

**APPENDIX 13**

**Agricultural Impact Assessment**



# SOILS, LAND AND AGRICULTURE IMPACT ASSESSMENT

Wattle Creek Battery Energy Storage System - SSD-63345458

Report Number: MS-126\_Final  
Prepared for: Umwelt (Australia) Pty Ltd  
Prepared by: Minesoils Pty Ltd

March 2025



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# 1 INTRODUCTION

## 1.1 OVERVIEW

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Ltd (Umwelt) on behalf of Spark Renewables Pty Ltd (the Proponent) to conduct a Soil and Agricultural Impact Assessment of the Wattle Creek Battery Energy Storage System- SSD-63345458 (the Project), located in the Southern Highlands region of New South Wales (refer **Figure 1**). The baseline soil and agriculture resources are detailed within this report. The impacts on these resources from the proposed construction, operation and decommissioning phases of the Project are addressed in this report in accordance with relevant regulatory requirements and guidelines.

This report supports a State Significant Development (SSD) development application under Part 4 Division 4.7 of the Environmental Planning and Assessment Act 1979, as part of an Environmental Impact Statement for the BESS Project (herein referred to as the Project). This Soils, Land and Agricultural Impact Assessment (SLAIA) assesses impacts on agricultural land and resources associated with the Project.

Soil, land and agriculture related Secretary's Environmental Assessment Requirements (SEAR's) items that are included for the Project consist of the following:

- *A soil survey to determine the soil characteristics and consider the potential for salinity, acid sulfate soils and erosion to occur;*
- *an assessment of the potential impacts of the development on existing land uses on the site and adjacent land, including agricultural land.*

The objective of this report is to address the above SEARs items.

## 1.2 THE PROJECT

The Project comprises the installation, operation, maintenance and decommissioning of a large-scale BESS, supported by associated infrastructure. The Project will have a capacity of up to approximately 350 MW (AC or DC coupled) and will have provision for up to two (2) hours of storage (1600 MWh), with the aim of providing both storage as well as firming capacity to the NEM and assisting in grid stability by providing frequency control ancillary services. The design of the BESS will allow for the storage and exportation of renewable energy within the network so that it can be used during times of peak demand.

The conceptual project layout represents a development footprint of approximately 75 ha, including associated ancillary infrastructure (i.e. substations, the operations and maintenance facility, test bed and both transmission line corridors for optionality) (refer **Figure 2**).

Two transmission line options are being investigated, to allow for optionality during the assessment process and greater flexibility in the connection design. The two transmission options are shown on **Figure 2**.

Once the Project reaches the end of its operational life (noting Project duration is specified), a decision will be made to either decommission or re-power the facility, subject to land agreements and approval requirements.

If the Project is decommissioned, all aboveground structures built as part of the Project will be removed and the site rehabilitated generally to a pre-existing condition. There are provisions in the land and lease agreements with the site landowners for rehabilitation of the site after decommissioning. All impacted land would then be returned to agricultural land use.

## 1.3 THE PROJECT AREA

The Project Area is located on Arthursleigh Farm (Lot 3 of DP 1120270), approximately 80 kilometres (km) west of Wollongong and 15 km northwest of Marulan within the Upper Lachlan Shire Council Local Government Area (LGA).



The Project Area encompasses all land within the wider Project Area boundary and covers approximately 6,334 ha. The development footprint is defined as the area within which all Project infrastructure (and associated disturbance) will be placed and covers approximately 75 ha, as shown on **Figure 2**.

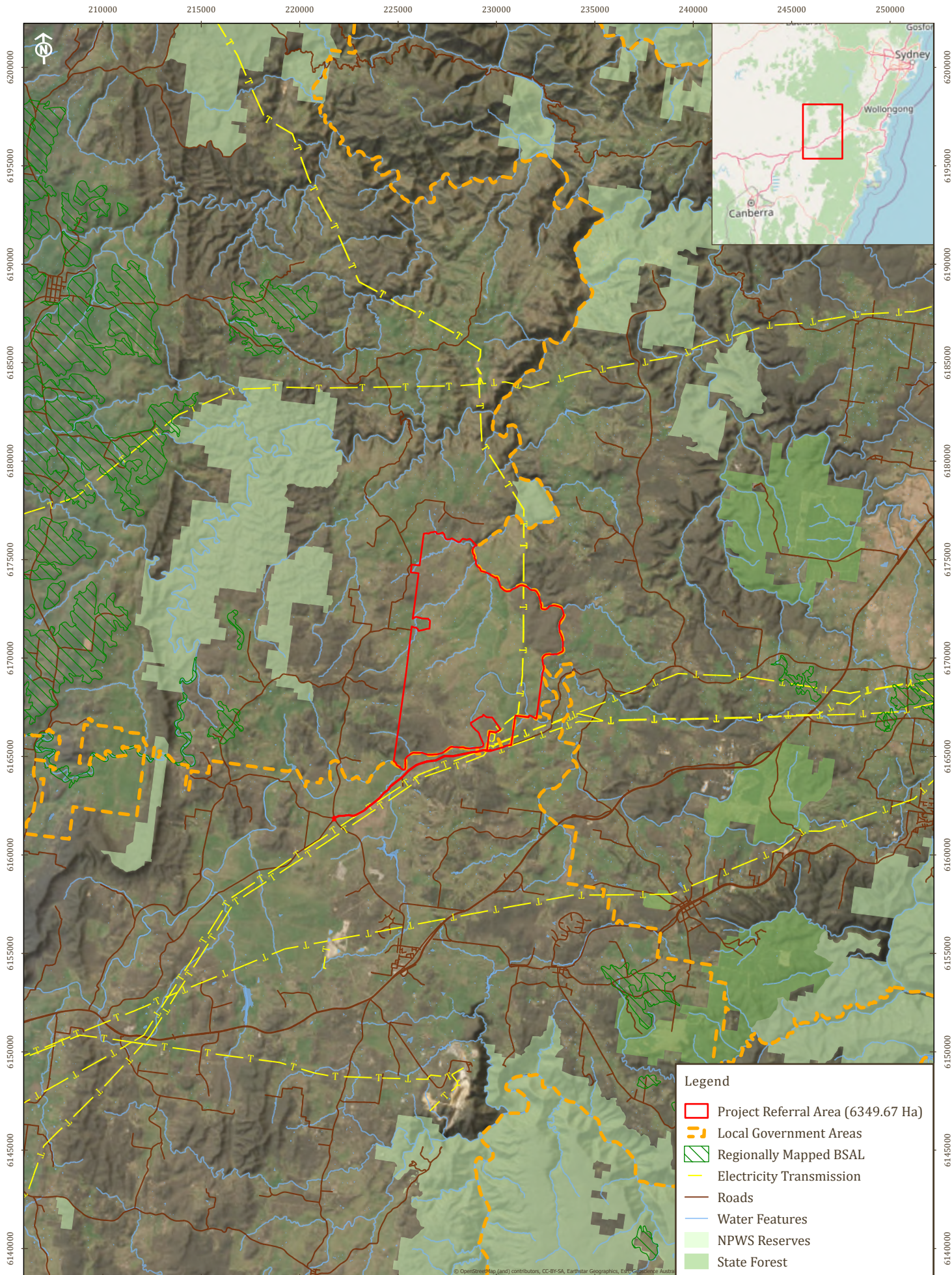
The development footprint and locality has historically been utilised for agricultural practices primarily consisting of livestock grazing on native pastures as well as some cropping and cultivation, with evidence of broad native vegetation modification resulting from extensive clearing and agricultural land use. Current land use of the development footprint comprises grazing of sheep and cattle.

## 1.4 ASSESSMENT APPROACH

The assessment has been undertaken in accordance with the *Large-Scale Solar Energy Guidelines* (LSSE Guidelines) (NSW DPIE, 2022) which includes requirements for all large-scale solar energy projects or associated infrastructure, such as battery energy storage systems.

This includes the requirement to undertake a soil survey and verify land and soil capability (LSC) in accordance with *Land and Soil Capability Assessment Scheme* (LSC Scheme) (EOH 2012). The results of the site verification, as presented in Section 3.2, determined the level of agriculture impact assessment as a Level 1 – Basic assessment as per the LSSE Guidelines. Despite this, a Level 2 – Reduced was undertaken. The assessment requirement pathway for this assessment from the LSSE Guidelines is presented in **Figure 3**. The requirements for the Level 2 assessment, and where these items are addressed in this report, are presented in **Table 1**.





- Legend**
- Project Referral Area (6349.67 Ha)
  - Local Government Areas
  - Regionally Mapped BSAL
  - Electricity Transmission
  - Roads
  - Water Features
  - NPWS Reserves
  - State Forest

Project Locality

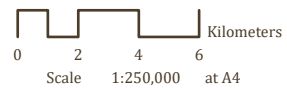
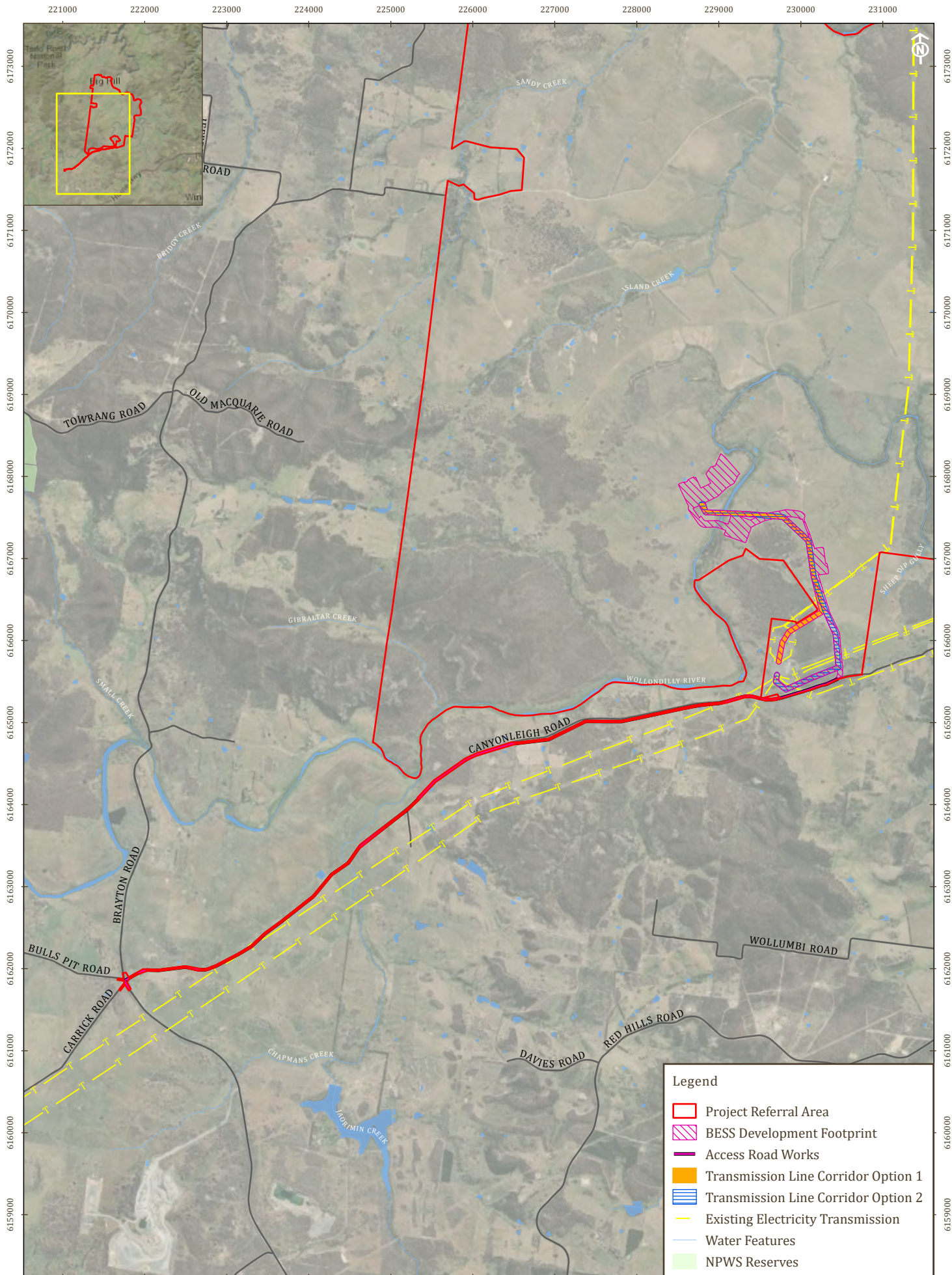


FIGURE 1

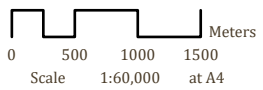


**Legend**

- Project Referral Area
- BESS Development Footprint
- Access Road Works
- Transmission Line Corridor Option 1
- Transmission Line Corridor Option 2
- Existing Electricity Transmission
- Water Features
- NPWS Reserves

GDA2020 MGA Zone 56

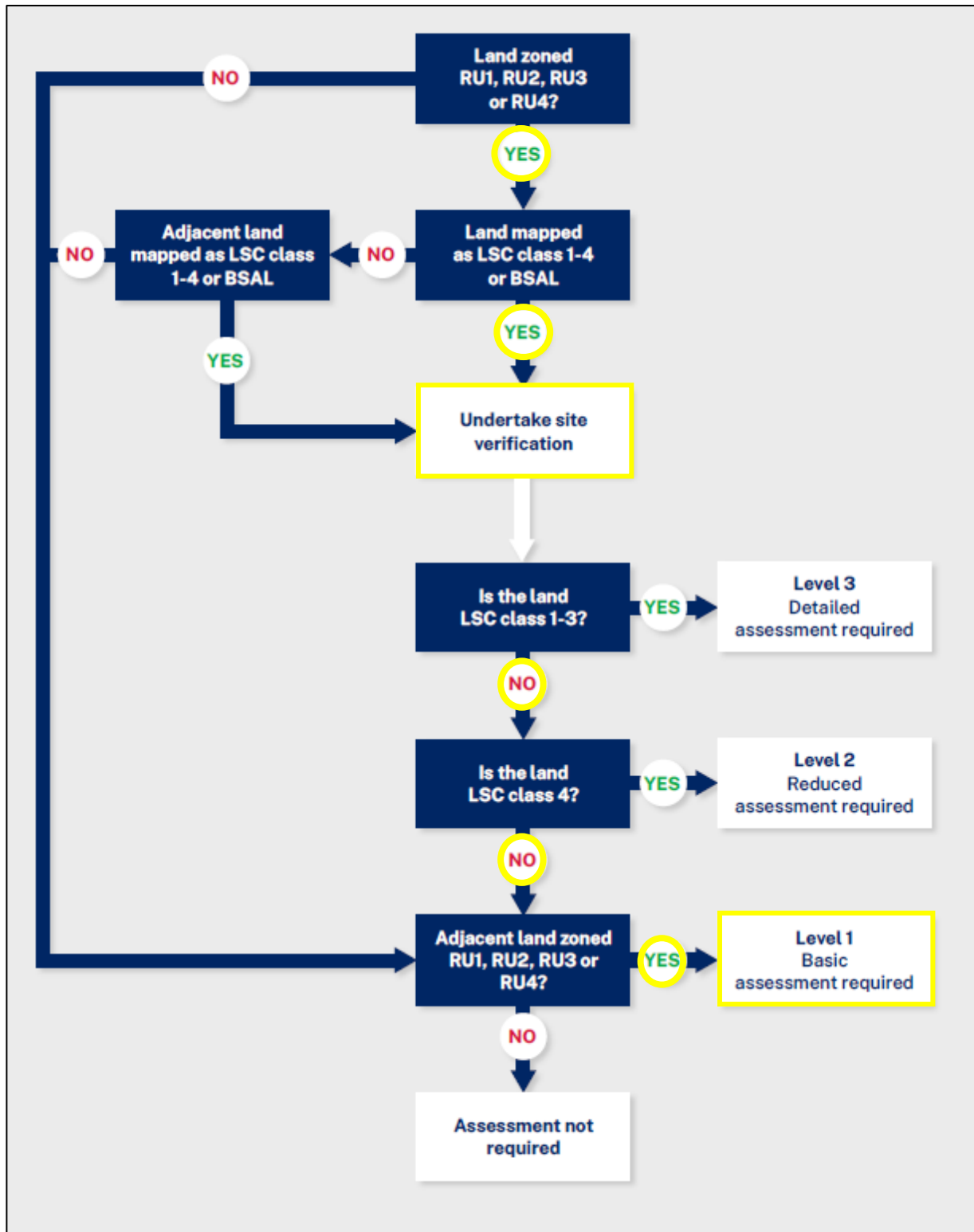
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Development Footprint

**FIGURE 2**

Figure 3. Adopted Agricultural Assessment Pathway



(NSW DPIE, 2022)



Table 2: Requirements of ‘Level 2 - Reduced’ Assessment and Section Addressed (NSW DPIE, 2022)

Assessment	Content and form	Section Addressed
<p><b>Project description</b></p> <p>Describe the nature, location, intensity and duration of the project and include a map of the Project Area.</p>	<ul style="list-style-type: none"> <li>• project description</li> <li>• areas of the site that would be disturbed or temporarily removed from agricultural use</li> <li>• location</li> <li>• duration</li> </ul>	1
<p><b>Regional context</b></p> <p>Describe the regional context.</p>	<ul style="list-style-type: none"> <li>• zoning of the Project Area</li> <li>• climate and rainfall</li> <li>• regional landform</li> <li>• regional land use including any significant agricultural industries and/or infrastructure</li> </ul>	2
<p><b>Site characteristics and land use description</b></p> <p>Describe the nature and location of agricultural land with the potential to be impacted by the development. Describe the current agricultural status and productivity of the proposed development area and surrounding locality including the land capability as per Office of Environment and Heritage’s (OEH) Land and Soil Capability Assessment Scheme.</p>	<ul style="list-style-type: none"> <li>• describe the land subject to the project site</li> <li>• describe existing agricultural land uses (i.e. orchards, vineyards, breeding paddocks, intensive livestock areas)</li> <li>• describe the history of agricultural practices on the project site</li> <li>• identify soil type, fertility, land and soil capability</li> <li>• provide a map showing the verified LSC class of the project site</li> <li>• provide a map showing topography of the site</li> <li>• describe the agricultural productivity of the site</li> </ul>	3
<p><b>LUCRA assessment</b></p> <p>Conduct an assessment of potential land use conflicts, including completion of an assessment in accordance with the Department of Industries’ Land Use Conflict Risk Assessment Guide</p>	<ul style="list-style-type: none"> <li>• land use compatibility and conflicts</li> <li>• discuss compatibility of the development with the existing land uses on the site and adjacent land during operation and after decommissioning, with reference to the zoning provisions applying to the land</li> </ul>	4 (Appendix 2)
<p><b>Impacts on agricultural land</b></p> <p>Identify and describe the nature, duration and consequence of any potential impacts on agricultural land subject to the project site and in the wider region</p>	<ul style="list-style-type: none"> <li>• describe project impacts on identified agricultural lands, including but not limited to, potential weeds, pests, dust, bushfire, livestock, crop production</li> <li>• consider impacts to the agricultural land of the site</li> <li>• consider project potential to temporarily and/or permanently remove agricultural land and/or fragment or displace existing agricultural industries</li> <li>• consider cumulative impacts of multiple projects on agriculture in the region</li> </ul>	5
<p><b>Mitigation strategies</b></p> <p>Outline strategies which may be adopted to mitigate potential impacts on agricultural land and minimise land use conflict.</p>	<ul style="list-style-type: none"> <li>• outline and consider strategies to mitigate project impacts on agricultural land</li> </ul>	6



## 2 REGIONAL CONTEXT

### 2.1 ZONING

The Project Area is contained within thirteen cadastral lots and zoned as Rural Use 1 (RU2) – Rural Landscape under the *Upper Lachlan Local Environmental Plan 2010* (Upper Lachlan Council 2013) (refer **Figure 4**). The objectives of this zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To maintain the rural landscape character of the land.
- To provide for a range of compatible land uses, including extensive agriculture.
- To protect, manage and restore areas with high conservation, scientific, cultural or aesthetic value.
- To encourage development that generates employment opportunities, integrates with tourism and is compatible with, and adds value to, local agricultural production.
- To retain the significant historic and social values expressed in existing landscapes and land use patterns.
- To conserve and enhance the quality of potentially valuable environmental assets, including waterways, riparian land, wetlands and other surface and groundwater resources, remnant native vegetation and fauna movement corridors.

The development is permitted with consent under Clause 2.36(1)(b) of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP), being “development for the purpose of electricity generating works may be carried out with consent on land in a prescribed rural zone”.

### 2.2 CLIMATE AND RAINFALL

The Project Area is located in the NSW Southern Tablelands regions which, owing to its elevation, has an oceanic climate with warm summers and cool winters and a high diurnal range. Its climate is variable much of the year. The region experiences a distinct seasonal variation in temperature, and temperature extremes, both hot and cold, occur infrequently but can have significant impacts on agriculture (OEH, 2014).

Rainfall varies considerably across the region. This variability is due to the complex interactions between weather patterns in the region, the influence of larger-scale climate patterns such as El Niño Southern Oscillation, the topography of the Great Dividing Range and the influence of sea surface temperature near the coast (OEH, 2014).

The nearest open Bureau of Meteorology (BOM) daily rainfall gauge to the Project Area is at Marulan (George St gauge 070063), 20 km south of the Project Area. Given the proximity of the gauge to the Project Area, the recorded data is considered representative of the local region rainfall patterns (BOM, 2024a). The period of record for the observation covers 112 years from 1894 to 1923 and then 1941 until 2024. The annual average rainfall is 717.3 mm, falling throughout the year over approximately 86 rainy days, with the average highest rainfall in the month of February and the lowest in the month of September.

The closest BOM weather station to the Project Area with temperature data is Moss Vale Automated Weather Station (Site No. 068239), approximately 30km north east (BOM, 2024b). The annual average maximum temperature recorded at the site is 19.0°C and the annual average minimum temperature is 8.2°C. The highest average maximum temperature of 26.1°C is recorded in January, while the lowest average maximum temperature of 12.0°C is recorded in July.

### 2.3 REGIONAL LANDFORM

The Project lies within the broader region known as the Southern Tablelands, a geographic area of NSW, located south-west of Sydney and west of the Great Dividing Range, consisting of the three LGAs of Goulburn-Mulwaree, Upper Lachlan Shire and Yass Valley. The area is characterised by high, flat country which has generally been



extensively cleared and used for grazing purposes (Goulburn Mulwaree Council et al, 2016). The region also contains a range of nature resources and features, including a number of national parks and State forests, Wombeyan Caves and over 5,000 linear km of waterways.

The Southern Tablelands region falls within the Hawkesbury-Nepean catchment which is within the Sydney drinking water catchment. The confluence of the Wollondilly and Mulwaree Rivers occur within the city of Goulburn east of the Project Area.

Geomorphically, the region has a general north-west trend which reflects the strike of the underlying geology. Streams tend to either follow the general north-west trend or cut sharply across it. The region is characterised by a series of mountain and valley systems which follow the general trend, with altitudes ranging from between 560 and 1200 metres.

Geologically, the Southern Tablelands lie within the southern portion of the Lachlan Fold Belt. Ordovician rocks are the oldest and most extensive. They are usually sharply dipping and tightly folded metasediments. Silurian volcanics comprising a range of tuffaceous and rhyolitic materials and granitic intrusions are also common. Fluvial sands and gravels of the ancient Shoalhaven River system occur extensively in the Braidwood Area. Common lithologies include siltstones, quartzites, rhyolites, tuffs and alluvium.

## 2.4 REGIONAL LAND USE

### 2.4.1 AGRICULTURAL LAND USE

Since the non-Indigenous settlement of the Southern Highlands of New South Wales from the early 1800s, the predominant agriculture land uses have focused on livestock (in particular sheep and beef) and mixed farming production.

As shown in **Figure 5**, the land use of the Project Area and Project locality is dominated by grazing on modified pasture, with some land subject to minimal use and native conservation. This is generally representative of the wider region, with grazing on modified pasture being the most prevalent land use occurring within the wider LGA and southern tablelands region.

At the scale of the Upper Lachlan Shire, 343,911 ha of land is subject to agricultural activity (ABS, 2022a). The area of land mainly being used for the broad agricultural types for the Upper Lachlan LGA is presented in **Table 2**, which shows grazing as the dominant land use, accounting for approximately 95% of this area (ABS, 2022a).

Table 2: Upper Lachlan LGA Agricultural Land Use by Type 2020 - 2021

Agricultural Land Use	Area	
	ha	%
Grazing	328,241	95
Cropping	13,328	4
Forestry	2,162	1
Other	180	<1
Total	343,911	100



### 2.4.1 AGRICULTURAL ENTERPRISES

Agricultural enterprises within the Southern Highlands are characterised by sheep and cattle grazing, with a strong wool production presence with some cultivation for hay and broadacre crops including canola and wheat for grain as well grapes and vegetables such potato and mushrooms (ABS, 2022b). Specific areas have developed alternative land uses to grazing, such as Crookwell, which is renowned as a potato growing area. In addition, viticulture for cool climate wine is developing in the region (Goulburn Mulwaree Council et al, 2016).

Beef production is undertaken on a large scale in the region, with some production on smaller properties, usually in peri-urban areas. In recent times, beef prices have increased along with global demand for protein. Beef farming often occurs in mixed farming systems with cropping or wool, enabling economies of scale through grazing rotation, feed production and storage (DPI, 2020).

As with beef, sheep grazing for meat and wool is usually a large-scale enterprise although some smaller properties can also contribute to regional production.

Wool production is the most prominent industry in terms of number of enterprises. The southern tablelands region is known for ‘superfine’, ‘ultrafine’ and fine-medium wool production from merino sheep. Wool from the region is sought after as an exclusive fibre globally. Wool growing is a specialised industry with a specific set of biophysical (land and climate) and on-farm management requirements (animal husbandry, wool production and value adding). Sheep are particularly vulnerable to attacks from animals such as dogs and foxes, and producers have added costs (e.g. fencing, eradication) in managing these pests. Typically, wool growing involves producing lambs for meat as part of the enterprise, however moving wool to lamb enterprises is a longer term trend as wool prices continue to fluctuate (DPI, 2020).

For the last agricultural census year of 2020 – 2021, there were 538 livestock grazing businesses in the LGA (ABS 2022a). The gross value of agricultural enterprises within the Upper Lachlan LGA for 2020-2021 was \$153 million (ABS 2022b). As shown in **Table 3**, livestock for slaughter accounts for 65% of the total gross value of agriculture for the LGA. Other key enterprises are livestock products (23%) and cropping (12%).

For livestock slaughtered, sheep and lambs make up 49% of the gross value with cattle and calves making up 43% (refer **Table 4**). Pigs, poultry and other livestock slaughter enterprises contribute <10% combined (ABS, 2022b).

Wool dominates livestock products, with 94% of the gross margin (refer **Table 5**) and hay and broadacre crops comprising 80% of the cropping gross value (**Table 6**).

**Table 3: Upper Lachlan LGA Agricultural Commodity Gross Value by Type 2020 - 2021**

Agricultural Commodity	Gross Value	
	\$	%
Livestock for slaughter	100,211,248	65
Livestock products	34,807,334	23
Crops	18,214,648	12
Total	153,233,230	100



Table 4: Upper Lachlan LGA Livestock Gross Value by Type 2020 - 2021

Livestock	Value	
	\$	%
Sheep and lambs	49,388,031	49
Cattle and calves	42,655,693	43
Poultry	7,973,543	8
Pigs	173,118	<1
Other	20,862	<1
Total	100,211,248	100

Table 5: Upper Lachlan LGA Livestock Products Gross Value by Type 2020 - 2021

Livestock	Value	
	\$	%
Wool	32,882,737	94
Milk	987,696	3
Eggs	936,902	3
Total	34,807,334	100

Table 6: Upper Lachlan LGA Crop Gross Value by Type 2020 - 2021

Crop	Value	
	\$	%
Hay	8,294,139	46
Broadacre Crops	6,308,646	35
Vegetables	2,557,091	14
Nurseries, cut flowers or cultivated turf	814,134	4
Fruit and nuts (excluding grapes)	154,280	1
Grapes	86,359	<1
Total	18,214,648	100



## 2.4.2 REGIONAL AGRICULTURAL INFRASTRUCTURE

The key infrastructure item assisting agricultural market access and cost of production is the transport network servicing the Southern Tablelands region. Underlining the importance of this issue, total freight costs from farm to port can be as much as 30% of the value of the crop being marketed depending on Australian and world commodity prices in a given season. The Project Area is serviced by Canyonleigh Road which connects to the state highway network of the Hume Highway that links Sydney to Melbourne and the Barton Highway that connects the Hume Highway to Canberra and the Australian Capital Territory. The Project Area is approximately 20kms from Marulan Railway Station, part of the Main Southern Railway Line which services the Southern Regional and Southern Highlands Lines. Connections to Port Kembla, Port Botany, the Port of Melbourne and Western Sydney Airport Badgerys Creek give the region a competitive advantage for general agricultural exports. Further, Sydney and Canberra airports have freight capability. The demand from middle-class global markets, combined with the ability to transport produce from Canberra and Sydney Airports to Singapore and beyond to Chinese cities, present opportunities for more niche agricultural exports.

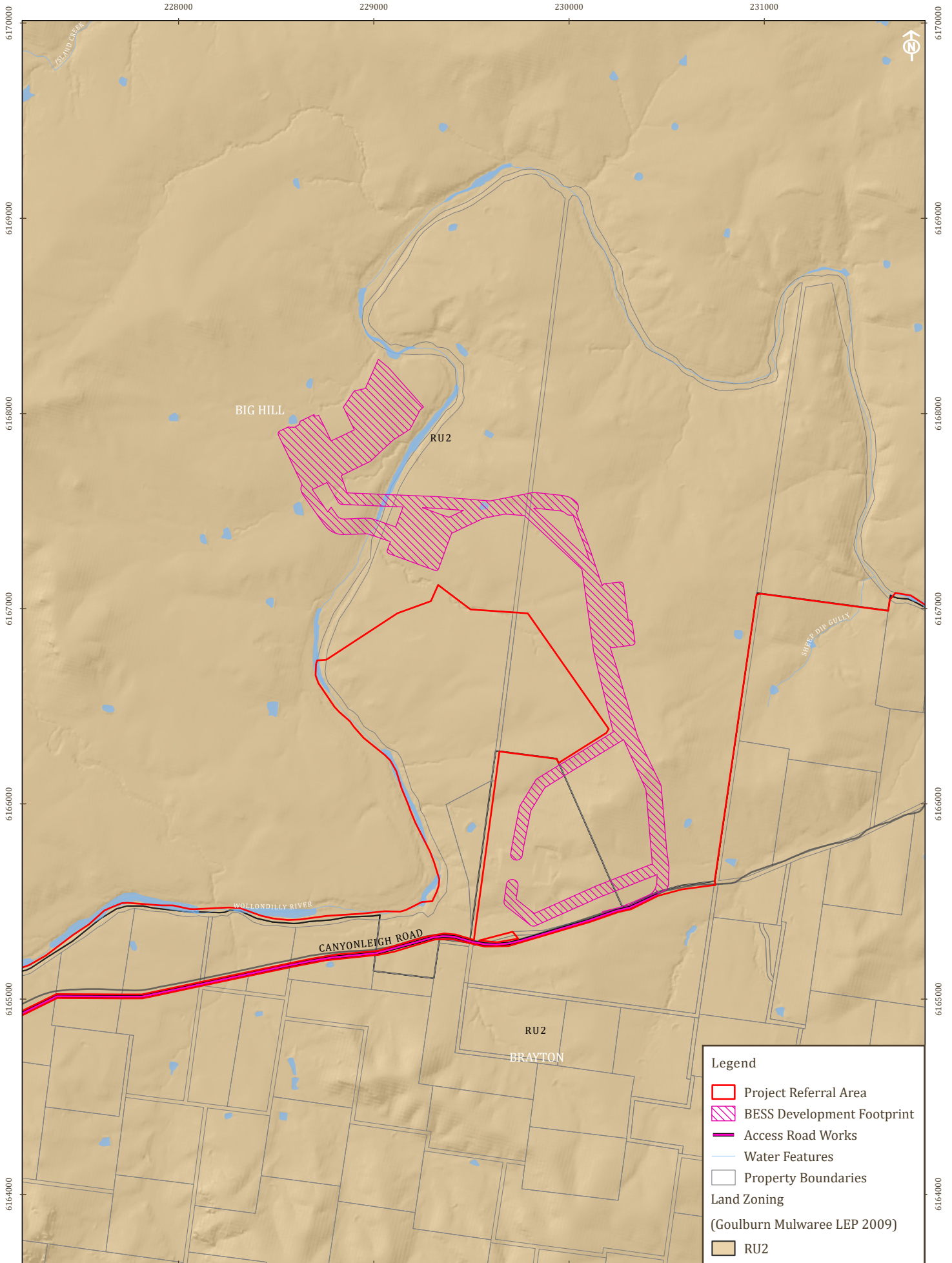
In proximity to the Project Area, the large agricultural service centre of Goulburn (approximately 40 km south west), and Moss Vale (approximately 30 km north east) allows access to businesses providing agricultural equipment and supplies, including animal fencing, animal vaccinations, livestock ID, stock supplements, seed, fertiliser and crop protection.

The Project locality is serviced by sale yards at Moss Vale (Southern Regional Livestock Exchange) and the wider region is serviced by sale yards at Yass (South Eastern Livestock Exchange) as well as smaller saleyards located at Bega, Boorowa and Young. There are also a number of abattoirs throughout the region located at Moss Vale, Goulburn, Harden, Young, Polo Flat in Cooma, and Moruya in the Illawarra Shoalhaven Region.

Wool is sold off farm through brokerages, with the Goulburn based Australian Wool Network offering wool rehandling and sales. Wool enterprises are reliant on shearing and other sheep-specific support services.

Other infrastructure critical to agricultural production include energy needs (gas and electricity), telecommunications services, urban water and wastewater services. General agricultural improvements such as stock fences, shedding, dams and access tracks are widespread throughout the locality which reflects the historical and current development of the local lands for agricultural use.

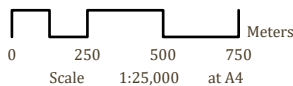




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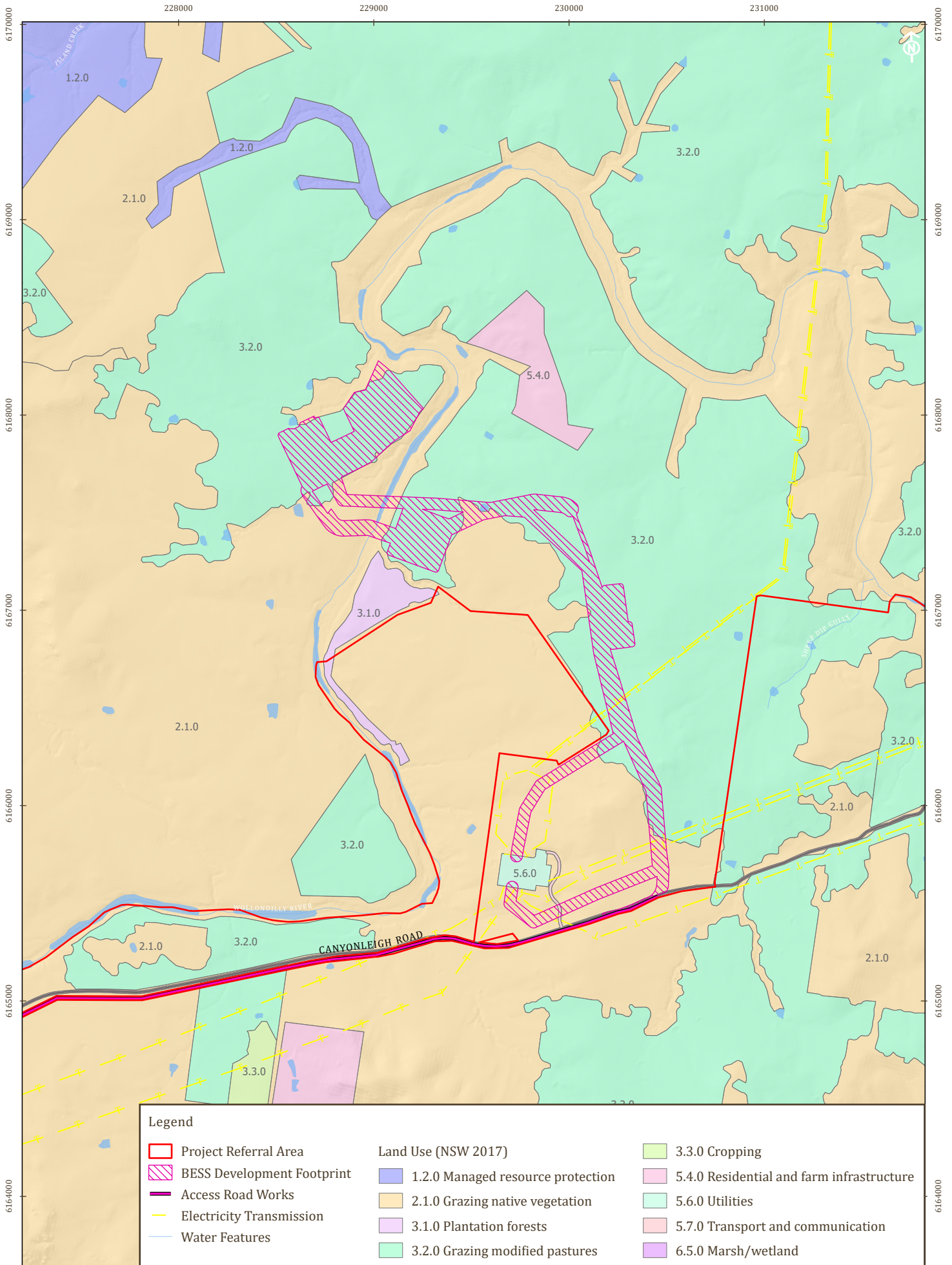
- Project Referral Area
- BESS Development Footprint
- Access Road Works
- Water Features
- Property Boundaries
- Land Zoning  
(Goulburn Mulwaree LEP 2009)
- RU2

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Land Zoning

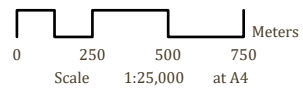
**FIGURE 4**



**Legend**

Project Referral Area	<b>Land Use (NSW 2017)</b>	3.3.0 Cropping
BESS Development Footprint	1.2.0 Managed resource protection	5.4.0 Residential and farm infrastructure
Access Road Works	2.1.0 Grazing native vegetation	5.6.0 Utilities
Electricity Transmission	3.1.0 Plantation forests	5.7.0 Transport and communication
Water Features	3.2.0 Grazing modified pastures	6.5.0 Marsh/wetland

GDA2020 MGA Zone 56



Landuse

FIGURE 5

## 3 SITE CHARACTERISTICS AND LAND USE

### 3.1 SITE CHARACTERISTICS

#### 3.1.1 LANDSCAPE

A site inspection was undertaken by Minesoils in March 2023. The development footprint was determined to be a generally stable, free draining landform with 70 - 100% surface cover of pasture that has been highly disturbed in the past by land clearing for agriculture, with isolated stands of native trees occurring sporadically over the Project Area.

The landforms within the development footprint comprise undulating hills, slopes, crests and broad ridges, and some narrow low lying alluvial gullies and colluvial flats. The lowest elevation is approximately 580m on very gently undulating lower slope/flats associated with Wollondilly River in the northernmost section of the development footprint, and rises to 660m on crested areas in the south east (refer **Figure 6**).

Wollondilly River and the tributaries in the Project locality are part of the Hawkesbury Nepean Catchment which is one of the largest coastal basins in NSW.

#### 3.1.2 AGRICULTURAL LAND USE

The development footprint are subject to livestock grazing on native and introduced pastures as the primary land-use, supporting sheep, cattle and calves, which are grazed on rotation for breeding and fattening.

Stock are generally watered through a series of surface dams with some pumped water in troughs. General agricultural improvements are present in the wider Project Area, including shedding for livestock and shedding for equipment, grain silos, cattle yards, stock fences and gates, cattle grids and unsealed access tracks.

At the time of inspection, neighbouring properties in the immediate vicinity were observed to be used primarily for livestock grazing, with some isolated broadacre cropping and cultivation also being undertaken within the broader locality. Similar agricultural improvements (e.g. cattle yards, stock fences, dams, cattle grids. and existing access tracks) are widespread throughout the locality which reflects the historical and current development of the local lands for these land uses. No sensitive agricultural activities such as intensive plant or livestock agriculture have been identified within the Project Area or its immediate surrounds.

#### 3.1.3 AGRICULTURAL PRODUCTIVITY

Agricultural productivity is subject to long term climate and rainfall variables, as well as changes in economic, social and policy frameworks, often at a scale well beyond the Project Area. There is no set agricultural productivity value for land under agricultural use.

The NSW Department of Primary Industries (DPI) (2023) *Gross Margin Budgets for Livestock* can be used to provide a broad estimation of the potential productivity of the land for grazing that is subject to change as a result of the Project. Based on modelling a conservative enterprise of Merino ewes (20 micron) – Merino rams as a stocking rate of 3 DSE/ha, the estimated productivity of the development footprint is \$10,568 per annum as summarised in **Table 7**.

An alternative method by which to estimate the potential productivity of the development footprint that accounts for the land and soil capability and best reflects current land use, is by analysing the information presented from the last agricultural census of 2020 – 2021 in Section 2.3 (ABS 2022a and 2022b). This information shows that within the Upper Lachlan LGA 328,241 ha of land was used for grazing activities, of which the gross commodity value of cattle and calves, and sheep and lambs, from livestock slaughtered and wool and milk from livestock products can be attributed (totalling \$125,914,157 combined). This resulting in an annual \$/ha ratio of \$384/ ha.



By modelling a combination of cropping and grazing enterprises over the development footprint based on the approximate area of land attributed to agriculture at the time of inspection, the potential productivity of the development footprint is estimated to be up to \$28,800 per year, as shown in **Table 8**.

Table 7: Estimated Potential Productivity of Agricultural Land within the development footprint

Enterprise	Estimated Gross Margin (\$/DSE/year)*	Stocking Rate (DSE)	development footprint (ha)	Project Gross Margin (\$/year)
Merino ewes (20 micron) – Merino rams	46.97	3	75	10,568

\*Source: DPI, 2023

Table 8: Estimated Potential Productivity of the development footprint based on LGA Data

Enterprise	Estimated Gross Value in LGA (\$/ha/year)	development footprint (ha)	Estimated Productivity (\$/year)
Grazing	384	75	28,800

## 3.2 SOIL SURVEY AND SITE VERIFICATION

### 3.2.1 EXISTING SOILS INFORMATION

The following section presents the NSW state government regional mapping data for soil types, inherent soil fertility and LSC as applied to the Project Area (NSW and Department of Planning, Industry and Environment, 2022).

#### **Soil Landscapes**

The development footprint lie within the *Soil and Land Resources of Central and Eastern NSW* (OEH, 2018). Soil landscapes are an inventory of soil and landscape information with relatively uniform land management requirements, allowing major soil and landscape qualities and constraints to be identified.

The soil landscapes within the development footprint are shown in **Figure 7** and described below.

#### **Marulan Soil Landscape**

Landscapes consist of rises and low hills on Devonian Marulan Granite (granite) in the Moss Vale Tablelands, Canyonleigh Hills and Wollondilly Gorge. Local relief 10-50 m; altitude 500-706 m; slopes 2-15%; rock outcrop 10-20%. Extensively cleared open forest.

Soils are Paralithic Leptic Rudosols (Lithosols), Chernic Tenosols (Earthy Sands), Shallow Red Kandosols (Red Earths), Red Kurosols (Red Podzolic Soils) and Brown Sodosols (Solodic Soils). Granite tors (rounded boulders) commonly outcrop.

Landscape is prone to gully erosion. Gullies commonly form in drainage lines due to highly dispersive subsoils.

#### **Jaqua Soil Landscape**

Landscapes consist of footslopes within rises on Ordovician Metasediments (alluvium, colluvium and unconsolidated) in the Moss Vale Tablelands, Baw Baw Hills, Bullamalito Hills and Bungonia Hills. Local relief 5-30 m; altitude 508-728 m; slopes 2-7%; rock outcrop nil. Extensively cleared open woodland.

Soils are Yellow/Brown Kurosols (Yellow Podzolic Soils), Sodosols (Soloths, Solodic Soils and Solodised Solonetz) and Stratic Rudosols (Alluvial Soils).



Scald erosion and salinisation are common. Gully erosion is localised to drainage lines.

#### Jaqua Variant A Soil Landscape

Landscapes consist of footslopes and drainage depressions within plain on Ordovician Metasediments and Quaternary Alluvium (metamorphic) in the Moss Vale Tablelands. Local relief 5-30 m; altitude 578-597 m; slopes 2-7%; rock outcrop <2%. Completely cleared open grassland.

Soils are Grey Sodosols (Solodic Soils) and Salic Hydrosols (Gleyed Podzolic Soils). Salinity surface expression is often apparent. These soils commonly display surface scalding, salt efflorescence and loss of vegetation.

Scald erosion and salinisation are common. Gully erosion is common.

#### Wollondilly River Soil Landscape

Landscapes consist of Alluvial plain and terrace on Quaternary Alluvium (alluvium) in the Mulwaree Plains, Jooriland Hills, Wingecarribee Gorge and Wollondilly Gorge. Local relief 0-15 m; altitude 110-720 m; slopes 1-6%; rock outcrop nil. Extensively cleared riparian forest.

Soils are Fluvic Clastic Rudosols (Alluvial Soils), Brown Dermosols (Alluvial Soils/Chernozems), Yellow/Brown Kandosols (Yellow Earths/Brown Earths), and Brown Chromosols (Yellow/Brown Podzolic Soils).

Minor sheet and streambank erosion. Common gullying along drainage lines, particularly in areas with highly eroded surrounding landscapes, e.g. Garland (glz). High sediment and nutrient delivery potential.

#### Soil Types

The NSW regional soil mapping indicates the dominant soil types within the development footprint are Kurosols and Natric Kurosols as per Australian Soil Classification (ASC) (Isbell, R. F., 2021) (refer **Figure 8**).

Sodosols are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid.

Kurosols are soils other than Hydrosols with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is strongly acid. If the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) of the Kurosol is sodic, it is classed as a Natric Kurosol.

#### Inherent Soil Fertility

NSW regional mapping provides an estimation of the inherent fertility of soils in NSW. It uses the best available soils and natural resource mapping developed for LSC dataset. The mapping describes soil fertility in NSW according to a five-class system: Low (1), Moderately Low (2), Moderate (3), Moderately High (4), High (5).

Soils with 'Low' fertility, due to their poor physical and/or chemical status, only support limited plant growth. Soils with 'Moderately Low' fertility can generally only support plants suited to grazing; large inputs of fertiliser are required to make the soil suitable for arable purposes. Soils with 'Moderate' fertility usually require fertilisers and/or have some physical restrictions for arable use. Soils with 'Moderately High' fertility have a high level of fertility in their virgin state which is significantly reduced after a few years of cultivation (Murphy *et al.*, 2007).

The development footprint is dominated by soils with Moderately Low (2) fertility (refer **Figure 9**).

#### Land and Soil Capability

Land capability, as detailed in LSC Scheme, is the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources. Failure to manage land in accordance with its capability risks degradation of resources both on- and off-site, leading to a decline in natural ecosystem values, agricultural productivity, and infrastructure functionality.



The scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. The LSC classes are described in **Table 9** and their definition has been based on two considerations:

- The biophysical features of the land to derive the LSC classes associated with various hazards.
- The management of the hazards including the level of inputs, expertise and investment required to manage the land sustainably.

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform, specifically noted as slope, landform position, acidity, salinity, drainage, rockiness; and climate. The eight hazards associated with these biophysical features that are assessed by the LSC scheme are:

1. Water erosion
2. Wind erosion
3. Soil structure decline
4. Soil acidification
5. Salinity
6. Water logging
7. Shallow soils and rockiness
8. Mass movement

Each hazard is assessed against set criteria tables, as described in the LSC Guideline, with each hazard ranked from 1 through to 8 with the overall ranking of the land determined by its most significant limitation.

The NSW regional based maps of LSC indicate the Project Area consists of LSC class 4: moderate capability land, LSC class 5: moderately low capability land, and LSC class 6: low capability land (refer **Figure 10**).

Table 9: Land and Soil Capability Classification

Class	Land and Soil Capability
<b>Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)</b>	
1	<b>Extremely high capability land:</b> Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	<b>Very high capability land:</b> Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	<b>High capability land:</b> Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
<b>Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)</b>	
4	<b>Moderate capability land:</b> Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.



Class	Land and Soil Capability
5	<b>Moderate-low capability land:</b> Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
<b>Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)</b>	
6	<b>Low capability land:</b> Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
<b>Land generally incapable of agricultural land use (selective forestry and nature conservation)</b>	
7	<b>Very low capability land:</b> Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	<b>Extremely low capability land:</b> Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

### ***Strategic Regional Land Use Policy Mapping***

The 'NSW Government's Strategic Regional Land Use Policy' (the Policy) defines and identifies strategic agricultural land across NSW. Strategic agricultural land includes land with unique natural resource characteristics, known as biophysical strategic agricultural land (BSAL), and clusters of significant agricultural industries known as critical industry clusters (CICs). The Policy has been developed to achieve balanced land use outcomes, specifically between mining, coal seam gas and agriculture.

There is no BSAL or CICs mapped within the development footprint, Project Area or the Project locality. The nearest BSAL is located approximately 10 km to the west of the Project Area.

### ***State Significant Agricultural Land***

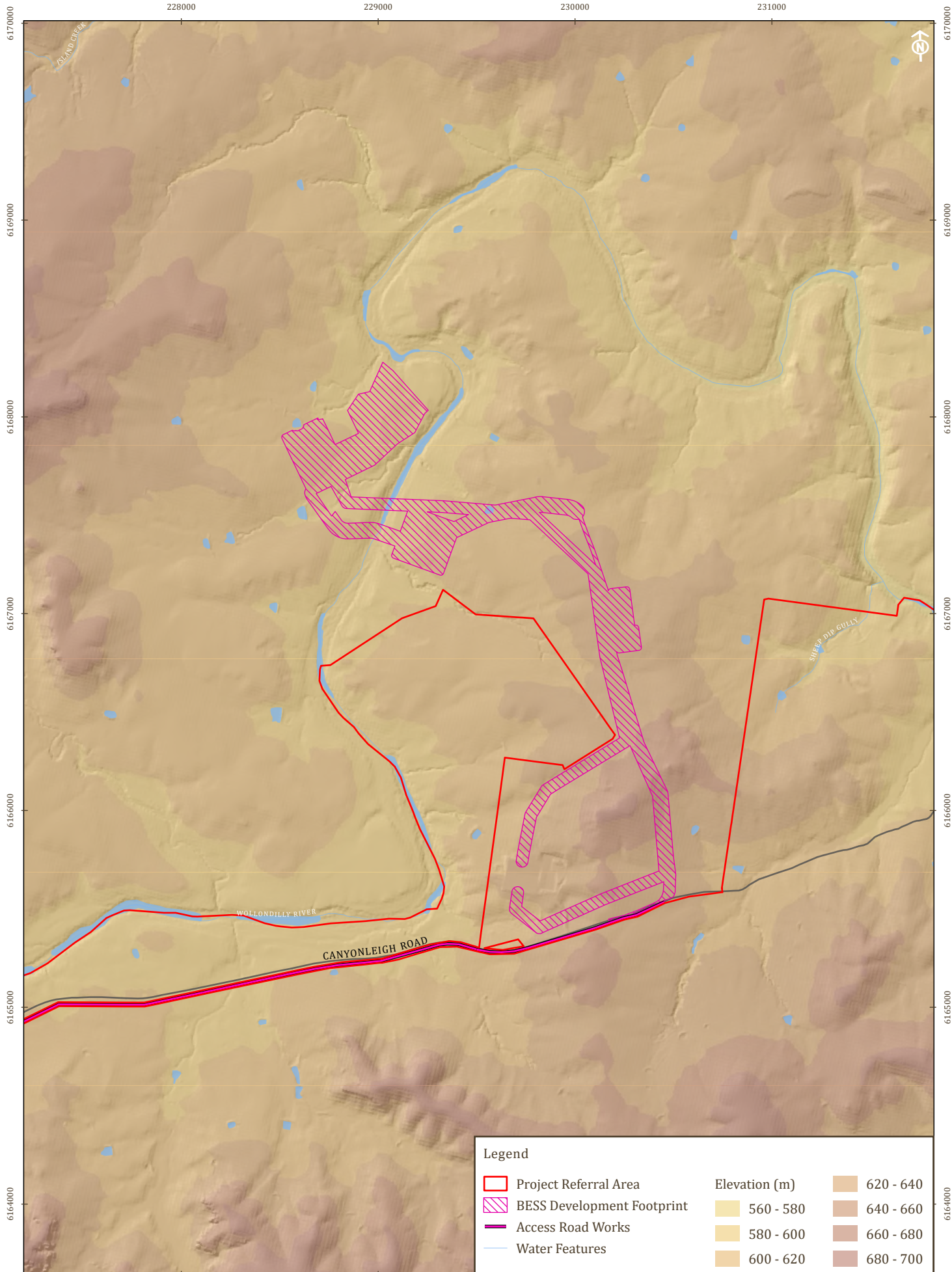
The NSW Department of Primary Industries is undertaking a mapping program to identify State Significant Agricultural Land (SSAL). A map of SSAL is an essential component of agricultural land use planning, enabling clearer local planning with informed prioritisation of future land uses.

SSAL is not mapped within the Project Area. A limited area immediate to the east of the Project Area is mapped as SSAL.

There is presently no method to verify SSAL, nor is there a contextual framework for how SSAL should be considered and assessed (as there is for LSC and BSAL).

Consideration of SSAL is not a requirement of the *LSSE Guidelines*.





6170000  
6169000  
6168000  
6167000  
6166000  
6165000  
6164000

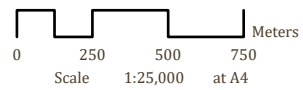
228000 229000 230000 231000

6170000  
6169000  
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6167000  
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6164000

**Legend**

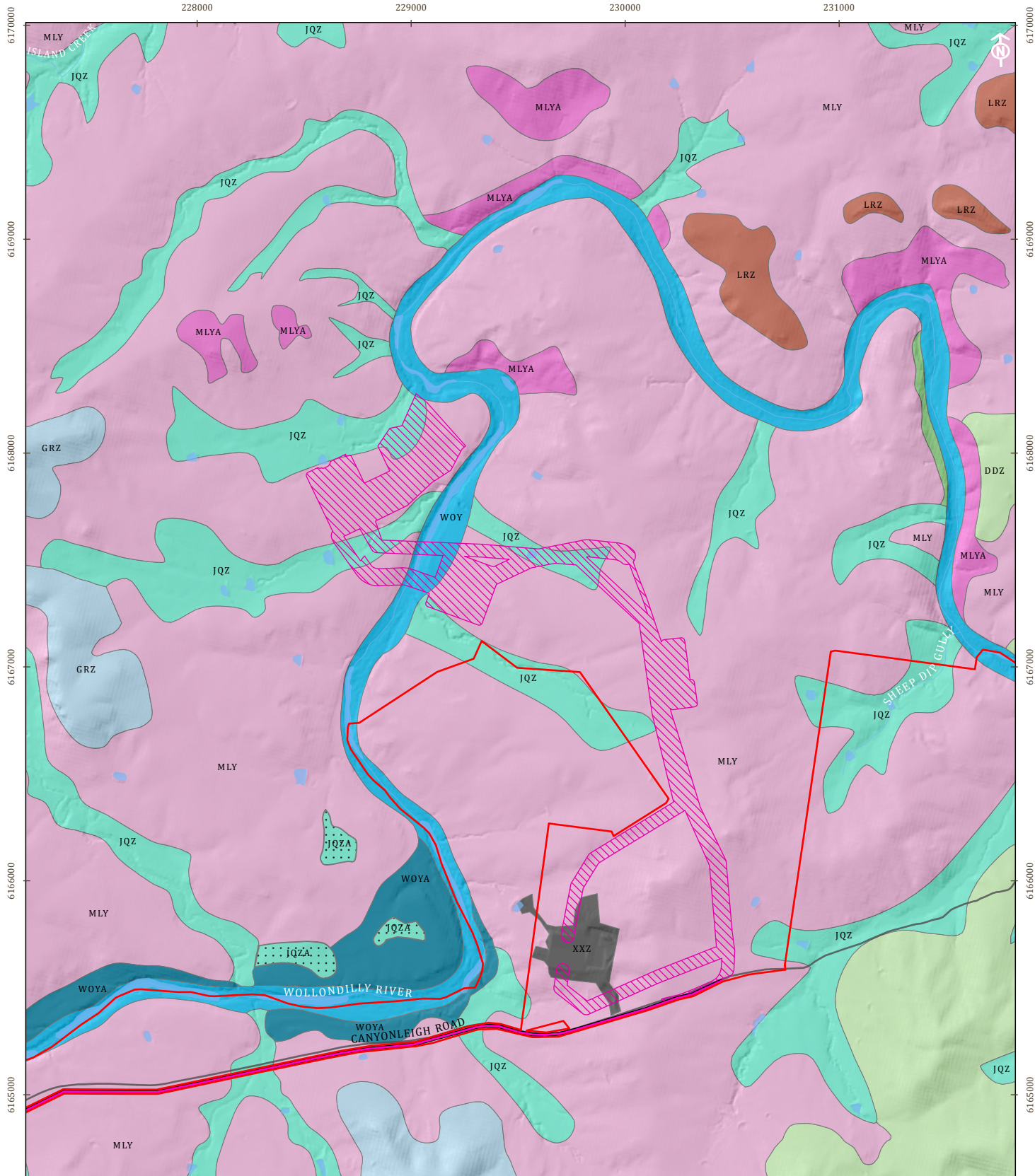
- Project Referral Area
  - BESS Development Footprint
  - Access Road Works
  - Water Features
- | Elevation (m) |  |           |
|---------------|--|-----------|
| 560 - 580     |  | 620 - 640 |
| 580 - 600     |  | 640 - 660 |
| 600 - 620     |  | 660 - 680 |
|               |  | 680 - 700 |

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Topography

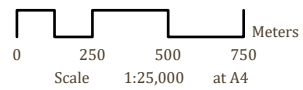
**FIGURE 6**



**Legend**

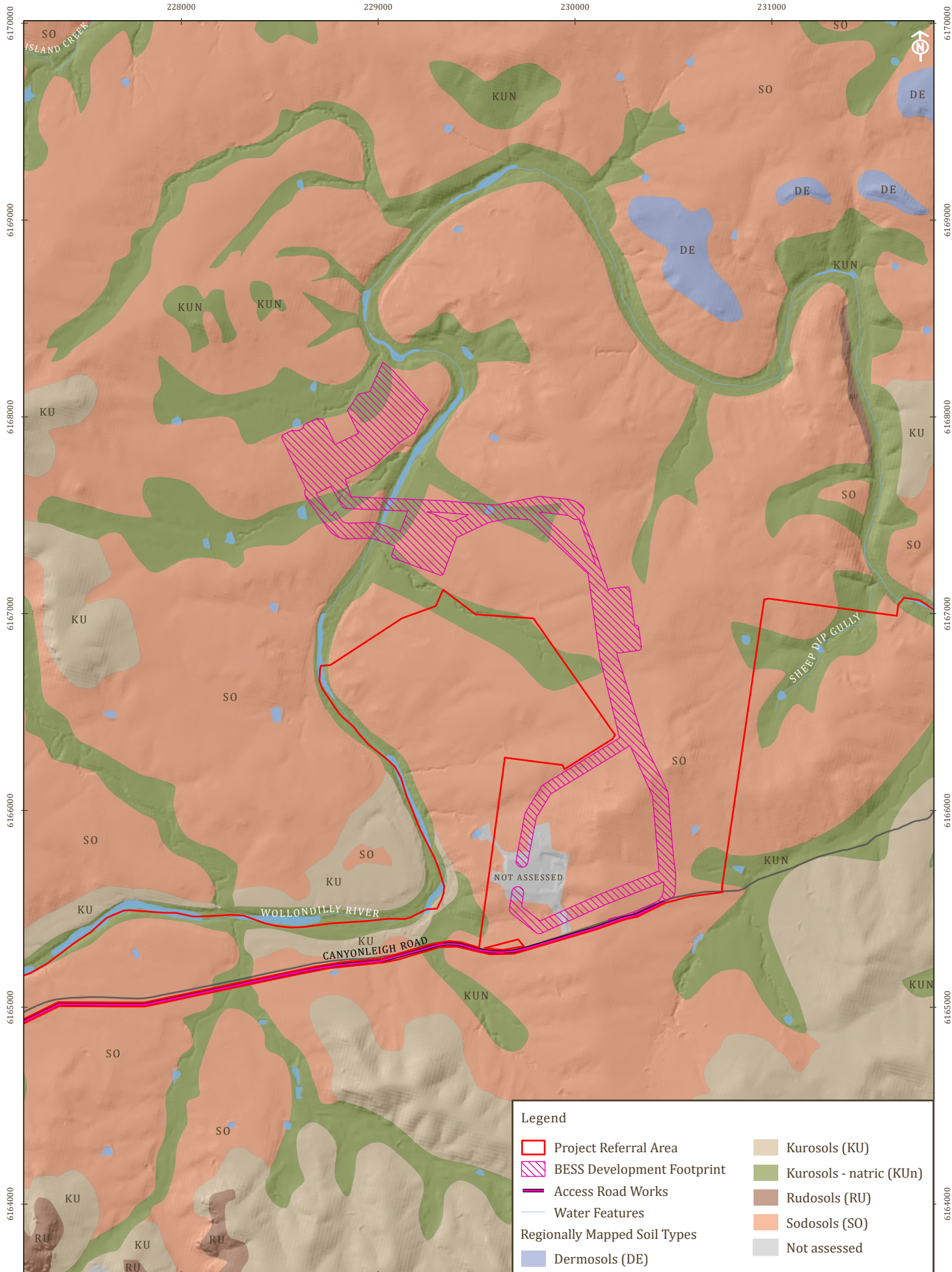
Project Referral Area	Disturbed Terrain, xxx	Larkin, lrz
BESS Development Footprint	Durrans Durra, ddz	Marulan, mly
Access Road Works	Gibraltar Rocks, grz	Marulan var a, mlya
Water Features	Gibraltar Rocks var a, grza	Wollondilly River, woy
<b>Regionally Mapped Soil Landscapes</b>	Barralier, bay	Wollondilly River var a, woya
Jaqua, jqz	Jaqua var a, jqza	

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Regionally Mapped Soil Landscapes

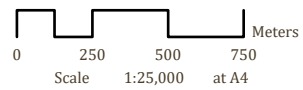
FIGURE 7



**Legend**

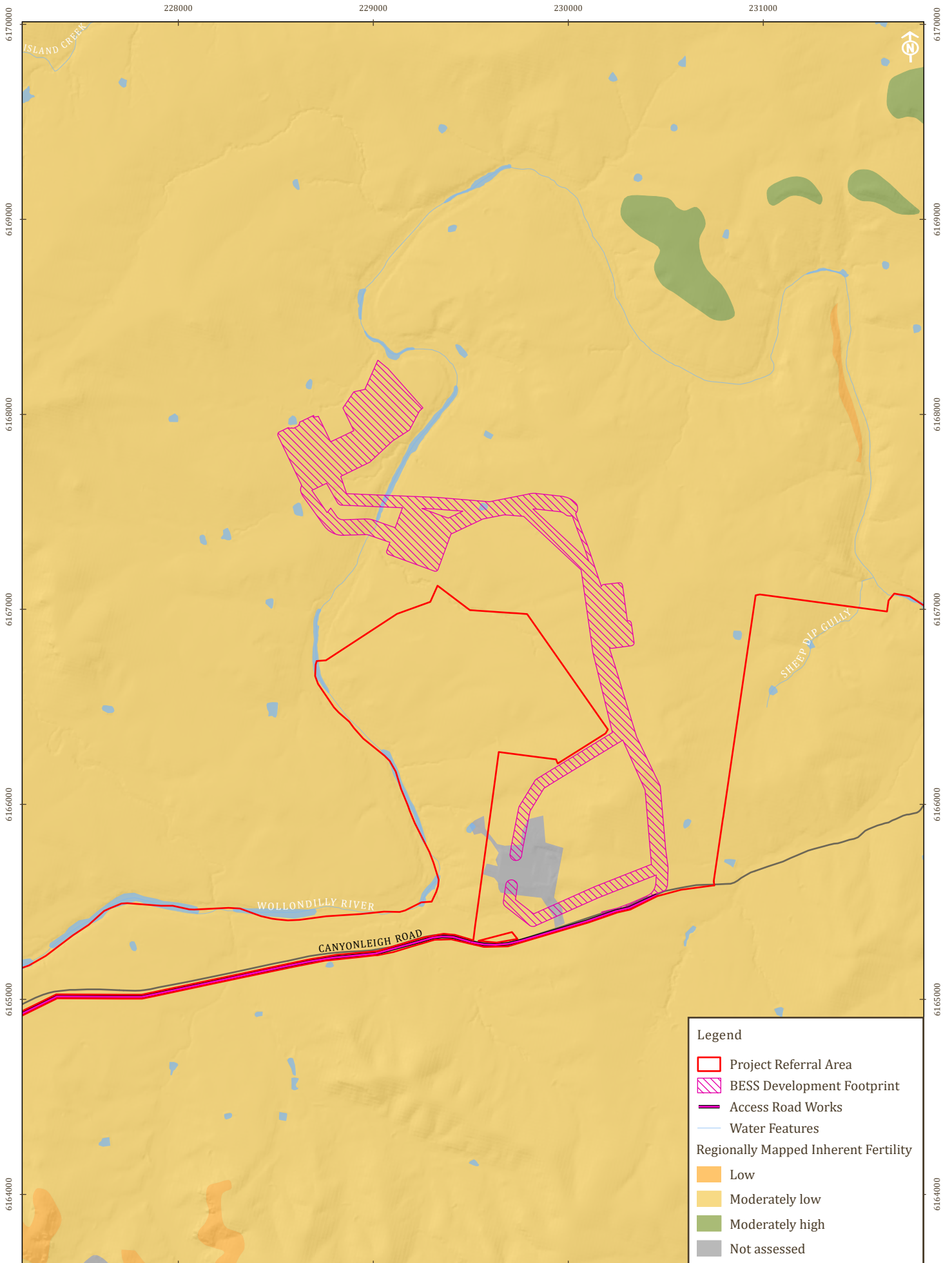
Project Referral Area	Kurosol (KU)
BESS Development Footprint	Kurosol - natric (KUN)
Access Road Works	Rudosol (RU)
Water Features	Sodosol (SO)
<b>Regionally Mapped Soil Types</b>	Not assessed
Dermosol (DE)	

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Regionally Mapped Soil Types

FIGURE 8



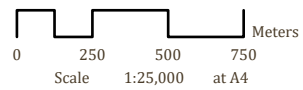
**Legend**

- Project Referral Area
- BESS Development Footprint
- Access Road Works
- Water Features

**Regionally Mapped Inherent Fertility**

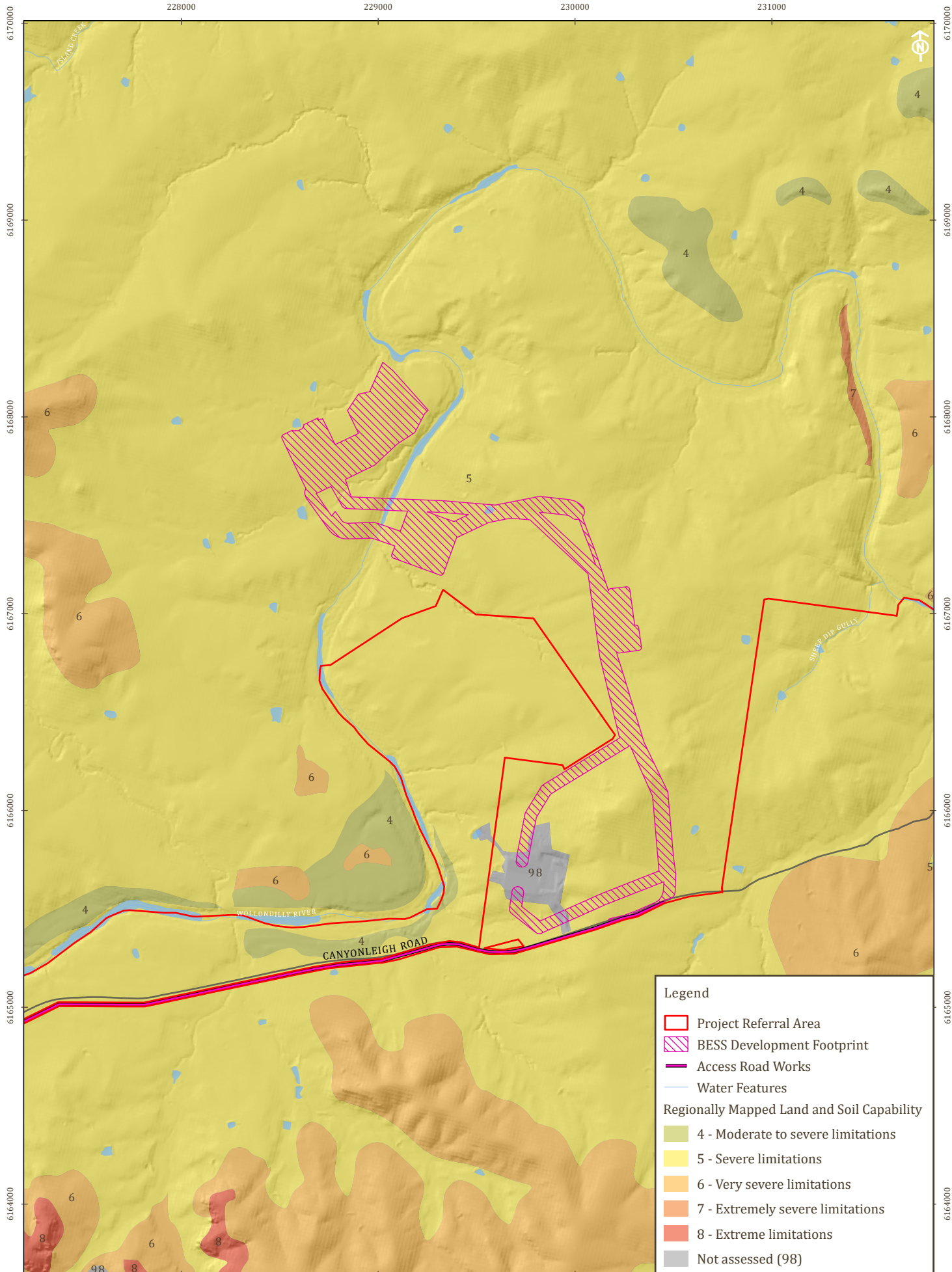
- Low
- Moderately low
- Moderately high
- Not assessed

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**Regionally Mapped Inherent Soil Fertility**

**FIGURE 9**

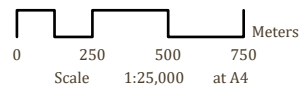


**Legend**

- Project Referral Area
- BESS Development Footprint
- Access Road Works
- Water Features

**Regionally Mapped Land and Soil Capability**

- 4 - Moderate to severe limitations
- 5 - Severe limitations
- 6 - Very severe limitations
- 7 - Extremely severe limitations
- 8 - Extreme limitations
- Not assessed (98)



**Regionally Mapped Land and Soil Capability**

**FIGURE 10**

### 3.2.2 SOIL SURVEY METHODOLOGY

Minesoils undertook a soil and land resource survey to inform the following tasks to be undertaken throughout the EIS process:

- Soil assessment, identifying soil units, soil qualities and risks including erosion, acid sulfate soils (ASS) risk and salinity.
- Land and soil capability (LSC) verification.
- Management and mitigation measures for mitigating soil erosion during construction, operations and decommissioning.

The objective of the Minesoils fieldwork program was to satisfy the field assessment, sampling and testing requirements related to soil and land resources of the LSSE Guideline. The fieldwork plan outlined below was designed to satisfy the following requirements:

- Soil survey and mapping: This was undertaken at a 1:25,000 survey intensity (1 site every 25 ha), and requires collection of landform pattern and element information, soil profile data, and taxonomic parameters to distinguish soil units according to the Australian Soil Classification criteria, within the Project Area.
- LSC verification: The information required for the LSC assessment was collected during both the desktop assessment and verified on the ground during the field program. The LSC system requires data on biophysical features from in situ measurements regional mapping.
- Soil qualities and risks: Additional information was recorded in the field on erosion and evidence of potentially erosive soils including tunnelling, rill, gully and sheet erosion, which may require specific handling and management techniques during construction or operational activities, and the consequences of this on stripping and rehabilitation. Observations were made on risks of ASS and salinity.

The field program was designed as an integrated free survey. An integrated survey assumes that many land characteristics are interdependent and tend to occur in correlated sets (NSCT, 2008). Survey points are irregularly located according to the survey teams' judgement to enable the delineation of soil boundaries. Soil boundaries can be abrupt or gradual, and catena and toposequences are used to aid the description of gradual variation. Soil cores were excavated by a soil corer to a depth of approximately 0.8 – 1.0m or to a point of refusal. Site clearances and dial before you dig (DBYD) plans were undertaken as part of the safety planning requirements and found underground service running through the centre of the Project Area which were avoided during excavation activities.

The survey was over the full 75 ha development footprint. A total of 7 sites were assessed, resulting in a survey intensity of 1 site per approximately 11 ha. Soil profiles within the Project Area (refer to **Figure 11**) were assessed in accordance with the 'Australian Soil and Land Survey Field Handbook soil classification procedures' (NCST, 2009). Detailed soil profile descriptions were recorded covering the major parameters specified in **Table 10**. Soil profile logging was undertaken in the field using Minesoils' soil data sheets, including GPS recordings and photographs of the landforms and soil profiles. Soils were keyed out in accordance with the Australian Soil Classification (ASC) Third Edition (2008) (Isbell, R. F.,2021).

Soil samples were collected at each of the assessment site's soil horizons to a depth of 1 m, with a total of 22 samples collected. Minesoils chose 12 of these samples that were considered representative to be subject to laboratory testing. The laboratory testing suite for these sites is detailed in the **Table 11**.

Duplicate samples at every site were collected during the fieldwork and stored until the EIS is finalised.



Table 10: Detailed soil profile description parameters

Detailed Field Assessment Parameters	
Horizon depth including distinctiveness and shape	Pan presence and form
Field texture grade	Permeability and drainage
Field colour (Munsell colour chart)	Field pH
Pedality structure, grade and consistence	Field moisture
Soil fabric and stickiness	Surface condition
Stones (abundance and size)	Landform pattern / element
Mottles (amount, size and distinctiveness)	Current land use and previous disturbance
Segregations (abundance, nature, form and size)	Vegetation

Table 11: Soil Sample Laboratory Analysis

Lab Analysis	
Analyte	Methodology
pH (1:5 water & CaCl)	Rayment & Lyons 2011-4A1
Electrical Conductivity (EC) and Chloride	Rayment & Lyons 2011-3A1
Cation Exchange Capacity (CEC) & ESP and Ca:Mg Ratio	Rayment & Lyons 2011-15J1
Particle Size Analysis (PSA) (Select samples)	ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book')
Emerson Aggregate Test (EAT) (Select samples)	AS1289.3.8.1-2017



### 3.2.3 SOIL SURVEY FINDINGS

#### *Soil Mapping Units*

The soil survey undertaken by Minesoils found the development footprint to contain two dominant soil mapping units, as shown on **Figure 11**, and presented in **Table 11**:

- Soil Unit 1: Sodosols – covering 46 ha.
- Soil Unit 2: Chromosol/Kurosol Complex – covering 29 ha.

Full soil profile descriptions are included as **Appendix 2**. Laboratory certificates of analysis are included as **Appendix 3**.

#### *Soil Unit 1: Sodosols*

Soil Unit 1 is characterised by Sodosols, which, as outlined in Section 3.2.1, are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid. Soils with strongly subplastic upper B2 horizons are excluded.

This unit is characterised by loamy sand and sandy loam topsoils with weak to moderate structure overlying sodic clay subsoils with moderate to strong structure. pH ranges from strongly acidic to moderately alkaline, with most soil profiles encountered exhibiting slight or moderate acidity. These soils are consistently non-saline. Soil profile drainage ranges from poor to moderate and depth ranges from shallow on some crests and upper slopes to deep elsewhere.

Soil Unit 1 exhibits a very high erosion risk, based on landform context and physical and chemical characteristics. The sodic nature of this unit (frequently strongly sodic), and its heightened susceptibility to dispersion, as observed throughout the Project Area and surrounding lands, presents an increased management risk.

Representative sites for this unit, which include detailed laboratory data, consist of sites 5 and 27.

#### *Soil Unit 2: Chromosol/ Kurosol Complex*

Soil Unit 2 is characterised by Chromosols, which are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is not sodic and not strongly acid. Soils with strongly subplastic upper B2 horizons are also included even if they are sodic. Within this Unit some soils have strongly acidic B horizons, and are therefore Kurosols, as defined in Section 3.2.1.

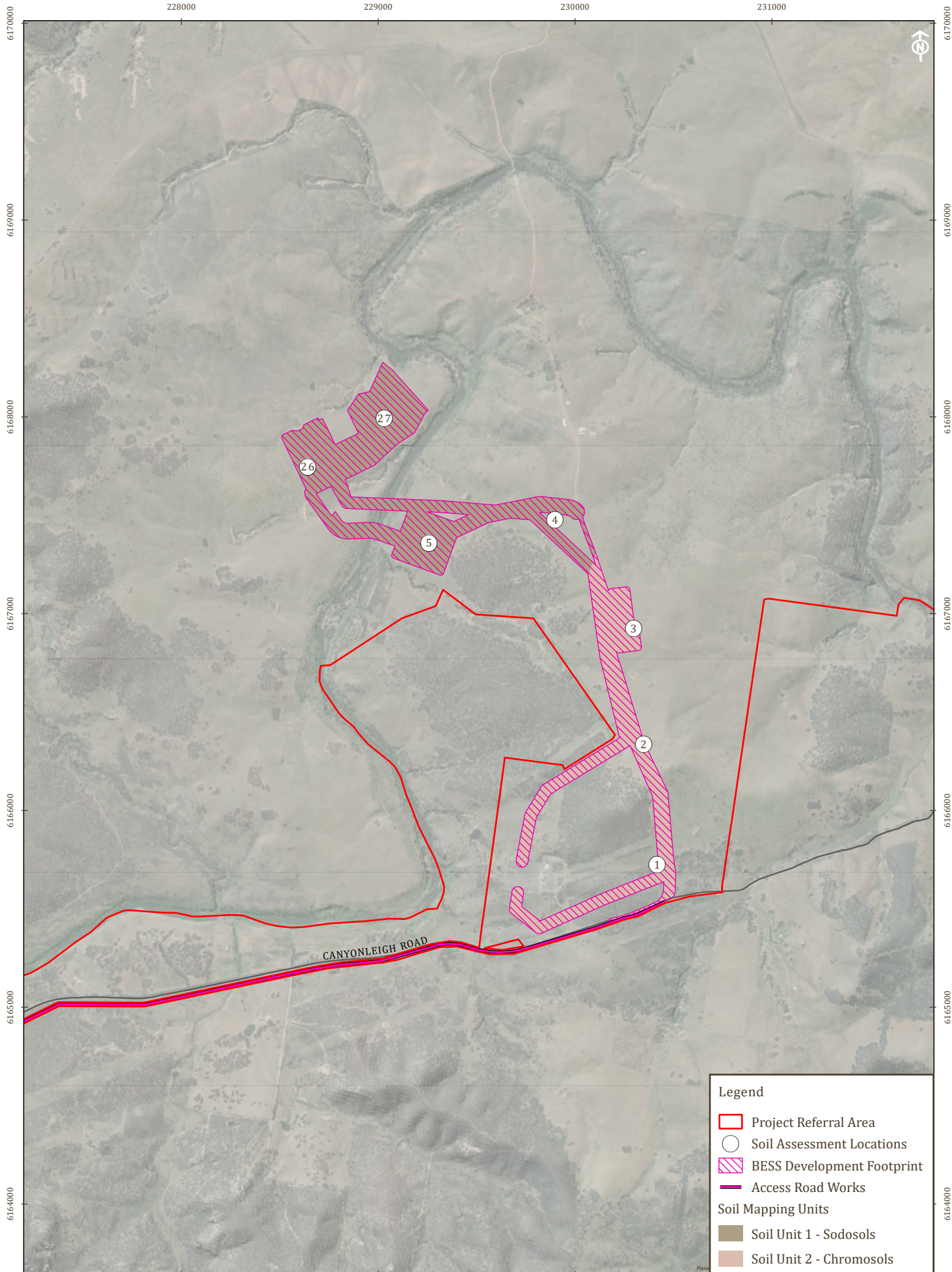
This soil unit characterised by loam, loamy sand and sandy loam topsoils with weak to moderate structure overlying light-medium to heavy clay subsoils with moderate to strong structure. pH ranges from strongly acidic to moderately alkaline, with most soil profiles encountered exhibiting slight or moderate acidity. These soils are consistently non-saline and generally non-sodic. Some soils within this unit have bleached A2 horizons, and subsoil mottling occurs sporadically. Soil profile drainage ranges from imperfect to moderate and depth is generally deep.

This soil unit has a sub-dominant soil type present in a Kurosol, which are similar to a Chromosols albeit with a strongly acidic B horizon. One Kurosols detailed site was encountered during the soil survey. Based on the physical and chemical properties, as well as determined erosion risk, this soil type was designated to Soil unit 1 due to behavioural similarities to the Chromosols assessed within the project Area.

Soil Unit 2 exhibits moderate to high erosion risk, based on landform context and physical and chemical characteristics.

Representative sites for this unit, which include detailed laboratory data, consist of sites 1 and 2.





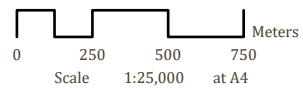
**Legend**

- Project Referral Area
- Soil Assessment Locations
- BESS Development Footprint
- Access Road Works

**Soil Mapping Units**

- Soil Unit 1 - Sodosols
- Soil Unit 2 - Chromosols

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Soil Mapping Units

FIGURE 11

Table 12: Soil Mapping Units and Soil Units Summary

Site #	Soil Mapping Units		Soil Profile - Australian Soil Classification	ASC Family Criteria
	#	Name		
1	2	Chromosols	Bleached Eutrophic Brown Chromosol	BFKOWNR
2	2	Chromosols	Mottled Mesotrophic Brown Kurosol	BGLOWNR
3	2	Chromosols	Red Chromosol	-
4	1	Sodosols	Yellow Sodosol	-
5	1	Sodosols	Eutrophic Mesonatric Brown Sodosol	BFKOWNR
26	1	Sodosols	Brown Sodosol	-
27	1	Sodosols	Mesotrophic Subnatric Brown Sodosol	BEKOWNR

**Soil Erodibility**

Based on site observation, which included assessment for indicators of erodibility, it can be concluded that there is a visible erosion and sedimentation risk associated with the soil types currently present in the development footprint. In addition, high levels of sodicity throughout the development footprint, as indicated in the laboratory testing, further highlight this risk.

Due to undulating nature of the landscape, combined with the rainfall characterises of the region, the risk of soil erosion from surface water flows is very high where sodic soils are directly impacted.

The erosion risk of the soil mapping units, as described in the soil mapping unit descriptions, is presented in **Table 13**.

Table 13: Dispersion Degree and Risk Correlation to EAT Class

Soil Mapping Unit	Erosion Risk
1: Sodosols	Very High
2: Chromosol/Kurosol Complex	Moderate to High



Erosion and sediment control management options are available to be implemented by the Project to mitigate the heightened risk of erosion (refer Section 6.2.1).

### ***Acid Sulphate Soils***

Acid sulfate soils (ASS) have been classified into 5 different classes based on the likelihood of the ASS being present in particular areas and at certain depths (NSW Department of Planning and Environment, 2018):

- Class 1: ASS in a class 1 area are likely to be found on and below the natural ground surface.
- Class 2: ASS in a class 2 area are likely to be found below the natural ground surface.
- Class 3: ASS in a class 3 area are likely to be found beyond 1 metre below the natural ground surface.
- Class 4: ASS in a class 4 area are likely to be found beyond 2 metres below the natural ground surface.
- Class 5: ASS are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres on adjacent class 1,2,3 or 4 land.

The Project Area does not contain any of the above classes on the NSW Acid Sulfate Soil Planning Map.

Assessing land elevation and distance from the coast, in conjunction with existing ASS mapping for NSW, the potential for ASS is considered a very low risk.

Further, there was no evidence of ASS indicators such as soil gleying, odour, marine sediments and organic materials recorded as part of the soils survey.

### **3.2.4 SITE VERIFICATION OF LSC**

The 33 soil test sites within the development footprint have been assessed and classified ranging from LSC class 4 to class 7, as presented in **Table 14**. The verified LSC classes present within the development footprint are as follows:

- LSC class 5: moderate-low capability land – covering 59 ha;
- LSC class 6: low capability land – covering 16 ha.

The spatial extent of each verified LSC class is shown in **Figure 12**.

#### ***Class 5 Land***

This classification indicates land has high limitations for high-impact land uses and will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation. The defining constraints to this land class within the Project Area are wind erosion and soil acidity.

#### ***Class 6 Land***

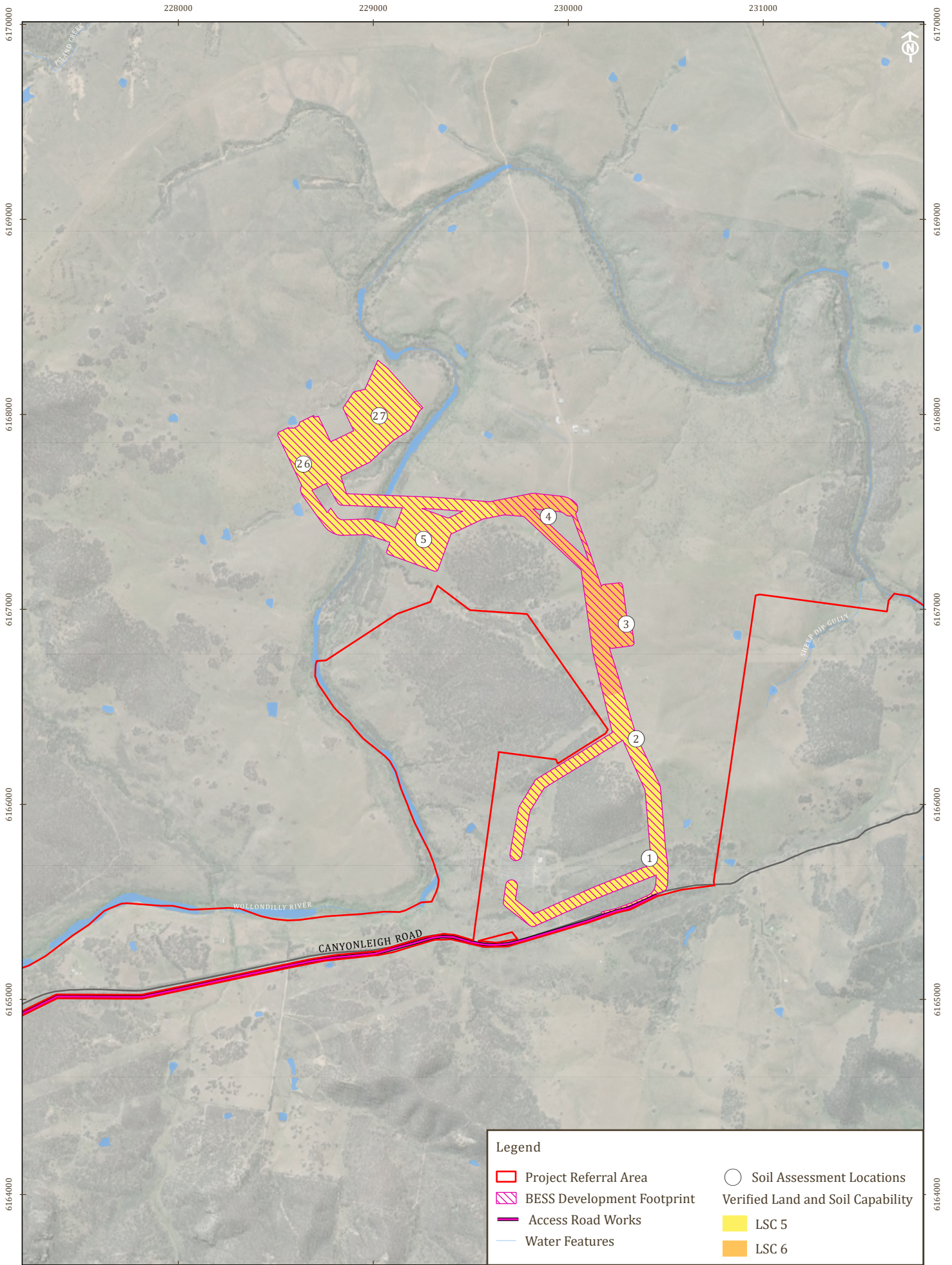
This classification indicates the land has very high limitations for high-impact land uses. Land use is restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation. The defining constraints to this land class within the Project Area are wind erosion and soil depth.



Table 14: LSC Parameters and Overall Class

		Hazard Criteria								
		1	2	3	4	5	6	7	8	Overall
		Water erosion	Wind erosion	Structure	Acidity	Salinity	Water-logging	Soil depth	Movement	Class
1	Bleached Eutrophic Brown Chromosol	3	5	1	5	1	4	1	1	5
2	Mottled Mesotrophic Brown Kurosol	4	4	3	5	1	4	1	1	5
3	Red Chromosol	3	6	1	5	1	3	1	1	6
4	Yellow Sodosol	3	6	1	5	1	4	4	1	6
5	Eutrophic Mesonatric Brown Sodosol	3	5	1	5	1	4	1	1	5
26	Brown Sodosol	3	5	1	5	1	3	4	1	5
27	Mesotrophic Subnatric Brown Sodosol	3	5	1	5	1	3	1	1	5



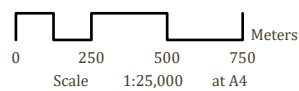


**Legend**

- Project Referral Area
- BESS Development Footprint
- Access Road Works
- Water Features
- Soil Assessment Locations
- Verified Land and Soil Capability  
LSC 5
- LSC 6

GDA2020 MGA Zone 56

**Verified Land and Soil Capability**



**FIGURE 12**

## 4 LAND USE CONFLICT RISK ASSESSMENT

### 4.1 OVERVIEW

The Land Use Conflict Risk Assessment (LUCRA) (NSW Department of Primary Industries, 2011) is required as part of an Agricultural Impact Assessment as per the LSSE Guideline. The LUCRA is a system to identify and assess the potential for land use conflict to occur between neighbouring land uses. It helps land managers and consent authorities assess the possibility for and potential level of future land use conflict. LUCRA aims to:

- Accurately identify and address potential land use conflict issues and risk of occurrence before a new land use proceeds or a dispute arises.
- Objectively assess the effect of a proposed land use on neighbouring land uses.
- Increase the understanding of potential land use conflict to inform and complement development control and buffer requirements.
- Highlight or recommend strategies to help minimise the potential for land use conflicts to occur and contribute to the negotiation, proposal, implementation and evaluation of separation strategies.

Land use conflicts occur when one land user is perceived to infringe upon the rights or impact the values or amenity of another. In rural areas land use conflicts commonly occur between agricultural and residential uses. However, land use conflicts can also occur between different agricultural enterprises and other primary industries.

Rural amenity issues are the most common land use conflict issues, followed by environmental protection issues. Rural amenity issues include impacts to air quality due to agricultural and rural industry (odour, pesticides, dust, smoke and particulates); use and enjoyment of neighbouring land e.g., noise from machinery; and visual amenity associated with rural industry e.g., the use of netting, planting of monocultures and impacts on views.

Environmental protection issues include soil erosion leading to land and water pollution, clearing of native vegetation, and stock access to waterways.

Direct impacts from neighbouring land uses on farming operations can also cause conflict, such as: harassment of livestock from straying domestic animals; trespass; changes to storm water flows or water availability; and poor management of pest animals and weeds.

### 4.2 APPROACH

The LUCRA as presented in **Appendix 1** compares and contrasts the Project against adjoining/surrounding land uses and activities for incompatibility and conflict issues based on the risks and impacts identified in Section 5, and the mitigation measures and controls presented in Section 6. Each potential conflict between the operation of the BESS and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in **Appendix 1**. Performance targets will be determined via management plans specified by the EIS (and specialist impact assessments) and development consent conditions (if approved). Monitoring will be undertaken in accordance with those management plans. Indicative performance targets are presents in **Appendix 1**.

Given the significant overlap between the agricultural impact assessment and land use conflict considerations, many agriculture-related risk items listed in the LUCRA are further detailed in Section 5.

### 4.3 FINDINGS

The following land use conflict risk items were identified for the Project:

- Construction ground disturbance;
- Construction noise and vibration;
- Construction dust;
- Construction traffic;



- Construction workforce;
- Construction biosecurity;
- Visual amenity;
- Fire spread;
- Change in land use;
- Operational traffic;
- Operational noise;
- Waste;
- Property devaluation;
- Erosion and sedimentation;
- Livestock interaction;
- Electro-magnetic fields;
- Neighbouring operations;
- Foreign ownership;
- Cumulative impacts; and
- Rehabilitation.

Within these risk item categories, 29 potential conflicts were considered as part of the LUCRA. The mitigation measures and controls outlined in this assessment and the wider EIS reduce the level of risk for the majority of considered potential risks with complaints or conflict being managed within normal operations. However a number of items of potential conflict remain a moderate risk and may require further consultation and management in addition to standard operations. Note, these potential conflicts pertain to the wider locality and community, as well as to immediate neighbours. The moderate and high potential conflicts are summarised in **Table 15**. The LUCRA methodology including risk ranking matrix and full LUCRA assessment are included as **Appendix 1**.

Table 15: LUCRA Moderate and High Risk Items

Potential Conflict	Risk
Residents of the local community who are looking to build 'Bed and Breakfast' style short-stay accommodation on their properties to capitalise on existing rural values may be concerned the Project will detract from their accommodation offering in terms of reduced visual and social amenity and decrease any potential earnings from such a business venture.	Moderate
Stakeholders may be concerned about potential impacts to biodiversity within the site and locality.	Moderate
Land users in the locality may be concerned about biosecurity breaches including weed, plant pest, plant disease or pest animal introduction and/or spread, as a result of the increased personnel, vehicles and materials entering the Project Area during construction of the Project.	Moderate
Land users in the locality may be concerned about the possibility of increased vehicles during construction or operation may result in an accident with livestock, farm machinery or wildlife on narrow and partially unsealed local roads.	Moderate
Land users in the locality may be concerned about the risk of fires occurring at the site and their potential to spread to surrounding land, infrastructure or livestock	Moderate
The placement of the Project in proximity to agricultural business operators may affect insurance premiums for surrounding private property owners.	Moderate
Stakeholders may be concerned about the potential for poor rehabilitation outcomes, including inadequate removal of infrastructure and industrial wastes, and poor reinstatement of soils resources, resulting in long term environmental and agricultural consequence.	Moderate



## 5 IMPACTS ON AGRICULTURAL LAND

The impacts BESS developments can have on land resources and agricultural productivity range from short term temporary impacts to long term and permanent impacts. Temporary impacts can include the removal of agriculture from development footprint over full the life of the Project, including during the construction, operation and decommissioning phases. Permanent impacts may include changes to land and soil capability and agricultural resources of the Project Area. Permanent impacts are irreversible and can be mitigated by the reinstatement of agricultural lands and land productivity to a pre-disturbance condition and productivity.

This section identifies and describes the nature, duration and consequence of the potential impacts on agricultural land as a result of the Project, for the Project Area and in the wider region, across five risk areas:

- Changes in the amount of land used for agriculture.
- Changes to agricultural productivity and agricultural enterprises.
- Changes to agricultural resources.
- Other potential impacts to agriculture considered for the Project.
- Cumulative impacts of the potential for multiple large scale renewable projects within the region.

### 5.1 LAND USED FOR AGRICULTURE

The Project will be undertaken on an area of up to 75 ha of land that is currently subject to agriculture land use. Therefore, there will be a temporary decrease of up to 75 ha of land used for agriculture for the duration of the Project, as presented in **Table 16**.

This is considered negligible impact in the context of the agricultural industry gross value of the Upper Lachlan LGA as outlined in Section 2.4.2 (0.02%).

It is anticipated that agricultural land use will be re-established over the entire 75 ha development footprint at the time of decommissioning and rehabilitation (unless otherwise agreed with the landowner and/or regulatory authorities). There will be no permanent decrease in land available for agriculture use.

Current agricultural land use immediate to the Project Area, and in the broader Project locality, will not change as a result of the Project, and there will be no fragmentation or displacement of existing agricultural industries.

### 5.2 PRODUCTIVITY AND ENTERPRISES

#### 5.2.1 PRIMARY PRODUCTIVITY

The productivity of the development footprint is described in Section 3.1.3. For the purpose of this assessment, the impact of the Project on productivity of agricultural land based on the change in land use is up to \$28,800 per year, as presented in **Table 8**.

This is considered negligible impact in the context of the agricultural industry gross value of the Upper Lachlan LGA as outlined in Section 2.4.2 (<0.02%).

Due to the minimal disturbance to the landform, following the life of the Project, all land removed from agriculture will be returned to agricultural use, with anticipated mitigation controls available to ensure no reductions in land and soil capability. Agricultural enterprises can then re-commence at an equivalent agricultural productivity.



## 5.2.2 PRODUCTIVITY OF LAND WITHIN LOCALITY

Agricultural productivity of land outside of the development footprint but within the Project Area, as well as neighbouring properties adjacent to the Project Area, will not be affected by the Project as the associated agricultural resources will not be affected. Therefore, the Project will not negatively impact any existing agricultural enterprise outside of the development footprint.

## 5.2.3 AGRICULTURE SUPPORT SERVICES

The Project will have a negligible impact on the viability local and regional agricultural services and employment. There will be minimal impacts experienced by employees, suppliers or contracting services currently engaged. Changes to the supply and viability of agricultural support services in the main service centres of Griffith and Narrandera are driven by social and market trends far exceeding the scale of the negligible reduction in agricultural land use and productivity as a result of the Project.

## 5.2.4 CRITICAL MASS THRESHOLDS

Due to the limited reduction in agricultural activity as a result of the Project, and given the nature and scale of the established agricultural industries within the region and wider state, there will be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural industries and infrastructure.

# 5.3 AGRICULTURAL RESOURCES

## 5.3.1 SOILS

In areas where earthworks are necessary for construction of the BESS, site facilities or access tracks, soils will be subject to higher impact disturbance.

All soil that is proposed to be disturbed during the Project will be stripped and re-used during construction and/or rehabilitation in order to mitigate long term effects on soil resources during operation. Given the limited surface disturbance anticipated, any soil stripping and re-use will be localised; that is, soil may be stripped and stored adjacent to disturbance and respread from where it was stripped. This localised approach will promote reinstatement of the soil profile to its original condition.

Additionally, soils may be stripped only in areas where soil disturbance occurs. The depth of soil salvaged will be as deep as excavations or surface disturbance is required, or to a depth where parent material is encountered.

Impacts on soil biological balance and nutrient availability are linked to the status of vegetation beneath the panels. If grass cover is maintained across the site both between and under the panel rows to provide groundcover, there will be negligible soil composition and productivity impacts as a result of the panels.

However, if vegetation beneath the panels is significantly reduced or eliminated over long periods during operations, the soil may be temporarily sterilised and will require additional efforts and costs at the time of site decommissioning to restore the soil to a level of productivity equivalent to pre-disturbance conditions.

The impacts to the soils within the development footprint are expected to be heightened due to the nature of earthworks expected to be required. However, these can also be considered temporary given the available mitigation measures.

There will be no direct or indirect impacts to the soil resources of the Project locality outside the Project Area.

Soil impact mitigation measures are outlined in Section 6.2.

## 5.3.2 LAND AND SOIL CAPABILITY

The development footprint occurs on moderately low to low capability land (LSC classes 5 and 6)



No important agricultural land (defined as LSC classes 1, 2 and 3 as per the *LSSE Guidelines*) will be impacted by the Project.

Due to the nature of the Project which will require only localised and sporadic landform modification including minor soil stripping (for excavation works and leveling), impacts on LSC are expected to be minor.

Following the end of life for the Project, disturbance footprints will be re-graded (where required) and any minor stockpiles of topsoil and subsoil be respread over disturbed areas and rehabilitated with either native vegetation or improved pastures depending on the intended final land use. This strategy, along with good soil management practices as outlined in Section 6.2 will facilitate the rehabilitation in returning the land to an equivalent LSC class.

Therefore, it is anticipated there will be no permanent impacts on LSC classes within the Project Area as a result of the Project.

### 5.3.3 WATER

A Water Resources Impact Assessment (WRM, 2024) considered the potential impacts and appropriate measures to mitigate any potential impacts on water resources associated with the Project.

The Project will have minimal impact on water resources as it involves limited ground disturbance, does not store or handle large volumes of pollutants, and once constructed does not consume significant quantities of water.

For these reasons, the key potential risks to surface water are only associated with the Project's construction. These risks can be adequately managed through the application of well-established construction environmental management practices and appropriate design.

Key issues relevant to the water resources impacts of the Project are summarised below:

- Impacts to surface water resources occur during the construction. These potential impacts can be mitigated to represent negligible risk.
- The operational phase of the Project presents minimal risk provided that by the conclusion of the construction phase appropriate groundcover and drainage is established.
- The Project will not interact with the groundwater table and therefore, no impacts to groundwater resources or GDEs are expected.
- The Project Area does not contain areas of major flood hazard.
- The large extent of the Project Area and distributed nature of minor impacts (if any) does not pose a risk to drainage features, downstream watercourses or receiving waters.

Therefore, water related impacts are not anticipated to be experienced by agricultural operators within locality and region.

### 5.3.4 EROSION AND SEDIMENTATION

There is a high potential risk for dispersion where soils are disturbed by Project construction efforts within the Project Area. Higher impact activities such as where earthworks are necessary for construction of sub-station pads or site facilities are very likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised.

With the strict adherence to an erosion and sediment control plan (ESCP) prepared for the Project, and the implementation of mitigation measures detailed in Section 6.2, it is expected that direct and indirect erosion and sedimentation risks would be limited and manageable, and the risk of erosion and sedimentation impacts on agriculture as a result of the Project is low.



### 5.3.5 AGRICULTURAL INFRASTRUCTURE

The Project will have a negligible impact on local and regional agricultural infrastructure. There will be negligible impacts on the road and rail network that connects the agricultural industry to markets, services and suppliers (refer Section 5.4.4).

If dams within the Project Area are decommissioned during construction they will be reconstructed during the decommissioning phase of the Project. Adequate paddock fencing will be reinstated to suit post-Project land use. Upgrades to access tracks throughout the Project will benefit post-Project agricultural land uses and is considered a positive impact.

## 5.4 OTHER POTENTIAL IMPACTS ON AGRICULTURE

### 5.4.1 PEST SPECIES

Weeds and pest species could be inadvertently brought into the project area with imported materials, machinery, or allowed to invade naturally through removal or damage of current vegetation. The presence of weed species has the potential to be a major long term hindrance to agricultural endeavours within the locality and region, as well as rehabilitation efforts within the project area.

The impacts of weeds and pest species on agriculture as a result of the Project are anticipated to be minor due to mitigation measures available, which are described in Section 6.3.

### 5.4.2 BIOSECURITY

Biosecurity is defined in the 'Draft NSW Biosecurity Strategy' (DPI, 2021) as 'the protection of the economy, environment and community from pests, diseases and weeds'. It includes measures to prevent new pests, diseases and weeds from entering our country and becoming established.

Given the available mitigation measures as described in Section 6.4, it is considered that biosecurity risks as a result the Project are low and impacts to agricultural resources and enterprises within the region are unlikely to be experienced.

### 5.4.3 AIR QUALITY AND DUST

Construction and decommissioning activities have the potential to increase dust through movement of traffic on unsealed roads on dry days, vegetation removal, and localised dust emissions generated by land disturbance (such as excavation activities required for infrastructure). Dust control measures will be detailed in a Construction environmental management plan (CEMP). With the implementation of the CEMP, it is expected that the construction and decommissioning activities would have a negligible impact on local air quality.

During operations, ongoing maintenance of infrastructure and land will result in very minor, localised vehicle emissions and generation of dust from vehicles travelling along unsealed internal access tracks. These impacts are unlikely to affect agriculture and standard dust suppression measures will be outlined in an Operational Environmental Management Plan (OEMP) to manage and control dust where required.

### 5.4.4 TRAFFIC

Agricultural enterprises can be impacted by increased traffic movements through an increase in noise and dust, and also through the cumulative impact of road transport being utilised by renewable energy developments, leaving fewer transport options for agricultural enterprises.

Local roads in proximity to the Project are anticipated to experience an increase in traffic volumes during the peak construction period. However, the traffic impacts of the Project are not likely to have material consequences on agricultural enterprises within the Project locality. Based on the Traffic and Transport Assessment undertaken for the Project (Access Traffic Consulting, 2024), conditional to the provision of the identified mitigation measures and



road network upgrade works as part of the Project, the potential traffic impacts of the construction, operations and decommissioning phases of the Project can be appropriately managed, with minimal traffic impacts anticipated on the relevant sections of the local government and state-controlled road networks.

Further, no increases in levels of noise and dust that could impact agriculture will result from increased traffic.

Therefore, the traffic impacts of the Project are not likely to have consequences on agricultural enterprises within the Project locality.

#### 5.4.5 NOISE AND VIBRATION

Background noise levels are expected to reflect the site's location in a rural setting away from population centres. Background noise sources would include site vehicles, farm equipment, wind through trees, birds and insects.

Noise levels during construction and operation are predicted to comply with relevant guidelines and noise criteria (Marshall Day Acoustics, 2024) . It is expected that noise will be effectively managed and minimised through the adoption of standard management practices. The proponent will implement practicable measures to reduce noise impacts including for example, the careful location of noise generating components within the site to increase the distance to sensitive receivers. Supportive evidence is provided through a Noise Impact Assessment in the EIS.

Generally, agriculture is only impacted by noise when constantly high noise levels or sudden loud noise leads to a decrease in animal production through increased livestock stress. Cattle may tolerate moderate levels of noise and may easily adapt to an intensity level of 60-90 dB. Continuous exposure to noise above 90dB has been known to severely affect animals (Dairy Global, 2017).

Generally, agriculture is only impacted by noise when constantly high noise levels or sudden loud noise leads to a decrease in animal production through increased livestock stress. The predicted noise levels are anticipated to pose a negligible impact on agricultural activities.

Further, vibration issues are not expected to be significant during either construction or operation due to the distance between the site and the nearest sensitive receivers.

### 5.5 CUMULATIVE IMPACTS

The Project has the potential to generate cumulative impacts with numerous other existing, approved or proposed developments in the region, which are detailed in the EIS. These include solar, wind and storage projects, with some mining, quarry and other infrastructure projects.

In the context of agriculture, increased cumulative impacts including changes to land used for agriculture, localised productivity, secondary productivity and some agricultural support services are likely to be experienced. This will be a result of agriculture land use being inhibited by landform modification and infrastructure, such as the development footprints for wind and solar farms. However, given the nature and scale of the established agricultural industries within the region that interfaces with renewable energy and other proposed projects (that is, predominantly livestock grazing with some broadacre cropping), significant impacts to agriculture are unlikely to occur in the foreseeable future.

The applicability of agrisolar to the solar industry is especially relevant to the Upper Lachlan Shire and Goulburn Mulwaree LGA's and wider region given the suitable conditions for sheep grazing and the established sheep and lambing industries and infrastructure (as outlined in Section 2.4.3). Where agrisolar is implemented, the cumulative impact of solar farm projects on agriculture for the region is considered to be low given changes to agricultural land use and agricultural productivity are anticipated to be minor for each respective Project reducing the overall cumulative impact of the renewable energy industry.



Therefore, the cumulative impact on agriculture from the renewables developments in the region is considered to be low given changes to agricultural land use and agricultural productivity are anticipated to be minor for each respective renewable energy project (wind, solar and storage projects).



## 6 MITIGATION MEASURES

The Project will include a number of measures to prevent, minimise and manage adverse impacts on agricultural resources. This incorporates procedural mitigation measures along with a land management process that ensures the Project has negligible impact on agricultural resources and enterprises.

In addition to the specific measures described in this assessment, all activities associated with the Project will be conducted in consideration of approval obligations and environmental management measures in development consent stipulated environmental management plans.

The mitigation measures pertaining to soils and agriculture discussed below will form part of the Project approval commitments. A summary of these is presented in **Table 18**.

### 6.1 PROJECT DESIGN

The Project was created with early consideration of environmental and social matters and was revised during the Scoping phase to incorporate community and stakeholder feedback towards maximising positive social, economic, and environmental outcomes and minimising adverse impacts.

The layout of the Project has also been revised during the preparation of the EIS to avoid and reduce impacts to both Aboriginal Archaeology and Biodiversity.

The key strategies implemented by Spark Renewables to avoid and minimise impacts include maintaining a balance of functional agricultural land by utilising land which has lower productivity and avoiding higher value cropping areas.

Given the negligible effect the Project will have on agricultural resources and enterprises, (as outlined in Section 5), no further design controls are recommended to address agricultural impacts.

The complete Project design consideration process, as well as an analysis of Project alternatives, is presented in the EIS.

### 6.2 DECOMMISSIONING AND REHABILITATION STRATEGY

Once the Project reaches the end of its operational life, a decision will be made to either decommission or re-power the facility, subject to land agreements and approval requirements.

If the Project is decommissioned, all aboveground structures built as part of the Project will be removed and the site rehabilitated generally to its pre-existing land use, as far as practicable. As agreed with the landowner some infrastructure may be retained (e.g. access tracks) where beneficial to the agreed land use.

The disposal and recycling of project related infrastructure will be done in accordance with waste management legislation at the time of decommissioning. Whenever possible, efforts will be made to reduce the amount going to landfill in line with best-practice sustainability principles. If re-powering is proposed, an appropriate stakeholder consultation process will be undertaken, and all necessary approvals will be sought.

Given the timeframe associated with the operation of the Project, all decommissioning activities would be undertaken in accordance with the relevant guidelines at the time of completion and in consideration of the relevant site constraints (e.g. productivity and erosion risk). Spark Renewables will develop and implement a detailed Decommissioning and Rehabilitation Plan for the Project, 2 years prior to closure. Spark Renewables will consult with relevant stakeholders the development of the Decommissioning Plan.



## 6.3 LAND AND SOIL DISTURBANCE MITIGATION

### 6.3.1 SOIL EROSION MANAGEMENT

Based on site observations, there are significant water erosion and sedimentation issues present at the Project Area. In addition, as the chemical analysis and dispersion risk status of the tested soils indicate, there is a widespread potential high risk for dispersion for the soils within the development footprint.

Generally, channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures.

The Project will prepare a CEMP which will include appropriate erosion and sediment control measures that address specific soil dispersion risks based on disturbance activity and phase of the Project. The ESC management and mitigation should include the following:

#### Construction Phase

- The Project should utilise the existing landform and not endeavour to undertake broad-scale re-contouring of the existing ground levels without referring to this soil and land resource assessments and implementing erosion and sediment control accordingly. As a result, the existing vegetative cover and soil structure will be maintained intact across much of the Project Area.
- At locations where earthworks are necessary, such as for cable trenching, localised erosion and sediment controls will be placed in accordance with the Landcom (2004) guidelines.
- Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance will be prioritised during construction.
- Where sodic soils are subject to high impact disturbance activity, it is recommended to apply gypsum as an ameliorant to displace the sodium and provide the soil with a stronger aggregate and hold structure when wet, as should be further detailed in a site soil management plan.
- All areas disturbed during construction that are not in active use for over 3 months should be sown with grass and pasture species with starter fertiliser to provide stabilising ground cover and a healthy topsoil to provide long term protection against erosion.

#### Operation Phase

- Soil disturbance during operation of the Project should be minimal and limited to maintenance activities, involving very small, localised development footprint on an infrequent basis.
- Standard erosion and sediment control measures should be implemented to minimise the potential for sediment export within areas to be disturbed during operations. These measures would be developed on a case-by-case basis referring to this soil assessment and are likely to include measures such as sediment fencing, localised sediment traps, and progressive stabilisation with vegetation.

#### Decommissioning and Rehabilitation Phase

- A detailed Decommissioning and Rehabilitation Plan should be prepared within 18 months of the planned closure of the Project. This plan will detail all aspects of decommissioning and removal of all infrastructure unwanted for post Project land use (some infrastructure may remain for post Project land use purposes i.e., constructed internal roads may be kept as part of the agricultural infrastructure), which may require temporary erosion and sediment control measures.
- During decommissioning, where potential erosive impacts have been identified due to the disturbance of sodic subsoils in locations of significant disturbance, soil amelioration should be undertaken as part of remediation earthworks. Standard temporary erosion and sediment control measures are to be put in place for high disturbance area.



### 6.3.2 SOIL STRIPPING FOR REHABILITATION

Soil that is proposed to be disturbed during the construction phase will be stripped and re-used in construction rehabilitation and/or end of Project rehabilitation efforts in order to mitigate long term effects on the land and soil capability of the Project Area.

The entirety of the development footprint has been assessed to determine suitability for stripping and re-use. This will allow site managers to make decisions on soil stripping for re-use when the locations of soil disturbance for surface infrastructure have been finalised. This localised, fluid approach is an integral process for successful rehabilitation of the Project. This section provides information on the following key areas related to the management of the topsoil resources for the development footprint.

#### **Soil Stripping Strategy**

Laboratory soil analytical results (refer **Appendix 3**) were used in conjunction with the field assessment to determine the potential risk associated with soil material recovery and re-use. Structural and textural properties of soils, along with stones, dispersion potential, sodicity and high acidity are the most common and significant limiting factors in determining depth of soil suitability for re-use, however, given the limited surface disturbance and lack of a soil bank for the site, it is anticipated that all soil stripping and re-use will be localised; that is, soil will be respread from where it is stripped during construction, reinstating the soil profile to its original condition.

Additionally, soils will be stripped only in areas where soil disturbance occurs. The depth of soil salvaged should be as deep as excavations or surface disturbance is required, or to a depth where parent material is encountered.

Due to the sodic nature and dispersion risk of the subsoils soil throughout the entire Distance Area, targeted controls (such as amelioration) must be implemented to manage the risk of surface water erosion with potential to occur once excavated. Upon respreading, sodic clay subsoils that have been excavated for trenching will be used exclusively as a subsoil, and encapsulated by the more chemically stable topsoils with which they are currently capped.

This general strategy will be further detailed in a site soil management plan.

#### **Higher Impact Areas**

It is recommended that proposed long term small scale stockpiles in areas associated with the higher impact activities where larger amounts of soil will be displaced should be stripped of topsoil. Then the excavated subsoil (only if requiring disturbance) should be placed on the exposed subsoil of the stockpile area to create a low-profile landform of subsoil. A thin layer of topsoil material from the stripped areas should be placed as a 'cap' over the subsoil stockpiles to promote vegetation growth. Topsoil materials should otherwise be stockpiled separately to subsoils. Sodic subsoils should be treated gypsum prior to stockpiling.

Topsoil and subsoil depths for these areas should be recorded in GIS and rehabilitated with target species to build up the seedbank over the years of stockpiling.

#### **Stripped Soil Management**

The following soil handling techniques are recommended to prevent excessive soil deterioration and dispersion. It is not anticipated the Project will involve significant amounts of soil excavation requiring long-term stockpile solutions, however small scale potential soil stockpiling from trenched areas and hardstand locations should abide by the following measures where practicable:

- Strip soil material to maximum excavation depths only.
- Soil should ideally be stripped in a slightly moist condition, where practicable. Material should not be stripped in either an excessively dry or wet condition.



- Push soil into windrows or small stockpiles with graders. This technique is an example of preferential less aggressive soil handling. This minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material.
- The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- Where necessary, a flow diversion bank or catch drain should be placed up-slope of a stockpile to direct surface water flows away. All stockpiles shall remain in a free-draining location to avoid long term soil saturation.
- Where necessary, silt fences or cleared vegetation should be installed around topsoil stockpiles or stripped areas as a form of erosion and sediment control. Mulch or wood chip from cleared vegetation can also be applied as a veneer over topsoil stockpiles to slow erosion, weed establishment and to maintain moisture content.
- As a general rule, maintain a maximum stockpile height of 3 m. Clayey soils should be stored in lower stockpiles for shorter periods of time compared to coarser textured sandy soils.
- Seed and fertilise stockpiles as soon as possible. An annual cover crop species that produce sterile florets or seeds may be sown. A rapid growing and healthy annual pasture sward will provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil. Final rehabilitation target species should be established on stockpiles to build up a desirable species seed bank in the topsoil.
- An inventory of available soil should be maintained to ensure adequate materials are available for planned rehabilitation activities when the time comes.
- Prior to re-spreading stockpiled topsoil onto the development footprint, an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.

### **Soil Re-spreading and Seedbed Preparation**

The Project does not anticipate large volumes of topsoil to require significant stockpile and respreading management measures, however the following re-spreading and seedbank preparation techniques are recommended to prevent excessive soil deterioration and dispersion for any minor areas of topsoil removal.

- Topsoil should be spread to a depth that reflects pre-disturbance soil horizons.
- Topsoil should be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion. Thorough seedbed preparation should be undertaken to ensure optimum establishment and growth of vegetation.
- All topsoiled areas should be lightly contour ripped (after topsoil spreading or following removal of hardstand from topsoil areas) to create a “key” between the soil and material below. Ripping should be undertaken on the contour. Best results will be obtained by ripping when soil is moist and when undertaken immediately prior to sowing.
- The respread soil surface should be scarified prior to, or during seeding, to reduce run-off and increase infiltration. This can be undertaken by contour tilling with a fine-tynded plough or disc harrow.

## **6.4 PEST SPECIES**

Weeds in general will be managed across the site through the CEMP and appropriate Pest and Weed Management measures. This will include an ongoing effort to identify and eliminate existing weed populations on-site over the life of the Project. The spread of declared noxious weeds will be prevented by using site specific measures such as direct spraying.



Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with the regulatory requirements. Records will be maintained of weed infestations and control programs will be implemented according to best management practice for the weed species concerned.

Feral animals may include foxes, rabbits, cats, pigs, and dogs and will be controlled in accordance with Livestock Health and Pest Authority procedures. Feral animal control may be undertaken in consultation with host and neighbouring landholders, as required. Programs to control feral animals will include the determination of appropriate control practices, consultation with appropriate authorities, obtaining appropriate approvals, implementing control practices, and undertaking follow-up monitoring and control as required. If a substantial increase in the numbers of any known feral fauna species, or the occurrence of a previously unrecorded feral fauna species, is discovered, advice will be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species.

## 6.5 BIOSECURITY

At the local level, the mitigation measures outlined for pest species will reduce biosecurity risks. On a regional level, any import of equipment or machinery from overseas will follow the standard procurement safeguards and quarantine procedures as per Australian requirements.

Further, the CEMP will include appropriate agricultural biosecurity management measures including detailed construction and operational risks and controls in relation to pests, weeds, and diseases applicable to the Project.

As DPI Agriculture has noted for other similar large scale renewable projects, the agricultural biosecurity management measures should include controls to address the current elevated threat of foot-and-mouth disease (FMD), a serious and highly contagious animal disease that affects all cloven-hoofed animals including cattle and sheep. An incursion of the virus would have severe consequences for Australia's animal health and trade. Key controls should include adherence to government FMD awareness, prevention and preparedness programs and guidance.

## 6.6 MONITORING PROGRAMS

Monitoring programs are instituted to assess predicted versus actual impacts as the Project progresses in order to implement controls where required. All operations associated with the Project undertaken in accordance with approved environmental management plans and strategies. The management plans will include environmental monitoring programs, where required. Key management plans, or chapters housed within a larger CEMP, that will assist in managing impacts on agricultural land will be stipulated in conditions of development consent.

This will include mitigation measures to control impacts to soils and agriculture, will be reviewed and revised where necessary to incorporate the requirements associated with the Project prior to commencement.

## 6.7 MITIGATION SUMMARY

The mitigation measures pertaining to soils and agriculture that have been referenced in this assessment will form part of the Project approval commitments. A summary of these is presented in **Table 16**.



Table 16: Summary of Mitigation Measures

Risk Category	Mitigation Measures
<b>Agricultural Land Use</b>	Agriculture land use will be re-established over the entire development footprint at the time of decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities).
<b>Agricultural Productivity</b>	Project Area will be returned to an equivalent agricultural productivity following the Project.
<b>Soil</b>	<p>All soil that is proposed to be disturbed during the Project will be stripped and re-used in construction and/or stockpiled for use in rehabilitation.</p> <p>Channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures.</p> <p>All soil resources are to be managed throughout construction, operation and decommissioning phases of the Project in accordance with recommendations outlined in Section 6.2, and a site soil management plan prepared for the Project.</p>
<b>LSC</b>	Return disturbed land to an equivalent LSC class following the end of life for the Project, through site rehabilitation and good soil management practices as outlined in Section 6.2 and measures included in a site soil management plan prepared for the Project.
<b>Erosion and Sedimentation</b>	Suitable erosion and sedimentation controls, as outlined in Section 6.2, will be implemented in accordance with an ESCP prepared for the Project.
<b>Pest Species</b>	Pest species will be managed in accordance with measures outlined in Section 6.3, and CEMP prepared for the Project.
<b>Biosecurity</b>	Biosecurity will be managed in accordance with measures outlined in Section 6.4 and CEMP prepared for the Project.
<b>Rehabilitation</b>	Develop and implement a Decommissioning and Rehabilitation Plan for the Project, two years prior to closure, to ensure that agriculture, land and soil are returned to an approximate pre-disturbance condition.



## 7 SUMMARY

There is a high level of certainty about the status of agricultural resources and enterprises in the Disturbance Area, locality and broader region, based on the site verification assessment undertaken, consultation and desktop studies carried out. Further, there is a high level of confidence regarding the Project activities, surface disturbance requirements and commitments to returning land to pre-disturbance agricultural status following the life of the Project.

Based on these factors, the impacts on agriculture as a result of the Project are determined to be low, temporary, and limited to the development footprint. These impacts can be summarised as the following:

- Temporary removal of up to 75 ha from agricultural land use within the Project Area for the duration of the Project.
- Temporary removal of potential agricultural primary productivity to the estimated value of up to \$28,800 per year for the duration of the Project.
- Temporary impacts on soil resources within the development footprint where surface disturbance occurs.
- Temporary impacts on LSC classes 5 and 6 (noting no important agricultural land, defined as LSC classes 1, 2 and 3 as per the *LSSE Guidelines*, will be impacted by the Project).

The temporary impacts on agriculture listed above are considered a negligible impact in the context of the gross commodity values and land use coverage of the agricultural industries operating within the Upper Lachlan Shire LGA. Further, at the scale of the enterprises operating within the Project Area, impacts are considered offset as the involved landowners would be financially compensated.

It is anticipated that by adopting the principles of impact minimisation and targeted soil and erosion management during Project construction and operation, and implementing effective decommissioning and rehabilitation at the end of Project life, the Project will have no permanent negative impacts on agricultural resources or enterprises.

A summary of mitigation measures and management recommendations have been provided at Section 6.7 to eliminate the permanent risks and control the temporary risks of the Project on land and soil resources. The strict adherence to the mitigation measures available to the Project, including the salvage of topsoil material for re-use purposes combined with sound erosion and sedimentation management practices during construction, operational and decommissioning phases of the Project, will ensure rehabilitation requirements are met and land is returned to a pre-disturbance agricultural status.



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# Appendix 1

## Land Use Conflict Risk Assessment



## Overview

LUCRA is a system to identify and assess the potential for land use conflict to occur between neighbouring land uses. It helps land managers and consent authorities assess the possibility for and potential level of future land use conflict.

The LUCRA compares and contrasts the Project against adjoining/surrounding land uses and activities for incompatibility and conflict issues based on the risks and impacts identified in Section 5, and the mitigation measures and controls presented in Section 6. Each potential conflict between the operation of the Project and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in the following section.

## Assumption

The current status of rural land use in the area is not considered likely to change significantly during the life of the Project. For example, due to the location of the Project Area relative to major regional towns, it is considered unlikely that surrounding properties will undergo subdivision to accommodate residential or small-block rural developments. Accordingly, it is not expected that future changes to land use will occur that will generate new land use conflicts in addition to those identified.

## Methodology

A risk ranking matrix (**Table A1**) provided by the DPI (2011) is used to rank the identified potential land use conflicts. The risk ranking matrix assesses the economic, social and environmental impacts according to the probability of occurrence and consequence of the impact.

Table A1: Risk Ranking Matrix

Consequence	Probability				
	A	B	C	D	E
Level 1	25	24	22	19	15
Level 2	23	21	18	14	10
Level 3	20	17	13	9	6
Level 4	16	12	8	5	3
Level 5	11	7	4	2	1

(Source: DPI, 2011)

The risk ranking matrix yields a risk ranking from 25 to 1. It covers each combination of five levels of ‘probability’ (a letter A to E as defined in **Table A2**) and 5 levels of ‘consequence’, (a number 1 to 5 as defined in **Table A3**) to identify the risk ranking of each impact. For example, an activity with a ‘probability’ of D and a ‘consequence’ of 3 yields a risk rank of 9. A rank of 25 is the highest magnitude of risk; a highly likely, very serious event. A rank of 1 represents the lowest magnitude of risk; an almost impossible, very low consequence event. Low risk is a ranking score of 10 or below.



Table A2: Probability Definitions

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

(Source: DPI, 2011)



Table A3: Consequence Definitions

	Description	Example of Implications
<b>Level 1</b>		
<b>Severe</b>	<ul style="list-style-type: none"> <li>Severe and/or permanent damage to the environment</li> <li>Irreversible</li> <li>Severe impact on the community</li> <li>Neighbours are in prolonged dispute and legal action involved</li> </ul>	<ul style="list-style-type: none"> <li>Harm or death to animals, fish, birds or plants</li> <li>Long term damage to soil or water</li> <li>Odours so offensive some people are evacuated or leave voluntarily</li> <li>Many public complaints and serious damage to Council's reputation</li> <li>Contravenes Protection of the Environment &amp; Operations Act and the conditions of Council's licences and permits. Almost certain prosecution under the POEO Act</li> </ul>
<b>Level 2</b>		
<b>Major</b>	<ul style="list-style-type: none"> <li>Serious and/or long-term impact to the environment</li> <li>Long-term management implications</li> <li>Serious impact on the community</li> <li>Neighbours are in serious dispute</li> </ul>	<ul style="list-style-type: none"> <li>Water, soil or air impacted, possibly in the long term</li> <li>Harm to animals, fish or birds or plants</li> <li>Public complaints. Neighbour disputes occur. Impacts pass quickly</li> <li>Contravenes the conditions of Council's licences, permits and the POEO Act</li> <li>Likely prosecution</li> </ul>
<b>Level 3</b>		
<b>Moderate</b>	<ul style="list-style-type: none"> <li>Moderate and/or medium-term impact to the environment and community</li> <li>Some ongoing management implications</li> <li>Neighbour disputes occur</li> </ul>	<ul style="list-style-type: none"> <li>Water or soil known to be affected, probably in the short to medium-term (e.g. 1-5 years)</li> <li>Management could include significant change of management needed for agricultural enterprises to continue</li> </ul>
<b>Level 4</b>		
<b>Minor</b>	<ul style="list-style-type: none"> <li>Minor and/or short-term impact to the environment and community</li> <li>Can be effectively managed as part of normal operations</li> <li>Infrequent disputes between neighbours</li> </ul>	<ul style="list-style-type: none"> <li>Theoretically could affect the environment or people but no impacts noticed</li> <li>No complaints to Council</li> <li>Does not affect the legal compliance status of Council</li> </ul>
<b>Level 5</b>		
<b>Negligible</b>	<ul style="list-style-type: none"> <li>Very minor impact to the environment and community</li> <li>Can be effectively managed as part of normal operations</li> <li>Neighbour disputes unlikely</li> </ul>	<ul style="list-style-type: none"> <li>No measurable or identifiable impact on the environment</li> <li>No measurable impact on the community or impact is generally acceptable</li> </ul>

(Source: DPI, 2011)



## LUCRA Table



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Ground Disturbance	Land users in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect the site and locality, including local waterways and farm dams, from surface disturbances during construction activities.	C	3	13	<p>Consideration of impacts to surrounding water courses and water quality has been undertaken within the water impact assessment for the EIS. Appropriate mitigation measures are specified within the EIS, including soil erosion and sedimentation controls within this report, to minimise impacts to watercourse health and quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to watercourse health and quality.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved), such as a soil management plan and an erosion and sediment control management measures.</p>	D	4	5	Effectiveness of mitigation measures will be measured as part of the Environmental Management Strategy (EMS), specifically the CEMP and Erosion and Sediment Control (ESC) management measures.
Construction Ground Disturbance	Stakeholders may have concerns that the construction and operation of the Project may alter and disturb existing soil properties, undermining the suitability of the land for future agricultural production.	C	2	18	<p>The assessment of soil characteristics, erodibility and land and soil capability has been undertaken within this soils and agricultural impact assessment. Anticipated impacts and appropriate mitigation measures are provided within this report. Compliance with mitigation measures is anticipated to reduce the risk of potential conflicts related to future land capability for agriculture.</p> <p>Implement all measures specified in this report and associated management plans identified in the EIS and/or consent conditions (if approved).</p>	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the soil and water management measures to be outlined in the CEMP and OEMP



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Ground Disturbance	Stakeholders may be concerned about impacts to heritage items or values at the site and locality.	B	4	12	An assessment of impacts to heritage has been undertaken with the preparation of an Aboriginal Cultural Heritage Assessment Report (ACHAR) and a historic heritage assessment. Appropriate mitigation measures are specified within the ACHAR and the historic heritage assessment to minimise impacts to heritage. Compliance with mitigation measures specified within the ACHAR and the historic heritage assessment is anticipated to reduce the risk of conflict related to environmental features, culturally sensitive land and heritage. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, specifically through the CEMP, OEMP and an Aboriginal Cultural Heritage Management Plan (ACHMP).
Construction Ground Disturbance	Stakeholders may be concern about potential impacts to biodiversity within the site and locality.	B	3	17	The assessment of impacts to biodiversity has been undertaken via a BDAR. Appropriate mitigation measures are specified within the BDAR and this assessment to minimise the risk for impacts on biodiversity within the site and locality. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved). Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS, specifically through the CEMP, OEMP Effectiveness of engagement will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Noise	Land users in the locality may be concerned construction activity disturbances may affect livestock behaviour and/or breeding at host and neighbouring properties.	D	3	9	<p>The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). Low stocking rates and distance between neighbouring farms in the locality suggest a low risk. Appropriate mitigation measures are specified within the NIA to minimise noise impacts.</p> <p>Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on agricultural land users.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p>	D	4	5	Any complaints from neighbours regarding effects to livestock can be managed within normal operations.
Construction Noise	Increased noise generated by construction activities and heavy vehicle movements may be perceived as nuisance to nearby residential properties.	C	4	8	<p>The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). The distance between the Project Area and neighbouring residences suggest a low risk. Appropriate mitigation measures are specified within the NIA to minimise noise impacts.</p> <p>Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on agricultural land users.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p>	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, which will include reference to relevant noise criteria.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Dust	Land users in the locality may be concerned that dust generated by construction activities may have adverse health implications for residential land users within the locality, or personnel on host land.	D	3	9	<p>The assessment of potential dust impacts has been undertaken as part of the EIS. The distance between the Development Corridor and neighbouring residences suggest a low risk. With readily available mitigation measures, the Project can be constructed without any significant impact to local air quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to air quality impacts.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).</p>	E	4	3	Effectiveness of mitigation measures will be measured as part of the EMS and CEMP that outlines dust suppression strategies.
Construction Biosecurity	Land users in the locality may be concerned about biosecurity breaches including weed, plant pest, plant disease or pest animal introduction and/or spread, as a result of the increased personnel, vehicles and materials entering the Project Area during construction of the Project.	B	2	21	<p>The assessment of impacts to biodiversity has been undertaken via a BDAR. Consideration of the potential for pest species to impact agriculture has been included in this assessment. Appropriate mitigation measures are specified within the BDAR and this assessment to minimise the risk for weeds and pests to spread throughout the site and onto neighbouring land.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).</p>	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS, specifically biodiversity management measures included in the CEMP and OEMP.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Traffic	Use of local roads during construction of the Project may cause conflict by interacting with agricultural and/or local transport activities, and/or resulting in additional travel time for road users	C	4	8	<p>The assessment of potential traffic impacts has been undertaken via a Traffic Impact Assessment (TIA), which found the road network can accommodate the traffic generated by the Project during the construction stage. Appropriate mitigation measures, including design controls, are specified within the TIA to minimise impacts to the traffic environment. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved)</p>	D	4	5	The EMS, specifically the Traffic Management Plan (TMP), will include a complaint resolution as a mechanism to address any issues identified by neighbouring land users.
Construction Traffic	Land users in the locality may be concerned about the possibility of increased vehicles during construction or operation may result in an accident with livestock, farm machinery or wildlife on roads.	D	1	19	<p>The assessment of potential traffic impacts has been undertaken via a Traffic Impact Assessment (TIA). The low volume of traffic on local roads suggest a low risk. Appropriate mitigation measures are specified within the TIA to minimise impacts to the traffic environment. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).</p>	E	2	10	The EMS, specifically TMP, will include a complaint resolution as a mechanism to address any issues identified by neighbouring land users



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Works	Stakeholders may have concerns that construction activities associated with the Project may damage existing infrastructure including transmission lines and public infrastructure.	C	4	8	<p>Consideration of potential impacts to surrounding service provider infrastructure has been undertaken as part of the EIS. Appropriate mitigation measures are specified within the EIS and will be detailed in a CEMP to minimise the risk of construction activities damaging existing infrastructure. Compliance with construction management measures anticipated to reduce the risk of conflict related to damaging existing infrastructure.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).</p>	D	4	5	<p>No damage to existing infrastructure including transmission lines during the construction phase due to project activities.</p> <p>Any impacts to public infrastructure will be remedied.</p>
Construction Workforce	Public authorities may be concern about the increased demand for services and infrastructure that may result from the development, especially during the construction stage, including increased accommodation for workers, availability of medical facilities and capacity of surrounding waste facilities	C	5	4	<p>The assessment of impacts related to the increased demand for surrounding services and infrastructure has been undertaken via a Social Impact Assessment (SIA) and as part of the EIS. Levels of anticipated increased demand and appropriate mitigation measures are specified within the SIA to minimise the risk for logistical issues associated with the increased demand for existing infrastructure and services.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p>	D	5	2	Effectiveness of mitigation measures will be measured as part of the EMS.
Construction Workforce	Additional Project related workers present may be perceived to adversely affect a resident's or USYD students privacy or security.	D	3	9	Workforce behaviour will be managed through the implementation of the EMS, which will encourage positive workforce behaviour.	E	4	3	Effectiveness of engagement will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Visual Amenity	Stakeholders in the locality who wish to maintain views of the existing agricultural landscape may be concerned about the change in visual amenity resulting from the Project.	B	3	17	<p>The assessment of visual impacts to surrounding amenity has been undertaken via a Landscape and Visual Impact Assessment (LVIA) which determined impacts to be low. Appropriate mitigation measures are specified within the LVIA to minimise the risk of altered amenity for surrounding residents and public within the locality. Compliance with mitigation measures specified within the LVIA is anticipated to further limit visual impact from the Project. Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).</p>	D	5	4	Effectiveness of mitigation measures will be measured as part of the EMS which will include reference to measures proposed to minimise visual impacts.
Land Use Change	Stakeholders in the locality may be concerned about the reduction of land used for agricultural purposes or the reduction of productivity of the land	A	4	16	<p>The assessment of the reduction of land used for agriculture and the productivity of land has been undertaken within this agricultural assessment. The negligible anticipated impacts and appropriate mitigation measures are provided within the agricultural impact assessment report for stakeholder consideration.</p> <p>A Decommissioning and Rehabilitation Management Plan will ensure the land can be successfully returned to agricultural production following decommissioning.</p>	D	4	5	Rehabilitation objectives and strategies (including performance measures) will be established in the Decommissioning and Rehabilitation Management Plan.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Land Use Change	Land users in the locality may be concerned about impacts to agricultural support infrastructure in the Project locality and wider region	D	4	5	The assessment of the impacts to agricultural support infrastructure in the Project locality and wider region has been undertaken within this agricultural assessment. Anticipated impacts are determined to be negligible and presented in this report for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	5	2	No complaints from agriculture enterprises regarding impact to agricultural support infrastructure due to project activities.
Land Use Change	Residents of the local community who are looking to build 'Bed and Breakfast' style short-stay accommodation on their properties to capitalise on existing rural values may be concerned the Project will detract from their accommodation offering in terms of reduced visual and social amenity and decrease any potential earnings from such a business venture.	D	4	5	The assessment of visual impacts to surrounding amenity has been undertaken via a Landscape and Visual Impact Assessment (LVIA) which determined impacts to be low. Visibility of the site from surrounding land is limited. ' Social amenity issues largely associated with the construction phase which is temporary and will be managed.	E	2	10	Effectiveness of mitigation measures will be measured against OEMP and conditions of consent, or as raised by community members



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Fire Spread	Land users in the locality may be concerned about the risk of fires occurring at the site and their potential to spread to surrounding land, infrastructure or livestock on narrow and partially unsealed local roads.	C	2	18	<p>Consideration of potential bushfire impacts has been undertaken as part of a Preliminary Hazard Analysis (PHA) informing the EIS. Further, a Bushfire Assessment Report (BFAR) was prepared to identify and evaluate the potential hazards and risks associated with bushfires to and from the Project and the use of bushfire prone land. Appropriate mitigation measures are specified within the PHA and BFAR within the EIS to minimise the risk of fire to and from the Project incidents including their risk to people and potential to damage surrounding land.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all management and mitigation measures through implementation of CEMP, OEMP and Emergency Management Plan and/or consent conditions (if approved).</p>	E	2	10	Effectiveness of mitigation measures will be measured as part of the CEMP, OEMP, Emergency Management Plan and EMS.
Operation Traffic	Land users in the locality may be concerned about an increase in traffic volume on local roads throughout the operational phase of the Project, which may cause conflict by interacting with agriculture transport activities or increasing travel times over the life of the Project.	D	4	5	<p>The assessment of potential traffic impacts during the operational phase of the Project has been undertaken via a Traffic Impact Assessment (TIA). Anticipated impacts are determined to be negligible and presented in the EIS for land user consideration.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p>	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operation Traffic	Land users in the locality may be concerned that dust generated by increased vehicle movements along access roads during the operational phase of the Project has the potential to impact air quality and may have adverse health implications for residential land users within the locality and host land personnel.	D	3	9	<p>The assessment of potential dust impacts during the operational phase of the Project has been undertaken as part of the EIS. Anticipated impacts are determined to be negligible and presented in the EIS for land user consideration.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p> <p>Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).</p>	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.
Operation Pest Control	Land users in the locality may be concerned that waste generated by the development, including the accommodation camp, may increase the presence of pest animals and/or vermin which could impact agricultural productivity.	D	4	5	<p>Consideration of waste related impacts has been undertaken as part of the EIS. Appropriate mitigation measures are specified in the Waste Management Plan (WMP) to minimise the risk of attracting pest animals and/or vermin.</p> <p>Compliance with mitigation measures specified in the EIS is anticipated to reduce the risk of conflict related to pest animals and/or vermin.</p> <p>Ongoing consultation with stakeholders will identify and address concerns if they arise.</p>	E	4	3	Effectiveness of mitigation measures will be measured as part of the EMS, and CEMP.
Operation Workforce	Stakeholders in the locality may be concerned about the effects on local and regional employment	C	1	4	<p>Consideration of employment impacts has been undertaken as part of the SIA and Economic Assessment. Anticipated impacts are determined to be negligible and outweighed by the employment opportunities of the Project. This finding is presented in the SIA and Economic Assessment. for stakeholder consideration.</p>	E	5	1	Nil



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Livestock Interaction	Neighbouring landowners may be concerned about their livestock entering the Development Corridor and becoming injured or causing damage.	D	4	5	Operational management plans will include a provision to ensure boundary fence is maintained to a suitable standard. Regular inspection of fences should be conducted to assess the condition of the fence, and any issues rectified as soon as practical. If livestock enter the site, the surrounding landowners should be contacted. Efforts will be made to ensure the animal is not distressed and kept away from public roads.  Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	4	3	Effectiveness of mitigation measures will be measured as part of the EMS.
Insurance Premiums	The placement of the Project in proximity to agricultural business operators may affect insurance premiums for surrounding private property owners.	D	3	9	Spark Renewables are investigating neighbour benefit sharing initiatives.	D	3	9	-
Foreign Ownership	Stakeholders may have concerns regarding the foreign ownership of the Project i.e., that it is a foreign-owned company	D	4	5	Engagement for the Project has introduced the Project and the Proponent (Malaysian Owned 'Tenaga Nasional Berhad') to surrounding stakeholders. Notification to stakeholders outlined the Proponent's ownership and consultation has provided an opportunity for stakeholders to provide feedback.	E	4	3	Effectiveness of engagement will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Electro-magnetic Fields	Land users in the locality and personnel on host lands may be concerned about electro-magnetic fields (EMF) resulting from electrical infrastructure associated with the Project.	D	2	14	Consideration of EMF impacts resulting from the development has been undertaken as part of the EIS. The EIS finds that the potential for the EMF to exceed the accepted levels is considered negligible. This finding is presented in the EIS for stakeholder consideration.	E	5	1	Nil.
Decommissioning	Stakeholders may be concerned about the potential for poor rehabilitation outcomes, including inadequate removal of infrastructure and industrial wastes, and poor reinstatement of soils resources, resulting in long term environmental and agricultural consequence.	C	1	22	A Decommissioning and Rehabilitation Plan will ensure the land can be successfully returned to pre-disturbance land and soil capability and final land use commitments following decommissioning.	E	2	10	Rehabilitation objectives and strategies (including performance measures) will be established in the Decommissioning and Rehabilitation Management Plan.



## Appendix 2

### Soil Profile Descriptions



### Site Description – Site 1

<b>Site Reference</b>	1	<b>ASC Name</b>	Bleached Eutrophic Brown Chromosol (BFKOWNR)	
<b>Average Slope</b>	3%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderately High	MGA 55
<b>Landform Element</b>	Lower Slope	<b>Drainage</b>	Imperfect	X: 780570
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6165396



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description				
A1	0.00 – 0.20	Dark greyish brown (Munsell 10YR 4/2) Loamy Sand with weak pedality, earthy fabric and weak consistence. Moderately acidic pH, non-saline and sodic. 5% coarse fragments 5mm. Many roots and well drained. Clear boundary.				
A2	0.20 – 0.50	Bleached Grey (Munsell 10YR 6/1) apedal Loamy Sand with sandy fabric. Slightly acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Abrupt boundary.				
B2	0.50 +	Yellowish brown (Munsell 10YR 5/6) Medium Clay with moderate pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Trace roots and imperfectly drained. 20% grey mottling.				
Sample Depth	ECe		pH <sub>(1-5water)</sub>		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.6	Non-saline	5.6	Moderately Acidic	11.3	Sodic
0.30 – 0.40	0.4	Non-saline	6.4	Slightly Acidic	7.2	Marginally Sodic
0.60 – 0.70	0.2	Non-saline	5.7	Moderately Acidic	5.2	Non sodic



**Site Description – Site 2**

<b>Site Reference</b>	2	<b>ASC Name</b>	Mottled Mesotrophic Brown Kurosol (BGLOWNR)	
<b>Average Slope</b>	11%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderate	MGA 55
<b>Landform Element</b>	Upper Slope	<b>Drainage</b>	Imperfect	X: 780538
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6166012



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description				
A1	0.00 - 0.25	Very dark brown (Munsell 7.5YR 2.5/3) Sandy Loam with weak pedality, earthy fabric and weak consistence. Neutral pH, non-saline and non-sodic. 15% coarse fragments 5 – 20mm. Many roots and well drained. Abrupt boundary.				
B2	0.25 +	Yellowish brown to light yellowish brown (Munsell 10YR 5/6 to 2.5Y 6/3) Heavy Clay with moderate pedality, rough fabric and moderate consistence. Strongly to moderately acidic pH, non-saline and non-sodic. 10% coarse fragments 5 – 20mm in upper profile. Very few roots and imperfectly drained. 30% red mottling.				
Sample Depth	ECe		pH <sub>(1-5water)</sub>		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 - 0.10	0.9	Non-saline	6.6	Neutral	1.5	Non sodic
0.30 - 0.40	0.2	Non-saline	5.3	Strongly Acidic	3.4	Non sodic
0.60 - 0.70	0.3	Non-saline	5.9	Moderately Acidic	2.5	Non sodic



**Site Description – Site 3**

<b>Site Reference</b>	3	<b>ASC Name</b>	Red Chromosol	
<b>Average Slope</b>	4%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderate	MGA 55
<b>Landform Element</b>	Upper Slope	<b>Drainage</b>	Imperfect	X: 780522
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6166601



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description
A1	0.00 - 0.20	Dark brown (Munsell 7.5YR 3/2) Loamy Sand with weak pedality, earthy fabric and weak consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	0.20 - 0.45	Dark reddish brown (Munsell 2.5YR 2.5/4) Medium Clay with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Common roots and imperfectly drained. 10% grey mottling. Gradual boundary.
B22	0.45 +	Brown (Munsell 7.5YR 5/4) Light Clay with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Trace roots and imperfectly drained. 10% grey mottling.



**Site Description – Site 4**

<b>Site Reference</b>	4	<b>ASC Name</b>	Yellow Sodosol	
<b>Average Slope</b>	3%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderately Low	MGA 55
<b>Landform Element</b>	Midslope	<b>Drainage</b>	Imperfect	X: 780156
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6167178



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description
A1	0.00 - 0.15	Dark greyish brown (Munsell 10YR 4/2) Loamy Sand with weak pedality, earthy fabric and weak consistence. 5% coarse fragments 5 - 10mm. Many roots and well drained. Clear boundary.
A2	0.15 - 0.35	Bleached light brownish grey (Munsell 10YR 5/2) Sand with weak pedality, earthy fabric and weak consistence. 30% coarse fragments 5 - 10mm. Few roots and imperfectly drained. Abrupt boundary.
B22	0.35 - 0.5	Brownish yellow (Munsell 10YR 6/6) Medium Clay with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Trace roots and imperfectly drained. 10% grey mottling.
C	50+	Decomposing parent material.



**Site Description – Site 5**

<b>Site Reference</b>	5	<b>ASC Name</b>	Eutrophic Mesonatric Brown Sodosol (BFKOWNR)	
<b>Average Slope</b>	9%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderately Low	MGA 55
<b>Landform Element</b>	Midslope	<b>Drainage</b>	Imperfect	X: 779509
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6167098



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description
A1	0.00 – 0.20	Dark yellowish brown (Munsell 10YR 4/4) Loamy Sand with weak pedality, earthy fabric and weak consistence. Moderately acidic pH, non-saline and non-sodic. 5% coarse fragments 5mm. Many roots and well drained. Clear boundary.
A2	0.20 – 0.35	Brown (Munsell 10YR 4/3) apedal Loamy Sand with sandy fabric. Slightly acidic pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. Abrupt boundary.
B2	0.35 – 0.65	Dark yellowish brown (Munsell 10YR 4/4) Heavy Clay with moderate pedality, rough fabric and moderate consistence. Slightly acidic pH, non-saline and sodic. No coarse fragments. Trace roots and imperfectly drained.
BC	0.65+	Transition horizon to decomposing parent material.

Sample Depth	ECe		pH <sub>(1-5water)</sub>		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	5.8	Moderately Acidic	4.5	Non sodic
0.25 – 0.35	0.4	Non-saline	6.4	Slightly Acidic	7.7	Marginally Sodic
0.45 – 0.55	0.6	Non-saline	6.4	Slightly Acidic	17.9	Strongly Sodic



**Site Description – Site 26**

<b>Site Reference</b>	26	<b>ASC Name</b>	Brown Sodosol	
<b>Average Slope</b>	4%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderately Low	MGA 55
<b>Landform Element</b>	Midslope	<b>Drainage</b>	Imperfect	X: 778917
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6167521



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description
A1	0.00 - 0.20	Dark greyish brown (Munsell 10YR 4/2) Loamy Sand with weak pedality, earthy fabric and weak consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	0.20 - 0.55	Light olive brown (Munsell 2.5Y 5/4) Medium Clay with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
C	0.55 +	Decomposing parent material.



**Site Description – Site 27**

<b>Site Reference</b>	27	<b>ASC Name</b>	Mesotrophic Subnatric Brown Sodosol (BEKOWNR)	
<b>Average Slope</b>	8%	<b>Land Use</b>	Livestock Grazing	<b>Coordinates</b>
<b>Landform Pattern</b>	Hillslope	<b>Soil Fertility</b>	Moderately Low	MGA 55
<b>Landform Element</b>	Midslope	<b>Drainage</b>	Imperfect	X: 779321
<b>Surface Condition</b>	Soft	<b>Permeability</b>	Moderate	Y: 6167743



**Plate 1 – Soil Profile**



**Plate 2 – Landscape**



**Plate 3 – Surface**

Horizon	Depth (m)	Description
A1	0.00 - 0.20	Dark brown (Munsell 10YR 3/3) Sand with weak pedality, earthy fabric and weak consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Clear boundary.
B21	0.20 - 0.55	Dark yellowish brown (Munsell 10YR 4/6) Light Clay with moderate pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
B22	0.55 +	Strong brown (Munsell 7.5YR 5/8) Light Medium Clay with moderate pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and sodic. No roots and imperfectly drained.

Sample Depth	ECe		pH <sub>(1-5water)</sub>		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 - 0.10	0.3	Non-saline	5.9	Moderately Acidic	8.4	Marginally Sodic
0.30 - 0.40	0.3	Non-saline	5.8	Moderately Acidic	10.8	Sodic
0.60 - 0.70	0.3	Non-saline	5.9	Moderately Acidic	11.5	Sodic



## **Appendix 3**

### Laboratory Certificates of Analysis



**GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)**

48 soil samples supplied by Minesoils Pty. Ltd. on 3rd April, 2024 - Lab Job No. R2538  
 Analysis requested by Matt Hemingway. Job ref. MS126 Wattle Creek  
 PO Box 11034 TAMWORTH NSW 2340

SAMPLE ID	Lab Code	MOISTURE CONTENT	TOTAL GRAVEL > 2 mm	GRAVEL > 4.75 mm	GRAVEL 2.00-4.75 mm	COARSE SAND 200-2000 µm (0.2-2.0 mm)	FINE SAND 20-200 µm (0.02-0.2 mm)	SILT 2-20 µm	CLAY < 2 µm
		(% of water in sample)	(% of total oven-dry equivalent)	(% of total oven-dry equivalent)	(% of total oven-dry equivalent)	(% of total oven-dry equivalent)	(% of total oven-dry equivalent)	(% of total oven-dry equivalent)	(% of total oven-dry equivalent)
1 0 - 10	R2538/1	15.0%	1.8%	0.5%	1.3%	36.6%	37.7%	15.0%	8.9%
1 30 - 40	R2538/2	9.7%	7.9%	3.6%	4.3%	41.2%	31.8%	11.8%	7.3%
1 60 - 70	R2538/3	15.9%	4.8%	0.4%	4.4%	25.2%	21.7%	5.2%	43.1%
2 0 - 10	R2538/4	18.2%	13.0%	9.8%	3.2%	36.0%	39.0%	4.0%	7.9%
2 30 - 40	R2538/5	23.7%	3.1%	0.0%	3.1%	7.1%	22.5%	4.7%	62.7%
2 60 - 70	R2538/6	19.1%	1.1%	0.7%	0.3%	6.3%	11.5%	9.0%	72.2%
5 0 - 10	R2538/7	11.1%	0.4%	0.0%	0.4%	33.7%	45.9%	11.7%	8.3%
5 25 - 35	R2538/8	8.1%	3.8%	0.7%	3.2%	36.7%	42.9%	9.2%	7.4%
5 45 - 55	R2538/9	23.1%	0.5%	0.0%	0.5%	10.6%	7.7%	7.0%	74.2%
7 0 - 10	R2538/10	19.0%	2.3%	0.0%	2.3%	31.5%	32.4%	13.4%	20.4%
7 20 - 30	R2538/11	23.9%	4.1%	0.0%	4.1%	16.9%	16.1%	7.1%	55.8%
7 50 - 60	R2538/12	15.6%	6.0%	0.0%	6.0%	28.4%	20.8%	7.0%	37.8%
8 0 - 10	R2538/13	13.7%	0.8%	0.0%	0.8%	36.9%	37.2%	11.2%	13.9%
8 20 - 30	R2538/14	23.1%	0.4%	0.0%	0.4%	20.7%	13.4%	12.3%	53.1%
8 45 - 55	R2538/15	23.4%	0.2%	0.0%	0.2%	23.1%	19.7%	7.3%	49.7%
10 0 - 10	R2538/16	14.3%	1.7%	0.6%	1.1%	43.7%	35.3%	10.6%	8.7%
10 30 - 40	R2538/17	18.3%	0.9%	0.0%	0.9%	19.2%	25.3%	8.1%	46.5%
10 60 - 70	R2538/18	14.4%	0.4%	0.0%	0.4%	22.1%	26.3%	10.6%	40.7%
12 0 - 10	R2538/19	13.6%	13.1%	6.4%	6.7%	39.8%	33.7%	4.4%	8.9%
12 20 - 30	R2538/20	19.4%	2.8%	1.1%	1.7%	24.6%	32.3%	2.1%	38.2%
12 40 - 50	R2538/21	18.2%	0.5%	0.0%	0.5%	34.8%	39.9%	1.6%	23.3%
15 0 - 10	R2538/22	14.2%	26.8%	12.5%	14.3%	33.2%	30.3%	5.6%	4.2%
15 10-20	R2538/23	6.8%	31.5%	5.4%	26.1%	35.3%	23.0%	4.7%	5.6%
15 30 - 40	R2538/24	25.3%	8.6%	3.8%	4.8%	9.1%	12.4%	3.1%	66.8%
15 60 - 70	R2538/25	22.6%	10.1%	3.0%	7.1%	14.1%	13.1%	8.8%	53.8%
17 0 - 10	R2538/26	10.7%	1.5%	0.0%	1.5%	48.3%	37.0%	7.2%	6.0%
17 20 - 30	R2538/27	8.8%	5.1%	0.0%	5.1%	47.6%	34.9%	8.4%	3.9%
17 50 - 60	R2538/28	12.5%	13.5%	1.8%	11.7%	13.1%	16.3%	7.8%	49.3%
17 70 - 80	R2538/29	16.3%	16.0%	3.5%	12.6%	37.9%	18.2%	0.9%	26.9%
19 0 - 10	R2538/30	9.9%	23.9%	8.6%	15.3%	40.6%	22.9%	7.9%	4.6%
19 20 - 30	R2538/31	7.2%	0.1%	0.0%	0.1%	33.2%	56.5%	5.7%	4.5%
19 50 - 50	R2538/32	21.3%	2.1%	0.0%	2.1%	15.5%	22.7%	8.0%	51.7%
19 70 - 80	R2538/33	24.9%	2.1%	0.0%	2.1%	11.5%	21.3%	3.8%	61.3%
22 0 - 10	R2538/34	11.0%	3.7%	0.0%	3.7%	41.6%	44.3%	5.7%	4.8%
22 20 - 30	R2538/35	8.7%	13.3%	5.9%	7.4%	35.1%	40.5%	7.3%	3.8%
23 0 - 10	R2538/36	13.5%	1.5%	0.0%	1.5%	25.1%	55.2%	12.5%	5.8%
23 10 - 20	R2538/37	19.3%	1.4%	0.0%	1.4%	26.7%	51.5%	15.1%	5.3%
23 40 - 50	R2538/38	19.4%	0.0%	0.0%	0.0%	3.5%	30.6%	2.2%	63.6%
23 70 - 80	R2538/39	13.7%	0.0%	0.0%	0.0%	6.3%	44.8%	7.6%	41.3%
27 0 - 10	R2538/40	12.5%	18.4%	16.7%	1.7%	30.0%	42.7%	3.0%	5.9%
27 30 - 40	R2538/41	18.4%	1.8%	1.1%	0.7%	21.7%	27.5%	11.5%	37.5%
27 60 - 70	R2538/42	18.2%	2.2%	1.6%	0.6%	21.6%	29.9%	6.2%	40.1%
28 0 - 10	R2538/43	11.1%	2.7%	0.4%	2.4%	49.7%	34.6%	7.1%	5.8%
28 25 - 35	R2538/44	9.3%	8.5%	0.8%	7.7%	51.0%	30.8%	3.7%	5.9%
28 45 - 55	R2538/45	15.9%	12.1%	2.4%	9.7%	31.4%	20.2%	4.3%	32.1%
32 0 - 10	R2538/46	11.7%	12.9%	8.4%	4.5%	41.1%	33.0%	4.3%	8.7%
32 25 - 35	R2538/47	17.0%	1.9%	0.0%	1.9%	32.1%	28.2%	10.0%	27.9%
32 55 - 65	R2538/48	14.1%	1.9%	0.0%	1.9%	47.4%	23.3%	8.1%	19.4%

**Note:**

- The Hydrometer Analysis method was used to determine the percentage sand, silt and clay, modified from SOP meth004 (California Dept of Pesticide Regulation), using method of Gee & Bauder (1986), in *Methods of Soil Analysis. Part 1* Agron. Monogr. 9 (2nd Ed). Klute, A., American Soc. of Agronomy Inc., Soil Sci. Soc. America Inc., Madison WI: 383-411.
- Australian Standard 1289.3.8.1-1997 (see attached)
- Analysis conducted between sample arrival date and reporting date.
- This report is not to be reproduced except in full. Results only relate to the item tested.
- All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).
- This report was issued on 24/04/2024.

## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 03/04/2024. Lab Job No.R2538

Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample 1	Sample 2	Sample 3	Sample 4
Sample ID:		1 0 - 10	1 30 - 40	1 60 - 70	2 0 - 10
Crop:		N/G	N/G	N/G	N/G
Client:		Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	R2538/1	R2538/2	R2538/3	R2538/4
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.63	6.42	5.66	6.56
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.026	0.017	0.022	0.062
Exchangeable Calcium	(cmol/kg)	0.77	0.67	0.37	5.8
	(kg/ha)	347	301	164	2,609
	(mg/kg)	155	135	73	1,165
Exchangeable Magnesium	(cmol/kg)	1.8	0.40	5.6	1.5
	(kg/ha)	477	109	1,516	414
	(mg/kg)	213	49	677	185
Exchangeable Potassium	(cmol/kg)	0.15	<0.12	0.25	0.41
	(kg/ha)	133	<112	217	359
	(mg/kg)	59	<50	97	160
Exchangeable Sodium	(cmol/kg)	0.44	0.10	0.58	0.12
	(kg/ha)	228	50	297	62
	(mg/kg)	102	22	132	28
Exchangeable Aluminium	(cmol/kg)	0.80	0.08	4.3	0.10
	(kg/ha)	161	17	866	20
	(mg/kg)	72	7.5	387	8.8
Exchangeable Hydrogen	(cmol/kg)	<0.01	0.04	<0.01	<0.01
	(kg/ha)	<1	<1	<1	<1
	(mg/kg)	<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)	3.9	1.4	11	8.0
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100	20	49	3.3	73
Magnesium (%)		45	29	50	19
Potassium (%)		3.9	5.1	2.2	5.2
Sodium - ESP (%)		11	7.2	5.2	1.5
Aluminium (%)		20	6.1	39	1.2
Hydrogen (%)		0.00	3.0	0.00	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)	0.44	1.7	0.07	3.8
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 4/2 Dark Grayish Brown	10YR 5/3 Brown	10YR 6/2 Light Brownish Gray	7.5YR 2.5/3 Very Dark Brown
Mottles Munsell Colour		..	..	7.5YR 5/6	..
		..	..	Strong Brown	..
Degree of Mottling (%)		..	..	50	..

## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 03/04/2024. Lab Job No.R2538

Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

	Sample 1	Sample 2	Sample 3	Sample 4	
Sample ID:	1 0 - 10	1 30 - 40	1 60 - 70	2 0 - 10	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/1	R2538/2	R2538/3	R2538/4

### Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol<sub>c</sub>/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- \*\* NATA accreditation does not cover the performance of this service.
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- This report was issued on 23/04/2024.

Quality Checked: Kris Saville  
 Agricultural Co-Ordinator




**NATA**  
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 Accredited for compliance  
 with ISO/IEC 17025 - Testing

## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample 5	Sample 6	Sample 7	Sample 8	
Sample ID:		2 30 - 40	2 60 - 70	5 0 - 10	5 25 - 35	
Crop:		N/G	N/G	N/G	N/G	
Client:		Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/5	R2538/6	R2538/7	R2538/8	
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.34	5.89	5.83	6.44	
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.026	0.044	0.023	0.017	
Exchangeable Calcium	(cmol/kg)	1.5	7.1	1.7	0.73	
	(kg/ha)	661	3,179	743	327	
	(mg/kg)	295	1,419	332	146	
Exchangeable Magnesium	(cmol/kg)	5.7	4.0	0.70	0.45	
	(kg/ha)	1,550	1,078	191	122	
	(mg/kg)	692	481	85	54	
Exchangeable Potassium	(cmol/kg)	0.21	0.33	0.18	<0.12	
	(kg/ha)	185	286	162	<112	
	(mg/kg)	82	128	72	<50	
Exchangeable Sodium	(cmol/kg)	0.63	0.32	0.13	0.12	
	(kg/ha)	322	165	68	61	
	(mg/kg)	144	74	30	27	
Exchangeable Aluminium	(cmol/kg)	10	1.1	0.25	0.03	
	(kg/ha)	2,067	215	51	6.2	
	(mg/kg)	923	96	23	2.8	
Exchangeable Hydrogen	(cmol/kg)	<0.01	<0.01	<0.01	0.13	
	(kg/ha)	<1	<1	<1	3.0	
	(mg/kg)	<1	<1	<1	1.3	
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)	18	13	2.9	1.5	
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100	8.1	56	57	47	
Magnesium (%)		31	31	24	29	
Potassium (%)		1.2	2.6	6.3	5.5	
Sodium - ESP (%)		3.4	2.5	4.5	7.7	
Aluminium (%)		56	8.4	8.7	2.0	
Hydrogen (%)		0.00	0.00	0.00	8.6	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)	0.26	1.8	2.4	1.6	
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 5/6 Yellowish Brown	2.5Y 6/3 Light Yellowish Brown	10YR 4/4 Dark Yellowish Brown	10YR 4/3 Brown	
Mottles Munsell Colour		10YR 3/3 2.5YR 4/6 Dark Brown Red	2.5YR 4/6 5YR 5/6 Red Yellowish Red	.. .. ..	10YR 6/8 ..	
Degree of Mottling (%)		20	15	40	25	..
						20

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PO Box 11034 TAMWORTH NSW 2340

	Sample 5	Sample 6	Sample 7	Sample 8
Sample ID:	2 30 - 40	2 60 - 70	5 0 - 10	5 25 - 35
Crop:	N/G	N/G	N/G	N/G
Client:	Umwelt	Umwelt	Umwelt	Umwelt

Parameter	Method reference	R2538/5	R2538/6	R2538/7	R2538/8

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 Agricultural Co-Ordinator



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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample 9	Sample 10	Sample 11	Sample 12
Sample ID:		5 45 - 55	7 0 - 10	7 20 - 30	7 50 - 60
Crop:		N/G	N/G	N/G	N/G
Client:		Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	R2538/9	R2538/10	R2538/11	R2538/12
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.35	6.14	6.92	7.86
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.111	0.041	0.032	0.034
Exchangeable Calcium	(cmol/kg)	3.1	8.1	18	22
	(kg/ha)	1,376	3,630	8,232	9,947
	(mg/kg)	614	1,621	3,675	4,441
Exchangeable Magnesium	(cmol/kg)	7.5	4.2	10	13
	(kg/ha)	2,053	1,133	2,810	3,596
	(mg/kg)	917	506	1,254	1,605
Exchangeable Potassium	(cmol/kg)	0.34	0.41	0.37	0.25
	(kg/ha)	299	359	323	216
	(mg/kg)	134	160	144	96
Exchangeable Sodium	(cmol/kg)	2.4	0.22	0.31	0.63
	(kg/ha)	1,242	113	162	322
	(mg/kg)	554	50	72	144
Exchangeable Aluminium	(cmol/kg)	0.11	0.05	0.04	0.03
	(kg/ha)	21	9.4	7.3	6.3
	(mg/kg)	9.6	4.2	3.3	2.8
Exchangeable Hydrogen	(cmol/kg)	0.02	0.11	<0.01	<0.01
	(kg/ha)	<1	2.5	<1	<1
	(mg/kg)	<1	1.1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)	13	13	29	36
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100	23	62	62	61
Magnesium (%)		56	32	35	36
Potassium (%)		2.5	3.1	1.3	0.68
Sodium - ESP (%)		18	1.7	1.1	1.7
Aluminium (%)		0.79	0.36	0.12	0.09
Hydrogen (%)		0.12	0.85	0.00	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)	0.41	1.9	1.8	1.7
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 4/4 Dark Yellowish Brown	7.5YR 2.5/2 Very Dark Brown	2.5YR 2.5/4 Dark Reddish Brown	10YR 4/4 Dark Brownish Yellow
Mottles Munsell Colour		..	..	..	..
Degree of Mottling (%)		..	..	..	..

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

	Sample 9	Sample 10	Sample 11	Sample 12
Sample ID:	5 45 - 55	7 0 - 10	7 20 - 30	7 50 - 60
Crop:	N/G	N/G	N/G	N/G
Client:	Umwelt	Umwelt	Umwelt	Umwelt

Parameter	Method reference	R2538/9	R2538/10	R2538/11	R2538/12

### Notes:

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 13	Sample 14	Sample 15	Sample 16
			8 0 - 10	8 20 - 30	8 45 - 55	10 0 - 10
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/13	R2538/14	R2538/15	R2538/16
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		5.46	6.95	7.20	5.80
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.108	0.032	0.030	0.026
Exchangeable Calcium	(cmol/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	5.6	15	20	2.9
	(kg/ha)		2,534	6,606	9,200	1,303
	(mg/kg)		1,131	2,949	4,107	582
Exchangeable Magnesium	(cmol/kg)		2.3	7.5	11	1.5
	(kg/ha)		631	2,038	2,900	400
	(mg/kg)		282	910	1,295	179
Exchangeable Potassium	(cmol/kg)	0.50	0.36	0.42	0.23	
	(kg/ha)	434	313	367	205	
	(mg/kg)	194	140	164	92	
Exchangeable Sodium	(cmol/kg)	0.15	0.28	0.43	0.11	
	(kg/ha)	77	144	220	56	
	(mg/kg)	34	64	98	25	
Exchangeable Aluminium	(cmol/kg)	**Inhouse S37 (KCl)	0.17	0.03	0.03	0.31
	(kg/ha)		35	6.7	6.5	63
	(mg/kg)		16	3.0	2.9	28
Exchangeable Hydrogen	(cmol/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01
	(kg/ha)		<1	<1	<1	<1
	(mg/kg)		<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)		8.8	23	32	5.0
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100		64	64	64	58
Magnesium (%)		26	33	33	29	
Potassium (%)		5.6	1.6	1.3	4.7	
Sodium - ESP (%)		1.7	1.2	1.3	2.2	
Aluminium (%)		2.0	0.15	0.10	6.2	
Hydrogen (%)		0.09	0.00	0.00	0.00	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)		2.4	2.0	1.9	2.0
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 2/2 Very Dark Brown	2.5YR 3/4 Dark Reddish Brown	5YR 3/4 Dark Reddish Brown	7.5YR 3/4 Dark Brown
Mottles Munsell Colour		..	..	..	..	
		..	..	..	..	
Degree of Mottling (%)		..	..	..	..	

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	Sample 13	Sample 14	Sample 15	Sample 16	
Sample ID:	8 0 - 10	8 20 - 30	8 45 - 55	10 0 - 10	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/13	R2538/14	R2538/15	R2538/16

### Notes:

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		Sample 17	Sample 18	Sample 19	Sample 20
	Sample ID:	10 30 - 40	10 60 - 70	12 0 - 10	12 20 - 30
	Crop:	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	R2538/17	R2538/18	R2538/19	R2538/20
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.65	7.16	6.22	5.85
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.067	0.154	0.030	0.054
Exchangeable Calcium	(cmol./kg)	3.7	3.4	1.8	2.9
	(kg/ha)	1,651	1,533	799	1,315
	(mg/kg)	737	685	357	587
Exchangeable Magnesium	(cmol./kg)	22	25	3.5	11
	(kg/ha)	5,927	6,857	949	2,867
	(mg/kg)	2,646	3,061	424	1,280
Exchangeable Potassium	(cmol./kg)	0.33	0.26	0.59	0.32
	(kg/ha)	286	231	516	282
	(mg/kg)	128	103	230	126
Exchangeable Sodium	(cmol./kg)	2.9	4.6	0.35	1.9
	(kg/ha)	1,478	2,394	181	954
	(mg/kg)	660	1,069	81	426
Exchangeable Aluminium	(cmol./kg)	0.29	0.07	0.10	6.1
	(kg/ha)	59	14	20	1,228
	(mg/kg)	26	6.0	8.9	548
Exchangeable Hydrogen	(cmol./kg)	<0.01	<0.01	0.02	<0.01
	(kg/ha)	<1	<1	<1	<1
	(mg/kg)	<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol./kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol./kg)	29	34	6.3	22
Calcium (%)	**Base Saturation Calculations - Cation cmol./kg / ECEC x 100	13	10	28	13
Magnesium (%)		75	75	55	48
Potassium (%)		1.1	0.79	9.3	1.5
Sodium - ESP (%)		9.9	14	5.6	8.5
Aluminium (%)		1.0	0.20	1.6	28
Hydrogen (%)		0.00	0.00	0.29	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol./kg)	0.17	0.14	0.51	0.28
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 5/8 Strong Brown	7.5YR 5/8 Strong Brown	7.5YR 3/3 Dark brown	10YR 5/3 Brown
Mottles Munsell Colour		2.5YR 4/6 ..	5YR 4/6 ..	.. ..	2.5YR 3/6, 10YR 3/1 Dark red, Very dark grey
Degree of Mottling (%)		40	40	..	40, 1

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	Sample 17	Sample 18	Sample 19	Sample 20
Sample ID:	10 30 - 40	10 60 - 70	12 0 - 10	12 20 - 30
Crop:	N/G	N/G	N/G	N/G
Client:	Umwelt	Umwelt	Umwelt	Umwelt

Parameter	Method reference	R2538/17	R2538/18	R2538/19	R2538/20

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		Sample ID:	Sample 21	Sample 22	Sample 23	Sample 24
			12 40 - 50	15 0 - 10	15 10--20	15 30 - 40
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/21	R2538/22	R2538/23	R2538/24
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		5.75	5.92	5.98	5.61
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.090	0.040	0.016	0.021
Exchangeable Calcium	(cmol./kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.4	2.1	0.79	0.75
	(kg/ha)		1,099	950	355	336
	(mg/kg)		491	424	158	150
Exchangeable Magnesium	(cmol./kg)		12	0.82	0.58	4.3
	(kg/ha)		3,165	223	159	1,178
	(mg/kg)		1,413	100	71	526
Exchangeable Potassium	(cmol./kg)	0.20	0.39	0.20	0.53	
	(kg/ha)	180	341	174	463	
	(mg/kg)	80	152	77	207	
Exchangeable Sodium	(cmol./kg)	2.4	0.07	<0.065	0.39	
	(kg/ha)	1,214	34	<33	201	
	(mg/kg)	542	15	<15	90	
Exchangeable Aluminium	(cmol./kg)	**Inhouse S37 (KCl)	5.2	0.11	0.28	5.6
	(kg/ha)		1,054	22	57	1,124
	(mg/kg)		471	9.7	26	502
Exchangeable Hydrogen	(cmol./kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.07	<0.01	<0.01
	(kg/ha)		<1	1.7	<1	<1
	(mg/kg)		<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol./kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol./kg)		22	3.6	1.9	12
Calcium (%)	**Base Saturation Calculations - Cation cmol./kg / ECEC x 100		11	59	41	6.5
Magnesium (%)		53	23	30	37	
Potassium (%)		0.94	11	10	4.6	
Sodium - ESP (%)		11	1.8	3.1	3.4	
Aluminium (%)		24	3.0	15	48	
Hydrogen (%)		0.00	2.1	0.00	0.00	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol./kg)		0.21	2.6	1.4	0.17
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 5/6 Yellowish brown	2.5YR 2.5/2 Very dark brown	10YR 7/4 Very pale brown	10YR 5/6 Yellowish brown
Mottles Munsell Colour		5YR 5/8 Yellowish red	..	10YR 5/2 Greyish brown	2.5YR 3/6, 2.5Y 4/3 Dark red, Olive brown	
Degree of Mottling (%)		50	..	40	50, 10	

## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 03/04/2024. Lab Job No.R2538

Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

	Sample 21	Sample 22	Sample 23	Sample 24	
Sample ID:	12 40 - 50	15 0 - 10	15 10--20	15 30 - 40	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/21	R2538/22	R2538/23	R2538/24

### Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results
- Conversions for 1 cmol<sub>c</sub>/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- \*\* NATA accreditation does not cover the performance of this service.
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 Agricultural Co-Ordinator



## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 25	Sample 26	Sample 27	Sample 28
			15 60 - 70	17 0 - 10	17 20 - 30	17 50 - 60
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/25	R2538/26	R2538/27	R2538/28
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		5.53	5.98	6.48	7.85
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.031	0.023	0.012	0.131
Exchangeable Calcium	(cmol./kg)		0.45	1.0	0.78	5.2
	(kg/ha)		203	459	350	2,336
	(mg/kg)		91	205	156	1,043
Exchangeable Magnesium	(cmol./kg)		5.3	0.90	0.41	14
	(kg/ha)		1,443	244	112	3,727
	(mg/kg)		644	109	50	1,664
Exchangeable Potassium	(cmol./kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.34	0.21	<0.12	0.27
	(kg/ha)		299	188	<112	239
	(mg/kg)		133	84	<50	107
Exchangeable Sodium	(cmol./kg)		0.73	0.12	0.08	3.9
	(kg/ha)		373	59	39	2,015
	(mg/kg)		167	27	17	900
Exchangeable Aluminium	(cmol./kg)		6.6	0.33	0.15	0.05
	(kg/ha)	**Inhouse S37 (KCl)	1,326	66	30	9.3
	(mg/kg)		592	30	13	4.2
Exchangeable Hydrogen	(cmol./kg)		<0.01	<0.01	0.02	<0.01
	(kg/ha)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<1	<1	<1	<1
	(mg/kg)		<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol./kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol./kg)		13	2.6	1.5	23
Calcium (%)	**Base Saturation Calculations - Cation cmol./kg / ECEC x 100		3.4	40	52	22
Magnesium (%)			40	35	28	59
Potassium (%)			2.5	8.3	3.9	1.2
Sodium - ESP (%)			5.4	4.5	5.0	17
Aluminium (%)			49	13	10.0	0.20
Hydrogen (%)			0.00	0.00	1.4	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol./kg)		0.09	1.1	1.9	0.38
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 7/2 Light grey	10YR 4/4 Dark yellowish brown	10YR 5/4 Yellowish brown	2.5YR 4/6 Red
Mottles Munsell Colour			5YR 5/6, 2.5YR4/6 Yellowish red, Red	..	..	10YR 5/6 Yellowish brown
Degree of Mottling (%)			20, 1	..	..	50

## AGRICULTURAL SOIL ANALYSIS REPORT

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PO Box 11034 TAMWORTH NSW 2340

	Sample 25	Sample 26	Sample 27	Sample 28	
Sample ID:	15 60 - 70	17 0 - 10	17 20 - 30	17 50 - 60	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/25	R2538/26	R2538/27	R2538/28

### Notes:

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- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 29	Sample 30	Sample 31	Sample 32
			17 70 - 80	19 0 - 10	19 20 - 30	19 50 - 50
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/29	R2538/30	R2538/31	R2538/32
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		8.33	6.16	6.29	6.01
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.112	0.018	0.013	0.046
Exchangeable Calcium	(cmol/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	3.9	1.2	0.62	0.37
	(kg/ha)		1,743	520	279	167
	(mg/kg)		778	232	124	75
Exchangeable Magnesium	(cmol/kg)		9.7	1.1	0.38	9.4
	(kg/ha)		2,640	290	104	2,550
	(mg/kg)		1,179	130	46	1,138
Exchangeable Potassium	(cmol/kg)		0.18	0.25	0.16	0.26
	(kg/ha)		160	222	142	225
	(mg/kg)		71	99	63	100
Exchangeable Sodium	(cmol/kg)		3.3	0.22	0.07	1.8
	(kg/ha)	1,720	114	35	929	
	(mg/kg)	768	51	16	415	
Exchangeable Aluminium	(cmol/kg)	**Inhouse S37 (KCl)	0.02	0.06	0.05	0.75
	(kg/ha)		3.9	12	10	151
	(mg/kg)		1.7	5.3	4.6	67
Exchangeable Hydrogen	(cmol/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.12	0.12	0.32
	(kg/ha)		<1	2.7	2.7	7.3
	(mg/kg)		<1	1.2	1.2	3.2
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)		17	2.9	1.4	13
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100		23	40	44	2.9
Magnesium (%)			57	37	27	73
Potassium (%)			1.1	8.8	12	2.0
Sodium - ESP (%)			20	7.7	4.8	14
Aluminium (%)			0.11	2.0	3.7	5.8
Hydrogen (%)			0.00	4.2	8.5	2.5
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)		0.40	1.1	1.6	0.04
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		2.5Y 5/4 Light olive brown	10YR 4/3 Brown	10YR 4/4 Dark yellowish brown	2.5YR 4/6 Red
Mottles Munsell Colour			2.5YR 2.5/4 Reddish brown	..	..	10YR 6/2, 10YR5/6 Light brownish grey, Yellowish brown
Degree of Mottling (%)			50	..	..	20, 30

## AGRICULTURAL SOIL ANALYSIS REPORT

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 PO Box 11034 TAMWORTH NSW 2340

	Sample 29	Sample 30	Sample 31	Sample 32	
Sample ID:	17 70 - 80	19 0 - 10	19 20 - 30	19 50 - 50	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/29	R2538/30	R2538/31	R2538/32

### Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
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- Total Acid Extractable Nutrients indicate a store of nutrients.
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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 33	Sample 34	Sample 35	Sample 36
			19 70 - 80	22 0 - 1 0	22 20 - 30	23 0 -10
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/33	R2538/34	R2538/35	R2538/36
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		6.13	5.60	6.03	5.72
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.035	0.021	0.010	0.036
Exchangeable Calcium	(cmol/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.89	0.70	0.34	0.88
	(kg/ha)		400	314	154	393
	(mg/kg)		179	140	69	175
Exchangeable Magnesium	(cmol/kg)		9.3	1.0	0.22	0.50
	(kg/ha)		2,519	281	59	136
	(mg/kg)		1,124	126	26	61
Exchangeable Potassium	(cmol/kg)		0.43	0.18	<0.12	0.18
	(kg/ha)		377	155	<112	160
	(mg/kg)		168	69	<50	71
Exchangeable Sodium	(cmol/kg)		1.5	0.12	<0.065	0.15
	(kg/ha)	783	62	<33	76	
	(mg/kg)	349	28	<15	34	
Exchangeable Aluminium	(cmol/kg)	**Inhouse S37 (KCl)	0.64	0.26	0.14	0.22
	(kg/ha)		128	53	29	45
	(mg/kg)		57	24	13	20
Exchangeable Hydrogen	(cmol/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.03	<0.01	0.07	<0.01
	(kg/ha)		<1	<1	1.5	<1
	(mg/kg)		<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)		13	2.3	0.86	1.9
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100		7.0	30	40	45
Magnesium (%)			73	45	25	26
Potassium (%)			3.4	7.7	7.9	9.5
Sodium - ESP (%)			12	5.2	2.6	7.7
Aluminium (%)			5.0	12	17	11
Hydrogen (%)			0.23	0.00	8.0	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)		0.10	0.68	1.6	1.8
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 5/6 Yellowish brown	7.5YR 4/3 Brown	7.5YR 4/6 Strong brown	10YR 3/3 Dark brown
Mottles Munsell Colour			2.5YR 4/6 Red	..	..	..
Degree of Mottling (%)			10	..	..	..

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PO Box 11034 TAMWORTH NSW 2340

	Sample 33	Sample 34	Sample 35	Sample 36
Sample ID:	19 70 - 80	22 0 -1 0	22 20 - 30	23 0 -10
Crop:	N/G	N/G	N/G	N/G
Client:	Umwelt	Umwelt	Umwelt	Umwelt

Parameter	Method reference	R2538/33	R2538/34	R2538/35	R2538/36

### Notes:

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		Sample ID:	Sample 37	Sample 38	Sample 39	Sample 40
			23 10 -20	23 40 - 50	23 70 - 80	27 0 -10
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/37	R2538/38	R2538/39	R2538/40
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		5.88	6.02	6.11	5.85
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.019	0.070	0.093	0.015
Exchangeable Calcium	(cmol <sub>e</sub> /kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.55	0.39	0.37	0.54
	(kg/ha)		245	174	167	242
	(mg/kg)		109	78	74	108
Exchangeable Magnesium	(cmol <sub>e</sub> /kg)		0.51	12	11	1.4
	(kg/ha)		140	3,163	3,129	368
	(mg/kg)		63	1,412	1,397	164
Exchangeable Potassium	(cmol <sub>e</sub> /kg)	<0.12	0.26	0.23	0.22	
	(kg/ha)	<112	227	204	195	
	(mg/kg)	<50	101	91	87	
Exchangeable Sodium	(cmol <sub>e</sub> /kg)	0.15	2.4	3.1	0.23	
	(kg/ha)	76	1,238	1,590	117	
	(mg/kg)	34	553	710	52	
Exchangeable Aluminium	(cmol <sub>e</sub> /kg)	**Inhouse S37 (KCl)	0.31	1.2	0.60	0.37
	(kg/ha)		63	233	121	74
	(mg/kg)		28	104	54	33
Exchangeable Hydrogen	(cmol <sub>e</sub> /kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.04	0.28	<0.01
	(kg/ha)		<1	<1	6.3	<1
	(mg/kg)		<1	<1	2.8	<1
Effective Cation Exchange Capacity (ECEC) (cmol <sub>e</sub> /kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol <sub>e</sub> /kg)		1.6	16	16	2.7
Calcium (%)	**Base Saturation Calculations - Cation cmol <sub>e</sub> /kg / ECEC x 100		34	2.4	2.3	20
Magnesium (%)		32	73	72	50	
Potassium (%)		5.0	1.6	1.4	8.2	
Sodium - ESP (%)		9.2	15	19	8.4	
Aluminium (%)		20	7.3	3.7	14	
Hydrogen (%)		0.00	0.24	1.8	0.00	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol <sub>e</sub> /kg)		1.1	0.03	0.03	0.40
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 5/4 Yellowish brown	10YR 4/6 Dark yellowish brown	10YR 6/2 Light brownish grey	10YR 3/3 Dark brown
Mottles Munsell Colour		..	5Y 6/1	10YR 5/6	..	
		..	Grey	Yellowish brown	..	
Degree of Mottling (%)		..	30	50	..	

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	Sample 37	Sample 38	Sample 39	Sample 40	
Sample ID:	23 10 --20	23 40 - 50	23 70 - 80	27 0 -10	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/37	R2538/38	R2538/39	R2538/40

**Notes:**

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- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results
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- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Quality Checked: Kris Saville  
 Agricultural Co-Ordinator



## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 03/04/2024. Lab Job No.R2538

Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 41	Sample 42	Sample 43	Sample 44
			27 30 - 40	27 60 - 70	28 0 - 10	28 25 - 35
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/41	R2538/42	R2538/43	R2538/44
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		5.84	5.85	5.85	6.03
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.036	0.037	0.017	0.014
Exchangeable Calcium	(cmol/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.33	0.17	0.89	1.1
	(kg/ha)		147	76	400	473
	(mg/kg)		66	34	178	211
Exchangeable Magnesium	(cmol/kg)		3.6	5.8	0.77	0.32
	(kg/ha)		979	1,587	210	88
	(mg/kg)		437	709	94	39
Exchangeable Potassium	(cmol/kg)		0.19	0.19	0.20	0.14
	(kg/ha)		166	166	173	126
	(mg/kg)		74	74	77	56
Exchangeable Sodium	(cmol/kg)		0.66	1.0	0.08	<0.065
	(kg/ha)	340	536	42	<33	
	(mg/kg)	152	239	19	<15	
Exchangeable Aluminium	(cmol/kg)	**Inhouse S37 (KCl)	1.3	1.8	0.24	0.17
	(kg/ha)		266	360	49	33
	(mg/kg)		119	160	22	15
Exchangeable Hydrogen	(cmol/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	0.02
	(kg/ha)		<1	<1	<1	<1
	(mg/kg)		<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol/kg)		6.1	9.0	2.2	1.7
Calcium (%)	**Base Saturation Calculations - Cation cmol/kg / ECEC x 100		5.4	1.9	41	61
Magnesium (%)		59	65	35	19	
Potassium (%)		3.1	2.1	9.1	8.3	
Sodium - ESP (%)		11	12	3.7	1.1	
Aluminium (%)		22	20	11	9.6	
Hydrogen (%)		0.00	0.00	0.00	1.3	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol/kg)		0.09	0.03	1.2	3.3
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 4/6 Dark yellowish brown	7.5 YR 5/8 Strong brown	10YR 3/3 Dark brown	10YR 4/4 Dark yellowish brown
Mottles Munsell Colour			2.5YR 4/6 Red	10YR 6/2, 5YR 5/6 Light brownish grey, Yellowish red	..	..
Degree of Mottling (%)			50	10, 50	..	..

## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

	Sample 41	Sample 42	Sample 43	Sample 44	
Sample ID:	27 30 - 40	27 60 - 70	28 0 - 10	28 25 - 35	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/41	R2538/42	R2538/43	R2538/44

### Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 45	Sample 46	Sample 47	Sample 48
			28 45 - 55	32 0 - 10	32 25 - 35	32 55 - 65
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference		R2538/45	R2538/46	R2538/47	R2538/48
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		6.82	6.42	6.71	7.22
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.026	0.079	0.047	0.057
Exchangeable Calcium	(cmol <sub>c</sub> /kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	9.2	3.5	7.9	12
	(kg/ha)		4,109	1,588	3,525	5,238
	(mg/kg)		1,834	709	1,574	2,338
Exchangeable Magnesium	(cmol <sub>c</sub> /kg)		5.3	1.6	4.1	7.8
	(kg/ha)		1,435	443	1,129	2,135
	(mg/kg)		641	198	504	953
Exchangeable Potassium	(cmol <sub>c</sub> /kg)		0.33	1.5	1.0	0.22
	(kg/ha)		292	1,332	876	192
	(mg/kg)		130	595	391	86
Exchangeable Sodium	(cmol <sub>c</sub> /kg)		0.36	<0.065	0.09	0.34
	(kg/ha)	187	<33	49	176	
	(mg/kg)	84	<15	22	78	
Exchangeable Aluminium	(cmol <sub>c</sub> /kg)	**Inhouse S37 (KCl)	0.04	0.03	0.02	0.02
	(kg/ha)		7.4	6.2	4.9	4.5
	(mg/kg)		3.3	2.8	2.2	2.0
Exchangeable Hydrogen	(cmol <sub>c</sub> /kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.09	<0.01	<0.01
	(kg/ha)		<1	2.1	<1	<1
	(mg/kg)		<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol <sub>c</sub> /kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol <sub>c</sub> /kg)		15	6.9	13	20
Calcium (%)	**Base Saturation Calculations - Cation cmol <sub>c</sub> /kg / ECEC x 100		60	52	60	58
Magnesium (%)			35	24	32	39
Potassium (%)			2.2	22	7.6	1.1
Sodium - ESP (%)			2.4	0.67	0.72	1.7
Aluminium (%)			0.24	0.45	0.18	0.11
Hydrogen (%)			0.00	1.3	0.00	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol <sub>c</sub> /kg)		1.7	2.2	1.9	1.5
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		10YR 5/6 Yellowish brown	7.5YR 3/4 Dark brown	2.5YR 2.5/4 Dark reddish brown	2.5YR 2.5/4 Reddish brown
Mottles Munsell Colour			10YR 4/4, 10YR 5/3 Dark yellowish brown, Brown	..	..	..
Degree of Mottling (%)			20, 30	..	..	..

## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 03/04/2024. Lab Job No.R2538

Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

	Sample 45	Sample 46	Sample 47	Sample 48	
Sample ID:	28 45 - 55	32 0 - 10	32 25 - 35	32 55 - 65	
Crop:	N/G	N/G	N/G	N/G	
Client:	Umwelt	Umwelt	Umwelt	Umwelt	
Parameter	Method reference	R2538/45	R2538/46	R2538/47	R2538/48

### Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
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- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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## AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek

PO Box 11034 TAMWORTH NSW 2340

		<i>Heavy Soil</i>	<i>Medium Soil</i>	<i>Light Soil</i>	<i>Sandy Soil</i>
Sample ID:					
Crop:					
Client:		<i>Clay</i>	<i>Clay Loam</i>	<i>Loam</i>	<i>Loamy Sand</i>
Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.5	6.5	6.3	6.3
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.200	0.150	0.120	0.100
Exchangeable Calcium	(cmol <sub>e</sub> /kg)	15.6	10.8	5.0	1.9
	(kg/ha)	7000	4816	2240	840
Exchangeable Magnesium	(mg/kg)	3125	2150	1000	375
	(cmol <sub>e</sub> /kg)	2.4	1.7	1.2	0.60
Exchangeable Potassium	(kg/ha)	650	448	325	168
	(mg/kg)	290	200	145	75
Exchangeable Sodium	(cmol <sub>e</sub> /kg)	0.60	0.50	0.40	0.30
	(kg/ha)	526	426	336	224
Exchangeable Aluminium	(mg/kg)	235	190	150	100
	(cmol <sub>e</sub> /kg)	0.3	0.26	0.22	0.11
Exchangeable Hydrogen	(kg/ha)	155	134	113	57
	(mg/kg)	69	60	51	25
Exchangeable Aluminium	(cmol <sub>e</sub> /kg)	0.6	0.5	0.4	0.2
	(kg/ha)	121	101	73	30
Exchangeable Hydrogen	(mg/kg)	54	45	32	14
	(cmol <sub>e</sub> /kg)	0.6	0.5	0.4	0.2
Effective Cation Exchange Capacity (ECEC) (cmol <sub>e</sub> /kg)	(kg/ha)	13	11	8	3
	(mg/kg)	6	5	4	2
Effective Cation Exchange Capacity (ECEC) (cmol <sub>e</sub> /kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol <sub>e</sub> /kg)	20.1	14.3	7.8	3.3
Calcium (%)	**Base Saturation Calculations - Cation cmol <sub>e</sub> /kg / ECEC x 100	77.6	75.7	65.6	57.4
Magnesium (%)		11.9	11.9	15.7	18.1
Potassium (%)		3.0	3.5	5.2	9.1
Sodium - ESP (%)		1.5	1.8	2.9	3.3
Aluminium (%)		6.0	7.1	10.5	12.1
Hydrogen (%)		6.0	7.1	10.5	12.1
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol <sub>e</sub> /kg)	6.5	6.4	4.2	3.2
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification			..	
Mottles Munsell Colour				..	
Degree of Mottling (%)				..	
				..	

## AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied by Minesoils Pty. Ltd. on 03/04/2024. Lab Job No.R2538  
 Analysis requested by Matt Hemingway. Your Job: MS126 Wattle Creek  
 PO Box 11034 TAMWORTH NSW 2340

<b>Sample ID:</b>	<b>Heavy Soil</b>	<b>Medium Soil</b>	<b>Light Soil</b>	<b>Sandy Soil</b>
<b>Crop:</b>				
<b>Client:</b>	Clay	Clay Loam	Loam	Loamy Sand

Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8
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**Notes:**

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