Appendix H
Geochemical Assessment

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Geochemical Assessment of Overburden and Potential Coal Reject from the Proposed Caval Ridge Project

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1. INTRODUCTION

Terrenus Earth Sciences has been engaged by URS Australia Pty Ltd (URS) on behalf of BM Alliance Coal Operations Pty Ltd (BMA) to undertake a Geochemical Assessment of mineral waste materials from the Caval Ridge Project (the Project) currently proposed by BMA. The Project is a proposed open-cut coal mining development in Central Queensland, north of the existing BMA Peak Downs coal mine. The most northern boundary of the study area is located approximately six kilometres southwest of the town of Moranbah. The geochemical assessment is an integral component of the Environmental Impact Assessment of the Project being managed by URS.

This assessment is an extension to earlier geochemical work on this project undertaken by URS in 2006 and reported to BMA in a letter report in February 2007 (**Attachment B**). At that time the Project was referred to as the Peak Downs Expansion (PDX) Project, and was a concept project that became the forerunner to what is now the Caval Ridge Project.

Since the initial geochemical letter report was submitted to BMA in early 2007, BMA has revised many aspects of the project, including the lease boundaries, the quantities of coal, overburden and potential rejects likely to be mined, and the proposed methods of handling, storing and disposing of mineral waste materials. In light of these project revisions the earlier geochemical assessment needed to be reviewed in the context of the current proposal and assessed to determine the potential impacts that mineral wastes from the Project (overburden, coal and rejects) could have on the surrounding environment.

The purpose of this update report is to place the results of the earlier geochemical study into the context of the current proposed Project.

2. BACKGROUND TO THE CAVAL RIDGE PROJECT

The Project will involve the mining of a coking coal deposit split between two open pits. From a geochemical and mineral waste management perspective the key components of the Project are as follows:

- An open-cut coal strip mining operation mining various seam splits within the Q-, P-, Harrow Creek- and Dysart seams. Coal and overburden will be mined using typical dragline and truck-shovel operations.

- The mine will operate from two pits: the Horse Pit (the larger of the two pits) located north of Peak Downs Highway and the Heyford Pit located south of the highway between Cherwell Creek and Harrow Creek. The Heyford Pit was previously mined as part of the Peak Downs Mine (PDM) operations. Following approval the Project, this pit will be separated from the PDM operations and mined and managed by the Project.
- Spoil and rejects are proposed to be disposed into the Horse and Heyford pits.
- The nature of the strip mining operation at the Horse Pit will enable a continual backfill and rehabilitation programme to be undertaken, minimising the volume of out-of-pit (OOP) spoil.
- An initial OOP spoil pile will be established along the western edge of the Horse Pit during construction. The OOP spoil pile will comprise approximately 28 million cubic metres of overburden mined from the box-cut. It will cover an area of approximately 340 ha, along a narrow strip (approximately 350 metres wide by 9.5 kilometres long). After the box-cut is constructed and drag-line operation commences overburden will be disposed of in-pit behind the active strip face.
- Overburden from reworking the Heyford Pit will be used to stabilise the pit, and will be disposed of in-pit.
- The Caval Ridge mine is expected to produce up to 5.5 million tonnes per annum (Mtpa) of product coal, generated from the two pits. In addition the Project will process approximately 2.5 Mtpa of ROM coal from the Peak Downs mine.
- Most coal will be produced following a screening and washing process. The processing will produce coarse and fine rejects. The fine rejects will be dewatered and dumped into the pits along with the coarse rejects. Rejects will be buried with spoil.
- The Horse Pit is expected to leave a final void at the eastern side of the project area along the highwall. The Heyford Pit is expected to leave a similar final void.
- Based on the current estimate of reserves, the anticipated life of the mine is approximately 30 years.

2.1 Project Geology Summary

The following geological summary is derived from the BMA report: *Selection Study Report - Caval Ridge Mine (Draft v3)*. Document No. PHCVR01-0000-MP-RP-5005.1, 25 March 2008.

The Caval Ridge mining complex is situated on the relatively undisturbed western limb of the northern Bowen Basin at the southern end of the Collinsville Shelf. The economic coal seams of the Project area (and PDM operations) occur mainly in the terrestrial Moranbah Coal Measures. The area generally consists of sandstones, siltstones, mudstones, tuffaceous claystones and coal seams. Surface Tertiary alluvial and surface basalt flows, both fresh and weathered, along with weathering of the Permian sediments make up the variations in the stratigraphy. Minor faulting occurs in most pits within the PDM and throughout the seams in the Project area.

The target coal seams for the Project are all the coal seams in the lease that are greater than 0.3 metres thickness, with the primary coal targets being the Q seam - P seam zone, the Harrow Creek Seams and the Dysart Seams. Seam splitting is prevalent along the length of the lease, with a general trend to split to the north and also down dip (east). The seam splitting lends itself to generate a complicated geological model; the discussion of which is beyond the scope of this summary. Generally, in descending stratigraphic order, the seams are briefly described as follows:

S and R seams

The S seam is the highest seam stratigraphically and is considered to be the basal seam of the Fort Cooper Coal Measures. It is 3 to 4 metres thick with high inherent ash and numerous claystone partings. The R seam is 1 to 2 metres thick and has a high inherent ash. These two seams are rarely found in the lease and only at the eastern margins.

Q seam

The Q seam comprises several coal intervals with a cumulative thickness of 2 to 3.5 metres. Through much of the Project area, the Q seam is unsplit, splitting in the central part of the Project area into two ply's (sub-seams).

P seam

The P seam is together as one seam in the south and splits to the north. The three major P seam units are modelled as P02, P07, P08 and are named due to the association with the P Tuff that is consistent through this part of the Bowen Basin. P07 and P08 splits are present in most of the Project area, with unsplit P02 occurring near the P seam oxidation line in the southern and central part of the Project area.

Harrow Creek seam

The Harrow Creek group of seams is up to 12 metres thick and where fully coalesced is modelled as the H13 in the Harrow Pit in the centre of the PDM. From there it splits both to the north and south into a major separation as the Harrow Creek Upper (H16) and Lower (H15).

Dysart seam

The Dysart Upper seam attains a maximum thickness of 3.5 metres where fully coalesced, but splits into multiple units at both ends of the lease. Most of the Dysart Upper seam splits are uneconomic (less than 0.3 metres thick).

The primary Dysart Seam can be a single high quality coal seam that reaches 5 metres in thickness. North of Heyford Pit, it divides quickly into 2 major splits (D02 and D04) and remains that way over the Project area.

The Dysart Lower (DL) seam is a moderately consistent 0.5 metre thick band that correlates under the D02 seam split through most of the Project area.

Geochemical samples were collected and tested from coal, roof and floor materials from the Q-, P-, Harrow Creek and Dysart seams.

2.2 Mineral Waste Quantities

Overburden and Reject Volumes Likely to be Generated by the Project

The quantities presented in this section are based on the "EIS Production Data by Pit.xls" spreadsheet provided by BMA, 7 August 2008.

The total mined overburden and interburden volumes from the Horse and Heyford Pits (combined) are expected to approximate over 1600 million bulk cubic metres (Mbcm) over a 30-year mine life (*i.e.* about 55 Mbcm per year). This equates to over 2000 million tonnes over mine life based on an assumed sandstone/siltstone excavated density of 1.3 to 1.4.

There will also be additional poor-coal reject material generated by the Project; primarily coal seam roof and coal seam floor material from the P-, Harrow- and Dysart-seams, but also including ROM coal from PDM, which will be processed at Caval Ridge. Approximately 161 million tonnes of coarse rejects and 54 million tonnes of fine rejects (215 million tonnes of rejects in total) are expected to be produced from the coal handling and preparation plant (CHPP) at Caval Ridge over a 30-year life (*i.e.* about 7 Mtpa). Coarse rejects will comprise approximately 80 per cent of the total reject volumes, and fine tailings the remainder.

On this basis, rejects (coarse and fine) are expected to comprise in the order of 10 per cent of all geological waste (*i.e.* overburden, interburden and rejects) produced by the Project. The proportion of rejects to overburden is marginally greater for the Project (compared to similar coal mines in the Bowen Basin, which average about 5 per cent of geological waste) due to the additional rejects generated from processing ROM coal from PDM. All of the rejects are expected to be co-disposed with spoil into the mined-out Horse Pit. Mineral waste disposal is discussed in the following section.

2.3 Mineral Waste Disposal

Spoil Disposal

Overburden and interburden will be predominantly disposed of into the mined-out Horse and Heyford pits behind the operating strips, however an out-of-pit (OOP) spoil pile will be constructed along the western edge of the Horse Pit box-cut, between the box-cut and the haul road, for the first year of mining. Approximately 28 Mbcm (less than 2 per cent) of all (life-of-mine) mined overburden and interburden is expected to report to the OOP spoil pile.

Reject Disposal

The rejects materials from the Project CHPP will consist of coarse reject, spiral tailings and flotation tailings material generated from Caval Ridge ROM coal and PDM ROM coal.

Coarse rejects will be dewatered and discharged onto the CHPP rejects conveyor, which reports to the rejects bin. Fine reject from the spirals will be thickened and dewatered before being discharged onto the coarse rejects conveyor. The flotation tailings will also be thickened before reporting to belt press filters. The solids discharged from the belt press filters (tailings paste) will be discharged onto the coarse rejects conveyor.

All rejects (coarse and thickened tailings) from the CHPP will be truck-dumped into the Horse and Heyford pits (co-disposed with spoil) at approximately 20 per cent moisture content before being covered with spoil.

3. GEOCHEMICAL NATURE OF MINERAL WASTE MATERIALS

The following sections summarise and highlight the results and implications of the geochemical testing of mineral wastes undertaken in 2006 and reported by URS in **Attachment B**.

3.1 Acid Generating Potential

The geochemical static-test data collected from seven drill holes (**Figure 1 – Attachment A**) indicate that all overburden (including interburden) and almost all potential rejects tested are clearly non acid forming (NAF). In addition, the total sulphur contents of these materials is very low, with 29 of the 31 overburden and interburden samples having total sulphur concentrations equal to or less than 0.1 per cent and therefore are classed as “barren”. Similarly for the potential reject samples, where the average and median total sulphur concentrations for the 43 samples tests were 0.1 per cent and 0.06 per cent, respectively. One coal-seam roof sample from the P08 seam was classified as potentially acid forming (PAF), indicating the some fine-grained sulphide mineral is likely to be present in some materials, most likely the roof and floor (potential reject) materials, but the proportions of such PAF materials are expected to be very low.

From an acid-base perspective these results are very encouraging. Not only are almost all materials NAF, but the high acid neutralising capacity (ANC) of many of the samples combined with the very low sulphur concentrations, indicates there would be excess alkalinity to buffer the small quantity of acid that could potentially be produced by a very small proportion of the likely mineral waste materials.

This is highlighted by the ratio of ANC to MPA (maximum potential acidity). The purpose of the ANC/MPA ratio is to provide an indication of the relative margin of safety (or lack thereof) within a material. Various ANC/MPA values are reported in the literature for indicating safe values for prevention of acid generation. These values typically range from one to three, with significantly higher ratios evident in strongly alkaline materials. As a general rule, an ANC/MPA ratio of two or more generally signifies that there is a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to acid rock drainage. The median ANC/MPA ratio for the Project samples tested is 31.

Comparison of potential rejects with coarse rejects and tailings from Peak Downs Mine

The geochemical results from potential reject samples likely to be generated by the Project are supported by similar geochemistry of coarse rejects and tailings at the adjacent BMA PDM, located immediately south of the proposed Heyford Pit. A geochemical assessment of coarse rejects and tailings at PDM (URS, 2002) found that approximately 36 per cent (10 samples) of coarse reject samples tested were NAF, and a further 57 per cent (16 samples) were classified as PAF-Low Capacity, due to their very low sulphur concentrations. Two coarse reject samples were classified as PAF-High Capacity, but these two samples had low total sulphur concentrations of less than 0.5 per cent.

Comparatively, over 60 per cent (22 samples) of fine tailings were NAF and 33 per cent (12 samples) were classified as PAF-Low Capacity, again with low sulphur concentrations. Two fine tailing samples were classified as PAF-High Capacity. The tailing samples had similar sulphur concentrations to the coarse rejects.

These results showed that, overall, the majority of coarse rejects and tailings had little or no capacity to generate acid and all materials appear to retain a modest neutralising capacity. These results are supported in the day-to-day management at PDM where the ROM stockpile and the tailing storage facility (TSF) are not known for generating acid seepage.

Therefore, rejects from PDM to be processed and disposed at the Project are not expected to generate acid.

3.2. Multi-element Composition and Water Quality

Composite overburden and potential reject samples underwent testing for total and water-soluble metals concentrations (**Attachment B**). The results show that only total manganese (Mn) is present in concentrations in solids that exceed the applied Draft Qld Guidelines for the Assessment and Management of Contaminated Land (1998), but still well within the applied NEPC (1999a) health-based investigation level (HIL) guidelines.

Despite the presence of Mn in solids (albeit at concentrations still well below the applied NEPC guideline levels), the water extracts[1] from all composite samples have soluble metal concentrations below applied ANZECC (2000) values for livestock drinking water and below NEPC (1999b) groundwater investigation levels.

Although soluble metals concentrations are low, the electrical conductivity (EC) of the materials is moderate to high, ranging from 388 to 1970 µS/cm (median 679 µS/cm), and is similar for both overburden and potential rejects.

These results indicate that metals concentrations in overburden and potential reject materials is low and that the initial water solubility of these materials with respect to metals in mineral waste materials from the Project is also low, but the materials may contribute some salt load to the surrounding environment.

Comparison of potential rejects with coarse rejects and tailings from Peak Downs Mine

The multi-element analyses undertaken by URS (2002) on coarse rejects and tailings from PDM found that coarse rejects and tailings from PDM also had relatively low concentrations of total and soluble metals, generally below the applied guidelines. Selenium (Se) and sulphate (SO_4) were marginally elevated above the applied ANZECC (2000) and NEPC (1999b) water quality guidelines in some leachate water quality samples.

Therefore, rejects from PDM to be processed and disposed at the Project are not expected to cause environmental issues with respect to metal and salt concentrations in leachate.

[1] The water extract test facilitates evaluation of the immediate solubility of multi-elements in solids. It is made from a solution of 1 part solid to 5 parts water. The solution is analysed for the required parameters: primarily soluble metals and salts.

5. SUITABILITY OF OVERBURDEN MATERIALS FOR USE IN REVEGETATION AND REHABILITATION

The proposed mining strategy is to dump all rejects and almost all overburden materials together back into the void behind the mining (stripping) face in the Horse and Heyford pits. Some quantity of overburden materials will need to be “set aside” for rehabilitation and revegetation of the spoil piles (*i.e.* it is generally not acceptable mining practice to allow rejects to report to final surfaces – typically they are buried well into the overburden material). Also, a small proportion of overburden (less than 2 per cent of the overall total) will be disposed into an out-of-pit dump along the western edge of the Horse Pit box-cut. With this in mind, the suitability of mineral waste materials for use in revegetation and rehabilitation is focused on the overburden materials, even though from a basic soil chemistry viewpoint the overburden materials have similar characteristics compared to the potential reject materials, as shown in the URS letter report (**Attachment B)** and discussed below.

All of the tested overburden composite materials (and also the potential reject materials) had variously elevated Exchangeable Sodium Percentage (ESP) values, ranging from 8.5 per cent to 25 per cent (median 11 per cent). An ESP value of between 6 per cent and 14 per cent indicates that these materials are regarded as marginally sodic to sodic and may be prone to dispersion (Isbell, 2002). Soil with an ESP value greater than 14 per cent is regarded as strongly sodic (Northcote and Skene, 1972). Strongly sodic materials are likely to have structural stability problems related to potential dispersion (Van de Graaff and Patterson, 2001). Treatment of all sodic overburden (and potential reject materials) would be required if these are to be used as vegetation growth medium.

Ideally, sodic and dispersive materials should be identified, selectively handled and placed within the core of spoil piles away from final surfaces, or returned to voids during mining. However, since most overburden and coarse reject material is expected to be marginally sodic, this method of managing potentially sodic material is unlikely to be cost effective (*i.e.* it should be assumed that all spoil material will be sodic). Therefore, it is likely that treatment of the sodic waste materials may be required if these were to be used as an additional source of topsoil.

In addition to potential dispersion problems, sodic soils often have unbalanced nutrient ratios that can lead to macro-nutrient deficiencies (Hazelton and Murphy, 2007). The table below (**Table 1**) shows the proportions of each exchangeable cation relative to the effective cation exchange capacity (eCEC). The ‘desirable’ proportions of each major cation are also shown (Abbott, 1989, *in* Hazelton and Murphy, 2007).

Table 1 Proportions of eCEC of major exchangeable cations

Exchangeable Cation	Desirable ranges	Overburden	Potential Rejects
	% eCEC		
Calcium (Ca)	65 - 80	26 – 65 (average 53)	29 – 65 (average 50)
Magnesium (Mg)	10 - 15	15 – 35 (average 24)	14 – 34 (average 25)
Potassium (K)	1 - 5	3 – 20 (average 11)	10 – 25 (average 14)
Sodium (Na)	0 - 1	9 – 25 (average 13)	9 – 15 (average 12)

The median eCEC of overburden materials is 27 meq/100g, which is regarded as moderate (Metson, 1961, *in* Hazelton and Murphy, 2007). The shallow clay composite sample tested had a very high eCEC value (50 meq/100g) and high EC (approximately1380 µS/cm), which is probably the result of evaporative concentration of salts in shallow soil.

When compared to the desirable ranges for exchangeable cations in soil (**Table 1**) exchangeable cation proportions are outside the average ranges, but are not 'extreme'. The exchangeable proportions of the alkali metals Na and K are high, which supports the naturally alkaline nature of most mineral waste materials (refer below). Exchangeable Ca and exchangeable Mg proportions are marginally imbalanced, but are generally acceptable. Exchangeable Ca:Mg ratios less than two typically require some form of amelioration before these materials can be used as a growth layer. The overburden materials have a median exchangeable Ca:Mg ratio of 2.7, whereas the potential reject materials have a median exchangeable Ca:Mg ratio of 1.6, indicating that amelioration of overburden materials for use as a growth layer may not be required.

It should be noted that in soil chemistry a $pH_{1:5}$ (solid:water w/v) of between 7.9 and 8.4 is regarded as moderately alkaline and a soil $pH_{1:5}$ of between 8.5 and 9.0 is regarded as strongly alkaline. 58 per cent of the overburden samples are regarded as moderately alkaline and 29 per cent are regarded as strongly alkaline. Comparatively, 77 per cent of the potential reject samples are regarded as moderately alkaline and 16 per cent are regarded as strongly alkaline. Therefore some degree of nutrient imbalance is likely to already exist in these materials, despite exchangeable Ca:Mg ratios in these materials being generally acceptable.

In summary, most of the overburden materials are regarded as moderately to strongly alkaline. All have generally moderate salinity (median EC = 700 µS/cm) and display moderate to high eCEC values. All overburden materials can be regarded as being marginally sodic and have a marginal exchangeable cation imbalance.

6. MANAGEMENT MEASURES

The ongoing management of mineral waste (overburden and potential reject materials) should consider the geochemistry of materials with respect to their potential risk to cause harm to the environment and their suitability for use in revegetation. The design of a mineral waste management strategy for the Project should focus on:

- Placement of mineral waste materials to minimise run-off and erosion; and
- Evaluating the geochemical characteristics of materials from 'untested' areas or lithologies that have not been evaluated.

This study has identified that almost all overburden and potential reject materials are expected to be overwhelmingly non-acid forming (NAF). A very small proportion of potential reject materials may have a low capacity to generate small quantities of acid, however the small quantity of acid that could potentially be produced from these materials (based on the very low sulphur concentrations), would be sufficiently neutralised (buffered) by the relatively high acid neutralising capacity and naturally high alkalinity of the overburden materials. Therefore no specific management measures are likely to be required to manage potential acid generation in spoil or rejects.

The possible exception here is the final void of the Heyford Pit, which will likely have seepage generated from the coal seams, of which a small proportion (from potential coal reject testing) has been shown to be potentially acid forming (albeit at a low capacity). The impact this may have on final void water quality is outside the scope of this study.

6.1 Continued Geochemical Sampling and Analysis

As would be evident from the distribution of drill holes used for geochemical sampling shown in **Figure 1** (**Attachment A**) the geochemical information to date has largely been derived from drill holes in the Horse Pit area (north of the Peak Downs Highway), since this was the primary focus of the concept study in 2006 (as presented in **Attachment B**).

The geology of the Project area, from the existing PDM north to the northern boundary of the proposed Horse Pit, is relatively lithologically uniform (*i.e.* the same units and lithology) despite seam splits. Therefore, the geochemical characteristics of mineral waste materials from the Heyford Pit (the southern section of the Project) are expected to be the same as those further north and, as previously discussed, similar to the geochemical characteristics of the existing PDM to the south. Despite the expectation that the geochemical characteristics of the southern section of the Project area will be the same as other areas nearby, BMA will be undertaking ongoing geochemical characterisation of mineral waste materials in the southern section of the Project area as part of in-fill drilling programs to confirm the expected geochemical characteristics of these materials.

Continued characterisation of reject materials from the CHPP (once constructed) will also be undertaken to verify the expected geochemical data of rejects. This data will be used to re-evaluate the management strategies of mineral waste materials.

For future work, in addition to standard acid-base and metals testing (static tests), geochemical characterisation will include assessing the general soil properties (sodicity, exchangeable cations) of mined waste materials to evaluate their suitability for use in revegetation activities.

6.2 Water Quality Monitoring and Management

Leachate and site water derived from, or in contact with, spoil piles, reject materials or other mineral waste is not expected to be problematic with respect to pH (acid) and metals, however the moderate EC of the overburden materials suggests that salt concentrations in leachate may need to be carefully monitored to ensure nearby drainages are not receiving salt loads that could impact upon the existing ecosystem. This will be managed by retaining seepage and runoff water on-site and re-using as part of the overall site water resource. This will be particularly important in the vicinity of the CHPP where coal washing is likely to produce brackish run-off.

Seepage collection ponds and drainages will be monitored to ensure that soluble metals and salt concentrations are below regulatory guidelines or licence conditions prior to discharge off-site. The parameters monitored and the frequency of monitoring will be considered in the design of the site water monitoring program, taking into account the results of the geochemical investigation tabled herein and also the baseline surface water and groundwater water quality studies being undertaken by others.

At a minimum, the range of analyses included in the water quality monitoring program for runoff/seepage from overburden and potential reject storage facilities will focus on pH, EC and total dissolved solids (TDS). Periodic sampling and testing of the full suite of dissolved metals described in this report (*e.g.* annually) will be included in the water quality monitoring program developed for the project. If the pH of runoff and seepage from overburden or potential reject materials drops below pH 6.0 or the EC value increases by more than 50 per cent, then a more comprehensive range of water quality analysis may be warranted. Also, if the pH drops below 6.0 or the EC increases, the handling and storage (management) of all mineral waste materials will be re-evaluated.

7. REFERENCES

ANZECC (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*: Livestock Drinking Water. Australian and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). Canberra, ACT.

Hazelton, P.A. and Murphy, B.W (eds). (2007). *Interpreting Soil Test Results: What do all the numbers mean?* [2nd edn.] CSIRO Publishing, Collingwood, Victoria.

Isbell, R.F. (2002). *The Australian Soil Classification* (revised edition). CSIRO Publishing. Victoria.

NEPC (1999)a. National Environment Protection Council. National Environmental Protection (Assessment of Site Contamination) Measure. Guideline on investigation levels for soil and groundwater. HIL(E); parks, recreation open space and playing fields; HIL(F); commercial/industrial.

NEPC (1999)b. National Environment Protection Council. National Environmental Protection (Assessment of Site Contamination) Measure. Guideline on investigation levels for soil and groundwater. Groundwater Investigations Levels.

Northcote, K.H., and Skene, J.K.M. (1972). *Australian soils with saline and sodic properties*. CSIRO Australia, Soil Publication No. 27, Canberra.

URS (2002). Geochemical assessment of coarse rejects and tailings at BMA Peak Downs Coal Mine. Consultants report 24628\R001-B prepared for BMA, 3 May 2002.

URS (2007). Geochemical Characterisation and Assessment of Waste Rock from the Peak Downs Expansion Project. Consultants letter report Project No. 42625922 prepared for Shaun Ferris, BMA, 27 February 2007. (**refer to Attachment B**)

Van de Graaff, R. and Patterson, R.A. (2001). Explaining the Mysteries of Salinity, Sodicity, SAR and ESP in On-site Practice. *In*: Proceedings of On-Site '01 Conference: Advancing On-Site Wastewater Systems. Patterson, R.A. & Jones, M.J. (*Eds*). Lanfax Laboratories, Armidale. pp 361-368.

8. LIMITATIONS

Terrenus Earth Sciences (Terrenus) has prepared this memo report in accordance with the usual care and thoroughness of the consulting profession for the use of URS Australia Pty Ltd (URS), BM Alliance Coal Operations Pty Ltd (BMA) and only those additional parties who have been authorised in writing by Terrenus to rely on this report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Terrenus Earth Sciences proposal to URS dated 24 June 2008.

The methodology adopted and sources of information used by Terrenus are outlined in this report. Terrenus has made no independent verification of this information beyond the agreed scope of works and Terrenus assumes no responsibility for any inaccuracies or omissions outside of Terrenus' direct control. No indications were found during our investigations that information contained in this report as provided to Terrenus was false or misleading.

This report was prepared between August and September 2008 (issued as final on 13 February 2009), from geochemical data collected by URS in 2006 and updated project information provided by URS and BMA to Terrenus during 2008. The report is based on the conditions encountered and information reviewed during this period. Terrenus disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by parties other than URS and BMA. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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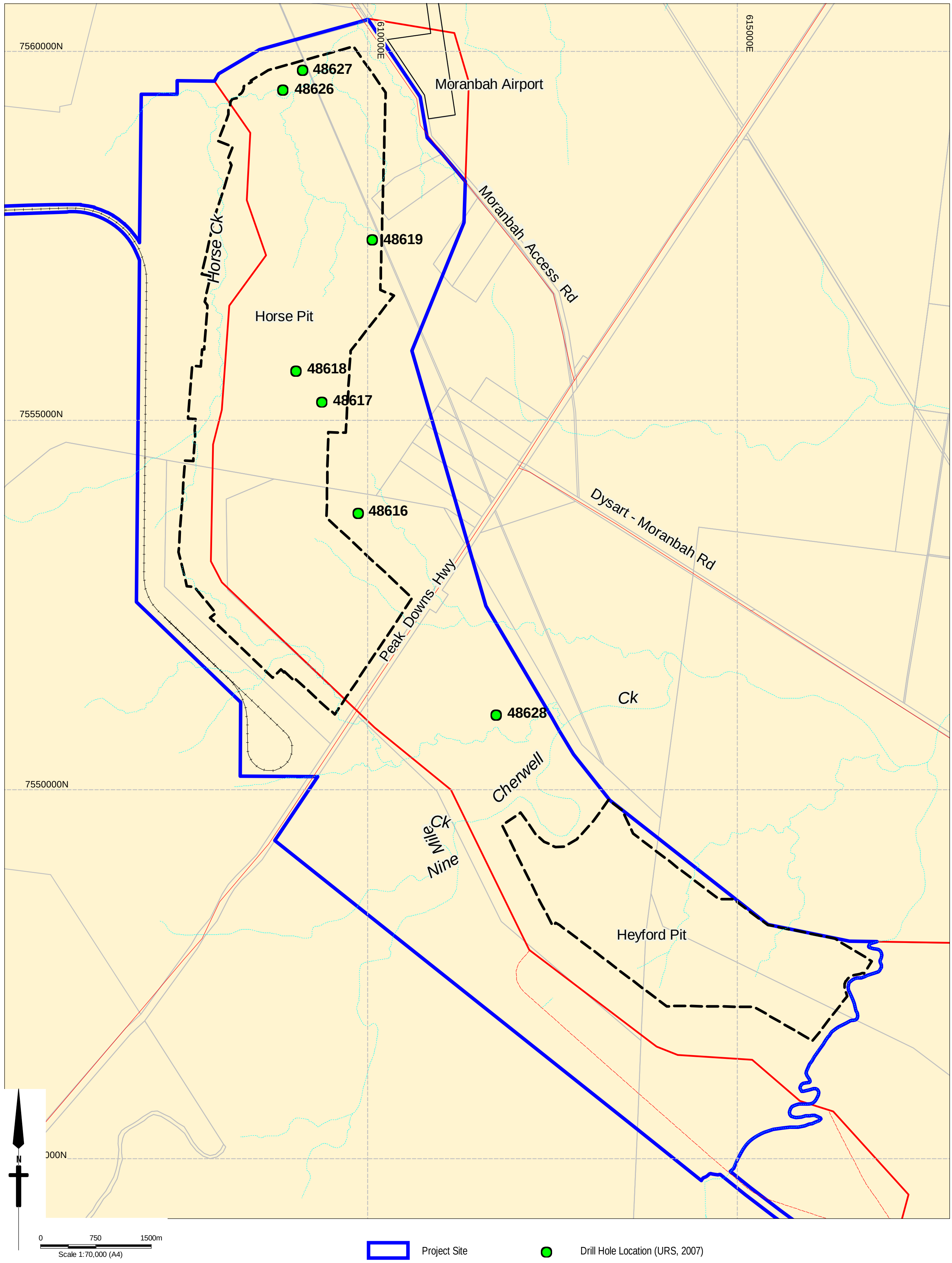
Terrenus Earth Sciences

Dr. Ian P Swane
Director & Principal Consultant

13 February 2009

Attachments:

- Attachment A - Figure 1: Drill hole locations for geochemical samples
- Attachment B - URS 2007 Letter Report.



Project Site
ML1775
Drill Hole Location (URS, 2007)
Mine Pit Outlines

Source: Client Supplied Data

Client	Project	Title
BMA BHP Billiton Mitsubishi Alliance URS	CAVAL RIDGE PROJECT GEOCHEMICAL REPORT	**DRILL HOLE LOCATIONS FOR GEOCHEMICAL SAMPLES**

Drawn: VH	Approved: IS	Date: 13-02-2009	Figure: **1**	Rev:B
Job No: **4262 6158**	File No: 42626158-g-119b.wor			A4

URS

27 February 2007
Project No. 42625922

BHP-Billiton Mitsubishi Alliance
GPO Box 1389
Brisbane
QLD 4001

Attention: Shaun Ferris
Senior Environmental Coordinator

Dear Shaun,

Subject: Geochemical Characterisation and Assessment of Waste Rock from the Peak Downs Expansion Project - Letter Report

URS Australia Pty Ltd (URS) has been commissioned by BHP-Billiton Mitsubishi Alliance (BMA) to provide consulting services associated with the proposed expansion of an existing coal mine (Peak Downs Coal Mine), located approximately 30 km south of the town of Moranbah and approximately 195 km south west of the Hay Point port facilities on the Whitsunday Coast. These consulting services were required as an integral component of the Environmental Assessment documentation for the proposed expansion of the Peak Downs Coal Mine (Peak Downs Expansion (PDX) Project).

URS has geochemically characterised overburden and interburden material from the proposed PDX Project. Potential coal reject materials have also been included in the scope to address potential environmental management issues should this (coal reject) material be generated as part of future coal processing activities.

1. Scope and Methodology

This letter report addresses the scope of work provided in a URS revised e-mail proposal submitted to BMA on 23 August 2006. The objective of this work is to evaluate the geochemical nature of overburden, interburden and potential coal reject materials likely to be produced at the Peak Downs Expansion Project and identify potential environmental issues that may be associated with mining, handling, storage and rehabilitation of these materials.

URS developed a geochemical sampling and testing program based on information provided by BMA from exploration drilling. The program focussed on acquiring representative samples of the main overburden, interburden and potential reject material types (sandstone, siltstone, carbonaceous siltstone and mudstone). On the basis of the initial BMA-supplied information, URS selected a total of 74 overburden, interburden and potential coal reject samples for collection and analysis from seven drill holes in the proposed mine expansion area (**Figure 1**).

All samples were initially screened using a series of standard static geochemical tests including:

- pH (1:5 solid:water);
- Electrical Conductivity (EC) (1:5 solid:water);
- Acidity or Alkalinity (pH dependent) (1:5 solid:water);
- Total Sulfur (TS);
- Sulfate Sulfur (SO_4S); and
- Acid Neutralising Capacity (ANC).

The potential for a sample to generate acid was derived from the Total Oxidisable Sulfur (TOS) content (TS – SO_4S = TOS) and the calculated Net Acid Production Potential (NAPP) value.

All analytical testwork was conducted by Australian Laboratory Services (ALS). The laboratory results received from ALS are provided at **Appendix A**.

Upon receipt of initial screening results, the 74 samples were combined into 16 composite samples according to rock type, depth and geochemical nature as described in **Table B1** (**Appendix B**). The multi-element composition of the composite samples was determined to identify the presence of any elements at concentrations of environmental significance. Water extracts from the composite samples were also subjected to multi-element analyses to determine the initial solubility and potential mobility of any elements of concern from the mine materials. **Table 1.1** summarises the geochemical test program.

Table 1.1 Summary of the geochemical test program

Analytical Tests	Overburden Materials[1]	Potential Reject Material
Static acid-base	31 samples	43 samples
Multi-element	7 composites	9 composites

[1] Includes interburden material

2. Results

2.1 Acid-Base Tests: Individual Samples

Overburden (including interburden)

Acid-Base test results for the 31 Overburden samples representing specific lithological rock types are presented in **Table 2.1** and summarised below.

- The current $pH_{1:5}$ of the overburden samples is slightly alkaline (average pH 8.2) and ranges from 6.9 to 8.7. The current alkalinity is generally low (average value of 0.005 kg H_2SO_4/t) and ranges from 0.0003 to 0.035 kg H_2SO_4/t.
- The current $EC_{1:5}$ is relatively low and ranges from 388 to 1,970 µS/cm, with an average value of 820 µS/cm.
- The total sulfur content of the overburden samples is low, ranging from less than 0.01 % to 0.19 % (average 0.05 %). Only two samples contained a total sulfur content greater than 0.1%. Sulfate sulfur content was low, ranging from 0.004 to 0.024 %, indicating that sulfur is mostly present in the sulfide (unoxidised) form or as organic sulfur. Based on the difference between total sulfur and sulfate sulfur, the TOS content ranges from less than 0.01 % to 0.18 %. The Maximum Potential Acidity (MPA) that could be generated by these samples ranges from less than 0.02 kg H_2SO_4/t to 5.59 kg H_2SO_4/t and is generally low (average value is 1.21 kg H_2SO_4/t).
- The ANC values range from low to high (8.7 to 210 kg H_2SO_4/t) and are generally moderate (average ANC value is 65 kg H_2SO_4/t).
- The NAPP values range from -210 to -4.6 kg H_2SO_4/t, with an average NAPP value of -64 kg H_2SO_4/t. Therefore, all samples returned a negative NAPP value.

On the basis of these results:

- o 17 of the overburden samples are classified as Non-Acid Forming (NAF); and
- o 14 are classified as Acid Consuming (AC).

Twenty-nine (29) of the 31 overburden samples (94%) have total sulfur values less than 0.10 % and hence are also classified as barren.

Roof and Floor

Acid-Base test results for the 43 samples that could potentially report as waste or reject are presented in **Table 2.1** and summarised below.

- The current $pH_{1:5}$ of the roof and floor samples is slightly alkaline (average pH 8.3) and ranges from 7.7 to 8.6. The current alkalinity is low (ranges from 0.0002 to 0.0158 kg H_2SO_4/t) and has an average value of less than 0.0026 kg H_2SO_4/t.
- The current $EC_{1:5}$ is relatively low and ranges from 389 to 1,710 µS/cm (average value of 693 µS/cm).
- The total sulfur content is generally very low (0.03 to 1.05%; average 0.10%), and is mostly present in the sulfide (unoxidised) form. The TOS content ranges from 0.02 to 1.04 %S. The MPA that could be generated by roof and floor samples is low to moderate (0.57 to 31.79 kg H_2SO_4/t) and has an average value of 1.6 kg H_2SO_4/t.
- The ANC value is low to high, ranging from 9.3 to 176 kg H_2SO_4/t (average ANC value is 49.9 kg H_2SO_4/t).
- The NAPP values range from -175 to +22.5 kg H_2SO_4/t, with an average NAPP value of -47 kg H_2SO_4/t. Only one sample returned a positive NAPP value.

On the basis of these results:

  - 31 of the 43 roof and floor samples are classified as NAF;
  - 11 are classified AC; and
  - One sample (roof of P08 seam) is classified as Potentially-Acid Forming (PAF).

Thirty-four (34) of the 43 roof and floor samples (79%) have total sulfur values less than or equal to 0.10 % and are also classified as barren.

Table 2.1. Acid-Base Test Results for Overburden and Potential Reject Samples - Peak Downs Expansion Project

Sample Number	Drillhole Number	Sample Interval		Sample Description		pH[1]	Alkalinity (to pH 5.5)	EC[1]	Total Sulfur	Sulfate Sulfur	TOS[2]	MPA[2]	ANC[2]	NAPP[2]	Sample Classification[3]
		from (m)	to (m)				(kg H_2SO_4/t)	(μS/cm)	(%)			(kg H_2SO_4/t)			
Overburden (and interburden)															
113311	48628	0.00	1.00	100% Clay.	Overburden	8.5	0.0223	937	0.03	0.013	0.02	0.5	54	-53	Acid Consuming
113298	48627	0.00	2.00	100% Clay.	Overburden	8.6	0.0004	1240	0.01	0.01	0.00	<0.01	33	-33	Non Acid Forming
97951	48616	0.00	4.00	100% Clay.	Overburden	7.0	0.0011	1860	0.02	0.006	0.01	0.4	11	-10	Non Acid Forming
97995	48617	0.00	3.00	100% Clay.	Overburden	7.8	0.0078	1500	0.03	0.024	0.01	0.2	56	-56	Acid Consuming
113312	48628	1.00	15.00	100% Clayey Sand.	Overburden	8.5	0.0022	735	<0.01	0.006	<0.01	<0.2	31	-31	Non Acid Forming
113299	48627	2.00	7.00	60% Sandstone, Fine Grained, 40% Carb Siltstone.	Overburden	8.4	0.0003	918	<0.01	0.006	<0.01	<0.2	88	-88	Acid Consuming
113285	48626	2.00	4.00	100% Sandstone, Fine To Medium.	Overburden	8.4	0.0003	1100	0.01	0.008	0.00	0.1	43	-43	Non Acid Forming
113200	48618	3.00	6.00	100% Siltstone.	Overburden	6.9	0.0006	1970	0.01	0.010	0.00	<0.01	9	-9	Non Acid Forming
113300	48627	7.00	24.00	100% Sandstone, Fine To Medium.	Overburden	8.4	0.0006	601	0.05	0.007	0.04	1.3	100	-99	Acid Consuming
97998	48617	12.00	21.00	100% Siltstone.	Overburden	7.7	0.0003	1370	0.07	0.010	0.06	1.8	36	-34	Non Acid Forming
113218	48619	18.00	24.00	100% Siltstone.	Overburden	8.5	0.0019	841	0.03	0.009	0.02	0.6	33	-32	Non Acid Forming
97956	48616	20.50	23.00	100% Sandstone, Fine To Medium.	Overburden	8.5	0.0221	571	0.02	0.004	0.02	0.5	210	-210	Acid Consuming
98000	48617	27.00	30.00	100% Sandstone, Very Fine Grained.	Overburden	8.4	0.0017	721	0.03	0.006	0.02	0.7	91	-91	Acid Consuming
113314	48628	31.00	38.00	100% Sandstone, Fine To Medium.	Overburden	8.5	0.0347	433	0.05	0.008	0.04	1.3	155	-154	Acid Consuming
97959	48616	38.50	42.00	100% Siltstone.	Overburden	8.2	0.0019	532	0.07	0.009	0.06	1.9	37	-36	Non Acid Forming
97964	48616	50.00	51.00	100% Carb Siltstone.	Interburden	7.9	0.0011	388	0.19	0.007	0.18	5.6	10	-5	Non Acid Forming
113180	48617	51.00	55.00	100% Sandstone, Fine Grained.	Interburden	8.3	0.0014	625	0.03	0.006	0.02	0.7	66	-65	Acid Consuming
113205	48618	54.00	60.00	100% Siltstone.	Interburden	8.2	0.0009	568	0.04	0.006	0.03	1.1	30	-29	Non Acid Forming
113206	48618	60.00	67.50	100% Sandstone, Very Fine Grained.	Interburden	8.3	0.0076	518	0.04	0.006	0.03	1.0	37	-36	Non Acid Forming
97967	48616	61.00	79.00	100% Sandstone, Fine To Medium.	Interburden	8.7	0.0204	494	0.02	0.005	0.01	0.5	132	-132	Acid Consuming
113224	48619	62.38	78.00	83% Sandstone, Fine To Mediu, 17% Sandstone, Very Fine Gra.	Interburden	8.7	0.0006	581	0.04	0.008	0.03	1.0	140	-139	Acid Consuming
113296	48626	71.00	73.00	100% Sandstone, Fine Grained.	Interburden	8.4	0.0004	588	0.14	0.007	0.13	4.1	43	-39	Non Acid Forming
113297	48626	73.00	76.00	100% Mudstone.	Interburden	8.4	0.0003	907	0.08	0.010	0.07	2.1	37	-35	Non Acid Forming
113184	48617	82.00	98.80	100% Sandstone, Fine To Medium.	Interburden	8.3	0.0018	621	0.04	0.005	0.03	1.1	80	-79	Acid Consuming
97978	48616	144.70	149.00	100% Siltstone.	Interburden	8.2	0.0006	773	0.03	0.007	0.02	0.7	36	-36	Acid Consuming
97979	48616	149.00	157.00	100% Sandstone, Fine To Medium.	Interburden	8.6	0.0155	703	0.03	0.005	0.02	0.8	181	-180	Acid Consuming
97981	48616	163.00	165.00	100% Mudstone.	Interburden	8.2	0.0013	744	0.06	0.007	0.05	1.6	41	-39	Non Acid Forming
97988	48616	187.00	189.00	100% Siltstone.	Interburden	8.3	0.0070	748	0.05	0.006	0.04	1.3	64	-63	Acid Consuming
97989	48616	189.00	196.00	100% Sandstone, Very Fine Grained.	Interburden	8.4	0.0031	638	0.05	0.006	0.04	1.3	45	-43	Non Acid Forming
113278	48619	101.00	103.00	100% Sandstone, Fine Grained.	Interburden	8.2	0.0035	604	0.04	0.005	0.04	1.1	40	-39	Non Acid Forming
113329	48628	158.00	166.00	63% Sandstone, Fine Grained, 38% Sandstone, Very Fine Gra.	Interburden	8.2	0.0051	586	0.07	0.007	0.06	1.9	50	-48	Non Acid Forming
Coal Seam Roof and Floor															
113286	48626	4.00	12.31	100% Sandstone, Very Fine Gra.	roof	8.3	0.0003	1710	0.03	0.011	0.02	0.6	68	-67	Acid Consuming
113288	48626	17.85	24.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.0004	1080	0.16	0.011	0.15	4.6	48	-43	Non Acid Forming
113291	48626	27.70	44.35	82% Sandstone, Very Fine Gra, 18% Sandstone, Fine Grained.	floor-roof	8.4	0.0003	814	0.06	0.010	0.05	1.5	30	-29	Non Acid Forming
113302	48627	29.37	36.55	63% Sandstone, Very Fine Gra, 37% Siltstone.	floor-roof	8.3	0.0003	838	0.28	0.012	0.27	8.2	32	-24	Non Acid Forming
113177	48617	30.00	40.64	100% Siltstone.	roof	8.4	0.0024	725	0.03	0.007	0.02	0.7	89	-88	Acid Consuming
113204	48618	36.11	54.00	100% Sandstone, Fine Grained.	floor	8.3	0.0006	677	0.05	0.009	0.04	1.3	34	-32	Non Acid Forming
113304	48627	37.35	50.50	100% Mudstone.	floor	8.5	0.0038	886	0.06	0.011	0.05	1.5	35	-33	Non Acid Forming
113221	48619	38.67	54.00	52% Sandstone, Fine To Mediu, 48% Sandstone, Very Fine Gra.	floor	8.4	0.0008	576	0.03	0.003	0.03	0.8	42	-41	Non Acid Forming
97960	48616	42.00	43.49	100% Carb Siltstone.	roof	8.0	0.0013	441	1.05	0.012	1.04	32	9.3	22	Potentially Acid Forming
113179	48617	46.02	51.00	49% Sandstone, Very Fine Gra, 48% Siltstone, 3% Coal.	roof-floor	8.1	0.0025	798	0.08	0.010	0.07	2.1	60	-58	Acid Consuming
97963	48616	48.68	50.00	100% Claystone.	floor	7.7	0.0023	466	0.05	0.006	0.04	1.4	41	-40	Non Acid Forming
113293	48626	48.69	61.45	100% Siltstone.	floor-roof	8.5	0.0004	854	0.09	0.012	0.08	2.4	31	-29	Non Acid Forming
113316	48628	52.50	62.41	70% Siltstone, 30% Sandstone, Very Fine Gra.	roof	8.4	0.0075	505	0.03	0.008	0.02	0.7	50	-49	Non Acid Forming
113181	48617	55.00	73.14	100% Sandstone, Very Fine Gra.	roof	8.6	0.0037	576	0.03	0.006	0.02	0.7	110	-109	Acid Consuming
113307	48627	60.24	73.62	96% Siltstone, 4% Sandstone, Fine Grained.	floor-roof	8.5	0.0031	621	0.12	0.008	0.11	3.4	31	-28	Non Acid Forming
113295	48626	66.56	71.00	100% Sandstone, Very Fine Gra.	floor	8.2	0.0003	815	0.08	0.011	0.07	2.1	33	-31	Non Acid Forming
113318	48628	68.05	70.00	100% Carb Siltstone.	floor	8.3	0.0016	519	0.48	0.019	0.46	14	43	-29	Non Acid Forming
113183	48617	76.94	82.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.0014	389	0.06	0.008	0.05	1.6	39	-38	Non Acid Forming
113309	48627	77.15	79.00	92% Siltstone, 8% Carb Siltstone.	D02-floor	8.5	0.0022	743	0.17	0.019	0.15	4.6	30	-26	Non Acid Forming

Table 2.1. Acid-Base Test Results for Overburden and Potential Reject Samples - Peak Downs Expansion Project

Sample Number	Drillhole Number	Sample Interval		Sample Description		pH[1]	Alkalinity (to pH 5.5)	EC[1]	Total Sulfur	Sulfate Sulfur	TOS[2]	MPA[2]	ANC[2]	NAPP[2]	Sample Classification[3]
		from (m)	to (m)				(kg H_2SO_4/t)	(μS/cm)	(%)			(kg H_2SO_4/t)			
Coal Seam Roof and Floor															
113209	48618	76.09	81.75	38% Siltstone, 34% Carb Siltstone, 28% Sandstone, Very Fine Gra.	floor-roof	7.9	0.0008	660	0.03	0.004	0.03	0.8	69	-68	Acid Consuming
97968	48616	79.00	93.11	100% Sandstone, Fine Grained.	roof	7.9	0.0158	923	0.04	0.009	0.03	1.0	112	-111	Acid Consuming
113211	48618	88.00	99.75	100% Sandstone, Very Fine Gra.	roof	8.2	0.0023	565	0.05	0.006	0.04	1.3	176	-175	Acid Consuming
113213	48618	103.79	114.00	86% Sandstone, Very Fine Gra, 13% Claystone, 2% Carb Siltstone.	floor	8.5	0.0005	542	0.04	0.006	0.03	1.0	24	-23	Non Acid Forming
113281	48619	110.40	125.80	100% Sandstone, Very Fine Gra.	floor-roof	8.4	0.0006	637	0.06	0.006	0.05	1.6	56	-55	Acid Consuming
113322	48628	113.18	129.33	100% Sandstone, Very Fine Gra.	floor-roof	8.4	0.0057	723	0.07	0.009	0.06	1.9	41	-39	Non Acid Forming
113192	48617	121.00	141.20	100% Sandstone, Fine To Mediu.	floor-roof	8.5	0.0008	582	0.05	0.007	0.04	1.3	42	-40	Non Acid Forming
97973	48616	122.31	130.32	96% Sandstone, Very Fine Gra, 4% Coal.	roof-floor	8.4	0.0015	833	0.07	0.008	0.06	1.9	46	-44	Non Acid Forming
113324	48628	130.84	145.75	98% Sandstone, Very Fine Gra, 2% Coal.	roof-floor	8.4	0.0041	587	0.08	0.007	0.07	2.2	39	-36	Non Acid Forming
97975	48616	131.10	133.00	100% Siltstone.	floor	8.2	0.0013	768	0.07	0.005	0.07	2.0	39	-37	Non Acid Forming
97976	48616	133.00	138.00	100% Sandstone, Very Fine Gra.	roof	8.2	0.0028	594	0.06	0.005	0.05	1.7	41	-40	Non Acid Forming
97977	48616	138.10	144.70	100% Sandstone, Fine Grained.	floor	8.3	0.0005	700	0.03	0.005	0.02	0.8	35	-34	Non Acid Forming
113326	48628	146.20	153.00	96% Sandstone, Very Fine Gra, 4% Coal.	roof-floor	7.8	0.0028	612	0.08	0.008	0.07	2.2	32	-29	Non Acid Forming
113327	48628	153.00	154.95	54% Carb Sandstone, 46% Coal.	roof-H00	7.8	0.0029	754	0.12	0.008	0.11	3.4	34	-31	Non Acid Forming
113328	48628	154.95	158.00	100% Siltstone.	floor	8.0	0.0026	501	0.04	0.005	0.04	1.1	31	-29	Non Acid Forming
113196	48617	155.52	168.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.0011	498	0.08	0.005	0.07	2.3	51	-49	Non Acid Forming
97982	48616	165.00	171.25	98% Sandstone, Fine To Mediu, 2% Coal.	roof-floor	8.3	0.0115	759	0.03	0.005	0.03	0.8	54	-54	Acid Consuming
97984	48616	171.75	175.50	100% Siltstone.	floor	8.3	0.0008	709	0.06	0.007	0.05	1.6	46	-44	Non Acid Forming
113333	48628	175.00	182.83	89% Siltstone, 8% Coal, 3% Carb Siltstone.	roof-D45	8.0	0.0022	680	0.1	0.006	0.09	2.9	39	-36	Non Acid Forming
113198	48617	175.17	181.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.0045	490	0.05	0.004	0.05	1.4	83	-81	Acid Consuming
113334	48628	182.83	209.05	100% Sandstone, Fine Grained.	floor-roof	8.2	0.0053	552	0.13	0.006	0.12	3.8	45	-42	Non Acid Forming
97990	48616	196.00	200.87	100% Sandstone, Very Fine Gra.	roof	8.3	0.0015	673	0.05	0.006	0.04	1.3	43	-42	Non Acid Forming
97992	48616	205.34	209.99	92% Sandstone, Very Fine Gra, 8% Coal.	roof-D00	8.4	0.0059	738	0.06	0.006	0.05	1.6	72	-70	Acid Consuming
97993	48616	209.99	215.00	100% Carb Siltstone.	floor	8.2	0.0002	702	0.07	0.008	0.06	1.9	39	-37	Non Acid Forming

Notes:

1. Natural pH and EC provided for 1:5 sample:water extracts
2. TOS = Total oxidisable sulfur; MPA = Maximum potential acidity; ANC = Acid neutralising capacity; NAPP = Net acid producing potential
3. Sample classifications are as follows:
   - Samples with TOS ≤ 0.2 % and NAPP > 50 kg H_2SO_4/t were classified AC (Acid consuming)
   - Samples with TOS ≤ 0.2 % and NAPP ≤ 20 kg H_2SO_4/t were classified NAF (Non-acid forming)
   - Samples with 0.2 < TOS ≤ 0.5 and NAPP ≤ 20 kg H_2SO_4/t were classified as Uncertain
   - Samples with NAPP > 20 kg H2SO4/t or > 0.5 TOS and NAPP≤ 20 kg H_2SO_4/t were classified as PAF (Potentially acid forming)

2.2 Multi-Element Composition of Overburden and Potential Reject Material

Table 2.2 presents the multi-element test results for the 16 composite samples, which represent seven overburden samples and eight roof and floor samples. All materials tested (except Mn) have metal concentrations in solids below relevant QLD-EPA[1] and NEPC[2] guideline criteria for soils. The concentration of Mn in solids were above QLD-EPA (1998) environmental investigation levels in five of the seven overburden samples and in seven of the eight roof and floor samples likely to report as waste. Mn concentrations were well below relevant NEPC health-based guideline values for soils.

Bicarbonate extractable phosphorus (extractable P) concentration in overburden materials is moderate and ranges from 28 to 77 mg/kg (average 59 mg/kg), with no correlation to sample depth or lithology. Extractable P concentrations in roof and floor composite samples is low and ranges from less than 2 to 33 mg/kg (average is approximately 5 mg/kg).

The exchangeable sodium percentage (ESP) is calculated from the cation exchange capacity (eCEC) and ranges from 8.5 to 24.9 % (average 12.1%; median 11.1%). In general terms, ESP values of less than 6 indicate that a material has a low risk of dispersion and ESP values greater than 12 indicate that a material has a higher risk of dispersion. There is no clear distinction between the ESP of overburden materials compared to potential reject materials, with 3 of the 7 overburden samples and 4 of the 9 potential reject samples having ESP values greater than 12%.

2.3 Multi-Element Composition of Water Extracts

The results of the geochemical (multi-element) testing of water extracts from composite overburden and potential reject samples are provided in **Table 2.3**. The water extract test facilitates evaluation of the immediate solubility of multi-elements in solids.

The results indicate that the waste rock solids contain low to moderate concentrations of soluble salts, since the total concentration of soluble cations in each composite sample ranges from 150 to 380 mg/L.

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[1].QLD-EPA (1998). Queensland Government. Department of Environment. Draft guidelines for the assessment & management of contaminated land in Queensland. May 1998.

[2].National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM). Guideline on Investigation Levels for Soil and Groundwater (1999). HIL(E): parks, recreational open space and playing fields.

Water extracts from all composite samples have soluble metal concentrations below ANZECC[3] values for livestock drinking water and below NEPC[4] groundwater investigation levels.

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[3].ANZECC and ARMCANZ, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water.

[4].National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM). Guideline on Investigation Levels for Soil and Groundwater (1999). Groundwater Investigation Levels (Livestock drinking water).

Table 2.2

Multi-Element Concentration of Solids from Overburden and Potential Reject Samples - Peak Downs Expansion Project

					Overburden (and interburden)							Potential Reject Materials (Roof and Floor)								
				Composite Number ---->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				Material Type ---->	Clay (Overburden)	Sandstone (Overburden) (1- 38 m)	Siltstone (Overburden) (3-48 m)	Claystone / Mudstone	Sandstone (Interburden) (51-73 m)	Sandstone (Interburden) (82-196 m)	Mudstone (Interburden)	Sandstone (4-71 m)	Sandstone (76-138 m)	Sandstone (138-200 m)	Sandstone/Coal	Siltstone	Carbonaceous Siltstone	Sandstone / Siltstone	Sandstone / Carbonaceous Siltstone	Claystone/Mudstone
Parameters	Units	Detection Limit	QLD-EPA[1] Environmental Investigation Level	NEPC[2] Health-Based Investigation Level																
Major Elements																				
Ca	mg/kg	10	-	-	12,800	26,700	5,690	23,100	22,700	6,550	5,360	12,000	16,100	14,500	12,900	13,100	9,010	3,000	12,300	8,160
Mg	mg/kg	10	-	-	5,350	11,000	5,780	9,360	7,310	3,770	4,410	6,700	8,100	5,330	6,540	6,480	6,580	2,950	7,560	5,880
Na	mg/kg	10	-	-	2,110	1,320	1,940	1,140	1,260	1,230	1,420	1,460	1,230	1,260	1,300	1,160	1,220	850	890	1,190
K	mg/kg	10	-	-	1,530	2,160	2,350	2,910	3,630	4,120	4,080	2,950	3,290	2,960	3,910	3,700	4,340	2,180	2,560	4,100
Al	mg/kg	50	-	-	17,700	16,200	12,200	12,700	12,600	11,600	13,500	10,900	12,400	8,930	12,200	14,800	15,500	7,430	12,800	13,600
Fe	mg/kg	50	-	-	30,500	43,600	28,400	45,400	36,200	22,600	34,800	29,400	38,600	30,200	29,100	36,500	33,300	19,200	36,200	39,000
Minor Elements																				
Ag	mg/kg	2	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
As	mg/kg	5	20	200	<5	<5	7	6	6	<5	<5	6	7	8	6	7	7	17	9	9
B	mg/kg	50	1 to 75 (Background)	6,000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Ba	mg/kg	10	-	-	330	160	440	140	80	260	290	150	160	100	80	210	150	300	100	150
Be	mg/kg	1	-	-	1	<1	<1	1	1	1	1	1	1	1	1	1	1	<1	1	1
Bi	mg/kg	0.1	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cd	mg/kg	1	3	40	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Co	mg/kg	2	2 to 170 (background)	200	19	18	11	12	13	7	10	10	12	9	11	11	11	8	11	10
Cr	mg/kg	2	50[3]	200	36	42	13	21	12	8	10	12	13	7	11	12	13	4	12	10
Cu	mg/kg	5	60	2,000	26	29	38	23	24	26	26	29	24	25	29	32	33	34	45	38
F	mg/kg	40	-	-	140	130	220	120	160	160	170	180	170	180	190	200	250	180	240	200
Hg	mg/kg	0.1	1	30	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1
Mn	mg/kg	5	500	3,000	681	897	481	1000	866	406	835	652	891	612	601	691	608	326	696	884
Mo	mg/kg	2	<1 to 20 (background)	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Ni	mg/kg	2	60	600	33	39	33	35	28	20	19	32	29	19	28	27	31	13	21	18
Pb	mg/kg	5	300	600	10	10	13	14	14	17	16	15	14	18	16	15	17	17	14	17
Sb	mg/kg	5	20	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Se	mg/kg	5	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
SO4	mg/kg	100	-	-	710	350	600	220	200	320	350	340	250	180	250	320	290	810	270	370
Sn	mg/kg	5	50	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Sr	mg/kg	2	-	-	62	88	41	115	139	82	88	74	127	121	86	119	102	143	86	93
Tl	mg/kg	5	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
V	mg/kg	5	-	-	58	70	31	39	32	20	27	26	32	22	29	33	31	17	37	29
Zn	mg/kg	5	200	14,000	40	59	67	62	65	69	74	71	65	74	77	75	80	60	66	80
Exctractable P	mg/kg	2	-	-	77	28	49	39	97	55	69	<2	<2	<2	33	<2	<2	<2	<2	<2
Sodicity																				
Exchangeable Ca	meq/100g	0.1	-	-	27.5	20.8	6.1	19.2	20.6	17.2	10.3	15.4	14.7	19.1	12.3	20.6	10.7	6.4	12.0	6.2
Exchangeable Mg	meq/100g	0.1	-	-	14.7	7.7	9.0	5.7	4.7	5.0	6.3	6.2	5.5	4.2	7.1	4.9	6.7	5.7	6.2	7.4
Exchangeable K	meq/100g	0.1	-	-	1.6	2.1	2.4	2.7	3.6	4.0	5.0	2.8	3.1	2.9	3.7	3.6	4.3	2.2	3.3	5.4
Exchangeable Na	meq/100g	0.1	-	-	6.2	3.0	5.8	2.6	2.7	3.0	3.7	3.4	2.9	3.2	2.9	2.8	3.0	2.5	2.6	2.8
eCEC	meq/100g	0.1	-	-	49.9	33.6	23.2	30.2	31.5	29.0	25.1	27.8	26.2	29.3	25.9	31.8	24.6	16.8	24.1	21.6
ESP	%	0.1	-	-	12.4	8.9	24.9	8.6	8.5	10.3	14.6	12.2	11.1	10.9	11.2	8.8	12.1	14.9	10.8	12.8

Notes:

< indicates less than the analytical detection limit.

Shaded cells indicate values which exceed relevant QLD-EPA or NEPC guideline values.

1. Queensland Government. Department of Environment. Draft Guidelines for the Assessment & Management of Contaminated Land in Queensland. May 1998.
2. National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM). Guideline on Investigation Levels for Soil and Groundwater (1999). HIL(E): parks, recreational open space and playing fields.
3. Cr (III). No background or QLD-EPA EIL's are available for Cr (VI).

Table 2.3

Multi-Element Concentration of Water Extracts from Overburden and Potential Reject Samples - Peak Downs Expansion Project

		Material Group -->	Overburden (and interburden)								Potential Reject Materials (Roof and Floor)							
		Composite No. & Material Type --->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Parameters	Detection Limit	ANZECC[2]/NEPC[3] Guidelines	Clay (Overburden)	Sandstone (Overburden) (1- 38 m)	Siltstone (Overburden) (3-48 m)	Claystone / Mudstone	Sandstone (Interburden) (51-73 m)	Sandstone (Interburden) (82-196 m)	Mudstone (Interburden)	Sandstone (4-71 m)	Sandstone (76-138 m)	Sandstone (138-200 m)	Sandstone/Coal	Siltstone	Carbonaceous Siltstone	Sandstone / Siltstone	Sandstone / Carbonaceous Siltstone	Claystone/Mudstone
Soluble Cations	(mg/L)	(mg/L)	(mg/L)							(mg/L)								
Ca	2	1000	29	18	<2	5	9	6	7	12	6	6	5	8	8	3	6	7
Mg	2	-	19	12	3	2	3	3	5	9	3	<2	5	3	6	3	6	2
Na	2	-	202	144	151	98	129	141	125	210	120	141	108	90	112	64	98	86
K	2	-	10	33	28	38	63	69	55	66	48	42	48	48	62	25	45	43
SO_4	2	1000	77	51	36	41	48	66	60	84	51	48	53	39	50	53	64	48
Soluble Metals	(mg/L)	(mg/L)	(mg/L)							(mg/L)								
Ag	0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Al	0.2	5	<0.2	<0.2	<0.2	0.2	0.3	<0.2	<0.2	<0.2	0.3	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	0.5
As	0.02	0.5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
B	0.2	5	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ba	0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Be	0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bi	0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cd	0.02	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Co	0.02	1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cr	0.02	1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cu	0.02	0.5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fe	0.2	1 (irrigation)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
F	0.2	-	2.6	1.8	1.4	1.2	1.5	1.5	1.7	1.8	1.5	1.5	1.7	1.1	1.7	0.6	1.4	1.2
Hg	0.0001	0.002	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mn	0.02	2 (irrigation)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mo	0.02	0.15	<0.02	0.03	0.03	0.05	0.03	0.06	0.02	0.06	0.03	0.03	0.05	<0.02	<0.02	0.06	0.08	<0.02
Ni	0.02	1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Pb	0.02	0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sb	0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Se	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Si	0.20	-	10.32	8.10	7.84	5.52	6.00	8.40	5.52	7.80	6.30	7.20	5.28	6.16	6.16	7.28	7.28	6.72
Sn	0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sr	0.02	-	0.24	<0.02	<0.02	<0.02	0.30	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Tl	0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
V	0.02	0.1	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Zn	0.02	20	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Notes:

< Indicates concentration less than the detection limit.

Shaded cells indicate values which exceed recommended maximum ANZECC/NEPC guideline values.

2. ANZECC and ARMCANZ, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water.
3. National Environmental Protection Council (NEPC). National Environmental Protection (Assessment of Site Contamination) Measure (NEPM). Guideline on Investigation Levels for Soil and Groundwater (1999). Groundwater Investigation Levels (Livestock drinking water)

3. Conclusions

Geochemical test results on representative waste rock samples from the Peak Downs Expansion (PDX) Project indicate that:

- Overburden generated by the proposed mine expansion is likely to be Non-Acid Forming (NAF) or Acid Consuming (AC).
- The majority of the potential reject material (roof and floor) generated by the proposed mine expansion is likely to be NAF or AC (approximately 98%). The acid forming nature of the remainder of the roof and floor material (2%) is likely to be Potentially Acid Forming (PAF).
- The concentration of total metals in waste rock materials are within applied environmental investigation guideline levels for soils. The exception is Mn, which is present in most of the tested roof and floor materials at a concentration marginally in excess of the relevant environmental investigation guideline level, but well within the relevant health-based investigation guideline level.
- Approximately half of the overburden and potential reject materials have ESP values above 12% and, therefore, may be prone to some degree of dispersion and erosion.
- The concentration of soluble metals and salts in waste rock materials and runoff/seepage is unlikely to present significant environmental risks for rehabilitation and on-site/downstream water quality.

4. Recommendations

Although most materials tested were found to be non-acid forming or acid consuming, the potential remains for some roof, floor and coal reject material to be potentially acid forming, particularly from the P08 seam. As such, BMA should consider undertaking a short-term laboratory-controlled kinetic leach column test of potential reject material from the P08 seam to determine if this material is likely to generate acidic leachate and/or produce leachate elevated in metals or salts.

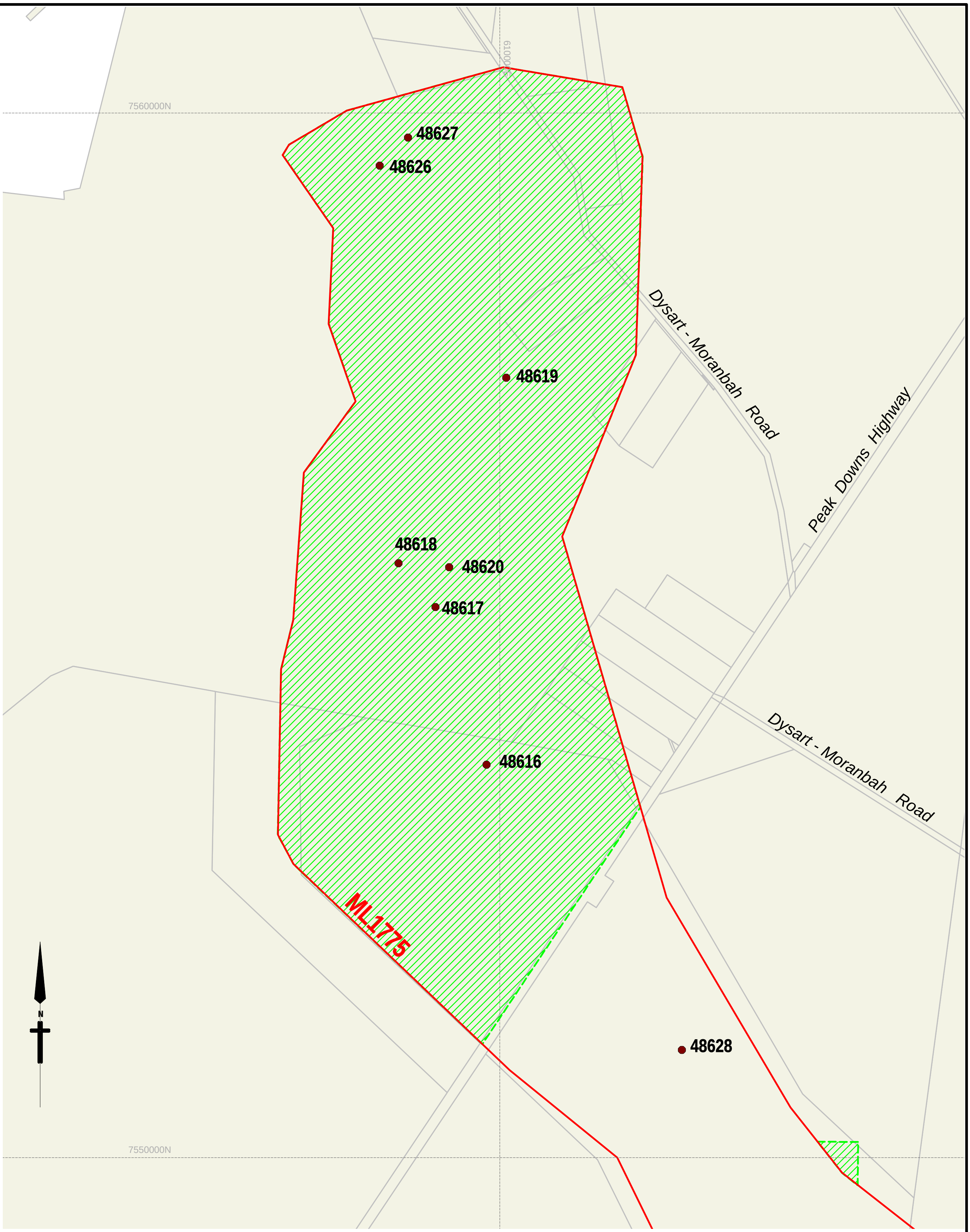
We trust that this report satisfies your requirements for the geochemical characterisation and assessment of waste rock material for the Peak Downs Expansion Project. If you have any questions regrading the information presented in this report or recommended additional test work, please contact the undersigned on 07 3243 2111.

Yours sincerely,
URS AUSTRALIA PTY LTD

Dr. Alan Robertson
Principal Geochemist - Mining

Dr. Ian Swane
Senior Hydrogeologist / Geochemist

Figure 1
Drill hole Locations



48627 ● Drillhole Sample Locations (Klohn Crippen Berger 15-06-06)

ML1775

Exploration SSE Areas

Source: Client Supplied Data (December 2006)

Client	Project	Title
BMA BHP Billiton Mitsubishi Alliance	PEAK DOWNS EXPANSION GEOCHEMISTRY LETTER REPORT	**GEOCHEMISTRY DRILLHOLE LOCATIONS**
URS	Drawn: LL; Approved: IS; Date: 28-02-2007; Job No: **4262 5920**; File No: 42625920-g-006.wor	Figure: **1**; Rev: B; A4

Appendix A
Laboratory Reports

Laboratory reports can be provided on request

Appendix B
Composite Sample Makeup

Table B1 Composite Samples for Overburden and Potential Reject Samples
Peak Downs Expansion Project

Sample Number	Drillhole Number	Sample Interval from (m)	Sample Interval to (m)	Sample Description		pH	Total Sulfur (%)	NAPP (kg H_2SO_4/t)	Sample Classification	Sample Composites
113311	48628	0.00	1.00	100% Clay.	Overburden	8.5	0.03	-53.1	Acid Consuming	1
113298	48627	0.00	2.00	100% Clay.	Overburden	8.6	0.01	-32.6	Non Acid Forming	
97951	48616	0.00	4.00	100% Clay.	Overburden	7	0.02	-10.1	Non Acid Forming	
97995	48617	0.00	3.00	100% Clay.	Overburden	7.8	0.03	-56.1	Acid Consuming	
113312	48628	1.00	15.00	100% Clayey Sand.	Overburden	8.5	<0.01	-31.0	Non Acid Forming	2
113285	48626	2.00	4.00	100% Sandstone, Fine To Medium.	Overburden	8.4	0.01	-42.8	Non Acid Forming	
113299	48627	2.00	7.00	60% Sandstone, Fine Grained, 40% Carb Siltstone.	Overburden	8.4	<0.01	-88.0	Acid Consuming	
113300	48627	7.00	24.00	100% Sandstone, Fine To Medium.	Overburden	8.4	0.05	-98.7	Acid Consuming	
97956	48616	20.50	23.00	100% Sandstone, Fine To Medium.	Overburden	8.5	0.02	-209.5	Acid Consuming	
98000	48617	27.00	30.00	100% Sandstone, Very Fine Grained.	Overburden	8.4	0.03	-90.7	Acid Consuming	
113314	48628	31.00	38.00	100% Sandstone, Fine To Medium.	Overburden	8.5	0.05	-153.7	Acid Consuming	
113200	48618	3.00	6.00	100% Siltstone.	Overburden	6.9	0.01	-8.7	Non Acid Forming	3
97998	48617	12.00	21.00	100% Siltstone.	Overburden	7.7	0.07	-34.0	Non Acid Forming	
113218	48619	18.00	24.00	100% Siltstone.	Overburden	8.5	0.03	-32.0	Non Acid Forming	
97959	48616	38.50	42.00	100% Siltstone.	Overburden	8.2	0.07	-35.5	Non Acid Forming	
113180	48617	51.00	55.00	100% Sandstone, Fine Grained.	Interburden	8.3	0.03	-65.3	Acid Consuming	4
113206	48618	60.00	67.50	100% Sandstone, Very Fine Gra.	Interburden	8.3	0.04	-36.3	Non Acid Forming	
97967	48616	61.00	79.00	100% Sandstone, Fine To Mediu.	Interburden	8.7	0.02	-131.5	Acid Consuming	
113224	48619	62.38	78.00	83% Sandstone, Fine To Mediu, 17% Sandstone, Very Fine Gra.	Interburden	8.7	0.04	-139.0	Acid Consuming	
113296	48626	71.00	73.00	100% Sandstone, Fine Grained.	Interburden	8.4	0.14	-38.9	Non Acid Forming	
113184	48617	82.00	98.80	100% Sandstone, Fine To Medium.	Interburden	8.3	0.04	-79.2	Acid Consuming	5
113278	48619	101.00	103.00	100% Sandstone, Fine Grained.	Interburden	8.2	0.04	-38.6	Non Acid Forming	
97979	48616	149.00	157.00	100% Sandstone, Fine To Medium.	Interburden	8.6	0.03	-180.2	Acid Consuming	
113329	48628	158.00	166.00	63% Sandstone, Fine Grained, 38% Sandstone, Very Fine Gra.	Interburden	8.2	0.07	-47.6	Non Acid Forming	
97989	48616	189.00	196.00	100% Sandstone, Very Fine Gra.	Interburden	8.4	0.05	-43.5	Non Acid Forming	
113205	48618	54.00	60.00	100% Siltstone.	Interburden	8.2	0.04	-29.1	Non Acid Forming	6
97978	48616	144.70	149.00	100% Siltstone.	Interburden	8.2	0.03	-35.6	Acid Consuming	
97988	48616	187.00	189.00	100% Siltstone.	Interburden	8.3	0.05	-62.7	Acid Consuming	
97964	48616	50.00	51.00	100% Carb Siltstone.	Interburden	7.9	0.19	-4.6	Non Acid Forming	
113297	48626	73.00	76.00	100% Mudstone.	Interburden	8.4	0.08	-35.1	Non Acid Forming	7
97981	48616	163.00	165.00	100% Mudstone.	Interburden	8.2	0.06	-39.4	Non Acid Forming	
113286	48626	4.00	12.31	100% Sandstone, Very Fine Gra.	roof	8.3	0.03	-67.4	Acid Consuming	8
113288	48626	17.85	24.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.16	-43.0	Non Acid Forming	
113291	48626	27.70	44.35	82% Sandstone, Very Fine Gra, 18% Sandstone, Fine Grained.	floor-roof	8.4	0.06	-28.7	Non Acid Forming	
113204	48618	36.11	54.00	100% Sandstone, Fine Grained.	floor	8.3	0.05	-32.3	Non Acid Forming	
113221	48619	38.67	54.00	52% Sandstone, Fine To Mediu, 48% Sandstone, Very Fine Gra.	floor	8.4	0.03	-41.2	Non Acid Forming	
113181	48617	55.00	73.14	100% Sandstone, Very Fine Gra.	roof	8.6	0.03	-109.3	Acid Consuming	
113295	48626	66.56	71.00	100% Sandstone, Very Fine Gra.	floor	8.2	0.08	-30.9	Non Acid Forming	
113183	48617	76.94	82.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.06	-37.5	Non Acid Forming	9
97968	48616	79.00	93.11	100% Sandstone, Fine Grained.	roof	7.9	0.04	-111.0	Acid Consuming	
113211	48618	88.00	99.75	100% Sandstone, Very Fine Gra.	roof	8.2	0.05	-174.7	Acid Consuming	
113281	48619	110.40	125.80	100% Sandstone, Very Fine Gra.	floor-roof	8.4	0.06	-54.7	Acid Consuming	
113322	48628	113.18	129.33	100% Sandstone, Very Fine Gra.	floor-roof	8.4	0.07	-39.1	Non Acid Forming	
113192	48617	121.00	141.20	100% Sandstone, Fine To Mediu.	floor-roof	8.5	0.05	-40.3	Non Acid Forming	
97976	48616	133.00	138.00	100% Sandstone, Very Fine Gra.	roof	8.2	0.06	-39.7	Non Acid Forming	
97977	48616	138.10	144.70	100% Sandstone, Fine Grained.	floor	8.3	0.03	-33.9	Non Acid Forming	10
113196	48617	155.52	168.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.08	-48.5	Non Acid Forming	
113198	48617	175.17	181.00	100% Sandstone, Very Fine Gra.	floor	8.4	0.05	-81.3	Acid Consuming	
113334	48628	182.83	209.05	100% Sandstone, Fine Grained.	floor-roof	8.2	0.13	-41.6	Non Acid Forming	
97990	48616	196.00	200.87	100% Sandstone, Very Fine Gra.	roof	8.3	0.05	-41.8	Non Acid Forming	
113179	48617	46.02	51.00	49% Sandstone, Very Fine Gra, 48% Siltstone, 3% Coal.	roof-floor	8.1	0.08	-58.0	Acid Consuming	11
97973	48616	122.31	130.32	96% Sandstone, Very Fine Gra, 4% Coal.	roof-floor	8.4	0.07	-44.1	Non Acid Forming	
113324	48628	130.84	145.75	98% Sandstone, Very Fine Gra, 2% Coal.	roof-floor	8.4	0.08	-36.4	Non Acid Forming	
113326	48628	146.20	153.00	96% Sandstone, Very Fine Gra, 4% Coal.	roof-floor	7.8	0.08	-29.5	Non Acid Forming	
113327	48628	153.00	154.95	54% Carb Sandstone, 46% Coal.	roof-H00	7.8	0.12	-30.6	Non Acid Forming	
97982	48616	165.00	171.25	98% Sandstone, Fine To Mediu, 2% Coal.	roof-floor	8.3	0.03	-53.6	Acid Consuming	
97992	48616	205.34	209.99	92% Sandstone, Very Fine Gra, 8% Coal.	roof-D00	8.4	0.06	-70.2	Acid Consuming	
113177	48617	30.00	40.64	100% Siltstone.	roof	8.4	0.03	-88.1	Acid Consuming	12
113293	48626	48.69	61.45	100% Siltstone.	floor-roof	8.5	0.09	-28.9	Non Acid Forming	
97975	48616	131.10	133.00	100% Siltstone.	floor	8.2	0.07	-37.1	Non Acid Forming	
113328	48628	154.95	158.00	100% Siltstone.	floor	8	0.04	-29.4	Non Acid Forming	
97984	48616	171.75	175.50	100% Siltstone.	floor	8.3	0.06	-44.4	Non Acid Forming	
97960	48616	42.00	43.49	100% Carb Siltstone.	roof	8	1.05	22.5	Potentially Acid Forming	13
113318	48628	68.05	70.00	100% Carb Siltstone.	floor	8.3	0.48	-29.2	Non Acid Forming	
97993	48616	209.99	215.00	100% Carb Siltstone.	floor	8.2	0.07	-37.4	Non Acid Forming	
113302	48627	29.37	36.55	63% Sandstone, Very Fine Gra, 37% Siltstone.	floor-roof	8.3	0.28	-23.7	Non Acid Forming	14
113316	48628	52.50	62.41	70% Siltstone, 30% Sandstone, Very Fine Gra.	roof	8.4	0.03	-48.9	Non Acid Forming	
113307	48627	60.24	73.62	96% Siltstone, 4% Sandstone, Fine Grained.	floor-roof	8.5	0.12	-27.9	Non Acid Forming	
113213	48618	103.79	114.00	86% Sandstone, Very Fine Gra, 13% Claystone, 2% Carb Siltstone.	floor	8.5	0.04	-23.0	Non Acid Forming	15
113309	48627	77.15	79.00	92% Siltstone, 8% Carb Siltstone.	D02-floor	8.5	0.17	-25.6	Non Acid Forming	
113209	48618	76.09	81.75	38% Siltstone, 34% Carb Siltstone, 28% Sandstone, Very Fine Gra.	floor-roof	7.9	0.03	-68.0	Acid Consuming	
113333	48628	175.00	182.83	89% Siltstone, 8% Coal, 3% Carb Siltstone.	roof-D45	8	0.1	-36.3	Non Acid Forming	
97963	48616	48.68	50.00	100% Claystone.	floor	7.7	0.05	-39.6	Non Acid Forming	16
113304	48627	37.35	50.50	100% Mudstone.	floor	8.5	0.06	-33.5	Non Acid Forming	

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