MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS PROJECT

Assessment of Biophysical Strategic Agricultural Land (BSAL)

LAMAC Management, October 2015

Document Control

Document Title	Marulan South Limestone Mine Continued Operations Project – BSAL Assessment
General Description	Assessment of Project site against BSAL verification criteria

Rev No	Date	Description	By	Checked
0	06 September 2015	Draft	L.Crawford	N.Hattingh
1	10 October 2015	Final	L.Crawford	D.McKenzie

TABLE OF CONTENTS

1. Introduction

The Marulan South Limestone Mine (the mine) is an existing open cut mining operation situated in Marulan South, 10 km southeast of Marulan village and 35 km east of Goulburn, within the Goulburn Mulwaree Local Government Area in the Southern Tablelands of NSW.

Limestone mining and lime manufacturing has occurred on the site since 1875, with the current mine having been in continuous operation since 1953. The mine has produced up to 3.38 million tonnes of limestone and lime-based products per year for the cement, steel, agricultural, construction and commercial markets. The mine is owned and operated by Boral Cement Limited (BCL).

The mine currently operates under Consolidated Mining Lease (CML) 16, Environment Protection Licence 944, a combination of development consents issued by Goulburn Mulwaree Council and continuing use rights. BCL is seeking approval for continued operations at the site through a development application for a State Significant Development (SSD) including a 30 year mine plan, associated overburden emplacement areas and a mine water supply dam (hereafter referred to as 'the Project').

LAMAC Management Pty Ltd has been engaged by BCL to undertake a soils, land and rehabilitation assessment, as part of the SSD approval process. A component of the SSD approval process is the completion of a Biophysical Strategic Agricultural Land (BSAL) verification assessment in support of a Site Verification Certificate (SVC) application for the Project area.

This BSAL assessment report has been prepared in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (NSW Government 2013) (interim protocol).

1.1. Project Area

The mine is located in a rural area bordered by extractive industry (Peppertree Quarry) to the north, Bungonia National Park and State Conservation Area to the South, Morton National Park to the East and an agricultural lime facility, fireworks storage facility and Turkey farm to the west.

The mine is situated on the edge of a plateau, approximately 560 m above the deeply incised Shoalhaven River. The terrain bordering the mine to the east and south-west is very steep with limited accessibility, characteristic of limestone environments. The land to the west and north-west of the mine (on which the BSAL assessment area is largely situated) consists of flat to undulating plateau landforms.

Local tributary gullies drain the Project area in an easterly and southerly direction to Barbers and Bungonia Creeks, which discharge into the Shoalhaven River further to the east.

The BSAL assessment area is described in greater detail in Section 3.1.

1.2. BSAL Process

The NSW government introduced a *Gateway Process* in 2013 to protect high value agricultural land from potential mining development impacts. The Gateway Process requires BSAL to be identified, and potential impacts assessed, before a development application can be lodged for mining and petroleum projects.

Under the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment (Resource Significance) 2013* (Mining SEPP amendment), the Gateway process applies to the following State Significant Development located wholly or partially on BSAL:

- State significant mining development that requires a new mining lease;
- Extraction of a bulk sample of more than 20,000 tonnes of coal or any mineral ore (ie. State significant mining exploration activity);
- State significant petroleum development that requires a new petroleum production lease;
- State significant petroleum exploration activity;
- Excluding any associated development, such as linear infrastructure, outside the area of a proposed mining or production lease.

The NSW government has mapped BSAL at a regional scale to assist with preliminary identification of BSAL during project planning. Regardless of whether a project area has been regionally mapped as BSAL or not, project proponents may apply for a SVC, which certifies that a project area does not meet BSAL criteria and is, therefore, exempt from the Gateway process. Applications for SVC must be accompanied by a BSAL assessment report completed in accordance with the interim protocol.

Under clause 17A of the Mining SEPP amendment, only those parts of a project area requiring a new mining lease (under the *Mining Act 1992*) are subject to the Gateway Process. Project development on existing mining leases, or on land not proposed for a mining lease, is not subject to, BSAL assessment or the Gateway Process.

2. Method

This assessment followed the initial steps outlined in Section 5 of the interim protocol to verify the presence of BSAL. These steps consisted of:

Step 1: Identify the project area which will be assessed for BSAL;
Step 2: Confirm access to a reliable water supply;
Step 3: Choose the appropriate approach to map the soils information; and
Step 4: Risk Assess the project area with respect to the proposed development.

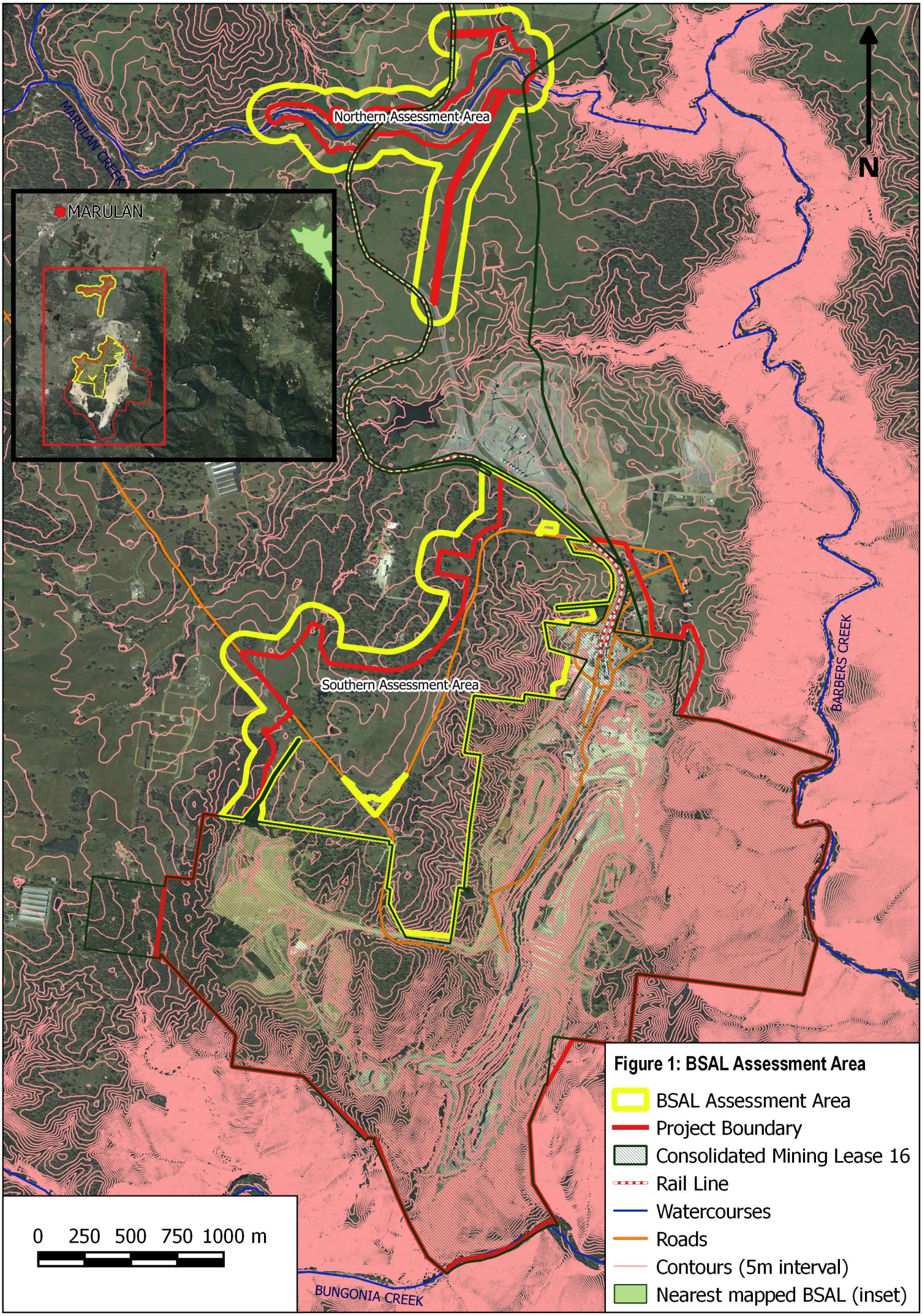
The methods used to complete these steps are presented in the following sections.

2.1. Assessment Area Definition

For the purposes of this BSAL assessment, the Project has been separated into two areas, referred to as the *Northern assessment area* and *Southern assessment area*, and are shown on Figure 1.

The Northern assessment area includes a proposed water supply dam for the Project on Marulan Creek, approximately 3km north of the mine. The Northern assessment area is defined by the likely maximum inundation level, and possible surface disturbance area resulting from the construction of the dam, including two proposed haul roads to facilitate construction access. The interim protocol also requires a 100m buffer zone around the proposed Project area to be included in the BSAL assessment area. Including this 100m buffer zone, the Northern assessment area is 94 ha.

The Southern assessment area includes land within the proposed Project boundary for the continued open cut mine operations, but excluding land within CML 16 and other areas subject to historic disturbance. The Southern assessment area was delineated by the maximum proposed surface disturbance footprint required for continued operations of the mine including expansion of the open cut pit, out of pit overburden emplacement and the construction or realignment of associated infrastructure such as Marulan South Road. Including the 100m buffer zone, the Southern assessment area is 226 ha. Therefore the total BSAL assessment area is 320 ha. The 100m buffer zone to the Project boundary required under the interim protocol represents 102 ha, or 32% of the total assessment area.


Northern Assessment Area
Southern Assessment Area
MARULAN CREEK
MARULAN
BARBERS CREEK
BUNGONIA CREEK
N
0 250 500 750 1000 m
Figure 1: BSAL Assessment Area
BSAL Assessment Area
Project Boundary
Consolidated Mining Lease 16
Rail Line
Watercourses
Roads
Contours (5m interval)
Nearest mapped BSAL (inset)

2.2. Access to Water

The interim protocol requires a property to have a reliable water supply to be classified as BSAL land.

Rainfall records are available from the Bureau of Meteorology Station at Marulan (George St) (Station 70063), located approximately 6km to the northwest of the Project Area. Rainfall data from this station indicates Annual Mean Rainfall of 709mm for the period July 1894 to May 2015. This meets the BSAL criteria for reliable water supply of rainfall of 350mm or more per annum (9 out of 10 years).

2.3. Assessment Approach

The BSAL assessment areas are situated on land owned by Boral and access was possible to both areas. Therefore, soils and landscape were assessed against BSAL verification criteria using on-site assessment.

2.4. Risk assessment

A risk assessment was completed to identify potential impact on agricultural/land resources and determine the appropriate scale of investigation. The methodology for the risk assessment followed the process outlined in the *Guideline for Agricultural Impact Statements at the Exploration Stage* (DTIRIS, 2012). This process assesses risk based on the probability of impact occurring, and the expected consequence of that impact. The interim protocol indicates that soil sampling densities can range between:

- 1 site per 25 – 400 ha for low risk; and
- 1 site per 5 – 25 ha for high risk.

Determination of appropriate investigation scale, based on risk assessment outcomes, is outlined below. Detailed risk assessment results are presented in Appendix 1.

Northern Assessment Area

Of the 94 ha investigated in the Northern assessment area, 18 ha is predicted to be impacted by the Project. This includes approximately 10 ha of inundation (at maximum dam capacity as defined by the 598m AHD contour) and up to 8 ha of disturbance related to dam construction. This 18 ha was assessed as being moderate to high risk of impact to agricultural resources. The remaining 76 ha of land within the Northern assessment area, was assessed as having a low risk of impact as it is located outside of the Project disturbance footprint. A survey density of 1 detailed site per 30 ha, with the priority of effort being centred on the high risk zone, was selected for the Northern assessment area.

Southern Assessment Area

Of the 226 ha investigated in the Southern assessment area, approximately 169 ha is predicted to be impacted by the Project. This includes approximately 164 ha of overburden emplacement and approximately 5 ha in the construction or realignment of roads and the development of the Road Sales Stockpile Area. This 169 ha is assessed as being a high risk of impact to agricultural resources. The remaining 57 ha of land within the Southern assessment area was assessed as having a low risk of impact as it is located outside of the Project disturbance footprint. An investigation density of approximately 1 detailed site per 20 ha was selected for the Southern assessment area.

2.5. Soils and Landscape Assessment

Following the completion of the four initial BSAL verification steps, an investigation of the assessment areas was undertaken to identify and map soil types, and compare soil and landscape properties with the BSAL verification criteria presented in the interim protocol. The assessment consisted of two main components: the preliminary assessment and the field assessment.

The soil and landscape assessment was completed in accordance with the requirements of the interim protocol, and following the methodology presented in Part 5 of *Guidelines for Surveying Soil and Land Resources* (McKenzie *et al*. 2008). Soil and landscape attributes were characterised using the terminology described in the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain 2009), and soil profiles were classified according to the *Australian Soil Classification* (Isbell 2002) (ASC).

2.5.1. Personnel

The planning and assessment work for this BSAL investigation was undertaken by Lachlan Crawford of LAMAC Management. Lachlan is an environmental consultant with 20 years' experience in land resource management and disturbed land rehabilitation, including numerous soil and land resource assessments for mining projects in NSW and QLD.

David McKenzie (Certified Professional Soil Scientist, Stage 3, Soil Science Australia and 'CPSS Competent in Australian Soil Survey') was engaged to audit the approach, quality and accuracy of the work completed as part of the BSAL assessment.

2.5.2. Preliminary Assessment

Before commencing the field assessment, a preliminary assessment was undertaken to produce a preliminary soil and landscape map. This assessment involved the following sources of information.

- Surface Geology Mapping (online Atlas of NSW, NSW Land & Property Information);
- Regional BSAL mapping (NSW Government 2014);
- Land and Soil Capability mapping (Office of Environment and Heritage 2013);
- Soils and landscape information contained in BCL documents;
- Aerial photography and LIDAR imagery provided by BCL; and
- Soil profile and landscape information contained in the Soil and Land Information System (SALIS), accessed via eSPADE spatial viewer.

No detailed soil mapping covers the assessment area; however, *Soil Landscapes of the Goulburn 1:250 000 sheet* (Hird, 1991) maps soil landscape units to within 800 m of the western boundary of the assessment area and was referenced for background information.

During the preliminary assessment, land within the assessment area of slope greater than 10 percent was identified using Light Detection and Ranging (LIDAR) imagery provided by BCL. Detail on the slope analysis methodology is provided in Appendix 2.

Provisional site locations for soil investigation were allocated during the preliminary assessment, based on the information discussed above.

2.5.3. Field Assessment

2.5.3.1. Reconnaissance Inspection

An inspection of the assessment areas was undertaken on the 7 April 2015 to finalise and mark out the soil investigation site locations selected during the preliminary assessment. Likely exclusion areas were identified during this inspection, based on the BSAL criteria relating to rock outcropping, surface rock fragments and gilgai presence.

2.5.3.2. Test Pits

Thirteen test pits (Sites 1 to 14, excluding Site 10) were excavated to 1.4m, or until refusal on weathered bedrock, to facilitate detailed soil profile description. Test pit locations were selected to provide even and representative coverage of the assessment areas, according to the selected investigation densities discussed in Section 2.4.

The proposed Site 10 was not investigated, as it was located within the existing CML 16 boundary.

Landscape features surrounding each test pit were photographed and described including:

- Site identification and location;
- Excavation method and depth;
- Landuse and vegetation cover;
- Slope gradient;
- Microrelief; and
- Rock outcropping.

Soil profiles were photographed and sampled, with soil profiles being described in accordance with the requirements of the interim protocol. The following soil profile attributes were recorded for each location.

- Horizon identification and lower boundary depth;
- Horizon boundary distinctiveness;
- Horizon colour and mottling;
- Field texture;
- Soil structure/ pedality;
- Field pH (using Raupach test kit);
- Soil moisture and drainage conditions;
- Coarse fragments and segregations;
- Root presence;
- Dispersion and slaking in deionised water; and
- Lower horizon carbonate presence (effervescence with 1M HCL).

Several test pits had been hand-excavated to the upper boundary of the B horizon as part of an archaeological assessment being undertaken across the Project area. Several of these pits were inspected during the field assessment, with near surface soil horizons being assessed. As these pits were only 30 cm deep, they did not meet interim protocol requirements for check sites, and are not designated as such. However, these archaeological test pits (ATP) were used, along with other surface observations (such as road, creek and erosion cuttings) to assist with delineation of soil unit boundaries. Test Pits ATP 18 and ATP 38, in particular, were used to confirm soil type

along the proposed Marulan Creek Dam southern construction access road. Photographs of ATP 18 and 38 are included in Appendix 3, with locations shown on Figure 3.

2.5.3.3. Laboratory Analysis

Sixty-three soil samples were collected from test pit horizons and sent for analysis to the NATA (National Association of Testing Authorities) registered NSW Soil Conservation Service Laboratory, Scone NSW.

Samples were typically collected from depth intervals 0-5cm; 5-15cm; 15-30cm; 30-60cm; and, 60-100cm. However, minor variations in sampling interval depths did occur to ensure samples did not cross horizon boundaries.

Samples were analysed for:

- Soil pH (1:5 soil:water or 1:5 soil:$CaCl_2$);
- Electrical conductivity (EC 1:5, and calculation of ECe);
- Cation Exchange Capacity (CEC);
- Exchangeable cations for calculation of exchangeable sodium percentage (ESP) and Ca:Mg ratio; and
- Seven samples that indicated moderate to high dispersion in field testing were also tested for EAT including:
    - Site 1: 30-60 cm;
    - Site 4: 30-48 cm;
    - Site 6: 9-15 cm;
    - Site 7: 32-60 cm;
    - Site 8: 8-15 cm;
    - Site 8: 15-30 cm; and
    - Site 14: 15-30 cm.

Tabulated analytical results are included in Appendix 4, and the laboratory analysis report is included as Appendix 5.

2.5.3.4. Mapping and BSAL Verification

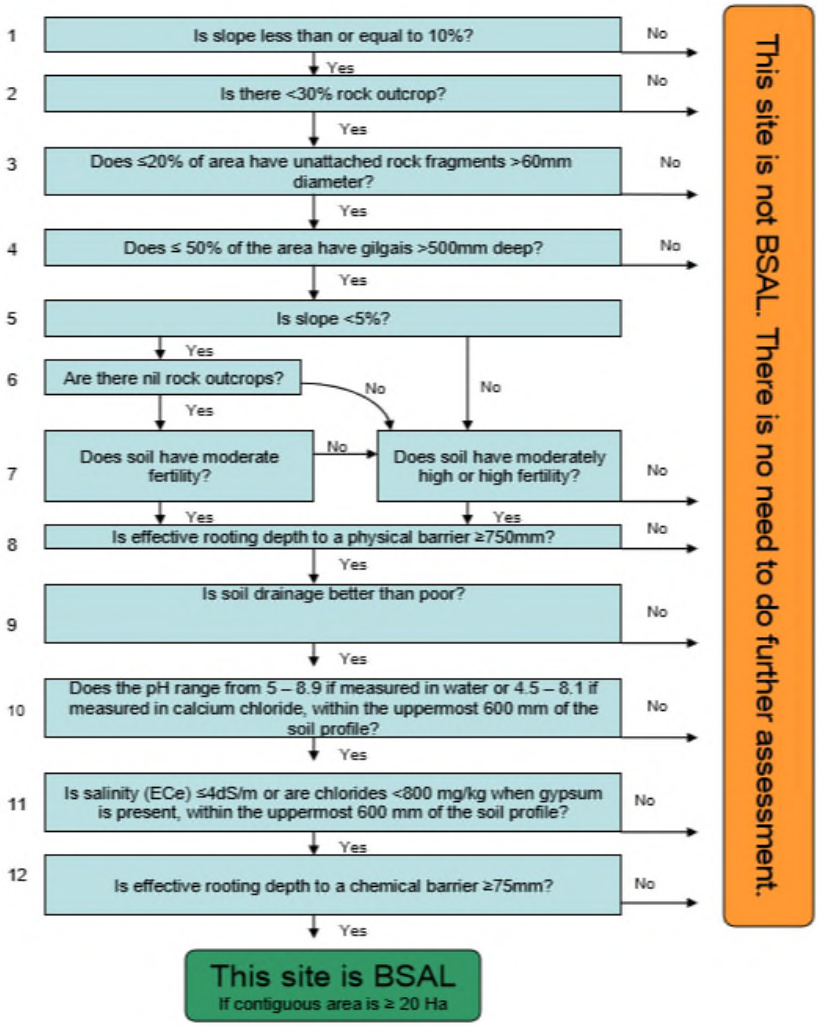
The interim protocol presents ten criteria for verifying the presence of BSAL, as shown in Figure 2, with the minimum area for BSAL being 20 ha. If soils or landform (of area > 20 ha) does not meet any one of these criteria, it is not considered BSAL.

Exclusion mapping based on the first criterion (land gradient > 10% slope) was undertaken during the preliminary assessment, and potential for exclusion due to criteria 2 to 4 (rock outcrop, surface rock fragments and gilgai) was assessed during the field assessment.

Soil profile and landscape attributes recorded during the field assessment were used to:

a) Classify soil type, using the ASC, to Family level;
b) Map soil types within the assessment areas; and
c) Compare soil and landscape attributes against BSAL verification criteria.

Figure 2: Twelve criteria presented in interim protocol to verify presence of BSAL.



3. Assessment Results

3.1. Preliminary Assessment

The following background information on soils and landscape within the assessment areas was noted during the preliminary assessment from the sources outlined in Section 2.5.2.

3.1.1. Geology

The Northern assessment area overlies the Glenrock Granodiorite intrusion. The majority of the Southern assessment area overlies a Silurian-Devonian geology unit known as the Bungonia Limestone formation, consisting of interbedded fossiliferous shale, sandstone, limestone and siltstone. Weathered granodiorite bedrock was also encountered in the far south and east of the Southern assessment area.

3.1.2. Landscape

Land and Soil Capability mapping (OEH 2013) indicates that the flat to undulating plateau that comprises the majority of the Northern and Southern assessment areas is considered *Class V: Severe Limitations - land not capable of sustaining high impact landuses without special management*. The eastern margins of the Southern assessment area, consisting of moderately steep upper slopes, are mapped as *Class VII: Extremely severe limitations – land incapable of sustaining most landuses*. The far eastern corner of the Northern assessment area, consisting of extremely steep and rocky upper slopes is mapped as *Class VIII: Extreme limitations – land incapable of sustaining any landuses*.

Slope exclusion mapping, derived from aerial photography and LIDAR imagery and prepared in accordance with the methodology presented in Appendix 2, indicates that approximately 6.9 ha (7%) of the Northern assessment area has a slope gradient greater than 10 percent. Approximately 37.7 ha (17%) of the Southern assessment area has a slope gradient greater than 10 percent. This slope exclusion mapping is presented in Figures 3 and 4.

3.1.3. Soils

A review of the background soils information listed in Section 2.5.2 indicates that texture contrast soils are dominant within the BSAL assessment area. An assessment of topsoil suitability for use in post-mine rehabilitation identified the dominant soil types in the south and east of the Southern assessment area as Yellow Duplex and Red Duplex soils (GSS Environmental, 2010).

Regional mapping of ASC soil types (accessed via eSPADE) within the BSAL assessment area identifies the following soil landscape associations:

- Kurosols, natric – lower slopes, flats and drainage depressions within the Southern assessment area;
- Sodosols – mid-slopes, upper-slopes and crests within the Northern and Southern assessment areas; and
- Rudosols/Tenosols – steep slopes in east margins of the Southern assessment area.

The SALIS database (accessed via eSPADE) identified two recorded soil profiles in the vicinity of the assessment areas. Although neither of these eSPADE soil profiles included laboratory analyses, they did include detailed descriptions. The profiles included:

Location	***ASC Classification***
50m east of northeast boundary of Southern assessment area	Brown Chromosol, - Haplic, thin, slightly gravelly, loamy, clayey, deep
350m northwest of western boundary of Southern assessment area	Brown Sodosol, -, -, thin, non-gravelly, loamy, clayey, deep

3.1.4. Mapped BSAL and Critical Industry Clusters

The 2014 BSAL mapping of NSW indicates that the nearest mapped BSAL is approximately 7.5 km to the northeast of the assessment areas. The nearest mapped BSAL land is shown on Figure 1.

Critical Industry Clusters (CIC) are concentrations of highly productive agricultural industries located within the NSW Upper Hunter, such as the equine (horse) and viticulture (wine) industries. The NSW government has mapped CIC, and potential Project impacts on CIC are assessed as part of the Gateway Process.

As CIC mapping covers only the NSW Hunter Valley, approximately 300km north of the assessment areas, mapped CIC are of no relevance to this assessment.

3.2. Field Assessment

Soil profiles at each of the 13 sites were classified according to the ASC, to Family level. Soil attributes observed during field assessment are presented in Appendix 4. The soil types identified are shown in Table 1, to Subgroup level. From these soil classifications, three soil units were identified within the assessment areas, consisting of:

- 87 ha (Northern assessment area) and 138 ha (Southern assessment area) of Brown/Red Sodosols (dominant)/ Brown Chromosol (minor) associated with mid to upper slopes across both the Northern and Southern assessment areas;
- 38.6 ha of Brown-Orthic/ Bleached-Orthic Tenosols associated with the crests and steep eastern slopes of the ridgeline in the south and east of the Southern assessment area; and
- A minor area (12.5 ha) of Brown Kurosol associated with the lower slopes, flats and depressions in the central part of the Southern assessment area.

Based on assessment of archaeological test pits ATP 18 and 38, which were exposed as deep as the upper boundary of the B horizon, soils along the proposed Marulan Creek Dam, southern construction access road within the Northern assessment area were identified as texture contrast soils, consistent with the Red Sodosols observed at nearby Site 01. On this basis, the Brown/Red Sodosol soil unit extended across the entire Northern assessment area.

The typical attributes of these soil units are described in Section 3.5, with mapped soil units shown on Figure 3.

Soil profile descriptions have been submitted via the eDIRT online data entry portal for inclusion in the SALIS database. Acknowledgements of successful submission of soil profiles are included in Appendix 6. These soil profiles will be available for viewing on the eSPADE online access.

3.3. BSAL Presence

The soil and landscape attributes of each site were compared against the BSAL verification criteria presented in the interim protocol. As indicated in Table 1, none of the 13 sites met all the BSAL criteria. Limiting factors for each soil landscape unit are discussed in Section 3.4 and major limiting factors for BSAL are shown in Figure 4.

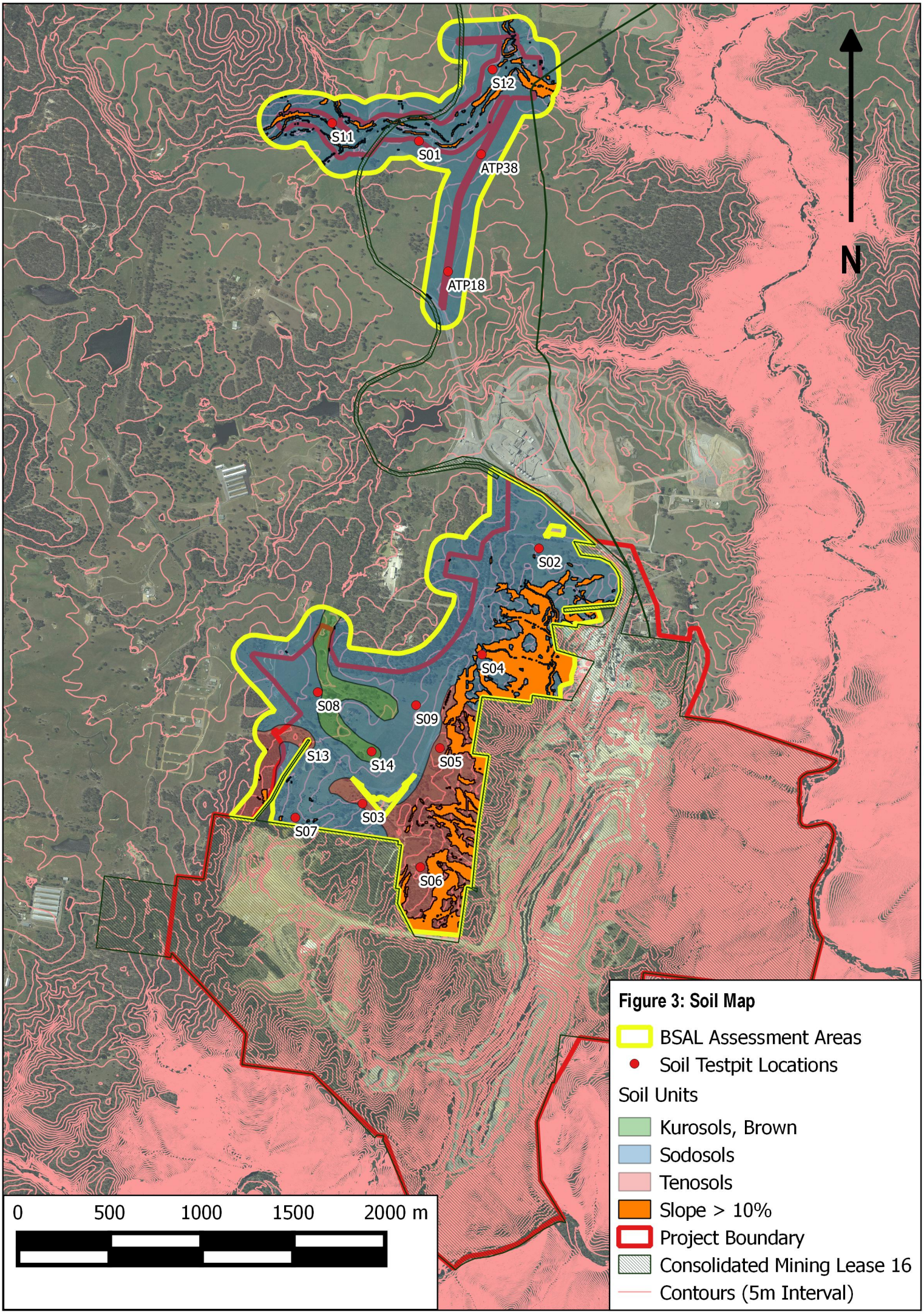
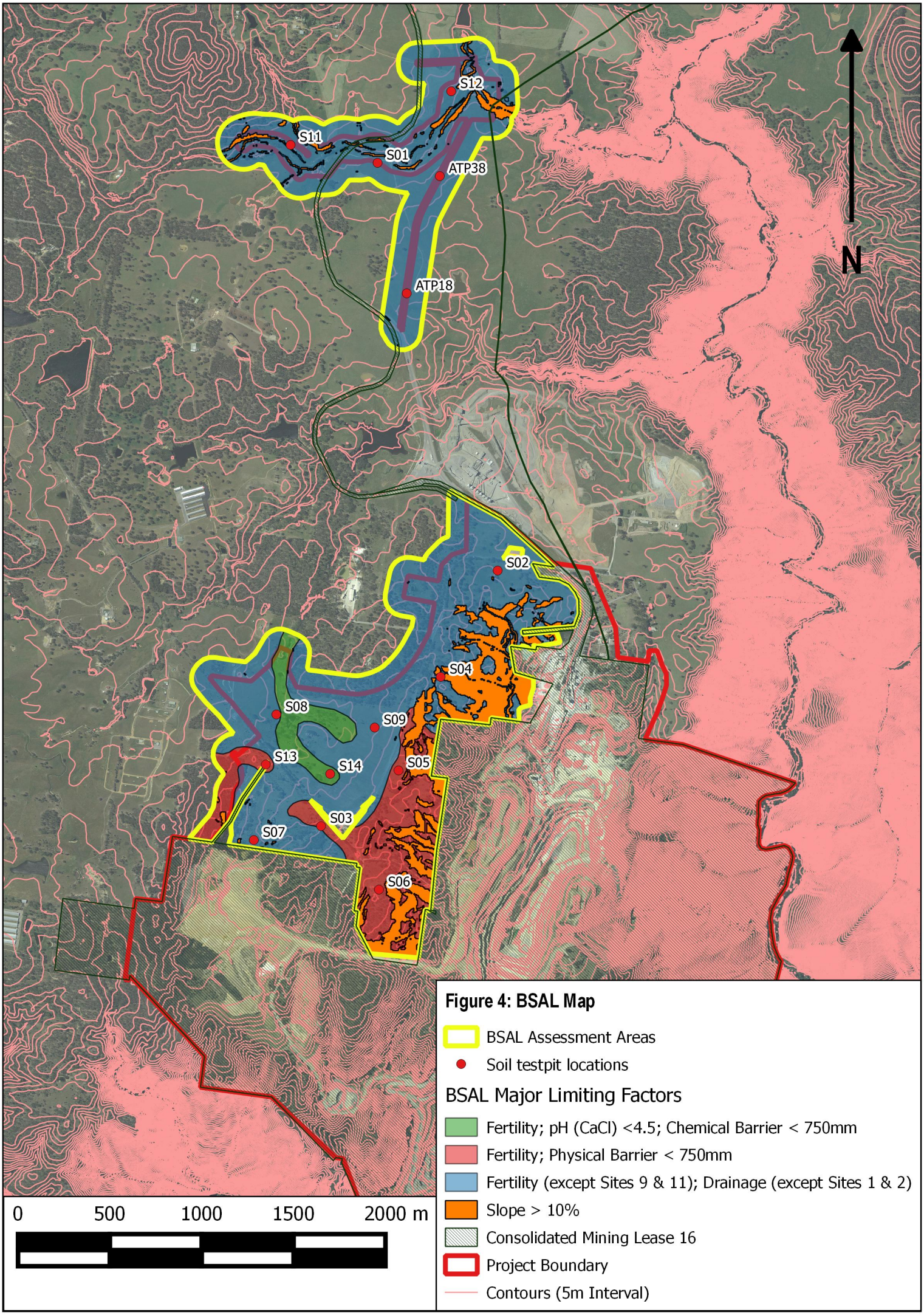

S12
S11
S01
ATP38
ATP18
N
S02
S04
S08
S09
S13
S14
S05
S03
S07
S06
0
500
1000
1500
2000 m
Figure 3: Soil Map
BSAL Assessment Areas
Soil Testpit Locations
Soil Units
Kurosols, Brown
Sodosols
Tenosols
Slope > 10%
Project Boundary
Consolidated Mining Lease 16
Contours (5m Interval)

Table 1: BSAL Verification Summary

Site Number	Inspection Site Type	Australian Soil Classification (to ASC Family)					1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgais >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does Soil Have Moderate fertility?	7b. Does soil have Moderately High or High fertility?	8. Is effective rooting depth to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH (CaCl2) between 4.5 and 8.1 in upper most 600mm?	11. Is salinity (ECe) < 4 dS/m in uper most 600mm?	12. Is effective rooting depth to a chemical barrier >750mm?	Is the Site BSAL?
		Subgroup	Great Group	Suborder	Order	Family														
1	Detailed	Eutrophic	Subnatric	Red	Sodosol	Medium, non-gravelly, loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No
2	Detailed	Eutrophic	Mottled-Subnatric	Brown	Sodosol	Medium, non-gravelly, loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No
3	Detailed	Basic	Ferric	Bleached-Orthic	Tenosols	Medium, non-gravelly, loamy, clay loamy, shallow	Yes	Yes	Yes	Yes	Yes	Yes	No	No	50% Fe nodule layer at 30-41cm	Red mottle 30% & distinct	No	Yes	pH 4.3 at 41-60cm	No
4	Detailed	Eutrophic	Mottled-Subnatric	Brown	Sodosols	Medium, non-gravelly, loamy, clayey, shallow	Yes	Yes	Yes	Yes	No	N/A	N/A	No	Yes	Grey mottle 30% & distinct	No	Yes	pH 4.4 at 30-48cm	No
5	Detailed	Basic	Paralithic	Brown-Orthic	Tenosol	Thick, slightly gravelly, loamy, clayey, shallow	Yes	Yes	Yes	Yes	Yes	Yes	No	No	50% weath sandstone at 60cm	Yes	Yes	Yes	Yes	No
6	Detailed	Basic	Paralithic	Bleached-Orthic	Tenosol	Medium, slightly gravelly, loamy, clayey, shallow	Yes	Yes	Yes	Yes	Yes	Yes	No	No	60% weath granite at 60cm	Grey mottle 30% & distinct	Yes	Yes	Yes	No
7	Detailed	Magnesic	Mottled-Subnatric	Red	Sodosol	Thick, non-gravelly, loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Y.br. mottle 20% & distinct	Yes	Yes	Ca:Mg ratio < 0.1 at 60cm	No
8	Detailed	Eutrophic	Mottled-Subnatric	Brown	Sodosol	Medium, non-gravelly, loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	R.Br. mottle 40% & distinct	Yes	Yes	Yes	No
9	Detailed	Bleached-Mottled	Mesotrophic	Brown	Chromosol	Thick, non-gravelly, loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Red mottle 40% & distinct	Yes	Yes	Ca:Mg ratio < 0.1 at 60cm; pH 4.3	No
11	Detailed	Mottled-Sodic	Eutrophic	Brown	Chromosol	Medium, non-gravelly, clay loamy, clayey, deep	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Grey mottle 50% & distinct	Yes	Yes	Yes	No
12	Detailed	Eutrophic	Mottled-Subnatric	Brown	Sodosol	Thick, non-gravelly, loamy, clayey, deep	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Grey mottle 20% & distinct	Yes	Yes	Yes	No
13	Detailed	Basic	Paralithic	Brown-Orthic	Tenosol	Medium, slightly gravelly, clay loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	No	No	70% weath granite at 70cm	Yes	Yes	Yes	Yes	No
14	Detailed	Bleached-Sodic	Mesotrophic	Brown	Kurosol	Thick, non-gravelly, loamy, clayey, moderate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	pH 4.4 at 45-60cm	No

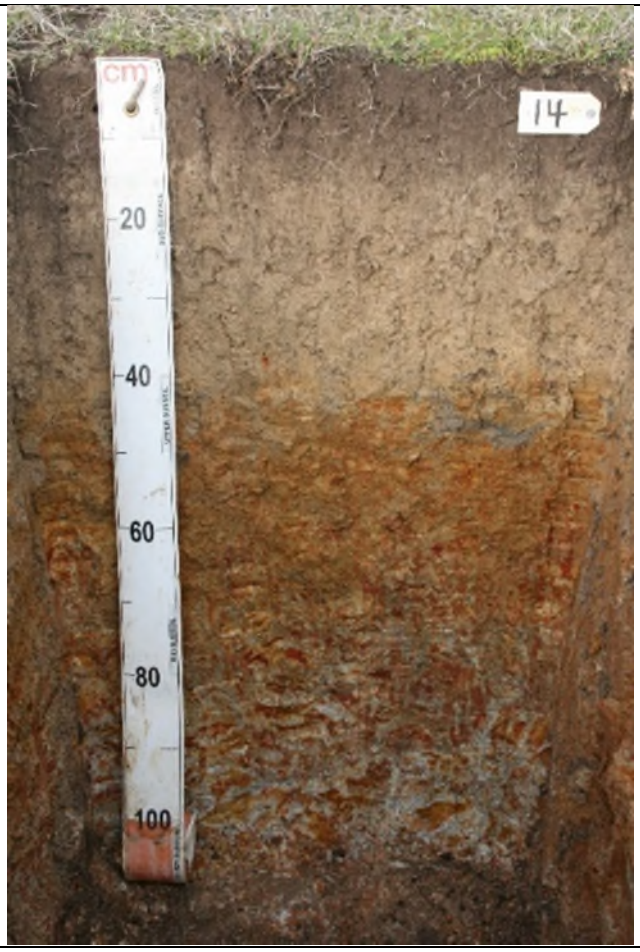

S12
S11
S01
ATP38
ATP18
S02
S04
S08
S09
S13
S14
S05
S03
S07
S06
N
0
500
1000
1500
2000 m
Figure 4: BSAL Map
BSAL Assessment Areas
Soil testpit locations
BSAL Major Limiting Factors
Fertility; pH (CaCl) <4.5; Chemical Barrier < 750mm
Fertility; Physical Barrier < 750mm
Fertility (except Sites 9 & 11); Drainage (except Sites 1 & 2)
Slope > 10%
Consolidated Mining Lease 16
Project Boundary
Contours (5m Interval)

3.4. Soil Units Identified in Assessment Area

<table>
<tr><td colspan="3">Soil Unit: Sodosol, Red/ Brown</td></tr>
<tr><td>Representative Dominant Sites:</td><td>1 & 7 (Red)
2, 4, 8and 12(Brown)</td><td rowspan="5"> 
</td></tr>
<tr><td>Minor Sites</td><td>9 & 11 (Brown Chromosol)</td></tr>
<tr><td rowspan="4">Typical Soil Profile</td><td>A1: 0-11 – Very dark grey loam, very weak angular-blocky, rough-faced, peds 30-40mm, moist, nil gravel</td></tr>
<tr><td>A2: 11-21 – Yellowish brown, sandy loam, weak polyhedral, rough faced peds, 20-40mm, moist, nil gravel</td></tr>
<tr><td>B2: 21-95 – Light olive brown heavy clay, apedal massive, moist, increasing weathered bedrock fragments</td></tr>
<tr><td>B/C: 95- >140 – weathered bedrock</td><td>Soil Profile Site: 2 (Brown Sodosol)</td></tr>
<tr><td>Roots:</td><td>Fine, few to 44cm</td><td rowspan="4">  </td></tr>
<tr><td>Landscape Association:</td><td>Mid to upper slopes</td></tr>
<tr><td>Landuse:</td><td>Low density sheep grazing</td></tr>
<tr><td colspan="2" rowspan="2">BSAL Status and limiting factors:
Not BSAL.
Fertility Moderately Low at all sites except 9 and 11.
Indicators of poor drainage (such as distinct mottling) at all sites except Sites 1 and 2.
Site 4 has pH ($CaCl_2$) of 4.4 at < 600mm depth which also represents a chemical barrier at <750 mm depth. Site 9 has pH of 4.3 at <600mm depth and Ca:Mg ratio < 0.1 at < 750mm depth.</td></tr>
<tr><td>Landscape Site: 4</td></tr>
</table>

<table>
<tr><td colspan="3">Soil Unit: Tenosol, Bleached-Orthic / Brown-Orthic</td></tr>
<tr><td>Representative Dominant Sites:</td><td>3 & 6 (Bleached-Orthic)</td><td rowspan="3"> 


</td></tr>
<tr><td>Co-dominant Sites:</td><td>5 & 13 (Brown-Orthic)</td></tr>
<tr><td rowspan="3">Typical Soil Profile</td><td>A1: 0-11 – Dark brown sandy loam, weak angular-blocky, rough-faced, peds 10-30mm, moist, 0-10% gravel</td></tr>
<tr><td>B2: 11-60 – Yellowish brown heavy clay, apedal massive</td></tr>
<tr><td>B/C: 60- >95 – weathered bedrock</td><td>Soil Profile Sites: 6 & 13</td></tr>
<tr><td>Roots:</td><td>Fine, few to 58cm</td><td rowspan="4">  </td></tr>
<tr><td>Landscape Association:</td><td>Crests and steep slopes</td></tr>
<tr><td>Landuse:</td><td>Mine buffer land</td></tr>
<tr><td colspan="2">BSAL status and limiting factors:
Not BSAL.
Fertility Moderately Low at all sites.
Physical barrier (typically high proportion of weathered bedrock fragments) at <750 mm depth at all sites;
Site 3 has pH ($CaCl_2$) of 4.3 at < 600mm depth, which also represents a chemical barrier at <750 mm depth.
Indicators of poor drainage at Sites 3 and 6.</td><td>Landscape Site: 3</td></tr>
</table>

<table>
<tr><td colspan="3">Soil Unit: Kurosol, Brown</td></tr>
<tr><td>Representative Sites:</td><td>14</td><td rowspan="4"> 
</td></tr>
<tr><td rowspan="3">Typical Soil Profile</td><td>A1: 0-12 – Dark greyish brown sandy loam, weak polyhedral, rough-faced, peds 10-20mm, moist, nil gravel</td></tr>
<tr><td>A2: 12-44 – Light yellowish brown, sandy clay loam, weak polyhedral, rough faced peds, 20-30mm, moist, 20% ironstone nodules</td></tr>
<tr><td>B2: 44-65 – Yellowish brown medium clay, weak polyhedral to platy peds, 5-10mm, moist, 5% weathered bedrock fragments</td></tr>
<tr><td></td><td>B/C: 65- >110 – weathered bedrock</td><td>Soil Profile Site: 14</td></tr>
<tr><td>Roots:</td><td>Fine, few to 57cm</td><td rowspan="4">  </td></tr>
<tr><td>Landscape Association:</td><td>Flats and drainage depressions</td></tr>
<tr><td>Landuse:</td><td>Low density sheep grazing</td></tr>
<tr><td colspan="2">BSAL status and limiting factors:
Not BSAL.
Fertility ranking Moderate.
Site 14 has pH ($CaCl_2$) of 4.4 at < 600 mm depth, which also represents a chemical barrier at <750 mm depth.
Indicators of poor drainage (bleached A2 horizon) at Site 14.</td><td>Landscape Site: 14</td></tr>
</table>

4. Conclusion

The BSAL assessment was completed in June- July 2015. The BSAL assessment area, consisting of the Northern assessment area and Southern assessment area, totalled 320 ha. The BSAL assessment was undertaken in accordance with the requirements of the interim protocol. No BSAL was identified within the BSAL assessment area.

5. References

Department of Trade and Investment Regional Infrastructure and Services (2012) *Strategic Regional Land Use Policy, Guideline for Agricultural Impact Statements at the Exploration Stage*

GSS Environmental (2010) *Marulan South Limestone Mine Rehabilitation Strategy*

Hazelton P and Murphy B (2007) Interpreting Soil Test Results – What do all the numbers mean? (CSIRO Publishing: Collingwood Australia)

Hird C (1991) *Soil Landscapes of the Goulburn 1:250 000 sheet*. Department of Conservation and Land Management, NSW

Isbell RF (2002) *The Australian Soil Classification*, Revised Edition (CSIRO Publishing: Collingwood Australia)

McKenzie NJ, Grundy MJ, Webster R, Ringrose-Voase AJ (2008). *Guidelines for Surveying Soil and Land Resources*. 2nd Edition (CSIRO Publishing: Collingwood Australia)

Munsell Color (2009) Munsell Soil-Color Book

National Committee on Soil and Terrain (2009) *Australian Soil and Land Survey Field Handbook* (CSIRO Publishing: Collingwood Australia)

NSW Government (2013) *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*

NSW Government (2014) *Regional Biophysical Strategic Agricultural Land mapping.* Online

NSW Land & Property Information. Online Atlas of NSW - Surface Geology Mapping.

Office of Environment and Heritage (2013) Land and Soil Capability mapping. Online

Office of Environment and Heritage. Soil and Land Information System (SALIS), accessed via eSPADE spatial viewer.

Appendix 1 - Risk Assessment

A risk assessment of potential impact to agricultural land was completed for the proposed Project disturbance areas. The assessment utilised the Risk Ranking matrix presented in Table A1, and probability and consequence descriptions presented in Tables A2 and A3, respectively. These risk ranking criteria are taken from the *Guideline for Agricultural Impact Statements at the Exploration Stage* (DTIRIS, 2012). A summary of the assessment findings are presented in Table A4.

Table A1: Risk ranking matrix.

Consequence \ PROBABILITY	A Almost Certain	B Likely	C Possible	D Unlikely	E Rare
1. Severe and/or permanent damage. Irreversible impacts	**A1 high**	**B1 high**	**C1 high**	D1 high	E1 medium
2. Significant and /or long term damage. Long term mgt implications. Impacts difficult or impractical to reverse.	**A2 high**	**B2 high**	**C2 high**	D2 medium	E2 medium
3. Moderate damage and/or medium-term impact to agricultural resources or industries. Some ongoing mgt implications which may be expensive to implement. Minor damage or impacts over the long term.	**A3 high**	**B3 high**	**C3 medium**	D3 medium	**E3 medium**
4. Minor damage and/or short-term impact to agricultural resources or industries. Can be managed as part of routine operations	A4 medium	B4 medium	C4 low	D4 low	**E4 low**
5. Very minor damage and minor impact to agricultural resources or industries. Can be effectively managed as part of normal operations	A5 low	B5 low	C5 low	**D5 low**	**E5 low**

where:

= low risk

= medium risk

= high risk

Table A2: Risk probability class descriptions

Level	Descriptor	Description
A	Almost Certain	Common or repeating occurrence
B	Likely	Known to occur or it has happened
C	Possible	Could occur or I've heard of it happening
D	Unlikely	Could occur in some circumstances but not likely to occur
E	Rare	Practically impossible or I've never heard of it happening

Table A3: Risk consequence class descriptions

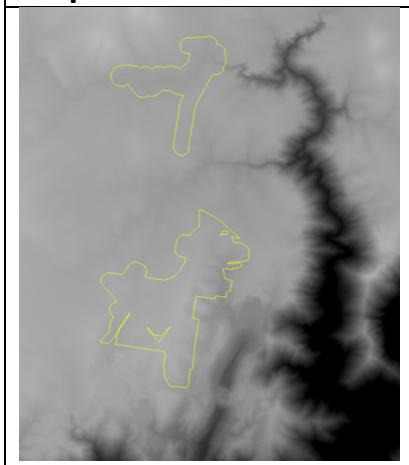
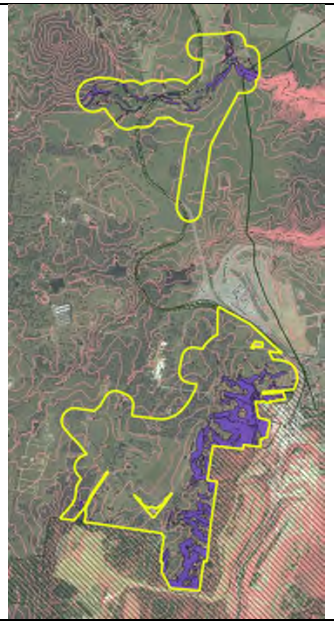
Level: 1	Severe Consequences	Example of Implications
Description	Severe and/or permanent damage to agricultural resources, or industries Irreversible Severe impact on the community	Long term (eg 20 years) damage to soil or water resources Long term impacts (eg 20 years) on a cluster of agricultural industries or Important agricultural lands
Level: 2	**Major Consequences**	**Example of Implications**
Description	Significant and/or long-term impact to agricultural resources, or industries Long-term management implications Serious detrimental impact on the community	Water and / or soil impacted, possibly in the long term (eg 20 years) Long term (eg 20 years) displacement / serious impacts on agricultural industries
Level:3	**Moderate Consequences**	**Example of Implications**
Description	Moderate and/or medium-term impact to agricultural resources, or industries Some ongoing management implications Minor damage or impacts but over the long term.	Water and/ or soil known to be affected, probably in the short – medium term (eg 1-5 years) Management could include significant change of management needed to agricultural enterprises to continue.
Level: 4	**Minor Consequences**	**Example of Implications**
Description	Minor damage and/or short-term impact to agricultural resources, or industries Can be effectively managed as part of normal operations	Theoretically could affect the agricultural resource or industry in short term, but no impacts demonstrated Minor erosion, compaction or water quality impacts that can be mitigated. For example, dust and noise impacts in a 12 month period on extensive grazing enterprises.
Level: 5	**Negligible Consequences**	**Example of Implications**
Description	Very minor damage or impact to agricultural resources, or industries Can be effectively managed as part of normal operations	No measurable or identifiable impact on the agricultural resource or industry

Table A4: Risk ranking for proposed Project disturbance activities.

Assessment Area	Existing Environment	Proposed Disturbance	Area (ha)	Probab-ility	Conse-quence	Risk Ranking
Northern	Cleared land used for livestock grazing. Low undulating rises along creek bed (Land Capability Class V). Steeply incised gully towards eastern margin (Land Capability Class VIII).	Construction of dam at eastern end of area and access roads.	8	A	2/3	High
		Dam inundation area	10	A	2	High
		Buffer zone	76	D	5	Low
Southern	Predominantly cleared land used as mine buffer land in the east and for livestock grazing in the west. Gentle slopes and flats in the west ((Land Capability Class V). Moderate to steep slopes in the east (Land Capability Class VII).	Overburden emplacements	164	A	1	High
		Infrastructure: realignment of Marulan South Rd and drainage infrastructure.	5	A	1	High
		Buffer Zone	57	C	5	Low

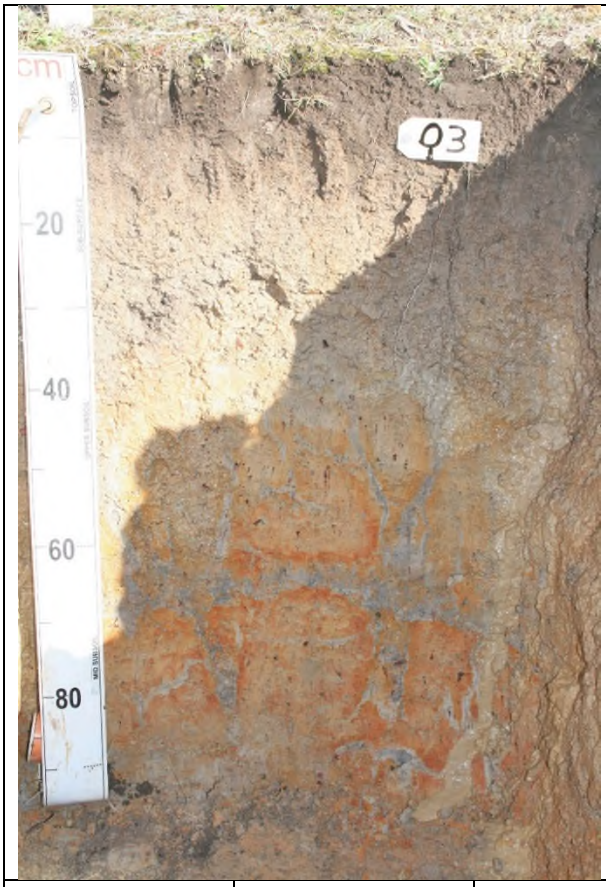
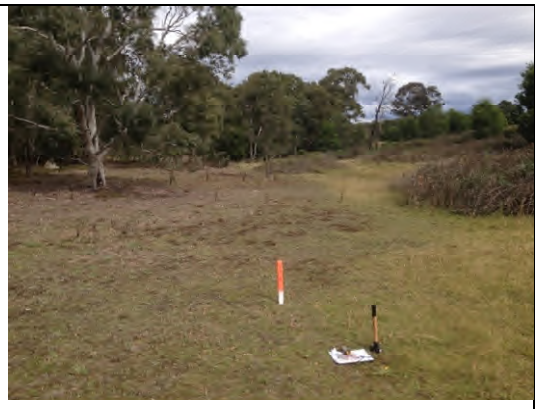
Appendix 2 – Slope Analysis

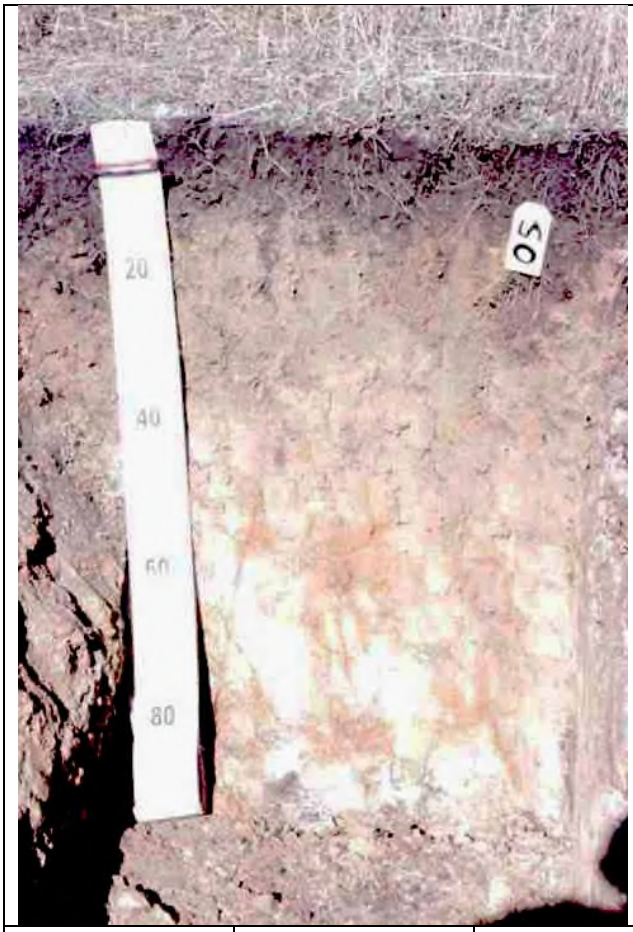
An analysis of terrain within the BSAL assessment areas was undertaken to identify slope gradient greater than ten percent (10%), and exclude those areas from further assessment. LIDAR imagery of the assessment areas was collected in November 2014, and processed using QGIS as described below.

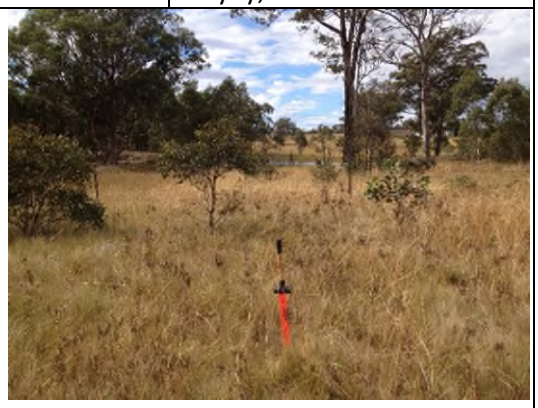
Step 1	Step 2	Step 3	Step 4	Step 5
				
LIDAR imagery of Project area displayed as raster layer in QGIS, with vector polygons of BSAL assessment areas shown in yellow.	LIDAR image clipped to 100m buffer around BSAL assessment areas and analysed for slope using QGIS *Terrain Analysis*, giving a range of 0-25% slope within the area.	QGIS *Raster Calculator* used to identify areas of slope greater than 10% (white areas).	Raster image converted to vector polygons, with brown areas representing slope less than 10%, and green showing areas greater than 10% slope.	Polygons clipped to BSAL assessment areas, with purple polygons representing those areas with slope greater than 10%.

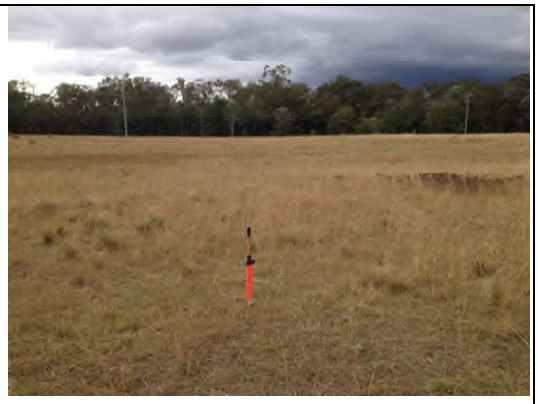
Appendix 3 – Test Pit Photographs

Soil Profile			***Landscape***	
				
1. Eutrophic	Subnatric	Red	Sodosol	Medium, non-gravelly, loamy, clayey, moderate
				
2. Eutrophic	Mottled-Subnatric	Brown	Sodosol	Medium, non-gravelly, loamy, clayey, moderate

				
3. Basic	Ferric	Bleached-Orthic	Tenosols	Medium, non-gravelly, loamy, clay loamy, shallow
				
4. Eutrophic	Mottled-Subnatric	Brown	Sodosols	Medium, non-gravelly, loamy, clayey, shallow

				
5. Basic	Paralithic	Brown-Orthic	Tenosol	Thick, slightly gravelly, loamy, clayey, shallow
				
6. Basic	Paralithic	Bleached-Orthic	Tenosol	Medium, slightly gravelly, loamy, clayey, shallow

				
7. Magnesic	Mottled-Subnatric	Red	Sodosol	Thick, non-gravelly, loamy, clayey, moderate
				
8. Eutrophic	Mottled-Subnatric	Brown	Sodosol	Medium, non-gravelly, loamy, clayey, moderate

				
9. Bleached-Mottled	Mesotrophic	Brown	Chromosol	Thick, non-gravelly, loamy, clayey, moderate
				
11. Mottled-Sodic	Eutrophic	Brown	Chromosol	Medium, non-gravelly, clay loamy, clayey, deep

				
12. Eutrophic	Mottled-Subnatric	Brown	Sodosol	Thick, non-gravelly, loamy, clayey, deep
				
13. Basic	Paralithic	Brown-Orthic	Tenosol	Medium, slightly gravelly, clay loamy, clayey, moderate

14. Bleached-Sodic	Mesotrophic	Brown	Kurosol	Thick, non-gravelly, loamy, clayey, moderate

ATP 18	Surface Observation: Dark brown loam over reddish brown clay (texture contrast profile)

ATP 38	Surface Observation: Dark brown loam over yellowish brown clay (texture contrast profile)

Appendix 4 – Soil Profile Descriptions

Site ID	Hori-zon	Lower Boundary Depth (cm)	Boundary Distinct.	Colour (Munsell)	Mottles			Textu re	Structure			Fabric	Consist -ence	Field pH	HCl Test	Dispersion (10 min in water)	Roots		Mois-ture	Coarse Fragments		
					Col	%	Contrast		Ped Type	Size (mm)	Grade						Size	Abun-dance		%	Size (mm)	Lithology
1	A1	20	Clear	10YR 3/2	-	-	-	SCL	AB	20-30	Weak	Rough ped	Weak	5	-	1	1	1	Moist	2	0-5	-
1	B2	58	Diffuse	5YR 4/6	Grey	5	Distinct	HC	Mass-ive	-	-	Earthy	Firm	6	-	3	1	0.5 (58cm)	Moist	nil	-	-
1	C	>140	-	10YR 6/6	-	-	-	HC	-	-	-	-	-	7.5	N	Slake	-	-	Mod. Moist	>50	-	Granod-iorite
2	A1	11	Abrupt	10YR 3/1	-	-	-	L	AB	40	Very Weak	Rough ped	Very Weak	6	-	0	1	1	Very Moist	nil	-	-
2	A2	21	Abrupt	10YR 5/3	-	-	-	SL	Poly-hedral	20-40	Weak	Sandy	Weak	6	-	1	1	1	Very Moist	nil	-	-
2	B21	57	Gradual	2.5Y 5/3	-	-	-	HC	Massive	-	-	Earthy	Firm	6	-	1	1	0.5 (45cm)	Moist	nil	-	-
2	B22	95	Diffuse	7.5YR 4/6	-	-	-	MC	Poly-hedral	40-60	Weak	Rough ped	Strong	7.5	-	0	-	-	Moist	10	0-5	Sand-stone
2	B3	>140	-	(multi)	-	-	-	-	AB	10-20	Weak	Sandy	-	-	N	-	-	-	Mod. Moist	30	0-5	Sand-stone
3	A1	11	Clear	10YR 3/2	-	-	-	L	AB	30-50	Weak	Rough ped	Weak	6	-	0	1	1	Moist	nil	-	-
3	A2	30	Clear	10YR 5/3	Red	5	Faint	L	Poly-hedral	40-70	Weak	Rough ped	Very Weak	6	-	1	1	1	Wet	nil	-	-
3	A2c	41	Clear	10YR 5/3	-	-	-	-	Aped	-	-	-	Loose	5.5	-	0	-	-	Wet	>50	5	ironstone
3	B22	65	Diffuse	10YR 6/6	Red	30	Distinct	SL	AB/ platy	50	Weak	Sandy	Firm	5	N	0	-	-	Mod. Moist	20	-	Sand-stone
3	B3	>90	-	10YR 6/6	-	-	-	SL	Massive	-	-	Sandy	Weak	-	-	-	-	-	Mod. Moist	60	-	Sand-stone
4	A1	11	Clear	10YR 3/2	-	-	-	L	AB	5-10	Weak	Rough ped	Very Weak	7.5	-	0	1	2	Moist	-	-	-
4	A2	28	Clear	2.5Y 5/2	Red	5	Faint	SL	Poly-hedral	5-10	Weak	Rough ped	Very Weak	7	-	0	1	1	Moist	10	5	Sand-stone
4	B21	48	Diffuse	10YR 5/6	Grey	30	Distinct	HC	Poly-hedral	30-50	Weak	Rough ped	Firm	5.5	N	2	3	0.5	Very Moist	20	20-50	Sand-stone
4	B3	>120	-	(multi)	-	-	-	-	Massive	-	-	Sandy	Firm	5.5	N	1	-	-	Moist	50	-	Sand-

Marulan South Limestone Mine - BSAL Assessment

Site ID	Hori-zon	Lower Boundary Depth (cm)	Boundary Distinct.	Colour (Munsell)	Mottles			Textu re	Structure			Fabric	Consist -ence	Field pH	HCl Test	Dispersion (10 min in water)	Roots		Mois-ture	Coarse Fragments		
					Col	%	Contrast		Ped Type	Size (mm)	Grade						Size	Abun-dance		%	Size (mm)	Lithology
																						stone
5	A1	13	Clear	10YR 3/2	-	-	-	L	AB	3-5	Weak	Rough ped	Very Weak	7.5	-	0	1	3	Moist	5	5	Sand-stone
5	A2	38	Clear	10YR 5/4	-	-	-	SL	Poly-hedral	5-10	Weak	Sandy	Very Weak	7	-	0	1	1	Moist	5	5	Sand-stone
5	B3	60	Diffuse	7.5YR 6/6	-	-	-	SC	Poly-hedral	30-50	Weak	Rough ped	Weak	5	N	1	1	0.5 (53cm)	Mod. Moist	50	-	Sand-stone
5	C	>90	-	(multi)	-	-	-	-	Massive	-	-	Sandy	-	-	N	-	1	2	Dry	>90	-	Sand-stone
6	A1	9	Clear	10YR 2/2	-	-	-	L	Poly-hedral	30-50	Weak	Rough ped	Very Weak	6	-	1	1	1	Moist	10	5-20	ironstone
6	A2	17	Abrupt	10YR 6/3	-	-	-	SL	Poly-hedral	10-20	Weak	Sandy	Very Weak	6	-	2	1	1	Very Moist	10	50-100	ironstone
6	B21	44	Diffuse	5YR 4/6	Grey	30	Distinct	HC	Massive	-	-	Rough ped	Firm	7.5	-	1	4	1	Moist	30	5-20	ironstone
6	B3	>60	-	(multi)	-	-	-	-	Massive	-	-	-	Strong	-	N	-	-	-	Mod. Moist	60	-	Granod-iorite
7	A1	11	Clear	10YR 3/3	-	-	-	L	AB	10-30	Weak	Rough ped	Weak	6	-	0	1	1	Moist	nil	-	-
7	A2	32	Abrupt	10YR 5/4	-	-	-	L	AB	30-50	Weak	Rough ped	Very Weak	6	-	1	1	1 (22cm)	Wet	10	5-10	ironstone
7	B21	64	Diffuse	5YR 5/8	Yellow Brown	20	Distinct	MC	Massive	-	-	-	Firm	5.5	N	2	-	-	Moist	5	-	Weath. Sedi-mentary
7	B3	>100	-	(multi)	-	-	-	-	Massive	-	-	-	Firm	-	-	-	-	-	Moist	40	-	Weath. Sedi-mentary
8	A1	8	Clear	10YR 3/3	-	-	-	L	Poly-hedral	10-20	Weak	Rough ped	Very Weak	6.5	-	1	1	1	Very Moist	nil	-	-
8	A2	15	Abrupt	10YR 5/3	-	-	-	SL	Poly/ lentic	5-10	Weak	Rough ped	Weak	7.5	-	2	1	1	Wet	10	5-20	ironstone
8	B21	65	Diffuse	7.5YR 5/6	Red Brown	40	Distinct	MC	Poly/ lentic	50-70	Weak	Rough ped	Firm	5.5	-	2	1	0.5 (28cm)	Mod. Moist	10	-	Weath. Sedi-mentary
8	B3	>85	-	(multi)	-	-	-	MC	Poly/ lentic	30-50	Weak	Rough ped	Firm	-	N	-	-	-	Mod. Moist	>70	-	Sedi-mentary
9	A1	11	Gradual	10YR 3/2	-	-	-	L	Poly-hedral	10-30	Weak	Rough ped	Weak	7	-	0	1	1	Moist	nil	-	-
9	A2	32	Clear	10YR 5/4	-	-	-	SL	Poly-hedral	5-20	Weak	Sandy	Weak	6	-	1	1	0.5	Wet	10	5	ironstone

Marulan South Limestone Mine - BSAL Assessment

Site ID	Hori-zon	Lower Boundary Depth (cm)	Boundary Distinct.	Colour (Munsell)	Mottles			Textu re	Structure			Fabric	Consist -ence	Field pH	HCl Test	Dispersion (10 min in water)	Roots		Mois-ture	Coarse Fragments		
					Col	%	Contrast		Ped Type	Size (mm)	Grade						Size	Abun-dance		%	Size (mm)	Lithology
9	B21	85	Diffuse	10YR 6/4	Red	40	Distinct	LC	Poly/ lentic	30-50	Weak	Rough ped	Weak	5	-	0	-	-	Moist	10	5	ironstone
9	C	>120	-	-	-	-	-	-	Massive	-	-	-	-	-	-	-	-	-	Mod. Moist	>70	-	Sand-stone
11	A1	17	Clear	10YR 2/2	-	-	-	L	SB	20-30	Weak	Rough ped	Weak	5.5	-	1	1	1	Moist	-	-	-
11	B21	45	Clear	10YR 3/3	Grey	50	Distinct	CL	AB	30-50	Weak	Rough ped	Weak	5.5	-	1	1	1	Moist	-	-	-
11	B22	100	Gradual	2.5Y 4/2	Yellow Brown	5	Faint	HC	Massive	-	-	-	Firm	6	-	0	-	-	Moist	-	-	-
11	B3	130	Clear	2.5Y 6/2	Yellow Brown	30	Prom-inent	HC	Poly-hedral	30-50	Weak	Rough ped	Firm	7.5	N	0	-	-	Moist	>70	-	Granod-iorite
11	C	>140	-	-	-	-	-	-	-	-	-	Sandy	-	-	-	-	-	-	Dry	>90	-	Granod-iorite
12	A1	13	Gradual	10YR 4/2	-	-	-	SL	AB	20-50	Weak	Rough ped	Weak	5.5	-	0	1	1	Mod. Moist	-	-	-
12	A2	42	Clear	10YR 6/2	Yellow Brown	5	Faint	SL	Poly-hedral	15	Weak	Rough ped	Very Weak	5.5	-	0	1	1	Moist	-	-	-
12	B21	95	Diffuse	10YR 5/6	Grey	20	Distinct	HC	Massive	-	-	Earthy	Firm	6	-	1	-	-	Moist	-	-	-
12	B22	>120	-	7.5YR 4/2	-	-	-	HC	Poly/ lentic	30-70	Weak	Rough ped	Weak	7.5	N	2	-	-	Moist	-	-	-
13	A1	13	Clear	10YR 3/4	-	-	-	CL	AB	20-30	Weak	Rough ped	Weak	6	-	1	1	1	Moist	5	5	-
13	B21	64	Gradual	7.5YR 5/6	Grey	10	Distinct	MC	Massive	-	-	Earthy	Firm	5.5	-	1	1	1 (47cm)	Moist	5	-	Granod-iorite
13	C	>70	-	10YR 6/8	multi	-	-	HC	Poly-hedral	30-50	Weak	Sandy	Firm	5.5	N	1	-	-	Mod. Moist	>70	-	Granod-iorite
14	A1	12	Clear	10YR 3/2	-	-	-	SL	Poly-hedral	10-20	Weak	Rough ped	Weak	6	-	0	1	1	Moist	-	-	-
14	A2	44	Clear	2.5Y 6/3	-	-	-	SCL	Poly/ lentic	20-30	Weak	Rough ped	Weak	6	-	2	1	1	Moist	20	5-20	ironstone
14	B21	65	Gradual	10YR 5/4	Red	10	Distinct	MC	Poly/ platy	5-10	Weak	Rough ped	Firm	5.5	-	0	1	1 (57cm)	Moist	5	-	Weath. Sedi-mentary
14	B22	>110	-	(multi)	-	-	-	LC	Platy	10-20	Weak	Rough ped	Weak	5.5	N	0			Moist	60	-	Weath. Sedi-mentary

Appendix 5 – Laboratory Analysis Report

Department of Primary Industries
Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO15/131R1
REPORT TO:	Lachlan Crawford Lamac Management Pty Ltd 22 Lerra Road Windella NSW 2320
REPORT ON:	Sixty Three soil samples
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	19 August 2015
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED

SR Young
(Laboratory Manager)

Scone Research Centre, PO Box 283 Scone 2337, 709 Gundy Road Scone 2337
Ph: 02 6545 1666, Fax: 02 6545 2520

Report No: SCO15/131R1
Client Reference: Lachlan Crawford
Lamac Management Pty Ltd
22 Lerra Road
Windella NSW 2320

Lab No	Method	P9B/2	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (me/100g)						
	Sample Id	EAT	EC (dS/m)	pH	pH ($CaCl_2$)	CEC	Na	K	Ca	Mg	Al	Texture
1	1 : 0-5	nt	0.06	6.7	6.0	14.3	0.2	0.4	9.0	2.3	nt	Sandy loam
2	1 : 5-15	nt	0.03	6.5	5.6	13.2	0.3	0.3	6.0	2.1	nt	Sandy clay loam
3	1 : 20-30	nt	0.03	7.0	5.6	29.6	1.3	0.4	10.3	12.1	nt	Heavy clay
4	1 : 30-60	3(2)	0.03	7.8	6.2	26.2	1.8	0.3	8.1	10.6	nt	Heavy clay
5	2 : 0-5	nt	0.05	7.2	6.5	14.9	0.4	0.6	10.4	1.8	nt	Sandy loam
6	2 : 5-11	nt	0.03	6.9	6.1	12.1	0.4	0.4	6.6	1.6	nt	Sandy loam
7	2 : 11-15	nt	0.01	6.8	5.8	4.4	0.5	0.4	1.8	1.2	nt	Sandy loam
8	2 : 21-30	nt	0.13	6.9	5.9	30.9	2.3	0.4	5.8	18.2	nt	Heavy clay
9	2 : 30-57	nt	0.27	7.0	6.0	33.5	3.6	0.5	3.9	21.5	nt	Heavy clay
10	2 : 60-100	nt	0.37	8.0	6.8	35.8	4.5	0.4	3.5	22.0	nt	Medium clay
11	3 : 0-5	nt	0.04	6.8	6.0	12.2	0.6	0.4	8.7	1.5	nt	Loam
12	3 : 5-11	nt	0.02	6.6	5.8	9.3	0.2	0.3	6.1	1.4	nt	Loam
13	3 : 15-30	nt	<0.01	7.0	6.0	4.8	0.2	0.3	2.4	1.4	nt	Sandy loam
14	3 : 41-60	nt	0.01	5.5	4.3	4.2	0.2	0.3	0.8	2.4	1.5	Sandy loam
15	4 : 0-5	nt	0.06	8.1	7.5	13.2	0.2	0.7	10.9	1.5	nt	Loam

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO15/131R1
Client Reference: Lachlan Crawford
Lamac Management Pty Ltd
22 Lerra Road
Windella NSW 2320

Lab No	Method	P9B/2	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (me/100g)						
	Sample Id	EAT	EC (dS/m)	pH	pH ($CaCl_2$)	CEC	Na	K	Ca	Mg	Al	Texture
16	4 : 5-10	nt	0.05	8.0	7.2	11.8	0.2	0.6	9.3	1.4	nt	Loam
17	4 : 15-30	nt	0.01	7.8	6.9	4.5	0.1	0.4	3.0	1.1	nt	Sandy loam
18	4 : 30-48	2(1)	0.08	5.9	4.4	19.9	1.5	0.5	2.7	10.4	0.9	Heavy clay
19	4 : 60-100	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
20	5 : 0-5	nt	0.08	7.5	7.0	18.3	0.1	1.0	14.1	1.8	nt	Loam
21	5 : 5-13	nt	0.06	7.4	6.8	15.1	0.1	1.1	11.6	1.8	nt	Sandy clay loam
22	5 : 15-30	nt	0.03	6.9	6.0	7.4	0.1	0.7	3.8	1.4	nt	Sandy clay
23	5 : 30-60	nt	0.02	5.6	4.5	8.0	0.1	0.9	2.2	1.7	3.1	Medium clay
24	6 : 0-5	nt	0.04	7.5	6.8	16.2	0.1	0.8	12.1	1.9	nt	Loam
25	6 : 9-15	3(2)	0.02	7.2	6.3	5.8	0.2	0.3	3.4	2.2	nt	Sandy loam
26	6 : 17-30	nt	0.05	8.0	6.7	22.5	0.5	0.5	7.9	8.5	nt	Heavy clay
27	6 : 30-44	nt	0.06	8.0	6.8	19.2	0.6	0.5	5.6	9.1	nt	Heavy clay
28	6 : 44-60	nt	0.07	8.0	6.7	21.7	1.0	0.5	3.3	13.1	nt	Heavy clay
29	7 : 0-5	nt	0.04	6.1	5.3	12.3	0.2	0.5	5.9	2.9	<0.5	Loam
30	7 : 5-11	nt	0.02	6.1	5.1	10.3	0.2	0.4	4.9	2.7	<0.5	Loam

Report No: SCO15/131R1
Client Reference: Lachlan Crawford
Lamac Management Pty Ltd
22 Lerra Road
Windella NSW 2320

Lab No	Method	P9B/2	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (me/100g)						
	Sample Id	EAT	EC (dS/m)	pH	pH ($CaCl_2$)	CEC	Na	K	Ca	Mg	Al	Texture
31	7 : 15-30	nt	0.01	6.3	5.1	6.9	0.2	0.3	2.7	2.4	<0.5	Loam
32	7 : 32-60	2(1)	0.04	5.8	4.6	20.8	1.3	0.4	0.8	13.5	0.9	Medium clay
33	8 : 0-5	nt	0.03	6.8	6.1	8.0	0.3	0.4	5.1	1.2	nt	Loam
34	8 : 8-15	2(1)	0.01	7.1	6.1	7.0	0.4	0.1	1.4	1.6	nt	Sandy loam
35	8 : 15-30	2(2)	0.10	6.3	5.1	24.3	2.3	0.2	3.6	14.3	<0.5	Medium clay
36	8 : 30-60	nt	0.12	6.3	5.1	22.0	2.6	0.2	2.6	14.2	<0.5	Medium clay
37	8 : 65-85	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
38	9 : 0-5	nt	0.03	7.3	6.6	8.1	0.3	0.2	6.9	1.4	nt	Loam
39	9 : 5-11	nt	0.03	7.1	6.4	6.8	0.3	0.1	4.9	1.3	nt	Sandy loam
40	9 : 15-30	nt	0.01	6.7	5.8	6.4	0.4	0.1	2.4	1.7	nt	Sandy clay
41	9 : 32-60	nt	0.01	5.7	4.9	9.8	0.5	0.1	3.5	3.7	2.4	Light clay
42	9 : 60-85	nt	0.01	5.2	4.3	10.6	0.5	0.1	0.2	3.8	7.4	Light clay
43	11 : 0-5	nt	0.07	6.5	5.9	19.7	0.5	1.0	12.2	5.7	nt	Clay loam
44	11 : 5-15	nt	0.03	6.2	5.3	15.8	0.6	0.3	8.6	5.6	<0.5	Clay loam
45	11 : 17-30	nt	0.02	6.1	4.9	22.6	1.0	0.3	8.2	8.9	0.6	Medium clay

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO15/131R1
Client Reference: Lachlan Crawford
Lamac Management Pty Ltd
22 Lerra Road
Windella NSW 2320

Lab No	Method	P9B/2	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (me/100g)						
	Sample Id	EAT	EC (dS/m)	pH	pH ($CaCl_2$)	CEC	Na	K	Ca	Mg	Al	Texture
46	11 : 30-60	nt	0.03	6.5	5.2	26.8	1.3	0.3	8.5	11.8	<0.5	Heavy clay
47	11 : 60-100	nt	0.09	7.1	5.9	28.8	1.8	0.4	9.1	13.6	nt	Heavy clay
48	12 : 0-5	nt	0.04	6.2	5.5	5.9	0.5	0.2	2.4	0.8	nt	Sandy loam
49	12 : 5-15	nt	0.04	5.9	5.1	5.2	0.4	0.1	5.3	1.2	<0.5	Sandy loam
50	12 : 17-30	nt	0.02	5.8	4.8	5.2	0.5	0.1	1.1	0.6	<0.5	Sandy loam
51	12 : 42-60	nt	0.11	6.8	5.7	23.6	1.9	0.2	7.1	11.8	nt	Heavy clay
52	12 : 60-100	nt	0.08	7.7	6.4	20.3	1.7	0.1	5.5	9.9	nt	Heavy clay
53	13 : 0-5	nt	0.04	6.6	5.7	22.4	0.6	0.8	10.3	8.8	nt	Light clay
54	13 : 5-13	nt	0.04	6.2	5.4	22.5	1.0	0.3	9.4	11.0	<0.5	Medium clay
55	13 : 17-30	nt	0.04	5.9	4.7	37.9	1.7	0.1	7.1	23.4	1.0	Heavy clay
56	13 : 42-60	nt	0.05	5.9	4.6	36.1	2.2	0.1	3.1	24.8	1.1	Heavy clay
57	13 : 60-80	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
58	14 : 0-5	nt	0.02	7.2	6.4	8.3	0.4	0.1	6.1	1.0	nt	Sandy loam
59	14 : 5-12	nt	0.01	6.9	6.1	6.8	0.4	0.1	4.2	0.9	nt	Sandy loam
60	14 : 15-30	2(1)	<0.01	6.7	5.8	4.1	0.4	<0.1	1.6	0.6	nt	Sandy clay loam

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO15/131R1
Client Reference: Lachlan Crawford
Lamac Management Pty Ltd
22 Lerra Road
Windella NSW 2320

Lab No	Method	P9B/2	C1A/5	C2A/4	C2B/4	C5A/4 CEC & exchangeable cations (me/100g)						
	Sample Id	EAT	EC (dS/m)	pH	pH ($CaCl_2$)	CEC	Na	K	Ca	Mg	Al	Texture
61	14 : 30-44	nt	<0.01	6.6	5.6	1.2	0.4	<0.1	1.5	0.7	nt	Sandy clay loam
62	14 : 45-60	nt	0.01	5.4	4.4	14.4	0.7	<0.1	2.5	4.3	6.7	Medium clay
63	14 : 60-100	nt	0.01	5.2	4.1	10.5	0.7	0.1	0.3	2.5	4.4	Light clay

nt = not tested

END OF TEST REPORT

Appendix 6 – Acknowledgement of Soil Profile submission via eDIRT

Tue 6/10/2015 11:02 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 50m sth of Marulan Creek. 220m east of rail line, profile number: 1
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

This email is intended for the addressee(s) named and may contain confidential and/or privileged information.
If you are not the intended recipient, please notify the sender and then delete it immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment and Heritage.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

Tue 6/10/2015 11:03 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 60 m south of Marulan South Road, profile number: 2
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

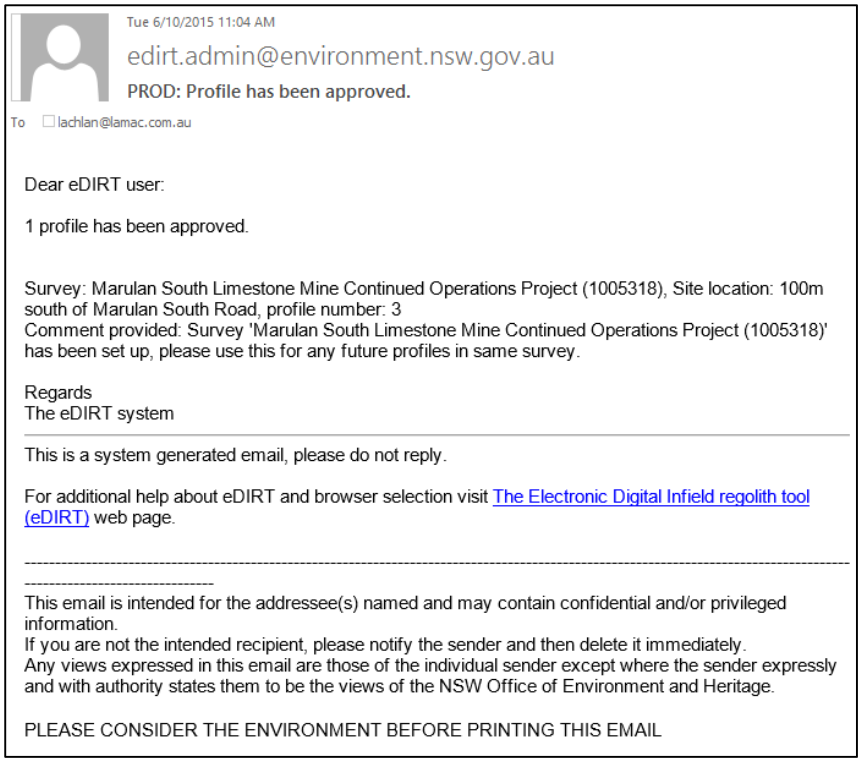
Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

This email is intended for the addressee(s) named and may contain confidential and/or privileged information.
If you are not the intended recipient, please notify the sender and then delete it immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment and Heritage.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL



Tue 6/10/2015 11:04 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 100m south of Marulan South Road, profile number: 3
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

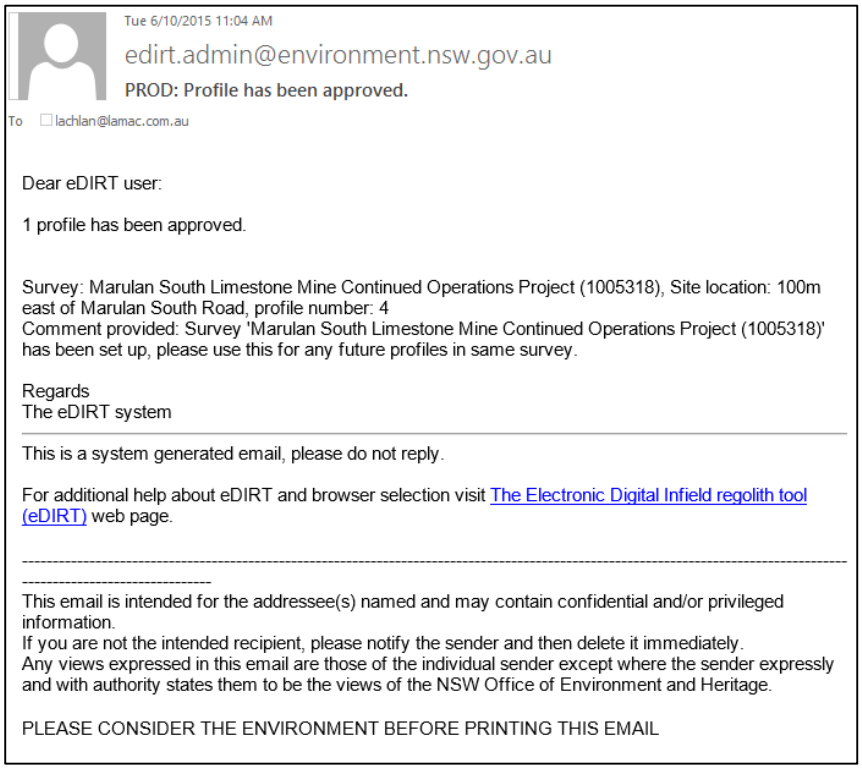
Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

This email is intended for the addressee(s) named and may contain confidential and/or privileged information.
If you are not the intended recipient, please notify the sender and then delete it immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment and Heritage.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL



Tue 6/10/2015 11:04 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 100m east of Marulan South Road, profile number: 4
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

This email is intended for the addressee(s) named and may contain confidential and/or privileged information.
If you are not the intended recipient, please notify the sender and then delete it immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment and Heritage.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

Tue 6/10/2015 11:05 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 60 east of Marulan South Road, profile number: 5
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:05 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 500m south east of Marulan South Road, profile number: 6
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

This email is intended for the addressee(s) named and may contain confidential and/or privileged information.
If you are not the intended recipient, please notify the sender and then delete it immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment and Heritage.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

Tue 6/10/2015 11:06 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 380m south west of Marulan South Road, profile number: 7
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:06 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 150m north east of Marulan South Road, profile number: 8
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:07 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 140m west of Marulan South Road, profile number: 9
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:08 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 250m north west of rail line, profile number: 11
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:09 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 180m east of railway, profile number: 12
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:10 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 60m southwest of Marulan South Road, profile number: 13
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Tue 6/10/2015 11:11 AM

edirt.admin@environment.nsw.gov.au

PROD: Profile has been approved.

To lachlan@lamac.com.au

Dear eDIRT user:

1 profile has been approved.

Survey: Marulan South Limestone Mine Continued Operations Project (1005318), Site location: 170m north of Marulan South Road, profile number: 14
Comment provided: Survey 'Marulan South Limestone Mine Continued Operations Project (1005318)' has been set up, please use this for any future profiles in same survey.

Regards
The eDIRT system

This is a system generated email, please do not reply.

For additional help about eDIRT and browser selection visit The Electronic Digital Infield regolith tool (eDIRT) web page.

Appendix 7 – CPSS Project Audit Comments

9 October 2015

Lachlan Crawford
Director
LAMAC Management Pty Ltd

SOILmgt
P.O. Box 2171
ORANGE NSW 2800
ph: (02) 6361 1913
f: (02) 6361 3268
e: david.mckenzie@soilmgt.com.au
www.soilmgt.com.au
ABN 37 076 676 616

COMMENTS REGARDING LAMAC MANAGEMENT'S BIOPHYSICAL STRATEGIC AGRICULTURAL LAND VERIFICATION ASSESSMENT', MARULAN SOUTH LIMESTONE PROJECT, OCTOBER 2015

Dear Lachlan

In April 2015, you invited me to carry out a technical review for LAMAC Management. It was associated with the 'Biophysical Strategic Agricultural Land (BSAL) Verification Assessment' for Boral's Marulan South Limestone Project near Goulburn, NSW. I have 38 years experience as a soil scientist. My qualifications include a PhD (soil physics) from University of Sydney and a MScAg degree (soil chemistry & agronomy) from University of New England. I have 'Certified Professional Soil Scientist (Stage 3)' and 'CPSS Competent in Australian Soil Survey' accreditation from Soil Science Australia, and I am a 'Chartered Scientist' with British Society of Soil Science.

My half day in the field with you on 30.6.15 allowed me to examine your soil description and sampling techniques in soil pits, and to discuss my experiences with BSAL assessment in northern NSW. It was clear that you had a good understanding of soil and landscape processes. Although you were out of practice with soil surveying procedures, I was impressed by your ability to quickly refine your techniques to suit the landscape conditions at Marulan South.

In addition to this brief field meeting, I enjoyed our recent phone and email discussions regarding your report, map preparation and soil data entry via eDIRT. Your clear writing style was appreciated. I note that my comments were taken on board by you.

The information presented in your report has convinced me that declarable areas of BSAL almost certainly do not exist within the Marulan South study area.

Yours sincerely

Dr David McKenzie
Soil Science Consultant
Soil Management Designs