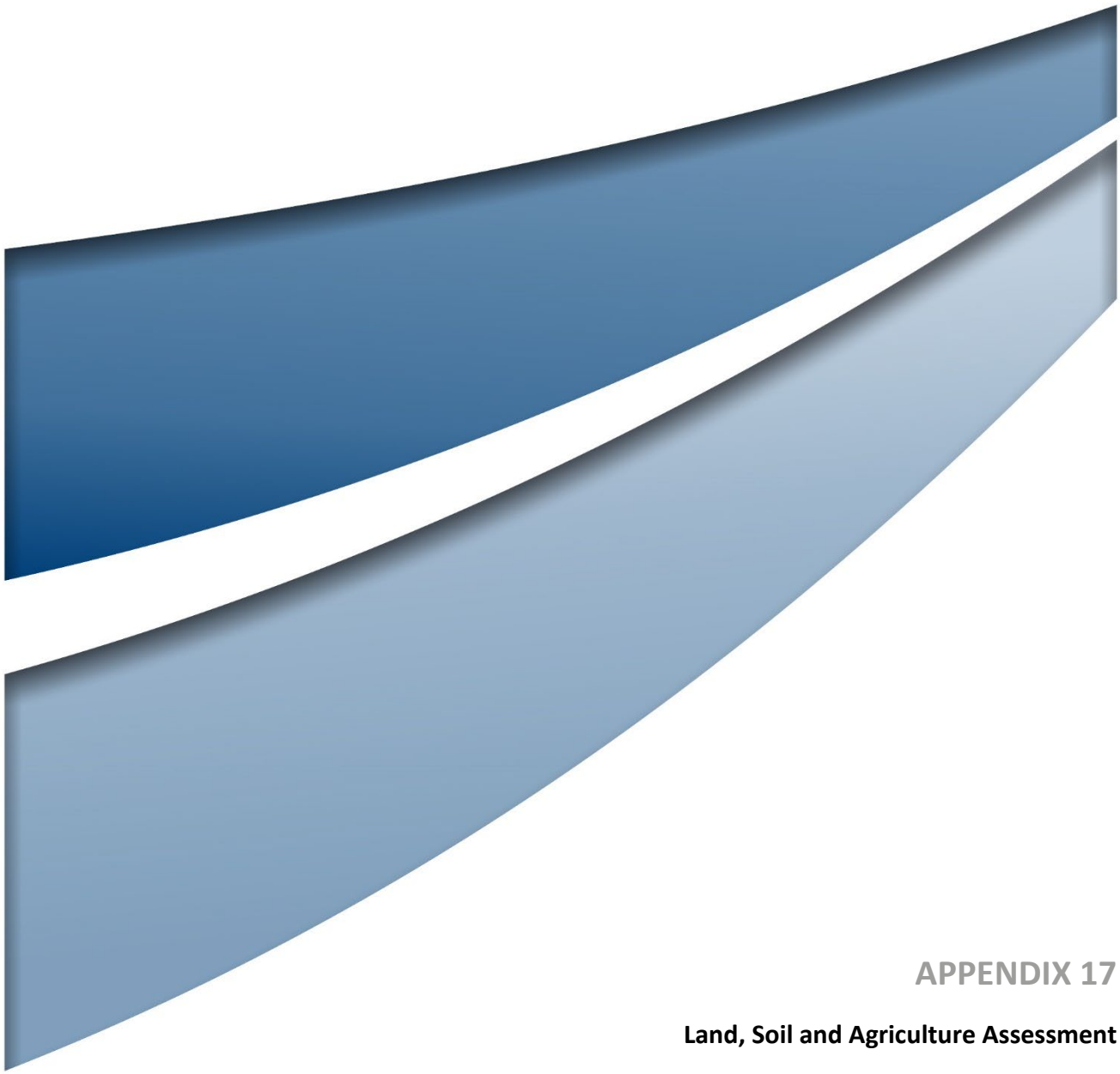
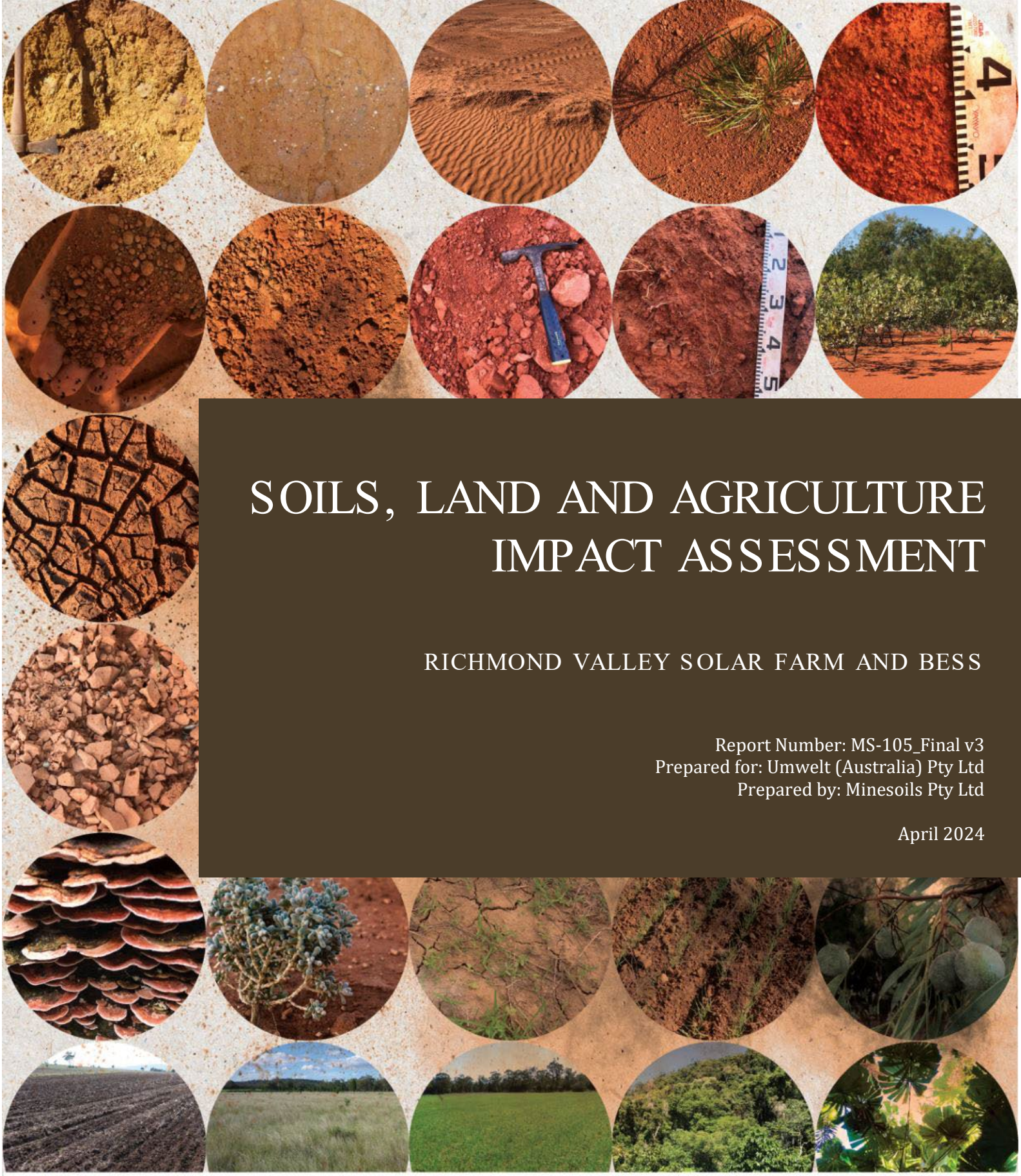


APPENDIX 17

Land, Soil and Agriculture Assessment

This report has been prepared for Richmond Valley Solar & BESS Pty Ltd (ABN 43 672 993 869) a wholly owned special purpose vehicle of Ark Energy Projects Pty Ltd and the Proponent of the Project. Richmond Valley Solar & BESS Pty Ltd will herein be referred to as Ark Energy or Ark Energy Projects.



SOILS, LAND AND AGRICULTURE IMPACT ASSESSMENT

RICHMOND VALLEY SOLAR FARM AND BESS

Report Number: MS-105_Final v3
Prepared for: Umwelt (Australia) Pty Ltd
Prepared by: Minesoils Pty Ltd

April 2024

MINESOILS
LAND & REHABILITATION SPECIALISTS

PREPARED BY

Minesoils Pty Ltd
ABN 84 627 497 509

0408 474 248
clayton@minesoils.com.au
www.minesoils.com.au
PO Box 11034 Tamworth NSW 2340

DISCLAIMER

This report has been prepared by Minesoils Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Umwelt (Australia) Pty Ltd. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Minesoils. Minesoils disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared by	Approved
MS-105_ Draft 1	22 September 2023	Matt Hemingway	Clayton Richards
MS-105_ Draft 2	20 December 2023	Matt Hemingway	Clayton Richards
MS-105_ Final v1	18 March 2024	Matt Hemingway	Clayton Richards
MS-105_ Final v2	8 April 2024	Matt Hemingway	Clayton Richards
MS-105_ Final v3	16 April 2024	Matt Hemingway	Clayton Richards

TABLE OF CONTENTS

List of Figures

EXECUTIVE SUMMARY

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Limited (Umwelt) to conduct a Soil and Agricultural Impact Assessment of the Richmond Valley Solar Farm (the Project) located in the North Coast region of New South Wales. The Project involves the construction, operation and decommissioning of up to 500 megawatts (MW) solar photovoltaic (PV) generation, Battery Energy Storage System (BESS) of up to 2,200--megawatt hour (MWh) capacity and a transmission line to connect the Project from the substation to the national electricity market. The Project will include various associated infrastructure including, temporary construction facilities, operation and maintenance buildings, internal access roads, civil works and other required electrical infrastructure. The Project is anticipated to have an operational life of 30 years or more.

The Project is located approximately 7 kilometres to the west of the town of Rappville, 25 kilometres south of Casino and 26 kilometres to the west of Woodburn within the Richmond Valley LGA. The Project Area (1,475 ha), consists of the Development Footprint (803 ha) which is accessible from and bisected by Avenue Road. The Development Footprint has historically been utilised for agricultural and forestry activities with evidence of broad native vegetation modification resulting from extensive clearing and agricultural land use. Current land use comprises grazing land with occasional cultivation, and is consistent with the surrounding locality which is predominately utilised for grazing activities, forestry, or is remnant native bushland.

A soil survey undertaken by Minesoils found the Development Footprint to contain five dominant soil mapping units:

- Soil Unit 1: Chromosols – covering 55 ha.
- Soil Unit 2: Kurosols – covering 191 ha.
- Soil Unit 3: Sodosols – covering 147 ha.
- Soil Unit 4: Dermosols – covering 339 ha.
- Soil Unit 5: Kandosols – covering 71 ha.

Laboratory testing results, including sodicity and dispersibility, indicate there is moderate to high potential risk for dispersion and erosion across the entire Development Footprint where soil impacts occur. Direct disturbance activities such as where earthworks are necessary for construction of hard stands or site facilities are therefore likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised. Notwithstanding, there is a high level of confidence regarding the Project activities, surface disturbance requirements, and erosion and sediment control management options available to mitigate this risk.

The Development Footprint was also subject to a site verification assessment of land and soil capability (LSC), in accordance with the LSC Guideline, and was found to contain two LSC classes:

- LSC class 4: moderate capability land – covering 731 ha.
- LSC class 5: moderately-low capability land – covering 72 ha.

There is a high level of certainty about the status of agricultural resources and enterprises in the Development Footprint, locality and broader region, based on the soil survey and 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 generally minor, temporary, and limited to the development footprint. These impacts can be summarised as the following:

- Temporary removal of 790 ha of land that is considered agricultural land within the Development Footprint from agricultural land use for the duration of the Project.
- Temporary removal of potential agricultural primary productivity to the estimated value of up to $305,572 per year for the duration of the Project.
- Temporary impacts on soil resources and LSC within the Development Footprint where surface disturbance occurs.

Due to the Switching Substation infrastructure potentially remaining as a permanent feature of the Development Footprint following the Project, for the purpose of this conservative assessment the minor permanent impacts as a result of the Project consist of the following:

- Permanent removal of 4 ha from agricultural land use.
- Permanent removal of potential agricultural primary productivity to the estimated value of up to $1,547 per year.
- Permanent impacts on soil resources and LSC over 4 ha.

(Note that conditions of consent may require the removal of all infrastructure so the impacts of the Switching Substation may not be permanent, however for the purpose of this assessment a conservative approach was taken.)

The temporary and permanent 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 Richmond Valley Council LGA. 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. Further, at the scale of the enterprises operating within the Development Footprint, impacts are considered to be offset as the associated landowner would be financially compensated.

Following construction and resting period of approximately 24 months, subject to the approval of Project stakeholders, the Applicant will consider implementing agrisolar and/or other land sharing opportunities within the Project boundary.

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 productivity over the 786 ha area being returned to agriculture (that is, lands within the Development Footprint considered suitable for agricultural use (790 ha), minus the 4 ha Switching Substation footprint).

A summary of mitigation measures and management recommendations have been provided in Section 6.5 to minimise any permanent impacts and control the temporary impacts of the Project on land and soil resources. 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 able to be met and 786 ha of the 790 ha of agricultural land being disturbed is able to be returned to a pre-disturbance agricultural status.

1 . INTRODUCTION

1.1 OVERVIEW

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Limited (Umwelt) to conduct a Soil and Agricultural Impact Assessment of the proposed Richmond Valley Solar Farm and Battery Energy Storage System (BESS) (the Project) located in the North Coast region of New South Wales. The baseline soil and agriculture resources are detailed within this report. The impacts on these resources and agricultural enterprises 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 (SDD) Development Consent approval under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (SSD-36651552), as part of the Environmental Impact Statement (EIS) for the Project.

Secretary's Environmental Assessment Requirements (SEAR's) have been issued for the Proponent to address. The objective of this report is address the following items included in the SEAR's for the Project (SSD-41020244):

- *a soil survey to determine the soil characteristics and consider the potential for erosion to occur; and*
- *an assessment of the agricultural impacts in accordance with the Solar Guidelines.*

In addition, agency advice regarding the SEARs were received from DPI Agriculture (28 July 2022) and Biodiversity and Conservation Division (25 July 2022), which have been considered in this report (refer **Appendix 1**).

1.2 PROJECT DESCRIPTION

The Project involves the construction, operation and decommissioning of up to 500 megawatts (MW DC) of solar photovoltaic (PV) generation, Battery Energy Storage System (BESS) with 2,200-megawatt hour (MWh) capacity and a transmission line to connect the Project from the substation to the National Electricity Market. The Project will include various associated infrastructure including, temporary construction facilities, O&M facility, internal roads, civil works and other required electrical infrastructure. A detailed Project description is included in the EIS. The primary components of the Project are as follows:

- Up to 730,000 bifacial solar panels on ground-mounted single axis tracking framework;
- 118 PV inverter stations;
- Substation;
- Centralised 275 MW / 2,200 MWh BESS
- Construction of an approximately 2 km 330 kV transmission line including 11 transmission towers;
- Temporary facilities to include office amenities, parking, storage, a control room and data, water and electrical reticulation.
- Temporary laydown areas suitable for storing plant material and equipment, solar panels and cable drums.
- Permanent operational facilities including a system control building, switch room and storage facilities, and car parking.
- Upgrading the Project access and internal roads.

The Project is expected to remain operational for approximately 30 years, at which time the Project will be assessed for renewal or decommissioning.

Upon decommissioning of the Project the following indicative steps would occur:

- With the exception of the Switching Substation, all above ground equipment including solar panels, tracking system and foundational pillars would be removed. BESS and site substation infrastructure would be

unbolted from concrete slabs and removed by crane onto transporters. All site infrastructure would be taken away from site to an appropriate recycling or waste facility;

- Underground services would be removed; and
- The site would then be landscaped to a safe, clean and stable state.
- The exception will be the Switching Substation, conservatively estimated to cover approximately 4 ha, which may remain in-situ post-Project.

1.3 PROJECT AREA

The Project Area is situated approximately 7 kilometres to the west of the town of Rappville, 25 kilometres south of Casino and 26 kilometres to the west of Woodburn within the Richmond Valley LGA (refer **Figure 1**). The Project Area covers an area of 1,475 ha and consists of the Development Footprint which is accessible from and bisected by Avenue Road and covers an area of approximately 803 ha (refer **Figure 2**).

The Project Area is within a predominantly rural area, bordered by Bungawalbin State Forest in the east, surrounding primary production land and the proposed Myrtle Creek solar farm to the south-west. The surrounding locality is characterised by predominantly rural land uses with land in the immediate vicinity occupied by scattered rural residential dwellings and used for forestry and plantation purposes. The Project Area has historically been utilised for agricultural and forestry practices with evidence of broad native vegetation modification resulting from extensive clearing and agricultural land use.

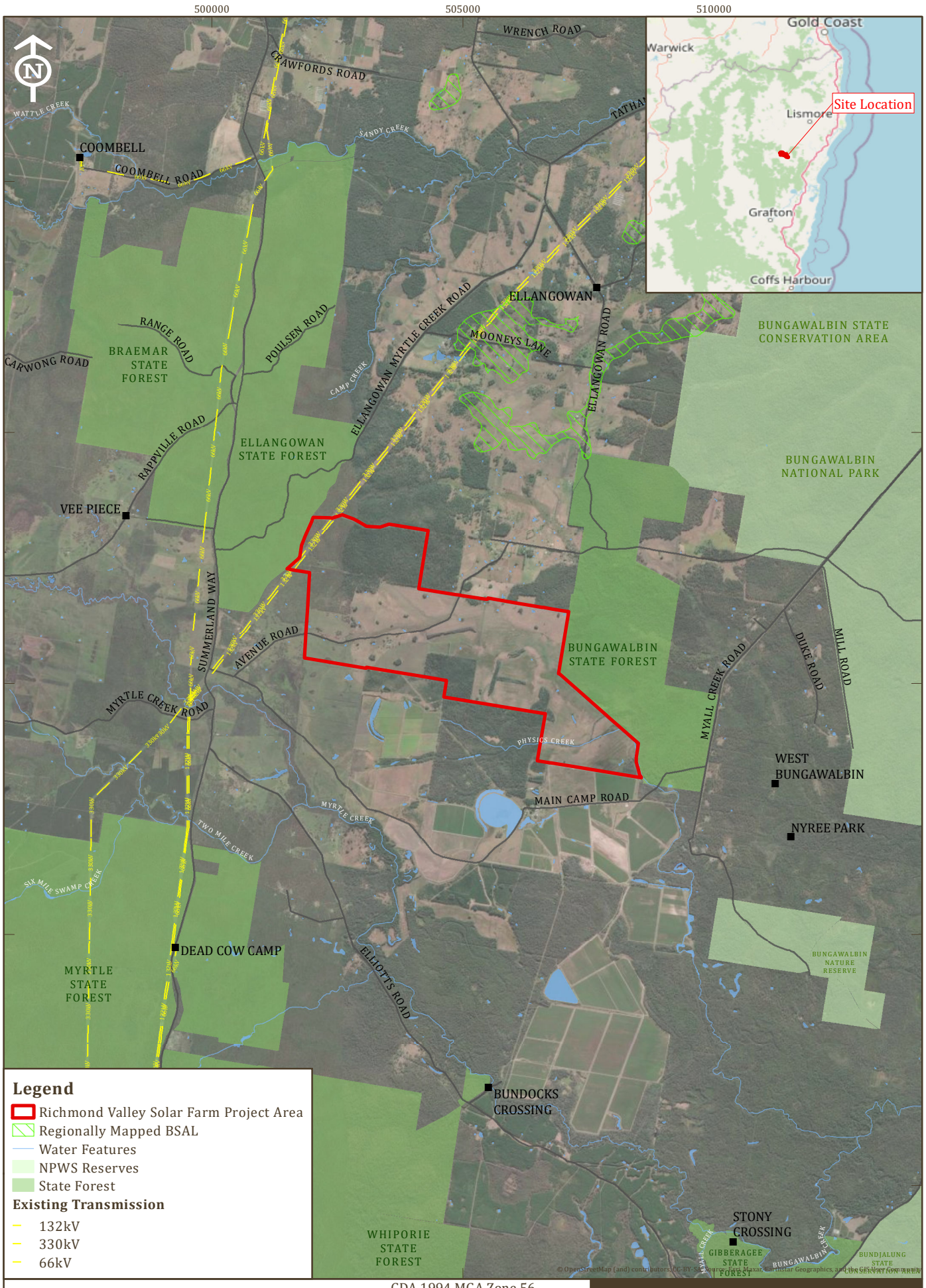
1.4 ASSESSMENT APPROACH

The assessment has been undertaken in accordance with the *Large-Scale Solar Energy Guidelines* (LSSE Guidelines) (NSW DPIE, 2022) which includes requirements 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 Level 2 – Reduced, as per the LSSE Guidelines. The assessment requirement pathway is presented in **Figure 3**. The requirements for this level of assessment, and where these items are addressed in this report, are presented in **Table 2**.

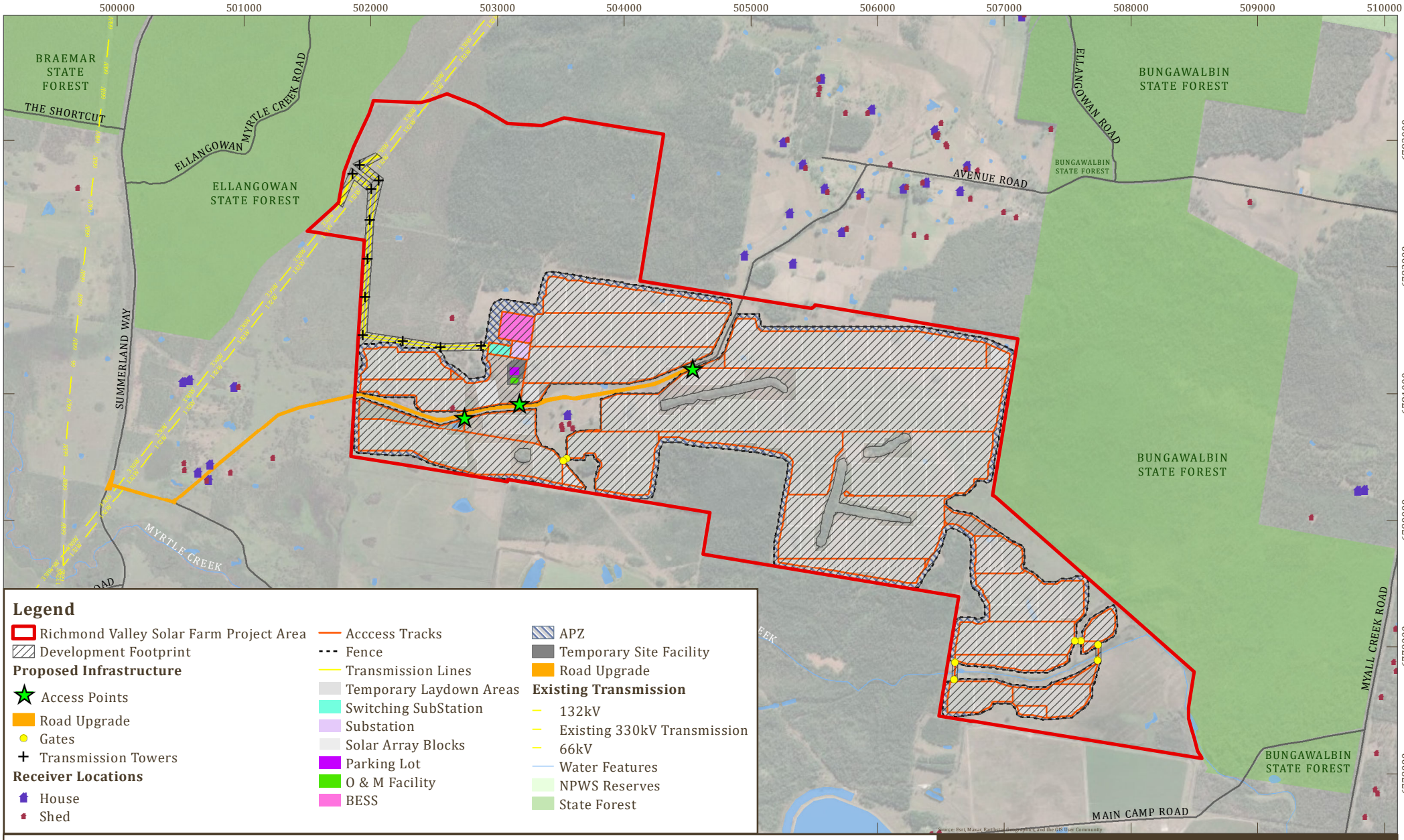
1.5 CONSULTATION

Extensive consultation was carried out with a range of stakeholder groups and individual stakeholders during the scoping and EIS phases of the Project, as detailed in the main body of the EIS. These include regulators who have a decision-making role in project approvals, and groups or individuals who may be directly or indirectly affected by the Project.

A meeting was held with the DPI to introduce the Project and present the methodology of this assessment. DPI expressed initial satisfaction to the approach of the soil survey and agricultural impact assessment.



D:\RST002_MineSoils\MS105_RichmondValley\MS105_001_ProjectLocality.mxd 13/03/2024 11:23:01 PM



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

0 250 500 1,000 Meters

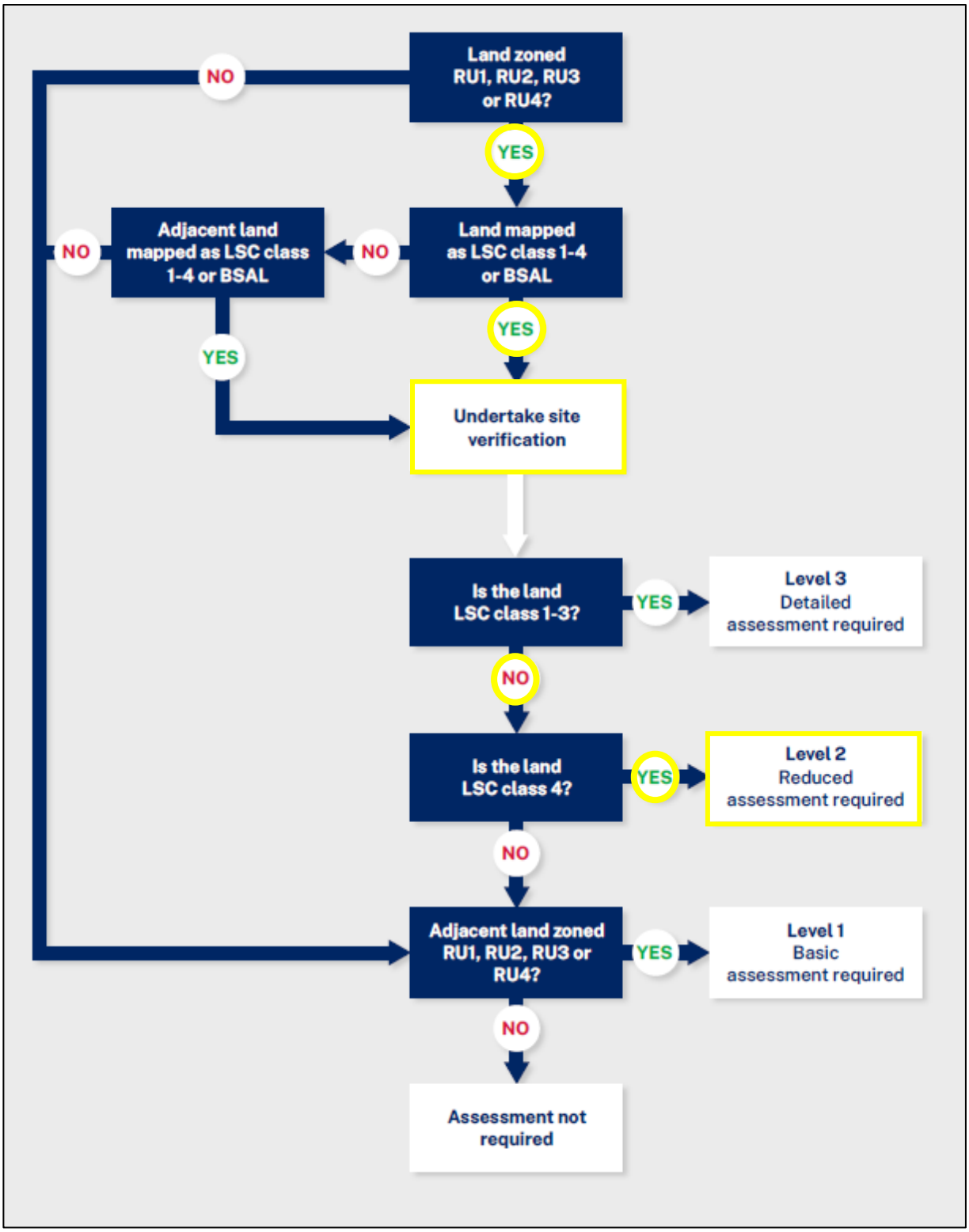
Scale 1:40000 at A4

Study Area

FIGURE 2

MS105_002_StudyAreaL 14/03/2024 12:14:46 AM

Figure 3. Assessment Requirement Pathway (showing the pathway for this assessment highlighted yellow)



(Source: LSSE Guidelines, NSW DPIE, 2022)

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

Assessment	Content and form	Section Addressed
Project description Describe the nature, location, intensity and duration of the project and include a map of the Project Area.	• project description • areas of the site that would be disturbed or temporarily removed from agricultural use • location • duration	**1**
Regional context Describe the regional context.	• zoning of the Project Area • climate and rainfall • regional landform • regional land use including any significant agricultural industries and/or infrastructure	**2**
Site characteristics and land use description 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.	• describe the land subject to the project site • describe existing agricultural land uses (i.e. orchards, vineyards, breeding paddocks, intensive livestock areas) • describe the history of agricultural practices on the project site • identify soil type, fertility, land and soil capability • provide a map showing the verified LSC class of the project site • provide a map showing topography of the site • describe the agricultural productivity of the site	**3**
LUCRA assessment 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	• land use compatibility and conflicts • 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	**4 (Appendix 2)**
Impacts on agricultural land 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	• describe project impacts on identified agricultural lands, including but not limited to, potential weeds, pests, dust, bushfire, livestock, crop production • consider impacts to the agricultural land of the site • consider project potential to temporarily and/or permanently remove agricultural land and/or fragment or displace existing agricultural industries • consider cumulative impacts of multiple solar energy projects on agriculture in the region	**5**
Mitigation strategies Outline strategies which may be adopted to mitigate potential impacts on agricultural land and minimise land use conflict.	• outline and consider strategies to mitigate project impacts on agricultural land • consider co-location with existing agricultural practices and investigate feasibility of agrisolar where it would result in a meaningful benefit (see Clean Energy Council's Australian Guide to Agrisolar for Large -Scale Solar)	**6**

2 REGIONAL CONTEXT

2.1 ZONING

The Project is located within the Richmond Valley LGA and wholly located within land zoned as RU1 Primary Production as illustrated in **Figure 4**. Electricity generating works are not permitted in this zone however Clause 2.36(1)(b) of the Transport and Infrastructure SEPP states that development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Under Clause 2.7(1) of the Transport and Infrastructure SEPP, the provisions prevail where there are inconsistencies with any other EPIs, including LEPs.

2.2 CLIMATE AND RAINFALL

The Development Footprint sits within the NSW North Coast climate zone, which has a regional rainfall annual average of approximately 1300 mm (Bureau of Meteorology and the CSIRO, 2019). Over the longer term, between the years of 1989–2018, 'dry' years (lowest 30%) have occurred 11 times and 'wet' years (highest 30%) have occurred 11 times, while the remaining years were in the average range. Over this period, summer rainfall has been moderately reliable across the region, with usually about 170 mm difference from one year to the next. This is in contrast to autumn rainfall, which is generally less reliable. Although there have been some wet winters in the past 30 years, winter rainfall has not been reliable from year to year.

The closest Bureau of Meteorology (BOM) Automatic Weather Station (AWS) to the Development Footprint at Casino Airport (Station No. 058208), approximately 25 km north (BOM, 2023). The annual average rainfall is 1,062.9 mm, falling throughout the year over approximately 92 rain days, with the average highest rainfall in the month of February and the lowest in the month of July.

The annual average maximum temperature recorded at the site is 26.2°C and the annual average minimum temperature is 13.3°C. The highest average maximum temperature of 30.6°C is recorded in January, while the lowest average maximum temperature of 20.8°C is recorded in June and July. The annual average humidity is 72% at 9am and 50% at 3pm (BOM, 2023).

2.3 REGIONAL LANDFORM

2.3.1 REGIONAL LANDFORM CHARACTERISTICS

The Project Area is located the Northern Rivers region, which is bounded by the Tasman Sea to the east and the New England region to the west, where the Great Dividing Range forms a mountainous boundary. To the north is the border between New South Wales and Queensland, where the Darling Downs are located to the north-west and South East Queensland directly to the north. The southern boundary is the Dorrigo ranges, which also mark the southern boundary of the Clarence River Basin.

The defining characteristics of the region are the fertile valleys of the Clarence, Richmond and Tweed Rivers and their sources.

The northernmost part of the region contains Mount Warning and the surrounding remnants of the long-extinct Tweed Volcano, portions of which extend into southern Queensland. Immediately to the south of this region was formerly an extensive area of subtropical rainforest that was largely cleared for timber-getting and subsequently dairy farming in the nineteenth century.

The Richmond catchment, within which the Development Footprint lies, comprises a variety of landscapes from rainforests to rich agricultural valleys and coastal estuaries. The Richmond catchment drains an area of over 7,000 square kilometres from the Border Ranges in the north to the Richmond Range in the west and south. The upland ranges and the plateau north of Lismore remain mostly forested while the lower coastal plains are cleared for

agriculture. Elevations range from over 1,000 metres in the Border Ranges to near sea level on the coastal floodplain.

2.3.2 REGIONAL GEOLOGY

The underlying geology of the region is a Mesozoic sedimentary basin known as the Clarence Moreton Basin. It formed by oblique extension of the underlying Paleozoic New England Orogen basement. It consists of continental deposits, starting with a small amount of Triassic coal beds, and then mostly Jurassic and Cretaceous sedimentary rocks. The Grafton Formation is the sedimentary unit in the core of the basin. It is the youngest of the beds, being between Late Jurassic and Early Cretaceous. It occurs from Grafton to Casino, including the Development Footprint, consisting of soft sandstone, siltstone and claystone (refer **Figure 5**).

At the scale of the Project locality, the Ellangowan and Physics Lagoon soil landscapes characterise the Development Footprint and its surrounds (Morand, D. T., 2001). The Ellangowen soil landscape consists of undulating rises within the Ellangowan Hills on the Grafton Formation (lithic sandstone, siltstone, claystone and conglomerate). Slopes are generally 2 – 10% with relief 25 – 35 m and elevation 10 – 60 m. The Physics Lagoon soil landscape consist of alluvium of unknown depth derived predominantly from rocks of the Grafton Formation (sandstone, siltstone, claystone, conglomerate) and the Kangaroo Creek Sandstone (quartz sandstone). Sand deposits are common and have been interpreted as prior streams.

2.4 REGIONAL LAND USE

2.4.1 AGRICULTURAL LAND USE

The Northern Rivers is made up of six councils, spanning from a western agricultural hinterland (Kyogle and Richmond Valley, Casino), through its services hub (Lismore) to coastal communities (Byron, Ballina and some easterly sections of the Richmond Valley). The Region's economy began in the timber trade. The major towns of the area developed at the navigable heads of the local river systems (Murwillumbah on the Tweed, Lismore on the Wilsons – a tributary of the Richmond – and Grafton on the Clarence) rather than on the coast, in order to be able to transport the valuable timber products (in particular the Australian red cedar, *Toona ciliata*) to markets interstate and overseas.

Over time, development saw expansion into agriculture and tourism, which has led to growth in population and business services. Dairy production in the region was extensive up until the 1970s and many towns in the area retain their dairy processing plants (known as butter factories) from that era, now largely re-purposed for other uses. Dairy cattle were then largely replaced with beef cattle for economic reasons, although some dairy production remains. The north of the region is an important sugarcane growing area with smaller contributions from coffee, bananas and assorted tropical fruit and vegetables.

At the scale of the Richmond Valley LGA, 565,620 ha of land is subject to agricultural activity as of the last agricultural census of 2020 - 2021 (ABS, 2022a). The area of land used by agricultural type within the Richmond Valley LGA is presented in **Table 2**, which shows grazing of livestock is the dominant land use, accounting for 75% of this area.

Table 2: Richmond Valley LGA Agricultural Land Use by Type 2020 - 2021

Agricultural Land Use	Area	
	ha	%
Grazing	61,678	75
Cropping	12,843	16
Forestry	7,916	10
Other	304	<1
Total	565,620	100.0

2.4.2 AGRICULTURAL ENTERPRISES

The Northern Rivers economy is widely diversified, with business income concentrated in agriculture, forestry and fishing, construction, financial and insurance services, manufacturing and retail trade. Together, these sectors make up more than half of the Northern Rivers' business income. Agriculture contributes approximately 10% of the economic output of the LGA by industry (Remplan, 2022, using ABS 2016 Census Place of Work Employment (Scaled), ABS 2019 / 2020 National Input Output Tables, and ABS June 2021 Gross State Product).

At a scale of the locality, agricultural enterprises and land use surrounding the Project Area largely consist of cattle grazing on native and improved pastures, with some pine plantation timber forestry approximately two kilometres to the southwest and poultry farms approximately 5 kilometres to the north. A large portion of the Project locality to the north, east and south west of the Project Area is native vegetation not subject to agriculture use.

The gross value of agricultural enterprises within the Richmond Valley LGA for 2020-2021 is $71 million (ABS, 2022b). As shown in **Table 3**, livestock slaughtering accounts for approximately half of the total gross value of agriculture for the LGA (ABS, 2022b). Other key enterprises are cropping and livestock products.

Within the category of livestock slaughtered, cattle and calves make up more than three quarters of gross value (refer **Table 4**), with an estimated 42,438 head of cattle over 200 business enterprises for the reporting period of 2020 – 2021 (ABS, 2022). For crops, broadacre crops consisting largely of wheat, rice and maize for grain make up 54% of the gross value (**Table 5**). Milk dominates livestock products with 87% of gross value (**Table 6**) (ABS, 2022b).

Table 3: Richmond Valley LGA Agricultural Commodity Gross Value by Type 2020 – 2021

Agricultural Commodity	Gross Value	
	$	%
Livestock slaughtered	34,703,773	49
Crops	22,322,736	31
Livestock products	13,989,173	20
Total	71,015,682	100

Table 4: Richmond Valley LGA Livestock Slaughtered Gross Value by Type 2020 – 2021

Livestock Type	Area	
	$	%
Cattle and calves	26,384,283	76
Pigs	7,343,842	21
Poultry	953,146	3
Other	17,992	<1
Sheep and lambs	4,509	<1
Total	34,703,773	100

Table 5: Richmond Valley LGA Crop Gross Value by Type 2020 – 2021

Crop	Value	
	$	%
Broadacre crops	11,981,475	54
Nurseries, cut flowers or cultivated turf	4,214,475	19
Vegetables	3,576,310	16
Fruit and nuts	1,781,093	8
Hay	769,384	3
Total	22,322,736	100

Table 6: Richmond Valley LGA Livestock Products Gross Value by Type 2020 – 2021

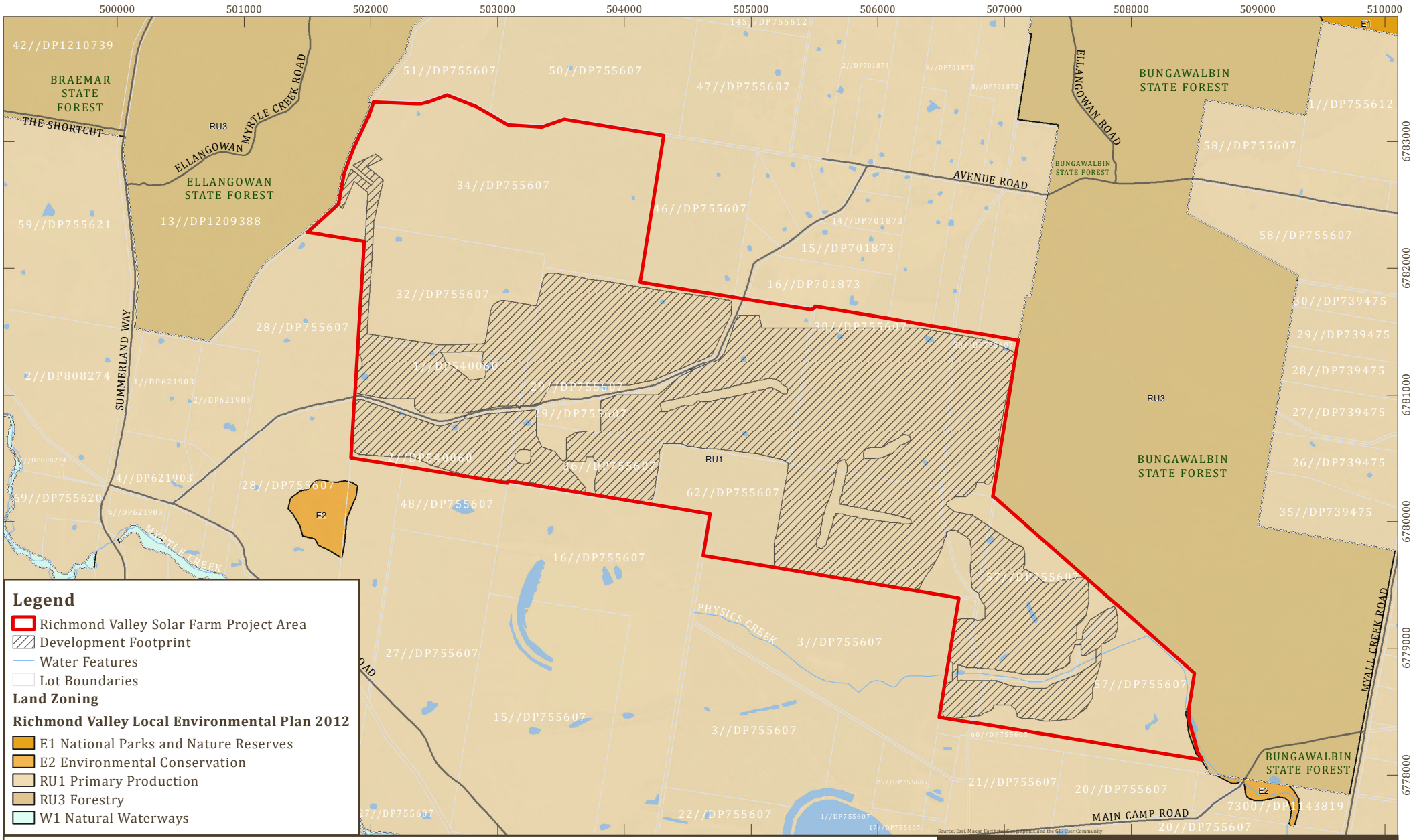
Livestock	Value	
	$	%
Milk	12,206,257	87
Eggs	1,756,405	13
Wool	26,510	0
Total	13,989,173	100

2.4.3 REGIONAL AGRICULTURAL INFRASTRUCTURE

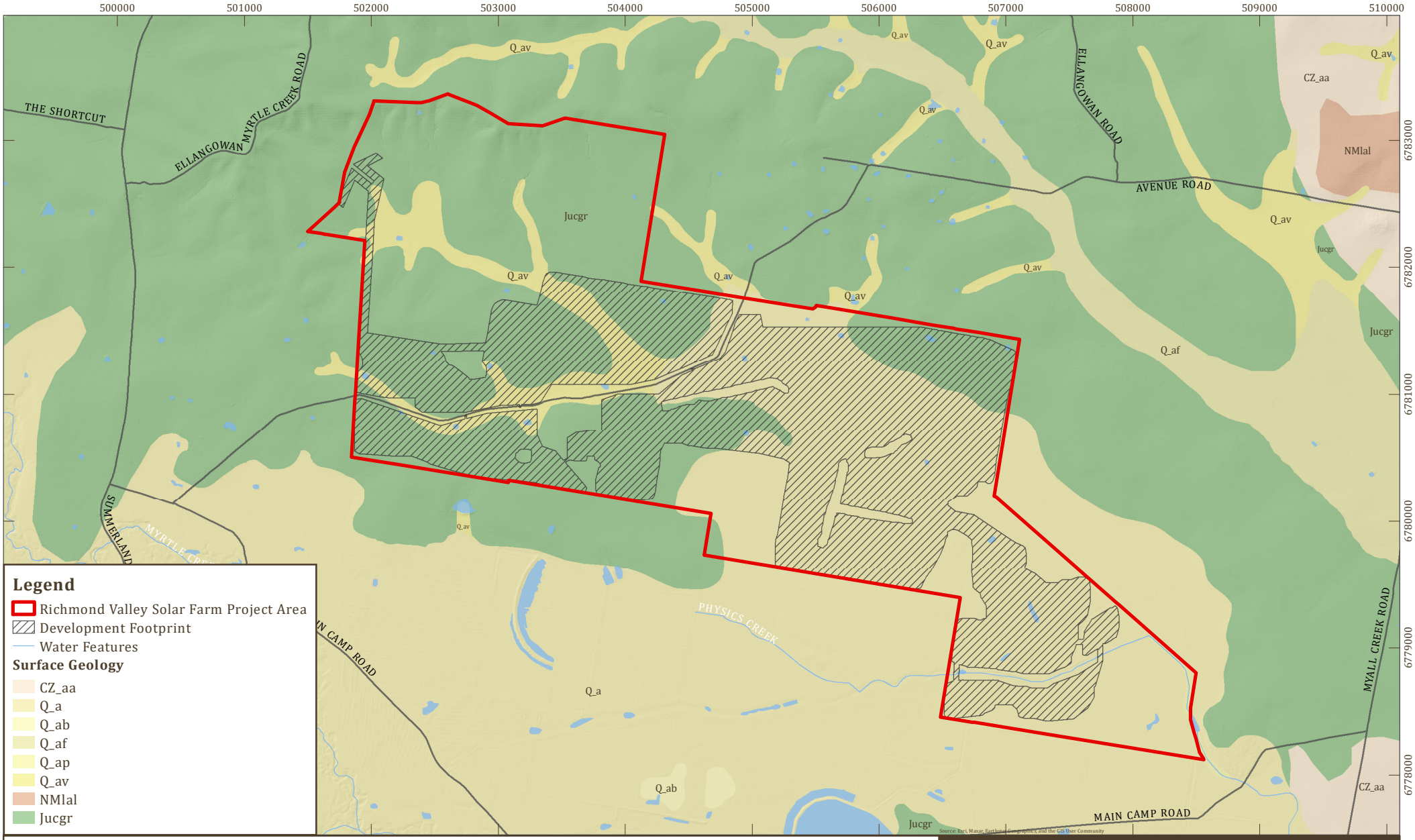
The key infrastructure item assisting agricultural market access and cost of production is the transport network servicing the North Coast region. Underlining the importance of this issue, total freight costs from farm to port can be as much as 30% of the value of the crop being marketed depending on Australian and world commodity prices in a given season (AgriFutures Australia, 2019). The region is traversed by the Pacific Highway, Bruxner Highway, Clarence Way, Summerland Way and the North Coast Line which links agricultural enterprises to Sydney and Newcastle in NSW and to Brisbane in Queensland.

In proximity to the Project Area, the large agricultural service centres of Casino (30 km north) and Grafton (80 km south) allow access to businesses providing agricultural equipment and supplies, including animal fencing, animal vaccinations, livestock ID, stock supplements, seed, fertiliser and crop protection. The nearby town of Casino is the focal centre of Richmond Valley and the region's beef industry and is the location of the Northern Co-operative Meat Company and the Northern Rivers Livestock Exchange, the largest abattoir and livestock exchange in Northern NSW which sold 123,713 head of cattle for the year 2021 – 2022, representing 10.8% of the cattle sold in NSW(MLA, 2022).

Other infrastructure critical to agricultural production includes energy needs (gas and electricity), telecommunications services, irrigation water infrastructure and 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 livestock grazing.



MS105_004_ZoningL 14/03/2024 12:13:08 AM



MS105_005_GeologyL 14/03/2024 12:30:01 AM

3 SITE CHARACTERISTICS AND LAND USE

3.1 SITE CHARACTERISTICS

3.1.1 LANDSCAPE

A site inspection was undertaken by Minesoils in August 2023. The Development Footprint was generally stable, free draining landform with 90 - 100% surface cover in the form of sustainable pasture and fodder crop for grazing (**Plates 1** and **2**). The Development Footprint would have historically consisted of densely vegetated areas, which has since been highly disturbed by land clearing for agriculture and pasture development, as well as previous use as a plantation forest, with isolated areas of remnant native trees on some hill crests and hillslopes (**Plate 1**).

The Development Footprint landscape is characterised by undulating and rolling hills, low crests and rises adjacent to broad, flat alluvial plains. The lowest elevation is approximately 25 m above sea level (ASL) on drainage plains in the south eastern portion of the Development Footprint, and rises to 70 m (ASL) on crested areas in the west (refer **Figure 6**). Minor sheet erosion was observed on slopes.
The Development Footprint contains several small waterbodies along with a number of 1st and 2nd order Strahler streams. A 3rd order Strahler stream transects the northern portion of the site, extending eastwards before draining south-east towards Physics Creek. A 4th order Strahler stream (Physics Creek), mapped as a sensitive watercourse, bisects the south-eastern corner of the site, draining towards the north-east before transitioning to drain south towards Myrtle Creek.

3.1.2 AGRICULTURAL LAND USE

For the purpose of this assessment, land that is being used for agriculture, or land that is not currently being used for agriculture but has previously been used for agricultural land use, or is capable of agricultural land use, is referred to as agricultural land, covers an area of 790 ha within the Development Footprint and is shown on **Figure 7**. The remaining 13 ha remains as in-tact remnant bushland.
The agricultural land within the Development Footprint is subject to livestock grazing as the primary land-use, supporting Bos Indicus and Hereford cattle and calves, which are grazed on pastures and fodder crops on rotation for breeding and fattening, and watered through a series of surface dams and water troughs (**Plates 3** and **4**). Historically, outside of times when the Project Area has been used as a plantation forest, the Development Footprinthas been consistently subject to grazing of livestock on native pastures, with occasional cultivation and/or pasture improvement to select paddocks.

General agricultural improvements are present, including cattle yards (**Plate 5**), stock fences and gates (**Plate 6**), lick feeders (**Plate 7**), dams (**Plate 8**), water pumps and tanks, cattle grids (**Plate 9**) sheds and unsealed access tracks (**Plate 10**).

At the time of inspection, neighbouring properties in the immediate vicinity were observed to be used primarily for livestock grazing or as plantation forests/ production native forestry, with some isolated cultivation also being undertaken within the broader locality. The Bungawalbin State Forest is located to the east. Other State forests in the vicinity of the site include Ellangowan State Forest (approximately one kilometre to the north-west) and Myrtle State Forest (approximately eight kilometres to the south-west). Similar agricultural improvements (e.g. cattle yards, stock fences, dams and existing access tracks) are widespread throughout the locality which reflects the historical and current development of the local lands for agriculture land use in addition to extensive forestry.

No sensitive agricultural activities such as intensive plant or livestock agriculture were observed to be being undertaken within the Development Footprint or its immediate surrounds.

Plate 1: The Development Footprint contains lands extensively cleared for agriculture dominated by sustainable pasture.

Plate 2: The Development Footprint contains lands extensively cleared for agriculture subject to periodic fodder cropping.

Plate 3: Livestock present within the Development Footprint at the time of inspection included Bos Indicus cattle.

Plate 4: Livestock present within the Development Footprint at the time of inspection included Hereford cattle and calves.

Plate 5: Agricultural infrastructure within the Development Footprint includes cattle yards.

Plate 6: Agricultural infrastructure within the Development Footprint includes fencing and gates.

Plate 7: Agricultural infrastructure within the Development Footprint includes lick feeders.

Plate 8: Agricultural infrastructure within the Development Footprint includes farm dams.

Plate 9: Agricultural infrastructure within the Development Footprint includes cattle grids.

Plate 10: Agricultural infrastructure within the Development Footprint includes shedding, access tracks and water tanks.

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 Development Footprint. 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 productivity of the land for grazing within the Development Footprint. Based on modelling conservative enterprises including Coastal Weaners on improved pasture and Growing Out Steers (240 – 460 kgs), the estimated productivity of the agricultural land within the Development Footprint ranges from $261,237 to $305,572 per annum as summarised in **Table 7**.

Table 7: Estimated Productivity of Agricultural Land within the Development Footprint

Enterprise	Estimated Gross Margin ($/ha/year)*	Agricultural Land (ha)	Project Area Gross Margin ($/year)
Coastal Weaners (improved pasture)	330.68	790	261,237
Growing-out Steers 240 – 460kg	386.80	790	305,572

*Source: DPI, 2023

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 landscapes, soil types, inherent soil fertility and LSC as applied to the Development Footprint (NSW and Department of Planning, Industry and Environment, 2022).

Soil Landscapes

The Development Footprint lies within the *Soil Landscapes of the Woodburn 1:100 000 Sheet* (Morand, 2001). 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 on **Figure 7** and described below**.**

Physics Lagoon Soil Landscape

Landscapes consist of undulating stagnant alluvial plain forming the mid-section of the Bungawalbin catchment. Slopes 1 – 5%; local relief 150 cm), Slopes 1 – 5%; local relief <5 m; elevation 10 – 20 m. A complex and poorly drained landscape that includes plains, backplains, floodouts, prior streams, swamps and terrace surfaces. Partially cleared, tall eucalypt open forest.

Soils are characterised by deep (>150 cm), poorly drained Grey Kurosols (Gleyed Podzolic Soils) and deep (>150 cm), poorly drained Redoxic and Oxyaquic Hydrosols (Humic Gleys) . Deep (>150 cm), rapidly drained Aeric Podosols (Podzols; Humus Podzols) and Tenosols (Siliceous Sands) occur within landscape variants.

Limitations include complex and poorly drained terrain and soils; localised flood hazard; permanently high watertables. Highly erodible, acidic, sodic/ dispersive soils with low wet bearing strength, low available waterholding capacities and low fertility. Soil permeability is varied. Some moderate to high shrink-swell.

Ellangowen Soil Landscape

Landscapes consist of undulating rises within the Ellangowan Hills on the Grafton Formation (lithic sandstone, siltstone, claystone and conglomerate). Slopes 2 – 10%; relief 25 – 35 m; elevation 10 – 60 m. Partially cleared, tall open-forest, previously logged.

Soils consist of moderately deep to deep (>100 cm), poorly drained Grey and Brown Kurosols and Kandosols (Gleyed Podzolic Soils and Yellow Podzolic Soils) on hillslopes and crests. Moderately deep to deep (>100 cm), well-drained Chernic Tenosols (Siliceous Sands) on areas of gravels. Moderately deep to deep (>100 cm), poorly drained Yellow and Brown Kurosols (Yellow Podzolic Soils) within landscape variants.

Limitations include erodible, acidic and sodic/dispersive soils with low fertility, low permeability, high aluminium toxicity potential and localised stoniness. Moderately saline subsoils exist. High sheet and gully erosion hazard

when cleared. High run-on when adjacent to erosional soil landscapes. Stony and highly permeable soils within landscape variants.

Cahills Road Soil Landscape

Landscapes consist of rolling low hills on predominantly iron-indurated sandstones of the Grafton Formation (sandstone, siltstone, claystone and conglomerate). Relief 30 – 50 m; slopes 5 – 15%, 25% on upper slopes; elevation 50 – 120 m. Partially cleared, tall open-forest and woodland, previously logged.

Soils are shallow to moderately deep (50 – 80 cm), moderately well-drained Red and Brown Kurosols/ Chromosols (Red and Yellow Podzolic Soils) on upper slopes and moderately deep to deep (70 – 150 cm), moderately well-drained Red and Brown Kurosols/ Chromosols (Red and Yellow Podzolic Soils) on mid to lower slopes. Shallow to deep (>50 cm), moderately well-drained Red Kandosols (Red Podzolic Soils) within variants.

Limitations include stony, strongly acidic, erodible and sodic/dispersive soils with low fertility and low permeability. Localised steep slopes; high sheet erosion risk. Mass movement within landscape variants.

Soil Types

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

Kurosols 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 strongly acid.

Natric Kurosols 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 strongly acid and sodic.

Podosols are defined as soils with which possess either a Bs horizon (visible dominance of iron compounds), a Bhs horizon (organic-aluminium and iron compounds), or a Bh horizon (organic-aluminium compounds). These horizons may occur singly in a profile or in combination.

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 Low (1) and 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 8** 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.

Table 8: Land and Soil Capability Classification

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land**: 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	**High capability land**: 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.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	**Moderate capability land**: 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.
5	**Moderate–low capability land**: 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.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	**Low capability land**: 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.
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	**Very low capability land**: 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	**Extremely low capability land**: 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.

The NSW regional based maps of LSC indicate the Development Footprint 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**).

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 or the Project Area. The nearest BSAL is located approximately 5 km north of the site and approximately 12 km west of the site (refer **Figure 1**).

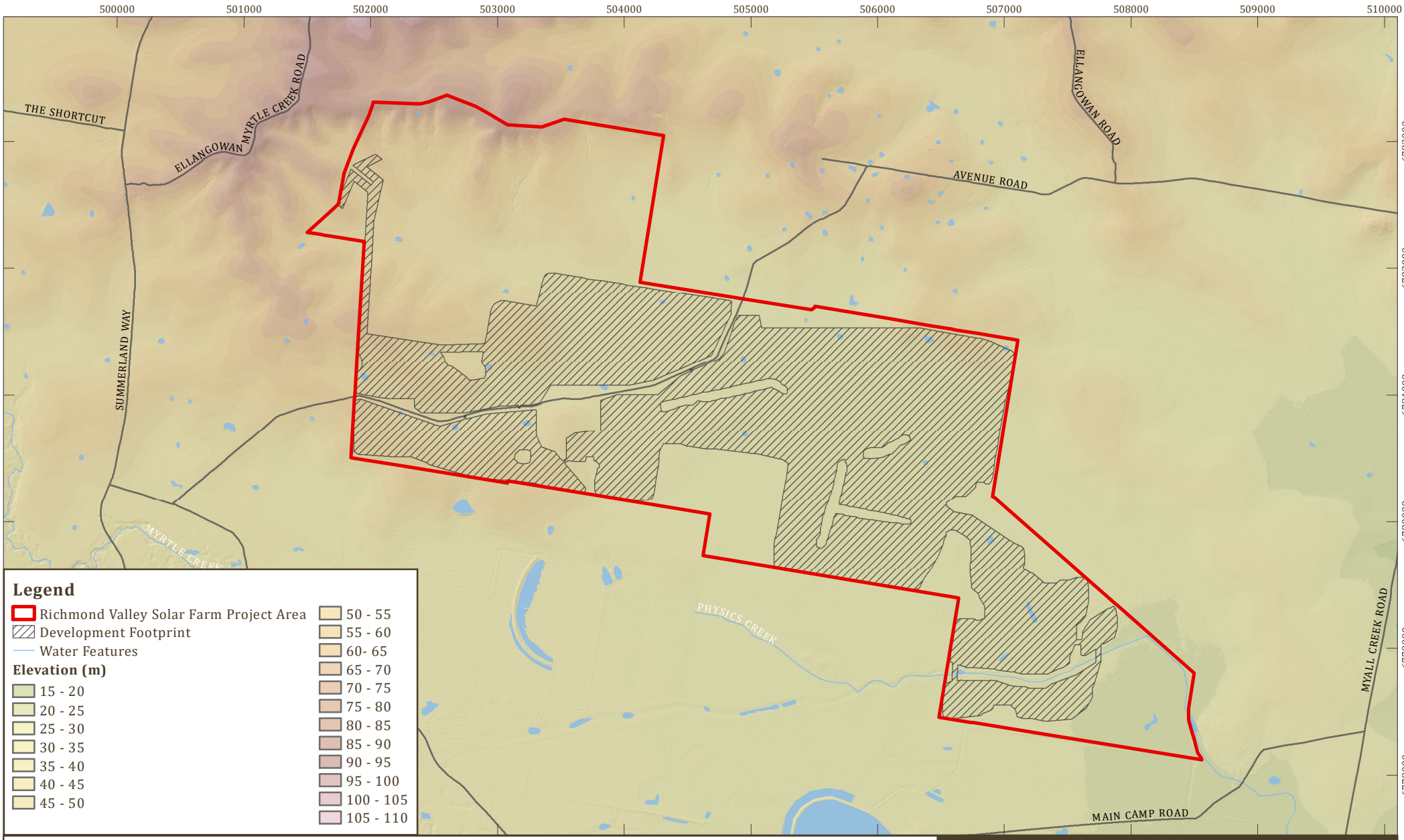
The verification of BSAL is not required as per the *LSSE Guidelines*.

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 being developed as an essential component of agricultural land use planning, enabling clearer local planning with informed prioritisation of future land uses.

SSAL is mapped over an area of 279 ha within the Development Footprint (refer **Figure 12**).

The *LSSE Guidelines* do not cover SSAL. There is presently no method to verify SSAL, nor is there a contextual framework for how it SSAL should be considered and assessed (as there is for LSC and BSAL).



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

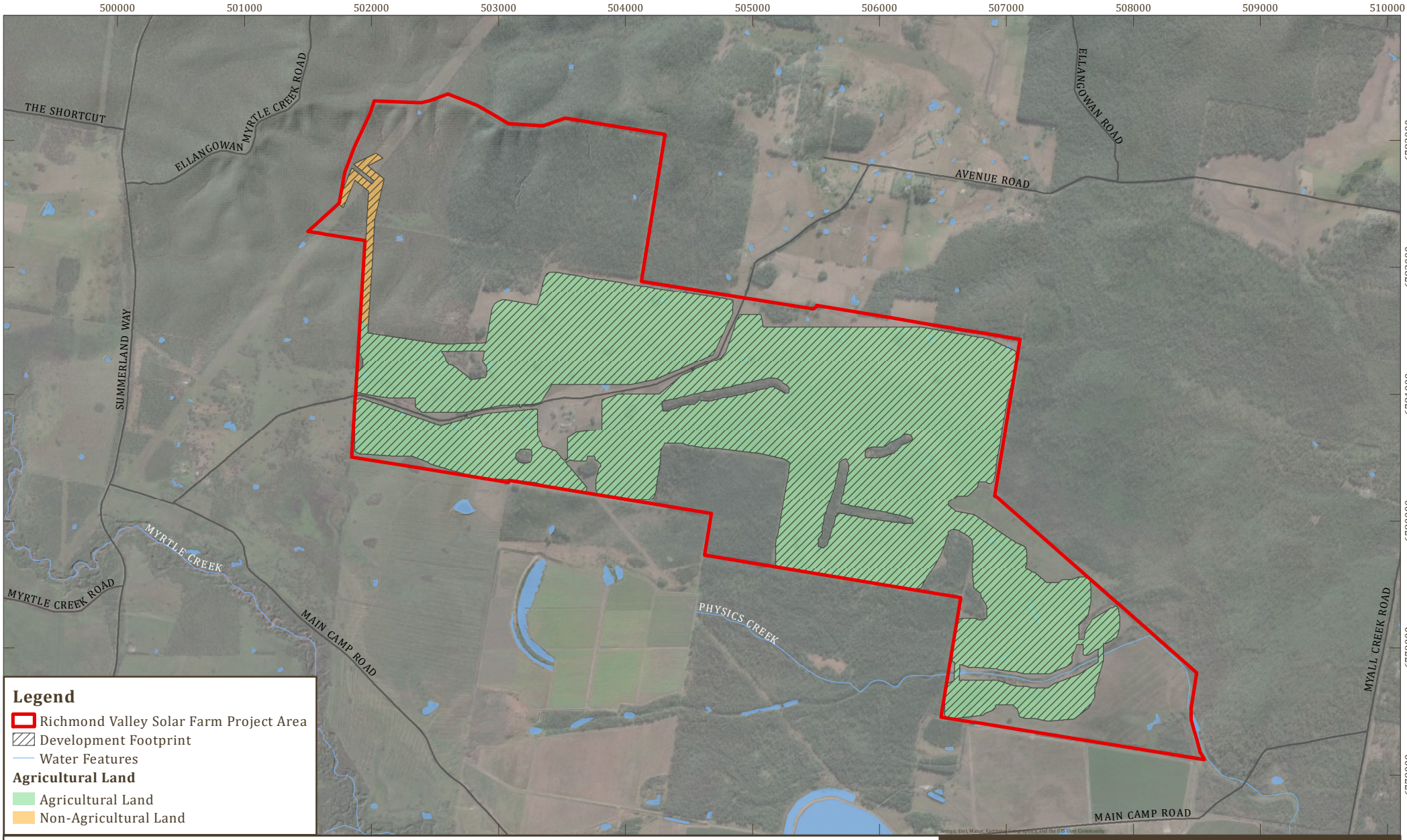
0 250 500 1,000 Meters

Scale 1:40000 at A4

Topography

FIGURE 6

MS105_006_TopographyL 14/03/2024 12:33:25 AM



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

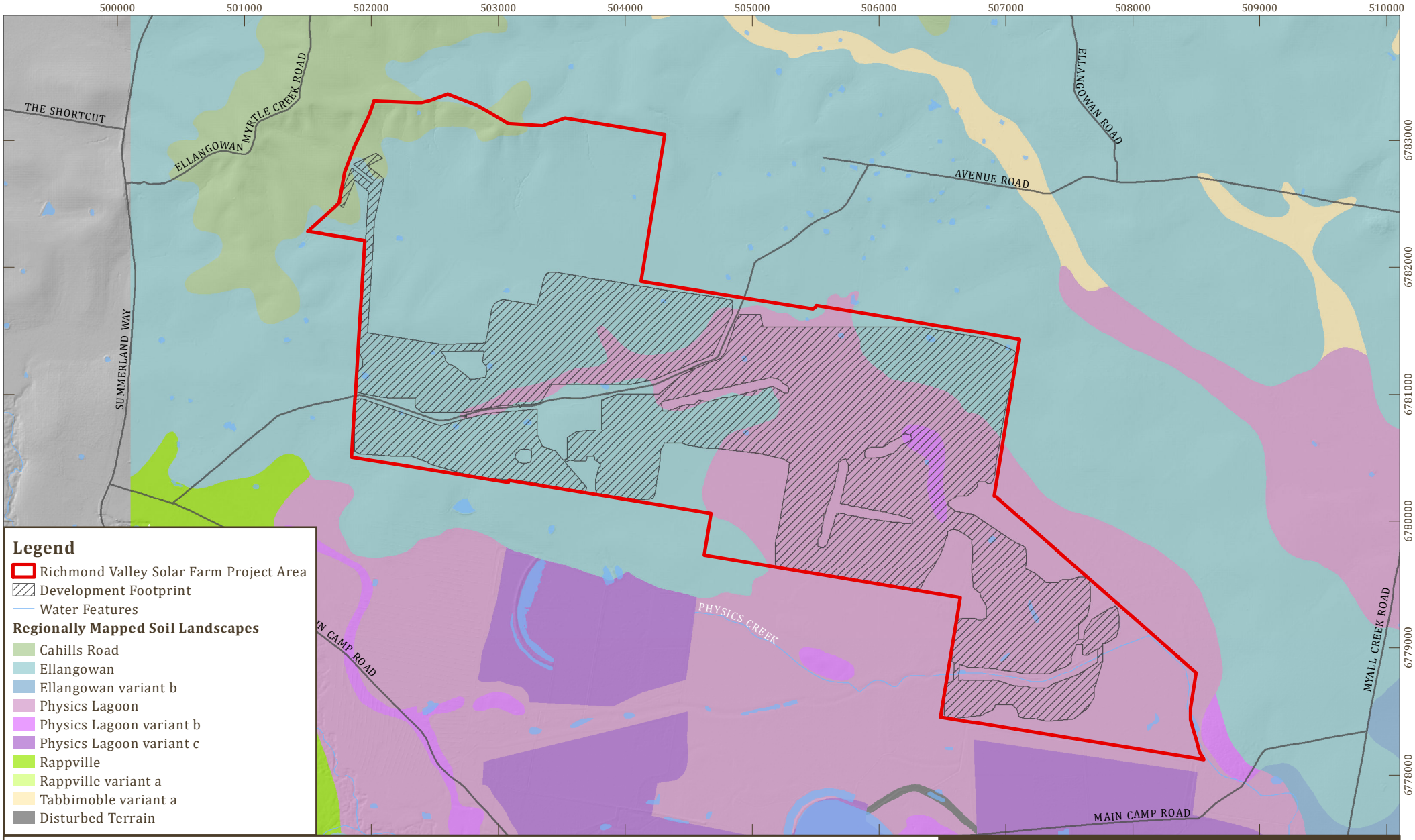
0 250 500 1,000 Meters

Scale 1:40000 at A4

Agricultural Land

FIGURE 7

MS105_007_AgLandL 14/03/2024 12:57:57 AM



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

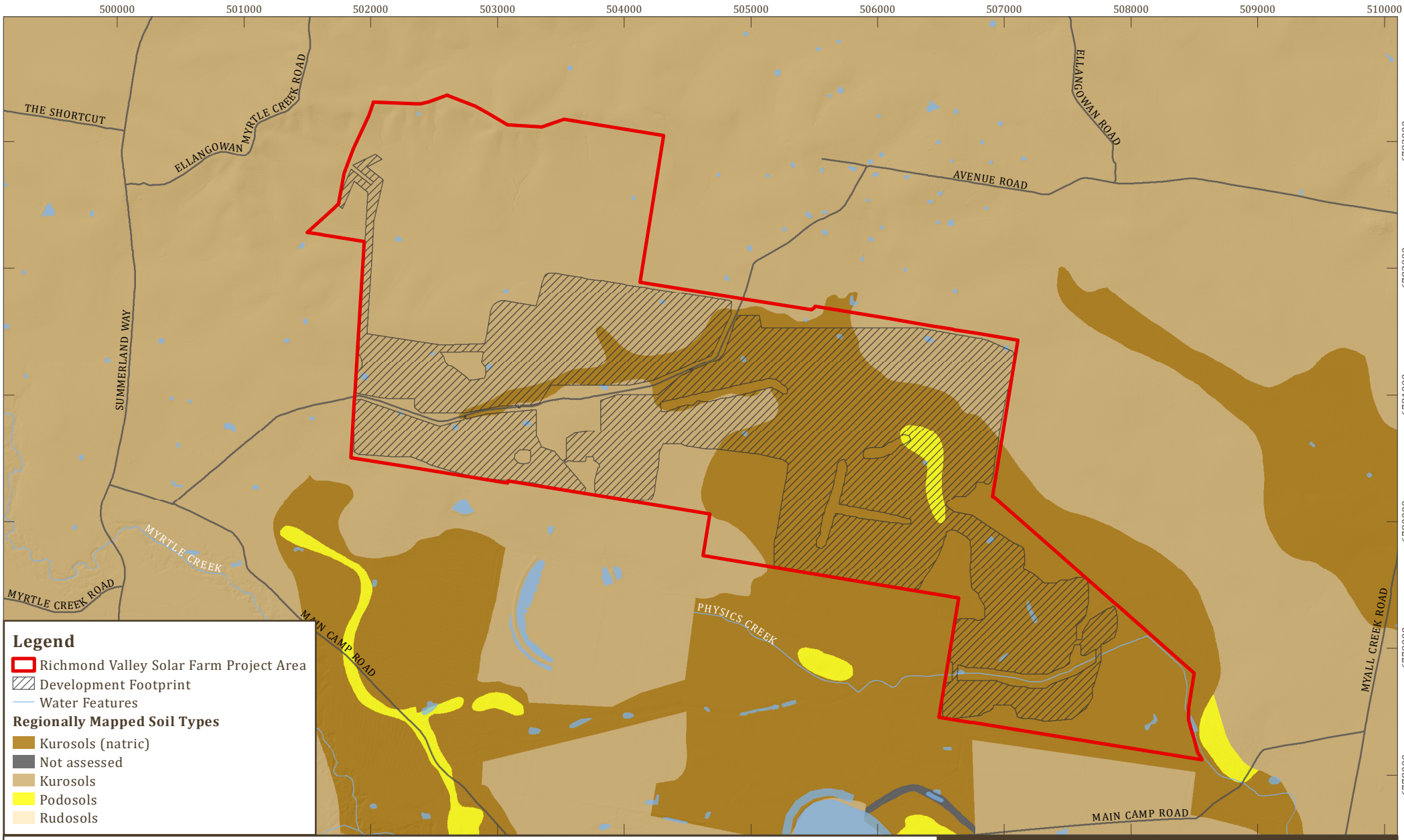
0 250 500 1,000 Meters

Scale 1:40000 at A4

Regionally Mapped Soil Landscapes

FIGURE 8

MS105_008_RegionalSoilLandscapesL 14/03/2024 1:07:02 AM



GDA 1994 MGA Zone 56

0 250 500 1,000 Meters

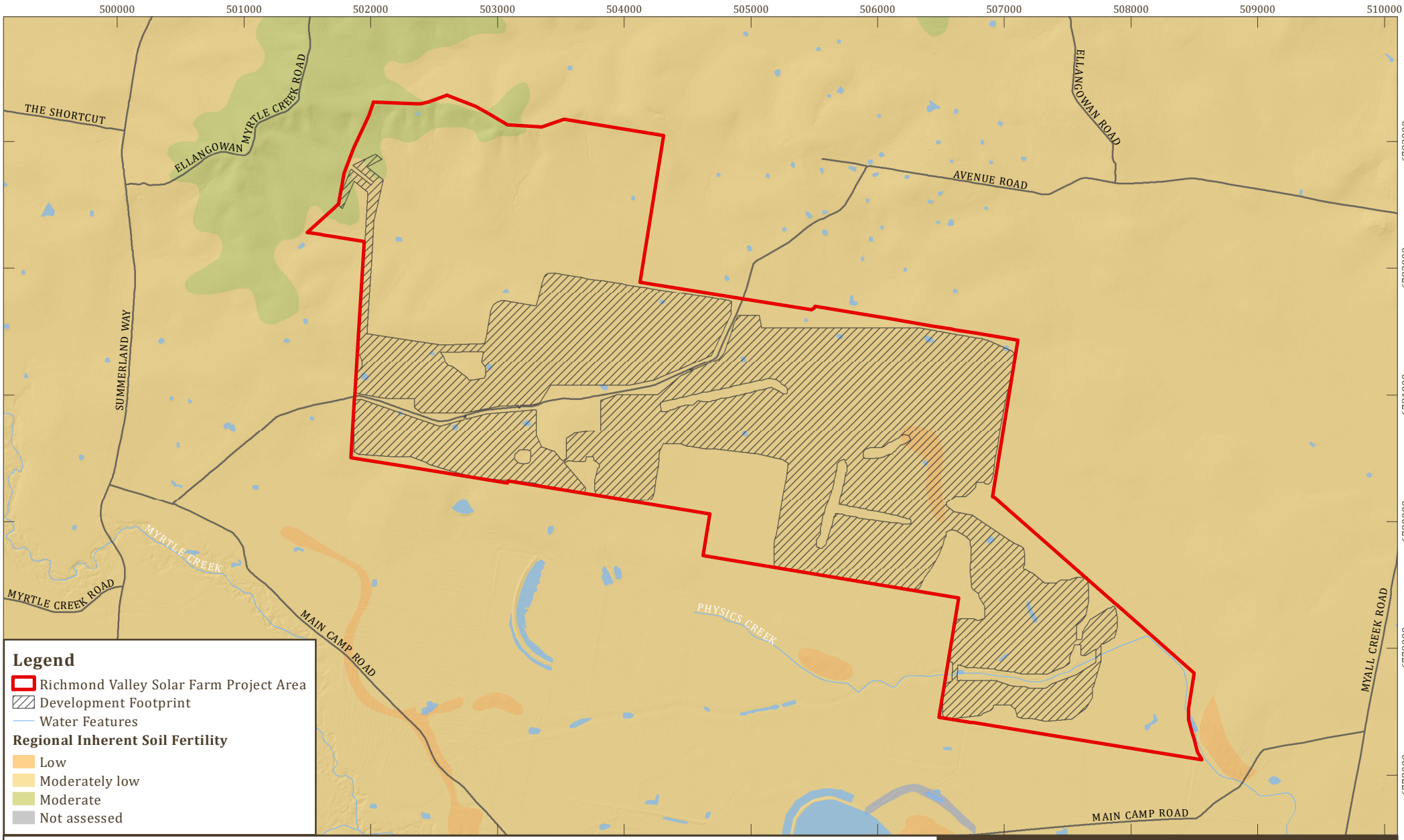
Scale 1:40000 at A4

MINESOILS
LAND & REHABILITATION SPECIALISTS

Regionally Mapped Soil Types

FIGURE 9

MS105_009_RegionalSoilTypesL 14/03/2024 1:09:25 AM



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

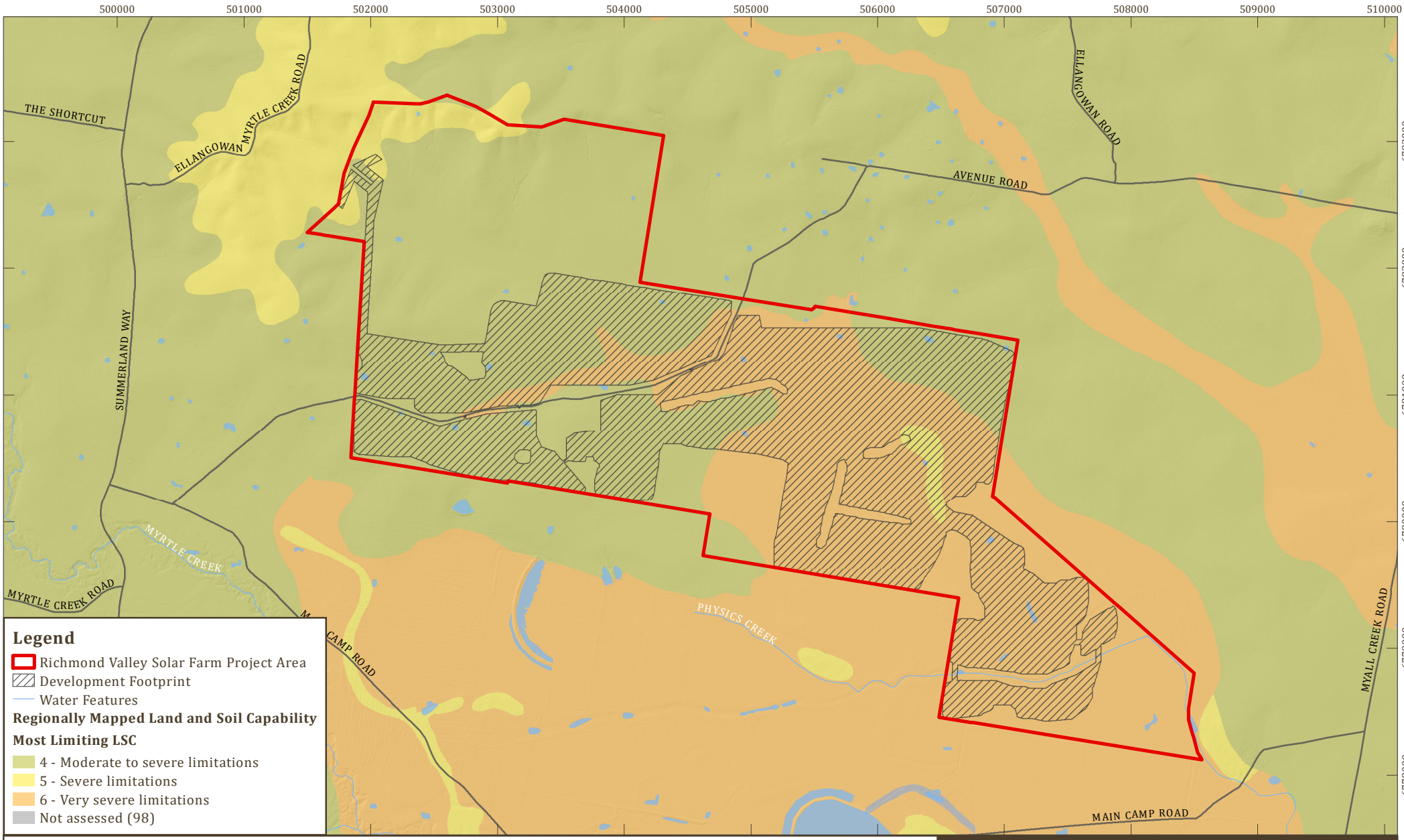
0 250 500 1,000 Meters

Scale 1:40000 at A4

Regionally Mapped Inherent Soil Fertility

FIGURE 10

MS105_010_InherentfertilityL 14/03/2024 1:12:04 AM



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

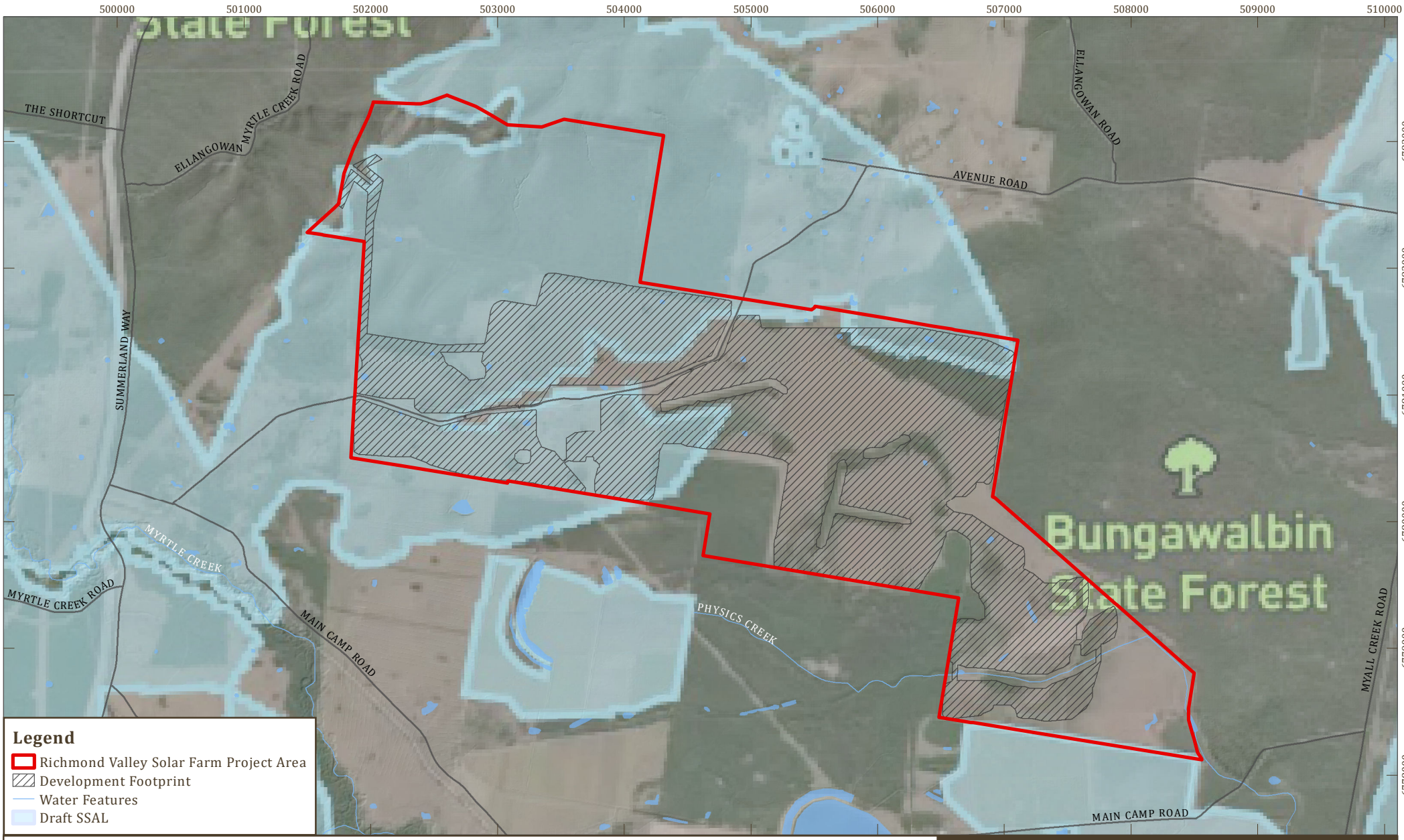
0 250 500 1,000 Meters

Scale 1:40000 at A4

Regionally Mapped Land and Soil Capability

FIGURE 11

MS105_011_RegionalLSCL 14/03/2024 1:14:40 AM


500000
501000
502000
503000
504000
505000
506000
507000
508000
509000
510000
6783000
6782000
6781000
6780000
6779000
6778000
THE SHORTCUT
ELLANGOWAN MYRTLE CREEK ROAD
ELLANGOWAN ROAD
AVENUE ROAD
SUMMERLAND WAY
MYRTLE CREEK
MYRTLE CREEK ROAD
MAIN CAMP ROAD
PHYSICS CREEK
MYALL CREEK ROAD
Bungawalbin State Forest
Legend
Richmond Valley Solar Farm Project Area
Development Footprint
Water Features
Draft SSAL
GDA 1994 MGA Zone 56
0 250 500 1,000 Meters
Scale 1:40000 at A4
MINESOILS
LAND & REHABILITATION SPECIALISTS
Draft State Significant Agricultural Land
FIGURE 12
MS105_012_SSALL 14/03/2024 1:17:09 AM

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.
- Recommendation of management and mitigation measures for minimising 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 Development Footprint.
- 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 and 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 Development Footprint which were avoided during excavation activities.

The survey area was the full 803 ha of the Development Footprint. A total of 39 sites were assessed, resulting in a survey intensity of 1 site per <25 ha. Soil profiles within the Development Footprint (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 9**. 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) (refer **Appendix 3**).

Soil samples were collected at each of the assessment site's soil horizons to a depth of 1 m, with a total of 128 samples collected. Minesoils chose 49 of these samples that were considered representative and subject to laboratory testing. The laboratory testing suite for these sites is detailed in the **Table 10**.

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

Table 9: 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 10: 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)	ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book')
Emerson Aggregate Test (EAT)	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 five dominant soil mapping units, as shown on **Figure 13**, and presented in **Table 11**:

- Soil Unit 1: Chromosols – covering 55 ha.
- Soil Unit 2: Kurosols – covering 191 ha.
- Soil Unit 3: Sodosols – covering 147 ha.
- Soil Unit 4: Dermosols – covering 339 ha.
- Soil Unit 5: Kandosols – covering 71 ha.

Soil Unit 1: Chromosols

Soil Unit 1 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.

This unit is characterised by loam topsoils with moderate structure overlying heavy clay subsoils with strong structure. pH is consistently moderately acidic with strong acidity occurring in the lower subsoil. These soils are consistently non-saline and non-sodic, mottled, imperfectly drained and deep.

This soil mapping unit occurs in close association with Soil Unit 1: Kurosols and Soil Unit 3: Sodosols, occupying undulating lower to mid slope areas. Representative sites for this unit, which include detailed laboratory data, consist of sites 1 and 6.

Soil Unit 2: Kurosols

Soil Unit 2 is characterised by Kurosols, which, as outlined in Section 3.2.1, are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2t horizon (or the major part of the entire B2t horizon if it is less than 0.2 m thick) is strongly acid.

This unit is characterised by loam, clay loam and silty loam topsoils with weak to moderate structure overlying light to heavy clay subsoils with moderate to strong structure. pH is consistently moderately to strongly acidic in the topsoil with strongly acidic subsoils, which are occasionally sodic. These soils are consistently non-saline, mottled, poorly to imperfectly drained and deep.

This soil mapping unit occurs in close association with Soil Unit 2: Sodosols and Soil Unit 3: Kurosols, occupying undulating lower to mid slope areas and open plains. Representative sites for this unit, which include detailed laboratory data, consist of sites 9 and 36.

Soil Unit 3: Sodosols

Soil Unit 3 is characterised by Sodosols, 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 sodic and not strongly acid. Soils with strongly subplastic upper B2 horizons are excluded.

This unit is characterised by loam and silty loam topsoils with weak to moderate structure overlying light-medium to heavy clay subsoils with moderate to strong structure. pH ranges from moderately and strongly acidic in the topsoil to moderately acidic in the upper B subsoil, occasionally trending to strongly acidic at depth. These soils are generally non-saline, with some exceptions of slightly to moderately saline subsoils. Soil profile drainage is imperfect and depth is generally deep. The sodic nature of this unit presents an increased management risk.

This soil mapping unit covers the lower, mid and upper slopes and crests that characterise the Development Footprint. Representative sites for this unit, which include detailed laboratory data, consist of sites 3, 16, 26 and 31.

Soil Unit 4: Dermosols

Soil Unit 4 is characterised by Dermosols, which are defined as soils which:

1. Have B2 horizons that have a grade of pedality greater than weak throughout the major part of the horizon, and
2. Do not have clear or abrupt textural B horizon.

This unit is characterised by silty clay, silty clay loam and clay topsoils with moderate to strong structure overlying medium to heavy clay subsoils with strong structure. pH ranges from strongly acidic to mildly alkaline. These soils are generally non saline, with an exception of the minor, sporadic presence of highly saline soil. Sodicity ranges from non-saline to strongly sodic. Soil profiles are imperfectly drained, and depth is anticipated to be very deep.

This soil mapping unit is the most dominant within the Development Footprint and occurs on open drainage plains. Representative sites for this unit, which include detailed laboratory data, consist of sites 5, 8, 10, 12, 18 and 24.

Soil Unit 5: Kandosols

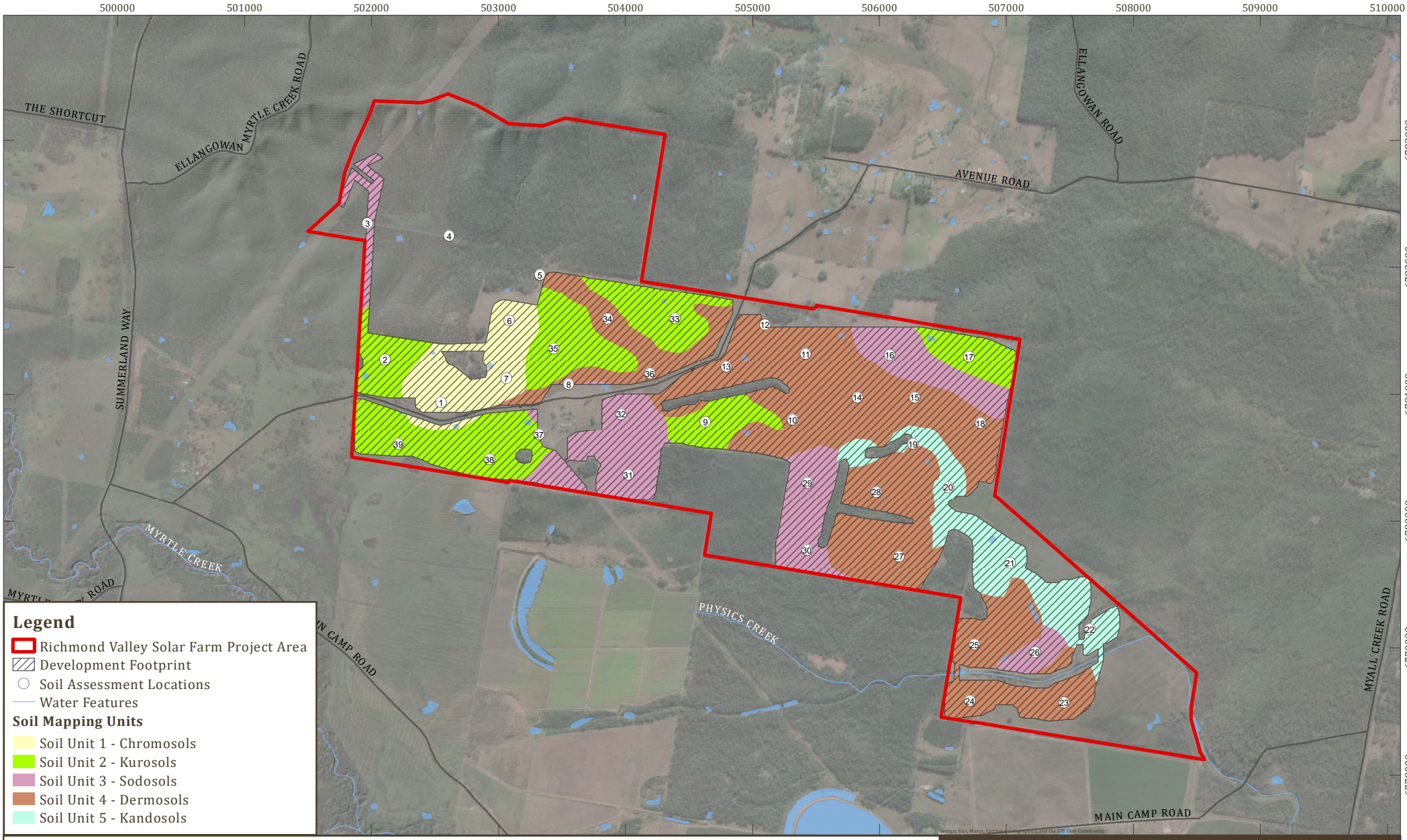
Soil Unit 5 is characterised by Kandosols, which are soils which have all of the following:

1. B2 horizons in which the major part has a grade of pedality that is massive or weak.
2. A maximum clay content in some part of the B2 horizon which exceeds 15% (ie. heavy sandy loam [SL+] or heavier).
3. Do not have a clear or abrupt textural B horizon.
4. Are not calcareous throughout the solum, or below the A1 or Ap horizon or to a depth of 0.2 m if the A1 horizon is only weakly developed.

This unit is characterised by sand, sandy loam, loam and loamy sand profiles with weak to moderate topsoils and massive or weakly structured subsoils, which are consistently non-saline, strongly acidic, and generally sodic. Soil profile drainage ranges from well to imperfectly drained, and depth is anticipated to be very deep.

This soil mapping unit occurs on open drainage plains in close association with Soil unit 4. Representative sites for this unit, which include detailed laboratory data, consist of sites 19 and 21.

Full soil profile descriptions are included as **Appendix 3**. Laboratory certificates of analysis are included as **Appendix 4**.



MS105_013_SMUsL 14/03/2024 8:15:41 PM

Table 11: Soil Mapping Units and Soil Units Summary

Site # (refer Figure 13)	Soil Mapping Units		Soil Profile - Australian Soil Classification	ASC Family Criteria
	#	Name		
1	1	Chromosols	Mottled Eutrophic Brown Chromosol	BELOWNR
2	2	Kurosols	Red Kurosol	-
3	3	Sodosols	Eutrophic Subnatric Brown Sodosol	BEMOWNR
4	3	Sodosols	Brown Sodosol	-
5	4	Dermosols	Mottled-Sodic Eutrophic Brown Dermosol	BEOOW
6	1	Chromosols	Mottled-Sodic Mesotrophic Red Chromosol	BELOWNR
7	1	Chromosols	Brown Chromosol	-
8	4	Dermosols	Mottled-Sodic Eutrophic Brown Dermosol	BEOOW
9	2	Kurosols	Bleached-Mottled Mesotrophic Grey Kurosol	BELOWNR
10	4	Dermosols	Acid-Sodic Mesotrophic Brown Dermosol	BEMOW
11	4	Dermosols	Grey Dermosol	-
12	4	Dermosols	Acid-Sodic Eutrophic Grey Dermosol	BEOOW
13	4	Dermosols	Brown Dermosol	-
14	4	Dermosols	Grey Dermosol	-
15	4	Dermosols	Brown Dermosol	-
16	3	Sodosols	Eutrophic Subnatric Brown Sodosol	BEMOWNR
17	2	Kurosols	Brown Kurosol	-
18	4	Dermosols	Mottled-Sodic Eutrophic Brown Dermosol	BEMOW
19	5	Kandosols	Mottled-Sodic Eutrophic Grey Kandosol	BFKLWNR
20	5	Kandosols	Grey Kandosol	-
21	5	Kandosols	Acidic Eutrophic Black Kandosol	BFLLVNR
22	5	Kandosols	Grey Kandosol	-
23	4	Dermosols	Brown Dermosol	-

Site # (refer Figure 13)	Soil Mapping Units		Soil Profile - Australian Soil Classification	ASC Family Criteria
	#	Name		
24	4	Dermosols	Sodic Eutrophic Black Dermosol	BEOOW
25	4	Dermosols	Grey Dermosol	-
26	3	Sodosols	Eutrophic Mesonatric Grey Sodosol	BEKOWNR
27	4	Dermosols	Red Dermosol	-
28	4	Dermosols	Black Dermosol	-
29	3	Sodosols	Grey Sodosol	-
30	3	Sodosols	Brown Sodosol	-
31	3	Sodosols	Eutrophic Subnatric Grey Sodosol	BFMOWNR
32	3	Sodosols	Grey Sodosol	-
33	2	Kurosols	Brown Kurosol	-
34	4	Dermosols	Brown Dermosol	-
35	2	Kurosols	Brown Kurosol	-
36	4	Dermosols	Brown Dermosol	-
37	2	Kurosols	Mottled-Sodic Natric Brown Kurosol	BEMOWNR
38	2	Kurosols	Red Kurosol	-
39	2	Kurosols	Brown Kurosol	-

Soil Erodibility

Soil aggregate stability refers to the stability of soil structural units (aggregates) when immersed in water. Instability may be indicated by slaking or clay dispersion. A soil with low aggregate stability is likely to be less resilient to mechanical impacts, more likely to be compacted and poorly structured, or susceptible to tunnelling if used for earthworks. The Emerson Aggregate Test (EAT) classifies the behaviour of soil aggregates, when immersed, on their coherence in water. **Table 12** shows the EAT class and the dispersion degree during testing and resulting risk of dispersion for that soil.

Table 12: Dispersion Degree and Risk Correlation to EAT Class

EAT Class	Dispersion	
	Degree	Risk
1	Complete dispersion	Very High
2	Partial dispersion	High
3	Complete or partial dispersion after remoulding	Moderate
4 - 8	Well aggregated with no dispersion after remoulding	Negligible

Source: Adapted from Hazelton and Murphy (2011)

Emerson Class Numbers of 1 and 2 indicates a high to very high potential for the soil to disperse when inundated with water. These classes represent the greatest erosion and sediment control hazard to surface disturbance works.

Emerson Class Numbers of 3 indicate that while the soil is only slightly dispersive, the remoulding and breaking down of soil bonds can result in increased dispersive behaviour. Remoulding of the soil at a moisture content near the optimum for compaction (simulating the use of these soils in a filling and compaction operation) does not increase the potential for dispersive behaviour, however further breakdown of the soil may occur, by water turbulence or concentrated rapid water flow. Under these circumstances this class of soil may disperse.

Emerson Class Numbers greater than 4 have a low potential for dispersive behaviour. Some swelling or slaking may occur but generally such soils are not readily dispersive.

Table 13 highlights the lowest Emerson Class Number recorded for select laboratory data representative sites of the Development Footprint, as an indicator of highest potential risk during disturbance activities.

Table 13: Potential Dispersion Risk

Site No.	ASC	Soil Depth (m)	EAT	Potential Risk
1	Mottled Eutrophic Brown Chromosol	0.20 - 0.30	4	Negligible
		0.50 - 0.60	4	Negligible
3	Eutrophic Subnatric Brown Sodosol	0.20 - 0.30	3	Moderate
		0.50 - 0.60	3	Moderate
5	Mottled-Sodic Eutrophic Brown Dermosol	0.20 - 0.30	3	Moderate
		0.50 - 0.60	4	Negligible
6	Mottled-Sodic Mesotrophic Red Chromosol	0.20 - 0.30	4	Negligible
		0.50 - 0.60	3	Moderate
8	Mottled-Sodic Eutrophic Brown Dermosol	0.25 - 0.35	4	Negligible
		0.55 - 0.65	2	High
9	Bleached-Mottled Mesotrophic Grey Kurosol	0.50 - 0.60	4	Negligible
10	Acid-Sodic Mesotrophic Brown Dermosol	0.25 - 0.35	3	Moderate
		0.55 - 0.65	4	Negligible
12	Acid-Sodic Eutrophic Grey Dermosol	0.20 - 0.30	4	Negligible
		0.50 - 0.60	4	Negligible
16	Eutrophic Subnatric Brown Sodosol	0.20 - 0.30	3	Moderate
		0.50 - 0.60	2	High
18	Bottled-Sodic Natric Brown Kurosol	0.20 - 0.30	4	Negligible
		0.50 - 0.60	4	Negligible
19	Mottled-Sodic Eutrophic Grey Kandosol	0.50 - 0.60	2	High
21	Acidic Eutrophic Black Kandosol	0.20 - 0.30	3	Moderate
		0.50 - 0.60	4	Negligible
24	Sodic Eutrophic Black Dermosol	0.20 - 0.30	3	Moderate
		0.50 - 0.60	2	High
26	Eutrophic Mesonatric Grey Sodosol	0.50 - 0.60	2	High
31	Eutrophic Subnatric Grey Sodosol	0.20 - 0.30	3	Moderate
		0.50 - 0.60	3	Moderate
37	Mottled-Sodic Natric Brown Kurosol	0.25 - 0.35	4	Negligible
		0.55 - 0.65	4	Negligible

Based on site observation, which included assessment for indicators of erodibility, such as sheet or gully erosion, it can be concluded that there is a very minimal erosion and sedimentation risk associated with the topsoils currently present in the Development Footprint with evidence of minor sheet erosion. However, the dispersion risk status of the tested soils indicate there is moderate to high potential risk for dispersion of Soil Unit 3: Sodosols, Soil Unit 4: Dermosols, and Soil Unit 5: Kandosols.

The representative laboratory tested soils also indicate high levels of sodicity across all soils within the Development Footprint. While sodic soils are generally dispersive, it is important to acknowledge that not all sodic soils disperse, and that not all dispersive soils are sodic. However, given the ranges in salinity of the soils tested within the Development Footprint, all sodic soils should be considered dispersive.

Based on these results, there is a moderate to high potential risk for dispersion and erosion where soils are disturbed within the Development Footprint. 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.

Caution must be taken over the entire Development Footprint despite the range in chemical and physical properties or landscape location of specific soil test sites. The sodicity and dispersion risk variability throughout the Development Footprint indicates controls should be consistent and applied across the entire Development Footprint where any disturbance occurs (including changes to vegetation cover). Recommended control measures are presented in Section 6.2.1.

A summary of the erodibility of the Soil Units within the Development Footprint, which takes into account site observation, dispersion risk, the general physical and chemical characteristics of each unit, and landscape position, is presented in **Table 14**.

Table 14: Erosion Risk for Soil Units

Soil Unit #	Soil Unit Name	Erosion Risk
1	Chromosols	Low - Moderate
2	Kurosols	Moderate - High
3	Sodosols	High
4	Dermosols	Moderate - High
5	Kandosols	Moderate - High

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 Development Footprint 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.

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 39 soil test sites within the Development Footprint have been subject to the site verification assessment of LSC, in accordance with the LSC Guideline and outlined in Section 3.2.1.

Based on the results of the LSC verification assessment, it is concluded that the Development Footprint contains two LSC classes:

- LSC class 4: high capability land – covering 731 ha.
- LSC class 5: moderate capability land – covering 72 ha.

The 39 test sites and spatial extent of each LSC class is shown in **Figure 14**. The LSC verification assessment outcomes for the eight hazards group for the soil profiles assessed is presented in **Table 15**.

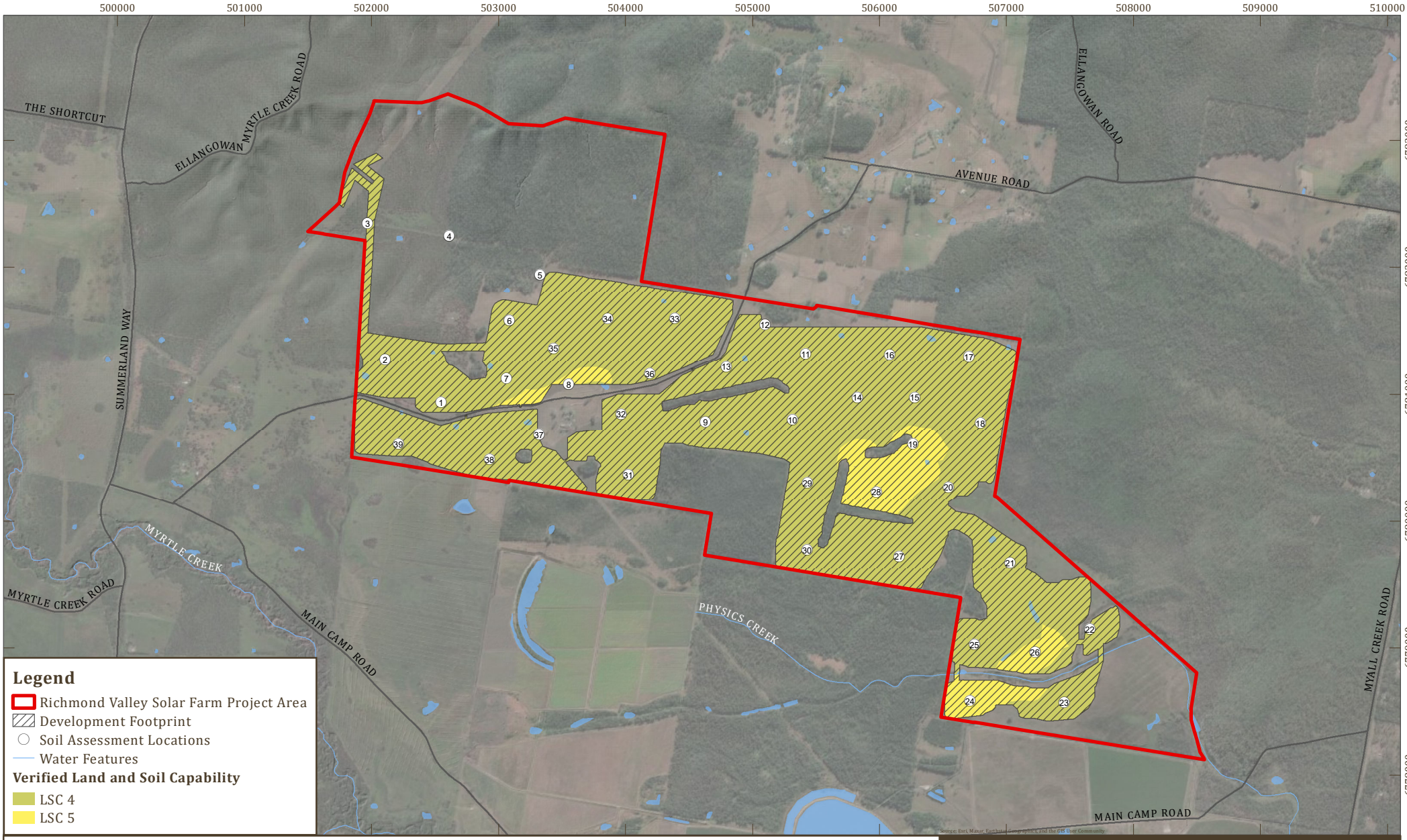
Class 4 land has moderate to high limitations for high-impact land uses that will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology. The key limitations of this class within the Development Footprint are soil structure decline, water-logging and soil acidity.

Class 5 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. The key limitations of this class within the Development Footprint are salinity, soil acidity and waterlogging.

Table 15: 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	Mottled Eutrophic Brown Chromosol	3	1	4	3	3	3	1	1	4
2	Red Kurosol	3	1	4	-	3	3	1	1	4
3	Eutrophic Subnatric Brown Sodosol	3	1	4	4	3	3	1	1	4
4	Brown Sodosol	2	1	4	-	3	4	1	1	4
5	Mottled-Sodic Eutrophic Brown Dermosol	2	1	3	2	3	4	1	1	4
6	Mottled-Sodic Mesotrophic Red Chromosol	2	1	4	4	3	3	1	1	4
7	Brown Chromosol	3	1	3	-	3	4	1	1	4
8	Mottled-Sodic Eutrophic Brown Dermosol	1	1	3	3	5	4	1	1	5
9	Bleached-Mottled Mesotrophic Grey Kurosol	3	1	4	3	3	4	1	1	4
10	Acid-Sodic Mesotrophic Brown Dermosol	1	1	4	4	3	4	1	1	4
11	Grey Dermosol	1	1	3	-	3	4	1	1	4
12	Acid-Sodic Eutrophic Grey Dermosol	1	1	3	3	3	4	1	1	4
13	Brown Dermosol	1	1	3	-	3	4	1	1	4
14	Grey Dermosol	1	1	3	-	3	4	1	1	4
15	Brown Dermosol	2	1	3	-	3	4	1	1	4
16	Eutrophic Subnatric Brown Sodosol	3	1	4	3	3	3	1	1	4
17	Brown Kurosol	3	1	4	-	3	2	4	1	4
18	Bottled-Sodic Natric Brown Kurosol	2	1	3	4	3	4	1	1	4
19	Mottled-Sodic Eutrophic Grey Kandosol	2	3	1	5	3	4	1	1	5
20	Grey Kandosol	2	1	4	-	3	4	1	1	4
21	Acidic Eutrophic Black Kandosol	2	1	4	4	3	4	3	1	4
22	Grey Kandosol	2	1	4	-	3	4	1	1	4
23	Brown Dermosol	1	1	4	-	3	4	1	1	4
24	Sodic Eutrophic Black Dermosol	1	1	4	3	3	5	1	1	5
25	Grey Dermosol	1	1	3	-	3	4	1	1	4
26	Eutrophic Mesonatric Grey Sodosol	2	3	1	5	3	4	1	1	5
27	Red Dermosol	2	1	3	-	3	4	1	1	4
28	Black Dermosol	1	1	3	-	3	5	1	1	5
29	Grey Sodosol	2	1	3	-	3	4	1	1	4

		Hazard Criteria								
		1	2	3	4	5	6	7	8	Overall
		Water erosion	Wind erosion	Structure	Acidity	Salinity	Water-logging	Soil depth	Movement	Class
30	Brown Sodosol	2	1	3	-	3	4	1	1	4
31	Eutrophic Subnatric Grey Sodosol	3	1	3	4	3	3	1	1	4
32	Grey Sodosol	3	1	4	-	3	3	1	1	4
33	Brown Kurosol	3	1	3	-	3	4	1	1	4
34	Brown Dermosol	1	1	3	-	3	4	1	1	4
35	Brown Kurosol	3	1	4	-	3	4	1	1	4
36	Brown Dermosol	1	1	3	-	3	4	1	1	4
37	Mottled-Sodic Natric Brown Kurosol	3	1	4	3	3	3	1	1	4
38	Red Kurosol	3	1	4	-	3	3	1	1	4
39	Brown Kurosol	3	1	4	-	3	3	1	1	4



MINESOILS
LAND & REHABILITATION SPECIALISTS

GDA 1994 MGA Zone 56

0 250 500 1,000 Meters

Scale 1:40000 at A4

Verified Land and Soil Capability

FIGURE 14

MS105_014_VerifLSCL 14/03/2024 8:13:40 PM

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/ biosecurity.

4.2 APPROACH

The LUCRA as presented in **Appendix 2** 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 proposed solar farm and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in **Appendix 2**. 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 2**.

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

4.3 FINDINGS

There are 45 risk items that 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. There are no high risk potential conflicts, however a number of items of potential conflict remain a moderate risk and may require further consultation and

management in addition to standard operations. These are summarised in **Table 16**. The LUCRA methodology including risk ranking matrix and full LUCRA assessment are included as **Appendix 2**.

Table 16: LUCRA Moderate Risk Items and Risk Controls Summary

Risk Item	Risk Reduction Controls
Land users in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect the Development Footprint and locality, including local waterways and dams, from surface disturbances during construction activities.	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. Ongoing consultation with stakeholders will identify and address concerns if they arise. 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 plan.
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.	The assessment of potential traffic impacts has been undertaken via A Traffic Impact Assessment (TIA). Appropriate mitigation measures are specified within the TIA to minimise impacts to the traffic environment, including reduced speed limits and increased number of road warning signs. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users. Ongoing consultation with stakeholders will identify and address concerns if they arise. There will be a 24/7 complaint line available. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).
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 solar farm.	The assessment of visual impacts to surrounding amenity has been undertaken via a Landscape and Visual Impact Assessment (LVIA). 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.
Land users in the locality may be concerned about weed, plant pest, plant disease or pest animal introduction and/or spread.	The assessment of impacts to biodiversity has been undertaken via a Biodiversity Development assessment Report (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 Development Footprint and onto neighbouring land. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).
Land users in the locality may be concerned about the risk of fires occurring at the Development Footprint and their potential to spread to surrounding land, infrastructure or livestock.	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. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).

Risk Item	Risk Reduction Controls
Landowners in the locality may be concerned about potential devaluation of properties due to proximity to solar farm infrastructure.	As outlined in the EIS, there are many factors that may influence land value, being amenities impact of the Project to the locality the key factor to devaluation. Given construction impacts will be temporary, it is unlikely to have a permanent impact on the amenity of the locality. The Project has been refined and where impacts could not be avoided, management and mitigation measures will be adopted to further reduce potential impacts that may cause devaluation of properties. This includes the introduction of vegetation screening and landscaping, and noise barriers to reduce potential views and noise disturbance of Project infrastructures. Therefore, the residual impacts of the Project during operational phase, after implementation of management and mitigation measures are predicted to be minimal. Ongoing consultation with stakeholders will identify and address concerns if they arise.
Stakeholders may be concern about potential impacts to biodiversity within the Development Footprint and locality.	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 Development Footprint 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.
Public Authorities may have concerns regarding the potential for cumulative impacts arising from the proximity of state significant developments.	An assessment of potential cumulative impacts has been undertaken as part of the EIS. Appropriate mitigation measures (where required) are specified in the EIS to minimise the potential for cumulative impacts to occur at or near the Development Footprint. Anticipated impacts are determined to be minor and presented in the EIS for Public Authority consideration.
Stakeholders may be concerned about the potential for poor rehabilitation outcomes and the resulting long term environmental and agricultural consequence.	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 over 786 ha following decommissioning.

5 IMPACTS ON AGRICULTURAL LAND

The impacts solar farming activities 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 the Development Footprint over the full life of the Project, including the construction, operation and decommissioning phases. Permanent impacts may include changes to land and soil capability and agricultural resources of the Development Footprint. Permanent impacts are irreversible and can be mitigated by the reinstatement of agricultural lands and land productivity to a pre-disturbance condition and productivity. Australian solar farming practices assessed in recent years have generally presented a low risk of permanent and irreversible impacts to agricultural land.

Modern solar farms have a relatively light footprint on the land compared with other forms of development. For example, in contemporary solar farms, steel piles that support the solar arrays are driven directly into the soil, without the need for concrete foundations. This light footprint makes it relatively straight forward to return solar farms to their former land uses at the end of their permitted operating life. It is anticipated that any conditions of planning consent will define the obligations for removal of infrastructure and reinstatement of the land at the end of the operating phase of the project

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 Development Footprint and in the wider region, across five risk areas:

1. Changes in the amount of land used for agriculture.
2. Changes to agricultural productivity and agricultural enterprises.
3. Changes to agricultural resources.
4. Other potential impacts to agriculture considered for the Project.
5. Cumulative impacts of the potential for multiple solar farms within the region.

5.1 LAND USED FOR AGRICULTURE

The Project will be undertaken on an area of approximately 790 ha of land that is currently subject to agriculture land use. The Proponent may use part or as much of the Development Footprint as possible for agricultural purposes during the operational phase of the Project. Land being used simultaneously for agriculture and the solar farm is known as agrisolar and is further described in Section 6.4. However, for the purpose of this assessment and to apply a conservative approach, it is assumed that the agriculture will cease within the Development Footprint for the duration of the Project.

Therefore, there will be a temporary decrease of approximately 790 ha of land used for agriculture for the duration of the Project. It is anticipated that agricultural land use will be re-established over 786 ha of agricultural land at the time of decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities). The only permanent decrease in land available for agriculture use will be associated with the Switching Substation which may remain post-Project, and has a footprint of approximately 4 ha. This would be up to the discretion of the asset's owner, Transgrid.

Therefore, within the Development Footprint there will be a temporary reduction in land used for agricultural over an area of approximately 790 ha, and a permanent reduction of land used for agriculture over an area of approximately 4 ha.

Current agricultural land use surrounding to the Development Footprint, 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.

The permanent reduction of 4 ha is considered a negligible impact in the context of the land area subject to agriculture use in the Richmond Valley Council LGA as outlined in Section 2.4.1 (0.0007%).

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 temporary impact of the Project on productivity of agricultural land based on the change in land use for the duration of the Project is up to $305,572 per year. This reduction is considered a negligible impact in the context of the agricultural industry gross value of the Richmond Valley Council LGA as outlined in Section 2.4.2 (0.4%).

Due to the minimal disturbance to the landform, following the life of the Project, 786 ha of land removed from agriculture will be returned to agricultural use, with no reductions in land and soil capability. Agricultural enterprises can then re-commence at an equivalent agricultural productivity.

The permanent impact of the Project on productivity of agricultural land based on the removal of the remaining 4 ha following the Project is estimated up to $1,547 per year. The permanent reduction of $1,547 per year is considered negligible impact in the context of the agricultural industry gross value of the Richmond Valley Council LGA as outlined in Section 2.4.2 (0.002%).

5.2.2 PRODUCTIVITY OF LAND WITHIN LOCALITY

Agricultural productivity of land outside of the Development Footprint 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. Impacts may be experienced for contracting services associated with cultivation activities, weed control, sowing, stock feeding, cutting, raking, bailing, and harvesting services. However, changes to the supply and viability of agricultural support services in the main service centres of Grafton and Casino are driven by social and market trends far exceeding the scale of the anticipated 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

Over the majority of the Development Footprint, soils will be subject to minor disturbance as part of the construction or maintenance of solar arrays and electrical cabling trenches. In areas where earthworks are necessary for construction of the BESS, substation and Switching Substation, 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.

Land clearing activities associated with the construction phase will be controlled and managed through the effective implementation of a Construction Environmental Management Plan (CEMP). Furthermore, a Vegetation Management Plan will be developed for the operational phase of the Project to maintain groundcover.

Overall, the impacts to the soils of the Development Footprint are expected to be minimal and temporary. The exception is the Switching Substation footprint area of 4 ha, which will be permanently disturbed as a result of the Project.

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

Soil impact mitigation measures are outlined in Section 6.2.

5.3.2 LAND AND SOIL CAPABILITY

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. The preliminary surface Development Footprint for large site infrastructure is shown on **Figure 2**.

Following the end of life for the Project, Development Footprint 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, with the exception of the Switching Substation footprint area of 4 ha, which will be permanently removed from LSC classification.

Therefore, it is anticipated there will be no permanent impacts on LSC classes as a result of the Project over the 821 ha being returned to agriculture.

5.3.3 WATER

Water for construction would be sourced from commercial suppliers in the nearby region (via water trucks) and farm dams located within the Project Area. Water sources would be determined prior to the commencement of construction in consultation with suppliers and landholders, subject to availability. A water sourcing strategy would be developed to ensure there are no water supply impacts to adjacent landowners or other stakeholders.

Based on the above, it is anticipated that the Project's proposed water use during construction and decommissioning would not have a negative impact on water supply to the Project Area and the region.

During operations, a minimal water demand would be required for ongoing maintenance activities washing PV panels, amenities, and potable purposes by operational staff as well as for stock. Potable water demands for both the construction and operational phases of the Project will be primarily sourced from rainfall stored in on-site water tanks at the O&M facility and augmented by water trucks if required.

It is anticipated that the Project will have minor interaction with groundwater based on the extent of ground disturbance, depth of post holes for solar arrays and the features of the existing environment including the depth of nearby boreholes. Additional investigations will be undertaken to verify the depth groundwater prior to construction and support detailed design of ground disturbance and excavation across the Development Footprint to avoid intercepting groundwater.

Groundwater is not proposed to be used to supply water to the Project and the depth to groundwater within the Project Area (based on available information) means that groundwater quality impacts are also unlikely.

There will be no impacts to groundwater resources, including GDEs and bore users, during operation on the basis that the groundwater table will not be intercepted.

Should the final Project design identify that construction activities will result in the interception of the groundwater table, further assessment will be undertaken in accordance with the NSW *Aquifer Interference Policy* (NSW Government, 2012) and appropriate management measures developed to mitigate any potential impacts.

5.3.4 EROSION AND SEDIMENTATION

Erosion risks are associated with the widespread presence of sodic and dispersive soils with a moderate to high potential dispersion risk and are anticipated where higher impact surface disturbance is undertaken (such as earthworks for infrastructure). Suitable erosion and sedimentation controls, as outlined in Section 6.2, will be implemented that target these specific erosion hazards to reduce impacts to surface soils and waterways.

With the implementation of these mitigation measures, it is expected that direct and indirect erosion and sedimentation risks would be limited and manageable.

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).

Within the Development Footprint, enough fences, dams and access tracks may be retained or reinstated during operations to accommodate potential agrisolar or other land sharing opportunities, as required.

The dams within the Development Footprint to be decommissioned during construction 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 WEEDS AND PEST SPECIES

Weeds and pest species could be inadvertently brought into the Development Footprint 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 hindrance to rehabilitation, regeneration activities, and agricultural endeavours.

Weeds in general will be managed across the site through a series of control measures, including:

- Prior to re-spreading stockpiled topsoil onto the disturbance area, an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.
- Rehabilitation monitoring programs and routine inspections will be undertaken to identify potential weed infestations; and
- There will be an ongoing effort to identify and eliminate (spray) existing weed populations on-site over the life of the Project.

The spread of declared noxious weeds will be prevented by using the measures above. The monitoring and control of weed populations using herbicides within the site will significantly reduce weed infestations. 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 animal control may potentially be undertaken in consultation with 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.

Feral animals may include goats, foxes, cats, rabbits, pigs, and dogs and will be controlled in accordance with Livestock Health and Pest Authority procedures.

With the effective implementation of measures to manage and control the spread of weeds and pest species within and around the Development Footprint, it is unlikely that weeds and pests will have an impact on agriculture within the Project locality.

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. At the local level, as per Section 5.4.1 above, appropriate weed management 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.

An agricultural biosecurity management plan detailing construction and operational risks and controls in relation to pests, weeds, and diseases will be prepared for the Project.

Controls should be included 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.

Controls are available to mitigate impacts on the biosecurity of agricultural resources and enterprises within the region.

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 CEMP, with the implementation of the CEMP and mitigation controls, 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 solar farm operations, leaving fewer transport options for agricultural enterprises.

The Summerland Way approximately 1 km from the Development Footprint and Avenue Road immediate to Development Footprint is anticipated to experience an increase in traffic volumes during the peak construction period. The Traffic Impact Assessment as detailed in the EIS determined the road network is able to accommodate the traffic generated by the development during the construction, operation and decommissioning stages.

Further, Avenue Road would be sealed to the site access point which will also reduce dust and traffic impacts.

Increased traffic will therefore not result in increases in levels of noise or dust, or transport times that would impact agricultural productivity or enterprises in the 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 traffic, farm equipment, wind through trees, birds and insects.

An assessment of the potential noise and vibration impacts has been prepared for the Project (Umwelt, 2024). The assessment found that during some stages of construction, exceedance of the noise management level was predicted to occur at some receivers but no receiver was predicted to be 'highly noise affected' (i.e. exposed to noise levels greater than 75 dB(A)). Reasonable and feasible noise mitigation measures have been recommended and will be required during the construction phase of the Project.

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). Construction noise levels are anticipated to be well below those found to impact livestock, where livestock will be located on non-associated properties adjacent to the Development Footprint. The predicted noise levels are therefore anticipated to pose a negligible impact on agricultural activities.

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 for the Project.

In the context of agriculture, increased cumulative impacts including changes to land used for agricultural, localised productivity, secondary productivity and some agricultural support services are likely to be experienced where solar farm Projects in the region do not implement agrisolar. Further, within the Myrtle Creek suburb boundary, there is 5,652 ha land mapped as SSAL(refer **Figure 12**). Of this land, 478 ha, or 8.5%, lies within the combined Development Footprints of the Project Development Footprint (279 ha or 5%), the Summerville Solar Farm Development Footprint (69 ha or 1.2%) and the Myrtle Creek Solar Farm Development Footprint (estimated at 130 ha, or 2.3%).

However, given the nature and scale of the established agricultural industries within the region that interface with renewable energy projects (that is, predominantly livestock grazing, with some broadacre cropping), it is anticipated that while reductions in agriculture being undertaken on lands mapped as SSAL within Myrtle Creek will occur, significant impacts to regional agricultural enterprises and support services, industry critical mass thresholds and regional agricultural infrastructure are unlikely to occur in the foreseeable future. On a broader scale, the cumulative risk to agricultural land and productivity across NSW because of large-scale solar development is estimated to be very low (DPE 2022). The Australian Energy Market Operator estimates that NSW will need

approximately 20,000 MW of large-scale solar generation by 2050. This would require approximately 40,000 ha of land or only 0.06% of rural land in NSW. Even in the highly unlikely scenario that all of NSW's solar generation were located on important agricultural land (this land covers around 13.8% of the state and is 6 to 7 times more agriculturally productive than the remaining 86.2% of the state) only 0.4% of this land would be required (DPE 2022).

6 MITIGATION MEASURES

The Project will include a number of measures to avoid, 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 enterprise.

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.

6.1 LAND AND SOIL DISTURBANCE MITIGATION

6.1.1 SOIL EROSION MANAGEMENT

Based on site observations and an analysis of laboratory data, there are significant erosion and sedimentation risks present at the Development Footprint, which could result in long term, irreversible agricultural impacts if suitable controls are not implemented.

Generally, channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures in accordance with the Landcom (2004) guidelines.

The Project will prepare an Erosion and Sediment Control Plan (ESCP) that addressed specific soil dispersion risks based on disturbance activity and phase of the Project. The ESCP 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 Development Footprint.
- Solar arrays are typically pole mounted, with the poles being supported on a driven or screw pile, so that there is minimal excavation required other than for electrical cabling.
- Construction areas should be progressively revegetated with grass and pasture species as installation of solar panels proceeds across the site.
- At locations where earthworks are necessary, such as for internal roads, 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.
- 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 disturbance areas 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.

- During operation, mounted solar panels will change orientation during the day, with any rainfall runoff being distributed in the area around each panel, and not drained permanently to a single point on the ground.
- Measures to manage any bare areas and erosion that develop beneath the solar arrays over time should be included in an operational management plan for implementation during ongoing operation of the proposal.
- Groundcover should be maintained at a minimum of 70% where practical (subject to long terms seasonal variations, such as drought), including if the site becomes subject to agrisolar or other dual land uses.

Decommissioning and Rehabilitation Phase

- A detailed Decommissioning and Rehabilitation Plan should be prepared within 18 months of the planned closure of the Project or as otherwise stated in the development consent conditions. 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 areas.

6.1.2 SOIL STRIPPING FOR REHABILITATION

Soil that is proposed to be disturbed during the Project will be stripped and re-used in construction and/or rehabilitation efforts in order to mitigate long term effects on the land and soil capability of the Development Footprint (with the exception of disturbance associated with piling, which will have a negligible impact to the soil profile and not warrant soil stripping and re-use methods).

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 area within the Development Footprint.

Soil Stripping Strategy

Laboratory soil analytical results (refer **Appendix 4**) 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 dispersion potential, sodicity and high acidity are the most common and significant limiting factors in determining 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 soils throughout the Development Footprint, targeted controls must be implemented to manage the risk of surface water erosion with potential to occur once excavated. Upon respreading, clay subsoils that have been excavated for trenching will be used exclusively as a subsoil, and encapsulated by the sandy and loamy topsoils with which they are currently capped.

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. 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 major 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 disturbance area, 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 best 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-tyned plough or disc harrow.

6.1.3 SOIL BIOLOGY MANAGEMENT

During the approximately 30 year life of the Project soil hydrological and ecological processes may be impacted. In addition to reducing the landscape's ability to support ecosystem services during the solar facility's lifespan, these changes may leave legacy effects that persist long after the installation is removed, if effective rehabilitation is not undertaken post decommissioning.

Based on the intensity of the panel array layout, the soil will be able to retain and store nutrients. Upon decommissioning the areas under the panels may be seen to have a short term decrease in productivity compared to adjacent areas, however commitments to achieve a groundcover level during the post operative period will be sufficient to increase soil productivity to match adjacent analogue areas.

Several mitigation measures are available for the operational phase to mitigate the long term impacts of the Projects on soil biological balance and nutrient availability. These include:

- Routine vegetation monitoring and maintenance.
- Erosion and sediment controls to preserve topsoil material.
- Routine monitoring and management of visible surface erosion, such as rilling caused by concentrated flows from infrastructure.
- Weed management strategies to promote continued presence of pasture species and seedbank within topsoil.

These should be incorporated into the Operational Environmental Management Plan, which will guide operational environmental management following the final design of the Project and would be approved by the relevant statutory authority.

A small soil sampling program is a means to demonstrate the ongoing protection of soil health during operation of the Projects. This may be required where existing grass cover is considered marginal.

Soil sterilisation, localised or widespread, remains a minor risk throughout the Project. However, soil rehabilitation measures at the decommissioning stage can be employed to restore soil biological balance and nutrient availability. Measures include the application of mulch and organic materials, fertilisers, soil ameliorants and regenerative farming practices. Further, the spacing between each of the solar panel rows are anticipated to remain biologically active and act as an established source of bioactivity for spreading into potentially sterilised islands following the removal of panels.

6.2 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 Operation Environmental Management Plan, that will assist in managing impacts on agricultural land will be stipulated in conditions of development consent.

These management plans, which 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.

6.3 DUAL LAND USE

Dual land use refers to co-developing the same area of land for both use as a solar farm as well as for agriculture activities (Clean Energy Council, 2021). By implementing complementary solar energy and agricultural production, impacts to existing agricultural land use and enterprises, including primary and secondary productivity, can be reduced.

Solar farms typically require access to relatively flat or gently sloping land in sunny areas within proximity to electricity transmission networks, where biodiversity impacts can be avoided or minimised. This often means that land which has been previously cleared or zoned for agricultural use is well-situated to host solar farm developments.

Where solar farms are proposed and developed, there is increasing interest in exploring the opportunities for complementary agricultural activities which can benefit from a number of the valuable characteristics of solar arrays, including:

- the provision of partial shading and weather protection (including sun, rain, hail and wind).
- improved soil moisture retention, which can lead to improved vegetation growth beneath the panels.
- protection from predators for sheep.

Livestock grazing under solar panels is referred to agrisolar. Sheep grazing is generally the only successfully implemented dual land use for similar sized solar farm projects in Australia. Agrisolar delivers benefits for the operation of solar farms, as the vegetation is maintained in a cost-effective and safe manner by reducing the need for mowing or spraying. This maintenance reduces the risk of fire hazard, protecting the solar assets and neighbouring properties. With the development of solar farms commencing in Australia from around 2015 onwards, the local experience of agrisolar practices is still developing and currently dominated by the practice of sheep grazing on solar farms (Clean Energy Council, 2021).

The Proponent is committed to exploring the integration of solar panel installation with agricultural use at the Development Footprint as a means of mitigating the impacts to agriculture. However, merino sheep, the most common livestock used for agrisolar in NSW, are considered potentially unsuitable for the local climate, which may inhibit implementation.

Alternative dual land use options will therefore also be considered. These may be implemented as part of cooperative trial and/or research efforts with involvement from government, universities, agronomy groups or other relevant business enterprises interested in pursuing dual land use opportunities.

6.4 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 17**.

Table 17: Summary of Mitigation Measures

Risk Category	Mitigation Measure
Agricultural Land Use	Consider implementing Agrisolar or other dual land use opportunities to reduce area of land removed from agricultural service. Agriculture land use will be re-established over 786 ha of agricultural land removed from agriculture at the time of decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities).
Agricultural Productivity	Consider implement Agrisolar at a suitable stocking rate for groundcover maintenance. Development Footprint will be returned to an agricultural productivity following the Project that is an approximate equivalent of pre-Project status.
Soil	All soil that is proposed to be disturbed during the Project will be stripped and re-used in construction and/or stockpiled for later use in decommissioning/rehabilitation as per recommendations in 6.2.2. Channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures. All soil resources are to be managed throughout construction, operation and decommissioning phases of the Project in accordance with an ESCP which should include recommendations outlined in Section 6.2.1
LSC	Return 786 ha of 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.
Erosion and Sedimentation	All soil resources are to be managed throughout construction, operation and decommissioning phases of the Project in accordance with an ESCP which should include recommendations outlined in Section 6.2.1.
Agricultural Infrastructure	Select stock fences, farm dams, and access tracks to be retained and maintained to accommodate agrisolar. Stock fences and farm dams to be reinstated during decommissioning to suit post-Project land use.
Pest Species	Pest species will be managed in accordance with measures outlined in Section 5.4.1
Biosecurity	Biosecurity will be managed in accordance with measures outlined in Section 5.4.2 and an Agricultural Biosecurity Management Plan prepared for the Project.

7 SUMMARY

There is a high level of certainty about the status of agricultural resources and enterprises in the Development Footprint, locality and broader region, based on the soil survey and 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 generally minor, temporary, and limited to the development footprint. These impacts can be summarised as the following:

- Temporary removal of 790 ha of arable land within the Development Footprint from agricultural land use for the duration of the Project.
- Temporary removal of potential agricultural primary productivity to the estimated value of up to $305,572 per year for the duration of the Project.
- Temporary impacts on soil resources and LSC within the Development Footprint where surface disturbance occurs.

Due to the Switching Substation infrastructure potentially remaining as a permanent feature of the Development Footprint following the Project, for the purpose of this assessment, the minor permanent impacts as a result of the Project consist of the following:

- Permanent removal of 4 ha from agricultural land use.
- Permanent removal of potential agricultural primary productivity to the estimated value of up to $1,547 per year.
- Permanent impacts on soil resources and LSC over 4 ha.

(Note that conditions of consent may require the removal of all above ground infrastructure so the impacts of the Switching Substation may not be permanent, however for the purpose of this assessment a conservative approach was taken.)

The temporary and permanent 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 Richmond Valley Council LGA. 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. Further, at the scale of the enterprises operating within the Development Footprint, impacts are considered offset as the involved landowner would be financially compensated.

Following construction and resting period of approximately one year, subject to the approval of Project stakeholders, the Applicant will consider dual land uses opportunities within the Project boundary.

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 productivity over the 786 ha area being returned to agriculture.

A summary of mitigation measures and management recommendations have been provided at Section 6.5 to eliminate the permanent risks and control the temporary risks of the Project on land and soil resources. The salvage of topsoil material for re-use purposes combined with sound erosion and sedimentation management practices during the construction, operational and decommissioning phases of the Project, will ensure rehabilitation requirements are able to be met and 786 ha of the 790 ha of agricultural land being disturbed is able to be returned to a pre-disturbance agricultural status.

8 REFERENCES

AgriFutures Australia (2019) *The Impact of Freight Costs on Australian Farms*

Australian Bureau of Statistics (2022a), Agricultural Commodities, Australia. Year 2020-2021. https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia

Australian Bureau of Statistics (2022b), Value of Agricultural Commodities Produced, Australia. Year 2020–2021 https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia

Bureau of Meteorology (2021). Climate statistics for Australian locations, Casino Airport AWS (station no. 058208) Australian Government. Accessed 9 Sep 2023 http://www.bom.gov.au/climate/averages/tables/cw_058208.shtml

Clean Energy Council (2021) *Australian Guide to Agrisolar for Large Scale Solar*

Elliot, G.L. and Reynolds, K.C. *in* Charman, P.E.V. and Murphy, B.W. (2007) *Soils their Properties and Management* (Oxford University Press, Australia).

Geoscience Australia (2016) *GA Surface Geology of Australia* MapServer, Canberra.

Isbell, R. F. (2021) *The Australian Soil Classification Third Edition* (CSIRO Publication, Australia).

McKenzie, N.J, Grundy, M.J., Webster, R. and Ringrose-Voase, A.J. (2008) *Guidelines for Surveying Soil and Land Resources (2nd Ed)*. CSIRO Publishing, Melbourne.

Meat and Livestock Australia (MLA) (2022) National Livestock Reporting Service – Saleyard Survey 2021-2022.

Morand, D. T. (2001), *Soil Landscapes of the Woodburn 1:100 000 Sheet*, Department of Land and Water Conservation, Sydney

NSW Department of Planning, Industry and Environment (2022) Retrieved of following layers: soil landscapes, soil types, inherent soil fertility, land and soil capability. espade.environment.nsw.gov.au

NSW Department of Planning and Environment (2022) *Large-Scale Solar Energy Guideline*

NSW Department of Primary Industries (2011) *Land and Use Conflict Risk Assessment Guide.*

NSW Department of Industry & Investment (2021) *Biosecurity Strategy*

NSW Department of Primary Industries (2023) *Farm Enterprise Budget Series - Summary of gross margins for NSW beef enterprises*

NSW Office of Environment and Heritage and DPI-OAS&FS (2013). *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land.*

NSW Office of Environment and Heritage (2012). *The land and soil capability assessment scheme: second approximation – A general rural land evaluation system for NSW.*

Richmond Valley Council (2012) *Richmond Valley Local Environmental Plan 2012*

Umwelt (2024) *Richmond Valley Solar Farm Noise and Vibration Impact Assessment*

Appendix 1
Agency Advice Items and Where Addressed in Report

Table A1: Agency Advice Items and Where Addressed in Report

Agency	Advice Item	Section Addressed
DPI - Agriculture	The AIS should include an assessment of agriculture on the site and locality, and the changes due to the proposed development during construction and operation.	**3, 5**
	The AIS should include an assessment of the state-wide scarcity of highly productive agricultural land and the relative amount of State Significant Agricultural Land in the Myrtle Creek locality and address the cumulative impacts of this proposal and other energy generation and transmission infrastructure in the vicinity.	**3.2.1, 5.5**
	Identification of agricultural land sharing opportunities needs to be included during the operation of the solar farm. Groundcover management should be addressed as part of this.	**6.3**
	Our recommendation is such cabling be buried to a depth greater than 500mm for this land use or be completely removed upon decommissioning. This will enable the land to return to full production including cropping/pasture improvement programs using agricultural machinery.	**1.2**
	The soil survey referred to in the SEARS should also include baseline information that can be used to determine rehabilitation goals.	**3**
	An agricultural biosecurity management plan detailing construction and operational risks and controls in relation to pests, weeds, and diseases should be required. The relevant weed or pest animals for a region are described in the regional plans or strategies issued by NSW Local Land Services.	**5.4.2**
Biodiversity and Conservation Division	6a. e EIS must map the following features relevant to water and soils including… Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).	**3.2.1**

Appendix 2
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 solar farm 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 Development Footprint 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 A2.1**) 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 A2.1: Risk Ranking Matrix

	Probability				
Consequence	**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 A2.2**) and 5 levels of 'consequence', (a number 1 to 5 as defined in **Table A2.3**) 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 A2.2: 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 A2.3: Consequence Definitions

	Description	Example of Implications
Level 1		
Severe	• Severe and/or permanent damage to the environment • Irreversible • Severe impact on the community • Neighbours are in prolonged dispute and legal action involved	• Harm or death to animals, fish, birds or plants • Long term damage to soil or water • Odours so offensive some people are evacuated or leave voluntarily • Many public complaints and serious damage to Council's reputation • Contravenes Protection of the Environment & Operations Act and the conditions of Council's licences and permits. Almost certain prosecution under the POEO Act
Level 2		
Major	• Serious and/or long-term impact to the environment • Long-term management implications • Serious impact on the community • Neighbours are in serious dispute	• Water, soil or air impacted, possibly in the long term • Harm to animals, fish or birds or plants • Public complaints. Neighbour disputes occur. Impacts pass quickly • Contravenes the conditions of Council's licences, permits and the POEO Act • Likely prosecution
Level 3		
Moderate	• Moderate and/or medium-term impact to the environment and community • Some ongoing management implications • Neighbour disputes occur	• Water or soil known to be affected, probably in the short to medium-term (e.g. 1-5 years) • Management could include significant change of management needed for agricultural enterprises to continue
Level 4		
Minor	• Minor and/or short-term impact to the environment and community • Can be effectively managed as part of normal operations • Infrequent disputes between neighbours	• Theoretically could affect the environment or people but no impacts noticed • No complaints to Council • Does not affect the legal compliance status of Council
Level 5		
Negligible	• Very minor impact to the environment and community • Can be effectively managed as part of normal operations • Neighbour disputes unlikely	• No measurable or identifiable impact on the environment • No measurable impact on the community or impact is generally acceptable

(Source: DPI, 2011)

LUCRA Table

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction	Land users in the locality may be concerned construction activity disturbances may affect livestock behaviour and/or breeding.	D	3	9	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). Appropriate mitigation measures are specified within the NIA to minimise noise impacts. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on agricultural land users. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Any complaints from neighbours regarding effects to livestock can be managed within normal operations.
Construction	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.	D	3	9	The assessment of potential dust impacts has been undertaken as part of the EIS. With the implementation of mitigation measures, the Project can be constructed without any significant impact to local and regional air quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to air quality impacts. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	4	3	Effectiveness of mitigation measures will be measured as part of the Environmental Management System (EMS), which will include a Construction Environmental Management Plan (CEMP) that outlines dust suppression strategies.
Construction	Increased noise generated by construction activities and heavy vehicle movements may be perceived as nuisance to surrounding residential properties.	C	4	8	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). Appropriate mitigation measures are specified within the NIA to minimise noise impacts. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on agricultural land users. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, which will include reference to relevant noise criteria.
Construction	Land users in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect the Study Area and locality, including local waterways and dams, from surface disturbances during construction activities.	C	3	13	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. Ongoing consultation with stakeholders will identify and address concerns if they arise. 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 plan.	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the Soil and Water Management Plan (SWMP). Groundcover is maintained where possible and practical. Identified erosion areas progressively rehabilitated.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction	Use of surrounding roadways during construction of the solar farm may cause conflict by interacting with agricultural and/or local transport activities, and/or resulting in additional travel time for road users or potentially impacting / degrading the physical condition of local roads, particularly Avenue Road.	C	4	8	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, operation and decommissioning stages. 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. Liaison with relevant road authorities (ie. Council and Transport for NSW) regarding ongoing maintenance of road surface during construction Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved)	D	4	5	The EMS, specifically the Traffic Management Plan (TMP), will include a complaint resolution and disciplinary procedure as a mechanism to address any issues identified by neighbouring land users. Damaged or degraded roads to be repaired
Construction	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	The assessment of potential traffic impacts has been undertaken via a Traffic Impact Assessment (TIA). Appropriate mitigation measures are specified within the TIA to minimise impacts to the traffic environment, including reduced speed limits and increased number of road warning signs. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users. Ongoing consultation with stakeholders will identify and address concerns if they arise. There will be a 24/7 complaint line available. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	2	10	The EMS, specifically TMP, will include a complaint resolution and disciplinary procedure as a mechanism to address any issues identified by neighbouring land users.
Construction	Public authorities may be concerned 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	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. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	5	2	Effectiveness of mitigation measures will be measured as part of the EMS.
Construction	Stakeholders may have concerns that construction activities associated with the solar farm may damage existing infrastructure including transmission lines and public infrastructure.	C	4	8	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 Construction Environmental Management Plan (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. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS.	D	4	5	No damage to existing infrastructure including transmission lines during the construction phase due to project activities. Any impacts to public infrastructure will be remedied.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction	Stakeholders may have concerns that the construction and operation of the solar farm may alter and disturb existing soil properties, undermining the suitability of the land for future agricultural production.	C	2	18	The assessment of soil characteristics, erodibility and land and soil capability has been undertaken within this agricultural 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. Implement all measures specified in this report and associated management plans identified in the EIS and/or consent conditions (if approved).	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the Soil and Water Management Plan (SWMP).
Agriculture Cessation	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	The assessment of the reduction of land used for agriculture and the productivity of land has been undertaken within this agricultural assessment. Anticipated impacts and appropriate mitigation measures are provided within the agricultural impact assessment report for stakeholder consideration. A Decommissioning and Rehabilitation Management Plan will ensure the land can be successfully returned to agricultural production following decommissioning.	D	4	5	Rehabilitation objectives and strategies (including performance measures) will be established in the Decommissioning and Rehabilitation Management Plan.
Agriculture Cessation	Stakeholders in the locality may be concerned about the removal of agriculture over an area that is mapped as SSAL.	D	4	5	The identification of SSAL mapping within the Study Area has been undertaken within this agricultural assessment. SSAL mapping is currently draft only. Given that there is currently no assessment method to verify SSAL, or decision-making framework to prioritise SSAL in the context of developments such as the Project, no further consideration of SSAL is required.	D	5	2	Nil.
Agriculture Cessation	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 stakeholder 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.
Agriculture Cessation	Stakeholders may be concerned about impacts to agricultural industries and critical mass thresholds that determine viability.	D	4	5	The assessment of the impacts to agricultural industries has been undertaken within this agricultural assessment. Given the nature of agriculture being removed (i.e., cattle grazing) and in the context of the scale of the established agricultural industries within the region and wider state, impacts to critical mass thresholds and regional and state agricultural industries are unlikely to occur.	D	5	2	No complaints from wider agriculture industries due to Project activities.
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	D	4	5	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. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.

Activity	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.	D	3	9	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. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.
Operation Noise	Land users in the locality may be concerned about an increase in noise levels generated from power inverters, substation, transformer system, tracker motors and maintenance activities throughout the operational phase of the Project.	C	3	13	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). Anticipated impacts are determined presented in the EIS for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS. Noise does not exceed the adopted Noise Policy. Exceedance no greater than 5dBA above background levels.
Operation 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 solar farm.	B	3	17	The assessment of visual impacts to surrounding amenity has been undertaken via a Landscape and Visual Impact Assessment (LVIA). 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.	C	4	8	Effectiveness of mitigation measures will be measured as part of the EMS which will include reference to measures proposed to minimise visual impacts.
Operation Visual Amenity	The solar farm location and potential for glare and reflectivity has the potential to impact the amenity of surrounding residential properties.	C	3	13	The assessment of glare and reflectivity impacts to surrounding residential properties has been undertaken via a LVIA. Appropriate mitigation measures are specified within the LVIA to reduce and mitigate glare impact of the Project. Compliance with mitigation measures specified within the LVIA is anticipated to avoid potential glare impact from the Project. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS which will include reference to measures proposed to minimise glare impact.
Operation Social	Stakeholders in the locality may be concerned about impacts on agriculture-based tourism.	C	3	13	Consideration of potential impacts to agriculture-based tourism has been undertaken as part of the EIS. Anticipated impacts are determined to be negligible and presented in the EIS for stakeholder consideration. 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 which will include a complaint handling system.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operation Pest Control	Land users in the locality may be concerned about weed, plant pest, plant disease or pest animal introduction and/or spread.	B	2	21	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 Study Area and onto neighbouring land. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS, specifically Vegetation Management Plan (VMP).
Operation Pest Control	Neighbouring property owners may be concerned about sprays from weed control adversely affecting adjacent land.	D	4	5	Weed mitigation measures will be undertaken as per methodology specified in the Vegetation Management Plan (VMP) identified in the EIS and/or consent conditions (if approved), including spraying in a manner to prevent spray drift. 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, specifically Vegetation Management Plan (VMP).
Operation Pest Control	Land users in the locality may be concerned that waste generated by the development may increase the presence of pest animals and/or vermin which could impact agricultural productivity	D	4	5	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. Compliance with mitigation measures specified in the EIS is anticipated to reduce the risk of conflict related to pest animals and/or vermin. 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, specifically WMP.
General Operation	Land users in the locality may be concerned about changes to Study Area run-off water quality during operational phases of the Project	C	3	13	Consideration of impacts to surrounding water courses and water quality has been undertaken within the water impact assessment of 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. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved), such as an erosion and sediment control plan.	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	Land users in the locality may be concerned about the risk of fires occurring at the Study Area and their potential to spread to surrounding land, infrastructure or livestock.	C	2	18	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. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	2	10	Effectiveness of mitigation measures will be measured as part of the EMS. No fires caused by the construction, operation and decommissioning of the Study Area.
General Operation	Stakeholders in the locality may be concerned about the effects on local and regional employment.	C	1	4	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.	E	5	1	No unreasonable additional pressure to local employment due to project activities
General Operation	Neighbouring landowners may be concerned about livestock used for vegetation control on Study Area entering adjacent properties.	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. 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.
General Operation	Neighbouring landowners may be concerned about their livestock entering the Study Area 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 Study Area, 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.
General Operation	Land users in the locality 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.
General Operation	The placement of the solar farm on agriculturally viable land may cause conflict with surrounding agricultural and forestry operators interested in expanding their operations onto the Study Area.	C	3	13	Existing consultation and engagement for the Project has not identified any intent for surrounding agricultural or forestry enterprises to expand operations onto the Study Area in the short term. The reversibility of the Project would allow the Study Area to be returned to its existing agricultural land use, or made available for forestry use, therefore minimising potential for long term conflict.	E	3	6	Effectiveness of engagement will be measured as part of the EMS.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	The placement of the solar farm on land that may be viable for sub-division may cause conflict with surrounding business operators interested in expanding production onto the Study Area.	D	3	9	Existing consultation and engagement for the Project has not identified any intent for nearby enterprises to expand operations onto the Study Area in the short term. The reversibility of the project would allow the Study Area to be returned to its existing land use, therefore minimising potential for long term conflict.	E	3	6	Effectiveness of engagement will be measured as part of the EMS.
General Operation	The placement of the solar farm on land that may be viable for extractive industry (mining, quarrying) may cause conflict with stakeholders interested in development of the Study Area.	D	3	9	The Study Area is not located on land the subject of any current exploration or mining title claims or applications.	E	5	1	Nil.
General Operation	Local forestry operators may be concerned the Project may impact activities of forestry operations.	B	3	17	Consideration of impacts to surrounding forestry operations has been undertaken as part of the EIS. No interactions are expected between the Project and forestry land that would affect standard operations. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of engagement will be measured as part of the EMS.
General Operation	The placement of the solar farm in proximity to agricultural business operators may affect insurance premiums for surrounding private property owners.	C	3	13	The Project will implement measures to reduce bushfire risk and manage any potential impacts, such as incorporating an Asset Protection Zone (APZ) around the perimeter of the solar farm which ensures that fire cannot spread either from Project's infrastructures to surrounding properties or from adjoining properties. Therefore, avoiding the implications of costs and loss and difficulty in obtaining appropriate insurance for a reasonable premium. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Landowners in the locality may be concerned about potential devaluation of properties due to proximity to solar farm infrastructure.	B	3	17	As outlined in the EIS, there are many factors that may influence land value, being amenities impact of the Project to the locality the key factor to devaluation. Given construction impacts will be temporary, it is unlikely to have a permanent impact on the amenity of the locality. The Project has been refined and where impacts could not be avoided, management and mitigation measures will be adopted to further reduce potential impacts that may cause devaluation of properties. This includes the introduction of vegetation screening and landscaping, and noise barriers to reduce potential views and noise disturbance of Project infrastructures. Therefore, the residual impacts of the Project during operational phase, after implementation of management and mitigation measures are predicted to be minimal. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	3	9	Effectiveness of engagement will be measured as part of the EMS.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	Landowners in the locality may be concerned about potential increase in council rates as a result of the change in land use of the Study Area.	C	3	13	Under the *Local Government Act 1993* solar farms or renewable energy developments are not identified as a subcategory and as such they are required to be identified as a business category or agriculture or may be grouped with other locational activity. This could result in some increase in land value and subsequent increases in rates. However, it is not anticipated that this will impact land value or council rates on neighbouring agricultural properties. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Land users in the locality may be concerned that waste generated by the development has the potential to enter surrounding residential land.	D	4	5	Consideration of waste related impacts has been undertaken as part of the EIS. Risk will be mitigated by implementing standard operation measures specified in the WMP identified in the EIS and/or consent conditions (if approved). Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS, specifically WMP
General Operation	Land users in the locality may be concerned that the change in land use may attract people to the area who may not otherwise visit the area, including workers. This may be perceived to adversely affect a resident's security.	D	3	9	Workforce behaviour will be managed through the implementation of the EMS, which will encourage positive workforce behaviour. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	4	3	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Stakeholders may have concerns regarding the ownership of the Study Area i.e., whether it is a foreign-owned company	D	4	5	Engagement for the Project has introduced the Project and the Proponent 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.
General Operation	Stakeholders may be concerned about impacts to heritage items or values at the Study Area 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 Historic Heritage Assessment (HHA). Appropriate mitigation measures are specified within the ACHAR and HHA to minimise impacts to heritage. Compliance with mitigation measures specified within the ACHAR and HHA 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 an Aboriginal Cultural Heritage Management Plan (ACHMP) and Unanticipated Finds Protocol (UFP).

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	Stakeholders may be concern about potential impacts to biodiversity within the Study Area 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 Study Area 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 engagement will be measured as part of the EMS.
General Operation	Public Authorities may have concerns regarding the potential for cumulative impacts arising from the proximity of state significant developments.	B	3	17	An assessment of potential cumulative impacts has been undertaken as part of the EIS. Appropriate mitigation measures (where required) are specified in the EIS to minimise the potential for cumulative impacts to occur at or near the Study Area. Anticipated impacts are determined to be minor and presented in the EIS for Public Authority consideration.	D	3	9	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Dispersion of dust and/or pollen from agricultural/ forestry operations on surrounding land uses may impact the productivity of the solar farm panels, potentially causing conflict between agricultural land users and the solar	C	4	8	Compliance with mitigation measures specified within the EIS together within the ongoing maintenance of solar panels and Study Area infrastructure, is anticipated to reduce the risk of conflict related to the functioning of the solar farm panels.	D	5	2	No impact to solar farm operations or infrastructure.
Decommissioning	Amenity impacts (noise and dust) associated with decommissioning of the project infrastructure and rehabilitation of the Study Area	D	3	9	Continued implementation of the EMS Ensure potentially affected sensitive receivers have access to a Study Area contact to report issues and are consulted as to the potential impacts from decommissioning. Reduce speed of vehicles accessing the Study Area.	D	4	5	No exceedances of noise and dust criteria
Decommissioning	Inadequate removal of infrastructure including commercial and industrial wastes.	D	3	9	Removal of infrastructure and remediation of Study Area to an agreed standard is stipulated in land contracts with Project landowners. Removal of infrastructure and remediation of Study Area will be a condition of project approval/ consent. The adequacy of removal will be as required through relevant legislation, such as the POEO Act 1997 prior to returning the Study Area back to the landowners.	D	4	5	Complete removal of infrastructure including commercial and industrial wastes as per Project consent conditions
Decommissioning	Stakeholders may be concerned about the potential for poor rehabilitation outcomes and the resulting 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 3
Soil Profile Descriptions

Site Description – Site 1				
Site Reference	1	**ASC Name**	Mottled Eutrophic Brown Chromosol (BELOWNR)	
Average Slope	5%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Midslope	**Drainage**	Imperfect	X: 502547
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780936

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Very dark brown (Munsell 7.5YR 2.5/3) Loam with strong pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Abrupt boundary.
B21	**0.20 – 0.50**	Very dark brown (Munsell 7.5YR 2.5/3) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Common roots and imperfectly drained. 40% distinct red mottling. Gradual boundary.
B22	**0.50 +**	Dark brown (Munsell 7.5YR 3/4) Heavy Clay with moderate pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Trace roots and imperfectly drained. 30% distinct red mottling.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.4	Non-saline	5.6	Moderately Acidic	3.7	Non sodic
0.20 – 0.30	0.1	Non-saline	6.0	Moderately Acidic	3.7	Non sodic
0.50 – 0.60	0.2	Non-saline	5.8	Moderately Acidic	4.3	Non sodic

Site Description – Site 2				
Site Reference	2	**ASC Name**	Red Kurosol	
Average Slope	4%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Crest	**Drainage**	Imperfect	X: 502107
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781273

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark brown (Munsell 7.5YR 3/2) Loam with moderate pedality, rough fabric and moderate consistence. 5% coarse fragments 5mm. Many roots and well drained. Clear boundary.
B21	**0.15 – 0.50**	Dark red (Munsell 2.5YR 3/6) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. 40% distinct grey mottling. Gradual boundary.
B22	**0.50 +**	Light grey (Munsell 5YR 7/1) Heavy Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Very few roots and imperfectly drained. 40% distinct red mottling.

Site Description – Site 3				
Site Reference	3	**ASC Name**	Eutrophic Subnatric Brown Sodosol (BEMOWNR)	
Average Slope	5%	**Land Use**	Bushland	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Midslope	**Drainage**	Imperfect	X: 501968
Surface Condition	Firm	**Permeability**	Moderate	Y: 6782345

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark brown (Munsell 7.5YR 3/4) Silty Loam with moderate pedality, earthy fabric and weak consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Abrupt boundary.
B21	**0.20 – 0.80**	Dark yellowish brown (Munsell 10YR 3/4) Light Medium Clay with strong pedality, rough fabric and strong consistence. Moderately to strongly acidic pH, non-saline to slightly saline and sodic. No coarse fragments. Common roots and imperfectly drained. 20% distinct orange mottling. 20% distinct grey mottling. Clear boundary.
B22	**0.80 +**	Light brownish grey (Munsell 10YR 6/2) Heavy Clay with moderate pedality, rough fabric and strong consistence. Very strongly acidic pH, moderately saline and sodic. No coarse fragments. No roots and imperfectly drained. 40% distinct red mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.6	Non-saline	5.5	Strongly Acidic	6.5	Sodic
0.20 – 0.30	1.2	Non-saline	5.5	Moderately Acidic	11.5	Sodic
0.50 – 0.60	3.0	Slightly saline	5.1	Strongly Acidic	19.6	Sodic
0.80 – 0.90	6.6	Moderately saline	5.0	Very Strongly Acidic	25.2	Sodic

Site Description – Site 4				
Site Reference	4	**ASC Name**	Brown Sodosol	
Average Slope	2%	**Land Use**	Bushland	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Flat	**Drainage**	Moderately Well	X: 502611
Surface Condition	Firm	**Permeability**	Moderate	Y: 6782247

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) Loam with weak pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.15 – 0.55**	Dark brown (Munsell 10YR 3/3) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and moderately drained. 20% faint orange mottling. Gradual boundary.
B22	**0.55 +**	Yellowish brown (Munsell 10YR 5/4) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. No roots and moderately drained.

Site Description – Site 5				
Site Reference	5	**ASC Name**	Mottled-Sodic Eutrophic Brown Dermosol (BEOOW)	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Moderately Well	X: 503326
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781938

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) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and non-sodic. Many roots and well drained. Gradual boundary.
B21	**0.20 – 0.50**	Dark yellowish brown (Munsell 10YR 3/4) Heavy Clay with strong pedality, rough fabric and strong consistence. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Few roots and moderately drained. 20% distinct grey mottling. Gradual boundary.
B22	**0.50 +**	Dark yellowish brown (Munsell 10YR 4/4) Heavy Clay with strong pedality, rough fabric and strong consistence. Slightly acidic pH, non-saline and sodic. No coarse fragments. Trace roots and moderately drained. 20% faint orange mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.3	Non-saline	5.9	Moderately Acidic	4.3	Non sodic
0.20 – 0.30	0.3	Non-saline	6.1	Slightly Acidic	5.1	Non sodic
0.50 – 0.60	1.6	Non-saline	6.1	Slightly Acidic	11.1	Sodic

Site Description – Site 6				
Site Reference	6	**ASC Name**	Mottled-Sodic Mesotrophic Red Chromosol (BELOWNR)	
Average Slope	2%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Crest	**Drainage**	Imperfect	X: 503087
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781581

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Very dark brown (Munsell 7.5YR 2.5/3) Loam with moderate pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.35**	Dark reddish brown (Munsell 5YR 3/3) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Few roots and imperfectly drained. 30% faint grey mottling. Clear boundary.
B22	**0.35 +**	Dark reddish brown (Munsell 5YR 3/3) Heavy Clay with moderate pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Very few roots and imperfectly drained. 20% distinct red mottling.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.4	Non-saline	5.7	Moderately Acidic	6.0	Non sodic
0.20 – 0.30	0.3	Non-saline	5.5	Moderately Acidic	5.0	Non sodic
0.50 – 0.60	0.4	Non-saline	5.4	Strongly Acidic	7.5	Sodic

Site Description – Site 7				
Site Reference	7	**ASC Name**	Brown Chromosol	
Average Slope	4%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Lower Slope	**Drainage**	Imperfect	X: 503062
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781124

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) Loam with moderate pedality, rough fabric and moderate consistence. 10% coarse fragments 5mm. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.40**	Yellowish brown (Munsell 10YR 5/4) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. 10% distinct red mottling. Gradual boundary.
B22	**0.40 +**	Pinkish grey (Munsell 5YR 6/2) Heavy Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Very few roots and imperfectly drained. 30% distinct red mottling.

Site Description – Site 8				
Site Reference	8	**ASC Name**	Mottled-Sodic Eutrophic Brown Dermosol (BEOOW)	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Poor	X: 503552
Surface Condition	Soft	**Permeability**	Moderate	Y: 6781081

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) Silty Clay with strong pedality, rough fabric and moderate consistence. Strongly acidic pH, moderately saline and sodic. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.55**	Brown (Munsell 10YR 4/3) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, moderately saline and sodic. No coarse fragments. Common roots and poorly drained. 20% distinct orange mottling. Clear boundary.
B22	**0.55 +**	Dark greyish brown (Munsell 10YR 4/2) Silty Clay with moderate pedality, rough fabric and strong consistence. Mildly alkaline pH, highly saline and sodic. No coarse fragments. No roots and poorly drained.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	5.6	Moderately saline	5.4	Strongly Acidic	21.9	Sodic
0.25 – 0.35	7.6	Moderately saline	5.7	Moderately Acidic	31.2	Sodic
0.55 – 0.66	13.0	Highly saline	7.4	Mildly Alkaline	32.9	Sodic

Site Description – Site 9				
Site Reference	9	**ASC Name**	Bleached-Mottled Mesotrophic Grey Kurosol (BELOWNR)	
Average Slope	3%	**Land Use**	Fodder Crop for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Lower Slope	**Drainage**	Poor	X: 504628
Surface Condition	Soft	**Permeability**	Moderate	Y: 6780783

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Very dark brown (Munsell 7.5YR 2.5/2) Loam with weak pedality, earthy fabric and weak consistence. Moderately acidic pH, non-saline and non-sodic. 20% coarse fragments 10mm. Many roots and well drained. Clear boundary.
A2	**0.20 – 0.40**	Bleached very pale brown (Munsell 10YR 8/2) Loam with weak pedality. Moderately acidic pH, non-saline and non-sodic. 30% coarse fragments 10mm. Common roots and imperfectly drained. Abrupt boundary.
B2	**0.40 +**	Dark grey (Munsell 5YR 4/1) Heavy Clay with strong pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and non-sodic. No coarse fragments. Very few roots and imperfectly drained. 40% distinct orange mottling, 20% distinct grey mottling.

Sample Depth	ECe		pH(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	5.7	Moderately Acidic	3.8	Non sodic
0.20 – 0.30	0.4	Non-saline	5.6	Moderately Acidic	5.3	Non sodic
0.50 – 0.60	0.2	Non-saline	5.5	Strongly Acidic	4.8	Non sodic

Site Description – Site 10				
Site Reference	10	**ASC Name**	Acid-Sodic Mesotrophic Brown Dermosol (BEMOW)	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 505316
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780799

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Very dark grey (Munsell 5YR 3/1) Silty Clay Loam with strong pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Many roots and moderately drained. Gradual boundary.
B21	**0.25 – 0.55**	Dark brown (Munsell 7.5YR 3/2) Silty Clay Loam with strong pedality, earthy fabric and strong consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. 10% faint orange mottling. Gradual boundary.
B22	**0.55 +**	Dark grey (Munsell 7.5YR 4/1) Heavy Clay with strong pedality, rough fabric and strong consistence. Very strongly acidic pH, non-saline and non-sodic. No coarse fragments. Trace roots and imperfectly drained. 20% distinct orange mottling.

Sample Depth	ECe		pH(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.0	Non-saline	5.4	Strongly Acidic	13.5	Sodic
0.25 – 0.35	0.7	Non-saline	5.2	Strongly Acidic	8.2	Sodic
0.55 – 0.65	1.1	Non-saline	4.6	Very Strongly Acidic	5.8	Non sodic

Site Description – Site 11				
Site Reference	11	**ASC Name**	Grey Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 505419
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781315

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark reddish brown (Munsell 5YR 3/2) Silty Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Many roots and moderately drained. Gradual boundary.
B21	**0.15 – 0.55**	Greyish brown (Munsell 10YR 5/2) Silty Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. Clear boundary.
B22	**0.55 +**	Grey (Munsell 10YR 6/1) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Trace roots and imperfectly drained. 10% distinct grey mottling.

Site Description – Site 12				
Site Reference	12	**ASC Name**	Acid-Sodic Eutrophic Grey Dermosol (BEOOW)	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 505101
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781546

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark grey (Munsell 7.5YR 4/1) Silty Clay with strong pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and moderately drained. Gradual boundary.
B21	**0.15 – 0.50**	Brown (Munsell 7.5YR 4/2) Heavy Clay with strong pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and non-sodic. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
B22	**0.50 +**	Dark grey (Munsell 7.5YR 4/1) Heavy Clay with strong pedality, rough fabric and strong consistence. Very strongly acidic pH, non-saline and sodic. No coarse fragments. Very few roots and moderately drained. 10% distinct red mottling.

Sample Depth	ECe		pH(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.7	Non-saline	5.4	Strongly Acidic	4.5	Non sodic
0.20 – 0.30	0.7	Non-saline	5.2	Strongly Acidic	5.1	Non sodic
0.50 – 0.60	1.6	Non-saline	4.7	Very Strongly Acidic	6.8	Sodic

Site Description – Site 13				
Site Reference	13	**ASC Name**	Brown Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 504794
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781218

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark brown (Munsell 7.5YR 3/2) Silty Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Many roots and moderately drained. Gradual boundary.
B21	**0.15 – 0.50**	Brown (Munsell 10YR 4/3) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
B22	**0.50 +**	Light brownish grey (Munsell 10YR 6/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Trace roots and moderately drained. 10% distinct red mottling.

Site Description – Site 14				
Site Reference	14	**ASC Name**	Grey Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 505829
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780976

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Dark brown (Munsell 7.5YR 3/2) Silty Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.10 – 0.40**	Grey (Munsell 7.5YR 5/1) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. Gradual boundary.
B22	**0.40 +**	Dark Grey (Munsell 7.5YR 4/1) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Very few roots and imperfectly drained.

Site Description – Site 15				
Site Reference	15	**ASC Name**	Brown Dermosol	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 506277
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780973

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark brown (Munsell 7.5YR 3/2) Silty Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.15 – 0.35**	Brown (Munsell 10YR 4/3) Heavy Clay with strong pedality, rough fabric and strong consistence. 10% coarse fragments 10mm. Few roots and imperfectly drained. Gradual boundary.
B22	**0.35 +**	Dark grey (Munsell 10YR 4/1) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Very few roots and imperfectly drained. 10% faint orange mottling.

Site Description – Site 16				
Site Reference	16	**ASC Name**	Eutrophic Subnatric Brown Sodosol (BEMOWNR)	
Average Slope	8%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Lower Slope	**Drainage**	Moderately Well	X: 506080
Surface Condition	Soft	**Permeability**	Moderate	Y: 6781311

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) Silty Loam with moderate pedality, rough fabric and moderate consistence. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Abrupt boundary.
B21	**0.20 – 0.50**	Yellowish brown (Munsell 10YR 5/4) Heavy Clay with strong pedality, rough fabric and strong consistence. Slightly acidic pH, non-saline and sodic. No coarse fragments. Few roots and moderately well drained. 10% faint orange mottling. Gradual boundary.
B22	**0.50 +**	Yellowish brown (Munsell 10YR 5/4) Silty Clay with moderate pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. No roots and moderately well drained. 10% faint grey mottling.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	6.3	Slightly Acidic	5.2	Non sodic
0.20 – 0.30	0.4	Non-saline	6.1	Slightly Acidic	8.2	Sodic
0.50 – 0.60	1.9	Non-saline	5.8	Moderately Acidic	14.0	Sodic

Site Description – Site 17				
Site Reference	17	**ASC Name**	Brown Kurosol	
Average Slope	7%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Upper Slope	**Drainage**	Moderately Well	X: 506704
Surface Condition	Soft	**Permeability**	Moderate	Y: 6781298

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark grey (Munsell 7.5YR 4/1) Silty Loam with moderate pedality, rough fabric and moderate consistence. 10% coarse fragments 10mm. Many roots and well drained. Clear boundary.
B2	**0.20 – 0.60**	Brown (Munsell 10YR 5/3) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and moderately well drained. 10% distinct orange mottling.
C	**0.60 +**	Decomposing parent material.

Site Description – Site 18				
Site Reference	18	**ASC Name**	Mottled-Sodic Eutrophic Brown Dermosol (BEMOW)	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderate	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 506796
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780771

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Dark brown (Munsell 7.5YR 3/2) Clay Loam with strong pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and non-sodic. 5% coarse fragments 10mm. Many roots and well drained. Gradual boundary.
B21	**0.10 – 0.45**	Brown (Munsell 10YR 4/3) Light Clay with strong pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and non-sodic. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
B22	**0.45 +**	Grey (Munsell 7.5YR 5/1) Medium Clay with strong pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Very few roots and imperfectly drained. 40% distinct red mottling. 10% distinct orange mottling.

Sample Depth	ECe		pH(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.4	Non-saline	5.5	Strongly Acidic	5.4	Non sodic
0.20 – 0.30	0.4	Non-saline	5.3	Strongly Acidic	3.5	Non sodic
0.50 – 0.60	0.6	Non-saline	5.3	Strongly Acidic	6.0	Sodic

Site Description – Site 19				
Site Reference	19	**ASC Name**	Mottled-Sodic Eutrophic Grey Kandosol (BFKLWNR)	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderate	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 506265
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780609

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Brown (Munsell 10YR 4/3) Sand with weak pedality, sandy fabric and weak consistence. Moderately acidic pH, non-saline and sodic. 10% coarse fragments 5mm. Many roots and well drained. Clear boundary.
A2	**0.15 – 0.35**	Brown (Munsell 10YR 4/3) Loamy Sand with weak pedality, sandy fabric and weak consistence. Slightly acidic pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. Abrupt boundary.
B2	**0.35 +**	Grey (Munsell 10YR 5/1) Sandy Loam with massive pedality, sandy fabric and weak consistence. Mildly alkaline pH, non-saline and sodic. No coarse fragments. Trace roots and imperfectly drained. 20% distinct orange mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.9	Non-saline	5.9	Moderately Acidic	15.0	Sodic
0.20 – 0.30	0.9	Non-saline	6.1	Slightly Acidic	22.1	Sodic
0.50 – 0.60	1.9	Non-saline	7.4	Mildly Alkaline	32.4	Sodic

Site Description – Site 20				
Site Reference	20	**ASC Name**	Grey Kandosol	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderate	MGA 56
Landform Element	Flat	**Drainage**	Moderately Well	X: 506544
Surface Condition	Soft	**Permeability**	Moderate	Y: 6780269

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A11	**0.00 – 0.15**	Dark brown (Munsell 7.5YR 3/4) Silty Loam with moderate pedality, sandy fabric and moderate consistence. No coarse fragments. Many roots and well drained. Gradual boundary.
A12	**0.15 – 0.40**	Brown (Munsell 7.5YR 4/2) Loam with moderate pedality, earthy fabric and moderate consistence. No coarse fragments. Common roots and imperfectly drained. Clear boundary.
A2	**0.40 – 0.60**	Bleached very pale brown (Munsell 10YR 7/3) Sandy Loam with weak pedality, sandy fabric and weak consistence. 20% coarse fragments 10 – 20mm. Common roots and imperfectly drained. Abrupt boundary.
B2	**0.60 +**	Grey (Munsell 7.5YR 6/1) Sandy Loam with massive pedality, sandy fabric and weak consistence. No coarse fragments. No roots and imperfectly drained. 20% distinct orange mottling.

Site Description – Site 21				
Site Reference	21	**ASC Name**	Acidic Eutrophic Black Kandosol (BFLLVNR)	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderate	MGA 56
Landform Element	Flat	**Drainage**	Well	X: 507028
Surface Condition	Soft	**Permeability**	High	Y: 6779671

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Brown (Munsell 7.5YR 4/2) Loam with moderate pedality. Strongly acidic pH, non-saline and sodic. 10% coarse fragments 5 – 10mm. Many roots and well drained. Gradual boundary.
B21	**0.15 – 0.40**	Dark brown (Munsell 7.5YR 3/2) Loam with massive pedality. Strongly acidic pH, non-saline and non-sodic. 10% coarse fragments 5 – 10mm. Common roots and well drained. Clear boundary.
B22	**0.40 – 0.80**	Light brownish grey (Munsell 10YR 6/2) Loamy Sand with weak pedality. Strongly acidic pH, non-saline and non-sodic. 30% coarse fragments 5 – 10mm. Few roots and well drained.
C	**0.80+**	Loose, decomposed parent material.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	5.2	Strongly Acidic	6.5	Sodic
0.20 – 0.30	0.2	Non-saline	5.3	Strongly Acidic	2.8	Non sodic
0.50 – 0.60	0.4	Non-saline	5.4	Strongly Acidic	3.9	Non sodic

Site Description – Site 22				
Site Reference	22	**ASC Name**	Grey Kandosol	
Average Slope	2%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderate	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 507658
Surface Condition	Soft	**Permeability**	Moderate	Y: 6779151

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Black (Munsell 7.5YR 2.5/1) Silty Loam with weak pedality, sandy fabric and weak consistence. 5% coarse fragments 5mm. Many roots and well drained. Clear boundary.
A2	**0.15 – 0.45**	Bleached very pale brown (Munsell 10YR 7/3) Silt Loam with weak pedality, sandy fabric and weak consistence. 5% coarse fragments 5mm. Common roots and imperfectly drained. Clear boundary.
B2	**0.45 +**	Grey (Munsell 7.5YR 6/1) Sandy Loam with massive pedality. No coarse fragments. Very few roots and imperfectly drained. 30% distinct orange mottling.

Site Description – Site 23				
Site Reference	23	**ASC Name**	Brown Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 507455
Surface Condition	Soft	**Permeability**	Moderate	Y: 6778571

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Dark brown (Munsell 7.5YR 3/2) Silty Loam with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.25 – 0.45**	Brown (Munsell 10YR 4/3) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. Clear boundary.
B22	**0.45 +**	Grey (Munsell 7.5YR 6/1) Heavy Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Trace roots and imperfectly drained.

Site Description – Site 24				
Site Reference	24	**ASC Name**	Sodic Eutrophic Black Dermosol (BEOOW)	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 506715
Surface Condition	Soft	**Permeability**	High	Y: 6778586

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Black (Munsell 10YR 2/1) Medium Clay with weak pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.15 – 0.40**	Black (Munsell 10YR 2/1) Silty Clay with moderate pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
B22	**0.40 +**	Very dark greyish brown (Munsell 10YR 3/2) Light Medium Clay with moderate pedality, rough fabric and strong consistence. Neutral pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. 10% faint orange mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.8	Non-saline	5.2	Strongly Acidic	8.0	Sodic
0.20 – 0.30	0.7	Non-saline	5.9	Moderately Acidic	11.8	Sodic
0.50 – 0.60	0.7	Non-saline	7.0	Neutral	13.3	Sodic

Site Description – Site 25				
Site Reference	25	**ASC Name**	Grey Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 506748
Surface Condition	Soft	**Permeability**	Moderate	Y: 6779029

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Black (Munsell 7.5YR 2.5/1) Silty Clay with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.15 – 0.50**	Pale brown (Munsell 10YR 6/3) Medium Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. Gradual boundary.
B22	**0.50 +**	Light grey (Munsell 10YR 7/1) Heavy Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 20% distinct orange mottling.

Site Description – Site 26				
Site Reference	26	**ASC Name**	Eutrophic Mesonatric Grey Sodosol (BEKOWNR)	
Average Slope	1%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 507226
Surface Condition	Soft	**Permeability**	Moderate	Y: 6778969

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Brown (Munsell 10YR 4/3) Loamy Sand with weak pedality, sandy fabric and weak consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.15 – 0.40**	Brown (Munsell 10YR 4/3) apedal Loamy Sand, earthy fabric and no consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Common roots and imperfectly drained. Clear boundary.
B2	**0.40 +**	Grey (Munsell 7.5YR 5/1) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Very few roots and imperfectly drained. 10% distinct orange mottling.

Sample Depth	ECe		pH(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.6	Non-saline	5.8	Moderately Acidic	8.5	Sodic
0.20 – 0.30	0.4	Non-saline	5.9	Moderately Acidic	11.5	Sodic
0.50 – 0.60	0.5	Non-saline	5.6	Moderately Acidic	15.5	Sodic

Site Description – Site 27				
Site Reference	27	**ASC Name**	Red Dermosol	
Average Slope	2%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 506154
Surface Condition	Firm	**Permeability**	Moderate	Y: 6779722

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark grey (Munsell 5YR 4/1) Silty Clay with moderate pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.20 – 0.50**	Yellowish red (Munsell 5YR 4/6) Heavy Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. 15% faint orange mottling. Gradual boundary.
B22	**0.50 +**	Light grey (Munsell 7.5YR 7/1) Medium Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 25% distinct orange mottling.

Site Description – Site 28				
Site Reference	28	**ASC Name**	Black Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Flat	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Plain	**Drainage**	Imperfect	X: 505977
Surface Condition	Soft	**Permeability**	High	Y: 6780230

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Very dark grey (Munsell 7.5YR 3/1) Medium Clay with weak pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.10 – 0.50**	Black (Munsell 10YR 2/1) Medium Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. Gradual boundary.
B22	**0.40 +**	Black (Munsell 10YR 2/1) Medium Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. 10% faint orange mottling.

Site Description – Site 29				
Site Reference	29	**ASC Name**	Grey Sodosol	
Average Slope	2%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 505435
Surface Condition	Soft	**Permeability**	Moderate	Y: 6780302

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Dark brown (Munsell 7.5YR 3/2) Loam with weak pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.35**	Yellowish brown (Munsell 10YR 5/4) apedal Sandy Loam. No coarse fragments. Common roots and moderately well drained. Clear boundary.
B2	**0.35 +**	White (Munsell 10YR 8/1) Medium Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Very few roots and imperfectly drained. 15% distinct orange mottling, with more in upper horizon.

Site Description – Site 30				
Site Reference	30	**ASC Name**	Brown Sodosol	
Average Slope	2%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 505431
Surface Condition	Soft	**Permeability**	Moderate	Y: 6779772

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark grey (Munsell 10YR 4/1) Loam with moderate pedality, rough fabric and weak consistence. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.15 – 0.35**	Bleached very pale brown (Munsell 10YR 7/3) Loam with weak pedality, rough fabric and weak consistence. 10% coarse fragments 5mm. Many roots and well drained. Abrupt boundary.
B21	**0.35 – 0.55**	Yellowish brown (Munsell 10YR 5/4) Light Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. Gradual boundary. 10% district orange mottling.
B22	**0.55 +**	Light grey (Munsell 10YR 7/1) Medium Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 15% district orange mottling.

Site Description – Site 31				
Site Reference	31	**ASC Name**	Eutrophic Subnatric Grey Sodosol (BFMOWNR)	
Average Slope	3%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Rise Crest	**Drainage**	Imperfect	X: 504024
Surface Condition	Hardset	**Permeability**	Moderate	Y: 6780366

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Light brownish grey (Munsell 2.5Y 6/2) Clay Loam with weak pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and sodic. 10% coarse fragments 5mm. Moderately drained. Sharp boundary.
B21	**0.15 – 0.50**	Pale brown (Munsell 10YR 6/3) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. Few roots and imperfectly drained. 10% distinct red mottling. Gradual boundary.
B22	**0.50 +**	Yellowish brown (Munsell 10YR 5/4) Heavy Clay with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and sodic. No coarse fragments. No roots and imperfectly drained. 20% distinct orange mottling.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.7	Non-saline	5.5	Strongly Acidic	17.8	Sodic
0.20 – 0.30	0.8	Non-saline	5.6	Moderately Acidic	7.5	Sodic
0.50 – 0.60	1.1	Non-saline	5.6	Moderately Acidic	12.7	Sodic

Site Description – Site 32				
Site Reference	32	**ASC Name**	Grey Sodosol	
Average Slope	3%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 56
Landform Element	Lower Slope	**Drainage**	Imperfect	X: 503966
Surface Condition	Soft	**Permeability**	Moderate	Y: 6780843

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.25	Dark greyish brown (Munsell 10YR 4/2) Silty Clay Loam with weak pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	0.25 – 0.50	Dark reddish grey (Munsell 5YR 4/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. 5% distinct red mottling. Clear boundary.
B22	0.55 +	Dark reddish brown(Munsell 5YR 3/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 10% distinct red mottling, 10% distinct orange mottling.

Site Description – Site 33				
Site Reference	33	**ASC Name**	Brown Kurosol	
Average Slope	3%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderate	MGA 56
Landform Element	Rise	**Drainage**	Imperfect	X: 504389
Surface Condition	Soft	**Permeability**	Moderate	Y: 6781597

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Brown (Munsell 7.5YR 4/2) Clay Loam with strong pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.45**	Brown (Munsell 7.5YR 5/4) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. 10% distinct red mottling. Gradual boundary.
B22	**0.45 +**	Light grey (Munsell 7.5YR 7/1) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Very few roots and imperfectly drained. 15% distinct red mottling.

Site Description – Site 34				
Site Reference	34	**ASC Name**	Brown Dermosol	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 503859
Surface Condition	Soft	**Permeability**	Moderate	Y: 6781594

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Dark brown (Munsell 7.5YR 3/2) Light Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.25 – 0.50**	Brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. Gradual boundary. 10% distinct orange mottling.
B22	**0.50 +**	Greyish brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 10% faint orange mottling.

Site Description – Site 35				
Site Reference	35	**ASC Name**	Brown Kurosol	
Average Slope	8%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Midslope	**Drainage**	Imperfect	X: 503434
Surface Condition	Firm	**Permeability**	Moderate	Y: 6781359

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Brown (Munsell 7.5YR 5/3) Silty Clay Loam with strong pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.45**	Brown (Munsell 10YR 4/3) Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Common roots and imperfectly drained. 10% distinct red mottling. Clear boundary.
B22	**0.45 +**	Pinkish white (Munsell 2.5YR 8/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Trace roots and imperfectly drained. 15% distinct red mottling.

Site Description – Site 36				
Site Reference	36	**ASC Name**	Mottled-Sodic Natric Brown Kurosol (BEMOWNR)	
Average Slope	0%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 56
Landform Element	Flat	**Drainage**	Imperfect	X: 504193
Surface Condition	Soft	**Permeability**	Moderate	Y: 6781163

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Dark brown (Munsell 7.5YR 3/2) Light Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.25 – 0.50**	Brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. Gradual boundary. 15% distinct orange mottling.
B22	**0.50 +**	Greyish brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 15% distinct orange mottling.

Site Description – Site 37 (36 on Lab COA)				
Site Reference	37 (36 on COA)	**ASC Name**	Mottled-Sodic Natric Brown Kurosol (BEMOWNR)	
Average Slope	6%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Lower Slope	**Drainage**	Imperfect	X: 503320
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780683

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Brown (Munsell 10YR 4/3) Silty Clay Loam with moderate pedality, rough fabric and moderate consistence. Slightly acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.55**	Brown (Munsell 7.5YR 4/4) Heavy Clay with strong pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Very few roots and imperfectly drained. 40% distinct orange mottling. Gradual boundary.
B22	**0.55 +**	Greyish brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and strong consistence. Strongly acidic pH, non-saline and sodic. No coarse fragments. Trace roots and imperfectly drained. 15% distinct red mottling.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	6.1	Slightly Acidic	5.6	Non sodic
0.25 – 0.35	0.7	Non-saline	5.4	Strongly Acidic	6.6	Sodic
0.55 – 0.65	1.3	Non-saline	5.1	Strongly Acidic	10.2	Sodic

Site Description – Site 38				
Site Reference	38	**ASC Name**	Red Kurosol	
Average Slope	4%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Crest	**Drainage**	Imperfect	X: 502930
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780488

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Brown (Munsell 7.5YR 5/3) Silty Clay Loam with moderate pedality, rough fabric and moderate consistence. 10% coarse fragments 10mm. Many roots and well drained. Clear boundary.
B21	**0.15– 0.40**	Red (Munsell 2.5YR 4/6) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. 10% distinct grey mottling. Abrupt boundary.
B22	**0.40 +**	Pinkish white (Munsell 2.5YR 8/2) Heavy Clay with moderate pedality, rough fabric and strong consistence. No coarse fragments. Trace roots and imperfectly drained. 15% distinct red mottling.

Site Description – Site 39				
Site Reference	39	**ASC Name**	Brown Kurosol	
Average Slope	4%	**Land Use**	Pasture for Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderate	MGA 56
Landform Element	Crest	**Drainage**	Imperfect	X: 502211
Surface Condition	Firm	**Permeability**	Moderate	Y: 6780610

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Brown (Munsell 7.5YR 5/3) Silty Loam with moderate pedality, rough fabric and weak consistence. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.60**	Brown (Munsell 7.5YR 4/3) Light Medium Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. Few roots and imperfectly drained. 15% distinct red mottling. Gradual boundary.
B22	**0.60 +**	Light brown (Munsell 7.5YR 6/4) Heavy Clay with strong pedality, rough fabric and strong consistence. No coarse fragments. No roots and imperfectly drained. 10% distinct red mottling

Appendix 4
Laboratory Certificates of Analysis

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	1 0 -10	1 20 -30	1 50 - 60	3 0 - 10	3 20 - 30
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/1	P4361/2	P4361/3	P4361/4	P4361/5
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.57	5.96	5.79	5.48	5.53
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.040	0.021	0.028	0.064	0.145
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.9	8.1	5.8	1.8	3.3
	Exchangeable Calcium (kg/ha)		1,307	3,632	2,598	809	1,493
	Exchangeable Calcium (mg/kg)		584	1,622	1,160	361	666
	Exchangeable Magnesium (cmol+/kg)		2.8	7.2	6.0	3.4	8.4
	Exchangeable Magnesium (kg/ha)		757	1,966	1,646	918	2,292
	Exchangeable Magnesium (mg/kg)		338	878	735	410	1,023
	Exchangeable Potassium (cmol+/kg)		0.18	0.13	0.14	0.30	0.19
	Exchangeable Potassium (kg/ha)		161	113	120	260	167
	Exchangeable Potassium (mg/kg)		72	50	53	116	75
	Exchangeable Sodium (cmol+/kg)		0.28	0.76	0.94	0.51	2.1
	Exchangeable Sodium (kg/ha)		145	392	486	265	1,077
	Exchangeable Sodium (mg/kg)		65	175	217	118	481
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	1.2	4.2	8.7	1.6	4.0
	Exchangeable Aluminium (kg/ha)		235	852	1,764	319	797
	Exchangeable Aluminium (mg/kg)		105	380	787	143	356
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.28	0.27	0.03	0.34	0.21
	Exchangeable Hydrogen (kg/ha)		6.3	6.0	<1	7.7	4.6
	Exchangeable Hydrogen (mg/kg)		2.8	2.7	<1	3.4	2.1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	7.6	21	22	7.9	18
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	38	39	27	23	18
	Magnesium (%)		37	35	28	43	46
	Potassium (%)		2.4	0.62	0.63	3.8	1.0
	Sodium - ESP (%)		3.7	3.7	4.3	6.5	11
	Aluminium (%)		15	20	40	20	22
	Hydrogen (%)		3.7	1.3	0.16	4.4	1.1
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	1.0	1.1	0.96	0.53	0.39
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	4	4	..	3
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 2.5/3 Very Dark Brown	7.5YR 2.5/3 Very Dark Brown	7.5YR 3/4 Dark Brown	7.5YR 3/4 Dark Brown	10YR 3/4 Dark Yellowish Brown
	Mottles Munsell Colour		..	..	..	..	..
	Degree of Mottling (%)		..	..	..	..	..

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Sample ID:	1 0 -10	1 20 -30	1 50 - 60	3 0 - 10	3 20 - 30
Crop:	N/G	N/G	N/G	N/G	N/G
Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter **Method reference**	P4361/1	P4361/2	P4361/3	P4361/4	P4361/5

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal).
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Accreditation No. 14960
Accredited for compliance with ISO/IEC 17025 - Testing

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361
Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		Sample ID:	3 50 - 60	3 80 - 90	5 0 -10	5 20 -30	5 50 - 60
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/6	P4361/7	P4361/8	P4361/9	P4361/10
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.10	4.99	5.93	6.12	6.07
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.513	0.766	0.044	0.049	0.279
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	5.0	5.4	8.6	9.8	11
	Exchangeable Calcium (kg/ha)		2,222	2,403	3,847	4,385	4,961
	Exchangeable Calcium (mg/kg)		992	1,073	1,718	1,958	2,215
	Exchangeable Magnesium (cmol+/kg)		15	17	10	11	13
	Exchangeable Magnesium (kg/ha)		3,972	4,541	2,729	2,958	3,435
	Exchangeable Magnesium (mg/kg)		1,773	2,027	1,218	1,320	1,533
	Exchangeable Potassium (cmol+/kg)		0.30	0.27	0.35	0.29	0.29
	Exchangeable Potassium (kg/ha)		266	240	308	255	257
	Exchangeable Potassium (mg/kg)		119	107	137	114	115
	Exchangeable Sodium (cmol+/kg)		6.0	8.9	0.94	1.2	3.1
	Exchangeable Sodium (kg/ha)		3,101	4,577	485	632	1,571
	Exchangeable Sodium (mg/kg)		1,384	2,043	216	282	701
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	4.4	3.3	1.6	1.2	0.14
	Exchangeable Aluminium (kg/ha)		895	661	331	239	28
	Exchangeable Aluminium (mg/kg)		400	295	148	107	12
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.42	0.76	0.49	0.58	0.23
	Exchangeable Hydrogen (kg/ha)		9.4	17	11	13	5.1
	Exchangeable Hydrogen (mg/kg)		4.2	7.6	4.9	5.8	2.3
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	31	35	22	24	27
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	16	15	39	41	40
	Magnesium (%)		47	47	46	45	46
	Potassium (%)		0.99	0.78	1.6	1.2	1.1
	Sodium - ESP (%)		20	25	4.3	5.1	11
	Aluminium (%)		14	9.3	7.5	5.0	0.50
	Hydrogen (%)		1.4	2.1	2.2	2.4	0.83
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.34	0.32	0.85	0.90	0.88
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	3	..	..	3	4
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 4/4 Dark Yellowish Brown	10YR 6/2 Light Brownish Gray	10YR 3/3 Dark Brown	10YR 3/4 Dark Yellowish Brown	10YR 4/4 Dark Yellowish Brown
	Mottles Munsell Colour		2.5YR 4/8 Red	2.5YR 4/8 Red	.. ..	.. ..	.. ..
	Degree of Mottling (%)		30	45	..	..	..

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
	Sample ID:	3 50 - 60	3 80 - 90	5 0 -10	5 20 -30	5 50 - 60
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/6	P4361/7	P4361/8	P4361/9	P4361/10

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
		Sample ID:	6 0 -10	6 20 -30	6 50 - 60	8 0 -10	8 25 - 35
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/11	P4361/12	P4361/13	P4361/14	P4361/15
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.67	5.52	5.44	5.37	5.69
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.037	0.053	0.062	0.653	1.310
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.2	1.6	0.26	5.1	6.6
	Exchangeable Calcium (kg/ha)		1,005	732	119	2,306	2,947
	Exchangeable Calcium (mg/kg)		449	327	53	1,030	1,316
	Exchangeable Magnesium (cmol+/kg)		2.2	4.6	5.1	7.0	10
	Exchangeable Magnesium (kg/ha)		605	1,247	1,398	1,910	2,729
	Exchangeable Magnesium (mg/kg)		270	557	624	853	1,218
	Exchangeable Potassium (cmol+/kg)		0.18	0.16	0.22	0.17	0.16
	Exchangeable Potassium (kg/ha)		159	139	191	150	142
	Exchangeable Potassium (mg/kg)		71	62	85	67	63
	Exchangeable Sodium (cmol+/kg)		0.41	1.1	2.2	3.7	7.7
	Exchangeable Sodium (kg/ha)		213	573	1,144	1,910	3,988
	Exchangeable Sodium (mg/kg)		95	256	511	852	1,780
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	1.7	15	19	0.86	0.14
	Exchangeable Aluminium (kg/ha)		341	2,978	3,918	174	28
	Exchangeable Aluminium (mg/kg)		152	1,330	1,749	78	13
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.15	<0.01	2.4	<0.01	0.22
	Exchangeable Hydrogen (kg/ha)		3.3	<1	53	<1	5.0
	Exchangeable Hydrogen (mg/kg)		1.5	<1	24	<1	2.2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	6.9	22	30	17	25
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	32	7.3	0.89	30	26
	Magnesium (%)		32	21	17	42	40
	Potassium (%)		2.6	0.71	0.74	1.0	0.65
	Sodium - ESP (%)		6.0	5.0	7.5	22	31
	Aluminium (%)		25	66	66	5.1	0.56
	Hydrogen (%)		2.2	0.00	8.0	0.00	0.90
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	1.0	0.36	0.05	0.73	0.65
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	4	3	..	4
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 2.5/3 Very Dark Brown	5YR 3/3 Dark Reddish Brown	5YR 3/3 Dark Reddish Brown	7.5YR 3/2 Dark Brown	10YR 4/3 Brown
	Mottles Munsell Colour		..	2.5YR 4/8	2.5YR 4/8	..	10YR 5/8
	Degree of Mottling (%)		..	Red	Red	..	Yellowish Brown
			..	40	40	..	20

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
	Sample ID:	6 0 -10	6 20 -30	6 50 - 60	8 0 -10	8 25 - 35
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/11	P4361/12	P4361/13	P4361/14	P4361/15

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
		Sample ID:	8 55 - 65	9 0 -10	9 20 - 30	9 50 - 60	10 0 - 10
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/16	P4361/17	P4361/18	P4361/19	P4361/20
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.39	5.67	5.62	5.48	5.38
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	1.515	0.053	0.037	0.036	0.116
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	8.4	2.6	1.2	0.18	0.91
	Exchangeable Calcium (kg/ha)		3,789	1,177	540	81	407
	Exchangeable Calcium (mg/kg)		1,692	525	241	36	182
	Exchangeable Magnesium (cmol+/kg)		12	0.96	1.4	4.1	2.6
	Exchangeable Magnesium (kg/ha)		3,388	262	368	1,105	721
	Exchangeable Magnesium (mg/kg)		1,512	117	164	493	322
	Exchangeable Potassium (cmol+/kg)		0.19	<0.12	<0.12	<0.12	<0.12
	Exchangeable Potassium (kg/ha)		165	<112	<112	<112	<112
	Exchangeable Potassium (mg/kg)		74	<50	<50	<50	<50
	Exchangeable Sodium (cmol+/kg)		10	0.16	0.19	0.60	0.90
	Exchangeable Sodium (kg/ha)		5,339	85	99	309	466
	Exchangeable Sodium (mg/kg)		2,383	38	44	138	208
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.05	0.40	0.68	6.9	1.7
	Exchangeable Aluminium (kg/ha)		10	80	136	1,382	333
	Exchangeable Aluminium (mg/kg)		4.7	36	61	617	149
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.15	0.18	0.68	0.50
	Exchangeable Hydrogen (kg/ha)		<1	3.4	4.1	15	11
	Exchangeable Hydrogen (mg/kg)		<1	1.5	1.8	6.8	5.0
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	31	4.4	3.6	12	6.7
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	27	60	33	1.4	13
	Magnesium (%)		40	22	37	33	39
	Potassium (%)		0.60	2.1	0.96	0.45	1.5
	Sodium - ESP (%)		33	3.8	5.3	4.8	13
	Aluminium (%)		0.17	9.1	19	55	25
	Hydrogen (%)		0.00	3.5	5.0	5.4	7.5
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.68	2.7	0.89	0.04	0.34
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	2	..	..	4	..
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 4/2 Dark Grayish Brown	7..5YR 2.5/2 Very Dark Brown	7.5YR 3/4 Dark Brown	5YR 4/1 Dark Gray	5YR 3/1 Very Dark Gray
	Mottles Munsell Colour		10YR 5/6 Yellowish Brown	.. ..	.. ..	2.5YR 3/6 Dark Red	2.5YR 3/6 Dark Red
	Degree of Mottling (%)		10	..	..	50	10

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
	Sample ID:	8 55 - 65	9 0 -10	9 20 - 30	9 50 - 60	10 0 - 10
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/16	P4361/17	P4361/18	P4361/19	P4361/20

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361
Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 21	Sample 22	Sample 23	Sample 24	Sample 25
		Sample ID:	10 25 - 35	10 55 - 65	12 0 -10	12 20 - 30	12 50 - 60
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/21	P4361/22	P4361/23	P4361/24	P4361/25
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.21	4.59	5.36	5.15	4.67
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.083	0.182	0.084	0.128	0.279
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.69	0.84	6.8	5.5	2.6
	Exchangeable Calcium (kg/ha)		308	379	3,066	2,461	1,157
	Exchangeable Calcium (mg/kg)		138	169	1,369	1,099	516
	Exchangeable Magnesium (cmol+/kg)		2.0	2.2	7.0	5.8	3.9
	Exchangeable Magnesium (kg/ha)		532	604	1,915	1,569	1,062
	Exchangeable Magnesium (mg/kg)		237	270	855	700	474
	Exchangeable Potassium (cmol+/kg)		<0.12	<0.12	0.23	0.15	0.14
	Exchangeable Potassium (kg/ha)		<112	<112	203	134	124
	Exchangeable Potassium (mg/kg)		<50	<50	91	60	55
	Exchangeable Sodium (cmol+/kg)		0.71	1.1	0.85	1.0	1.4
	Exchangeable Sodium (kg/ha)		364	549	435	521	706
	Exchangeable Sodium (mg/kg)		163	245	194	232	315
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	5.0	13	3.2	5.7	10
	Exchangeable Aluminium (kg/ha)		1,006	2,554	639	1,144	2,113
	Exchangeable Aluminium (mg/kg)		449	1,140	285	511	943
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.23	1.4	0.54	1.6	1.8
	Exchangeable Hydrogen (kg/ha)		5.2	31	12	36	41
	Exchangeable Hydrogen (mg/kg)		2.3	14	5.4	16	18
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	8.6	18	19	20	20
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	8.0	4.6	37	28	13
	Magnesium (%)		23	12	38	29	19
	Potassium (%)		0.44	0.35	1.2	0.78	0.69
	Sodium - ESP (%)		8.2	5.8	4.5	5.1	6.8
	Aluminium (%)		58	69	17	29	52
	Hydrogen (%)		2.7	7.5	2.9	8.2	9.0
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.35	0.38	0.97	0.95	0.66
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	3	4	..	4	4
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 3/2 Dark Brown	7.5YR 4/1 Dark Gray	7.5YR 4/1 Dark Gray	7.5YR 4/2 Brown	7.5YR 4/1 Dark Gray
	Mottles Munsell Colour		7.5YR 4/2, 2.5YR 3/6 Brown, Dark Red	7.5YR 4/6 Strong Brown	5YR 5/8 Yellowish Red	.. ..	2.5YR 4/6 Red
	Degree of Mottling (%)		30, 5	30	10	..	25

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 21	Sample 22	Sample 23	Sample 24	Sample 25
		Sample ID:	10 25 - 35	10 55 - 65	12 0 -10	12 20 - 30	12 50 - 60
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/21	P4361/22	P4361/23	P4361/24	P4361/25

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361
Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 26	Sample 27	Sample 28	Sample 29	Sample 30
		Sample ID:	16 0 -10	16 20 - 30	16 50 - 60	18 0 - 10	18 20 - 30
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/26	P4361/27	P4361/28	P4361/29	P4361/30
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.32	6.06	5.83	5.49	5.30
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.050	0.075	0.225	0.043	0.042
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	6.0	4.3	4.3	1.7	0.91
	Exchangeable Calcium (kg/ha)		2,687	1,913	1,950	775	409
	Exchangeable Calcium (mg/kg)		1,200	854	871	346	183
	Exchangeable Magnesium (cmol+/kg)		4.6	10	15	2.2	2.4
	Exchangeable Magnesium (kg/ha)		1,243	2,774	4,116	612	656
	Exchangeable Magnesium (mg/kg)		555	1,238	1,837	273	293
	Exchangeable Potassium (cmol+/kg)		0.17	0.19	0.19	<0.12	<0.12
	Exchangeable Potassium (kg/ha)		147	165	170	<112	<112
	Exchangeable Potassium (mg/kg)		66	73	76	<50	<50
	Exchangeable Sodium (cmol+/kg)		0.63	1.8	4.5	0.41	0.45
	Exchangeable Sodium (kg/ha)		322	920	2,310	210	231
	Exchangeable Sodium (mg/kg)		144	411	1,031	94	103
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.33	4.4	6.5	2.7	8.5
	Exchangeable Aluminium (kg/ha)		67	885	1,319	535	1,717
	Exchangeable Aluminium (mg/kg)		30	395	589	239	766
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.25	1.1	1.3	0.42	0.28
	Exchangeable Hydrogen (kg/ha)		5.6	25	28	9.4	6.2
	Exchangeable Hydrogen (mg/kg)		2.5	11	13	4.2	2.8
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	12	22	32	7.5	13
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	50	19	14	23	7.2
	Magnesium (%)		38	46	47	30	19
	Potassium (%)		1.4	0.86	0.61	1.3	0.76
	Sodium - ESP (%)		5.2	8.2	14	5.4	3.5
	Aluminium (%)		2.8	20	20	35	67
	Hydrogen (%)		2.1	5.0	4.0	5.5	2.2
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	1.3	0.42	0.29	0.77	0.38
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	3	2	..	4
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 3/2 Dark Brown	10YR 5/4 Yellowish Brown	10YR 5/4 Yellowish Brown	7.5YR 3/2 Dark Brown	10YR 4/3 Brown
	Mottles Munsell Colour		..	5YR 5/6, 10yr 2/1	2.5YR 2.5/1, 5YR 4/6	..	5YR 5/8, 5YR 4/1
	Degree of Mottling (%)		..	Yellowish Red, Black 40, 3	Reddish Black, Yellowish Red 20, 40	..	Yellowish Red, Dark Gray 5, 30

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 26	Sample 27	Sample 28	Sample 29	Sample 30
	Sample ID:	16 0 -10	16 20 - 30	16 50 - 60	18 0 - 10	18 20 - 30
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	P4361/26	P4361/27	P4361/28	P4361/29	P4361/30

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361
Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 31	Sample 32	Sample 33	Sample 34	Sample 35
		Sample ID:	18 50 - 60	19 0 -10	19 20 - 30	19 50 - 60	21 0 - 10
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/31	P4361/32	P4361/33	P4361/34	P4361/35
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.25	5.92	6.09	7.38	5.19
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.081	0.040	0.040	0.137	0.051
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.34	0.30	0.17	0.47	0.96
	Exchangeable Calcium (kg/ha)		152	133	77	210	431
	Exchangeable Calcium (mg/kg)		68	59	34	94	192
	Exchangeable Magnesium (cmol+/kg)		3.6	0.29	0.23	5.6	0.83
	Exchangeable Magnesium (kg/ha)		967	80	64	1,534	227
	Exchangeable Magnesium (mg/kg)		432	36	28	685	101
	Exchangeable Potassium (cmol+/kg)		0.15	<0.12	<0.12	<0.12	0.14
	Exchangeable Potassium (kg/ha)		129	<112	<112	<112	122
	Exchangeable Potassium (mg/kg)		57	<50	<50	<50	55
	Exchangeable Sodium (cmol+/kg)		1.1	0.22	0.20	3.0	0.25
	Exchangeable Sodium (kg/ha)		577	112	104	1,529	130
	Exchangeable Sodium (mg/kg)		258	50	46	683	58
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	12	0.24	0.10	0.01	1.4
	Exchangeable Aluminium (kg/ha)		2,449	48	21	3.0	274
	Exchangeable Aluminium (mg/kg)		1,094	21	9.4	1.3	122
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	1.4	0.38	0.19	<0.01	0.32
	Exchangeable Hydrogen (kg/ha)		31	8.5	4.2	<1	7.2
	Exchangeable Hydrogen (mg/kg)		14	3.8	1.9	<1	3.2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	19	1.5	0.91	9.2	3.9
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	1.8	20	19	5.1	25
	Magnesium (%)		19	20	26	61	22
	Potassium (%)		0.79	2.0	1.6	0.98	3.6
	Sodium - ESP (%)		6.0	15	22	32	6.5
	Aluminium (%)		65	16	11	0.16	35
	Hydrogen (%)		7.3	26	20	0.00	8.3
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.10	1.0	0.73	0.08	1.2
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	4	..	..	2	..
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 5/1 Gray	10YR 4/3 Brown	10YR 4/3 Brown	10YR 5/1 Gray	7.5YR 4/2 Brown
	Mottles Munsell Colour		2.YR 3/6, 10YR 2/1 Dark Red, Black	..	..	10YR 4/6, 10YR 2/1 Dark Yellowish Brown, Black	..
	Degree of Mottling (%)		30, 10	..	..	40, 7	..

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 31	Sample 32	Sample 33	Sample 34	Sample 35
	Sample ID:	18 50 - 60	19 0 -10	19 20 - 30	19 50 - 60	21 0 - 10
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/31	P4361/32	P4361/33	P4361/34	P4361/35

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361
Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 36	Sample 37	Sample 38	Sample 39	Sample 40
		Sample ID:	21 20 - 30	21 50 - 60	24 0 -10	24 20 - 30	24 50 - 60
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/36	P4361/37	P4361/38	P4361/39	P4361/40
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.33	5.42	5.18	5.88	6.97
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.026	0.017	0.107	0.085	0.086
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	1.8	0.26	4.6	5.7	5.2
	Exchangeable Calcium (kg/ha)		796	115	2,063	2,564	2,333
	Exchangeable Calcium (mg/kg)		356	51	921	1,145	1,042
	Exchangeable Magnesium (cmol+/kg)		2.0	0.49	3.8	6.0	6.4
	Exchangeable Magnesium (kg/ha)		556	132	1,024	1,632	1,748
	Exchangeable Magnesium (mg/kg)		248	59	457	728	780
	Exchangeable Potassium (cmol+/kg)		<0.12	<0.12	0.42	0.25	0.20
	Exchangeable Potassium (kg/ha)		<112	<112	369	216	172
	Exchangeable Potassium (mg/kg)		<50	<50	165	97	77
	Exchangeable Sodium (cmol+/kg)		0.20	0.07	0.99	1.8	1.8
	Exchangeable Sodium (kg/ha)		105	38	511	920	937
	Exchangeable Sodium (mg/kg)		47	17	228	411	418
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	2.5	0.69	1.9	0.69	0.03
	Exchangeable Aluminium (kg/ha)		504	140	376	139	6.6
	Exchangeable Aluminium (mg/kg)		225	62	168	62	3.0
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.57	0.34	0.86	0.71	<0.01
	Exchangeable Hydrogen (kg/ha)		13	7.6	19	16	<1
	Exchangeable Hydrogen (mg/kg)		5.7	3.4	8.6	7.1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	7.2	1.9	12	15	14
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	25	14	37	38	38
	Magnesium (%)		29	26	30	40	47
	Potassium (%)		0.96	0.97	3.4	1.6	1.4
	Sodium - ESP (%)		2.8	3.9	8.0	12	13
	Aluminium (%)		35	37	15	4.6	0.24
	Hydrogen (%)		8.0	18	6.9	4.7	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.87	0.53	1.2	0.95	0.81
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	3	4	..	3	2
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	7.5YR 3/2 Dark Brown	10YR 6/2 Light Brownish Gray	10YR 2/1 Black	10YR 2/1 Black	10YR 3/2 Very Dark Grayish Brown
	Mottles Munsell Colour		5YR 4/6 Yellowish Red	10YR 5/4, 10YR 3/2 Yellowish Brown, Very Dark Grayish Brown	..	..	7.5YR 2.5/1, 5YR 4/6 Black, Yellowish Red
	Degree of Mottling (%)		20	30, 15	..	..	50, 20

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 36	Sample 37	Sample 38	Sample 39	Sample 40
	Sample ID:	21 20 - 30	21 50 - 60	24 0 -10	24 20 - 30	24 50 - 60
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/36	P4361/37	P4361/38	P4361/39	P4361/40

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 41	Sample 42	Sample 43	Sample 44	Sample 45
		Sample ID:	26 0 -10	26 20 -30	26 50 - 60	31 0 -10	31 20 - 30
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/41	P4361/42	P4361/43	P4361/44	P4361/45
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.84	5.88	5.63	5.48	5.61
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.027	0.018	0.087	0.297	0.089
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.41	0.18	0.17	0.58	1.8
	Exchangeable Calcium (kg/ha)		183	79	75	261	817
	Exchangeable Calcium (mg/kg)		82	35	34	117	365
	Exchangeable Magnesium (cmol+/kg)		0.51	0.26	7.5	12	4.1
	Exchangeable Magnesium (kg/ha)		139	71	2,048	3,222	1,126
	Exchangeable Magnesium (mg/kg)		62	32	914	1,438	503
	Exchangeable Potassium (cmol+/kg)		<0.12	<0.12	0.20	0.25	0.30
	Exchangeable Potassium (kg/ha)		<112	<112	179	215	259
	Exchangeable Potassium (mg/kg)		<50	<50	80	96	115
	Exchangeable Sodium (cmol+/kg)		0.14	0.12	3.1	5.0	0.69
	Exchangeable Sodium (kg/ha)		75	63	1,574	2,550	353
	Exchangeable Sodium (mg/kg)		33	28	703	1,138	158
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.25	0.28	7.0	7.5	1.4
	Exchangeable Aluminium (kg/ha)		51	56	1,404	1,506	279
	Exchangeable Aluminium (mg/kg)		23	25	627	672	124
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.29	0.20	1.7	2.7	0.80
	Exchangeable Hydrogen (kg/ha)		6.5	4.6	39	60	18
	Exchangeable Hydrogen (mg/kg)		2.9	2.0	17	27	8.0
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	1.7	1.1	20	28	9.1
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	24	17	0.85	2.1	20
	Magnesium (%)		30	25	38	43	45
	Potassium (%)		5.7	2.0	1.0	0.89	3.2
	Sodium - ESP (%)		8.5	11	16	18	7.5
	Aluminium (%)		15	26	35	27	15
	Hydrogen (%)		17	19	8.9	9.7	8.7
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.80	0.68	0.02	0.05	0.44
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	..	2	..	3
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 4/3 Brown	10YR 4/3 Brown	7.5YR 5/1 Gray	2.5Y 6/2 Light Brownish Gray	10YR 6/3 Pale Brown
	Mottles Munsell Colour		..	..	7.5YR 5/8 Strong Brown	2.5YR 4/8 Red	..
	Degree of Mottling (%)		..	..	50	40	..

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 41	Sample 42	Sample 43	Sample 44	Sample 45
	Sample ID:	26 0 -10	26 20 -30	26 50 - 60	31 0 -10	31 20 - 30
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/41	P4361/42	P4361/43	P4361/44	P4361/45

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Sample 46	Sample 47	Sample 48	Sample 49
		Sample ID:	31 50 -60	36 0 -10	36 25 - 35	36 55 - 65
		Crop:	N/G	N/G	N/G	N/G
		Client:	Umwelt	Umwelt	Umwelt	Umwelt
	Parameter	Method reference	P4361/46	P4361/47	P4361/48	P4361/49
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.56	6.05	5.43	5.10
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.187	0.053	0.113	0.216
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	1.3	3.9	2.6	1.3
	Exchangeable Calcium (kg/ha)		596	1,738	1,179	586
	Exchangeable Calcium (mg/kg)		266	776	527	262
	Exchangeable Magnesium (cmol+/kg)		11	4.4	6.9	8.0
	Exchangeable Magnesium (kg/ha)		2,940	1,204	1,880	2,185
	Exchangeable Magnesium (mg/kg)		1,312	537	839	976
	Exchangeable Potassium (cmol+/kg)		0.24	0.18	<0.12	0.15
	Exchangeable Potassium (kg/ha)		207	157	<112	134
	Exchangeable Potassium (mg/kg)		92	70	<50	60
	Exchangeable Sodium (cmol+/kg)		3.4	0.55	1.2	2.6
	Exchangeable Sodium (kg/ha)		1,755	284	627	1,351
	Exchangeable Sodium (mg/kg)		784	127	280	603
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	8.3	0.54	6.5	11
	Exchangeable Aluminium (kg/ha)		1,678	109	1,312	2,207
	Exchangeable Aluminium (mg/kg)		749	49	586	985
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	2.8	0.31	1.2	2.6
	Exchangeable Hydrogen (kg/ha)		62	7.0	26	58
	Exchangeable Hydrogen (mg/kg)		28	3.1	12	26
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	27	9.9	19	26
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	4.9	39	14	5.1
	Magnesium (%)		40	45	37	31
	Potassium (%)		0.88	1.8	0.60	0.59
	Sodium - ESP (%)		13	5.6	6.6	10
	Aluminium (%)		31	5.5	35	43
	Hydrogen (%)		10	3.2	6.2	10
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.12	0.88	0.38	0.16
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	3	..	4	4
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 5/4 Yellowish Brown	10YR 4/3 Brown	7.5YR 4/4 Brown	10YR 5/2 Grayish Brown
	Mottles Munsell Colour		10YR 4/2, 10YR 5/6 Dark Grayish Brown, Yellowish Brown	..	5YR 4/4 Reddish Brown	2.5YR 4/6 Yellowish Red
	Degree of Mottling (%)		15, 40	..	30	30

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

		Sample 46	Sample 47	Sample 48	Sample 49
	Sample ID:	31 50 -60	36 0 -10	36 25 - 35	36 55 - 65
	Crop:	N/G	N/G	N/G	N/G
	Client:	Umwelt	Umwelt	Umwelt	Umwelt
Parameter	Method reference	P4361/46	P4361/47	P4361/48	P4361/49

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Environmental Analysis Laboratory

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361
Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	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+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	15.6	10.8	5.0	1.9
	Exchangeable Calcium (kg/ha)		7000	4816	2240	840
	Exchangeable Calcium (mg/kg)		3125	2150	1000	375
	Exchangeable Magnesium (cmol+/kg)		2.4	1.7	1.2	0.60
	Exchangeable Magnesium (kg/ha)		650	448	325	168
	Exchangeable Magnesium (mg/kg)		290	200	145	75
	Exchangeable Potassium (cmol+/kg)		0.60	0.50	0.40	0.30
	Exchangeable Potassium (kg/ha)		526	426	336	224
	Exchangeable Potassium (mg/kg)		235	190	150	100
	Exchangeable Sodium (cmol+/kg)		0.3	0.26	0.22	0.11
	Exchangeable Sodium (kg/ha)		155	134	113	57
	Exchangeable Sodium (mg/kg)		69	60	51	25
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.6	0.5	0.4	0.2
	Exchangeable Aluminium (kg/ha)		121	101	73	30
	Exchangeable Aluminium (mg/kg)		54	45	32	14
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.6	0.5	0.4	0.2
	Exchangeable Hydrogen (kg/ha)		13	11	8	3
	Exchangeable Hydrogen (mg/kg)		6	5	4	2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	20.1	14.3	7.8	3.3
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/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 (%)					
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	6.5	6.4	4.2	3.2
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	Class 3–8			
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	..			
	Mottles Munsell Colour		..			
	Degree of Mottling (%)		..			

Southern Cross University
PO Box 157 Lismore NSW 2480
P: +61 2 6620 3678
E: eal@scu.edu.au
www.scu.edu.au/eal
ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

49 samples supplied by Minesoils Pty. Ltd. on 21/08/2023. Lab Job No.P4361

Analysis requested by Matt Hemingway. Your Job: MS105-Richmond Valley

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	*Clay*	*Clay Loam*	*Loam*	*Loamy Sand*
	Parameter	**Method reference**	**Indicative guidelines - refer to Notes 6 and 8**			

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This report was issued on 11/09/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

49 soil samples supplied by Minesoils Pty Ltd on 21st August, 203 - Lab Job No. P4361
Analysis requested by Matt Hemingway. Job Ref: MS105-Richmond Valley
Address Not Given.

SAMPLE ID	Lab Code	MOISTURE CONTENT (% of water in sample)	TOTAL GRAVEL > 2 mm (% of total oven-dry equivalent)	GRAVEL > 4.75 mm (% of total oven-dry equivalent)	GRAVEL 2.00-4.75 mm (% of total oven-dry equivalent)	COARSE SAND 200-2000 µm (0.2-2.0 mm) (% of total oven-dry equivalent)	FINE SAND 20-200 µm (0.02-0.2 mm) (% of total oven-dry equivalent)	SILT 2-20 µm (% of total oven-dry equivalent)	CLAY < 2 µm (% of total oven-dry equivalent)
1 0 -10	P4361/1	12.3%	2.6%	0.9%	1.7%	4.2%	48.7%	23.7%	20.8%
1 20 -30	P4361/2	20.4%	1.5%	1.2%	0.4%	1.5%	29.6%	13.1%	54.3%
1 50 - 60	P4361/3	21.4%	0.9%	0.0%	0.9%	1.1%	27.5%	13.5%	56.9%
3 0 - 10	P4361/4	6.7%	1.0%	0.0%	1.0%	12.2%	37.2%	28.7%	20.9%
3 20 - 30	P4361/5	11.7%	1.5%	0.6%	0.9%	8.7%	29.7%	20.6%	39.4%
3 50 - 60	P4361/6	16.3%	1.0%	0.0%	1.0%	5.4%	24.7%	16.8%	52.0%
3 80 - 90	P4361/7	18.3%	0.0%	0.0%	0.0%	13.0%	23.3%	20.0%	43.7%
5 0 -10	P4361/8	17.0%	1.2%	0.0%	1.2%	1.2%	20.1%	21.8%	55.7%
5 20 -30	P4361/9	17.0%	0.8%	0.0%	0.8%	0.3%	17.8%	21.9%	59.3%
5 50 - 60	P4361/10	17.3%	0.5%	0.0%	0.5%	0.3%	14.9%	24.7%	59.6%
6 0 -10	P4361/11	8.9%	2.7%	0.0%	2.7%	5.2%	57.3%	15.2%	19.7%
6 20 -30	P4361/12	20.5%	3.2%	1.9%	1.3%	0.7%	22.5%	9.8%	63.8%
6 50 - 60	P4361/13	22.1%	0.0%	0.0%	0.0%	0.6%	28.5%	10.6%	60.4%
8 0 -10	P4361/14	13.8%	13.1%	7.7%	5.4%	3.0%	21.4%	22.8%	39.6%
8 25 - 35	P4361/15	18.8%	2.4%	0.0%	2.4%	1.3%	13.2%	24.4%	58.8%
8 55 - 65	P4361/16	21.3%	2.4%	0.0%	2.4%	1.0%	14.3%	25.8%	56.4%
9 0 -10	P4361/17	4.6%	6.0%	1.0%	5.0%	6.7%	53.0%	18.2%	16.1%
9 20 - 30	P4361/18	4.3%	9.9%	7.1%	2.8%	4.8%	53.1%	15.9%	16.4%
9 50 - 60	P4361/19	20.9%	1.0%	0.0%	1.0%	1.7%	26.0%	12.0%	59.3%
10 0 - 10	P4361/20	20.7%	0.8%	0.0%	0.8%	2.1%	35.8%	35.2%	26.0%
10 25 - 35	P4361/21	19.8%	1.5%	0.0%	1.5%	2.2%	32.1%	25.3%	38.9%
10 55 - 65	P4361/22	24.8%	0.0%	0.0%	0.0%	0.5%	24.0%	10.8%	64.7%
12 0 -10	P4361/23	22.9%	2.4%	0.0%	2.4%	2.4%	18.5%	29.2%	47.4%
12 20 - 30	P4361/24	23.5%	0.1%	0.0%	0.1%	1.1%	17.4%	19.5%	61.9%
12 50 - 60	P4361/25	24.5%	0.7%	0.0%	0.7%	2.0%	12.0%	23.5%	61.9%
16 0 -10	P4361/26	14.5%	7.9%	0.5%	7.3%	8.8%	29.6%	30.2%	23.5%
16 20 - 30	P4361/27	19.8%	9.3%	4.3%	5.0%	4.1%	19.0%	16.1%	51.5%
16 50 - 60	P4361/28	23.0%	0.6%	0.0%	0.6%	1.3%	8.5%	28.8%	60.8%
18 0 - 10	P4361/29	13.6%	0.3%	0.0%	0.3%	20.8%	36.3%	15.4%	27.2%
18 20 - 30	P4361/30	17.9%	0.5%	0.0%	0.5%	18.6%	31.4%	13.5%	36.0%
18 50 - 60	P4361/31	21.7%	0.0%	0.0%	0.0%	15.3%	30.5%	4.5%	49.7%
19 0 -10	P4361/32	8.3%	0.6%	0.0%	0.6%	34.7%	56.0%	4.1%	4.6%
19 20 - 30	P4361/33	6.4%	0.9%	0.7%	0.2%	39.1%	50.5%	5.8%	3.8%
19 50 - 60	P4361/34	10.8%	0.5%	0.0%	0.5%	25.2%	52.3%	5.0%	17.1%
21 0 - 10	P4361/35	12.9%	2.2%	1.3%	0.9%	36.1%	28.9%	17.1%	15.6%
21 20 - 30	P4361/36	13.9%	2.1%	1.0%	1.0%	44.9%	24.3%	9.8%	18.8%
21 50 - 60	P4361/37	7.1%	5.6%	4.1%	1.5%	52.3%	27.8%	8.1%	6.2%
24 0 -10	P4361/38	52.7%	0.1%	0.0%	0.1%	10.5%	19.9%	23.4%	46.1%
24 20 - 30	P4361/39	28.5%	0.0%	0.0%	0.0%	4.9%	17.0%	27.8%	50.3%
24 50 - 60	P4361/40	19.0%	0.0%	0.0%	0.0%	11.9%	29.7%	17.4%	40.9%
26 0 -10	P4361/41	14.3%	1.1%	1.1%	0.0%	53.1%	27.8%	9.9%	8.0%
26 20 -30	P4361/42	9.6%	2.1%	0.4%	1.7%	50.6%	28.9%	12.6%	5.8%
26 50 - 60	P4361/43	22.4%	0.0%	0.0%	0.0%	21.1%	18.4%	9.3%	51.3%
31 0 -10	P4361/44	21.8%	3.2%	0.0%	3.2%	1.5%	23.3%	14.3%	57.7%
31 20 - 30	P4361/45	3.3%	13.9%	7.0%	6.9%	7.3%	34.5%	21.0%	23.3%
31 50 -60	P4361/46	18.7%	2.2%	0.0%	2.2%	1.6%	27.9%	13.4%	55.0%
36 0 -10	P4361/47	11.6%	2.7%	0.0%	2.7%	6.1%	33.3%	28.2%	29.8%
36 25 - 35	P4361/48	17.8%	2.4%	1.8%	0.6%	1.6%	25.1%	19.5%	51.4%
36 55 - 65	P4361/49	18.3%	5.1%	4.4%	0.7%	1.4%	23.9%	15.1%	54.5%

Note:

1: 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.
2: Australian Standard 1289.3.8.1-1997 (see attached)
3. Analysis conducted between sample arrival date and reporting date.
4. This report is not to be reproduced except in full. Results only relate to the item tested.
5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).
6. This report was issued on 07/09/2023.

Environmental Analysis Laboratory, Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

checked: .....
Graham Lancaster (Nata signatory)
Laboratory Manager