



LIDDELL COAL MINE

APPLICATION FOR
Site Verification Certificate

for

Liddell Coal Operations Pty Limited

March 2018

Hansen Bailey

ENVIRONMENTAL CONSULTANTS

LIDDELL COAL MINE

APPLICATION FOR A SITE VERIFICATION CERTIFICATE

Prepared by:

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March 2018

for

Liddell Coal Operations Pty Limited
PO BOX 7
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APPLICATION FOR A SITE VERIFICATION CERTIFICATE

1 INTRODUCTION

1.1 PURPOSE

Liddell Coal Operations Pty Limited (LCO) operates the Liddell Coal Mine (Liddell) in the Upper Hunter Valley of New South Wales (NSW). LCO is a wholly owned subsidiary of Glencore Coal Pty Limited (Glencore).

Hansen Bailey is currently preparing an application on behalf of LCO to modify Liddell's Development Approval (DA 305-11-01). This modification application will be made under the former section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). LCO is seeking to facilitate a number of administrative amendments to the conditions of DA 305-11-01. One of these amendments is to extend the Development Application Boundary (DA Boundary) to which DA 305-11-01 applies to cover part of the Mountain Block Offset Area to enable necessary remediation works to be undertaken (see **Figure 1**).

The proposed application to modify DA 305-11-01 under the former section 75W of the EP&A Act triggers the requirement for a Site Verification Certificate. This document assesses the relevant land in accordance with the *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (NSW Government, 2013) (Interim Protocol). The legislative requirement for a Site Verification Certificate is discussed further in **Section 2**.

LCO engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a Biophysical Strategic Agricultural Land (BSAL) Assessment to support an application for a Site Verification Certificate.

1.2 MODIFICATION DESCRIPTION

The Modification seeks to amend some administrative conditions of the DA 305-11-01 to facilitate operational efficiencies whilst providing the flexibility required for the development of a cost effective and practical environmental outcome for the final landform leading into the final years of mining operations at Liddell. Specifically, and the subject of the Site Verification application, the Modification requires a minor adjustment of the DA Boundary to which DA 305-11-01 applies. The extension of the DA Boundary to the north is required to include an approximate 14.64 hectare (ha) portion of the Mountain Block Offset to facilitate required remediation works. The proposed boundary extension is shown in **Figure 1**.

1.3 DOCUMENT STRUCTURE

This application for a Site Verification Certificate is structured as follows:

- **Section 2** outlines the legislative provisions that are relevant to the application;
- **Section 3** identifies the land that is the subject of this application and assesses this land against the criteria for BSAL in accordance with the Interim Protocol; and
- **Section 4** summarises the outcomes of the assessment.

HB LIDDELL 1805 F1 Boundary Extension within Mountain Block Offset Area 07 03 2018

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Boundary Extension within Mountain Block Offset Area

FIGURE 1

2 REGULATORY FRAMEWORK

2.1 MINING ACT

Section 5 of the *Mining Act 1992* (Mining Act) states that mining can only be conducted in accordance with a mining lease (ML) issued under the Mining Act. **Figure 2** shows the mining leases held by Liddell Tenements Pty Limited, a subsidiary of Glencore, applicable to Liddell. The definition of "mine" within the dictionary of the Mining Act includes:

> *"**…**to extract material from land for the purpose of recovering minerals from the material so extracted or to rehabilitate land (other than a derelict mine site) from which material has been extracted but does not include any activity declared not to be mining by a regulation under section 11A or by an order made under such a regulation."*

The remediation and rehabilitation work required within the Mountain Block Offset Area is deemed a mining activity under the Mining Act. Therefore, a mining lease will be sought over this area to the north of the existing boundary of ML 1597 (refer **Figure 2**).

2.2 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT

LCO currently operates under DA 305-11-01 granted under the former Part 4 of the EP&A Act on 20 November 2002. Part 3A was repealed on 1 October 2011. However, the former Schedule 6A of the Act provided savings provisions whereby section 75W of Part 3A continued to apply to modifications of Part 4 development consents referred to in Clause 8J(8) of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). In recent legislative updates to the EP&A Act, transitional agreements for former Part 3A projects have been repealed.

The former Section 75W of the EP&A Act remains an available modification pathway to Part 3A projects, subject to the lodgement of a request to modify on or prior to 28 February 2018, preceding the commencement of legislative changes on 1 March 2018. Post 1 March 2018, all future modifications to the former Part 3A projects are to be assessed as State Significant Development or State Significant Infrastructure under Division 4.7 and Division 5.2 of the EP&A Act.

LCO lodged a request to modify on 27 February 2018 under the former Section 75W of Part 3A of the EP&A Act. The modification will therefore be assessed under the former Section 75W of the EP&A Act.

Clause 50A of the EP&A Regulation imposes additional requirements upon proposed mining or petroleum activities that are located on Strategic Agricultural Land. This clause provides that the modification application must be accompanied by either a Gateway Certificate or a Site Verification Certificate if the application relates to "*mining or petroleum development*" on the following land:

(a) Land shown on the Strategic Agricultural Land Map; or

(b) Land that is the subject of a Site Verification Certificate.

The definition of "*mining or petroleum development*" is limited to proposed developments that are located outside of existing mining leases (and therefore require a new mining lease). As explained in **Section 2.1**, a new mining lease is required for the proposed mining activities, being rehabilitation and remediation of the Mountain Block Offset area. As such, the Modification constitutes "*mining and petroleum development*".

Clause 17A(2) states that "*mining or petroleum development*" does not include development undertaken outside the mining area of a proposed mining lease. That is, "*mining or petroleum development*" only includes the aspects of a proposed development that require a new mining lease. The area of the proposed mining lease is shown in **Figure 2**.

The Modification is located on land that is shown on the Strategic Agricultural Land Map, thereby triggering the requirement for a Site Verification Certificate. The land that is the subject of the Modification is shown on Map 4 for the Upper Hunter Region.

2.3 MINING SEPP

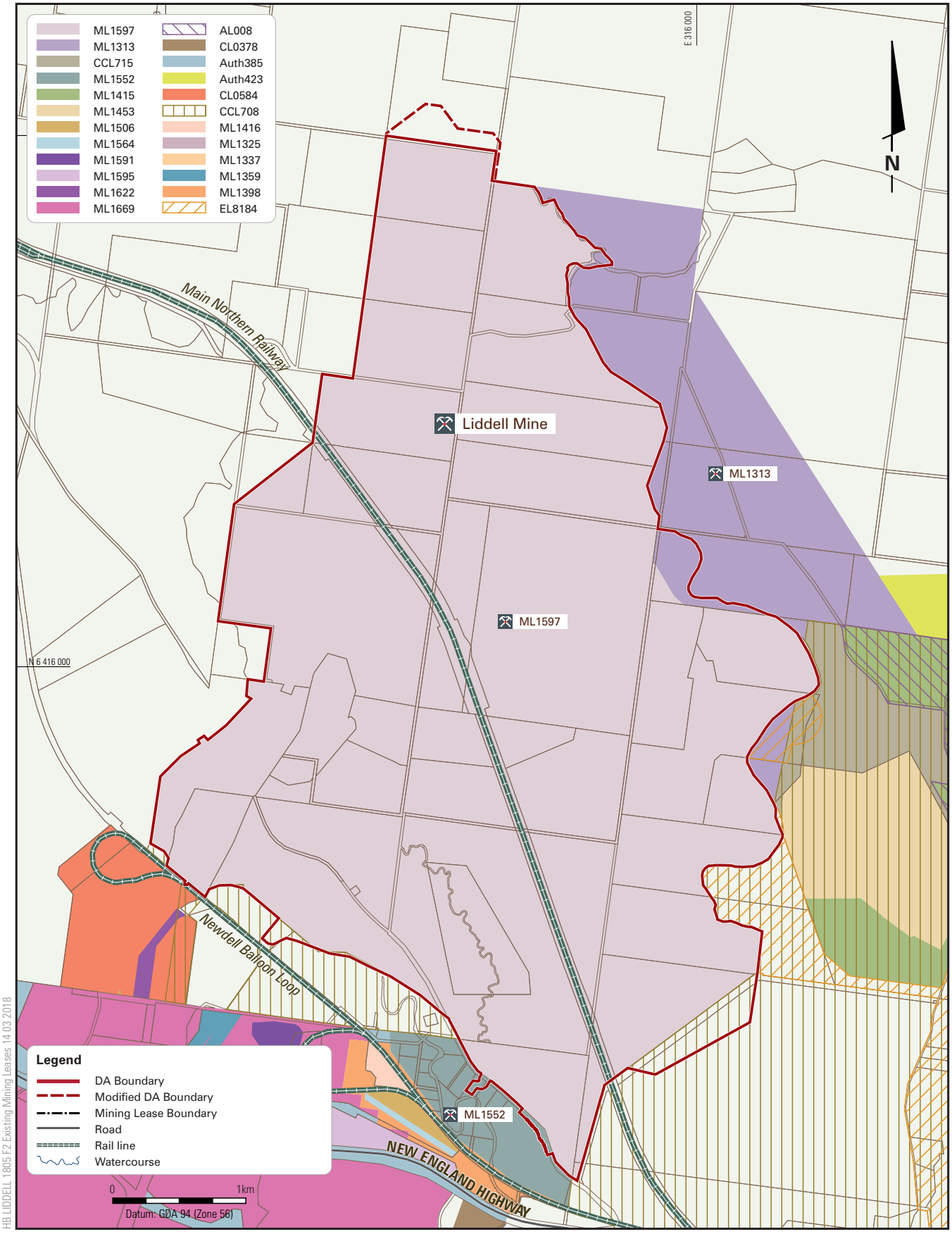
Clause 17C of Part 4AA of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) identifies the persons that can apply for a Site Verification Certificate. Clause 17C relevantly states:

> *"**17C Site verification certificates — biophysical strategic agricultural land***
>
> *1) The Director-General may issue a site verification certificate in respect of specified land certifying, in the Director-General's opinion, that the land is or is not biophysical strategic agricultural land.*
>
> *…*
>
> *3) A person who proposes to carry out mining or petroleum development on land shown on the Strategic Agricultural Land Map may apply to the Director-General for a site verification certificate in respect of the land, but only if the person gives notice of the application:*
>
> *(a) by written notice to the owner of the land before the application is made, or*
>
> *(b) by advertisement published in a newspaper circulating in the area in which the development is to be carried out no later than 30 days before the application is made.*
>
> *4) Only one certificate may be issued under this clause in respect of the same land."*

The land that is contained within the Assessment Area (defined in **Section 3.1**) and the subject of this application is predominantly owned by LCO, a subsidiary of Glencore, however also extends into neighbouring land parcels. In accordance with clause 17C(3) of the Mining SEPP,

LCO provided written notice of the application to the landowners within the Assessment Area on 22 March 2018 (see **Appendix A**).

The land that is the subject of this application has not been the subject of any previously issued Site Verification Certificates.



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Existing Mining Leases

FIGURE 2

HB LIDDELL 1805 F3 Assessment Area 01 03 2018

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Assessment Area

FIGURE 3

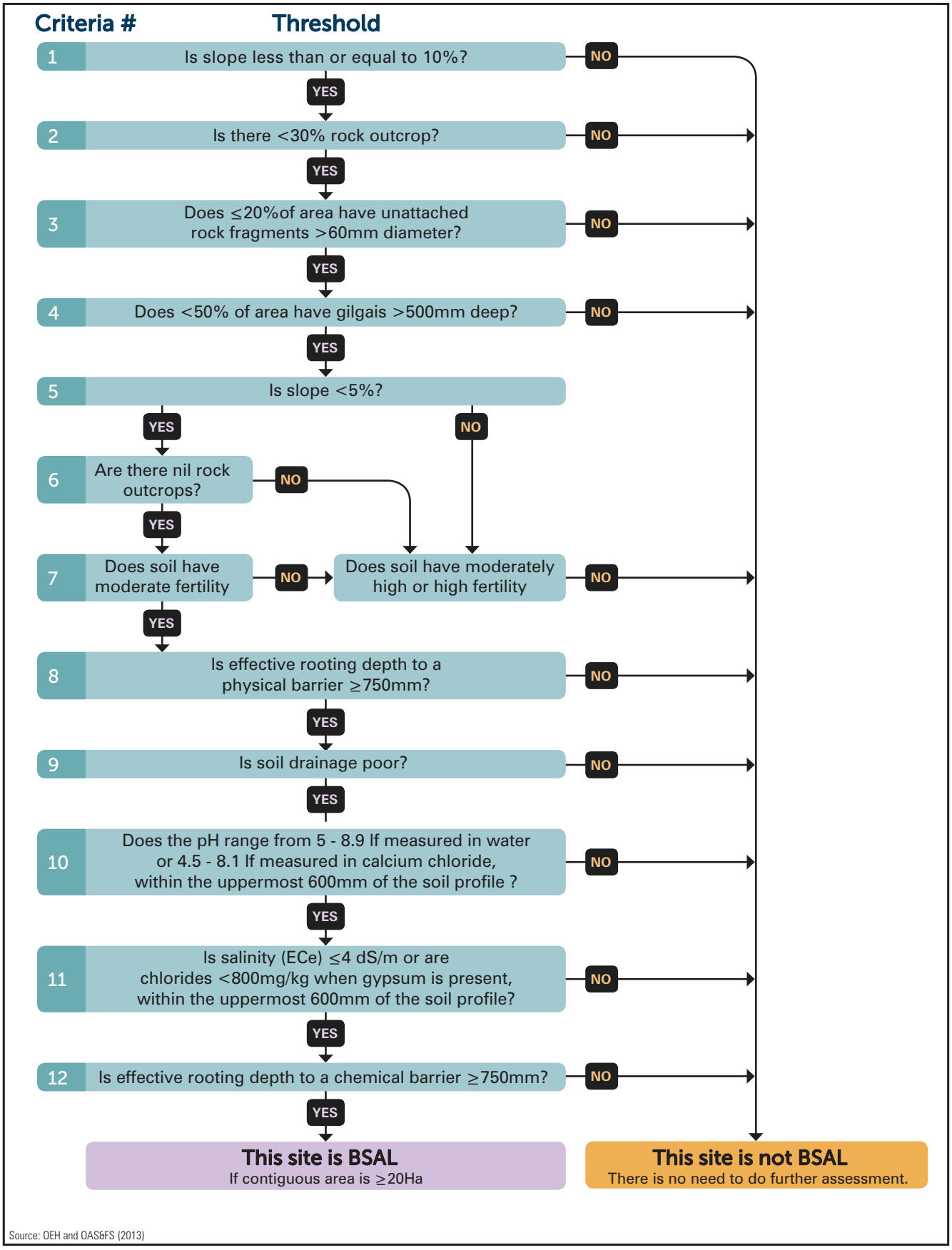
Clause 17D of the Mining SEPP outlines the prescribed form and content of an application for a Site Verification Certificate. Clause 17D relevantly states:

> *"**17D Applications for site verification certificates***
>
> *1) An application for a site verification certificate must:*
>
> *(a) be in writing and include the following information:*
>
> *i. the name and address of the applicant,*
>
> *ii. the address, and particulars of title, of the subject land,*
>
> *iii. whether the land is shown as biophysical strategic agricultural land on the Strategic Agricultural Land Map, and*
>
> *(b) be in the form (if any) approved by the Director-General from time to time, and*
>
> *(c) be accompanied by the relevant fee (if any) specified in the regulations.*
>
> *2) The Director-General must have regard to the criteria set out in the Site Verification Protocol when determining an application for a site verification certificate.*
>
> *3) The Director-General is to determine an application within 21 days of it being made."*

The Interim Protocol states that applications for Site Verification Certificates are to be made via the electronic form on the DP&E website. The required particulars regarding the applicant and the Assessment Area, are provided in the application form. An assessment of the land in accordance with the Interim Protocol is provided in **Section 3**.

2.4 INTERIM PROTOCOL

The Interim Protocol outlines the criteria that must be satisfied in order for land to be verified as BSAL. If any of the criteria are not satisfied, that land does not constitute BSAL. The prescribed process for the verification of BSAL is shown in **Figure 4**.



Source: OEH and OAS&FS (2013)

HB LIDDELL 1805 F4 Site Assessment BSAL Verification Process 28 02 2018

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Site Assessment BSAL Verification Process

FIGURE 4

3 SITE VERIFICATION ASSESSMENT

3.1 ASSESSMENT AREA

The area that is the subject of a proposed mining lease is shown on **Figure 2**.

The Interim Protocol advises that the "*assessment area should include the entire project area and include at least a 100 m buffer to take into account changes in design, surrounding disturbance and minor expansion*". In accordance with this recommendation, the Assessment Area for this application is defined by a 100 m buffer around the area of the proposed mining lease (see **Figure 2**).

The Assessment Area consists of a previously mined portion of Liddell (known as Mountain Block) as well as the surrounding area of undisturbed pre-mining topography. The Mountain Block area was actively mined until 2003. A remnant highwall remained which has undergone numerous stabilisation attempts that have been unsuccessful. Stabilisation works occurred between 2004 and 2006 and again in 2009. This is evident in the historical aerial photographs (see **Appendix B**).

The Interim Protocol (p. 5) states:

> *"The minimum area for BSAL is 20 hectares. If the area subject to assessment falls below 20 hectares at any point of the assessment because of exclusion of land that does not meet the criteria, then the land is not BSAL and there is no need to continue the assessment".*

The area subject to the assessment (the Assessment Area) is approximately 42.1 ha.

3.2 METHODOLOGY

The BSAL assessment was conducted by SLR. The methodology in accordance with the Interim Protocol is provided in the detailed BSAL Assessment report included in **Appendix C**.

In summary, the assessment against the BSAL verification criteria included a desktop assessment and soil sampling program. The soil sampling program consisted of four sites, three sampling locations and one check site (see **Figure 3**).

The results of the laboratory tests for the soil samples are provided in **Appendix C** and summarised in the following sections.

3.3 RELIABLE WATER SUPPLY

Under the Interim Protocol, the first step of the BSAL site verification process is to determine whether the proposed development area has access to a "*reliable water supply*". The Interim Protocol declares that the entire Upper Hunter Region has access to a "*reliable water supply*".

3.4 SLOPE

The Interim Protocol states that the surface gradient must be less than 10% in order for the land to be BSAL. The gradient of the land within the Assessment Area is shown in **Figure 5**. The topographic data used in the slope analysis was sourced from aerial surveys (LIDAR). As shown in **Figure 5**, a large portion (39.3 ha) of the Assessment Area possesses a slope gradient greater than 10%. The remaining 2.8 ha of the Assessment Area has a slope gradient of less than or equal to 10%. The 2.8 ha is comprised of small fragmented areas with the largest contiguous area, of gradient less than or equal to 10%, being 0.4 ha.

Therefore, the 39.3 ha of the Assessment Area does not satisfy the slope criteria for BSAL.

Figure 4 identifies that if the slope criteria is not satisfied then the site is not deemed to be BSAL and no further assessment is required.

The remaining 2.8 ha of land within the Assessment Area is less than 20 ha, the minimum contiguous area required for BSAL determination. All land has effectively been excluded from requiring further assessment against the BSAL criteria. The assessment from this point is provided for completeness and to further categorise the soil types within the Assessment Area.

3.5 ROCK OUTCROP AND SURFACE ROCKINESS

The Interim Protocol states that in order to be BSAL, land must satisfy the following criteria:

- Less than 30% rock outcrop; and
- Less than 20% of the surface area contains unattached rock fragments greater than 60 mm diameter.

The soil sampling program confirmed that the all four sampling sites satisfy the criteria for rock outcrop and surface rockiness.

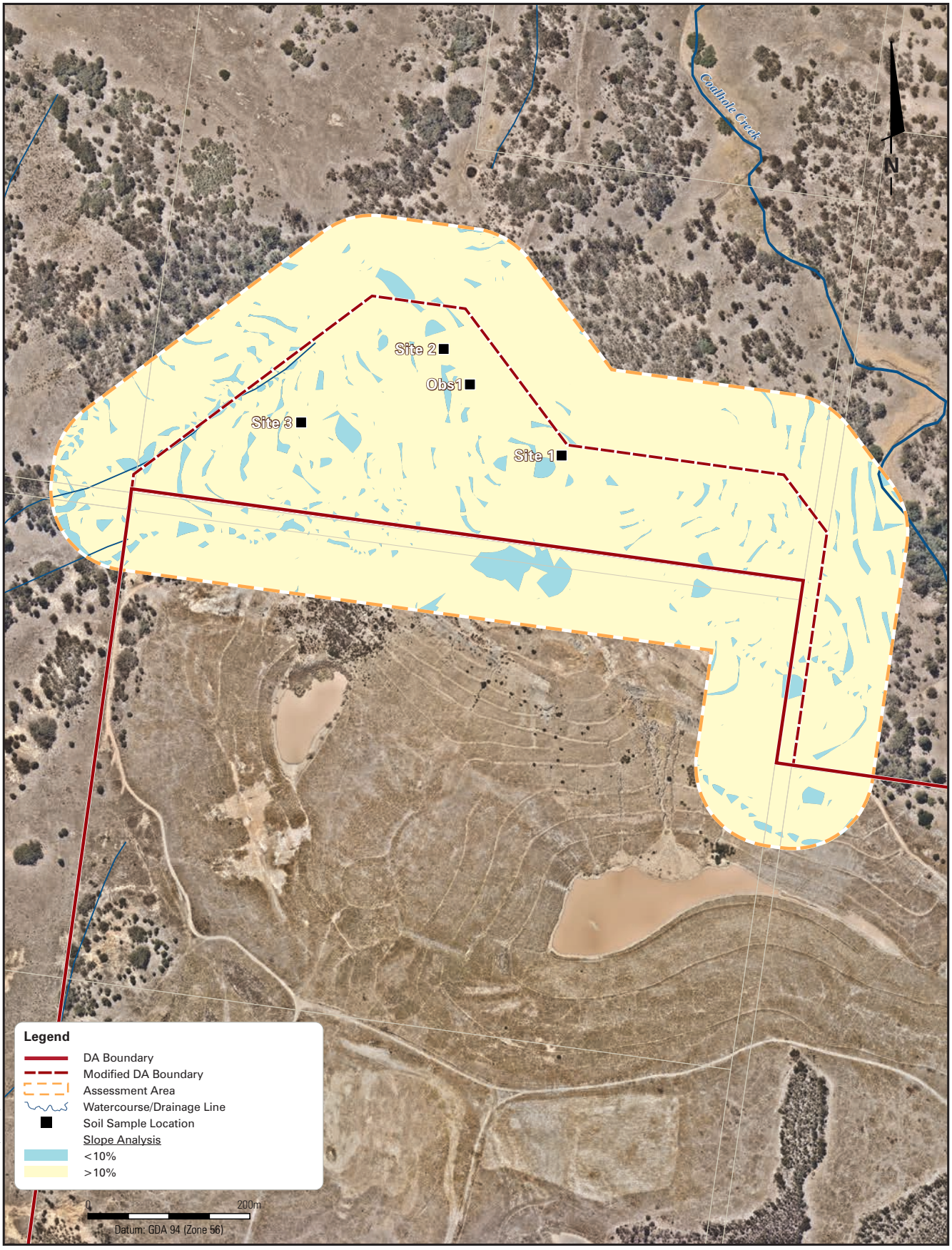
3.6 GILGAI MICRORELIEF

The Interim Protocol states that if gilgai depressions are present, depressions with a depth of greater than 500 mm must account for less than 50% of the mapped area of gilgai. Otherwise, the land does not constitute BSAL.

The soil sampling program determined that the Assessment Area was comprised of three soil types being:

- Eutrophic Brown Kandosol;
- Eutrophic Brown Chromosol; and
- Black-Orthic Paralithic Tenosol.

Gilgai depressions were evident within all four soil types. Therefore, all four sampling locations satisfy the criteria regarding gilgai microrelief.



HB LIDDELL 1805 F5 Slope Analysis 01 03 2018

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Slope Analysis

FIGURE 5

3.7 SOIL FERTILITY

The Interim Protocol states that BSAL must be of a soil type that is characterised as having high, moderately high or moderate fertility.

Appendix 2 of the Interim Protocol provides fertility rankings for each of the Australian Soil Classification (ASC) orders. The Black-Orthic Paralithic Tenosol associated with Site 3 has a fertility level of moderately low and therefore does not meet the criteria. Sites 1, 2 and 4 satisfy the soil fertility criteria for BSAL.

3.8 EFFECTIVE ROOTING DEPTH

The effective rooting depth of a soil is the depth from the surface to a physical or chemical barrier. The Interim Protocol states that in order for land to be BSAL, the effective rooting depth to a physical or chemical barrier must be at least 750 mm.

All sites do not satisfy the criteria for effective rooting depth to a physical barrier. Sites 1 and 2 satisfy the criteria for effective rooting depth to a chemical barrier (noting that results for Site 4 were not confirmed). Site 3 does not satisfy the criteria for effective rooting depth to a chemical barrier.

3.9 DRAINAGE

The Interim Protocol states that poorly drained soils, as defined in the *Australian Soil and Land Survey Field Handbook* (NCST, 2009), do not constitute BSAL.

NCST (2009) explains that “poorly drained” and “very poorly drained” soils generally exhibit significant groundwater and subsurface flow and tend to support a perched water table. The results of the soil sampling program indicate poor drainage characteristics at all four sampling sites. Therefore, none of the sites satisfy the drainage criteria.

3.10 PH

The Interim Protocol states that in order for land to be BSAL, the soil pH must be in the range of:

- 5.0 to 8.9 when measured in water; or
- 4.5 to 8.1 when measured in calcium chloride.

The results of the soil sampling program confirmed that the pH of the soils at Sites 1, 2 and 4 are within the prescribed range for BSAL (see **Appendix C**), and therefore satisfy the criteria for pH. The Black-Orthic Paralithic Tenosol of Site 3 does not meet the criteria for pH.

3.11 SOIL SALINITY

The Interim Protocol states that BSAL must satisfy one of the following criteria regarding soil salinity:

- Electrical Conductivity (EC) in a saturated extract (ECe) of less than 4 dS/m; or

- Chloride concentration of less than 800 mg/kg (if gypsum is present).

The soil sampling program determined that Sites 1, 2 and 3 exhibit an ECe of less than 4 dS/m. Salinity was not measured at Site 4. Sites 1, 2 and 3 satisfy the salinity criteria for BSAL.

4 CONCLUSION

LCO is seeking administrative amendments to DA 305_11_01 under the former section 75W of the EP&A to facilitate operational efficiencies whilst providing the flexibility required for the development of a cost effective and practical environmental outcome for the final landform leading into the final years of mining operations at Liddell.

A component of the Modification is seeking expansion of the DA Boundary to which DA 305-11-01 applies. The extension of the DA Boundary to the north is required to include a 14.64 ha portion of the Mountain Block Offset Area to facilitate required remediation works. A mining lease is not held over the subject land of the Mountain Block Offset.

Pursuant to Clause 20 under Schedule 6A of the EP&A Act, the modification application must be accompanied by a Site Verification Certificate because the following elements are satisfied:

- The Modification constitutes "*mining and petroleum development*" because a new mining lease is required for the development to be carried out; and
- The Modification is proposed to be carried out on land that is shown on the Strategic Agricultural Land Map.

In accordance with the Interim Protocol, the Assessment Area for this Site Verification Certificate application is the area of the proposed mining lease plus a 100 m buffer. The Assessment Area has an area of 42.1 ha. This assessment consisted of a desktop review and soil sampling program.

This assessment determined that 39.3 ha of the Assessment Area did not comply with the slope gradient criteria, which states the surface gradient must be less than 10% in order for the land to be BSAL. Further to this, the remaining 2.8 ha was fragmented and well below the minimum 20 ha contiguous area for BSAL verification.

Three soil types were defined within the assessment area including:

- Eutrophic Brown Kandosol;
- Eutrophic Brown Chromosol; and
- Black-Orthic Paralithic Tenosol.

All soil types do not comply with the criteria for effective rooting depth to a physical barrier of greater than 750 mm.

Full results of the soil sampling program will be provided in a separate report, which will be included in the EA for the Modification.

This Site Verification Certificate application confirms that there is no BSAL within the Assessment Area due to the slope gradient being greater than 10% on 39.3 ha and the remaining land being of an area less than 20 ha, which is the minimum area for BSAL.

We trust that this document provides sufficient information for the Secretary of DP&E to issue a Site Verification Certificate certifying that the land within the Assessment Area is not BSAL.

* * *

For
HANSEN BAILEY

Nathan Cooper
Principal

5 REFERENCES

- Isbell R. F. (2002), *The Australian Soil Classification*. Revised 1st Edition. Prepared for the CSIRO.
- National Committee on Soil and Terrain (2009), *Australian Soil and Land Survey Field Handbook*.
- NSW Government (2013), *Interim protocol for site verification and mapping of biophysical strategic agricultural land.*

APPENDIX A

Landholder Notification

LIDDELL
GLENCORE

22 March 2018

Mr David Scriven
26 Calgaroo Ave
Muswellbrook NSW 2333
Also by email: *dsnds@bigpond.net.au*

Dear David,

Liddell Coal Mine
Notice of Application for a Site Verification Certificate

Liddell Coal Operations Pty Limited (LCO) is proposing to apply for a modification to its Development Consent (DA 305-11-01) under the former Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). LCO is seeking administrative amendments to its development consent to improve the operations efficiency as well as gaining the flexibility required for the final landform leading into the final years of mining operations at Liddell Coal Mine (the Modification). The proposed modification entails an extension to the northern boundary of DA 305-11-01 to enable necessary remediation and rehabilitation works to be undertaken within the Liddell Coal Mine Mountain Block Offset Area.

To facilitate the modification application, LCO intends to lodge an application for a Site Verification Certificate over an assessment area under Clause 17C of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP). The assessment area for this application includes the land subject of the DA boundary extension, plus a 100 m buffer in accordance with the requirements under the *Interim Protocol for the Site Verification and Mapping of Biophysical Strategic Agricultural Land* (DPI-OAS&FS, 2013).

Clause 17C(3) of the Mining SEPP states that an applicant for a Site Verification Certificate must provide written notice of the application to the land owner. As a landholder for which part of the assessment area extends over a small section of your Muddles due to the required buffer, LCO hereby provides notification of the Site Verification Application in respect of the Subject Land shown in Figure 1.

The Subject Land includes the following parcels of land:

- Lot 1 DP 48556 (Crown Land);
- Lot 39 DP 6842 (private Landholder);
- Lot 13C DP 6841 (Liddell);

PO Box 7, Singleton, NSW 2330
Old New England Highway, Ravensworth, NSW 2330
T + 61 2 6570 9900 F + 61 2 6570 9999 www.glencore.com

Liddell Coal Operations Pty Ltd ABN 40 058 857 882
Manager and Agent of the Liddell & Foybrook Joint Ventures

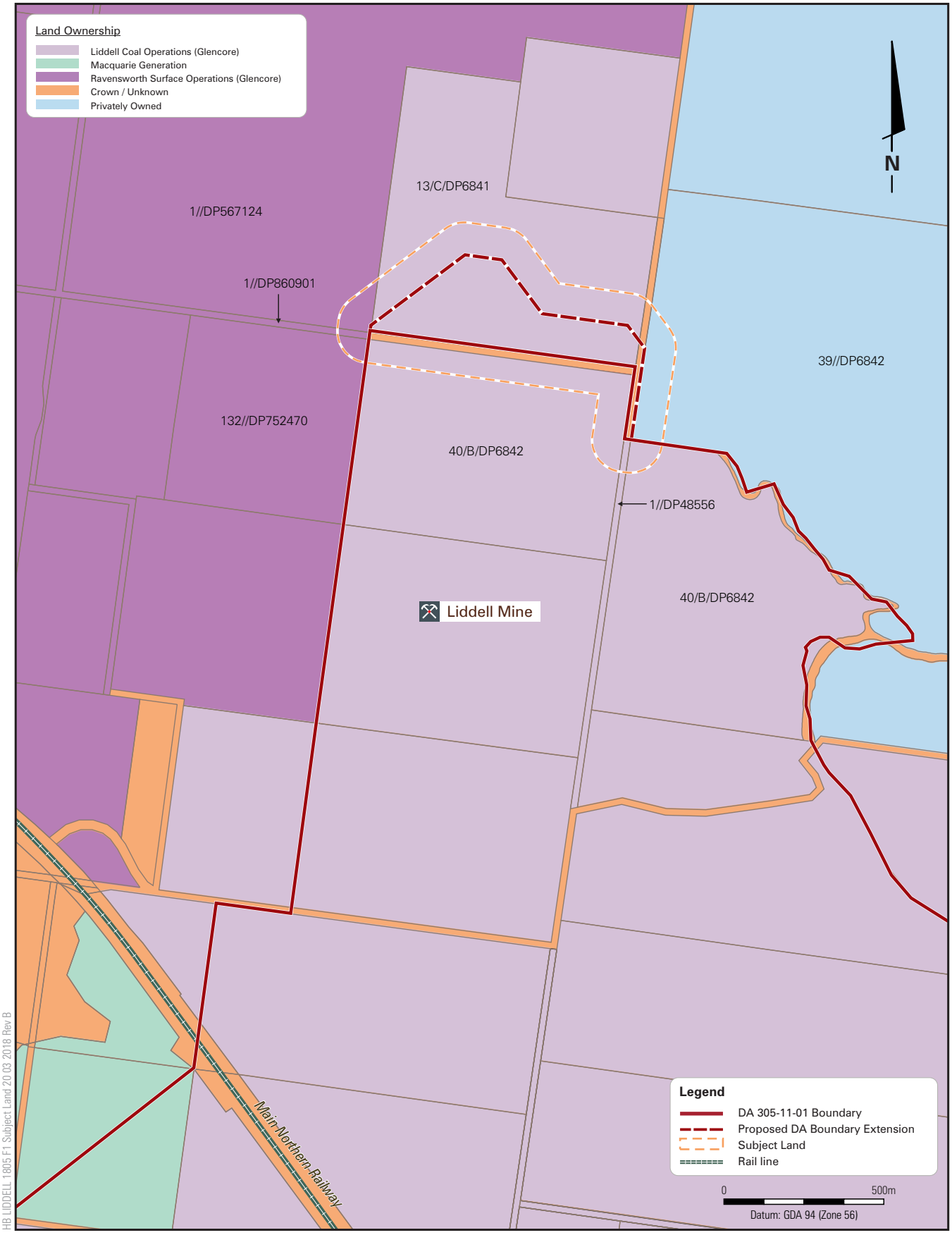
- Lot 40B DP 6842 (Liddell);
- Lot 132 DP 752470 (Hillcrest);
- Lot 1 DP 860901 (Hillcrest);
- Lot 1 DP 567124 (Hillcrest); and
- A portion of Crown road aligned in a general east to west direction with no lot reference.

As discussed on the 21 March 2018, this notification does not mean that we intend to undertake any development on your land, rather is for notification purposes only. Should you have any further queries in relation to this letter, please do not hesitate to contact myself on 02 6570 9947 or via email Ben.Desomer@glencore.com.au.

Yours sincerely

Ben de Somer

Environment and Community Manager



HB LIDDELL 1805 F1 Subject Land 20 03 2018 Rev B

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Subject Land

FIGURE 1

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22 March 2018

Crown Land
Department of Industry]
PO Box 2185
DANGAR NSW 2309

Also by email: *maitland.crownland@crownland.nsw.gov.au*

Attention: Maitland District Office

Liddell Coal Mine
Notice of Application for a Site Verification Certificate

Liddell Coal Operations Pty Limited (LCO) is proposing to apply for a modification to its Development Consent (DA 305-11-01) under the former Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). LCO is seeking administrative amendments to its development consent to improve the operations efficiency as well as gaining the flexibility required for the final landform leading into the final years of mining operations at Liddell Coal Mine (the Modification). The proposed modification entails an extension to the northern boundary of DA 305-11-01 to enable necessary remediation and rehabilitation works to be undertaken within the Liddell Coal Mine Mountain Block Offset Area.

To facilitate the modification application, LCO intends to lodge an application for a Site Verification Certificate over an assessment area under Clause 17C of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP). The assessment area for this application includes the land subject of the DA boundary extension, plus a 100 m buffer in accordance with the requirements under the *Interim Protocol for the Site Verification and Mapping of Biophysical Strategic Agricultural Land* (DPI-OAS&FS, 2013).

Clause 17C(3) of the Mining SEPP states that an applicant for a Site Verification Certificate must provide written notice of the application to the land owner. As a landholder for which part of the assessment area extends over sections of Crown Road due to the required buffer, LCO hereby provides notification of the Site Verification Application in respect of the Subject Land shown in Figure 1.

The Subject Land includes the following parcels of land:

- Lot 1 DP 48556 (Crown Land);
- Lot 39 DP 6842;

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Liddell Coal Operations Pty Ltd ABN 40 058 857 882
Manager and Agent of the Liddell & Foybrook Joint Ventures

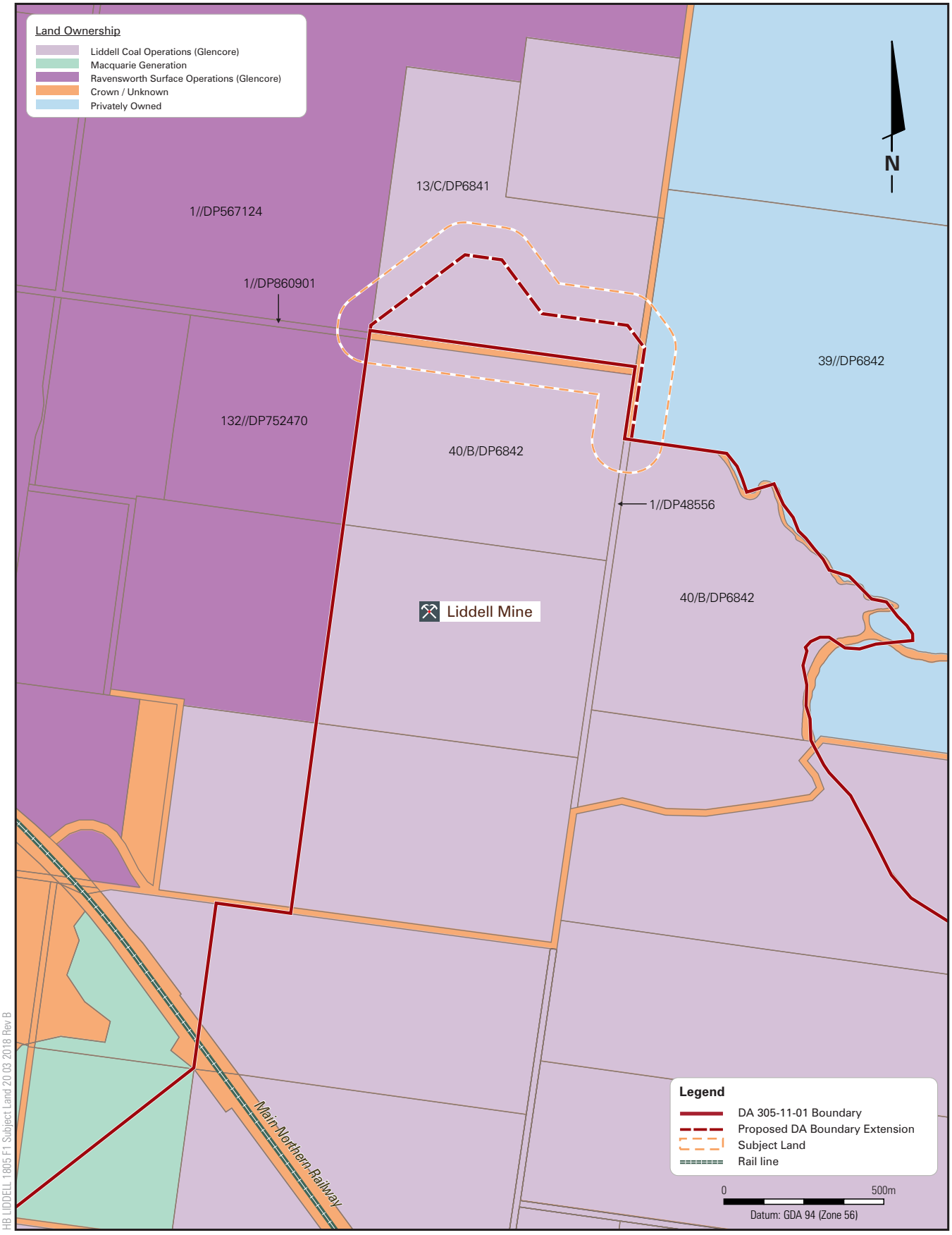
- Lot 13C DP 6841
- Lot 40B DP 6842;
- Lot 132 DP 752470;
- Lot 1 DP 860901;
- Lot 1 DP 567124; and
- A portion of Crown road aligned in a general east to west direction with no lot reference.

Should you have any queries in relation to this letter, please do not hesitate to contact myself on 02 6570 9947 or via email Ben.Desomer@glencore.com.au.

Yours sincerely

Ben de Somer

Environment and Community Manager



HB LIDDELL 1805 F1 Subject Land 20 03 2018 Rev B

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Subject Land

FIGURE 1

LIDDELL
GLENCORE

22 March 2018

Hillcrest
C/- Ravensworth Operations
PO Box 294
Muswellbrook NSW 2333
Also by email: *Luke.Bowden@glencore.com.au*

Dear Luke,

Liddell Coal Mine
Notice of Application for a Site Verification Certificate

Liddell Coal Operations Pty Limited (LCO) is proposing to apply for a modification to its Development Consent (DA 305-11-01) under the former Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). LCO is seeking administrative amendments to its development consent to improve the operations efficiency as well as gaining the flexibility required for the final landform leading into the final years of mining operations at Liddell Coal Mine (the Modification). The proposed modification entails an extension to the northern boundary of DA 305-11-01 to enable necessary remediation and rehabilitation works to be undertaken within the Liddell Coal Mine Mountain Block Offset Area.

To facilitate the modification application, LCO intends to lodge an application for a Site Verification Certificate over an assessment area under Clause 17C of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP). The assessment area for this application includes the land subject of the DA boundary extension, plus a 100 m buffer in accordance with the requirements under the *Interim Protocol for the Site Verification and Mapping of Biophysical Strategic Agricultural Land* (DPI-OAS&FS, 2013).

Clause 17C(3) of the Mining SEPP states that an applicant for a Site Verification Certificate must provide written notice of the application to the land owner. As a landholder for which part of the assessment area extends over sections of Hillcrest due to the required buffer, LCO hereby provides notification of the Site Verification Application in respect of the Subject Land shown in Figure 1.

The Subject Land includes the following parcels of land:

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- Lot 39 DP 6842 (private Landholder);

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Liddell Coal Operations Pty Ltd ABN 40 058 857 882
Manager and Agent of the Liddell & Foybrook Joint Ventures

- Lot 13C DP 6841 (Liddell);
- Lot 40B DP 6842 (Liddell);
- Lot 132 DP 752470 (Hillcrest);
- Lot 1 DP 860901 (Hillcrest);
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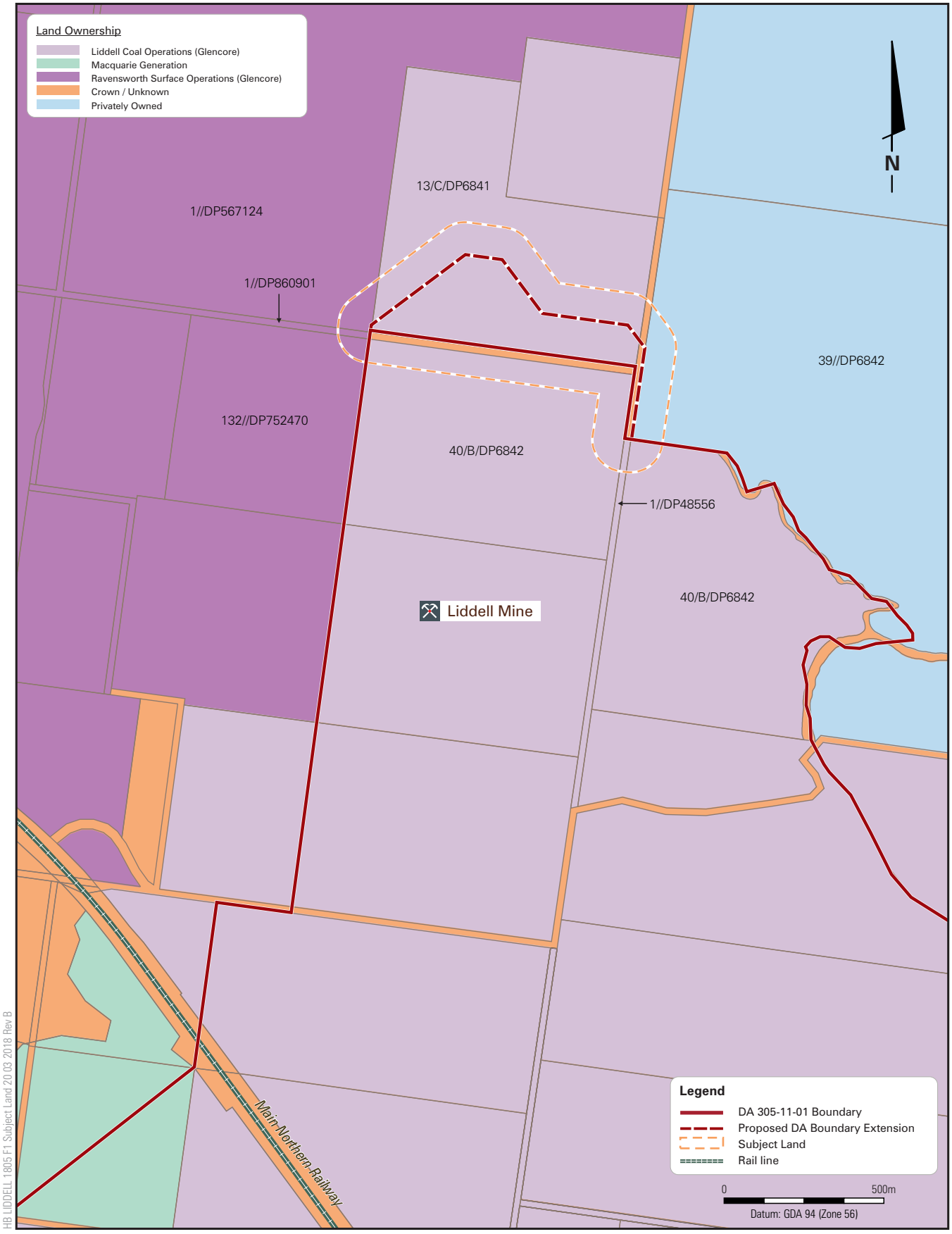
Yours sincerely

Ben de Somer

Environment and Community Manager



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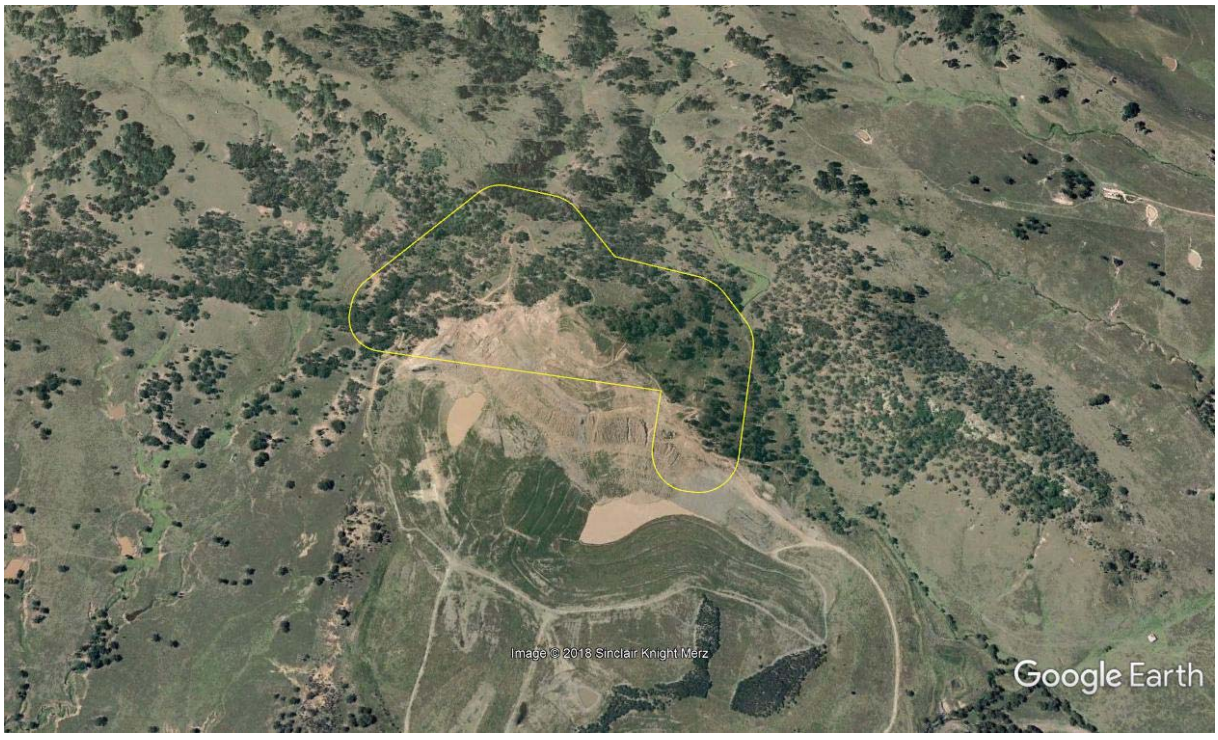
Subject Land

FIGURE 1

APPENDIX B

Historical Aerial Photographs

Aerial image from 3 May 2007 (Source: Google Earth)



Aerial image from 13 January 2009 (Source: Google Earth)

Aerial image from 15 May 2009 (Source: Google Earth)

Aerial image from 11 October 2013 (Source: Google Earth)

Aerial image from 22 August 2015 (Source: Google Earth)

APPENDIX C

BSAL Assessment

global environmental solutions

Liddell Coal Mine

Biophysical Strategic Agricultural Land Assessment

Report Number 630.12415

March 2018

Liddell Coal Mine

Version: Final

Liddell Coal Mine

Biophysical Strategic Agricultural Land Assessment

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
630.12415	Final	March 2018	Murray Fraser	Clayton Richards	

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TABLES

Table of Contents

1 INTRODUCTION

Liddell Coal Operations Pty Limited (LCO) operates the Liddell Coal Mine (Liddell) in the Upper Hunter Valley of New South Wales (NSW). LCO is a wholly owned subsidiary of Glencore Coal Pty Limited (Glencore).

Hansen Bailey is currently preparing an application on behalf of LCO to modify Liddell's Development Approval (DA 305-11-01). This modification application will be made under the former section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). LCO is seeking to facilitate a number of administrative amendments to the conditions of DA 305-11-01. One of these amendments is to extend the Development Application Boundary (DA Boundary) to which DA 305-11-01 applies, covering part of the Mountain Block Offset Area to enable necessary remediation works to be undertaken (**Figure 1**).

The proposed application to modify DA 305-11-01 under the former section 75W of the EP&A Act triggers the requirement for a Site Verification Certificate. This document assesses the relevant land in accordance with the *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OASFS), 2013) (Interim Protocol). The legislative requirement for a Site Verification Certificate is discussed further in **Section 1.3**.

LCO engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a Biophysical Strategic Agricultural Land (BSAL) Assessment to support an application for a Site Verification Certificate.

1.1 Modification Description

The Modification seeks to amend some administrative conditions of the DA 305-11-01 to facilitate operational efficiencies whilst providing the flexibility required for the development of a cost effective and practical environmental outcome for the final landform leading into the final years of mining operations at Liddell.

Specifically, and the subject of the Site Verification application, the Modification requires a minor adjustment of the DA Boundary to which DA 305-11-01 applies. The extension of the DA Boundary to the north is required to include an approximate 14.64 hectare portion of the Mountain Block Offset Area to facilitate required remediation works. The proposed boundary extension is shown in **Figure 1**.

1.2 Study Area

The Assessment Area for the BSAL Assessment (Study Area) includes the DA Boundary amendment plus a 100 metre buffer, totalling 42.1 hectares (**Figure 2**). None of the Study Area is mapped as BSAL according to the NSW Government (DP&I, 2012).

1.3 Legislation and Standards

1.3.1 Interim Protocol for Site Verification and Mapping of BSAL

In April 2013, the Interim Protocol (DPI-OASFS, 2013) was released by the NSW Government. The Interim Protocol outlines the process for seeking verification of whether or not land mapped as BSAL meets the established BSAL criteria. The *State Environment Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment 2013* (the 2013 Mining SEPP amendment) requires certain types of developments to verify whether the proposed site is on BSAL.

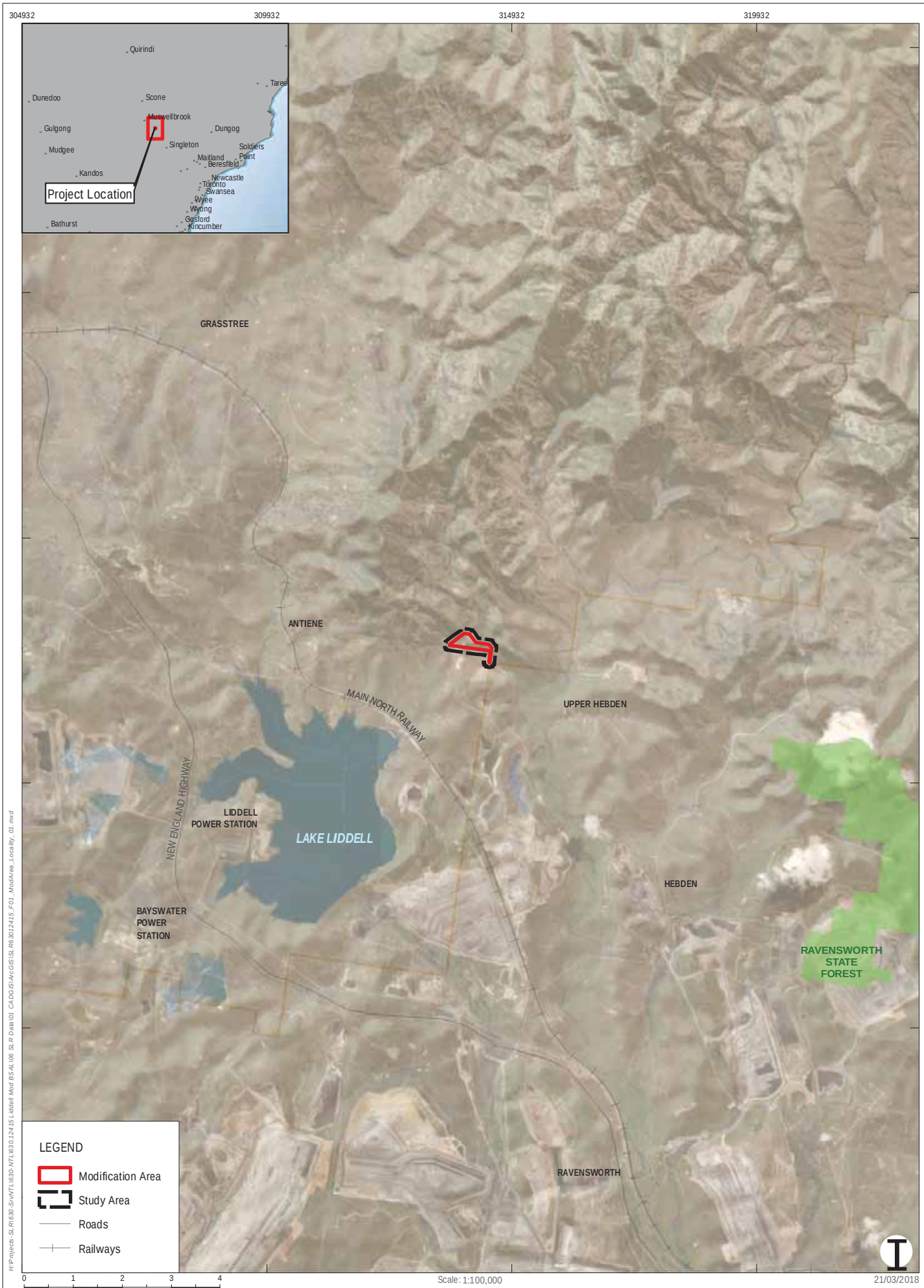
The purpose of the Interim Protocol is to assist proponents and landholders to understand what is required to identify the existence of BSAL. It outlines the technical requirements for the on-site identification and mapping of BSAL.

All figures within this assessment have been presented at 1:25,000 scale, as per the Interim Protocol. Zoomed figures at a scale of 1:5,000 are presented in **Appendix A**.

1.3.2 Assessment Standards

The key standards for this assessment include:

- Interim Protocol;
- Australian Soil Classification (ASC) system (Isbell, 2002);
- Guidelines for Surveying Soil and Land Resources (National Committee on Soil and Terrain (NCST), 2008); and
- Australian Soil and Land Survey Field Handbook (NCST, 2009).



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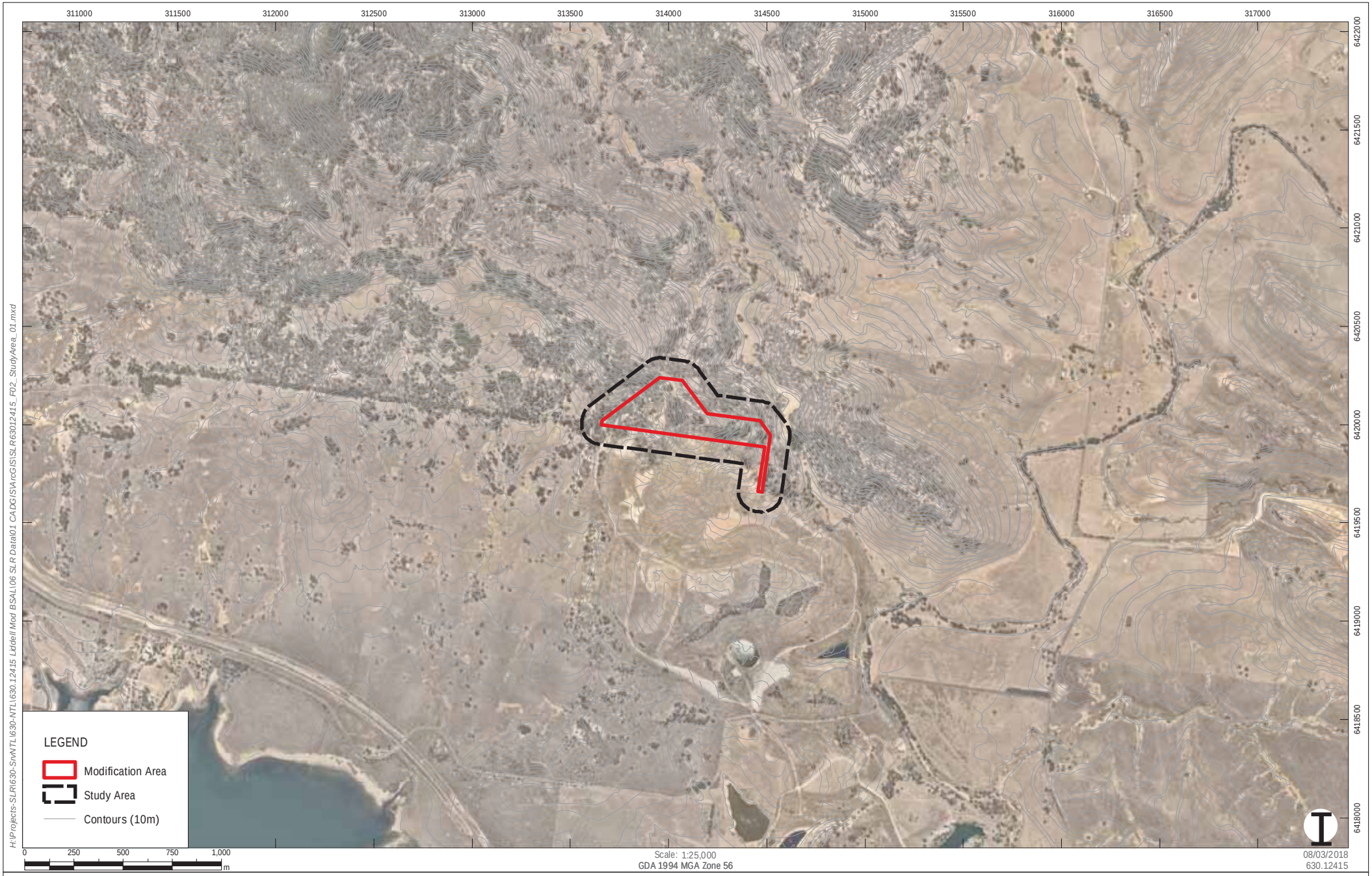
Regional Locality

FIGURE 1



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Study Area

FIGURE 2

2 METHODOLOGY

The site verification methodology for the Study Area has been undertaken consistent with the process described within the Interim Protocol; including the following steps:

1. Identify the project area (termed Study Area in this report) which will be assessed for BSAL;
2. Confirm access to a reliable water supply;
3. Choose the appropriate approach to map the soils information;
4. Risk assessment; and
5. Field Soil Survey and BSAL Assessment.

Each of these steps is described in further detail in the following subsections.

2.1 Step 1: Identify the project area which will be assessed for BSAL

The Interim Protocol requires that *"the assessment area should include the entire project area and include at least a 100 m buffer to take into account minor changes in design, surrounding disturbance and minor expansion. If BSAL is part of a larger contiguous mass of BSAL then the boundary of this area must also be identified."*

The Study Area for this BSAL Assessment is shown in **Figure 2**. The Study Area includes a 100 metre buffer surrounding the Modification Area and totals 42.1 hectares.

2.2 Step 2: Confirm access to a reliable water supply

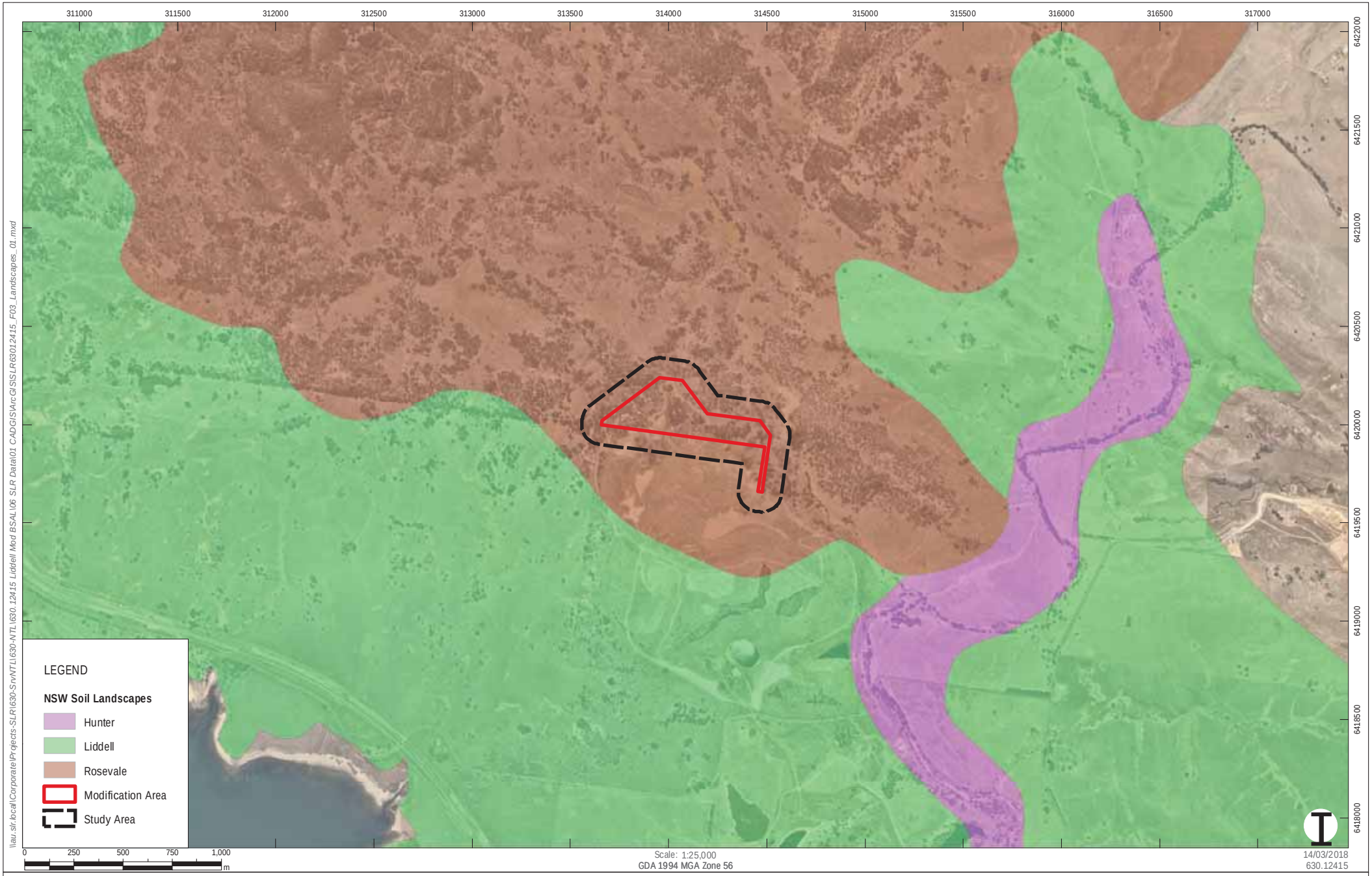
The Interim Protocol requires that *"BSAL lands must have access to a reliable water supply."*

Representative rainfall data for the Study Area has been obtained from the nearest Bureau of Meteorology (BOM) weather station with long term rainfall records located at Jerrys Plains (BOM 61086). The Jerrys Plains BOM Station has recorded an average annual rainfall of 645 millimetres (based on records from 1886 – present) therefore, the Study Area meets the minimum average annual rainfall of 350 millimetres to have access to a reliable water supply.

2.3 Step 3: Choose the appropriate approach to map the soils information

The Interim Protocol states *"access to the project area will define the level of investigation that the proponent can undertake. If the proponent has access to the land then the BSAL verification requirements for on-site soils assessment as described in sections 6 and 9 of the Interim Protocol should be met. If the proponent does not have access then the proponent should develop a model of soils distribution guided by sections 6 and 9 based on landscape characteristics using the information listed in Section 5 of the Interim Protocol."*

Access was limited in the western portion of the Study Area due to very steep topography and poor access tracks. The entire Study Area was mapped as the Rosevale Soil Landscape Unit by Kovac and Lawrie (1991) on the Soil Landscapes of the Singleton 1:250,000 Sheet (**Figure 3**).



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Soil Landscapes

FIGURE 3

2.4 Step 4: Risk assessment

The Interim Protocol states *"the proponent should undertake a risk assessment as this will influence the density of soil sampling required as explained in Section 9.6.1. The proposed activity on parts or all of the project area may be of low risk to agriculture and so may only require a sampling density of 1:100 000. Alternatively other areas may be at higher risk of impact and so should have a sampling density of 1:25 000."*

The Study Area comprises a portion of LCO's Biodiversity Offset Area and as such is not used for agriculture. SLR has assessed the following potential impacts of the Modification within the Study Area on agriculture:

- Consequence: Level 5 – Very minor damage and minor impact to agricultural resources or industries; and
- Probability: E – Very minor damage and minor impact to agricultural resources or industries. Can be effectively managed as part of normal operations.

The risk matrix result was E5 which is considered a low risk. The Study Area therefore required an inspection density of 1:100,000.

2.5 Step 5: Field Soil Survey and BSAL Assessment

The field survey for the BSAL Assessment was undertaken on February 15th, 2018 by SLR's Associate Agronomist, Murray Fraser, while Clayton Richards (CPSS 2) was responsible for technical input into the field work methodology and review of the BSAL Assessment.

2.6 Field Soil Survey Methodology

For soil to be classified as BSAL it must meet the criteria outlined in the flow chart shown in **Diagram 1**. If any criteria is not met (except for those outlined in step 5 or step 6), the site is not BSAL and there is no need to continue the assessment.

Section 6 of the Interim Protocol states *"slope is the upward or downward incline of the land surface, measured in per cent. BSAL soils must have a slope of less than or equal to 10 per cent. If any criteria are not met, the site is not BSAL and there is no need to continue the assessment"*.

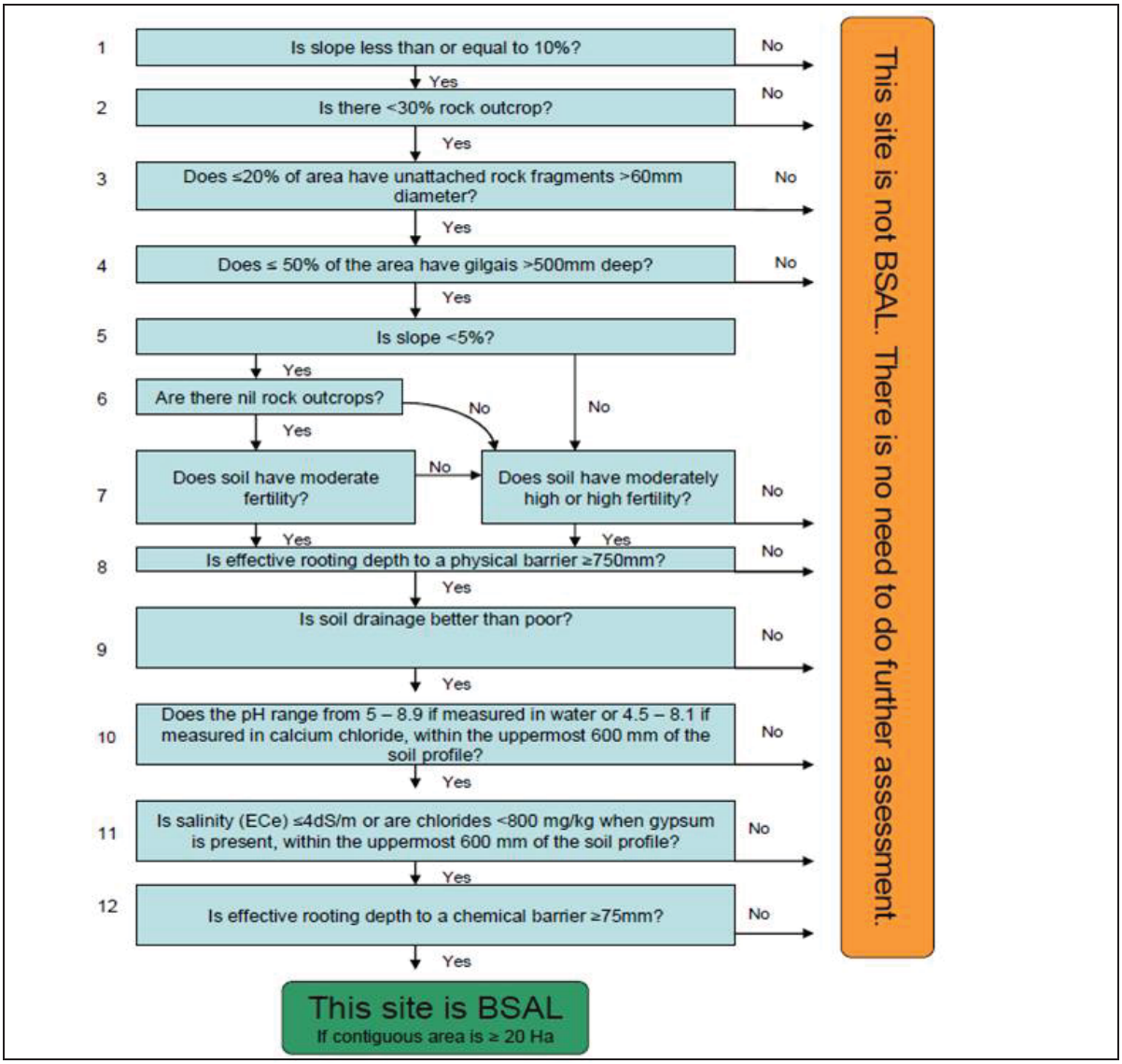
The design of the soil survey program was developed by following a process of applying the BSAL methodology as a desktop exercise in the first instance to identify any areas that would obviously not meet the criteria (termed exclusion zones). The field survey program was then developed to ensure that areas of relatively higher likelihood of meeting BSAL criteria were targeted for field analysis.

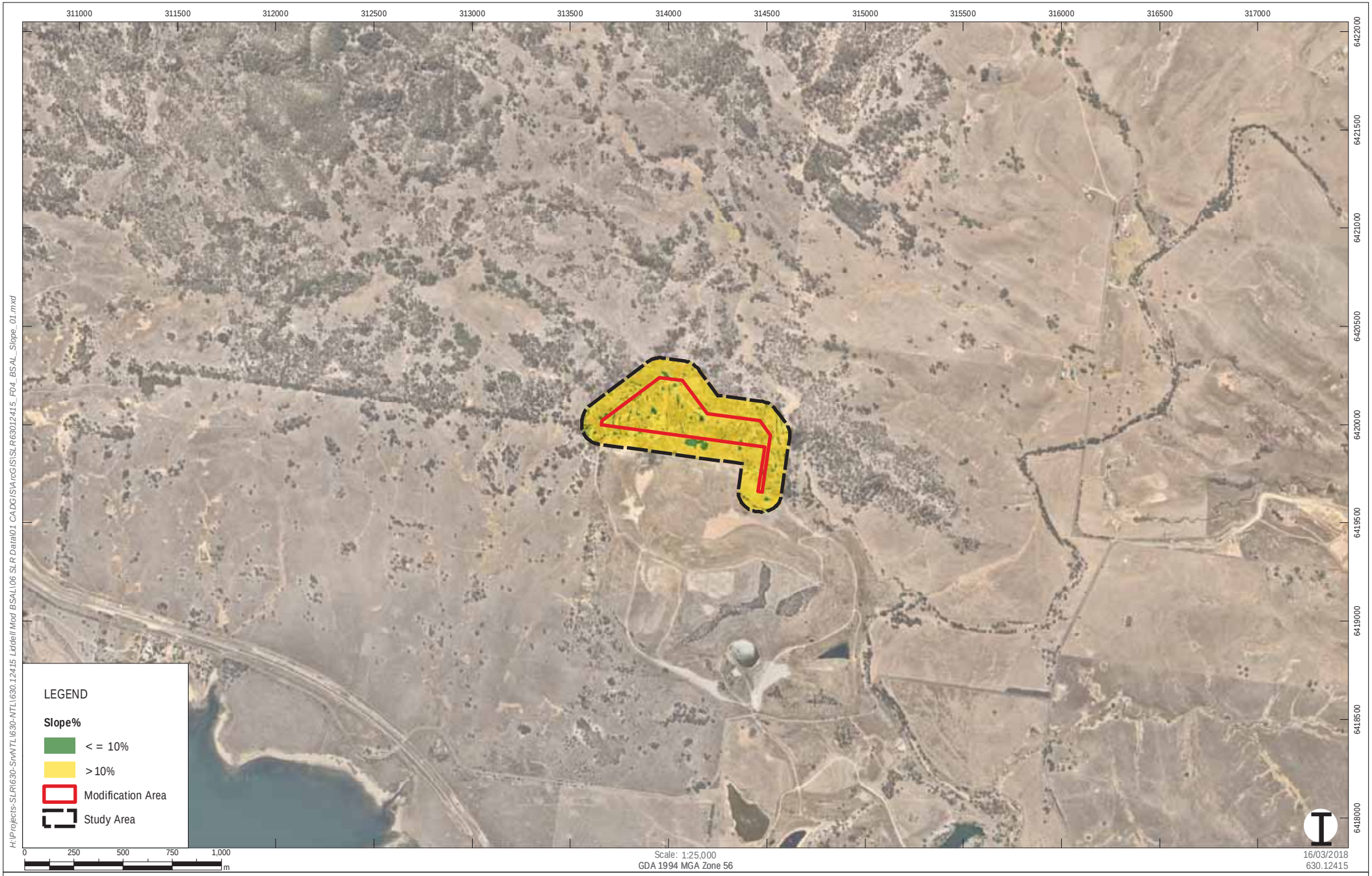
2.6.1 Exclusion Zones

Land greater than 10% slope (**Figure 3**) within the Study Area was identified using topographical data derived from LIDAR. Areas with greater than 10% slope were excluded from the soil survey program. In total, 39.3 hectares of the Study Area was determined not to meet the BSAL methodology Criteria 1 (**Figure 4**). The Slope Analysis methodology is provided in **Appendix B**. The remaining 2.8 hectares is less than 20 hectares contiguous area, and so failed the final BSAL methodology Criteria of *the site is BSAL if contiguous area is great than or equal to 20 hectares* (**Diagram 1**).

In summary, 42.1 hectares was determined not to meet the BSAL methodology criteria within the Assessment Area. Notwithstanding, four sites were selected for field sampling to identify soil types present within the Study Area (**Figure 5**).

Diagram 1 BSAL Criteria Flow Diagram





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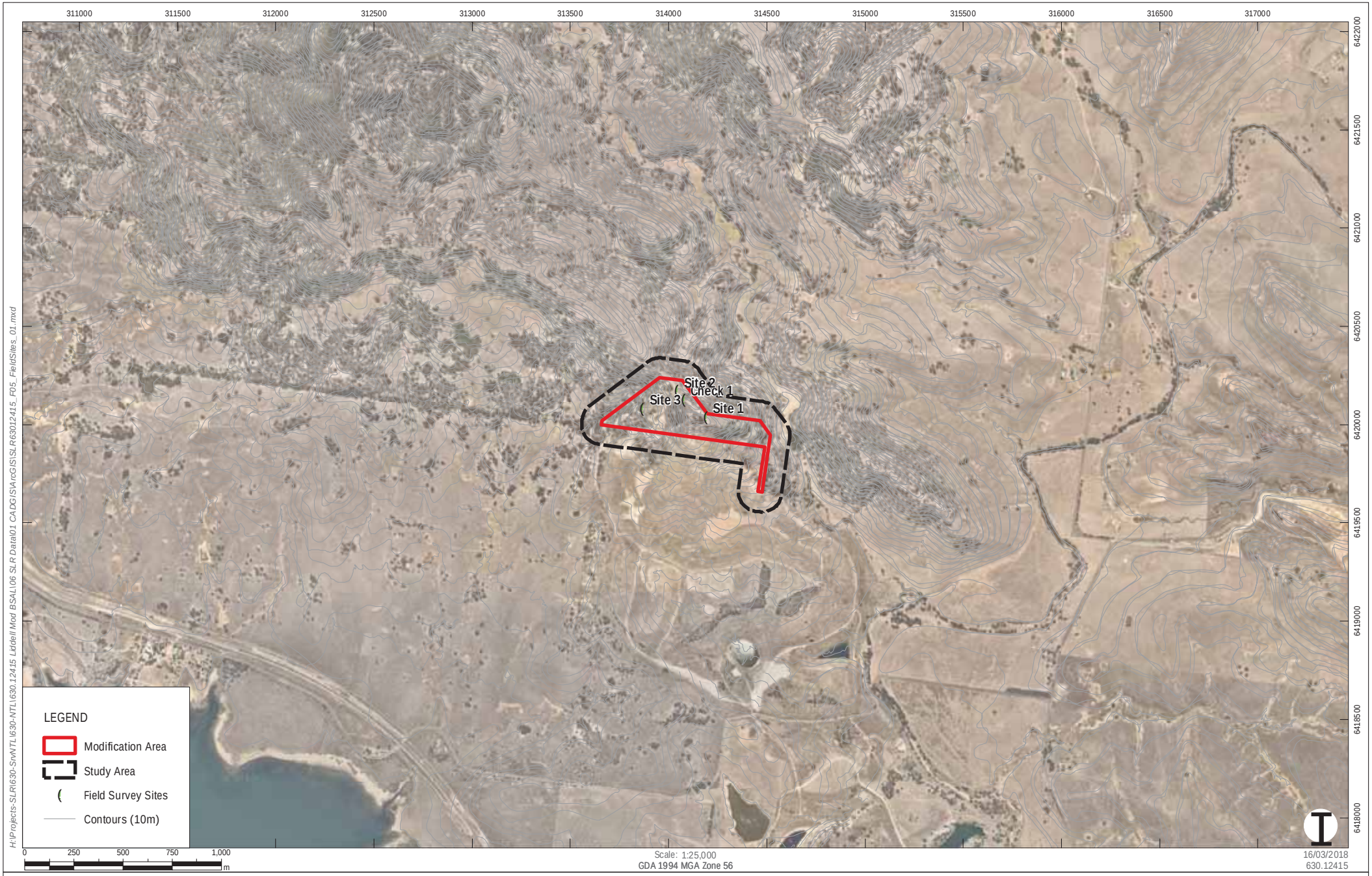
Slope Analysis

FIGURE 4



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Field Survey Sites

FIGURE 5

2.6.2 Soil Survey Density

To satisfy soil mapping requirements, the field soil survey program was undertaken and comprised of three detailed sites and one check site, as shown on **Figure 5**. A breakdown of the soil survey density, as per Interim Protocol requirements, is provided in **Table 1**.

Due to the entire Study Area being excluded no sites were required to be surveyed. Notwithstanding, four sites were selected to survey to gain a better understanding of the soils within the Study Area.

Table 1 Soil Survey Density

Survey Area	Hectares	Survey Scale	Required Sites	Sites Completed
< 10% slope & > 20 ha	Nil	1:100,000	Nil	Nil
Exclusion > 10% Slope	39.3	Nil	Nil	4
Exclusion < 20 ha	2.8	Nil	Nil	Nil
Total	**42.1**	**1:100,000**	**Nil**	**4**

2.6.3 Soil Survey Observation Types

Detailed Sites

Soil profiles were assessed in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure was excavated by a hydraulic soil corer to either a depth of 1.0 metre, to equipment refusal, or to bedrock. After assessment, soil core holes were backfilled with the remaining soil. Detailed soil profile morphological descriptions were prepared to record the information specified in the Interim Protocol.

Samples were sent to the Scone Research Centre (NSW, Australia) for analysis of the suite of parameters listed in **Table 2**. This laboratory is National Association of Testing Authority (NATA) accredited. Laboratory Soil Test Results Certificates of Analysis are contained in **Appendix C**.

Table 2 BSAL Soil Laboratory Analysis Parameters

Laboratory Analysis	
• Electrical Conductivity (EC) • pH (1:5 Water & $CaCl_2$) • Total Cation Exchange & Exchangeable Cations	• Cation Exchange Capacity (CEC) • Particle Size Analysis • Munsell Colour

Soil salinity data was determined through measurement of the electrical conductivity (EC) of soil:water (1:5) suspensions. These values are converted to the EC of a saturated extract (ECe) based on soil texture in accordance with the Interim Protocol.

Check Sites

Check sites are mapping observations examined in sufficient detail to allocate the site to a specific soil type and map unit.

3 SOILS ASSESSMENT

Three soil types were identified during the soil survey a Brown Kandosol, a Brown Chromosol and Black-Orthic Tenosol, which are described in the following tables.

Table 3 Summary: Eutrophic Brown Kandosol (Site 1)

Overview	
	
Landscape Site 1	
ASC Name	Eutrophic Brown Kandosol
Representative Site	Site 1
Survey Type	Detail
Dominant Topography	Upper Slope Cutting
Dominant Land Use	Biodiversity Offset Area
Vegetation	Grey Box, Ironbark, Spotted Gum, Wire Grass
Inherent Soil Fertility	Moderate
Slope	32%
Verified	Non-BSAL

Table 4 Profile: Eutrophic Brown Kandosol (Site 1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Very dark greyish brown (10YR 3/2) loam, weakly structured 5-10 mm crumb peds with weak consistence and a rough fabric. Nil mottling, 30% gravel 5-30 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	B2 0.15 – 0.40	Dark yellowish brown (10YR 3/6) light-medium clay, weakly structured 5-20 mm blocky peds with a weak consistence and a rough fabric. Nil mottling, 15% gravel 5-50 mm, coarse roots common. Well drained with a clear and even boundary. Sampled 0.20 – 0.30 and 0.30 – 0.40
	BC +0.40	Rock and weathered parent material. Not sampled

Table 5 Chemical Parameters: Eutrophic Brown Kandosol (Site 1)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.1	Moderately Acidic	0.8	Non-Sodic	0.1	Non-Saline	3.7	Moderate
B2	5.1	Moderately Acidic	1.5	Non-Sodic	0.4	Non-Saline	1.8	Low
B2	5.5	Slightly Acidic	1.8	Non-Sodic	0.5	Non-Saline	2.1	Moderate

Table 6 Summary: Eutrophic Brown Chromosol (Site 2)

Overview	
 **Landscape Site 2**	
ASC Name	Eutrophic Brown Chromosol
Representative Site	Site 2
Survey Type	Detail
Dominant Topography	Upper Slope
Current Land Use	Biodiversity Offset Area
Vegetation	Grey Box, Ironbark, Spotted Gum, Wire Grass
Inherent Soil Fertility	Moderately High
Slope	20%
Verified	Non-BSAL

Table 7 Profile: Eutrophic Brown Chromosol (Site 2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark reddish-brown (5YR 2.5/2) loamy sand, weakly structured 5-10 mm crumb peds with weak consistence and a rough fabric. Nil mottling, 20% gravel 5-25 mm, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.0 – 0.10
	B2 0.15 – 0.50	Dark brown (7.5YR 3/4) clay loam, moderately structured 10-30 mm blocky peds with moderate consistence and a rough fabric. Nil mottling, 20% gravel 10-25 mm, coarse roots common. Well drained with clear and even boundary. Sampled 0.20 – 0.30 and 0.30 – 0.40
	BC +0.50	Weathered parent material. Not sampled

Table 8 Chemical Parameters: Eutrophic Brown Chromosol (Site 2)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.9	Moderately Acidic	0.6	Non-Sodic	0.2	Non-Saline	4.19	Balanced
B2	4.9	Moderately Acidic	1.4	Non-Sodic	0.3	Non-Saline	1.54	Low
B2	5.0	Slightly Acidic	1.7	Non-Sodic	0.3	Non-Saline	1.56	Low

Table 9 Summary: Black-Orthic Paralithic Tenosol (Site 3)

Overview	
	
Landscape Site 3	
ASC Name	Black-Orthic Paralithic Tenosol
Representative Site	Site 3
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Biodiversity Offset Area
Vegetation	Grey Box, Ironbark, Spotted Gum, Wire Grass
Inherent Soil Fertility	Moderately Low
Slope	16%
Verified	Non-BSAL

Table 10 Profile: Black-Orthic Paralithic Tenosol (Site 3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Very dark brown (10YR 2/2) loamy sand, weakly structured 5-10 mm crumb peds with weak consistence and a rough fabric. Nil mottling, 10% gravel 5-10 mm, abundant fine roots. Well drained with a clear and wavy boundary. Sampled 0.0 – 0.10
	B2 0.15 – 0.45	Dark brown (7.5YR 3/2) loam, apedal with a sandy fabric. Nil mottling, 10% gravel 5-20 mm, coarse roots common. Well drained with a clear and wavy boundary Sampled 0.20 – 0.30 and 0.30 – 0.40
	BC +0.45	Weathered parent material. Not sampled

Table 11 Chemical Parameters: Black-Orthic Paralithic Tenosol (Site 3)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.5	Strongly Acidic	0.8	Non-Sodic	0.9	Non-Saline	2.32	Moderate
B2	4.0	Strongly Acidic	7.2	Marginally Sodic	0.2	Non-Saline	0.56	Low
B2	4.1	Strongly Acidic	11.6	Sodic	0.3	Non-Saline	0.55	Low

Table 12 Summary: Brown Kandosol (Site 4)

Overview	
	
Landscape Site 4	
ASC Name	Brown Kandosol
Representative Site	Site 4
Survey Type	Check
Dominant Topography	Upper Slope Cutting
Dominant Land Use	Biodiversity Offset Area
Vegetation	Grey Box, Ironbark, Spotted Gum, Wire Grass
Inherent Soil Fertility	Moderate
Slope	32%
Verified	Non-BSAL

Table 13 Profile: Brown Kandosol (Site 4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Brown (10YR 4/3) loam, weakly structured 2-5 mm crumb peds with weak consistence and a rough fabric. Nil mottling, 20% gravel 5-30 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	B2 0.15 – 0.30	Dark yellowish brown (10YR 3/4) light clay, weakly structured 5-10 mm blocky peds with a weak consistence and a rough fabric. Nil mottling, 25% gravel 5-50 mm, coarse roots common. Well drained with a clear and even boundary. Sampled 0.20 – 0.30
	BC +0.30	Weathered parent material. Not sampled

Table 14 Field Chemical Parameters: Brown Kandosol (Site 4)

Horizon	Field pH		Dispersivity
	Unit	Rating	Rating
A1	5.5	Moderately Acidic	Low
B2	5.5	Moderately Acidic	Low

4 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND ASSESSMENT

This BSAL Assessment has been conducted in accordance with Interim Protocol. The BSAL status was determined on the dominant soil type within each Soil Unit. The BSAL assessment and limitations for each soil unit and sample site is shown in **Table 16**.

According to the Interim Protocol, the findings of this BSAL Assessment, as shown in **Table 15**, are:

- An exclusion area of 39.3 hectares for land greater than 10% slope was identified and excluded as potential BSAL.
- An exclusion area of 2.8 hectares for land less the 20 hectares contiguous area was identified and excluded as potential BSAL.
- Three soil types were identified during the soil survey and all were considered non-BSAL:
    - Eutrophic Brown Kandosol which failed Criteria 1 (slope), Criteria 5 (rock outcrop), Criteria 7 (fertility) and Criteria 8 (soil depth).
    - Eutrophic Brown Chromosol which failed Criteria 1 (slope), Criteria 5 (rock outcrop) and Criteria 8 (soil depth).
    - Black-Orthic Paralithic Tenosol which failed Criteria 1 (slope), Criteria 5 (rock outcrop), Criteria 7 (fertility) Criteria 8 (soil depth), Criteria 10 (pH) and Criteria 12 (sodicity).

Table 15 BSAL Assessment Summary

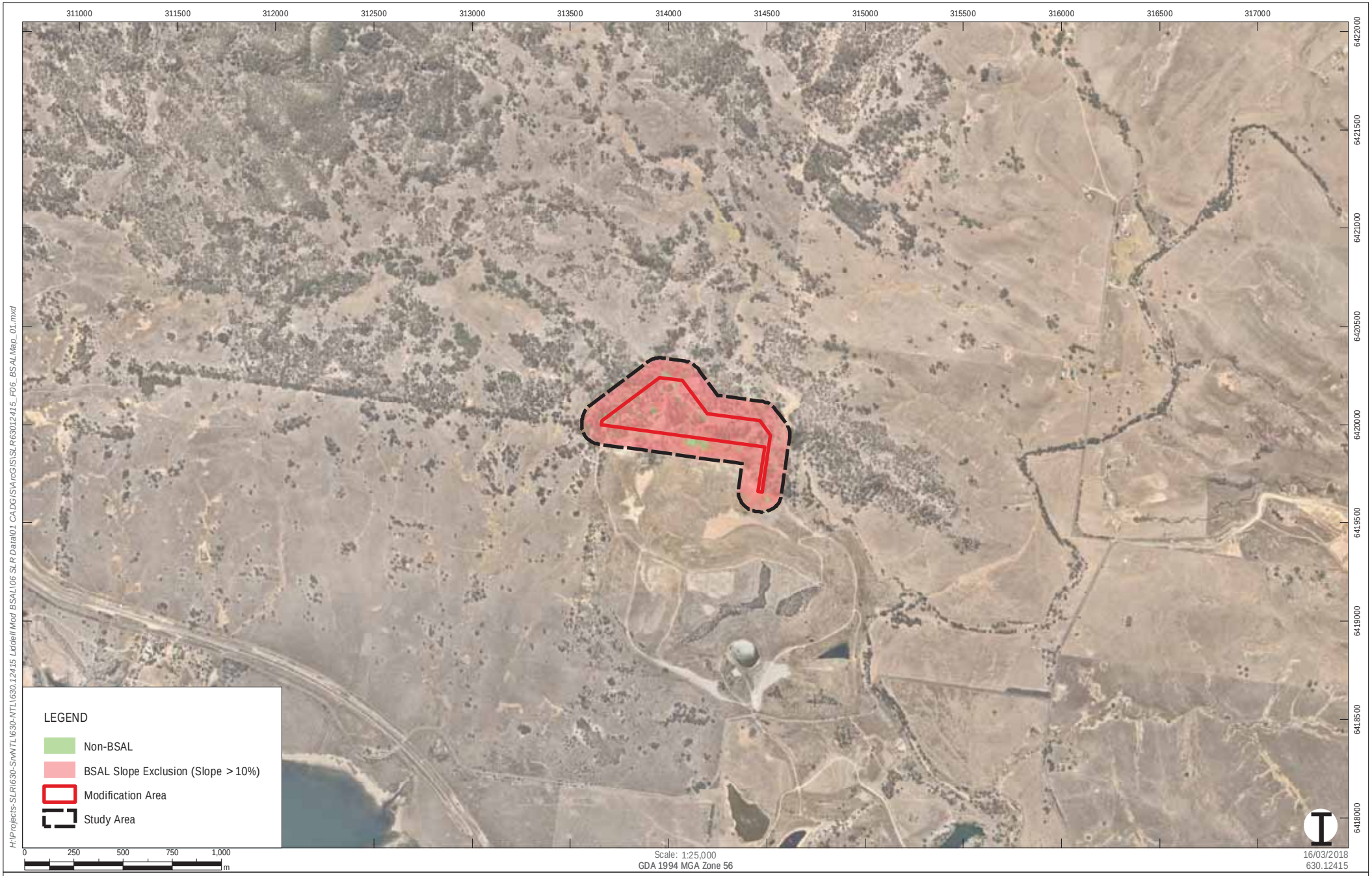
Soil Survey BSAL Assessment	Hectares
Verified BSAL	Nil
Verified Non-BSAL	42.1
Non-BSAL Total	**42.1**
Exclusion > 10% Slope	39.3
Exclusion < 20 ha	2.8
Exclusion Total	**42.1**
BSAL Assessment Area Total	**42.1**

There were no soil types within the Study Area which met the criteria in the Interim Protocol to be classified as BSAL, and as such the entire Study Area has been mapped as non-BSAL, shown in **Figure 6.**

Table 16 BSAL Assessment

Site Number	Inspection Type	ASC Soil Type (to Great Group for detailed sites)	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 ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9 (water) and 4.5 and 8.1 (CaCl2)?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Type BSAL?
Soil Types																
1	Detailed	Eutrophic Brown Kandosol	✘	✓	✓	✓	✘	✘	✓	✘	✘	✓	✓	✓	✓	No
2	Detailed	Eutrophic Brown Chromosol	✘	✓	✓	✓	✘	✘	✓	✓	✘	✓	✓	✓	✓	
3	Detailed	Black-Orthic Paralithic Tenosol	✘	✓	✓	✓	✘	✘	✘	✘	✘	✓	✘	✓	✘	
4	Check	Brown Kandosol	✘	✓	✓	✓	✘	✘	✓	✘	✘	✓	✓	-	-	

✓ = passes the BSAL criteria ✘ = fails the BSAL criteria - Check sites are not laboratory tested



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BSAL Map

FIGURE 6

5 CONCLUSION

This BSAL Assessment for a portion of the Liddell Mountain Block Offset Area was undertaken by SLR Consulting. The Assessment Area for this BSAL Assessment comprises the proposed amendment to the Liddell DA Boundary, plus a 100 metre buffer, totalling 42.1 hectares. None of the Assessment Area is mapped as BSAL according to the NSW Government mapping (DP&I, 2012).

The three soil types identified during the soil survey all failed multiple BSAL Criteria.

Additionally, there was 39.3 hectares excluded as BSAL due to containing greater than 10% slope and 2.8 hectares excluded due to it being less than 20 hectares contiguous area. Therefore, the total Study Area has been mapped as non-BSAL.

It can be concluded that there is no qualifying BSAL within the Assessment Area.

6 REFERENCES

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DPI-OASFS (2013) Interim protocol for site verification and mapping of biophysical strategic agricultural land

Isbell (2002) Australian Soil Classification Revised Edition

Kovac and Lawrie (1991) Soil Landscapes of the Singleton 1:250,000 Sheet

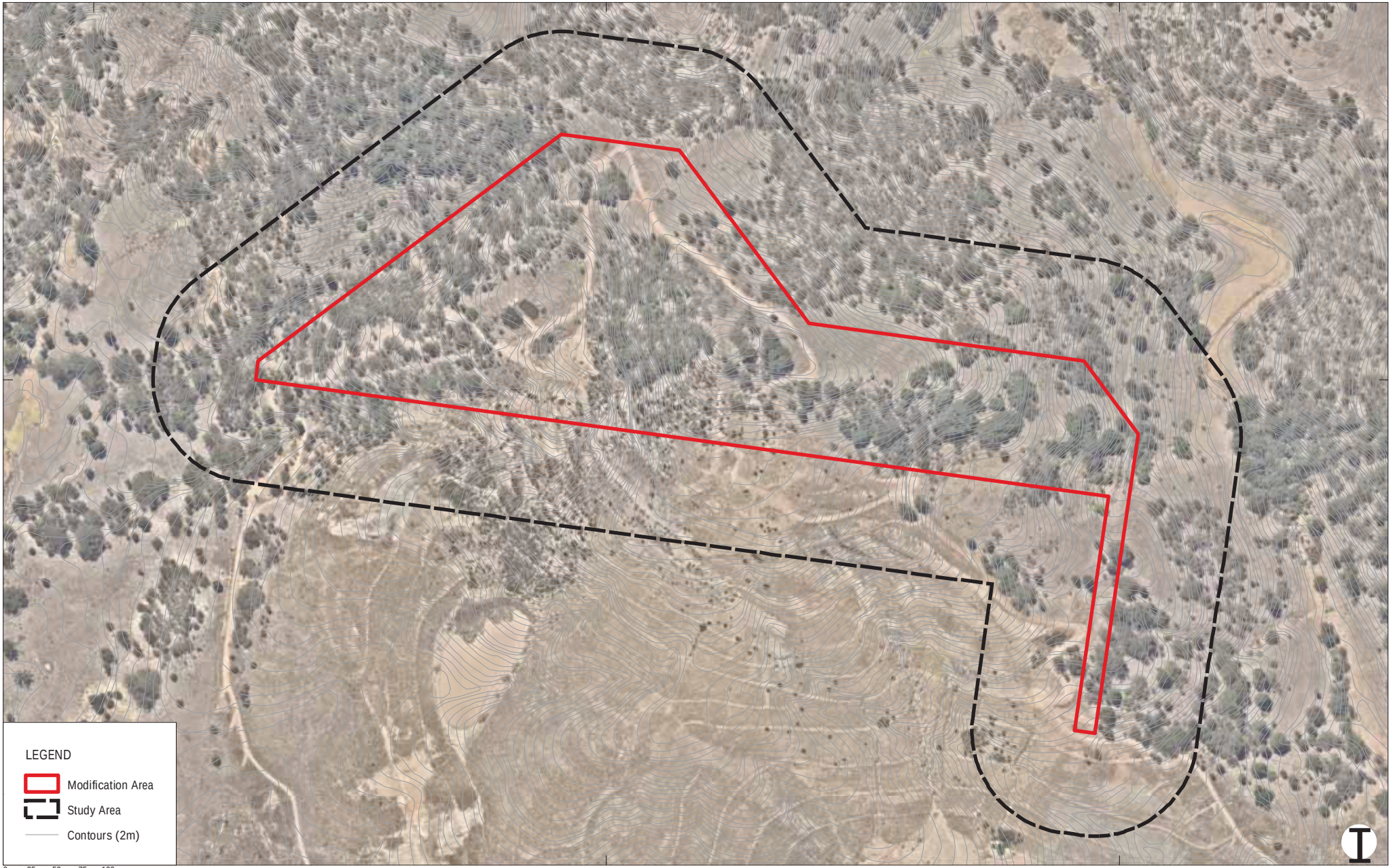
NCST (2008) Guidelines for Surveying Soil and Land Resources NCST (2008)

NCST (2009) Australian Soil and Land Survey Field Handbook

Appendix A

Zoomed Figures

1:25,000 Scale



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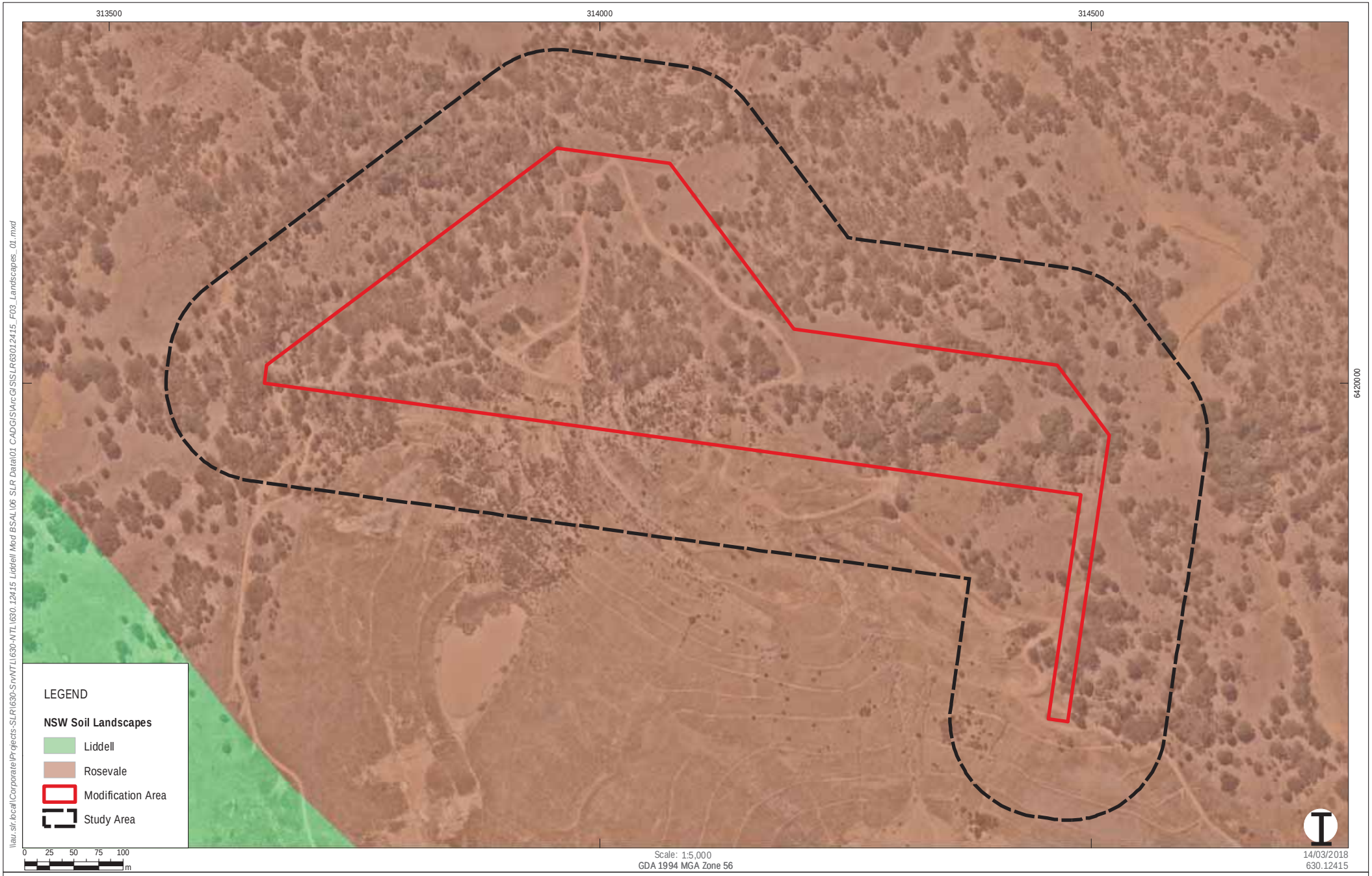
Study Area

FIGURE 2



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Soil Landscapes

FIGURE 3

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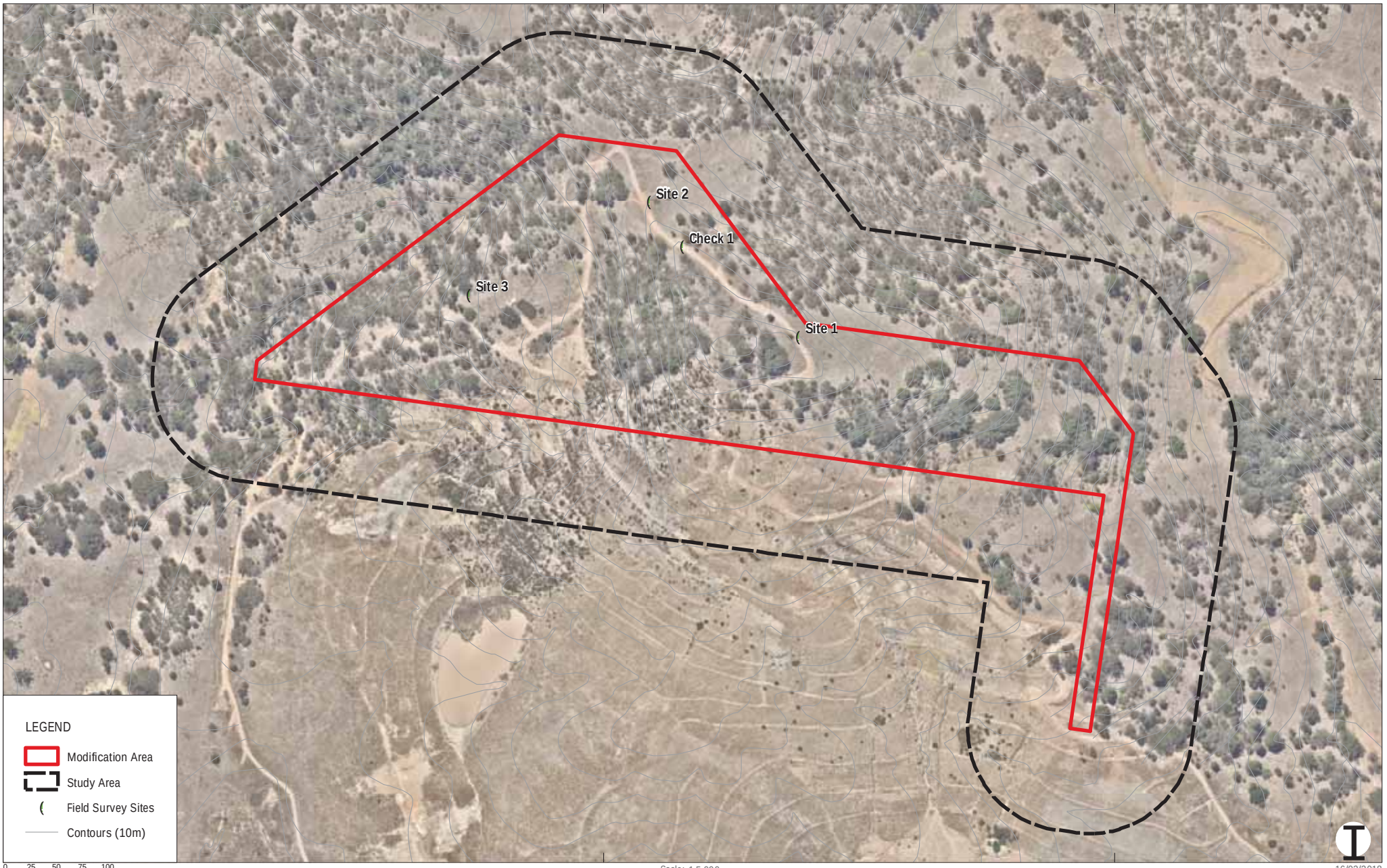
Slope Analysis

FIGURE 4



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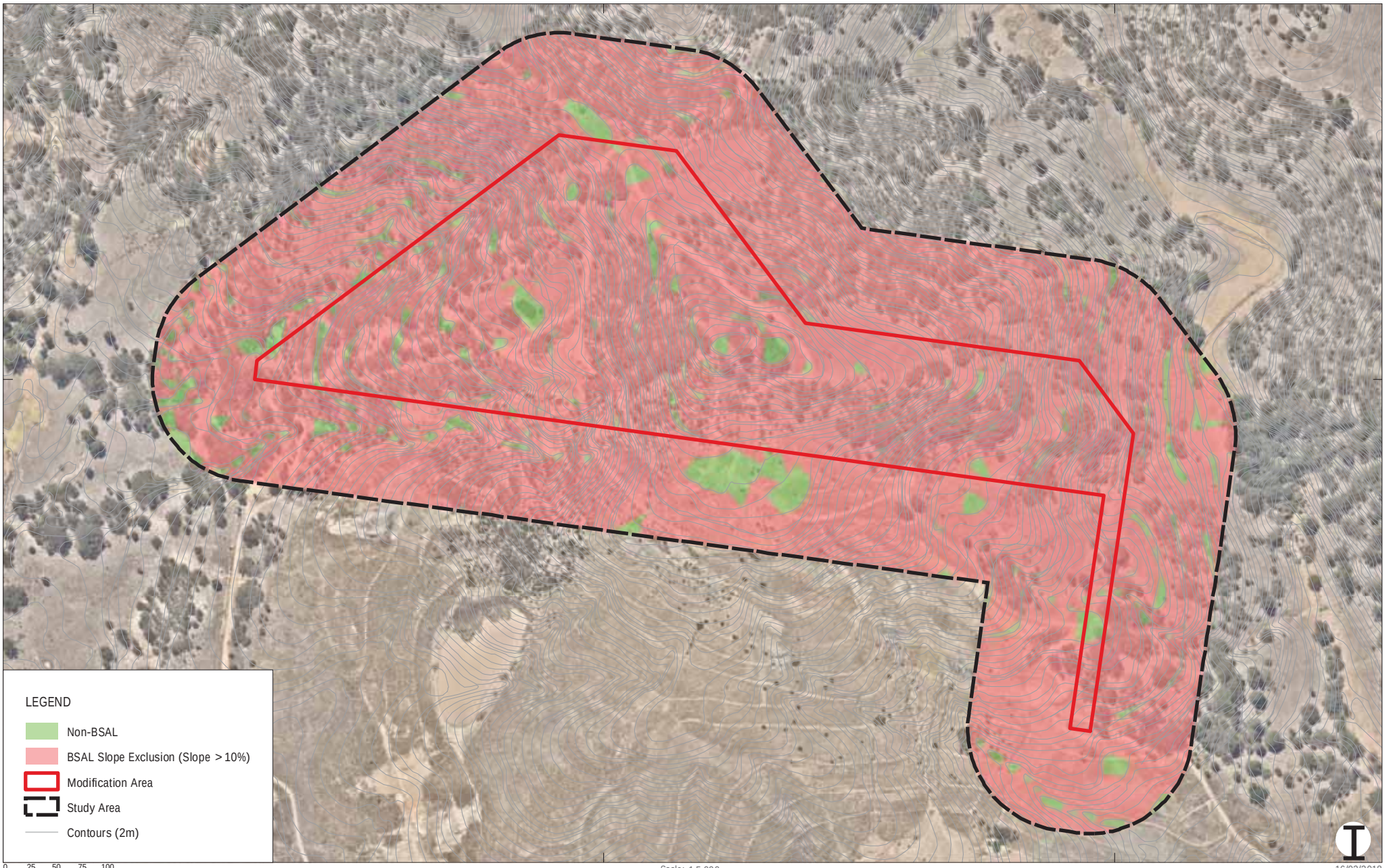
Field Survey Sites

FIGURE 5



Sheet Size : A4

SLR

www.slrconsulting.com PH: 02 4037 3200

BSAL Map

FIGURE 6

Appendix B

Slope Analysis Methodology

7th March 2018

Liddell Coal Mine
BSAL Verification Assessment
SLR Slope Analysis Methodology

1. Acquire appropriate elevation information. In this case, LIDAR data provided by Liddell Coal Mine.

2. Load Contours into ArcMap 10.3

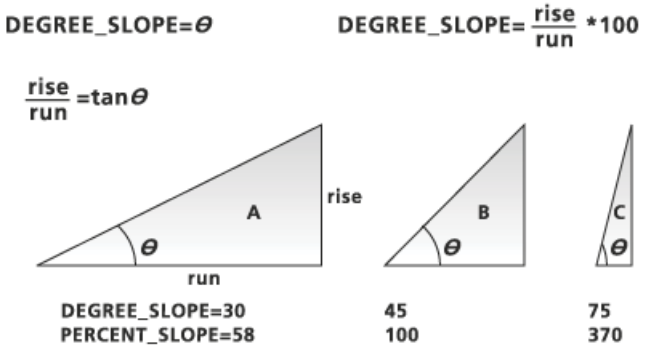
3. Using 3D Analyst Extension - Create a TIN Surface based on the contours (http://resources.arcgis.com/en/help/main/10.1/index.html#/Create_TIN/00q90000001v000000/)

4. Using 3D Analyst Extension – Run the Surface Slope Tool (http://resources.arcgis.com/en/help/main/10.1/index.html#//00q900000076000000) using a custom Break File (attached).

5. Using a Spatial Join, correlate the Surface Slope at the Soil Survey coordinates.

The Surface Slope Tool

Surface Slope creates an output polygon feature class containing polygons that classify an input TIN or terrain dataset by slope. The slope is the angle of inclination between the surface and a horizontal plane, which may be analysed in degrees or percent. Slope in degrees is given by calculating the arctangent of the ratio of the change in height (dZ) to the change in horizontal distance (dS), or slope = Arctan (dZ/dS). Percent slope is equal to the change in height divided by the change in horizontal distance multiplied by 100, or (dZ/dX) * 100.



The {**slope_field**} is the name of attribute field used to record the polygon aspect codes. Its default value is SlopeCode.

Each triangle is classified into a slope class. Contiguous triangles belonging to the same class are merged during the formation of output polygons. The {units} parameter can be set to use PERCENT or DEGREES. The default is PERCENT. The default percent slope class breaks are 1.00, 2.15, 4.64, 10.00, 21.50, 46.40, 100.00, 1000.00. Optionally, DEGREES may be used to classify slope. The default degree slope class breaks are 0.57, 1.43, 2.66, 5.71, 12.13, 24.89, 45.0, 90.0.

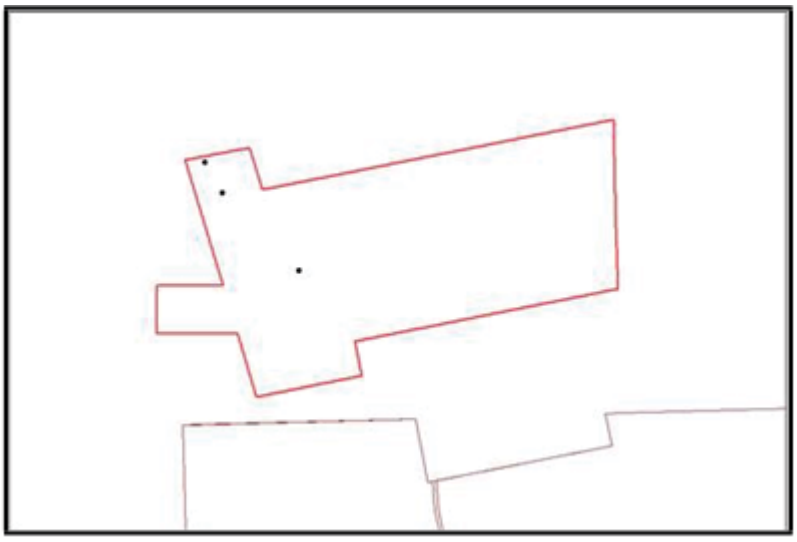
The {**class_breaks_table**} is used to define custom slope classes. The table can be either a TXT or DBF file for a Windows environment, and a DBF file in a UNIX environment. Each record in the table needs to contain two values that are used to represent the slope range of the class and its corresponding class code.

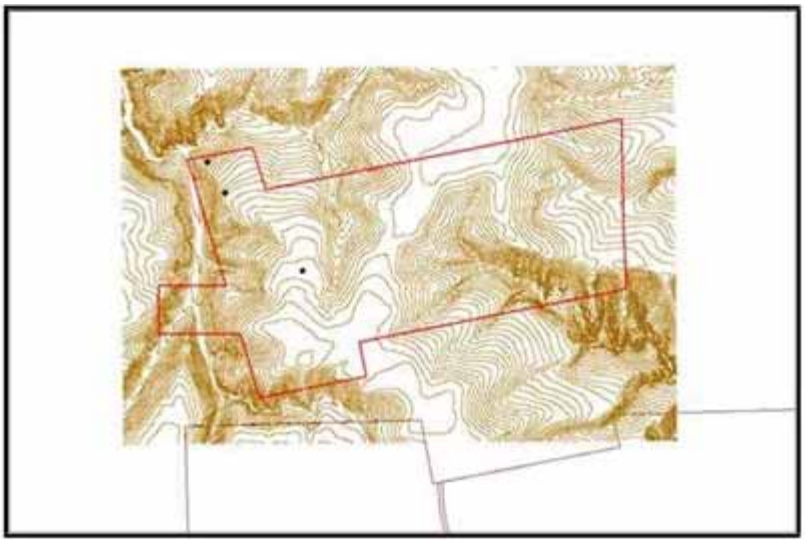
Table example:

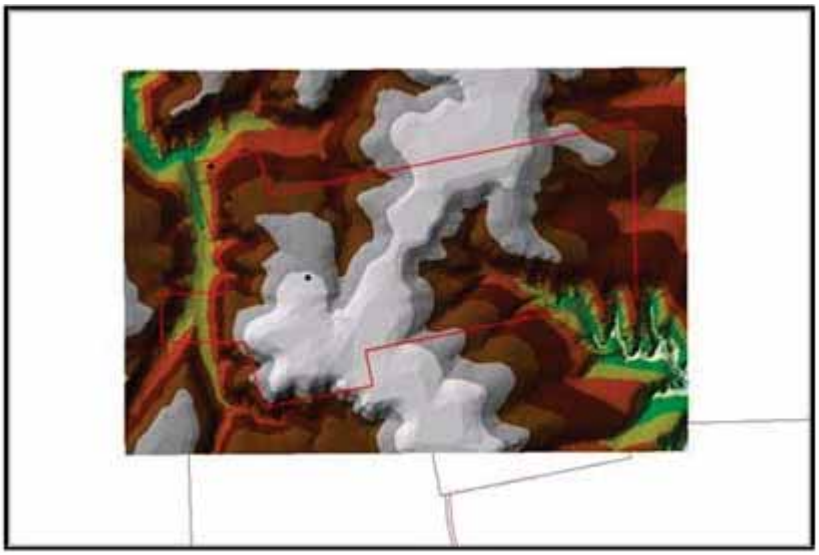
```
break, code

  10.0, 11

  25.0, 22

  40.0, 33

  70.0, 44
```

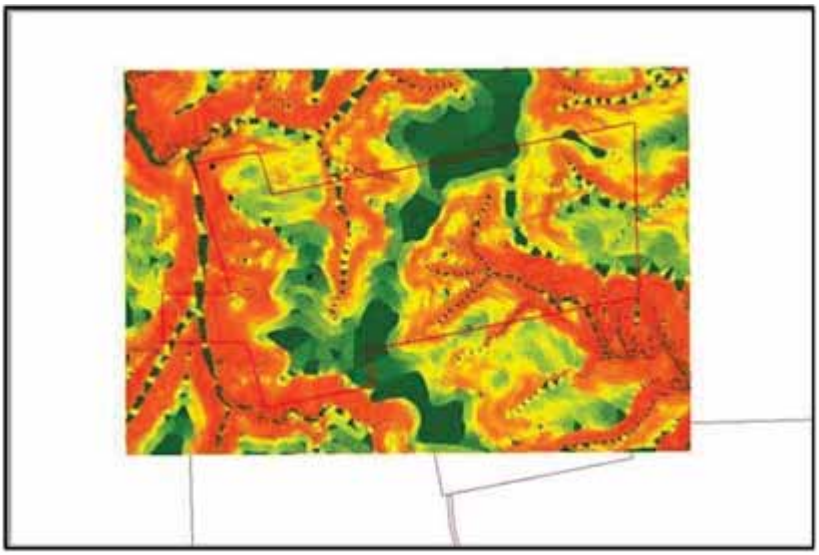
Note the comma delineation and use of decimals in the first field. Field names are needed but are ignored. The first field represents the breaks and values need to be decimal, the second field represents codes and values need to be integer. The units of the slope range are defined by the {units}. When this argument is not specified, the default classification is used.

And here is how we do it pictographically (example study shown):









Appendix C

Laboratory Soil Test Results

NSW GOVERNMENT Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO18/022R1
REPORT TO:	Murray Fraser SLR Consulting 10 Kings Rd New Lambton NSW 2305
REPORT ON:	Nine soil samples Your ref: Liddell BSAL 630.12415
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	9 March 2018
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED

L Dunn
Scone Laboratory

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO18/022R1
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	Colour		P7B/2 Particle Size Analysis (%)				
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	Dry	Moist	clay	silt	f sand	c sand	gravel
1	1 0-10cm	0.01	5.9	5.1	10YR5/2	10YR3/2	11	10	17	26	36
2	1 20-30cm	0.05	6.0	5.1	10YR5/4	10YR3/6	35	10	16	23	16
3	1 30-40cm	0.06	6.4	5.5	7.5YR5/3	7.5YR4/6	26	8	12	27	27
4	2 0-10cm	0.01	5.7	4.9	7.5YR5/2	5YR2.5/3	7	11	33	36	13
5	2 20-30cm	0.03	6.1	4.9	7.5YR6/2	7.5YR3/4	20	8	21	31	20
6	2 30-40cm	0.02	6.1	5.0	7.5YR6/2	7.5YR3/4	15	8	27	33	17
7	3 0-10cm	0.04	5.4	4.5	10YR5/2	10YR2/2	7	12	26	29	26
8	3 20-30cm	0.02	5.1	4.0	7.5YR6/1	7.5YR3/2	9	10	26	28	27
9	3 30-40cm	0.03	5.5	4.1	7.5YR7/1	7.5YR4/3	11	11	21	36	21

nt=not tested

END OF TEST REPORT

Report No. **WN180669**

Biosecurity Laboratory Operations
Environmental Laboratory
1243 Bruxner Highway, WOLLONGBAR NSW 2477
Phone: 02 6626 1103 Email: wollongbar.csu@dpi.nsw.gov.au

Lynn Dunn
Soil Conservation Service
PO Box 283
SCONE NSW 2337

Soil Analysis Report

9 Sample(s) received on 8/03/18 . Tested as per the following methods.

Method	Method Description
S273	Gillman & Sumpter Exchangeable Cations

Notes:

Results relate only to the items tested.

- When required, samples air dried at 40ºC as per Soil Chemical Methods - Australasia (Rayment and Lyons 2011).
- Results are expressed on an air-dry weight basis unless otherwise stated.
- This report should not be reproduced except in full.
- Samples will be retained for one calendar month from the date of the final report. Samples will then be discarded.
- Clients wishing to recover their samples must contact the laboratory within this period. This laboratory will return residual samples at client expense.

Date of issue 13/03/18

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Accredited for compliance with ISO/IEC 17025 – Testing
Accreditation No. 14173

ASPAC

Approved for Release by: Craig Hunt
Craig Hunt
Technical Officer

Laboratory No. **Client's ID**	**Units**	**Limit of Reporting**	**1** **SCO18/ 022/1**	**2** **SCO18/ 022/2**	**3** **SCO18/ 022/3**	**4** **SCO18/ 022/4**	**5** **SCO18/ 022/5**	**6** **SCO18/ 022/6**	**7** **SCO18/ 022/7**	**8** **SCO18/ 022/8**	**9** **SCO18/ 022/9**
Exchangeable Cations											
Aluminium	cmol(+)/kg	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.25	1.1	0.50
Calcium	cmol(+)/kg	0.030	8.1	11	12	6.7	5.7	5.0	4.4	0.79	1.1
Potassium	cmol(+)/kg	0.010	1.4	0.74	0.63	1.3	1.1	0.97	0.72	0.35	0.24
Magnesium	cmol(+)/kg	0.0070	2.2	5.9	5.8	1.6	3.7	3.2	1.9	1.4	2.0
Sodium	cmol(+)/kg	0.030	0.10	0.27	0.32	0.057	0.15	0.16	0.11	0.28	0.50
CEC (effective)	cmol(+)/kg	0.20	12	18	18	9.6	11	9.3	7.3	3.9	4.3
Calcium/ Magnesium			3.6	1.9	2.0	4.1	1.6	1.6	2.4	0.58	0.54
Percent Aluminium Saturation	% of ECEC		N/A	N/A	N/A	N/A	N/A	N/A	3	28	12
Exchangeable Calcium	% of ECEC		68	62	63	69	54	54	60	21	25
Exchangeable Potassium	% of ECEC		12	4.1	3.4	13	10	10	9.8	9.2	5.5
Exchangeable Magnesium	% of ECEC		19	32	31	17	34	34	25	35	46
Exchangeable Sodium Percentage	% of ECEC		0.87	1.5	1.7	0.59	1.4	1.7	1.5	7.2	12