Appendix 10 – Biophysical Strategic Agricultural Land Assessment (SLR, 2017b)

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Biophysical Strategic Agricultural Land Assessment

Mandalong Mine

LW24 – LW24A Modification

Report Number 630.11810

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Centennial Mandalong Pty Ltd

Version: Final

Biophysical Strategic Agricultural Land Assessment

Mandalong Mine

LW24 – LW24A Modification

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1 INTRODUCTION

Operations at the Mandalong Mine are approved under development consent SSD-5144, which was granted on 12 October 2015 by the NSW Planning and Assessment Commission under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). Centennial Mandalong Pty Limited (Centennial Mandalong) is proposing to modify SSD-5144 (Mod 5) to facilitate an extension to the approved first workings and secondary extraction area for the existing Longwall Panel 24 and the development and extraction of Longwall Panel 24A (LW24 – LW24A) (the Project). Centennial Mandalong engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a Biophysical Strategic Agricultural Land (BSAL) Assessment to support the Project.

1.1 Study Area

The Study Area for the BSAL Assessment was the LW24 – LW24A footprint of the LW24 – LW24A extraction area plus a 100 metre buffer, totalling 251 hectares (**Figure 1**). The Study Area is partially mapped as BSAL according to the NSW Government (DP&I, 2012) (**Figure 1**).

Two main drainage lines occur within the Study Area, Tobins Creek in the north, and Morans Creek in the south, as shown on **Figure 2**. The valley floor area associated with Morans Creek contains the mapped BSAL area.

1.2 Legislation and Standards

1.2.1 Interim Protocol for Site Verification and Mapping of BSAL

In April 2013, the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (Interim Protocol) ((Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (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.

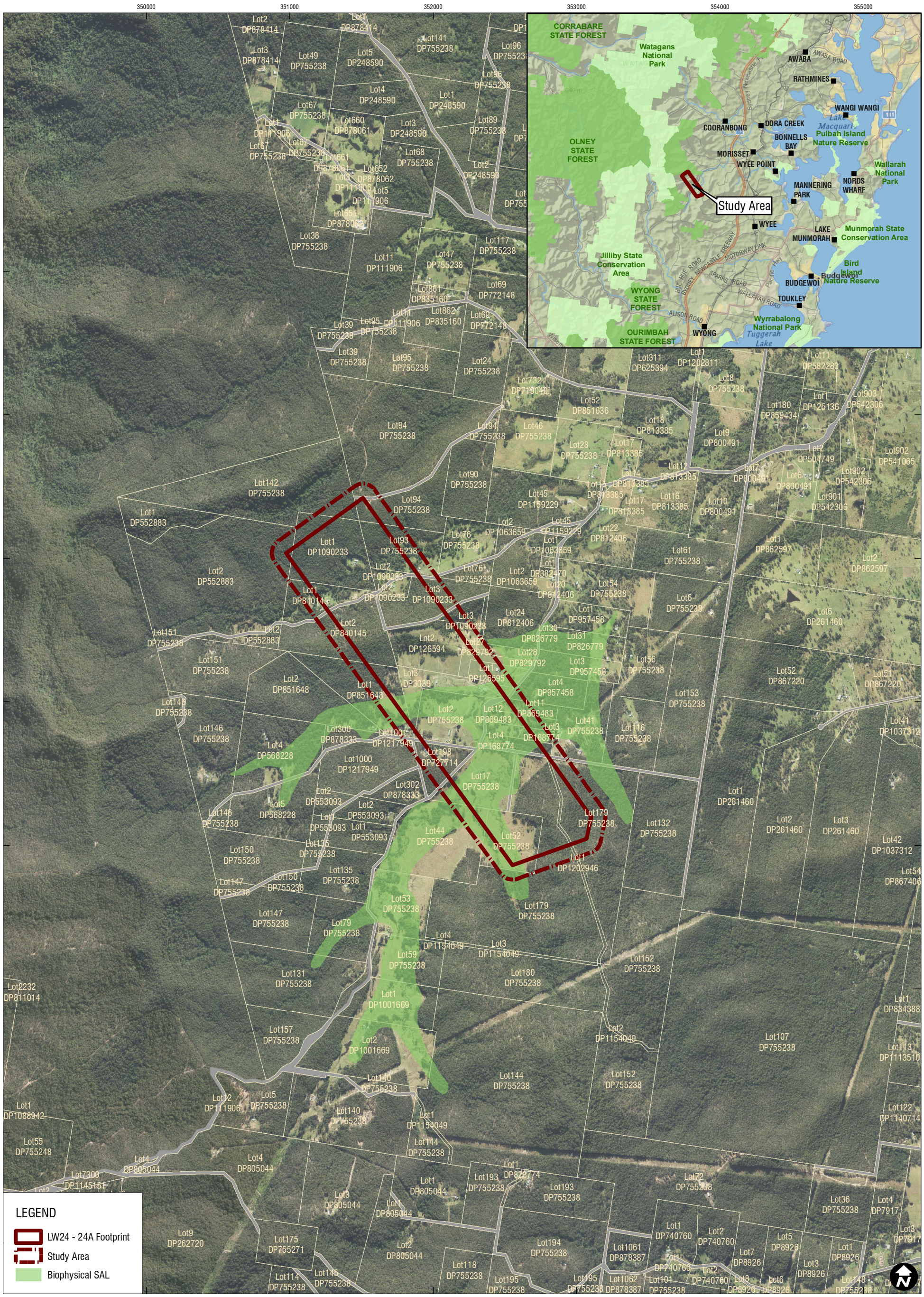
The purpose of the Interim Protocol is to assist proponents and landholders to understand what is required to identify the existence of BSAL. It outlines the technical requirements for the on-site identification and mapping of BSAL.

All figures within this assessment have been presented at 1:25,000 scale, as per the Interim Protocol. Zoomed figures at a scale of 1:10,000 are presented in **Appendix A**.

1.2.2 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 (NCST, 2008).
- Australian Soil and Land Survey Field Handbook (NCST, 2009).



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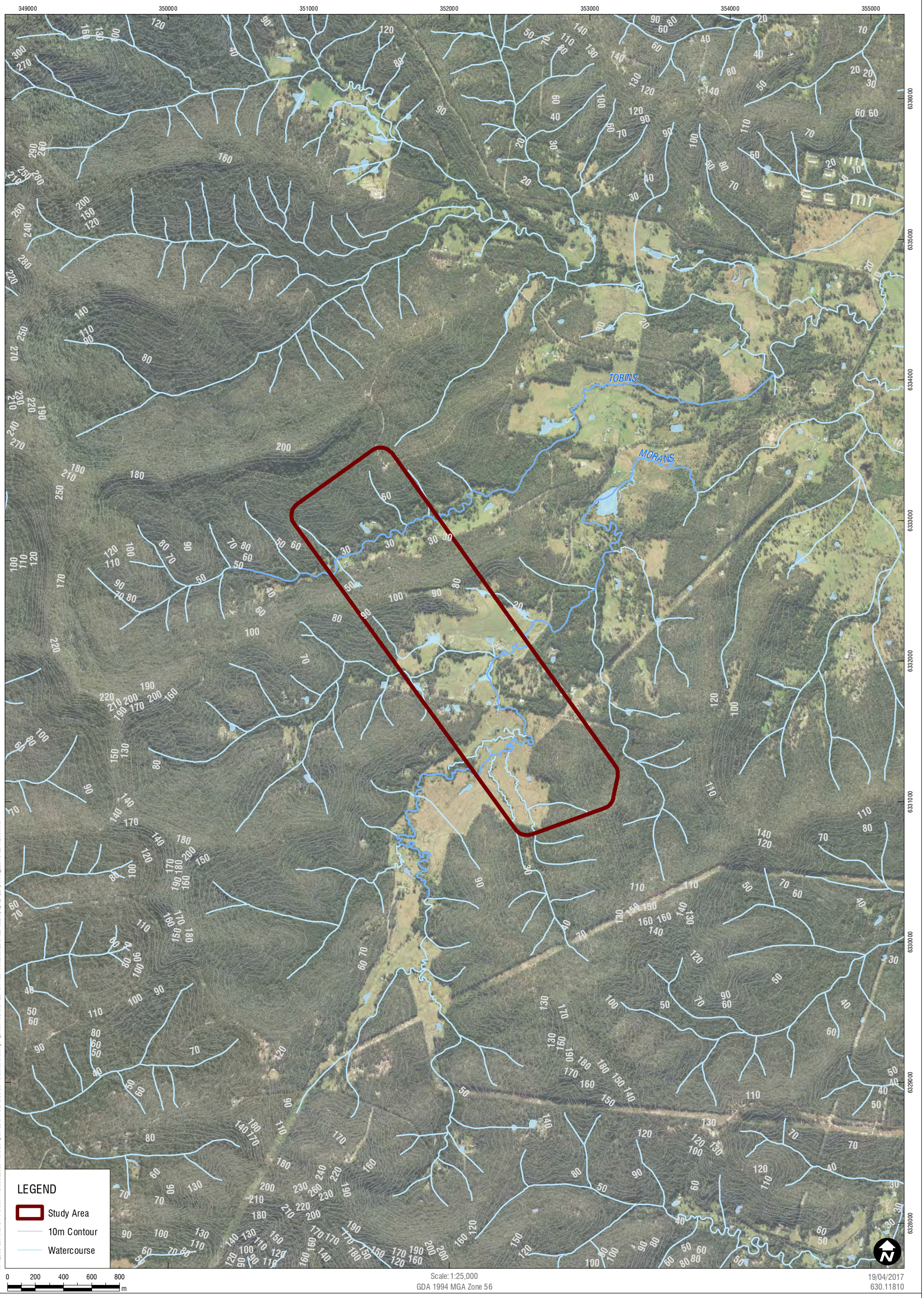
Study Area
LW24-24A

FIGURE 1



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Topography and Hydrology
LW24-24A

FIGURE 2

2 METHODOLOGY

The site verification methodology for the Study Area has been undertaken based on 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 1**. The Study Area includes a 100 metre buffer surrounding the footprint of LW24 – LW24A, and totals 251 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 located at Cooranbong. The Cooranbong BOM Station has recorded an average annual rainfall of 1,135 millimetres (based on records from 1903 – present); therefore the Study Area meets the minimum average annual rainfall of 350 millimetres to have access to reliable water supply.

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

The Interim Protocol states that:

> *"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."*

The Proponent has access to the majority of the Study Area; however, land access was unavailable for properties in the centre of the Study Area: Lot 2 DP126594, Lot 27 DP829792, Lot 28 DP828792, Lot 3 DP3039, Lot 1 DP 126595, Lot 198 DP727714, Lot 17 DP755238 and Lot 2 DP755238 (**Figure 1**).

Land access was also constrained by physical access and field personnel safety due to slopes and forested terrain. Where land access was not available, soil distribution has been based on landscape characteristics in accordance with the Interim Protocol and SLR's prior soil mapping experience adjacent to the Study Area.

2.4 Step 4: Risk assessment

The Interim Protocol states that:

> *"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 Project consists of the extension of underground mining for two longwall panels. SLR has assessed the following potential impacts of the project activities within the Study Area on agriculture:

- Consequence: Level 5 – Very minor damage and minor impact to agricultural resources or industries.

- Probability: B – Likely. Known to occur or it has happened.

The risk matrix result was B5 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

Two field surveys were undertaken for the BSAL Assessment; the first in June 2016 (sample location field points prefixed with an M), and the second in October 2016 (no prefix). Murray Fraser undertook the fieldwork for both surveys while Clayton Richards (CPSS 2) was responsible for technical 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.

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.

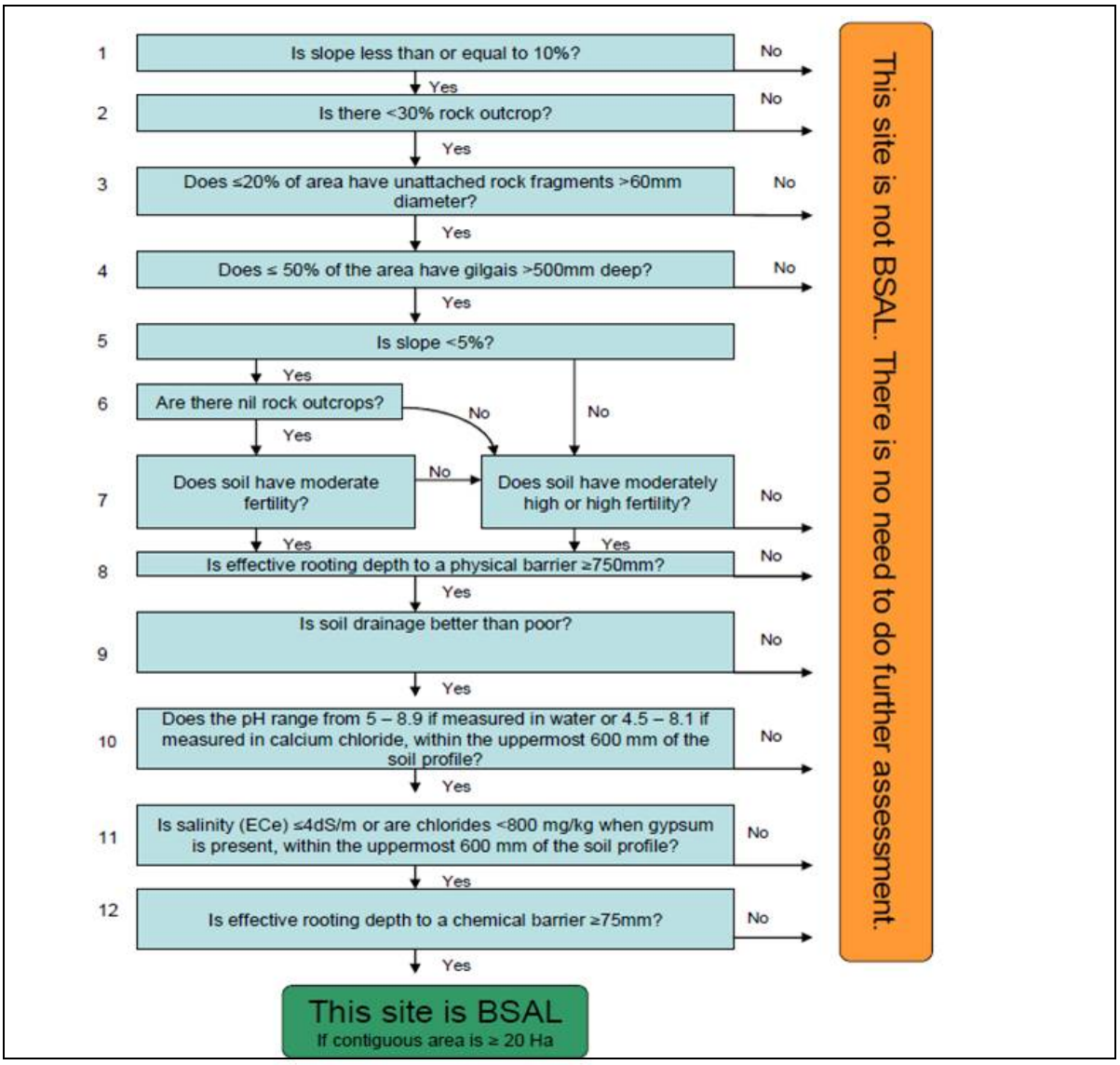
2.6.1 Exclusion Zones

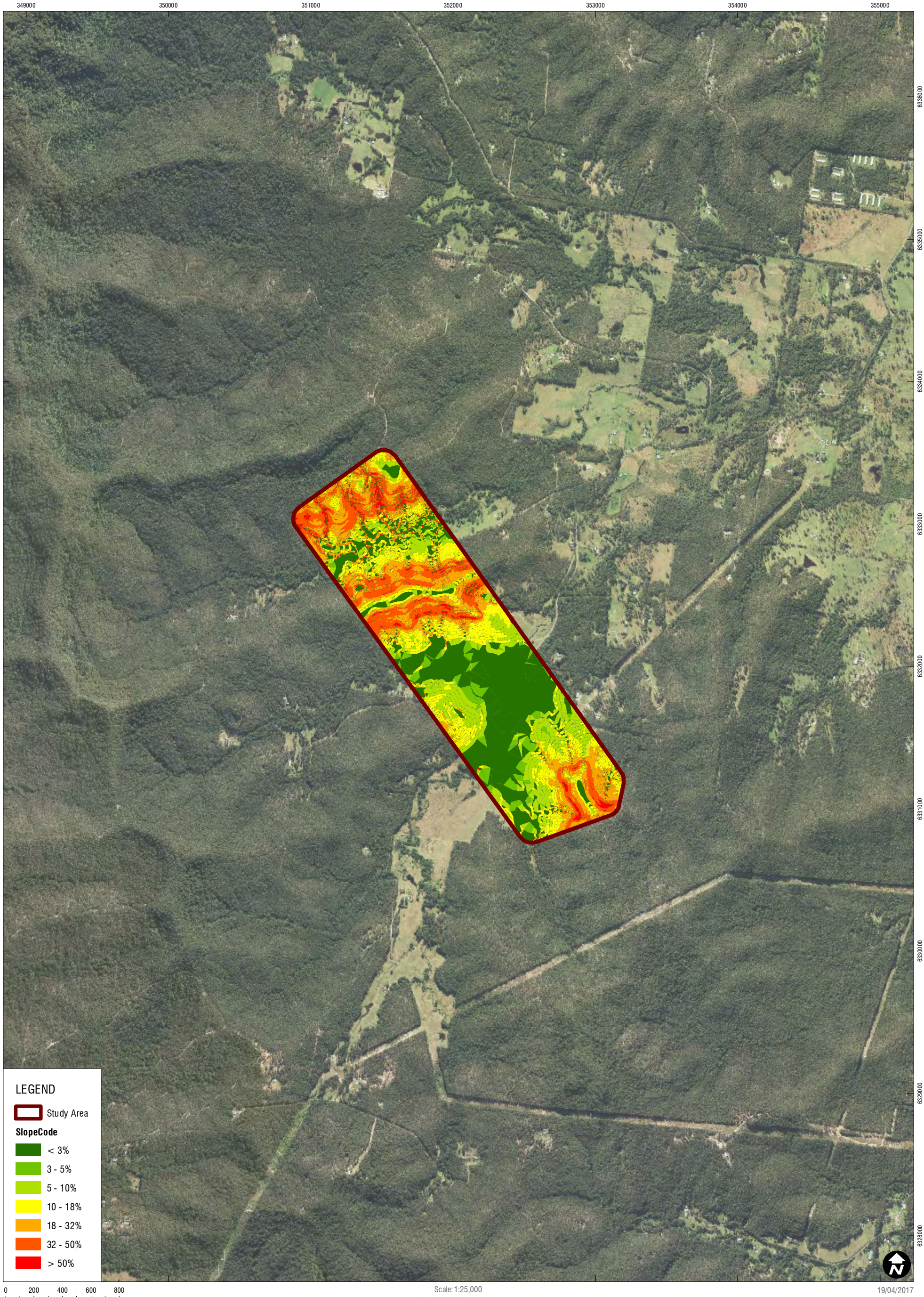
Initially, land greater than 10% slope (**Figure 3**) within the Study Area was identified using topographical data derived from LIDAR. Areas with slope greater than 10% slope were excluded from the soil survey program. In total, 132 hectares was determined not to meet the BSAL methodology Criteria 1 (**Figure 4**). The Slope Analysis methodology is provided in **Appendix B**.

Subsequently, any land that did not meet the minimum contiguous 20 hectares to be classified as BSAL was also excluded. In total, 6 hectares was determined not to meet the Interim Protocol BSAL methodology criteria within the Study Area (**Figure 4**). Land contiguous to the Study Area was taken into consideration when classifying areas of land to be less than 20 contiguous hectares.

In summary, 138 hectares was determined not to meet the BSAL methodology criteria within the Study Area. This comprised 132 hectares of land with slope greater than 10% and 6 hectares of land less than 20 hectares contiguous area. This reduced the land to be assessed by the field soil survey program to 113 hectares (**Table 1** and **Figure 4**).

Diagram 1 BSAL Soil Laboratory Analysis Parameters





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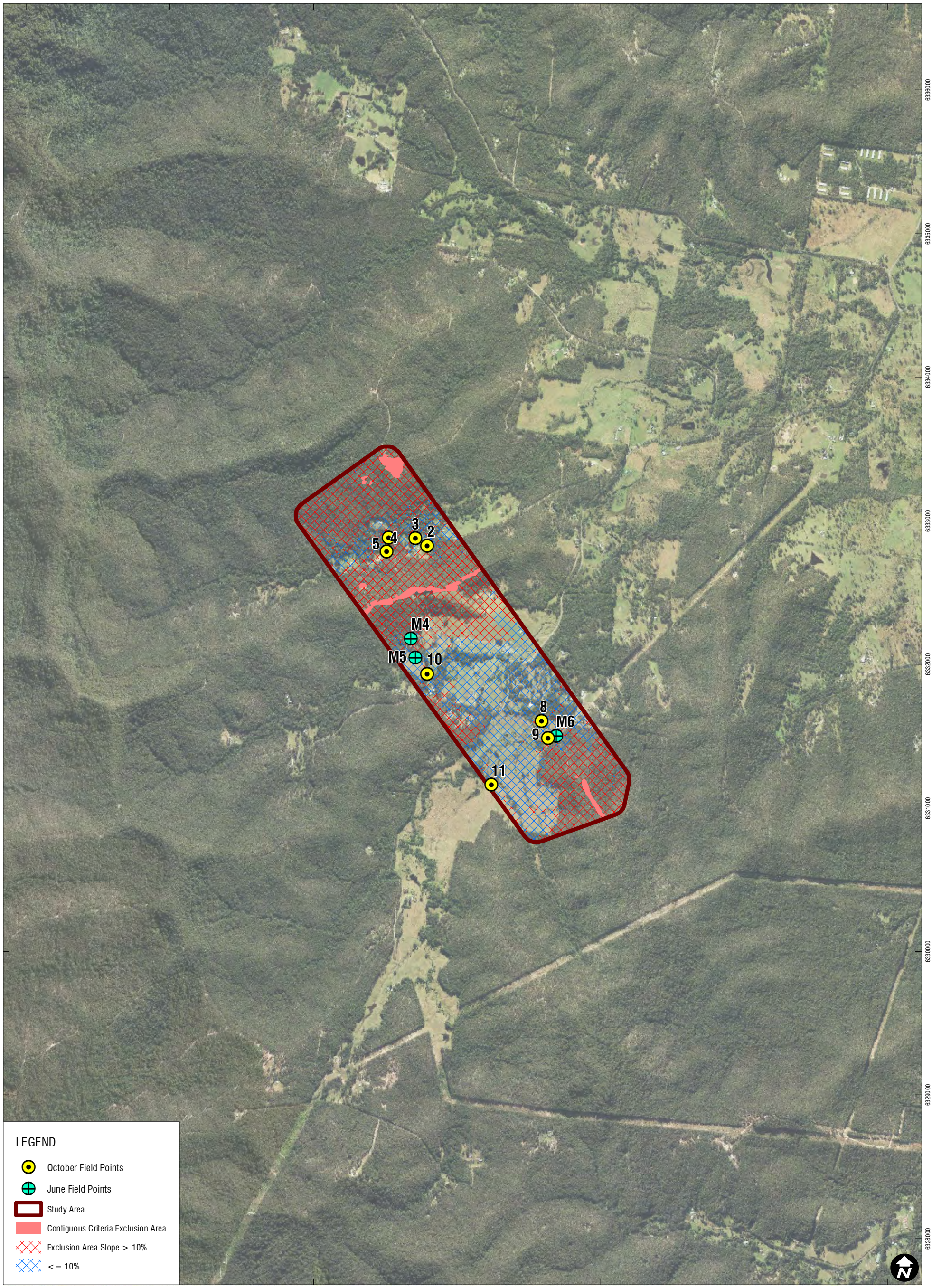
Slope Analysis
LW24-24A

FIGURE 3



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Exclusion Areas and Field Survey Sites LW24-24A

FIGURE 4

2.6.2 Soil Survey Density

To satisfy the Interim Protocol requirements, the field soil survey program was comprised of 11 detailed sites, as shown on **Figure 4**. A breakdown of the soil survey density, as per Interim Protocol requirements, is provided in **Table 1**.

Table 1 Soil Survey Density

Survey Area	Hectares	Survey Scale	Protocol Required Sites	Sites Completed
< 10% slope & > 20 ha	113	1:100,000	3*	11
Exclusion > 10% Slope	132	Nil	Nil	Nil
Exclusion < 20 ha	6	Nil	Nil	Nil
Total	**251**	**1:100,000**	**3***	**11**
* Minimum of 3 observation sites per soil mapping unit (Soil Unit) are required according to the Interim Protocol				

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^

^ Laboratory colour has been used except when mottling was 20% or greater as field colour more accurately assesses primary colour and dominant mottle 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. Due to the high number of detailed sites completed and laboratory assessed, no check sites were completed in this assessment.

3 SOILS ASSESSMENT

In accordance with the Interim Protocol, a soil mapping unit (Soil Unit) may contain some soil variation, but will typically only contain a single dominant soil type. The dominant soil type will comprise greater than 70% of the Soil Unit. Therefore, a Soil Unit may contain a dominant soil type as well as subdominant and/or soil variants. When a Soil Unit does not have a clear dominant soil type, soil variation must be accepted.

Within the Study Area, three Soil Units have been identified based on the dominant soil types (**Table 3** and **Figure 5**). Each Soil Unit contains a minimum of three detailed sites in compliance with the Interim Protocol.

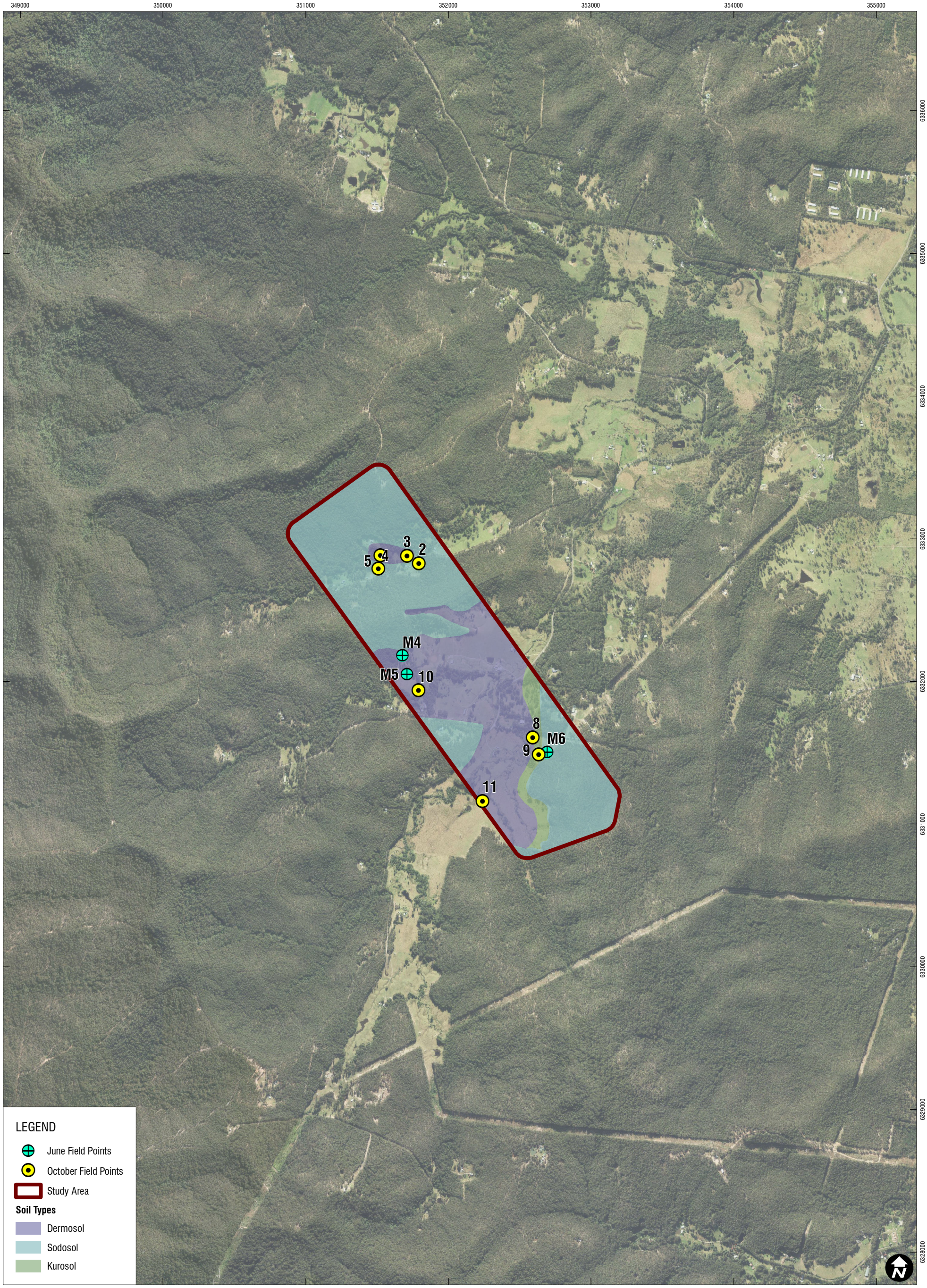
Table 3 Soils Assessment Summary

Soil Unit	Dominant Soil Type	Area	Survey Type	Site Number
1	Brown Kurosol	10 Hectares	Detailed	9 (1 & 7*)
			Check	Nil
2	Brown Sodosol	147 Hectares	Detailed	M6, 2, 4
			Check	Nil
3	Brown Dermosol	94 Hectares	Detailed	M4, M5, 3, 5, 8, 10, 11
			Check	Nil
*Correlated sites from *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW22 – LW23 Modification* (SLR, 2016)				

One representative soil profile from each of the dominant soil types is described in the following sections. All detailed profile descriptions and laboratory results are found in **Appendix D**.

Although Soil Unit 1, the Brown Kurosol (**Section 3.1**), covers less than 20 hectares, it has been included in this BSAL Assessment as it would cover an area greater than 20 hectares contiguous area outside of the Study Area, as per the Interim Protocol. Due to land access restrictions, the Brown Kurosol was correlated with two other assessment sites (Site 1 and Site 7) which border the Study Area to the east. These sites were assessed in the *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW22 – LW23 Modification* (SLR, 2016), with locations of these two sites shown in **Appendix E**.

Note that in the Chemical Parameters Table for each soil type, pH ($CaCl_2$) is presented for the assessment of Interim Protocol Criteria 10, whereas pH (1:5 water) was used to classify ASC soil type.



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Soil Types
LW24-24A

FIGURE 5

3.1 Soil Unit 1: Brown Kurosol

Soil Unit 1 is a Brown Kurosol. Kurosols are soils with a strong texture contrast between the A horizon and strongly acidic B horizons. Many Kurosols have unusual subsoil chemical attributes such as high magnesium, sodium and aluminium. One representative site for Soil Unit 1 is described below. As stated previously, the Brown Kurosol was correlated with two other assessment sites (Site 1 and Site 7), which were assessed in the *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW22 – LW23 Modification* (SLR, 2016). Site 1 and Site 7 are described in **Appendix D** and their locations shown in **Appendix E**.

Table 4 Summary: Magnesic Brown Kurosol (Site 9)

Overview	
	
Landscape Site 9	
ASC Name	Magnesic Brown Kurosol
Representative Site	Site 9
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Cattle Grazing
Vegetation	Spotted Gum, Annual Ryegrass, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	9%
Verified	Non-BSAL

Table 5 Profile: Magnesic Brown Kurosol (Site 9)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (10YR 5/3) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.25	Brown (10YR 6/2) loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <10% gravel 5-10 mm, abundant fine roots. Well drained with an abrupt and even boundary. Sampled 0.10 – 0.20
	B21 0.25 – 0.40	Yellowish brown (10YR 5/6^) heavy clay, strongly structured 20-40 mm subangular blocky peds with strong consistence and a rough fabric. 20% distinct orange mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.30 – 0.40
	B22 0.40 – 0.90	Yellowish brown (10YR 5/8^) heavy clay, strongly structured 30-50 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct grey mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.40 – 0.50 and 0.65 – 0.75

Table 6 Chemical Parameters: Magnesic Brown Kurosol (Site 9)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	3.8	Non-sodic	0.2	Non-saline	0.57	Low
A2	4.2	Strongly Acidic	4.3	Non-sodic	0.1	Non-saline	0.37	Low
B21	4.0	Strongly Acidic	4.0	Non-sodic	0.2	Non-saline	0.06	Very Low
B22	4.0	Strongly Acidic	4.1	Non-sodic	0.3	Non-saline	0.04	Very Low
B22	4.1	Strongly Acidic	4.9	Non-sodic	0.1	Non-saline	0.02	Very Low

3.2 Soil Unit 2: Brown Sodosol

Soil Unit 2 is a Brown Sodosol. Sodosols are soils with a strong texture contrast between the A horizon and a sodic B horizon which is not strongly acidic. The strongly sodic nature of the B horizon in these Sodosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. One representative site for Soil Unit 2 is described below. The two remaining soil profiles from Soil Unit 2 are described and shown in **Appendix D**.

Table 7 Summary: Mesonatric Brown Sodosol (Site M6)

Overview	
	
Landscape Site M6	
ASC Name	Mesonatric Brown Sodosol
Representative Site	Site M6
Survey Type	Detail
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Sydney Blue Gum, Red Grass, Barbed Wire Grass
Inherent Soil Fertility	Moderately Low
Slope	7%
Verified	Non-BSAL

Table 8 Profile: Mesonatric Brown Sodosol (Site M6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Brown (10YR 5/3) loam, weakly structured 5-20 mm crumb peds with a weak consistence and a rough fabric. Nil mottling, <5% gravel 5-15 mm, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.0 – 0.10
	B21 0.15 – 0.40	Yellowish brown (10YR 5/4^) heavy clay, strongly structured 20-30 mm subangular blocky peds with strong consistence and a rough fabric. 25% faint grey mottles, nil stone content, common coarse roots. Poorly drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B22 0.40 – 0.90	Yellowish brown (10YR 5/8^) medium clay, strongly structured >40 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct-grey mottles, nil stone content, few coarse roots. Poorly drained with a clear and even boundary. Sampled 0.50 – 0.60
	BC +0.90	Weathered parent material. Not sampled

Table 9 Field Chemical Parameters: Mesonatric Brown Sodosol (Site M6)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.1	Strongly Acidic	12.3	Sodic	0.5	Non-saline	0.04	Very Low
B21	4.3	Strongly Acidic	15.6	Strongly Sodic	1.2	Non-saline	<0.01	Very Low
B22	4.4	Strongly Acidic	19.4	Strongly Sodic	2.0	Non-saline	<0.01	Very Low

3.3 Soil Unit 3: Brown Dermosol

Soil Type 3 is a Brown Dermosol. Dermosols are soils with structured B2 horizons and lacking strong texture contrast between the A and B horizons. The sodic nature of the B horizon in the majority of these Dermosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. One representative site for Soil Unit 3 is described below. The six remaining soil profiles from Soil Unit 3 are described and shown in **Appendix D**.

Table 10 Summary: Eutrophic Brown Dermosol (Site 3)

Overview	
	
Landscape Site 3	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site 3
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Horse Grazing
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	6%
Verified	Non-BSAL

Table 11 Profile: Eutrophic Brown Dermosol (Site 3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (10YR 5/3) loamy sand, weakly structured 5-15 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.35	Pale brown (10YR 6/3) loam, moderately structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.35 – 0.60	Yellowish brown (10YR 5/4^) loam, moderately structured 20-30 mm blocky peds with weak consistence and a rough fabric. 30% distinct yellow mottles; <5% gravel 5-15 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 +0.60	Yellowish brown (10YR 5/8^) loam, moderately structured 20-40 mm blocky peds with moderate consistence and a rough fabric. 40% distinct grey mottles, <5% gravel 5-15 mm, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 12 Chemical Parameters: Eutrophic Brown Dermosol (Site 3)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.6	Non-sodic	1.2	Non-saline	2.38	Low
A2	4.4	Strongly Acidic	2.2	Non-sodic	0.3	Non-saline	1.00	Low
B21	4.4	Strongly Acidic	4.9	Non-sodic	0.2	Non-saline	0.19	Low
B22	4.1	Strongly Acidic	16.4	Strongly Sodic	0.7	Non-saline	0.02	Very Low

4 BIOPHYSICAL STRAGTEGIC 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 14**.

According to the Interim Protocol, the findings of this BSAL Assessment, as shown in **Table 13**, are:

- An Exclusion Zone of 132 hectares for land greater than 10% slope was identified and excluded from the soil survey.
- An Exclusion Zone of 6 hectares for land less than 20 hectares contiguous area was identified and excluded from the soil survey.
- Three Soil Units, a Kurosol, a Sodosol and a Dermosol, were identified during the soil survey and all were considered non-BSAL.
- The Kurosol (10 hectares) failed BSAL Criteria **7** (low fertility), **9** (poor drainage), **10** (pH < 4.5 $CaCl_2$) and **12** (estimated rooting depth to a chemical barrier < 750 millimetres).
- The Sodosol (147 hectares) failed BSAL Criteria **7** (low fertility), **9** (poor drainage), **10** (pH < 4.5 $CaCl_2$) and **12** (estimated rooting depth to a chemical barrier < 750 millimetres).
- The Dermosol (94 hectares) failed BSAL Criteria **9** (poor drainage) **10** (pH < 4.5 $CaCl_2$) and **12** (estimated rooting depth to a chemical barrier < 750 millimetres).
- Eight of eleven sites which underwent laboratory analysis failed BSAL Criteria **12**, with either exchangeable sodium percentage greater than 15 and/or a calcium to magnesium ratio of less than 0.1.
- Ten of eleven sites which underwent laboratory analysis failed BSAL Criteria **10**, with pH in $CaCl_2$ being less than 4.5.

Table 13 BSAL Assessment Summary

Soil Survey BSAL Assessment	Hectares
Verified BSAL	0
Verified Non-BSAL	113
BSAL Sub Total	**113**
Exclusion Zone (> 10% slope)	132
Exclusion Zone (< 20 ha)	6
Exclusion Sub Total	**138**
BSAL Assessment Area Total	**251**

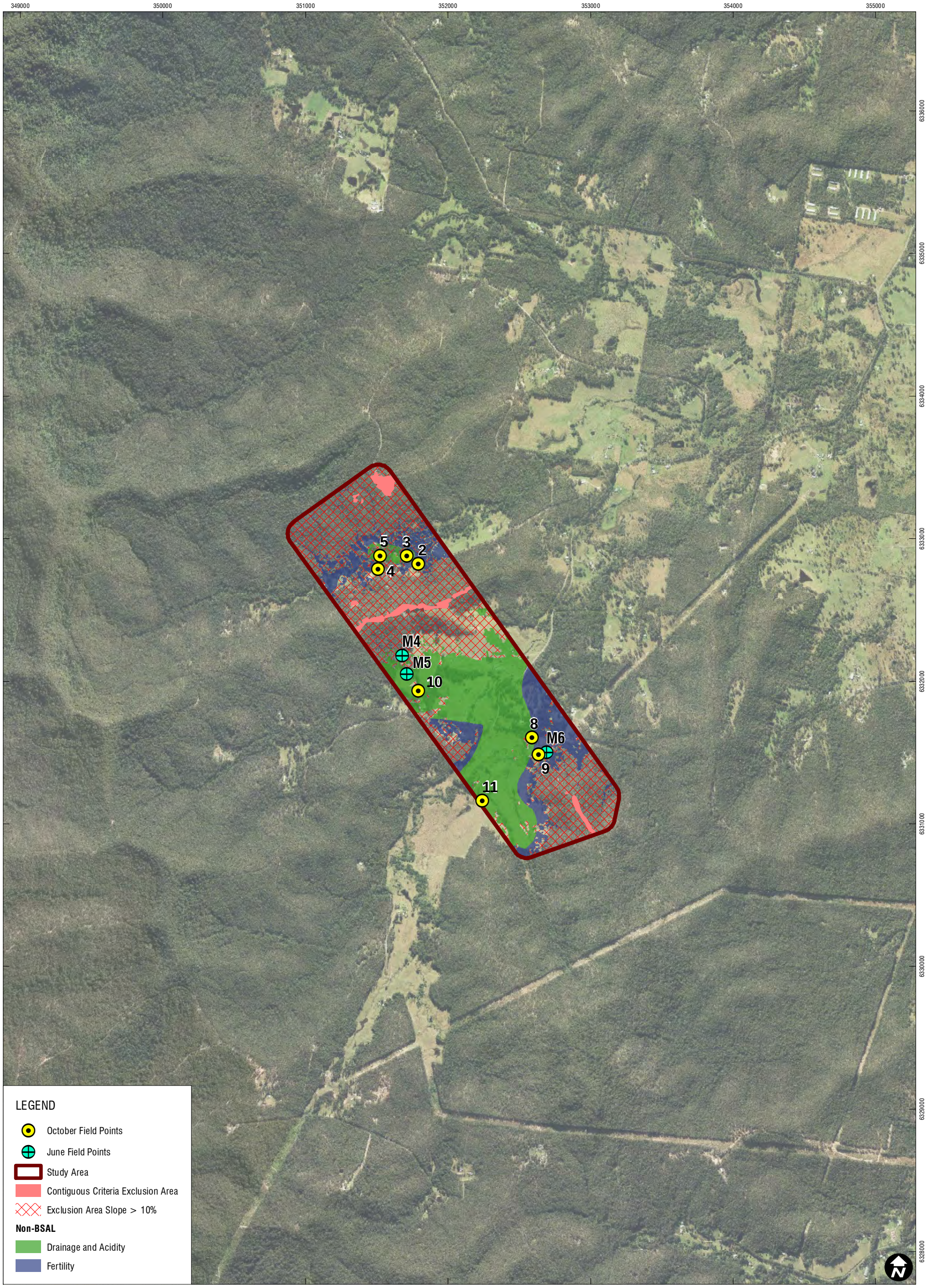
There were no soil types within the Study Area which met the criteria in the Interim Protocol to be classified as BSAL, and as such the entire Study Area has been mapped as non-BSAL, shown in **Figure 6**.

Table 14 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 ($CaCl_2$)?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Soil Unit BSAL?
Soil Unit 1 Brown Kurosol																
1*	Detailed	Magnesic-Natric Brown Kurosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✖	✓	✖	No
7*	Detailed	Mesotrophic Brown Kurosol	✓	✓	✓	✓	✓	✓	✓	✖	✓	✖	✖	✓	✓	
9	Detailed	Magnesic Brown Kurosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✖	✓	✖	
Soil Unit 2 Brown Sodosol																
M6	Detailed	Mesonatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✖	✓	✖	No
2	Detailed	Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✓	✓	✓	
4	Detailed	Mesonatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✖	✓	✖	
Soil Unit 3 Brown Dermosol																
M4	Detailed	Eutrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	No
M5	Detailed	Mesotrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	
3	Detailed	Eutrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	
5	Detailed	Eutrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	
8	Detailed	Dystrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✖	✓	✖	✖	✓	✖	
10	Detailed	Mesotrophic Brown Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	✓	
11	Detailed	Eutrophic Grey Dermosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	✓	

✓ = passes the BSAL criteria ✖ = fails the criteria but not excluded as BSAL ✖ = fails the BSAL criteria

* = Correlated sites from *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW22 – LW23 Modification* (SLR, 2016).



Sheet Size : A3

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BSAL Map
LW24-24A

FIGURE 6

5 CONCLUSION

This BSAL Assessment for the Mandalong Mine LW24 – LW24A Modification was undertaken by SLR Consulting. The Study Area for this BSAL Assessment is the LW24 – LW24A footprint, plus a 100 metre buffer, totalling 251 hectares. The Study Area is partially mapped as BSAL according to the NSW Government (DP&I, 2012).

Three Soil Units that were identified and mapped with the Study Area were verified as non-BSAL due their failure of Interim Protocol Criteria 9 (poor soil drainage) and/or Criteria 10 (pH). There was 113 hectares of land verified as non-BSAL within the Study Area based on the soil survey results.

Additionally, there was 138 hectares excluded as BSAL due to greater than 10% slope, or 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 Study Area.

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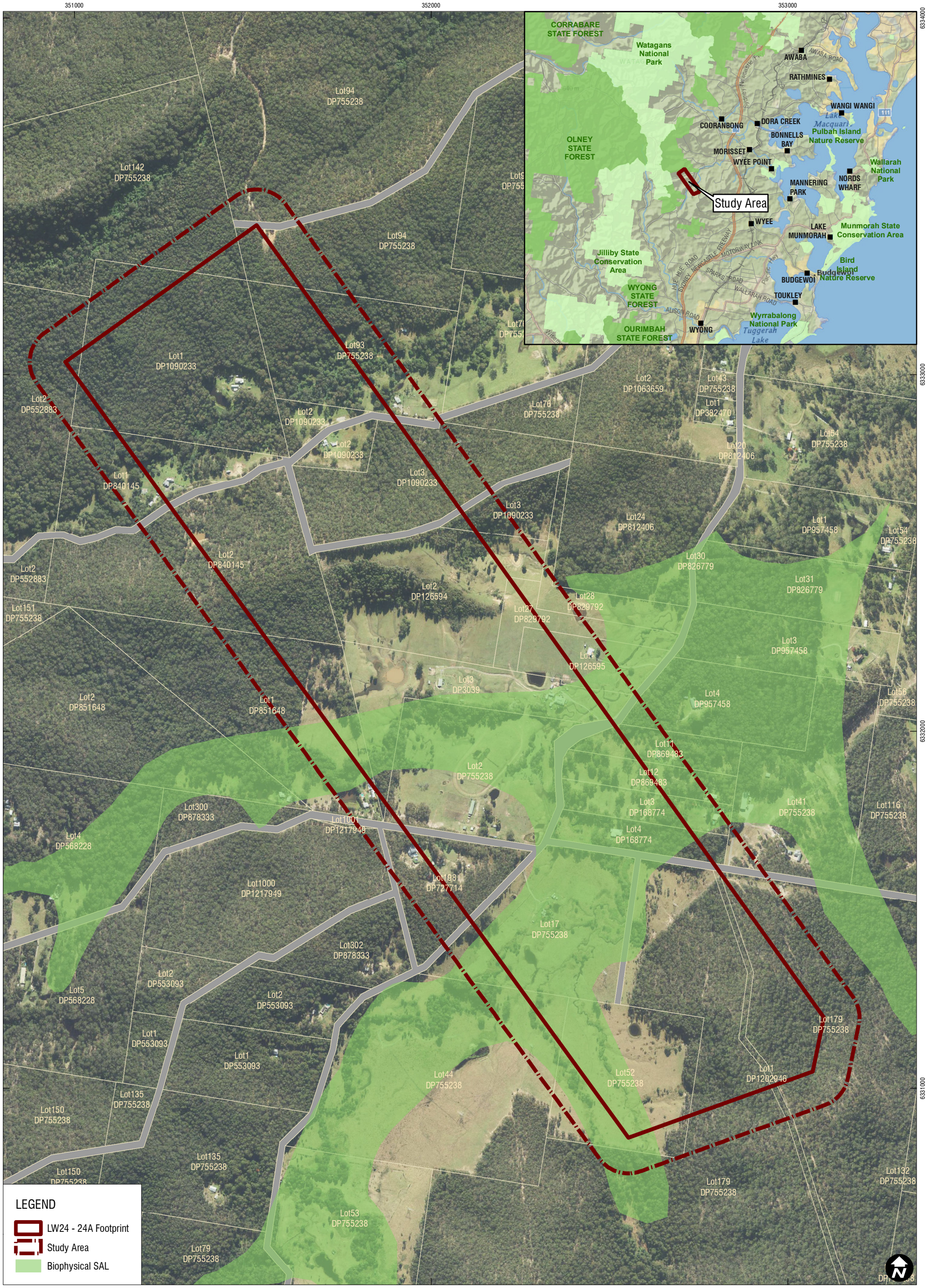
Appendix A

Zoomed Figures

1:10,000 Scale



Sheet Size : A3

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Study Area
LW24-24A

FIGURE 1

351000
352000
353000
6333000
6332000
6331000

TOBINS
MORANS

LEGEND
Study Area
10m Contour
Watercourse

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

19/04/2017
630.11810

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11810 Mandalong LW22-24A BSAL\06 SLR Data\01 Drafting\Figures\ArcGIS\LW_24-24A ISL R630\11810_BSAL_F02_Topography_Hydrology_LW24_24A_02.mxd

Sheet Size : A3

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Topography and Hydrology
LW24-24A

FIGURE 2

351000
352000
353000
6333000
6332000
6331000

LEGEND

Study Area

SlopeCode

- < 3%
- 3 - 5%
- 5 - 10%
- 10 - 18%
- 18 - 32%
- 32 - 50%
- > 50%

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

19/04/2017
630.11810

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11810 Mandalong LW22-24A BSAL\06 SLR Data\01 Drafting\Figures\ArcGIS\LW_24-24A\SLR630111810_BSAL_F03_Slopes_24_24A_02.mxd

Sheet Size : A3

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Slope Analysis
LW24-24A

FIGURE 3

351000
352000
353000
6333000
6332000
6331000

5
3
2
4
M4
M5
10
8
9
M6
11

LEGEND

- October Field Points
- June Field Points
- Study Area
- Contiguous Criteria Exclusion Area
- Exclusion Area Slope > 10%
- <= 10%

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

19/04/2017
630.11810

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11810 Mandalong LW22-24A BSAL\06 SLR Data\01 Drafting\Figures\ArcGIS\LW_24-24A\SLR630.11810_BSAL_F04_ExclusionArea_LW24_24A_02.mxd

Sheet Size : A3

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Exclusion Areas and Field Survey Sites LW24-24A

FIGURE 4

351000
352000
353000
6334000
6333000
6332000
6331000

5
3
2
4
M4
M5
10
8
9
M6
11

LEGEND

June Field Points
October Field Points
Study Area

Soil Types

Dermosol
Sodosol
Kurosol

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

19/04/2017
630.11810

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11810 Mandalong LW22-24A BSAL\06 SLR Data\01 Drafting\Figures\ArcGIS\LW_24-24A SLR\630.11810_BSAL_F05_Soil Types_LW24_24A_02.mxd

Sheet Size : A3

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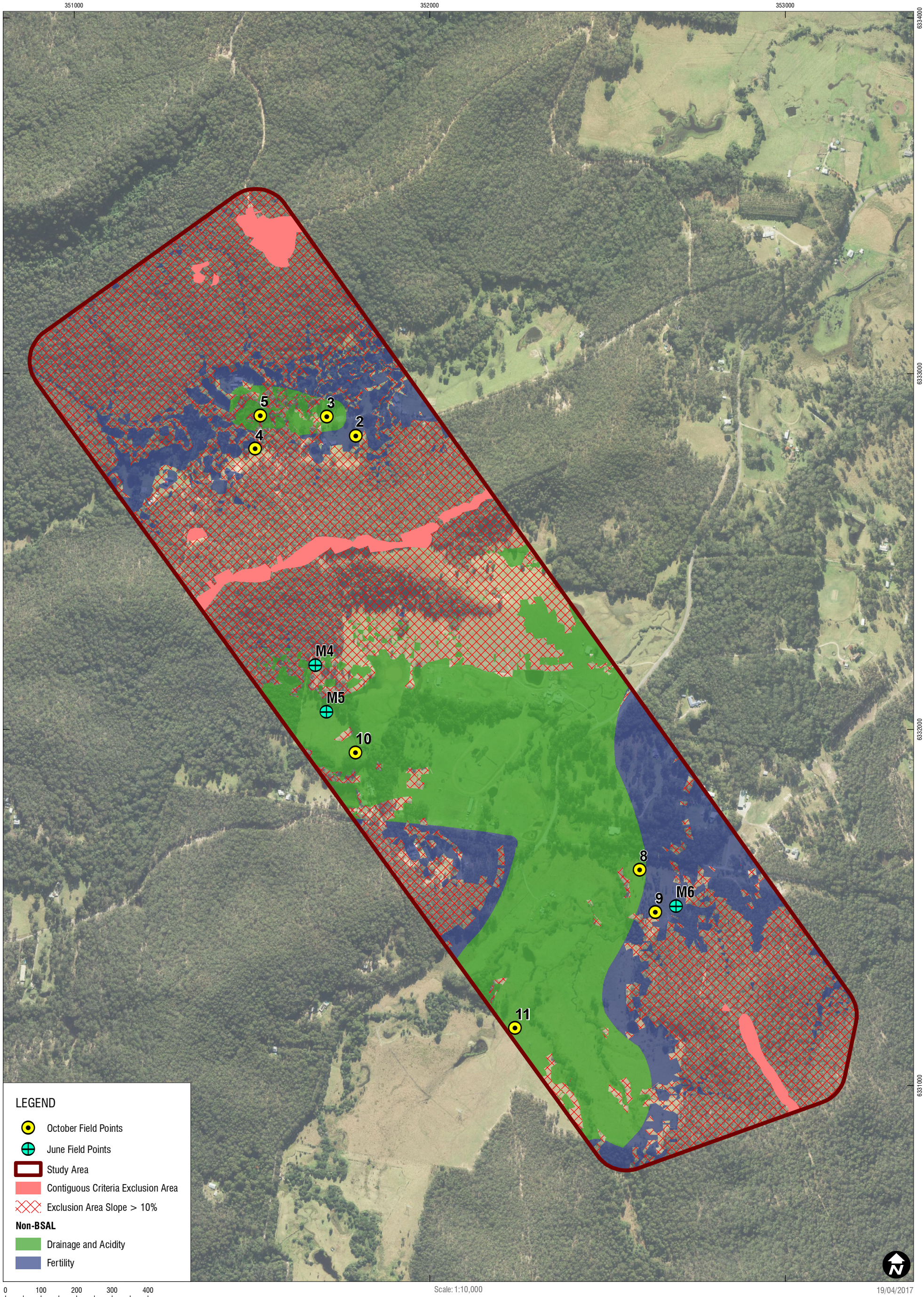
Soil Types
LW24-24A

FIGURE 5



Sheet Size : A3

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BSAL Map
LW24-24A

FIGURE 6

Appendix B

Slope Analysis Methodology

Slope Analysis Methodology

Methodology

1. Acquire appropriate elevation information. In this case, LIDAR data provided by Centennial Mandalong Pty Ltd..

2. Load Contours into ArcMap 10.3

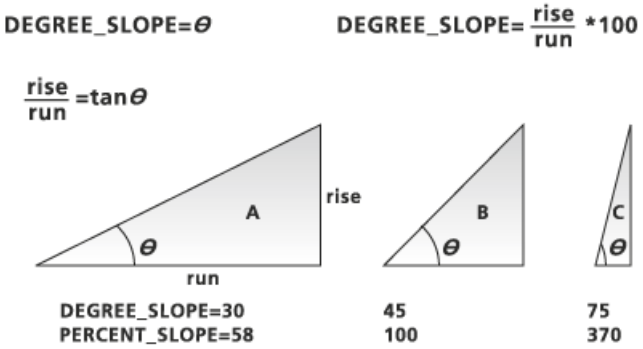
3. Using 3D Analyst Extension - Create a TIN Surface based on the contours (http://resources.arcgis.com/en/help/main/10.1/index.html#/Create_TIN/00q90000001v000000/)

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.

Appendix C

Laboratory Soil Test Results

Department of Primary Industries
Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO16/099R1
REPORT TO:	Murray Fraser SLR Consulting 10 Kings Rd New Lambton NSW 2305
REPORT ON:	Fifteen soil samples Your ref: 630.11678 Mandalong EP
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	27 June 2016
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED

SR Young
(Laboratory Manager)

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO16/099R1
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	P9B/2	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	EAT	clay	silt	fine sand	coarse sand	gravel	Dry	Moist
1	M1 0-10	0.04	5.8	4.8	7	5	19	57	18	1	7.5YR 6/2	7.5YR 4/2
2	M1 20-30	<0.01	5.9	4.7	3(1)	8	20	54	17	1	7.5YR 6/2	7.5YR 4/3
3	M1 45-55	0.01	6.4	4.6	2(2)	15	20	49	16	<1	10YR 6/3	10YR 5/4
4	M1 65-75	0.04	6.2	4.4	2(3)	21	4	42	18	15	10YR 6/4	10YR 5/6
5	M3 0-10	0.02	5.2	4.1	8	5	10	38	28	19	10YR 5/4	10YR 3/6
6	M3 20-30	<0.01	5.7	4.4	3(2)	9	11	53	24	3	10YR 6/3	10YR 4/4
7	M3 50-60	0.08	6.0	4.6	2(1)	19	9	31	36	5	10YR 6/4	10YR 5/6
8	M4 0-10	0.02	5.5	4.4	3(1)	10	15	46	27	2	7.5YR 5/2	7.5YR 4/2
9	M4 15-25	<0.01	5.8	4.3	3(2)	12	15	44	24	5	10YR 6/2	10YR 4/3
10	M4 40-50	0.01	6.0	4.3	2(1)	21	16	37	24	2	10YR 6/3	10YR 5/4
11	M4 65-75	0.11	5.2	4.0	2(1)	40	16	30	14	<1	10YR 6/3	10YR 5/4
12	M7 0-10	0.02	5.5	4.3	8	7	25	55	12	1	7.5YR 5/2	7.5YR 3/3
13	M7 20-30	<0.01	6.1	4.3	2(1)	11	23	56	10	<1	7.5YR 6/2	7.5YR 4/3
14	M7 40-50	0.06	5.7	4.2	2(1)	16	24	52	8	0	10YR 6/3	10YR 5/4
15	M7 65-75	0.25	5.1	4.0	2(1)	38	37	22	3	0	10YR 7/3	10YR 6/4

END OF TEST REPORT

Department of Primary Industries

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

Report No. **WN160475**

Stephen Young
Soil Conservation Service
PO Box 283
SCONE NSW 2337

Soil Analysis Report

Samples as received on 15/06/16, 15 Soil sample(s). 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 24/06/16

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

ASPAC

Approved for Release by: Craig Hunt.
Craig Hunt
Technical Officer

Sample No. Identification	Units	Limit of Reporting	1 SCO16/099 /1	2 SCO16/099 /2	3 SCO16/099 /3	4 SCO16/099 /4	5 SCO16/099 /5
Exchangeable Cations							
Exchangeable Sodium	%		4.3	6.2	12	17	3.1
Exchangeable Magnesium	%		17	14	61	61	30
Exchangeable Potassium	%		4.4	2.2	0.89	0.98	9.8
Exchangeable Calcium	%		67	63	15	3.8	8.9
Aluminium Saturation	%		7.4	15	11	17	48
Calcium/ Magnesium			4.0	4.5	0.24	0.06	0.30
CEC	cmol(+)/kg	0.20	3.1	1.6	3.8	5.8	3.6
Sodium	cmol(+)/kg	0.03	0.13	0.098	0.46	0.99	0.11
Magnesium	cmol(+)/kg	0.007	0.52	0.22	2.3	3.6	1.1
Potassium	cmol(+)/kg	0.01	0.14	0.035	0.034	0.057	0.36
Calcium	cmol(+)/kg	0.03	2.1	0.99	0.56	0.22	0.32
Aluminium	cmol(+)/kg	0.1	0.23	0.24	0.42	0.99	1.8

Sample No. Identification	Units	Limit of Reporting	6 SCO16/099 /6	7 SCO16/099 /7	8 SCO16/099 /8	9 SCO16/099 /9	10 SCO16/099 /10
Exchangeable Cations							
Exchangeable Sodium	%		3.0	13	4.8	6.2	7.0
Exchangeable Magnesium	%		49	75	39	42	57
Exchangeable Potassium	%		8.9	1.6	3.8	3.2	2.2
Exchangeable Calcium	%		N/A	0.48	25	8.5	3.6
Aluminium Saturation	%		40	10	28	40	31
Calcium/ Magnesium			N/A	0.006	0.66	0.20	0.06
CEC	cmol(+)/kg	0.20	2.9	9.3	3.6	2.6	5.7
Sodium	cmol(+)/kg	0.03	0.085	1.2	0.17	0.16	0.40
Magnesium	cmol(+)/kg	0.007	1.4	7.0	1.4	1.1	3.2
Potassium	cmol(+)/kg	0.01	0.25	0.15	0.14	0.082	0.12
Calcium	cmol(+)/kg	0.03	<0.03	0.045	0.91	0.22	0.21
Aluminium	cmol(+)/kg	0.1	1.1	0.95	0.99	1.0	1.8

Sample No. Identification	Units	Limit of Reporting	11 SCO16/099 /11	12 SCO16/099 /12	13 SCO16/099 /13	14 SCO16/099 /14	15 SCO16/099 /15
Exchangeable Cations							
Exchangeable Sodium	%		16	4.8	8.7	15	20
Exchangeable Magnesium	%		44	34	46	46	38
Exchangeable Potassium	%		2.1	4.1	3.3	1.4	1.4
Exchangeable Calcium	%		0.33	26	2.5	0.81	0.44
Aluminium Saturation	%		38	31	40	37	40
Calcium/ Magnesium			0.008	0.76	0.06	0.02	0.01
CEC	cmol(+)/kg	0.20	11	4.2	2.7	5.0	12
Sodium	cmol(+)/kg	0.03	1.8	0.20	0.23	0.76	2.4
Magnesium	cmol(+)/kg	0.007	4.9	1.5	1.2	2.3	4.5
Potassium	cmol(+)/kg	0.01	0.23	0.17	0.087	0.069	0.16
Calcium	cmol(+)/kg	0.03	0.037	1.1	0.068	0.040	0.053
Aluminium	cmol(+)/kg	0.1	4.3	1.3	1.1	1.8	4.8

Department of Industry
Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO16/175R3
REPORT TO:	Murray Fraser SLR Consulting 10 Kings Rd New Lambton NSW 2305
REPORT ON:	Fifty Four soil samples Your ref: 630.11810 Mandalong BSAL
PRELIMINARY RESULTS ISSUED:	18 October 2016, 21 October 2016
REPORT STATUS:	Final
DATE REPORTED:	31 October 2016
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: SCO16/175R3
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	clay	silt	f sand	c sand	gravel	Dry	Moist
1	1 0-10	0.03	5.8	4.9	12	48	30	10	<1	10YR 6/2	10YR 4/2
2	1 15-25	0.01	5.9	4.3	15	51	25	9	<1	10YR 6/2	10YR 4/3
3	1 40-50	0.08	5.3	4.0	51	34	11	4	<1	10YR 6/4	10YR 5/4
4	1 65-75	0.11	4.8	3.8	38	27	29	5	1	10YR 6/4	10YR 5/4
5	1 80-90	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
6	2 0-10	0.02	6.0	5.0	4	21	66	9	<1	10YR 5/2	7.5YR 3/2
7	2 30-40	0.01	6.6	5.4	11	20	62	7	<1	10YR 6/2	10YR 4/3
8	2 -40-50	0.04	6.3	4.9	25	19	50	6	<1	10YR 6/4	10YR 5/4
9	2 65-75	0.07	5.9	4.5	26	16	51	7	<1	10YR 6/4	10YR 5/4
10	3 0-10	0.05	5.9	5.0	8	23	59	10	0	10YR 5/3	10YR 3/4
11	3 20-30	0.03	5.5	4.4	12	22	58	8	<1	10YR 6/3	10YR 4/4
12	3 40-50	0.02	5.6	4.4	15	20	56	8	1	10YR 6/3	10YR 5/4
13	3 65-75	0.07	5.7	4.1	19	13	54	10	4	10YR 6/4	10YR 4/6
14	4 0-10	0.02	5.6	4.4	9	25	49	14	3	10YR 5/2	10YR 3/3
15	4 15-25	0.04	6.1	4.4	16	23	50	11	<1	10YR 6/2	10YR 4/4

nt = not tested

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO16/175R3
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	clay	silt	f sand	c sand	gravel	Dry	Moist
16	4 40-50	0.20	5.5	4.3	41	18	33	8	<1	10YR 6/4	10YR 5/4
17	4 65-75	0.29	5.4	4.2	38	16	37	9	<1	10YR 6/4	10YR 5/4
18	5 0-10	0.02	5.7	4.4	16	29	40	15	<1	10YR 5/2	7.5YR 3/2
19	5 25-35	0.01	5.8	4.4	14	27	39	19	1	10YR 5/2	7.5YR 3/2
20	5 40-50	<0.01	6.1	4.2	13	24	36	24	3	10YR 5/3	7.5YR 3/3
21	5 65-75	0.01	6.3	4.2	14	19	34	28	5	10YR 5/3	7.5YR 3/3
22	6 0-10	0.02	5.2	4.0	11	19	57	13	<1	10YR 4/2	10YR 2/2
23	6 20-30	0.01	5.6	4.2	13	18	57	12	<1	10YR 5/2	10YR 3/2
24	6 40-50	0.01	5.8	4.2	13	18	59	10	<1	10YR 5/2	7.5YR 3/3
25	6 65-75	0.01	5.9	4.0	26	11	50	11	2	10YR 5/3	10YR 4/3
26	7 0-10	0.01	5.4	4.2	11	15	50	23	1	10YR 4/2	10YR 2/2
27	7 20-30	0.01	5.7	4.1	18	15	50	16	1	10YR 6/2	10YR 4/3
28	7 40-50	0.04	5.3	3.9	54	13	27	6	<1	10YR 6/3	10YR 4/4
29	7 65-75	0.06	5.1	3.8	45	13	35	7	0	10YR 6/4	10YR 5/4
30	8 0-10	0.01	5.7	4.4	12	12	39	37	<1	10YR 5/2	10YR 3/3

nt = not tested

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO16/175R3
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	clay	silt	f sand	c sand	gravel	Dry	Moist
31	8 20-30	<0.01	5.6	4.2	18	9	37	35	1	10YR 6/3	10YR 5/4
32	8 40-50	0.01	5.2	3.9	32	11	26	31	0	10YR 6/6	10YR 5/6
33	8 65-75	0.02	5.1	3.8	35	8	26	31	0	10YR 6/6	10YR 5/8
34	9 0-10	0.02	5.6	4.4	16	22	43	17	2	10YR 5/3	7.5YR 3/3
35	9 10-20	0.01	5.6	4.2	16	18	42	17	7	10YR 6/2	10YR 4/3
36	9 30-40	0.04	5.4	4.0	54	17	20	9	0	10YR 6/4	10YR 5/4
37	9 40-50	0.05	5.3	4.0	54	17	20	9	0	10YR 7/3	10YR 5/6
38	9 65-75	0.02	5.4	4.1	65	0	24	11	<1	10YR 7/4	10YR 6/4
39	10 0-10	0.03	6.0	5.0	12	21	56	11	<1	10YR 5/2	7.5YR 3/2
40	10 20-30	<0.1	6.1	4.4	15	17	55	12	1	10YR 6/3	10YR 5/4
41	10 40-50	0.02	5.9	4.3	27	18	41	14	<1	10YR 6/4	10YR 5/6
42	10 65-75	0.03	5.8	4.4	22	15	52	11	<1	10YR 6/4	10YR 5/6
43	M2 0-10	0.02	5.8	4.9	12	32	47	9	<1	10YR 6/2	10YR 4/2
44	M2 15-25	0.01	6.0	4.6	13	35	43	9	<1	10YR 6/2	10YR 5/2
45	M2 25-35	0.03	6.3	4.6	25	32	34	6	3	10YR 7/2	10YR 6/3

nt = not tested

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO16/175R3
Client Reference: Murray Fraser
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C1A/5	C2A/4	C2B/4	P7B/2 Particle Size Analysis (%)					Colour	
	Sample Id	EC (dS/m)	pH	pH ($CaCl_2$)	clay	silt	f sand	c sand	gravel	Dry	Moist
46	M2 40-50	0.09	5.9	4.3	45	23	27	5	0	10YR 7/4	10YR 5/3
47	M2 65-75	0.16	5.5	4.2	36	22	33	9	0	10YR 6/4	10YR 5/4
48	M5 0-10	0.02	5.6	4.5	11	15	64	10	<1	10YR 5/3	10YR 3/3
49	M5 30-40	<0.01	6.0	4.4	14	20	56	10	<1	10YR 6/2	7.5YR 4/3
50	M5 50-60	0.01	6.2	4.3	20	19	53	6	2	10YR 6/2	10YR 5/3
51	M5 65-75	0.02	6.2	4.2	27	15	53	5	0	10YR 7/3	10YR 5/4
52	M6 0-10	0.05	5.5	4.1	16	12	57	12	3	10YR 5/3	10YR 3/3
53	M6 20-30	0.20	5.5	4.3	53	11	33	3	<1	2.5Y 6/4	10YR 5/6
54	M6 50-60	0.26	5.5	4.4	47	13	39	1	<1	10YR 7/6	10YR 6/6

nt = not tested

END OF TEST REPORT

Department of Primary Industries

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

Report No. **WN160808**

Lynn Dunn
Soil Conservation Service
PO Box 283
SCONE NSW 2337

Soil Analysis Report

54 Sample(s) received on 19/10/16 . Tested as per the following methods.

Method	Method Description
S017	Gillman & Sumpter Exchangeable Cations

Notes: Sample 5 was received, but will not be tested, as per your instructions.

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 21/10/16

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 SCO016/ 175/1	2 SCO016/ 175/2	3 SCO016/ 175/3	4 SCO016/ 175/4	6 SCO016/ 175/6
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	0.35	1.2	5.9	6.5	0.12
Calcium	cmol(+)/kg	0.03	3.3	0.31	0.055	0.079	5.8
Potassium	cmol(+)/kg	0.01	0.14	0.091	0.24	0.21	0.16
Magnesium	cmol(+)/kg	0.007	2.1	2.5	5.9	3.2	0.80
Sodium	cmol(+)/kg	0.03	0.27	0.31	1.0	0.81	0.087
CEC	cmol(+)/kg	0.20	6.2	4.4	13	11	7.0
Calcium/ Magnesium			1.6	0.13	0.009	0.02	7.2
Aluminium Saturation	%		5.6	27	45	60	2
Exchangeable Calcium	%		54	7.1	0.42	0.73	83
Exchangeable Potassium	%		2.3	2.1	1.9	2.0	2.2
Exchangeable Magnesium	%		34	57	45	30	12
Exchangeable Sodium	%		4.4	7.2	7.8	7.5	1.3

Laboratory No. Client's ID	Units	Limit of Reporting	7 SCO016/ 175/7	8 SCO016/ 175/8	9 SCO016/ 175/9	10 SCO016/ 175/10	11 SCO016/ 175/11
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	<0.1	0.17	0.79	<0.1	0.80
Calcium	cmol(+)/kg	0.03	3.3	3.3	1.9	3.8	1.9
Potassium	cmol(+)/kg	0.01	0.042	0.088	0.11	0.58	0.30
Magnesium	cmol(+)/kg	0.007	0.81	3.5	4.9	1.6	1.9
Sodium	cmol(+)/kg	0.03	0.15	0.59	1.0	0.093	0.11
CEC	cmol(+)/kg	0.20	4.3	7.6	8.7	6.0	5.0
Calcium/ Magnesium			4.1	0.95	0.39	2.4	1.0
Aluminium Saturation	%		N/A	2	9.0	N/A	16
Exchangeable Calcium	%		77	43	22	63	38
Exchangeable Potassium	%		0.98	1.2	1.3	9.6	5.9
Exchangeable Magnesium	%		19	45	56	26	38
Exchangeable Sodium	%		3.5	7.8	12	1.5	2.3

Laboratory No. Client's ID	Units	Limit of Reporting	12 SCO016/ 175/12	13 SCO016/ 175/13	14 SCO016/ 175/14	15 SCO016/ 175/15	16 SCO016/ 175/16
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	0.68	1.4	0.57	0.43	1.6
Calcium	cmol(+)/kg	0.03	0.50	0.069	2.1	0.98	0.98
Potassium	cmol(+)/kg	0.01	0.064	0.11	0.16	0.092	0.25
Magnesium	cmol(+)/kg	0.007	2.7	3.9	1.8	2.3	6.5
Sodium	cmol(+)/kg	0.03	0.25	1.1	0.15	0.63	2.3
CEC	cmol(+)/kg	0.20	4.2	6.7	4.8	4.4	12
Calcium/ Magnesium			0.19	0.02	1.1	0.43	0.15
Aluminium Saturation	%		17	21	12	9.9	14
Exchangeable Calcium	%		12	1.0	43	22	8.4
Exchangeable Potassium	%		1.5	1.7	3.4	2.1	2.1
Exchangeable Magnesium	%		64	59	38	51	56
Exchangeable Sodium	%		6.0	17	3.2	14	20

Laboratory No. Client's ID	Units	Limit of Reporting	17 SCO016/ 175/17	18 SCO016/ 175/18	19 SCO016/ 175/19	20 SCO016/ 175/20	21 SCO016/ 175/21
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	1.3	0.90	1.2	1.3	1.2
Calcium	cmol(+)/kg	0.03	0.61	2.9	1.1	0.41	0.087
Potassium	cmol(+)/kg	0.01	0.25	0.22	0.12	0.081	0.092
Magnesium	cmol(+)/kg	0.007	6.1	3.7	2.3	2.0	2.5
Sodium	cmol(+)/kg	0.03	2.9	0.16	0.19	0.25	0.46
CEC	cmol(+)/kg	0.20	11	8.0	4.9	4.0	4.3
Calcium/ Magnesium			0.10	0.79	0.45	0.21	0.03
Aluminium Saturation	%		12	11	24	33	27
Exchangeable Calcium	%		5.5	37	22	10	2.0
Exchangeable Potassium	%		2.2	2.8	2.4	2.0	2.1
Exchangeable Magnesium	%		55	47	48	49	58
Exchangeable Sodium	%		26	2.0	3.8	6.2	11

Laboratory No. Client's ID	Units	Limit of Reporting	22 SCO016/ 175/22	23 SCO016/ 175/23	24 SCO016/ 175/24	25 SCO016/ 175/25	26 SCO016/ 175/26
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	2.5	1.8	1.4	2.3	1.7
Calcium	cmol(+)/kg	0.03	0.22	0.16	0.11	0.031	2.5
Potassium	cmol(+)/kg	0.01	0.11	0.045	0.066	0.12	0.20
Magnesium	cmol(+)/kg	0.007	0.75	0.70	0.96	2.6	1.4
Sodium	cmol(+)/kg	0.03	0.18	0.17	0.20	0.48	0.16
CEC	cmol(+)/kg	0.20	3.8	2.9	2.7	5.6	5.9
Calcium/ Magnesium			0.29	0.23	0.11	0.01	1.8
Aluminium Saturation	%		66	63	51	42	28
Exchangeable Calcium	%		5.9	5.5	3.9	0.55	42
Exchangeable Potassium	%		3.0	1.6	2.5	2.1	3.4
Exchangeable Magnesium	%		20	24	36	47	23
Exchangeable Sodium	%		4.7	6.0	7.5	8.6	2.7

Laboratory No. Client's ID	Units	Limit of Reporting	27 SCO016/ 175/27	28 SCO016/ 175/28	29 SCO016/ 175/29	30 SCO016/ 175/30	31 SCO016/ 175/31
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	1.7	6.9	7.6	0.83	1.4
Calcium	cmol(+)/kg	0.03	1.3	1.4	1.1	1.2	0.21
Potassium	cmol(+)/kg	0.01	0.14	0.27	0.27	0.17	0.095
Magnesium	cmol(+)/kg	0.007	1.7	4.0	4.2	0.81	0.66
Sodium	cmol(+)/kg	0.03	0.23	0.58	0.67	0.090	0.10
CEC	cmol(+)/kg	0.20	5.1	13	14	3.1	2.5
Calcium/ Magnesium			0.72	0.35	0.26	1.5	0.32
Aluminium Saturation	%		34	52	55	27	57
Exchangeable Calcium	%		25	11	7.9	39	8.5
Exchangeable Potassium	%		2.8	2.0	1.9	5.4	3.8
Exchangeable Magnesium	%		34	31	30	26	26
Exchangeable Sodium	%		4.5	4.4	4.8	2.9	4.1

Laboratory No. Client's ID	Units	Limit of Reporting	32 SCO016/ 175/32	33 SCO016/ 175/33	34 SCO016/ 175/34	35 SCO016/ 175/35	36 SCO016/ 175/36
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	5.0	5.8	1.0	1.8	7.8
Calcium	cmol(+)/kg	0.03	0.068	0.039	1.6	0.44	0.32
Potassium	cmol(+)/kg	0.01	0.16	0.17	0.32	0.15	0.31
Magnesium	cmol(+)/kg	0.007	0.96	1.1	2.8	1.2	5.4
Sodium	cmol(+)/kg	0.03	0.21	0.25	0.23	0.16	0.56
CEC	cmol(+)/kg	0.20	6.3	7.3	6.0	3.7	14
Calcium/ Magnesium			0.07	0.04	0.57	0.38	0.06
Aluminium Saturation	%		78	79	17	49	54
Exchangeable Calcium	%		1.1	0.53	27	12	2.2
Exchangeable Potassium	%		2.5	2.4	5.2	3.9	2.2
Exchangeable Magnesium	%		15	15	47	31	38
Exchangeable Sodium	%		3.4	3.4	3.8	4.4	3.9

Laboratory No. Client's ID	Units	Limit of Reporting	37 SCO016/ 175/37	38 SCO016/ 175/38	39 SCO016/ 175/39	40 SCO016/ 175/40	41 SCO016/ 175/41
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	7.9	6.8	<0.1	0.71	1.1
Calcium	cmol(+)/kg	0.03	0.21	0.10	7.8	0.85	0.82
Potassium	cmol(+)/kg	0.01	0.32	0.29	0.27	0.13	0.18
Magnesium	cmol(+)/kg	0.007	5.8	6.3	1.7	0.83	1.7
Sodium	cmol(+)/kg	0.03	0.61	0.69	0.18	0.12	0.34
CEC	cmol(+)/kg	0.20	15	14	10	2.6	4.1
Calcium/ Magnesium			0.04	0.02	4.5	1.0	0.49
Aluminium Saturation	%		53	48	N/A	27	26
Exchangeable Calcium	%		1.4	0.71	78	32	20
Exchangeable Potassium	%		2.1	2.1	2.7	4.7	4.4
Exchangeable Magnesium	%		39	44	17	32	41
Exchangeable Sodium	%		4.1	4.9	1.8	4.7	8.3

Laboratory No. Client's ID	Units	Limit of Reporting	42 SCO016/ 175/42	43 SCO016/ 175/43	44 SCO016/ 175/44	45 SCO016/ 175/45	46 SCO016/ 175/46
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	0.87	0.25	0.58	0.87	2.0
Calcium	cmol(+)/kg	0.03	0.86	4.6	2.3	0.91	0.37
Potassium	cmol(+)/kg	0.01	0.17	0.14	0.12	0.093	0.16
Magnesium	cmol(+)/kg	0.007	2.2	0.94	1.0	3.6	7.1
Sodium	cmol(+)/kg	0.03	0.40	0.089	0.21	0.83	2.0
CEC	cmol(+)/kg	0.20	4.6	6.0	4.2	6.3	12
Calcium/ Magnesium			0.38	4.8	2.3	0.26	0.05
Aluminium Saturation	%		19	4	14	14	17
Exchangeable Calcium	%		19	76	55	15	3.2
Exchangeable Potassium	%		3.8	2.4	2.8	1.5	1.4
Exchangeable Magnesium	%		49	16	23	57	62
Exchangeable Sodium	%		8.7	1.5	5.0	13	17

Laboratory No. Client's ID	Units	Limit of Reporting	47 SCO016/ 175/47	48 SCO016/ 175/48	49 SCO016/ 175/49	50 SCO016/ 175/50	51 SCO016/ 175/51
Exchangeable Cations							
Aluminium	cmol(+)/kg	0.1	1.5	0.47	0.65	0.96	1.8
Calcium	cmol(+)/kg	0.03	0.044	2.0	0.88	0.51	0.20
Potassium	cmol(+)/kg	0.01	0.14	0.12	0.058	0.064	0.094
Magnesium	cmol(+)/kg	0.007	5.7	0.84	0.83	2.0	3.9
Sodium	cmol(+)/kg	0.03	2.4	0.15	0.16	0.38	0.66
CEC	cmol(+)/kg	0.20	9.7	3.6	2.6	3.9	6.7
Calcium/ Magnesium			0.008	2.4	1.1	0.25	0.05
Aluminium Saturation	%		15	13	25	24	27
Exchangeable Calcium	%		0.45	56	34	13	3.1
Exchangeable Potassium	%		1.5	3.4	2.3	1.6	1.4
Exchangeable Magnesium	%		58	23	32	51	58
Exchangeable Sodium	%		25	4.1	6.1	9.7	10

Laboratory No. Client's ID	Units	Limit of Reporting	52 SCO016/ 175/52	53 SCO016/ 175/53	54 SCO016/ 175/54
Exchangeable Cations					
Aluminium	cmol(+)/kg	0.1	1.8	2.6	1.3
Calcium	cmol(+)/kg	0.03	0.081	<0.03	0.034
Potassium	cmol(+)/kg	0.01	0.18	0.32	0.28
Magnesium	cmol(+)/kg	0.007	1.9	11	12
Sodium	cmol(+)/kg	0.03	0.54	2.5	3.3
CEC	cmol(+)/kg	0.20	4.4	16	17
Calcium/ Magnesium			0.04	N/A	0.003
Aluminium Saturation	%		40	17	8.0
Exchangeable Calcium	%		1.8	N/A	0.20
Exchangeable Potassium	%		4.0	2.0	1.7
Exchangeable Magnesium	%		42	66	70
Exchangeable Sodium	%		12	15	20

Department of Primary Industries
Soil Conservation Service

SOIL TEST REPORT

Scone Research Centre

REPORT NO:	SCO14/154R1
REPORT TO:	Adam Koppers SLR Consulting 10 Kings Rd New Lambton NSW 2305
REPORT ON:	Twenty-three soil samples Your ref: 630.10707 Mandalong
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	28 August 2014
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

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO14/154R1
Client Reference: Adam Koppers
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	P7B/2 Particle Size Analysis (%)					C1A/5	C2A/4	C2B/4
	Sample Id	clay	silt	f sand	c sand	gravel	EC (dS/m)	pH	pH $Cacl_2$
12	Site 4 0-10 Mandalong 22/07/2014	15	26	42	17	<1	0.03	5.7	4.6
13	Site 4 20-30 Mandalong 22/07/2014	18	18	45	17	2	0.03	5.5	4.3
14	Site 4 40-50 Mandalong 22/07/2014	24	17	39	17	3	0.05	5.6	4.3
15	Site 4 60-70 Mandalong 22/07/2014	nt	nt	nt	nt	nt	0.10	5.4	4.1
16	Site 5 0-10 Mandalong 22/07/2014	10	18	45	19	8	0.02	5.7	4.6
17	Site 5 20-30 Mandalong 22/07/2014	15	18	42	16	9	0.01	5.7	4.4
18	Site 5 40-50 Mandalong 22/07/2014	47	14	30	9	<1	0.03	5.7	4.2
19	Site 5 60-70 Mandalong 22/07/2014	36	15	40	9	0	0.04	5.6	4.2
20	Site 7 0-10 Mandalong 22/07/2014	3	25	65	7	0	0.02	5.7	4.5
21	Site 7 20-30 Mandalong 22/07/2014	9	30	58	3	<1	0.01	5.9	4.6
22	Site 7 40-50 Mandalong 22/07/2014	11	30	56	3	<1	0.02	6.0	4.5
23	Site 7 70-80 Mandalong 22/07/2014	23	30	45	2	<1	0.06	6.1	4.3

nt=not tested

SOIL CONSERVATION SERVICE
Scone Research Centre

Report No: SCO14/154R1
Client Reference: Adam Koppers
SLR Consulting
10 Kings Rd
New Lambton NSW 2305

Lab No	Method	C5A/4 CEC & exchangeable cations (me/100g)						Colour	
	Sample Id	CEC	Na	K	Ca	Mg	Al	Dry	Moist
12	Site 4 0-10 Mandalong 22/07/2014	13.0	0.3	0.4	2.9	5.2	1.6	10YR 5/3	10YR 4/2
13	Site 4 20-30 Mandalong 22/07/2014	9.5	0.2	0.2	1.8	3.5	na	10YR 5/3	10YR 4/2
14	Site 4 40-50 Mandalong 22/07/2014	10.5	0.5	0.2	0.8	3.4	3.2	10YR 5/2	10YR 3/2
15	Site 4 60-70 Mandalong 22/07/2014	19.0	1.1	0.2	0.6	5.9	0.9	10YR 5/4	10YR 4/4
16	Site 5 0-10 Mandalong 22/07/2014	7.2	<0.1	0.3	1.3	2.4	0.9	10YR 5/3	10YR 4/3
17	Site 5 20-30 Mandalong 22/07/2014	8.6	0.2	0.3	1.0	2.6	1.3	10YR 6/3	10YR 4/3
18	Site 5 40-50 Mandalong 22/07/2014	17.8	0.6	0.5	0.4	7.3	5.0	2.5Y 7/4	2.5Y 6/4
19	Site 5 60-70 Mandalong 22/07/2014	16.4	0.7	0.4	0.8	6.5	4.4	2.5Y 7/4	2.5Y 6/4
20	Site 7 0-10 Mandalong 22/07/2014	6.5	0.2	0.1	2.0	1.2	<0.5	10YR 5/2	10YR 4/2
21	Site 7 20-30 Mandalong 22/07/2014	4.7	0.2	<0.1	1.1	1.1	0.5	10YR 6/2	10YR 5/2
22	Site 7 40-50 Mandalong 22/07/2014	5.3	0.4	<0.1	1.1	2.0	0.6	10YR 6/2	10YR 5/2
23	Site 7 70-80 Mandalong 22/07/2014	9.5	1.2	0.1	1.3	4.3	1.3	10YR 6/3	10YR 5/4

na – not available

END OF TEST REPORT

Appendix D

Full Soil Profile Descriptions

Soil Unit 1: Brown Kurosol

Soil Unit 1 is a Brown Kurosol. Kurosols are soils with a strong texture contrast between the A horizon and strongly acidic B horizons. Many Kurosols have unusual subsoil chemical attributes such as high magnesium, sodium and aluminium. One representative site for Soil Unit 1 is described below. The Magnesic Brown Kurosol has been correlated with two other assessment sites which border the BSAL Assessment Area to the east (Site 1 and Site 7). These sites were assessed in the *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW22 – LW23 Modification* (SLR, 2016).

Table 1 Summary: Magnesic Brown Kurosol (Site 9)

Overview	
	
Landscape Site 9	
ASC Name	Magnesic Brown Kurosol
Representative Site	Site 9
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Cattle Grazing
Vegetation	Spotted Gum, Annual Ryegrass, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	9%
Verified	Non-BSAL

Table 2 Profile: Magnesic Brown Kurosol (Site 9)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (10YR 5/3) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.25	Brown (10YR 6/2) loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <10% gravel 5-10 mm, abundant fine roots. Well drained with an abrupt and even boundary. Sampled 0.10 – 0.20
	B21 0.25 – 0.40	Yellowish brown (10YR 5/6^) heavy clay, strongly structured 20-40 mm subangular blocky peds with strong consistence and a rough fabric. 20% distinct orange mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.30 – 0.40
	B22 0.40 – 0.90	Yellowish brown (10YR 5/8^) heavy clay, strongly structured 30-50 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct grey mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.40 – 0.50 and 0.65 – 0.75

Table 3 Chemical Parameters: Magnesic Brown Kurosol (Site 9)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	3.8	Non-sodic	0.2	Non-saline	0.57	Low
A2	4.2	Strongly Acidic	4.3	Non-sodic	0.1	Non-saline	0.37	Low
B21	4.0	Strongly Acidic	4.0	Non-sodic	0.2	Non-saline	0.06	Very Low
B22	4.0	Strongly Acidic	4.1	Non-sodic	0.3	Non-saline	0.04	Very Low
B22	4.1	Strongly Acidic	4.9	Non-sodic	0.1	Non-saline	0.02	Very Low

Table 4 Summary: Magnesic-Natric Brown Kurosol (Site 1)

Overview	
	
Landscape Site 1	
ASC Name	Magnesic-Natric Brown Kurosol
Representative Site	Site 1
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Native Vegetation
Vegetation	Melaleuca, Stringybark, Blady Grass
Inherent Soil Fertility	Moderately Low
Slope	3%
Verified	Non-BSAL

Table 5 Profile: Magnesic-Natric Brown Kurosol (Site 1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark greyish-brown (10YR 4/2) silty loam, weakly structured 5-15 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.25	Brown (7.5YR 4/3) bleached silty loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with an abrupt and even boundary. Sampled 0.15 – 0.25
	B21 0.25 – 0.75	Yellowish brown (10YR 5/4^) silty clay, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct orange mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 +0.75	Yellowish brown (10YR 5/4^) silty clay loam, moderately structured 30-50 mm subangular blocky peds with moderate consistence and a rough fabric. 40% distinct grey mottles, <5% gravel 5-15 mm, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 6 Chemical Parameters: Magnesic-Natric Brown Kurosol (Site 1)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.9	Moderately Acidic	4.4	Non-sodic	0.3	Non-saline	1.57	Low
A2	4.3	Strongly Acidic	7.0	Marginally Sodic	0.1	Non-saline	0.12	Low
B21	4.0	Strongly Acidic	7.7	Marginally Sodic	0.7	Non-saline	0.01	Very Low
B22	3.8	Strongly Acidic	7.4	Marginally Sodic	0.9	Non-saline	0.02	Very Low

Table 7 Summary: Mesotrophic Brown Kurosol (Site 7)

Overview	
	
Landscape Site 7	
ASC Name	Mesotrophic Brown Kurosol
Representative Site	Site 7
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Native Vegetation
Vegetation	Smooth Barked Apple, Kangaroo Grass
Inherent Soil Fertility	Moderate
Slope	6%
Verified	Non-BSAL

Table 8 Profile: Mesotrophic Brown Kurosol (Site 7)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark greyish-brown (10YR 4/2) loam, moderately structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.15 – 0.35	Light-brownish-grey (10YR 6/2) loam, moderately structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.15 – 0.25
	B21 0.35 – 0.60	Yellowish brown (10YR 5/4^) heavy clay, strongly structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 25% distinct orange mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.60 – 0.80	Yellowish brown (10YR 5/8^) light-medium clay, moderately structured 30-50 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with a clear and even boundary. Sampled 0.65 – 0.75
	BC +0.80	Weathered parent material. Not sampled.

Table 9 Chemical Parameters: Mesotrophic Brown Kurosol (Site 7)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.2	Strongly Acidic	2.7	Non-sodic	0.1	Non-saline	1.79	Low
A2	4.1	Strongly Acidic	4.5	Non-sodic	0.1	Non-saline	0.76	Low
B21	3.9	Strongly Acidic	4.5	Non-sodic	0.2	Non-saline	0.35	Low
B22	3.8	Strongly Acidic	4.8	Non-sodic	0.5	Non-saline	0.26	Low

Soil Unit 2: Brown Sodosol

Soil Unit 2 is a Brown Sodosol. Sodosols are soils with a strong texture contrast between the A horizon and a sodic B horizon which is not strongly acidic. The strongly sodic nature of the B horizon in these Sodosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. Three representative sites for Soil Unit 2 are described below.

Table 10 Summary: Mesonatric Brown Sodosol (Site M6)

Overview	
	
Landscape Site M6	
ASC Name	Mesonatric Brown Sodosol
Representative Site	Site M6
Survey Type	Detail
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Sydney Blue Gum, Red Grass, Barbed Wire Grass
Inherent Soil Fertility	Moderately Low
Slope	7%
Verified	Non-BSAL

Table 11 Profile: Mesonatric Brown Sodosol (Site M6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Brown (10YR 5/3) loam, weakly structured 5-20 mm crumb peds with a weak consistence and a rough fabric. Nil mottling, <5% gravel 5-15 mm, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.0 – 0.10
	B21 0.15 – 0.40	Yellowish brown (10YR 5/4^) heavy clay, strongly structured 20-30 mm subangular blocky peds with strong consistence and a rough fabric. 25% faint grey mottles, nil stone content, common coarse roots. Poorly drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B22 0.40 – 0.90	Yellowish brown (10YR 5/8^) medium clay, strongly structured >40 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct-grey mottles, nil stone content, few coarse roots. Poorly drained with a clear and even boundary. Sampled 0.50 – 0.60
	BC +0.90	Weathered parent material. Not sampled

Table 12 Field Chemical Parameters: Mesonatric Brown Sodosol (Site M6)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.1	Strongly Acidic	12.3	Sodic	0.5	Non-saline	0.04	Very Low
B21	4.3	Strongly Acidic	15.6	Strongly Sodic	1.2	Non-saline	<0.01	Very Low
B22	4.4	Strongly Acidic	19.4	Strongly Sodic	2.0	Non-saline	<0.01	Very Low

Table 13 Summary: Subnatric Brown Sodosol (Site 2)

Overview	
	
Landscape Site 2	
ASC Name	Subnatric Brown Sodosol
Representative Site	Site 2
Survey Type	Detail
Dominant Topography	Creek Flat
Dominant Land Use	Horse Grazing
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	9%
Verified	Non-BSAL

Table 14 Profile: Subnatric Brown Sodosol (Site 2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.25	Greyish-brown (10YR 5/2) loamy sand, weakly structured 5-15 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.25 – 0.45	Brown (10YR 6/2) bleached loamy sand, weakly structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.30 – 0.40
	B21 0.45 – 0.60	Yellowish brown (10YR 5/4^) clay loam, moderately structured 20-30 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.60 – 0.80	Yellowish brown (10YR 5/4^) clay loam, moderately structured 30-50 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with clear and even boundary. Sampled 0.65 – 0.75
	BC +0.80	Weathered parent material. Not sampled

Table 15 Chemical Parameters: Subnatric Brown Sodosol (Site 2)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.2	Non-sodic	0.5	Non-saline	7.25	High
A2	5.4	Moderately Acidic	3.5	Non-sodic	0.2	Non-saline	4.07	Balanced
B21	4.9	Strongly Acidic	7.8	Marginally Sodic	0.3	Non-saline	0.94	Low
B22	4.5	Strongly Acidic	11.5	Strongly Sodic	0.6	Non-saline	0.39	Low

Table 16 Summary: Mesonatric Brown Sodosol (Site 4)

Overview	
	
Landscape Site 4	
ASC Name	Mesonatric Brown Sodosol
Representative Site	Site 4
Survey Type	Detail
Dominant Topography	Mid slope
Dominant Land Use	Mown Lawn
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	10%
Verified	Non-BSAL

Table 17 Profile: Mesonatric Brown Sodosol (Site 4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Greyish-brown (10YR 5/2) silty loam, moderately structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.30	Light brownish-grey (10YR 6/2) bleached loam, moderately structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with an abrupt and even boundary. Sampled 0.15 – 0.25
	B21 0.30 – 0.60	Yellowish brown (10YR 5/4^) light-medium clay, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 +0.60	Yellowish brown (10YR 5/6^) light clay, moderately structured 30-50 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct yellow mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 18 Chemical Parameters: Mesonatric Brown Sodosol (Site 4)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	3.1	Non-sodic	0.2	Non-saline	1.17	Low
A2	4.4	Strongly Acidic	14.3	Strongly Sodic	0.4	Non-saline	0.43	Low
B21	4.3	Strongly Acidic	19.2	Strongly Sodic	1.7	Non-saline	0.15	Low
B22	4.2	Strongly Acidic	26.4	Strongly Sodic	2.5	Slightly Saline	0.10	Low

Soil Unit 3: Brown Dermosol

Soil Type 3 is a Brown Dermosol. Dermosols are soils with structured B2 horizons and lacking strong texture contrast between the A and B horizons. The sodic nature of the B horizon in some of these Dermosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. Six representative sites for Soil Unit 3 are described be

Table 19 Summary: Eutrophic Brown Dermosol (Site 3)

Overview	
	
Landscape Site 3	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site 3
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Horse Grazing
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	6%
Verified	Non-BSAL

Table 20 Profile: Eutrophic Brown Dermosol (Site 3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (10YR 5/3) loamy sand, weakly structured 5-15 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.35	Pale brown (10YR 6/3) loam, moderately structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.35 – 0.60	Yellowish brown (10YR 5/4^) loam, moderately structured 20-30 mm blocky peds with weak consistence and a rough fabric. 30% distinct yellow mottles; <5% gravel 5-15 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 +0.60	Yellowish brown (10YR 5/8^) loam, moderately structured 20-40 mm blocky peds with moderate consistence and a rough fabric. 40% distinct grey mottles, <5% gravel 5-15 mm, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 21 Chemical Parameters: Eutrophic Brown Dermosol (Site 3)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.6	Non-sodic	1.2	Non-saline	2.38	Low
A2	4.4	Strongly Acidic	2.2	Non-sodic	0.3	Non-saline	1.00	Low
B21	4.4	Strongly Acidic	4.9	Non-sodic	0.2	Non-saline	0.19	Low
B22	4.1	Strongly Acidic	16.4	Strongly Sodic	0.7	Non-saline	0.02	Very Low

Table 22 Summary: Eutrophic Brown Dermosol (Site 5)

Overview	
	
Landscape Site 5	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site 5
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Mown Lawn
Vegetation	Melaleuca, Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	1%
Verified	Non-BSAL

Table 23 Profile: Eutrophic Brown Dermosol (Site 5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Greyish-brown (10YR 5/2) silty loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.20 – 0.40	Greyish-brown (10YR 5/2) silty loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.25 – 0.35
	B21 0.40 – 0.60	Dark-yellowish brown (10YR 4/4^) loam, moderately structured 20-30 mm blocky peds with weak consistence and a rough fabric. 20% distinct grey mottles; <5% gravel 5-10 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.60 – 0.75	Dark-yellowish brown (10YR 4/6^) loam, moderately structured 20-40 mm blocky peds with moderate consistence and a rough fabric. 20% distinct grey and 20% distinct yellow mottles, 5% gravel 5-15 mm, few coarse roots. Poorly drained an abrupot and even boundary. Sampled 0.65 – 0.75
	BC +0.75	Weathered parent material. Not sampled

Table 24 Chemical Parameters: Eutrophic Brown Dermosol (Site 5)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	2.0	Non-sodic	0.2	Non-saline	0.78	Low
A2	4.4	Strongly Acidic	3.9	Non-sodic	0.1	Non-saline	0.48	Low
B21	4.2	Strongly Acidic	6.3	Marginally Sodic	<0.1	Non-saline	0.21	Low
B22	4.2	Strongly Acidic	10.7	Sodic	0.1	Non-saline	0.03	Very Low

Table 25 Summary: Dystrophic Brown Dermosol (Site 8)

Overview	
	
Landscape Site 8	
ASC Name	Dystrophic Brown Dermosol
Representative Site	Site 8
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Cattle Grazing
Vegetation	Melaleuca, Kikuyu, Rhodes Grass
Inherent Soil Fertility	Moderate
Slope	7%
Verified	Non-BSAL

Table 26 Profile: Dystrophic Brown Dermosol (Site 8)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Greyish-brown (10YR 5/2) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.35	Pale brown (10YR 6/3) sandy loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.35 – 0.50	Yellowish brown (10YR 5/6^) clay loam, moderately structured 20-30 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.50 – 0.80	Yellowish brown (10YR 5/8^) light clay, strongly structured 30-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75
	BC +0.80	Weathered parent material. Not sampled

Table 27 Chemical Parameters: Dystrophic Brown Dermosol (Site 8)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	2.9	Non-sodic	0.1	Non-saline	1.48	Low
A2	4.2	Strongly Acidic	4.0	Non-sodic	0.1	Non-saline	0.32	Low
B21	3.9	Strongly Acidic	3.3	Non-sodic	0.1	Non-saline	0.07	Low
B22	3.8	Strongly Acidic	3.4	Non-sodic	0.2	Non-saline	0.04	Very Low

Table 28 Summary: Mesotrophic Brown Dermosol (Site 10)

Overview	
	
Landscape Site 10	
ASC Name	Mesotrophic Brown Dermosol
Representative Site	Site 10
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Cattle Grazing
Vegetation	Melaleuca, Kikuyu, Rhodes Grass
Inherent Soil Fertility	Moderately High
Slope	1%
Verified	Non-BSAL

Table 29 Profile: Mesotrophic Brown Dermosol (Site 10)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Greyish-brown (10YR 5/2) loam, weakly structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.15 – 0.30	Pale brown (10YR 6/3) sandy loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.30 – 0.50	Yellowish brown (10YR 5/4^) clay loam, moderately structured 10-30 mm blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.50 – 0.90	Dark yellowish brown (10YR 4/6^) loam, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct yellow mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 30 Chemical Parameters: Mesotrophic Brown Dermosol (Site 10)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.8	Non-sodic	0.3	Non-saline	4.59	Balanced
A2	4.4	Strongly Acidic	4.6	Non-sodic	0.0	Non-saline	1.02	Low
B21	4.3	Strongly Acidic	8.3	Marginally Sodic	0.2	Non-saline	0.48	Low
B22	4.4	Strongly Acidic	8.7	Marginally Sodic	0.3	Non-saline	0.39	Low

Table 31 Summary: Eutrophic Brown Dermosol (Site M4)

Overview	
	
Landscape Site M4	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site M4
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Cattle Grazing
Vegetation	Spotted Gum, Kangaroo Grass, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	<1%
Verified	Non-BSAL

Table 32 Profile: Eutrophic Brown Dermosol (Site M4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (7.5YR 4/2) loamy sand, weakly structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.30	Brown (10YR 4/3) loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, 5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.15 – 0.25
	B21 0.30 – 0.50	Yellowish brown (10YR 5/8^) clay loam, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct orange mottles; <5% gravel 5-10 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.50 – 0.90	Yellowish brown (10YR 5/8^) light clay, strongly structured 30-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 33 Chemical Parameters: Eutrophic Brown Dermosol (Site M4)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	4.7	Non-sodic	0.5	Non-saline	0.65	Low
A2	4.3	Strongly Acidic	6.2	Marginally Sodic	0.0	Non-saline	0.20	Low
B21	4.3	Strongly Acidic	7.0	Marginally Sodic	0.1	Non-saline	0.07	Very Low
B22	4.0	Strongly Acidic	16.4	Strongly Sodic	0.9	Non-saline	0.01	Very Low

Table 34 Summary: Mesotrophic Brown Dermosol (Site M5)

Overview	
	
Landscape Site M5	
ASC Name	Mesotrophic Brown Dermosol
Representative Site	Site M5
Survey Type	Detail
Dominant Topography	Creek Flat
Dominant Land Use	Cattle Grazing
Vegetation	Melaleuca, Kikuyu, Rhodes Grass
Inherent Soil Fertility	Moderately High
Slope	3%
Verified	Non-BSAL

Table 35 Profile: Mesotrophic Brown Dermosol (Site M5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Brown (10YR 5/3) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.20 – 0.50	Light brownish-grey (10YR 6/2) sandy loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.50 – 0.60	Yellowish brown (10YR 5/4^) clay loam, moderately structured 10-30 mm blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; <5% gravel 5-10 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.50 – 0.60
	B22 0.60 – 0.90	Yellowish brown (10YR 5/6^) light clay, strongly structured 30-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 36 Chemical Parameters: Mesotrophic Brown Dermosol (Site M5)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.5	Strongly Acidic	4.2	Non-sodic	0.2	Non-saline	2.38	Low
A2	4.4	Strongly Acidic	6.2	Marginally Sodic	0.0	Non-saline	1.06	Low
B21	4.3	Strongly Acidic	9.7	Marginally Sodic	0.1	Non-saline	0.26	Low
B22	4.2	Strongly Acidic	9.9	Marginally Sodic	0.2	Non-saline	0.05	Very Low

Table 37 Summary: Eutrophic Grey Dermosol (Site 11)

Overview	
	
Landscape Site 11	
ASC Name	Eutrophic Grey Dermosol
Representative Site	Site 11
Survey Type	Detail
Dominant Topography	Mid Slope Bench
Dominant Land Use	Cattle Grazing
Vegetation	Bothriochloa, Poa Tussock, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	1%
Verified	Non-BSAL

Table 38 Profile: Eutrophic Grey Dermosol (Site 11)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Dark grayish brown (10YR 4/2) silty loam, weak structure 2-5 mm crumb peds with weak consistence and an earthy fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.30	Dark grayish brown (10YR 4/2) loam, moderate structure 5-10 mm angular blocky peds with weak consistence and a rough fabric. 10% distinct red mottles, <5% gravel <10 mm, common fine roots. Imperfectly drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B22 0.30 – 0.50	Dark grey (5YR 4/1^) clay loam, moderate structure 20-40 mm angular blocky peds with moderate consistence and a rough fabric. 30% distinct red mottles; <5% gravel <10 mm, few coarse roots. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B23 0.50 – 0.70	Light grey (7.5YR 7/1^) medium clay, massive structure with moderate consistence and a rough fabric. 50% distinct yellow mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sample depth. Sampled 0.60 – 0.70

Table 39 Chemical Parameters: Eutrophic Grey Dermosol (Site 11)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	4.6	Strongly Acidic	2.3	Non-sodic	0.3	Non-saline	0.56	Low
A2	4.3	Strongly Acidic	2.1	Non-sodic	0.3	Non-saline	0.51	Low
B21	4.3	Strongly Acidic	4.8	Non-sodic	0.4	Non-saline	0.24	Low
B22	4.1	Strongly Acidic	5.8	Marginally Sodic	0.8	Non-saline	0.10	Low

Note 1 Where mottling presence was 20% or greater Munsell field colour, indicated by ^ was used as a more representative soil colour.

Appendix E

Correlated Kurosol Sites

351000
352000
353000
6334000
6333000
6332000
6331000

M1
M2
M3
M4
M5
M6
M7
1
2
3
4
5
6
7
8
9
10
11

LEGEND

- June Field Points
- October Field Points
- Study Area LW22-23
- Study Area LW24-24A

Soil Types

- Dermosol
- Sodosol
- Kurosol

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

19/04/2017
630.11810

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11810 Mandalong LW22-24A BSAL\06 SLR Data\01 Drafting\Figures\ArcGIS\LW_24-24A\SLR630.11810_BSAL_AppE_SoilTypes_02.mxd

Sheet Size : A3

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Soil Types

APPENDIX E