F.2 2004 Soil Survey – Poitrel and Red Mountain Mining Leases

F.2.1 Introduction

A soil survey was conducted for the Poitrel and Red Mountain Mining Leases in August 2004. This appendix presents the methodology and soil type descriptions relevant to the soils found within the Red Mountain Lease, as this lies within the Daunia Project Site. Details relating solely to the soils found within the Poitrel Lease were documented in the Poitrel EIS and are not reproduced here.

At the time of the 2004 survey conditions were extremely dry with soil profiles completely devoid of noticeable moisture. Most native trees and shrubs were clearly water stressed. Much of the young Brigalow regrowth that is common on the clay soils were heavily impacted by drought and quite brown in colour.

The first soil and land suitability work in the survey area was completed by CSIRO who mapped land system boundaries (Gunn et al 1967) and described soil types. Bourne and Tuck (1993) described agricultural management units (AMU's) for the Central highlands region of Queensland that includes this survey area. Gunn et al (1967) and Bourne and Tuck (1993) produced soils and land information at a scale of 1:500 000 which is far too large for the purpose of mine planning but nevertheless relevant and useful. Other work relevant to the area is the Kilcummin land suitability survey conducted by Shields and Williams (1991) which covers an area to the west of this survey but has directly transferable soils and land suitability information.

F.2.2 Survey Methodology

The survey was designed to provide sufficient information on land resources to allow the determination of land suitability, soil erosion, rehabilitation potential and storm water runoff quality consistent with the methods set out by the Queensland DPI (1990), Shields and Williams (1991) and DME (1995). Advice on local production systems, land suitability and flood levels was obtained from local NR&M staff and the primary producer managing the leases.

A review of available information, published or not, was undertaken prior to commencement of fieldwork and included where appropriate. Initial site mapping based on accurate high resolution rectified aerial photogrammetry (with DTM contour detail overlay) has been undertaken to provisionally identify landform and vegetation patterns to assist with site inspections and ground observation location selections. The map was progressively refined during the field work phase and completed following review of collected results including chemical and physical analyses.

Free survey techniques (Gunn et al 1988) have been used to verify proposed soil types and assign boundaries to each. Free survey is a commonly used method in broader scale agricultural lands as it enables flexibility in site selection (over grid mapping techniques), to achieve a more accurate and time effective result. It is particularly appropriate in this survey as topographic, vegetative and soil associations were quite uniform across most of the area. The survey has focussed on areas that are likely to be affected by mining operations, although sampling beyond planned disturbance areas has also been undertaken to enable soil units to be extended into the adjoining areas not proposed for future mining activity.

Soils were mapped at approximately 1:25,000 scale in general accordance with guidelines provided by Gunn et al (1988), Australian Soil and Survey Handbook. The survey design also had due regard to government guidelines for the Identification of Good Quality Agricultural Land (DLGP and DPI 1993). The guideline is

flexible and recognises complexity of landform, surveyors' experience and purpose of survey in the determination of location and number of ground observations. Soil sampling locations within the Red Mountain Lease are shown in **Figure F-1** in **Appendix F.1**.

Major soil characteristics were determined from examination of soil profile morphology and determination of key chemical attributes. Physical properties such as permeability and drainage characteristics were inferred from profile morphological characteristics such as concretions, depth to rock, observed root depth, colour and mottling.

Typical depths of primary and secondary topsoil were determined using DME (1995) guidelines and the site data. Primary topsoil is the uppermost layer of soil used in site rehabilitation. It is salvaged from the surface horizons of areas to be disturbed, is relatively stable, contains seeds and micro organisms and is relatively fertile.

Sampling and profile inspection points were spread across the entire project area to characterise all landform elements and geological units.

Profile descriptions have been established with due regard to the Australian Soil and Land Survey Field Handbook (MacDonald et al 1998), the Australian Soil Classification (Isbell, 1996) and Munsell soil colour charts. Profiles have been sampled using hand augers and spades. Where possible profiles at cuttings and eroded channels have also been sampled and recorded. Slope, landform, vegetation, land condition and geology were also assessed at inspection points. Sampling and observation points were recorded using a global positioning system data logger.

The guidelines suggest a range between 4 and 16 sample points per 100 ha for a 1:25,000 scale survey depending on pre existing resource information as well as the local knowledge and experience of the surveyor. Further, the guideline also recommends that between 1% and 5% of all sites are sampled and subject to laboratory analysis and that between 10% and 30% of sites are described in detail (i.e. field profile morphological description).

The Poitrel and Red Mountain Lease areas cover 3964 and 754 ha respectively. Some 203 sites were mapped across both lease areas using GPS equipment. Of this total, soil samples from various depths at 12 representative sites have been subject to laboratory analysis for chemical and physical characterisation, 73 sites have been described in detail (including lab sites), and some 130 sites have been established at lower descriptive levels to confirm soil type, land condition and soil unit boundaries.

Detailed sites were generally augured up to 1.5 m depth unless rock or irretrievable media was encountered. Non-detailed sites were also excavated, sufficient to confirm depth of A horizon and upper B seam characteristics. pH was sampled at all augured sites as well as in all cuttings and erosion channels which were used as observation sites.

Photographs were taken at all representative sites and also at many of the non-detailed observation sites to assist with final interpretation on soils and suitability.

Section F.2.5 of this appendix provides detailed descriptions of representative sites, including landform perspective, surface condition, profile description, chemical and physical characterisation as well as a summary of the soil type and recommended stripping depth and rehabilitation landform application.

Descriptions are only provided for the soil types that were (1) found within the Red Mountain Lease and (2) not found in the 2008 survey of the Daunia and Daunia East Leases.

Attachments 1 and 2 of this appendix include copies of all observation data and laboratory results relevant to the soils found within the Red Mountain Lease.

F.2.3 Soil Origins

Galloway (1967) described the geology of the area as part of the CSIRO land research program. Most soils in the survey area were considered to have formed from sediments originating from the old Tertiary weathered zone which range from conglomerate through sandstone to clay.

The subsequent survival, partial or complete removal of the old Tertiary land surface and deep weathered zone determine major characteristics of soils and the land in general. The area includes remnants of the old Tertiary land surface in the form of partially or in-tact mesas and ridgelines.

The distribution of soils in the survey area reinforces this view as each of 6 land units described by Gunn et al (1967) as making up the Humboldt land system were clearly evident in the survey area. Humboldt is described as weathered Tertiary clay and claystone, with various mixtures of quartz, billy and ironstone gravel, together with areas of deeply weathered shale older rocks. Soils associated with the Humboldt land system make up most of the survey area. The land use of most of these soils is restricted to grazing of native and improved pastures.

An area of friable dark cracking scrub soils occurs in the eastern rim of the survey area, which CSIRO has described as Daunia land system. Soils have formed from deep weathering of non-quartzose sedimentary rocks, in this case shale. These soils supported thick Brigalow and with more favourable climatic conditions would offer potential for cash cropping. The current use is grazing.

The third soil group in the area is the post-tertiary alluvium which includes the deep recent sands and loams associated with the Isaac River as well as sandy duplex flats with mixed Poplar Box woodlands.

F.2.4 Soil Mapping Units

In the 2004 survey a total of nine soil types were identified, as well as three variants. A soil variant may possess attributes that are somewhat different from the mainstream soil attributes but either cannot be mapped out at this scale or does not constitute any significant deviation from the agricultural suitability or basic soil morphology. The nine soil types are summarised in **Table F-2-1** below.

Of the nine soil types identified, only six were found on the Red Mountain Lease and of these six, two were equivalent to soils identified in the 2008 survey in the Daunia and Daunia East Leases. The two soil types that were common to both surveys have been described in the Daunia Project EIS using the soil type descriptions from the 2008 survey. The remaining four soil types within the Red Mountain Lease that were not found in the 2008 survey have been described in the Daunia EIS using the soil type descriptions from the 2004 survey. This arrangement is presented in **Table F-2-1**.

Soil mapping units have been developed on the basis of similarity in morphology, laboratory data, original vegetation, soil origin and topographic position. The principal soil types identified in the 2004 survey were non cracking sandy clay Brigalow undulating plains and associated gravely ridgelines (B1 and B2) which dominated the central portion of the survey area.

A prominent strip of hard sandy duplex alluvia with mixed poplar box woodland (A2) formed a boundary to well structured, softer Brigalow clay scrub soils to the east (B4). On the western portions of the survey area lay the undulating poplar box duplex plains while gilgai-ed Brigalow clay lowlands (B3) occur to the north.

Table F-2-1 Summary of Soil Types – 2004 Survey

2004 Survey Code	Name	Found on Red Mountain?	2008 Survey Equivalent	Soil Type Adopted for Daunia EIS
A1	Alluvial – deep Isaac sands	No*	N/A	N/A
A2	Alluvial -Sandy hard duplex	Yes	N/A	A2
A3	Alluvial – Uniform Brigalow clay	Yes	DB3	DB3
B1	Red / brown deeper uniform clay undulating plains	Yes	DB1	DB1
B2	Gravely clay on ridgelines	No	N/A	N/A
B3	Uniform Brigalow grey / brown clays.	Yes	DB4	DB4
B3v	Melon holed Brigalow clay lowlands	Yes	DB4	DB4
B4	Friable Brigalow scrub soil	Yes	N/A	B4
B4v	Variant to B4	Yes	N/A	B4v
B5	Linear Gilgai Brigalow	Yes	DB2	DB2
E1	Sandy duplex plains with Poplar Box	No	N/A	N/A
E2	Residuals (mesas)	No	N/A	N/A
E3	Texture contrast Soil	No	N/A	N/A

* Only soil types found on the Red Mountain Lease are further documented in this Appendix. Data on the soil types found on the Poitrel Lease were documented in the Poitrel EIS.

Table F-2-2 provides details of soil types identified within the Red Mountain Lease and laboratory analysis undertaken for each soil type.

Table F-2-2 Soil Types and Sampling Site Details – 2004 Survey (Red Mountain Lease only)

Soil	Concept	Description	Detailed Sites*	Non-Detailed Sites*	Lab. Sites*
A2	Alluvial - Sandy hard duplex	Hard setting sandy loam duplex soils alongside New Chum Creek often with bleached A2 over hard, coarse structured medium yellow clay often heavily mottled. Poplar Box mixed woodlands with associated Brigalow and blackbutt.	2, 30, 41, 50, 57, 58, 117	40, 42, 51, 68, 70, 98, 108, 113, 120, 126, 127, 130, 179, 180, 193, 194, 195, 196, 199, 200	41
A3 (DB3**)	Alluvial – Uniform Brigalow clay	Deep, generally alkaline with carbonate nodules, possibly bleached A2 horizon, uniform medium sandy clay which is non-cracking. Brigalow, Blackbutt and Bauhinia.	9, 59, 133, 174	6, 101, 141, 173, 183, 184	9
B1 (DB1)	Red / brown deeper uniform clay undulating plains	Undulating plains up to 3 % slope of mostly cleared Brigalow, Blackbutt and Bauhinia. A firm to hard setting sandy surface, often gravely, overlies stiff medium sandy clays which are neutral and red to brown coloured. Weathered parent material or gravels generally predominate by 80 cm depth.	1, 7, 22, 23, 33, 62, 65, 72, 83, 85, 131, 132, 137, 139	4, 25, 27, 28, 34, 60, 64, 67, 71, 77, 78, 82, 84, 94, 97, 111, 112, 114, 116, 121, 134, 135, 136, 138, 140, 142, 144, 156, 167, 175, 192	1
B3 (DB4)	Uniform Brigalow grey / brown clays.	Generally non-cracking uniform grey/brown clay but includes areas of normal gilgai (up to 40 cm deep) which may crack. Also includes isolated areas of B4 (melanholes) in lower slope positions.	18, 54, 89, 92, 96, 123, 128, 204	55, 93, 95, 110, 119, 122, 124, 125, 129, 160, 198, 201, 202, 203	18
B3v (DB4)	Melon holed Brigalow clay lowlands	Approx. 50% or more of land surface is melanholed (40-100 cm deep) with deep grey cracking clay	24, 26, 106	29, 100	24
B4	Friable Brigalow scrub soil	Deep well structured black cracking clay with granular surface mulch.	104, 178, 181	103, 105, 107	178
B4v	Variant to B4	Fine granular non-cracking red / brown Brigalow scrub soil.		102, 182,197	
B5 (DB2)	Linear Gilgai Brigalow	Dark cracking clay in association with red non-cracking clay in linear gilgai complex.	43, 44, 46, 47, 48, 109	45, 49, 52, 53, 56	43

* Sampling site numbers refer to the 2004 survey and are distinct from the sampling site numbers assigned in the 2008 survey in the Daunia and Daunia East Leases.

** 2008 survey soil type equivalent.

F.2.5 Soil Types (Red Mountain Lease Only)

This section describes the soil types that were found within the Red Mountain Lease but do not have an equivalent within the Daunia and Daunia Mining Leases. These two soil types are as follows:

- A2 – Alluvial sandy hard duplex
- B4 and B4v – Friable Brigalow scrub soil

The remaining four soil types found within the Red Mountain Lease that have equivalents on Daunia are described in the 2008 soil survey in **Appendix F.1**. These soil types are as follows:

- A3, described as soil type DB3
- B1, described as soil type DB1
- B3, described as soil type DB4
- B5, described as soil type DB2

F.2.5.1 A2 Sandy Duplex Alluvial Plain

This soil type occupies the floodplain and channel of New Chum Creek. The soil is generally a hard setting sandy loam with a bleached A2 over hard, coarse structured medium yellow clay often heavily mottled. Poplar Box mixed woodlands predominate with occasional associated Brigalow. It occurs on 0 - 2% slopes, is susceptible to occasional flooding and supports generally sparser levels of buffel than found elsewhere on the site.

Nutrient levels are very low, typical of duplex country in the region. The surface has very low fertility and may tend to set hard given the proportion of fine sand and silt sized fraction. The effective soil depth is restricted mainly to the depth of the A horizon (which is 150 mm in the sampled site). Topsoil stripping for rehabilitation should avoid any contamination from the clay subsoil. Overall, a poor soil but still suitable for managed grazing.

The surface soil is dominated by fine sand over highly saline and alkaline clay subsoils. Trafficability is poor when wet, particularly once the subsoil wets out. The surface has very low fertility and may tend to set hard given the proportion of fine sand. The effective soil depth is restricted mainly to the depth of the A horizon (which is 150 mm in the sampled site). Topsoil stripping for rehabilitation should avoid any contamination from the clay subsoil which is moderately dispersive according to the lab analysis, although typically highly dispersive according to observation. Overall, it is a poor soil.

This soil unit is susceptible to erosion, particularly on slopes leading into New Chum Creek. Thus clearing and or compacting of slopes above the Creek should be undertaken with this in mind. Nitrogen and phosphorus is low, hence this soil will respond well to superphosphate application for pasture establishment. The soil may be stripped moist or dry.

Typically the soil can be stripped between 100 mm to 150mm, the stripping should not extend into the bleached layer (if present) and or the clayey B horizon. If stripped, the soil will be useful on rehabilitation of level surfaces such as dump tops.

BHP Billiton Mitsubishi Alliance

Representative Site Description: A2

Surface Features: Site 41

Soil Type	A2
Concept	Sandy duplex alluvial plain with mixed poplar box scrub.
AMG Reference	631239 mE 7554582 mN
Site No	41
Australian Soil Classification	Brown Sodosol
Landform Element	Drainage line
Landform Pattern	199 m Flat alluvial plain
Slope %	<0.5%
Microrelief	none.
Surface condition	Sandy, non cracking, hardsetting, no stone or rock

Land Condition	Quite bare and eroding in drainage line, stable above
Land Use	Being grazed by beef cattle
Major Vegetation Form and Type	Mostly cleared with remnant Blackbutt, Bauhinia, Leichhardt bean, Poplar Box and Brigalow. Buffel pasture 40% cover
Samples for analysis	0-10, 50-60 cm

Land Suitability Summary. Stocking rates recommended by Bourne & Tuck (1993) for cleared pasture as ha / adult equivalent beast (AE) for long term sustainability.	**Cropping** – Class 5 unsuitable with major limiting factor(s) moisture availability (5). **Grazing** – Class 4 suitable with major limitations from moisture (3), fertility (3). Stocking rate 15 ha/AE

Soil Profile: Site 41

Horizon	Depth	Description
A11	0-15	Dark Brown 10YR4/3, sandy loam, no mottles or coarse fragments, loose and massive. Field pH 6.5, clear to;
B21	15-45	Brown 7.5YR5/6, medium clay (sandy), field pH 7.0, some yellow mottles and fine sandstone gravel (<10%), very hard angular blocky. Gradual to;
B22	45 –100+	Brown 7.5YR4/4, medium clay (sandy), field pH 8.0, mottles increasing with calcium carbonate nodules and gravel, very hard angular blocky.
Recommended Topsoil Strip Depth		10 -15 cm
Preferred Rehabilitation Use		Flat sites only due to high erosion potential. Place > 25 cm depth

Major Aspects of Chemical Analysis

The surface soil is dominated by fine sand over highly saline and alkaline clay subsoils. The surface has very low fertility and may tend to set hard given the proportion of fine sand. The effective soil depth is restricted mainly to the depth of the A horizon (which is 150 mm in the sampled site). Topsoil stripping for rehabilitation should avoid any contamination from the clay subsoil. Overall, a poor soil.

Chemical Analysis: Site 41

Analyte	0-10 cm	Comment	50-60 cm	Comment
NO3-N ppm	3.7	very low		
P (Olsen) ppm	2	very low		
K meq/100g	0.28	adequate	1.11	
Mg meq/100g	1.40	low	9.74	
Ca meq/100g	3.75	moderate	27.72	
S ppm	2	low		
Mn ppm	8.9	moderate		
B ppm	-0.1	very low		
Cu ppm	0.3	low		
Fe ppm	27	moderate		
Zn ppm	0.3	low		
OM %	0.9	low		
CEC meq/100g	5.71	very low	42.43	good
Ca/Mg ratio	2.68	good	2.85	good
pH(CaCl2)	5.8	neutral		
pH(H20)	6.4	neutral	8.3	
EC dS/m	0.02	very low	1.00	highly saline
Al meq/100g	0.10	ok	0.21	ok
Cl ppm	9	very low		
Na meq/100g	0.18	very low	3.65	low - moderate
ESP	3	non dispersive	8.6	moderate
Dispersion R1	0.72	Ok as soil dominated by sands		

Particle Size Analysis 0-10cm: Site 41

Coarse Sand%	Fine Sand%	Silt%	Clay%	Comment
18	65	8	11	Predominantly sand dominated by fine fraction which may compact into hard mass predisposing high runoff.

F.2.5.2 B4 Well Structured Scrub Soils

This classic black Brigalow soil unit occupies gently sloping Brigalow regrowth plains between drainage lines on the western side of the lease area. The soil is friable and soft underfoot and is a self-mulching black cracking clay. Nutrient levels are reasonable except phosphorus, which is low.

A high cation exchange capacity and absence of salinity / sodicity issues, ideal pH and particle size ranges and good overall fertility indicates an excellent scrub soil. The entire soil profile could be used in rehabilitation if required, although care should be taken to test for salt which may occur at depth. Accordingly, a 400 mm overall stripping depth is recommended due to the risk of saline / sodic subsoils being encountered at some sites. This well structured soil offers some erosion resistance, thus application on sloping sites in future rehabilitation areas is preferred.

Representative Site Description: B4

Surface Features: Site 178

Soil Type	B4
Concept Deep. Well structured scrub soils with soft granular mulch with Brigalow regrowth	
AMG Reference:	630032 mE 7561875 mN
Site No	178
Australian Soil Classification	Black Vertosol
Landform Element	Upper slope
Landform Pattern	RL 239 m. Gently undulating plains.
Slope %	1
Microrelief :	None.
Surface condition	Soft, granular mulch over cracking dark clay. Some lateritic gravel on mounds (< 5%).
Land Condition	Stable. Appears to have cropping potential. Extensive Brigalow regrowth.
Land Use	Being grazed by beef cattle
Major Vegetation Form and Type	Completely cleared with strong regrowth of Brigalow up to 1.5 m high. Strong cover of ragweed and buffel.
Samples for analysis	: 0-10, 40-50, 80-90 cm

Land Suitability Summary. Stocking rates recommended by Bourne & Tuck (1993) for cleared pasture as ha / adult equivalent beast (AE) for long term sustainability.	**Cropping –** Class 4 suitable for occasional cropping, significant moisture (climatic) limitation for sustainable cropping. Could be used for opportunistic forage or cropping. **Grazing -** Class 2 excellent grazing land (if Brigalow regrowth cleared and pasture established). Stocking rate - 5 ha/AE

Soil Profile: Site 178

Horizon	Depth	Description
Surface	0	Soft, friable Strong granular self mulching surface with carbonate nodules. Cracking with a few coarse fragments.
A1	0-5	Carbonate nodules, field pH 7.0, dark greyish brown 10YR4/2, Light medium clay, strong subangular blocky, firm, clear to;
B21	5-35	Strong subangular blocky structure, Carb. Nodules, pH 7.5, very dark greyish brown 10YR3/2, no mottles, well drained, light med clay.
B22	35-80	Strong subangular blocky, increasing carbonate nodules, field pH 8.0, Dark brown 10YR3/3, no mottles, medium heavy clay.
B23	80-120+	As for B22 except becoming lighter colour, Brown 10YR4/3.
Recommended Topsoil Strip Depth		40 cm
Preferred Rehabilitation Application		A quality black soil. However these soils are prone to droughting and are difficult to re-establish grasses and trees – except in very good seasons. Use on flat or gently sloping sites only as the soil may take several seasons to establish vegetation and re ripping and seeding may well be required. Place > 25 cm.

Major aspects of chemical analysis

Chemically this is an excellent soil. Very high cation exchange capacity combined with no saline / sodicity issues, ideal pH and particle size ranges and good overall fertility indicates an excellent scrub soil for this district. No major problems exist.

The entire soil profile could be used in mine site rehabilitation if required although care should be taken to test for salt which may occur at depth. Accordingly, a 300 mm overall tripping depth is recommended due to the risk of saline / sodic subsoils.

Chemical Analysis: Site 178

Analyte	0-10 cm	Comment	40-50 cm	Comment	80-90 cm	Comment
NO3-N ppm	13.6	Adequate				
P (Olsen) ppm	1	very low				
K meq/100g	1.93	Ok	1.41	ok	1.31	ok
Mg meq/100g	7.80	Ok	8.79	ok	10.00	ok
Ca meq/100g	34.66	Ok	55.65	ok	50.66	ok
S ppm	7	Ok				
Mn ppm	52.2	Ok				
B ppm	0.9	Ok				
Cu ppm	2.6	Ok				
Fe ppm	34	Ok				
Zn ppm	0.2	very low				
OM %	4.5					
CEC meq/100g	45.18	High	67.21	high	64.29	high
Ca/Mg ratio	4.44	very good	6.33	very good	5.07	very good
pH(H20)	7.5	Neutral	8.6		8.9	
EC dS/m	0.11	Low	0.15	low	0.15	low
Al meq/100g	0.18	Ok	0.07	ok	0.16	ok
Cl ppm	31	very low				
Na meq/100g	0.61	Low	1.29	low	2.16	low
ESP	1.3	very low	1.9	very low	3.4	very low
Dispersion R1	0.29	Low				

Particle Size Analysis 0-10cm: Site 178

Coarse Sand%	Fine Sand%	Silt%	Clay%	Comment
7	22	16	59	Good overall soil.

F.2.6 Attachment 1 – Site Description Summaries (Red Mountain Lease Only)

Note: this attachment provides site description summaries for the sampling sites within the Red Mountain Lease. Site description summaries for the sampling sites within the Poitrel Mine Lease are provided in the Poitrel EIS appendices.

Site	Soil	Easting	Northing	General Notes	Soil Profile
44	B5v	631357	7555619	Same as 43 but more upper slope position with small linear gilgai. Lot ragweed. Some Brigalow regrowth and Blackbutt to 15m high.	Black clay, mulching @ cracking. 0-35 6.0, MHC, 10YR3/2, strong SB structure, 35-90+ 7.5, MHC, increasing gravel, 10YR3/1.
45	B5v	631386	7555800	boundary back to Brigalow UF	
46	B5	631326	7556265	Cleared Brigalow @ Blackbutt	Brown UF soil in association with darker linear gilgai. Few surface coarse fragments. Site dug in non cracking uniform clay (inter gilgai soil). 0-35 SC, 6.0, reddish brown, mod SAB structure, no bleach, 5YR3/3, mod sub-ang blocky, no inclusions or gravel 25-90+ hard very hard angular blocky, SC, pH 7.0, some Mn nodules
47	B5v	631238	7556720	Ridge crest of mixed Brigalow remnants.	Non cracking uniform clay. 0-25 SC, 6.5, reddish brown, very hard angular blocky under this layer. 25-80+ hard SC 7.0
48	B5v	630969	7556665	Midslope of red / black linear gilgai complex. Old ragweed plentiful. Brigalow regrowth. Slope 1%.	Black clay. 0-40 6.0, SC, hard 10YR3/4, SB structure, 40-100 6.5, MHC, increasing gravel, 10YR3/2. 100+ weathered PM and increasing gravel.
49	B5v	630649	7556823	Area of sandy veneer wash over black clay, hard. Mixed Brigalow, Blackbutt, Currant Bush	Same as 48 other than sandy surface veneer
52	B5	631583	7557264	Brigalow	Black Brigalow soil all along fence line. Gilgai more pronounced here (20cm)
53	B5	631659	7557829	Whipstick Brigalow with Blackbutt.	Cracking black clay with strong granular mulch
54	B3	631621	7558532	Sample in railway cutting. Approx. 20% of surface is melanholes up to 60cm deep. Black soil starts 300m west of this site. Cleared Brigalow. Slope 0.5%. Some surface gravel with sandy crust.	Sandy UF 0-40 pH 6.0. 7.5YR4/4 moderate SM structure, SC, no bleach. 40-110 pH 6.5 7.5YR4/4 hard angular blocky, no mottles or inclusions. 110 - 180 pH 7.0 prominent grey mottles.
103	B5	629941	7561759	Undulating Brigalow quite dense regrowth .	Surface has no gilgai and forms soft granular mulch. Cracking clay. 0- 35 10YR4/3

Site	Soil	Easting	Northing	General Notes	Soil Profile
104	B5	630224	7561752	A classic black Brigalow scrub soil. The only real limitation to cropping (apart from climate) is a slope of up to 2% max.	Soft, friable self mulching surface with carbonate nodules. Cracking . Few coarse fragments. A1 0-5 Strong granular mulch. Carb. Nodules, pH 7.0, 10YR4/2, light med clay. B21 5-35 Strong subangular blocky structure, Carb. Nodules, pH 7.5, 10YR4/2, light med clay. B22 35-80 strong subangular blocky, carb nodules, pH 8.0, 10YR3/3, med heavy clay. B23 80-120+ as for B22 but colour becoming lighter 10YR4/3.
107	B5	630240	7561211	Thick Brigalow regrowth. Slope 0%.	No surface fragments, mulching grey clay, cracking in places.
108	A2	630735	7561223	Tall Blackbutt and associated Brigalow	
109	B2	629886	7560606	Broad low ridge of red soil. Mixed Brigalow, Blackbutt very good buffel.	Red gradational with gravel layer.. 0-10 sandy clay loam, weak structure, pH 6.0, 2.5YR4/4, 10-20 gravel layer 20-80+ light clay, red - 2.5YR4/8, pH 7.0, well drained, no inclusions.
122	B3	631301	7559110	Thick Brigalow regrowth. Flat. Slight gilgai	
123	B3	631415	7559704	Cleared Brigalow	Grey Brigalow clay. Non cracking with firm sandy crusting surface. 0-30 pH 6.5. 10YR4/3 SB structure, SC, no bleach. 30-100+ pH 6.5 10YR5/4 hard angular blocky, no mottles.
124	B3	631080	7559650	As for 123. Slightly more gilgai here.	Brown N/C clay.
125	B3	631375	7560210	Same as 124 but less gilgai here	
126	A2	631382	7560806	Cleared Brigalow 100m from mixed scrub to west.	
127	A2	630804	7560630	Tall open Blackbutt	Duplex
128	B3	631126	7560454	Brigalow regrowth with no gilgai	Non cracking with firm sandy crusting surface. About 10% mixed gravels rounded. 0-35 pH 6.0. 10YR4/3 SB structure, SC, no bleach. 35-90+ pH 7.0 10YR5/4 hard angular blocky, few grey/yellow mottles, no inclusions or gravel.
129	B3	630872	7560131	Edge of Brigalow. Poplar Box regrowth 100m to west.	
130	A2	630660	7559280	Moreton Bay Ash and other mixed scrub	Texture contrast

Site	Soil	Easting	Northing	General Notes	Soil Profile
178	B5	630032	7561875	Undulating plain up to 1% slope with thick Brigalow regrowth approx 1 m high. No surface stone and cracking.	Soft, friable self mulching surface with carbonate nodules. Cracking. Few coarse fragments. A1 0-5 Strong granular mulch. Carb. Nodules, pH 7.0, 10YR4/2, light med clay. B21 5-35 Strong subangular blocky structure, Carb. Nodules, pH 7.5, 10YR4/2, light med clay. B22 35-80 strong subangular blocky, carb nodules, pH 8.0, 10YR3/3, med heavy clay. B23 80-120+ as for B22 except 10YR4/3.
198	B3	631800	7561700	Brigalow regrowth	Slight gilgai. Non cracking clay
201	B3	631486	7559526	Brigalow scrub	
202	B3	631605	7558758	Brigalow	melanholes
203	B3	631998	7558052	Brigalow	No melanholes
204	B3	632190	7557500	Standing Brigalow. No gilgai here. Uniform non cracking clay	0-35 10YR5/4, pH 7.0, no gravel, mod SB structure, no inclusions. . 35-100+ 10YR4/3, Med clay, mod SB structure, carbonate & Mn nodules increasing, some mottles pH 8.5,

BHP Billiton Mitsubishi Alliance

F.2.7 Attachment 2 – Analytical Data and Methods

ESSA ENVIRONMENTAL						
5 Dunphy St						
Sunnybank Hills Q 4343			Reference Number:		04-02000-01	
			Sample Status:		Dried at 400C	
					Sieved 2mm	
			Date Received:		15/8/2004	
			Date Completed:		22/8/2004	
NA denotes "not applicable"			Printed:		22/8/2004	
IS denotes "insufficient sample"						
MS denotes "missing sample"					Pg 2 of 3	
<LOQ denotes "below limit of quantitation"						
Sample ID	**Lab No.**	**Coarse Sand**	**Fine Sand**	**Silt**	**Clay**	**R1**
		%	%	%	%	
Site 1 (0-10cm)	04/02000	24	39	12	28	0.58
Site 5 (0-10cm)	04/02001	17	28	12	46	0.28
Site 9 (0-10cm)	04/02002	11	30	29	34	0.46
Site 11 (0-10cm)	04/02003	33	37	15	19	0.77
Site 18 (0-10cm)	04/02004	12	28	20	44	0.33
Site 24 (0-10cm)	04/02005	8	22	21	53	0.45
Site 35 (0-10cm)	04/02006	51	41	3	5	0.84
Site 39 (0-10cm)	04/02007	9	75	11	9	0.71
Site 41 (0-10cm)	04/02008	18	65	8	11	0.72
Site 43 (0-10cm)	04/02009	12	30	16	46	0.39
Site 90 (0-10cm)	04/02010	12	54	10	26	0.52
Site 178 (0-10cm)	04/02011	7	22	16	59	0.29
All results for particle size analysis are reported on oven-dried basis (no pre-treatment applied to test samples)						

ESSA ENVIRONMENTAL **Methods used to Analyse Samples**			**SOIL REPORT - FINAL**			
Analyte	**Method**	**Reference**	**Uncertainty %**	**LOQ**	**Unit**	**Name**
Coarse Sand	SOIL-03	# AS 1289.C6.3	13.0	1.0	%	Particle size, coarse sand
Fine Sand	SOIL-03	# AS 1289.C6.3	13.6	1.0	%	Particle size, fine sand
Silt	SOIL-03	# AS 1289.C6.3	23.9	1.0	%	Particle size, silt
Clay	SOIL-03	# AS 1289.C6.3	7.0	1.0	%	Particle size, clay

Mechanical/chemical dispersion & hydrometer:sieve gravimetric (no pre-treatment of test samples)

Modification of AS 1289.C6.3-1977 "Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer".

Note: The test method used to obtain results in this report did not include pre-treatment of samples for the determination of particle size analysis.

Quality Control		**Check Soil No. B**	
		Actual Value	**Acceptance Criteria [Range]**
Coarse Sand	%	2.6	1.4 - 2.8
Fine Sand	%	18	13 - 18
Silt	%	26	20 - 26
Clay	%	59	55 - 60
R1		0.2	0.18 - 0.28