Premise

TERRAIN SOLAR

Marulan Solar Farm

LAND & SOIL CAPABILITY ASSESSMENT

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1. INTRODUCTION

1.1 Background

Terrain Solar is proposing to develop an approximately 150 megawatt (MW) solar farm, including a battery energy storage system of up to 150 MW/600 MW_{hours} on land approximately 3 kilometres (km) east of the village of Towrang, 14 km east of Goulburn NSW, referred to as the Marulan Solar Farm (MSF). The project is State Significant Development (SSD-13137914).

The study area for this Land and Soil Capability (LSC) assessment includes the following areas depicted in **Figure 1** overleaf.

- Solar farm and access investigation area – 377.6 ha
- Substation and potential AC-couple battery location – 8.9 ha
- Switching station investigation area – 8.8 ha

The total study area for this LSC assessment is 395.3 ha.

1.2 Purpose

This LSC assessment has been prepared to address relevant requirements of the Secretary's Environmental Assessment Requirements (SEARs) issued for the project by the NSW Department of Planning, Industry and Environment (DPIE) and to support the project Environmental Impact Statement (EIS).

SEARs requirements relevant to this LSC assessment are provided in **Table 1** and addressed in this report, as indicated in **Table 1**. It is noted that detailed consideration of land use and land use impacts is provided within the Land Use Conflict Risk Assessment (LUCRA) provided with the EIS and does not form part of the scope of this LSC assessment. Background on agricultural land use is provided as context for this assessment only. The focus of this assessment is land and soil capability.

Figure 1 – Study area

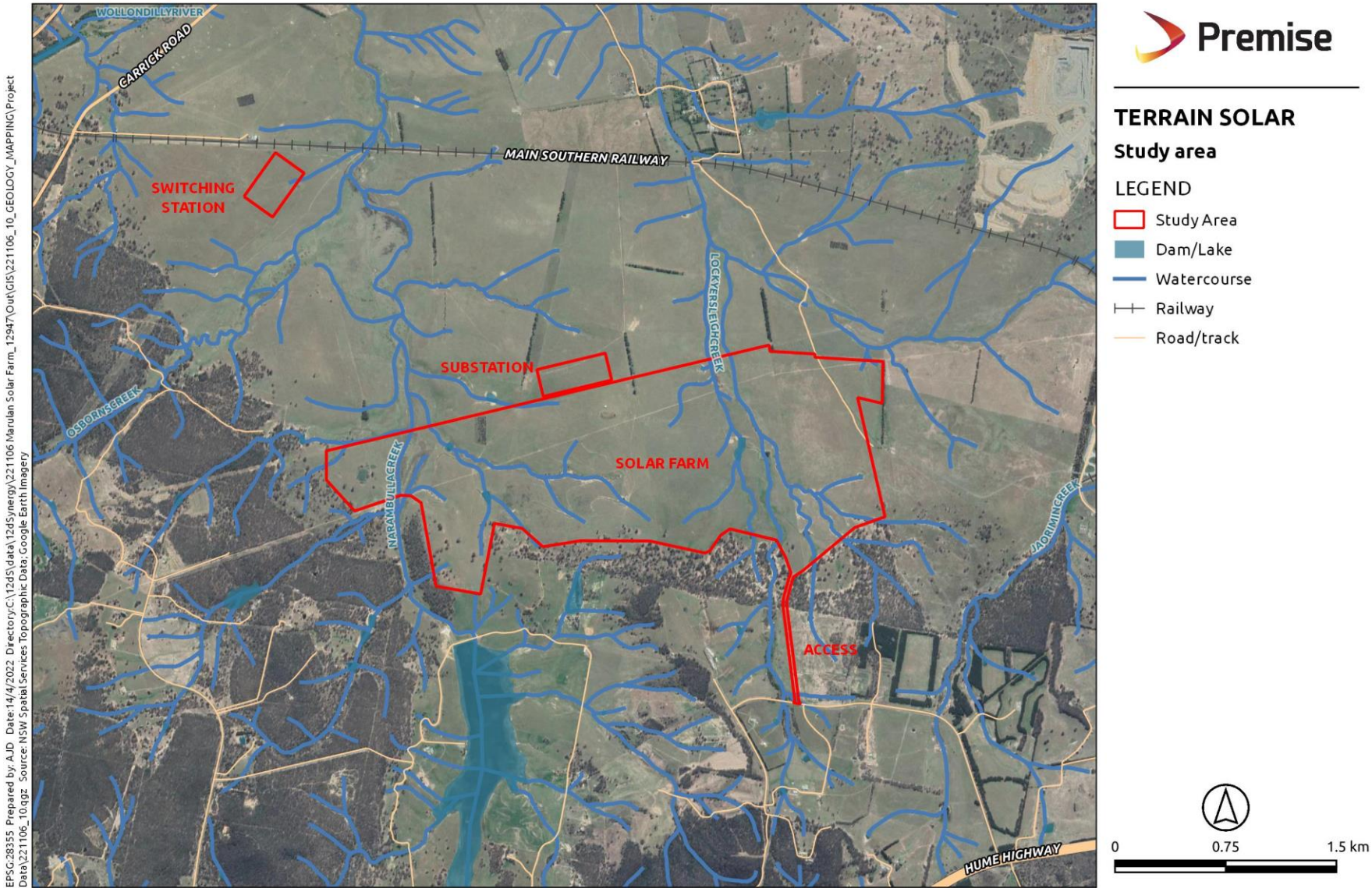


Table 1 – SEARs requirements

Source	Requirement	Relevant section
Planning Secretary's Environmental Assessment Requirements – Key Issues (Land)	An assessment of the potential impacts of the development on existing land uses on the site and adjacent land, including a soil survey to determine the soil characteristics and consider the potential for erosion to occur (including the identification of catchment protection scheme works).	**Section 3** – Soil assessment **Section 5** – Potential impacts Note: Consideration of Catchment Protection Scheme works is provided in the Water Cycle Management Study provided with the EIS.
NSW DPI Environmental Assessment Requirements (Cover Letter) Reference: OUT21/1428	Provide a complete soil survey, undertaken prior to works commencing, as a benchmark for rehabilitation.	**Section 3** – Soil assessment
NSW Department of Primary Industries (DPI) Environmental Assessment Requirements Attachment 1 Reference: OUT21/1428	Describe the soil, slope, land capability, agricultural productivity, land characteristics and the history of agricultural land uses on the proposed development site.	**Section 2** – Land use and agricultural history **Section 3** – Soil assessment **Section 4** – LSC assessment
	Full soil assessment due to the soil types and erosion potential of the area, earthworks, rehabilitation and decommissioning.	**Section 3** – Soil assessment
	Outline the monitoring and mitigation measures to be adopted for rehabilitation remedial actions.	**Section 7** – Mitigation measures
	Detail the cropping history or capability for cropping of the land and how the proposed rehabilitation works will enable this land to be used for cropping in the future. This detail is expected to require that for land with a cropping history or soil capability of category 1 to 3 in accordance with the land and soil capability assessment scheme: second approximation (OEH), , cables/pipes are to be buried at a depth of greater than 500mm below the finished surface level to allow agricultural activities to continue over the top, particularly for non-decommissioning cables/pipes once restoration is complete.	No land in the study area was identified as LSC Class 1-3 and land use is predominantly grazing. Notwithstanding that, the following sections provide relevant context. **Section 2** – Land use and agricultural history **Section 4** – LSC assessment Mitigation measures are provided in **Section 7**, including measures for decommissioning.
	Where the land contains sodic soils detail the proposed management practices which should ensure than any trenching through sodic soils during construction is to include soil amendment with Gypsum at a minimum rate of 10t/ha (actual rates to be determined following soil testing). Soil attributes such as clay content, CEC and ESP% (Exchangeable Sodium Percentage) will influence the quantity of Gypsum required.	**Section 7 –** Mitigation measures

Source	Requirement	Relevant section
WaterNSW response to request for SEARS Reference: D2021/8173	Recommendations for EIS: • Details of any existing erosion control measures (including Catchment Protection Scheme works), and any other constraints such as existing erosion gullies and the location of sodic and saline soils.	**Section 5 –** Erosion assessment Note: Consideration of Catchment Protection Scheme works is provided in the Water Cycle Management Study provided with the EIS.

2. LAND USE AND AGRICULTURAL HISTORY

2.1 Land use mapping

A review of the NSW Landuse 2017 v1.2 mapping from the DPIE SEED Portal identified a range of land uses at and surrounding the site. Land uses within the study area and the surrounding area (1km radius of the development site and excluding the study area) are outlined in the following tables and figures. The area of the mining land use (associated with the Lynwood Quarry) has been updated to be consistent with the area of quarry operations which has expanded since the 2017 Landuse mapping was completed.

A map of land uses within and surrounding the study area, as considered in the following tables and figures, is provided in **Figure 4**.

Review of land uses within the study area indicate land use is predominantly grazing, mostly on modified pastures and to a lesser extent, native vegetation.

Review of land uses surrounding the study area indicate land use is predominantly grazing (modified pasture and native vegetation) and cropping, which make up 75.5% of the surrounding land use.

Table 2 – Land use within the study area

Land Use	Percentage of Study Area (%)
Grazing modified pastures	79.3
Grazing native vegetation	20.3
Managed resource protection	0.4

Figure 2 – Graph of land use within the study area

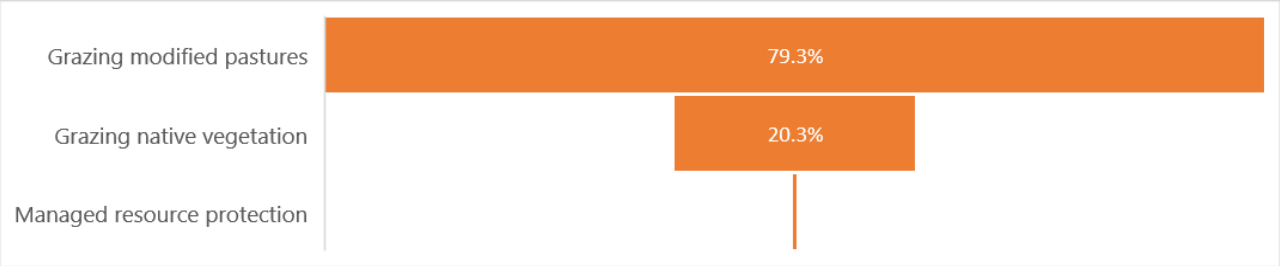


Table 3 – Land use surrounding the study area

Land Use	Percentage of surrounding area (%)
Grazing modified pastures	33.5%
Grazing native vegetation	21.6%
Cropping	20.4%
Other minimal use	14.5%
Residential and farm infrastructure	4.4%
Mining	2.1%
Plantation forests	1.1%
Managed resource protection	1.0%
Lake	0.8%
Perennial horticulture	0.3%
Reservoir/dam	0.2%

Figure 3 – Graph of land use surrounding the study area

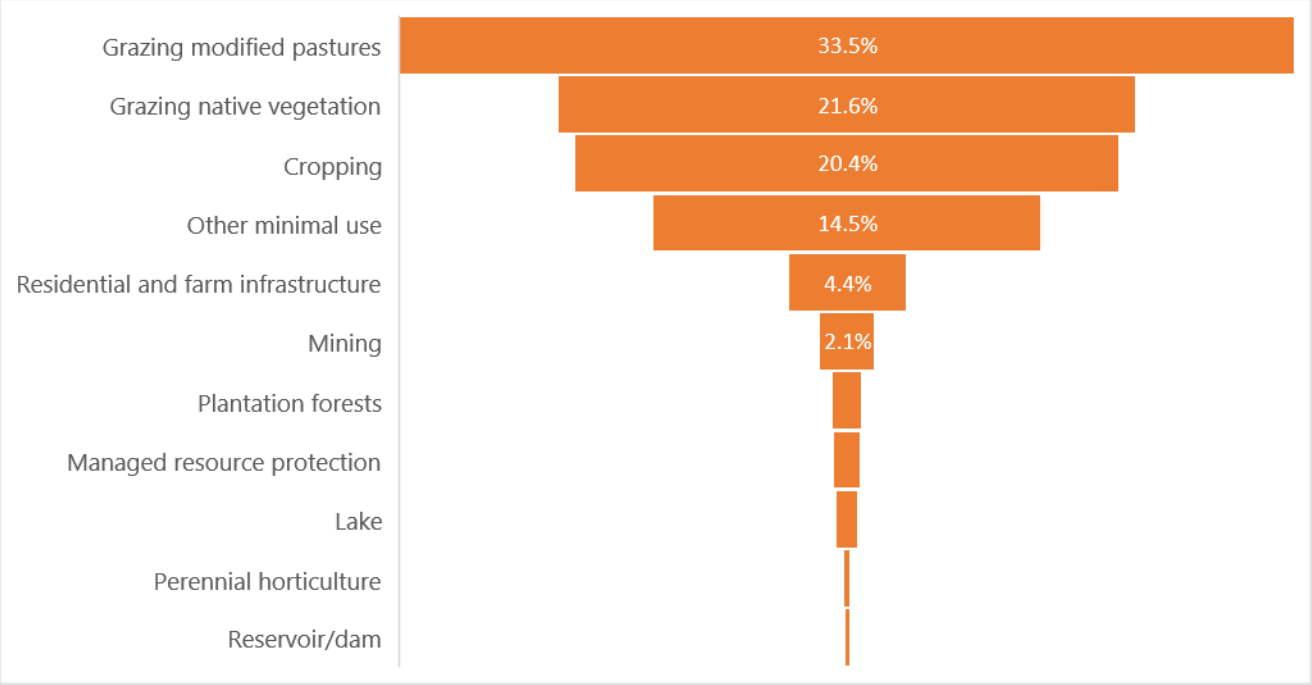
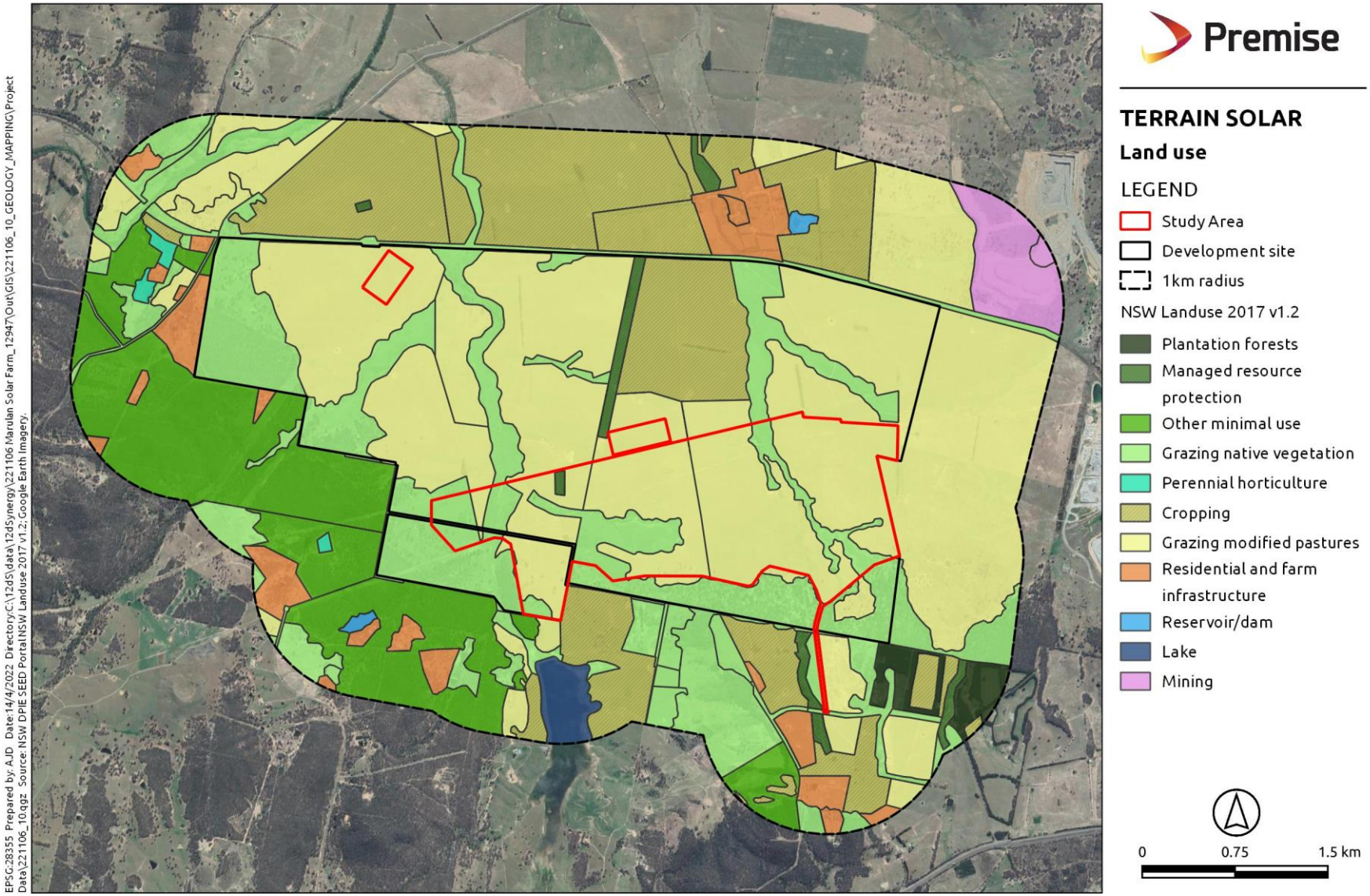


Figure 4 – NSW Landuse 2017



2.2 Agricultural history

The following sections provide an overview of the agricultural history of the study area. The information was obtained via discussions with the property manager as part of this assessment.

2.2.1 PROPERTY HISTORY

The study area is within the Lockyersleigh property, established in 1827 as a land grant to Major Lockyer. Lockyersleigh is one of the oldest privately owned properties in the Goulburn area has been in the same family since the 1850s. The property was initially cleared of timber for grazing sheep for wool production but has since also generated income from selling lambs.

2.2.2 CURRENT LAND MANAGEMENT PRACTICES

Current land management practices are primarily for grazing of sheep with occasional harvests in good seasons. An overview of pasture and grazing management at the study area is provided below.

2.2.2.1 Pastures and soil amendment

Most of the current pastures were sown about 15 – 17 years ago after applying 2 – 2.5 tonnes/hectare (t/ha) of lime. Triticale grazing crops have been grown to help reduce weeds. Super phosphate has been applied for over 30 years at a third of the recommended rate to apply necessary amounts of phosphorus and sulphur. Lime is currently being spread in paddocks outside and east of the study area to reduce the acidity of the surface soil.

2.2.2.2 Grazing

Grazing is currently time-controlled rotational grazing (30 day grazing period and a 50 day rest period, depending on pasture regrowth) for Prime Line sheep merinos that are bred for wool and meat lambs. Current grazing practices are considered to yield maximum value from the improved grazing management of native and improved pastures. Angus cattle have only occasionally grazed in the study area to reduce excessive pasture growth.

2.2.3 PRODUCTIVITY

2.2.3.1 Livestock

Consideration of income generated from the study area has considered an area of 400 ha, that is inclusive of the following areas that total 395.3 ha:

- Solar farm and access investigation area – 377.6 ha
- Substation and potential AC-couple battery location – 8.9 ha
- Switching station investigation area – 8.8 ha

Most income currently generated by the 400 ha of the Lockyersleigh property is from sheep grazing. The following information was determined in consultation with the property manager and landowner:

- The carrying capacity of sheep within the 400 ha area is estimated to be 2.5 Dry Sheep Equivalent (DSE). However, an approximation of the carrying capacity of Prime Line ewes producing 150% lambs is approximately 1.25 DSE.

- Assuming there are 500 breeding ewes in the 400 ha area with a lambing percentage of 150%, then 750 lambs would be produced annually and sold for an average price of approximately $200/head. This would generate approximately $150,000 income from the 400 ha area.
- Additional income is provided from wool but is not significant and likely to only cover the cost of shearing. Income from wool is estimated to be approximately $13/head from Prime Line ewes.

3. SOIL ASSESSMENT

3.1 Methodology

The methodology for the soil assessment include the following steps, as detailed in the following sections:

- Risk assessment to determine the sample density.
- Soil survey of the study area to undertake sampling and observations.
- Laboratory analysis to obtain sufficient information to classify soil units.

3.1.1 RISK ASSESSMENT

A risk assessment was undertaken in accordance with the NSW Government (2013) *Interim protocol for site verification and mapping of biophysical strategic agricultural land* to determine the soil sampling density, using the agricultural impacts risk ranking matrix provided below.

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

where:

= low risk
= medium risk
= high risk

The risk assessment determined that the risk is likely to be B4 (medium) risk on the following basis:

- Minor damage to soils may occur during construction that are likely to have short-term (i.e. construction period) impacts to the ability to use the land for agricultural purposes until such time that groundcover has re-established.
- Impacts are anticipated to be managed via routine environmental management during the construction, operation and decommissioning of the MSF.

The LSC Scheme states that:

> *Where it can be demonstrated that areas of land less than 10 per cent slope, and likely not to satisfy BSAL land and/or soil type criteria, and will be subject to low agricultural risk impact (DP&I, 2012), a sampling density appropriate to a scale between 1:25 000 and 1:100 000 is adequate.*
>
> *For example, sampling density should be:*
>
> *1. 1 site per 5 – 25 ha (Gallant et al. 2008) for more intensive developments, e.g., open-cut coal mining; or*
>
> *2. 1 site per 25 – 400 ha (Gallant et al. 2008) for less intensive developments, where there is a low risk to agriculture.*

A minimum sample density of 1:50,000 (i.e. 1 sample per 50 ha) was adopted for the soil survey, giving consideration to the following in relation to the above guidance from the LSC Scheme:

- There are some areas with slope over 10% within the study area.
- The land is not mapped as BSAL or considered to satisfy BSAL criteria.
- The assessed risk level of B4 (medium) risk

3.1.2 SOIL SURVEY

The field survey for this LSC Assessment was undertaken between 25 – 27 October 2021 by John Lawrie (Soil Scientist) and Isaac Westcott (Field Technician). Wet conditions were experienced prior to the survey.

Samples were collected with a trailer-mounted hydraulic soil corer to a maximum depth of one (1) metre. Sample site no. 20 was only sampled at surface (0-10 cm) due to access issues during the survey.

The location of all observation and sample sites were recorded via GPS. Photographs were taken at all sample sites and for all soil cores.

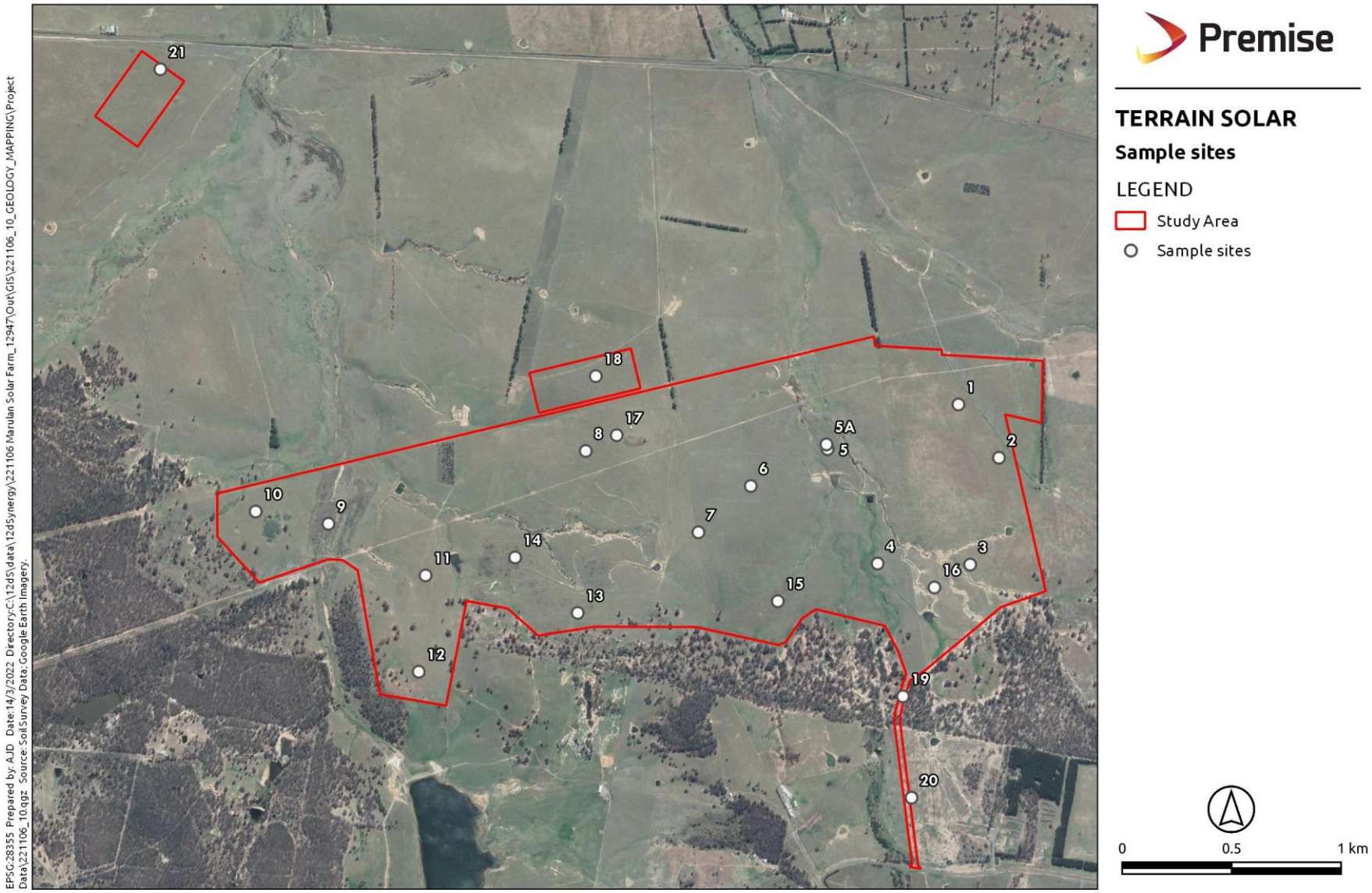
Soil profiles were assessed in accordance with the Australian Soil and Land Survey Field Handbook (NCST, 2009). Soil profile descriptions were prepared for all sample sites record the information specified in the LSC Scheme.

An overview of soil survey details is provided in **Table 4**. The location of all soil survey sites is provided in **Figure 5**.

Table 4 – Soil survey details

Parameter	Soil survey details
Total Study Area (ha)	395.3
Proposed minimum survey density	1:50,000 i.e. 7.9 samples over the study area (395.3 ha)
Total number of sites sampled	22
Laboratory analysed sites	13
Detailed soil profiles reported	9

Figure 5 – Sample site locations



3.1.3 LABORATORY ANALYSIS

Selected samples were analysed to provide sufficient information to classify soils in accordance with the Australian Soil Classification (ASC) (Isbell, 2002) soil taxonomic class and to determine the LSC classification. Samples were analysed by a National Association of Testing Authorities Australia (NATA) accredited laboratory (Nutrient Advantage). Samples selected for analysis are identified in the following section.

3.2 Soil units

Table 5 provides an overview of the soil units identified in the study area. A map of soil units is provided in **Figure 6** overleaf. Detailed soil profiles are provided in Appendix A and laboratory results are provided in **Appendix B**.

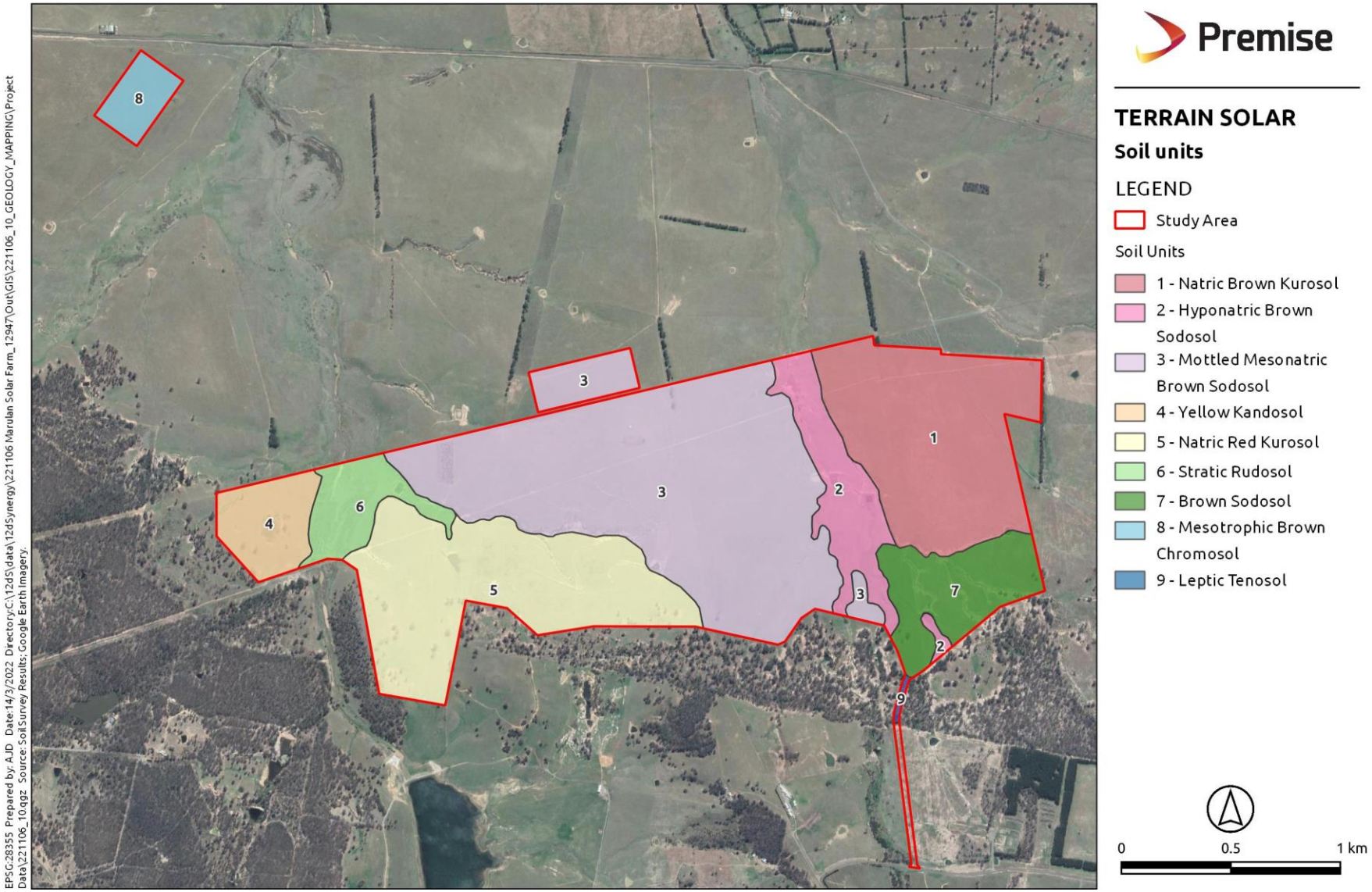
Only a topsoil (0-10cm) sample was collected at sample site no. 20 due to access issues at the time of the survey. Therefore, a soil unit and LSC class has not been determined or mapped for the southern extent of the access investigation area. The topsoil sample at sample site no. 20 is a dark brown, fine sandy loam and is moderately acidic (pH 5.7).

Table 5 – Study area soil units

Unit ID	ASC Soil Type	Soil Type Group	Sample Site
1	Natric Brown Kurosol	Dominant	1 and 2*
	Yellow Sodosol	Sub-Dominant	
2	Hyponatric Brown Sodosol	Dominant	4, 5 and 5A*
	Clastic Rudosol	Sub-Dominant	
3	Mottled Mesonatric Brown Sodosol	Dominant	6*, 7*, 8, 13, 15, 17 and 18*
	Brown Kurosol	Sub-Dominant	
4	Yellow Kandosol	Dominant	10*
5	Natric Red Kurosol	Dominant	11*, 12*, 13 and 14*
	Red and Brown Sodosols	Sub-Dominant	
6	Stratic Rudosol	Dominant	9*
7	Brown Sodosol	Dominant	3 and 16 **see note
	Brown Kurosol	Sub-Dominant	
8	Mesotrophic Brown Chromosol	Dominant	21*
9	Leptic Tenosol	Dominant	19*

* Denotes samples that were subject to laboratory analysis. Other samples were not selected for laboratory analysis.
** No laboratory analysis for Soil Unit 7 was completed as soils were considered similar to Soil Unit 1 with a granitic substrate.

Figure 6 – Study area soil units



4. LSC ASSESSMENT

4.1 LSC Scheme

This LSC assessment has prepared in accordance with the NSW Office of Environment and Heritage (OEH, 2012) *Land and Soil Capability Assessment Scheme: Second Approximation* (LSC Scheme). Relevant contextual information from the LSC Scheme is reproduced below:

> *The LSC assessment scheme uses the biophysical features of the land and soil including landform position, slope gradient, drainage, climate, soil type and soil characteristics to derive detailed rating tables for a range of land and soil hazards. These hazards include water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and mass movement. Each hazard is given a rating between 1 (best, highest capability land) and 8 (worst, lowest capability land). The final LSC class of the land is based on the most limiting hazard.*
>
> *The LSC class gives an indication of the land management practices that can be applied to a parcel of land without causing degradation to the land and soil at the site and to the off-site environment. High impact practices require good quality, high capability land, such as LSC classes 1 to 3, while low impact practices can be sustainable on poorer quality, lower capability land, such as LSC classes 5 to 8. As land capability decreases, the management of hazards requires an increase in knowledge, expertise and investment. In lands with lower capability, the hazards cannot be managed effectively for some land uses.*

LSC classes are defined in **Table 2** of the LSC Scheme, reproduced in **Table 6**.

Table 6 – LSC Definitions

Class	General definition
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, 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.

Class	General definition
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.

4.2 Determining LSC classes

Each hazard has been assessed against the below criteria from Table 3 of the LSC Scheme. Consideration of each hazard for each soil unit is provided in the following subsections.

	Water erosion	Wind erosion	Soil structure decline	Soil acidification	Salinity	Water-logging	Shallow soils and rock	Mass movement
NSW Division	✓							
Sand dune or mobile sand body	✓							
Slope %	✓							✓
Scree or talus slope								✓
Footslope or drainage plain receiving high run-on	✓							
Gully erosion or sodic dispersible subsoils	✓							
Annual rainfall		✓		✓				✓
Wind erosive power		✓						
Exposure to wind		✓						
Surface soil texture		✓	✓	✓				
Surface soil texture modifier			✓					
Great Soil Group				✓				
pH of surface soil				✓				
Surface soil modifier				✓				
Parent material				✓				
Recharge potential of landscape					✓			
Discharge potential of landscape					✓			
Salt store of landscape					✓			
Waterlogging duration						✓		
Return period of waterlogging						✓		
Rocky outcrop							✓	
Soil depth							✓	
Presence of existing mass movement								✓

4.2.1 HAZARD 1 – WATER EROSION

The following slope classes are provided in Table 4 of the LSC Scheme to determine the water erosion hazard class.

NSW division	Slope class (%) for each LSC class							
	Class 1	Class 2	Class 3	Class 4[1]	Class 5[2]	Class 6	Class 7	Class 8
Eastern and Central divisions	<1	1 to <3	3 to <10 or 1 to <3 with slopes >500 m length	10 to <20	10 to <20	20 to <33	33 – <50	>50
Western Division[3]	<1	1 to <3 or <1 for hardsetting red soils	1–3	3–5	3–5	5–33	33–50	>50

Sand bodies are classified as Class 1 for water erosion hazard.
[1] No gully erosion or sodic/dispersible soils are present.
[2] Gully erosion and/or sodic/dispersible subsoils are present.
[3] Western CMA provided advice on the slope classes.

A slope analysis for the study area is provided in **Figure 7** and has been used to inform the water erosion hazard assessment in **Table 7** below. Slope was derived from NSW Spatial Services (2013) 5 metre resolution Digital Elevation Model (DEM) processed by the QGIS Raster Analysis – Slope tool.

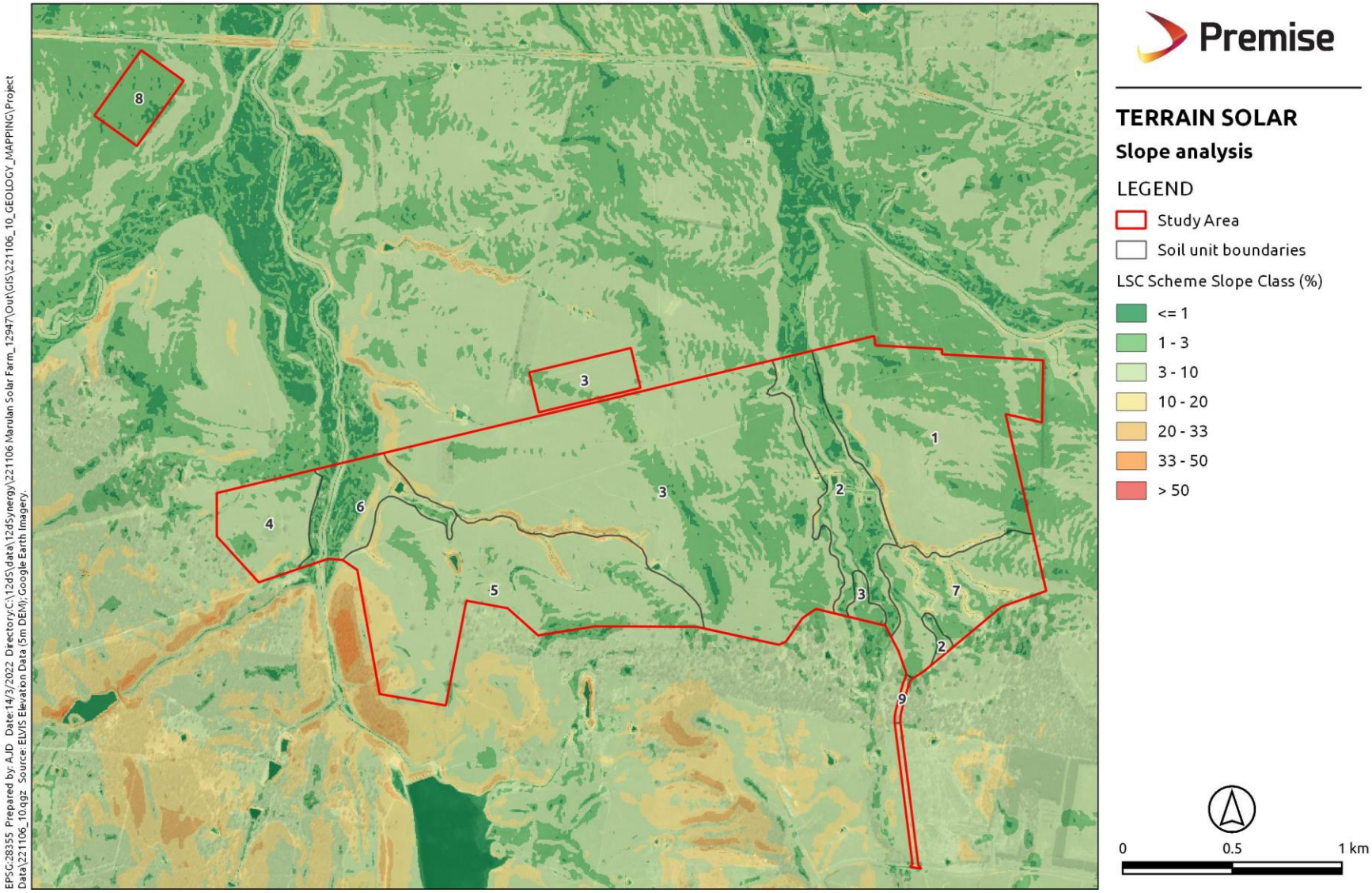
Table 7 – Hazard assessment – Water erosion

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope % and Class	Predominantly slopes between 1-3% (Class 2) and 3-10% (Class 3) with minor areas of slopes over 10% along drainage lines. Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Unit 1 could be susceptible to gully erosion due to strongly sodic subsoil. Assessed Class: 5	
Unit 2	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 1-3% (Class 2) and 3-10% (Class 3) with minor areas of slopes over 10% along drainage lines. Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	Poor drainage. Predicted to flood after heavy rain 1-2 each year on average.	

Soil unit	LSC Scheme Criteria	Assessment	Class
	Gully erosion or sodic dispersible subsoils	Saline and prone to gully erosion. Assessed Class: 5	
Unit 3	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 1-3% (Class 2) and 3-10% (Class 3) with minor areas of slopes over 10% along drainage lines. Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Unit 3 could be susceptible to gully erosion due to strongly sodic subsoil. Assessed Class: 5	
Unit 4	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 3-10% (Class 3) with a small areas with slopes over 10% . Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Unit 4 could be susceptible to gully erosion due to sodic subsoil. Assessed Class: 5	
Unit 5	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 1-3% (Class 2) and 3-10% (Class 3) with some areas of slopes over 10% along drainage lines and along a hill slope at the western margin of this soil unit. Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Unit 5 could be susceptible to gully erosion due to strongly sodic subsoil. Assessed Class: 5	
Unit 6	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	

Soil unit	LSC Scheme Criteria	Assessment	Class
	Slope %	Predominantly slopes between 1-3% (Class 2) and 3-10% (Class 3) with some areas of slopes over 10% along drainage lines. Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	Poor drainage. Predicted to flood after heavy rain 1-2 each year on average.	
	Gully erosion or sodic dispersible subsoils	Unit 6 is susceptible to gully erosion. Assessed Class: 5	
Unit 7	NSW Division	Eastern Division	6
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 1-3% (Class 2) and 3-10% (Class 3) with some areas of slopes over 10% along drainage lines. Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Unit 7 is susceptible to gully erosion due to strongly sodic subsoil. Existing gullying present. Assessed Class: 6	
Unit 8	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 1-3% (Class 2) Assessed Class: 2	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Slightly sodic subsoil. Assessed Class: 5	
Unit 9	NSW Division	Eastern Division	5
	Sand dune or mobile sand body	Not applicable	
	Slope %	Predominantly slopes between 3-10% (Class 3) with some smaller areas of slopes between 1-3% (Class 2). Assessed Class: 3	
	Screen or talus slope	N/A	
	Footslope or drainage plain receiving high run-on	N/A	
	Gully erosion or sodic dispersible subsoils	Unit 9 is susceptible to gully erosion due to strongly sodic subsoil. Assessed Class: 5	

Figure 7 – Study area slope analysis



4.2.2 HAZARD 2 – WIND EROSION

The LSC assessment scheme uses the following factors to determine the wind erosion hazard class:

- *the average rainfall which determines the capacity of the land to maintain surface cover and keep the soil wet. The wind erosion hazard increases as the average annual rainfall declines (Figure 5).*
- *the wind erosive power or wind erosivity based on overall wind patterns. Figure 6 is a map of the wind erosive power for NSW.*
- *the exposure of the tract of land to wind, taking into account local variations in wind power. For example, at the local scale, the landform might channel the prevailing wind into some areas (Table 5).*
- *the soil erodibility to wind. This is largely determined by the texture of the soil as this determines the detachability and transportability of the soil particles (Table 5).*

Consideration of the above criteria is provided in **Table 8** to determine the wind erosion hazard class for each soil unit.

Table 8 – Hazard assessment – Wind erosion

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	3
	Wind erosive power	High	
	Wind exposure	Moderate	
	Soil erodibility to wind	Low	
Unit 2	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	2
	Wind erosive power	High	
	Wind exposure	Low	
	Soil erodibility to wind	Low	
Unit 3	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	3
	Wind erosive power	High	
	Wind exposure	Moderate	
	Soil erodibility to wind	Low	
Unit 4	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	3
	Wind erosive power	High	
	Wind exposure	Moderate	
	Soil erodibility to wind	Low	

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 5	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	3
	Wind erosive power	High	
	Wind exposure	Moderate	
	Soil erodibility to wind	Low	
Unit 6	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	2
	Wind erosive power	High	
	Wind exposure	Low	
	Soil erodibility to wind	Low	
Unit 7	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	3
	Wind erosive power	High	
	Wind exposure	Moderate	
	Soil erodibility to wind	Low	
Unit 8	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	4
	Wind erosive power	High	
	Wind exposure	Moderate	
	Soil erodibility to wind	Moderate	
Unit 9	Average rainfall	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	2
	Wind erosive power	High	
	Wind exposure	Low	
	Soil erodibility to wind	Low	

4.2.3 HAZARD 3 – SOIL STRUCTURE DECLINE

The LSC Scheme assesses the soil structure decline hazard using the nature of the surface soils. The nature of the surface soils is assessed using the following criteria:

- surface soil texture
- degree of sodicity
- degree of self-mulching.

The soil structure decline hazard is assessed using a combination of Tables 7 and 8 of the LSC Scheme. Criteria from those tables are considered in **Table 9** to determine the soil structure decline hazard class for each soil unit.

Table 9 – Hazard assessment – Soil structure decline

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Field texture (surface soils)	Sandy loam	3
	Modifier	Nil	
	Outcome – surface soil type	Fragile light textured surface soil	
Unit 2	Field texture (surface soils)	Sandy loam	3
	Modifier	Nil	
	Outcome – surface soil type	Fragile light textured surface soil	
Unit 3	Field texture (surface soils)	Sandy loam	3
	Modifier	Nil	
	Outcome – surface soil type	Fragile light textured surface soil	
Unit 4	Field texture (surface soils)	Loam	4
	Modifier	High levels of silt and very fine sand	
	Outcome – surface soil type	Fragile medium textured soil – very hardsetting	
Unit 5	Field texture (surface soils)	Fine sandy loam	3
	Modifier	Normal	
	Outcome – surface soil type	Fragile light textured soil	
Unit 6	Field texture (surface soils)	Silty clay	2
	Modifier	Friable/ferric	
	Outcome – surface soil type	Friable clay surface soil	
Unit 7	Field texture (surface soils)	Fine sandy loam	3
	Modifier	Normal	
	Outcome – surface soil type	Fragile light textured soil	
Unit 8	Field texture (surface soils)	Fine sandy loam	3
	Modifier	Normal	
	Outcome – surface soil type	Fragile light textured soil	
Unit 9	Field texture (surface soils)	Fine sandy loam	4
	Modifier	High levels of silt and very fine sand	
	Outcome – surface soil type	Fragile medium textured soil – very hardsetting	

4.2.4 HAZARD 4 – SOIL ACIDIFICATION

Soil acidification hazard class is determined by soil buffering capacity, pH and mean annual rainfall, with reference to Tables 9-12 of the LSC Scheme. Relevant criteria from those tables are considered in **Table 10** to determine the soil acidification hazard class for each soil unit.

Table 10 – Hazard assessment – Soil acidification

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 5.5-6.7**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 2	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 4.7-5.5**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 3	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 5.5-6.7**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 4	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 5.5-6.7**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 5	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 5.5-6.7**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 6	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5

Soil unit	LSC Scheme Criteria	Assessment	Class
	pH (water) of the natural surface soil	**pH 5.5-6.7**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 7	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 5.5-6.7** (based on field pH)	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 8	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 5.5-6.7**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	
Unit 9	Buffering capacity based on surface soil texture	Sands and sandy loams – no calcium carbonate. **Very Low (VL)** buffering capacity.	5
	pH (water) of the natural surface soil	**pH 4.7-5.5**	
	Mean annual rainfall	**550 - 700 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	

4.2.5 HAZARD 5 – SALINITY

Table 3 of the LSC Scheme requires consideration of three inputs to determine the salinity hazard, including recharge potential, discharge potential and salt stores. These criteria are considered in **Table 11** to determine the salinity hazard class for each soil unit.

Table 11 – Hazard assessment – Salinity

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Recharge potential	High	1
	Discharge potential	Low	
	Salt store	Low	
Unit 2	Recharge potential	High	7
	Discharge potential	High	
	Salt store	High	
Unit 3	Recharge potential	High	4
	Discharge potential	Moderate	

Soil unit	LSC Scheme Criteria	Assessment	Class
	Salt store	Moderate	
Unit 4	Recharge potential	High	2
	Discharge potential	Moderate	
	Salt store	Low	
Unit 5	Recharge potential	High	1
	Discharge potential	Low	
	Salt store	Low	
Unit 6	Recharge potential	Low	1
	Discharge potential	Moderate	
	Salt store	Low	
Unit 7	Recharge potential	High	1
	Discharge potential	Low	
	Salt store	Low	
Unit 8	Recharge potential	Moderate	3
	Discharge potential	Low	
	Salt store	Moderate	
Unit 9	Recharge potential	Moderate	3
	Discharge potential	Low	
	Salt store	Moderate	

4.2.6 HAZARD 6 – WATER LOGGING

Table 14 of the LSC Scheme requires consideration of three inputs to determine the water logging hazard, including typical waterlogging duration, return period and typical soil drainage. These criteria are considered in **Table 12** to determine the water logging hazard class for each soil unit.

Table 12 – Hazard assessment – Water logging

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Typical waterlogging duration	0 months	6
	Return period	Every year	
	Typical soil drainage	Poorly drained	
Unit 2	Typical waterlogging duration	2-3 months	6
	Return period	Every year	
	Typical soil drainage	Poorly drained	
Unit 3	Typical waterlogging duration	0 months	2
	Return period	Every year	
	Typical soil drainage	Moderately well drained	

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 4	Typical waterlogging duration	0 months	2
	Return period	Every year	
	Typical soil drainage	Moderately well drained	
Unit 5	Typical waterlogging duration	0 months	2
	Return period	Every year	
	Typical soil drainage	Moderately well drained	
Unit 6	Typical waterlogging duration	2-3 months	7
	Return period	Every year	
	Typical soil drainage	Poorly drained	
Unit 7	Typical waterlogging duration	0 months	6
	Return period	Every year	
	Typical soil drainage	Poorly drained	
Unit 8	Typical waterlogging duration	0 months	2
	Return period	Every year	
	Typical soil drainage	Moderately well drained	
Unit 9	Typical waterlogging duration	0 months	2
	Return period	Every year	
	Typical soil drainage	Moderately well drained	

4.2.7 HAZARD 7 – SHALLOW SOILS AND ROCKINESS

Table 15 of the LSC Scheme requires consideration of two inputs to determine the shallow soils and rockiness hazard, including rocky outcrop percentage coverage and soil depth. These criteria are considered in **Table 13** to determine the shallow soils and rockiness hazard class for each soil unit.

Table 13 – Hazard assessment – Shallow soils and rockiness

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Rocky outcrop (% coverage)	Nil	3
	Soil depth (cm)	75-<100 cm	
Unit 2	Rocky outcrop (% coverage)	Nil	1
	Soil depth (cm)	>100 cm	
Unit 3	Rocky outcrop (% coverage)	Nil	3
	Soil depth (cm)	75-<100 cm	
Unit 4	Rocky outcrop (% coverage)	Nil	3
	Soil depth (cm)	75-<100 cm	
Unit 5	Rocky outcrop (% coverage)	Nil	1
	Soil depth (cm)	>100 cm	

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 6	Rocky outcrop (% coverage)	Nil	1
	Soil depth (cm)	>100 cm	
Unit 7	Rocky outcrop (% coverage)	Nil	3
	Soil depth (cm)	75-<100 cm	
Unit 8	Rocky outcrop (% coverage)	Nil	3
	Soil depth (cm)	75-<100 cm	
Unit 9	Rocky outcrop (% coverage)	<30% (localised)	6
	Soil depth (cm)	25-<50 cm	

4.2.8 HAZARD 8 – MASS MOVEMENT

Table 16 of the LSC Scheme requires consideration of three inputs to determine the mass movement hazard, including mean annual rainfall, mass movement present and slope class. These criteria are considered in **Table 14** to determine the mass movement hazard class for each soil unit.

Table 14 – Hazard assessment – Mass movement

Soil unit	LSC Scheme Criteria	Assessment	Class
Unit 1	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 2	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 3	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 4	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 5	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 6	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	

Soil unit	LSC Scheme Criteria	Assessment	Class
	Slope class (%)	N/A	
Unit 7	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 8	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	
Unit 9	Mean annual rainfall (mm)	**>500 mm** average annual rainfall based on 653.1 mm average annual rainfall from Station Number 070269.	1
	Mass movement present	No	
	Slope class (%)	N/A	

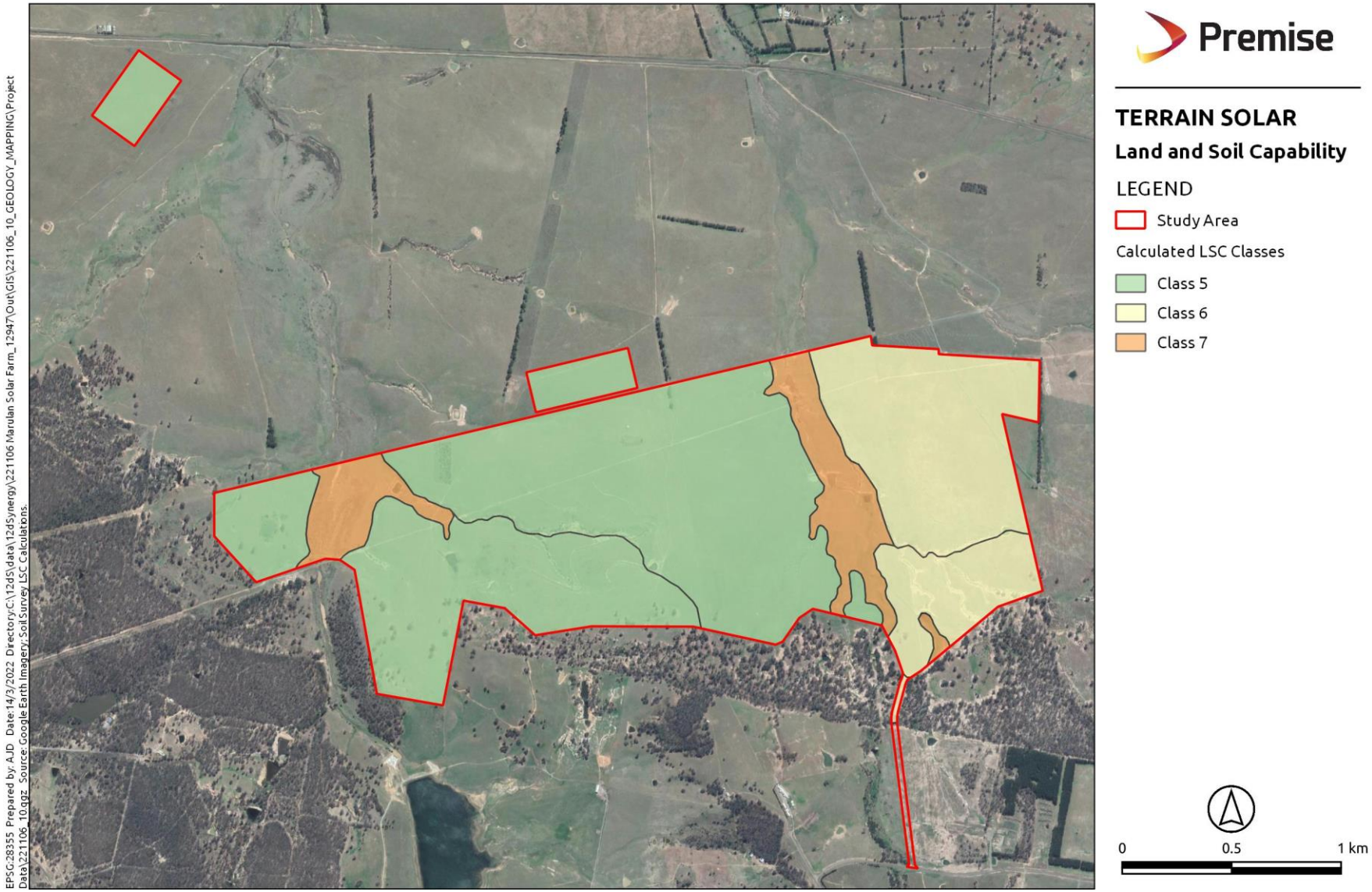
4.3 Land and soil capability

Overall LSC class for each soil unit is provided in **Table 15**, including an overview of all hazard classes by soil unit. A map of overall LSC classes by soil unit is provided in **Figure 8**.

Table 15 – Overall LSC assessment

Soil Unit	Hazard								Overall LSC
	1	2	3	4	5	6	7	8	
	Water erosion	Wind erosion	Soil structure decline	Soil acidification	Salinity	Water logging	Shallow soils /rockiness	Mass movement	
Unit 1	5	3	3	5	1	6	3	1	6
Unit 2	5	2	3	5	7	6	1	1	7
Unit 3	5	3	3	5	4	2	3	1	5
Unit 4	5	3	4	5	2	2	3	1	5
Unit 5	5	3	3	5	1	2	1	1	5
Unit 6	5	2	2	5	1	7	1	1	7
Unit 7	6	3	3	5	1	6	3	1	6
Unit 8	5	4	3	5	3	2	3	1	5
Unit 9	5	2	4	5	3	2	6	1	6

Figure 8 – Study area LSC classes



Overall land and soil capability for the study area ranges from Class 5 (moderate – low capability land) to Class 7 (very low capability land). Definitions for each class is reproduced below (**Table 16**) from Table 2 of the LSC Scheme.

Table 16 – LSC Classes 5-7 definitions

Class	General definition
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
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.

A summary of land and soil capability by soil unit and area is provided below in Table 17 and Table 18.

Table 17 – Summary of land and soil capability

Soil Unit	LSC Class	LSC Limitation	LSC Capability	Area (ha)
1	6	Water logging	Low capability land	71.6
2	7	Salinity	Very low capability land	26.4
3	5	Water erosion and soil acidification	Moderate to low capability land	149.9
4	5	Water erosion and soil acidification	Moderate to low capability land	17.1
5	5	Water erosion and soil acidification	Moderate to low capability land	75.7
6	7	Water logging	Very low capability land	16.1
7	6	Water erosion and water logging	Moderate to low capability land	27.2
8	5	Water erosion and soil acidification	Moderate to low capability land	8.8
9	6	Shallow soils/rockiness	Low capability land	0.6

Table 18 – LSC class areas and percentages

LSC Class	Area (ha)	Percentage (%)
5	215.5	63.9
6	99.4	25.3
7	42.5	10.8

5. EROSION ASSESSMENT

5.1 Site observations

During the soil survey, severe deep gully erosion was observed in soil units 5 and 7, including along the boundary of units 3 and 5 which is defined, in part, by a gully. Gullying in these units have evidence of severe sodicity in the subsoil which prevents water after heavy rain events from draining into the substrate, resulting in waterlogging. Water flows downslope through the bleached A2 horizons and washes salt from these subsoils into the flats below Units 2 and 6.

Wombat burrows were also observed within the study area. Disturbance of the burrows may increase risk of tunnelling soil erosion on soils with sodic subsoils.

Figure 9 identifies the location of existing erosion within the study area.

5.2 Existing erosion controls

Existing erosion controls observed during the soil survey included graded contour banks, predominantly associated with Units 3, 5 and 7 where gullies are located. The contour banks have been constructed to divert water from running into gullies and in places, they direct water towards dams.

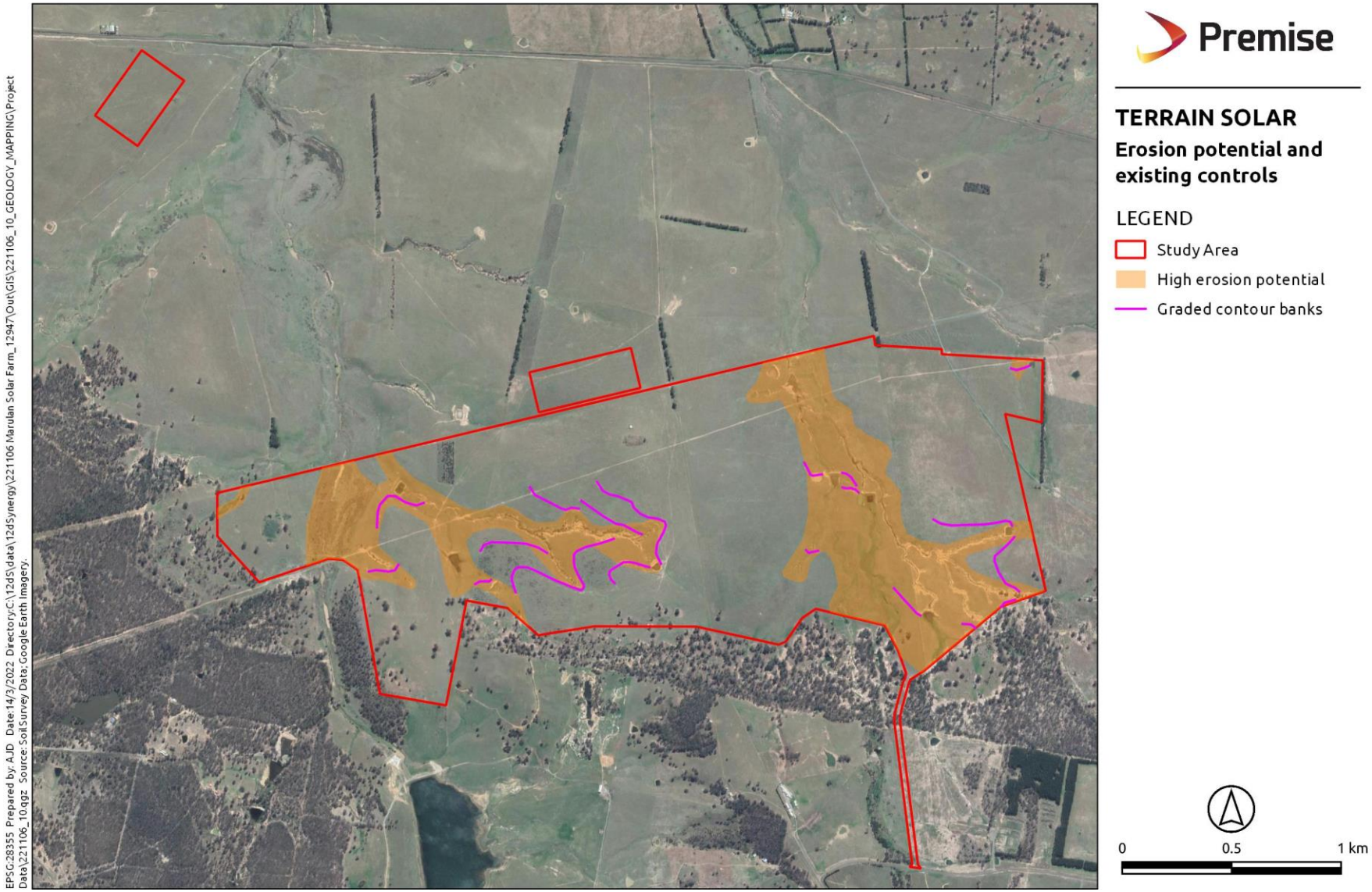
Figure 9 identifies the location of existing erosion controls within the study area.

5.3 Erosion potential

Areas of high erosion potential have been determined based on site observations, slope data and soil sodicity. These areas are identified in **Figure 9** overleaf.

An assessment of erosion potential has been completed using the Revised Universal Soil Loss Equation (RUSLE) calculation method, detailed in the following subsections. The objective of this assessment was to identify site control measures to limit the potential soil loss to less than 150 t/ha/year (Soil Loss Class 1).

Figure 9 – Erosion potential and existing controls



5.3.1 SOIL LOSS CLASSES

Table 4.2 of the Landcom (2004) *Managing Urban Stormwater: Soils and Construction* (Blue Book) provides soil loss classes that are considered in this assessment, reproduced in in **Table 19** below.

Calculated soil loss for the solar farm has been determined using the methodology, assumptions and limitations in following subsections.

Table 19 – Soil loss classes from the Blue Book

Soil Loss Class	Calculated Soil Loss (t/ha/year)	Erosion Hazard
1	0 - 150	Very Low
2	151 – 225	Low
3	226 – 350	Low – Moderate
4	351 – 500	Moderate
5	501 – 750	High
6	751 – 1,500	Very High
7	>1,500	Extremely High

5.3.1.1 Methodology

The RUSLE calculation is undertaken using the following equation: A = R x K x LS x P x C

where, A = computed soil loss (tonnes/ha/yr)

R = rainfall erosivity factor

K = soil erodibility factor

LS = slope length/gradient factor

P = erosion control practice factor

C = ground cover and management factor.

The inputs outlined in **Table 20** were adopted for the RUSLE calculation.

Table 20 – RUSLE calculation inputs

Factor	Input	Comment
C Factor	1.0 for construction area 0.5 for exclusion area	Assumes construction area has no vegetative cover Assumes exclusion area is vegetated and not disturbed
P Factor	1.3 for construction area 1.0 for exclusion area	Assumes construction area soil are hard and compact Assumes exclusion area is vegetated and not disturbed
K Factor	0.05 for all areas	Derived via review of the NSW DPIE (2020) *Modelled Hillslope Erosion over New South Wales* GIS data available via the SEED Portal.

Factor	Input	Comment
R Factor	970 for all areas	Derived via review of the NSW DPIE (2020) *Modelled Hillslope Erosion over New South Wales* GIS data available via the SEED Portal.
LS Factor	Variable based on LS Factors in Table A1 of the Blue Book, ranges from 0.19 – 1.28.	LS factors were assigned to slope gradients to ensure a maximum slope length was applied to achieve Soil Loss Class 1, specifically: • Slopes 0-6% have a maximum slope length of 80 m. • Slopes 7-9% have a maximum slope length of 60 m. • Slopes 10-11% have a maximum slope length of 40 m. • Slopes 12-13% have a maximum slope length of 30 m. • Slopes 14-17% have a maximum slope length of 20 m. • Slopes 18-29% have a maximum slope length of 10 m. • Slopes 30-35% have a maximum slope length of 5 m. Note: The only areas with slopes between 30-35% are within exclusion areas. Therefore, no areas within the solar farm study area would require a maximum slope length of 5 m.

5.3.1.2 Assumptions and limitations

The RUSLE calculation was undertaken using the following assumptions and limitations:

- The RUSLE assessment was only undertaken for the solar farm area, inclusive of 375.3 ha.
- The RUSLE calculation does not consider a detailed solar farm layout with C and P factors only varying between construction areas and exclusion areas.
- Soil loss calculations assume that:
  - the maximum slope lengths specified in **Table 20** are effectively implemented. This would be achieved using controls such as earth banks and sediment fences at the nominated spacing to break up slope lengths;
  - not more than 1.5 ha within a catchment within the site would be disturbed at any one time; and
  - no construction activities would be undertaken within the exclusion areas.

5.3.2 RESULTS

Calculated soil loss for the solar farm ranges from 5 – 125 t/ha/year, which is Soil Loss Class 1 – Very Low Erosion Hazard. Variation in soil loss for the solar farm is depicted in **Figure 10** overleaf.

The maximum slope lengths required to achieve Soil Loss Class 1 are depicted in **Figure 11** overleaf and is consistent with the slope lengths specified in **Table 20**.

Soil loss would be reduced following revegetation and would continue to reduce over time as the vegetation becomes established and stabilises the soil.

Figure 10 – Calculated soil loss

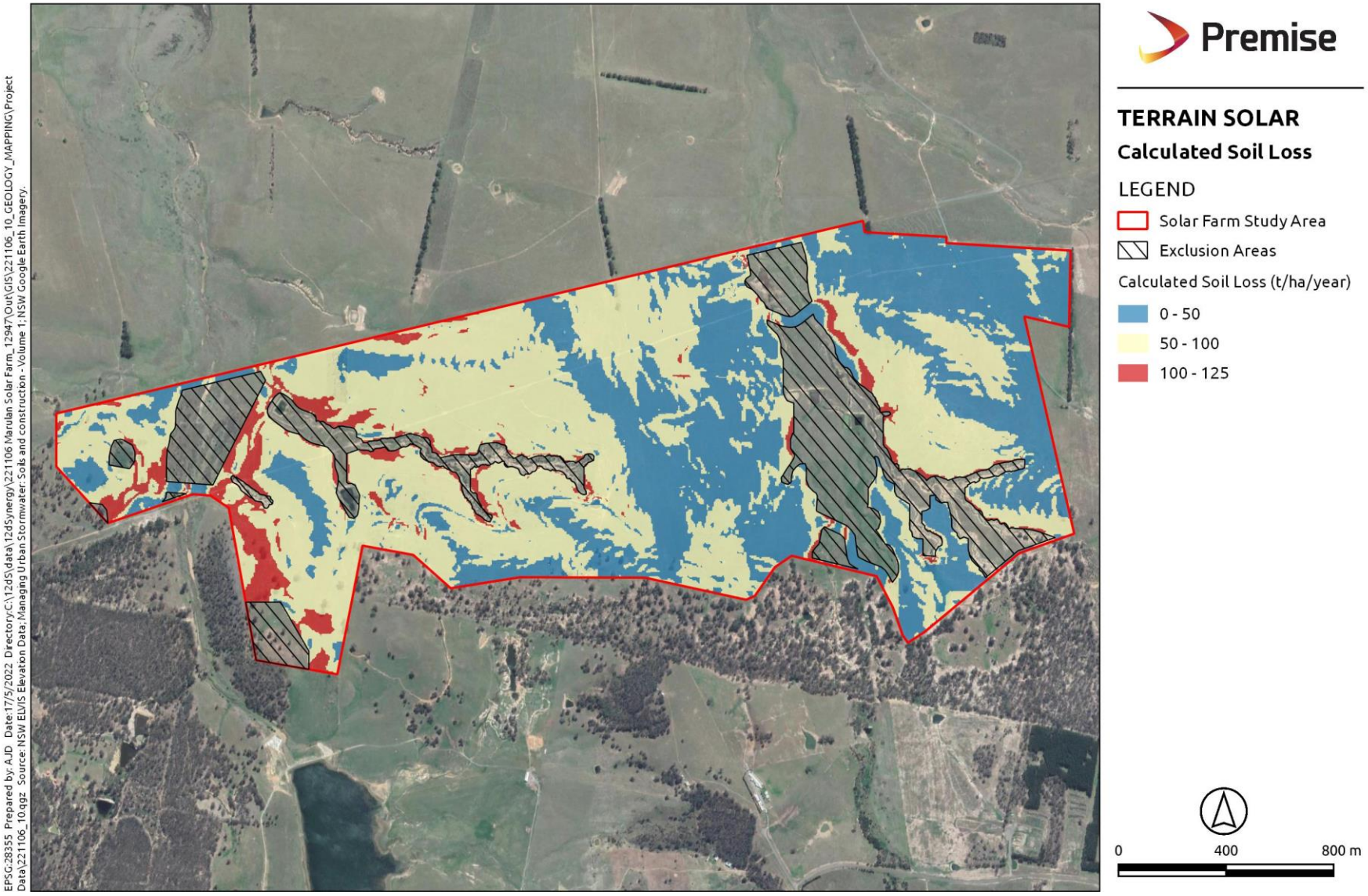
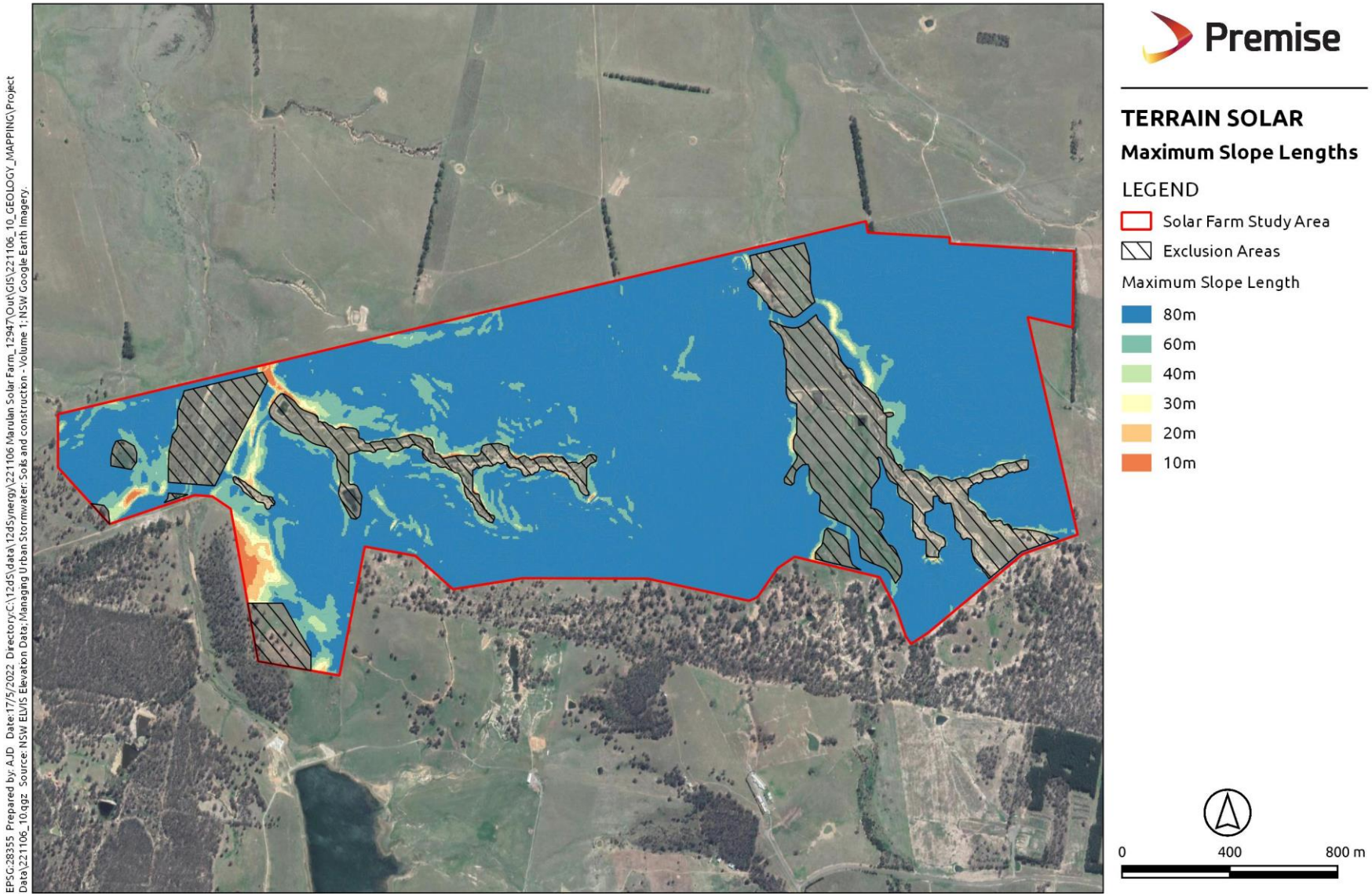


Figure 11 – Maximum slope lengths



6. POTENTIAL IMPACTS

6.1 Construction

The construction of the solar farm would disturb surface and subsurface soils. In general, disturbances during construction that are likely to cause impacts to soils include:

- Vegetation clearing that exposes soils
- Disturbance near existing Wombat burrows
- Construction (and use) of tracks
- Earthworks (cut and fill, grading and compacting)
- Excavation for trenching and sediment basins
- Stockpiling of soils

Potential impacts to soils during construction are likely to include:

- Reduced soil stability
- Mixing of soil horizons, affecting soil quality and impeding vegetation growth
- Exposure of saline and sodic sub-soils, affecting soil quality and plant growth
- Erosion, soil loss and sedimentation
- Reduced soil permeability and increased run-off
- Ground collapse and gullying near existing Wombat burrows

6.2 Operation

The operation of the solar farm is anticipated to involve minimal disturbance to soils. However, potential impacts may include:

- Erosion, soil loss and sedimentation.
- Localised erosion under solar panels from panel water run-off during rainfall or cleaning. This is likely if groundcover is not maintained under the panels.
- Reduced soil permeability and localised run-off. It is noted that the Hydraulic Assessment (Premise, 2021) completed for MSF concludes that "hydraulic modelling showed that there are no impacts external to the site" (p. 12).
- Downstream salinity impacts if water infiltration to saline subsoil increases; this may occur where pasture is not utilised (i.e. grazing or slashing) which reduces removal of water and salt from the soil profile.
- Impacts to metal or concrete structures in contact with acidic or saline soils in soil units 2 and 6.

6.3 Decommissioning

Potential impacts during decommissioning are anticipated to be similar to construction impacts from soil disturbance. Longer term impacts of decommissioning may include:

- Failure to return the site to existing land and soil capability (as outlined in this report) or improved land and soil capability.
- Failure to return the site to a safe, stable and non-polluting landform.

7. MITIGATION MEASURES

7.1 Prior to construction

The following mitigation measures are recommended prior to construction to minimise soil impacts during the construction period:

- Ensure the detailed design incorporates all necessary measures from:
  - A Construction Erosion and Sediment Control Plan (ESCP) in accordance with Landcom (2004) *Managing Urban Stormwater Managing Urban Stormwater: Soils and construction* (Blue Book).
  - A Soil and Water Management Plan (SWMP) prepared in accordance with the Blue Book. The SWMP objectives must include management of the site during construction to limit the potential soil loss to less than 150 t/ha/year (Soil Loss Class 1). This would be achieved by:
    a) Minimising disturbed areas
    b) Managing the slope length on disturbed areas to the maximum indicated in **Table 20** and **Figure 11**.
    c) Managing disturbed areas via the establishment and maintenance of perennial pasture species (to be determined in consultation with a local agronomist or equivalent).
    d) Develop and implement measures to address soil improvements across the site in consultation with a local agronomist (or equivalent)
- Ensure the detailed design minimises disturbance where possible.
- Advice should be sought from the NSW Soil Conservation Service during detailed design to identify the most appropriate management strategies for the following:
  - Filling and rehabilitation of gullies, in particular those in soil units 5 and 7, inclusive of the gullying at the intersection of soil units 3 and 5.
  - Gully exclusion fencing and control structures.
  - Sealing off creek beds and sand seams that may be buried during construction. This may be required in soil units 2 and 6 but additional areas may be identified during geotechnical investigations and should be managed in accordance with geotechnical recommendations.
  - Measures to prevent seepage along pipe bedding materials.
  - Amelioration of excavated soils during construction.
- Treat weeds and remove Sifton bushes from the construction area.

7.2 Construction

The following mitigation measures are recommended to minimise soil impacts during construction:

- Implement all measures from the ESCP and SWMP as and when specified in those documents.
- Minimise all ground disturbance where possible.
- Minimise construction activities during wet weather conditions.
- Retain and stockpile all disturbed or excavated soil.
- Ensure topsoil and subsoils are stockpiled separately and returned in order.
- Ensure that sodic soils or intervals are clearly identified and not mixed with other soils.
- Return stockpiled soil to its original location (where possible) as soon as reasonably practicable.
- Retain and return any cleared vegetation or organic matter as soon as reasonably practicable.

- Treat stockpiled or disturbed soils to manage any weed infestations as soon as reasonably practicable.
- Amelioration of excavated and stockpiled soils, in accordance with advice obtained from the NSW Soil Conservation Service.
- Exclude livestock during construction.
- Undertake rehabilitation and revegetation in accordance with an appropriate landscape, revegetation or rehabilitation plan prepared by a suitably qualified professional.
- Ensure rehabilitation is undertaken progressively to minimise the total disturbance area at any one time.

7.3 Operation

The following mitigation measures are recommended to be implemented to minimise soil impacts during operation:

- Implement and maintain all operational requirements of the SWMP, as and when specified in the SWMP.
- Prepare and implement a Pasture Management Plan to achieve the following:
  - Ensure grazing and/or slashing practices maintain groundcover. Management strategies for grazing and/or slashing should be determined in consultation with a local agronomist (or equivalent).
  - Consistent with the Lockyersleigh Hydrogeological Landscape (obtained via eSPADE), ensure the Pasture Management Plan encourages perennial plant growth to increase plant water use and reduce excess soil moisture.
- Undertake monitoring to identify any potential soil impacts requiring mitigation or remediation actions, including:
  - Any monitoring requirements specified in the SWMP.
  - Any monitoring requirements specified in the Pasture Management Plan.

7.4 Decommissioning

The following mitigation measures are recommended to minimise soil impacts during decommissioning:

- Prepare an appropriate decommissioning management plan that incorporates appropriate soil management to return the site to existing land and soil capability (as outlined in this report) or improved land and soil capability.
- Specific soil management practices should be determined at the time of decommissioning to ensure they are appropriate to the conditions at that time as they may change throughout the life of the development.

8. CONCLUSION

Premise has completed an LSC Assessment for the MSF project in accordance with the LSC Scheme. The study area is not considered highly productive agricultural land as defined in LSC Scheme.

The assessment found that overall land and soil capability for the study area ranges from Class 5 (moderate – low capability land) to Class 7 (very low capability land). The land and soil capability limitations of the study area will require careful management. Potential impacts to soil from the proposed development have been identified with appropriate mitigation measures provided for the construction, operation and decommissioning phases.

REFERENCES

Australian Government Bureau of Meteorology (BOM). (2021). *Rainfall – Marulan (Johnniefelds) Station Number* 070269. Accessed 1 December 2021, available via http://www.bom.gov.au/climate/data/

Hazelton P.A, Murphy B.W. (2007). Interpreting Soil Test Results What do All the Numbers Mean, CSIRO Publishing.

Isbell, R. F. (2002). *The Australian Soil Classification Revised Edition*. Australia: CSIRO Publishing.

Landcom. (2004). *Managing Urban Stormwater: Soils and Construction* (Blue Book)

McKenzie, N. J., Grundy, M. J., Webster, R., & Ringrose-Voase, A. J. (2008). *Guidelines for Surveying Soil and Land Resources*. Collingwood: CSIRO Publishing.

National Committee on Soil and Terrain. (2008). *Guidelines for Surveying Soil and Land Resources, 2nd edition*. Australia: CSIRO Publishing.

National Committee on Soil and Terrain. (2009). *Australian Soil and Land Survey Field Handbook, 3rd edition*. Australia: CSIRO Publishing.

NSW Department of Planning, Industry and Environment (DPIE). (n.d.). *eSPADE – Lockyersleigh Hydrogeological Landscape.* Available via https://www.environment.nsw.gov.au/eSpade2Webapp#

NSW Department of Planning, Industry and Environment (DPIE). (2017). *NSW Landuse 2017 v1.2*. Available via https://datasets.seed.nsw.gov.au/dataset/nsw-landuse-2017-v1p2-f0ed

NSW Office of Environment and Heritage (OEH). (2012). *The Land and Soil Capability Assessment Scheme, Second Approximation.* Sydney: NSW Office of Environment and Heritage.

NSW Office of Environment and Heritage (OEH). (2013). *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land.* NSW Government.

NSW Spatial Services. (2013). *GOULBURN, 2kmx2km 5 metre Resolution Digital Elevation Model*. Metadata available via https://elevation.fsdf.org.au/

Premise. (2021). *Marulan Solar Farm Hydraulic Assessment*. Prepared for Terrain Solar, Reference: 220334_PRO_001A (Revision R01A, dated 1 February 2021)

APPENDIX A

DETAILED SOIL PROFILES

A.1 Soil Unit 1 – Natric Brown Kurosol

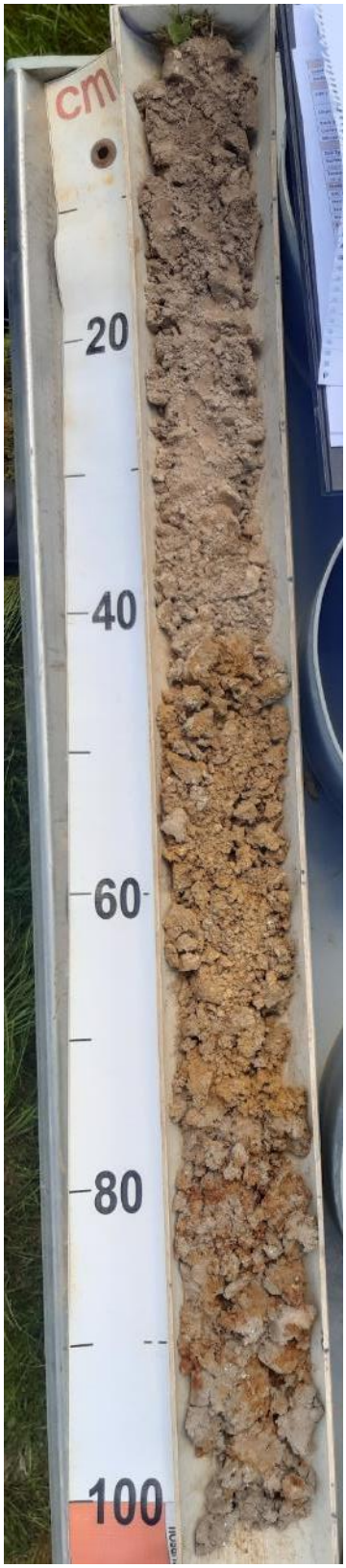
A.1.1 Overview

Site 2

ASC Name	Natric Brown Kurosol
Representative Site	2
Other Mapped Sites	1
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Mid Slope
Dominant Land Use	Sheep Grazing
Vegetation	Native and improved pastures
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South
Calculated LSC Class	6

A.1.2 Sample Site 2

Profile description

Profile	Layer / Depth (m)	Description
	1 0.00 – 0.15	Brown (7.5YR 4/3) sandy loam, weak structure of 5-10 mm peds with a rough earthy fabric and loose consistence. Nil mottling; less than 10% gravel content <5 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.00 – 0.10 m
	2 0.15 – 0.40	Pink (7.5YR 7/3)d bleached coarse sandy loam, weak structure of2- 5-mm crumbs with a weak sandy fabric and loose consistence, no mottling; 20% gravel content <5 mm; nil segregations; moderate drainage with a clear and even boundary. Sampled 0.20 – 0.30 m
	3 0.40 – 0.75	Yellowish Brown (10YR 5/6) sandy clay, moderate structure with a smooth fabric and moderate consistence. 30% distinct grey mottling; 30% gravel content 1-5 mm; poorly drained with a clear and wavy boundary. Sampled 0.50 – 0.60 m
	4 0.75 – 1.00	Greyish Brown (105Y 5/2) medium clay, strong structure of >40 mm blocky peds with a smooth fabric and strong consistence. 20% distinct red mottling; 15% quartz gravel content 5-10 mm; very poorly drained. Sampled 0.90 – 1.00 m. Layer continues beyond sample depth.

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	6.0	Moderately Acidic	2.8	Non-Sodic	1.12	Non-Saline	3.7	Ca Low
2	5.8	Moderately Acidic	<1.0	Non-Sodic	0.28	Non-Saline	3.6	Ca Low
3	6.9	Neutral	8.3	Marginally Sodic	0.62	Non-Saline	0.6	Ca Deficient
4	5.4	Strongly Acidic	17.0	Strongly Sodic	0.14	Non-Saline	0.1	Ca Very Deficient

Note: All ratings are based on Hazelton & Murphy (2007). This applies to all chemical parameter tables.

A.2 Soil Unit 2 – Hyponatric Brown Sodosol

A.2.1 Overview

Site 5A

ASC Name	Hyponatric Brown Sodosol
Representative Site	5A
Other Mapped Sites	4 and 5
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Closed depression
Dominant Land Use	Grazing
Vegetation	Rushes
Inherent Soil Fertility	Moderately high but saline
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	North
Calculated LSC Class	7

A.2.2 Sample Site 5A

Profile description

Profile	Layer / Depth (m)	Description
	1 0.00 – 0.25	Dark Brown (7.5YR 3/2) sandy loam, weak structure of 5-10 mm crumbs with a rough earthy fabric and loose consistence.; no segregations; moderate drainage with a clear and even boundary. Sampled 0.00 – 0.10 m
	2 0.25 – 0. 45	Brown (7.5YR 5/3) loamy sand, single grain with a weak sandy fabric and loose consistence. Nil mottling; 20% gravel content <5 mm; nil segregations; moderate drainage with a clear and even boundary. Sampled 0.20 – 0.30 m
	3 0.45 – 0.70	Brown (10YR 5/4) sandy medium clay, strong structure with a rough fabric and strong consistence. 30% distinct orange mottling; no segregations, poorly drained with a clear and wavy boundary. Sampled 0.50 – 0.60 m
	4 0.70 – refusal	Unable to sample with corer

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	5.4	Strongly Acidic	52	Strongly Sodic	104	Extremely Saline	0.5	Ca Deficient
2	6.5	Slightly Acidic	54	Strongly Sodic	36	Extremely Saline	0.6	Ca Deficient
3	8.1	Moderately Alkaline	33	Strongly Sodic	6.97	Moderately Saline	0.6	Ca Deficient

A.3 Soil Unit 3 – Mottled Mesonatric Brown Sodosol

A.3.1 Overview

Site 6

ASC Name	Mottled Mesonatric Brown Sodosol
Representative Site	6
Other Mapped Sites	7, 8, 13, 15, 17 and 18
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Crest
Dominant Land Use	Grazing
Vegetation	Native grasses and clover
Inherent Soil Fertility	Moderate
Slope (%)	7
Surrounding Slope (%)	3-5
Aspect	West
Calculated LSC Class	5

A.3.2 Sample Site 6

Profile description

Profile	Layer/ Depth (m)	Description
	1 0.00 – 0.10	Brown (5YR 4/2) sandy loam, weak structure of 5-10 mm crumbs with a rough earthy fabric and weak consistence. 5% angular quartz gravel <5 mm well drained with a clear and even boundary. Sampled 0.00 – 0.10 m
	2 0.10 – 0.20	Very pale brown (10YR 7/3)d bleached loamy sand , single grain a weak sandy fabric and loose consistence. 30% gravel content <5 mm; ferrous segregations; well drainage with a distinct and even boundary. Sampled 0.10 – 0.20 m
	3 0.20 – 0.65	Yellowish Brown (10YR 5/4) medium clay, strong structure with a rough fabric and strong consistence. 10% faint grey mottling; no gravel; moderate drainage with a gradual and wavy boundary. Sampled 0.50 – 0.60 m
	4 0.65 – 1.20	Dark Greyish Brown (105Y 4/2) heavy clay, strong structure of >40 mm blocky peds with a smooth fabric and strong consistence. 40% distinct brown mottling; 5% angular quartz gravel content 0-5mm mm; poorly drained. Sampled 0.90 – 1.00 m

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	6.0	Moderately Acidic	3.4	Non-Sodic	1.54	Non-Saline	3.8	Ca Low
2	6.0	Moderately Acidic	6.4	Marginally Sodic	1.2	Non-Saline	2.7	Ca Low
3	7.2	Neutral	15.0	Strongly Sodic	2.18	Non-Saline	0.3	Ca Very Deficient
4	6.6	Neutral	22.0	Strongly Sodic	2.78	Non-Saline	0.3	Ca Very Deficient

A.4 Soil Unit 4 – Yellow Kandosol

A.4.1 Overview

Site 10

ASC Name	Yellow Kandosol
Representative Site	10
Other Mapped Sites	Nil
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Mid slope
Dominant Land Use	Grazing sheep
Vegetation	Scattered Eucalyptus trees native grasses and medics
Inherent Soil Fertility	Moderately Low
Slope (%)	3-5
Surrounding Slope (%)	2-7
Aspect	North West
Calculated LSC Class	5

A.4.2 Sample Site 10

Profile description

Profile	Layer/ Depth (m)	Description
	1 0.00 – 0.13	Dark Brown (7.5YR 3/2) loam, weak structure of 2-5 mm crumbs with a rough earthy fabric and weak consistence. no segregations; well drained with a gradual and even boundary. Sampled 0.00 – 0.10 m
	2 0.13 – 0. 40	Brown (7.5YR 5/3) dry, sandy clay loam, weak crumbs 2-5mmwith a weak sandy fabric and weak consistence. Nil mottling; no gravel; nil segregations; moderate drainage with a clear and even boundary. Sampled 0.20 – 0.30 m
	3 0.40 – 0.70	Brownish Yellow (10YR 6/8) clay loam, moderate structure with earthy fabric and moderate consistence. *5% slate gravel 5-15mm, moderate drainage with* a clear and wavy boundary. Sampled 0.50 – 0.60 m
	4 0.70 – 0.90	Brownish Yellow (10YR 6/8) strong structure with rough peds moderate consistence 15% prominent grey mottling;10% slate gravel 5-15mm. Sampled 0.80-0.90 m

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	6.0	Moderately Acidic	0.84	Not Sodic	0.95	Non-Saline	3.3	Ca Low
2	6.2	Slightly Acidic	2.8	Not Sodic	0.29	Non-Saline	4.5	Balanced
3	6.5	Slightly Acidic	5.3	Sodic	0.60	Non-Saline	0.4	Ca Deficient
4	6.1	Slightly Acidic	9.2	Sodic	0.26	Non-Saline	0.3	Ca Deficient

A.5 Soil Unit 5 – Natric Red Kurosol

A.5.1 Overview

Site 11	
	
ASC Name	Natric Red Kurosol
Representative Site	11
Other Mapped Sites	12, 13 and 14
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Upper slope
Dominant Land Use	Sheep Grazing
Vegetation	Scattered Blakely's Red Gum native and improved grasses
Inherent Soil Fertility	Moderate low sodicity in subsoils
Slope (%)	5-10
Surrounding Slope (%)	3-10
Aspect	North West
Calculated LSC Class	5

A.5.2 Sample Site 11

Profile description

Site 11	Layer/ Depth (m)	Description
	1 0.00 – 0.10	Dark Brown (7.5YR 3/3) fine sandy loam, weak earthy structure of with a rough earthy fabric and weak consistence. nil segregations; well drained with a gradual and irregular boundary. Sampled 0.00 – 0.10 m
	2 0.10 – 0.20	Pink (7.5YR 7/3)d bleached sandy loam, weak structure with weak sandy fabric and firm consistence. nil gravel or segregations; moderately drained with a clear but irregular boundary. Sampled 0.10 – 0.20 m
	3 0.20 – 0.60	Yellowish Red (5YR5/6) medium clay, moderate structure with a smooth fabric and firm consistence. 5% distinct grey mottling; moderate drainage with a gradual and irregular boundary. Sampled 0.50 – 0.60 m
	4 0.60 – 0.90	Pale Brown (105Y 6/3) medium clay, moderate structure of >40 mm blocky peds with a rough fabric and strong consistence. 20% distinct red mottling; 15% quartz gravel content 5-10 mm; poorly drained. Sampled 0.80 – 0.90 m

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	5.9	Moderately Acidic	2.7	Non-Sodic	0.98	Non-Saline	2.9	Ca Low
2	5.5	Strongly Acidic	4.8	Non-Sodic	0.26	Non-Saline	1.1	Ca Low
3	5.4	Strongly Acidic	9.5	Sodic	0.53	Non-Saline	0.1	Ca Deficient
4	5.7	Moderately Acidic	11.0	Sodic	1.88	Non-Saline	0.0	Ca Very Deficient

A.6 Soil Unit 6 – Stratic Rudosol

A.6.1 Overview

Site 9	
	
ASC Name	Stratic Rudosol
Representative Site	9
Other Mapped Sites	Nil
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Open depression
Dominant Land Use	Sheep Grazing
Vegetation	Native grasses. Blackberry Bushes. Rushes in wetter areas.
Inherent Soil Fertility	Moderate but very poor drainage and waterlogged
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	North
Calculated LSC Class	7

A.6.2 Sample Site 9

Profile description

Profile	Layer/ Depth (m)	Description
	1 0.00 – 0.20	Dark Brown (7YR.3/3) silty clay, earthy structure of 2-5 mm crumbs with a rough earthy fabric and firm consistence; poorly drained with a gradual and even boundary. Sampled 0.00 – 0.10 m
	2 0.20 – 0. 60	Very Dark Brown (10YR 2/2) silty clay loam, earthy peds with an earthy fabric and moderate consistence. Nil mottling; nil segregations; very poor drainage with a clear and even boundary. Sampled 0.30 – 0.40 m
	3 0.60 – 0.80	Dark Brown (10YR 3/3) silty clay, strong structure with a smooth fabric and moderate consistence. 10% manganese nodules, very poorly drained with a clear and wavy boundary. Sampled 0.70 – 0.80 m
	4 0.80 – 1.10	Brown (10YR4.3) Smooth peds firm consistency.15% manganese nodules :10% distinct yellowish orange mottles very poor drainage. Sampled 1.00-1.10 m

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	5.9	Moderately Acidic	2.5	Not Sodic	0.77	Non-Saline	1.4	Ca Deficient
2	6.5	Slightly Acidic	1.7	Not Sodic	0.26	Not-Saline	1.7	Ca Deficient
3	7.1	Neutral	3.5	Strongly Sodic	0.26	Not- Saline	1.2	Ca Deficient
4	7.6	Mildly Alkaline	5.1	Slightly Sodic	0.34	Non-Saline	0.8	Ca Deficient

A.7 Soil Unit 7 – Brown Sodosol

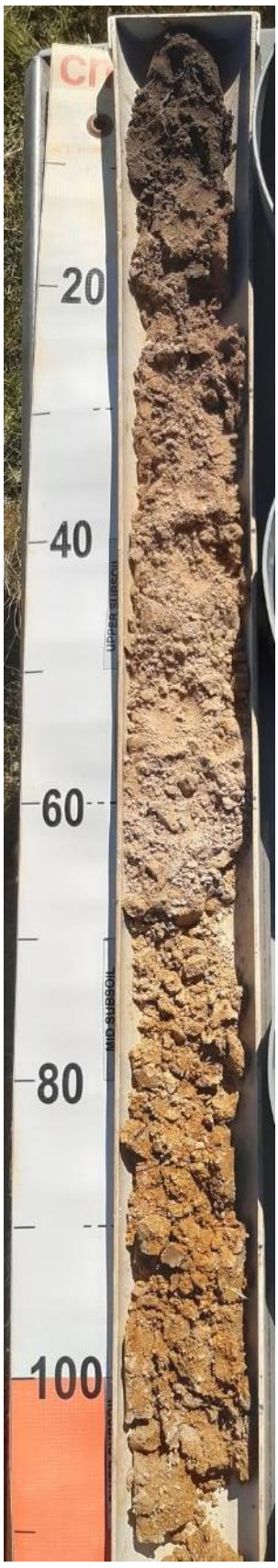
A.7.1 Overview

Site 3	
	
ASC Name	Brown Sodosol
Representative Site	3
Other Mapped Sites	16
Survey Type	No laboratory analysis. Similar soils with granitic substrate as Soil Unit 1.
Dominant Topography	Mid-slope
Dominant Land Use	Sheep grazing
Vegetation	Native grasses and medics
Inherent Soil Fertility	Moderate but sodic and acidic subsoils
Slope (%)	3-5
Surrounding Slope (%)	3-7
Aspect	West
Calculated LSC Class	6

A.7.2 Sample Site 3

Profile description

Profile	Layer/ Depth (m)	Description
	1 0.00 – 0.12	Brown (7.5YR 4/2) fine sandy loam, weak structure of single grains with a rough earthy fabric and weak consistence, moderate drainage with a clear and wavy boundary. Sampled 0.00 – 0.10 m. Not analysed.
	2 0.12 – 0.40	Very pale brown (7.5YR 7/2) d bleached sandy loam , single grain a weak sandy fabric and loose consistence. 30% gravel content <5 mm; ferrous segregations; well drainage with an abrupt and even boundary. Sampled 0.20 – 0.30 m. Not analysed.
	3 0.40 – 0.80	Brown (7.5YR 5/4) medium clay sandy, strong structure with a rough fabric and strong consistence. 15% distinct yellow mottling; quart z gravel; moderate drainage with a gradual and wavy boundary Sampled 0.50 – 0.60 m. Not analysed.

	4 0.80 – 1.00	Brown (7.5Y 5/4) medium clay sandy, strong structure of >40 mm blocky peds with rough fabric and strong consistence. 20% distinct yellow mottling; 5% ferrous nodules content 0-5mm mm; poorly drained. Weathered granite at 100cm. Sampled 0.90 – 1.00 m. Not analysed.

Chemical parameters

No laboratory analysis for Soil Unit 7 was completed as soils were considered similar to Soil Unit 1 with a granitic substrate.

A.8 Soil Unit 8 - Mesotrophic Brown Chromosol

A.8.1 Overview

Site 21

ASC Name	Mesotrophic Brown Chromosol
Representative Site	21
Other Mapped Sites	Nil
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Mid-slope
Dominant Land Use	Grazing
Vegetation	Native and improved pastures
Inherent Soil Fertility	Moderately low with moderately acidic subsoil
Slope (%)	3-5
Surrounding Slope (%)	1-2
Aspect	West
Calculated LSC Class	5

A.8.2 Sample Site 21

Profile description

Profile	Layer/ Depth (m)	Description
	1 0.00 – 0.12	Brown (7.5YR 4/2) fine sandy loam, weak structure of 2-5 mm crumbs with a rough earthy fabric and weak consistence. no segregations; well drained with a clear and wavy boundary. Sampled 0.00 – 0.10 m
	2 0.12 – 0. 50	Brown (7.5YR 5/3) m, loamy sand, weak crumbs 2-5mmwith a weak sandy fabric and weak consistence. Nil mottling; 30% round conglomerate 5-50mm gravel; nil segregations; well drained with an abrupt and wavy boundary. Sampled 0.20 – 0.30 m
	3 0.50 – 0.70	Strong Brown (7.5YR 5/6) medium clay, moderate structure with rough fabric and firm consistence. 20% rounded conglomerate gravel 5-15mm, imperfect drainage with a gradual and wavy boundary. Sampled 0.50 – 0.60 m
	4 0.70 – 0.90	Brown (7.5YR 5/4) medium clay strong structure with rough peds strong consistence 30% distinct grey and 20% red mottling; imperfect drainage 40% conglomerate gravel 10-50-mm Sampled 0.80 – 0.90 m

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	6.3	Slightly Acidic	0.93	Not Sodic	0.84	Non-Saline	5.8	Balanced
2	6.1	Slightly Acidic	<1.00	Not Sodic	1.84	Non-Saline	6.1	Balanced
3	5.8	Moderately Acidic	3.50	Not Sodic	0.23	Non-Saline	0.5	Ca Deficient
4	5.7	Moderately Acidic	4.60	Almost Sodic	0.30	Non-Saline	0.2	Ca Deficient

A.9 Soil Unit 9 - Leptic Tenosol

A.9.1 Overview

Site 19	
	
ASC Name	Leptic Tenosol
Representative Site	19
Other Mapped Sites	Nil
Survey Type	Full soil profile and laboratory analysis
Dominant Topography	Upper slope with isolated outcrops of siltstone
Dominant Land Use	Grazing
Vegetation	Scattered argyle apple trees and sifton bushes with native pastures
Inherent Soil Fertility	Moderately low with acidic subsoil
Slope (%)	6%
Surrounding Slope (%)	5-10%
Aspect	North East
Calculated LSC Class	6

A.9.2 Sample Site 19

Profile description

Profile	Layer/ Depth (m)	Description
	1 0.00 – 0.15	Dark Brown (7.5YR 3/2) fine sandy loam, weak structure of 5-10mm crumbs with a rough earthy fabric and weak consistence. No segregations; moderately drained with a clear and wavy boundary. Sampled 0.00 – 0.10 m
	2 0.15 – 0. 30	Light Brown (7.5YR 6/3) d, sandy clay loam, weak crumbs 2-5mm with a weak sandy fabric and weak consistence. Nil mottling; 50% angular siltstone gravel, 5-10mm; nil segregations; moderate drainage with an abrupt and wavy boundary. Sampled 0.20 – 0.30 m
	3 0.30 – 0.40	Brown (7.5YR 5/3) sand clay loam, moderate structure with weak consistence. 40% grey mottling, 85% angular siltstone gravel 5-15mm, poor drainage, grading into decomposing siltstone. Sampled 0.30 – 0.40 m

Chemical parameters

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	pH	Rating	%	Rating	dS/m	Rating	Ratio	Rating
1	5.3	Strongly Acidic	2.6	Not Sodic	0.56	Non-Saline	2.5	Low Ca
2	6.0	Moderately Acidic	7.3	Sodic	0.19	Non-Saline	1.3	Low Ca
3	6.4	Moderately Acidic	12.0	Sodic	0.38	Non-Saline	0.4	Ca Deficient

APPENDIX B

LABORATORY RESULTS

Sample No.	Sample Depth From	Sample Depth To	Moisture	pH (1:5 Water)	pH (1:5 $CaCl_2$)	Electrical Conductivity (1:5 water)	Chloride	Nitrate Nitrogen	Ammonium Nitrogen
	cm	cm	%			dS/m	mg/kg	mg/kg	mg/kg
2	0	10	10	6.0	5.2	0.08	13	13.0	6.3
2	20	30	5	5.8	4.7	0.02	<10	1.7	3.5
2	50	60	8	6.9	5.9	0.07	<10	1.9	8.2
2	90	100	17	5.4	4.3	0.19	96	<0.5	3.5
5A	0	10	17	5.4	5.3	7.41	14,000	4.4	21.0
5A	30	40	12	6.5	6.3	1.55	2,200	2.5	1.9
5A	50	60	19	8.1	7.5	0.93	1,200	0.6	4.0
6	0	10	8	6.0	5.3	0.11	41	19.0	11.0
6	10	20	2	6.0	5.1	0.05	19	3.6	3.4
6	50	60	19	7.2	6.3	0.29	230	1.0	2.0
6	90	100	21	6.6	5.9	0.48	490	0.7	2.1
7	0	10	12	6.1	5.3	0.09	27	4.6	8.3
7	20	30	4	6.1	5.0	0.03	<10	1.9	1.7
7	50	60	24	5.7	4.5	0.14	69	1.1	4.1
7	90	100	16	5.6	4.1	0.10	76	<0.5	2.2
9	0	10	31	5.9	5.1	0.09	33	6.1	7.9
9	30	40	21	6.5	5.2	0.03	11	2.7	2.1
9	70	80	15	7.1	5.8	0.03	11	1.4	1.6
9	100	110	11	7.6	6.1	0.04	10	1.4	1.0
10	0	10	15	6.0	5.3	0.10	15	24.0	8.5
10	20	30	5	6.2	5.3	0.03	<10	2.3	2.7
10	50	60	10	6.5	5.7	0.07	22	1.7	1.3
10	80	90	8	6.1	5.5	0.09	53	1.8	6.7
11	0	10	14	5.9	4.9	0.07	20	7.3	6.8
11	10	20	10	5.5	4.3	0.03	<10	2.8	2.0
11	50	60	25	5.4	4.1	0.07	14	1.8	3.8
11	80	90	17	5.7	4.1	0.25	21	1.5	1.8
12	0	10	17	5.8	5.2	0.16	33	35.0	28.0
12	20	30	6	5.9	5.0	0.05	<10	5.4	6.2
12	50	60	16	6.3	5.0	0.06	32	2.3	1.7
12	90	100	24	6.0	4.9	0.13	26	3.2	3.9
14	0	10	12	6.0	5.2	0.09	21	15.0	13.0
14	20	30	5	6.1	4.9	0.02	<10	1.4	2.7
14	50	60	17	6.7	5.5	0.15	69	<0.5	2.4
14	90	100	12	5.5	4.3	0.24	170	<0.5	2.4
18	0	10	7	5.9	5.1	0.08	13	9.9	9.6
18	20	30	3	5.2	4.3	0.03	<10	1.5	2.6
18	60	70	22	5.8	4.4	0.08	31	1.4	6.8
18	90	100	18	5.7	4.3	0.08	47	1.1	2.9
19	0	10	22	5.3	4.4	0.04	<10	1.5	5.4
19	20	30	9	6.0	4.7	0.02	<10	1.6	1.6
19	30	40	8	6.4	4.9	0.04	<10	1.2	3.8
20	0	10	20	5.7	4.7	0.06	23	1.1	7.5
21	0	10	16	6.3	5.6	0.08	<10	16.0	12.0
21	20	30	6	6.1	5.2	0.03	<10	2.3	2.7

21	50	60	8	5.8	4.7	0.04	13	1.9	1.4
21	80	90	9	5.7	4.6	0.05	26	2.2	6.5

Sample No.	Sample Depth From	Sample Depth To	Calcium (Amm-acet.)	Calcium (Amm-acet.)	Potassium (Amm-acet.)	Potassium (Amm-acet.)	Available Potassium
	cm	cm	cmol(+)/kg	%	cmol(+)/kg	%	mg/kg
2	0	10	1.8	63.0	0.35	12.00	140
2	20	30	0.3	45.0	0.11	16.00	42
2	50	60	1.7	32.0	0.38	7.20	150
2	90	100	0.9	6.8	0.25	1.90	98
5A	0	10	6.4	16.0	0.23	0.57	90
5A	30	40	1.3	17.0	0.03	0.38	12
5A	50	60	4.7	25.0	0.21	1.10	81
6	0	10	3.8	72.0	0.29	5.40	110
6	10	20	1.6	65.0	0.12	4.70	46
6	50	60	4.0	21.0	0.30	1.50	120
6	90	100	3.0	15.0	0.29	1.50	110
7	0	10	4.1	74.0	0.40	7.10	150
7	20	30	0.8	59.0	0.09	6.30	33
7	50	60	0.7	4.5	0.25	1.70	100
7	90	100	0.1	0.8	0.14	1.20	56
9	0	10	4.5	54.0	0.36	4.30	140
9	30	40	5.5	61.0	0.11	1.20	43
9	70	80	3.1	52.0	0.08	1.20	29
9	100	110	3.0	41.0	0.10	1.30	39
10	0	10	3.9	68.0	0.60	10.00	230
10	20	30	1.0	75.0	0.08	5.60	29
10	50	60	1.4	26.0	0.43	7.80	170
10	80	90	0.9	18.0	0.35	7.10	140
11	0	10	2.4	63.0	0.35	9.40	140
11	10	20	0.7	30.0	0.12	4.70	46
11	50	60	0.4	3.4	0.27	2.40	110
11	80	90	0.3	2.4	0.23	1.80	91
12	0	10	5.3	58.0	1.50	16.00	590
12	20	30	3.2	56.0	0.48	8.50	190
12	50	60	0.2	1.3	0.37	3.10	140
12	90	100	<0.0	<1.0	0.30	1.60	120
14	0	10	4.4	77.0	0.25	4.30	96
14	20	30	0.9	58.0	0.06	3.90	23
14	50	60	4.7	21.0	0.31	1.40	120
14	90	100	3.5	11.0	0.37	1.10	150
18	0	10	3.2	74.0	0.25	5.60	96
18	20	30	0.4	39.0	0.07	6.40	28
18	60	70	2.7	18.0	0.33	2.20	130
18	90	100	2.0	16.0	0.24	1.80	92
19	0	10	0.9	38.0	0.21	8.80	81
19	20	30	0.3	34.0	0.07	8.00	28
19	30	40	0.6	23.0	0.11	4.20	43
20	0	10	1.4	49.0	0.33	12.00	130
21	0	10	4.6	80.0	0.26	4.70	100
21	20	30	1.0	82.0	0.06	5.30	25

21	50	60	1.9	31.0	0.17	2.80	68
21	80	90	1.4	16.0	0.19	2.10	74

Sample No.	Sample Depth From	Sample Depth To	Magnesium (Amm-acet.)	Magnesium (Amm-acet.)	Sodium (Amm-acet.)	Calcium/Magnesium Ratio
	cm	cm	cmol(+)/kg	%	cmol(+)/kg	
2	0	10	0.5	18.0	0.08	3.7
2	20	30	0.1	13.0	<0.02	3.6
2	50	60	2.8	52.0	0.44	0.6
2	90	100	8.6	65.0	2.30	0.1
5A	0	10	13.0	32.0	21.00	0.5
5A	30	40	2.2	28.0	4.20	0.6
5A	50	60	7.6	40.0	6.20	0.6
6	0	10	1.0	20.0	0.18	3.8
6	10	20	0.6	24.0	0.16	2.7
6	50	60	12.0	63.0	2.80	0.3
6	90	100	12.0	62.0	4.30	0.3
7	0	10	0.9	17.0	0.12	4.4
7	20	30	0.2	17.0	0.09	3.5
7	50	60	10.0	70.0	2.50	0.1
7	90	100	8.1	68.0	2.10	0.0
9	0	10	3.3	39.0	0.21	1.4
9	30	40	3.2	36.0	0.15	1.7
9	70	80	2.5	42.0	0.21	1.2
9	100	110	3.9	53.0	0.38	0.8
10	0	10	1.2	21.0	0.05	3.3
10	20	30	0.2	17.0	0.04	4.5
10	50	60	3.2	58.0	0.29	0.4
10	80	90	3.1	63.0	0.46	0.3
11	0	10	0.8	22.0	0.10	2.9
11	10	20	0.7	26.0	0.12	1.1
11	50	60	6.8	60.0	1.10	0.1
11	80	90	9.0	70.0	1.40	0.0
12	0	10	2.1	23.0	0.08	2.5
12	20	30	1.6	29.0	0.06	2.0
12	50	60	10.0	87.0	0.84	0.0
12	90	100	16.0	88.0	1.70	0.0
14	0	10	1.0	17.0	0.14	4.6
14	20	30	0.3	22.0	0.08	2.7
14	50	60	16.0	67.0	2.30	0.3
14	90	100	22.0	68.0	4.70	0.2
18	0	10	0.8	18.0	0.12	4.1
18	20	30	0.2	15.0	0.02	2.6
18	60	70	9.1	62.0	1.60	0.3
18	90	100	8.0	62.0	1.50	0.3
19	0	10	0.4	15.0	0.06	2.5
19	20	30	0.2	26.0	0.07	1.3
19	30	40	1.4	53.0	0.30	0.4
20	0	10	0.5	17.0	0.10	2.9
21	0	10	0.8	14.0	0.05	5.8
21	20	30	0.2	13.0	<0.02	6.1

21	50	60	3.5	56.0	0.22	0.5
21	80	90	6.4	72.0	0.41	0.2

Sample No.	Sample Depth From	Sample Depth To	Aluminium (KCl)	Aluminium (KCl)	Cation Exch. Cap.	Sodium % of Cations (ESP)	Aluminium Saturation
	cm	cm	cmol(+)/kg	mg/kg	cmol(+)/kg	%	%
2	0	10	0.1	11.0	2.8	2.80	4.2
2	20	30	0.2	15.0	0.7	<1.00	25.0
2	50	60	<0.1	<9.0	5.3	8.30	<1.0
2	90	100	1.2	100.0	13.2	17.00	8.7
5A	0	10	0.1	13.0	40.6	52.00	0.4
5A	30	40	<0.1	<9.0	7.8	54.00	<1.0
5A	50	60	<0.1	<9.0	18.8	33.00	<1.0
6	0	10	<0.1	<9.0	5.3	3.40	<1.0
6	10	20	<0.1	<9.0	2.5	6.40	<1.0
6	50	60	<0.1	<9.0	19.2	15.00	<1.0
6	90	100	<0.1	<9.0	19.8	22.00	<1.0
7	0	10	<0.1	<9.0	5.6	2.10	<1.0
7	20	30	0.2	13.0	1.4	6.60	11.0
7	50	60	1.2	110.0	15.1	17.00	7.9
7	90	100	1.5	130.0	11.9	18.00	12.0
9	0	10	<0.1	<9.0	8.4	2.50	<1.0
9	30	40	<0.1	<9.0	8.9	1.70	<1.0
9	70	80	0.1	11.0	6.0	3.50	2.0
9	100	110	<0.1	<9.0	7.4	5.10	<1.0
10	0	10	<0.1	<9.0	5.8	0.84	<1.0
10	20	30	<0.1	<9.0	1.3	2.80	<1.0
10	50	60	0.1	11.0	5.5	5.30	2.2
10	80	90	0.1	12.0	4.9	9.20	2.7
11	0	10	0.1	9.3	3.7	2.70	2.8
11	10	20	0.9	76.0	2.5	4.80	34.0
11	50	60	2.8	250.0	11.3	9.50	25.0
11	80	90	1.9	170.0	12.8	11.00	15.0
12	0	10	0.1	9.2	9.1	0.87	1.1
12	20	30	0.3	28.0	5.6	1.10	5.5
12	50	60	0.2	21.0	12.0	7.00	2.0
12	90	100	0.2	18.0	18.5	9.30	1.1
14	0	10	<0.1	<9.0	5.7	2.50	<1.0
14	20	30	0.2	15.0	1.5	5.20	11.0
14	50	60	0.2	15.0	23.0	9.90	0.7
14	90	100	1.8	160.0	32.4	15.00	5.6
18	0	10	<0.1	<9.0	4.4	2.80	<1.0
18	20	30	0.4	39.0	1.1	2.00	38.0
18	60	70	1.0	94.0	14.8	11.00	7.0
18	90	100	1.1	96.0	12.9	12.00	8.2
19	0	10	0.9	77.0	2.4	2.60	36.0
19	20	30	0.2	20.0	0.9	7.30	25.0
19	30	40	0.2	19.0	2.6	12.00	8.2
20	0	10	0.5	49.0	2.9	3.60	19.0
21	0	10	<0.1	<9.0	5.7	0.93	<1.0
21	20	30	<0.1	<9.0	1.2	<1.00	<1.0

21	50	60	0.4	39.0	6.2	3.50	7.0
21	80	90	0.5	44.0	8.8	4.60	5.6

Sample No.	Sample Depth From	Sample Depth To	Copper (DTPA)	Iron (DTPA)	Manganese (DTPA)	Zinc (DTPA)	Boron (Hot CaCl2)
	cm	cm	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2	0	10	0.29	240.0	20.0	0.85	0.3
2	20	30	-	-	-	-	-
2	50	60	-	-	-	-	-
2	90	100	-	-	-	-	-
5A	0	10	-	-	-	-	-
5A	30	40	-	-	-	-	-
5A	50	60	-	-	-	-	-
6	0	10	-	-	-	-	-
6	10	20	-	-	-	-	-
6	50	60	-	-	-	-	-
6	90	100	-	-	-	-	-
7	0	10	0.48	290.0	15.0	1.70	0.5
7	20	30	-	-	-	-	-
7	50	60	-	-	-	-	-
7	90	100	-	-	-	-	-
9	0	10	-	-	-	-	-
9	30	40	-	-	-	-	-
9	70	80	-	-	-	-	-
9	100	110	-	-	-	-	-
10	0	10	0.21	220.0	12.0	1.90	0.5
10	20	30	-	-	-	-	-
10	50	60	-	-	-	-	-
10	80	90	-	-	-	-	-
11	0	10	0.23	320.0	7.7	0.90	0.3
11	10	20	-	-	-	-	-
11	50	60	-	-	-	-	-
11	80	90	-	-	-	-	-
12	0	10	-	-	-	-	-
12	20	30	-	-	-	-	-
12	50	60	-	-	-	-	-
12	90	100	-	-	-	-	-
14	0	10	0.31	210.0	26.0	1.30	0.3
14	20	30	-	-	-	-	-
14	50	60	-	-	-	-	-
14	90	100	-	-	-	-	-
18	0	10	0.21	180.0	21.0	1.20	0.2
18	20	30	-	-	-	-	-
18	60	70	-	-	-	-	-
18	90	100	-	-	-	-	-
19	0	10	0.16	260.0	14.0	0.78	0.2
19	20	30	-	-	-	-	-
19	30	40	-	-	-	-	-
20	0	10	0.15	320.0	17.0	0.64	0.3
21	0	10	0.38	160.0	15.0	2.40	0.4
21	20	30	-	-	-	-	-

21	50	60	-	-	-	-	-
21	80	90	-	-	-	-	-

Sample No.	Sample Depth From	Sample Depth To	Sulphur (KCl40)	Organic Carbon (W&B)	Organic Matter (W&B * 1.72)	Emerson Class	Phosphorus (Colwell)
	cm	cm	mg/kg	%	%		mg/kg
2	0	10	6	1.6	2.8	8	23
2	20	30	-	-	-	-	-
2	50	60	-	-	-	-	-
2	90	100	-	-	-	-	-
5A	0	10	-	-	-	-	-
5A	30	40	-	-	-	-	-
5A	50	60	-	-	-	-	-
6	0	10	-	-	-	-	-
6	10	20	-	-	-	-	-
6	50	60	-	-	-	-	-
6	90	100	-	-	-	-	-
7	0	10	7	3.5	6.1	7	32
7	20	30	-	-	-	-	-
7	50	60	-	-	-	-	-
7	90	100	-	-	-	-	-
9	0	10	-	-	-	-	-
9	30	40	-	-	-	-	-
9	70	80	-	-	-	-	-
9	100	110	-	-	-	-	-
10	0	10	6	2.7	4.6	7	9
10	20	30	-	-	-	-	-
10	50	60	-	-	-	-	-
10	80	90	-	-	-	-	-
11	0	10	5	2.4	4.2	7	18
11	10	20	-	-	-	-	-
11	50	60	-	-	-	-	-
11	80	90	-	-	-	-	-
12	0	10	-	-	-	-	-
12	20	30	-	-	-	-	-
12	50	60	-	-	-	-	-
12	90	100	-	-	-	-	-
14	0	10	6	2.6	4.5	7	10
14	20	30	-	-	-	-	-
14	50	60	-	-	-	-	-
14	90	100	-	-	-	-	-
18	0	10	6	2.2	3.9	7	16
18	20	30	-	-	-	-	-
18	60	70	-	-	-	-	-
18	90	100	-	-	-	-	-
19	0	10	4	1.7	2.9	7	5
19	20	30	-	-	-	-	-
19	30	40	-	-	-	-	-
20	0	10	4	2.0	3.4	7	8
21	0	10	8	2.4	4.1	7	17
21	20	30	-	-	-	-	-

21	50	60	-	-	-	-	-
21	80	90	-	-	-	-	-

Sample No.	Sample Depth From	Sample Depth To	Phosphorus Buffer Index (PBI-Col)	Phosphorus Environmental Risk Index	Potassium (Colwell)
	cm	cm			mg/kg
2	0	10	42	0.55	190
2	20	30	-	-	-
2	50	60	-	-	-
2	90	100	-	-	-
5A	0	10	-	-	-
5A	30	40	-	-	-
5A	50	60	-	-	-
6	0	10	-	-	-
6	10	20	-	-	-
6	50	60	-	-	-
6	90	100	-	-	-
7	0	10	45	0.71	180
7	20	30	-	-	-
7	50	60	-	-	-
7	90	100	-	-	-
9	0	10	-	-	-
9	30	40	-	-	-
9	70	80	-	-	-
9	100	110	-	-	-
10	0	10	38	0.24	240
10	20	30	-	-	-
10	50	60	-	-	-
10	80	90	-	-	-
11	0	10	50	0.36	150
11	10	20	-	-	-
11	50	60	-	-	-
11	80	90	-	-	-
12	0	10	-	-	-
12	20	30	-	-	-
12	50	60	-	-	-
12	90	100	-	-	-
14	0	10	43	0.23	110
14	20	30	-	-	-
14	50	60	-	-	-
14	90	100	-	-	-
18	0	10	20	0.80	120
18	20	30	-	-	-
18	60	70	-	-	-
18	90	100	-	-	-
19	0	10	68	0.08	68
19	20	30	-	-	-
19	30	40	-	-	-
20	0	10	95	0.08	170
21	0	10	44	0.39	95
21	20	30	-	-	-

21	50	60	-	-	-
21	80	90	-	-	-

Sample No.	Sample Depth From	Sample Depth To	% Clay	% Sand	% Silt	Gravel (>2mm)
	cm	cm	%	%	%	%
2	0	10	5	81	15	8.8
2	20	30	-	-	-	-
2	50	60	-	-	-	-
2	90	100	-	-	-	-
5A	0	10	-	-	-	-
5A	30	40	-	-	-	-
5A	50	60	-	-	-	-
6	0	10	-	-	-	-
6	10	20	-	-	-	-
6	50	60	-	-	-	-
6	90	100	-	-	-	-
7	0	10	4	83	14	10.0
7	20	30	-	-	-	-
7	50	60	-	-	-	-
7	90	100	-	-	-	-
9	0	10	-	-	-	-
9	30	40	-	-	-	-
9	70	80	-	-	-	-
9	100	110	-	-	-	-
10	0	10	5	78	17	4.5
10	20	30	-	-	-	-
10	50	60	-	-	-	-
10	80	90	-	-	-	-
11	0	10	6	84	10	11.1
11	10	20	-	-	-	-
11	50	60	-	-	-	-
11	80	90	-	-	-	-
12	0	10	-	-	-	-
12	20	30	-	-	-	-
12	50	60	-	-	-	-
12	90	100	-	-	-	-
14	0	10	6	83	11	14.5
14	20	30	-	-	-	-
14	50	60	-	-	-	-
14	90	100	-	-	-	-
18	0	10	4	85	11	11.6
18	20	30	-	-	-	-
18	60	70	-	-	-	-
18	90	100	-	-	-	-
19	0	10	5	78	17	2.3
19	20	30	-	-	-	-
19	30	40	-	-	-	-
20	0	10	6	73	21	13.2
21	0	10	5	81	14	2.8
21	20	30	-	-	-	-

21	50	60	-	-	-	-
21	80	90	-	-	-	-


Premise