'standard' water quality parameters including, but not limited to, pH, electrical conductivity (EC), major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids (TDS) and a broad suite of soluble metals/metalloids.

With the implementation of the proposed management and mitigation measures, the waste rock is regarded as posing a low risk of environmental harm.

Management and Mitigation of Coal Reject

Fine coal reject (tailings) is proposed to be dewatered at the CHPP and combined with mid/coarse coal reject at the reject bin within the CHPP. Coal reject would be trucked from the reject bin and placed within out-of-pit and in-pit emplacements and buried by at least 10 metres (m) of waste rock.

Over the life of the Project approximately 148 Mt of coal reject is expected to be produced during ROM coal processing and would comprise approximately 4% of all mineral waste generated by the Project. Based on the current assessment, a proportion of coarse reject has *some* uncertainty around its ability to generate acidity, and a small number of samples have been classified as PAF-LC – mostly from the Leichhardt seam. On this basis, coal reject generated by the Project is conservatively assumed to have a relatively low degree of environmental risk associated with potential acidity, but may generate elevated concentrations of sulfate salts. If sulfate salts are generated in surface water and seepage, these would be confined within the footprint of the open cut pits or within out-of-pit emplacements, and would drain into/towards open cut pit areas. Therefore, when placed amongst alkaline NAF waste rock the overall risk of environmental harm and health-risk that emplaced coal reject poses is low.

The management measures for coal reject would be addressed by a Mineral Waste Management Plan, with the main concepts outlined below.

Management of Coal Reject Within Out-of-Pit Emplacements

During Operations

Coal reject placed in out-of-pit emplacement areas would be buried by at least 10 m of waste rock generally within three months of placement. During operations, surface water run-off and

seepage from out-of-pit emplacements would be directed to the mine water management system.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of the out-of-pit emplacement areas would be addressed by a Progressive Rehabilitation and Closure Plan (PRCP). Coal reject within out-of-pit emplacements would be covered by a minimum of 10 m of waste rock and would not report to final landform surfaces (or near-surfaces). Therefore, the management of out-of-pit emplaced coal reject would not be expected to be significant to mine or pit decommissioning and rehabilitation.

Management of Coal Reject Within In-Pit Emplacements

During Operations

Coal reject within in-pit emplacements would be buried by at least 10 m of waste rock generally within three months of placement.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of partially or fully back-filled pits (and any subsequent final voids) would be addressed by a PRCP. However, as coal reject would be covered by a minimum of 10 m of waste rock and would not report to final landform surfaces (or near-surfaces), the management of coal reject emplaced within open cut pits would not be expected to be a significant issue with respect to mine or pit decommissioning and rehabilitation.

Validation of Coal Reject Characteristics

Whitehaven would undertake validation geochemical test-work for coal reject from the CHPP during development of the Project, particularly during the first two years of CHPP operation and whenever new seams/plys are being processed. Test-work would comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), acid-base account parameters and total and soluble metals/metalloids.

Management of ROM Coal and ROM Stockpiles

ROM coal is not mining waste, and surface water run-off and seepage from ROM stockpiles would not report off-site and would be managed as part of the mine water management system. The available information suggests that ROM coal generated by the Project is expected to have a low degree of risk associated with potential acid, salt and soluble metals generation. Surface water run-off from ROM coal and product coal stockpiles would also be assessed on a periodic basis.

ROM coal would be stored at the site for a relatively short period of time (days to weeks) compared to waste rock and coal reject, which would be stored at the site in perpetuity. Management practices are therefore different for ROM coal (compared to waste rock) and would largely be based around the operational (day-to-day) management of surface water run-off from ROM coal stockpiles, as is currently accepted practice at coal mines in Australia.

Surface water run-off from ROM coal stockpiles would be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS, acidity and a broad suite of soluble metals/metalloids.

Geochemical Assessment of Potential Waste Rock and Coal Reject Materials

WINCHESTER SOUTH PROJECT

TABLE of CONTENTS

LIST of TABLES, FIGURES and APPENDICES

List of Tables

Refer to **Appendix C** for geochemical results tables.

List of Figures

List of Appendices

GLOSSARY of TERMS

Acid	A measure of hydrogen ion (H^+) concentration; generally expressed as pH.
Acid-Base Account	Evaluation of the balance between acid generation and acid neutralisation processes. Generally determined by the maximum potential acidity (MPA) and the inherent acid neutralising capacity (ANC), as defined below. See also "MPA" and "ANC".
AMD	Acid and Metalliferous Drainage from mining waste material characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity. The term AMD is used more recently to replace the term Acid Rock Drainage (ARD) as metalliferous and saline drainage can occur under pH-neutral conditions.
ANC	Acid Neutralising Capacity, expressed as kg H_2SO_4 per tonne of rock/material. A measure of a sample's maximum potential ability to neutralise acid.
ANC/MPA ratio	Ratio of the acid neutralising capacity (ANC) to the maximum potential acidity (MPA) of a sample. Used to assess the risk of a sample generating acid conditions. See also "ANC" and "MPA".
Barren	A sample classified as barren has negligibly low total sulfur (and sulfide) concentration and, essentially, has no acid generating capacity. In essence, it represents an 'inert' material with respect to acid generation.
CHPP	Coal Handling and Preparation Plant.
Coal Reject	Solid waste produced during the processing of coal, typically from a CHPP. Coal reject at the Project would typically comprise crushed siltstone, mudstone and fine-grained sandstone, which is mined as coal seam roof, parting or floor material during the extraction of ROM coal. Coal reject is commonly produced in different size fractions – fine and coarse reject.
Coarse Reject	Coarse solid waste material (typically greater than 1.5 mm grain size) produced from the CHPP as part of the processing of coal. See also "Fine Reject".
EC	Electrical Conductivity, expressed as µS/cm.
Fine Reject	Fine-grained mining waste material (typically less than 1.5 mm grain-size) produced from the CHPP as part of the processing and washing of coal. Fine reject typically comprises mud/clay and silt present in CHPP wastewater, and is also known as "Tailings".
Interburden	Waste rock material between mined coal seams. See also "Overburden", "Mining Waste" and "Waste Rock".

Kinetic test	Procedure used to measure the geochemical/weathering behaviour of a sample of mine material over time.
MPA	Maximum Potential Acidity. Calculated by multiplying the total sulfur (S) or sulfide-sulfur (Scr) content of a sample by 30.6 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne of rock/material.
Mineral Waste	Overburden, interburden and similar 'waste rock' material mined and emplaced during extraction of coal. In this report, the definition of Mineral Waste also extends to coal reject from the CHPP. See "Coal Reject".
NAF	Non-Acid Forming. Geochemical classification criterion for a sample that would not generate acid conditions. A sample classified as NAF may, or may not, have a significant sulfur content but the availability of neutralising material within the sample is more than adequate to neutralise all the acid that theoretically could be produced by any contained sulfide minerals. As such, material classified as NAF is considered unlikely to be a source of acidic drainage.
NAPP	Net Acid Producing Potential, expressed as kg H_2SO_4 per tonne of rock/material. Calculated by subtracting the ANC from the MPA.
NATA accreditation	Accreditation by the National Association of Testing Authorities (Australia). NATA accreditation for a specific analytical test indicates that the test method and means of undertaking the test (following the method and achieving valid results) by the laboratory has been independently recognised by NATA. Accreditation provides a means of determining and formally recognising the competence of facilities to perform specific types of testing, inspection, calibration, and other related activities, on a routine basis.
Overburden	Waste rock material overlying the uppermost mined (economic) coal seam. See also "Waste Rock".
PAF	Potentially Acid Forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions. A sample classified as PAF almost always has a significant sulfur content, the acid generating potential (MPA) of which exceeds the inherent acid neutralising capacity (ANC) of the material. This means there is a high risk that such a material, even if pH circum-neutral when freshly mined or processed, could oxidise and generate acidic drainage if exposed to atmospheric conditions. See also PAF-LC.
PAF-LC	Potentially Acid Forming (low capacity). Geochemical classification criterion for a sample that has the potential to generate weak acidity.
ROM	Run-of-Mine. Coal as it comes from the mine prior to screening or processing. ROM coal is typically trucked from the mine and dumped onto a ROM pad (or into a ROM hopper), and from there it typically undergoes some degree of crushing, screening and washing.

S	Sulfur.
Scr	Chromium reducible sulfur. Analytical procedure to determine the sulfide-sulfur concentration in a sample.
SO_4	Sulfate.
Waste Rock	Rock material overlying and between coal seams, which will report as waste. Waste rock overlying a mined coal seam is called overburden. Waste rock between mined coal seams is called interburden.
Static test	Procedure for characterising the geochemical nature of a sample at one point in time. Static tests may include measurements of mineral and chemical composition of a sample and the Acid-Base Account.
Uncertain	In the context of classifying a material (sample) as NAF or PAF. An 'Uncertain' classification (UC) applies when there is an apparent conflict in results such that neither NAF nor PAF classification can be given. Uncertain samples are sometimes given a tentative sub-classification, such as UC-NAF or UC-PAF.
Water extract	A method to determine the water-soluble parameters in soil. Solid samples undergo a bottle leach method where 10 g of pulped solid (less than 70 micrometres) is combined with 20 grams or 50 grams of de-ionised water into a glass bottle. The 1:2 or 1:5 solution (1 part solid to 2 or 5 parts water) is tumbled end-over-end for one hour. Solutes are leached from the soil by the continuous suspension and agitation. The water extract solution is measured for pH and electrical conductivity (EC) prior to filtering for solute analysis (*eg*. metals/metalloids and major ions).

1 Introduction, Background and Context

Terrenus Earth Sciences (Terrenus) has completed a geochemical assessment of potential mineral waste (sub-soil and rock) from the proposed Winchester South Project (the Project). The geochemical assessment was completed to assist with mine planning and as part of the environmental regulatory documentation for the Project.

Whitehaven WS Pty Ltd (Whitehaven WS), a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven), proposes to develop the Project, an open cut coal mine and associated infrastructure within the Bowen Basin, located approximately 30 kilometres (km) south-east of Moranbah, within the Isaac Regional Council Local Government Area.

The Project involves the development of an open cut coal mine in an existing mining precinct for export of coal products. The Project would include construction and operation of a mine infrastructure area (MIA), including a Coal Handling and Preparation Plant (CHPP), train load-out facility and rail spur, which would be used for the handling, processing and transport of coal. An infrastructure corridor would also form part of the Project, including a raw water supply pipeline connecting to the Eungella pipeline network, an electricity transmission line and a mine access road. Coal processing (and disposal of coal reject) would be undertaken on-site. **Figure 1** shows the Project layout and the drill-hole sampling locations.

It is estimated the Project would extract 15 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal (and up to 17 Mtpa) for approximately 30 years. The coal resource would be mined by open cut mining methods, with product coal to be transported by rail to port for export.

This Geochemical Assessment forms part of an Environmental Impact Statement (EIS) which has been prepared in accordance with Part 4 of the *State Development and Public Works Organisation Act 1971*. This assessment has been prepared to satisfy the requirements of the *Terms of reference for an environmental impact statement – Winchester South Project* issued by the Coordinator-General on 4 September 2019.

Terrenus has geochemically assessed potential overburden and interburden (collectively called potential waste rock), coal seam material and potential coarse coal reject (obtained from coal processing pilot test-work). The geochemical characteristics of potential coarse reject and ROM coal are broadly representative of the expected environmental geochemical characteristics of coal reject.

Geochemical data was obtained from samples collected by Rio Tinto in 2012 and by Whitehaven in 2019 from 11 drill-holes located within the proposed open cut pit and waste rock emplacement areas (**Figure 1**), and comprised:

- sampling and geochemical analysis undertaken in 2012 from three (3) drill-holes from the previous tenement owners Rio Tinto (as reported by EGi, 2012); and
- sampling and geochemical analysis undertaken in 2019 from eight (8) exploration drill holes.

1.1 Background

The lithology within the Project area is characterised by typical basin-fill sediments, comprising mudstone, claystone, siltstone, sandstone (typically fine-grained), carbonaceous sediments and coal seams. The depth to base of weathering averages about 23 metres (m) below natural surface but ranges from about 15 m to 36 m below natural surface, depending on the local topography.

The coal bearing sequences within the Project area are the Permian-age Rangal Coal Measures (Leichardt seams and Vermont Upper seam) and the uppermost seam of the Fort Cooper Coal Measures (Vermont Middle Lower seams). The Rangal and Fort Cooper Coal Measures are separated by the Yarrabee Tuff Beds.

The Project proposes to mine coal from all seams where coal thickness and quality is economic. The ROM coal target seams include the Leichhardt Upper and Lower seams and the Vermont Upper and Middle Lower seams.

Overlying the Rangal Coal Measures is a thin veneer of Quaternary- and Tertiary-age sediments. At the Project area the Quaternary and Tertiary sediments are highly weathered, semi-consolidated and typically comprise sand, clay and gravel.

Coal would be mined for approximately 30 years by conventional open-cut methods, with ROM coal processed at the CHPP on-site. Waste rock would be placed within in-pit and out-of-pit emplacement areas. Fine coal reject would be dewatered and co-disposed with coarse coal reject into out-of-pit and in-pit emplacements on-site. Over the life-of-mine, coal reject is expected to comprise approximately four percent (%)[1] of all mineral waste for the Project.

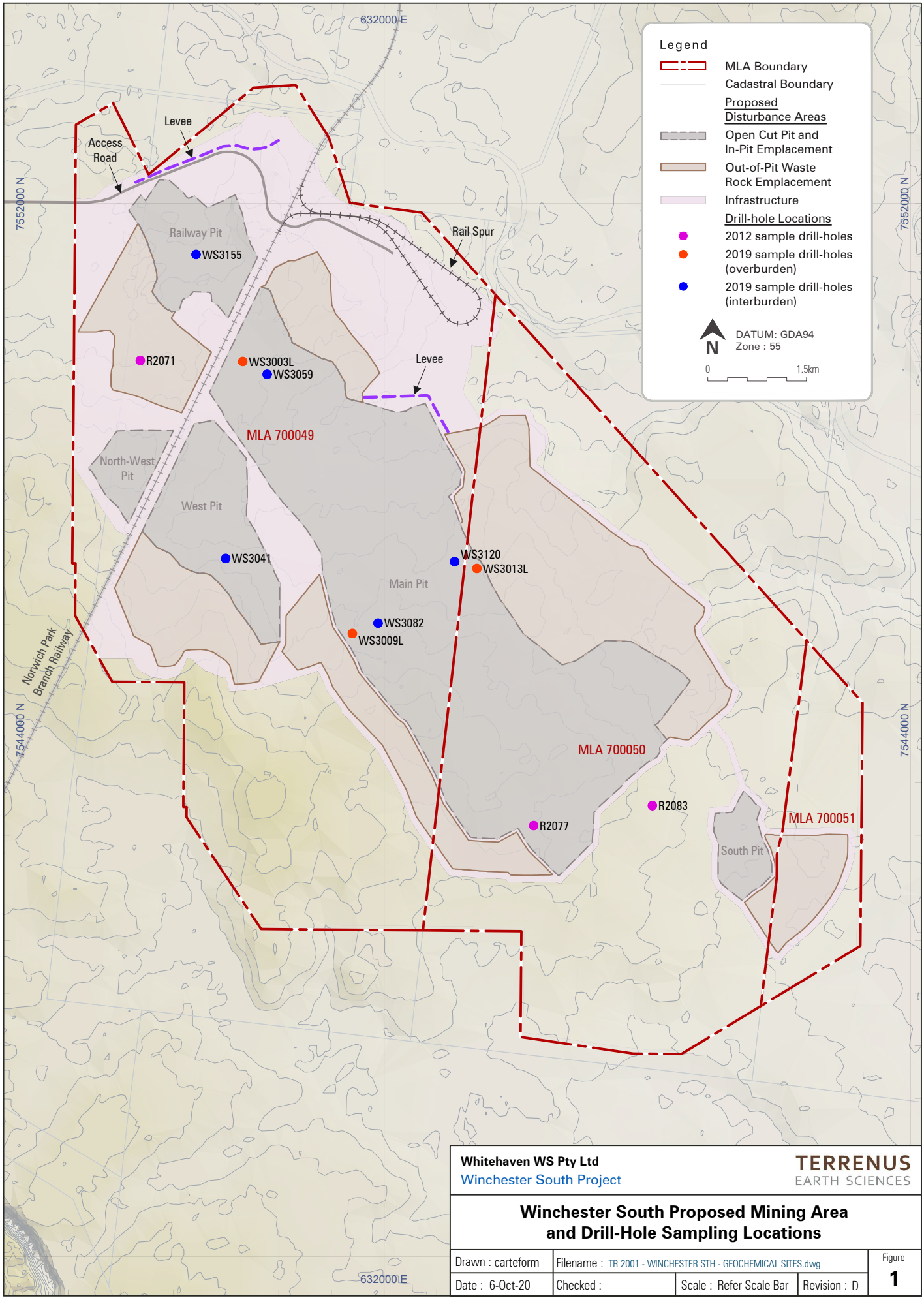
1.2 Objective

The overall objective of this geochemical assessment was to:

Evaluate the geochemical nature of potential waste rock and coal reject likely to be produced from the Project and identify any environmental issues that may be associated with mining, handling and storing these materials.

The scope of the geochemical assessment is consistent with the relevant requirements of the Terms of Reference for the Project (*ie*. requirements relating to mineral waste characterisation, water quality of surface water run-off and rehabilitation).

[1] Over the life-of-mine, approximately 2012 million cubic metres (Mm^3) of waste rock (approximately 3622 million tonnes (Mt) assuming a bulk density of 1.8 kg/m^3) and 148 Mt of coal reject will be produced.



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Winchester South Project

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Winchester South Proposed Mining Area and Drill-Hole Sampling Locations

Drawn : carteform	Filename : TR 2001 - WINCHESTER STH - GEOCHEMICAL SITES.dwg			Figure 1
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2 Geochemical Assessment Methodology

This section provides the methodology used for the geochemical assessment of potential waste rock and coal reject that could be generated by the Project.

2.1 Desktop Review of Existing Information

A desktop review of available project data and information was completed to provide a better understanding of the Project. The review included geological and geochemical data (from previous tenement owners – Rio Tinto), coal exploration drilling programs, proposed mining methods and mine plan, coal handling and processing methods, and mining waste disposal and management strategies. Discussions were held throughout 2019 with Whitehaven personnel (predominantly Project geologists) to identify and discuss relevant technical information. Primary geological information was obtained from drill-hole logs from the Project area, coupled with discussions with the Project geologists.

Based on the desktop review and previous experience in the Bowen Basin, including mines and projects close to the Project, Terrenus has a good understanding of the geological and geochemical environment at the Project area.

2.2 Sampling Strategy

The geochemical sampling and testing program developed for this assessment integrated with the exploration (resource definition) drilling program. This assessment is based on available data that is relevant to assessing the environmental geochemical characteristics of the Project.

There are currently no specific regulatory requirements regarding the number of samples required to be obtained and tested for coal, waste rock or potential coal reject material for mines in Queensland. Whilst historical guidelines do exist in Queensland (Department of Minerals and Energy [DME], 1995), more recent Australian and international guidelines (Department of Industry, Innovation and Science [DIIS], 2016; International Network on Acid Prevention [INAP], 2009) advocate a risk-based approach to sampling, especially for proposed coal mines where the geology and environmental geochemistry is well understood (from primary and secondary information sources).

The number and type of samples for the current assessment were selected based on a number of factors, including:

- the geological variability and complexity in rock types;
- the size of the operation, the proposed mining schedule and the volume of material;
- the potential for significant environmental or health impacts (based on the desktop review of available data and the environmental geochemical experience of Terrenus in the district and the greater Bowen Basin region);
- sample representation requirements and the representativeness of drill-hole samples; and
- the level of confidence in predictive ability.

The types of samples collected and assessed are outlined in this section.

Whitehaven's geologists supervised the drilling and sampling of eight partially cored exploration drill-holes within the deposit during 2019. This sampling program was to supplement existing data from sampling and analysis undertaken in 2012 (EGi, 2012). The drill-hole locations are shown on **Figure 1** and a description of the drill-hole details including location coordinates, collar elevations and depths are provided in **Appendix A – Table A1**. The lithological logs and sampling zones for all 11 drill-holes (from the 2012 and 2019 sampling programs) are provided in **Appendix B**. Only chip samples were able to be obtained from the 2012 and 2019 drilling programs for potential waste rock and seam samples. Potential coal reject samples were derived from drill-core samples from the coal quality test-work program.

Samples Collected

Including the 2012 and 2019 data, geochemical characterisation was undertaken on 365 samples, which comprise:

- 279 potential waste rock samples (from 2012 and 2019 sampling programs):
    - 54 weathered overburden samples (predominantly distinctly weathered);
    - 83 unweathered overburden samples (from base of weathering to top coal); and
    - 142 interburden samples (unweathered, between seams).
- 58 coal seam samples from the 2012 program (unweathered samples from Leichhardt and Vermont seams)
- 28 potential coarse reject samples from the 2019 coal quality test-work program (pilot plant). Coarse reject typically comprises harder, rocky materials derived from seam roof and/or parting and/or floor. Samples were provided from the target seams/plys: Leichhardt seam (L1/L1A and L2A) and Vermont seam (VA3 and VB-VH):
    - 6 x L1/L1A samples + 1 composite L1 sample;
    - 6 x L2A samples + 1 composite L2A sample;
    - 6 x VA3 samples + 1 composite VA3 sample; and
    - 6 x VB-VH samples + 1 composite VB-VH sample.

As indicated in **Section 1.1** coal reject is expected to comprise approximately 4% of the total mineral waste material generated over the life of mine. Therefore, from a statistical point-of-view the potential coal reject samples subjected to testing should only represent a relatively small proportion of all samples. However, in Permian deposits in the Bowen Basin, coal reject typically contains the greatest concentration of sulfur (potentially as reactive sulfide) and can sometimes have a comparatively greater concentration of metals/metalloids. Furthermore, there are a number of coal seams (plys) targeted at the Project, which all require sampling and assessment (undertaken as part of this assessment).

Drill-hole information is provided in **Appendices A and B** and the drill-hole (sampling) locations are shown on **Figure 1**. Sample descriptions are provided in **Appendix C – Table C1** for potential waste rock and ROM coal and **Table C2** for potential coarse reject.

2.3 Geochemical Tests

The potential waste rock and coarse reject samples were characterised using static geochemical test methods, which provide the fundamental geochemical characteristics of a sample. Static tests involve discrete analytical tests undertaken on samples, where the results represent the geochemical characteristics of the sample at a single point in time and under simple experimental conditions as a 'snapshot' of the sample's likely environmental geochemical characteristics.

Samples were prepared for static testing by pulverising each sample to a particle size of less than 75 micrometres (µm) in diameter. This is a standard preparation method that provides a homogenous sample for testing and creates a large surface contact area. This, in turn, provides a large potential for sample dissolution and reaction and therefore represents an initial 'assumed worst case' scenario for the potential waste rock and coal reject material.

The static testing has confirmed the non-carbonaceous and non-coal material to have a low environmental geochemical risk (**Section 4**) and, as such, kinetic leaching tests were not required on these materials as part of this assessment. For non-carbonaceous and non-coal material the static test results alone have been adequate and defining, in the context of the assessment objectives for the purposes of the Environmental Impact Statement (EIS).

The unmitigated environmental geochemical risks associated with carbonaceous and coaly material (*eg*. coal reject and coal seam material) have been found to be greater (compared with non-carbonaceous and non-coal material) (**Section 4**), however the static test results alone, for these carbonaceous and coaly materials, have been defining in the context of the assessment objectives for the purposes of the EIS. Further assessment of coal reject and coal seam material (and also bulk waste rock material) may be undertaken as the project develops to assist with management measures, including progressive rehabilitation and closure planning requirements.

Static Test Methodology

The test methods employed on all samples comprised:

- pH and electrical conductivity (EC) (1:2 weight:volume [w:v]) on finely crushed samples from the 2012 program and sample pulps from the 2019 program; and
- Net Acid Producing Potential (NAPP) (comprising total sulfur and acid neutralising capacity [ANC]).

Based on the results of the initial screening tests selected samples were subjected to several or all of the following tests:

- Net Acid Generation (NAG) [single addition];
- Extended boil NAG;
- Acid Buffering Characterisation Curves (ABCC);
- Chromium reducible sulfur (Scr);
- Total sulfate (SO_4);
- pH and EC (1:5 w:v water extracts);
- Soluble elements by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) / Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) and Flow Injection Mercury System (FIMS) (1:5 w:v water extracts);

- Soluble major cations and anions by ICP-AES (1:5 w:v water extracts);
- Total metals and metalloids:
  - The samples from the 2019 program underwent a mixed 4-acid digest. The digestion method from the 2012 program was not reported (in EGi, 2012), however based on the data (results) it is likely that a mixed 4-acid digest was undertaken.
  - The digest solutions of all samples were subsequently analysed by FIMS for Mercury (Hg) and ICP-MS / ICP-AES for all other elements.
- Exchangeable cations (Calcium [Ca], Magnesium [Mg], Sodium [Na], Potassium [K]) (with pre-treatment for salinity). Results were used to calculate the cation exchange capacity (CEC); and
- Emerson Aggregate Class testing (in accordance with Standards Australia method AS1289-3.8.1).

The geochemical test work program is summarised in **Table 1**.

Table 1. Summary of the Geochemical Test Program
(Number of samples subjected to each test regime)

Analytical tests	Potential Waste Rock	Coal Seams	Potential Coarse Reject
pH and EC on 1:2 water extracts	275 samples	56 samples	24 samples
pH and EC on 1:5 water extracts	20 samples	-	24 samples + 4 composite samples
Total sulfur and ANC	277 samples	60 samples	24 samples + 4 composite samples
NAG	179 samples	60 samples	4 composite samples
Extended boil NAG	1 sample	2 samples	-
Sulfide (Scr)	17 samples	-	24 samples + 4 composite samples
Sulfate (SO_4)	17 samples	-	-
Total elements in solids	33 samples	1 sample	4 composite samples
Soluble elements and major ions in 1:2 water extracts	13 samples	1 sample	-
Soluble elements and major ions in 1:5 water extracts	20 samples	-	4 composite samples
Exchangeable cations[2]	20 samples	-	-
Emerson Aggregate Class[2]	20 samples	-	-

All laboratory test work for the 2019 samples was undertaken by ALS Limited (ALS) Brisbane, using National Association of Testing Authorities (NATA) accredited methods (where such accreditation exists). Laboratory test-work undertaken on the 2012 samples was undertaken by

[2] Exchangeable cation and Emerson Aggregate Class tests have only been determined on potential waste rock samples (from the 2019 program), as waste rock materials are those likely to report to final landform surfaces and be used in rehabilitation and revegetation activities. ROM coal and coal reject will not report to final surfaces and not be used in final rehabilitation and revegetation activities.

EGi (in-house), ALS (Emerald, Brisbane and Sydney) and Levay & Co Environmental Services (Adelaide).

From the total sulfur (or Scr where available) and ANC results, maximum potential acidity (MPA) and NAPP were calculated. Where available, the MPA and NAPP of these samples were calculated using the Scr data instead of the total sulfur data. The use of Scr data (for fresh samples) provides a more accurate representation of the MPA that could theoretically be generated, as acid generation primarily occurs from reactive sulfide, whereas total sulfur includes other sulfur forms such as sulfate and organic sulfur.

The Acid-Base Account (ABA) method was used to assess the acid-neutralising and acid-generating characteristics of the samples. The total and water-soluble element data was used to indicate the potential for mineral waste material to leach metals and metalloids (under existing pH and oxygen [redox] conditions) at concentrations that could warrant further investigation (in a 'worst-case' leaching scenario).

Assessment of Element Enrichment

From an environmental perspective, multi-element scans are typically undertaken to identify any elements (particularly metals and metalloids) present in a material at concentrations that *may* be of environmental concern with respect to revegetation and surface water quality.

In this assessment the total concentration result for each element was compared to average element abundance in soil in the earth's crust (Bowen, 1979) to measure how the total elemental concentrations in the material proposed to be mined compare against average elemental concentrations in soil (worldwide). Such a comparison is undertaken to identify samples that contain what may be regarded as 'elevated' concentrations of metals and metalloids (relative to typical concentrations in this rock type) to assess any potential concerns related to mine operation, environmental issues and final rehabilitation.

There are no guidelines and/or regulatory criteria in Queensland (or elsewhere in Australia) specifically related to total metal and metalloid concentrations in mineral waste material. In the absence of specific guidelines and/or regulatory criteria, and to provide relevant context, the total assay result for each element (milligrams per kilogram [mg/kg]) were compared to the average background concentration (average crustal abundance) of those elements in soil and rock.

From the comparison with average crustal abundance in rocks a geochemical abundance index (GAI) was calculated. The GAI quantifies an assay result for a particular element in terms of the average abundance for that element (in 'intermediate' igneous rocks). The index, based on a log 2 scale, is expressed in seven integer increments (0 to 6), which correspond to enrichment factors from 0 to over 96 times average crustal abundance, as shown in **Table 2** below.

As a general rule, a GAI greater than or equal to three indicates enrichment to a level that potentially warrants further investigation or provides an indication of which elements may potentially be problematic with respect to environmental impacts. This is particularly the case with some environmentally important 'trace' elements, such as arsenic (As), cadmium (Cd), copper (Cu), zinc (Zn), *etc*., more so than with major rock-forming elements, such as aluminium (Al), Ca, Na, *etc*. This comparison does not take into account the background or baseline concentration of elements in soil/rock immediately outside the Project area (such data is not available to Terrenus for this assessment). That is, soil/rock outside the Project area may be naturally 'elevated' in some elements, well above the average background concentrations in soil (in the earth's crust).

Table 2. Geochemical Abundance Index (GAI)

GAI	Enrichment factor	GAI	Enrichment factor
0	Less than 3-fold enrichment	4	24 to 48-fold enrichment
1	3 to 6-fold enrichment	5	48 to 96-fold enrichment
2	6 to 12-fold enrichment	6	Greater than 96-fold enrichment
3	12 to 24-fold enrichment		

Elements identified as enriched may not necessarily be a concern for revegetation and rehabilitation, human and animal health or drainage water quality, but their significance should be evaluated. Similarly, if an element is not enriched it does not mean it would never be a concern, because under some conditions (*eg*. low pH) the geochemical behaviour of common environmentally important elements such as Al, As, Cu, Cd and Zn can change significantly.

The total metal/metalloid concentrations for individual elements in mineral waste material can also be relevant for revegetation activities and/or where the potential exists for human contact (*eg*. if the material was to be used off-site).

Assessment of Element Solubility

Under certain circumstances, mineral waste material can potentially leach soluble metals at concentrations that may impact the environment or human health. Selected samples were subjected to short-term leaching tests to determine the immediate solubility and potential mobility of elements under highly agitated and solubility-inducing conditions.

Thirty-eight (38) samples underwent 'water extract' leaching tests, which is a one hour bottle tumbling (end-over-end) leach at a solid:water ratio of 1:2 w:v (for the 2012 samples) or 1:5 w:v (for the 2019 samples). The samples comprised 33 potential waste rock samples (a selection of weathered and unweathered waste rock samples), one (1) coal seam sample and four (4) composite potential coarse reject samples. The water extract tests undertaken in 2012 were performed on finely crushed samples that had been allowed to equilibrate in the extract solution for 16 hours prior to undergoing a short-term tumble leach. The water extract tests undertaken on the 2019 samples were performed on pulped samples (80% passing 75 µm in diameter), which means the available surface area for dissolution/solubility and/or geochemical reaction is relatively high compared to dissolution/solubility of soil and rock at much greater grain sizes.

Leaching tests were used to determine the solubility and potential mobility of elements under existing pH and oxygen (redox) conditions. Soluble element concentrations can be compared with 'trigger values' from potentially relevant surface water and groundwater guidelines in order to provide some useful context.

There are no guidelines and regulatory criteria specifically related to direct surface run-off and/or seepage from waste rock and coal reject material since guidelines (and regulatory criteria) would depend upon the end-use and receiving environment of the seepage. Therefore, to provide relevant context, the soluble concentration of each element extracted from the samples was compared to livestock drinking water guidelines (Australian and New Zealand Environment and Conservation Council [ANZECC], 2000) and freshwater aquatic ecosystem guidelines for slightly to moderately disturbed systems (ANZECC, 2000).

Note: It is important to recognise that the direct comparison of bottle leachate concentration with applied water quality guideline concentration is provided for general context only. The guideline values provided in ANZECC (2000) are for receiving water environments, whereas the soluble element data in this assessment is 'point source' obtained from a finely-pulped (or finely crushed) sample subjected to rigorous and artificial extraction to obtain an assumed 'maximum' concentration. Therefore, the guideline values provided are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to soluble metals/metalloids in waste rock or coal reject material – nor should they be viewed as such.

2.4 Sample Classification Criteria

Sample classification of mineral waste material follows some general rules, however the classification has to take into account the site geology and other site-specific geochemical characteristics that may influence the classification criteria.

Samples were classified, with respect to acid generation, using total sulfur (S), NAPP, NAG and ANC/MPA ratio data into three broad categories:

- NAF Non-acid Forming;
- Uncertain Those samples with inconclusive results, leading to a degree of uncertainty about their ability to generate acid; and
- PAF Potentially Acid Forming.

Within these three broad categories, the sample classification was refined as follows. The classification basis differed slightly depending upon whether NAG results were available.

NAF – Barren[3]**:** S ≤0.05 %

***NAF – Low Sulfur (NAF-Low S)*:**

NAPP <0 kg sulfuric acid [H_2SO_4] per tonne of sample (kg H_2SO_4/t) and NAGpH ≥4.5 and S ≤0.2%

or

NAPP <0 kg H_2SO_4/t and ANC/MPA ratio ≥2 and S ≤0.2%

***NAF-S*:**

NAPP <0 kg H_2SO_4/t and NAGpH ≥4.5 and S >0.2%

or

NAPP <0 kg H_2SO_4/t and ANC/MPA ratio ≥2 and S >0.2%

***PAF – Low Capacity (PAF-LC)*:**

NAPP ≥0 and <10 kg H_2SO_4/t and NAGpH <4.5

or

NAPP ≥0 and <10 kg H_2SO_4/t and ANC/MPA ratio <2

[3] Based on Terrenus's significant experience working in the Bowen Basin, mineral waste materials from coal deposits in the Bowen Basin with a total sulfur content of ≤0.1% are essentially barren of sulfur and have negligible capacity to generate acidity, even in the absence of significant ANC. Conservatively, Terrenus has adopted a total sulfur 'barren' value of ≤0.05%.

***PAF*:**

NAPP ≥10 kg H_2SO_4/t and NAGpH <4.5

or

NAPP ≥10 kg H_2SO_4/t and ANC/MPA ratio <2

Uncertain: Any result outside of the above criteria, or results that appear to significantly conflict with the expected result based on lithology or mineralogy.

Heterogeneity is a characteristic of natural geological (soil and rock) material. Sometimes an analytical result for a rock sample can vary to that which may be expected based on the known rock type (from information contained in the lithological logs). In this case, a degree of conservatism is applied to the result (*ie*. the precautionary principle prevails) and the sample is classified as 'Uncertain' until further information becomes available. Depending on the level of risk, from a mineral waste management perspective 'Uncertain' samples are usually managed conservatively.

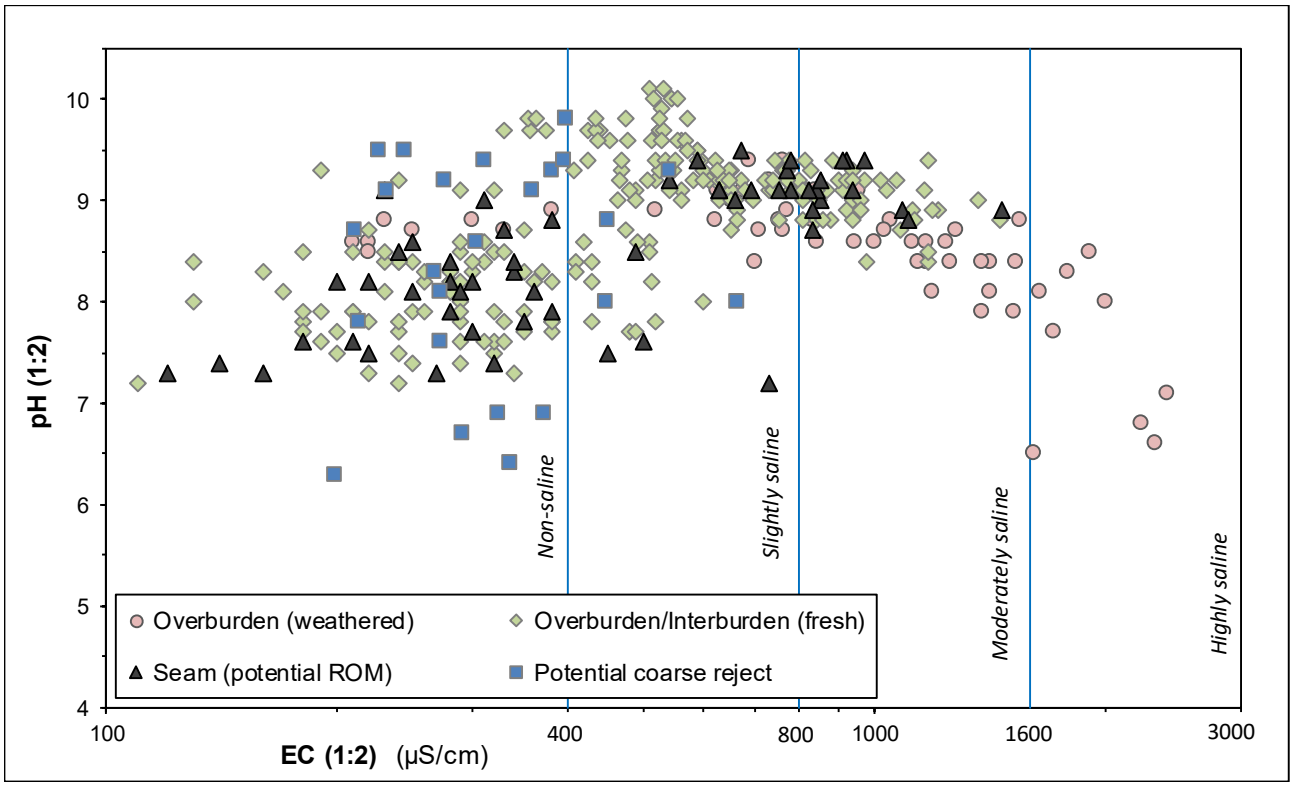
3 Geochemical Test Results

3.1 Salinity and pH

EC and pH results are presented in **Appendix C – Table C1** for potential waste rock and ROM coal and **Table C2** for potential coarse reject, and summarised as follows. The laboratory certificates for the samples collected from the 2019 drilling program are provided in **Appendix D**. The results for the samples from the 2012 program were obtained from EGi (2012).

The $EC_{1:2}$ values of all samples (n=355) are generally low to moderate and cover a broad range from 110 to 2410 microSiemens per centimetre (µS/cm), with a median $EC_{1:2}$ value of 520 µS/cm and 10th and 90th percentile values of 230 and 1102 µS/cm, respectively (**Figure 2**). Approximately 76% of samples fall in the non-saline to slightly saline range.

Figure 2. Electrical Conductivity (EC) and pH



As evident in **Figure 2**, potential waste rock and seam samples had the greatest range of $EC_{1:2}$ values, with the weathered overburden samples being generally more saline compared to other sample types. Less than 3% of samples were saline ($EC_{1:2}$ >1600 µS/cm) – all of which were extremely to distinctly weathered overburden samples from less than 10 m depth. The potential coarse reject samples generally had low salinity.

All samples (n=355) are pH-neutral to alkaline, with $pH_{1:2}$ values ranging from 6.3 to 10.1, with a median $pH_{1:2}$ of 8.8 and 10th and 90th percentile $pH_{1:2}$ values of 7.7 and 9.5, respectively (**Figure 2**). Three weathered overburden samples had $pH_{1:2}$ values between 6.5 and 6.8 and five potential coarse reject samples had $pH_{1:2}$ values between 6.5 and 6.9, however all samples had $pH_{1:2}$ values greater than pH 6 and show no inherent acidity. For context, deionised water used in the pH tests typically has a pH between 5.0 and 6.5.

3.2 Acid-Base Accounting (Potential for Acid Generation)

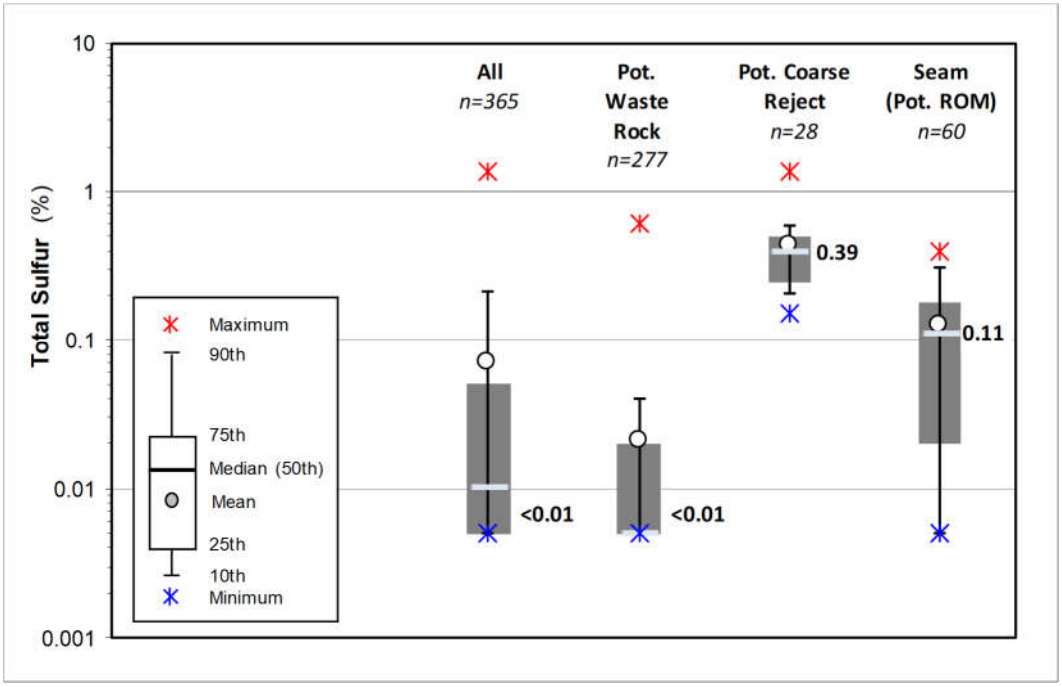
The ABA is the theoretical balance between the potential for a sample to generate acid and neutralise acid and in Australia is commonly expressed in units of kg H_2SO_4/t.

ABA results are presented in **Appendix C – Table C1** for potential waste rock and ROM coal and **Table C2** for potential coarse reject, and are summarised as follows. The laboratory certificates for the samples collected from the 2019 drilling program are provided in **Appendix D**. The results for the samples from the 2012 program were obtained from EGi (2012).

Sulfur, Sulfide and Sulfate

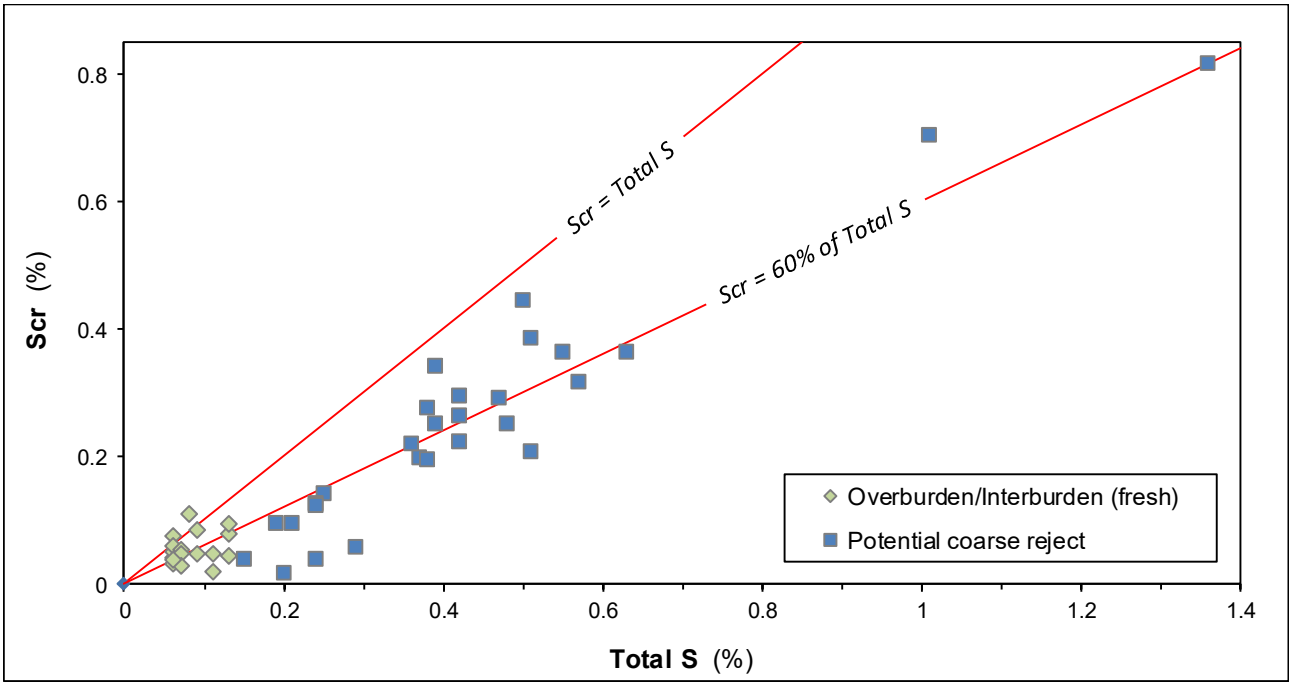
The total sulfur (total S) concentration values of all samples (n=365) ranged from <0.01% to 1.36%, with most samples having total S values below 0.4% (95th percentile = 0.38%). **Figure 3** is a box plot showing the distribution of total S values grouped by sample type, which clearly shows potential waste rock samples as having negligibly low total S concentrations, with 92% of all potential waste rock samples (255 out of 277 samples) having a total S concentration below 0.05%, thus rendering them 'barren' with respect to sulfur.

Figure 3. Distribution of Total Sulfur



For samples collected from the 2019 drilling program, Scr (and total sulfate [SO_4]) was measured on all samples with total S concentrations greater than 0.05% (n=45). No weathered overburden samples had total S values greater than 0.05%. As evident in **Figure 4**, the sulfide (Scr) concentration for almost all samples is much lower than the total S value, with almost all Scr values plotting below the 'unity' line (S% = Scr%). As a proportion of total S, Scr comprised a very wide range between 9% and >100% of total S, with a median value of 60% and 10th and 90th percentile values of 29% and 88%, respectively. That is, based on the median value, about 60% of total S is present as sulfide (Scr). There were only minor differences in proportion of total S as Scr between the potential waste rock samples compared with the potential coarse reject samples.

Figure 4. Total Sulfur (S) vs Sulfide (Scr)



Maximum Potential Acidity and Acid Neutralising Capacity

The ANC and MPA that could be generated by these samples (MPA calculated from Scr where available, or else calculated from total S) is summarised in **Table 3** and **Figure 5**.

Table 3. Summary Maximum Potential Acidity (MPA) and Acid Neutralising Capacity (ANC)

Sample Material	Min.	Max.	Median	90th Percentile	General Comments
Maximum potential acidity (MPA) *all units kg H_2SO_4/t*					
All samples (n=365)	<0.2	25	0.3	5.4	Very low (negligible)
Potential waste rock samples (n=277)	<0.2	19	0.2	1.2	Very low (negligible)
Seam samples (n=60)	<0.2	12	3.4	9.3	Low
Potential coarse reject samples (n=28)	0.5	25	7.2	12	Low

Sample Material	Min.	Max.	Median	10th Percentile	General Comments
Acid neutralising capacity (ANC) *all units kg H_2SO_4/t*					
All samples (n=365)	1.0	254	40	14	Moderate
Potential waste rock samples (n=277)	1.0	254	44	17	Moderate
Seam samples (n=60)	10	124	28	13	Moderate
Potential coarse reject samples (n=28)	2.2	101	22	11	Moderate

Due to the very low total sulfur values (generally) the MPA for all samples is very low, with a 90th percentile MPA value for all samples of 5.4 kg H_2SO_4/t (*ie*. 90% of samples have an MPA less than

5.4 kg H_2SO_4/t). The seam and potential coarse reject samples have greater MPA values, generally (compared to the potential waste rock samples), as expected by the typically greater sulfur and sulfide concentrations of coaly and carbonaceous material.

The ANC values are typically well in excess of the MPA values and span a relatively large range, from 1.0 to 254 kg H_2SO_4/t, with a median ANC value for all samples of 40 kg H_2SO_4/t and a moderate 10th percentile value of 14 kg H_2SO_4/t, respectively (*ie*. 90% of samples have an ANC greater than 14 kg H_2SO_4/t).

Available Neutralising Capacity

The availability of neutralising material is generally determined by the mineralogy of the sample – with calcite and dolomite carbonate minerals being more readily-available to neutralise acidity compared with, for example, siderite. Eight potential waste rock samples and four composite potential coarse reject samples underwent ABCC testing to assess the proportion of ANC that may be 'readily available' (*ie*. short-acting) in these materials. Three of the potential waste rock samples were logged as carbonaceous (at least in part). Coarse reject samples are usually coaly and/or carbonaceous. Coaly and carbonaceous materials often have a lower proportion of calcite and dolomite compared to non-carbonaceous and coaly materials and, as such, generally have lower ANC values.

The results are summarised in **Table 4** and show that the proportion of ANC at pH 4.5 (*ie*. readily available) ranges from 13% to 103% of the total ANC, with an average of 59% for potential waste rock (median = 64%) and an average of 62% for coarse reject samples (median = 71%). The results suggest that at least half of the 'standard' ANC can be assumed to be present in a readily available form (to neutralise any acid). The remaining ANC should still be available but is likely to react at a slower rate – providing long-term neutralisation more so than short-term neutralisation. The ABCC laboratory results are provided in **Appendix D**.

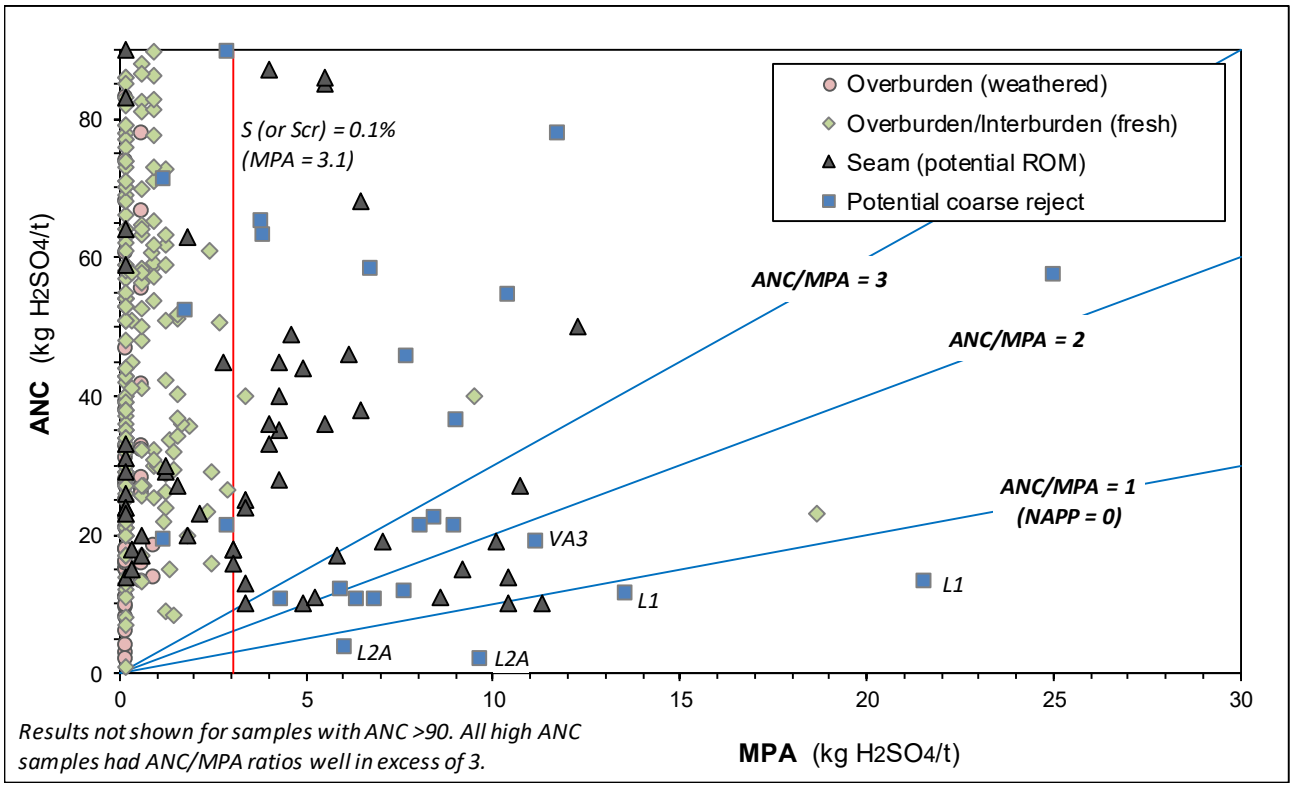
Table 4. Available Neutralising Capacity

Sample ID	Lithology	Type	ANC kg H_2SO_4/t	Proportion of ANC @ pH 4.5
130233	Sandstone, medium	Overburden (weathered)	90.5	87%
130214	Siltstone, carbonaceous	Overburden	33.6	52% (duplicate = 53%)
130246	Sandstone, fine; carbonaceous	Overburden	23.3	13%
3219216	Sandstone, medium	Interburden	123	103%
3219241	Sandstone, medium	Interburden	60.8	75%
3219255	Sandstone, fine	Interburden	40.0	46%
3219268	Carbonaceous Siltstone	Interburden	26.4	16%
3219281	Sandstone, fine	Interburden	82.8	79%
Comp-L1	Leichhardt seam, L1 ply	Coarse Reject	54.5	32% (duplicate = 33%)
Comp-L2A	Leichhardt seam, L2A ply	Coarse Reject	45.0	73%
Comp-VA3	Vermont seam, VA3 ply	Coarse Reject	94.8	72%
Comp-VBVH	Vermont seam, VB-VH plys	Coarse Reject	75.0	69%

ANC/MPA Ratios

Generally, those samples with an ANC/MPA mass ratio greater than two are considered to have a negligible/low risk of acid generation and a high factor of safety in terms of potential for acid and metalliferous drainage (AMD) (DIIS, 2016; INAP, 2009[4]). The results in **Figure 5** and **Table 5** show that 350 samples (96% of samples) have an ANC/MPA ratio greater than two, and 84% of samples have ANC/MPA ratios greater than 10. Almost all (99% of) potential waste rock samples have an ANC/MPA ratio greater than five. Therefore, bulk waste rock material represented by these potential waste rock samples is considered to have a very low risk of acid generation, excess ANC, and a high factor of safety with respect to acid generation. Ninety percent (90%) of coal seam samples and about 70% of potential coarse reject samples have an ANC/MPA ratio greater than two.

Figure 5. Maximum Potential Acidity (MPA) and Acid Neutralising Capacity (ANC)



[4] INAP (2009) considers that mine materials with an ANC/MPA ratio greater than 2 are likely to be NAF unless significant preferential exposure of sulfide minerals occurs along fracture planes, in combination with insufficiently reactive ANC.

Table 5. Summary ANC/MPA Ratios

Sample Material	Min.	Max.	Median	Number and (%) of samples with ANC/MPA ratios:			
				Less than 2	Between 2 and 5	Between 5 and 10	Greater than 10
All samples (n=365)	<1	>1600	115	15 (~4%)	16 (~4%)	26 (~7%)	308 (84%)
Potential waste rock samples (n=277)	1.2	>1600	163	1 (<1%)	1 (<1%)	6 (~2%)	269 (97%)
Seam samples (n=60)	<1	810	11	6 (10%)	8 (13%)	14 (23%)	32 (53%)
Potential coarse reject samples (n=28)	<1	194	3.4	8 (29%)	7 (25%)	6 (21%)	7 (25%)

Note: Percentages may have minor discrepancies due to rounding.

Net Acid Producing Potential and Net Acid Generation Capacity

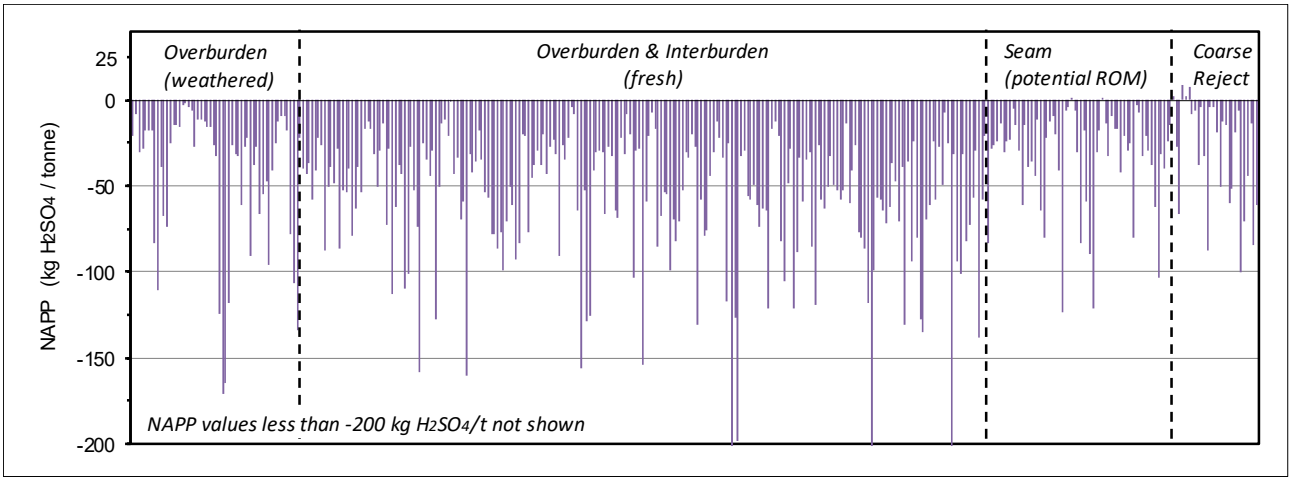
The calculated NAPP values for all samples are summarised in **Table 6**.

Table 6. Summary Net Acid Producing Potential (NAPP) Values

Sample Material	Min.	Max.	Median	10^{th} / 90^{th} percentile	General Comments
	NAPP kg H_2SO_4/t				
All samples (n=365)	-254	+8	-38	-101 / -11	Low (mostly strongly negative)
Potential waste rock samples (n=277)	-254	-1	-44	-112 / -16	Low (mostly strongly negative)
Seam samples (n=60)	-124	+1	-26	-81 / -6	Low (mostly strongly negative)
Potential coarse reject samples (n=28)	-100	+8	-32	-74 / +2	Low (mostly negative)

Based on the very low MPA and significantly higher ANC values (relative to the MPA), the calculated NAPP values are negative for almost all samples and strongly negative for a significant number of samples (**Figure 6**).

Figure 6. Net Acid Producing Potential (NAPP)



Two seam samples had near-zero NAPP values (~1 kg H_2SO_4/t) and four potential reject samples had low positive NAPP values (≤8 kg H_2SO_4/t). This indicates a significantly greater proportion of neutralising capacity (ANC) compared to potential acidity (MPA).

NAG test results are used in conjunction with NAPP values in determining the acid classification of samples. The calculated NAPP value assumes that all sulfur (or sulfide) will oxidise to generate acid (MPA) and that all neutralising material in a sample is in a readily available form to neutralise any acid that could be generated (ANC). Unlike the theoretical basis of the NAPP test, in a NAG test a sample is encouraged to oxidise by reaction with hydrogen peroxide and any acid generated through oxidation may be consumed by neutralising components in the sample. Any remaining acidity is measured and expressed as kg H_2SO_4/t. Samples with NAGpH values greater than pH 4.5 are considered to be NAF. Samples with NAGpH values less than or equal to pH 4.5 (*ie.* acid-generating) would also be expected to have measurable NAG capacity (*ie*. NAG capacity >0.1 kg H_2SO_4/t). As a guide, NAG capacity values between 0.1 and 5 kg H_2SO_4/t are considered 'low capacity' (AMIRA, 2002).

NAG tests were undertaken on 243 samples, comprising:

- All 162 potential waste rock samples from the 2012 program;
- All 60 seam samples from the 2012 program;
- 17 potential waste rock samples from the 2019 program (samples with total S > 0.05); and
- All 4 composite potential coarse reject samples from the 2019 program.

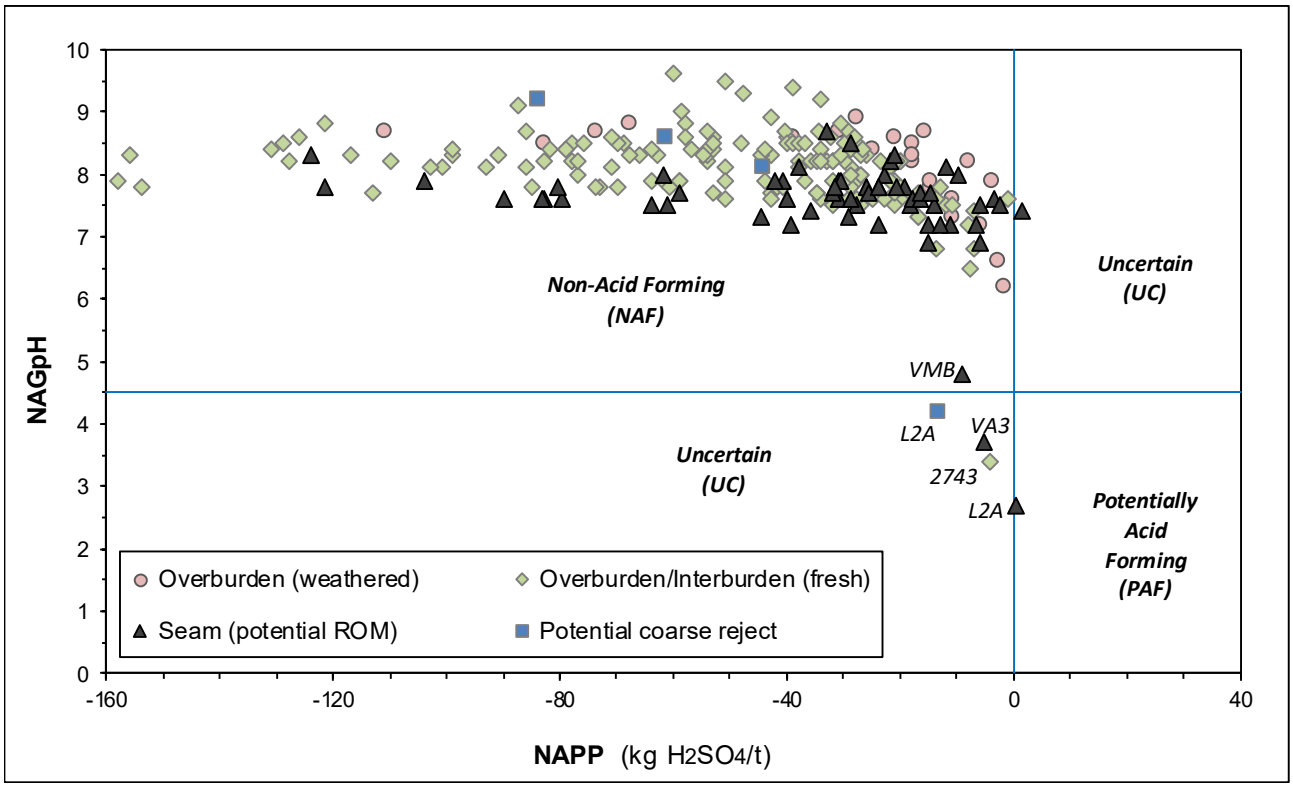
NAGpH values were greater than pH 4.5 (and had NAG capacities <0.1 kg H_2SO_4/t) for all except four samples tested. Of the four samples with NAGpH values less than 4.5, two were coal seam samples, one was a composite potential coal reject sample and the other was a potential waste rock sample.

The plot of NAGpH versus NAPP results (**Figure 7**) shows that essentially all samples with NAGpH values greater than 4.5 also have negative NAPP values, and so plot in the 'non-acid forming' domain. The remaining handful of samples plot in the 'Uncertain' domains.

Extended boil NAG tests (AMIRA, 2002) were undertaken (by EGi, 2012) on three samples that had 'Uncertain' classifications based on the NAPP and NAG test results (seam samples L2A and VA3 and potential waste rock sample 2743 – as marked on **Figure 7**). Samples 2702 (VA3) and

2743 were found to be NAF (the VA3 sample was NAF-Low S and sample 2743 was NAF-S), whereas the L2A sample was confirmed as PAF-LC.

Figure 7. Net Acid Generation pH (NAGpH) After Oxidation vs Net Acid Producing Potential (NAPP)



Geochemical Classification

The ABA results presented in this section have been used to classify the acid forming nature of the samples as shown in **Appendix C – Tables C1 and C2**, following the classification criteria outlined in **Section 2.4**. The geochemical classification (acid forming nature) of these samples is summarised in **Table 7**. No samples were classified as 'PAF' (*ie*. all 'PAF' samples were classified as PAF-LC).

Potential waste rock samples

The results in **Table 7** show that over 99% of potential waste rock samples tested fall in the NAF-Barren or NAF-Low S categories, and waste rock material represented by these samples has very low sulfur concentration, excess ANC (relative to the MPA) and clearly has negligible capacity to generate acidity or sulfate. One sample (each) was classified as NAF-S and PAF.

From an acid generating perspective, waste rock (as a bulk material) would be overwhelmingly NAF. This has implications for soluble metals/metalloids transport, as alkaline waste rock would inhibit the release of soluble metals/metalloids, compared to the relatively high soluble metals/metalloids concentrations possible in acidic drainage. Furthermore, the very low (negligibly low) sulfur concentrations in potential waste rock indicate that the sulfate concentration that could

be generated in waste rock from sulfide oxidation (in addition to any existing sulfate) would also be very low.

Table 7. Geochemical Classification

Potential waste rock samples					
Sample Material	**NAF-Barren[1]**	**NAF-Low S[2]**	**NAF-S[2]**	Uncertain	**PAF-LC**
No. and (%) of weathered overburden samples (n=54)	54 (100%)	-	-	-	-
No. and (%) of 'fresh' overburden & interburden samples (n=223)	201 (90%)	20 (9%)	1 (<1%)	-	1 (<1%)
No. and (%) of all potential waste rock samples (n=277)	255 (92%)	20 (~7%)	1 (<1%)	-	1 (<1%)
% of all potential waste rock samples (n=277)	***99 %***		***<1 %***	***<1 %***	

Coal seam samples					
Sample Material	**NAF-Barren[1]**	**NAF-Low S[2]**	**NAF-S[2]**	Uncertain	**PAF-LC**
No. and (%) of Leichardt seam samples (n=17)	9 (53%)	4 (24%)	4 (24%)	-	-
No. and (%) of Vermont seam samples (n=43)	13 (30%)	23 (53%)	6 (14%)	1 (~2%)	-
No. and (%) of all seam samples (n=60)	22 (37%)	27 (45%)	10 (17%)	1 (~2%)	-
% of all coal seam samples (n=60)	***82 %***		***17 %***	***<2 %***	

Potential coarse reject samples					
Sample Material	**NAF-Barren[1]**	**NAF-Low S[2]**	**NAF-S[2]**	Uncertain	**PAF-LC**
No. of L1 coarse reject samples (n=7)	-	-	4	1	2
No. of L2A coarse reject samples (n=7)	-	-	2	3	2
No. of VA3 coarse reject samples (n=7)	-	1	5	1	-
No. of VB-VH coarse reject samples (n=7)	-	2	5	-	-
No. and (%) of all coarse reject samples (n=28)	-	3 (11%)	16 (57%)	5 (18%)	4 (14%)
% of all potential coarse reject samples (n=28)	***11 %***		***57 %***	***32 %***	

1: Samples have been classified as NAF-Barren where total sulfur concentration is less than 0.05%.
2: NAF samples with total S concentrations >0.05% are further sub-classified by total S as 'NAF-Low S' (S between 0.05% and 0.2%) and 'NAF-S' (S >0.2%S) as per **Section 2.4**.
Note: Percentages may have minor discrepancies due to rounding.

Coal seam samples

Approximately 82% of coal seam samples tested (49 out of 60 samples) fall in the NAF-Barren or NAF-LowS categories, and seam material represented by these samples has very low sulfur values, excess ANC (relative to the MPA) and clearly has negligible capacity to generate acidity or sulfate. An additional 10 seam samples (17% of samples) were also classified as NAF, however these samples have total S concentrations greater than 0.2% and are therefore classified as NAF-S. One seam sample had an uncertain classification. These results suggest that coal stored on a ROM pad, coal located within pit walls or floor, and un-economic coal seam material reporting as waste rock (mixed with non-coal waste rock) would likely be NAF.

Potential coarse reject samples

Approximately 11% of potential coarse reject samples tested (3 out of 28 samples) were classified as NAF-Low S and coarse reject material represented by these samples have very low sulfur values, excess ANC (relative to the MPA) and clearly have negligible capacity to generate acidity or sulfate. A further 57% of potential coarse reject samples tested (16 out of 28 samples) were also classified as NAF, however these samples have total S concentrations greater than 0.2% and are therefore classified as NAF-S. Four samples from the L1 and L2A seams/plys were classified as PAF-LC. Approximately 18% of samples (5 out of 28 samples) had an 'Uncertain' classification.

Based on the number of samples tested, and the relatively simple static geochemical tests undertaken on most of the coarse reject samples, the results show that, conservatively, about one-third of coarse reject material *could* have *some* potential to generate acidity with no management controls in place. However, the magnitude of any acidity generated, if at all, would be expected to be very low and would be expected to be easily managed (refer to management measures outlined in **Section 5.2**).

From an acid generating perspective, the implication is that coarse reject (as a bulk material) is regarded as having a relatively low unmitigated environmental risk profile, but greater than waste rock samples. Regardless, the generally low sulfur (and, therefore, sulfide) concentrations of most coal reject (as a bulk material) indicates that the sulfate concentration that could be generated by this material if available sulfide were to completely oxidise is also expected to be very low.

3.3 Metals and Metalloids

Selected potential waste rock samples and four composite potential coarse reject samples were tested for a broad suite of metal and metalloid elements. The multi-element (solid) test results for 38 samples, comprising 33 potential waste rock samples, one coal seam sample and four potential coarse reject composite samples are presented in **Appendix C – Table C3** for potential waste rock and **Table C5** for potential coarse reject and ROM coal. The ALS laboratory certificates for 24 of these samples (samples from the 2019 program) are provided in **Appendix D**. The results for the samples from the 2012 program were obtained from EGi (2012).

The results are compared to background concentrations for each element, based on average elemental abundance in soil in the earth's crust. The comparison is determined by the GAI, as outlined in **Section 2.3**. GAI values of three are regarded as 'moderately' enriched (with respect to average elemental abundance) and GAI values of four or more are regarded as 'significantly' enriched. The GAI values are presented in **Appendix C – Table C4** for potential waste rock and **Table C6** for potential coarse reject and ROM coal show that:

- Potential Waste rock: one sample is significantly enriched (GAI = 5) with respect to As and four samples are moderately enriched (GAI = 3) with respect to Be; and
- Potential Coarse Reject: the VA3 composite sample is moderately enriched (GAI = 3) with respect to S.

The environmental significance of identified metal/metalloid concentrations in potential waste rock and coal reject material and the water solubility in terms of risk is discussed in **Section 4**.

3.4 Initial Solubility

To evaluate the initial solubility of multi-elements in potential waste rock and coarse reject material, water extract tests were completed for each of the 38 samples that also underwent 'total element' analysis. The samples from the 2012 program underwent a 1:2 w:v (solid:water) water extract procedure (EGi, 2012). The samples from the 2019 program underwent a 1:5 w:v (solid:water) water extract procedure. The results from these tests are provided in **Appendix C – Tables C7 to C10** and are summarised below. The ALS laboratory certificates for 24 of these samples (samples from the 2019 program) are provided in **Appendix D**. The results for the samples from the 2012 program were obtained from EGi (2012), but the laboratory certificates for these samples were not available.

Approximately 68% of potential waste rock samples (23 of 34 samples) have soluble metals/ metalloids concentrations that are 'elevated' with respect to applied water quality guideline levels for freshwater aquatic ecosystems (95% protection level) (ANZECC & ARMCANZ, 2000) for one or more of Al, As, Cu, Se and/or Zn. No samples have soluble element concentrations above the applied ANZECC & ARMCANZ (2000) livestock drinking water quality guideline levels.

With regard to soluble Al, As, Cu, Se and Zn the laboratory LOR for solutions derived from soil:water extract procedures is higher than the applied aquatic ecosystem guideline concentration for each of these three elements – despite high resolution analysis. Therefore, any result above the laboratory LOR results in a 'technical exceedance' of the applied aquatic ecosystem guideline value.

The remaining soluble elements (*ie*. other than Al, As, Cu, Se and Zn) and major ions are at concentrations below the applied livestock drinking water quality and aquatic ecosystem quality guidelines (where guideline values exist), and in most cases, below the laboratory LOR.

The environmental significance of identified soluble metal/metalloid concentrations in potential waste rock and coal reject material in terms of risk is discussed in **Section 4**. It is important to note that the soluble metal/metalloid results presented in this report represent an 'assumed worst case' scenario. The 2012 samples were undertaken on a finely crushed 'aged' sample, which means the samples were allowed to equilibrate in the extract solution for 16 hours prior to undergoing a short-term tumble leach – therefore these samples had a long 'extraction' period to encourage dissolution. The 2019 samples were pulverised to less than 75 µm in diameter prior to undergoing a short term tumble leach – therefore these samples have a very high surface area compared to similar material in the field. Individual materials would also be well mixed at storage locations. Hence, as is typically the case for many coal mines in the Bowen Basin, it is expected that the concentration of metals/metalloids in surface run-off and seepage from waste rock (and coal reject) material would be significantly less than the laboratory results from these 'pulped' samples in the field.

It should be noted that the applied guideline values are provided to place the results into context. The applied guideline values are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to total and soluble metals/metalloids in potential mineral waste material.

3.5 Cation Exchange Capacity, Sodicity and Dispersion

To evaluate the potential 'soil quality' of waste rock material, exchangeable cation concentrations were measured on 20 potential waste rock samples and the results are presented in **Appendix C – Table C11** and key aspects are summarised in **Table 8**. The laboratory certificates for these samples are provided in **Appendix D**.

From a soil chemistry view-point, waste rock has different soil characteristics compared to the coarse reject and coal seam materials – and coaly and carbonaceous materials would not report to final landform surfaces as they would be covered by waste rock (or buried in-pit prior to backfilling with waste rock). Furthermore, approximately 98% of all mineral waste would be mined waste rock. With this in mind, the suitability of mineral waste material for use in revegetation and rehabilitation is focused on waste rock material.

The CEC of potential waste rock samples (20 samples) range from 5.1 to 23 milliequivalents per 100 grams (meq/100g), with a moderate median CEC value of 12 meq/100g. The ESP results range from a 'high' 12.2% to a 'very high' 49.7%, however the results are generally very high, with a median ESP of 22%, and 25th and 75th percentile values of 17% and 26%, respectively.

To put these results into context, an ESP value of 6% or greater generally indicates that soil material is regarded as sodic and *may* be prone to dispersion (Isbell, 2002) and soil with an ESP value greater than 14% is regarded as strongly sodic (Northcote and Skene, 1972). Strongly sodic material is likely to have structural stability problems related to potential dispersion (Van de Graaff and Patterson, 2001). However, other important factors such as clay mineralogy, soil sodium concentration, soil salinity and irrigation water (rainwater) chemistry may enhance or limit that potential for soil to be sodic or become sodic over time. Therefore, values of 6% ESP and 14% ESP to represent soils as being sodic or strongly sodic are used as a *general guide and should not be taken as definitive*.

With regard to the 6% and 14% 'guide' values, 18 of the 20 potential waste rock samples tested have ESP values greater than 14% and are regarded as strongly sodic. The two remaining samples have ESP values of 12.2% and 13.3% – only marginally less than 14%.

Table 8. Cation Exchange Capacity, Sodicity and Dispersion Summary Results for Potential Waste Rock Samples

Sample ID	Type	Lithology	Weathering	EC1:5 µS/cm	CEC meq/100g	ESP %	Sodicity Rating	Exch. Ca/Mg	Emerson Class	Emerson Aggregate Class Dispersion Rating
130227	Weath. OB	Clay	Extremely	1100	17.1	22.4	Strongly sodic	1.0	2	Some dispersion (slaking)
130203	Weath. OB	Clay	Distinctly	1170	23.2	12.2	Sodic	1.1	2	Some dispersion (slaking)
130208	Weath. OB	Sandstone, med-coarse	Distinctly	331	10.4	25.3	Strongly sodic	0.5	4	Non-dispersive (calcite/gypsum)
130233	Weath. OB	Sandstone, medium	Distinctly	512	13.1	21.6	Strongly sodic	0.5	4	Non-dispersive (calcite/gypsum)
130251	Weath. OB	Sandstone, fine	Slightly	605	11.9	23.2	Strongly sodic	0.8	2	Some dispersion (slaking)
130214	Overburden	Siltstone, carb.	Fresh	436	14.1	25.6	Strongly sodic	0.4	4	Non-dispersive (calcite/gypsum)
130246	Overburden	Sandstone, fine; carb.	Fresh	190	7.4	17.7	Strongly sodic	0.9	2	Some dispersion (slaking)
130259	Overburden	Carb. Siltstone	Fresh	589	12.5	26.6	Strongly sodic	0.4	4	Non-dispersive (calcite/gypsum)
3219216	Interburden	Sandstone, medium	Fresh	256	8.6	15.1	Strongly sodic	1.0	4	Non-dispersive (calcite/gypsum)
3219219	Interburden	Sandstone, medium	Fresh	311	11.4	21.4	Strongly sodic	1.0	2	Some dispersion (slaking)
3219230	Interburden	Sandstone, fine	Fresh	358	12.1	34.2	Strongly sodic	1.7	2	Some dispersion (slaking)
3219241	Interburden	Sandstone, medium	Fresh	249	8.3	14.4	Strongly sodic	1.2	2	Some dispersion (slaking)
3219246	Interburden	Sandstone, medium	Fresh	236	7.3	18.2	Strongly sodic	1.2	2	Some dispersion (slaking)
3219252	Interburden	Sandstone, fine	Fresh	329	11.1	27	Strongly sodic	1.3	3	Dispersive
3219255	Interburden	Sandstone, fine	Fresh	406	10.2	22.4	Strongly sodic	0.9	4	Non-dispersive (calcite/gypsum)
3219264	Interburden	Sandstone, medium	Fresh	285	5.1	41	Strongly sodic	1.8	8	Non-dispersive
3219268	Interburden	Carb. Siltstone	Fresh	237	11.8	49.7	Strongly sodic	2.2	8	Non-dispersive
3219274	Interburden	Sandstone, fine	Fresh	457	9.8	13.3	Sodic	1.2	2	Some dispersion (slaking)
3219281	Interburden	Sandstone, fine	Fresh	329	12.8	17.1	Strongly sodic	1.3	2	Some dispersion (slaking)
3219287	Interburden	Carb. Siltstone	Fresh	545	13	15.2	Strongly sodic	1.3	4	Non-dispersive (calcite/gypsum)

The samples also underwent Emerson Aggregate Class tests to determine whether these samples were dispersive. Emerson Aggregate Class tests are a direct measure of soil dispersion, whereas ESP values are used as an indirect measure of the *potential* for a sample to have structural stability problems and hence *may be* dispersive. The results (**Table 8**) show 10 of the samples (weathered and fresh) had some dispersion [slaking] (Class 2) and one sample was dispersive (Class 3). Of the remaining samples, seven were non-dispersive [calcite or gypsum present] (Class 4) and two were non-dispersive [non-slaking and non-swelling] (Class 8).

The results indicate a poor correlation between the Emerson Aggregate Class test results (being dispersive or not) and the sodicity (predicting dispersion on the basis of ESP) for nearly all samples, which indicates that the use of sodicity as a guide to understanding dispersion for this potential waste rock material may be inaccurate. Materials with exchangeable calcium to magnesium ratios (exch. Ca/Mg) of less than 0.5 are often associated with dispersion. Of the 20 samples tested, only two samples had exch. Ca/Mg ratios of less than 0.5 (and the Emerson Aggregate Class testing found these samples to be non-dispersive). This poor correlation between exch. Ca/Mg ratio data and ESP data also supports the uncertainty around inferring (or assuming) dispersion on the basis of ESP data alone.

The results suggest that waste rock is expected to be sodic to strongly sodic, and dispersive to varying degrees – with no distinction between lithology or degree of weathering. Waste rock may also be prone to soil structure problems.

These exchangeable cation (and Emerson Aggregate Class) results are common (if not typical) for Bowen Basin Permian and Tertiary material based on Terrenus' significant experience in the region – and highlight that waste rock is likely to have mixed sodicity and dispersion potential.

Ideally, highly sodic and dispersive material should be identified, selectively handled and placed within the core of waste rock emplacements away from final surfaces or used to progressively backfill the voids during mining. However, in practice, waste rock comprises such a large amount of waste that selective handling and disposal of potentially sodic waste rock is impractical, if not impossible. As such, the management of waste rock would need to focus on maintaining relatively low (shallow) slopes and undertaking progressive rehabilitation of waste rock to minimise the potential for erosion and landform degradation.

The environmental significance of exchangeable cation values and sodicity levels in waste rock material in terms of risk and potential revegetation management is outlined in **Section 4**, however readers should consult the separate soils assessment undertaken as part of the environmental approvals for the Project for a detailed assessment of soil properties with regard to rehabilitation.

4 Geochemical Characteristics of Mineral Waste Materials

The geochemical characteristics of potential waste rock (overburden and interburden) and potential coal reject from the Project have been assessed. The assessment was undertaken to understand the existing environmental geochemical characteristics of these materials within the Project area, the potential operational impacts these materials may have on the Project and the potential environmental impacts these materials may have on the Project area and surrounds following closure (post-closure).

The environmental geochemical characteristics of the materials are summarised in the following sub-sections.

The main focus of the assessment is on waste rock, which would comprise almost all of the mineral waste for the Project, with coal reject comprising approximately 4% of all mineral waste over the life of the operation.

Potential Waste Rock

- Waste rock, as a bulk material, is expected to generate pH-neutral to alkaline, low- to moderate-salinity surface water run-off and seepage following surface exposure. Weathered waste rock should have similar soil pH to unweathered waste rock, however weathered waste rock is generally expected to be more saline than unweathered waste rock.
- The total S concentration of potential waste rock is very low, with over 99% of samples having a total S concentration below 0.2%. As such, greater than 99% of potential waste rock samples are classified as NAF, with 92% of all samples further classified as 'barren' with respect to sulfur concentrations (ie. S ≤0.05%). One sample (out of 277 samples) was classified as PAF with low acid-generating capacity (PAF-LC).
- Total metal and metalloid concentrations in potential waste rock samples are very low compared to average element abundance in soil in the earth's crust. One sample (out of 33 potential waste rock samples) was enriched in As and four samples were enriched in Be with respect to average crustal abundance in soil.
- Soluble multi-element results indicate that leachate from bulk waste rock has the potential to contain slightly elevated soluble Al, As, Cu, Se and/or Zn concentrations compared to applied water quality guideline values for slightly to moderately disturbed freshwater aquatic ecosystems (95% species protection) (ANZECC & ARMCANZ, 2000). Slightly elevated concentrations of some metals/metalloids from waste rock and coal reject is common at coal mines in the Bowen Basin and generally do not result in any significant water quality issues[5].

  It is important to note that the results presented in this report represent an 'assumed worst case' scenario as the samples were either 'aged' for 16 hours in the 1:2 (w:v) solution prior to leaching or were pulverised (to less than 75 µm in diameter) prior to a 1:5 (w:v) leach. Therefore, samples had a long equilibration period or had a very high surface area compared to similar material in the field. Individual material would also be well mixed at storage locations. The results therefore suggest that the concentration of metal/metalloids in surface

[5] Based on Terrenus' experience undertaking environmental geochemical assessments within the Bowen Basin for numerous coal projects and mines extracting waste rock and coal and producing coal reject.

run-off and seepage from waste rock materials in the field would be less than the recorded laboratory water extract concentrations of potential waste rock samples.

The applied guideline values are provided for context and are not intended as 'trigger values' or 'maximum permissible concentrations' with respect to total and soluble metals/metalloids in waste rock. Due to a number of factors in the field (compared to the laboratory), including scale-up and dilution, any direct comparison of soluble multi-element concentrations in leachate from waste rock is strictly not valid and should be used with caution.

- Potential waste rock samples have a wide range of CEC values and, generally, have high to very high ESP values. As such, bulk waste rock is expected to be 'strongly sodic'. About half of the samples tested, regardless of lithology or degree of weathering, have some potential to be dispersive. As such, it is reasonable to expect that a significant proportion of waste rock (regardless of lithology and weathering) may be erosive and dispersive to varying degrees.
- Based on Terrenus's experience, the geochemical characteristics of potential waste rock samples tested are consistent with the geochemical characteristics of waste rock at neighbouring mines (Poitrel and Daunia) and development projects (Olive Downs Project), which are all within the same geological setting (Rangal Coal Measures) as the Project.

Potential Coarse Reject

- Potential coarse reject is expected to generate pH-neutral to alkaline, low-salinity surface water run-off and seepage following initial surface exposure.
- Over two-thirds of the potential coarse reject samples (19 out of 28 samples) were classified as NAF and four samples were classified as PAF-LC. The remaining five samples were classified as Uncertain, primarily due to uncertainty around the availability of sufficient neutralising material. However, despite some uncertainty surrounding the acid classification of five samples, all have relatively low sulfur concentration and, at worst, would have a low capacity to generate significant acidity (*ie*. be conservatively classified as PAF-LC).
- Overall, the sulfur (and sulfide) concentration in potential coarse reject samples was generally low, with a 90th percentile sulfide (Scr) concentration of 0.4% (90th percentile total S = 0.59). Therefore, coarse reject (as a bulk material) is regarded as posing a low unmitigated risk of acid generation and a low to moderate unmitigated risk of sulfate generation.
- Total metal and metalloid concentrations in potential coarse reject samples are low compared to average element abundance in soil in the earth's crust. One potential coarse reject sample was enriched in S with respect to average crustal abundance in soil.
- The soluble multi-element concentrations in potential coarse reject samples are below applied water quality guideline values for slightly to moderately disturbed freshwater aquatic ecosystems (95% species protection) and livestock drinking water guideline values (ANZECC & ARMCANZ, 2000) and, in most cases, below the laboratory LOR.
- Based on Terrenus's experience, the geochemical characteristics of potential coarse reject samples tested are consistent with the geochemical characteristics of coarse reject at neighbouring mines (Poitrel and Daunia) and coal reject (generally) at the Olive Downs development project. Poitrel, Daunia and Olive Downs are located within the same geological setting (Rangal Coal Measures) as the Project and are mining/targeting the same coal seams.

- Potential coarse reject samples from individual and discrete seams/plys display very subtle geochemical variations, however the differences do not warrant selective handling and processing. As all coal reject is essentially 'mixed' during out-of-pit and in-pit emplacement amongst overwhelmingly NAF and alkaline waste rock, small proportions of potentially PAF materials and any elevated concentrations of soluble metals/metalloids from isolated coal reject sources would be significantly diluted amongst the bulk waste rock material.
- It is important to note that the quantity of coal reject produced (relative to waste rock) would be very low (approximately 4% of all mineral waste generated) and coal reject from ROM coal processed at the CHPP may have slightly different geochemical characteristics to these potential coal reject samples obtained from pilot plant test-work.

Potential ROM Coal

- Based on the results of coal seam samples, potential ROM coal is expected to generate pH-neutral to alkaline, low to moderate salinity surface water run-off and seepage following initial surface exposure.
- Over 98% of the coal seam samples (59 out of 60 samples) were classified as NAF, and most of these samples (82% of samples) were further classified as NAF-Barren or NAF-Low S due to their very low total S concentration. One sample has an Uncertain classification, but has negligible capacity to generate acid. Therefore, ROM coal (as a bulk material) represented by these coal seam samples is regarded as posing a low risk of acid and/or sulfate generation.
- Only one coal seam sample (from 2012) underwent analysis for total and soluble element concentrations. The total element concentrations are low compared to average element abundance in soil in the earth's crust. The sample has slightly elevated concentrations of soluble Al and As compared to applied water quality guideline values for slightly to moderately disturbed freshwater aquatic ecosystems (95% species protection) (ANZECC & ARMCANZ, 2000), which is common from Permian coal seams in the Bowen Basin[5].

ROM coal is not regarded as waste and would remain on-site for a relatively short period of time. The environmental management of coal (ROM coal and/or product coal) should therefore be focused on run-off and seepage collection and dust control, which are 'standard' management practices for ROM and product coal stockpiles, and are outlined in **Section 5** below. Surface water run-off from ROM coal and product coal stockpiles would be managed as part of the mine water management system.

5 Management and Mitigation Measures

5.1 Waste Rock Management Strategy

Overburden and interburden would be used to develop out-of-pit waste rock emplacements during the operation of the Project, before being used to progressively backfill the open cut pits, once space becomes available.

Waste rock is overwhelmingly NAF with excess ANC and has a negligible risk of developing acid conditions. Furthermore, waste rock is expected to generate relatively low to moderate salinity surface water run-off and seepage with relatively low soluble metal/metalloid concentrations. However, waste rock is expected to be sodic with some potential for dispersion and erosion (to varying degrees).

Where highly sodic and/or dispersive waste rock is identified it should, wherever practicable, not report to final landform surfaces and should not be used in construction activities. Tertiary waste rock has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program [ACARP], 2004 and 2019).

It may not be practical to selectively handle and preferentially emplace highly sodic and dispersive waste rock during operation of the Project, however Whitehaven should take reasonable measures to identify and selectively place (or alternatively manage) highly sodic and dispersive waste rock. Therefore, in the absence of such selective handling, waste rock landforms would need to be constructed with short and low (shallow) slopes and progressively rehabilitated to minimise erosion. Where practical, and where competent rock is available, armouring of slopes should be considered.

Where waste rock is used for construction activities, this should be limited (as much as practical) to unweathered Permian sandstone, as this material has been found to be more suitable for construction and for use as embankment covering on final landform surfaces. Regardless of the waste rock type, especially where engineering or geotechnical stability is required, laboratory testing and rehabilitation field trials should be undertaken by Whitehaven to determine the propensity for dispersion and erosion of waste rock landforms.

Surface water run-off and seepage from waste rock emplacements, including any rehabilitated areas, should be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS and a broad suite of soluble metals/metalloids.

With the implementation of the proposed management and mitigation measures, the waste rock is regarded as posing a low risk of environmental harm.

5.2 Coal Reject Management Strategy

Fine coal reject (tailings) is proposed to be dewatered at the CHPP and combined with mid/coarse coal reject at the reject bin within the CHPP. Coal reject would be trucked from the reject bin and placed within out-of-pit and in-pit emplacements and buried by at least 10 m of waste rock.

Over the life of the Project approximately 148 Mt of coal reject is expected to be produced during ROM coal processing and would comprise approximately 4% of all mineral waste generated by the Project. Based on the current assessment, a proportion of coarse reject has *some* uncertainty

around its ability to generate acidity, and a small number of samples have been classified as PAF-LC – mostly from the Leichhardt seam. On this basis, coarse reject generated by the Project is conservatively assumed to have a relatively low degree of environmental risk associated with potential acidity, but may generate elevated concentrations of sulfate salts. If sulfate salts are generated in surface water and seepage, these would be confined within the footprint of the open cut pits or within out-of-pit emplacements, and would drain into/towards open cut pit areas. Therefore, when placed amongst alkaline NAF waste rock the overall risk of environmental harm and health-risk that emplaced coal reject poses is low.

The management measures for coal reject would be addressed by a Mineral Waste Management Plan, with the main concepts outlined below.

5.2.1 Management of Coal Reject Within Out-of-Pit Emplacements

During Operations

Coal reject placed in out-of-pit emplacement areas would be buried by at least 10 m of waste rock generally within three months of placement. During operations, surface run-off and seepage from out-of-pit emplacements would be directed to the mine water management system.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of the out-of-pit waste rock emplacement areas would be addressed by a PRCP. Coal reject within out-of-pit emplacements would be covered by a minimum of 10 m of waste rock and would not report to final landform surfaces (or near-surfaces). Therefore, the management of out-of-pit emplaced coal reject would not be expected to be significant to mine or pit decommissioning and rehabilitation.

5.2.2 Management of Coal Reject Within In-Pit Emplacements

During Operations

Coal reject within in-pit emplacements would be buried by at least 10 m of waste rock generally within three months of placement.

During Decommissioning, Rehabilitation and Closure

The decommissioning, closure and post-closure aspects of partially or fully back-filled pits (and any subsequent final voids) would be addressed by a PRCP. However, as coal reject would be covered by a minimum of 10 m of waste rock and would not report to final landform surfaces (or near-surfaces), the management of coal reject emplaced within open pits would not be expected to be a significant issue with respect to mine or pit decommissioning and rehabilitation.

5.3 Validation of Coal Reject Characteristics

Whitehaven would undertake validation test-work of coal reject from the CHPP during development of the Project, particularly during the first two years of CHPP operation and whenever new seams/plys are being processed. Test-work would comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), acid-base account parameters and total and soluble metals/metalloids.

5.4 ROM Stockpiles and CHPP

ROM coal is not mining waste, and surface water run-off and seepage from ROM stockpiles would not report off-site and would be managed as part of the mine water management system. The available information suggests that ROM coal generated by the Project is expected to have a low degree of risk associated with potential acid, salt and soluble metals generation. Surface water run-off from ROM coal and product coal stockpiles would also be assessed on a periodic basis.

ROM coal would be stored on-site for a relatively short period of time (days to weeks) compared to mineral waste materials, which would be stored at the site in perpetuity. Management practices are therefore different for ROM coal (compared to waste rock) and would largely be based around the operational (day-to-day) management of surface water run-off from ROM coal stockpiles, as is currently accepted practice at coal mines in Australia.

Surface water run-off from ROM coal stockpiles would be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS, acidity and a broad suite of soluble metals/metalloids.

6 References

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Appendix A

Summary Information for Drill-holes Utilised
in the Geochemistry Assessment

Table A1. Drill-hole Summary Information

Drill-hole ID	**Easting** (m) GDA94, zone 55	**Northing** (m) GDA94, zone 55	**Collar elevation** (mRL)	**Depth** (m)	**Completion Date**	**Sampling Undertaken**	**Sampling Program**
R2071	628,294	7,549,615	203	210	2011	Potential waste rock (overburden/ interburden), Potential ROM coal (seam)	EGi (2012)
R2077	634,273	7,542,546	214	138	2011	Potential waste rock (overburden/ interburden), Potential ROM coal (seam)	EGi (2012)
R2083	636,078	7,542,850	205	168	2011	Potential waste rock (overburden/ interburden), Potential ROM coal (seam)	EGi (2012)
WS3003L	629,851	7,549,599	181	56	April 2019	Potential waste rock (overburden)	Terrenus (current)
WS3009L	631,518	7,545,465	172	92	April 2019	Potential waste rock (overburden)	Terrenus (current)
WS3013L	633,411	7,546,454	211	74	May 2019	Potential waste rock (overburden)	Terrenus (current)
WS3041	629,592	7,546,605	214	94	July 2019	Potential waste rock (interburden)	Terrenus (current)
WS3059	630,223	7,549,405	200	76	July 2019	Potential waste rock (interburden)	Terrenus (current)
WS3082	631,908	7,545,623	216	94	July 2019	Potential waste rock (interburden)	Terrenus (current)
WS3120	633,073	7,546,557	210	106	August 2019	Potential waste rock (interburden)	Terrenus (current)
WS3155	629,142	7,551,226	200	64	September 2019	Potential waste rock (interburden)	Terrenus (current)

* All drill-holes are vertical (dip = 90 degrees).

Samples representative of potential coarse reject were provided to Terrenus by Whitehaven for geochemical assessment. Samples were generated from the coal quality test-work program from a pilot plant process, using drill-core samples obtained from the following drill-holes:

WS3001L; WS3002L; WS3004L; WS3009L; WS3013L; WS3014L; WS3015L; WS3017L

Appendix B

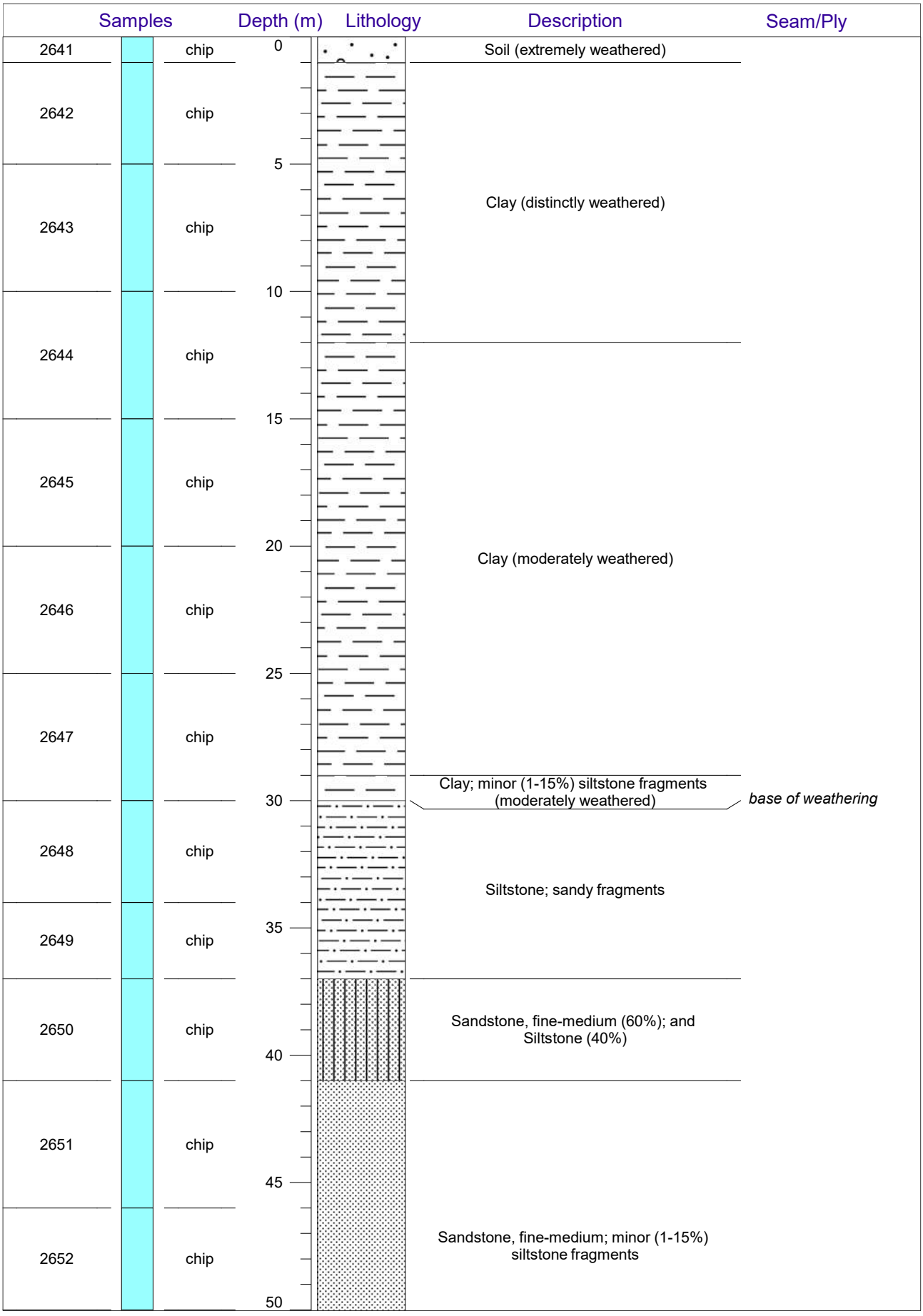
Drill-hole Logs

- Lithological logs are provided for all drill-holes where potential waste rock and potential ROM coal samples were collected:
    - R2071
    - R2077
    - R2083
    - WS3003L
    - WS3009L
    - WS3013L
    - WS3041
    - WS3059
    - WS3082
    - WS3120
    - WS3155
- Sampling information is also provided within drill-hole logs WS3009L and WS3013L for source material for potential coarse reject samples.

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2071

Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2071

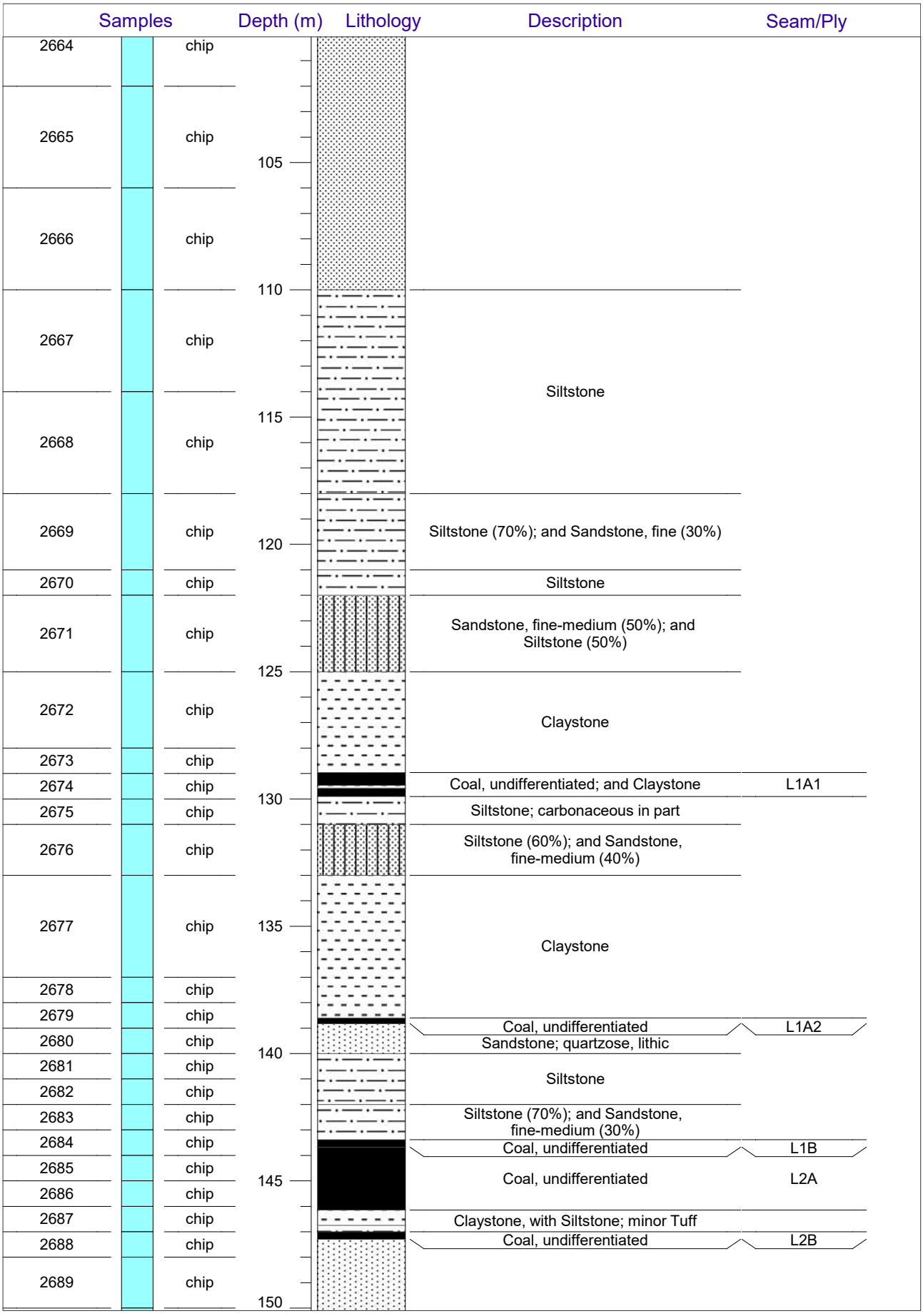
Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55

Samples			Depth (m)	Lithology	Description	Seam/Ply
2653		chip	50			
2654		chip	55		Sandstone, fine-medium (50%); and Siltstone (50%)	
2655		chip	60			
2656		chip			Siltstone (80%); and Sandstone (20%)	
2657		chip	65			
2658		chip	70		Sandstone, fine-medium; quartzose, lithic	
2659		chip	75		Siltstone	
2660		chip	80			
2661		chip	85			
2662		chip	90			
2663		chip	95		Sandstone, fine-medium	
			100			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2071

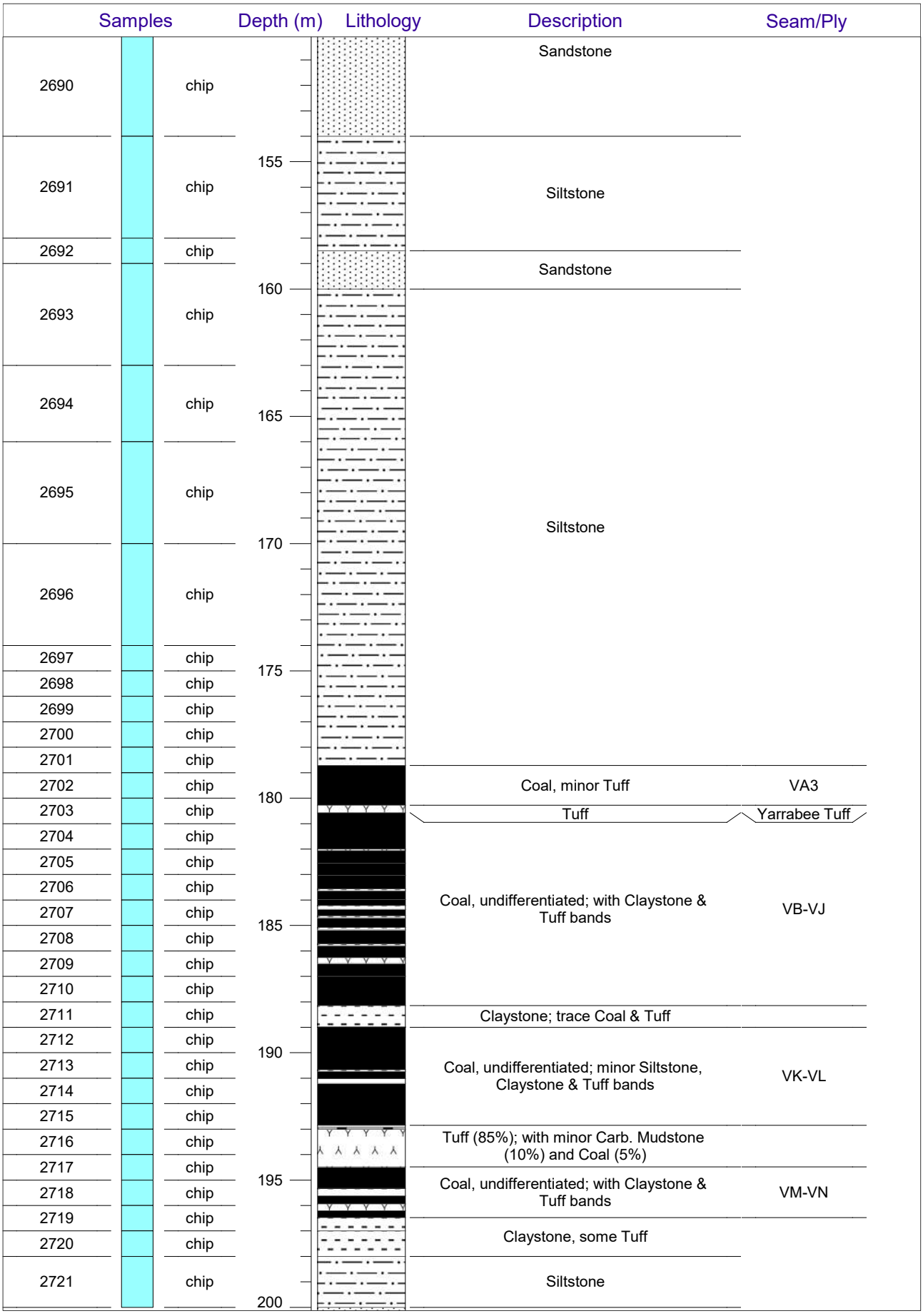
Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2071

Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2071

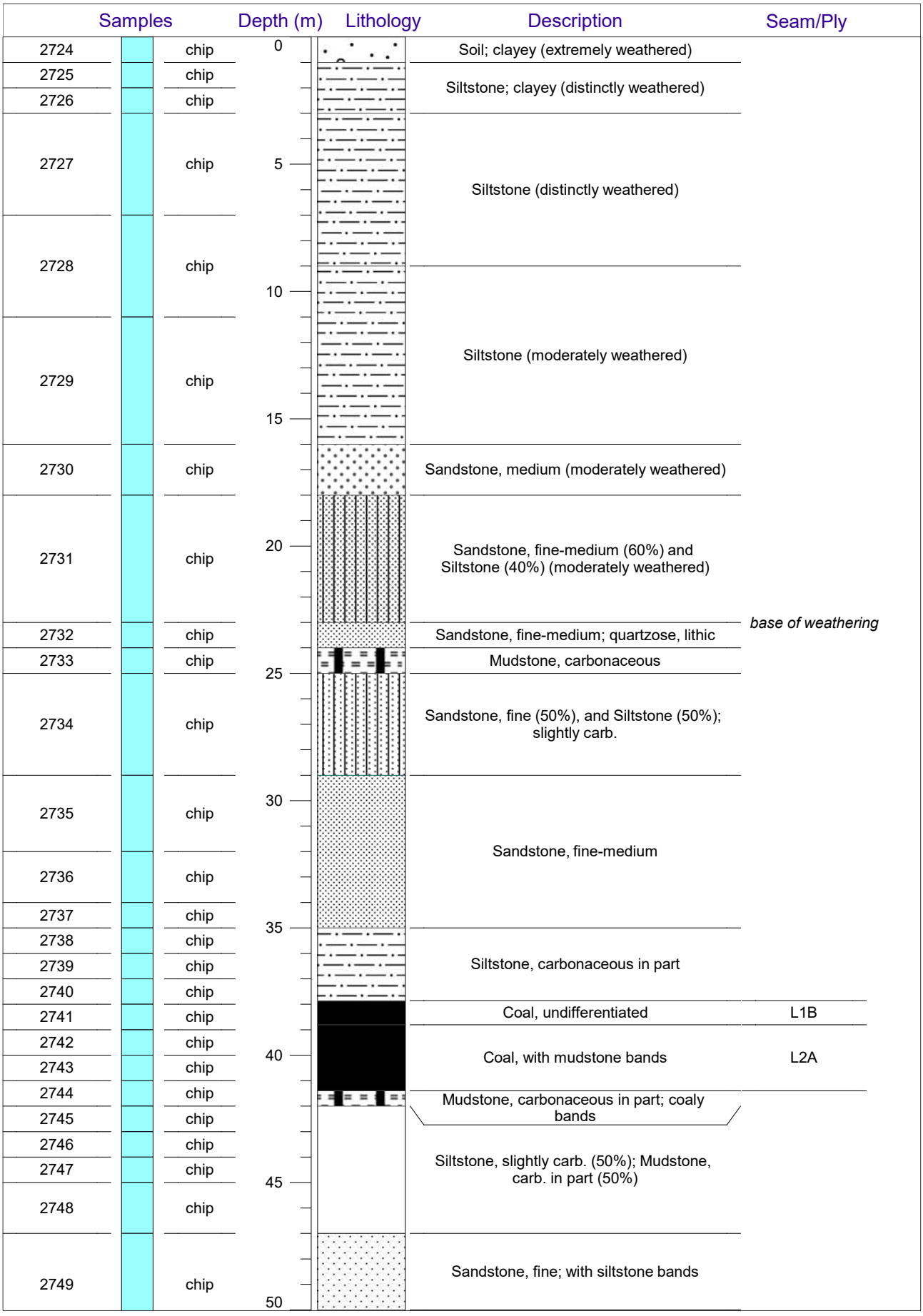
Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55

Samples	Depth (m)	Lithology	Description	Seam/Ply
	205		Sandstone	
	210			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2077

Easting: 634273 Northing: 7542546 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2077

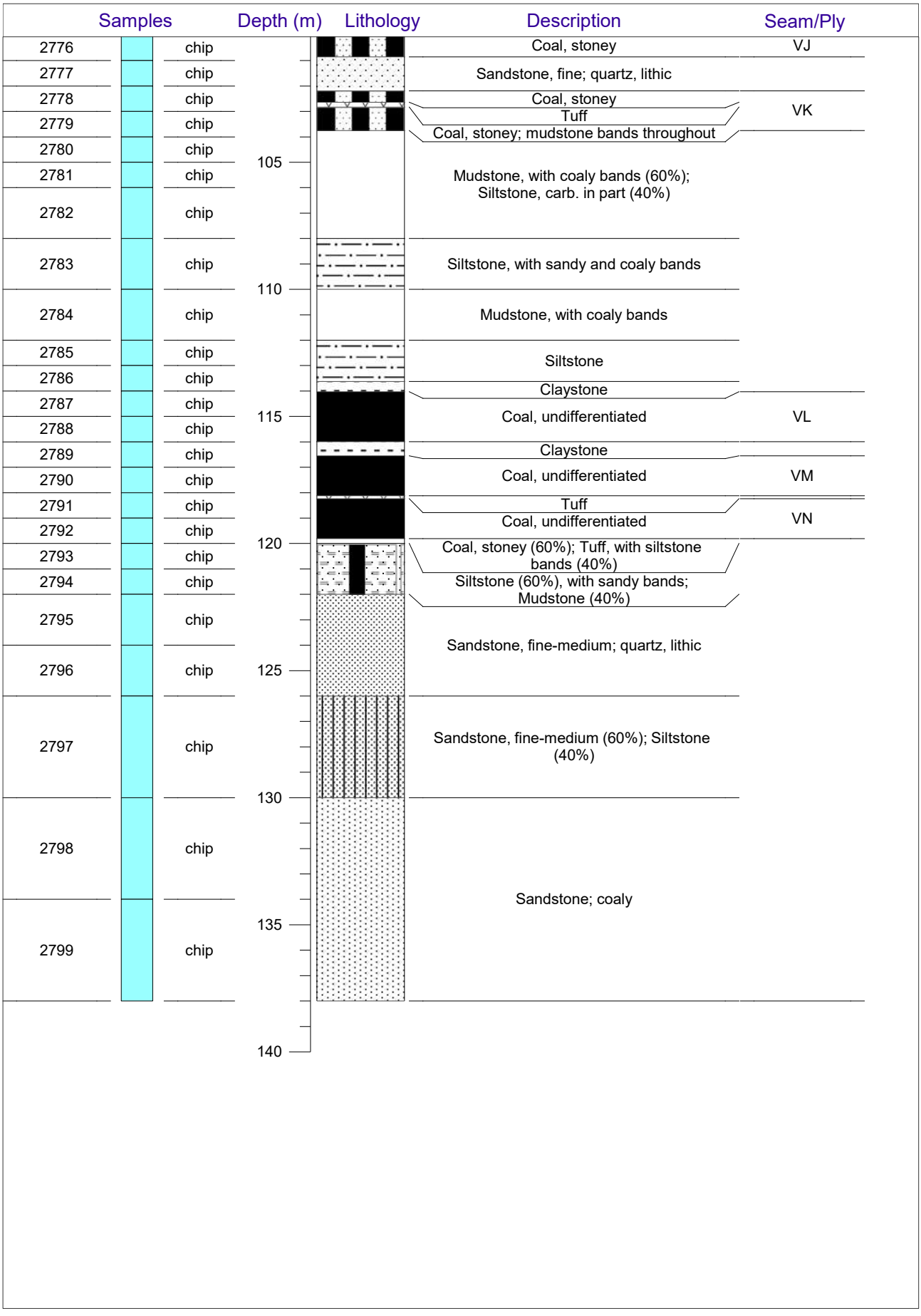
Easting: 634273 Northing: 7542546 Datum/Projection: GDA94, zone 55

Samples		Depth (m)	Lithology	Description	Seam/Ply
		50		Mudstone, carbonaceous in part	
2750	chip			Sandstone, fine; with siltstone bands	
		55			
2751	chip			Siltstone; slightly carbonaceous	
2752	chip				
2753	chip	60		Claystone	
2754	chip				
2755	chip				
2756	chip			Coal, undifferentiated; with minor Claystone, Sandstone & Tuff	VA(0-3)
2757	chip				
2758	chip	65		Tuff	Yarrabee Tuff
2759	chip			Coal, undifferentiated; with Tuff and minor Claystone	VB-VI
2760	chip				
2761	chip				
2762	chip				
2763	chip	70			
2764	chip				
2765	chip			Sandstone, medium; quartzose, lithic	
		75			
2766	chip				
2767	chip	80		Siltstone; carbonaceous with coaly bands	
2768	chip			Siltstone, with tuffaceous bands	
		85			
2769	chip			Sandstone, fine-medium	
2770	chip	90		Siltstone, carb. in part, coaly (70%); Sandstone, fine, banded (30%)	
2771	chip				
		95			
2772	chip				
2773	chip				
2774	chip				
2775	chip	100			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: R2077

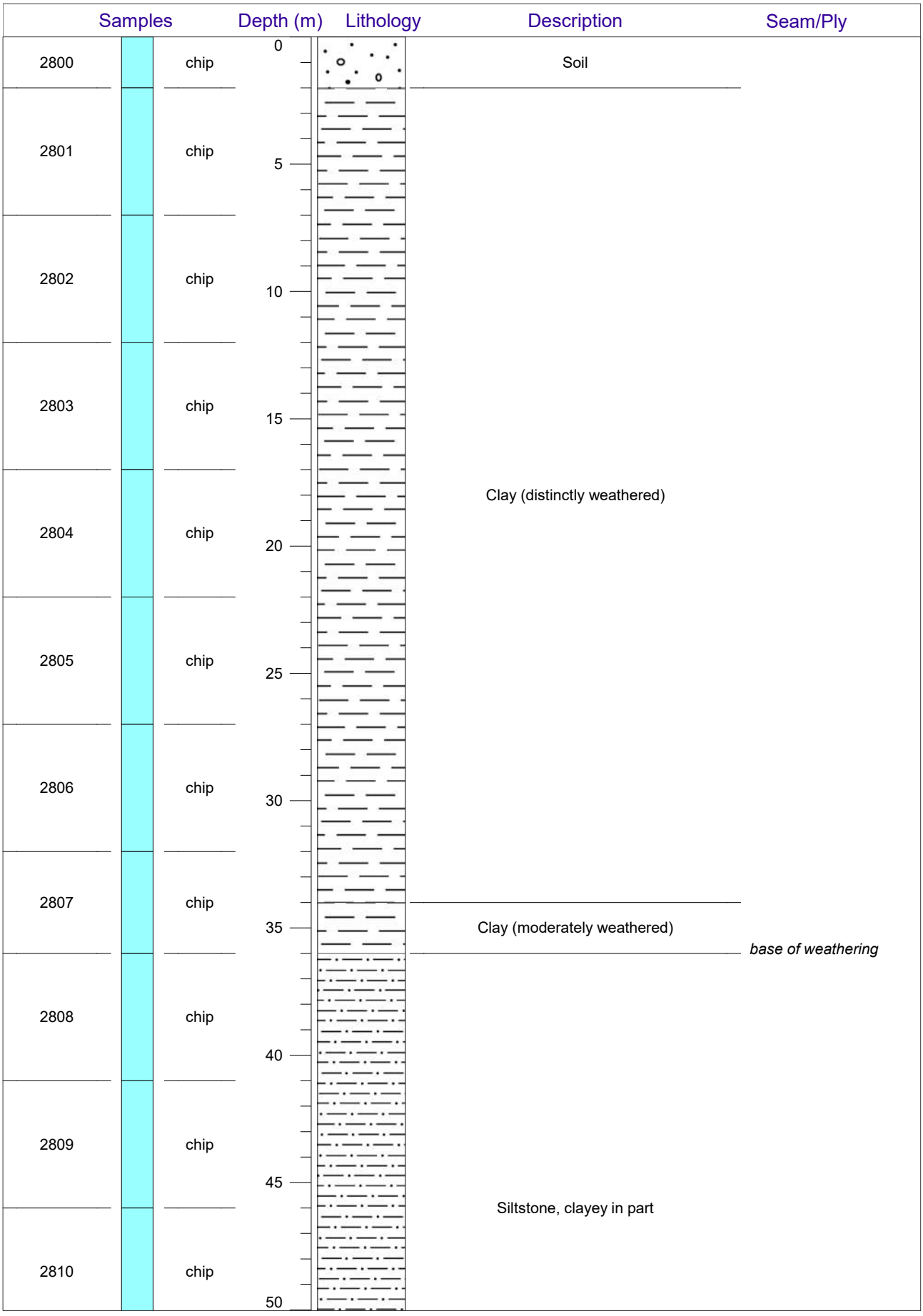
Easting: 634273 Northing: 7542546 Datum/Projection: GDA94, zone 55



TERRENUS
EARTH SCIENCES

Whitehaven Coal **Winchester South** Hole ID: R2083

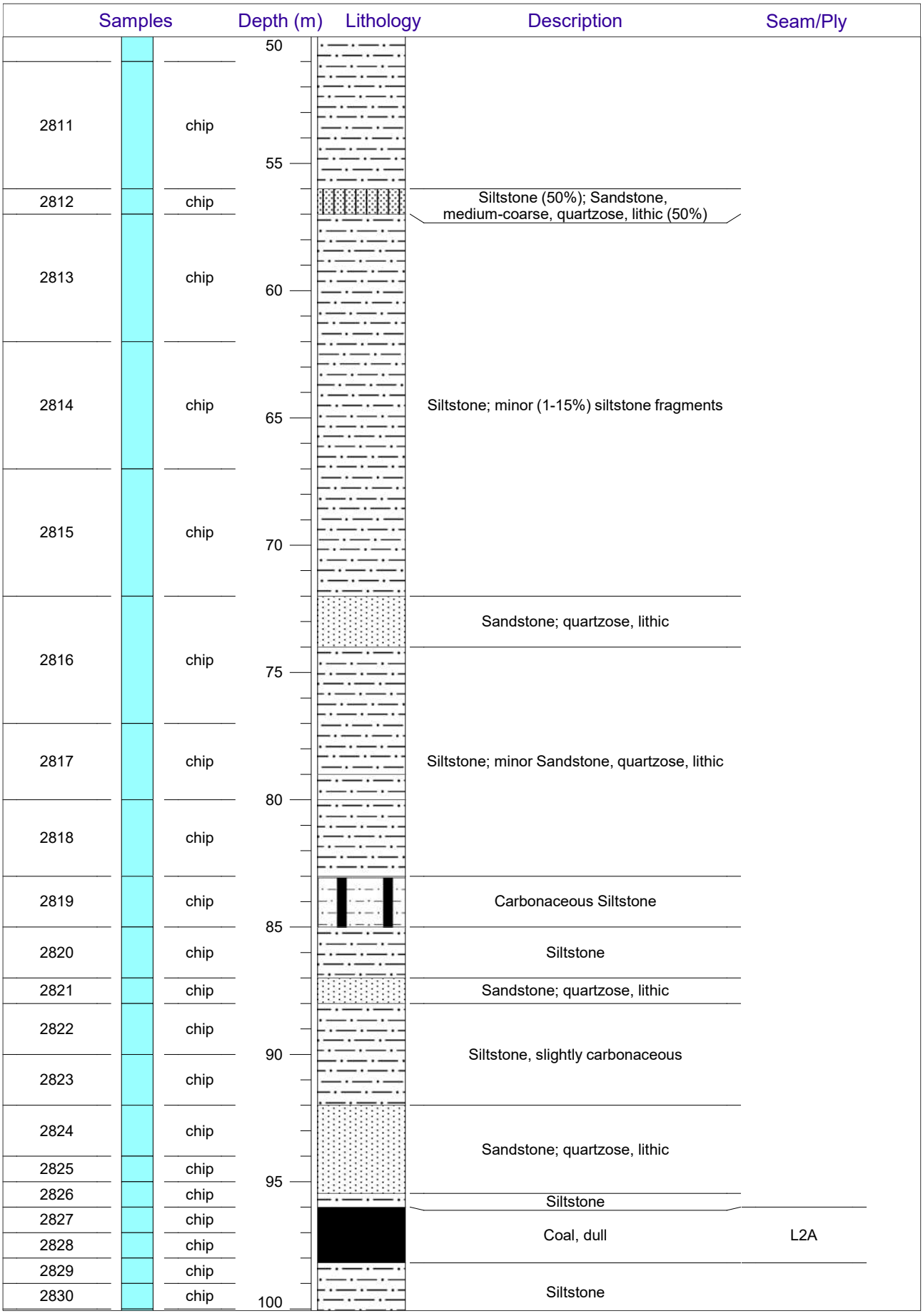
Easting: 636078 Northing: 7542850 Datum/Projection: GDA94, zone 55



TERRENUS
EARTH SCIENCES

Whitehaven Coal **Winchester South** Hole ID: R2083

Easting: 636078 Northing: 7542850 Datum/Projection: GDA94, zone 55



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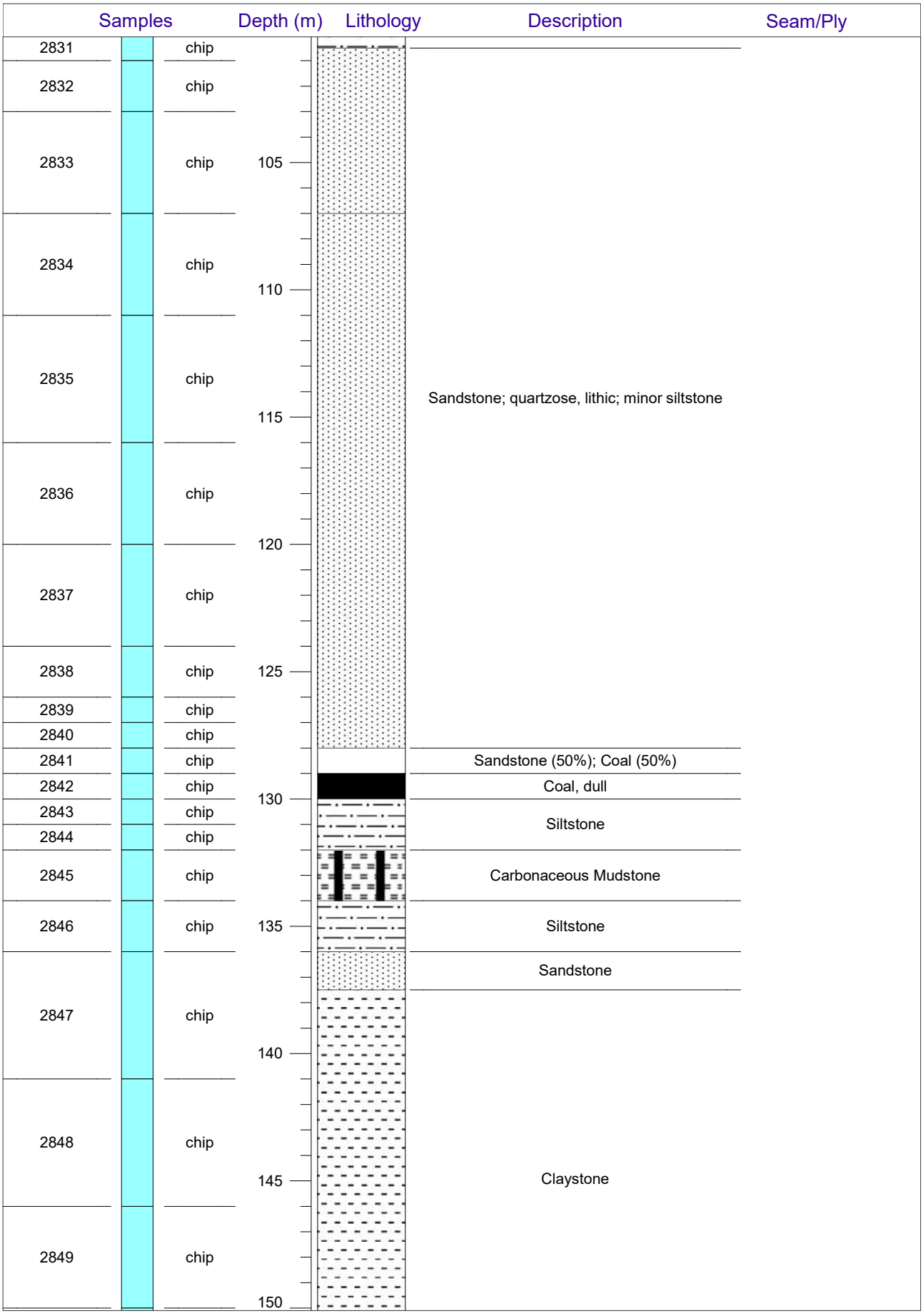
EARTH SCIENCES

Whitehaven Coal **Winchester South** Hole ID: R2083

Easting: 636078 Northing: 7542850 Datum/Projection: GDA94, zone 55



TERRENUS
EARTH SCIENCES

Whitehaven Coal **Winchester South** Hole ID: R2083

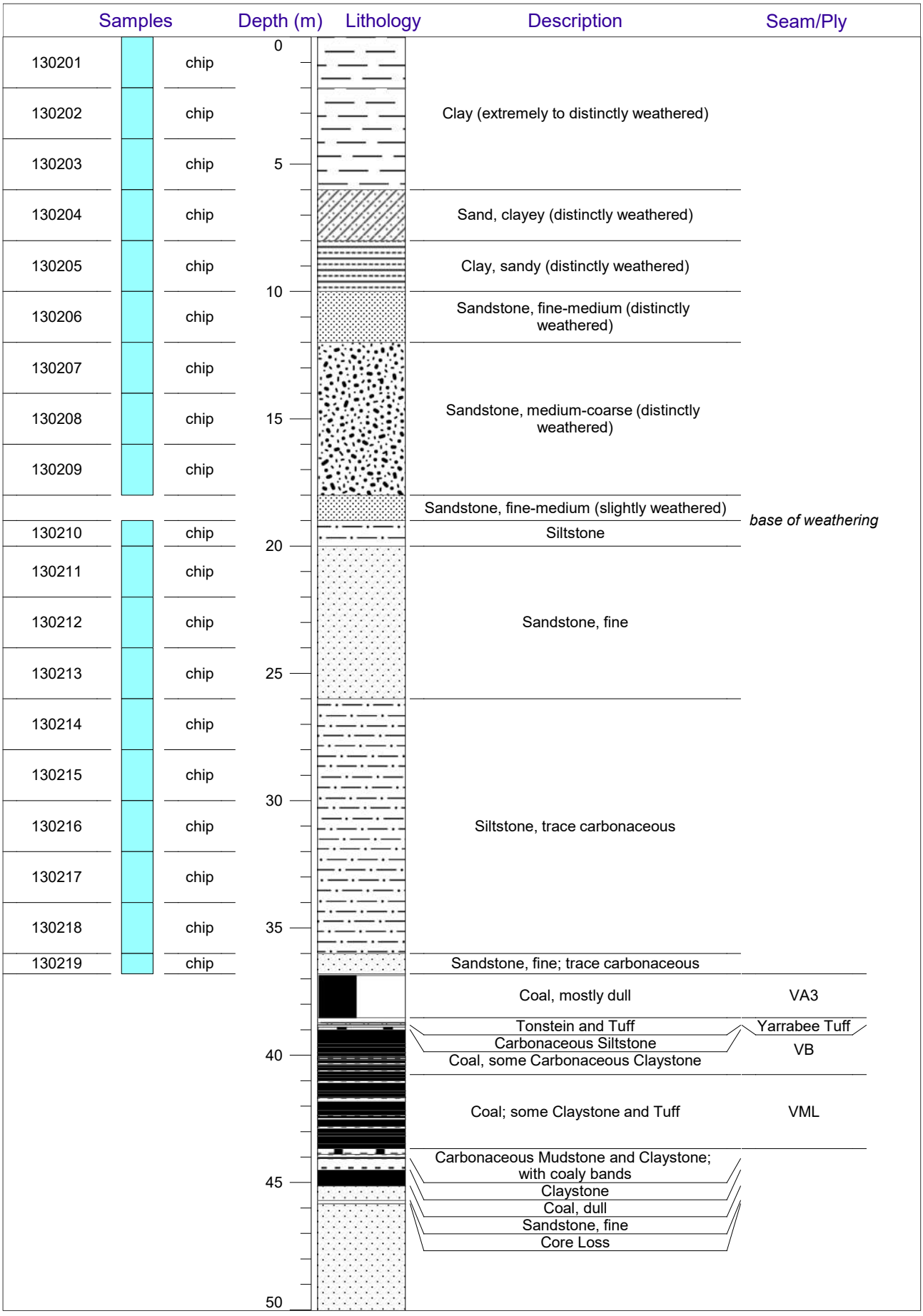
Easting: 636078 Northing: 7542850 Datum/Projection: GDA94, zone 55

Samples			Depth (m)	Lithology	Description	Seam/Ply
2850		chip				
2851		chip				
2852		chip			Coal; trace claystone and siltstone	VA0-VA1
2853		chip			Carbonaceous Mudstone	VA3
2854		chip			Coal, undifferentiated	
2855		chip	155		Tuff	Yarrabee Tuff
2856		chip			Coal, undifferentiated; some Claystone and Tuff	VE-VH
2857		chip				
2858		chip			Coal, dull (70%); Carb. Mudstone (15%); Tuff (15%)	
2859		chip				
2860		chip	160			
2861		chip			Siltstone	
2862		chip				
2863		chip			Sandstone, medium-coarse	
2864		chip	165			
			170			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3003L

Easting: 629851 Northing: 7549599 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3003L

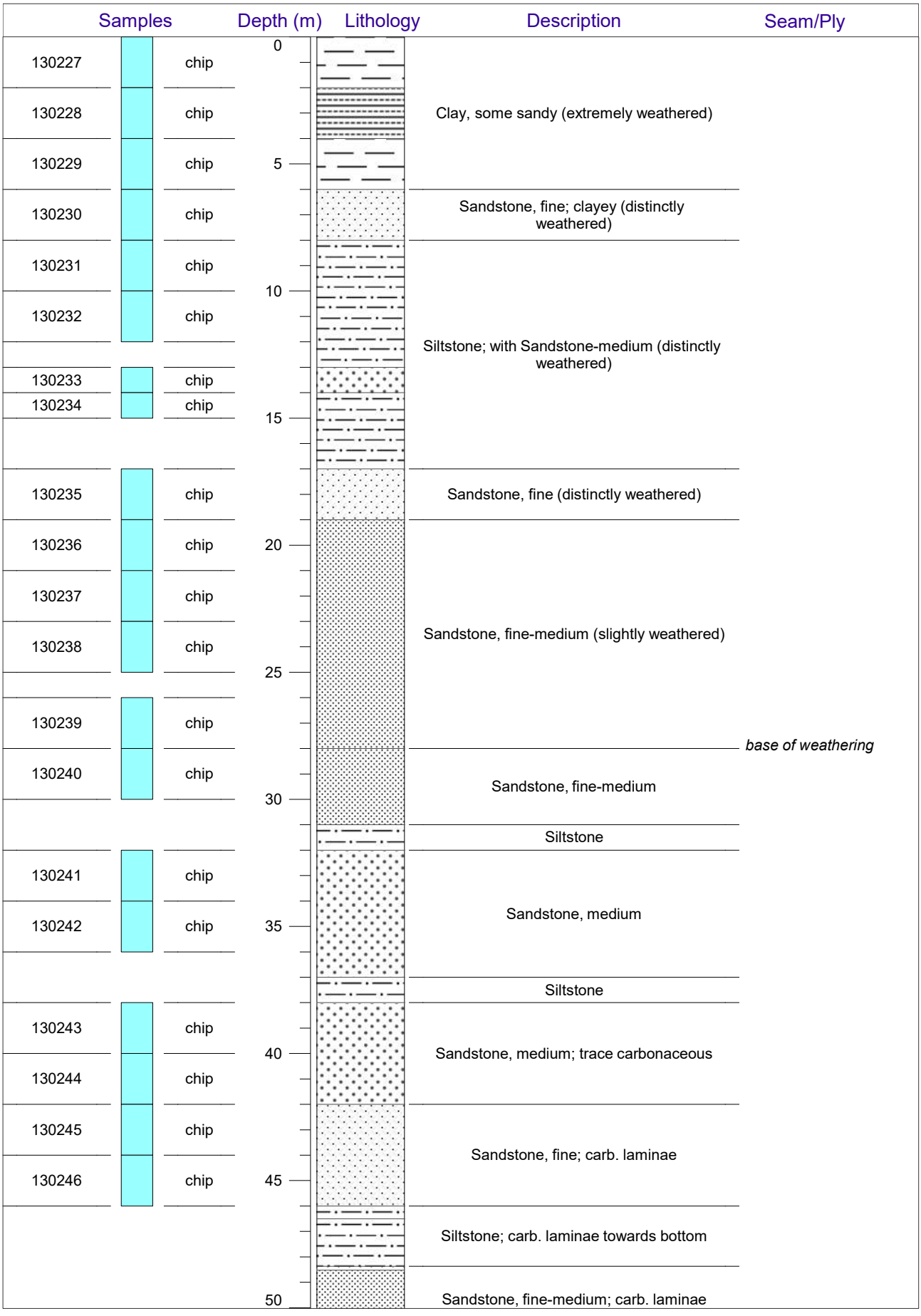
Easting: 629851 Northing: 7549599 Datum/Projection: GDA94, zone 55

Samples	Depth (m)	Lithology	Description	Seam/Ply
	50		Sandstone, fine	
	55			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3009L

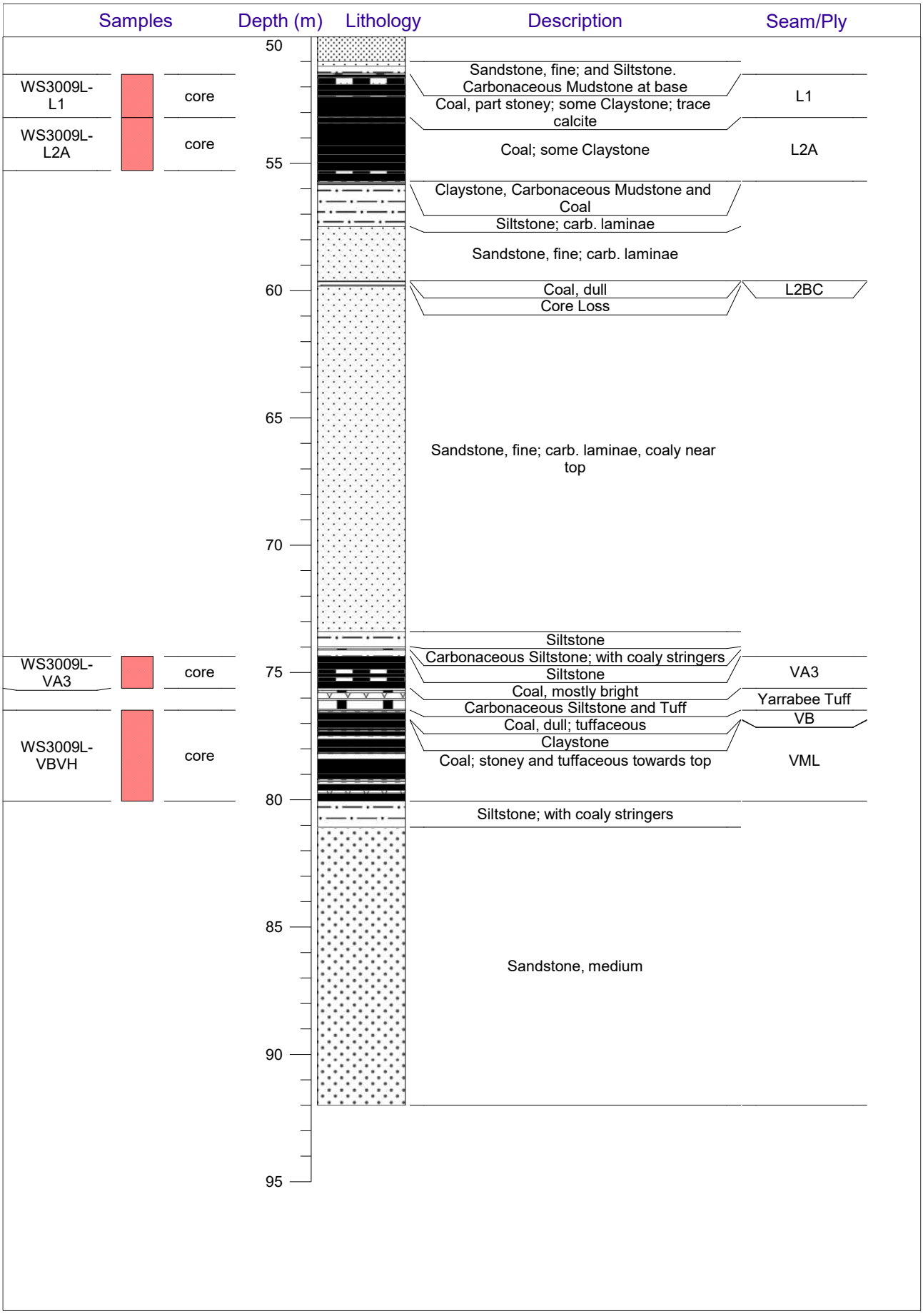
Easting: 631518 Northing: 7545465 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3009L

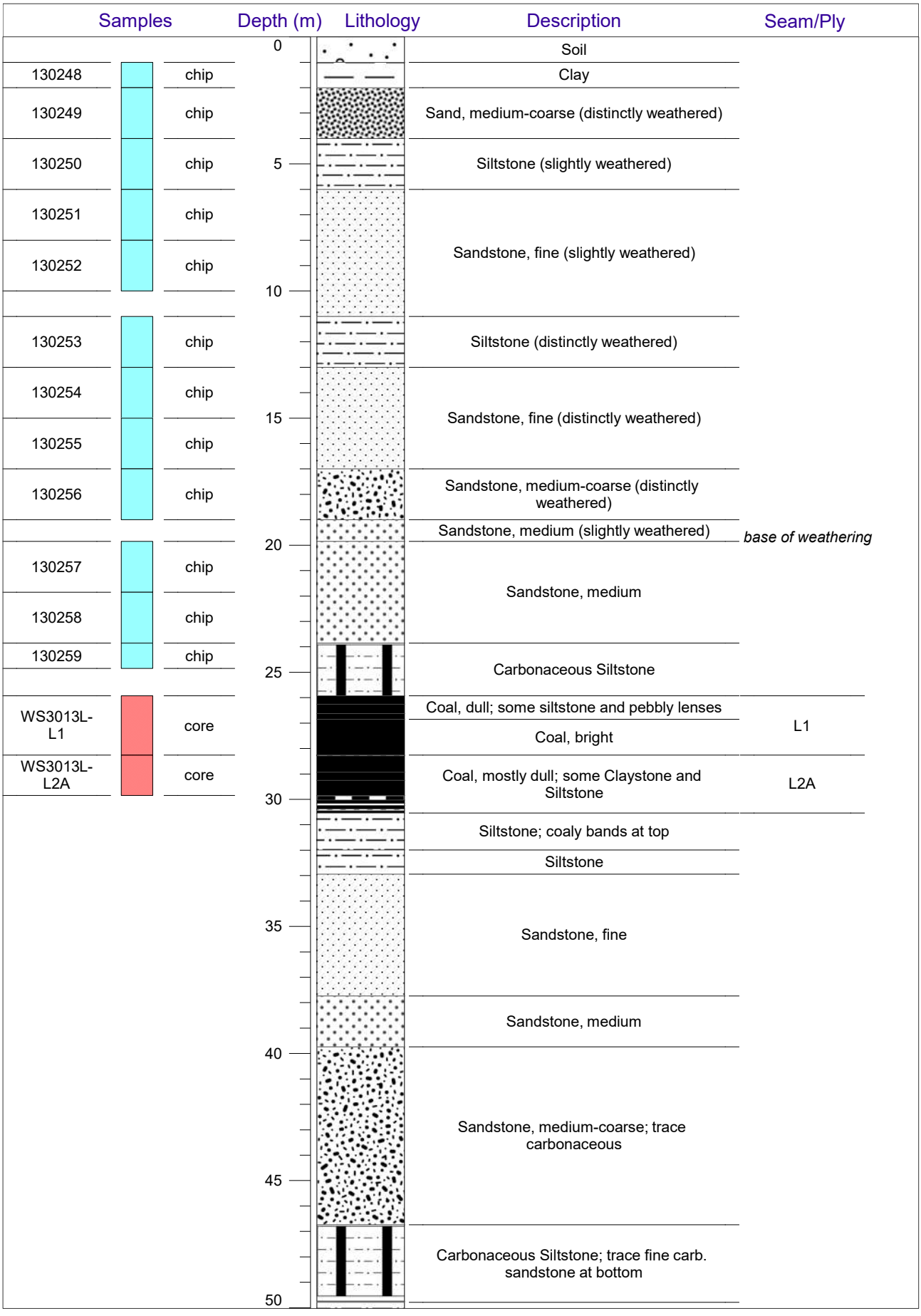
Easting: 631518 Northing: 7545465 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3013L

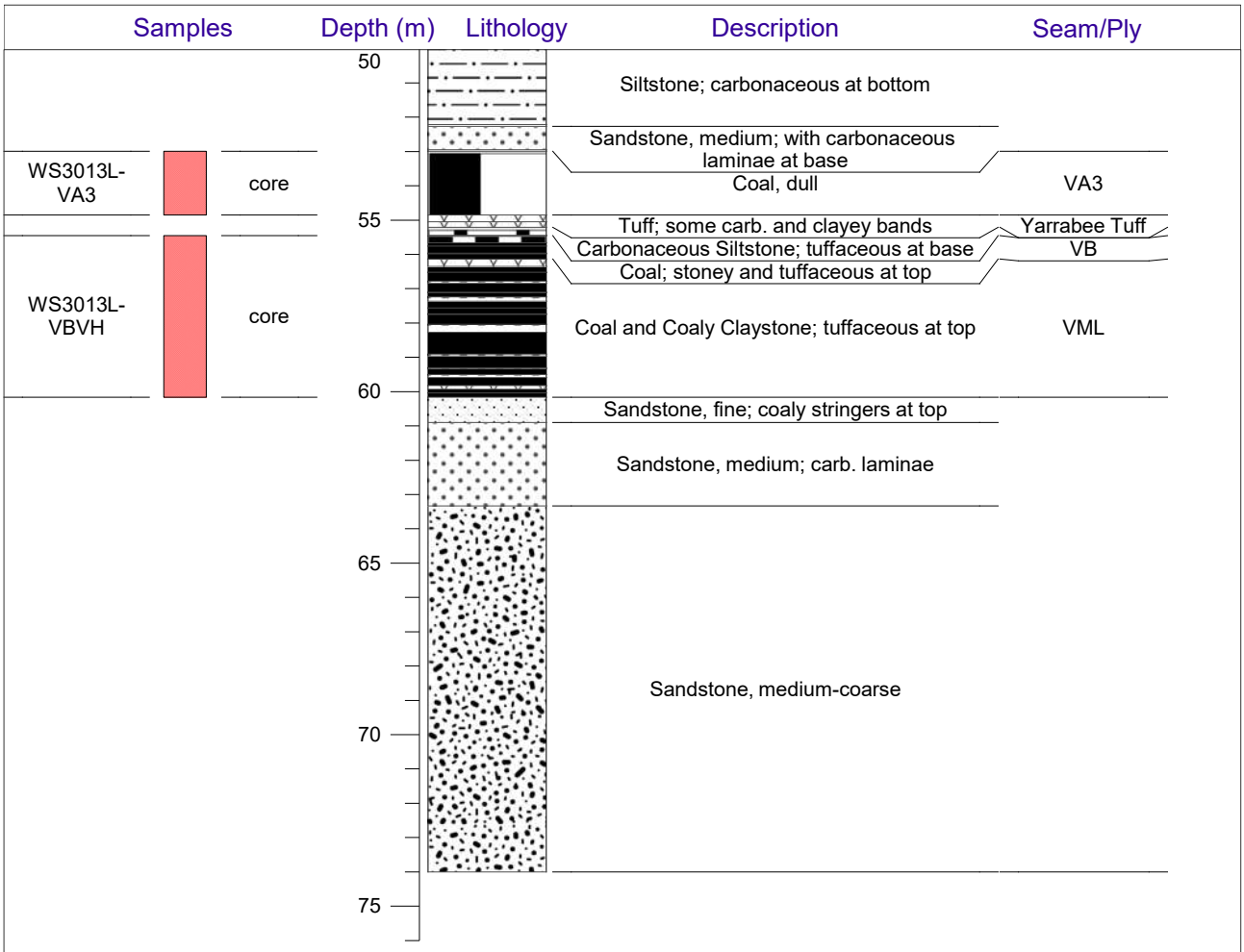
Easting: 633411 Northing: 7546454 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3013L

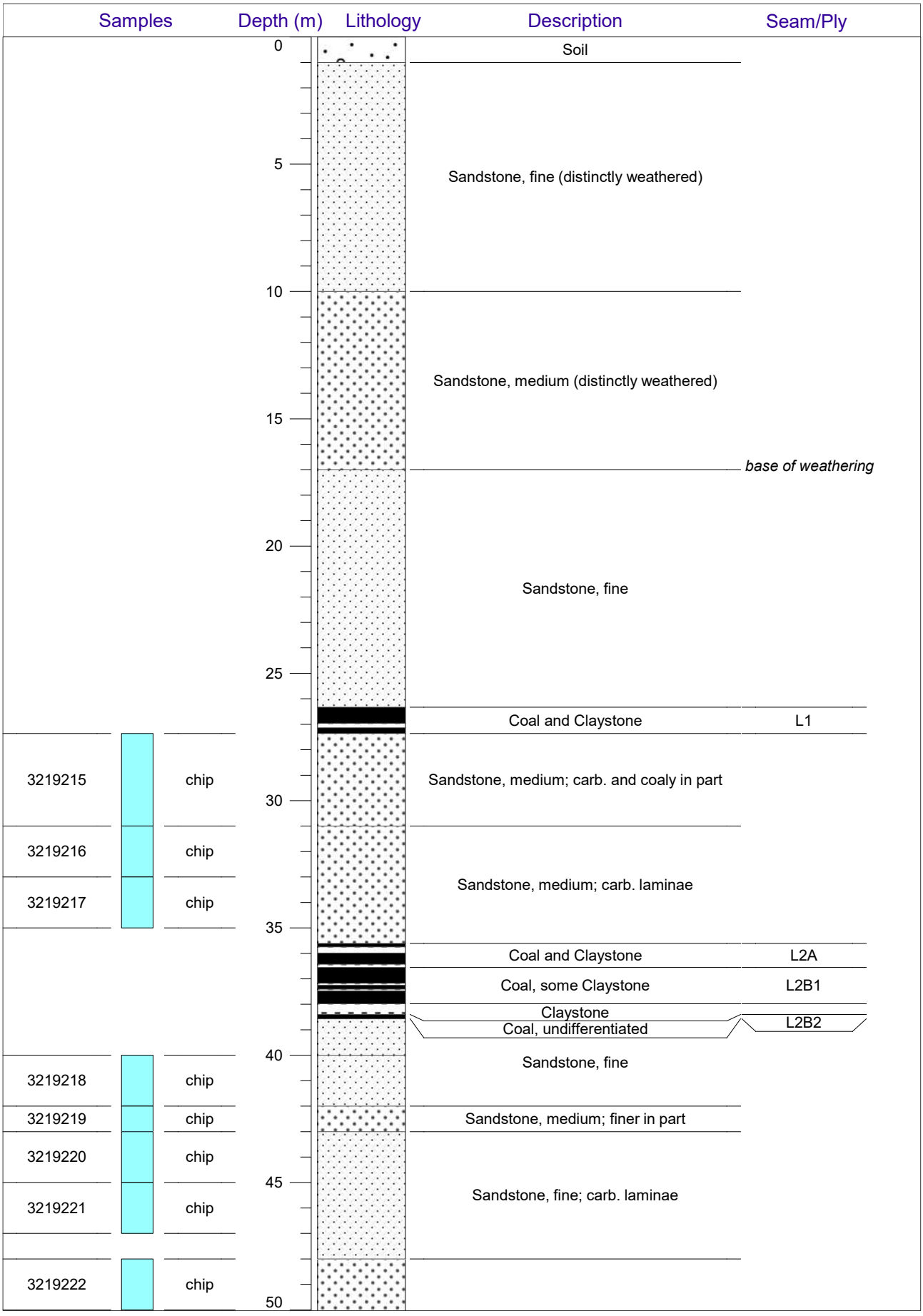
Easting: 633411 Northing: 7546454 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3041

Easting: 629592 Northing: 7546605 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3041

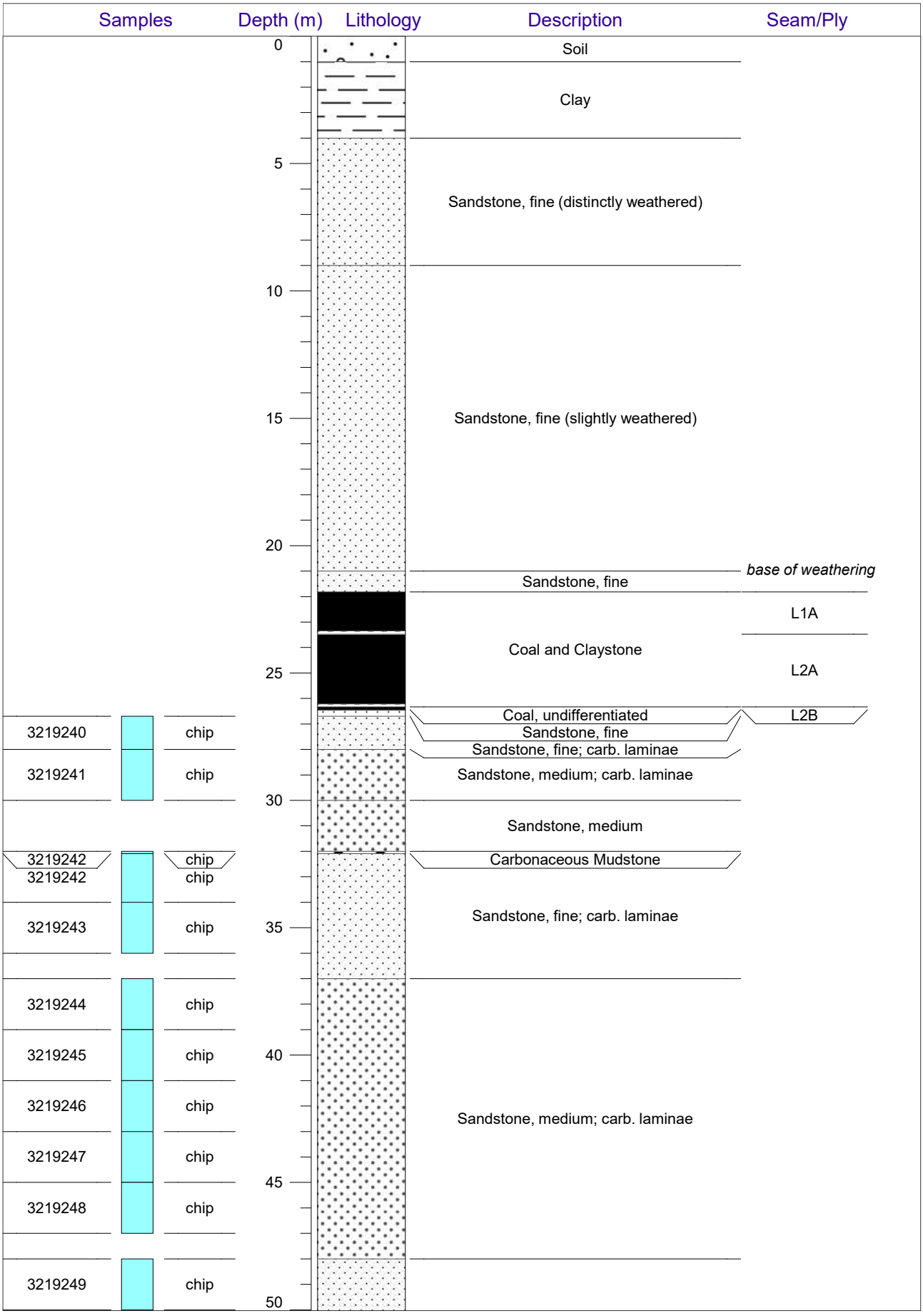
Easting: 629592 Northing: 7546605 Datum/Projection: GDA94, zone 55

Samples		Depth (m)	Lithology	Description	Seam/Ply
3219223	chip	50		Sandstone, medium; carb. laminae	
3219224	chip			Coal, undifferentiated	L2C
3219225	chip				
3219226	chip	55			
3219227	chip				
3219228	chip	60		Sandstone, fine; carb. laminae	
3219229	chip				
3219230	chip				
3219231	chip	65			
3219232	chip				
		70		Carbonaceous Mudstone	
				Sandstone, fine; carb. laminae	
				Coal, some Claystone	VA3
				Tuff	Yarrabee Tuff
		75		Coal, interbedded with Claystone and Tuff partings	VB-VI
				Tuff	
		80		Coal, some Claystone	VJ
				Tuff	
				Coal and Tuff	
				Coal, undifferentiated	VK
				Coal and Claystone	
				Coal and Claystone	VL
		85		Coal, undifferentiated	VM
				Tuff	
				Coal and Tuff	VN
		90		Sandstone, fine; carb. laminae	
		95			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3059

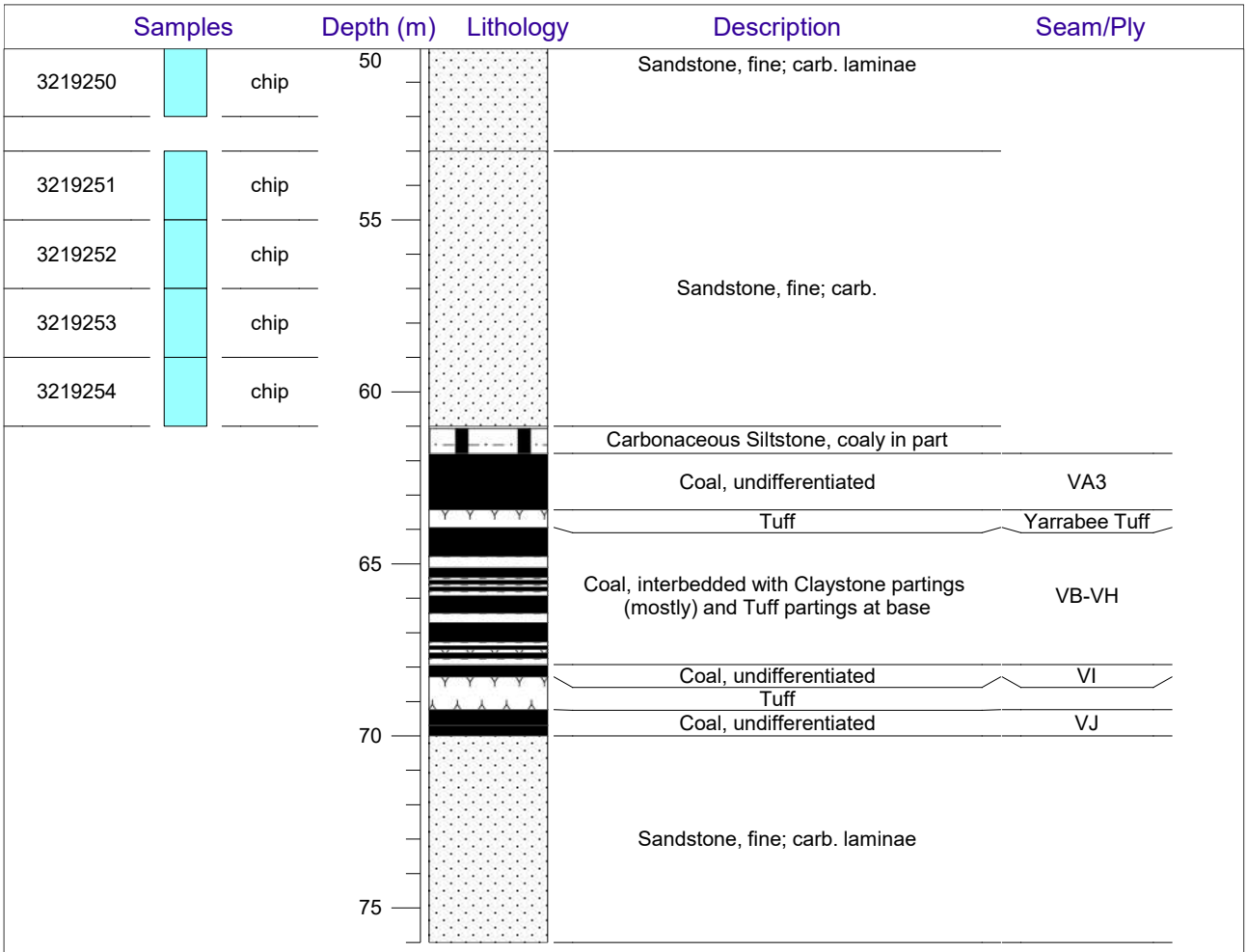
Easting: 630223 Northing: 7549405 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3059

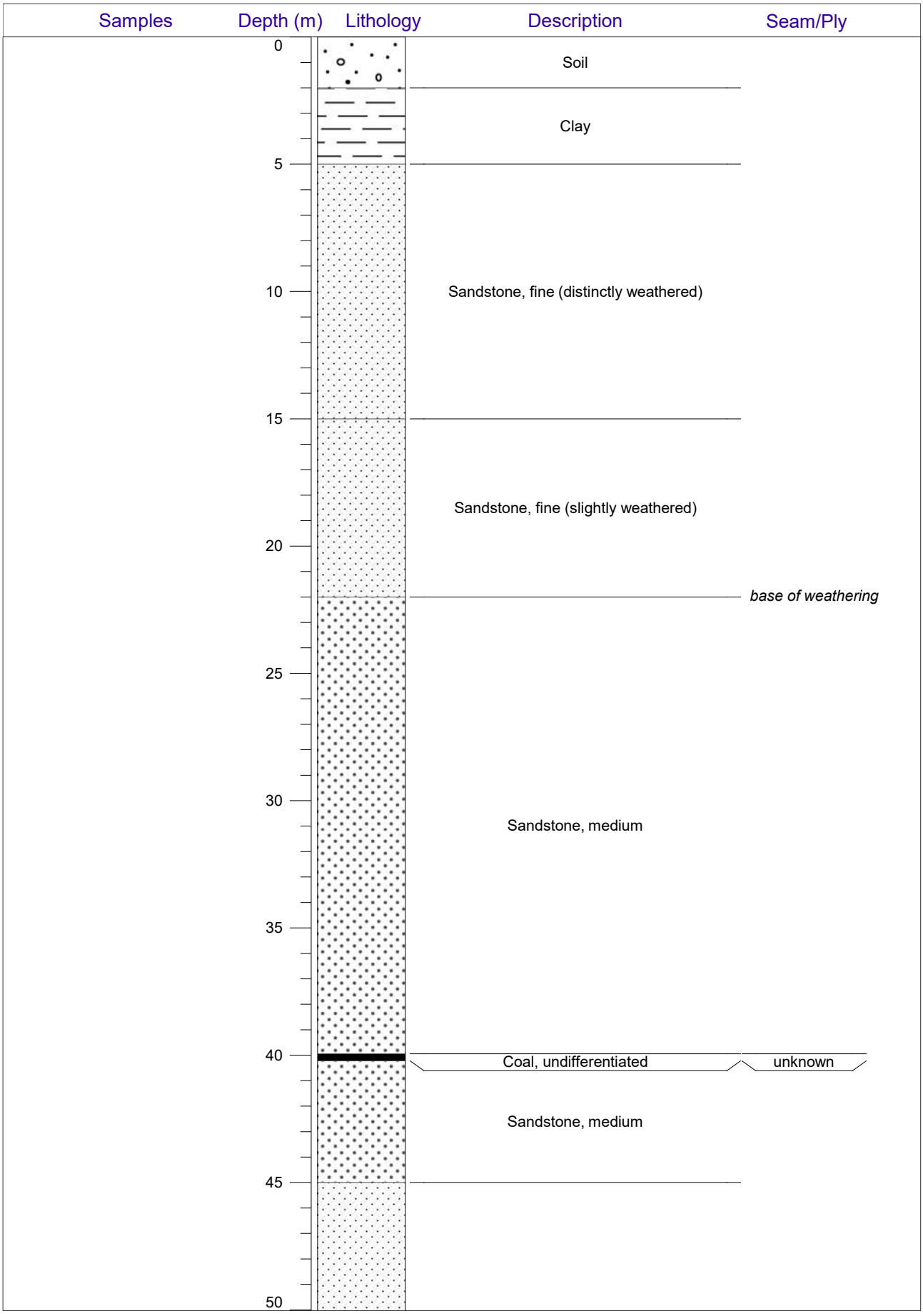
Easting: 630223 Northing: 7549405 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3082

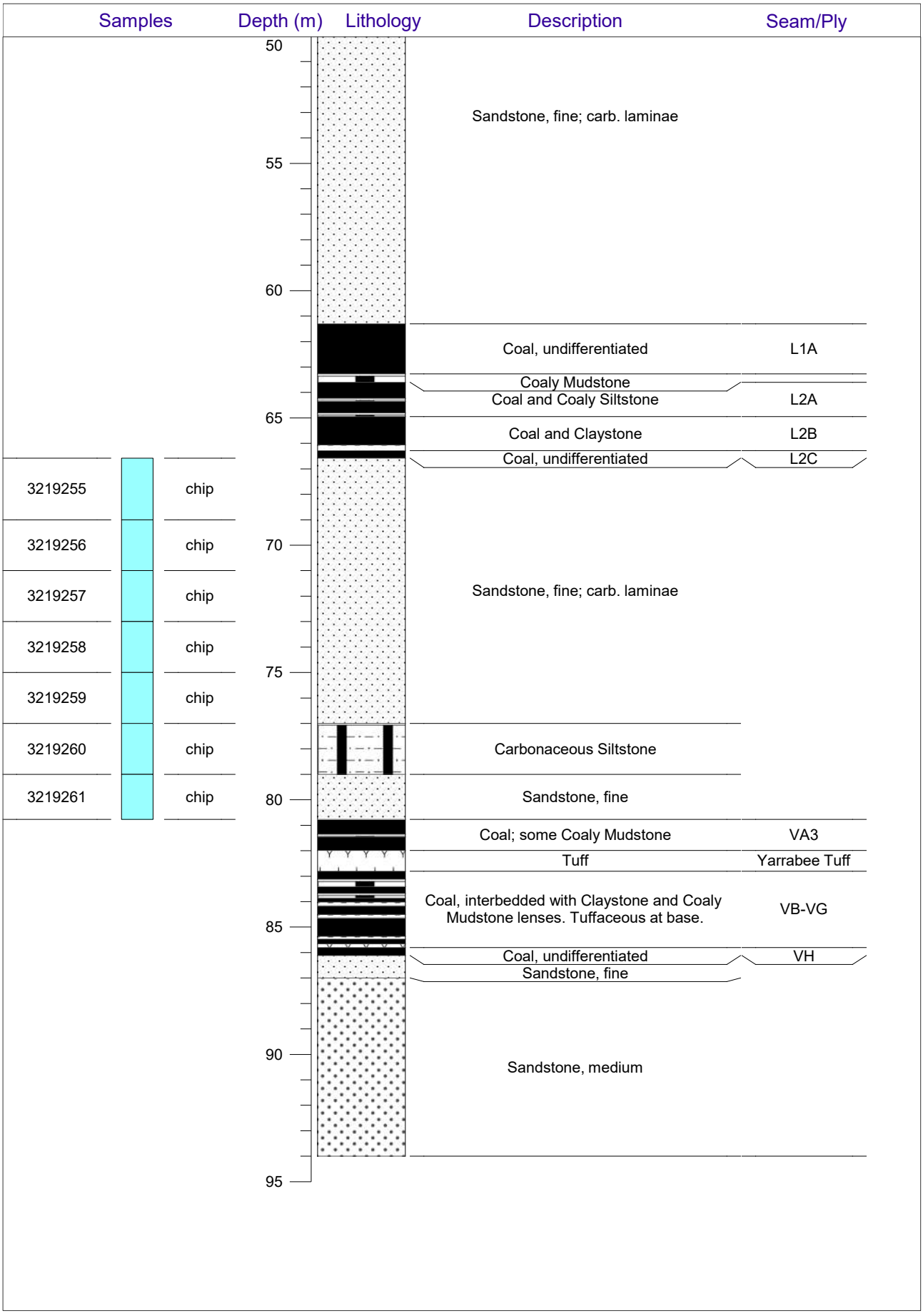
Easting: 631908 Northing: 7545623 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3082

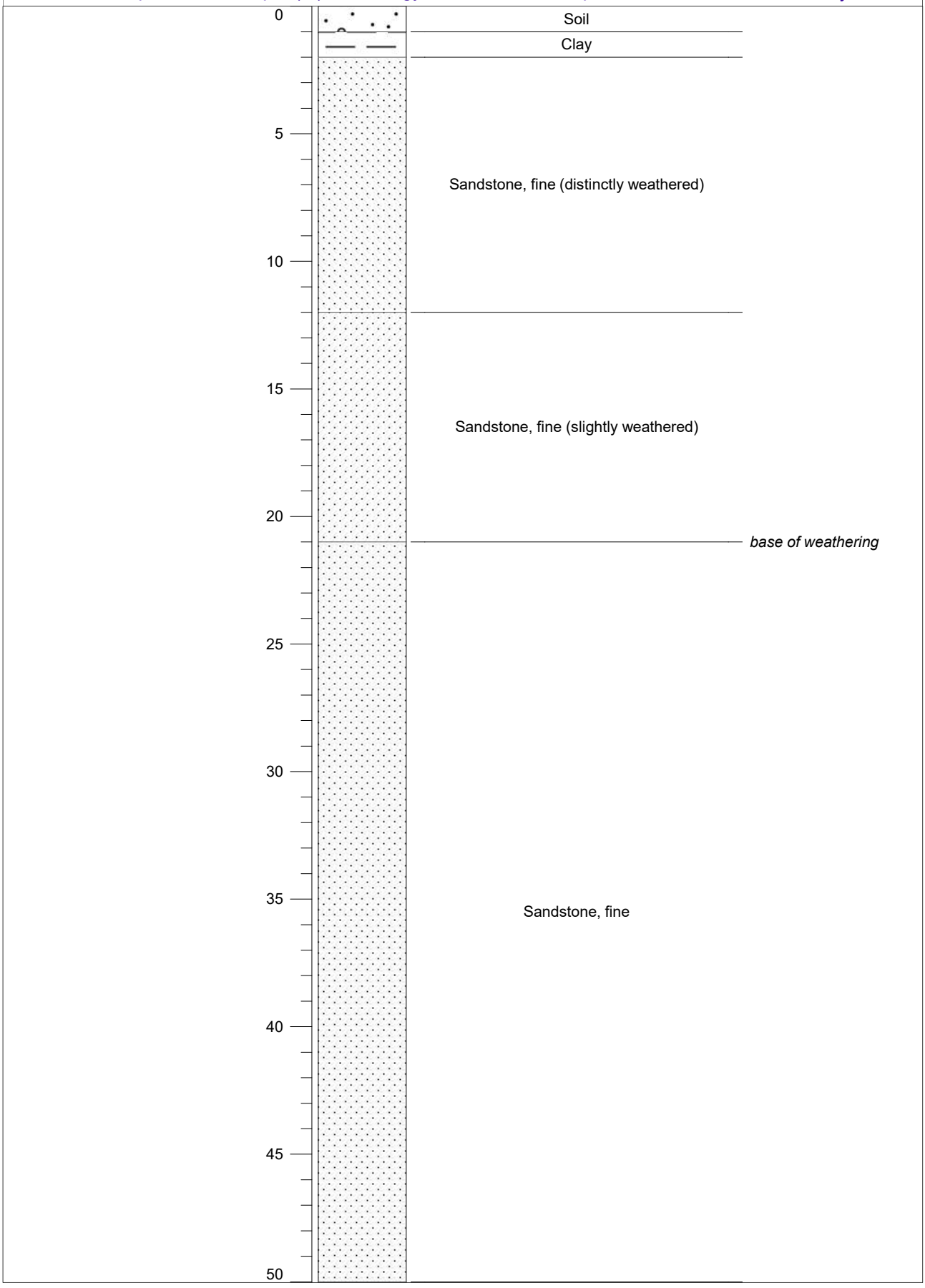
Easting: 631908 Northing: 7545623 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3120

Easting: 633073 Northing: 7546557 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3120

Easting: 633073 Northing: 7546557 Datum/Projection: GDA94, zone 55

Samples			Depth (m)	Lithology	Description	Seam/Ply
			50		Siltstone; trace carbonaceous	
					Sandstone	
			55		Carbonaceous Siltstone	
					Sandstone, fine; trace carbonaceous	
			60			
			65		Carbonaceous Siltstone	
					Coal, undifferentiated	L1
			70			
3219262		chip			Carbonaceous Siltstone	
3219263		chip			Sandstone, fine	
			75			
3219264		chip			Sandstone, medium	
3219265		chip				
3219266		chip	80		Sandstone, fine	
3219267		chip				
3219268		chip	85		Carbonaceous Siltstone	
3219269		chip			Sandstone, fine	
3219270		chip				
3219271		chip	90			
					Coal, undifferentiated	VA3
					Tuff	Yarrabee Tuff
			95		Coal; interbedded with Carb. Mudstone, Claystone, fine Sandstone and Tuff partings	VB-VH
			100			

TERRENUS EARTH SCIENCES

Whitehaven Coal | Winchester South | Hole ID: WS3120

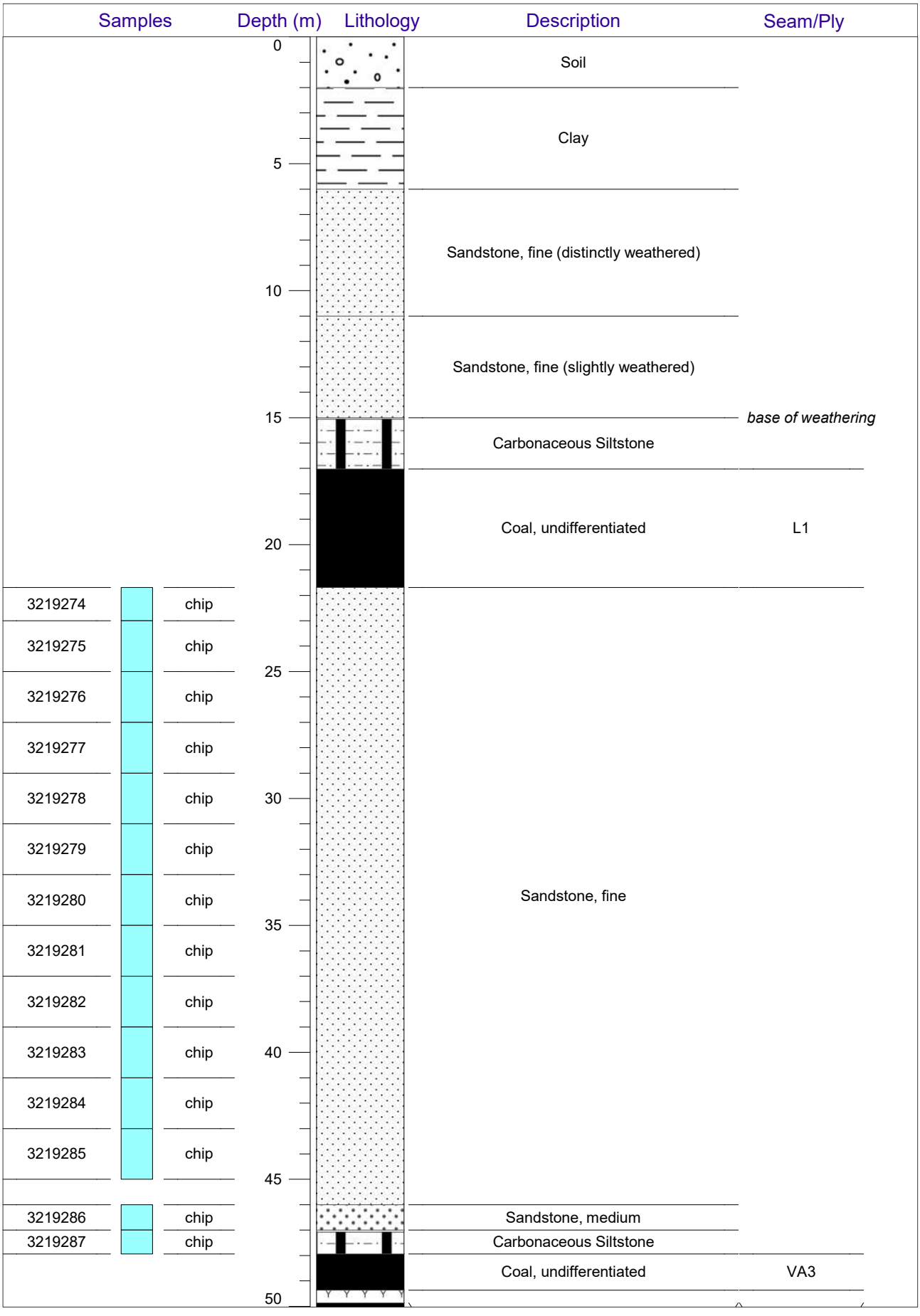
Easting: 633073 Northing: 7546557 Datum/Projection: GDA94, zone 55

Samples	Depth (m)	Lithology	Description	Seam/Ply
			Sandstone, fine	
	105		Sandstone, medium	
	110			

TERRENUS EARTH SCIENCES

Whitehaven Coal **Winchester South** Hole ID: WS3155

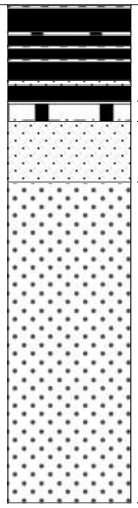
Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55



TERRENUS EARTH SCIENCES

Whitehaven Coal **Winchester South** Hole ID: WS3155

Easting: 629142 Northing: 7551226 Datum/Projection: GDA94, zone 55

Samples	Depth (m)	Lithology	Description	Seam/Ply
	50		Tuff	Yarrabee Tuff
			Coal; interbedded with Claystone partings. Carb. Mudstone parting near base.	VB-VF
			Carbonaceous Siltstone	
			Sandstone, fine	
	55		Sandstone, medium	

Appendix C

Static Geochemical Results Tables

- Table C1 – Acid-Base Characteristics of Potential Waste Rock and ROM coal
- Table C2 – Acid-Base Characteristics of Potential Coarse Reject
- Table C3 – Total Element Concentrations in Potential Waste Rock
- Table C4 – Geochemical Abundance Indices for Potential Waste Rock
- Table C5 – Total Element Concentrations in Potential Coarse Reject and ROM Coal
- Table C6 – Geochemical Abundance Indices for Potential Coarse Reject and ROM Coal
- Table C7 – Soluble Major Ions, pH and Electrical Conductivity in Water Extracts from Potential Waste Rock
- Table C8 – Soluble Multi-Element Concentrations in Water Extracts from Potential Waste Rock
- Table C9 – Soluble Major Ions, pH and Electrical Conductivity in Water Extracts from Potential Coarse Reject and ROM Coal
- Table C10 – Soluble Multi-Element Concentrations in Water Extracts from Potential Coarse Reject and ROM Coal
- Table C11 – Exchangeable Cations and Emerson Aggregate Class Test Results for Potential Waste Rock

Table C1. Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2641 *	R2071	0 - 1	Extremely	Soil	7.9	-	1520	-	<0.01	-	-	0.2	21	-21	137	8.6	<0.1	<0.1	NAF-barren
2642 *	R2071	1 - 5	Distinctly	Clay	6.5	-	1610	-	<0.01	-	-	0.2	8	-8	52	8.2	<0.1	<0.1	NAF-barren
2643 *	R2071	5 - 10	Distinctly	Clay	8.4	-	700	-	<0.01	-	-	0.2	31	-31	202	8.7	<0.1	<0.1	NAF-barren
2644 *	R2071	10 - 15	Distinctly	Clay	8.7	-	710	-	<0.01	-	-	0.2	28	-28	183	8.9	<0.1	<0.1	NAF-barren
2645 *	R2071	15 - 20	Distinctly	Clay	8.8	-	750	-	<0.01	-	-	0.2	18	-18	118	8.2	<0.1	<0.1	NAF-barren
2646 *	R2071	20 - 25	Distinctly	Clay	8.8	-	620	-	<0.01	-	-	0.2	18	-18	118	8.5	<0.1	<0.1	NAF-barren
2647 *	R2071	25 - 30	Distinctly	Clay	8.9	-	520	-	<0.01	-	-	0.2	18	-18	118	8.3	<0.1	<0.1	NAF-barren
2648 *	R2071	30 - 34	Fresh	Siltstone	9.2	-	580	-	<0.01	-	-	0.2	22	-22	144	7.9	<0.1	<0.1	NAF-barren
2649 *	R2071	34 - 37	Fresh	Siltstone	9.0	-	630	-	<0.01	-	-	0.2	40	-40	261	8.6	<0.1	<0.1	NAF-barren
2650 *	R2071	37 - 41	Fresh	Sandstone, fine-med.; & Siltst.	9.1	-	560	-	<0.01	-	-	0.2	43	-43	281	8.9	<0.1	<0.1	NAF-barren
2651 *	R2071	41 - 46	Fresh	Sandstone, fine-medium	9.3	-	470	-	<0.01	-	-	0.2	37	-37	242	7.9	<0.1	<0.1	NAF-barren
2652 *	R2071	46 - 50	Fresh	Sandstone, fine-medium	9.2	-	610	-	<0.01	-	-	0.2	58	-58	379	8.8	<0.1	<0.1	NAF-barren
2653 *	R2071	50 - 54	Fresh	Sandstone, fine-medium	8.4	-	1180	-	0.02	-	-	0.6	41	-40	67	8.7	<0.1	<0.1	NAF-barren
2654 *	R2071	54 - 58	Fresh	Sandstone, fine-med.; & Siltst.	8.7	-	650	-	<0.01	-	-	0.2	22	-22	144	8.1	<0.1	<0.1	NAF-barren
2655 *	R2071	58 - 62	Fresh	Sandstone, fine-med.; & Siltst.	9.1	-	540	-	<0.01	-	-	0.2	26	-26	170	8.3	<0.1	<0.1	NAF-barren
2656 *	R2071	62 - 66	Fresh	Siltstone; some Sandstone	9.2	-	670	-	0.02	-	-	0.6	88	-87	144	9.1	<0.1	<0.1	NAF-barren
2657 *	R2071	66 - 70	Fresh	Sandstone, fine-medium	8.9	-	920	-	<0.01	-	-	0.2	51	-51	333	9.5	<0.1	<0.1	NAF-barren
2658 *	R2071	70 - 73	Fresh	Sandstone, fine-medium	8.8	-	880	-	<0.01	-	-	0.2	39	-39	255	9.4	<0.1	<0.1	NAF-barren
2659 *	R2071	73 - 78	Fresh	Siltstone	9.1	-	730	-	<0.01	-	-	0.2	48	-48	313	9.3	<0.1	<0.1	NAF-barren
2660 *	R2071	78 - 83	Fresh	Sandstone, fine-medium	9.2	-	720	-	<0.01	-	-	0.2	28	-28	183	8.5	<0.1	<0.1	NAF-barren
2661 *	R2071	83 - 88	Fresh	Sandstone, fine-medium	9.2	-	620	-	<0.01	-	-	0.2	86	-86	562	8.7	<0.1	<0.1	NAF-barren
2662 *	R2071	88 - 93	Fresh	Sandstone, fine-medium	9.3	-	650	-	<0.01	-	-	0.2	53	-53	346	8.6	<0.1	<0.1	NAF-barren
2663 *	R2071	93 - 98	Fresh	Sandstone, fine-medium	9.1	-	790	-	<0.01	-	-	0.2	54	-54	353	8.7	<0.1	<0.1	NAF-barren
2664 *	R2071	98 - 102	Fresh	Sandstone, fine-medium	9.2	-	610	-	<0.01	-	-	0.2	40	-40	261	8.5	<0.1	<0.1	NAF-barren
2665 *	R2071	102 - 106	Fresh	Sandstone, fine-medium	9.0	-	560	-	<0.01	-	-	0.2	79	-79	516	8.4	<0.1	<0.1	NAF-barren
2666 *	R2071	106 - 110	Fresh	Sandstone, fine-medium	9.1	-	650	-	<0.01	-	-	0.2	63	-63	411	8.3	<0.1	<0.1	NAF-barren
2667 *	R2071	110 - 114	Fresh	Siltstone	9.2	-	520	-	<0.01	-	-	0.2	39	-39	255	8.5	<0.1	<0.1	NAF-barren
2668 *	R2071	114 - 118	Fresh	Siltstone	9.3	-	600	-	<0.01	-	-	0.2	54	-54	353	8.2	<0.1	<0.1	NAF-barren
2669 *	R2071	118 - 121	Fresh	Siltstone; with Sandstone, fine	9.2	-	630	-	<0.01	-	-	0.2	17	-17	111	7.3	<0.1	<0.1	NAF-barren
2670 *	R2071	121 - 122	Fresh	Siltstone	9.1	-	490	-	<0.01	-	-	0.2	12	-12	78	7.5	<0.1	<0.1	NAF-barren
2671 *	R2071	122 - 125	Fresh	Siltstone; & Sandstone, fine-med.	9.0	-	490	-	<0.01	-	-	0.2	17	-17	111	7.3	<0.1	<0.1	NAF-barren
2672 *	R2071	125 - 128	Fresh	Claystone	9.1	-	740	-	<0.01	-	-	0.2	32	-32	209	7.5	<0.1	<0.1	NAF-barren
2673 *	R2071	128 - 129	Fresh	Claystone	9.1	-	480	-	0.01	-	-	0.3	51	-51	167	7.6	<0.1	<0.1	NAF-barren
2674 *	R2071	129 - 130	Fresh	Coal & Claystone (L1A)	9.1	-	630	-	0.04	-	-	1.2	29	-28	24	7.5	<0.1	<0.1	NAF-barren
2675 *	R2071	130 - 131	Fresh	Siltstone, some carb.	9.0	-	660	-	0.03	-	-	0.9	30	-29	33	7.6	<0.1	<0.1	NAF-barren

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019. Grey rows are seam samples.
pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential;
NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2676 *	R2071	131 - 133	Fresh	Siltstone; some Sandst., fine-med.	9.1	-	680	-	<0.01	-	-	0.2	14	-14	91	7.7	<0.1	<0.1	NAF-barren
2677 *	R2071	133 - 137	Fresh	Claystone	9.1	-	870	-	<0.01	-	-	0.2	73	-73	477	7.8	<0.1	<0.1	NAF-barren
2678 *	R2071	137 - 138	Fresh	Claystone	8.9	-	1120	-	<0.01	-	-	0.2	28	-28	183	7.9	<0.1	<0.1	NAF-barren
2679 *	R2071	138 - 139	Fresh	Claystone & Coal (L1A2)	8.9	-	1090	-	<0.01	-	-	0.2	26	-26	170	7.8	<0.1	<0.1	NAF-barren
2680 *	R2071	139 - 140	Fresh	Sandstone	9.1	-	780	-	<0.01	-	-	0.2	113	-113	738	7.7	<0.1	<0.1	NAF-barren
2681 *	R2071	140 - 141	Fresh	Siltstone	9.0	-	940	-	<0.01	-	-	0.2	62	-62	405	7.9	<0.1	<0.1	NAF-barren
2682 *	R2071	141 - 142	Fresh	Siltstone	9.1	-	840	-	<0.01	-	-	0.2	38	-38	248	8.2	<0.1	<0.1	NAF-barren
2683 *	R2071	142 - 143	Fresh	Siltstone; some Sandst., fine-med.	9.3	-	770	-	<0.01	-	-	0.2	43	-43	281	8.3	<0.1	<0.1	NAF-barren
2684 *	R2071	143 - 144	Fresh	Siltst., Sandst.,FM, Coal (L1B)	9.1	-	630	-	<0.01	-	-	0.2	83	-83	542	7.6	<0.1	<0.1	NAF-barren
2685 *	R2071	144 - 145	Fresh	Coal (L2A)	8.8	-	1110	-	<0.01	-	-	0.2	24	-24	157	7.2	<0.1	<0.1	NAF-barren
2686 *	R2071	145 - 146	Fresh	Coal (L2A)	8.7	-	830	-	<0.01	-	-	0.2	14	-14	91	7.5	<0.1	<0.1	NAF-barren
2687 *	R2071	146 - 147	Fresh	Clayst.; some Coal (L2A) & Siltst.	9.0	-	850	-	<0.01	-	-	0.2	31	-31	202	7.6	<0.1	<0.1	NAF-barren
2688 *	R2071	147 - 148	Fresh	Sandstone; some Coal (L2B)	9.1	-	780	-	<0.01	-	-	0.2	24	-24	157	7.8	<0.1	<0.1	NAF-barren
2689 *	R2071	148 - 150	Fresh	Sandstone	8.8	-	940	-	<0.01	-	-	0.2	110	-110	718	8.2	<0.1	<0.1	NAF-barren
2690 *	R2071	150 - 154	Fresh	Sandstone	8.9	-	1210	-	<0.01	-	-	0.2	101	-101	660	8.1	<0.1	<0.1	NAF-barren
2691 *	R2071	154 - 158	Fresh	Siltstone	9.0	-	960	-	<0.01	-	-	0.2	27	-27	176	8.0	<0.1	<0.1	NAF-barren
2692 *	R2071	158 - 159	Fresh	Siltstone & Sandstone	9.1	-	910	-	<0.01	-	-	0.2	53	-53	346	7.7	<0.1	<0.1	NAF-barren
2693 *	R2071	159 - 163	Fresh	Siltstone; with Sandstone	9.2	-	800	-	<0.01	-	-	0.2	74	-74	483	7.8	<0.1	<0.1	NAF-barren
2694 *	R2071	163 - 166	Fresh	Siltstone	9.2	-	900	-	<0.01	-	-	0.2	158	-158	1032	7.9	<0.1	<0.1	NAF-barren
2695 *	R2071	166 - 170	Fresh	Siltstone	9.2	-	920	-	<0.01	-	-	0.2	25	-25	163	7.6	<0.1	<0.1	NAF-barren
2696 *	R2071	170 - 174	Fresh	Siltstone	9.1	-	1040	-	<0.01	-	-	0.2	35	-35	229	7.7	<0.1	<0.1	NAF-barren
2697 *	R2071	174 - 175	Fresh	Siltstone	9.2	-	1020	-	<0.01	-	-	0.2	44	-44	287	7.9	<0.1	<0.1	NAF-barren
2698 *	R2071	175 - 176	Fresh	Siltstone	9.1	-	1160	-	<0.01	-	-	0.2	29	-29	189	7.8	<0.1	<0.1	NAF-barren
2699 *	R2071	176 - 177	Fresh	Siltstone	9.0	-	1370	-	<0.01	-	-	0.2	128	-128	836	8.2	<0.1	<0.1	NAF-barren
2700 *	R2071	177 - 178	Fresh	Siltstone	8.8	-	1460	-	<0.01	-	-	0.2	51	-51	333	8.1	<0.1	<0.1	NAF-barren
2701 *	R2071	178 - 179	Fresh	Siltstone & Coal (VA3)	8.9	-	1470	-	<0.01	-	-	0.2	23	-23	150	8.0	<0.1	<0.1	NAF-barren
2702 *	R2071	179 - 180	Fresh	Coal (VA3)	8.9	-	830	-	0.16	-	-	4.9	10	-5	2.0	3.7	2	9	NAF-Low S
					Extended Boil NAGpH = 7.3; Extended Boil Calculated NAG = -7 kg H_2SO_4/t														
2703 *	R2071	180 - 181	Fresh	Coal & Tuff (VA3)	9.1	-	840	-	0.10	-	-	3.1	18	-15	5.9	7.2	<0.1	<0.1	NAF-Low S
2704 *	R2071	181 - 182	Fresh	Coal (VML)	9.1	-	750	-	0.13	-	-	4.0	33	-29	8.3	7.3	<0.1	<0.1	NAF-Low S
2705 *	R2071	182 - 183	Fresh	Coal (VML)	9.2	-	850	-	0.06	-	-	1.8	63	-61	34	7.5	<0.1	<0.1	NAF-Low S
2706 *	R2071	183 - 184	Fresh	Coal & Claystone (VML)	9.1	-	940	-	0.10	-	-	3.1	18	-15	5.9	6.9	<0.1	<0.1	NAF-Low S
2707 *	R2071	184 - 185	Fresh	Coal & Claystone (VML)	9.0	-	660	-	0.16	-	-	4.9	44	-39	9.0	7.2	<0.1	<0.1	NAF-Low S
2708 *	R2071	185 - 186	Fresh	Coal & Claystone (VML)	9.1	-	820	-	0.14	-	-	4.3	40	-36	9.3	7.4	<0.1	<0.1	NAF-Low S

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019. Grey rows are seam samples.
Sample 2702 underwent an Extended Boil NAG test to refine the uncertainty in the Acid Classification. Refer to main body of the report for further explanation.
pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential; NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2709 *	R2071	186 - 187	Fresh	Coal & Tuff (VMB)	9.1	-	690	-	0.15	-	-	4.6	49	-44	11	7.3	<0.1	<0.1	NAF-Low S
2710 *	R2071	187 - 188	Fresh	Coal, some Tuff (VMB)	9.2	-	540	-	0.19	-	-	5.8	17	-11	2.9	7.2	<0.1	<0.1	NAF-Low S
2711 *	R2071	188 - 189	Fresh	Claystone; some Coal (VMB)	9.4	-	920	-	<0.01	-	-	0.2	64	-64	418	7.5	<0.1	<0.1	NAF-barren
2712 *	R2071	189 - 190	Fresh	Coal & Tuff (VMB)	9.3	-	770	-	0.18	-	-	5.5	85	-79	15	7.6	<0.1	<0.1	NAF-Low S
2713 *	R2071	190 - 191	Fresh	Coal (VMB)	9.4	-	780	-	0.11	-	-	3.4	25	-22	7.4	8.2	<0.1	<0.1	NAF-Low S
2714 *	R2071	191 - 192	Fresh	Coal, with Siltst. & Tuff (VMB)	9.5	-	670	-	0.23	-	-	7.0	19	-12	2.7	8.1	<0.1	<0.1	NAF-S
2715 *	R2071	192 - 193	Fresh	Coal; some Carb. Siltst. & Tuff (VMB)	9.4	-	910	-	0.11	-	-	3.4	13	-10	3.9	8.0	<0.1	<0.1	NAF-Low S
2716 *	R2071	193 - 194	Fresh	Tuff; some Carb. Mudst. (V?)	9.4	-	970	-	0.02	-	-	0.6	20	-19	33	7.8	<0.1	<0.1	NAF-barren
2717 *	R2071	194 - 195	Fresh	Tuff; Carb. Mudst. & Coal (V?)	9.4	-	590	-	0.14	-	-	4.3	45	-41	10	7.9	<0.1	<0.1	NAF-Low S
2718 *	R2071	195 - 196	Fresh	Coal, some Claystone	9.3	-	770	-	0.08	-	-	2.5	16	-14	6.5	7.6	<0.1	<0.1	NAF-Low S
2719 *	R2071	196 - 197	Fresh	Claystone, with Coal & Tuff	9.2	-	1070	-	<0.01	-	-	0.2	11	-11	72	7.5	<0.1	<0.1	NAF-barren
2720 *	R2071	197 - 198	Fresh	Claystone/Tuff	9.3	-	940	-	<0.01	-	-	0.2	21	-21	137	7.9	<0.1	<0.1	NAF-barren
2721 *	R2071	198 - 200	Fresh	Siltstone	9.4	-	1180	-	<0.01	-	-	0.2	1	-1	6.5	7.6	<0.1	<0.1	NAF-barren
2724 *	R2077	0 - 1	Extremely	Soil	8.4	-	1260	-	<0.01	-	-	0.2	83	-83	542	8.5	<0.1	<0.1	NAF-barren
2725 *	R2077	1 - 2	Distinctly	Siltstone	8.3	-	1790	-	<0.01	-	-	0.2	111	-111	725	8.7	<0.1	<0.1	NAF-barren
2726 *	R2077	2 - 3	Distinctly	Siltstone	8.5	-	1910	-	<0.01	-	-	0.2	39	-39	255	8.6	<0.1	<0.1	NAF-barren
2727 *	R2077	3 - 7	Distinctly	Siltstone	8.8	-	1550	-	<0.01	-	-	0.2	68	-68	444	8.8	<0.1	<0.1	NAF-barren
2728 *	R2077	7 - 11	Distinctly	Siltstone	8.7	-	1280	-	<0.01	-	-	0.2	74	-74	483	8.7	<0.1	<0.1	NAF-barren
2729 *	R2077	11 - 16	Moderately	Siltstone	9.4	-	760	-	<0.01	-	-	0.2	25	-25	163	8.4	<0.1	<0.1	NAF-barren
2730 *	R2077	16 - 18	Moderately	Sandstone, medium	9.0	-	650	-	<0.01	-	-	0.2	15	-15	98	7.8	<0.1	<0.1	NAF-barren
2731 *	R2077	18 - 23	Moderately	Sandstone, fine-med.; & Siltst.	8.9	-	770	-	<0.01	-	-	0.2	15	-15	98	7.9	<0.1	<0.1	NAF-barren
2732 *	R2077	23 - 24	Fresh	Sandstone, fine-medium	9.0	-	650	-	<0.01	-	-	0.2	43	-43	281	7.7	<0.1	<0.1	NAF-barren
2733 *	R2077	24 - 25	Fresh	Mudstone	8.8	-	810	-	<0.01	-	-	0.2	34	-34	222	7.6	<0.1	<0.1	NAF-barren
2734 *	R2077	25 - 29	Fresh	Sandstone, fine; & Siltstone	8.1	-	280	-	<0.01	-	-	0.2	70	-70	457	7.8	<0.1	<0.1	NAF-barren
2735 *	R2077	29 - 32	Fresh	Sandstone, fine-medium	7.8	-	380	-	<0.01	-	-	0.2	59	-59	385	7.9	<0.1	<0.1	NAF-barren
2736 *	R2077	32 - 34	Fresh	Sandstone, fine-medium	7.5	-	320	-	<0.01	-	-	0.2	161	-161	1051	8.1	<0.1	<0.1	NAF-barren
2737 *	R2077	34 - 35	Fresh	Sandstone, fine-medium	7.6	-	320	-	<0.01	-	-	0.2	32	-32	209	7.9	<0.1	<0.1	NAF-barren
2738 *	R2077	35 - 36	Fresh	Siltstone	7.7	-	480	-	<0.01	-	-	0.2	42	-42	274	7.8	<0.1	<0.1	NAF-barren
2739 *	R2077	36 - 37	Fresh	Siltstone	7.2	-	110	-	<0.01	-	-	0.2	36	-36	235	8.2	<0.1	<0.1	NAF-barren
2740 *	R2077	37 - 38	Fresh	Siltstone; some Coal (L1B)	7.3	-	120	-	<0.01	-	-	0.2	124	-124	810	8.3	<0.1	<0.1	NAF-barren
2741 *	R2077	38 - 39	Fresh	Coal (L1B/L2A)	7.5	-	220	-	0.30	-	-	9.2	15	-6	1.6	7.5	<0.1	<0.1	NAF-S
2742 *	R2077	39 - 40	Fresh	Coal (L2A)	-	-	-	-	0.34	-	-	10.4	14	-4	1.3	7.6	<0.1	<0.1	NAF-S
2743 *	R2077	40 - 41	Fresh	Coal (L2A)	-	-	-	-	0.34	-	-	10.4	10	0	1.0	2.7	25	47	NAF-S
					Extended Boil NAGpH = 7.1; Extended Boil Calculated NAG = -16 kg H_2SO_4/t														

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019. Grey rows are seam samples.
Sample 2743 underwent an Extended Boil NAG test to refine the uncertainty in the Acid Classification. Refer to main body of the report for further explanation.
pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential;
NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2744 *	R2077	41 - 42	Fresh	Mudstone; some Coal (L2A)	8.2	-	220	-	0.17	-	-	5.2	11	-6	2.1	6.9	<0.1	<0.1	NAF-Low S
2745 *	R2077	42 - 43	Fresh	Siltstone & Mudstone	8.3	-	160	-	0.06	-	-	1.8	20	-18	11	7.6	<0.1	<0.1	NAF-Low S
2746 *	R2077	43 - 44	Fresh	Siltstone & Mudstone	8.0	-	130	-	<0.01	-	-	0.2	35	-35	229	7.7	<0.1	<0.1	NAF-barren
2747 *	R2077	44 - 45	Fresh	Siltstone & Mudstone	8.4	-	410	-	<0.01	-	-	0.2	54	-54	353	8.3	<0.1	<0.1	NAF-barren
2748 *	R2077	45 - 47	Fresh	Siltstone & Mudstone	8.6	-	510	-	<0.01	-	-	0.2	57	-57	372	8.4	<0.1	<0.1	NAF-barren
2749 *	R2077	47 - 51	Fresh	Sandstone, fine; & Mudstone	7.5	-	200	-	<0.01	-	-	0.2	78	-78	509	8.5	<0.1	<0.1	NAF-barren
2750 *	R2077	51 - 56	Fresh	Sandstone, fine; some Mudstone	7.3	-	220	-	<0.01	-	-	0.2	78	-78	509	8.2	<0.1	<0.1	NAF-barren
2751 *	R2077	56 - 59	Fresh	Siltstone	7.7	-	240	-	<0.01	-	-	0.2	86	-86	562	8.1	<0.1	<0.1	NAF-barren
2752 *	R2077	59 - 60	Fresh	Claystone	7.9	-	190	-	<0.01	-	-	0.2	77	-77	503	8.0	<0.1	<0.1	NAF-barren
2753 *	R2077	60 - 61	Fresh	Claystone	8.1	-	170	-	<0.01	-	-	0.2	99	-99	647	8.3	<0.1	<0.1	NAF-barren
2754 *	R2077	61 - 62	Fresh	Claystone	8.0	-	600	-	<0.01	-	-	0.2	71	-71	464	8.1	<0.1	<0.1	NAF-barren
2755 *	R2077	62 - 63	Fresh	Coal, some Claystone (VA)	7.6	-	210	-	0.14	-	-	4.3	35	-31	8.2	7.9	<0.1	<0.1	NAF-Low S
2756 *	R2077	63 - 64	Fresh	Coal, some Claystone (VA)	7.4	-	320	-	0.13	-	-	4.0	87	-83	22	7.6	<0.1	<0.1	NAF-Low S
2757 *	R2077	64 - 65	Fresh	Coal (VA)	7.3	-	160	-	0.06	-	-	1.8	20	-18	11	7.5	<0.1	<0.1	NAF-Low S
2758 *	R2077	65 - 66	Fresh	Tuff (YT); & Coal (VML)	7.5	-	450	-	<0.01	-	-	0.2	59	-59	385	7.7	<0.1	<0.1	NAF-barren
2759 *	R2077	66 - 67	Fresh	Coal (VML)	7.4	-	140	-	<0.01	-	-	0.2	90	-90	588	7.6	<0.1	<0.1	NAF-barren
2760 *	R2077	67 - 68	Fresh	Coal; & Tuff (VML)	7.2	-	730	-	0.05	-	-	1.5	123	-121	80	7.8	<0.1	<0.1	NAF-barren
2761 *	R2077	68 - 69	Fresh	Coal; & Claystone (VML)	7.3	-	270	-	0.18	-	-	5.5	36	-30	6.5	7.9	<0.1	<0.1	NAF-Low S
2762 *	R2077	69 - 70	Fresh	Coal; some Clayst. & Sandst. (VML)	7.6	-	500	-	0.01	-	-	0.3	18	-18	59	7.6	<0.1	<0.1	NAF-barren
2763 *	R2077	70 - 71	Fresh	Sandstone, medium	7.7	-	380	-	<0.01	-	-	0.2	51	-51	333	7.9	<0.1	<0.1	NAF-barren
2764 *	R2077	71 - 72	Fresh	Sandstone, medium	7.8	-	240	-	<0.01	-	-	0.2	61	-61	398	7.8	<0.1	<0.1	NAF-barren
2765 *	R2077	72 - 76	Fresh	Sandstone, medium	8.1	-	230	-	<0.01	-	-	0.2	93	-93	607	8.1	<0.1	<0.1	NAF-barren
2766 *	R2077	76 - 80	Fresh	Sandstone, medium	7.9	-	250	-	<0.01	-	-	0.2	83	-83	542	8.2	<0.1	<0.1	NAF-barren
2767 *	R2077	80 - 83	Fresh	Siltstone	8.2	-	260	-	<0.01	-	-	0.2	20	-20	131	7.6	<0.1	<0.1	NAF-barren
2768 *	R2077	83 - 86	Fresh	Siltstone	8.3	-	260	-	<0.01	-	-	0.2	21	-21	137	7.5	<0.1	<0.1	NAF-barren
2769 *	R2077	86 - 88	Fresh	Sandstone, fine-medium	8.0	-	290	-	<0.01	-	-	0.2	77	-77	503	8.2	<0.1	<0.1	NAF-barren
2770 *	R2077	88 - 92	Fresh	Siltstone; with Sandstone, fine	7.4	-	290	-	0.01	-	-	0.3	45	-45	147	8.3	<0.1	<0.1	NAF-barren
2771 *	R2077	92 - 96	Fresh	Siltstone; with Sandstone, fine	7.6	-	310	-	<0.01	-	-	0.2	38	-38	248	8.1	<0.1	<0.1	NAF-barren
2772 *	R2077	96 - 97	Fresh	Siltstone; with Sandstone, fine	7.7	-	490	-	<0.01	-	-	0.2	29	-29	189	8.4	<0.1	<0.1	NAF-barren
2773 *	R2077	97 - 98	Fresh	Siltstone; with Sandstone, fine	7.9	-	210	-	<0.01	-	-	0.2	38	-38	248	8.5	<0.1	<0.1	NAF-barren
2774 *	R2077	98 - 99	Fresh	Siltstone; with Sandstone, fine	7.8	-	180	-	<0.01	-	-	0.2	20	-20	131	8.2	<0.1	<0.1	NAF-barren
2775 *	R2077	99 - 100	Fresh	Siltst., Sandst., fine, Coal (VMB)	8.1	-	360	-	0.37	-	-	11.3	10	1	0.9	7.4	<0.1	<0.1	uncertain
2776 *	R2077	100 - 101	Fresh	Coal; some Sandst., F (VMB)	7.6	-	180	-	0.10	-	-	3.1	16	-13	5.2	7.2	<0.1	<0.1	NAF-Low S
2777 *	R2077	101 - 102	Fresh	Sandstone, fine (VB)	7.7	-	200	-	<0.01	-	-	0.2	43	-43	281	7.6	<0.1	<0.1	NAF-barren
2778 *	R2077	102 - 103	Fresh	Sandst., fine; Coal; Tuff (VMB)	8.2	-	200	-	0.13	-	-	4.0	36	-32	9.0	7.7	<0.1	<0.1	NAF-Low S

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019. Grey rows are seam samples.
pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential;
NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2779 *	R2077	103 - 104	Fresh	Coal; some Mudstone (VMB)	8.5	-	240	-	0.33	-	-	10.1	19	-9	1.9	4.8	<0.1	5	NAF-S
2780 *	R2077	104 - 105	Fresh	Mudstone; with Siltstone	8.4	-	250	-	<0.01	-	-	0.2	27	-27	176	7.5	<0.1	<0.1	NAF-barren
2781 *	R2077	105 - 106	Fresh	Mudstone; with Siltstone	7.4	-	250	-	0.04	-	-	1.2	24	-23	20	7.6	<0.1	<0.1	NAF-barren
2782 *	R2077	106 - 108	Fresh	Mudstone; with Siltstone	7.3	-	340	-	<0.01	-	-	0.2	32	-32	209	8.2	<0.1	<0.1	NAF-barren
2783 *	R2077	108 - 110	Fresh	Siltstone	7.2	-	240	-	<0.01	-	-	0.2	91	-91	594	8.3	<0.1	<0.1	NAF-barren
2784 *	R2077	110 - 112	Fresh	Mudstone	7.5	-	240	-	0.08	-	-	2.5	29	-27	12	8.4	<0.1	<0.1	NAF-Low S
2785 *	R2077	112 - 113	Fresh	Siltstone	7.6	-	290	-	<0.01	-	-	0.2	35	-35	229	8.2	<0.1	<0.1	NAF-barren
2786 *	R2077	113 - 114	Fresh	Siltstone & Claystone	9.3	-	190	-	<0.01	-	-	0.2	22	-22	144	8.1	<0.1	<0.1	NAF-barren
2787 *	R2077	114 - 115	Fresh	Coal (VMB)	9.1	-	230	-	0.02	-	-	0.6	17	-16	28	7.6	<0.1	<0.1	NAF-barren
2788 *	R2077	115 - 116	Fresh	Coal (VMB)	9.0	-	310	-	0.35	-	-	10.7	27	-16	2.5	7.7	<0.1	<0.1	NAF-S
2789 *	R2077	116 - 117	Fresh	Claystone; & Coal (VMB)	8.7	-	330	-	0.09	-	-	2.8	45	-42	16	7.9	<0.1	<0.1	NAF-Low S
2790 *	R2077	117 - 118	Fresh	Coal (VMB)	8.8	-	380	-	0.11	-	-	3.4	24	-21	7.1	7.8	<0.1	<0.1	NAF-Low S
2791 *	R2077	118 - 119	Fresh	Coal & Tuff (VMB)	8.5	-	490	-	0.04	-	-	1.2	30	-29	24	7.6	<0.1	<0.1	NAF-barren
2792 *	R2077	119 - 120	Fresh	Coal stony (VMB)	8.6	-	250	-	0.05	-	-	1.5	27	-25	18	7.7	<0.1	<0.1	NAF-barren
2793 *	R2077	120 - 121	Fresh	Siltstone & Mudstone	7.9	-	260	-	0.61	-	-	18.7	23	-4	1.2	3.4	3	6	PAF-LC
					Extended Boil NAGpH = 4.0; Extended Boil Calculated NAG = 8 kg H_2SO_4/t														
2794 *	R2077	121 - 122	Fresh	Siltstone & Mudstone	8.1	-	280	-	0.04	-	-	1.2	9	-8	7.3	6.5	<0.1	<0.1	NAF-barren
2795 *	R2077	122 - 124	Fresh	Sandstone, fine-medium	8.4	-	240	-	<0.01	-	-	0.2	64	-64	418	7.9	<0.1	<0.1	NAF-barren
2796 *	R2077	124 - 126	Fresh	Sandstone, fine-medium	9.2	-	240	-	0.01	-	-	0.3	156	-156	509	8.3	<0.1	<0.1	NAF-barren
2797 *	R2077	126 - 130	Fresh	Sandstone, fine-med.; & Siltst.	9.1	-	290	-	<0.01	-	-	0.2	53	-53	346	8.4	<0.1	<0.1	NAF-barren
2798 *	R2077	130 - 134	Fresh	Sandstone, coaly	8.5	-	290	-	<0.01	-	-	0.2	129	-129	842	8.5	<0.1	<0.1	NAF-barren
2799 *	R2077	134 - 138	Fresh	Sandstone, coaly	8.6	-	310	-	<0.01	-	-	0.2	126	-126	823	8.6	<0.1	<0.1	NAF-barren
2800 *	R2083	0 - 2	Extremely	Soil	8.7	-	330	-	<0.01	-	-	0.2	16	-16	104	8.7	<0.1	<0.1	NAF-barren
2801 *	R2083	2 - 7	Distinctly	Clay	8.8	-	300	-	<0.01	-	-	0.2	3	-3	20	6.6	<0.1	1	NAF-barren
2802 *	R2083	7 - 12	Distinctly	Clay	8.6	-	220	-	<0.01	-	-	0.2	2	-2	13	6.2	<0.1	5	NAF-barren
2803 *	R2083	12 - 17	Distinctly	Clay	8.9	-	380	-	<0.01	-	-	0.2	4	-4	26	7.9	<0.1	<0.1	NAF-barren
2804 *	R2083	17 - 22	Distinctly	Clay	8.8	-	230	-	<0.01	-	-	0.2	6	-6	39	7.2	<0.1	<0.1	NAF-barren
2805 *	R2083	22 - 27	Distinctly	Clay	8.7	-	250	-	<0.01	-	-	0.2	27	-27	176	7.5	<0.1	<0.1	NAF-barren
2806 *	R2083	27 - 32	Distinctly	Clay	8.5	-	220	-	<0.01	-	-	0.2	11	-11	72	7.6	<0.1	<0.1	NAF-barren
2807 *	R2083	32 - 36	Mod-Distinc.	Clay	8.6	-	210	-	<0.01	-	-	0.2	11	-11	72	7.3	<0.1	<0.1	NAF-barren
2808 *	R2083	36 - 41	Fresh	Siltstone	8.7	-	220	-	0.01	-	-	0.3	41	-41	134	7.8	<0.1	<0.1	NAF-barren
2809 *	R2083	41 - 46	Fresh	Siltstone	8.4	-	240	-	<0.01	-	-	0.2	30	-30	196	7.9	<0.1	<0.1	NAF-barren
2810 *	R2083	46 - 51	Fresh	Siltstone	8.4	-	130	-	<0.01	-	-	0.2	29	-29	189	8.1	<0.1	<0.1	NAF-barren
2811 *	R2083	51 - 56	Fresh	Siltstone	7.9	-	350	-	<0.01	-	-	0.2	30	-30	196	8.2	<0.1	<0.1	NAF-barren

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019. Grey rows are seam samples.
Sample 2793 underwent an Extended Boil NAG test to refine the uncertainty in the Acid Classification. Refer to main body of the report for further explanation.
pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential;
NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2812 *	R2083	56 - 57	Fresh	Siltstone; & Sandst., med-coarse	8.5	-	180	-	<0.01	-	-	0.2	66	-66	431	8.3	<0.1	<0.1	NAF-barren
2813 *	R2083	57 - 62	Fresh	Siltstone	8.2	-	280	-	<0.01	-	-	0.2	27	-27	176	8.0	<0.1	<0.1	NAF-barren
2814 *	R2083	62 - 67	Fresh	Siltstone	9.1	-	320	-	<0.01	-	-	0.2	33	-33	216	8.2	<0.1	<0.1	NAF-barren
2815 *	R2083	67 - 72	Fresh	Siltstone	8.6	-	420	-	<0.01	-	-	0.2	64	-64	418	8.4	<0.1	<0.1	NAF-barren
2816 *	R2083	72 - 77	Fresh	Siltstone; some Sandstone	8.5	-	320	-	<0.01	-	-	0.2	69	-69	451	8.5	<0.1	<0.1	NAF-barren
2817 *	R2083	77 - 80	Fresh	Siltstone; some Sandstone	7.8	-	290	-	<0.01	-	-	0.2	22	-22	144	8.1	<0.1	<0.1	NAF-barren
2818 *	R2083	80 - 83	Fresh	Siltstone	8.3	-	300	-	<0.01	-	-	0.2	32	-32	209	8.2	<0.1	<0.1	NAF-barren
2819 *	R2083	83 - 85	Fresh	Carbonaceous Siltstone	7.9	-	180	-	<0.01	-	-	0.2	8	-8	52	7.2	<0.1	<0.1	NAF-barren
2820 *	R2083	85 - 87	Fresh	Siltstone	7.7	-	350	-	<0.01	-	-	0.2	20	-20	131	7.8	<0.1	<0.1	NAF-barren
2821 *	R2083	87 - 88	Fresh	Sandstone	8.4	-	430	-	<0.01	-	-	0.2	103	-103	673	8.1	<0.1	<0.1	NAF-barren
2822 *	R2083	88 - 90	Fresh	Siltstone	7.8	-	520	-	<0.01	-	-	0.2	29	-29	189	8.0	<0.1	<0.1	NAF-barren
2823 *	R2083	90 - 92	Fresh	Siltstone	7.9	-	320	-	<0.01	-	-	0.2	28	-28	183	7.6	<0.1	<0.1	NAF-barren
2824 *	R2083	92 - 94	Fresh	Sandstone	8.2	-	430	-	<0.01	-	-	0.2	154	-154	1006	7.8	<0.1	<0.1	NAF-barren
2825 *	R2083	94 - 95	Fresh	Sandstone	8.3	-	350	-	<0.01	-	-	0.2	59	-59	385	7.9	<0.1	<0.1	NAF-barren
2826 *	R2083	95 - 96	Fresh	Sandstone & Siltstone	8.4	-	310	-	<0.01	-	-	0.2	21	-21	137	7.7	<0.1	<0.1	NAF-barren
2827 *	R2083	96 - 97	Fresh	Coal (L2A)	8.2	-	300	-	0.18	-	-	5.5	86	-80	16	7.8	<0.1	<0.1	NAF-Low S
2828 *	R2083	97 - 98	Fresh	Coal (L2A)	8.1	-	250	-	0.28	-	-	8.6	11	-2	1.3	7.5	<0.1	<0.1	NAF-S
2829 *	R2083	98 - 99	Fresh	Siltstone; with Coal (L2A)	7.9	-	380	-	0.11	-	-	3.4	10	-7	3.0	7.2	<0.1	<0.1	NAF-Low S
2830 *	R2083	99 - 100	Fresh	Siltstone	8.4	-	300	-	<0.01	-	-	0.2	7	-7	46	7.4	<0.1	<0.1	NAF-barren
2831 *	R2083	100 - 101	Fresh	Siltstone & Sandstone	8.5	-	330	-	<0.01	-	-	0.2	17	-17	111	7.7	<0.1	<0.1	NAF-barren
2832 *	R2083	101 - 103	Fresh	Sandstone	8.2	-	360	-	<0.01	-	-	0.2	85	-85	555	7.8	<0.1	<0.1	NAF-barren
2833 *	R2083	103 - 107	Fresh	Sandstone	8.3	-	370	-	<0.01	-	-	0.2	68	-68	444	8.3	<0.1	<0.1	NAF-barren
2834 *	R2083	107 - 111	Fresh	Sandstone; some Siltstone lam.	8.4	-	230	-	<0.01	-	-	0.2	54	-54	353	8.4	<0.1	<0.1	NAF-barren
2835 *	R2083	111 - 116	Fresh	Sandstone; some Siltstone lam.	7.8	-	330	-	<0.01	-	-	0.2	55	-55	359	8.3	<0.1	<0.1	NAF-barren
2836 *	R2083	116 - 120	Fresh	Sandstone; some Siltstone lam.	8.2	-	280	-	<0.01	-	-	0.2	99	-99	647	8.4	<0.1	<0.1	NAF-barren
2837 *	R2083	120 - 124	Fresh	Sandstone; some Siltstone lam.	7.9	-	210	-	<0.01	-	-	0.2	70	-70	457	8.5	<0.1	<0.1	NAF-barren
2838 *	R2083	124 - 126	Fresh	Sandstone; some Siltstone lam.	8.5	-	230	-	<0.01	-	-	0.2	82	-82	536	8.4	<0.1	<0.1	NAF-barren
2839 *	R2083	126 - 127	Fresh	Sandstone; some Siltstone lam.	7.8	-	220	-	<0.01	-	-	0.2	71	-71	464	8.6	<0.1	<0.1	NAF-barren
2840 *	R2083	127 - 128	Fresh	Sandstone; some Siltstone lam.	7.9	-	290	-	<0.01	-	-	0.2	53	-53	346	8.5	<0.1	<0.1	NAF-barren
2841 *	R2083	128 - 129	Fresh	Sandstone & Coal (L?)	8.2	-	280	-	<0.01	-	-	0.2	33	-33	216	8.7	<0.1	<0.1	NAF-barren
2842 *	R2083	129 - 130	Fresh	Coal, dull (L?)	8.1	-	290	-	0.07	-	-	2.1	23	-21	11	8.3	<0.1	<0.1	NAF-Low S
2843 *	R2083	130 - 131	Fresh	Siltstone	7.6	-	330	-	<0.01	-	-	0.2	30	-30	196	8.5	<0.1	<0.1	NAF-barren
2844 *	R2083	131 - 132	Fresh	Siltstone	8.3	-	410	-	<0.01	-	-	0.2	34	-34	222	8.4	<0.1	<0.1	NAF-barren
2845 *	R2083	132 - 134	Fresh	Carb. Mudstone	8.2	-	380	-	<0.01	-	-	0.2	20	-20	131	8.2	<0.1	<0.1	NAF-barren
2846 *	R2083	134 - 136	Fresh	Siltstone	7.8	-	380	-	<0.01	-	-	0.2	27	-27	176	8.3	<0.1	<0.1	NAF-barren

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pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential; NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
2847 *	R2083	136 - 141	Fresh	Sandstone & Claystone	8.7	-	350	-	<0.01	-	-	0.2	131	-131	856	8.4	<0.1	<0.1	NAF-barren
2848 *	R2083	141 - 146	Fresh	Claystone	8.6	-	290	-	<0.01	-	-	0.2	58	-58	379	8.6	<0.1	<0.1	NAF-barren
2849 *	R2083	146 - 150	Fresh	Claystone	8.5	-	210	-	<0.01	-	-	0.2	79	-79	516	8.4	<0.1	<0.1	NAF-barren
2850 *	R2083	150 - 151	Fresh	Claystone	-	-	-	-	<0.01	-	-	0.2	76	-76	496	8.5	<0.1	<0.1	NAF-barren
2851 *	R2083	151 - 152	Fresh	Claystone	8.3	-	280	-	<0.01	-	-	0.2	44	-44	287	8.4	<0.1	<0.1	NAF-barren
2852 *	R2083	152 - 153	Fresh	Claystone; Coal (VA0/1) & Siltstone (\	7.8	-	350	-	<0.01	-	-	0.2	29	-29	189	8.5	<0.1	<0.1	NAF-barren
2853 *	R2083	153 - 154	Fresh	Carbonaceous Mudstone (VU)	8.2	-	290	-	0.31	-	-	9.5	40	-31	4.2	8.3	<0.1	<0.1	NAF-S
2854 *	R2083	154 - 155	Fresh	Coal (VA3) (VU)	8.4	-	280	-	0.40	-	-	12.3	50	-38	4.1	8.1	<0.1	<0.1	NAF-S
2855 *	R2083	155 - 156	Fresh	Coal (VA3); Tuff (YT); Coal (VML)	7.7	-	300	-	0.21	-	-	6.4	68	-62	11	8.0	<0.1	<0.1	NAF-S
2856 *	R2083	156 - 157	Fresh	Coal; some Claystone (VML)	-	-	-	-	0.04	-	-	1.2	105	-104	86	7.9	<0.1	<0.1	NAF-barren
2857 *	R2083	157 - 158	Fresh	Coal; Claystone & Tuff (VML)	-	-	-	-	0.21	-	-	6.4	38	-32	5.9	7.8	<0.1	<0.1	NAF-S
2858 *	R2083	158 - 159	Fresh	Coal; Carb. Mudstone & Tuff (V?)	7.9	-	280	-	0.20	-	-	6.1	46	-40	7.5	7.6	<0.1	<0.1	NAF-Low S
2859 *	R2083	159 - 160	Fresh	Coal; Carb. Mudstone & Tuff (V?)	8.3	-	340	-	0.14	-	-	4.3	28	-24	6.5	7.8	<0.1	<0.1	NAF-Low S
2860 *	R2083	160 - 161	Fresh	Coal; Carb. Mudstone & Tuff (V?)	8.4	-	340	-	0.01	-	-	0.3	15	-15	49	7.7	<0.1	<0.1	NAF-barren
2861 *	R2083	161 - 162	Fresh	Siltstone	7.8	-	430	-	<0.01	-	-	0.2	13	-13	85	7.8	<0.1	<0.1	NAF-barren
2862 *	R2083	162 - 163	Fresh	Siltstone	-	-	-	-	<0.01	-	-	0.2	22	-22	144	7.9	<0.1	<0.1	NAF-barren
2863 *	R2083	163 - 165	Fresh	Sandstone, medium-coarse	7.6	-	190	-	<0.01	-	-	0.2	34	-34	222	8.2	<0.1	<0.1	NAF-barren
2864 *	R2083	165 - 168	Fresh	Sandstone, medium-coarse	7.7	-	180	-	<0.01	-	-	0.2	117	-117	764	8.3	<0.1	<0.1	NAF-barren
130201	WS3003L	0 - 2	Extremely	Clay	6.8	-	2230	-	0.03	-	-	0.9	14	-13	15	-	-	-	NAF-barren
130202	WS3003L	2 - 4	Distinctly	Clay	6.6	-	2330	-	<0.01	-	-	0.2	16	-16	105	-	-	-	NAF-barren
130203	WS3003L	4 - 6	Distinctly	Clay	7.1	7.3	2410	1170	0.02	-	-	0.6	16	-15	26	-	-	-	NAF-barren
130204	WS3003L	6 - 8	Distinctly	Sand	8.4	-	1420	-	0.02	-	-	0.6	27	-26	44	-	-	-	NAF-barren
130205	WS3003L	8 - 10	Distinctly	Clay	8.6	-	1240	-	0.02	-	-	0.6	33	-32	54	-	-	-	NAF-barren
130206	WS3003L	10 - 12	Distinctly	Sandstone, fine-medium	9.2	-	729	-	0.02	-	-	0.6	125	-124	204	-	-	-	NAF-barren
130207	WS3003L	12 - 14	Distinctly	Sandstone, medium-coarse	9.1	-	623	-	0.02	-	-	0.6	172	-171	281	-	-	-	NAF-barren
130208	WS3003L	14 - 16	Distinctly	Sandstone, medium-coarse	9.4	9.8	689	331	0.02	-	-	0.6	165	-164	269	-	-	-	NAF-barren
130209	WS3003L	16 - 18	Distinctly	Sandstone, medium-coarse	9.1	-	675	-	0.02	-	-	0.6	119	-118	194	-	-	-	NAF-barren
130210	WS3003L	19 - 20	Fresh	Siltstone	8.8	-	842	-	0.02	-	-	0.6	26	-25	42	-	-	-	NAF-barren
130211	WS3003L	20 - 22	Fresh	Sandstone, fine	9.2	-	640	-	<0.01	-	-	0.2	254	-254	1659	-	-	-	NAF-barren
130212	WS3003L	22 - 24	Fresh	Sandstone, fine	9.4	-	773	-	0.03	-	-	0.9	127	-126	138	-	-	-	NAF-barren
130213	WS3003L	24 - 26	Fresh	Sandstone, fine	9.4	-	743	-	0.03	-	-	0.9	199	-198	217	-	-	-	NAF-barren
130214	WS3003L	26 - 28	Fresh	Siltstone; carbonaceous	9.2	9.8	972	436	0.06	0.043	0.007	1.3	34	-32	26	8.6	<0.1	<0.1	NAF-Low S
130215	WS3003L	28 - 30	Fresh	Siltstone; carbonaceous	9.2	-	937	-	0.06	0.033	0.008	1.0	30	-29	30	8.7	<0.1	<0.1	NAF-Low S
130216	WS3003L	30 - 32	Fresh	Siltstone; carbonaceous	9.3	-	828	-	0.02	-	-	0.6	57	-56	92	-	-	-	NAF-barren
130217	WS3003L	32 - 34	Fresh	Siltstone; carbonaceous	9.3	-	759	-	0.03	-	-	0.9	59	-58	64	-	-	-	NAF-barren

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Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
130218	WS3003L	34 - 36	Fresh	Siltstone; carbonaceous	9.3	-	764	-	0.05	-	-	1.5	51	-50	33	-	-	-	NAF-barren
130219	WS3003L	36 - 36.8	Fresh	Sandstone, fine; carbonaceous	9.2	-	770	-	0.04	-	-	1.2	62	-61	51	-	-	-	NAF-barren
130227	WS3009L	0 - 2	Extremely	Clay	8.6	8.5	946	1100	0.02	-	-	0.6	27	-26	43	-	-	-	NAF-barren
130228	WS3009L	2 - 4	Extremely	Clay, sandy	8.0	-	2000	-	0.02	-	-	0.6	32	-32	53	-	-	-	NAF-barren
130229	WS3009L	4 - 6	Extremely	Clay	8.6	-	1120	-	<0.01	-	-	0.2	33	-33	214	-	-	-	NAF-barren
130230	WS3009L	6 - 8	Distinctly	Sandstone, fine	8.4	-	1380	-	<0.01	-	-	0.2	61	-61	397	-	-	-	NAF-barren
130231	WS3009L	8 - 10	Distinctly	Siltstone	8.6	-	1170	-	<0.01	-	-	0.2	28	-27	180	-	-	-	NAF-barren
130232	WS3009L	10 - 12	Distinctly	Siltstone	8.4	-	1170	-	<0.01	-	-	0.2	22	-22	146	-	-	-	NAF-barren
130233	WS3009L	13 - 14	Distinctly	Sandstone, medium	8.8	9.3	1050	512	<0.01	-	-	0.2	91	-90	591	-	-	-	NAF-barren
130234	WS3009L	14 - 15	Distinctly	Siltstone	8.6	-	1000	-	<0.01	-	-	0.2	38	-38	248	-	-	-	NAF-barren
130235	WS3009L	17 - 19	Distinctly	Sandstone, fine	8.6	-	842	-	0.02	-	-	0.6	28	-28	46	-	-	-	NAF-barren
130236	WS3009L	19 - 21	Slightly	Sandstone, fine-medium	8.7	-	759	-	0.02	-	-	0.6	67	-66	109	-	-	-	NAF-barren
130237	WS3009L	21 - 23	Slightly	Sandstone, fine-medium	8.7	-	1030	-	0.02	-	-	0.6	55	-55	90	-	-	-	NAF-barren
130238	WS3009L	23 - 25	Slightly	Sandstone, fine-medium	8.4	-	1140	-	<0.01	-	-	0.2	47	-47	307	-	-	-	NAF-barren
130239	WS3009L	26 - 28	Slightly	Sandstone, fine-medium	8.8	-	834	-	<0.01	-	-	0.2	96	-96	628	-	-	-	NAF-barren
130240	WS3009L	28 - 30	Fresh	Sandstone, fine-medium	8.8	-	855	-	<0.01	-	-	0.2	74	-74	482	-	-	-	NAF-barren
130241	WS3009L	32 - 34	Fresh	Sandstone, medium	8.8	-	754	-	0.02	-	-	0.6	63	-63	103	-	-	-	NAF-barren
130242	WS3009L	34 - 36	Fresh	Sandstone, medium	8.9	-	662	-	0.02	-	-	0.6	65	-64	105	-	-	-	NAF-barren
130243	WS3009L	38 - 40	Fresh	Sandstone, med.; carbonaceous	9.0	-	463	-	0.02	-	-	0.6	122	-121	199	-	-	-	NAF-barren
130244	WS3009L	40 - 42	Fresh	Sandstone, med.; carbonaceous	8.6	-	493	-	0.02	-	-	0.6	17	-16	28	-	-	-	NAF-barren
130245	WS3009L	42 - 44	Fresh	Sandstone, fine; carbonaceous	8.5	-	510	-	0.02	-	-	0.6	13	-13	22	-	-	-	NAF-barren
130246	WS3009L	44 - 46	Fresh	Sandstone, fine; carbonaceous	8.2	8.7	512	190	0.06	0.077	0.009	2.4	23	-21	10	8.2	<0.1	<0.1	NAF-Low S
130248	WS3013L	1 - 2	Distinctly	Clay	8.1	-	1640	-	0.02	-	-	0.6	42	-41	68	-	-	-	NAF-barren
130249	WS3013L	2 - 4	Distinctly	Sand, medium-coarse	8.1	-	1190	-	0.02	-	-	0.6	26	-25	42	-	-	-	NAF-barren
130250	WS3013L	4 - 6	Slightly	Siltstone	8.1	-	1420	-	0.02	-	-	0.6	13	-13	22	-	-	-	NAF-barren
130251	WS3013L	6 - 8	Slightly	Sandstone, fine	7.9	8.2	1380	605	<0.01	-	-	0.2	10	-10	63	-	-	-	NAF-barren
130252	WS3013L	8 - 10	Slightly	Sandstone, fine	7.7	-	1710	-	<0.01	-	-	0.2	10	-10	64	-	-	-	NAF-barren
130253	WS3013L	11 - 13	Distinctly	Siltstone	8.4	-	1530	-	0.03	-	-	0.9	18	-17	20	-	-	-	NAF-barren
130254	WS3013L	13 - 15	Distinctly	Sandstone, fine	9.2	-	773	-	0.02	-	-	0.6	78	-77	127	-	-	-	NAF-barren
130255	WS3013L	15 - 17	Distinctly	Sandstone, fine	9.1	-	836	-	0.03	-	-	0.9	107	-106	116	-	-	-	NAF-barren
130256	WS3013L	17 - 19	Distinctly	Sandstone, medium-coarse	9.1	-	952	-	0.03	-	-	0.9	135	-134	147	-	-	-	NAF-barren
130257	WS3013L	19.85 - 21.85	Fresh	Sandstone, medium	9.4	-	813	-	0.02	-	-	0.6	83	-82	135	-	-	-	NAF-barren
130258	WS3013L	21.85 - 23.85	Fresh	Sandstone, medium	9.4	-	886	-	0.03	-	-	0.9	106	-105	115	-	-	-	NAF-barren
130259	WS3013L	23.85 - 24.85	Fresh	Carb. Siltstone	8.8	9.7	1130	589	0.09	0.087	0.010	2.7	51	-48	19	8.5	<0.1	<0.1	NAF-Low S
3219215	WS3041	27.4 - 31	Fresh	Sandstone, medium; some coal	8.8	-	663	-	0.09	0.047	0.016	1.4	30	-28	20	8.6	<0.1	<0.1	NAF-Low S

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Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
3219216	WS3041	31 - 33	Fresh	Sandstone, medium	9.2	9.4	466	256	0.06	0.050	0.010	1.5	123	-121	80	8.8	<0.1	<0.1	NAF-Low S
3219217	WS3041	33 - 35	Fresh	Sandstone, medium	9.4	-	423	-	0.03	-	-	0.9	90	-89	98	-	-	-	NAF-barren
3219218	WS3041	40 - 42	Fresh	Sandstone, fine	9.3	-	524	-	0.06	0.061	0.006	1.9	36	-34	19	9.2	<0.1	<0.1	NAF-Low S
3219219	WS3041	42 - 43	Fresh	Sandstone, medium	9.4	9.5	519	311	0.13	0.078	0.006	2.4	61	-59	25	9.0	<0.1	<0.1	NAF-Low S
3219220	WS3041	43 - 45	Fresh	Sandstone, fine	9.3	-	547	-	0.07	0.054	0.009	1.7	36	-34	22	8.7	<0.1	<0.1	NAF-Low S
3219221	WS3041	45 - 47	Fresh	Sandstone, fine	9.4	-	535	-	0.07	0.048	0.008	1.5	32	-31	22	8.8	<0.1	<0.1	NAF-Low S
3219222	WS3041	48 - 50	Fresh	Sandstone, medium	9.7	-	438	-	0.03	-	-	0.9	86	-85	94	-	-	-	NAF-barren
3219223	WS3041	50 - 52.1	Fresh	Sandstone, medium	9.7	-	423	-	0.02	-	-	0.6	120	-119	196	-	-	-	NAF-barren
3219224	WS3041	52.1 - 52.6	Fresh	Coal	9.6	-	453	-	0.11	0.021	0.004	0.6	27	-27	42	8.4	<0.1	<0.1	NAF-Low S
3219225	WS3041	52.6 - 55	Fresh	Sandstone, fine	9.8	-	476	-	0.03	-	-	0.9	59	-58	64	-	-	-	NAF-barren
3219226	WS3041	55 - 57	Fresh	Sandstone, fine	9.6	-	514	-	0.02	-	-	0.6	64	-63	105	-	-	-	NAF-barren
3219227	WS3041	57 - 59	Fresh	Sandstone, fine	9.6	-	560	-	0.05	-	-	1.5	52	-50	34	-	-	-	NAF-barren
3219228	WS3041	59 - 61	Fresh	Sandstone, fine	9.6	-	556	-	0.05	-	-	1.5	34	-33	22	-	-	-	NAF-barren
3219229	WS3041	61 - 63	Fresh	Sandstone, fine	9.7	-	524	-	0.04	-	-	1.2	51	-50	42	-	-	-	NAF-barren
3219230	WS3041	63 - 65	Fresh	Sandstone, fine	9.7	9.8	528	358	0.03	-	-	0.9	54	-53	58	-	-	-	NAF-barren
3219231	WS3041	65 - 67	Fresh	Sandstone, fine	9.7	-	527	-	0.02	-	-	0.6	58	-58	95	-	-	-	NAF-barren
3219232	WS3041	67 - 69	Fresh	Sandstone, fine	9.7	-	532	-	0.02	-	-	0.6	53	-52	86	-	-	-	NAF-barren
3219240	WS3059	26.7 - 28	Fresh	Sandstone, fine	8.7	-	476	-	0.13	0.044	0.016	1.3	15	-14	11	6.8	<0.1	0.3	NAF-Low S
3219241	WS3059	28 - 30	Fresh	Sandstone, MM	9.3	9.2	406	249	0.07	0.029	0.012	0.9	61	-60	68	9.6	<0.1	<0.1	NAF-Low S
3219242	WS3059	32 - 34	Fresh	Carb. Mudstone & Sandst., fine	9.2	-	508	-	0.04	-	-	1.2	42	-41	34	-	-	-	NAF-barren
3219243	WS3059	34 - 36	Fresh	Sandstone, fine	9.4	-	468	-	0.02	-	-	0.6	27	-27	44	-	-	-	NAF-barren
3219244	WS3059	37 - 39	Fresh	Sandstone, medium	9.7	-	330	-	0.03	-	-	0.9	78	-77	84	-	-	-	NAF-barren
3219245	WS3059	39 - 41	Fresh	Sandstone, medium	9.7	-	356	-	0.02	-	-	0.6	81	-80	132	-	-	-	NAF-barren
3219246	WS3059	41 - 43	Fresh	Sandstone, medium	9.7	9.7	374	236	0.02	-	-	0.6	87	-86	141	-	-	-	NAF-barren
3219247	WS3059	43 - 45	Fresh	Sandstone, medium	9.8	-	355	-	0.01	-	-	0.3	118	-118	385	-	-	-	NAF-barren
3219248	WS3059	45 - 47	Fresh	Sandstone, medium	9.8	-	362	-	0.02	-	-	0.6	224	-223	366	-	-	-	NAF-barren
3219249	WS3059	48 - 50	Fresh	Sandstone, fine	9.7	-	435	-	0.02	-	-	0.6	100	-99	163	-	-	-	NAF-barren
3219250	WS3059	50 - 52	Fresh	Sandstone, fine	9.6	-	477	-	0.03	-	-	0.9	57	-56	62	-	-	-	NAF-barren
3219251	WS3059	53 - 55	Fresh	Sandstone, fine	9.4	-	551	-	0.04	-	-	1.2	59	-58	48	-	-	-	NAF-barren
3219252	WS3059	55 - 57	Fresh	Sandstone, fine	9.6	9.6	568	329	0.03	-	-	0.9	65	-64	71	-	-	-	NAF-barren
3219253	WS3059	57 - 59	Fresh	Sandstone, fine	9.5	-	589	-	0.04	-	-	1.2	73	-72	59	-	-	-	NAF-barren
3219254	WS3059	59 - 61	Fresh	Sandstone, fine	9.4	-	596	-	0.04	-	-	1.2	63	-62	52	-	-	-	NAF-barren
3219255	WS3082	66.6 - 69	Fresh	Sandstone, fine	9	9.0	810	406	0.08	0.11	0.012	3.4	40	-37	12	8.5	<0.1	<0.1	NAF-Low S
3219256	WS3082	69 - 71	Fresh	Sandstone, fine	9.1	-	819	-	0.02	-	-	0.6	48	-47	79	-	-	-	NAF-barren
3219257	WS3082	71 - 73	Fresh	Sandstone, fine	9.4	-	622	-	0.03	-	-	0.9	71	-70	77	-	-	-	NAF-barren

pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential; NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C1 (cont.) Acid-Base Characteristics of Potential Waste Rock and ROM Coal

Sample ID	Drill-hole ID	Sample Interval (m)	Weathering	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	SO_4	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
							µS/cm		%			kg H_2SO_4/t					kg H_2SO_4/t		
3219258	WS3082	73 - 75	Fresh	Sandstone, fine	9.3	-	648	-	0.05	-	-	1.5	40	-39	26	-	-	-	NAF-barren
3219259	WS3082	75 - 77	Fresh	Sandstone, fine	9.5	-	589	-	0.02	-	-	0.6	131	-130	214	-	-	-	NAF-barren
3219260	WS3082	77 - 79	Fresh	Carb. Siltstone; some coal	9.5	-	571	-	0.05	-	-	1.5	37	-35	24	-	-	-	NAF-barren
3219261	WS3082	79 - 80.8	Fresh	Sandstone, fine	9.6	-	437	-	0.02	-	-	0.6	95	-94	155	-	-	-	NAF-barren
3219262	WS3120	72.6 - 73.8	Fresh	Carb. Siltstone	9.8	-	434	-	0.03	-	-	0.9	25	-24	28	-	-	-	NAF-barren
3219263	WS3120	73.8 - 77	Fresh	Sandstone, fine	10	-	544	-	0.03	-	-	0.9	81	-80	88	-	-	-	NAF-barren
3219264	WS3120	78 - 80	Fresh	Sandstone, MM	10.1	10.0	510	285	<0.01	-	-	0.2	128	-128	836	-	-	-	NAF-barren
3219265	WS3120	80 - 82	Fresh	Sandstone, fine	10.1	-	533	-	0.02	-	-	0.6	136	-135	222	-	-	-	NAF-barren
3219266	WS3120	82 - 84	Fresh	Sandstone, fine	10	-	556	-	0.02	-	-	0.6	70	-69	114	-	-	-	NAF-barren
3219267	WS3120	84 - 86	Fresh	Sandstone, fine	9.9	-	528	-	0.03	-	-	0.9	62	-61	67	-	-	-	NAF-barren
3219268	WS3120	86 - 87	Fresh	Carbonaceous Siltstone	9.6	9.6	530	237	0.13	0.094	0.009	2.9	26	-24	9.2	8.2	<0.1	<0.1	NAF-Low S
3219269	WS3120	87 - 89	Fresh	Sandstone, fine	10	-	516	-	0.02	-	-	0.6	59	-58	96	-	-	-	NAF-barren
3219270	WS3120	89 - 91	Fresh	Sandstone, fine	9.8	-	570	-	0.04	-	-	1.2	29	-27	23	-	-	-	NAF-barren
3219271	WS3120	91 - 92.5	Fresh	Sandstone, fine	9.8	-	525	-	0.02	-	-	0.6	50	-49	82	-	-	-	NAF-barren
3219274	WS3155	21.69 - 23	Fresh	Sandstone, fine	8.4	8.3	977	457	0.11	0.048	0.019	1.5	8	-7	5.6	6.8	<0.1	0.2	NAF-Low S
3219275	WS3155	23 - 25	Fresh	Sandstone, fine	8.9	-	960	-	0.04	-	-	1.2	26	-25	21	-	-	-	NAF-barren
3219276	WS3155	25 - 27	Fresh	Sandstone, fine	9	-	849	-	0.02	-	-	0.6	224	-223	366	-	-	-	NAF-barren
3219277	WS3155	27 - 29	Fresh	Sandstone, fine	8.9	-	1190	-	0.03	-	-	0.9	32	-31	35	-	-	-	NAF-barren
3219278	WS3155	29 - 31	Fresh	Sandstone, fine	9.4	-	589	-	0.02	-	-	0.6	94	-93	154	-	-	-	NAF-barren
3219279	WS3155	31 - 33	Fresh	Sandstone, fine	9.2	-	599	-	<0.01	-	-	0.2	101	-101	660	-	-	-	NAF-barren
3219280	WS3155	33 - 35	Fresh	Sandstone, fine	9	-	697	-	0.02	-	-	0.6	32	-32	53	-	-	-	NAF-barren
3219281	WS3155	35 - 37	Fresh	Sandstone, fine	9.2	9.3	635	329	0.03	-	-	0.9	83	-82	90	-	-	-	NAF-barren
3219282	WS3155	37 - 39	Fresh	Sandstone, fine	9.3	-	625	-	0.03	-	-	0.9	73	-72	79	-	-	-	NAF-barren
3219283	WS3155	39 - 41	Fresh	Sandstone, fine	9.1	-	810	-	0.02	-	-	0.6	58	-57	94	-	-	-	NAF-barren
3219284	WS3155	41 - 43	Fresh	Sandstone, fine	9.2	-	737	-	0.03	-	-	0.9	31	-30	33	-	-	-	NAF-barren
3219285	WS3155	43 - 45	Fresh	Sandstone, fine	9.2	-	646	-	0.02	-	-	0.6	139	-138	227	-	-	-	NAF-barren
3219286	WS3155	46 - 47	Fresh	Sandstone, medium	8.7	-	1080	-	0.01	-	-	0.3	58	-58	189	-	-	-	NAF-barren
3219287	WS3155	47 - 47.94	Fresh	Carb. Siltstone	8.5	8.5	1180	545	0.06	0.038	0.016	1.2	22	-21	19	8.2	<0.1	<0.1	NAF-Low S

pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential; NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C2. Acid-Base Characteristics of Potential Coarse Reject

Sample ID	Drill-hole ID	Sample Interval (m)	Description	pH 1:2	pH 1:5	EC 1:2	EC 1:5	S	S_{CR}	MPA	ANC	NAPP	ANC/MPA ratio	NAG pH after ox.	NAG @ pH4.5	NAG @ pH7.0	Acid Classification
						µS/cm		%		kg H_2SO_4/t					kg H_2SO_4/t		
WS3001L-L2A	WS3001L	31.72 - 34.09	L2A: [Coal]	6.3	-	198	-	0.37	0.197	6.0	4	2	0.6	-	-	-	PAF-LC
WS3001L-VA3	WS3001L	64.82 - 66.38	VA3: [Coal]	9.2	-	276	-	0.42	0.295	9.0	37	-28	4.1	-	-	-	NAF-S
WS3001L-VB-VH	WS3001L	66.72 - 71.69	VB-VH: [Coal]; Tuff; some Claystone	9.3	-	541	-	0.51	0.384	11.8	78	-66	6.6	-	-	-	NAF-S
WS3002L-L1A	WS3002L	29.95 - 31.68	L1: [Coal]; minor Tonstein	6.4	-	336	-	1.01	0.704	21.6	13	8	0.6	-	-	-	PAF-LC
WS3004L-L1	WS3004L	30.54 - 32.28	L1: [Coal]; partly stony with trace pyrite; Tonstein	6.9	-	323	-	0.50	0.443	13.6	12	2	0.8	-	-	-	PAF-LC
WS3004L-L2A	WS3004L	32.28 - 34.83	L2A: [Coal]; trace pyrite; carb. bands	6.9	-	371	-	0.57	0.316	9.7	2	7	0.2	-	-	-	PAF-LC
WS3004L-VA3	WS3004L	63.42 - 64.99	VA3: [Coal]; with Carb. Siltstone	8.1	-	273	-	0.63	0.364	11.1	19	-8	1.7	-	-	-	uncertain
WS3004L-VB-VH	WS3004L	65.29 - 69.36	VB-VH: [Coal]; Clayst.; some Tuff and Siltst., coaly	8.8	-	450	-	0.25	0.142	4.3	11	-6	2.5	-	-	-	NAF-S
WS3009L-L1	WS3009L	51.50 - 53.20	L1: [Coal]; part stony; some Clayst.; trace calcite	6.7	-	291	-	0.39	0.251	7.7	46	-38	5.9	-	-	-	NAF-S
WS3009L-L2A	WS3009L	53.20 - 55.28	L2A: [Coal]; some Claystone	7.6	-	273	-	0.51	0.208	6.4	11	-4	1.7	-	-	-	uncertain
WS3009L-VA3	WS3009L	74.36 - 75.62	VA3: [Coal]; Stony Coal; trace pyrite & calcite	8.0	-	662	-	1.36	0.816	25.0	57	-32	2.3	-	-	-	NAF-S
WS3009L-VB-VH	WS3009L	76.48 - 80.05	VB-VH: [Coal]; Claystone; some Tuff; part stony	9.3	-	380	-	0.19	0.094	2.9	90	-87	31	-	-	-	NAF-Low S
WS3013L-L1	WS3013L	25.93 - 28.26	L1: [Coal]; trace pyrite and calcite	8.3	-	267	-	0.42	0.223	6.8	11	-4	1.6	-	-	-	uncertain
WS3013L-L2A	WS3013L	28.26 - 29.85	L2A: [Coal]; some Claystone; trace pyrite	7.8	-	213	-	0.48	0.250	7.7	12	-4	1.6	-	-	-	uncertain
WS3013L-VA3	WS3013L	52.99 - 54.85	VA3: [Coal]	9.5	-	227	-	0.24	0.039	1.2	19	-18	16	-	-	-	NAF-S
WS3013L-VB-VH	WS3013L	55.45 - 60.16	VB-VH: [Coal]; with Claystone and Tuff	9.1	-	359	-	0.29	0.058	1.8	52	-50	29	-	-	-	NAF-S
WS3014L-L2A	WS3014L	86.45 - 88.68	L2A: [Coal]; some Claystone	8.0	-	447	-	0.47	0.292	8.9	21	-12	2.4	-	-	-	NAF-S
WS3014L-VA3	WS3014L	104.10 - 105.45	VA3: [Coal]	9.4	-	311	-	0.38	0.276	8.5	23	-14	2.7	-	-	-	NAF-S
WS3014L-VB-VH	WS3014L	105.86 - 110.69	VB-VH: [Coal]; with Claystone and Tuff	9.4	-	394	-	0.24	0.126	3.9	63	-59	16	-	-	-	NAF-S
WS3015L-L1A	WS3015L	84.28 - 86.30	L1: [Coal]; some Siltstone	8.6	-	303	-	0.36	0.220	6.7	58	-52	8.7	-	-	-	NAF-S
WS3017L-L1	WS3017L	36.14 - 37.52	L1: [Coal]; some Claystone	9.1	-	232	-	0.21	0.095	2.9	21	-18	7.4	-	-	-	NAF-S
WS3017L-L2A	WS3017L	37.52 - 39.69	L2A: [Coal]	8.7	-	211	-	0.38	0.194	5.9	12	-6	2.1	-	-	-	NAF-S
WS3017L-VA3	WS3017L	68.24 - 69.70	VA3: [Coal]; part stony; some Carb. Siltstone	9.5	-	245	-	0.20	0.017	0.5	101	-100	194	-	-	-	NAF-Low S
WS3017L-VB-VH	WS3017L	70.27 - 73.33	VB-VH: [Coal]; part stony; with Claystone	9.8	-	398	-	0.15	0.038	1.2	71	-70	61	-	-	-	NAF-Low S
Comp-L1	composite	composite	L1 composite reject; pilot program	-	8.2	-	269	0.39	0.340	10.4	55	-44	5.2	8.1	<0.1	<0.1	NAF-S
Comp-L2A	composite	composite	L2A composite reject; pilot program	-	8.2	-	224	0.42	0.263	8.1	21	-13	2.6	4.2	2.9	46.5	uncertain
Comp-VA3	composite	composite	VA3 composite reject; pilot program	-	8.6	-	270	0.55	0.362	11.1	95	-84	8.6	9.2	<0.1	<0.1	NAF-S
Comp-VBVH	composite	composite	VB-VH composite reject; pilot program	-	9.2	-	345	0.24	0.124	3.8	65	-61	17	8.6	<0.1	<0.1	NAF-S

pH and EC on 1:2 or 1:5 water extracts, as indicated [1:2 on crushed samples; 1:5 on pulps]; Scr = Chromium reducible sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential; NAG = Net acid generation (refer to report body for explantion). MPA is calculated from Scr, where available, or else from Total S; NAPP is calculated from MPA and ANC. Refer to main body of the report for Acid Classification definition.

Table C3. Total Element Concentrations in Potential Waste Rock

					Ag	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	V	Zn
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Potential waste rock (overburden and interburden) all units mg/kg**																			
130227	WS3009L	0 - 2	Extremely	Clay	0.04	3.70	330	1.91	0.26	0.03	17.1	55	35.4	0.006	1140	0.37	30.2	16.3	200	0.68	<1	2.1	113	87
130233	WS3009L	13 - 14	Distinctly	Sandstone, medium	0.08	2.20	310	1.92	0.30	0.23	14.3	44	42.6	<0.005	1230	0.21	28.0	22.6	<100	0.71	<1	2.2	116	93
2644 *	R2071	10 - 15	Distinctly	Clay	0.07	3.8	230	2.1	0.34	0.08	14.9	47	44.9	0.005	820	0.44	29.6	15.1	<100	1.06	1	2.7	119	85
130203	WS3003L	4 - 6	Distinctly	Clay	0.08	8.60	470	2.16	0.33	0.03	14.4	45	47.9	0.019	699	0.34	32.5	17.7	200	0.54	1	1.9	129	88
130208	WS3003L	14 - 16	Distinctly	Sandst., med.-coarse	0.07	23.0	160	1.15	0.11	0.06	15.5	34	17.6	0.030	1150	0.75	26.0	10.9	100	0.6	<1	1.0	96	76
130251	WS3013L	6 - 8	Slightly	Sandstone, fine	0.04	11.2	230	3.30	0.84	0.04	12.5	43	74.4	0.113	263	0.73	22.4	41.2	100	1.04	1	4.7	147	92
2653 *	R2071	50 - 54	Fresh	Sandstone, fine-med.	0.13	5.1	600	1.6	0.24	0.10	22.5	46	27.7	0.037	644	0.80	28.5	17.1	200	1.14	1	2.1	116	73
2659 *	R2071	73 - 78	Fresh	Siltstone	0.12	2.6	290	1.9	0.35	0.14	18.8	44	40.5	<0.005	1080	0.58	29.2	21.4	<100	0.76	1	2.4	118	90
2660 *	R2071	78 - 83	Fresh	Sandstone, fine-med.	0.1	3.2	340	2.2	0.42	0.07	19.2	50	48.6	<0.005	880	0.66	33.3	22.9	<100	0.85	1	2.7	131	100
2666 *	R2071	106 - 110	Fresh	Sandstone, fine-med.	0.09	1.9	360	1.9	0.36	0.13	17.4	50	47.2	<0.005	1070	0.56	29.5	21.5	<100	1.04	1	2.5	126	91
2670 *	R2071	121 - 122	Fresh	Siltstone	0.12	4.0	330	3.4	0.69	0.07	10.2	43	54.3	0.016	617	0.90	18.7	33.9	<100	0.80	1	4.4	123	65
2689 *	R2071	148 - 150	Fresh	Sandstone	0.16	16.1	410	1.4	0.14	0.08	21	73	26.1	0.083	699	1.28	36.7	11.5	<100	0.89	1	1.7	156	86
2691 *	R2071	154 - 158	Fresh	Siltstone	0.09	22.6	490	1.9	0.32	0.13	16	48	46.4	0.053	785	1.15	31.7	17.9	<100	0.74	1	2.2	127	87
2699 *	R2071	176 - 177	Fresh	Siltstone	0.11	9.7	440	1.6	0.31	0.13	11.9	35	45	0.051	1010	0.72	24.0	17.2	<100	0.61	1	2	109	83
2718 *	R2071	195 - 196	Fresh	Coal, some Claystone	0.09	12.6	490	2.3	0.37	0.13	14.9	48	88.5	0.101	227	2.68	47.0	18.3	800	0.96	1	2.1	132	74
2784 *	R2077	110 - 112	Fresh	Mudstone	0.11	18.2	790	2.8	0.35	0.13	14.5	36	67.7	0.07	935	2.13	38.2	19.4	800	0.92	1	2.4	110	82
2793 *	R2077	120 - 121	Fresh	Siltstone & Mudstone	0.12	184.5	510	2.3	0.39	0.12	5	35	40	0.121	156	2.2	23.8	24.1	610	1.62	1	2.9	87	65
2853 *	R2083	153 - 154	Fresh	Carb. Mudstone	0.12	28.9	420	1.8	0.4	0.18	17.8	33	41.8	0.152	921	2.61	27.8	21.4	310	2.38	1	1.9	87	87
130214	WS3003L	26 - 28	Fresh	Siltstone; carb.	0.09	10.2	250	1.94	0.44	0.11	15.1	43	58.2	0.064	1080	0.78	31.0	20.5	500	0.77	1	2.2	136	101
130246	WS3009L	44 - 46	Fresh	Sandst., fine; carb.	0.13	29.3	130	3.08	0.59	0.10	13.6	50	55.0	0.090	339	1.49	27.9	35.8	1000	1.94	2	4.2	131	90
130259	WS3013L	23.85 - 24.85	Fresh	Carb. Siltstone	0.10	18.5	320	2.31	0.38	0.15	22.2	45	44.7	0.098	1410	1.97	36.2	20.8	1300	1.18	<1	2.1	138	102
3219216	WS3041	31 - 33	Fresh	Sandstone, medium	0.05	23.4	370	1.41	0.16	0.05	16.8	41	19.5	0.061	773	0.90	27.8	13.0	700	0.61	1	1.4	102	90
3219219	WS3041	42 - 43	Fresh	Sandstone, medium	0.09	13.4	330	1.66	0.28	0.11	16.0	44	42.7	0.064	633	1.18	30.7	16.5	1300	0.63	1	1.8	118	136
3219230	WS3041	63 - 65	Fresh	Sandstone, fine	0.09	18.4	470	1.86	0.32	0.13	15.5	49	54.6	0.057	1020	0.69	32.9	18.9	400	0.78	1	2.1	129	111
3219241	WS3059	28 - 30	Fresh	Sandstone, medium	0.09	15.5	540	1.27	0.17	0.08	12.1	41	24.5	0.049	449	0.99	19.7	13.9	2000	0.65	<1	1.5	99	98
3219246	WS3059	41 - 43	Fresh	Sandstone, medium	0.08	23.2	200	1.20	0.10	0.07	16.8	36	16.9	0.031	617	0.72	29.3	10.9	300	0.87	1	1.2	90	72
3219252	WS3059	55 - 57	Fresh	Sandstone, fine	0.09	9.80	280	1.94	0.34	0.11	14.4	40	48.1	0.058	954	0.80	28.9	18.6	400	0.75	1	2.0	120	91
3219255	WS3082	66.6 - 69	Fresh	Sandstone, fine	0.09	40.9	570	1.88	0.38	0.15	10.8	37	53.5	0.179	633	2.11	25.2	20.9	3000	0.78	1	2.3	137	100
3219264	WS3120	78 - 80	Fresh	Sandstone, medium	0.04	18.0	340	1.30	0.13	0.07	13.6	41	26.8	0.040	830	0.62	24.0	11.4	200	0.46	1	1.2	98	73
3219268	WS3120	86 - 87	Fresh	Carb. Siltstone	0.09	23.8	460	2.30	0.50	0.15	18.7	28	46.8	0.081	1870	1.72	32.3	19.0	2700	1.79	1	2.3	132	94
3219274	WS3155	21.69 - 23	Fresh	Sandstone, fine	0.08	24.9	1770	1.83	0.30	0.17	10.4	44	50.5	0.149	74	1.78	29.2	20.9	1500	0.86	<1	2.3	137	116
3219281	WS3155	35 - 37	Fresh	Sandstone, fine	0.08	15.3	220	1.85	0.26	0.12	13.7	50	49.6	0.042	1060	0.74	31.4	16.2	400	0.62	1	1.9	128	90
3219287	WS3155	47 - 47.94	Fresh	Carb. Siltstone	0.12	9.20	650	2.24	0.43	0.15	18.6	43	56.0	0.076	1500	1.88	35.1	23.4	800	1.33	1	2.4	144	108

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019.
'<' indicates less than the laboratory limit of reporting.

Table C4. Geochemical Abundance Indices for Potential Waste Rock

					Ag	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	V	Zn
				Average background conc. in soil (mg/kg):	0.1	6	500	0.3	0.2	0.35	8	70	30	0.06	1000	1.2	50	35	700	1	0.4	4	90	90
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Potential waste rock (overburden and interburden) (GAI)**																			
130227	WS3009L	0 - 2	Extremely	Clay				2			<1													
130233	WS3009L	13 - 14	Distinctly	Sandstone, medium	<1			2			<1													
2644 *	R2071	10 - 15	Distinctly	Clay				2	<1		<1										<1			
130203	WS3003L	4 - 6	Distinctly	Clay	<1			2	<1		<1		<1								<1			
130208	WS3003L	14 - 16	Distinctly	Sandstone, medium-coarse		1		1			<1													
130251	WS3013L	6 - 8	Slightly	Sandstone, fine		<1		3	1		<1		<1	<1							<1		<1	
2653 *	R2071	50 - 54	Fresh	Sandstone, fine-medium	<1			2			<1										<1			
2659 *	R2071	73 - 78	Fresh	Siltstone	<1			2	<1		<1										<1			
2660 *	R2071	78 - 83	Fresh	Sandstone, fine-medium	<1			2	<1		<1		<1								<1			
2666 *	R2071	106 - 110	Fresh	Sandstone, fine-medium	<1			2	<1		<1		<1								<1			
2670 *	R2071	121 - 122	Fresh	Siltstone	<1			3	1				<1								<1			
2689 *	R2071	148 - 150	Fresh	Sandstone	1	<1		2			<1										<1		<1	
2691 *	R2071	154 - 158	Fresh	Siltstone	<1	1		2	<1		<1		<1								<1			
2699 *	R2071	176 - 177	Fresh	Siltstone	<1	<1		2	<1												<1			
2718 *	R2071	195 - 196	Fresh	Coal, some Claystone	<1	<1		2	<1		<1		<1	<1		<1					<1			
2784 *	R2077	110 - 112	Fresh	Mudstone	<1	1	<1	3	<1		<1		<1			<1					<1			
2793 *	R2077	120 - 121	Fresh	Siltstone & Mudstone	<1	4		2	<1					<1		<1				<1	<1			
2853 *	R2083	153 - 154	Fresh	Carbonaceous Mudstone	<1	2		2	<1		<1			<1		<1				<1	<1			
130214	WS3003L	26 - 28	Fresh	Siltstone; carbonaceous	<1	<1		2	<1		<1		<1								<1		<1	
130246	WS3009L	44 - 46	Fresh	Sandstone, fine; carbonaceous	<1	2		3	<1		<1		<1							<1	2			
130259	WS3013L	23.85 - 24.85	Fresh	Carbonaceous Siltstone	<1	1		2	<1		<1			<1		<1			<1				<1	
3219216	WS3041	31 - 33	Fresh	Sandstone, medium		1		2			<1										<1			
3219219	WS3041	42 - 43	Fresh	Sandstone, medium	<1	<1		2			<1								<1		<1			<1
3219230	WS3041	63 - 65	Fresh	Sandstone, fine	<1	1		2	<1		<1		<1								<1			
3219241	WS3059	28 - 30	Fresh	Sandstone, medium	<1	<1		1			<1								<1					
3219246	WS3059	41 - 43	Fresh	Sandstone, medium	<1	1		1			<1										<1			
3219252	WS3059	55 - 57	Fresh	Sandstone, fine	<1	<1		2	<1		<1		<1								<1			
3219255	WS3082	66.6 - 69	Fresh	Sandstone, fine	<1	2		2	<1				<1	<1		<1			2		<1		<1	
3219264	WS3120	78 - 80	Fresh	Sandstone, medium		1		2			<1										<1			
3219268	WS3120	86 - 87	Fresh	Carb. Siltstone	<1	1		2	<1		<1		<1		<1				1	<1	<1			
3219274	WS3155	21.69 - 23	Fresh	Sandstone, fine	<1	1	1	2					<1	<1					<1				<1	
3219281	WS3155	35 - 37	Fresh	Sandstone, fine	<1	<1		2			<1		<1								<1			
3219287	WS3155	47 - 47.94	Fresh	Carb. Siltstone	<1	<1		2	<1		<1		<1			<1					<1		<1	

Average background concentration in soil from Bowen (1979). Blank cells = GAI <1.
Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019.

Table C5. Total Element Concentrations in Potential Coarse Reject and ROM Coal

					Ag	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	V	Zn
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Coal seam all units mg/kg**																			
2757 *	R2077	64 - 65	Fresh	Coal (VA)	0.09	1.9	310	2.0	0.48	0.12	3.3	14	21.4	0.085	133	0.68	18.8	30.7	600	0.30	1	2.6	56	61
Sample ID	**Seam/Ply**	**Depth (m)**		**Description**	**Potential coarse reject from pilot process all units mg/kg**																			
Comp-L1	L1	composite		L1 reject; pilot program	0.04	3.1	290	1.28	0.28	0.08	3.4	16	33.0	0.079	493	1.03	8.3	13.1	5500	0.75	2	1.6	59	29
Comp-L2A	L2A	composite		L2A reject; pilot program	0.02	3.1	210	0.55	0.18	0.05	5.3	12	19.8	0.043	678	1.05	10.6	6.7	5000	0.60	<1	0.9	32	22
Comp-VA3	VA3	composite		VA3 reject; pilot program	0.04	1.4	850	1.49	0.35	0.06	2.8	13	34.1	0.071	567	0.60	5.8	11.8	6400	0.50	2	1.7	49	27
Comp-VBVH	VB-VH	composite		VB-VH reject; pilot program	0.07	9.3	860	2.38	0.32	0.12	7.8	7.0	39.8	0.092	383	2.36	7.5	18.8	5100	0.82	1	2.1	96	72

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019.
Potential coarse reject samples have been ashed prior to analysis due to carbon content exceeding 5%. '<' indicates less than the laboratory limit of reporting.

Table C6. Geochemical Abundance Indices for Potential Coarse Reject and ROM Coal

					Ag	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	V	Zn
Average background conc. in soil (mg/kg):					0.1	6	500	0.3	0.2	0.35	8	70	30	0.06	1000	1.2	50	35	700	1	0.4	4	90	90
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Coal seam (GAI)**																			
2757 *	R2077	64 - 65	Fresh	Coal (VA)	<1			2	<1												<1			
Sample ID	**Seam/Ply**	**Depth (m)**		**Description**	**Potential coarse reject from pilot process (GAI)**																			
Comp-L1	L1	composite		L1 reject; pilot program				2											2		2			
Comp-L2A	L2A	composite		L2A reject; pilot program				<1											2					
Comp-VA3	VA3	composite		VA3 reject; pilot program			<1	2	<1										3		2			
Comp-VBVH	VB-VH	composite		VB-VH reject; pilot program		<1	<1	2	<1					<1		<1			2		<1			

Average background concentration in soil from Bowen (1979). Blank cells = GAI <1.

Table C7. Soluble Major Ions, pH and Electrical Conductivity in Water Extracts from Potential Waste Rock

						pH	EC	Tot. alk.	HCO3 alk.	CO3 alk.	SO4	Cl	Ca	Mg	Na	K
Sample ID	Drill-hole	Depth (m)	Weath.	Description	Type	pH units	uS/cm	all units mg/L								
130227	WS3009L	0 - 2	Extremely	Clay	Weath. OB	8.5	1100	1,442	1,442	<0.2	12	280	10	8	190	<5
130233	WS3009L	13 - 14	Distinctly	Sandstone, MM	Weath. OB	9.3	512	372	308	63	<2	112	<2	<2	102	5
2644 *	R2071	10 - 15	Distinctly	Clay	Weath. OB	8.8	750	88	-	-	6	198	3	1	159	2
130203	WS3003L	4 - 6	Distinctly	Clay	Weath. OB	7.3	1170	189	189	<0.2	14	338	8	8	212	10
130208	WS3003L	14 - 16	Distinctly	Sandstone, MC	Weath. OB	9.8	331	1,252	1,168	84	4	36	<2	<2	70	<5
130251	WS3013L	6 - 8	Slightly	Sandstone, FF	Weath. OB	8.2	605	80	80	<0.2	2	172	<2	<2	110	<5
2653 *	R2071	50 - 54	Fresh	Sandstone, FM	Overburden	8.2	1420	53	-	-	319	196	50	16	261	6
2659 *	R2071	73 - 78	Fresh	Siltstone	Overburden	9.1	850	405	-	-	10	185	4	1	131	3
2660 *	R2071	78 - 83	Fresh	Sandstone, FM	Overburden	9.1	810	68	-	-	6	196	4	<1	176	4
2666 *	R2071	106 - 110	Fresh	Sandstone, FM	Overburden	8.9	790	194	-	-	6	171	7	2	193	4
2670 *	R2071	121 - 122	Fresh	Siltstone	Overburden	8.7	530	78	-	-	21	132	2	<1	135	1
2689 *	R2071	148 - 150	Fresh	Sandstone	Interburden	9.0	910	165	-	-	30	191	3	1	204	3
2691 *	R2071	154 - 158	Fresh	Siltstone	Interburden	9.3	920	165	-	-	23	191	3	<1	210	2
2699 *	R2071	176 - 177	Fresh	Siltstone	Interburden	9.1	1360	74	-	-	16	346	4	1	317	4
2718 *	R2071	195 - 196	Fresh	Coal, some Claystone	Interburden	9.4	850	79	-	-	77	131	1	<1	207	2
2784 *	R2077	110 - 112	Fresh	Mudstone	Interburden	8.8	1040	149	-	-	26	204	2	<1	279	3
2793 *	R2077	120 - 121	Fresh	Siltstone & Mudstone	Interburden	8.1	1460	83	-	-	57	489	7	2	440	6
2853 *	R2083	153 - 154	Fresh	Carb. Mudstone	Interburden (parting VU)	8.9	630	-	-	-	110	75	3	<1	229	3
130214	WS3003L	26 - 28	Fresh	Siltstone; carb.	Overburden	9.8	436	1,138	998	140	30	48	<2	<2	92	10
130246	WS3009L	44 - 46	Fresh	Sandstone, FF; carb.	Overburden	8.7	190	77	77	<0.2	32	26	<2	<2	42	<5
130259	WS3013L	23.85-24.85	Fresh	Carb. Siltstone	Overburden	9.7	589	384	350	35	40	106	<2	<2	114	5
3219216	WS3041	31 - 33	Fresh	Sandstone, MM	Interburden	9.4	256	1,172	1,140	32	28	16	2	<2	50	10
3219219	WS3041	42 - 43	Fresh	Sandstone, MM	Interburden	9.5	311	360	322	38	28	20	<2	<2	62	10
3219230	WS3041	63 - 65	Fresh	Sandstone, FF	Interburden	9.8	358	432	330	102	24	8	<2	<2	76	10
3219241	WS3059	28 - 30	Fresh	Sandstone, MM	Interburden	9.2	249	612	524	88	24	16	2	<2	50	5
3219246	WS3059	41 - 43	Fresh	Sandstone, MM	Interburden	9.7	236	462	428	35	22	10	<2	<2	48	10
3219252	WS3059	55 - 57	Fresh	Sandstone, FF	Interburden	9.6	329	626	570	56	22	22	<2	<2	72	5
3219255	WS3082	66.6 - 69	Fresh	Sandstone, FF	Interburden	9	406	262	256	7	44	58	<2	<2	80	15
3219264	WS3120	78 - 80	Fresh	Sandstone, MM	Interburden	10	285	412	364	49	12	6	<2	<2	70	<5
3219268	WS3120	86 - 87	Fresh	Carb. Siltstone	Interburden	9.6	237	318	312	7	46	6	<2	<2	64	<5
3219274	WS3155	21.69 - 23	Fresh	Sandstone, FF	Interburden	8.3	457	112	112	<0.2	34	90	2	<2	82	10
3219281	WS3155	35 - 37	Fresh	Sandstone, FF	Interburden	9.3	329	332	312	21	18	40	<2	<2	68	10
3219287	WS3155	47 - 47.94	Fresh	Carb. Siltstone	Interburden	8.5	545	172	172	<0.2	48	102	4	2	94	20

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019.
EGi (2012) (*) analysis results performed on 1:2 water extracts on crushed samples, and excluding pH and EC results all results were reported on a wt.:vol. basis (mg/L).
All other analyses results performed on 1:5 water extracts on pulps (<75 micron), and results were reported on a wt.:wt. basis (mg/kg) and then converted to a volumetric basis (mg/L).
Alkalinity is reported as mg CaCO3/L; FF = 'fine grained'; FM = 'fine to medium grained'; MM= 'medium grained'; MC = 'medium to coarse grained'

Table C8. Soluble Multi-Element Concentrations in Water Extracts from Potential Waste Rock

						Al	As	Ba	Be	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	V	Zn
					Aquatic ecosystems water quality value:	0.055	0.024	-	-	0.37	0.0002	0.0014	0.001	0.0014	0.3	0.00006	1.9	0.011	0.0034	0.011	-	0.008
					Livestock drinking water quality:	5	0.5	-	-	5	0.01	1	1	0.5	-	0.002	-	1	0.1	0.02	-	20
Sample ID	Drill-hole	Depth (m)	Weath.	Description	Type	all units mg/L																
130227	WS3009L	0 - 2	Extremely	Clay	Weath. OB	<0.2	<0.02	<0.2	<0.02	0.4	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	0.04	<0.02	<0.02	<0.02	<0.02	<0.02
130233	WS3009L	13 - 14	Distinctly	Sandstone, MM	Weath. OB	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2644 *	R2071	10 - 15	Distinctly	Clay	Weath. OB	0.04	<0.001	0.63	<0.001	0.29	<0.0001	<0.001	0.001	0.005	0.08	<0.0010	0.006	<0.001	<0.001	<0.01	-	<0.005
130203	WS3003L	4 - 6	Distinctly	Clay	Weath. OB	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
130208	WS3003L	14 - 16	Distinctly	Sandstone, MC	Weath. OB	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
130251	WS3013L	6 - 8	Slightly	Sandstone, FF	Weath. OB	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2653 *	R2071	50 - 54	Fresh	Sandstone, FM	Overburden	<0.01	0.012	0.19	<0.001	0.19	<0.0001	<0.001	<0.001	0.003	<0.05	<0.0010	0.071	<0.001	<0.001	<0.01	-	0.012
2659 *	R2071	73 - 78	Fresh	Siltstone	Overburden	<0.10	0.046	0.08	<0.010	0.23	<0.0010	<0.010	<0.010	0.012	<0.50	<0.0010	<0.010	<0.010	<0.010	<0.10	-	<0.005
2660 *	R2071	78 - 83	Fresh	Sandstone, FM	Overburden	0.03	0.004	0.53	<0.001	0.36	<0.0001	<0.001	0.002	0.003	<0.05	<0.0010	0.007	<0.001	<0.001	<0.01	-	<0.005
2666 *	R2071	106 - 110	Fresh	Sandstone, FM	Overburden	<0.10	<0.010	0.28	<0.010	0.18	<0.0010	<0.010	<0.010	<0.010	<0.50	<0.0010	<0.010	<0.010	<0.010	<0.10	-	<0.005
2670 *	R2071	121 - 122	Fresh	Siltstone	Overburden	<0.10	<0.010	0.18	<0.010	<0.10	<0.0010	<0.010	<0.010	<0.010	<0.50	<0.0010	<0.010	<0.010	<0.010	<0.10	-	<0.005
2689 *	R2071	148 - 150	Fresh	Sandstone	Interburden	0.02	0.004	0.34	<0.001	0.07	<0.0001	<0.001	<0.001	0.003	<0.05	<0.0001	<0.001	<0.001	<0.001	<0.01	-	<0.005
2691 *	R2071	154 - 158	Fresh	Siltstone	Interburden	0.04	0.007	0.34	<0.001	0.08	<0.0001	<0.001	<0.001	0.002	<0.05	<0.0001	<0.001	<0.001	<0.001	0.02	-	<0.005
2699 *	R2071	176 - 177	Fresh	Siltstone	Interburden	0.03	0.003	0.94	<0.001	0.16	<0.0001	<0.001	<0.001	0.002	<0.05	<0.0001	0.001	<0.001	<0.001	0.01	-	<0.005
2718 *	R2071	195 - 196	Fresh	Coal, some Clayst.	Interburden	<0.10	0.041	0.18	<0.010	0.21	<0.0010	<0.010	<0.010	0.010	<0.50	<0.0010	<0.010	<0.010	<0.010	<0.10	-	<0.005
2784 *	R2077	110 - 112	Fresh	Mudstone	Interburden	<0.10	<0.010	0.23	<0.010	<0.10	<0.0010	<0.010	<0.010	<0.010	<0.50	<0.0010	<0.010	<0.010	<0.010	<0.10	-	<0.005
2793 *	R2077	120 - 121	Fresh	Siltstone & Mudst.	Interburden	0.01	0.003	0.51	<0.001	<0.05	<0.0001	<0.001	<0.001	0.007	<0.05	<0.0001	0.003	<0.001	<0.001	0.01	-	<0.005
2853 *	R2083	153 - 154	Fresh	Carb. Mudstone	Interburden (parting VU)	0.03	<0.001	0.06	<0.001	<0.05	<0.0001	<0.001	<0.001	0.001	<0.05	<0.0001	0.001	<0.001	<0.001	0.01	-	<0.005
130214	WS3003L	26 - 28	Fresh	Siltstone; carb.	Overburden	<0.2	0.08	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
130246	WS3009L	44 - 46	Fresh	Sandst., FF; carb.	Overburden	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
130259	WS3013L	23.85-24.85	Fresh	Carb. Siltstone	Overburden	<0.2	0.04	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219216	WS3041	31 - 33	Fresh	Sandstone, MM	Interburden	<0.2	0.12	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219219	WS3041	42 - 43	Fresh	Sandstone, MM	Interburden	<0.2	0.10	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
3219230	WS3041	63 - 65	Fresh	Sandstone, FF	Interburden	<0.2	0.16	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
3219241	WS3059	28 - 30	Fresh	Sandstone, MM	Interburden	<0.2	0.08	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219246	WS3059	41 - 43	Fresh	Sandstone, MM	Interburden	<0.2	0.40	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219252	WS3059	55 - 57	Fresh	Sandstone, FF	Interburden	<0.2	0.06	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219255	WS3082	66.6 - 69	Fresh	Sandstone, FF	Interburden	<0.2	0.04	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
3219264	WS3120	78 - 80	Fresh	Sandstone, MM	Interburden	<0.2	0.08	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219268	WS3120	86 - 87	Fresh	Carb. Siltstone	Interburden	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
3219274	WS3155	21.69 - 23	Fresh	Sandstone, FF	Interburden	<0.2	0.24	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
3219281	WS3155	35 - 37	Fresh	Sandstone, FF	Interburden	<0.2	0.16	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3219287	WS3155	47 - 47.94	Fresh	Carb. Siltstone	Interburden	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019. EGi (2012) (*) analysis results performed on 1:2 water extracts on crushed samples, and excluding pH and EC results all results were reported on a wt.:vol. basis (mg/L). All other analyses results performed on 1:5 water extracts on pulps (<75 micron), and results were reported on a wt.:wt. basis (mg/kg) and then converted to a volumetric basis (mg/L). Alkalinity is reported as mg CaCO3/L; FF = 'fine grained'; FM = 'fine to medium grained'; MM= 'medium grained'; MC = 'medium to coarse grained'

Table C9. Soluble Major Ions, pH and Electrical Conductivity in Water Extracts from Potential Coarse Reject and ROM Coal

						pH	EC	Tot. alk.	HCO3 alk.	CO3 alk.	SO4	Cl	Ca	Mg	Na	K
Sample ID	**Drill-hole**	**Depth (m)**	**Weath.**	**Description**	**Type**	**pH units**	**uS/cm**	**Coal seam all units mg/L**								
2757 *	R2077	64 - 65	Fresh	Coal (VA)	Seam/Ply VA	8.6	350	101	-	-	<10	115	1	1	131	2
Sample ID	**Drill-hole**	**Depth (m)**	**Description**		**Type**	**pH units**	**uS/cm**	**Potential coarse reject from pilot process all units mg/L**								
Comp-L1	L1	composite	L1 reject; pilot program		Pot. coarse reject (L1)	8.2	269	420	420	<0.2	40	22	24	8	30	10
Comp-L2A	L2A	composite	L2A reject; pilot program		Pot. coarse reject (L2A)	8.2	224	328	328	<0.2	38	16	18	8	22	5
Comp-VA3	VA3	composite	VA3 reject; pilot program		Pot. coarse reject (VA3)	8.6	270	1,522	1,522	<0.2	36	18	12	4	44	10
Comp-VBVH	VB-VH	composite	VB-VH reject; pilot program		Pot. coarse reject (VB-VH)	9.2	345	1,390	1,390	<0.2	28	20	<2	<2	82	10

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019.
EGi (2012) (*) analysis results performed on 1:2 water extracts on crushed samples, and excluding pH and EC results all results were reported on a wt.:vol. basis (mg/L).
All other analyses results performed on 1:5 water extracts on pulps (<75 micron), and results were reported on a wt.:wt. basis (mg/kg) and then converted to a volumetric basis (mg/L).
Alkalinity is reported as mg CaCO3/L.

Table C10. Soluble Multi-Element Concentrations in Water Extracts from Potential Coarse Reject and ROM Coal

				Al	As	Ba	Be	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	V	Zn
Aquatic ecosystems water quality value:				0.055	0.024	-	-	0.37	0.0002	0.0014	0.001	0.0014	0.3	0.00006	1.9	0.011	0.0034	0.011	-	0.008
Livestock drinking water quality:				5	0.5	-	-	5	0.01	1	1	0.5	-	0.002	-	1	0.1	0.02	-	20
Sample ID	**Drill-hole**	**Depth (m)**	**Description**	**Coal seam all units mg/L**																
2757 *	R2077	64 - 65	Coal (VA [VU]), fresh	0.15	0.033	0.12	<0.010	<0.10	<0.0010	<0.010	<0.010	<0.010	<0.50	<0.0010	<0.010	<0.010	<0.010	<0.10	-	<0.005
Sample ID	**Drill-hole**	**Depth (m)**	**Description**	**Potential coarse reject from pilot process all units mg/L**																
Comp-L1	L1	composite	L1 pot. coarse reject	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Comp-L2A	L2A	composite	L2A pot. coarse reject	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	0.04	<0.02	<0.02	<0.02	<0.02	<0.02
Comp-VA3	VA3	composite	VA3 pot. coarse reject	<0.2	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Comp-VBVH	VB-VH	composite	VB-VH pot. coarse reject	<0.2	0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.2	<0.0001	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Samples denoted with an asterix (*) are from sampling and analysis undertaken in 2012 (EGi, 2012 - unpublished). All other results are from sample collection and analysis undertaken in 2019.
EGi (2012) (*) analysis results performed on 1:2 water extracts on crushed samples, and excluding pH and EC results all results were reported on a wt.:vol. basis (mg/L).
All other analyses results performed on 1:5 water extracts on pulps (<75 micron), and results were reported on a wt.:wt. basis (mg/kg) and then converted to a volumetric basis (mg/L).

Table C11. Exchangeable Cations and Emerson Aggregate Class Test Results in Potential Waste Rock

Sample ID		130227	130203	130208	130233	130251	130214	130246	130259	3219216	3219219	3219230	3219241	3219246	3219252	3219255	3219264	3219268	3219274	3219281	3219287
Drill-hole ID (WS prefix)		3009L	3003L	3003L	3009L	3013L	3003L	3009L	3013L	3041	3041	3041	3059	3059	3059	3082	3120	3120	3155	3155	3155
Sample Depth (m)		0-2	4-6	14-16	13-14	6-8	26-28	44-46	23.9-24.9	31-33	42-43	63-65	28-30	41-43	55-57	66.6-69	78-80	86-87	21.7-23	35-37	47-47.94
Material Type		Weathered Overburden					Overburden			Interburden											
Lithology (1)		CL	CL	SS-MC	SS-MM	SS-FF	ST, X	SS-FF, X	XT	SS-MM	SS-MM	SS-FF	SS-MM	SS-MM	SS-FF	SS-FF	SS-MM	XT	SS-FF	SS-FF	XT
Weathering		Extremely	Distinctly	Distinctly	Distinctly	Slightly	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh	Fresh
Parameter	**Units**	**Results**																			
pH (1:5)	--	8.5	7.3	9.8	9.3	8.2	9.8	8.7	9.7	9.4	9.5	9.8	9.2	9.7	9.6	9	10	9.6	8.3	9.3	8.5
EC (1:5)	µS/cm	1100	1170	331	512	605	436	190	589	256	311	358	249	236	329	406	285	237	457	329	545
Chloride	mg/kg	1400	1690	180	560	860	240	130	530	80	100	40	80	50	110	290	30	30	450	200	510
Exchangeable Ca	meq/100g	6.4	10.5	2.6	3.5	4.1	2.8	2.8	2.6	3.5	4.2	4.6	3.8	3.1	4.3	3.6	1.8	3.7	4.4	5.6	5.8
Exchangeable Mg	meq/100g	6.6	9.3	4.9	6.4	5.1	7.1	3.1	6.1	3.5	4.3	2.7	3.1	2.5	3.3	3.8	1	1.7	3.7	4.4	4.6
Exchangeable K	meq/100g	0.2	0.4	0.2	0.3	<0.2	0.6	<0.2	0.4	0.3	0.5	0.6	0.2	0.3	0.5	0.6	<0.2	0.5	0.4	0.5	0.6
Exchangeable Na	meq/100g	3.8	2.8	2.6	2.8	2.8	3.6	1.3	3.3	1.3	2.4	4.1	1.2	1.3	3	2.3	2.1	5.9	1.3	2.2	2
Cation Exchange Cap.	meq/100g	17.1	23.2	10.4	13.1	11.9	14.1	7.4	12.5	8.6	11.4	12.1	8.3	7.3	11.1	10.2	5.1	11.8	9.8	12.8	13
Exchangeable Na %	%	22.4	12.2	25.3	21.6	23.2	25.6	17.7	26.6	15.1	21.4	34.2	14.4	18.2	27	22.4	41	49.7	13.3	17.1	15.2
Ca/Mg	ratio	1.0	1.1	0.5	0.5	0.8	0.4	0.9	0.4	1.0	1.0	1.7	1.2	1.2	1.3	0.9	1.8	2.2	1.2	1.3	1.3
Emerson Class	--	2	2	4	4	2	4	2	4	4	2	2	2	2	3	4	8	8	2	2	4
Sodicity rating		Strongly sodic	Sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Strongly sodic	Sodic	Strongly sodic	Strongly sodic
Ca/Mg ratio <0.5 (2)		no	no	no	no	no	YES	no	YES	no	no	no	no	no	no	no	no	no	no	no	no
Dispersion rating (from Emerson Class)		Some dispers.	Some dispers.	Non-dispers. Calcite or gypsum present	Non-dispers. Calcite or gypsum present	Some dispers.	Non-dispers. Calcite or gypsum present	Some dispers.	Non-dispers. Calcite or gypsum present	Non-dispers. Calcite or gypsum present	Some dispers.	Some dispers.	Some dispers.	Some dispers.	Dispersive	Non-dispers. Calcite or gypsum present	Non-dispers.	Non-dispers.	Some dispers.	Some dispers.	Non-dispers. Calcite or gypsum present

(1). CL = clay; ST = siltstone; XT = carbonaceous siltstone; SS = sandstone; X = carbonaceous; FF = fine; MM = medium; MC = medium-coarse. (2). Ca/Mg ratios less than 0.5 are strongly associated with dispersion.

Appendix D

Laboratory Certificates of Analysis (2019 samples)

Laboratory certificates of analysis for 2012 samples are not available.

Potential Waste Rock: Stage 1 tests (all 2019 potential waste rock samples)
ABA ($pH_{1:2}$, $EC_{1:2}$, S, ANC and NAPP)

- ALS Batch EB1913513: Overburden samples from drill-holes WS3009L, WS3003L and WS3013L
- ALS Batch EB1925015: Interburden samples from drill-holes WS3041, WS3059, WS3082, WS3120 and WS3155

Potential Waste Rock: Stage 2 tests (selected 2019 potential waste rock samples)

- ALS Batch EB1928624: Scr, SO_4, NAG, $pH_{1:5}$, $EC_{1:5}$, soluble metals, soluble major cations, soluble major anions, exchangeable cations and Emerson aggregate class
- ALS Batch EB1928780: Acid buffering characterisation curves (ABCC)
- ALS Batch BR19288059: Total metals (sub-batch of EB1928624)

Potential Coarse Reject: Stage 1 tests (all 2019 potential coarse reject samples

- ALS Batch EB1927002: S, Scr, $pH_{1:2}$, $EC_{1:2}$, ANC and NAPP

Potential Coarse Reject: Stage 2 tests (composite potential coarse reject samples)

- ALS Batch EB1928714: S, Scr, NAG, $pH_{1:5}$, $EC_{1:5}$, soluble metals, soluble major cations, soluble major anions
- ALS Batch EB1928714: Acid buffering characterisation curves (ABCC)
- ALS Batch BR19292693: Total metals (sub-batch of EB1928714)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1913513**	Page	: 1 of 13
Client	: **WHITEHAVEN COAL MINING LIMITED**	Laboratory	: Environmental Division Brisbane
Contact	: B DILLON	Contact	: Customer Services EB
Address	: PO BOX 600 GUNNEDAH NSW, AUSTRALIA 2380	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Winchester South	Date Samples Received	: 22-May-2019 09:30
Order number	:	Date Analysis Commenced	: 12-Jun-2019
C-O-C number	: ----	Issue Date	: 14-Jun-2019 13:43
Sampler	: ----		
Site	: ----		
Quote number	: SY/503/12		
No. of samples received	: 52		
No. of samples analysed	: 52		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	130201	130202	130203	130204	130205
				Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1913513-001	EB1913513-002	EB1913513-003	EB1913513-004	EB1913513-005
					Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)									
pH Value	----	0.1	pH Unit		**6.8**	**6.6**	**7.1**	**8.4**	**8.6**
EA009: Nett Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**-12.9**	**-16.1**	**-15.4**	**-26.4**	**-32.2**
EA010: Conductivity (1:2)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**2230**	**2330**	**2410**	**1420**	**1240**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**13.8**	**16.1**	**16.0**	**27.0**	**32.8**
ANC as CaCO3	----	0.1	% CaCO3		**1.4**	**1.6**	**1.6**	**2.8**	**3.4**
Fizz Rating	----	0	Fizz Unit		**1**	**1**	**1**	**1**	**1**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.03**	<0.01	**0.02**	**0.02**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130206	130207	130208	130209	130210
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1913513-006	EB1913513-007	EB1913513-008	EB1913513-009	EB1913513-010
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.1	9.4	9.1	8.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-124	-171	-164	-118	-25.0
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	729	623	689	675	842
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	125	172	165	119	25.6
ANC as CaCO3	----	0.1	% CaCO3	12.7	17.5	16.8	12.2	2.6
Fizz Rating	----	0	Fizz Unit	3	3	3	3	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.02	0.02	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	130211	130212	130213	130214	130215
				Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1913513-011	EB1913513-012	EB1913513-013	EB1913513-014	EB1913513-015
					Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)									
pH Value	----	0.1	pH Unit		9.2	9.4	9.4	9.2	9.2
EA009: Nett Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		-254	-126	-198	-31.8	-28.2
EA010: Conductivity (1:2)									
Electrical Conductivity @ 25°C	----	1	µS/cm		640	773	743	972	937
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		254	127	199	33.6	30.0
ANC as CaCO3	----	0.1	% CaCO3		25.9	12.9	20.3	3.4	3.0
Fizz Rating	----	0	Fizz Unit		3	3	3	1	1
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		<0.01	0.03	0.03	0.06	0.06

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130216	130217	130218	130219	130227
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1913513-016	EB1913513-017	EB1913513-018	EB1913513-019	EB1913513-020
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.3	9.3	9.2	8.6
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-55.9	-57.7	-49.7	-60.7	-26.0
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	828	759	764	770	946
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	56.5	58.6	51.2	61.9	26.6
ANC as CaCO3	----	0.1	% CaCO3	5.8	6.0	5.2	6.3	2.7
Fizz Rating	----	0	Fizz Unit	2	2	2	2	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.03	0.05	0.04	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130228	130229	130230	130231	130232
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1913513-021	EB1913513-022	EB1913513-023	EB1913513-024	EB1913513-025
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**8.0**	**8.6**	**8.4**	**8.6**	**8.4**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-31.6**	**-32.8**	**-60.8**	**-27.6**	**-22.4**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2000**	**1120**	**1380**	**1170**	**1170**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**32.2**	**32.8**	**60.8**	**27.6**	**22.4**
ANC as CaCO3	----	0.1	% CaCO3	**3.3**	**3.4**	**6.2**	**2.8**	**2.3**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**2**	**1**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	130233	130234	130235	130236	130237
				Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1913513-026	EB1913513-027	EB1913513-028	EB1913513-029	EB1913513-030
					Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)									
pH Value	----	0.1	pH Unit		**8.8**	**8.6**	**8.6**	**8.7**	**8.7**
EA009: Nett Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**-90.5**	**-38.0**	**-27.6**	**-66.1**	**-54.8**
EA010: Conductivity (1:2)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1050**	**1000**	**842**	**759**	**1030**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**90.5**	**38.0**	**28.2**	**66.7**	**55.4**
ANC as CaCO3	----	0.1	% CaCO3		**9.2**	**3.9**	**2.9**	**6.8**	**5.6**
Fizz Rating	----	0	Fizz Unit		**2**	**1**	**1**	**2**	**2**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		<0.01	<0.01	**0.02**	**0.02**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	130238	130239	130240	130241	130242
				Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1913513-031	EB1913513-032	EB1913513-033	EB1913513-034	EB1913513-035
					Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)									
pH Value	----	0.1	pH Unit		**8.4**	**8.8**	**8.8**	**8.8**	**8.9**
EA009: Nett Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**-47.0**	**-96.2**	**-73.8**	**-62.7**	**-64.0**
EA010: Conductivity (1:2)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1140**	**834**	**855**	**754**	**662**
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**47.0**	**96.2**	**73.8**	**63.3**	**64.6**
ANC as CaCO3	----	0.1	% CaCO3		**4.8**	**9.8**	**7.5**	**6.5**	**6.6**
Fizz Rating	----	0	Fizz Unit		**2**	**2**	**2**	**2**	**2**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		<0.01	<0.01	<0.01	**0.02**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130243	130244	130245	130246	130248
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1913513-036	EB1913513-037	EB1913513-038	EB1913513-039	EB1913513-040
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.0	8.6	8.5	8.2	8.1
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-121	-16.5	-12.8	-21.5	-41.0
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	463	493	510	512	1640
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	122	17.1	13.4	23.3	41.6
ANC as CaCO3	----	0.1	% CaCO3	12.4	1.7	1.4	2.4	4.2
Fizz Rating	----	0	Fizz Unit	3	1	1	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.02	0.06	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130249	130250	130251	130252	130253
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1913513-041	EB1913513-042	EB1913513-043	EB1913513-044	EB1913513-045
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**8.1**	**8.1**	**7.9**	**7.7**	**8.4**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-25.2**	**-12.6**	**-9.7**	**-9.8**	**-17.5**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1190**	**1420**	**1380**	**1710**	**1530**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**25.8**	**13.2**	**9.7**	**9.8**	**18.4**
ANC as CaCO3	----	0.1	% CaCO3	**2.6**	**1.4**	**1.0**	**1.0**	**1.9**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**1**	**1**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.02**	<0.01	<0.01	**0.03**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130254	130255	130256	130257	130258
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1913513-046	EB1913513-047	EB1913513-048	EB1913513-049	EB1913513-050
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.1	9.1	9.4	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-77.4	-106	-134	-81.9	-105
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	773	836	952	813	886
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	78.0	107	135	82.5	106
ANC as CaCO3	----	0.1	% CaCO3	8.0	10.9	13.8	8.4	10.8
Fizz Rating	----	0	Fizz Unit	2	3	3	2	3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.03	0.03	0.02	0.03

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130259	130247	----	----	----
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1913513-051	EB1913513-052	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**8.8**	**8.6**	----	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-47.9**	**-28.5**	----	----	----
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1130**	**552**	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**50.7**	**29.4**	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	**5.2**	**3.0**	----	----	----
Fizz Rating	----	0	Fizz Unit	**2**	**1**	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.09**	**0.03**	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1925015**	Page	: 1 of 15
Client	: **WHITEHAVEN COAL MINING LIMITED**	Laboratory	: Environmental Division Brisbane
Contact	: MR IAN SWANE	Contact	: Customer Services EB
Address	: PO BOX 600 GUNNEDAH NSW, AUSTRALIA 2380	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Winchester South	Date Samples Received	: 11-Sep-2019 11:40
Order number	: ----	Date Analysis Commenced	: 02-Oct-2019
C-O-C number	: ----	Issue Date	: 08-Oct-2019 15:42
Sampler	: ----		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 64		
No. of samples analysed	: 64		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219215 WS3041	3219216 WS3041	3219217 WS3041	3219218 WS3041	3219219 WS3041
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-001	EB1925015-002	EB1925015-003	EB1925015-004	EB1925015-005
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	8.8	9.2	9.4	9.3	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-26.7	-121	-88.8	-33.9	-56.9
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	663	466	423	524	519
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	29.5	123	89.7	35.7	60.9
ANC as CaCO3	----	0.1	% CaCO3	3.0	12.6	9.2	3.6	6.2
Fizz Rating	----	0	Fizz Unit	1	3	2	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.09	0.06	0.03	0.06	0.13

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219220 WS3041	3219221 WS3041	3219222 WS3041	3219223 WS3041	3219224 WS3041
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-006	EB1925015-007	EB1925015-008	EB1925015-009	EB1925015-010
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.4	9.7	9.7	9.6
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-33.8	-29.8	-85.3	-119	-23.8
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	547	535	438	423	453
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	36.0	32.0	86.2	120	27.2
ANC as CaCO3	----	0.1	% CaCO3	3.7	3.3	8.8	12.2	2.8
Fizz Rating	----	0	Fizz Unit	1	1	2	3	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.07	0.07	0.03	0.02	0.11

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219225 WS3041	3219226 WS3041	3219227 WS3041	3219228 WS3041	3219229 WS3041
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-011	EB1925015-012	EB1925015-013	EB1925015-014	EB1925015-015
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.8	9.6	9.6	9.6	9.7
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-58.3	-63.5	-50.2	-32.7	-49.7
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	476	514	560	556	524
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	59.2	64.1	51.7	34.2	50.9
ANC as CaCO3	----	0.1	% CaCO3	6.0	6.5	5.3	3.5	5.2
Fizz Rating	----	0	Fizz Unit	2	2	2	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.02	0.05	0.05	0.04

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219230 WS3041	3219231 WS3041	3219232 WS3041	3219240 WS3059	3219241 WS3059
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-016	EB1925015-017	EB1925015-018	EB1925015-019	EB1925015-020
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**9.7**	**9.7**	**9.7**	**8.7**	**9.3**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-52.8**	**-57.7**	**-52.1**	**-10.9**	**-58.6**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**528**	**527**	**532**	**476**	**406**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**53.7**	**58.3**	**52.7**	**14.9**	**60.8**
ANC as CaCO3	----	0.1	% CaCO3	**5.5**	**6.0**	**5.4**	**1.5**	**6.2**
Fizz Rating	----	0	Fizz Unit	**2**	**2**	**2**	**1**	**2**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.03**	**0.02**	**0.02**	**0.13**	**0.07**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219242 WS3059	3219243 WS3059	3219244 WS3059	3219245 WS3059	3219246 WS3059
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-021	EB1925015-022	EB1925015-023	EB1925015-024	EB1925015-025
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**9.2**	**9.4**	**9.7**	**9.7**	**9.7**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-41.0**	**-26.6**	**-76.7**	**-80.5**	**-86.0**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**508**	**468**	**330**	**356**	**374**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**42.2**	**27.2**	**77.6**	**81.1**	**86.6**
ANC as CaCO3	----	0.1	% CaCO3	**4.3**	**2.8**	**7.9**	**8.3**	**8.8**
Fizz Rating	----	0	Fizz Unit	**2**	**1**	**2**	**2**	**2**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.04**	**0.02**	**0.03**	**0.02**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219247 WS3059	3219248 WS3059	3219249 WS3059	3219250 WS3059	3219251 WS3059
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-026	EB1925015-027	EB1925015-028	EB1925015-029	EB1925015-030
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.8	9.8	9.7	9.6	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-118	-223	-99.4	-56.4	-57.6
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	355	362	435	477	551
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	118	224	100	57.3	58.8
ANC as CaCO3	----	0.1	% CaCO3	12.0	22.8	10.2	5.8	6.0
Fizz Rating	----	0	Fizz Unit	3	3	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	0.02	0.02	0.03	0.04

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219252 WS3059	3219253 WS3059	3219254 WS3059	3219255 WS3082	3219256 WS3082
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-031	EB1925015-032	EB1925015-033	EB1925015-034	EB1925015-035
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.5	9.4	9.0	9.1
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-64.3	-71.6	-62.0	-37.6	-47.5
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	568	589	596	810	819
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	65.2	72.8	63.2	40.0	48.1
ANC as CaCO3	----	0.1	% CaCO3	6.6	7.4	6.4	4.1	4.9
Fizz Rating	----	0	Fizz Unit	2	2	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.04	0.04	0.08	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219257 WS3082	3219258 WS3082	3219259 WS3082	3219260 WS3082	3219261 WS3082
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-036	EB1925015-037	EB1925015-038	EB1925015-039	EB1925015-040
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**9.4**	**9.3**	**9.5**	**9.5**	**9.6**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-70.1**	**-38.9**	**-130**	**-35.2**	**-94.2**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**622**	**648**	**589**	**571**	**437**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**71.0**	**40.4**	**131**	**36.7**	**94.8**
ANC as CaCO3	----	0.1	% CaCO3	**7.2**	**4.1**	**13.3**	**3.7**	**9.7**
Fizz Rating	----	0	Fizz Unit	**2**	**2**	**2**	**1**	**2**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.03**	**0.05**	**0.02**	**0.05**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219262 WS3120	3219263 WS3120	3219264 WS3120	3219265 WS3120	3219266 WS3120
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-041	EB1925015-042	EB1925015-043	EB1925015-044	EB1925015-045
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**9.8**	**10.0**	**10.1**	**10.1**	**10.0**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-24.5**	**-80.3**	**-128**	**-135**	**-69.3**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**434**	**544**	**510**	**533**	**556**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**25.4**	**81.2**	**128**	**136**	**69.9**
ANC as CaCO3	----	0.1	% CaCO3	**2.6**	**8.3**	**13.0**	**13.8**	**7.1**
Fizz Rating	----	0	Fizz Unit	**1**	**2**	**2**	**2**	**2**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.03**	**0.03**	<0.01	**0.02**	**0.02**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219267 WS3120	3219268 WS3120	3219269 WS3120	3219270 WS3120	3219271 WS3120
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-046	EB1925015-047	EB1925015-048	EB1925015-049	EB1925015-050
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.9	9.6	10.0	9.8	9.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-61.0	-22.4	-57.9	-27.5	-49.4
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	528	530	516	570	525
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	61.9	26.4	58.5	28.7	50.0
ANC as CaCO3	----	0.1	% CaCO3	6.3	2.7	6.0	2.9	5.1
Fizz Rating	----	0	Fizz Unit	2	1	2	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.13	0.02	0.04	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219274 WS3155	3219275 WS3155	3219276 WS3155	3219277 WS3155	3219278 WS3155
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-051	EB1925015-052	EB1925015-053	EB1925015-054	EB1925015-055
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.9	9.0	8.9	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-4.9	-24.9	-223	-31.3	-93.5
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	977	960	849	1190	589
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	8.3	26.1	224	32.2	94.1
ANC as CaCO3	----	0.1	% CaCO3	0.8	2.7	22.8	3.3	9.6
Fizz Rating	----	0	Fizz Unit	1	1	3	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.11	0.04	0.02	0.03	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219279 WS3155	3219280 WS3155	3219281 WS3155	3219282 WS3155	3219283 WS3155
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1925015-056	EB1925015-057	EB1925015-058	EB1925015-059	EB1925015-060
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.0	9.2	9.3	9.1
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-101	-31.7	-81.9	-72.1	-57.2
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	599	697	635	625	810
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	101	32.3	82.8	73.0	57.8
ANC as CaCO3	----	0.1	% CaCO3	10.3	3.3	8.4	7.4	5.9
Fizz Rating	----	0	Fizz Unit	2	1	2	2	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.02	0.03	0.03	0.02

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219284 WS3155	3219285 WS3155	3219286 WS3155	3219287 WS3155	----
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	----
Compound	CAS Number	LOR	Unit	EB1925015-061	EB1925015-062	EB1925015-063	EB1925015-064	--------
				Result	Result	Result	Result	----
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**9.2**	**9.2**	**8.7**	**8.5**	**----**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-29.8**	**-138**	**-57.6**	**-20.0**	**----**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**737**	**646**	**1080**	**1180**	**----**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**30.7**	**139**	**57.9**	**21.8**	**----**
ANC as CaCO3	----	0.1	% CaCO3	**3.1**	**14.1**	**5.9**	**2.2**	**----**
Fizz Rating	----	0	Fizz Unit	**1**	**2**	**2**	**1**	**----**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.03**	**0.02**	**0.01**	**0.06**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1928624**	Page	: 1 of 15
Client	: **WHITEHAVEN COAL MINING LIMITED**	Laboratory	: Environmental Division Brisbane
Contact	: MR IAN SWANE	Contact	: Customer Services EB
Address	: PO BOX 600 GUNNEDAH NSW, AUSTRALIA 2380	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Winchester South	Date Samples Received	: 28-Oct-2019 13:50
Order number	: PO Not Required	Date Analysis Commenced	: 01-Nov-2019
C-O-C number	: ----	Issue Date	: 19-Nov-2019 13:25
Sampler	: ----		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 27		
No. of samples analysed	: 27		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED040T (Sulfate as SO42 - Total) : Sample EB1929122-001 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio for some samples as the required results for Magnesium/Potassium are below LOR.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130203 EB1913513-003	130208 EB1913513-008	130214 EB1913513-014	130215 EB1913513-015	130227 EB1913513-020
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1928624-001	EB1928624-002	EB1928624-003	EB1928624-004	EB1928624-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.3	9.8	9.8	----	8.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1170	331	436	----	1100
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	----	8.6	8.7	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	----	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	----	<0.1	<0.1	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	0.043	0.033	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Dark Grayish Brown (10YR 4/2)	Grayish Brown (10YR 5/2)	Black (10YR 2/1)	----	Dark Brown (7.5YR 3/3)
Texture	----	-	-	Sandy Clay	Sandy Clay Loam	Clay Loam	----	Sandy Clay
Emerson Class Number	EC/TC	-	-	2	2	4	----	4
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	2.6	2.8	----	6.4
ø Exchangeable Magnesium	----	0.2	meq/100g	----	4.9	7.1	----	6.6
ø Exchangeable Potassium	----	0.2	meq/100g	----	0.2	0.6	----	0.2
ø Exchangeable Sodium	----	0.2	meq/100g	----	2.6	3.6	----	3.8
ø Cation Exchange Capacity	----	0.2	meq/100g	----	10.4	14.1	----	17.1
ø Exchangeable Sodium Percent	----	0.2	%	----	25.3	25.6	----	22.4
ø Calcium/Magnesium Ratio	----	0.2	-	----	0.5	0.4	----	1.0
ø Magnesium/Potassium Ratio	----	0.2	-	----	19.2	12.7	----	26.2
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	10.5	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	9.3	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	2.8	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	23.2	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	12.2	----	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	1.1	----	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	23.6	----	----	----	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	945	6260	5690	----	7210

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	130203 EB1913513-003	130208 EB1913513-008	130214 EB1913513-014	130215 EB1913513-015	130227 EB1913513-020
				Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1928624-001	EB1928624-002	EB1928624-003	EB1928624-004	EB1928624-005
					Result	Result	Result	Result	Result
ED037: Alkalinity - Continued									
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg		945	5840	4990	----	7210
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg		<5	420	700	----	<5
ED040: Sulfur as SO4 2-									
Sulfate as SO4 2-	14808-79-8	100	mg/kg		----	----	210	230	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		70	20	150	----	60
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		1690	180	240	----	1400
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		40	<10	<10	----	50
Magnesium	7439-95-4	10	mg/kg		40	<10	<10	----	40
Sodium	7440-23-5	10	mg/kg		1060	350	460	----	950
Potassium	7440-09-7	10	mg/kg		20	<10	20	----	<10
EG005(ED093)S : Soluble Metals by ICPAES									
Aluminium	7429-90-5	1	mg/kg		<1	<1	<1	----	<1
Arsenic	7440-38-2	0.1	mg/kg		<0.1	<0.1	0.4	----	<0.1
Barium	7440-39-3	1	mg/kg		<1	<1	<1	----	<1
Beryllium	7440-41-7	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Boron	7440-42-8	1	mg/kg		<1	<1	<1	----	2
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Chromium	7440-47-3	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Cobalt	7440-48-4	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Copper	7440-50-8	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Iron	7439-89-6	1	mg/kg		<1	<1	<1	----	<1
Lead	7439-92-1	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Manganese	7439-96-5	0.1	mg/kg		0.1	<0.1	<0.1	----	0.2
Nickel	7440-02-0	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Selenium	7782-49-2	0.1	mg/kg		<0.1	<0.1	0.1	----	<0.1
Vanadium	7440-62-2	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
Zinc	7440-66-6	0.1	mg/kg		<0.1	<0.1	<0.1	----	<0.1
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		<0.0005	<0.0005	<0.0005	----	<0.0005
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%		0.28	2.15	3.97	----	1.23

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)	Client sample ID	130203 EB1913513-003	130208 EB1913513-008	130214 EB1913513-014	130215 EB1913513-015	130227 EB1913513-020
	Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00
Compound	CAS Number LOR Unit	EB1928624-001	EB1928624-002	EB1928624-003	EB1928624-004	EB1928624-005
		Result	Result	Result	Result	Result
EP003TC: Total Carbon (TC) in Soil - Continued						

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	130233 EB1913513-026	130246 EB1913513-039	130251 EB1913513-043	130259 EB1913513-051	3219215 EB1925015-001
			Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1928624-006	EB1928624-007	EB1928624-008	EB1928624-009	EB1928624-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	8.7	8.2	9.7	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	512	190	605	589	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	8.2	----	8.5	8.6
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	----	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	----	<0.1	<0.1
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	0.077	----	0.087	0.047
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Grayish Brown (10YR 5/2)	Black (10YR 2/1)	Dark Gray (7.5YR 4/1)	Black (10YR 2/1)	----
Texture	----	-	-	Sandy Clay Loam	Loamy Sand	Sandy Clay Loam	Clay Loam	----
Emerson Class Number	EC/TC	-	-	2	4	2	4	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.5	2.8	4.1	2.6	----
ø Exchangeable Magnesium	----	0.2	meq/100g	6.4	3.1	5.1	6.1	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	<0.2	<0.2	0.4	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.8	1.3	2.8	3.3	----
ø Cation Exchange Capacity	----	0.2	meq/100g	13.1	7.4	11.9	12.5	----
ø Exchangeable Sodium Percent	----	0.2	%	21.6	17.7	23.2	26.6	----
ø Calcium/Magnesium Ratio	----	0.2	-	0.5	0.9	0.8	0.4	----
ø Magnesium/Potassium Ratio	----	0.2	-	18.7	----	----	15.4	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	1860	385	402	1920	----
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	1540	385	402	1750	----
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	315	<5	<5	175	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	----	260	----	300	470
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	160	10	200	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	560	130	860	530	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	130233 EB1913513-026	130246 EB1913513-039	130251 EB1913513-043	130259 EB1913513-051	3219215 EB1925015-001
				Client sampling date / time	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	20-May-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EB1928624-006	EB1928624-007	EB1928624-008	EB1928624-009	EB1928624-010
					Result	Result	Result	Result	Result
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		<10	<10	<10	<10	----
Magnesium	7439-95-4	10	mg/kg		<10	<10	<10	<10	----
Sodium	7440-23-5	10	mg/kg		**510**	**210**	**550**	**570**	----
Potassium	7440-09-7	10	mg/kg		**10**	<10	<10	**10**	----
EG005(ED093)S : Soluble Metals by ICPAES									
Aluminium	7429-90-5	1	mg/kg		<1	<1	<1	<1	----
Arsenic	7440-38-2	0.1	mg/kg		<0.1	<0.1	<0.1	**0.2**	----
Barium	7440-39-3	1	mg/kg		<1	<1	<1	<1	----
Beryllium	7440-41-7	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Boron	7440-42-8	1	mg/kg		<1	<1	<1	<1	----
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Chromium	7440-47-3	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Cobalt	7440-48-4	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Copper	7440-50-8	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Iron	7439-89-6	1	mg/kg		<1	<1	<1	<1	----
Lead	7439-92-1	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Manganese	7439-96-5	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Nickel	7440-02-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Selenium	7782-49-2	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Vanadium	7440-62-2	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Zinc	7440-66-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		<0.0005	<0.0005	<0.0005	<0.0005	----
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%		**1.24**	**2.14**	**1.05**	**4.57**	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219216 EB1925015-002	3219218 EB1925015-004	3219219 EB1925015-005	3219220 EB1925015-006	3219221 EB1925015-007
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1928624-011	EB1928624-012	EB1928624-013	EB1928624-014	EB1928624-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.4	----	9.5	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	256	----	311	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.8	9.2	9.0	8.7	8.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.050	0.061	0.078	0.054	0.048
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Very Dark Gray (10YR 3/1)	----	Black (10YR 2/1)	----	----
Texture	----	-	-	Loamy Sand	----	Clay Loam	----	----
Emerson Class Number	EC/TC	-	-	4	----	2	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	3.5	----	4.2	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	3.5	----	4.3	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	----	0.5	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	1.3	----	2.4	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	8.6	----	11.4	----	----
ø Exchangeable Sodium Percent	----	0.2	%	15.1	----	21.4	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.0	----	1.0	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	12.4	----	8.2	----	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	5860	----	1800	----	----
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	5700	----	1610	----	----
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	158	----	192	----	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	290	180	190	260	230
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	140	----	140	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	80	----	100	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3219216 EB1925015-002	3219218 EB1925015-004	3219219 EB1925015-005	3219220 EB1925015-006	3219221 EB1925015-007
				Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EB1928624-011	EB1928624-012	EB1928624-013	EB1928624-014	EB1928624-015
					Result	Result	Result	Result	Result
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		**10**	----	<10	----	----
Magnesium	7439-95-4	10	mg/kg		<10	----	<10	----	----
Sodium	7440-23-5	10	mg/kg		**250**	----	**310**	----	----
Potassium	7440-09-7	10	mg/kg		**20**	----	**20**	----	----
EG005(ED093)S : Soluble Metals by ICPAES									
Aluminium	7429-90-5	1	mg/kg		<1	----	<1	----	----
Arsenic	7440-38-2	0.1	mg/kg		**0.6**	----	**0.5**	----	----
Barium	7440-39-3	1	mg/kg		<1	----	<1	----	----
Beryllium	7440-41-7	0.1	mg/kg		<0.1	----	<0.1	----	----
Boron	7440-42-8	1	mg/kg		<1	----	<1	----	----
Cadmium	7440-43-9	0.1	mg/kg		<0.1	----	<0.1	----	----
Chromium	7440-47-3	0.1	mg/kg		<0.1	----	<0.1	----	----
Cobalt	7440-48-4	0.1	mg/kg		<0.1	----	<0.1	----	----
Copper	7440-50-8	0.1	mg/kg		<0.1	----	<0.1	----	----
Iron	7439-89-6	1	mg/kg		<1	----	<1	----	----
Lead	7439-92-1	0.1	mg/kg		<0.1	----	<0.1	----	----
Manganese	7439-96-5	0.1	mg/kg		<0.1	----	<0.1	----	----
Nickel	7440-02-0	0.1	mg/kg		<0.1	----	<0.1	----	----
Selenium	7782-49-2	0.1	mg/kg		<0.1	----	**0.1**	----	----
Vanadium	7440-62-2	0.1	mg/kg		<0.1	----	<0.1	----	----
Zinc	7440-66-6	0.1	mg/kg		<0.1	----	<0.1	----	----
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		<0.0005	----	<0.0005	----	----
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%		**4.87**	----	**3.50**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219224 EB1925015-010	3219230 EB1925015-016	3219240 EB1925015-019	3219241 EB1925015-020	3219246 EB1925015-025
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1928624-016	EB1928624-017	EB1928624-018	EB1928624-019	EB1928624-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	9.8	----	9.2	9.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	358	----	249	236
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.4	----	6.8	9.6	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	0.3	<0.1	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.021	----	0.044	0.029	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	----	Black (10YR 2/1)	----	Very Dark Gray (10YR 3/1)	Dark Gray (5Y 4/1)
Texture	----	-	-	----	Loamy Sand	----	Loamy Sand	Loamy Sand
Emerson Class Number	EC/TC	-	-	----	2	----	2	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	4.6	----	3.8	3.1
ø Exchangeable Magnesium	----	0.2	meq/100g	----	2.7	----	3.1	2.5
ø Exchangeable Potassium	----	0.2	meq/100g	----	0.6	----	0.2	0.3
ø Exchangeable Sodium	----	0.2	meq/100g	----	4.1	----	1.2	1.3
ø Cation Exchange Capacity	----	0.2	meq/100g	----	12.1	----	8.3	7.3
ø Exchangeable Sodium Percent	----	0.2	%	----	34.2	----	14.4	18.2
ø Calcium/Magnesium Ratio	----	0.2	-	----	1.7	----	1.2	1.2
ø Magnesium/Potassium Ratio	----	0.2	-	----	4.2	----	12.1	9.0
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	----	2160	----	3060	2310
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	1650	----	2620	2140
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	508	----	438	175
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	120	----	490	360	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	120	----	120	110
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	40	----	80	50

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	3219224 EB1925015-010	3219230 EB1925015-016	3219240 EB1925015-019	3219241 EB1925015-020	3219246 EB1925015-025
				Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
					EB1928624-016	EB1928624-017	EB1928624-018	EB1928624-019	EB1928624-020
					Result	Result	Result	Result	Result
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		----	<10	----	**10**	<10
Magnesium	7439-95-4	10	mg/kg		----	<10	----	<10	<10
Sodium	7440-23-5	10	mg/kg		----	**380**	----	**250**	**240**
Potassium	7440-09-7	10	mg/kg		----	**20**	----	**10**	**20**
EG005(ED093)S : Soluble Metals by ICPAES									
Aluminium	7429-90-5	1	mg/kg		----	<1	----	<1	<1
Arsenic	7440-38-2	0.1	mg/kg		----	**0.8**	----	**0.4**	**2.0**
Barium	7440-39-3	1	mg/kg		----	<1	----	<1	<1
Beryllium	7440-41-7	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Boron	7440-42-8	1	mg/kg		----	<1	----	<1	<1
Cadmium	7440-43-9	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Chromium	7440-47-3	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Copper	7440-50-8	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Iron	7439-89-6	1	mg/kg		----	<1	----	<1	<1
Lead	7439-92-1	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Selenium	7782-49-2	0.1	mg/kg		----	**0.1**	----	<0.1	<0.1
Vanadium	7440-62-2	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/kg		----	<0.1	----	<0.1	<0.1
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		----	<0.0005	----	<0.0005	<0.0005
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%		----	**2.73**	----	**10.2**	**1.68**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219252 EB1925015-031	3219255 EB1925015-034	3219264 EB1925015-043	3219268 EB1925015-047	3219274 EB1925015-051
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1928624-021	EB1928624-022	EB1928624-023	EB1928624-024	EB1928624-025
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.0	10.0	9.6	8.3
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	329	406	285	237	457
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	8.5	----	8.2	6.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	----	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	----	<0.1	0.2
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	0.110	----	0.094	0.048
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Black (10YR 2/1)	Black (10YR 2/1)	Dark Gray (10YR 4/1)	Black (10YR 2/1)	Black (5Y 2.5/1)
Texture	----	-	-	Loamy Sand	Sandy Clay Loam	Sand	Sand	Clay Loam
Emerson Class Number	EC/TC	-	-	3	4	8	8	2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	4.3	3.6	1.8	3.7	4.4
ø Exchangeable Magnesium	----	0.2	meq/100g	3.3	3.8	1.0	1.7	3.7
ø Exchangeable Potassium	----	0.2	meq/100g	0.5	0.6	<0.2	0.5	0.4
ø Exchangeable Sodium	----	0.2	meq/100g	3.0	2.3	2.1	5.9	1.3
ø Cation Exchange Capacity	----	0.2	meq/100g	11.1	10.2	5.1	11.8	9.8
ø Exchangeable Sodium Percent	----	0.2	%	27.0	22.4	41.0	49.7	13.3
ø Calcium/Magnesium Ratio	----	0.2	-	1.3	0.9	1.8	2.1	1.2
ø Magnesium/Potassium Ratio	----	0.2	-	6.8	6.4	----	3.6	10.0
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	3130	1310	2060	1590	560
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	2850	1280	1820	1560	560
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	280	35	245	35	<5
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	----	360	----	280	560
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	110	220	60	230	170
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	110	290	30	30	450
ED093S: Soluble Major Cations								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3219252 EB1925015-031	3219255 EB1925015-034	3219264 EB1925015-043	3219268 EB1925015-047	3219274 EB1925015-051
				Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00	10-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EB1928624-021	EB1928624-022	EB1928624-023	EB1928624-024	EB1928624-025
					Result	Result	Result	Result	Result
ED093S: Soluble Major Cations - Continued									
Calcium	7440-70-2	10	mg/kg		<10	<10	<10	<10	**10**
Magnesium	7439-95-4	10	mg/kg		<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg		**360**	**400**	**350**	**320**	**410**
Potassium	7440-09-7	10	mg/kg		**10**	**30**	<10	<10	**20**
EG005(ED093)S : Soluble Metals by ICPAES									
Aluminium	7429-90-5	1	mg/kg		<1	<1	<1	<1	<1
Arsenic	7440-38-2	0.1	mg/kg		**0.3**	**0.2**	**0.4**	<0.1	**1.2**
Barium	7440-39-3	1	mg/kg		<1	<1	<1	<1	<1
Beryllium	7440-41-7	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Boron	7440-42-8	1	mg/kg		<1	<1	<1	<1	<1
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	1	mg/kg		<1	<1	<1	<1	<1
Lead	7439-92-1	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.1	mg/kg		<0.1	**0.1**	<0.1	**0.1**	**0.1**
Vanadium	7440-62-2	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%		**3.06**	**6.33**	**3.21**	**8.37**	**5.69**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219281 EB1925015-058	3219287 EB1925015-064	----	----	----
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1928624-026	EB1928624-027	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	8.5	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	329	545	----	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	----	8.2	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	----	<0.1	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	----	<0.1	----	----	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	0.038	----	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Black (10YR 2/1)	Black (10YR 2/1)	----	----	----
Texture	----	-	-	Sandy Clay Loam	Sandy Clay Loam	----	----	----
Emerson Class Number	EC/TC	-	-	2	4	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	5.6	5.8	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	4.4	4.6	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.5	0.6	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.2	2.0	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	12.8	13.0	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	17.1	15.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.2	1.2	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	8.4	7.1	----	----	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	1660	858	----	----	----
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	1560	858	----	----	----
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	105	<5	----	----	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	----	480	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	90	240	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	200	510	----	----	----
ED093S: Soluble Major Cations								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3219281 EB1925015-058	3219287 EB1925015-064	----	----	----
			Client sampling date / time	10-Sep-2019 00:00	10-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1928624-026	EB1928624-027	--------	--------	--------
				Result	Result	----	----	----
ED093S: Soluble Major Cations - Continued								
Calcium	7440-70-2	10	mg/kg	<10	**20**	----	----	----
Magnesium	7439-95-4	10	mg/kg	<10	**10**	----	----	----
Sodium	7440-23-5	10	mg/kg	**340**	**470**	----	----	----
Potassium	7440-09-7	10	mg/kg	**20**	**40**	----	----	----
EG005(ED093)S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	<1	<1	----	----	----
Arsenic	7440-38-2	0.1	mg/kg	**0.8**	<0.1	----	----	----
Barium	7440-39-3	1	mg/kg	<1	<1	----	----	----
Beryllium	7440-41-7	0.1	mg/kg	<0.1	<0.1	----	----	----
Boron	7440-42-8	1	mg/kg	<1	<1	----	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	----	----	----
Chromium	7440-47-3	0.1	mg/kg	<0.1	<0.1	----	----	----
Cobalt	7440-48-4	0.1	mg/kg	<0.1	<0.1	----	----	----
Copper	7440-50-8	0.1	mg/kg	<0.1	<0.1	----	----	----
Iron	7439-89-6	1	mg/kg	<1	<1	----	----	----
Lead	7439-92-1	0.1	mg/kg	<0.1	<0.1	----	----	----
Manganese	7439-96-5	0.1	mg/kg	<0.1	<0.1	----	----	----
Nickel	7440-02-0	0.1	mg/kg	<0.1	<0.1	----	----	----
Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	----	----	----
Vanadium	7440-62-2	0.1	mg/kg	<0.1	<0.1	----	----	----
Zinc	7440-66-6	0.1	mg/kg	<0.1	<0.1	----	----	----
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
EP003TC: Total Carbon (TC) in Soil								
Total Carbon	TC	0.02	%	**2.83**	**3.72**	----	----	----

ALS Environmental

Acid Buffering Characteristic Curve (ABCC) REPORT

Batch: EB1928780

CONTACT:	MR IAN SWANE	**LABORATORY:**	Brisbane
CLIENT:	WHITEHAVEN COAL MINING LIMITED	**DATE SAMPLED:**	As per report
		DATE RECEIVED:	28/10/2019
ADDRESS:	PO BOX 600	**DATE COMPLETED:**	8/11/2019
	GUNNEDAH NSW, 2380	**SAMPLE TYPE:**	Soil
		No. of SAMPLES:	8

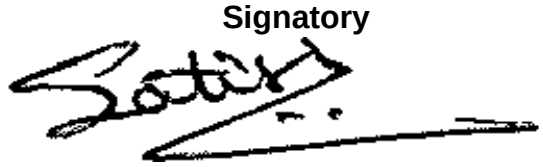
COMMENTS

EA046 : NATA accreditation does not cover performance of this service.

ISSUING LABORATORY: ALS BRISBANE

Address:	2 Byth Street STAFFORD QLD 4053 AUSTRALIA	**Telephone:** **Facsimile:** **E-mail:**	07 3243 7222 07 3243 7218 Satishkumar.Trivedi@alsglobal.com

Signatory



Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			130214
	Client Sample Identification 2			
	Sample Date			20/05/2019
Method	Analyte	Units	LOR	

	001
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.1**
Increments:	**mL**	**0.5**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**33.6**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.74				
1	0.5	1.225	8.61				
2	1	2.45	8.15				
3	1.5	3.675	7.91				
4	2	4.9	7.71				
5	2.5	6.125	7.50				
6	3	7.35	7.18				
7	3.5	8.575	6.80				
8	4	9.8	6.40				
9	4.5	11.025	6.04				
10	5	12.25	5.70				
11	5.5	13.475	5.37				
12	6	14.7	5.10				
13	6.5	15.925	4.87				
14	7	17.15	4.62				
15	7.5	18.375	4.34				
16	8	19.6	4.02				
17	8.5	20.825	3.72				
18	9	22.05	3.48				
19	9.5	23.275	3.30				
20	10	24.5	3.17				
21	10.5	25.725	3.05				
22	11	26.95	2.96				
23	11.5	28.175	2.88				
24	12	29.4	2.81				
25	12.5	30.625	2.75				
26	13	31.85	2.69				
27	13.5	33.075	2.64				
28	14	34.3	2.60				
29	14.5	35.525	2.55				
30	15	36.75	2.52				
31	15.5	37.975	2.48				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			130214
	Client Sample Identification 2			
	Sample Date			20/05/2019
Method	Analyte	Units	LOR	

001	Check
EB1928780	

EA046 - A Titration information

HCl Molarity:	**M**	**0.1**
Increments:	**mL**	**0.5**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**33.6**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.79				
1	0.5	1.225	8.72				
2	1	2.45	8.21				
3	1.5	3.675	7.95				
4	2	4.9	7.75				
5	2.5	6.125	7.58				
6	3	7.35	7.34				
7	3.5	8.575	7.06				
8	4	9.8	6.73				
9	4.5	11.025	6.39				
10	5	12.25	6.02				
11	5.5	13.475	5.65				
12	6	14.7	5.29				
13	6.5	15.925	5.00				
14	7	17.15	4.70				
15	7.5	18.375	4.37				
16	8	19.6	4.01				
17	8.5	20.825	3.69				
18	9	22.05	3.46				
19	9.5	23.275	3.29				
20	10	24.5	3.16				
21	10.5	25.725	3.05				
22	11	26.95	2.96				
23	11.5	28.175	2.88				
24	12	29.4	2.81				
25	12.5	30.625	2.75				
26	13	31.85	2.70				
27	13.5	33.075	2.65				
28	14	34.3	2.60				
29	14.5	35.525	2.56				
30	15	36.75	2.52				
31	15.5	37.975	2.49				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			130233
	Client Sample Identification 2			
	Sample Date			20/05/2019
Method	Analyte	Units	LOR	

	002
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**90.5**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.73	36	7.2	88.2	2.89
1	0.2	2.45	8.41	37	7.4	90.65	2.74
2	0.4	4.9	7.78	38	7.6	93.1	2.62
3	0.6	7.35	7.45	39	7.8	95.55	2.52
4	0.8	9.8	7.24	40	8	98	2.44
5	1	12.25	7.11				
6	1.2	14.7	7.01				
7	1.4	17.15	6.92				
8	1.6	19.6	6.84				
9	1.8	22.05	6.76				
10	2	24.5	6.69				
11	2.2	26.95	6.63				
12	2.4	29.4	6.56				
13	2.6	31.85	6.50				
14	2.8	34.3	6.45				
15	3	36.75	6.39				
16	3.2	39.2	6.35				
17	3.4	41.65	6.30				
18	3.6	44.1	6.25				
19	3.8	46.55	6.20				
20	4	49	6.14				
21	4.2	51.45	6.09				
22	4.4	53.9	6.03				
23	4.6	56.35	5.96				
24	4.8	58.8	5.89				
25	5	61.25	5.81				
26	5.2	63.7	5.72				
27	5.4	66.15	5.62				
28	5.6	68.6	5.48				
29	5.8	71.05	5.32				
30	6	73.5	5.12				
31	6.2	75.95	4.86				
32	6.4	78.4	4.53				
33	6.6	80.85	4.04				
34	6.8	83.3	3.45				
35	7	85.75	3.10				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			130246
	Client Sample Identification 2			
	Sample Date			20/05/2019
Method	Analyte	Units	LOR	

	003
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.1**
Increments:	**mL**	**0.5**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**23.3**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	7.92				
1	0.5	1.225	5.38				
2	1	2.45	4.66				
3	1.5	3.675	4.29				
4	2	4.9	4.02				
5	2.5	6.125	3.80				
6	3	7.35	3.62				
7	3.5	8.575	3.47				
8	4	9.8	3.34				
9	4.5	11.025	3.23				
10	5	12.25	3.13				
11	5.5	13.475	3.04				
12	6	14.7	2.97				
13	6.5	15.925	2.90				
14	7	17.15	2.83				
15	7.5	18.375	2.77				
16	8	19.6	2.72				
17	8.5	20.825	2.67				
18	9	22.05	2.62				
19	9.5	23.275	2.58				
20	10	24.5	2.54				
21	10.5	25.725	2.50				
22	11	26.95	2.47				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			3219216
	Client Sample Identification 2			
	Sample Date			10/09/2019
Method	Analyte	Units	LOR	

	004
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.4**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**123**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.26				
1	0.4	4.9	7.75				
2	0.8	9.8	6.99				
3	1.2	14.7	6.68				
4	1.6	19.6	6.48				
5	2	24.5	6.27				
6	2.4	29.4	6.16				
7	2.8	34.3	6.01				
8	3.2	39.2	5.94				
9	3.6	44.1	5.87				
10	4	49	5.81				
11	4.4	53.9	5.76				
12	4.8	58.8	5.69				
13	5.2	63.7	5.65				
14	5.6	68.6	5.61				
15	6	73.5	5.59				
16	6.4	78.4	5.58				
17	6.8	83.3	5.56				
18	7.2	88.2	5.52				
19	7.6	93.1	5.47				
20	8	98	5.39				
21	8.4	102.9	5.33				
22	8.8	107.8	5.26				
23	9.2	112.7	5.14				
24	9.6	117.6	5.00				
25	10	122.5	4.77				
26	10.4	127.4	4.41				
27	10.8	132.3	3.60				
28	11.2	137.2	3.01				
29	11.6	142.1	2.73				
30	12	147	2.55				
31	12.4	151.9	2.42				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			3219241
	Client Sample Identification 2			
	Sample Date			10/09/2019
Method	Analyte	Units	LOR	

	005
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**60.8**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.55				
1	0.2	2.45	8.13				
2	0.4	4.9	6.97				
3	0.6	7.35	6.56				
4	0.8	9.8	6.35				
5	1	12.25	6.22				
6	1.2	14.7	6.11				
7	1.4	17.15	6.01				
8	1.6	19.6	5.91				
9	1.8	22.05	5.79				
10	2	24.5	5.67				
11	2.2	26.95	5.54				
12	2.4	29.4	5.44				
13	2.6	31.85	5.30				
14	2.8	34.3	5.17				
15	3	36.75	5.04				
16	3.2	39.2	4.87				
17	3.4	41.65	4.73				
18	3.6	44.1	4.59				
19	3.8	46.55	4.40				
20	4	49	4.24				
21	4.2	51.45	4.00				
22	4.4	53.9	3.73				
23	4.6	56.35	3.47				
24	4.8	58.8	3.26				
25	5	61.25	3.09				
26	5.2	63.7	2.93				
27	5.4	66.15	2.80				
28	5.6	68.6	2.68				
29	5.8	71.05	2.58				
30	6	73.5	2.50				
31	6.2	75.95	2.43				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			3219255
	Client Sample Identification 2			
	Sample Date			10/09/2019
Method	Analyte	Units	LOR	

	006
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.1**
Increments:	**mL**	**0.5**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**40**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	8.83				
1	0.5	1.225	7.32				
2	1	2.45	6.77				
3	1.5	3.675	6.33				
4	2	4.9	6.07				
5	2.5	6.125	5.86				
6	3	7.35	5.66				
7	3.5	8.575	5.46				
8	4	9.8	5.30				
9	4.5	11.025	5.17				
10	5	12.25	5.05				
11	5.5	13.475	4.94				
12	6	14.7	4.83				
13	6.5	15.925	4.74				
14	7	17.15	4.62				
15	7.5	18.375	4.50				
16	8	19.6	4.33				
17	8.5	20.825	4.12				
18	9	22.05	3.84				
19	9.5	23.275	3.57				
20	10	24.5	3.35				
21	10.5	25.725	3.19				
22	11	26.95	3.06				
23	11.5	28.175	2.96				
24	12	29.4	2.88				
25	12.5	30.625	2.81				
26	13	31.85	2.75				
27	13.5	33.075	2.70				
28	14	34.3	2.65				
29	14.5	35.525	2.61				
30	15	36.75	2.56				
31	15.5	37.975	2.53				
32	16	39.2	2.49				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			3219268
	Client Sample Identification 2			
	Sample Date			10/09/2019
Method	Analyte	Units	LOR	

	007
	EB1928780

EA046 - A Titration information

HCl Molarity:	**M**	**0.1**
Increments:	**mL**	**0.5**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**26.4**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	8.35				
1	0.5	1.225	6.58				
2	1	2.45	5.31				
3	1.5	3.675	4.77				
4	2	4.9	4.28				
5	2.5	6.125	3.87				
6	3	7.35	3.57				
7	3.5	8.575	3.37				
8	4	9.8	3.21				
9	4.5	11.025	3.08				
10	5	12.25	2.97				
11	5.5	13.475	2.88				
12	6	14.7	2.81				
13	6.5	15.925	2.74				
14	7	17.15	2.68				
15	7.5	18.375	2.63				
16	8	19.6	2.59				
17	8.5	20.825	2.55				
18	9	22.05	2.52				
19	9.5	23.275	2.49				

Work Order :	EB1928780	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			3219281
	Client Sample Identification 2			
	Sample Date			10/09/2019
Method	Analyte	Units	LOR	

	008
	EB1928780

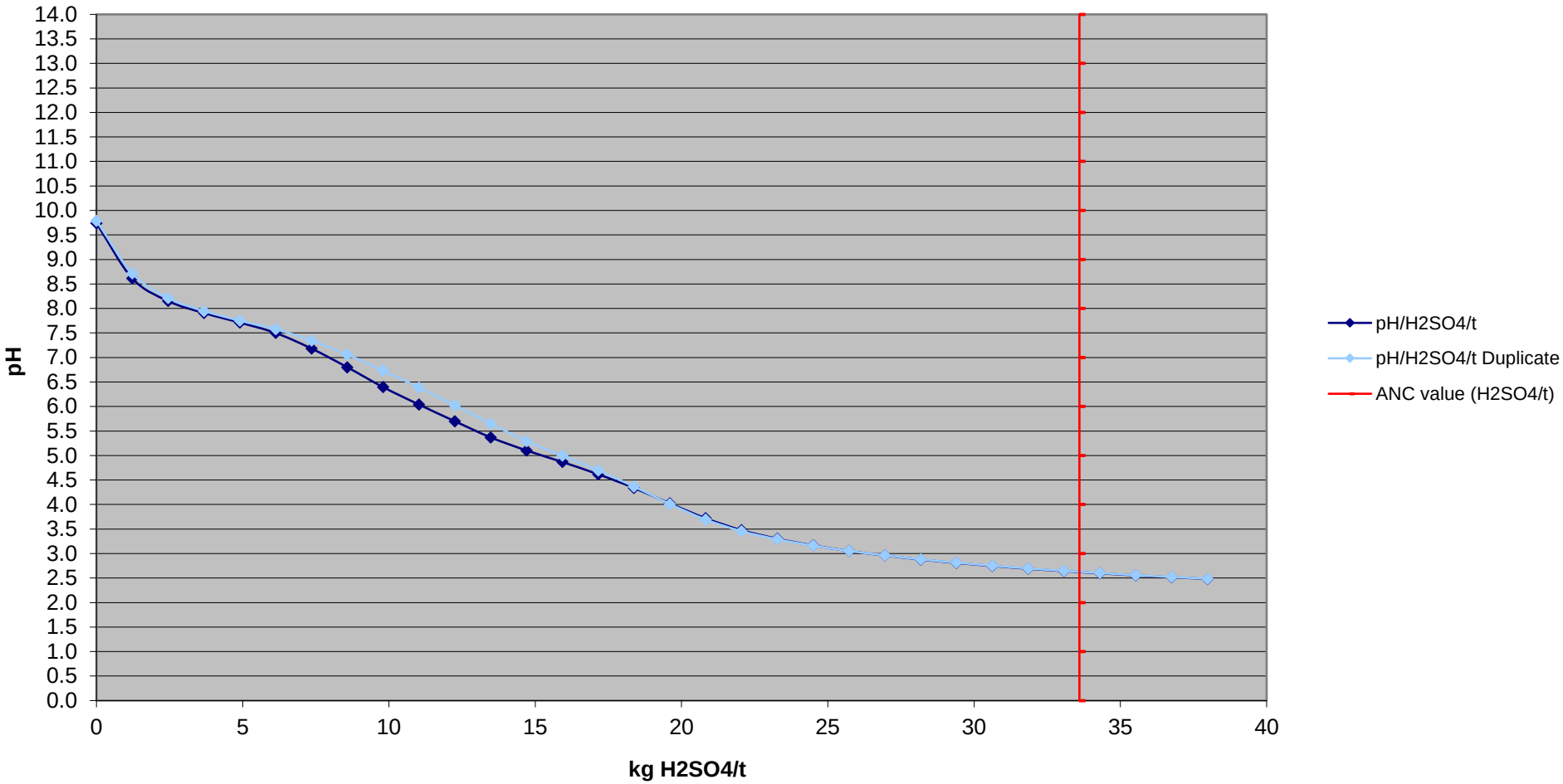
EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**82.8**

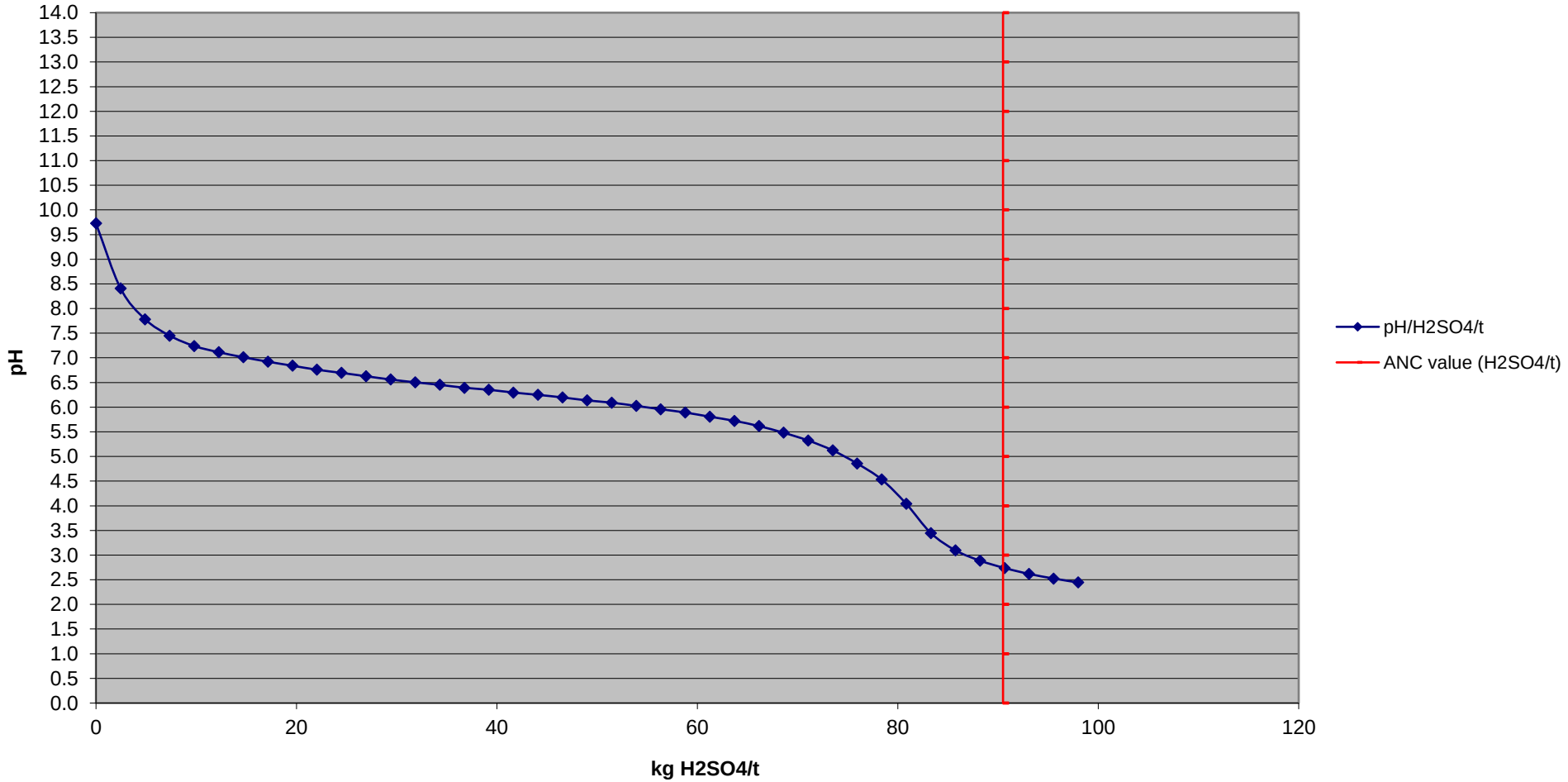
EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.23	36	7.2	88.2	2.43
1	0.2	2.45	8.36				
2	0.4	4.9	7.99				
3	0.6	7.35	7.82				
4	0.8	9.8	7.65				
5	1	12.25	7.52				
6	1.2	14.7	7.35				
7	1.4	17.15	7.18				
8	1.6	19.6	7.02				
9	1.8	22.05	6.89				
10	2	24.5	6.76				
11	2.2	26.95	6.64				
12	2.4	29.4	6.54				
13	2.6	31.85	6.42				
14	2.8	34.3	6.34				
15	3	36.75	6.25				
16	3.2	39.2	6.15				
17	3.4	41.65	6.07				
18	3.6	44.1	5.97				
19	3.8	46.55	5.85				
20	4	49	5.77				
21	4.2	51.45	5.64				
22	4.4	53.9	5.48				
23	4.6	56.35	5.32				
24	4.8	58.8	5.11				
25	5	61.25	4.90				
26	5.2	63.7	4.69				
27	5.4	66.15	4.46				
28	5.6	68.6	4.11				
29	5.8	71.05	3.58				
30	6	73.5	3.21				
31	6.2	75.95	2.96				
32	6.4	78.4	2.80				
33	6.6	80.85	2.68				
34	6.8	83.3	2.58				
35	7	85.75	2.51				

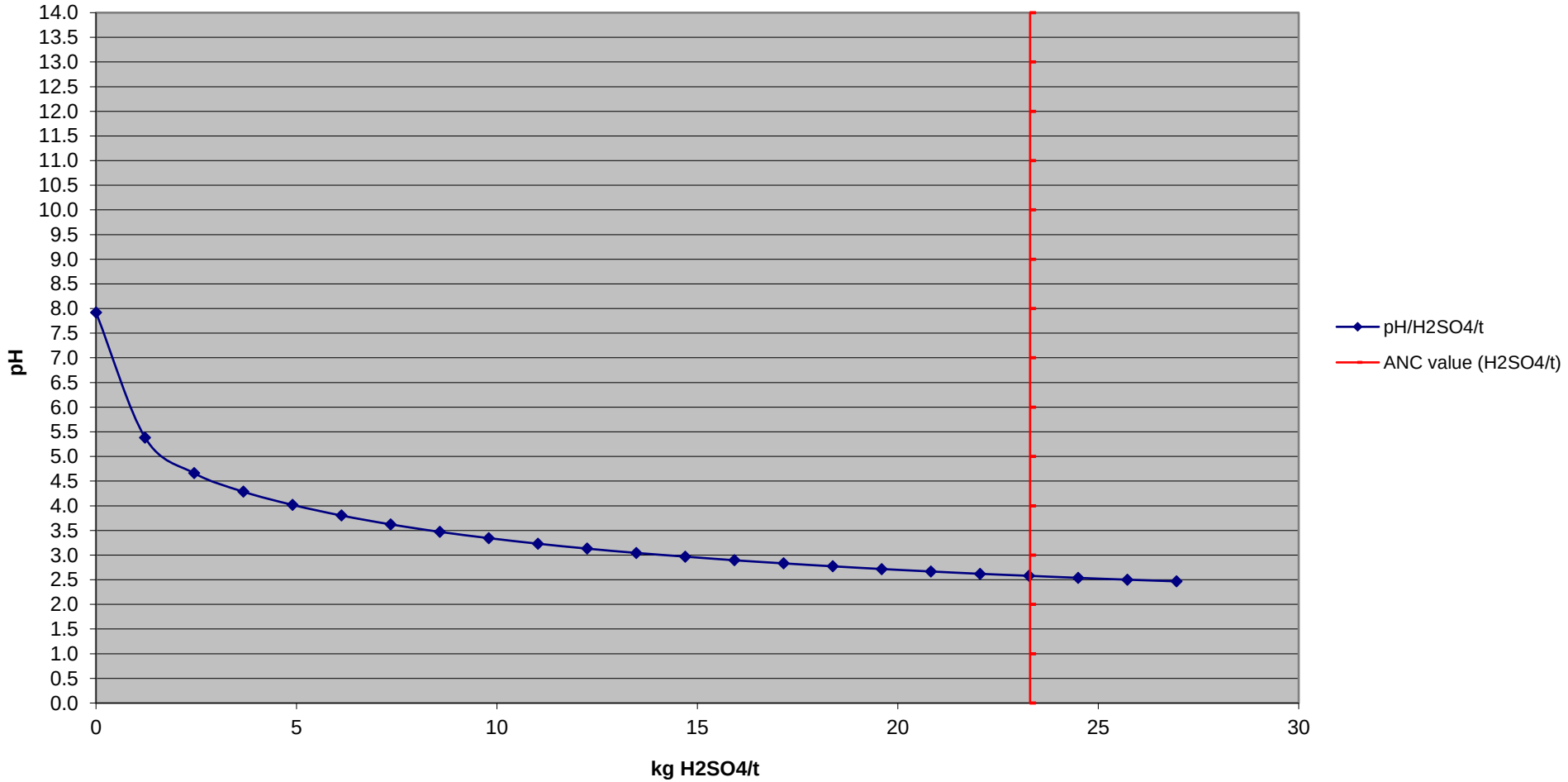
EB1928780 - 001 and Check 001 (130214)
Acid Buffering Characteristic Curve
Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds



EB1928780 - 002 (130233)
Acid Buffering Characteristic Curve
Titrating with 0.5M HCl, in increments of 0.2 mLs every 1000 seconds

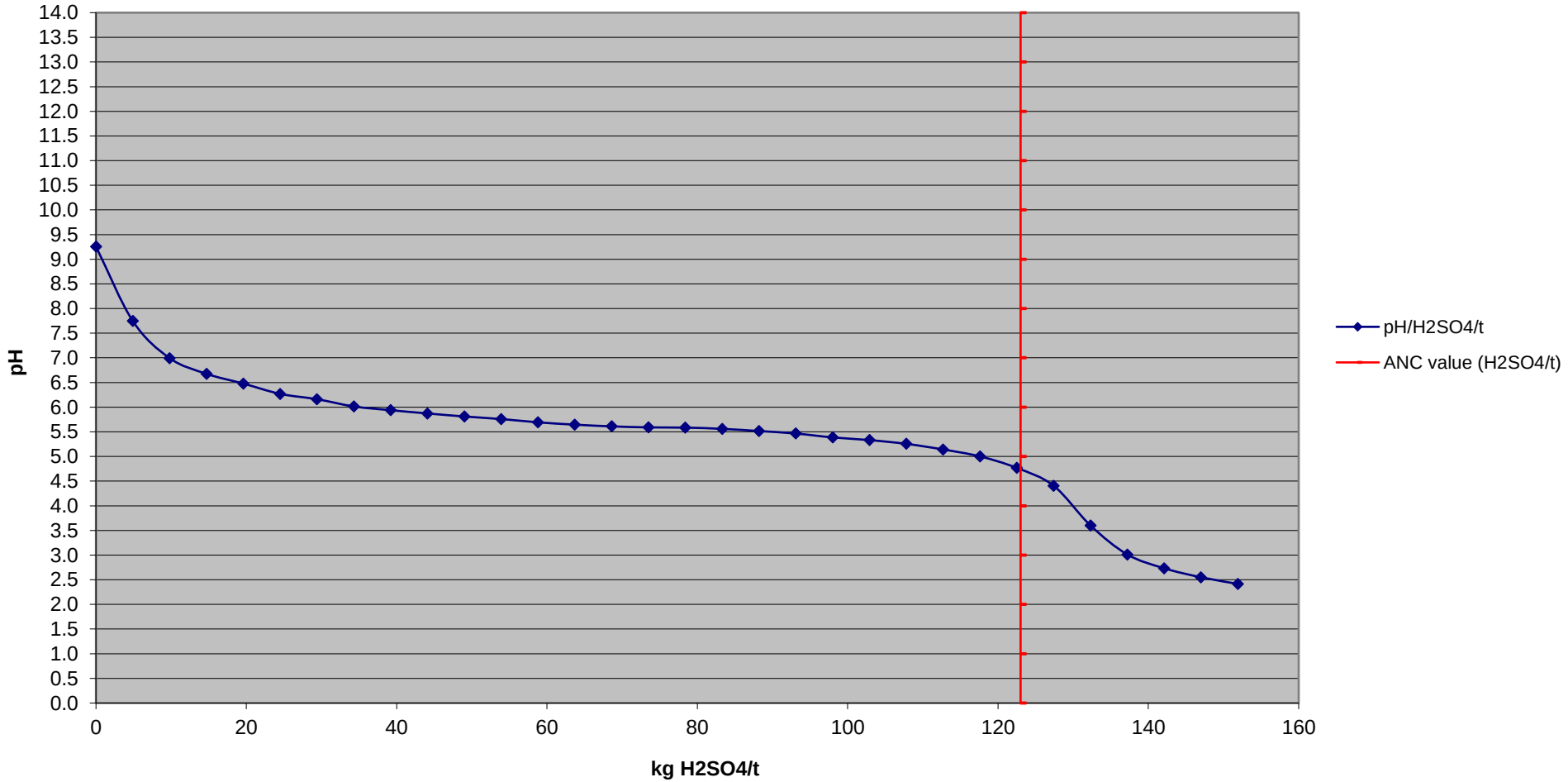


EB1928780 - 003 (130246)
Acid Buffering Characteristic Curve
Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds



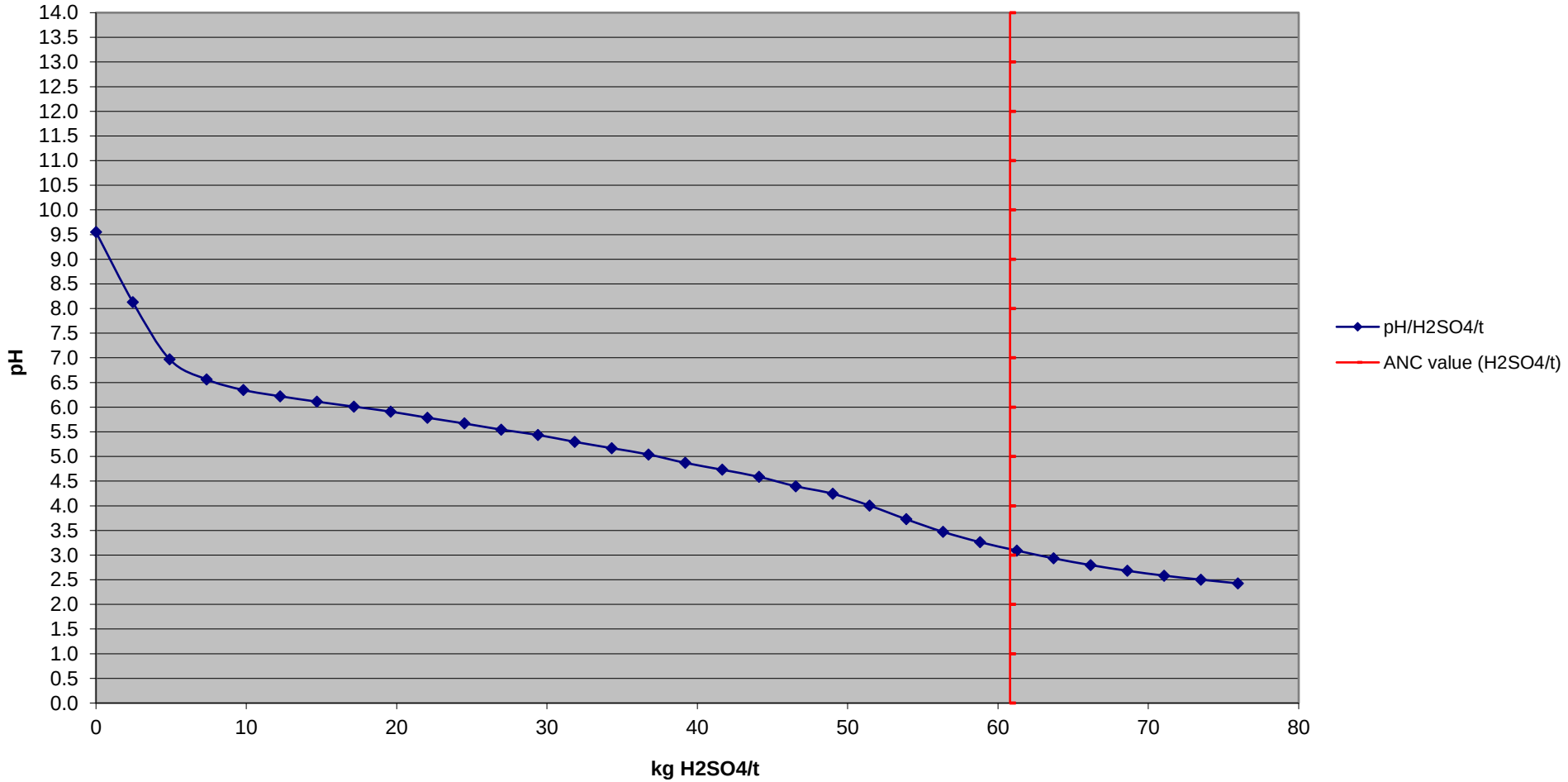
EB1928780 - 004 (3219216)
Acid Buffering Characteristic Curve

Titrating with 0.5M HCl, in increments of 0.4 mLs every 1000 seconds

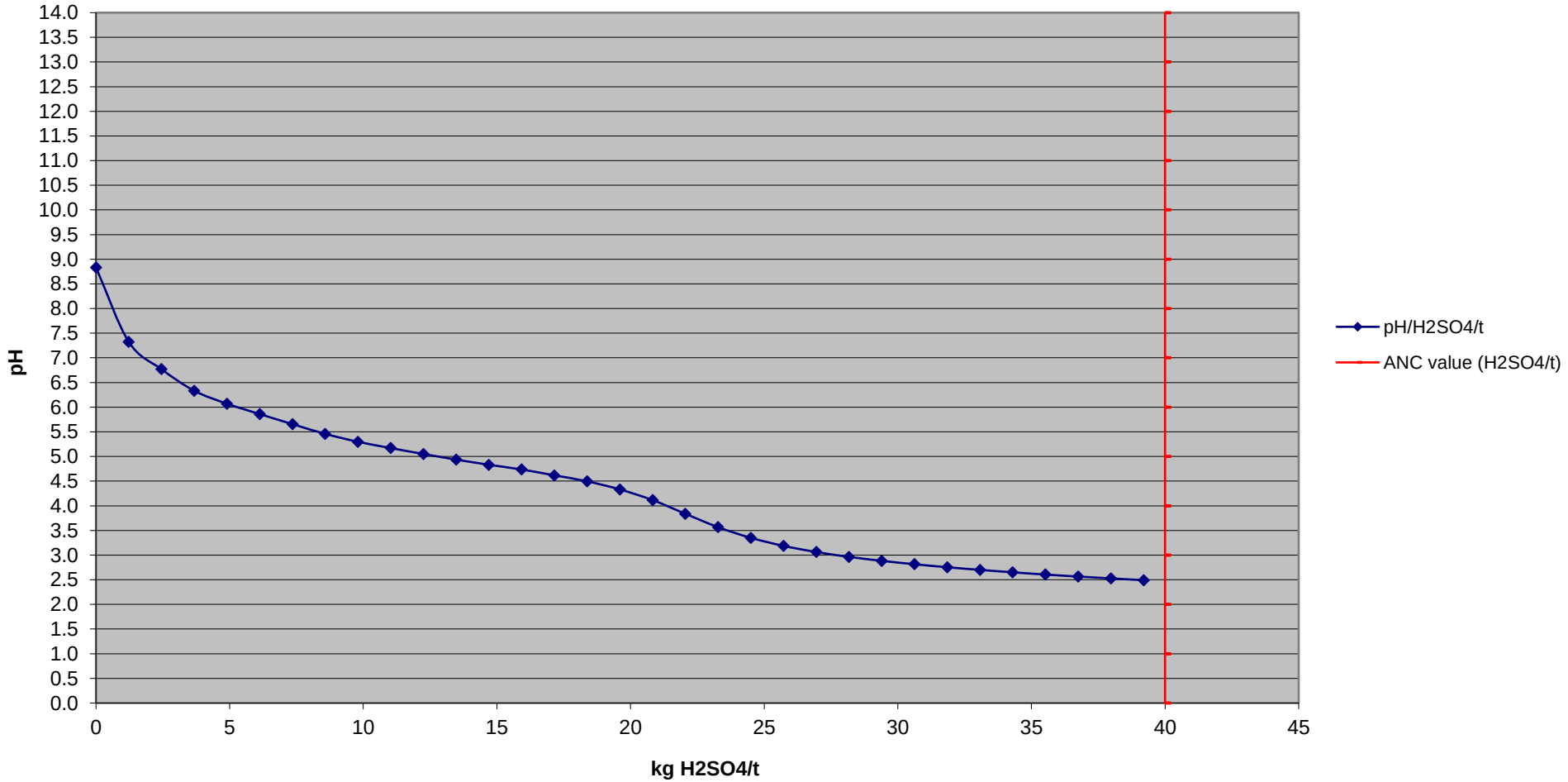


EB1928780 - 005 (3219241)
Acid Buffering Characteristic Curve

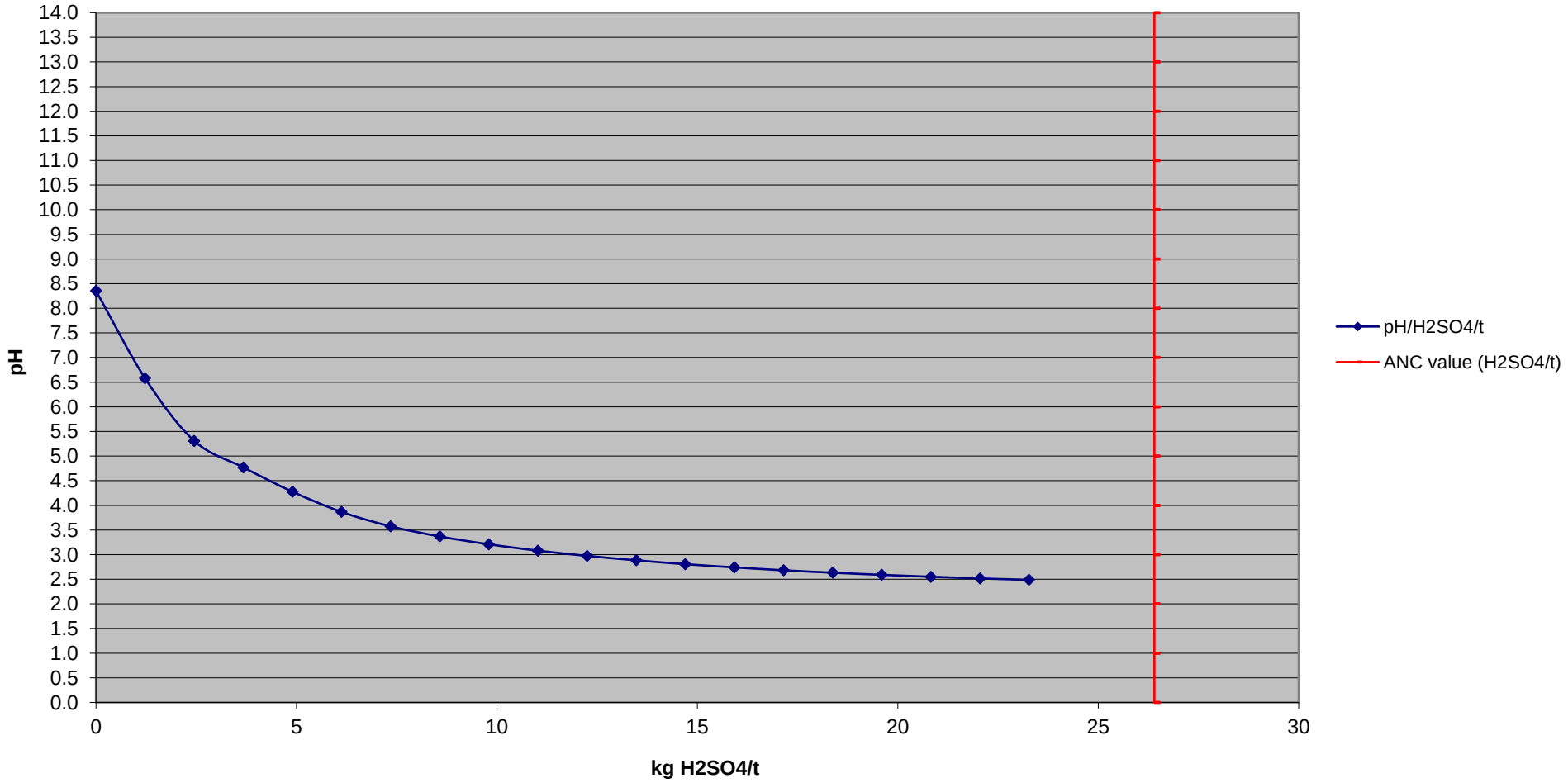
Titrating with 0.5M HCl, in increments of 0.2 mLs every 1000 seconds



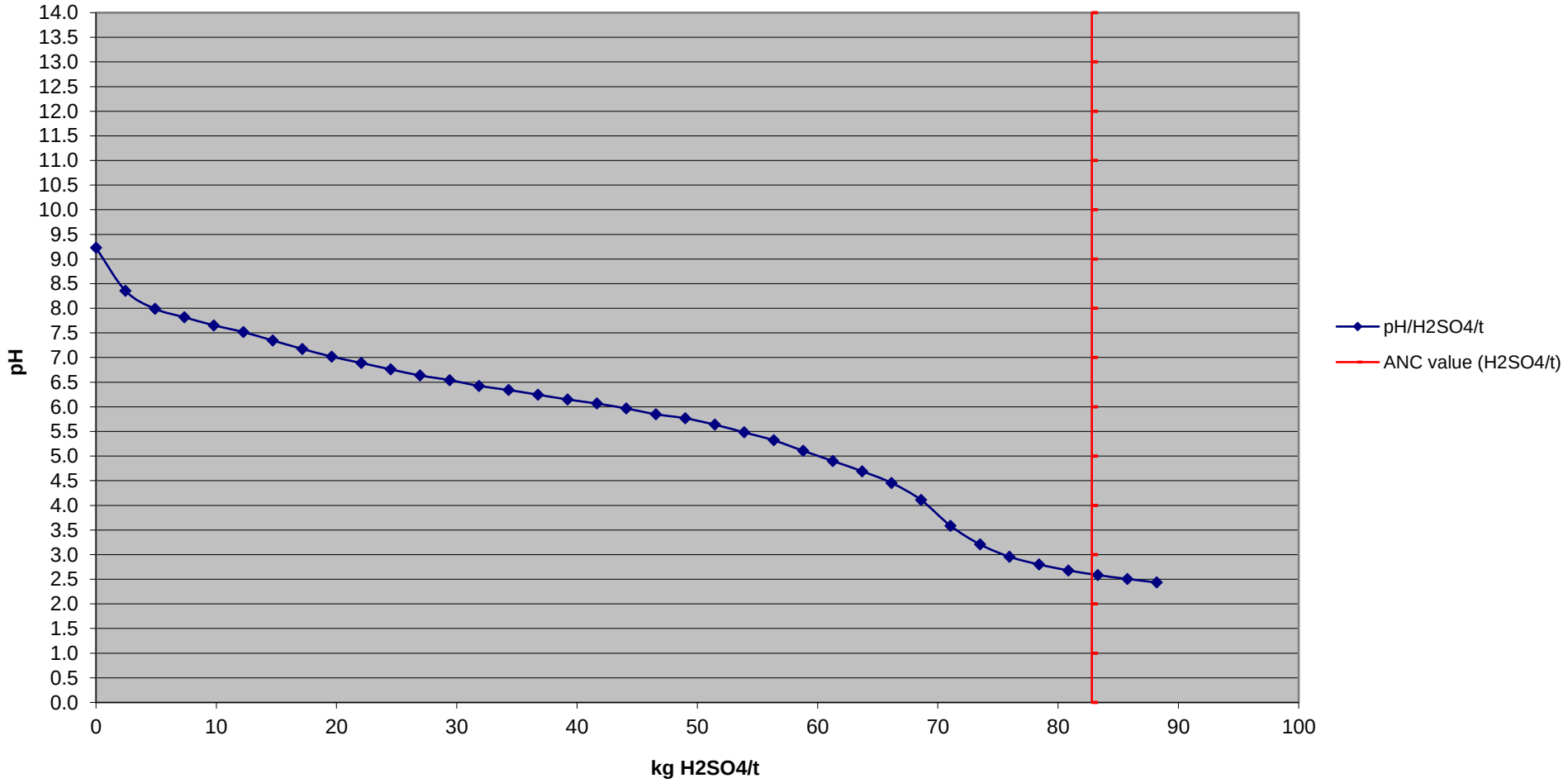
EB1928780 - 006 (3219255)
Acid Buffering Characteristic Curve
Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds



EB1928780 - 007 (3219268)
Acid Buffering Characteristic Curve
Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds



EB1928780 - 008 (3219281)
Acid Buffering Characteristic Curve
Titrating with 0.5M HCl, in increments of 0.2 mLs every 1000 seconds



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ALS Brisbane is a NATA Accredited Testing Laboratory. Corporate Accreditation No: 825, Corporate Site No: 818.

To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Finalized Date: 19-NOV-2019
Account: ALSENV

CERTIFICATE BR19288059

Project: EB1928624

P.O. No.: ME-MS61m + ASH

This report is for 20 Pulp samples submitted to our lab in Brisbane, QLD, Australia on 14-NOV-2019.

The following have access to data associated with this certificate:

SUB RESULTS -BRIS		

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
LOG-22	Sample login - Rcd w/o BarCode
ASH-01	Ashing of carbons/soils
LEV-01	Waste Disposal Levy

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
ME-MS61	48 element four acid ICP-MS	
Hg-MS42	Trace Hg by ICPMS	ICP-MS

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Shaun Kenny, Brisbane Laboratory Manager

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To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Finalized Date: 19-NOV-2019
Account: ALSENV

Project: EB1928624

CERTIFICATE OF ANALYSIS BR19288059

Sample Description	Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
	Units	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
	LOD	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01	0.05
130203		0.08	10.05	8.6	470	2.16	0.33	0.37	0.03	58.1	14.4	45	11.90	47.9	4.94	19.85
130208		0.07	7.27	23.0	160	1.15	0.11	4.75	0.06	36.5	15.5	34	2.95	17.6	4.29	14.10
130214		0.09	9.95	10.2	250	1.94	0.44	1.29	0.11	60.7	15.1	43	12.60	58.2	4.55	20.6
130227		0.04	7.05	3.7	330	1.91	0.26	0.77	0.03	36.8	17.1	55	5.36	35.4	4.29	17.05
130233		0.08	7.99	2.2	310	1.92	0.30	3.83	0.23	37.6	14.3	44	5.11	42.6	4.30	18.70
130246		0.13	8.46	29.3	130	3.08	0.59	0.45	0.10	36.2	13.6	50	2.19	55.0	2.72	33.1
130251		0.04	15.30	11.2	230	3.30	0.84	0.17	0.04	94.2	12.5	43	3.61	74.4	3.00	38.0
130259		0.10	10.15	18.5	320	2.31	0.38	0.95	0.15	64.6	22.2	45	11.40	44.7	5.66	21.2
3219216		0.05	7.23	23.4	370	1.41	0.16	3.64	0.05	39.5	16.8	41	3.93	19.5	5.34	15.75
3219219		0.09	7.46	13.4	330	1.66	0.28	1.72	0.11	41.9	16.0	44	5.96	42.7	3.66	18.85
3219230		0.09	9.66	18.4	470	1.86	0.32	1.53	0.13	58.1	15.5	49	9.39	54.6	4.46	20.4
3219241		0.09	7.26	15.5	540	1.27	0.17	1.76	0.08	44.2	12.1	41	3.04	24.5	2.11	16.30
3219246		0.08	7.27	23.2	200	1.20	0.10	2.87	0.07	42.8	16.8	36	3.26	16.9	2.63	14.30
3219252		0.09	7.29	9.8	280	1.94	0.34	1.81	0.11	39.5	14.4	40	7.71	48.1	4.38	19.65
3219255		0.09	7.25	40.9	570	1.88	0.38	0.61	0.15	29.9	10.8	37	11.05	53.5	3.46	22.1
3219264		0.04	7.58	18.0	340	1.30	0.13	4.16	0.07	34.5	13.6	41	3.68	26.8	4.35	14.95
3219268		0.09	7.56	23.8	460	2.30	0.50	0.57	0.15	33.9	18.7	28	10.35	46.8	7.33	21.0
3219274		0.08	7.99	24.9	1770	1.83	0.30	0.16	0.17	30.3	10.4	44	6.04	50.5	0.74	23.1
3219281		0.08	8.62	15.3	220	1.85	0.26	2.48	0.12	51.3	13.7	50	7.72	49.6	5.14	18.45
3219287		0.12	10.30	9.2	650	2.24	0.43	0.56	0.15	63.4	18.6	43	13.35	56.0	5.98	23.0

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Project: EB1928624

CERTIFICATE OF ANALYSIS BR19288059

Sample Description	Method	ME-MS61	ME-MS61	Hg-MS42	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb
	Units	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm
	LOD	0.05	0.1	0.005	0.005	0.01	0.5	0.2	0.01	5	0.05	0.01	0.1	0.2	10	0.5
130203		0.23	4.0	0.019	0.063	1.99	27.1	25.3	0.78	699	0.34	0.47	7.3	32.5	430	17.7
130208		0.21	2.0	0.030	0.035	1.29	17.5	9.6	1.29	1150	0.75	1.65	4.3	26.0	760	10.9
130214		0.19	4.2	0.064	0.070	2.16	27.8	21.9	0.98	1080	0.78	0.57	7.6	31.0	1150	20.5
130227		0.22	3.7	0.006	0.062	1.06	16.1	27.7	0.61	1140	0.37	0.42	7.8	30.2	350	16.3
130233		0.20	3.9	<0.005	0.062	1.55	16.3	27.1	0.61	1230	0.21	0.30	7.6	28.0	790	22.6
130246		0.28	7.0	0.090	0.117	0.46	13.5	137.5	0.19	339	1.49	0.07	14.6	27.9	2620	35.8
130251		0.26	9.0	0.113	0.136	0.58	40.4	110.0	0.21	263	0.73	0.16	15.5	22.4	390	41.2
130259		0.20	4.2	0.098	0.071	2.47	28.5	25.6	0.90	1410	1.97	0.40	7.2	36.2	1100	20.8
3219216		0.23	2.8	0.061	0.043	1.06	18.9	25.3	1.12	773	0.90	0.74	5.8	27.8	820	13.0
3219219		0.27	3.5	0.064	0.062	1.70	18.9	27.4	0.87	633	1.18	0.71	6.9	30.7	830	16.5
3219230		0.27	4.1	0.057	0.069	2.10	27.0	26.7	0.98	1020	0.69	0.79	7.8	32.9	1090	18.9
3219241		0.09	2.4	0.049	0.049	1.11	20.1	24.0	0.67	449	0.99	0.96	5.8	19.7	670	13.9
3219246		0.33	2.4	0.031	0.036	1.23	20.6	12.7	0.85	617	0.72	2.01	4.8	29.3	560	10.9
3219252		0.37	3.7	0.058	0.061	1.81	17.4	24.9	0.84	954	0.80	0.62	7.2	28.9	970	18.6
3219255		0.10	3.4	0.179	0.070	1.79	12.0	30.6	0.55	633	2.11	0.30	8.0	25.2	610	20.9
3219264		0.29	2.6	0.040	0.044	1.35	16.9	16.8	1.40	830	0.62	0.87	5.1	24.0	740	11.4
3219268		0.12	3.3	0.081	0.070	2.05	13.3	24.9	0.64	1870	1.72	0.60	7.1	32.3	1010	19.0
3219274		0.07	3.6	0.149	0.064	1.32	13.2	32.9	0.31	74	1.78	0.21	8.7	29.2	490	20.9
3219281		0.32	3.6	0.042	0.059	1.79	23.2	25.0	1.14	1060	0.74	0.55	7.1	31.4	850	16.2
3219287		0.19	4.5	0.076	0.080	2.37	28.5	34.4	0.97	1500	1.88	0.15	8.0	35.1	1340	23.4

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Project: EB1928624

CERTIFICATE OF ANALYSIS BR19288059

Sample Description	Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V
	Units	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
	LOD	0.1	0.002	0.01	0.05	0.1	1	0.2	0.2	0.05	0.05	0.01	0.005	0.02	0.1	1
130203		97.7	<0.002	0.02	0.54	17.8	1	1.9	127.5	0.56	0.08	9.31	0.461	0.54	3.0	129
130208		43.7	<0.002	0.01	0.60	10.0	<1	1.0	350	0.33	<0.05	4.95	0.306	0.30	1.2	96
130214		117.0	<0.002	0.05	0.77	17.8	1	2.2	247	0.59	0.11	9.92	0.439	0.62	2.4	136
130227		52.7	<0.002	0.02	0.68	12.9	<1	2.1	97.7	0.58	<0.05	5.95	0.472	0.47	3.1	113
130233		42.2	<0.002	<0.01	0.71	14.3	<1	2.2	136.5	0.60	0.05	6.18	0.468	0.49	1.9	116
130246		12.5	<0.002	0.10	1.94	12.1	2	4.2	129.5	1.13	0.14	9.49	0.685	0.46	5.9	131
130251		27.5	<0.002	0.01	1.04	23.5	1	4.7	165.5	1.21	0.16	23.6	0.762	0.24	5.9	147
130259		111.0	<0.002	0.13	1.18	17.8	<1	2.1	204	0.54	0.09	9.93	0.434	0.73	2.6	138
3219216		46.0	<0.002	0.07	0.61	11.6	1	1.4	226	0.43	<0.05	6.54	0.343	0.32	1.7	102
3219219		63.1	<0.002	0.13	0.63	14.1	1	1.8	262	0.52	0.07	6.40	0.413	0.48	1.9	118
3219230		96.3	<0.002	0.04	0.78	17.7	1	2.1	402	0.57	0.07	8.90	0.480	0.50	2.4	129
3219241		44.1	<0.002	0.20	0.65	14.4	<1	1.5	188.0	0.43	0.05	6.18	0.393	0.31	1.5	99
3219246		48.8	<0.002	0.03	0.87	11.6	1	1.2	320	0.36	<0.05	5.65	0.319	0.30	1.4	90
3219252		65.2	<0.002	0.04	0.75	14.1	1	2.0	269	0.52	0.10	6.16	0.409	0.53	2.0	120
3219255		60.0	<0.002	0.30	0.78	14.2	1	2.3	289	0.63	0.11	5.35	0.429	0.70	2.1	137
3219264		48.5	<0.002	0.02	0.46	11.9	1	1.2	414	0.37	<0.05	5.34	0.355	0.33	1.4	98
3219268		69.0	<0.002	0.27	1.79	13.8	1	2.3	279	0.53	0.13	6.19	0.362	0.71	2.3	132
3219274		55.9	<0.002	0.15	0.86	13.0	<1	2.3	115.0	0.64	0.08	6.11	0.529	0.45	2.2	137
3219281		71.1	<0.002	0.04	0.62	16.9	1	1.9	243	0.52	0.06	7.51	0.450	0.47	2.0	128
3219287		114.0	<0.002	0.08	1.33	19.4	1	2.4	185.5	0.61	0.11	10.35	0.458	0.69	2.6	144

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Finalized Date: 19-NOV-2019
Account: ALSENV

Project: EB1928624

CERTIFICATE OF ANALYSIS BR19288059

Sample Description	Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	W	Y	Zn	Zr
	Units	ppm	ppm	ppm	ppm
	LOD	0.1	0.1	2	0.5
130203		1.5	21.6	88	145.5
130208		1.0	12.6	76	70.0
130214		1.6	23.6	101	156.0
130227		2.2	17.2	87	137.5
130233		1.8	20.4	93	138.5
130246		2.7	16.9	90	236
130251		3.1	36.0	92	308
130259		1.5	26.5	102	154.5
3219216		1.4	15.8	90	104.0
3219219		1.8	16.8	136	129.5
3219230		1.6	23.7	111	150.0
3219241		7.3	16.5	98	90.0
3219246		8.4	15.2	72	83.3
3219252		2.0	17.3	91	137.0
3219255		1.9	12.7	100	114.5
3219264		1.1	15.8	73	89.3
3219268		1.3	18.9	94	126.0
3219274		3.1	10.1	116	122.5
3219281		1.7	23.2	90	134.0
3219287		1.9	27.7	108	164.0

***** See Appendix Page for comments regarding this certificate *****

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To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 19-NOV-2019
Account: ALSENV

Project: EB1928624

CERTIFICATE OF ANALYSIS BR19288059

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

REE's may not be totally soluble in this method.

Applies to Method: ME-MS61

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is David Jones,ICPMS Supervising Chemist

Applies to Method: ME-MS61

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 116 Delta Street, Geebung, QLD 4034, Australia

Applies to Method:

ASH-01	Hg-MS42	LEV-01	LOG-22
ME-MS61			

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1927002**	Page	: 1 of 7
Client	: **WHITEHAVEN COAL MINING LIMITED**	Laboratory	: Environmental Division Brisbane
Contact	: MR IAN SWANE	Contact	: Customer Services EB
Address	: PO BOX 600 GUNNEDAH NSW, AUSTRALIA 2380	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Winchester South	Date Samples Received	: 27-Sep-2019 12:00
Order number	: WS100034	Date Analysis Commenced	: 22-Oct-2019
C-O-C number	: ----	Issue Date	: 28-Oct-2019 16:46
Sampler	: ----		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 24		
No. of samples analysed	: 24		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	WS3001L-L2A	WS3001L-VA3	WS3001L-VB-VH	WS3002L-L1A	WS3004L-L1
			Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1927002-001	EB1927002-002	EB1927002-003	EB1927002-004	EB1927002-005
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	6.3	9.2	9.3	6.4	6.9
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	7.5	-23.7	-62.2	17.6	3.8
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	198	276	541	336	323
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	3.8	36.6	77.8	13.3	11.5
ANC as CaCO3	----	0.1	% CaCO3	0.4	3.7	7.9	1.4	1.2
Fizz Rating	----	0	Fizz Unit	0	1	2	1	1
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.197	0.295	0.384	0.704	0.443
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.37	0.42	0.51	1.01	0.50

Page : 4 of 7
Work Order : EB1927002
Client : WHITEHAVEN COAL MINING LIMITED
Project : Winchester South

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	WS3004L-L2A	WS3004L-VA3	WS3004L-VB-VH	WS3009L-L1	WS3009L-L2A
			Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1927002-006	EB1927002-007	EB1927002-008	EB1927002-009	EB1927002-010
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	6.9	8.1	8.8	6.7	7.6
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	15.2	<0.5	-3.2	-33.7	4.9
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	371	273	450	291	273
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.2	19.1	10.8	45.6	10.7
ANC as CaCO3	----	0.1	% CaCO3	0.2	1.9	1.1	4.6	1.1
Fizz Rating	----	0	Fizz Unit	0	1	1	2	1
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.316	0.364	0.142	0.251	0.208
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.57	0.63	0.25	0.39	0.51

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	WS3009L-VA3	WS3009L-VB-VH	WS3013L-L1	WS3013L-L2A	WS3013L-VA3
			Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1927002-011	EB1927002-012	EB1927002-013	EB1927002-014	EB1927002-015
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	8.0	9.3	8.3	7.8	9.5
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-15.8	-84.0	2.0	2.8	-12.0
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	662	380	267	213	227
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	57.4	89.8	10.8	11.9	19.4
ANC as CaCO3	----	0.1	% CaCO3	5.8	9.2	1.1	1.2	2.0
Fizz Rating	----	0	Fizz Unit	2	2	1	1	1
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.816	0.094	0.223	0.250	0.039
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	1.36	0.19	0.42	0.48	0.24

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	WS3013L-VB-VH	WS3014L-L2A	WS3014L-VA3	WS3014L-VB-VH	WS3015L-L1A
			Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EB1927002-016	EB1927002-017	EB1927002-018	EB1927002-019	EB1927002-020
				Result	Result	Result	Result	Result
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	9.1	8.0	9.4	9.4	8.6
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-43.3	-6.9	-11.0	-56.0	-47.3
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	359	447	311	394	303
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	52.2	21.3	22.6	63.3	58.3
ANC as CaCO3	----	0.1	% CaCO3	5.3	2.2	2.3	6.4	5.9
Fizz Rating	----	0	Fizz Unit	2	1	1	2	2
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.058	0.292	0.276	0.126	0.220
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.29	0.47	0.38	0.24	0.36

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	WS3017L-L1	WS3017L-L2A	WS3017L-VA3	WS3017L-VB-VH	----
			Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	----
Compound	CAS Number	LOR	Unit	EB1927002-021	EB1927002-022	EB1927002-023	EB1927002-024	--------
				Result	Result	Result	Result	----
EA002: pH 1:2 (Soils)								
pH Value	----	0.1	pH Unit	**9.1**	**8.7**	**9.5**	**9.8**	**----**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-15.0**	**-0.6**	**-94.9**	**-66.6**	**----**
EA010: Conductivity (1:2)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**232**	**211**	**245**	**398**	**----**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**21.4**	**12.2**	**101**	**71.2**	**----**
ANC as CaCO3	----	0.1	% CaCO3	**2.2**	**1.2**	**10.3**	**7.3**	**----**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**2**	**2**	**----**
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	**0.095**	**0.194**	**0.017**	**0.038**	**----**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.21**	**0.38**	**0.20**	**0.15**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1928714**	Page	: 1 of 4
Client	: **WHITEHAVEN COAL MINING LIMITED**	Laboratory	: Environmental Division Brisbane
Contact	: MR IAN SWANE	Contact	: Customer Services EB
Address	: PO BOX 600 GUNNEDAH NSW, AUSTRALIA 2380	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Winchester South	Date Samples Received	: 29-Oct-2019 13:03
Order number	: PO00202337	Date Analysis Commenced	: 04-Nov-2019
C-O-C number	: ----	Issue Date	: 22-Nov-2019 11:35
Sampler	: ----		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 28		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Santusha Pandra	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- EA046 ABCC: NATA Acreditation does not cover the performance of this service.

Page : 3 of 4
Work Order : EB1928714
Client : WHITEHAVEN COAL MINING LIMITED
Project : Winchester South

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	Comp-L1	Comp-L2A	Comp-VA3	Comp-VBVH	----
			Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	----
Compound	CAS Number	LOR	Unit	EB1928714-025	EB1928714-026	EB1928714-027	EB1928714-028	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.2	8.2	8.6	9.2	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-42.6	-8.3	-78.0	-57.8	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	269	224	270	345	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.1	4.2	9.2	8.6	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	2.9	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	46.5	<0.1	<0.1	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	54.5	21.2	94.8	65.2	----
ANC as CaCO3	----	0.1	% CaCO3	5.6	2.2	9.7	6.6	----
Fizz Rating	----	0	Fizz Unit	2	1	2	2	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.340	0.263	0.362	0.124	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	2100	1640	7610	6950	----
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	2100	1640	7610	6950	----
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<5	<5	<5	<5	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	200	190	180	140	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.39	0.42	0.55	0.24	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	110	80	90	100	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	120	90	60	<10	----
Magnesium	7439-95-4	10	mg/kg	40	40	20	<10	----
Sodium	7440-23-5	10	mg/kg	150	110	220	410	----
Potassium	7440-09-7	10	mg/kg	20	10	20	20	----
EG005(ED093)S : Soluble Metals by ICPAES								
Aluminium	7429-90-5	1	mg/kg	<1	<1	<1	<1	----

Page : 4 of 4
Work Order : EB1928714
Client : WHITEHAVEN COAL MINING LIMITED
Project : Winchester South

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)				Client sample ID	Comp-L1	Comp-L2A	Comp-VA3	Comp-VBVH	----
				Client sampling date / time	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	27-Sep-2019 00:00	----
Compound	CAS Number	LOR	Unit		EB1928714-025	EB1928714-026	EB1928714-027	EB1928714-028	--------
					Result	Result	Result	Result	----
EG005(ED093)S : Soluble Metals by ICPAES - Continued									
Arsenic	7440-38-2	0.1	mg/kg		<0.1	<0.1	<0.1	**0.1**	----
Barium	7440-39-3	1	mg/kg		<1	<1	<1	<1	----
Beryllium	7440-41-7	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Boron	7440-42-8	1	mg/kg		<1	<1	<1	<1	----
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Chromium	7440-47-3	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Cobalt	7440-48-4	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Copper	7440-50-8	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Iron	7439-89-6	1	mg/kg		<1	<1	<1	<1	----
Lead	7439-92-1	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Manganese	7439-96-5	0.1	mg/kg		**0.1**	**0.2**	<0.1	<0.1	----
Nickel	7440-02-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Selenium	7782-49-2	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Vanadium	7440-62-2	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
Zinc	7440-66-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	----
EG035S: Soluble Mercury by FIMS									
Mercury	7439-97-6	0.0005	mg/kg		<0.0005	<0.0005	<0.0005	<0.0005	----

ALS Environmental

Acid Buffering Characteristic Curve (ABCC) REPORT

Batch: EB1928714

CONTACT:	MR IAN SWANE	**LABORATORY:**	Brisbane
CLIENT:	WHITEHAVEN COAL MINING LIMITED	**DATE SAMPLED:**	27/09/2019
		DATE RECEIVED:	29/10/2019
ADDRESS:	PO BOX 600	**DATE COMPLETED:**	15/11/2019
	GUNNEDAH NSW, 2380	**SAMPLE TYPE:**	Soil
		No. of SAMPLES:	4

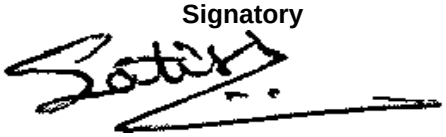
COMMENTS

EA046 : NATA accreditation does not cover performance of this service.

ISSUING LABORATORY: ALS BRISBANE

Address:	2 Byth Street STAFFORD QLD 4053 AUSTRALIA	**Telephone:** **Facsimile:** **E-mail:**	07 3243 7222 07 3243 7218 Satishkumar.Trivedi@alsglobal.com

Signatory



Work Order :	EB1928714	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			Comp-L1
	Client Sample Identification 2			
	Sample Date			27/09/2019
Method	Analyte	Units	LOR	

	025
	EB1928714

EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**54.5**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.10
1	0.2	2.45	6.75
2	0.4	4.9	6.00
3	0.6	7.35	5.75
4	0.8	9.8	5.53
5	1	12.25	5.25
6	1.2	14.7	4.90
7	1.4	17.15	4.56
8	1.6	19.6	4.23
9	1.8	22.05	3.99
10	2	24.5	3.73
11	2.2	26.95	3.50
12	2.4	29.4	3.32
13	2.6	31.85	3.19
14	2.8	34.3	3.05
15	3	36.75	2.93
16	3.2	39.2	2.83
17	3.4	41.65	2.75
18	3.6	44.1	2.68
19	3.8	46.55	2.61
20	4	49	2.55
21	4.2	51.45	2.50

Addition	mLs added (total)	kg H2SO4/t	pH

Work Order :	EB1928714	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			Comp-L1
	Client Sample Identification 2			
	Sample Date			27/09/2019
Method	Analyte	Units	LOR	

025	Check
EB1928714	

EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**54.5**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.18				
1	0.2	2.45	6.30				
2	0.4	4.9	5.82				
3	0.6	7.35	5.68				
4	0.8	9.8	5.47				
5	1	12.25	5.25				
6	1.2	14.7	4.94				
7	1.4	17.15	4.62				
8	1.6	19.6	4.26				
9	1.8	22.05	3.93				
10	2	24.5	3.69				
11	2.2	26.95	3.45				
12	2.4	29.4	3.27				
13	2.6	31.85	3.11				
14	2.8	34.3	2.98				
15	3	36.75	2.87				
16	3.2	39.2	2.77				
17	3.4	41.65	2.69				
18	3.6	44.1	2.62				
19	3.8	46.55	2.55				
20	4	49	2.50				
21	4.2	51.45	2.45				

Work Order :	EB1928714	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			Comp-L2A
	Client Sample Identification 2			
	Sample Date			27/09/2019
Method	Analyte	Units	LOR	

	026
	EB1928714

EA046 - A Titration information

HCl Molarity:	**M**	**0.1**
Increments:	**mL**	**0.5**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**21.2**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.23	36	18	44.1	2.43
1	0.5	1.225	8.36				
2	1	2.45	7.99				
3	1.5	3.675	7.82				
4	2	4.9	7.65				
5	2.5	6.125	7.52				
6	3	7.35	7.35				
7	3.5	8.575	7.18				
8	4	9.8	7.02				
9	4.5	11.025	6.89				
10	5	12.25	6.76				
11	5.5	13.475	6.64				
12	6	14.7	6.54				
13	6.5	15.925	6.42				
14	7	17.15	6.34				
15	7.5	18.375	6.25				
16	8	19.6	6.15				
17	8.5	20.825	6.07				
18	9	22.05	5.97				
19	9.5	23.275	5.85				
20	10	24.5	5.77				
21	10.5	25.725	5.64				
22	11	26.95	5.48				
23	11.5	28.175	5.32				
24	12	29.4	5.11				
25	12.5	30.625	4.90				
26	13	31.85	4.69				
27	13.5	33.075	4.46				
28	14	34.3	4.11				
29	14.5	35.525	3.58				
30	15	36.75	3.21				
31	15.5	37.975	2.96				
32	16	39.2	2.80				
33	16.5	40.425	2.68				
34	17	41.65	2.58				
35	17.5	42.875	2.51				

Work Order :	EB1928714	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			Comp-VA3
	Client Sample Identification 2			
	Sample Date			27/09/2019
Method	Analyte	Units	LOR	

	027
	EB1928714

EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**94.8**

EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.30	36	7.2	88.2	2.65
1	0.2	2.45	7.96	37	7.4	90.65	2.57
2	0.4	4.9	7.60	38	7.6	93.1	2.50
3	0.6	7.35	7.38				
4	0.8	9.8	7.27				
5	1	12.25	7.21				
6	1.2	14.7	7.13				
7	1.4	17.15	7.04				
8	1.6	19.6	6.97				
9	1.8	22.05	6.90				
10	2	24.5	6.84				
11	2.2	26.95	6.76				
12	2.4	29.4	6.67				
13	2.6	31.85	6.59				
14	2.8	34.3	6.54				
15	3	36.75	6.48				
16	3.2	39.2	6.41				
17	3.4	41.65	6.34				
18	3.6	44.1	6.27				
19	3.8	46.55	6.18				
20	4	49	6.07				
21	4.2	51.45	5.98				
22	4.4	53.9	5.86				
23	4.6	56.35	5.69				
24	4.8	58.8	5.57				
25	5	61.25	5.38				
26	5.2	63.7	5.17				
27	5.4	66.15	4.89				
28	5.6	68.6	4.54				
29	5.8	71.05	4.13				
30	6	73.5	3.76				
31	6.2	75.95	3.44				
32	6.4	78.4	3.22				
33	6.6	80.85	3.03				
34	6.8	83.3	2.88				
35	7	85.75	2.76				

Work Order :	EB1928714	Client ID:	WHITEHAVEN COAL MINING

	Sub Matrix			Soil
	Client Sample Identification 1			Comp-VBVH
	Client Sample Identification 2			
	Sample Date			27/09/2019
Method	Analyte	Units	LOR	

	028
	EB1928714

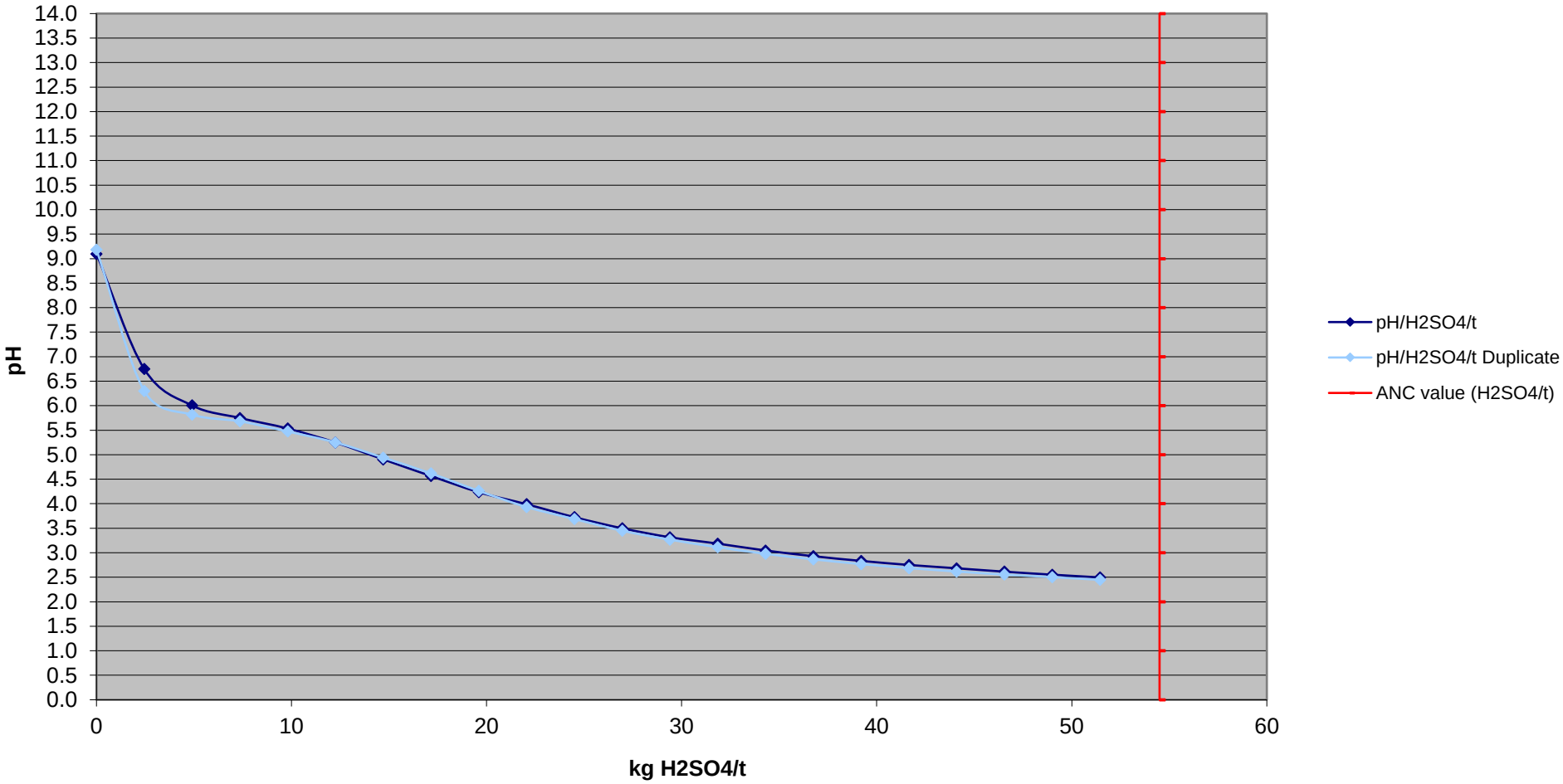
EA046 - A Titration information

HCl Molarity:	**M**	**0.5**
Increments:	**mL**	**0.2**
Weight	**(g)**	**2**
ANC	**kgH2SO4/t**	**65.2**

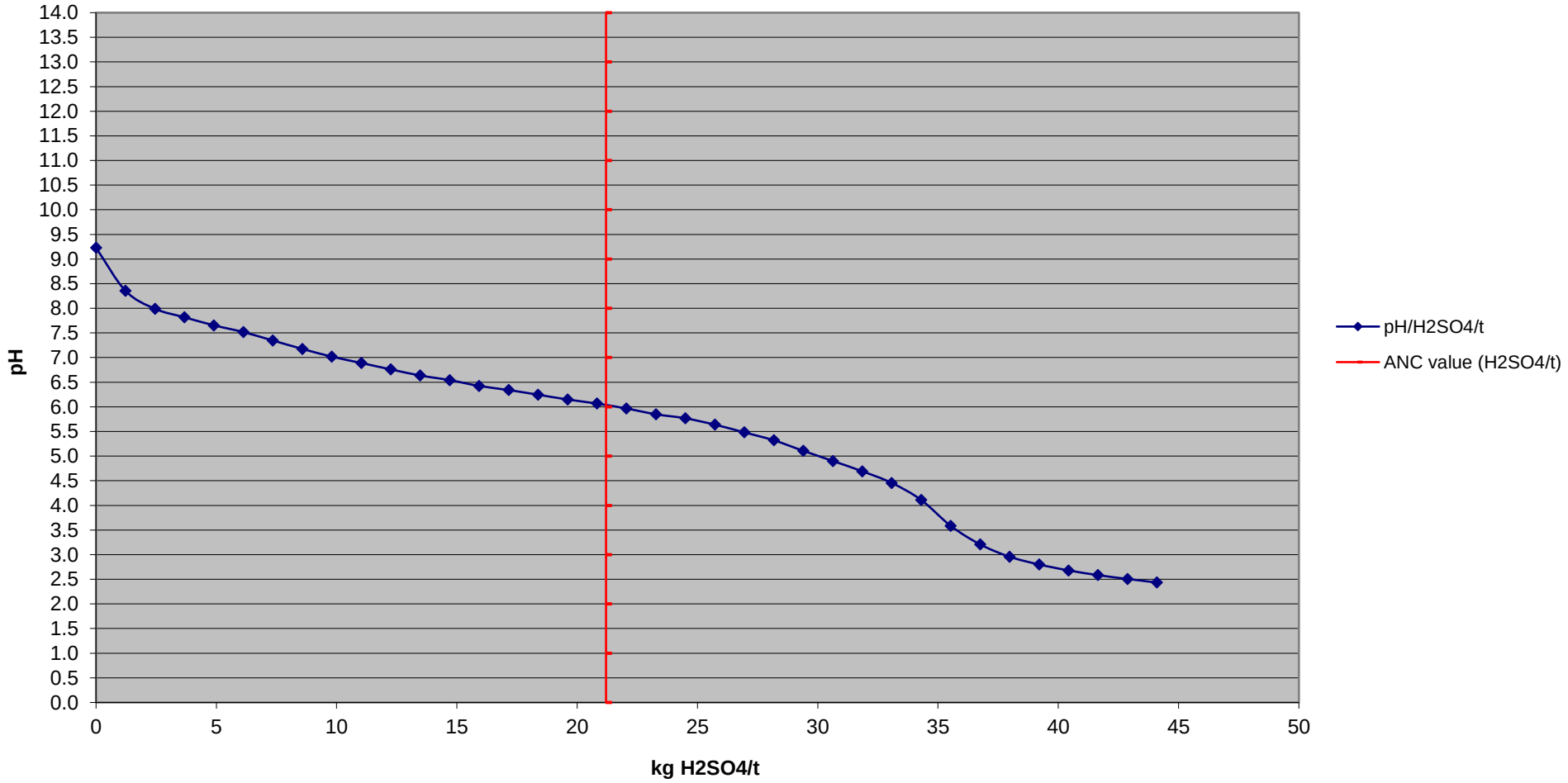
EA046 -B - Curve information

Addition	mLs added (total)	kg H2SO4/t	pH	Addition	mLs added (total)	kg H2SO4/t	pH
0	0	0	9.05				
1	0.2	2.45	7.58				
2	0.4	4.9	6.99				
3	0.6	7.35	6.72				
4	0.8	9.8	6.53				
5	1	12.25	6.39				
6	1.2	14.7	6.30				
7	1.4	17.15	6.22				
8	1.6	19.6	6.14				
9	1.8	22.05	6.05				
10	2	24.5	5.97				
11	2.2	26.95	5.86				
12	2.4	29.4	5.75				
13	2.6	31.85	5.62				
14	2.8	34.3	5.49				
15	3	36.75	5.38				
16	3.2	39.2	5.23				
17	3.4	41.65	5.13				
18	3.6	44.1	5.00				
19	3.8	46.55	4.87				
20	4	49	4.72				
21	4.2	51.45	4.52				
22	4.4	53.9	4.23				
23	4.6	56.35	3.86				
24	4.8	58.8	3.50				
25	5	61.25	3.22				
26	5.2	63.7	2.99				
27	5.4	66.15	2.82				
28	5.6	68.6	2.69				
29	5.8	71.05	2.58				
30	6	73.5	2.49				

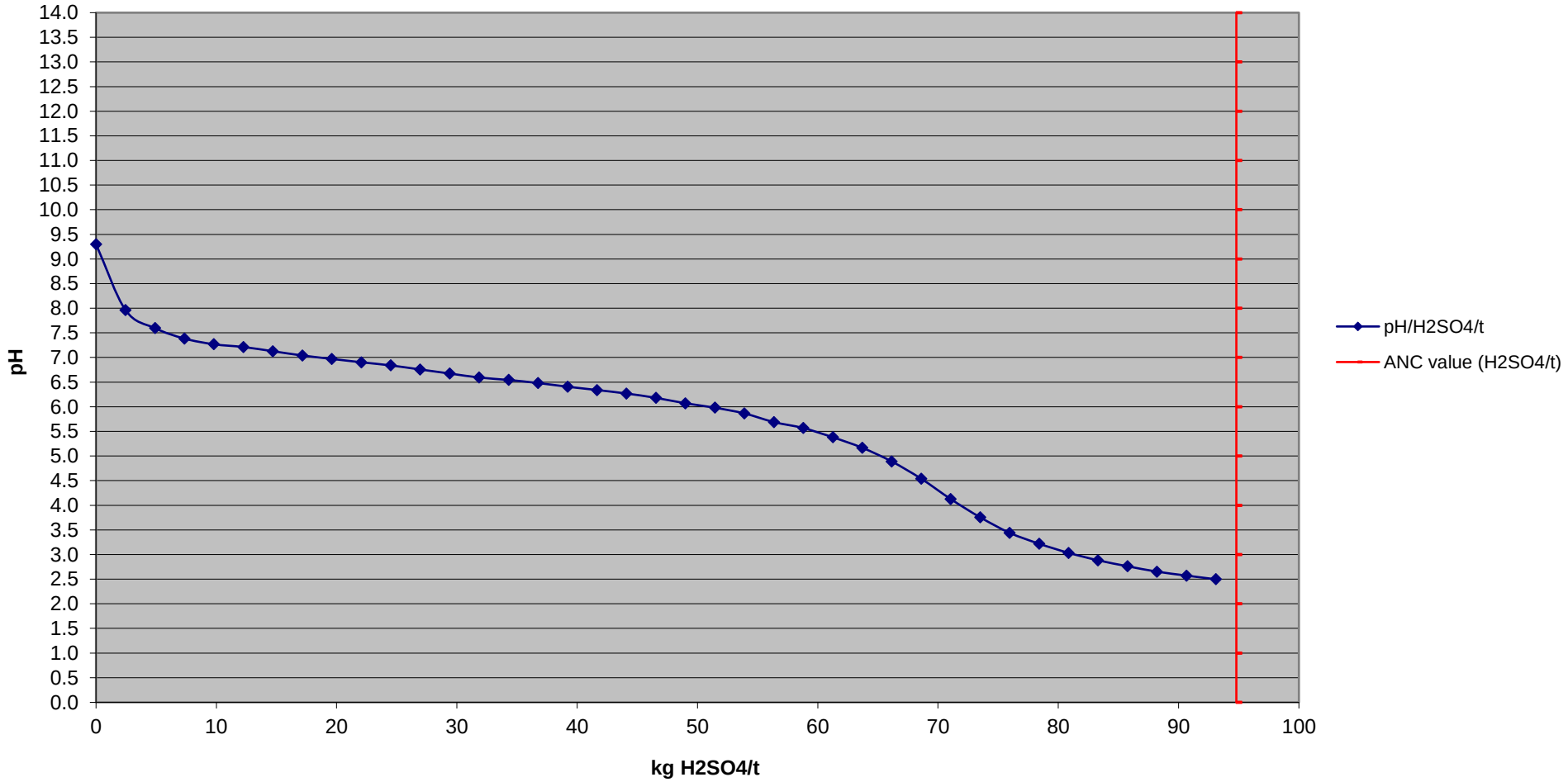
EB1928714 - 025 and Check 025 (Comp-L1)
Acid Buffering Characteristic Curve
Titrating with 0.5M HCl, in increments of 0.2 mLs every 1000 seconds



EB1928714 - 026 (Comp-L2A)
Acid Buffering Characteristic Curve
Titrating with 0.1M HCl, in increments of 0.5 mLs every 1000 seconds

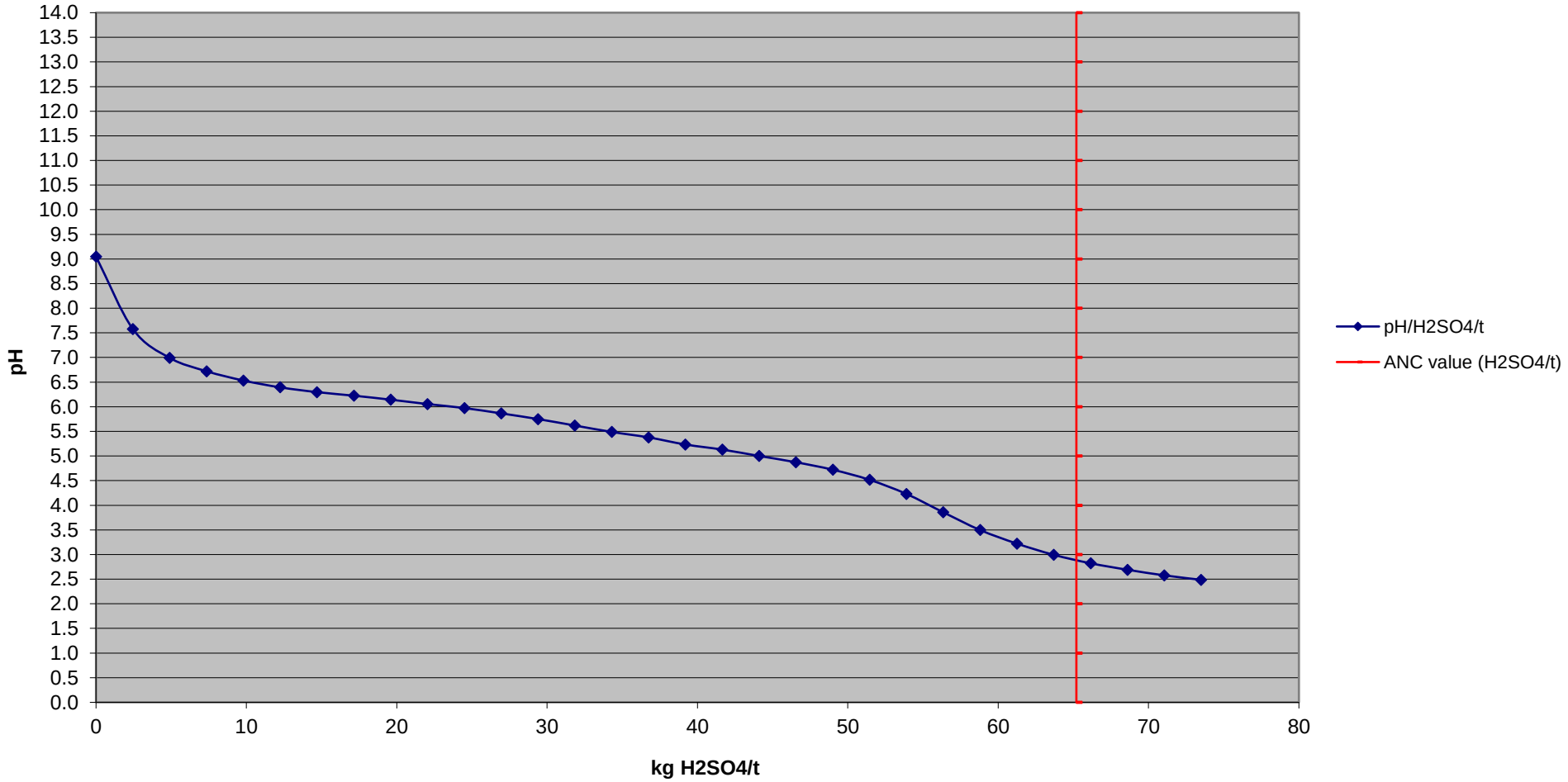


EB1928714 - 027 (Comp-VA3)
Acid Buffering Characteristic Curve
Titrating with 0.5M HCl, in increments of 0.2 mLs every 1000 seconds



EB1928714 - 028 (Comp-VBVH)
Acid Buffering Characteristic Curve

Titrating with 0.5M HCl, in increments of 0.2 mLs every 1000 seconds



Australian Laboratory Services Pty. Ltd.

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ALS Brisbane is a NATA Accredited Testing Laboratory. Corporate Accreditation No: 825, Corporate Site No: 818.

To: **ALS ENVIRONMENTAL**
32 SHAND STREET
STAFFORD QLD 4053

Finalized Date: 21-NOV-2019
Account: ALSENV

CERTIFICATE BR19292693

Project: EB1928714

P.O. No.: ME-MS61m ashed

This report is for 4 Pulp samples submitted to our lab in Brisbane, QLD, Australia on 19-NOV-2019.

The following have access to data associated with this certificate:

SUB RESULTS -BRIS		

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
LOG-22	Sample login - Rcd w/o BarCode
ASH-01	Ashing of carbons/soils
LEV-01	Waste Disposal Levy

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
ME-MS61	48 element four acid ICP-MS	
Hg-MS42	Trace Hg by ICPMS	ICP-MS

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Shaun Kenny, Brisbane Laboratory Manager

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Finalized Date: 21-NOV-2019
Account: ALSENV

Project: EB1928714

CERTIFICATE OF ANALYSIS BR19292693

Sample Description	Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
	Units	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
	LOD	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01	0.05
Comp-L1		0.04	5.90	3.1	290	1.28	0.28	1.89	0.08	23.4	3.4	16	0.53	33.0	2.43	14.75
Comp-L2a		0.02	3.22	3.1	210	0.55	0.18	0.85	0.05	20.6	5.3	12	1.70	19.8	3.81	7.07
Comp-VA3		0.04	5.10	1.4	850	1.49	0.35	3.28	0.06	47.8	2.8	13	2.06	34.1	2.27	12.05
Comp-VBVH		0.07	8.78	9.3	860	2.38	0.32	1.62	0.12	42.8	7.8	7	3.46	39.8	1.72	19.60

***** See Appendix Page for comments regarding this certificate *****

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Project: EB1928714

CERTIFICATE OF ANALYSIS BR19292693

Sample Description	Method / Analyte / Units / LOD	ME-MS61 Ge ppm 0.05	ME-MS61 Hf ppm 0.1	Hg-MS42 Hg ppm 0.005	ME-MS61 In ppm 0.005	ME-MS61 K % 0.01	ME-MS61 La ppm 0.5	ME-MS61 Li ppm 0.2	ME-MS61 Mg % 0.01	ME-MS61 Mn ppm 5	ME-MS61 Mo ppm 0.05	ME-MS61 Na % 0.01	ME-MS61 Nb ppm 0.1	ME-MS61 Ni ppm 0.2	ME-MS61 P ppm 10	ME-MS61 Pb ppm 0.5
Comp-L1		0.07	2.1	0.079	0.068	0.16	9.4	81.7	0.18	493	1.03	0.21	4.5	8.3	4450	13.1
Comp-L2a		<0.05	1.2	0.043	0.031	0.19	8.7	23.6	0.19	678	1.05	0.20	1.8	10.6	2140	6.7
Comp-VA3		0.08	2.4	0.071	0.060	0.39	22.2	51.4	0.44	567	0.60	0.26	6.2	5.8	2280	11.8
Comp-VBVH		0.09	3.9	0.092	0.060	1.40	18.5	60.4	0.71	383	2.36	0.30	5.2	7.5	470	18.8

***** See Appendix Page for comments regarding this certificate *****

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CERTIFICATE OF ANALYSIS BR19292693

Sample Description	Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V
	Units	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
	LOD	0.1	0.002	0.01	0.05	0.1	1	0.2	0.2	0.05	0.05	0.01	0.005	0.02	0.1	1
Comp-L1		5.2	0.002	0.55	0.75	8.8	2	1.6	144.5	0.35	0.08	4.09	0.387	0.23	3.9	59
Comp-L2a		10.6	0.002	0.50	0.60	5.3	<1	0.9	108.5	0.18	0.06	3.15	0.114	0.14	1.2	32
Comp-VA3		14.8	0.002	0.64	0.50	8.7	2	1.7	244	0.36	0.08	8.15	0.269	0.22	3.0	49
Comp-VBVH		34.6	0.002	0.51	0.82	10.3	1	2.1	293	0.44	0.09	8.63	0.376	0.51	2.6	96

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Project: EB1928714

CERTIFICATE OF ANALYSIS BR19292693

Sample Description	Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61
	Analyte	W	Y	Zn	Zr
	Units	ppm	ppm	ppm	ppm
	LOD	0.1	0.1	2	0.5
Comp-L1		1.0	18.4	29	88.9
Comp-L2a		0.4	10.0	22	43.8
Comp-VA3		1.6	22.8	27	96.6
Comp-VBVH		1.5	18.7	72	128.0

***** See Appendix Page for comments regarding this certificate *****

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Finalized Date: 21-NOV-2019
Account: ALSENV

Project: EB1928714

CERTIFICATE OF ANALYSIS BR19292693

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

REE's may not be totally soluble in this method.

Applies to Method: ME-MS61

ACCREDITATION COMMENTS

NATA Accreditation covers the performance of this service but does not cover the performance of ALS Brisbane Sample Preparation. Corporate Accreditation No: 825, Corporate Site No: 818. The Technical Signatory is David Jones,ICPMS Supervising Chemist

Applies to Method: ME-MS61

LABORATORY ADDRESSES

Processed at ALS Brisbane located at 32 Shand Street, Stafford, Brisbane, QLD, Australia. Processed at ALS Brisbane Sample Preparation at 116 Delta Street, Geebung, QLD 4034, Australia

Applies to Method:

ASH-01	Hg-MS42	LEV-01	LOG-22
ME-MS61			

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