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REPORT
on
PRELIMINARY GEOTECHNICAL, CONTAMINATION AND MINE SUBSIDENCE ASSESSMENT

PROPOSED EMPLOYMENT LANDS DEVELOPMENT
BLACK HILL

Prepared for

COAL & ALLIED INDUSTRIES LTD

Project 39664.03

FEBRUARY 2011

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Douglas Partners Pty Ltd
ABN 75 053 980 117

Box 324
Hunter Region Mail Centre
NSW 2310 Australia

15 Callistemon Close
Warabrook, NEWCASTLE

Phone: 02 4960 9600
Fax: 02 4960 9601
newcastle@douglaspartners.com.au

TABLE OF CONTENTS

APPENDIX A

Notes Relating to this Report
Test Pit Logs (Pits 1 to 41)

APPENDIX B

Laboratory Test Results

APPENDIX C

QA/QC

APPENDIX D

Drawing 1 – Test Pit Locations and Surface Features
Drawing 2 – 1974 Aerial Photograph of Former Ironbark Colliery and Test Locations
Drawing 3 – Proposed Abel Mine Plan

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16 February 2011

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1. INTRODUCTION

This report presents the results of a preliminary geotechnical, contamination and mine subsidence assessment for a proposed Employment Lands development at Black Hill. The assessment was carried out at the request of Coal & Allied Industries Limited (Coal & Allied), in consultation with Catylis Pty Ltd.

The assessment comprised the following components:

- Desktop review of regional geology, hydrogeology, and acid sulphate soils;
- Review of previous and current operations at the subject site;
- History review comprising a review of aerial photos and interviews with current site users;
- Site walkover survey to describe the current site condition and surface features;
- Subsurface investigation by test pits;
- Soil sampling and chemical testing;

- Comments on actual and anticipated development constraints and opportunities including the following:
  - Potential contamination;
  - Depth, extent and nature of filling, including the presence of potentially combustible material;
  - Depth of groundwater;
  - Presence of soft alluvial soils;
  - Slope stability;
  - Likely founding conditions;
  - Presence of aggressive soil conditions with respect to buried structures;
  - Presence of shallow rock.
- General recommendations for further investigation.

The contamination assessment was carried out in general accordance with the NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites" (Ref 1) and SEPP 55 "Remediation of Land" (Ref 2).

2. PROPOSED DEVELOPMENT

It is proposed that the entire Coal & Allied owned Black Hill and Tank Paddock sites be rezoned/listed as a 'State Significant Site' in Schedule 3 of State Environmental Planning Policy (SEPP) (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The Concept Plan will apply to the entire 183 ha Black Hill and the 147 ha Tank Paddock sites plus 398 ha of the Stockrington owned land The key parameters for the proposed development of the sites are as follows:

- Dedication of 545 ha of conservation land to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan, comprising 100% of the Tank Paddock site and 398 ha of the Stockrington site;

- Use of the 183 ha Black Hill site as 'employment lands' for a range of employment generating activities;
- Indicative development staging. The number of lots and extent of staging for release areas will be largely dictated by the service infrastructure requirements as well as responding to market forces;
- The provision of associated infrastructure.

Approval will not be sought under the Concept Plan for a specific lot or road layout. An indicative super- lot layout has been prepared, which indicates how subdivision could be achieved that will enable a range of industrial and ancillary activities to be undertaken.

An existing mining consent under the Black Hill site will defer development on the site until post June 2013. Accordingly, a detailed built form layout has not been prepared at this stage. Approval is not sought under the Concept Plan for subdivision or for individual buildings on the site. Urban Design Guidelines will be prepared to inform the Concept Plan in respect of urban form, built form, open space and landscape, access and movement and visual impact for the site.

It is proposed to dedicate land for conservation purposes via a Voluntary Planning Agreement between Coal & Allied and the NSWG in accordance with s.93F of the Environmental Planning & Assessment Act, 1979.

The proposed Concept Plan and a Plan showing the proposed development areas and conservation areas is included in the Preliminary Environmental Assessment prepared by Urbis.

3. SITE IDENTIFICATION

The Black Hill site is identified as Lot 30 DP 870411, and is within the Newcastle City Council area. The site has an approximate area of 183 ha, and is shown on the attached Drawing 1, Appendix D. At the time of the investigation, a Boral asphalt plant was located in the north-eastern portion of the site, with the remainder of the site area generally comprising vacant bushland.

Adjacent land use comprised the following:

- North – John Renshaw Drive and industrial development;
- East – Sydney-Newcastle Freeway and rural-residential development;
- South – Bushland and rural-residential development;
- West – Former poultry farming activities.

4. DESKTOP REVIEW

4.1 Regional Geology and Hydrogeology

Reference to the Newcastle Coalfield Regional Geology Sheet indicates that the site is underlain by the late Permian Tomago Coal Measures which generally comprise siltstone, sandstone, coal, tuff and claystone.

Reference to the CALM soil landscape map for Newcastle indicates the soils are typical of the Beresfield landscape. Typical limitations include the following:

- Water erosion hazard;
- Localised foundation hazard;
- Strongly acidic.

Reference to the Beresfield Acid Sulphate Soil Risk Map prepared by the Department of Land & Water Conservation indicates that there is no known occurrence of acid sulphate soils at the site.

The regional groundwater flow regime is believed to be to the east and north-north-east of the site, towards Hexham Swamp and Woodberry Swamp, which are approximately 1 km and 2 km from the site respectively, and are considered to be the nearest sensitive receptors. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

The nearest registered groundwater wells are registered as monitoring bores, and are described below:

- GW078126 (N6367547, E371751), monitoring bore located on subject site. Drilled to 30 m depth. Drillers log indicates a water bearing zone from 9 m depth to 30 m depth with the static water level at 9 m;
- GW078128 (N6366733, E370773) monitoring bore located to the west of the subject site. Drilled to 30 m depth. Drillers log indicates a water bearing zone from 7.8 m depth to 30 m depth with the static water level at 7.8 m;
- GW078120 (N6368400, E371037) monitoring bore located to the north-west of the subject site. Drilled to 24 m depth. Drillers log indicates a water bearing zone from 6.1 m depth to 24 m depth with the static water level at 6.1 m;
- GW078045 (N6369702, E371697) monitoring bore located to the north of the subject site. Drilled to 30.5 m depth. Drillers log indicates a water bearing zone from 17.3 m depth to 30.5 m depth with the static water level at 17.3 m.

4.2 Mine Subsidence/Proposed Mining

4.2.1 Former Activities

Review of Mine Subsidence Board (MSB) maps for the area indicate that the site is not within a proclaimed mine subsidence district.

Discussions with the Department of Mineral Resources indicate that the site has not been undermined, however a mining development named Ironbark Colliery was proposed by Coal & Allied in the 1970s. Although underground mining operations were never undertaken, construction of some infrastructure was undertaken, including a cut and cover portal, winding building, wash plant and site shed, as show in Photos A to C below and indicated on Drawing 2, Appendix D.

Photo A – Wash Plant looking south with site shed in background

Photo B - Wash plant looking south with drive engine in background

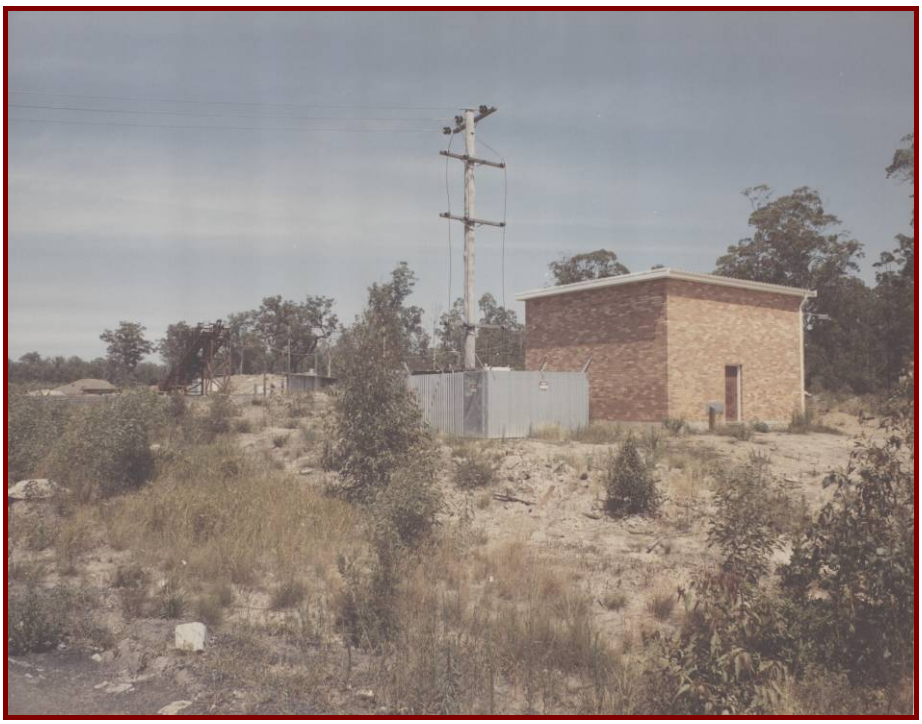

Photo C – Winding Building looking north east with decline structure in background

4.2.2 Proposed Mining

Underground mining is proposed beneath the site by Abel Mine. Reference to the Abel Mine Subsidence Management Plan (Ref 10) application, which is currently being considered for approval by the Department of Industry & Investment - Minerals, indicates that underground workings will extend across the northern parts of the site and will generally comprise bord and pillar workings with extraction of pillars proposed in most areas except for under an existing Schedule 2 creek which runs diagonally across the site. The current proposed extent of mining is shown on Drawing 3 attached.

One of Abel Mines Project Approval Conditions requires "within 6 years (June 2013) of this approval, the proponent shall ensure that any subsidence caused by undermining the (*Coal & Allied Operations*) land has been effectively completed". This is to allow the proposed Coal & Allied development to proceed following mining.

It is noted that Abel Mine may lodge an application for approval of a Subsidence Management Plan covering the southern portion of the site at some stage in the future. Any mining beneath the southern portion of the site would need to comply with the above condition.

A mine subsidence Impact Assessment has been undertaken by Ditton Geotechnical Services (Appendix A of Ref 10) as part of the current Abel Mine Subsidence Management Plan application. The report indicates the following:

- Mining will be in the Upper Donaldson Seam in thirteen 160.5 m wide pillar extraction panels (Panels 7 to 13 will be below the site);
- The seam thickness ranges from about 2.0 m to 3.0 m where workings are proposed below the site;
- The depth of cover ranges from about 60 m to 145 m where workings are proposed below the site;
- The impacts to the site from mining may include the following:
  - Maximum subsidence ranging from 1.0 m to 1.3 m;
  - Surface cracking from 40 mm to 230 mm wide;
  - Localised surface ponding potential of up to 1.0 m;
  - Changes to surface gradients of ±4% above pillar extraction panels.
- Approximately 90% to 95% of mine subsidence development will occur within six to 10 weeks after undermining occurs. Ongoing residual settlement due to goaf reconsolidation may continue for up to 1 year, however movements are unlikely to result in further damage occurring to the surface.

5. SITE HISTORY

5.1 Overview

The brief review of site history comprised the following:

- Interview with current Regional Manager for Boral;

- Interview with former employee of ironbark mine;
- Review of Coal & Allied historical photographs;
- Review of historical aerial photos;
- Searches with NSW Department of Environment, Climate Change and Water (DECCW).

5.2 Interviews with Personnel Familiar with the Site

Current Regional Manager for Boral

The historical information presented below was a result of an interview conducted on 9 February 2007 with the current Regional Manager for Boral, Mr Tony Seears.

Chronological site history is summarised below:

Prior to Mid 1970s

- The site was vacant and comprised bushland. Mr Seears noted that timber on the site was cut and used as coal props.

Mid 1970s

- Construction of the Ironbark Colliery infrastructure, possibly comprising a washery and decline. According to Mr Seears, mining operations never commenced on the site. The infrastructure was demolished and the decline possibly filled with building materials, fill, machinery etc;
- Is Tony Seears positioned to comment on Coal & Allied activities prior to Boral's occupation of the site?

1980 to Present – Boral Asphalt

- Asphalt operations commenced in 1980 in the north-eastern portion of the site (i.e. the current Boral site);
- The site use generally comprises asphalt and spray seal production along with raw materials storage (i.e. materials used in the production), washdown bays, aboveground fuel storage, plant storage, workshop areas, gravel wash and waste asphalt storage areas;
- The site holds a NSW EPA license due to the an asphalt production capacity of greater than 30,000 tonnes per year;
- According to Mr Seears, the Boral site is to be left in a state suitable for commercial/industrial landuse when the asphalt plant operations cease.

Washdown Bays

- A washdown bay with an oil-water separator was observed in the western portion of the Boral site (adjacent to the workshop area);
- A second (enclosed) washdown bay was observed in the central portion of the Boral site, and used kerosene as a washing agent to clean the spray seal vehicles.

Asphalt Plant Area

The asphalt plant area was located in the western portion of the Boral site area and comprised aggregate hoppers, bitumen tanks, a heated mixer, gravel washer, lime hopper, conveyor and asphalt loading area.

Materials Used/Stored On-Site

Materials used and stored on site include the following:

- Bitumen in aboveground storage tanks (AST), not bunded;
- Diesel, burner fuel and kerosene in bunded ASTs;
- Emulsion in ASTs, not bunded;
- Liquid Petroleum Gas (LPG) in stationary and transportable cylinders;
- Kentucky Horse Fence Black in an AST (not bunded) and in sealed buckets;
- Lime;
- Gravel wash waste (approximately silt sized material) stored in a drying area;
- Waste asphalt stockpile;
- Raw aggregate,
- Diesel treated aggregate (for use in spray seal pavements).

Waste Management Practices

- Gravel wash waste is dried and stockpiled on site, and taken to landfill;
- Asphalt waste is stockpiled on site, then used as fill off site (e.g. beneath pavements);
- Oil waste from the oil water separators is removed from site by Veolia.

Interview with Former Employee of Ironbark Mine – Ian McLeod

Ian McLeod is a former employee of Coal & Allied who was also involved in removal of infrastructure at Ironbark Mine in the mid 1980s. Ian indicated the following:

Surface infrastructure was constructed over about a six month period in 1972 and included the following:

- Portal structure comprising a length of cut and cover tunnel constructed using a concrete slab supporting a steel arch. He was unsure of the depth of the portal, however may have been in the order of 5 m deep;
- The decline was never sunk;
- The portal was backfilled using crushed concrete, material excavated from the original cut as well as granulated slag;

- There was also a steel framed wash plant and a masonry drift engine constructed and both were dismantled or demolished and removed from the site;
- There was a power supply to the drift engine, however no PCB type transformers were installed on the site;
- He did not recall any asbestos material on site, the cladding was steel;
- Ian identified a number of the site features including the portal, drift engine, wash shed and site shed shown on the historical aerial photographs as well as photographs from Coal & Allied archives.

5.3 Review of Historical Aerial Photos

The following historical aerial photos were reviewed for the assessment:

Table 1 – Aerial Photo Review

Year	Approximate Scale	Black and White/Colour
1954	1:30,000	B & W
1966	1:40,000	B & W
1974	1:40,000	B & W
1984	1:40,000	B & W
1996	1:50,000	Colour
1998	Digital[1]	Colour
2004	NTS[2]	Colour

Notes to Table 1:

1 – Sourced from plan - http://iplan.australis.net.au
2 – Photo supplied by Urbis JHD

1954 Aerial Photograph

- The site is generally bushland;
- A road/track is evident to the east and north of the site;
- Possible access track in the central portion of the site;
- Chicken sheds to the west of the site not yet constructed.

1966 Aerial Photograph

- Similar to 1954 photograph;
- Possible access track in the south-eastern portion of the site (i.e. off the main road to the east of the site);
- Cleared area (easement) on the western boundary of the site.

1974 Aerial Photograph

- Majority of site still bushland;
- Access track in the south-eastern and central portions of the site;
- Large access track in the north-eastern corner heading south-west to large cleared area in central northern and central western portion of the site comprising cleared land, scattered trees, two structures in central portion of cleared area, large structure in western portion of cleared area, some stockpiles and an access track heading south-west towards the western boundary;
- Poultry sheds had been constructed to the west of the site.

1984 Aerial Photograph

- Cleared area in the central northern and central western portion of the site is similar to 1974 photo;
- Additional cleared area in the northern portion of the site (easement);
- Additional circular shaped cleared area in the northern portion of the site, with possible structures and an access road from the eastern boundary to the cleared area (current Boral site);
- Remainder of the site is bushland.

1996 Aerial Photograph

- Northern cleared area further developed (i.e. defined access roads, cleared areas and structures);
- Cleared/developed area in central-northern and central-western portion of the site appears to be no longer in use, with some tree/vegetation growth and a smaller cleared area;
- Access track from northern developed area to central-northern cleared area evident;
- Possible structures adjacent to south-eastern corner of the site (i.e. off-site);
- Access track from the central northern portion of the site to the south-eastern corner evident;
- Cleared area stripped of vegetation evident along eastern boundary.

1998 Digital Aerial Photograph

- Similar to 1996 photo;
- Some access tracks and cleared areas (possible structures?) in the central northern and central western portion of the site as previous;
- Northern cleared area (i.e. current Boral site) as previous.

2004 Aerial Photograph

- Central western cleared area appears to be grassed with no structures;
- An access track still evident from the north-eastern corner of the site to the central-western cleared area, with the track continuing to the western boundary;
- Structures, stockpiles vehicles and unpaved hardstand observed within the northern cleared area (i.e. Boral);
- Remainder of site is vegetated bushland.

It is noted that data obtained from aerial photos was limited due to the relatively small scale and poor resolutions.

NSW Department of Environment Climate Change and Water (DECCW)

A property information inquiry with the NSW DECCW indicated the site has no statutory notices issued under the provision of the Contaminated Land Management Act.

5.4 Summary of Site History

Based on the above information, a summary of collected site history information is as follows:

- Prior to the 1970s, the site was predominantly bushland;
- Establishment of the Ironbark Colliery was commenced in the 1970s in the central northern and central western portion of the site. It is understood that mining was not undertaken at the site, and the mining infrastructure was decommissioned;
- Construction of surface infrastructure for Ironbark mine included portal, winding building, wash plant and site sheds. The drift was never driven and the portal was backfilled;
- The north-eastern portion of the site has been occupied since 1980 to the present and has been used as an asphalt plant;
- An electricity transmission line easement and access tracks have been established across the site.

6. SITE CONDITION

6.1 Site Features

Major site features include the following:

- Boral asphalt plant in the north-eastern portion of the site;
- Cleared area in the central northern and central western portion of the site (with associated access tracks) associated with the former Ironbark Colliery;

- Electricity transmission line easement on the western boundary and northern portion of the site;
- Hunter Water Corporation 900mm water main above ground along the northern boundary;
- Access tracks on the southern and eastern boundary, south-eastern and eastern portions of the site;
- A densely vegetated drainage channel running north-south through the central portion of the site.

Major site features are identified on Drawing 1, and described below.

6.2 Boral Asphalt

The Boral asphalt plant is located in the north-eastern portion of the site. The plant layout is shown in Photos 1 to 3 below.

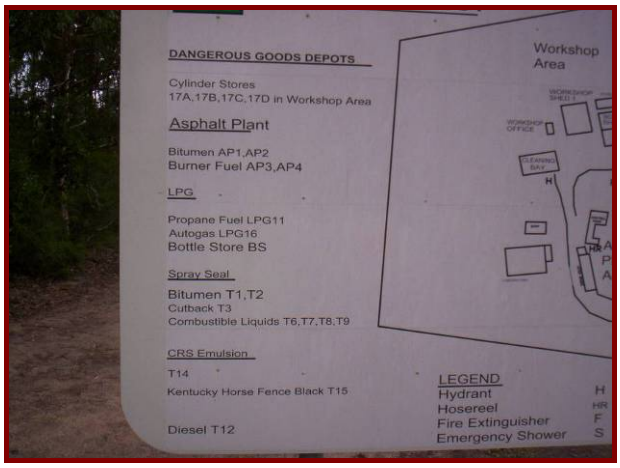

Photo 1 – Boral site layout

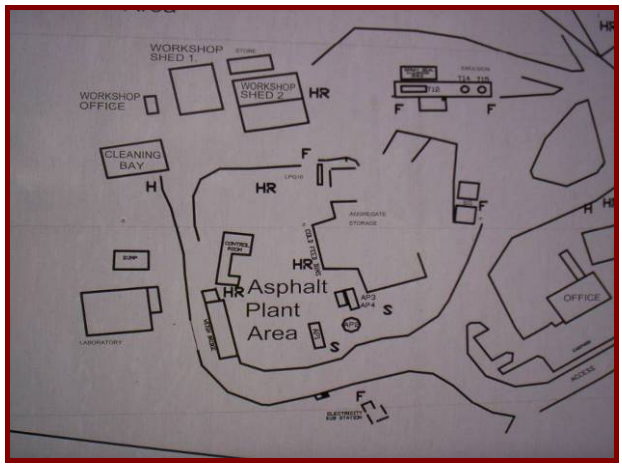

Photo 2 – Boral site layout (western portion)

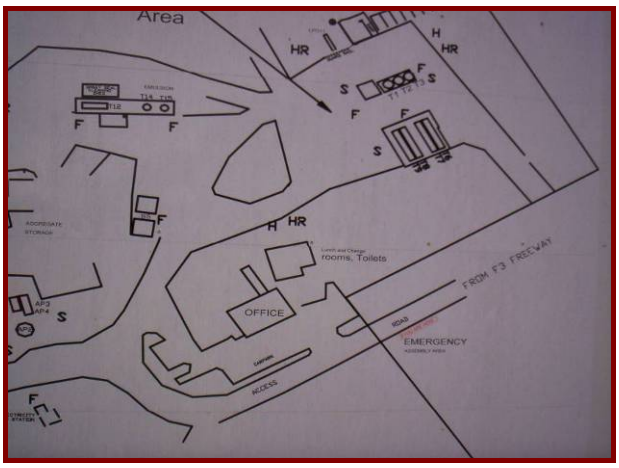

Photo 3 – Boral site layout (eastern portion)

The asphalt plant area was observed in the western portion of the Boral area, and comprised aggregate hoppers, bitumen tanks, a heated mixer, gravel washer, lime hopper, conveyor, waste asphalt stockpile and asphalt loading area. Features of the asphalt plant area are shown in Photos 4 and 5 below.

Photo 4 – Asphalt Plant Area

Photo 5 – Asphalt Plant Area

Localised surface hydrocarbon staining and bitumen were observed in the asphalt plant area, as shown in Photos 4 and 5 above and in Photo 6 below.

Photo 6 – Surface hydrocarbon staining adjacent to the asphalt plant area

Additional features within the Boral site area included:

- Exposed rock cuttings in the western portion of the Boral area (Photo 7);
- Equipment/fuel storage and workshop areas (Photos 8 and 9);
- General washdown bay and kerosene washdown bay (for spray seal trucks - Photos 10 and 11);
- Waste asphalt and gravel fines stockpiles (Photo 12);
- Aggregate stockpile area (Photo 13);
- Diesel-coated aggregate stockpile area and associated oil/water separator for runoff (Photos 14 and 15);
- Above ground bitumen and kerosene storage (Photo 16);
- Office and amenities area (Photo 17).

Photo 7 – Exposed rock cutting in the western portion of the Boral area

Photo 8 – Equipment and fuel storage area

Photo 9 – Equipment and workshop area

Photo 10 – General washdown bay

Photo 11 – Spray seal vehicle washdown bay (kerosene used)

Photo 12 – Waste asphalt and gravel fines stockpiles

Photo 13 – Aggregate stockpile area

Photo 14 – Diesel coated aggregate stockpile area

Runoff from the diesel-coated aggregate stockpile area was directed to a stormwater pit and oil-water separator as shown in Photo 15 below.

Photo 15 – Oil water separator (runoff from diesel aggregate stockpile area)

Photo 16 – Aboveground bitumen and kerosene coated storage

Photo 17 – Office/amenities area

6.3 Former Ironbark Colliery (cleared area) and Access Tracks

A generally flat cleared area associated with the former Ironbark Colliery was observed in the central-western portion of the site. At the time of the investigation, the cleared area was grassed, with some areas of disturbed/uneven ground, gullies, scattered small trees and some access tracks, as shown in Photo 18. A dam with overgrown water tolerant vegetation was observed in the north-western corner of the cleared area, as shown in Photo 19.

Photo 18 – Cleared area in the central-western portion of the site

Photo 19 – Dam and water-tolerant vegetation within the cleared area

An access track was observed from the southern boundary of the Boral site to the cleared area in the central-western portion of the site. Stockpiled soil and building rubble were observed in the northern portion of the access track, as shown in Photos 20 to 23 below.

Photo 20 – stockpiled soil and building rubble in the central-northern portion of the site

Photo 21 – stockpiled building rubble in the - central northern portion of the site

Photo 22 – stockpiled building rubble in the central northern portion of the site

Photo 23 – stockpiled soil and building rubble in the central-northern portion of the site

A smaller cleared area adjoining the above area was observed in the central-northern portion of the site, as shown in Photos 24 and 25.

Photo 24 - Cleared area in the central-northern portion of the site

Photo 25 – Fibreglass sheeting in the central-northern portion of the site

6.4 Electricity Easement

An electricity transmission line easement is located in the northern portion of the site and along the western site boundary. The easement generally comprises a cleared strip of bushland approximately 60 m wide. The easement is shown in Photos 26 and 27 below.

Photo 26 – Electricity easement in the northern portion of the site (looking east)

Photo 27 – Electricity easement on the western site boundary (looking north)

A gully formation was observed in the south-western corner of the site within the easement, extending to the east. Slopes of up to 10° were observed on the banks of the gully . The gully formation is shown in Photo 28. The remainder of the easement was generally flat.

Photo 28 – Gully formation in the south-western portion of the site (looking south)

6.5 Access Tracks

An unpaved track is located along the southern site boundary, as shown in Photo 29.

Photo 29 – Access track on the southern site boundary (looking east)

The western portion of the access track falls to the east at approximately 2° to 3° towards a drainage channel located approximately 350 m east of the western boundary. The access track rises to the east at approximately 3° on the eastern side of the creek (creek discussed in Section 6.6).

Localised gully formations and erosion scour were observed on the southern access track, as shown in Photos 30 and 31. Gully formations had been filled with crushed concrete and bricks, as shown in Photo 30.

Photo 30 – Small gully formation and associated erosion in the central southern portion of the site

Photo 31 – Local erosion on the access track on the southern site boundary

Scattered fibro fragments were observed along the southern boundary, as shown in Photo 32 below.

Photo 32 – Surface fibro fragments on the southern site boundary

A secondary access track was observed in the south-eastern portion of the site (i.e. off the southern boundary). Localised opportunistic dumping was observed, including fuel/oil drums (with surface oil staining), fibro and building rubble, as shown in Photos 33 to 35.

Photo 33 – Dumped building rubble and oil drums in the south-eastern portion of the site

Photo 34 – Surface fibro fragments in the south eastern portion of the site

Photo 35 – Oil drums and surface oil staining in the south-eastern portion of the site

An access track was also located along the eastern site boundary as shown in Photo 36. Car wrecks and parts were observed adjacent to the eastern boundary in the central-eastern portion of the site, as shown in Photo 37.

Photo 36 – Access track on the eastern site boundary (looking south)

Photo 37 – Dumped car wreck adjacent to the eastern site boundary

An additional access track was observed in the central eastern portion of the site, heading west from the eastern boundary. Up to ten building rubble and fibro fragment piles were observed on the access track, as shown in Photos 38 to 40 below. Coal/carbonaceous materials were also observed on the surface of the access track, as shown in Photo 38 below.

Photo 38 – Fibro pile in the central eastern portion of the site

Photo 39 – Fibro and building rubble in the central eastern portion of the site

Photo 40 – Fibro in the central eastern portion of the site

6.6 Creek

A creek was observed running north-south in the central portion of the site. The creek entering the site on the southern boundary was densely overgrown with non-native vegetation, as shown in Photo 41 below. The creek had been filled with crushed concrete and brick fragments, as shown in Photo 42.

Photo 41 – Non-native vegetation within the creek on the southern site boundary

Photo 42 – Filled creek on the southern site boundary

Slopes observed in accessible areas in the vicinity of the creek were relatively minor, however the majority of the creek was within thick bushland areas.

At the time of the investigation, minimal surface water was observed within the southern portion of the creek.

7. SURFACE FEATURE MAPPING

Various site features described in the preceding sections above have been mapped on Drawing 1. The general categories of surface condition are described below.

Existing Site Use

- Boral Asphalt, located in the north-eastern portion of the site. Site activities include asphalt productions, diesel, kerosene, bitumen and other petroleum product storage (aboveground), workshops, plant storage, aggregate storage (including diesel treated aggregate), washdown bays etc.

Access Tracks and Easements

- Located around the site boundaries and in the central-northern, south-eastern and eastern portions of the site;
- Localised fill stockpiles, building rubble, fibro stockpiles and oil drums observed along access tracks, particularly in the south-eastern and eastern portions of the site.

Disturbed Ground

- Boral site area;
- The cleared area in the central western portion of the site, characterised by an uneven ground surface and cleared bushland (i.e. former Ironbark Colliery area). The original ground surface in the area is expected to have been reworked and in many places filled. Therefore the nature of the ground disturbance is difficult to assess, however based on preliminary subsurface investigation, it would be expected to comprise several metres of filling in places. Localised deeper filling can be expected, such as is expected in the area of the former portal/drift (Pits 7 and 10) as well as an area of mounded filling on the northern access track (Pit 3). The estimated extent of disturbed ground is shown on Drawing 1.

Creek

- A creek runs north – south, bisecting the site;
- Fill materials were observed in the southern portion of the creek, refer to Drawing 1.

Cleared Ground for Electricity Easements

- The north, east and west boundaries have been cleared for electricity easements, as shown on Drawing 1.

8. FIELD WORK

8.1 Sampling Rationale

A systematic and judgemental sampling procedure was conducted for the current assessment to address the potential sources of contamination and geotechnical constraints identified from the walk over and desktop assessment.

A total of 41 test pit locations (Pits 1 to 41) were sampled and analysed as part of the current assessment. It is noted that this is less than the number of tests recommended by NSW EPA Guidelines (Ref 1), however is considered adequate for a preliminary assessment.

The former Ironbark Colliery in the central northern portion of the site, and the access tracks in the eastern portion of the site were targeted during the subsurface investigation.

Testing was not undertaken within the Boral site at this stage.

Samples were selected for analysis on the basis of the likely presence of contamination, based on material type, visual or olfactory evidence of possible contamination (i.e. odour or staining), proximity to a known source of contamination, and whether generally representative of soil/fill conditions.

8.2 Methods

The field work was undertaken on 25, 26 and 29 October 2007 and comprised the following:

- Excavation of 41 test pits to depths of 0.75 m to 4.6 m by backhoe;
- Collection of soil samples for environmental, combustibility and aggressivity testing and identification.

The test locations were set out by an environmental engineer from DP who also logged the subsurface profile in the pits and collected samples for identification and testing purposes. The test pits were pegged on completion and then surveyed by Monteath & Powys Pty Ltd. The locations of the pits are shown on Drawing 1, Appendix D and coordinates are listed in Table 3, Section 8.5.

Test locations were selected to further assess identified areas of potential contamination and geotechnical constraints, and in accessible areas, as summarised in Table 2 below:

Table 2 – Areas of Investigation

Area of Investigation	Pits
Electricity Easement	1, 2, 21-26
Access Tracks	27, 29-39
Cleared area (former Ironbark Colliery area)	3-20, 40, 41
Creek	28

Samples for environmental purposes were generally collected from filling within each pit. Soil samples were collected directly from the side walls of the test pits or from the backhoe bucket using disposable gloves. Care was taken to remove any extraneous material deposited on the sample.

All sampling data was recorded on DP chain of custody sheets, and the general sampling procedure comprised:

- Decontamination of all sampling equipment using a 3% solution of phosphate free detergent (Decon 90) and tap water prior to collecting each sample;
- The use of disposable gloves for each sampling event;
- Transfer of samples into laboratory-prepared glass jars, and capping immediately;
- Collection of 10% replicate samples for QA/QC purposes;
- Collection of replicate soil samples in zip-lock plastic bags at each depth for PID screening;
- Labelling of sample containers with individual and unique identification, including project number, sample location and sample depth;

- Placement of the sample jars and replicate sample bags into a cooled, insulated and sealed container for transport to the laboratory;
- Use of chain of custody (C-O-C) documentation ensuring that sample tracking and custody could be cross-checked at any point in the transfer of samples from the field to the laboratory.

The process of obtaining samples and their transportation, storage and delivery to laboratories for analysis was documented on a DP standard chain-of-custody form. Copies of completed forms are contained in Appendix C.

Replicate samples for each sample were screened for the presence of volatile organic compounds (VOCs), using a Photovac 2020 photo-ionisation detector (PID) with a 10.6 eV lamp, calibrated to 100 ppm Isobutylene. The PID is capable of detecting over 300 VOCs.

The work was undertaken in accordance with the DP quality system and procedures for contamination assessments as presented in the company's field procedures manual. A list of the procedures used and other information on quality assurance and quality control, including analysis of replicate samples, is found in Appendix C.

8.3 Data Quality Objectives (DQOs)

Table 3 summarises data quality objectives (DQOs) and the procedures designed to enable achievement of the DQOs.

Table 3 – Data Quality Objectives

DQO	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of test pit logs.
Data completeness	Analysis of appropriate determinants based on site history and on-site observation.
Data comparability	Use of NATA certified laboratory, use of consistent sampling technique.
Precision and accuracy for sampling and analysis	Achievement of 50% RPD for replicate analysis, acceptable levels for laboratory QC criteria.

8.4 Results

The subsurface conditions are presented in detail in the test pit logs, Appendix A. These should be read in conjunction with the general notes preceding them, which explain definitions of the classification methods and descriptive terms.

The following is a summary of the subsurface conditions encountered:

FILLING - encountered to depths of 0.15 m to greater than 4.6 m depth in Pits 1 to 14, Pits 16 to 21, Pit 28, Pit 32 to 36 and Pits 40 and 41. Fill materials generally comprised clays, silty clays , clayey sands, silty sands, sand and gravel, cemented sands, coal reject and deleterious materials including fibro.

TOPSOIL – encountered in Pits 15, 22, 24 to 27, 29 to 31 and 37 to 39 generally comprising silty clay and silty sand topsoil with some roots and rootlets.

CLAY – encountered in the majority of pits from below topsoil/filling to termination or bedrock. Generally comprising clay, silty clay or sandy clay, varying in strength between stiff and hard.

SANDY CLAY/CLAYEY SAND AND GRAVEL – encountered in Pit 28 (adjacent to the creek) comprising various fractions of sandy clay, clayey sand and fine to medium grained gravels. The soils were generally wet.

BEDROCK - encountered in Pits 2, 5, 6, 17, 20, 22 to 24, 26, 28 and 30 to 37 from depths of 0.6 m to 3.0 m to termination, or virtual refusal for Pits 2, 17 and 30 to 37. Rock types varied across the site but generally comprised sandstone, siltstone and claystone at strengths between very low and medium strength.

Groundwater seepage was encountered in Pit 7 at a depth of 1.6 m in filling, and in Pit 28 from a depth of 2.1 m to 2.5 m. Groundwater seepage was not observed in the remaining pits. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

8.5 Summary

A summary of the depth of filling, depth to rock and depth of groundwater is presented in Table 4 below.

Table 4 – Summary of Depth of Filling, Rock, Backhoe Refusal and Groundwater

Pit	Easting	Northing	Surface Level (AHD)	Depth of Fill (m)	Depth to Rock (m)	Refusal/Slow Progress Depth (m)	Groundwater seepage (m)
1	372136.2	6368027.0	18.77	0.3	-	-	-
2	371839.7	6368076.7	21.67	0.2	0.65	0.95	-
3	371686.4	6367973.1	19.09	>4.5	-	-	-
4	371581.7	6367752.1	14.42	0.4	-	-	-
5	371251.6	6367603.1	21.64	0.2	2.5	-	-
6	371228.7	6367626.5	22.81	0.2	2.2	-	-
7	371253.8	6367675.8	22.74	>4.6	-	-	1.6
8	371259.4	6367622.2	21.95	1.4	-	-	-
9	371306.4	6367664.8	21.24	1.3	-	-	-
10	371282.2	6367679.8	21.78	>4.1	-	4.1 obstruction	-
11	371264.3	6367581.1	21.31	0.5	-	-	-
12	371299.2	6367595.2	19.65	0.4	-	-	-
13	371336.7	6367634.8	18.40	0.4	-	-	-
14	371358.5	6367666.5	18.25	0.3	-	-	-
15	371058.1	6367416.7	29.04	-	-	-	-
16	371381.3	6367660.1	17.38	0.4	-	-	-
17	371366.1	6367707.3	19.62	0.15	1.5	2.0	-
18	371489.9	6367842.0	14.71	0.5	-	-	-
19	371483.0	6367912.1	13.93	0.5	-	-	-
20	371483.5	6367957.5	13.32	0.4	2.3	-	-
21	371663.2	6368140.6	12.33	1.0	-	-	-
22	371392.8	6368072.7	16.62	-	1.4	-	-
23	371111.9	6368204.9	15.14	0.3	2.3	-	-
24	371094.3	6368008.6	21.09	-	0.7	-	-
25	370972.4	6367170.1	32.72	-	-	-	-
26	370892.0	6366944.3	26.64	-	1.4	2.2	-
27	371025.8	6366800.2	28.10	-	-	-	-
28	371145.5	6366779.0	19.40	0.4	3.0	-	2.1-2.5
29	371404.6	6366730.4	27.85	-	-	-	-
30	371707.2	6366808.0	37.49	-	0.6	0.75	-
31	371921.0	6366825.0	31.88	-	0.8	0.95	-
32	371996.9	6367138.9	29.99	0.3	0.8	1.1	-
33	371928.2	6367156.1	32.64	0.25	1.3	1.4	-
34	371860.0	6367184.9	32.37	0.2	0.8	0.9	-
35	371696.8	6367212.0	28.99	0.4	1.0	1.1	-
36	371848.5	6366893.7	33.66	0.4	0.85	1.0	-
37	371667.1	6367302.1	25.96	-	0.7	1.5	-
38	372068.7	6367647.4	22.41	-	-	-	-
39	372148.5	6368137.0	17.69	-	-	-	-
40	371257.7	6367649.7	22.53	1.2	-	-	-
41	371291.7	6367671.7	21.63	1.2	-	-	-

The presence of potentially combustible material (coal and chitter / coal reject) as noted on the test pit logs and is summarised in Table 5 below.

Table 5 – Potentially Combustible Material within Test Pits

Test Pit	Depth (m)	Combustible Material
2	0.0-0.2	Coal reject (possible bitumen)
4	0.2-0.4	Coal reject
5	0.0-0.2	Coal reject
6	0.0-0.2	Coal reject
8	0.0-1.0	Some coal in filling
10	0.0-4.2	Some coal in filling
40	0.5-1.2	Some coal in filling

Based on the absence of potential or actual acid sulphate soils indicated on the acid sulphate soil risk map, no sampling or analysis for acid sulphate soils was undertaken.

8.6 Contaminant Observations

Based on the available site history information and observations made during the site inspection the principal sources of potential contamination are considered to be:

General Site Area

- Illegal dumping of building rubble and fibro, which may contain asbestos, and dumping of oil/fuel drums, which may be a source of hydrocarbons, PAH, BTEX and heavy metals;
- Car wrecks observed within the site, which may be a source of hydrocarbons, PAH and heavy metals;
- Fill materials (source unknown) found as fill stockpiles, disturbed ground and within test pits (refer to Table 4), which may contain a range of contaminants including asbestos, hydrocarbons, heavy metals etc;
- Possible fill materials within the abandoned decline at the former Ironbark Mine area which may contain a range of contaminants including asbestos, hydrocarbons, heavy metals etc;

- Potential building rubble/demolition materials from the demolition of former site structures at the Ironbark Mine site, which may contain asbestos;
- Former washery/workshop and machinery associated with surface operations at the former Ironbark Colliery, which may be a source of hydrocarbons, PAHs, heavy metals, solvents etc;
- Former poultry farm to the west of the site, which may be a source of microbiological contaminants and nutrients.

Boral Site Area

- Aboveground diesel, kerosene and bitumen storage, which may be a source of hydrocarbons, PAH and BTEX;
- Stockpiled waste asphalt, which may be a source of hydrocarbons and PAH;
- Washdown bays and associated sumps, which may be a source of hydrocarbons, PAH, solvents etc;
- Equipment/plant storage and workshop areas which may be a source of hydrocarbons, PAH, solvents etc;
- Localised staining/spills within the asphalt plant area and aboveground fuel/bitumen storage areas, which may be a source of hydrocarbons, PAH an heavy metals;
- Car parking areas at the Boral site which may be a source of hydrocarbon, PAH and heavy metal contamination.

Observations of potential contamination within the test pits are detailed in Table 6 below:

Table 6 – Contaminant Observations within Pits

Potential Contamination	Pit/Depth (m)	Description
Possible bitumen	2/0.0-0.2	Possible bitumen/coal reject
Deleterious materials, including fibro	3/0.0->4.5	Bricks, concrete, timer, rubber in filling
	7/0.0-1.8	Concrete, asphalt, plastic pipe, paper in filling
	32/0.0-0.2	Glass, bricks, plaster, fibro in filling
	33/0.0-0.2	Concrete, glass, fibro in filling
	34/surface	Concrete and fibro
	35/0.0-0.4	Bricks, ceramic tiles, plaster, fibro, metal fragments
	36/0.0-0.4	Plastic, metals fragments, glass
Slag materials	16/0.1-0.4	Slag cobbles in filling
Blue staining	11/0.3-0.5	Blue stained cemented sand filling
	12/0.2-0.4	Blue stained cemented sand filling
	40/0.0-0.5	Blue stained cemented sand filling

The results of PID screening on soil samples are shown on the test pit logs in Appendix A, and suggest the absence of gross volatile hydrocarbon impact.

There was no visual or olfactory evidence (i.e. staining or odours) to suggest the presence of gross contamination within the soils investigated.

Seepage water was observed in two test pits. There was no visual or olfactory evidence (i.e. staining or odours) to suggest the presence of gross contamination within seepage water.

It is noted, however, that groundwater was not sampled or analysed to confirm groundwater constituents.

9. LABORATORY TESTING

9.1 Analytical Programme

Laboratory testing was undertaken by SGS Environmental, a National Association of Testing Authorities, Australia (NATA) registered laboratory.

A total of 37 soil samples from the pits were selected to provide an assessment of soil/fill conditions. The samples were selected to target identified potential sources of contamination (Ref 1), namely uncontrolled filling.

The selected samples were analysed for the following potential contaminants:

- Total Recoverable Hydrocarbons (TRH);
- Polycyclic Aromatic Hydrocarbons (PAH);
- Organochlorine Pesticides (OCP);
- Organophosphorus Pesticides (OPP);
- Polychlorinated Biphenyls (PCB);
- Benzene, Toluene, Ethyl Benzene, Xylene (BTEX);
- Metals: Arsenic (As); Cadmium (Cd); Chromium (Cr); Copper (Cu); Lead (Pb); Mercury (Hg); Nickel (Ni); Zinc (Zn).

Five soil samples and four fibro samples were also analysed for asbestos.

Five soil samples were analysed for sulphate, chloride and pH as part of aggressivity analysis of soil samples. The results of aggressivity testing is presented in Section 9.4.

Eight filling samples were analysed for combustibility. The results of combustibility analysis are presented in Section 9.3.

9.2 Analytical Results

The results of chemical analysis of soil samples are presented in the laboratory report sheets (Appendix B), and are summarised in Tables 7 to 10 below.

Table 7 - Laboratory Results for Metals in Soil

Pit / Depth (m)	PID (ppm)	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Pit 1/0.1	<1	4	0.4	12	5.9	21	<PQL	7.2	29
Pit 2/0.05	<1	7	0.6	14	41	76	<PQL	9.1	1000
Pit 3/0.4	<1	29	0.2	2.1	4.5	11	0.52	4	9.3
Pit 3/1.5	<1	7	0.4	11	11	12	0.15	4.6	75
Pit 3/2.5	<1	6	0.4	12	5.7	13	<PQL	3.3	18
Pit 3/3.6	<1	5	0.4	20	3.2	13	<PQL	3	8.5
Pit 6/0.05	<1	5	0.5	20	19	12	<PQL	72	60
Pit 7/0.5	<1	4	0.1	7	4.2	6	<PQL	4.9	19
D1	<1	4	0.2	8.2	3.8	7	<PQL	4.9	18
Pit 7/3.0	<1	10	0.5	39	28	20	<PQL	100	90
Pit 8/0.5	<1	10	0.6	28	35	19	<PQL	120	100
Pit 8/1.2	<1	4	0.5	23	22	14	<PQL	130	99
Pit 9/0.7	<1	6	0.5	35	6.9	28	<PQL	20	23
Pit 10/0.3	<1	9	0.7	25	29	17	0.05	120	90
D2	<1	8	0.5	24	26	17	0.05	100	87
Pit 10/4.0	<1	14	0.6	32	26	20	<PQL	76	70
Pit 11/0.1	<1	3	0.1	7.5	5.1	5	<PQL	9.1	18
Pit 12/0.25	<1	<PQL	<PQL	7	1.2	2	<PQL	2.4	4.5
Pit 13/0.1	<1	3	<PQL	5.1	1.5	2	<PQL	1.6	4.4
D3	<1	<PQL	<PQL	4.8	1.3	1	<PQL	1.5	3.5
Pit 16/0.3	<1	16	0.3	15	17	14	<PQL	33	58
Pit 17/0.1	<1	9	0.3	1.2	8.7	17	0.15	3.8	43
D4	<1	19	0.3	1.5	10	22	0.14	3.8	72
Pit 19/0.2	<1	6	1.1	31	17	19	<PQL	12	110
Pit 20/0.2	<1	4	0.2	6.2	3.2	13	<PQL	3.9	29
Pit 21/0.5	<1	4	0.2	5.6	3.1	14	<PQL	2.9	21
Pit 23/0.1	<1	9	0.4	10	5	23	<PQL	10	41
Pit 28/0.2	<1	5	0.3	7.6	9.5	16	<PQL	11	60
Pit 28/0.6	<1	5	0.2	6.3	5.2	9.9	<PQL	11	23
Pit 30/0.05	<1	11	0.4	9.2	5.3	25	<PQL	1.8	27

Table 7 - Laboratory Results for Metals in Soil Continued

Pit / Depth (m)	PID (ppm)	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Pit 32/0.1	<1	5	0.5	21	11	66	0.07	3.9	310
Pit 33/0.01	<1	5	1.2	38	25	37	<PQL	19	550
Pit 34/0.01	<1	12	0.5	9.7	47	210	0.19	5	120
Pit 34/0.1	<1	7	0.3	2.3	13	15	0.12	4	35
Pit 35/0.2	<1	4	0.2	2.8	6	15	0.06	1.9	52
D5	<1	4	0.2	3.7	6.2	17	0.08	2	66
Pit 36/0.2	<1	3	0.8	5.1	9.3	63	<PQL	3.2	99
PQL		3	0.1	0.3	0.5	1	0.05	0.5	0.3
NEHF A (Ref 4)		100	20	100	1000	300	15	600	7000
NEHF F (Ref 4)		500	100	500	5000	1500	75	3000	35000
General Solid Waste (Ref 5)		100	20	100	NC	100	4	40	NC
Restricted Solid Waste (Ref 5)		400	80	400	NC	400	16	160	NC

Notes to Table 7:
All results expressed in mg/kg on a dry weight basis
NC – No Criteria
PQL – Laboratory Practical Quantitation Limit
NEHF A - NSW EPA health-based criteria for residential landuse with accessible soil
NEHF F - NSW EPA health-based criteria for commercial/industrial land use
Shaded results exceed 'General Solid Waste'

Table 8 - Laboratory Results for TRH and BTEX in Soil

Pit / Depth (m)	PID (ppm)	TRH				Benzene	Toluene	Ethyl Benzene	Total Xylene
		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}				
Pit 1/0.1	<1	<PQL	<PQL	<PQL	53	<PQL	<PQL	<PQL	<PQL
Pit 2/0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 3/0.4	<1	<PQL	<PQL	96	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 3/1.5	<1	<PQL	<PQL	150	130	<PQL	<PQL	<PQL	<PQL
Pit 3/2.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 3/3.6	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 6/0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 7/0.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 7/3.0	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 8/0.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 8/1.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 9/0.7	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 10/0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 10/4.0	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 11/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 12/0.25	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 13/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 16/0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 17/0.1	<1	<PQL	<PQL	200	60	<PQL	<PQL	<PQL	<PQL
D4	<1	<PQL	<PQL	290	100	<PQL	<PQL	<PQL	<PQL
Pit 19/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 20/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 21/0.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 23/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28/0.6	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 30/0.05	<1	<PQL	<PQL	130	160	<PQL	<PQL	<PQL	<PQL
Pit 32/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33/0.01	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 34/0.01	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 34/0.1	<1	<PQL	24	360	160	<PQL	<PQL	<PQL	<PQL
Pit 35/0.2	<1	<PQL	<PQL	150	120	<PQL	<PQL	<PQL	<PQL
D5	<1	<PQL	<PQL	130	91	<PQL	<PQL	<PQL	<PQL
Pit 36/0.2	<1	<PQL	<PQL	150	250	<PQL	<PQL	<PQL	<PQL
PQL		20	50	50	50/100*	0.5	0.5	0.5	1.5
Service Station (Ref 6)		65	1000 total			1	1.4	3.1	14
General Solid Waste (Ref 5)		650	10000 total			10	288	600	1000
Restricted Solid Waste (Ref 5)		2600	40000 total			40	1152	2400	4000

Notes to Table 8
All results expressed in mg/kg on a dry weight basis PQL – Laboratory Practical Quantitation Limit
Service Station - NSW EPA Service Station Guidelines (Ref 6)

Table 9 - Laboratory Results for OCP, OPP, PCB and PAH in Soil

Pit / Depth (m)	PID (ppm)	PCB	OPP	OCP				Total PAH	Benzo (a) pyrene
				Aldrin/Dieldrin	Chlordane	DDT	Heptachlor		
Pit 1/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 2/0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	2.88	0.28
Pit 3/0.4	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	1	<PQL
Pit 3/1.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.6	<PQL
Pit 3/2.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 3/3.6	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 6/0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 7/0.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 7/3.0	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 8/0.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.1	<PQL
Pit 8/1.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.1	<PQL
Pit 9/0.7	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.1	<PQL
Pit 10/0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 10/4.0	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 11/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.2	<PQL
Pit 12/0.25	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 13/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
D3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 16/0.3	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.7	<PQL
Pit 17/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.8	<PQL
D4	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	1.2	<PQL
Pit 19/0.2	<1	<PQL	<PQL	1.43	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 20/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 21/0.5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 23/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 28/0.6	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 30/0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 32/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit 33/0.01	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.26	0.06
Pit 34/0.01	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	1.45	0.15
Pit 34/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	1.3	<PQL
Pit 35/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.6	<PQL
D5	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.6	<PQL
Pit 36/0.2	<1	<PQL	<PQL	<PQL	0.2	<PQL	<PQL	0.47	0.07
PQL		0.9	0.1	0.1	0.1	0.1	0.1	0.05	0.05
NEHF A (Ref 4)		10	NC	10	50	200	10	20	1
NEHF F (Ref 4)		10	NC	50	250	1000	50	100	5
General Solid Waste (Ref 5)		50	NC	NC	NC	NC	NC	200	0.8
Restricted Waste (Ref 5)		50	NC	NC	NC	NC	NC	800	3.2

Notes to Table 9
All results expressed in mg/kg on a dry weight basis PQL – Laboratory Practical Quantitation Limit
NEHF A - NSW EPA health-based criteria for residential landuse with accessible soil
NEHF F - NSW EPA health-based criteria for commercial/industrial landuse

Table 10 - Laboratory Results for Asbestos in Soil and Fibro Fragments

Sample Identification	Sample Type	Asbestos Detected
Pit 32/0.1	Soil	No asbestos detected *
	Fibro	No asbestos detected
Pit 33/0.01	Soil	No asbestos detected *
	Fibro	Chrysotile asbestos detected
Pit 34/0.01	Soil	No asbestos detected
	Fibro	Chrysotile asbestos detected
Pit 34/0.1	Soil	No asbestos detected
Pit 35/0.2	Soil	No asbestos detected
	Fibro	No asbestos detected

Notes to Table 10:
* synthetic mineral fibres detected

9.3 Combustibility Testing

Combustibility testing was undertaken by SGS Environmental on eight samples for assessment of the percentage of combustible material within filling. The results of testing are shown in Table 11, below.

Table 11 – Results of Combustibility Testing

Pit/Depth (m)	Description	Total Combustibles (%)
Pit 4/0.3	Dark grey/black silty clay, siltstone and coal filling	15.4
Pit 5/0.05	Yellow grey and dark grey sand filling, some coal reject	10.3
Pit 8/0.1	Dark grey/grey-brown silty clay filling, some gravel and coal	9.7
Pit 10/1.0	Dark grey brown and dark grey clay filling, some gravel, coal & organics	7.8
Pit 14/0.05	Intermixed grey-brown and dark grey silty sand and siltstone gravel filling	13.5
Pit 16/0.05	Grey-brown silty sand and dark grey/black siltstone gravel filling	8.0
Pit 18/0.2	Dark grey siltstone gravel filling	21
Pit 32/0.25	Dark grey brown silty sand filling, some siltstone gravel	11

Notes to Table 11:
Combustibility estimated from % ash created on a dry weight basis

Reference should be made to the attached laboratory report sheets for details.

9.4 Aggressivity Testing

Aggressivity testing was undertaken by SGS Environmental on five samples to assess the aggressiveness of the soil toward buried steel/concrete structures. The testing comprised the following analytes:

- Sulphate;
- Chloride;
- pH.

Detailed laboratory report sheets are attached and the results are summarised in Table 11, below:

Table 12 – Summary of Soil Aggressiveness

Pit/Depth (m)	Description	Laboratory Results			
		pH	FMC (%)	Sulphate* $S0_4$ (mg/kg)	Chloride* Cl (mg/kg)
Pit 12/0.5	Brown clay	5.4	17	310	260
Pit 22/0.2	Grey brown mottled orange silty sandy clay	5.9	5	32	33
Pit 26/0.4	Light brown clay	5.5	20	130	63
Pit 34/0.5	Grey-brown mottled orange clay	5.0	19	210	87
Pit 38/0.2	Dark grey-brown clay	5.1	22	87	110
PQL		0.1	1	2	0.5

Notes to Table 12:
FMC – field moisture content
* 1:5 soil:water

Reference should be made to the attached laboratory report sheets for details.

10. ASSESSMENT OF CONTAMINATION

10.1 Assessment Criteria

Results of the chemical analyses were compared to the following NSW EPA recommended guidelines.

- NSW EPA (1998). Contaminated Sites - Guidelines for the Site Auditor Scheme 2nd Edition, April 2006 (Ref 4);
- NSW EPA (1994). Contaminated Sites - Guidelines for Assessing Service Station Sites, December 1994, (Ref 6);
- NSW DECC (2008), "Waste Classification Guidelines: Part 1 – Classifying Waste", April 2008 (Ref 5).

The NSW EPA Guidelines for the NSW Site Auditor Scheme (Ref 4) contain National Environmental Health Forum (NEHF) levels for various beneficial use scenarios including: low density residential (A), high density residential (D), recreational (E) and commercial/industrial (F). These criteria are applicable where aesthetic and ecological concerns are not an issue.

Health based criteria for commercial/industrial landuse (NEHF F) are considered to be appropriate for the proposed employment lands development. Results have also been compared to the more stringent criteria for residential uses with access to soil (NEHF A).

The NSW EPA Guidelines for Assessing Service Station Sites (Ref 6) were used to assess total TRH and BTEX contamination across the site. The criteria used are threshold concentrations for sensitive land use.

The NSW DECCW Waste Classification Guidelines (Ref 4) was used to assess soil conditions for possible off-site disposal to a licensed landfill.

10.2 Assessment of Contamination

Soil chemical analysis results were within the health based criteria for commercial/industrial land use (i.e. NEHF F), the more stringent health-based criteria for residential land use with accessible soils, and NSW EPA sensitive land use criteria for TRH and BTEX.

Detectable levels of C_{10}-C_{36} hydrocarbons were found in several near surface samples, however, levels were within the adopted criteria.

The results of laboratory analysis indicated the presence of bonded asbestos in fibro sheet fragments found in Pits 33 and 34, near the surface at 0.01 m depth.

Slightly elevated heavy metal concentrations (nickel and lead) were observed in some samples in exceedence of 'General Solid Waste' criteria for disposal to landfill.

10.3 Conclusions

The results of preliminary sampling and analysis of the filling on the site indicates the absence of gross contamination.

Based on the identification of several metres of fill materials across the former Ironbark Colliery site (Pits 7 and 10), in a localised gully in the vicinity of Pit 3, and the potential of fill in the abandoned portal, it is recommended that additional investigation is undertaken to delineate the extent of filling, and associated potential contamination.

No subsurface investigation or laboratory testing was undertaken on the Boral site. Detailed assessment is recommended following cessation of their lease, if development is considered on this part of the site.

If development is proposed on the southern portion of the site, it is recommended additional investigation is conducted along the creek, following clearing of dense vegetation.

It is noted that unauthorised dumping has occurred at the site, including fibro materials as noted in the walk over and subsequent subsurface investigation. Localised asbestos materials have been identified at the surface in fibro fragments. Deleterious surface materials and possible associated surface impacts will require removal / remediation.

The majority of soil/fill materials tested at the site are classified as 'General Solid Waste' for off-site disposal with reference to NSW DECCW guidelines. Localised fill materials have been classified as 'Restricted Solid Waste' (without leachability testing) due to slightly increased heavy metal concentrations (i.e. lead and nickel). Waste classification of soils/filling should be confirmed prior to disposal.

The site is considered to be generally suitable for the proposed development in accordance with SEPP 55 and NSW DECCW guidelines, providing the following conditions are met as part of the development:

- Additional investigation is conducted to delineate the extent of fill and the potential for contamination within the fill across the former Ironbark Colliery site, including within the abandoned portal;
- Appropriate remediation of any contamination identified from detailed investigations, which exceeds the criteria for the specific proposed land use at that location;
- Appropriate remediation is conducted to remove bonded asbestos fragments and possible asbestos impacted surface soils beneath surface dumping;
- Car wrecks, deleterious materials and possible associated surface impacts (if encountered) are removed.

Assessment of soils/fill should be undertaken to classify materials prior to disposal to a licensed facility.

It is likely that the above localised remedial measures could be readily managed during the initial stages of earthworks and construction. This would require the preparation of a remediation action plan (RAP), appropriate removal/disposal of deleterious materials and asbestos materials (if encountered), followed by validation sampling and analysis in accordance with NSW DECCW guidelines (Ref 1) and SEPP 55 (Ref 2).

Removal and disposal of asbestos materials should be undertaken by a licensed contractor. Validation of asbestos contamination should be conducted by a qualified asbestos consultant.

11. GEOTECHNICAL CONSTRAINTS

11.1 Disturbed Ground and Filling at Former Ironbark Colliery

The majority of disturbed ground is expected to be associated with the former Ironbark Colliery, which comprises an area of about 24 ha as shown in light blue on Drawings 1 and 2. Potential constraints associated with disturbed ground and filling include the following.

- Potential for contamination, as described in Section 10.3 above, in particular possible buried asbestos;
- Uncontrolled filling, which has implications for building footings, requiring that the filling either be reworked or footings be founded in suitable bearing strata below the filling using piles;
- Uncontrolled filling also has implications for services such as roads, pavements, water and sewer;
- Potential for the combustion of the coal, possibly requiring removal or capping of the coal.

11.2 Founding Conditions

Former Ironbark Colliery

As discussed above, uncontrolled filling is unsuitable for founding of footings. Uncontrolled filling can be expected in the general area of the former Ironbark Colliery, and has been observed to be greater than 4.6 m depth during this investigation in the general area of the backfilled portal, however greater depths of filling may be present in this specific area.

A significant proportion of the filling is likely to be overburden material or mine spoil, which is likely to have been placed without compaction and therefore there is a potential for large settlements. This could be managed by removing the filling, re-compacting the filling, piling of building footings to the base of the filling, or a combination of the above.

Bushland Areas

The remainder of the site comprises bushland with scattered access tracks and underlain by the late Permian Tomago Coal Measures which generally comprise siltstone, sandstone, coal, tuff and claystone. These formations are generally expected to provide good founding conditions, probably allowing the use of conventional shallow footings. Reactive soils may be present, which can be confirmed during future detailed investigations prior to development and readily accommodated in design.

11.3 Slope Stability

There was generally no evidence of previous or incipient deep seated slope instability observed over the site. The site is generally considered to have a low to moderate risk of slope instability with respect to the natural topography.

Areas of steeper slopes were, however observed during the subsurface investigation, including in the northern portion of the site (i.e. to the west of Pit 3) and in the south-western corner of the site (i.e. the vicinity of Pit 26). It is expected that such localised instabilities can be managed by appropriate removal of filling, management of hillside development, and removal of surface water. Additional investigation is recommended in these areas to confirm requirements.

The following general guidelines for construction on slopes are provided to assist with urban planning.

It is expected that individual cuts or fills of up to 2 metres vertical height would generally be appropriate. Such cuts or fills should be either supported by a conventional engineered retaining wall or battered. Preliminary design or assessments should be based upon stage long term batter slopes being limited to 2H:1V, however steeper batters may be possible in rock, subject to geotechnical assessment.

11.4 Erosion

Based on the Soil Landscape Sheet for Newcastle the soils have high erosion potential. Areas of erosion observed during the investigation included along the access track in the northern portion of the site (i.e. in the vicinity of Pit 4), and the southern access track (i.e. in the vicinity of Pit 29).

Water quality may be impacted due to sediment laden run-off from the topsoil material occurring during construction. Such potential erosion and sedimentation are readily amenable to mitigation measures such as silt fences, revegetation / reshaping batters, drainage structures (catch drains), sediment traps and sedimentation basins.

11.5 Excavatability

The results of subsurface investigations indicated the depth to rock across the site was generally 2 m or deeper, with shallow rock in the south-eastern portion of the site. Backhoe refusal occurred at depths in the range 0.75 m to 1.5 m in the south-eastern parts of the site.

Soil and weak rock encountered to the depth of backhoe refusal as shown on Table 4 would be readily excavatable using hydraulic excavators or small bulldozers. Beyond the depth of backhoe refusal large earthmoving equipment may be required for excavation, such as excavators with rock teeth or bulldozers with rippers.

11.6 Saline / Aggressive Soils

The generic soil landscapes encountered on site can include the presence of naturally acidic or saline soils, however reference to the NSW Government Natural Resources Atlas indicates no known occurrences or indicators of salinity on the site. No notable signs of salinity were identified during the site walk over assessment.

Saline or acidic soils may be aggressive to buried structures or services. The results of testing listed in Table 10 above indicated generally non-aggressive and mild exposure classifications when compared to the requirements for steel/concrete piles presented in AS 2159-1995 (Ref 12).

It is recommended, however, to provide sufficient concrete cover and appropriate strength to accommodate for the environment and any changes in conditions.

11.7 Combustion

Coal, coal reject and possible carbonaceous siltstone was encountered within filling in selected test pits across the former Ironbark Colliery area. The materials were generally encountered in near surface filling, with some coal materials found in deeper filling (e.g. Pits 7 and 10). The percentage of coal within these layers was generally low, with visual estimates ranging from approximately 5% to 15%.

The results of laboratory testing on selected samples indicated percentages of combustible materials within the range 7.8% to 21%.

In situ combustion of such material can occur if the material is ignited by an external source such as a surface fire, or lightning. Combustion is encouraged if there is a ready supply of oxygen as typically occurs in loose filling, especially on steep slopes.

DP is unaware of any local or state or national guidelines with respect to combustible material, however Wollongong Council has developed guidelines. According to Wollongong Council Guidelines for the use of chitter material in residential development (copy attached), chitter material must have an average combustibility not exceeding 30%, and a maximum combustibility not exceeding 40%.

It is considered that there is low risk of combustion of coal and coal reject filling occurring. If, however, larger volumes/percentages of potentially combustible material is encountered during more detailed investigation or earthworks, the risk of combustion can be reduced by applying appropriate engineering solutions. Various engineering solutions to manage the potential for combustion may include one or more of the following:

- Removal of combustible material;
- Blending of inert material with combustible material;
- Compaction of the material;
- Limiting batter slopes, generally to less than about 4H:1V;
- Capping with a compacted inert layer.

It is recommended that additional investigation be undertaken in the former Ironbark Colliery area prior to development to further characterise the distribution of combustible material.

11.8 Acid Sulphate Soils

Reference to the Beresfield Acid Sulphate Soil Risk Map prepared by the Department of Land & Water Conservation indicates that there is no known occurrence of acid sulphate soils at the site.

Coastal, low-lying alluvial soils generally below RL 5 (and occasionally up to RL 10 (AHD) can contain pyrite or other sulphides. Surface elevations at the site range from RL10 to greater than RL 30.

Therefore it is expected that there are no actual or potential acid sulphate soils at the site.

11.9 Summary of Geotechnical Constraints

A number of potential geotechnical constraints have been identified as outlined in the sections above, however the site is considered to be suitable for the proposed industrial development, subject to application of appropriate engineering solutions including the following:

- Compaction of uncontrolled filling, where present below development or founding of footings below the filling using piles in some locations where appropriate;
- Assessment of site classifications with respect to reactive soils and design of footings in accordance with AS 2870-1996;
- Additional assessment of potentially combustible material and development of a management plan which may include the following options:
  - Removal of combustible material;
  - Blending of inert material with combustible material;
  - Compaction of the material;
  - Limiting batter slopes, generally to less than about 4H:1V;
  - Capping with a layer of compacted inert material.
- Provision of appropriate sedimentation and erosion controls during construction;
- Possible use of heavy ripping for excavations;
- Design of footings and buried services for appropriate exposure classifications with respect to aggressive soils.

12. MINE SUBSIDENCE AND FUTURE MINING CONSTRAINTS

12.1 Coal Mining

Based on the results of the desktop review, the site is not currently within a proclaimed mine subsidence district, however it is understood from discussions with the Mine Subsidence Board (MSB) that proclamation of a mine subsidence district including the site is imminent.

A mining development named Ironbark Colliery was proposed by Coal & Allied in the 1970s however the development didn't progress past construction of some surface infrastructure. It is understood that a shallow portal tunnel was constructed however the portal was never driven and that Industry & Investment - Minerals has no records of mine workings below the site.

Future mining by Abel coal mining operations is proposed below the site, which is expected to affect the timing of the proposed development. Based on subsidence predictions for the site it is considered that the subsidence would cause significant damage to any structures present and no development could occur until the subsidence was complete.

One of Abel Mines Project Approval Conditions requires "within 6 years (June 2013) of this approval, the proponent shall ensure that any subsidence caused by undermining the (*Coal & Allied Operations*) land has been effectively completed". This is to allow the proposed Coal & Allied development to proceed following mining.

In order for the site to be suitable for the proposed development with respect to post mining subsidence, the approval of the Mine Subsidence Board (MSB) will be required. It is expected that for MSB approval to be provided for development at the site, any remnant pillars will need to be deemed long term stable by the MSB and monitoring of subsidence will be required to confirm that effective subsidence is complete.

It is understood that the Abel Mine Subsidence Management Plan is currently being reviewed by Industry & Investment – Minerals, including inputs from the MSB with regard to the above issues.

The nature of restrictions post mining will be dependent on the outcomes of the mining process. Provided that the MSB are satisfied with the long term stability of remnant pillars below the site and adequate subsidence monitoring is undertaken and indicates that the mine subsidence has occurred as predicted, then minimal MSB restrictions may apply. If potentially unstable remnant pillars are left in place, or monitoring indicates incomplete subsidence then restrictions would apply to the development, which may include design of the structures to accommodate specific design parameters associated with potential subsidence.

12.2 Coal Seam Gases

Reference to the Part 3A Environmental Assessment for Abel Underground Mine (Ref 9) indicates the following:

> *"Methane testing undertaken as part of the most recent exploration program indicates the seams generate very low levels of methane. Therefore it is unlikely that methane extraction equipment will be required. However if the mine experiences methane generation from strata above or below the target seam that impedes production or overloads the ventilation system, goaf drainage plant may need to be installed.*
>
> *Goaf drainage plants are used to bleed off methane gas from the recently extracted areas of mine. If required boreholes would be drilled into the coal seam before mining commences and a diffuser attached at surface level."*

Therefore, based on the very low levels of methane measured it considered that the potential of the site as a coal seam methane resource is very low. Abel mine has no plans to extract the methane other than for operational / safety reasons.

If methane is encountered during the mining operations, it is proposed to vent the methane prior to or during the mining process. Therefore the risk of hazardous gases at the surface post mining is considered very low and is unlikely to impact on the proposed development.

13. ADDITIONAL INVESTIGATIONS

Contamination

Based on the results of the preliminary assessment, it is considered that detailed contamination assessment is required.

Areas of additional investigation should include, but not necessarily limited to, the following:

- Further assessment of surface fibro is undertaken to confirm the presence of asbestos associated with surface fibro fragments and possibly in near surface soils. Assessment of asbestos materials at the site should be undertaken by a qualified asbestos consultant;
- Additional detailed investigation of uncontrolled filling associated with the former Ironbark Colliery. Such investigation should include the following:
  - Additional delineation of the deeper filling associated with the backfilled portal.;
  - Laboratory testing of filling materials within the backfilled portal.

Investigations should be undertaken in conjunction with additional geotechnical investigation.

It is understood that a contamination assessment has been undertaken at the Boral site to assess areas of potential contamination from the asphalt operations. It is also understood that the Boral site is to be left suitable for commercial/industrial landuse following vacation of the site. Additional investigations should be undertaken to assess the condition of the site following Boral's occupation of the site.

Remediation, if required, would include the preparation of a remediation action plan (RAP), appropriate excavation and removal / disposal / capping of contaminated soil, followed by validation sampling and analysis in accordance with NSW EPA (Ref 1) and SEPP 55.(WW please name this SEPP)

Geotechnical

Additional geotechnical investigation is expected to be required prior to development which may include the following:

- Detailed subsurface investigation to confirm the location of the portal (as described above), and delineate the extent of deep filling in the former Ironbark Colliery area;
- Additional assessment of combustible material and improvement measures;
- Specific foundation investigation for proposed buildings;

- Earthworks procedures and specifications;
- Pavement thickness design for roads.

14. LIMITATIONS OF THIS REPORT

Douglas Partners (DP) has prepared this report for this project at Black Hill in accordance with DP's proposal dated 20 January 2010. The work was carried out under Rio Tinto Short Form General Conditions for Consultancy Services, August 2004 as amended by DP letter of 6 September 2007. This report is provided for the exclusive use of the Coal & Allied Industries Ltd and Catylis for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. DP's advice may be based on observations, measurements, tests or derived interpretations. The accuracy of the advice provided by DP in this report is limited by unobserved features and variations in ground conditions across the site in areas between test locations and beyond the site boundaries or by variations with time. The advice may be limited by restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site. Should variations in subsurface conditions be encountered, then additional advice should be sought from DP and, if required, amendments made.

It is noted that the site is within a proclaimed mine subsidence district. This report outlines the potential risks associated with mine subsidence and presents guidelines for managing the risk and obtaining Mine Subsidence Board consideration for the proposed development. It is noted that the guidelines presented are not intended to fully prevent damage to property or person, rather reduce the risks and Douglas Partners accept no liability with respect to such damage. The Mine Subsidence Board should be consulted with respect to the proposed development to obtain their consent of the proposal.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions from review by others of this report or test data, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

Patrick Heads
Environmental Engineer

Stephen Jones
Principal

Will Wright
Principal

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4. NSW EPA Contaminated Sites. “Guidelines for NSW Site Auditor Scheme, 2nd Edition”, April 2006.

5. NSW DECC, Waste Classification Guidelines – Part 1: Classifying Waste, April 2008.

6. NSW EPA Contaminated Sites, “Guidelines for Assessing Service Station Sites”, December 1994

7. Australian Standard AS 2870-1996 “Residential Slabs and Footings – Construction”, June 1996, Standards Australia.

8. Australian Standard AS2159-1995 “Piling – Design and Installation”, Standards Australia.

9. Donaldson Coal Pty Limited, “Abel Underground Mine Part 3A Environmental Assessment”, Application No 05_0136, 22 September 2006.

10. Donaldson Coal Pty Limited, “Abel Mine SMP Area 1 Pillar Extraction, Upper Donaldson Seam, Subsidence Management Plan”, December 2009.

APPENDIX A

NOTES RELATING TO THIS REPORT
TEST PITS (PITS 1 TO 41)

Douglas Partners
Geotechnics · Environment · Groundwater

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water

table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

This classification system provides a standardized terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments
Sandstone:	More than 50% of the rock consists of sand sized (.06 to 2mm) fragments
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06mm) granular particles and the rock is not laminated
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	Fs	Rock substance unaffected by weathering, limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (Reference).

Strength Term	Is(50) MPa	Field Guide	Approx. qu MPa*
Extremely Low:	0.03	Easily remoulded by hand to a material with soil properties	0.7
Very Low:	0.1	May be crumbled in the hand. Sandstone is “sugary” and friable.	2.4
Low:	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium:	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
High:	3	A piece of core 150 mm long x 50 mm dia. cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very High:	10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely High:		A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	

* The approximate unconfined compressive strength (qu) shownin the table is based on an assumed ratio to the point load index of 24:1. This ratio may vary widely.

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks

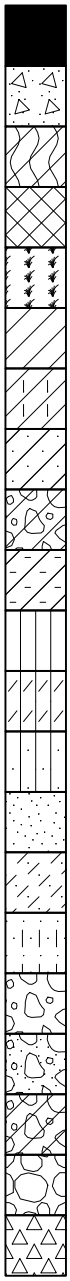
Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm - 100 mm with occasional shorter and longer sections.
Slightly Fractured:	Core lengths are generally 300 mm - 1000 mm with occasional longer sections and occasional sections of 100 mm - 300 mm.
Unbroken:	The core does not contain any fracture.

REFERENCE

International Society of Rock Mechanics, Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1 Final Draft October 1972

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

GRAVEL

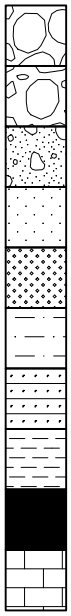
SANDY GRAVEL

CLAYEY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

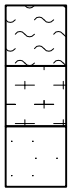
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

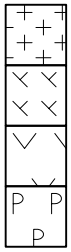


SLATE, PHYLITTE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 18.77 AHD*
EASTING: 372136.2
NORTHING: 6368027
DIP/AZIMUTH: 90°/--

PIT No: 1
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Dark grey-brown silty clay filling, with abundant organics, dry		D, PID	0.1		<1ppm		
	0.3	CLAY: Very stiff dark grey-brown mottled orange clay, M>Wp		D, PID, pp	0.5		220-280 kPa <1ppm		
		From 0.6m, grey							
1	1.0	CLAY AND GRAVEL: Stiff grey-brown clay and claystone gravel (extremely low strength claystone?), M>Wp		D, pp	1.4		300 kPa		1
2	2.0	SILTY CLAY: Very stiff light grey-brown mottled orange silty clay (extremely low strength claystone), some claystone gravel and iron staining and cementing		pp	2.2		350 kPa		2
				pp	2.8		350-400 kPa		
3	3.0	Pit discontinued at 3.0m							3
4									4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 21.67 AHD*
EASTING: 371839.7
NORTHING: 6368076.7
DIP/AZIMUTH: 90°/--

PIT No: 2
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Grey-brown fine to coarse grained sand, fine to medium sized gravel filling, dry, trace black gravel (bitumen?/coal reject?)		D, PID	0.05		<1ppm		
	0.2	CLAY: Hard grey and orange slightly sandy clay, M<Wp		D, PID, pp	0.3		>400 kPa <1ppm		
		From 0.4m, very stiff grey mottled orange, M>Wp		pp	0.5		300 kPa		
	0.65	SANDSTONE/CONGLOMERATE: Very low strength, highly weathered grey and orange sandstone, iron cemented, strength increasing with depth							
	0.95	Pit discontinued at 0.95m, refusal							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 19.09 AHD*
EASTING: 371686.4
NORTHING: 6367973.1
DIP/AZIMUTH: 90°/--

PIT No: 3
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Grey and grey-brown fine to coarse grained sand filling, fine to coarse sized gravel, some siltstone and coal gravel, bricks, concrete and organics, damp		D, PID	0.4		<1ppm		
1	1.0	FILLING: Grey fine grained cemented sand filling		D, PID	1.5		<1ppm		
	1.8	FILLING: Grey-brown, brown and orange intermixed clay filling, some timber, rubber belt (conveyor), M>Wp		D, PID	2.5		<1ppm		
2									
3		From 3.5m, organics (grading to natural?)		D, PID	3.6		<1ppm		
4									
	4.5	Pit discontinued at 4.5m, extent of reach							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Excavated through stockpile approximately 1.0m high.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 14.42 AHD*
EASTING: 371581.7
NORTHING: 6367752.1
DIP/AZIMUTH: 90°/--

PIT No: 4
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.2	FILLING: Light yellow-grey slightly clayey sand and sandstone cobbles, dry							
	0.4	FILLING: Dark grey/black silty clay, siltstone and coal filling (coal reject), with some organics, M<<Wp		D, PID	0.3		<1ppm		
	0.7	CLAYEY SILT: Grey-brown clayey silt, M<<Wp		D	0.5				
	1	SILTY CLAY: Hard dark grey-brown mottled orange silty clay, M<Wp		D, pp	1.0		>400 kPa		
				pp	1.5		>400 kPa		
	2	From 2.0m, very stiff sand, grading to clayey sand		pp	2.2		300 kPa		
	3	3.0 Pit discontinued at 3.0m, extent of reach							
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd
Adjacent to drainage channel

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 21.64 AHD*
EASTING: 371251.6
NORTHING: 6367603.1
DIP/AZIMUTH: 90°/--

PIT No: 5
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Yellow-grey and dark grey fine to coarse grained sand filling, some coal reject, damp		D, PID	0.05		<1ppm		
	0.2	CLAY: Very stiff grey-brown mottled orange clay, M>Wp		pp	0.3		350 kPa		
		From 0.4m, stiff, orange and grey		D, pp	0.5		200 kPa		
	1	From 0.9m, grey mottled orange		pp	1.2		200-250 kPa		1
	1.5	SANDY CLAY: Very stiff grey and yellow-brown sandy clay, possible rock structure							
	2			pp	2.0		250 kPa		2
	2.5	SILTSTONE: Very low strength, highly weathered grey-brown siltstone		D	2.7				
	3								3
	3.0	Pit discontinued at 3.0m							
	4								4

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 22.81 AHD*
EASTING: 371228.7
NORTHING: 6367626.5
DIP/AZIMUTH: 90°/--

PIT No: 6
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Yellow-grey and dark grey fine to coarse grained sand filling, some coal reject, damp		D, PID	0.05		<1ppm		
	0.2	CLAY: Stiff grey-brown mottled orange clay, M>Wp		pp	0.5		150 kPa		
	1	From 1.1m, stiff to very stiff grey mottled orange		pp	1.1		220 kPa		
		From 1.4m, moisture decreasing, possible rock structure (less plastic)							
	2			pp	1.8		250 kPa		
	2.2	SILTSTONE: Very low strength, highly weathered grey-brown siltstone							
	3								
	3.0	Pit discontinued at 3.0m							
	4								

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 22.74 AHD*
EASTING: 371253.8
NORTHING: 6367675.8
DIP/AZIMUTH: 90°/--

PIT No: 7
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0	FILLING: Grey-brown fine to coarse grained sand filling, fine to coarse sized gravel, cobbles and boulders, concrete boulders, asphalt boulders (up to 1m diameter), ag pipe, paper bags		D, PID	0.5		<1ppm		
	1	From 1.6m, heavy seepage						▷	
	1.8	FILLING: Dark grey/grey-brown mottled orange clay filling, trace gravel, coal, M>Wp		D, PID	3.0		<1ppm		
	4			D	4.5				
	4.6	Pit discontinued at 4.6m, extent of reach							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: Heavy seepage at 1.6m

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Adjacent to dam/surface water and reeds

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⧗	Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 21.95 AHD*
EASTING: 371259.4
NORTHING: 6367622.2
DIP/AZIMUTH: 90°/--

PIT No: 8
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Dark grey/dark grey-brown silty clay filling, some gravel and coal, M<Wp		D, PID	0.1		<1ppm		
				D, PID	0.5		<1ppm		
	1.0	FILLING: Grey-brown and yellow-brown slightly sandy clay filling, M>Wp		D, PID	1.2		<1ppm		
	1.4	CLAY: Stiff orange and grey clay, M>Wp		pp	1.5		150 kPa		
		From 1.6m, very stiff grey mottled orange, decreasing plasticity		pp	1.8		250 kPa		
	2.0	CLAY: Hard light grey and yellow-brown clay, M<Wp		pp	2.4		>400 kPa		
		From 2.7m, grading to siltstone/claystone							
	3.0	Pit discontinued at 3.0m							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3, 4

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Filling dipped between 0.6m and 1.4m across pit

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 21.24 AHD*
EASTING: 371306.4
NORTHING: 6367664.8
DIP/AZIMUTH: 90°/--

PIT No: 9
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Grey-brown, grey and orange-brown silty and sandy clay filling, some gravel, M<Wp		D, PID	0.1		<1ppm		
				D, PID	0.7		<1ppm		
	1.3	CLAY: Very stiff light brown clay, M>Wp		D, pp	1.4		350 kPa		
		From 1.6m, stiff to very stiff orange and grey		pp	1.8		180-250 kPa		
		From 2.0m, very stiff light grey mottled orange, plasticity decreasing		D, pp	2.2		250 kPa		
	2.5	CLAY: Very stiff light grey mottled orange slightly sandy clay, M<Wp		D, pp	2.7		300 kPa		
		From 2.8m, some dark grey siltstone layering							
	3.0	Pit discontinued at 3.0m							

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Pit excavated in raised platform area

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 21.78 AHD*
EASTING: 371282.2
NORTHING: 6367679.8
DIP/AZIMUTH: 90°/--

PIT No: 10
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		FILLING: Dark grey-brown and dark grey clay filling, some gravel, coal, organics, M>Wp		D, PID	0.3		<1ppm		
	1			D, PID	1.0		<1ppm		1
	2								2
	3								3
	4			D	4.0				4
		At 4.1m, obstruction, possible concrete							
	4.2	Pit discontinued at 4.2m, refusal on obstruction							

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 21.31 AHD*
EASTING: 371264.3
NORTHING: 6367581.1
DIP/AZIMUTH: 90°/--

PIT No: 11
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Light grey-brown coarse grained sand filling, dry		D, PID	0.1		<1ppm		
		From 0.3m, with some intermixed light grey-brown and blue cemented sand cobbles (industrial product?)		D	0.4				
	0.5	CLAY: Stiff brown/grey-brown clay, M>Wp							
		From 0.8m, orange-red and grey		pp	0.9		150-250 kPa		
	1								1
		From 1.6m, stiff light grey mottled orange-red		pp	1.8		250 kPa		
	2								2
	2.2	CLAY: Very stiff light grey mottled orange slightly sandy clay, M<Wp		pp	2.4		300 kPa		
		From 2.8m, some siltstone layers							
	3								3
	3.0	Pit discontinued at 3.0m							
	4								4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 19.65 AHD*
EASTING: 371299.2
NORTHING: 6367595.2
DIP/AZIMUTH: 90°/--

PIT No: 12
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Light yellow-brown coarse sand filling, with some cemented sand cobbles and gravel		D, PID	0.1		<1ppm		
		From 0.2m, some blue stained cemented sand cobble filling		D, PID	0.25		<1ppm		
	0.4	CLAY: Very stiff brown clay, M>Wp		D, pp	0.5		250-350 kPa		
		From 0.6m, orange-red and grey		D, pp	0.8		280-300 kPa		
	1								1
		From 1.5m, grey and orange-red		D, pp	1.6		250-350 kPa		
	2			pp	2.0		350->400 kPa		2
		From 2.5m, grey and yellow/orange		D, pp	2.6		250-350 kPa		
	3								3
	3.2	Pit discontinued at 3.2m							
	4								4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 18.40 AHD*
EASTING: 371336.7
NORTHING: 6367634.8
DIP/AZIMUTH: 90°/--

PIT No: 13
PROJECT No: 39664A
DATE: 25 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Intermixed light yellow-brown coarse sand filling and grey-brown silty clay filling, damp		D, PID	0.1		<1ppm		
	0.4	CLAY: Stiff to very stiff light brown clay, M>Wp		pp	0.5		300 kPa		
		From 0.7m, orange-red and grey		pp	0.8		180-200 kPa		
	1								1
		From 1.5m, very stiff, light grey mottled orange-red and orange		pp	1.6		300 kPa		
	2	From 2.0m, some iron cementing		pp	2.2		280 kPa		2
		From 2.7m, light grey mottled yellow-orange		pp	2.8		300 kPa		
	3 3.0	Pit discontinued at 3.0m							3
	4								4

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 18.25 AHD*
EASTING: 371358.5
NORTHING: 6367666.5
DIP/AZIMUTH: 90°/--

PIT No: 14
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Intermixed grey-brown and dark grey silty sand and siltstone gravel, damp		D, PID	0.05		<1ppm		
	0.3	CLAY: Hard light brown slightly sandy clay, M<Wp		D, pp	0.4		>400 kPa		
	0.6	CLAY: Very stiff orange-red and grey clay, M>Wp		D, pp	0.8		200-250 kPa		
1		From 1.1m, grey mottled orange							1
	1.6	SANDY CLAY: Very stiff grey mottled orange sandy clay, M>Wp		D, pp	1.8		200-250 kPa		
2	2.0	CLAY: Very stiff light grey mottled yellow-orange slightly silty clay, M<Wp, possible rock structure		D, pp	2.2		250-350 kPa		2
		From 2.5m, friable							
3	3.0	Pit discontinued at 3.0m							3
4									4

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 29.04 AHD*
EASTING: 371058.1
NORTHING: 6367416.7
DIP/AZIMUTH: 90°/--

PIT No: 15
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	TOPSOIL: Light grey-brown silty clay topsoil, some roots and rootlets, dry		D	0.1				
	0.2	CLAY: Very stiff, grey and orange clay, M>Wp		D, pp	0.5		300-350 kPa		
	0.7	CLAY: Very stiff to hard, light grey mottled orange clay, M>Wp		D, pp	1.0		300->400 kPa		
	1	From 1.4m, M<Wp, possible rock structure		D, pp	1.5		350->400 kPa		
	2	From 2.5m, very stiff, light grey mottled orange and yellow, with some dark grey/black mottling		D	2.0				
				D, pp	2.7		200-350 kPa		
	3 3.0	Pit discontinued at 3.0m							
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 17.38 AHD*
EASTING: 371381.3
NORTHING: 6367660.1
DIP/AZIMUTH: 90°/--

PIT No: 16
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	FILLING: Grey-brown silty sand and dark grey/black siltstone gravel filling, damp		D, PID	0.05		<1 ppm		
		FILLING: Dark grey silty clay, siltstone gravel and slag cobble filling, dry/M<<Wp		D, PID	0.3		<1 ppm		
	0.4	CLAY: Very stiff, light brown clay, M>Wp		pp	0.6		300 kPa		
		From 0.7m, grey and orange							
	1			pp	1.1		250-320 kPa		1
	1.6	SANDY CLAY: Very stiff, grey mottled orange sandy clay, M>Wp		pp	1.8		350-400 kPa		
	2 2.0	CLAY: Very stiff, light grey mottled yellow-orange slightly silty clay, M<Wp		pp	2.2		380->400 kPa		2
		From 2.7m to 2.9m, dark grey/black silty clay band		pp	2.8		250-300 kPa		
	3 3.0	Pit discontinued at 3.0m							3
	4								4

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧩ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 19.62 AHD*
EASTING: 371366.1
NORTHING: 6367707.3
DIP/AZIMUTH: 90°/--

PIT No: 17
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.15	FILLING: Dark grey/black siltstone gravel filling, some silty clay, dry		D, PID	0.1		<1 ppm		
	0.25	SILTY CLAY: (Former topsoil) grey-brown silty clay, M<<Wp		D, pp	0.3		>400 kPa		
		CLAY: Hard grey-brown/brown slightly silty clay, M<Wp From 0.45m, stiff light grey-brown mottled orange, M>Wp		D, pp	0.6		120-170 kPa		
	0.8	SANDY CLAY: Light grey and yellow sandy clay, M<Wp							
	1	From 1.1m, grading to extremely low strength sandstone		D	1.0				
	1.5	SANDSTONE: Low strength, moderately weathered fine to medium grained light grey, yellow and orange sandstone, strength increasing with depth							
	2.0	Pit discontinued at 2.0m, refusal on sandstone							

5 10 15 20

1 2 3 4

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 14.71 AHD*
EASTING: 371489.9
NORTHING: 6367842
DIP/AZIMUTH: 90°/--

PIT No: 18
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Dark grey siltstone gravel filling, damp		D, PID	0.2				
	0.5	SANDY CLAY: Very stiff, grey-brown mottled orange sandy clay		pp	0.8		250-350 kPa		
	1			pp	1.3		350 kPa		
		From 1.5m, grading to clayey sand							
	1.8	CLAYEY SAND: Grey-brown fine to medium grained clayey sand, moist		D	2.0				
	2								
	2.8	SANDY CLAY: Dark grey sandy clay, some organics, M>Wp		D	2.9				
	3								
	3.0	Pit discontinued at 3.0m							
	4								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Approximately 20m to 30m from drainage channel and 2.0m deep. Excavated adjacent to concrete footing

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 13.93 AHD*
EASTING: 371483
NORTHING: 6367912.1
DIP/AZIMUTH: 90°/--

PIT No: 19
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Light yellow-brown fine to coarse grained sand and fine to coarse sized gravel filling (crushed sandstone), damp		D, PID	0.2		<1ppm		
	0.5	SANDY CLAY/CLAYEY SAND (filling?): Hard dark grey-brown sandy clay/clayey sand, M<Wp		D, pp	0.7		>400 kPa		
	0.9	SANDY CLAY: Stiff dark grey sandy clay, some roots, M>Wp		D, pp	1.2		100-120 kPa		
	1.6	CLAY: Very stiff grey clay, M>Wp		D, pp	1.8		350 kPa		
		From 2.3m, grey mottled yellow-orange		D, pp	2.5		350 kPa		
	3.0	Pit discontinued at 3.0m							

5 10 15 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth
LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 13.32 AHD*
EASTING: 371483.5
NORTHING: 6367957.5
DIP/AZIMUTH: 90°/--

PIT No: 20
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Light grey-brown silty clay filling, dry		D, PID	0.2		<1 ppm		
	0.4	CLAY: Hard grey-brown mottled orange slightly sandy clay, M<Wp, sand content increasing with depth		D, pp	0.6		>400 kPa		
	1			pp	1.2		>400 kPa		
	1.8	SANDY CLAY: Very stiff light yellow-grey mottled orange sandy clay, M<Wp		pp	2.0		300-350 kPa		
	2.3	SANDSTONE: Extremely low strength, extremely weathered yellow-grey mottled orange sandstone, some sandy clay bands From 2.8m, slow progress (iron cementing)							
	3.0	Pit discontinued at 3.0m							

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Excavated through stockpile approximately 0.5m above surrounding levels

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 12.33 AHD*
EASTING: 371663.2
NORTHING: 6368140.6
DIP/AZIMUTH: 90°/--

PIT No: 21
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Light grey-brown silty clay filling, with some roots and rootlets, dry		D, PID	0.5		<1 ppm		
1	1.0	SANDY CLAY: Very stiff, grey-brown mottled orange sandy clay, M<Wp		D, pp	1.8		250 kPa		
2		From 2.0m, grey mottled orange, M>Wp		D, pp	2.0		200 kPa		
				D, pp	2.5		>400 kPa		
3		From 3.2m, clayey sand/sandy clay (moist)		D	3.5				
	3.8	Pit discontinued at 3.8m							
4									

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.
Excavated through stockpile approximately 1.0m above surrounding levels

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 16.62 AHD*
EASTING: 371392.8
NORTHING: 6368072.7
DIP/AZIMUTH: 90°/--

PIT No: 22
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.1	TOPSOIL: Grey-brown silty sand topsoil, some rootlets, damp to moist		D	0.05				
	0.25	SILTY SANDY CLAY: Stiff to very stiff, grey-brown mottled orange silty sandy clay, M<<Wp		D, pp	0.2		180-250 kPa		
		CLAY: Very stiff, grey and orange clay, M>Wp		D, pp	0.4		300 kPa		
	1			pp	1.0		300 kPa		1
	1.4	SANDSTONE: Extremely low strength, extremely weathered grey and yellow-orange sandstone		D	1.5				
	2			D	2.0				2
		From 2.2m, clayey sand and sandy clay bands		D	2.5				
	3 3.0	Pit discontinued at 3.0m							3
	4								4

5 10 15 20

RIG: Case 590 Super M backhoe, 450mm bucket with teeth
LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal and Allied Operations Pty Limited
PROJECT: Preliminary Contamination & Geotechnical Assessment
LOCATION: Black Hill

SURFACE LEVEL: 15.14 AHD*
EASTING: 371111.9
NORTHING: 6368204.9
DIP/AZIMUTH: 90°/--

PIT No: 23
PROJECT No: 39664A
DATE: 26 Oct 07
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.0	FILLING: Grey-brown and yellow-brown clayey sand filling, dry		D, PID	0.1		<1 ppm		
	0.3	SILTY CLAY: Grey-brown silty clay, M<<Wp							
	0.5	SANDY CLAY: Very stiff grey-brown mottled orange sandy clay, M>Wp		D, pp	0.6		250-350 kPa		
	1			D, pp	1.2		250-350 kPa		
	1.4	SANDY GRAVELLY CLAY: Stiff orange-brown and grey-brown sandy gravelly clay, M>Wp		D, pp	1.7		150-220 kPa		
	1.8	SANDY CLAY: Stiff light grey mottled orange sandy clay, M>Wp		pp	2.0		150 kPa		
	2								
	2.3	CLAYSTONE: Extremely low strength, extremely weathered grey claystone							
	3								
	3.0	Pit discontinued at 3.0m							
	4								

RIG: Case 590 Super M backhoe, 450mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surveyed by Monteath & Powys Pty Ltd.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧭ Water level

CHECKED
Initials:
Date:

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