GLANMIRE SOLAR FARM

Agricultural Impact Assessment

Prepared for:

Elgin Energy

SLR Ref: 630.30108.001
Version No: v1.0 Final
September 2022

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Elgin Energy (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 the Client. 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 SLR.

SLR 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	Checked	Authorised
630.30108.001	September 2022	Murray Fraser	Rod Masters	Murray Fraser

CONTENTS

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1 Introduction

SLR has been commissioned by Elgin Energy to complete an Agricultural Impact Assessment (AIA) for the Glanmire Solar Farm Project (the Project). The purpose of this AIA is to form part of the Environmental Impact Statement (EIS) for the Project in support of a development application being prepared by NGH, to be submitted under Part 4 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW Department of Planning and Environment (DP&E), 1979).

1.1 Background

Elgin Energy is a leading international solar developer with operations in Australia, UK, and Ireland. To date, Elgin have delivered 21 projects including the largest operational solar farms in Scotland (13MW) and Northern Ireland (46MW)

Elgin Energy are proposing to develop the Glanmire Solar Farm at 4823 Great Western Highway, Glanmire, NSW 2795 (Lot 141 DP1144786), the Project Area. This site is located approximately 11 kilometres east of the township of Bathurst and approximately 4.5 kilometres east of Raglan. A Regional Locality and Project Area Plan is provided at **Figure 1** for reference. The site has a total area of approximately 186 hectares and is currently used for grazing and for intermittent cropping. The general area comprises a range of farming properties and rural living properties.

The project will cover a development footprint of approximately 159 hectares and comprise single axis tracking solar photovoltaic technology laid out in north south rows and will also include ancillary infrastructure such as inverters, connection equipment and energy storage equipment. The project is aiming to continue sheep grazing within the development footprint of the project once operational.

Lot 141 DP1144786 is wholly contained within the Bathurst Regional Council Local Government Area (LGA) and is zoned as RU1 – Primary Production.

1.2 Objective

The objective was to conduct an AIA for an area of land proposed for the Project to assess the impacts of the Project on agricultural and/or industries within and surrounding the Project Area to support an EIS/Development Application for the project.

1.3 Study Requirements

The EIS for the Project has been prepared in accordance with Division 4.1, Part 4 of the EP&A Act which ensures that the potential environmental effects of a proposal are properly assessed and considered in the decision-making process.

This report has been prepared based on the Strategic Regional Land Use Policy (the Policy) (NSW Department of Planning & Infrastructure (DP&I), 2012a). The Policy aims to assist the development of a long-term strategy for continued progress of the mining industry that also ensures local community sustainability and on-going viability of existing agricultural industries. The Policy applies to areas within NSW where there is high value agricultural land and increasing activity in the coal and coal seam gas industries.

Part of this policy requires all state-significant development proposals, whether or not they are located on land mapped as Strategic Agricultural Land (SAL), to prepare an Agricultural Impact Statement (AIS) for consideration at the development application stage. The purpose of an AIS is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project Area. The term 'agricultural resource' is used to describe the land on which agriculture is dependent and the associated water resources (quality and quantity) that are linked to that land. SLR has prepared this AIS to address the requirements of the Policy in accordance with the Guideline for Agricultural Impact Statements (DP&I, 2012b).

A Biophysical Strategic Agricultural Land (BSAL) Assessment (SLR, 2021a) (**Appendix A**) and a Land & Soil Capability (LSC) Assessment (SLR, 2021b) (**Appendix B**) for the Project were completed for the Project Area. These assessments confirmed there is no BSAL or 'high quality agricultural land" located in or within 100 metres of the Project Area.

SEARs

Planning Secretary's Environmental Assessment Requirements (SEARs) were issued for the Project on the 23rd September 2021. The SEARs as they specifically relate to agricultural resources and industry are:

Land – including:

- *a consideration of agricultural land, flood prone land, Crown lands, mining, quarries, mineral or petroleum rights;*
- *a soil survey to determine the soil characteristics and consider the potential for erosion to occur; and*
- *assessment of impact on agricultural resources and agricultural production on the site and region.*

1.3.2 Large-Scale Solar Energy Guideline

According to Appendix A of the *Large-Scale Solar Energy Guideline* (DPE, 2022) a Level 2 – reduced assessment was required as the Project Area is located on rural zoned land verified as LSC Class 4 (SLR, 2021b) and does not contain any verified BSAL (SLR, 2021a), as shown in the steps below:

- **Land zoned RU1, RU2, RU3 or RU4?** YES
- **Land mapped as LSC class 1-4 or BSAL?** YES

LSC and BSAL site verification undertaken by SLR in 2021

- **Is the land LSC class 4?** YES

Level 2 reduced assessment required

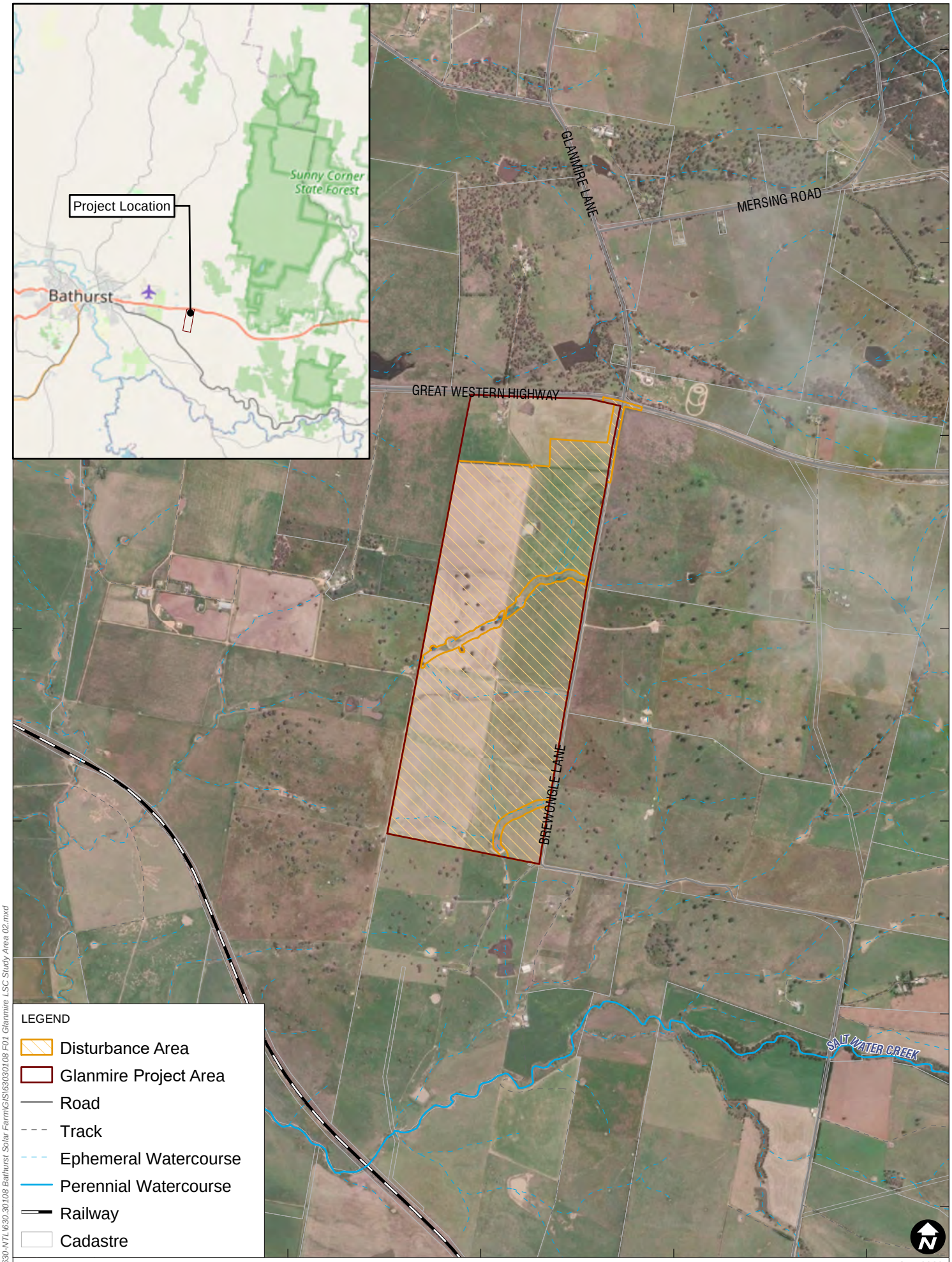
This AIA is compliant with the recently adopted *Large-Scale Solar Energy Guideline* (DPE, 2022).

1.4 Project Area

Elgin Energy requires an AIA for the Area of Interest (the Project Area) as shown in **Figure 1**, to support the Project. **Table 1** shows the breakdown of the Project Area.

Table 1 Project Area

Assessment Component	Hectares
Development Footprint	159
Remaining Area Lot 141 DP1144786	27
Total Project Area	**186**
Total Arable Area (area available for potential agricultural production)	180



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 14-Sep-2022
Project Number: 630.30108

Data Source: © OpenStreetMap contributors

SLR

Study Area

FIGURE 1

H:\Projects-SLR\610-SrvSYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F01 Glanmire LSC Study Area 02.mxd

1.5 Structure of this Report

This AIA, was developed in accordance with the framework provided in the *Strategic Agricultural Land Use Policy: Guideline for Agricultural Impact Statements* (DP&I, 2012b), and Appendix A of the *Large-Scale Solar energy Guideline* (2022) to addresses the information listed in **Table 2**. The 2012 Guideline was developed for mining and gas projects, and as such some requirements have been modified for relevance to the development of a solar farm.

Table 2 Level 2 AIA Requirements

Level 2 Assessment Requirement	Content & 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 • Location • Duration • Areas of the site that would be disturbed or temporarily removed from agricultural use	1
Regional context Describe the regional context.	• Zoning of the project site • Climate and rainfall • Regional landform • Regional land use including any significant agricultural industries and/or infrastructure	4
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	2 & 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 (e.g. aerial spraying, dust generation and biosecurity risk) during operation and after decommissioning, with reference to the zoning provisions applying to the land	NGH LUCRA (2022)

Level 2 Assessment Requirement	Content & Form	Section Addressed
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 productivity of the site • Consider project potential to 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 that 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

1.6 Methodology

The AIS was assessed using the methodology set out below:

- A desktop review of all publicly available information relating to the Project.
- Field survey and site inspections for the AIA was undertaken during November 2020 by SLR's Principal Agronomist Murray Fraser and overseen by SLR's Regional Sector Leader Rod Masters (CPSS-3)
- Description of the biophysical environment for the Project Area and surrounding locality.
- A review of other specialist impact assessments which also form part of the EIS for the Project.
- Assessment of potential impacts on agricultural resources and industry, including mitigation measures for any identified impacts.

2 Agricultural and Water Resources

2.1 Climate

Representative climate data for the Project Area has been obtained from the nearest Bureau of Meteorology (BOM) weather station located at Glanmire, approximately 4 km to the east of the Project Area (Bathurst Airport AWS, BOM Station 063291, Monthly Climate Statistics).

Bathurst Airport BOM Station has recorded an average annual rainfall of 606 millimetres (mm), of which approximately 365 mm (60%) falls between October and March, with an average of 124.8 rain days in any given year (Table 3). Mean monthly maximum temperatures range between 29.0°C and 12.1 C, with January being the warmest month. Mean monthly minimum temperatures range between 14.0 C and 0.8°C, with July being the coldest month.

Table 3 Glanmire Climate Data

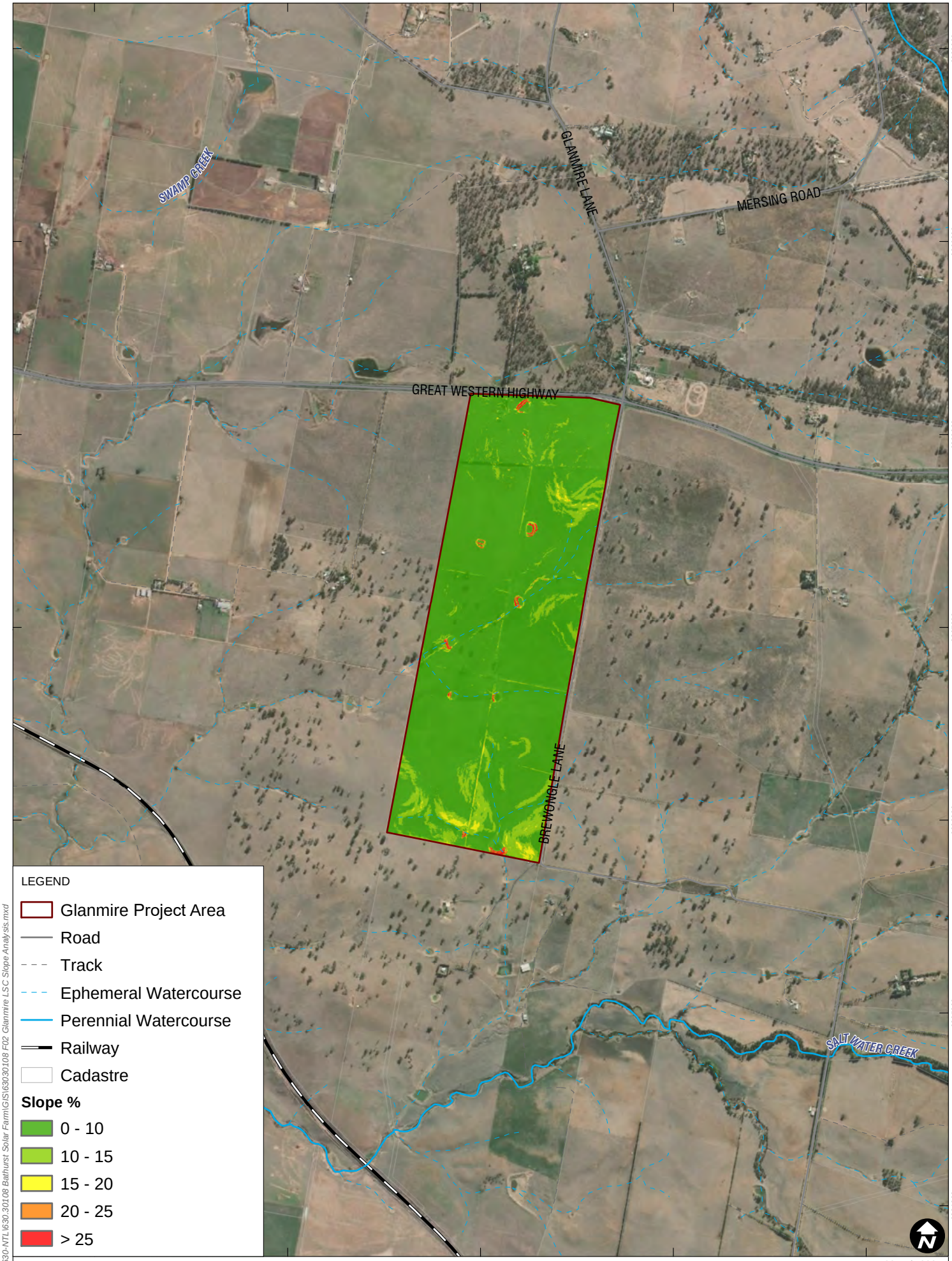
Temperature	Average (Mean)	Annual Range
Minimum Temperature	6.9°C	0.8 – 14.0 °C
Maximum Temperature	20.5°C	12.1 – 29.0 °C
Rainfall	**Average (Mean)**	**Number of Rain Days**
Annual Rainfall	606 mm	124.8
Wettest Month	72 mm	9.4
Driest Month	32.9 mm	11.5

The BOM classifies this as a temperate climate zone. The area can be susceptible to occasional heavy showers and thunderstorms due to easterly troughs during warmer months. Summer winds are generally from the south or south-east, with a tendency for afternoon north-easterly winds. During winter, winds are predominantly from the south or south-west.

2.2 Topography

Topography in the region (Bathurst Regional LGA) is varied, ranging from slightly undulating plateaus and low hills to a rugged landscape with very steep terrain.

Topography within the Project Area is generally undulating (**Figure 2**) with a fall from the north-west to the south-east with the lower section of the Project Area falling to the south. The major topographical features include first and second order streams of Salt Water Creek with some steeper slopes into the drainage lines at the south of the Project Area. Surface levels within the Project Area vary from a low point of approximately 760 metres Australian Height Datum (AHD), toward drainage lines to the south, to a high point of approximately 800 metres AHD, at the northern end of the Project Area.



LEGEND

- Glanmire Project Area
- Road
- Track
- Ephemeral Watercourse
- Perennial Watercourse
- Railway
- Cadastre

Slope %

- 0 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > 25

0 0.5 1 km

Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 09-Feb-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\63030108 F02 Glanmire LSC Slope Analysis.mxd

SLR

Topography & Hydrology

FIGURE 2

2.3 Hydrology

2.3.1 Surface Water

The Project Area is located in the catchment of the Macquarie River within the Murray-Darling Basin. The Project Area resides within the sub-catchments of the Fish River and Salt Water Creek (**Table 4**). From its headwaters near the township of Black Springs, The Macquarie River flows in a generally north-easterly direction to its confluence with the Barwon River to flow onto the Darling River. The Macquarie River consists of an important ecological system located downstream at the Macquarie Marshes which are Ramsar-listed and nationally important wetlands.

Fish River is one of the major tributaries of the Macquarie River and is located at the upstream headwaters of the River. Fish River flows to the south of the Project Area in an easterly direction to its confluence with the Macquarie River.

The Project is located solely within the Salt Water Creek Catchment with headwaters of the creek located within the Project Area as first and second order streams. Drainage lines within the Project Area are intersected by a number of farm dams (**Figure 2**). Salt Water Creek flows south-east from the Project Area approximately 7 kilometres to its confluence with the Fish River. Salt Water Creek comprises approximately 65 km^2 of the Fish River catchment.

Douglas Partners (2021) undertook a visual inspection of six farm dams within the Project Area and found them to generally be in a good condition with no signs of slumping of the embankments or major erosion. The dams generally had embankments of less than 3 metres in height with some minor erosion noted on the embankments.

Table 4 Project Area Catchments

Catchment	Sub Catchment	Associated Watercourses	Total Catchment Area
Macquarie River	Fish River	Salt Water Creek	6,500 hectares

Licensed Surface Water Users

The NSW Water Register indicates there are no Water Access Licences (WALs) associated with the Project Area.

2.3.2 Groundwater

The Project Area is located within the Lachlan Fold Belt Murray Darling Basin Groundwater Source which is classed as highly productive.

Groundwater User Extraction Points

The Project Area is covered by the NSW Murray Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan. There are no privately-owned groundwater extraction bores identified within the Project Area.

2.4 Geology

The Project is located within South Eastern Highlands Bioregion which is positioned within NSW, ACT and extends south into Victoria and situated just inland of the South East Corner and Sydney Basin coastal bioregions. The highlands is part of the Lachlan fold belt that runs through the eastern states as a complex series of metamorphosed Ordovician to Devonian sandstones, shales and volcanic rocks intruded by numerous granite bodies and deformed by four episodes of folding, faulting and uplifting (NSW OEH, 2003).

The Project is located on the Bathurst Granite formation which is one of the youngest granite bodies which intrudes the Ordovician Molong Volcanic Arc that extends from the northern end of the bioregion to Kiandra in the Snowy Mountains region. The area contains carboniferous granite with limited areas of Tertiary basalt caps and Quaternary sands along the Macquarie River. Rounded hills in a granite basin is surrounded by steep slopes on the contact margin. Outcrops with tors are also present near margins with Terrace alluvium along the Macquarie River (NSW OEH, 2003).

2.5 Soil Landscapes

The soil landscapes units within the Project Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of NSW Department of Primary Industries (DPI)), on the Bathurst 1:100,000 Sheet (Hazelton & Tille, 1990**.** Descriptions of the two soil landscape units are given below.

Raglan

The Raglan soil landscape unit comprises gently undulating to undulating rises with slopes less than 5%, but occasionally up top 10% and a local relief of 20-30 metres. It occurs on the Bathurst Granite geological unit, which is predominately comprised of medium to coarse-grained and massive granodiorite and adamellites. The dominant soils are Sodosols with some Chromosols associated with the associated Bathurst soil landscape unit on upper slopes. Some Kandosols are also present. Limitations to this soil landscape unit are moderately reactive soil, low soil fertility and seasonal waterlogging.

Bathurst

The Bathurst soil landscape unit covers undulating to rolling hills with slopes generally ranging from 6-10% and a local relief of 30-70 metres. It occurs on the Bathurst Granite geological unit, which is predominately comprised of medium to coarse-grained and massive granodiorite and adamellites. The dominant soils are Chromosols with Sodosols on lower slopes and in drainage lines. Some Rudosols also occur. Limitations to the soil landscape unit are moderately reactive soil, low soil fertility.

2.6 ASC Soil Type Assessment

The field survey for the LSC Assessment (SLR, 2021b) was undertaken during November 2020 by SLR's Principal Agronomist Murray Fraser and overseen by SLR's Technical Director, Rod Masters (CPSS-3).

One soil map unit (SMU) was identified within the Project Area, a Subnatric Grey-Brown Sodosol, and was mapped according to the dominant ASC soil type (**Figure 3**) using a combination of the soil survey and laboratory analysis results. This soil unit and the observation sites associated with each are shown below in **Table 5**.

A description of one detailed representative site from the mapped soil unit follows **Table 5**, with the remaining detailed soil profile descriptions, check site descriptions and laboratory certificates of analysis are shown in **Appendix A**.

Table 5 Soil Units within Project Area

SMU	ASC Soil Type	Soil Type Group	Detailed Site	Check Site	Hectares
1	Subnatric Grey-Brown Sodosol	Dominant	BS1, BS2, BS3, BS4, BS6	C1 – C8	186
	Eutrophic Grey Chromosol	Sub-Dominant	BS5	Nil	
Total					**186**

2.6.1 Soil Unit 1: Subnatric Grey-Brown Sodosol

Subnatric Grey Sodosol

Table 6 Summary Subnatric Grey Sodosol (Site BS2)

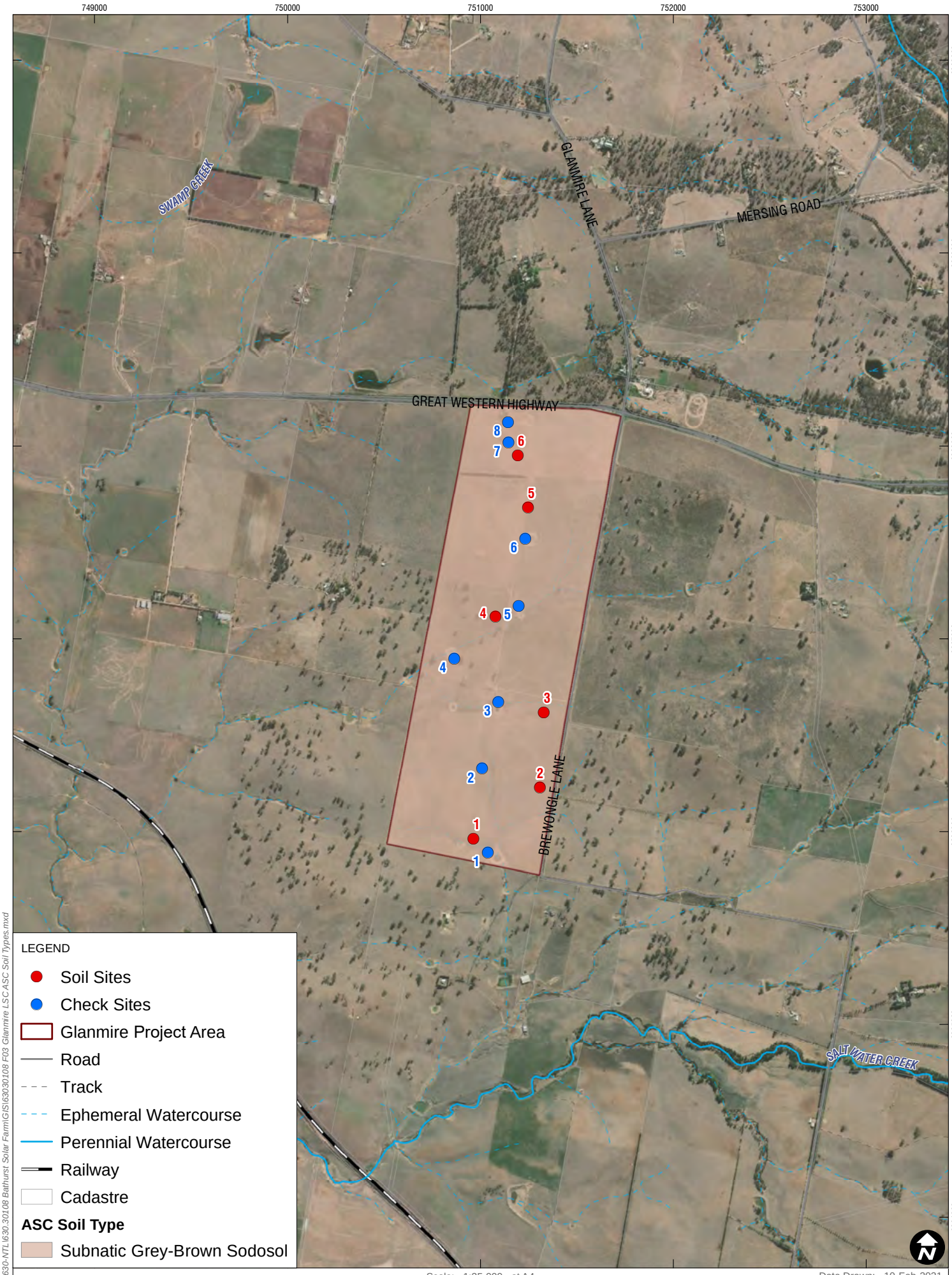
Overview	
Landscape Site BS2 	
ASC Name	Subnatric Grey Sodosol
Representative Site	BS2
Other Mapped Sites	BS1, BS3, BS4, BS6
Survey Type	Detailed Lab
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South
LSC Class	4
Verified	Non-BSAL – Inherent Fertility, Poor Drainage & Sodicity (ESP)

Table 7 Profile: Subnatric Grey Sodosol (Site BS2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (10YR 3/3) loam, weak structure of 5-10 mm crumb peds with a rough fabric and moderate consistence. Nil mottling; 50% gravel content <5 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.15 – 0.30	Brown (10YR 5/3) bleached loam, weak structure of 5-10 mm crumb peds with a rough fabric and moderate consistence. Nil mottling; 40% gravel content <5 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.20 – 0.30.
	B21 0.30 – 0.60	Grey (10YR 6/1) light clay, strong structure of 20-40 mm blocky peds with a rough fabric and moderate consistence. 30% distinct yellow mottling; 30% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.60	Grey (5Y 6/1) medium clay, strong structure of >40 mm blocky peds with a rough fabric and moderate consistence. 30% distinct yellow mottling; 25% gravel content 5-10 mm; 10% hard manganese nodules <10 mm; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sample depth.

Table 8 Chemical Parameters: Subnatric Grey Sodosol (Site BS2)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.3	Strongly Acidic	4.7	Non-Sodic	0.6	Non-Saline	3.4	Ca Low
A2	5.9	Moderately Acidic	8.1	Marginally Sodic	0.2	Non-Saline	3.3	Ca Low
B21	7.2	Neutral	8.8	Marginally Sodic	0.4	Non-Saline	1.3	Ca Low
B22	7.7	Mildly Alkaline	17.2	Strongly Sodic	0.7	Non-Saline	0.7	Ca Deficient



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 10-Feb-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F03 Glanmire LSC ASC Soil Types.mxd

SLR

ASC Soil Types

FIGURE 3

2.7 Vegetation

Vegetation within the Project Area was mapped by the NSW Office of Environment and Heritage (OEH) as part of the State Vegetation Type Map (SVTM) of plant community types in NSW and included predominantly non-native vegetation with minor scattered areas of Southern Tableland Grassy Woodlands.

No areas of outstanding biodiversity value, as identified under the *Biodiversity Conservation Act 2016*, occur within the Project Area (AREA, 2022).

2.8 Agricultural Land Use

A site inspection was undertaken by SLR's Principal Agronomist Murray Fraser in November 2020 in conjunction with a desktop assessment found majority of the Project Area has been cleared and is primarily used for agricultural activities. Grazing of improved pastures such as phalaris, ryegrass and clover, and intermittent planting of fodder crops such as wheat, oats and canola are the dominant agricultural enterprise identified within and surrounding the Project Area.

There is 180 hectares which is considered arable land within the Project Area, which encompasses the Project development footprint of approximately 159 hectares.

Strategic Agricultural Land

There is no land identified or mapped as Strategic Agricultural Land or State Significant Agricultural Land within or in the vicinity of the Project Area.

2.9 Acid Sulfate Soils

The likelihood of acid sulfate soils occurring within the Project Area is very low due to its position away from the coast and potential acid sulfate landform type. Furthermore, none of the Soil Landscape Units or soil types mapped within the Project Area have acid sulfate soil potential.

3 Land and Soil Capability

3.1 Land and Soil Capability

The Land and Soil Capability (LSC) classification applied to the Project Area was according to the Office of Environment & Heritage (OEH) guideline The Land and Soil Capability Assessment Scheme; Second Approximation (OEH, 2012). This 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 (**Table 9**) which classify the land based on the severity of long-term limitations according to:

- 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.

Table 9 Land and Soil Capability Classification

Class	Land and Soil Capability
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.
Land capable for a limited set of 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 LSC for the Project Area has been mapped as part of the *Glanmire Solar Farm Land and Soil Capability Assessment* (SLR, 2021b) and is summarised in **Table 10** and shown in **Figure 4**. Two LSC classes are present within the Project Area, Classes 4 and 5. The major assessment points are listed below.

- LSC Class 4 land covers 172 hectares within the Project Area. LSC Class 4 is rated as having moderate agricultural capability and has moderate to high limitations for high-impact land uses. It has restricted 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. This land is capable of pasture improvement and can be tilled for an occasional crop.
- LSC Class 5 land covers 14 hectares within the Project Area. LSC Class 5 is rated as having 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.

It should be noted that during the LSC Assessment the entire Study Area could have been classified as LSC Class 5 due to *Hazard 6: Water Logging*, however a conservative estimate was taken that the return period for waterlogging was "every 2 to 3 years" (LSC Class 4) rather than "every year" (LSC Class 5).

The entire Study Area is considered to have moderate to moderately low agricultural capability according to definitions given in *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2012).

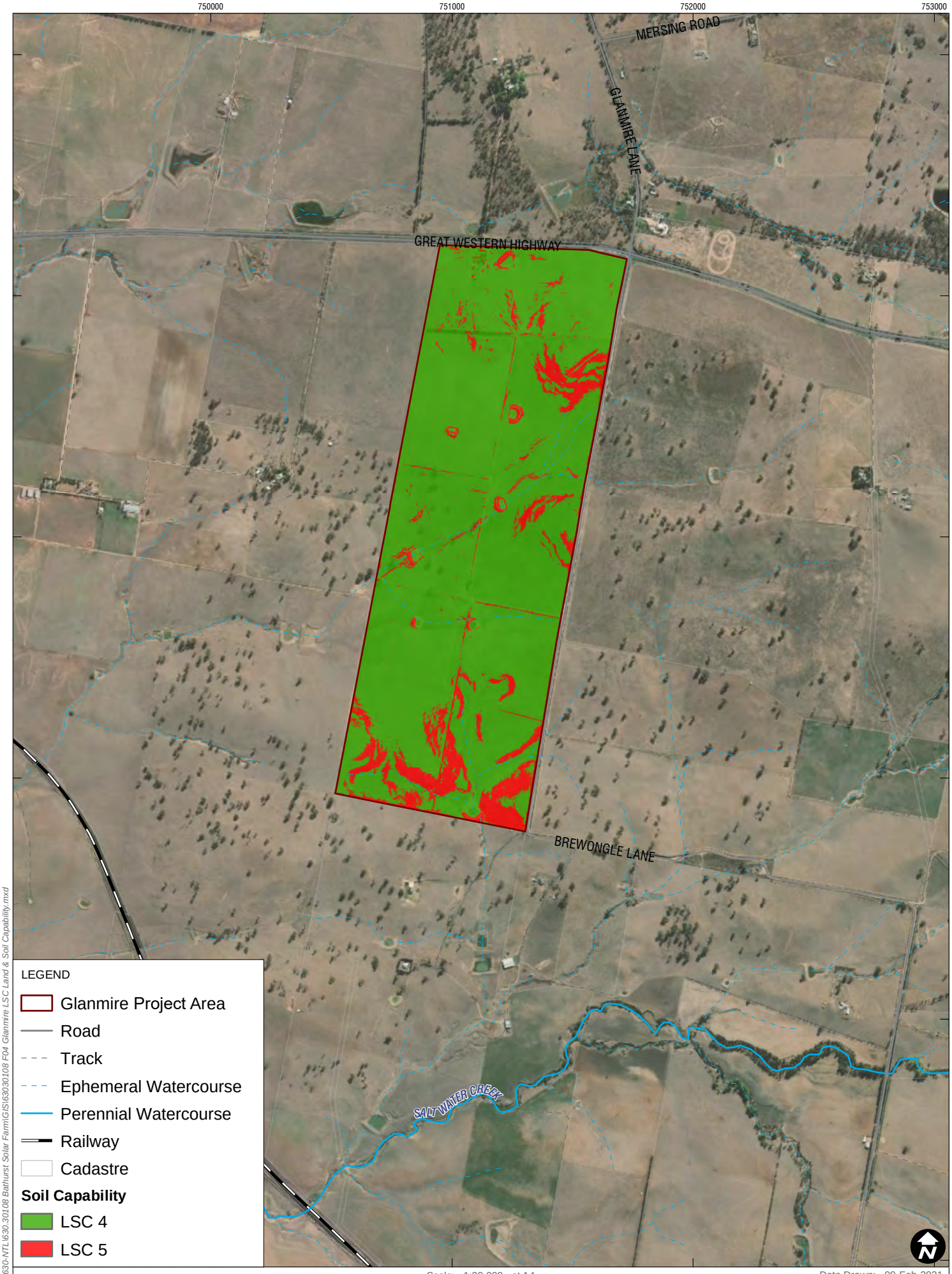
Table 10 Land & Soil Capability Classes

LSC	Site	LSC	Project Area		Agricultural Capability Rating
Class	Number	Limitation	Hectares	%	
4	1, 2, 3, 4, 5, 6	Water Logging	172	93	Moderate
5	Slope >10%	Water Logging & Water Erosion	14	7	Moderate-Low
		Total	**186**	**100**	

3.2 Biophysical Strategic Agricultural Land Assessment

The nearest mapped Biophysical Strategic Agricultural Land (BSAL) according to the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 – Strategic Agricultural Land Map – Sheet STA_41* (DP&I, 2013) to the south of the Project Area at Salt Water Creek.

In addition to this mapping, the *Glanmire Solar Farm Biophysical Strategic Agricultural Land Verification Assessment* (SLR, 2021a) found there is no verified BSAL within the Project Area according to the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2013).



Scale: 1:20,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 09-Feb-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F04 Glanmire LSC Land & Soil Capability.mxd

SLR

Land & Soil Capability

FIGURE 4

4 Local and Regional Agricultural Land Enterprises

The Project Area is located wholly within the Bathurst Regional Council LGA.

4.1 Agricultural History

Agriculture within the Bathurst LGA is based on grazing and cropping with some emerging niche industries becoming more prevalent in the area.

Early settlers judge the area ideally suited to pastoral purposes and in 1814 built a road from Emu Ferry to the Bathurst plains at the bank of the Macquarie River. Governor Macquarie sited the intended township of Bathurst and established a small party of convicts and soldiers brought to the area to plant wheat which became the start of a permanent agriculture on the Bathurst plains. Government herbs were relocated from Sydney and coastal areas to the region. Cattle and sheep breeding for meat production also become prominent in the area, together with oxen bullocks and horses for working stock (Bathurst Regional Council, 2021).

Today, Bathurst LGA has a prominent agricultural industry. Over the years some of the traditional cattle and sheep grazing land, and acreage crops and orchards, have made way for new niche industries such as vineyards, olive groves and nut farms.

4.2 Agricultural Enterprises and Associated Industries

4.2.1 Land Use

Agriculture is a minor land use for the regional area (Bathurst LGA), accounting for 42% of land use. (Australian Bureau of Statistics (ABS), 2016*). The agricultural land use is displayed in **Table 11**. It details the area of land used for agriculture in the region and the specific uses of the land. The major points are summarised below.

- Agricultural land is almost predominantly used for grazing, utilising 95% of all agricultural land. The primary enterprise is sheep and lamb farming, which accounts for 91% of livestock numbers, followed by meat cattle (9%) and dairy cattle farming (<1%).
- Cropping enterprises comprise a small portion of agricultural activities. The primary crops grown are cereals for grain. Minor cropping of vegetables for human consumption and fruit and nuts also takes place.
- Minor irrigation cropping is carried out, comprising <1% of the agricultural land in the region. Agriculture accounts for 1,328 megalitres of volume to irrigate approximately 480 ha of agricultural area, while 1,613 megalitres is utilised for other agricultural uses.

Table 11 Bathurst LGA Agricultural Land Use

Agricultural Land Area	Unit	Total
Total land area within LGA	Hectares	379,826
Area of National Parks, nature reserves & other protected lands	Hectares	11,316
Area of agricultural land	Hectares	160,553
Proportion of agricultural land	**%**	**42**
Agricultural Enterprise		
Land under cropping activities	Hectares	6,189

Agricultural Land Area	Unit	Total
Land under grazing activities	Hectares	153,028
Proportion of agricultural land used for grazing	**%**	**95**
Grazing Enterprises	**Total**	**%**
Sheep and lambs	356,371	91
Meat cattle	35,436	<1
Dairy cattle	65	9
Total	**391,872**	**100**
Cropping Enterprises		
Cereals for grain	Hectares	4,658
Vegetables for human consumption	Hectares	94
All fruit and nuts	Hectares	23
Total land cropped	Hectares	**4,775**
Irrigation		
Area irrigated	Hectares	480
Irrigation volume applied	Megalitres	1,328
Other agricultural uses	Megalitres	1,613
Total water use	Megalitres	2,941
Proportion of agricultural land irrigated	**%**	**<1**

Source: ABS (2016*) *2016 is the latest agricultural data available from ABS

4.2.2 Employment

A summary of the total regional employment and the proportion of agriculture related employment is shown in **Table 12**. The regional employment in the agriculture related occupations is shown in **Table 13** (ABS, 2016). Agriculture is not a major employer within the region; with the total of 689 persons employed in the agriculture, forestry and fisheries sector representing only 4% of the total employed population.

The Project Area is leased from the landowner by a local mixed farming operation.

Table 12 Bathurst LGA Employment Related to Agriculture

Employment Sector	No. of persons	%
Total Regional Employment	18,165	100
Total Regional Employment Related to Agriculture	**689**	**4**

Source: ABS (2016*)

Table 13 Bathurst LGA Agricultural Related Employment by Occupation

Agriculture, Forestry and Fisheries Occupation	Number of People	%
Managers	372	53
Professionals	29	4
Technicians and trade workers	70	10
Community and personal service workers	5	1
Clerical and administrative workers	37	5

Agriculture, Forestry and Fisheries Occupation	Number of People	%
Sales workers	10	1
Machinery operators and drivers	47	7
Labourers	123	18
Other	9	1
Total Regional Agriculture, Forestry and Fisheries Employment	**698**	**100**

Source: ABS (2016*)

4.3 Agricultural Production Value – Regional

Agricultural production values for the Bathurst LGA totals $45 million, detailed in **Table 14** The main agricultural production by value is from lamb and sheep production (livestock slaughtering and livestock products), accounting for almost 90% of the value of agricultural commodities produced (ABS, 2016*).

Table 14 Regional Agricultural Production

Agricultural Production Gross Value	Value (Million)	%
Crops	$5	11
Livestock slaughtering	$27	60
Livestock products	$13	29
Total gross agricultural production	**$45**	**100**

Source: ABS (2016*)

4.4 Potential Agricultural Production Value of the Project Area

Potential agricultural productivity was determined using the NSW Department of Primary Industry agricultural productivity data for agricultural enterprises suitable for each of the LSC Classes that will be impacted. This information can be used to generate potential farm incomes. The Merino Ewes (20 micron) – Terminal Rams Farm Enterprise Budget Series (DPI, 2020) gross margin has been applied to this assessment. The Agricultural Productivity Gross Margin Sensitivity Analysis information is contained in **Appendix C**.

Table 15 summarises the potential gross margin for each LSC Class. Carrying capacity was determined using the NSW DPI Beef Stocking Rates & Farm Size (DPI, 2006) which gives potential stocking rates using Dry Sheep Equivalents (DSE). The Bathurst LGA is in the 600 millimetre per annum rainfall zone and DSE for each LSC Class were calculated accordingly. The higher nominated DSE ratings take into account the current management strategy of growing fodder crops and subsequent increased stocking rates. The major points are listed below.

- LSC Class 4 land has the potential to generate a gross margin of $588 per hectare from lamb and wool production, with variable costs of $899 per hectare.
- LSC Class 5 land has the potential to generate a gross margin $515 per hectare from lamb and wool production, with variable costs of $787 per hectare.

Table 15 Gross Margin per LSC Class

LSC	Stocking Rate	Revenue	Variable Costs	Gross Margin
Class	DSE	Per Hectare	Per Hectare	Per Hectare
4	16	$1,488	$899	$588
5	14	$1,302	$787	$515

Based on the nominated gross margins, the Project Area has the capacity to generate an estimated gross margin of $105,2825 per annum (**Table 16**), with associated variable costs of $160,960. For the gross margin and variable costs calculations it is assumed the entire area of LSC Class 4 land within the arable area of 180 hectares is available for fodder crop production with the remaining 8 hectares of LSC Class 5 comprising the residual arable area. Using a conservative gross margin assessment it is also assumed the remaining 21 hectares which is considered arable is also unavailable for agricultural production during the life of the Project

Table 16 Potential Annual Gross Margins (Pre-Development)

LSC	Gross Margin	Actual Arable Area	
Class	Per Hectare	Hectares	Gross Margin
4	$588	172	$101,165
5	$515	8	$4,117
	Total	**180**	**$105,282**

4.5 Agricultural Support Infrastructure

Agricultural support infrastructure within the Bathurst LGA includes the Great Western Highway as the major arterial road, and rail infrastructure providing transport from agricultural areas in the north, west, and south of the state. The closest livestock selling centre, Central Tablelands Livestock Exchange is located at Carcoar, approximately 55 kilometres south-west of the Project Area.

There are a number of retail agricultural suppliers in Bathurst that service farms within the region.

The main purpose-built agricultural support infrastructure within the Project Area is paddock fencing and six small farm dams which are used to provide stock water.

5 Assessment of Potential Impacts

5.1 Land Temporarily Removed from Agriculture

The main impact of the Project will be the temporary removal of 180 hectares of arable land from its current use of lamb and wool production grazing fodder crops for wool and lamb production, which has a nominated potential annual gross margin of $105,282. Given the annual agricultural production for the Bathurst LGA is valued at $45 million, the Project Area represents approximately 0.2% of the total agricultural revenue,

Grazing with sheep is proposed as a vegetation management tool and fire hazard reduction measure throughout the life of the Project. There will be some income generated from grazing, however it will be significantly less then pre-development levels.

Soil Erosive Potential

Soil types within the Project Area is dominated by Sodosols. The strongly sodic nature of the B horizon in Sodosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall.

Impact on Soil

During the operational life of the Project, the fallowing (resting) impacts of the solar farm combined with operational management to protect groundcover may result in improved soil health and grazing production, particularly in drought conditions. The maintenance of soil health is imperative to the long-term sustainability of agricultural land. Resting the land through the life of the solar farm could play an important role in improvement of soil health across the development footprint. In comparison to grazing of fodder crops, rested land within the solar farm development could have the following benefits:

- Increased groundcover and diversity of groundcover with biosecurity management.
- Perennial grasses can be encouraged to increase soil stability of the grassland around the panels.
- Increase in soil moisture and nutrient holding capacity.
- Increases in soil organic matter giving great rainfall infiltration and moisture holding capacity, resulting in less impact of runoff and subsequent erosion.
- Controlled stocking rates reducing soil compaction.
- An increase in soil biota for decomposition of organic matter, nutrient cycling and improving soil structure.

The Project will not result in any change to the intrinsic characteristics of the site i.e. the dominant ASC soil type will still be a Sodosol of LSC Classes 4 and 5.

Therefore, it is expected that upon completion of decommissioning stage, the site would be in the same or better condition as it is today, in terms of potential agricultural productivity.

5.2 Land Permanently Removed from Agriculture

At conclusion of the Project all infrastructure will be removed and the area remediated commensurate with pre-disturbance LSC Class and agricultural land use. The Project will not change the intrinsic characteristics of the soil types found within the Project Area.

There is no land which will be permanently removed from agriculture as a result of the Project

5.3 Impact on BSAL & SSAL

There is no Biophysical Strategic Agricultural Land or State Significant Agricultural Land within or adjacent to the Project Area. The Project will not impact any Biophysical Strategic Agricultural Land or State Significant Agricultural Land.

5.4 Acid Sulfate Soils

There are no soil landscape units or soil types associated with the Project Area with acid sulfate potential. The Project therefore would not impact upon acid sulfate soils.

5.5 Water Resources

Surface Water & Farm Dams

No additional dams are proposed for the Project and given that drainage channels within the Project Area are considered ephemeral and there are no WALs associated with the Project Area, any impact on agricultural users dependent on flows from these watercourses is negligible.

With the decommissioning of 4 dams during construction there is the potential for a small positive increase in overland flows available for surface water users lower in the catchment.

Groundwater

There are no registered privately-owned groundwater bores identified within the Project Area, as such there no agricultural enterprises which rely on groundwater extraction that will be impacted by the Project.

Water Reallocation

The Project will not require Elgin to obtain alluvial WALs or groundwater allocations.

Water Resource Impacts on Agricultural Productivity

Given the impacts described previously, the Project result in negligible impact on water resources relied upon by agricultural enterprises and will not result in impacts on agricultural productivity.

5.6 Land Use Conflict

A Land Use Conflict Risk Assessment (LUCRA) for the Project was undertaken by NGH (2022) with the highest potential for conflict assessment points listed below:

- Agricultural conflicts:
  - The continued agricultural use on the Subject land during the life of the project. This is not considered a conflict at a local rural economy level, only for the one landowner who will be compensated by their involvement in the project.
  - The construction phase and operational phase fire risks require careful management in the design as well as through the life of the project.
  - Construction risks to soil and water are noted but considered highly manageable and likely to be offset by longer term benefits of less intensively worked land in operation.
- Rural residential conflicts:
  - Traffic disruption, dust and noise may affect nearby residents temporarily, during peak construction. These are considered manageable.
  - Operational views from dwellings may reduce enjoyment of these areas. Screening is able to mitigate impacts to an acceptable level.
- Regional growth:
  - Operational views from key vistas may affect landscape scenic value. Screening is able to mitigate impacts to an acceptable level.

Conflicts were assessed also for transport corridors and aviation but all rated 10 or below, unmitigated and 6 or below, mitigated.

5.7 Agricultural Infrastructure

Rural Structures

There are no rural structures such as sheds, yards or silos which will be impacted by the Project.

Water Tanks

There are no water tanks which will be impacted by the Project.

Gas and Fuel Storages

There are no gas or fuel storages which will be impacted by the Project.

Irrigation Systems

There are no irrigation systems which will be impacted by the Project.

Farm Fences

Boundary fences will remain in place, with an additional security fence being proposed inside the existing boundary fencelines. Internal will be realigned or removed as deemed necessary by the Project design. Due to the reduced livestock numbers during operation of the Project the removal of these internal fences will have a negligible impact on agricultural production. Any impacts to boundary farm fences are likely to be of a minor nature and relatively easy to remediate.

Farm Dams

A number of farm dams (approximately 4) will likely be removed during construction of the Project. Due to the reduced livestock numbers during operation of the Project the removal of these dams will have a negligible impact on agricultural production. Any impacts to farm dams are likely to be of a minor nature and relatively easy to remediate.

5.8 Impact on Agricultural Resources from Biodiversity Offsets

Any biodiversity offsets resulting from the Project will not be located on potentially agriculturally productive land. Therefore, any biodiversity offsets will have negligible impact on agricultural resources, enterprises or BSAL.

5.9 Impact on State Forests and Conservation Areas

There are no State forests or Conservation Areas within or adjacent to the Project Area.

5.10 Visual Amenity & Landscape Values

Site inspections by SLR's Principal Agronomist did not identify any agricultural enterprises which were reliant upon visual amenity or landscape values as component of their operations. On this basis, the Project is considered to have negligible impact on visual amenity and landscape value relied upon by local and regional agricultural enterprises.

5.11 Tourism

The agricultural audit conducted by SLR did not identify any tourism infrastructure within the vicinity of the Project Area upon which agricultural enterprises are reliant. The Project will have no anticipated impact on local agriculture-related tourism (e.g. wineries or farm stay).

5.12 Weed Management and Biosecurity

There is moderate risk from weed infestation during the construction and operational phases of the Project through continued vehicle movements on and off site. Weeds will be managed as part of an environmental management system and plan to be adopted prior to construction beginning, during operation and prior to decommissioning. Continued inspection for weed germination and growth will be conducted during the construction, operational and decommissioning phases of the Project.

Biosecurity is defined in the NSW Biosecurity Strategy 2013 – 2021 (NSW DPI, 2013) as 'protecting the economy, environment and community from the negative impacts of pests, diseases and weeds'. It includes measures to prevent new pests, diseases and weeds from entering our country and becoming established. On a regional level, appropriate weed management will reduce biosecurity risks.

Any import of equipment or machinery from interstate or overseas will follow the standard procurement safeguards and quarantine procedures as per NSW and Australian requirements.

Given the processes above, it is considered the Project is highly unlikely to represent an increased risk to the biosecurity of agricultural resources and enterprises within the region.

5.13 Air Quality

There is potential for the Project to generate dust primarily as a result of construction activities and site decommissioning and rehabilitation. NGH found disturbance of groundcover during the construction phase of the Project and site commissioning, along with mobilisation of equipment to and between sites, has the potential to generate dust, with impacts dependent on road and weather conditions. Mitigation measures are set out in the EIS to ensure this impacts are appropriate managed.

The project will have negligible impacts to air quality during operation of the Project.

5.14 Noise & Vibration

Renzo Tonin and Associates (2022) undertook an environmental noise and vibration assessment for the Project. Noise emissions from the construction phase of the project were predicted to exceed the nominated criteria at six of the nearest nominated receiver locations when the loudest plant and equipment or up to three plant and equipment are operating concurrently and at the closest proximity to the receivers. These construction noise levels of up to 55 dB at the nearest receivers are well below those found to NOT impact livestock.

In a study by Casaday and Lehmann (1967) grazing paddocks and feedlots were selected for observations on animal behaviour under sonic boom conditions. The number of animals observed in this study included approximately 10,000 commercial feedlot beef cattle, 100 horses, 150 sheep and 320 lactating dairy cattle. Booms during the test period were scheduled at varying intervals during the morning hours Monday to Friday of each week.

Results of the study showed that the reactions of the sheep and horses to sonic booms were slight. Dairy cattle were little affected by sonic booms (125 dB to 136 dB). Only 19 of 104 booms produced even a mild reaction, as evidenced by a temporary cessation of eating, rising of heads, or slight startle effects in a few of those being milked. Milk production was not affected during the test period, as evidenced by total and individual milk yield. The researchers developed a summary by species and farms indicating that the few abnormal behavioural changes observed were well within the range of activity variation within a group of animals. They defined these changes as horses jumping up and galloping around the paddock, bellowing of dairy cattle, and increased activity by beef cattle (Casaday and Lehmann, 1967). In order to provide for a conservative assessment, the lowest airblast exposure studied (125 dB) was adopted as a criterion for the purposes of assessment of livestock impacts.

Noise emissions from the operational phase of the project were predicted to comply with the nominated criteria at all existing nearest affected receivers and will have negligible impacts on agricultural resources and livestock.

Traffic noise generated during construction and operation of the Project is predicted to be within the NSW Road Noise Policy criteria at all receiver locations.

As a result of the above predicted noise and vibration levels for the construction and operation of the Project will have negligible impact on agricultural resources or production within the vicinity of the Project Area.

5.15 Traffic

Traffic Impact Assessment (Ambre, 2022) determined the Project is expected to generate up to 167 vehicle movements per day during peak construction times, including 60 truck movements. The road network is able to accommodate the traffic generated by the development during the construction, operation and decommissioning stages. In addition, the cumulative impact of the Project traffic with nearby developments is expected to be minimal.

The proposed access arrangements for the solar farm are suitable to accommodate the expected construction vehicle types and traffic volumes during the construction and operation phase of the project. A construction traffic management plan will be prepared prior to the beginning of construction at the site.

On this basis the impact to agricultural resources and enterprises as a result of increased traffic movements associated with the Project is considered negligible.

5.16 Other Impacts to Regional Community and the Environment

No other impacts are anticipated that will affect the regional community or the environment.

6 Mitigation Measures

This section describes the proposed management measures and monitoring plans to be implemented for the Project to minimise potential agricultural impacts. The proposed management and monitoring plans will include trigger points and plans for predicted and unforeseen impacts of the Project. It will include appropriate operational responses and remedial action, including the basis for each trigger response.

6.1 Soil Resources

During construction it is recommended that gypsum be applied for any earthworks where sodic subsoils (ESP of greater than 5%) are exposed. The application of gypsum would minimise the potential for sheet or tunnel erosion to occur on disturbed/exposed subsoil. The recommended application rates are shown in **Table 17**. Establishment of grass pasture on disturbed areas will be undertaken as soon as possible.

Table 17 Gypsum Application Rates

Exchangeable Sodium (ESP)	Gypsum Rate per Hectare	Gypsum Rate per Square Metre
5 to 10%	5 tonnes	0.5 kilograms
Greater than 10%	10 tonnes	1 kilogram

Topsoil and grass pasture should be kept in place where disturbance is not required.

Re-Establishment of Agricultural Lands

A Rehabilitation Plan associated with decommissioning activities would be developed and implemented with the objectives of:

- Identification and quantification of potential soil resources for rehabilitation.
- Optimisation and recovery of useable topsoil and subsoil during stripping operations.
- Management of soil reserves in stockpiles so as not to degrade the resource.
- Establishment of effective soil amelioration procedures to maximise the availability of soil reserve for future rehabilitation works.
- Returning the land to its pre-solar capability and improving the current state of the land.
- Development of completion criteria and monitoring reporting.

6.2 Agricultural Infrastructure

Farm Fences

Consultation will be undertaken with the landholder during operation, decommissioning and remediation of the Project Area to determine the reinstatement of any internal fencing that is removed during construction.

Farm Dams

Consultation will be undertaken with the landholder during decommissioning and remediation of the Project Area to determine the reinstatement of any farm dams which are removed during construction.

7 Stakeholder Consultation

Consultation was undertaken by NGH with neighbouring landholders for preparation of the EIS. No issues were raised regarding the ongoing agricultural operations or impact on agricultural resources of these neighbours.

Comment was received on the removal of “valuable agricultural land” during the life of the Project. There is no verified BSAL or LSC Class 1-3 land within the Project Area. Elgin Energy is committed to full site rehabilitation and remediation of land commensurate with the pre-disturbance LSC Class and agricultural land use.

8 Key Findings

This Agricultural Impact Assessment has been prepared for the Project based on the *Strategic Regional Land Use Policy* (DP&I, 2012a), *Guideline for Agricultural Impact Statements* (DP&I, 2012b) and the *Large-Scale Solar Energy Guideline* (DPIE, 2022). The purpose of this AIA is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project Area.

The key findings of the AIA are listed below.

- There will be 172 hectares of LSC Class 4 land and 8 hectares of LSC Class 5 arable land temporarily removed from potential agricultural production as a result of the Project.
- There is no land which has been, or is currently used for agriculture, which will be permanently impacted by surface disturbance associated with the Project.
- The Project Area contains no areas of verified BSAL. In addition, there is no mapped BSAL or SSAL within the vicinity of the Project Area.
- Post-rehabilitation agricultural potential within the Project Area is expected to be similar or better than pre-disturbance potential as there are no changes to the intrinsic nature of the soil type or LSC Classes.
- Any impacts to regional agricultural resources or enterprises from the Project are expected to be negligible.
- The Project will not impact surface or groundwater resources relied upon by agriculture.
- The Socio-Economic Impact Assessment for the Project prepared by NGH confirmed that the Project will provide considerable positive economic benefits to the local and broader communities. These benefits are much greater than the potential income lost by existing or potential agricultural enterprises, calculated as a precautionary assessment on impacted agricultural resources.
- Stakeholder and community consultation has not revealed any issues regarding surrounding agricultural resources or operation of agricultural enterprises during construction, operation and decommissioning, and will be ongoing throughout the life of the Project through continuation of the Glanmire Solar Farm Community Consultative Committee.

In summary, the Project will have negligible permanent impacts on surrounding agricultural resources, enterprises and dependent industries.

9 References

AREA Environmental & Heritage Consultants (2022) Biodiversity Development Assessment Report Elgin Energy

Australian Bureau of Statistics Census of Population and Housing 2016 accessed February 2021 www.abs.gov.au

Bathurst Regional Council (2021) website accessed February 2021 https://www.bathurst.nsw.gov.au/

Bureau of Meteorology (2021) BOM Station 063291 Climate Statistics accessed February 2021 www.bom.gov.au

Casaday R.B & Lehmann R.P (1967) Responses of Farm Animals to Sonic Booms, Sonic Boom Experiments at Edwards Airforce Base.

Douglas Partners (2021) Preliminary Geotechnical Investigation 4823 Great Western Highway Glanmire

Hazelton P.A. & Tille, P.J. (1990) Soil Landscapes of the Bathurst 1:100 000 Sheet, Soil Conservation Service of NSW

NGH (2022) Glanmire Solar Farm – Land Use Conflict Risk Assessment

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

NSW Department of Planning and Infrastructure (2012a) Strategic Regional Land Use Policy

NSW Department of Planning and Infrastructure (2012b) Guideline for Agricultural Impact Statements

NSW Department of Primary Industries (2006) Beef Stocking Rates& Farm Size

NSW Department of Primary Industries (2013) NSW Biosecurity Strategy 2013 – 2021

NSW Department of Primary Industries (2020) Merino Ewes (20 micron) – Terminal Rams Farm Enterprise Budget Series

NSW Office of Environment & Heritage (2003) The Bioregions of NSW – their biodiversity, conservation and history. Chapter 6 South Eastern Highlands

NSW Office of Environment & Heritage (2018) Land and Soil Capability Mapping accessed July 2021

NSW Office of Environment & Heritage (2012) The Land and Soil Capability Assessment Scheme 2nd Approximation

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

NSW Office of Environment and Heritage (2019) State Vegetation Type Map: Central Tablelands Region

Rezno Tonin & Associates (2022) Glanmire Solar Farm Construction & Operational Noise & Vibration Assessment

SLR (2021a) Glanmire Solar Farm – Biophysical Strategic Agricultural Land Verification Assessment

SLR (2021b) Glanmire Solar Farm – Land & Soil Capability Assessment

APPENDIX A

Glanmire Solar Farm – Biophysical Strategic Agricultural Land Verification

GLANMIRE SOLAR FARM

Biophysical Strategic Agricultural Land Verification

Prepared for:

Elgin Energy

SLR Ref: 630.30108
Version No: v1.0 Final
October 2022

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Elgin Energy (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 the Client. 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 SLR.

SLR 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	Checked	Authorised
630.30108 BSAL	October 2022	Murray Fraser	Rod Masters	Rod Masters

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1 Introduction

SLR has been commissioned by Elgin Energy to complete a Biophysical Strategic Agricultural Land (BSAL) Assessment for the Glanmire Solar Farm Project (the Project). The purpose of this BSAL assessment is to form part of the site due diligence and ultimately inform any Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW Department of Planning and Environment (DP&E), 1979).

1.1 Background

Elgin Energy is a leading international solar developer with operations in Australia, UK, and Ireland. To date, Elgin have delivered 21 projects including the largest operational solar farms in Scotland (13MW) and Northern Ireland (46MW)

Elgin Energy are proposing to develop the Glanmire Solar Farm at 4823 Great Western Highway, Glanmire, NSW 2795. This site is located approximately 11 kilometres east of the township of Bathurst and approximately 4.5 kilometres east of Raglan. The development will have a capacity of approximately 60 megawatts and comprise approximately 18 inverters, with an additional 17 inverters co-located with the Battery Energy Storage System (BESS). The projects indicative infrastructure layout in show on **Figure 1**.

For reference a Region Locality and Study Area Plan is provided on **Figure 2**. The site (Lot 141 DP1144786) has a total area of approximately 186 hectares and is currently used for grazing and for intermittent cropping. The general area comprises a range of farming properties and rural living properties.

The project will cover a development footprint of approximately 140 hectares and comprise single axis tracking solar photovoltaic technology laid out in north south rows and will also include ancillary infrastructure such as inverters, connection equipment and energy storage equipment.

Farm access gate

Temporary Construction Compound

Access point

66kV UG LINE

Waterway crossing 10m wide

Waterway crossing 10m wide

BESS AREA

66/33kV Substation

Glanmire Solar Farm
Indicative Site Layout Plan

Key

- F1 — Compound fence
- F2 — Stock Fence (retained or new)
- Retained Vegetation
- Landscape Area - 10m
- Landscape Area - 5m
- Waterway offset - Riparian vegetation
- Scattered Trees
- Retained Trees
- Trees to be removed
- 66 kV Connection Line
- Existing Transmission Line
- Project Boundary
- Gates
- Access Track
- Inverters
- Proposed substation and battery compound
- Temporary Construction Compound
- 10m Asset Protection Zone (measured from fence line to magenta line)
- Exclusion zone
- Full Length Tracker
- Half Length Tracker

Meters

100 0 100 200

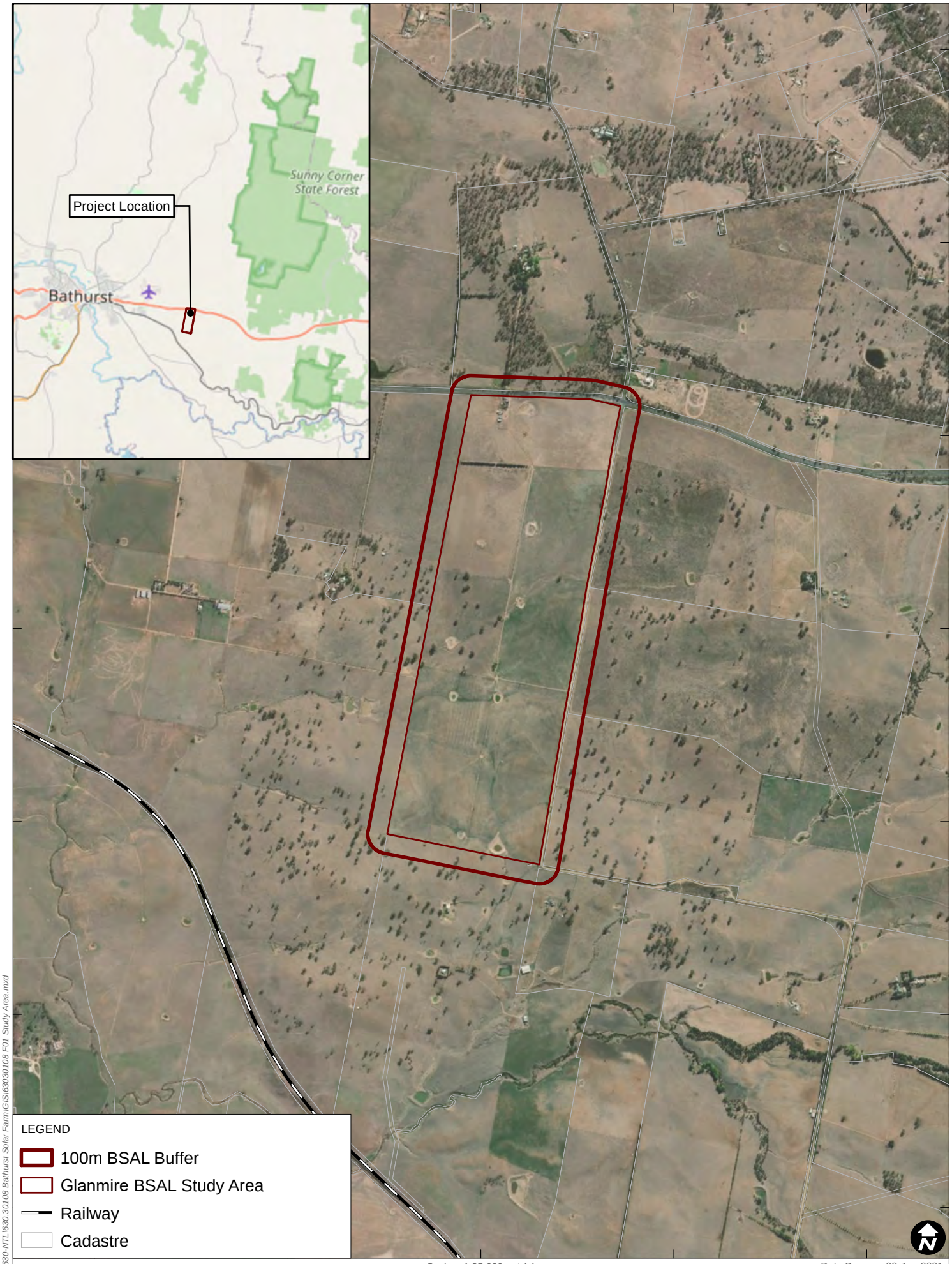
1:6500

Figure 1

Drawing	Site Layout Plan
Drawing Code	GLA-01
Drawn by	Davide Orio
Revised by	Christoph Pester
Version	V4.7
Revision Date	September 2022
Coordinate System	MGA/20-55
Notes	

N

ELGIN ENERGY



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 22-Jan-2021
Project Number: 630.30108

Data Source: © OpenStreetMap contributors

SLR

Study Area

FIGURE 2

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F01 Study Area.mxd

1.2 Objective

The objective was to conduct a BSAL assessment for an area of land proposed for the Project, to support a Site Verification Certificate application if no BSAL is identified and support any EIS/Development Application for the project.

1.3 Scope of Work

The BSAL Verification Assessment includes:

- Detailed assessment of the site and soil characteristics as per the requirements of the *Interim Protocol*;
- Completion of field work to obtain required level of field samples in accordance with any relevant guidelines (*Interim Protocol* and Land & Soil Capability);
- The assessment should identify areas of the Project Area that may be considered BSAL or otherwise including mapping at the appropriate scale;
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in the *Interim Protocol*; and
- Submission of on-line soil profile data to eDIRT and GIS data package in accordance with the *Interim Protocol*.

1.4 Study Area

Elgin Energy requires a BSAL Assessment for the Area of Interest (the Study Area) as shown on **Figure 2**, to support the Project. Table 1 shows the area requiring additional soil survey for BSAL Study Area.

Table 1 Study Area

Assessment Component	Hectares
BSAL Verification Area	186
100 Metre Buffer	65
Total BSAL Investigation Area	**251**

1.5 Legislation and Standards

The Large-Scale Solar Energy Guideline (LSSEG) for State Significant Development was issued in December 2018 by the NSW Government (NSW Government, 2018). The guideline provides the community, industry, applicants and regulators with general guidance on the planning framework for the assessment and determination of State Significant large-scale energy projects under the Environmental Planning and Assessment Act 1979. Under Section 4 of the LSSEG one of the key site constraints identified for site selection is agriculture including BSAL and land and soil capability.

The *State Environment Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment 2013* (the 2013 Mining SEPP amendment) requires certain types of developments to verify whether the proposed site is on BSAL. In April 2013, the *Interim Protocol* (NSW Office of Environment and Heritage, 2013) was released by the NSW Government. The *Interim Protocol* outlines the process for seeking verification of whether or not land mapped as BSAL meets the established BSAL criteria. The purpose of the Interim Protocol is to assist proponents and landholders to understand what is required to identify the existence of BSAL. It outlines the technical requirements for the on-site identification and mapping of BSAL.

BSAL is land with a rare combination of natural resources highly suitable for agriculture. These lands intrinsically have the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality.

The criteria used to measure BSAL under the original SRLUP were based on three parameters:

1. Soil Fertility – based on the Draft Inherent General Fertility of NSW;
2. Land and Soil Capability – based on Land and Soil Capability Mapping of NSW; and
3. Access to reliable water supply.

The Strategic Regional Land Use Plans (SRLUP) for the Upper Hunter and New England North West was released by the NSW Government in September 2012. The BSAL mapping for the remainder of the State was released in January 2014. The SRLUPs represent the Government's proposed framework to support growth, protect the environment and respond to competing land uses, whilst preserving key regional values over the next 20 years.

2 Methodology

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

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

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

2.1.1 Step 1: Identify the Project Area which will be Assessed for BSAL

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

The Study Area for the BSAL Verification Assessment is shown on **Figure 2**. The Study Area includes a 100 metre buffer surrounding the Study Area.

2.1.2 Step 2: Confirm Access to a Reliable Water Supply

The *Interim Protocol* requires that *"BSAL lands must have access to a 'reliable water supply'",* which includes rainfall of 350 millimetres (mm) or more per annum in 9 out of 10 years.

The Project is located near Bathurst in the Central West, with an annual average rainfall of 635 millimetres (BOM, 2021), therefore the Study Area has access to a "reliable water supply".

2.1.3 Step 3: Choose the Appropriate Approach to Map the Soils Information

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

Some assessment sites were relocated away from drainage lines with the revised locations selected to be still representative of the surrounding soil unit for mapping and assessment purposes.

2.1.4 Step 4: Risk Assessment

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

To identify the potential for a project to impact on agricultural resources and the appropriate level of soil survey required, an evaluation of risk to agricultural resources and enterprises has been undertaken. The risk assessment is based on the probability of occurrence and the consequence of the impact as described in the *Interim Protocol*. The potential impacts were assessed as:

- Level 5 – Very minor damage and minor impact to agricultural resources or industries. Probability: B – Likely, known to occur or it has happened. The risk matrix result was B5 which is considered a low risk. The Study Area requires an inspection density of 1:100,000.

Based on the Project only being temporary and having no permanent impact on the intrinsic properties of the soil and that grazing can still be undertaken during the life of the Project, an inspection density of 1:100,000 has been adopted across the Study Area.

2.1.5 Step 5: Field Soil Survey and BSAL Assessment

The field survey for the BSAL Verification Assessment was undertaken during November 2020 by SLR's Principal Agronomist Murray Fraser and overseen by SLR's Regional Sector Leader Rod Masters (CPSS-3).

An external peer review was undertaken by Minesoils Principal Consultant & Director, Clayton Richards (**Appendix E**).

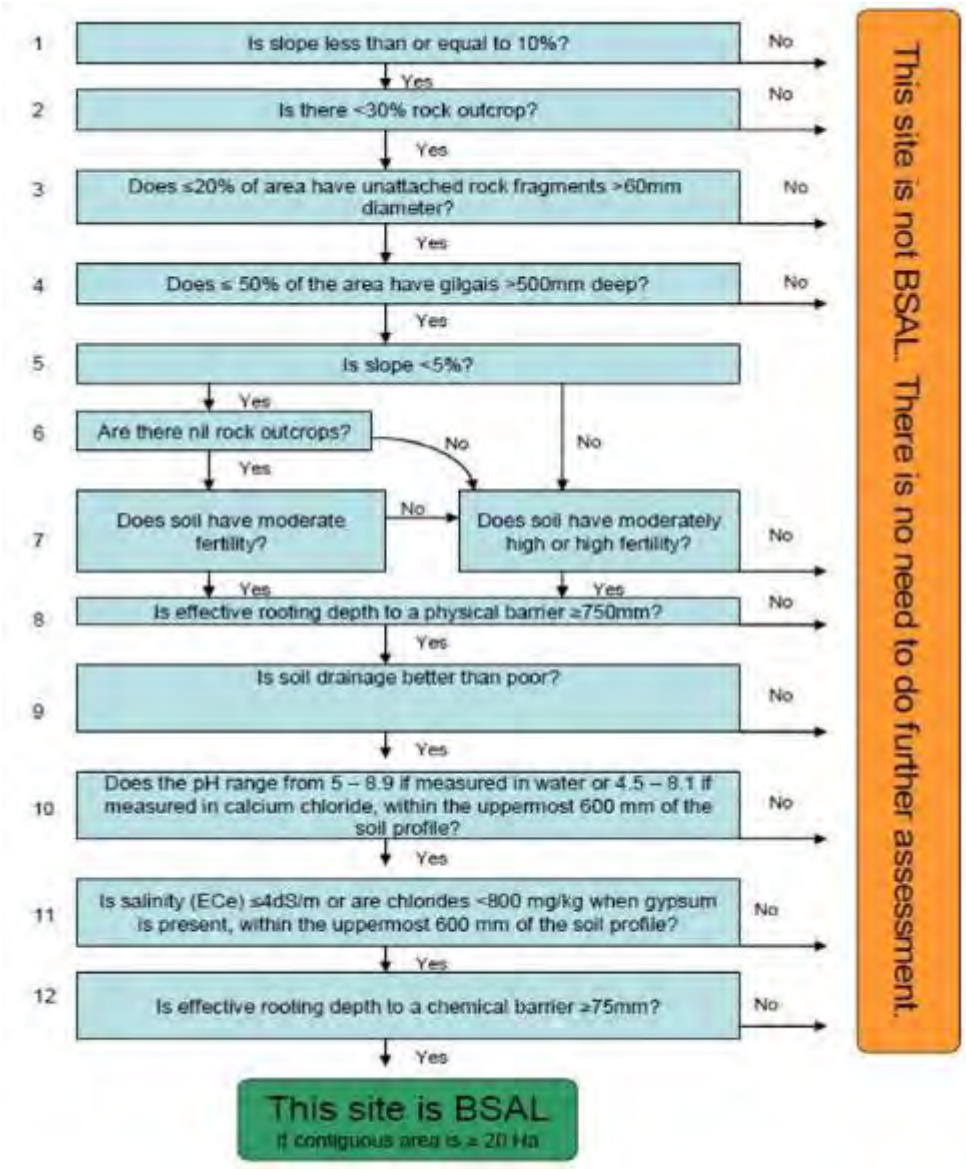
2.1.6 Field Soil Survey Methodology

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

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

The design of the soil survey program was developed by following a process of applying the BSAL methodology as a desktop exercise in the first instance to identify any areas that could not meet the criteria (termed exclusion zones). The field survey program was then developed to target the areas that could potentially meet BSAL criteria.

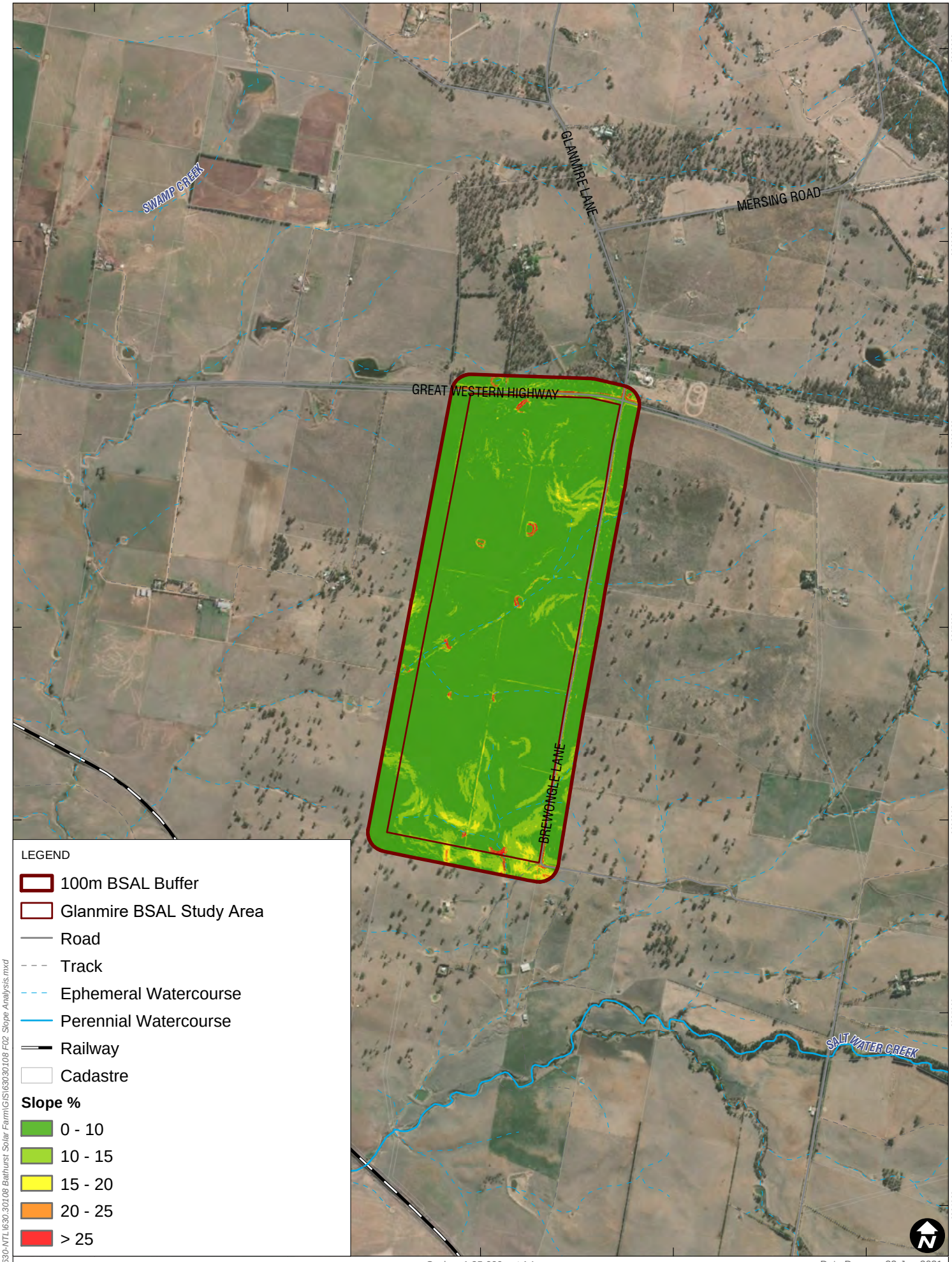
Diagram 1 BSAL Criteria Flow Diagram



Note: In applying step 12 it was assumed that the effective rooting depth to a chemical barrier of ≥75 mm was incorrect as stated in Diagram 1, and instead a value of ≥750 mm was adopted as stated in Section 6.10 of the Interim Protocol.

2.1.6.1 Exclusion Zones

Land greater than 10% slope (**Figure 3**) within the Study Area was identified, and excluded from the soil survey program, along with any areas which were less than or equal to 10% slope and also less than 20 hectares in contiguous area. In total, 24 hectares of the Study Area was determined not to meet the BSAL methodology Criteria 1, as shown in **Diagram 1** and on **Figure 4**. The Slope Analysis methodology is provided in **Appendix A**.



LEGEND

- 100m BSAL Buffer
- Glanmire BSAL Study Area
- Road
- Track
- Ephemeral Watercourse
- Perennial Watercourse
- Railway
- Cadastre

Slope %

- 0 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > 25

0 0.5 1 km

Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

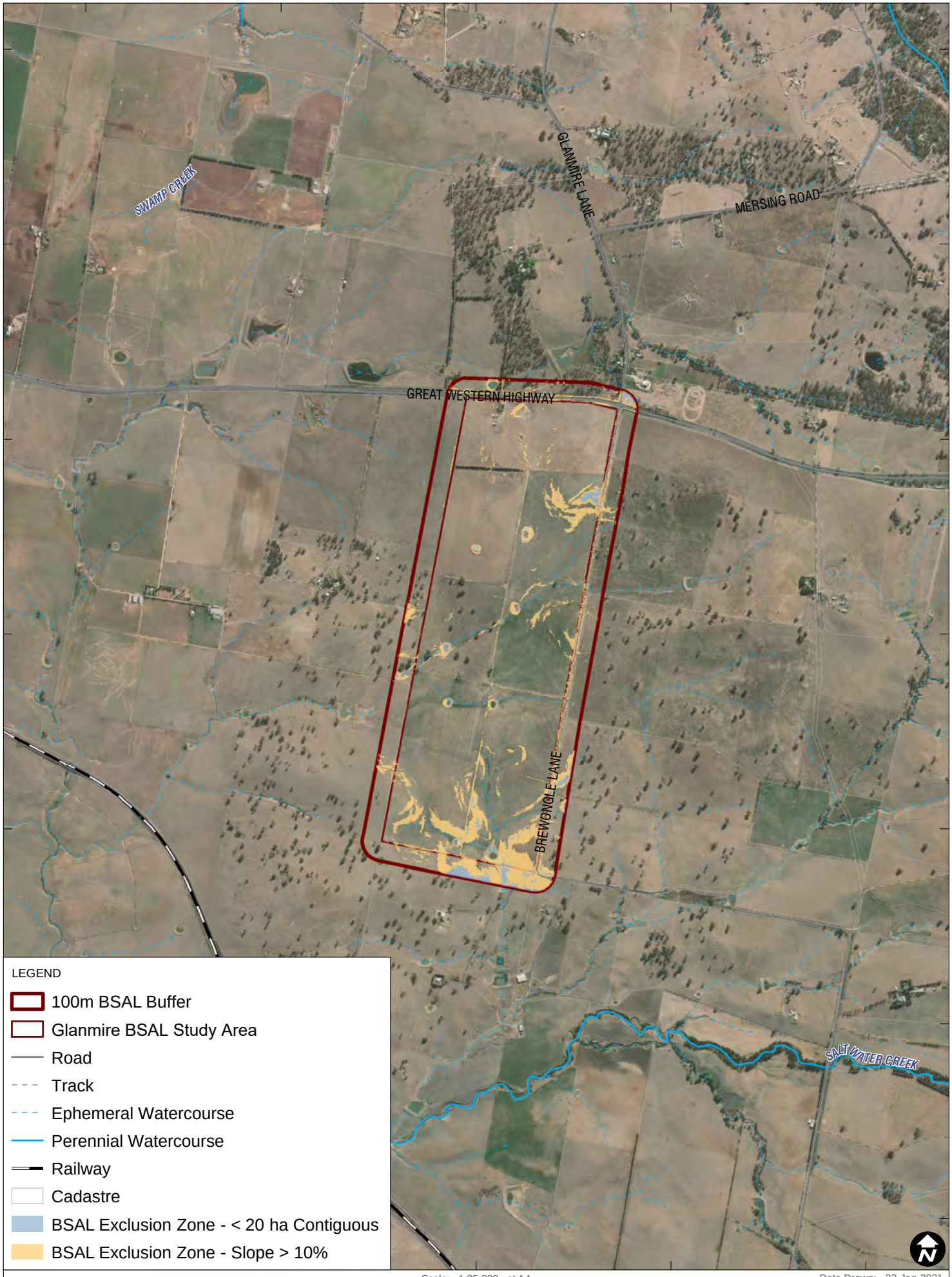
Date Drawn: 22-Jan-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F02 Slope Analysis.mxd

SLR

Slope Analysis

FIGURE 3



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 22-Jan-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F03 BSAL Exclusion Areas.mxd

SLR

BSAL Exclusion Areas

FIGURE 4

2.1.6.2 Soil Survey Density

To satisfy soil mapping requirements, although only a minimum of 3 sites were required, the field soil survey program comprised 14 described sites in total, as shown on **Figure 5**. A breakdown of the required soil survey density, as per *Interim Protocol* requirements, is provided in **Table 1**.

Table 2 Assessment of Soil Survey Density

Category	BSAL Study Area
Total Study Area Hectares	251
BSAL Exclusion Area (Greater Than 10% Slope) Hectares	22
BSAL Exclusion Area (Less Than 20 Hectares Contiguous)	2
BSAL Survey Area Hectares	**227**
Survey Density	**BSAL Survey Area**
1:100,000 Survey Area Hectares	227
1:100,000 Survey Density Target	Minimum 3 Required Sites
Total Number Sites	**6 Detailed and 8 Check Sites**
Laboratory Analysed Sites	**4**

2.1.6.3 Soil Survey Observation Types

Soil profiles were assessed at 6 sites in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure was sampled with a hydraulic soil corer, either a depth of 1.2 metres, to equipment refusal, or to bedrock. Detailed soil profile morphological descriptions were prepared at all sites to record the information specified in the *Interim Protocol*. Information was recorded for the major parameters specified in **Table 3**.

Global Positioning System (GPS) readings was taken for all sites where soil descriptions are recorded. Vegetation type, landform and aspect were also noted. Soil exposures from pits were photographed during field operations.

Table 3 Field Assessment Parameters

Descriptor	Application
Horizon depth	Weathering characteristics, soil development
Field colour	Permeability, susceptibility to dispersion/erosion
Field texture grade	Erodibility, hydraulic conductivity, moisture retention, root penetration
Boundary distinctness and shape	Erosional/dispositional status, textural grade
Consistence force	Structural stability, dispersion, ped formation
Structure pedality grade	Soil structure, root penetration, permeability, aeration
Structure ped and size	Soil structure, root penetration, permeability, aeration
Stones – amount and size	Water holding capacity, weathering status, erosional/depositional character

Descriptor	Application
Roots – amount and size	Effective rooting depth, vegetative sustainability
Ants, termites, worms etc.	Biological mixing depth

A total of 14 sites were evaluated. Of the 14 sites, 6 sites were detailed sites and 8 sites were check sites. Check sites are mapping observations examined in sufficient detail to allocate the site to a specific soil type and map unit. For detailed sites, soil was collected from each major soil horizon (soil layer).

Soil samples from 4 detailed sites were utilised in the BSAL verification laboratory testing program. Samples were analysed in order to classify Australian Soil Classification (ASC) (Isbell, 2002) soil taxonomic class and enable BSAL verification.

Soil collected from each major soil horizon (soil layer) was sent to a National Association of Testing Authorities Australia (NATA) accredited laboratory (EAL Laboratories) for analysis. The selected physical and chemical laboratory analysis properties and their relevant application are listed in **Table 4**.

Table 4 Laboratory Analysis Parameters

Property	Application
Coarse Fragments (>2mm)	Soil workability; root development
Particle-Size Distribution (<2mm)	Determine fraction of clay, silt, fine sand and coarse sand; nutrient retention; exchange properties; erodibility; workability; permeability; sealing; drainage; interpretation of most other physical and chemical properties and soil qualities
Soil Reaction (pH)	Nutrient availability; nutrient fixation; toxicities (especially aluminium and manganese); liming; Sodicity; correlation with other soil properties
Electrical Conductivity (EC)	Appraisal of salinity hazard in soil substrates or groundwater; total soluble salts
Cation Exchange Capacity (CEC) & Exchangeable Cations	Nutrient status; calculation of exchangeable cations including sodium, calcium, magnesium, potassium and exchangeable sodium percentage (ESP); assessment of other physical and chemical properties, especially dispersivity, shrink – swell, water movement, aeration
Munsell Colour Chart (Munsell)	Drainage, oxidation, fertility, correlation with other physical, chemical and biological properties

Soil salinity in the samples from the detailed sites was determined through measurement of the electrical conductivity (EC) of soil:water (1:5) suspensions. These values were converted to the EC of a saturated extract (EC_e) based on soil texture in accordance with the *Interim Protocol*.

3 Soil Assessment

One soil map unit (SMU)was identified within the Study Area, a Subnatric Grey-Brown Sodosol, and was mapped according to the dominant ASC soil type (**Figure 5**) using a combination of the soil survey and laboratory analysis results. This SMU and the observation sites associated with each are shown below in **Table 5**.

Section 9.6.2 of the *Interim Protocol* states "*All soil map units will have some soil variation. The dominant soil type upon which BSAL status is determined should comprise great [sic] than 70 per cent of a soil map unit*." Section 9.6.3 of the *Interim Protocol* further confirms "*BSAL status is determined on the dominant soil type within a soil map unit*."

A description of one detailed representative site from the mapped soil unit follows **Table 5**, with the remaining detailed soil profile descriptions shown in **Appendix B** and check site descriptions in **Appendix C**. Red font is used within these tables to indicate the BSAL criteria which are not met for each site. Laboratory certificates of analysis are shown in **Appendix D**.

Table 5 Soil Units within Study Area

SMU	ASC Soil Type	Soil Type Group	Detailed Site	Check Site	Hectares
1	Subnatric Grey-Brown Sodosol	Dominant	BS1, BS2, BS3, BS4, BS6	C1 – C8	251
	Eutrophic Grey Chromosol	Sub-Dominant	BS5	Nil	
				Total	**251**

3.1 Soil Map Unit 1: Subnatric Grey-Brown Sodosol

Eutrophic Mottled-Subnatric Grey Sodosol

Table 6 Summary Eutrophic Mottled-Subnatric Grey Sodosol (Site BS2)

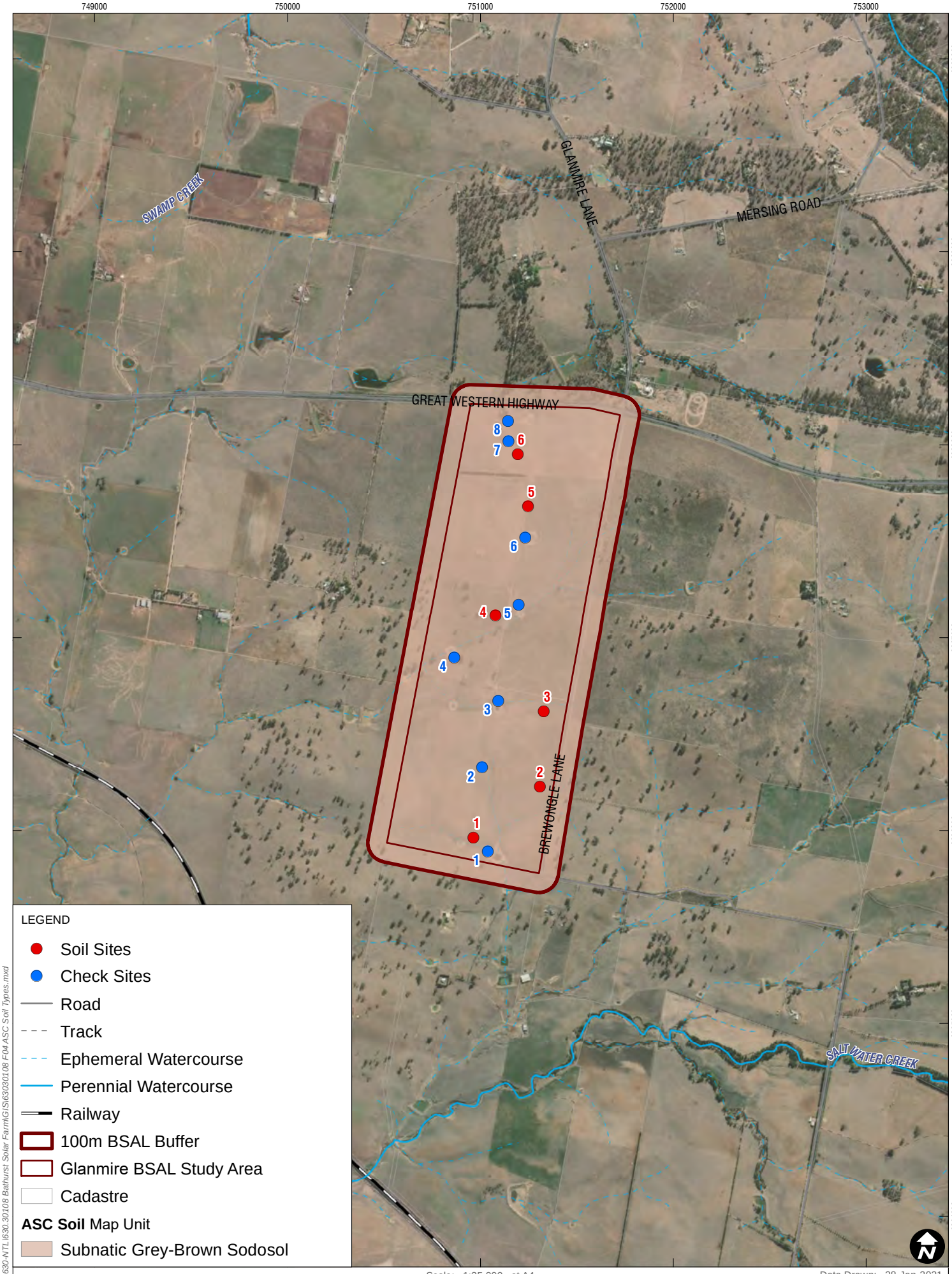
Overview	
Landscape Site BS2 	
ASC Name	Eutrophic Mottled-Subnatric Grey Sodosol
Representative Site	BS2
Other Mapped Sites	BS1, BS3, BS4, BS6
Survey Type	Detailed Lab
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South
Verified	Non-BSAL – Inherent Fertility, Poor Drainage & Sodicity

Table 7 Profile: Eutrophic Mottled-Subnatric Grey Sodosol (Site BS2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (10YR 3/3) loam, weak structure of 5-10 mm crumb peds with a rough fabric and moderate consistence. Nil mottling; 50% gravel content <5 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.15 – 0.30	Brown (10YR 5/3) bleached loam, weak structure of 5-10 mm crumb peds with a rough fabric and moderate consistence. Nil mottling; 40% gravel content <5 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.20 – 0.30.
	B21 0.30 – 0.60	Grey (10YR 6/1) light clay, strong structure of 20-40 mm blocky peds with a rough fabric and moderate consistence. 30% distinct yellow mottling; 30% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.60	Grey (5Y 6/1) medium clay, strong structure of >40 mm blocky peds with a rough fabric and moderate consistence. 30% distinct yellow mottling; 25% gravel content 5-10 mm; 10% hard manganese nodules <10 mm; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sample depth.

Table 8 Chemical Parameters: Eutrophic Mottled-Subnatric Grey Sodosol (Site BS2)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.3	Strongly Acidic	4.7	Non-Sodic	0.6	Non-Saline	3.4	Ca Low
A2	5.9	Moderately Acidic	8.1	Marginally Sodic	0.2	Non-Saline	3.3	Ca Low
B21	7.2	Neutral	8.8	Marginally Sodic	0.4	Non-Saline	1.3	Ca Low
B22	7.7	Mildly Alkaline	17.2	Strongly Sodic	0.7	Non-Saline	0.7	Ca Deficient



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 28-Jan-2021
Project Number: 630.30108

H:\Projects-SLR\610-SrvSYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F04 ASC Soil Types.mxd

SLR

ASC Soil Map Unit

FIGURE 5

3.2 Biophysical Strategic Agricultural Land

This BSAL Verification Assessment has been conducted in accordance with the *Interim Protocol*. The BSAL status was determined on the dominant soil type within each soil map unit. According to the *Interim Protocol*, the findings of this BSAL Verification Assessment are shown in **Table 9** and **Figure 6**.

- Exclusion areas of 22 hectares for land greater than 10% slope were identified and excluded as potential BSAL in the Study Area for this assessment.
- Exclusion areas of 2 hectares for land of slope less than 10%, but with less than 20 hectares contiguous area were identified and excluded as potential BSAL in the Study Area for this assessment.
- There were 227 hectares, comprising one SMU, a Grey-Brown Subnatric Sodosol, which was verified as non-BSAL due to poor drainage and moderately low inherent fertility, within the Study Area for this assessment.

The BSAL assessment and limitations of the SMU and sample sites is shown in **Table 10**.

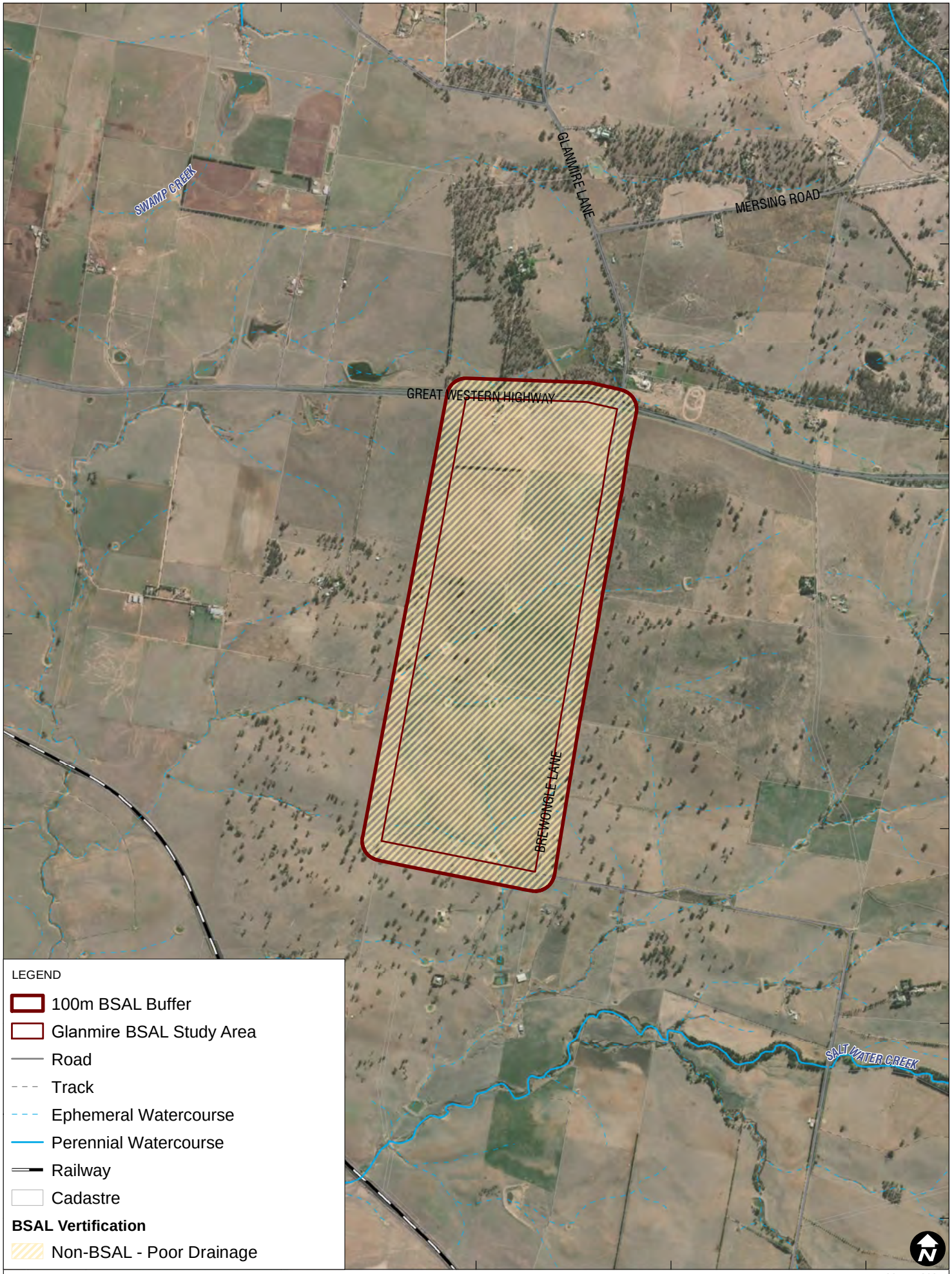
Table 9 BSAL Assessment Summary

Soil Survey BSAL Assessment	Hectares
Verified BSAL	Nil
Verified Non-BSAL	227
Exclusion Area	24
BSAL Assessment Total	**251**
Verified Non-BSAL	**Hectares**
Soil Type Verified Non-BSAL	227
Exclusion Greater Than 10% Slope	22
Exclusion Less Than 20 Hectares Contiguous Area	2
Verified Non-BSAL Total	**251**

Table 10 BSAL Assessment

SMU	Site Number	Inspection Type	ASC Soil Type (to ASC Great Group for detailed sites)	1. Is slope < 10%?	2. Is there < 30% Rock Outcrop?	3. < 20% unattached Rock Fragments > 60mm?	4. Does < 50% have Gilgai >500mm deep?	5. Is Slope <5%?	6. Are there nil rock outcrops?	7a. Does soil have moderate fertility?	7b. Does soil have moderately high or high fertility?	8. Is ERD to a physical barrier >750mm?	9. Is drainage better than poor?	10. Is pH between 5.0 and 8.9 (water) and 4.5 and 8.1 (CaCl2)?	11. Is salinity (ECe) < 4 dS/m	12. Is ERD to a chemical barrier >750mm?	Is the Site BSAL?	Is the Soil Unit BSAL?
1	BS1	Detailed	Mottled Brown Sodosol	✓	✓	✓	✓	✖	✓	✖	✖	✓	✖	NLT	NLT	NLT	Non-BSAL	No
	BS2	Detailed Lab	Eutrophic Mottled-Subnatric Grey Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✓	✓	✖	Non-BSAL	
	BS3	Detailed Lab	Eutrophic Mottled-Subnatric Grey Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✓	✓	✓	Non-BSAL	
	BS4	Detailed	Mottled Grey Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	NLT	NLT	NLT	Non-BSAL	
	BS5	Detailed Lab	Mottled Eutrophic Grey Chromosol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✖	✓	✓	✓	Non-BSAL	
	BS6	Detailed Lab	Eutrophic Mottled-Subnatric Brown Sodosol	✓	✓	✓	✓	✓	✓	✖	✖	✓	✖	✓	✓	✓	Non-BSAL	

✓ = passes the BSAL criteria ✖ = fails the criteria but not excluded as BSAL ✖ = fails the BSAL criteria NLT = Not Lab Tested



LEGEND

- 100m BSAL Buffer
- Glanmire BSAL Study Area
- Road
- Track
- Ephemeral Watercourse
- Perennial Watercourse
- Railway
- Cadastre

BSAL Vertification

- Non-BSAL - Poor Drainage

0 0.5 1 km

Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 22-Jan-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F05 BSAL Vertification.mxd

SLR

BSAL Vertification

FIGURE 6

4 Conclusion

SLR Consulting has completed a BSAL assessment according to the *Interim Protocol*, encompassing the proposed Glanmire Solar Farm, including a 100 metre buffer, totalling 251 hectares.

The assessment found no areas of verified BSAL within the Study Area. The entire Study Area is non-BSAL, comprising 24 hectares of BSAL exclusion area and one Soil Map Unit (a Subnatric Grey-Brown Sodosol), comprising the remaining 227 hectares, which was verified as non-BSAL due to poor drainage and moderately low inherent fertility.

This is consistent with the *Glanmire Solar Farm Land & Soil Capability Assessment* (SLR, 2022) which found the entire Study Area to comprise Land & Soil Capability Class 4 and Class 5, which are non-BSAL by definition of the Interim Protocol.

5 References

Bereau of Meteorology. (2020, 08 18). Retrieved June 2020, from http://www.bom.gov.au/

Department of Natural Resources. (2005). *Land Capability Spatial Data.* Hunter Region: Resource Information Unit.

Elliot, G. L., & Reynolds. (2007). *Soils their properties and management.* Australia: Oxford University Press.

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

King, D. P. (1993). *Soil Landscapes of the Wallerawang 1:100,00 sheet.* Sydney: Department of Conservation and Land Management .

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 .* Australia: CSIRO Publishing.

NSW Department of Planning and Environment (DP&E). (1979). Environmental Planning and Assessment Act. No 203. Sydney: NSW Governement.

NSW Department of Planning and Infrastructure (DP&I). (2012). Guideline for Agricultural Impact Statements. Sydney.

NSW Department of Planning and Infrastructure (DP&I). (2012). Strategic Regional Land Use Policy. Sydney.

NSW Government. (2018). *Large Scale Solar Energy Guideline for State Significant Development.*

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

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

Royal Australian Survey Corps. (1983). Soil Landscapes of Singleton 1:250 000. Soil Conservation Service NSW.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment. (2013). NSW Government.

APPENDIX A

Slope Analysis Methodology

10th December 2020

Elgin Energy
Glanmire Solar Farm
BSAL Verification
SLR Slope Analysis Methodology

1. Acquire appropriate elevation information.

2. Load Contours into ArcMap 10.3

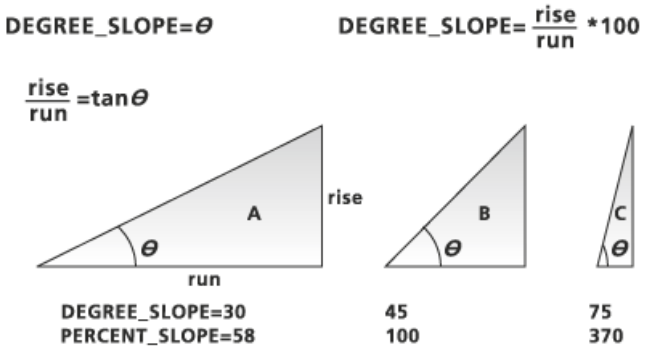
3. Using 3D Analyst Extension - Create a TIN Surface based on the contours (http://resources.arcgis.com/en/help/main/10.1/index.html#/Create_TIN/00q90000001v000000/)

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

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

The Surface Slope Tool

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



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

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

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

Table example:

break, code

10.0, 11

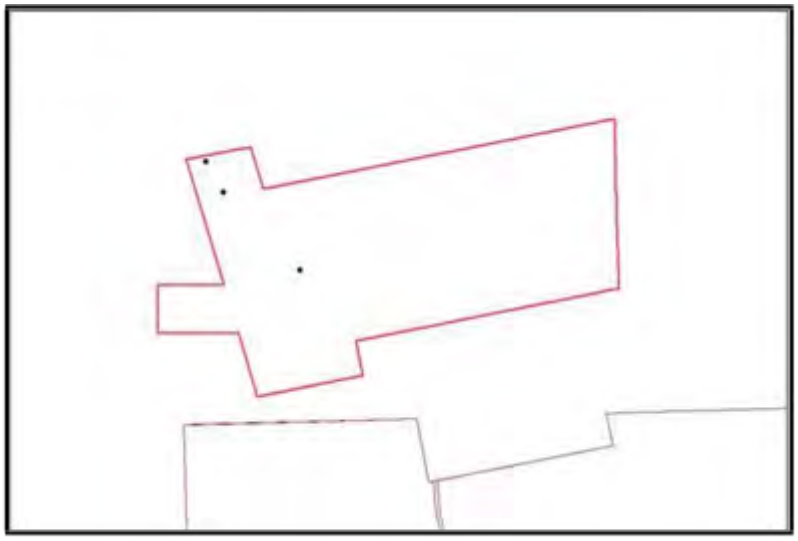
25.0, 22

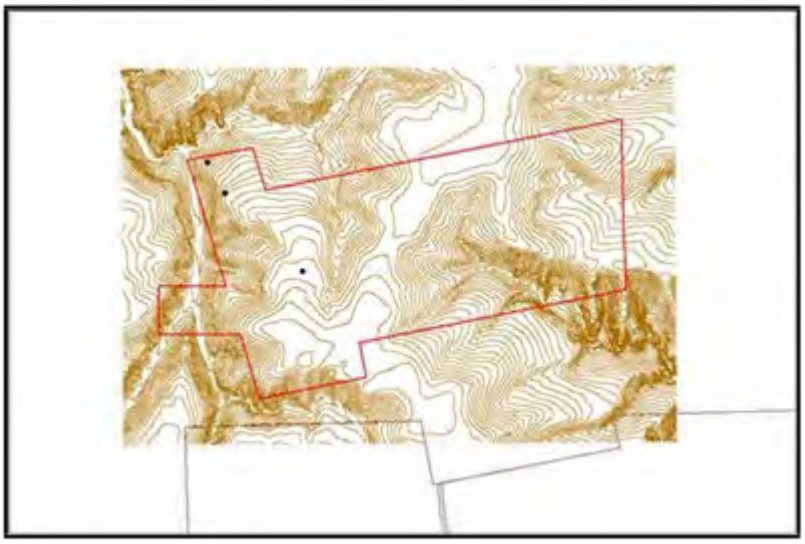
40.0, 33

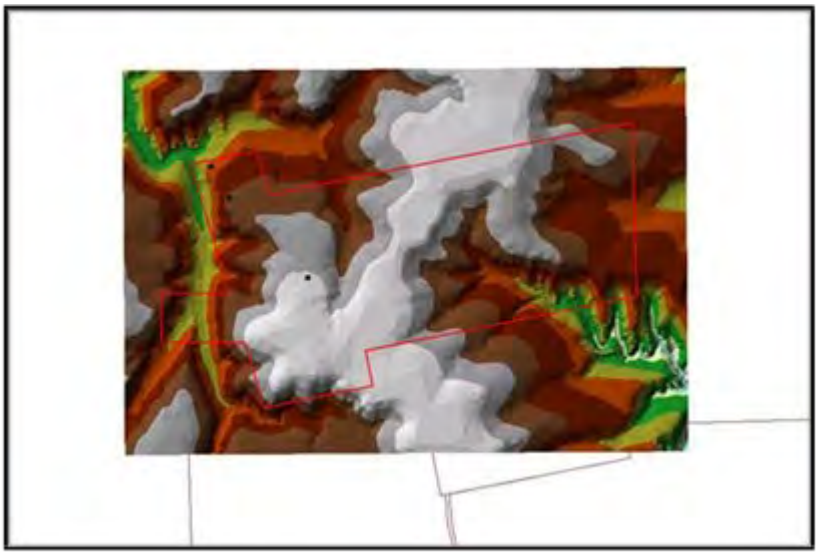
70.0, 44

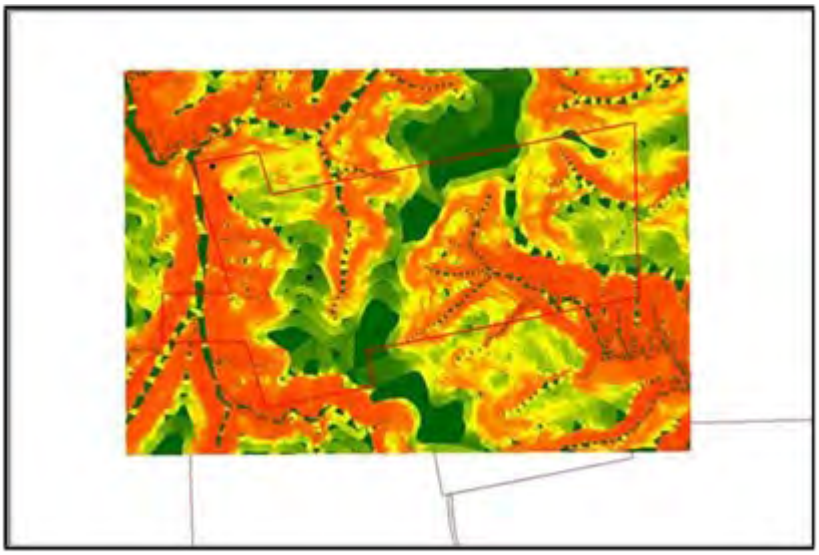
Note the comma delineation and use of decimals in the first field. Field names are needed but are ignored. The first field represents the breaks and values need to be decimal, the second field represents codes and values need to be integer. The units of the slope range are defined by the {units}. When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

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









APPENDIX B

Detailed Soil Profile Descriptions

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 1 Summary: Mottled Brown Sodosol (Site BS1)

Overview	
Landscape Site BS1	
	
ASC Name	Mottled Brown Sodosol
Representative Site	BS1
Other Mapped Sites	BS2, BS3, BS4, BS6
Survey Type	Detailed
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	19
Surrounding Slope (%)	<10
Aspect	South
Verified	Non-BSAL – Slope, Inherent Fertility & Poor Drainage

Table 2 Profile: Mottled Brown Sodosol (Site BS1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (7.5YR 3/4) loam, weak structure of 5-10 mm crumb peds with a rough fabric and weak consistence. Nil mottling; 20% gravel content 5-10 mm; nil segregations; well drained with a clear and wavy boundary. Sampled 0.0 – 0.10.
	B21 0.15 – 0.50	Dark yellowish-brown (10YR 4/6) medium clay, strong structure of 20-40 mm blocky peds with a rough fabric and strong consistence. 30% distinct yellow mottling; <10% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.20 – 0.30 and 0.40 – 0.50.
	B22 +0.50	Greyish brown (2.5Y 5/2) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 30% distinct yellow mottling; 10% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 3 Field Parameters: Mottled Brown Sodosol (Site BS1)

Layer	Field pH		Field Dispersion	Field Effervescence
	Unit	Rating	Rating	Rating
A1	5.5	Strongly Acidic	Nil	Nil
B21	6.5	Slightly Acidic	High	Nil
B22	7.0	Neutral	High	Nil

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 4 Summary: Eutrophic Mottled-Subnatric Grey Sodosol (Site BS3)

Overview	
Landscape Site BS3 	
ASC Name	Eutrophic Mottled-Subnatric Grey Sodosol
Representative Site	BS3
Other Mapped Sites	BS1, BS2, BS4, BS6
Survey Type	Detailed Lab
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	West
Verified	Non-BSAL – Inherent Fertility & Poor Drainage

Table 5 Profile: Eutrophic Mottled-Subnatric Grey Sodosol (Site BS3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Dark brown (7.5YR 3/2) loam, weak structure of 5-15 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 50% gravel content <10 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.20 – 0.40	Light brownish-grey (10YR 6/2) bleached loamy sand, weak structure of <10 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 50% gravel content <10 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.20 – 0.30.
	B21 0.40 – 0.60	Light brownish-grey (2.5Y 6/2) clay loam, strong structure of 20-40 mm blocky peds with a rough fabric and moderate consistence. 20% distinct red mottling; 40% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.60	Gray (2.5Y 6/1) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 30% distinct red mottling; 25% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 6 Chemical Parameters: Eutrophic Mottled-Subnatric Grey Sodosol (Site BS3)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.6	Moderately Acidic	2.5	Non-Sodic	0.6	Non-Saline	3.7	Ca Low
A2	5.9	Moderately Acidic	5.4	Non-Sodic	0.5	Non-Saline	4.1	Balanced
B21	7.0	Neutral	8.4	Marginally Sodic	0.3	Non-Saline	1.6	Ca Low
B22	7.3	Neutral	12.3	Sodic	0.4	Non-Saline	0.9	Ca Deficient

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 7 Summary: Mottled Grey Sodosol (Site BS4)

Overview	
Landscape Site BS4 	
ASC Name	Mottled Grey Sodosol
Representative Site	BS4
Other Mapped Sites	BS1, BS2, BS3, BS6
Survey Type	Detailed
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South
Verified	Non-BSAL – Inherent Fertility & Poor Drainage

Table 8 Profile: Mottled Grey Sodosol (Site BS4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.30	Very dark brown (7.5YR 2.5/2) loam, weak structure of 5-10 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 25% gravel content <10 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.30 – 0.50	Greyish brown (10YR 5/2) bleached loamy sand, weak structure of <10 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 40% gravel content <10 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.30 – 0.40.
	B2 +0.50	Light brownish-grey (2.5Y 6/2) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 40% distinct yellow mottling; 10% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 9 Field Parameters: Mottled Grey Sodosol (Site BS4)

Layer	Field pH		Field Dispersion	Field Effervescence
	Unit	Rating	Rating	Rating
A1	6.0	Moderately Acidic	Nil	Nil
A2	6.0	Moderately Acidic	Nil	Nil
B2	7.0	Neutral	High	Nil

Soil Unit 1: Subnatric Grey-Brown Sodosol

Sub-Dominant Soil Type: Mottled Eutrophic Grey Chromosol

Table 10 Summary: Mottled Eutrophic Grey Chromosol (Site BS5)

Overview	
Landscape Site BS5 	
ASC Name	Mottled Eutrophic Grey Chromosol
Representative Site	BS5
Other Mapped Sites	Nil
Survey Type	Detailed Lab
Dominant Topography	Midslope
Dominant Land Use	Fodder Cropping
Vegetation	Grazing Canola
Inherent Soil Fertility	Moderately High
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South-East
Verified	Non-BSAL –Poor Drainage

Table 11 Profile: Mottled Eutrophic Grey Chromosol (Site BS5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Dark brown (7.5YR 3/2) loamy sand, weak structure of 5-15 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 50% gravel content 5-10 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.0- 0.10.
	A2 0.20 – 0.50	Light brownish-grey (10YR 6/2) bleached loamy sand, apedal structure with a sandy fabric and weak consistence. Nil mottling; 50% gravel content 5-10 mm; nil segregations; well drained with an abrupt and even boundary. Sampled 0.30 – 0.40.
	B21 +0.50	Light brownish-grey (2.5Y 6/2) clay loam, moderate structure of 10-30 mm blocky peds with a rough fabric and weak consistence. 20% distinct brown mottling; 60% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 12 Chemical Parameters: Mottled Eutrophic Grey Chromosol (Site BS5)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.1	Strongly Acidic	1.1	Non-Sodic	1.3	Non-Saline	6.0	Mg Low
A2	6.6	Neutral	3.7	Non-Sodic	0.4	Non-Saline	5.6	Balanced
B21	6.2	Slightly Acidic	2.9	Non-Sodic	0.2	Non-Saline	3.9	Ca Low

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 13 Summary: Eutrophic Mottled-Subnatric Brown Sodosol (Site BS6)

Overview	
Landscape Site BS6 	
ASC Name	Eutrophic Mottled-Subnatric Brown Sodosol
Representative Site	BS6
Other Mapped Sites	BS1, BS2, BS3, BS4
Survey Type	Detailed Lab
Dominant Topography	Upper Slope
Dominant Land Use	Grazing
Vegetation	Saffron Thistle, Paterson's Curse
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	North-East
Verified	Non-BSAL – Inherent Fertility & Poor Drainage

Table 14 Profile: Eutrophic Mottled-Subnatric Brown Sodosol (Site BS6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Very dark brown (7.5YR 2.5/3) loam, weak structure of 5-10 mm crumb peds with a rough fabric and weak consistence. Nil mottling; 50% gravel content <5 mm; nil segregations; well drained with a gradual and wavy boundary. Sampled 0.0 – 0.10.
	A2 0.10 – 0.20	Dark yellowish-brown (10YR 4/4) bleached loam, weak structure of 5-10 mm crumb peds with a rough fabric and weak consistence. Nil mottling; 40% gravel content <5 mm; nil segregations; well drained with a clear and wavy boundary. Sampled 0.10 – 0.20.
	B21 0.20 – 0.50	Dark yellowish-brown (10YR 4/4) heavy clay, strong structure of 20-40 mm blocky peds with a rough fabric and strong consistence. 30% distinct yellow mottling; 10% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.50	Dark grey (2.5Y 4/1) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 40% distinct yellow mottling; 20% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 15 Chemical Parameters: Eutrophic Mottled-Subnatric Brown Sodosol (Site BS6)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.4	Strongly Acidic	1.9	Non-Sodic	0.7	Non-Saline	3.0	Ca Low
A2	6.2	Slightly Acidic	2.4	Non-Sodic	0.3	Non-Saline	1.8	Ca Low
B21	6.1	Slightly Acidic	7.1	Marginally Sodic	0.5	Non-Saline	0.7	Ca Deficient
B22	8.2	Moderately Alkaline	10.0	Sodic	0.8	Non-Saline	0.7	Ca Deficient

APPENDIX C

Check Site Descriptions

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 1 Site C1 Grey Sodosol

Profile	Horizon	Description
	B2	Pale brown (10YR 6/3) heavy clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C1
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Lower Slope
Dominant Land Use	Dam Bank
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 2 Site C2 Brown Sodosol

Profile	Horizon	Description
	B2	Yellowish brown (10YR 5/4) medium clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C2
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Mid Slope
Dominant Land Use	Stock Laneway
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Mildly Alkaline

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 3 Site C3 Brown Sodosol

Profile	Horizon	Description
	B2	Yellowish brown (10YR 5/6) light-medium clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C3
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Midslope
Dominant Land Use	Dam Inflow
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Slightly Acidic

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 4 Site C4 Brown Sodosol

Profile	Horizon	Description
	B2	Brown (7.5YR 5/4) light-medium clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C4
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Midslope
Dominant Land Use	Dam Inflow
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 5 Site C5 Grey Sodosol

Profile	Horizon	Description
	B2	Light brown (10YR 6/3) light-medium clay, moderate structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C5
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Lower Slope
Dominant Land Use	Dam Inflow
Vegetation	Grazing Canola
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 6 Site C6 Brown Sodosol

Profile	Horizon	Description
	B2	Brown (10YR 5/6) light-medium clay, moderate structure. Moderate field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C6
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Midslope
Dominant Land Use	Dam Inflow
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	Moderate
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 7 Site C7 Brown Sodosol

Profile	Horizon	Description
	B2	Strong brown (7.5YR 5/8) light-medium clay, moderate structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C7
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Upper Slope
Dominant Land Use	Stock Laneway
Vegetation	Grass Pasture
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Mildly Alkaline

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 8 Site C8 Brown Sodosol

Profile	Horizon	Description
	B2	Brown (10YR 4/4) light clay, moderate structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C8
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Upper Slope
Dominant Land Use	Stock Laneway
Vegetation	Grass Pasture
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

APPENDIX D

Laboratory Certificate 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

15 samples supplied by SLR Consulting Australia Pty Ltd on 30/11/2020. Lab Job No.K1174
Analysis requested by Murray Fraser. Your Job: PO: SLR 630 30108; Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
		Sample ID:	BS 2 0-10	BS 2 20-30	BS 2 40-50	BS 2 65-75	BS 3 0-10	BS 3 20-30
		Crop:	Soil	Soil	Soil	Soil	Soil	Soil
		Client:	Elgin	Elgin	Elgin	Elgin	Elgin	Elgin
	Parameter	Method reference	K1174/1	K1174/2	K1174/3	K1174/4	K1174/5	K1174/6
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.30	5.90	7.21	7.69	5.59	5.86
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.068	0.018	0.043	0.091	0.067	0.021
		(cmol$_+$/kg)	1.7	0.85	3.4	4.3	2.5	1.1
	Exchangeable Calcium	(kg/ha)	751	383	1,545	1,937	1,132	502
		(mg/kg)	335	171	690	865	505	224
		(cmol$_+$/kg)	0.49	0.26	2.6	5.9	0.69	0.27
	Exchangeable Magnesium	(kg/ha)	132	71	719	1,611	187	74
		(mg/kg)	59	32	321	719	83	33
		(cmol$_+$/kg)	0.36	<0.12	0.25	0.23	0.28	<0.12
	Exchangeable Potassium	(kg/ha)	312	<112	221	199	247	<112
		(mg/kg)	139	<50	99	89	110	<50
		(cmol$_+$/kg)	0.15	0.12	0.61	2.2	0.10	0.09
	Exchangeable Sodium	(kg/ha)	75	61	315	1,119	50	47
		(mg/kg)	33	27	141	500	22	21
		(cmol$_+$/kg)	0.19	0.06	0.01	0.01	0.04	0.05
	Exchangeable Aluminium	(kg/ha)	37	12	2.5	2.6	8.5	11
		(mg/kg)	17	5.2	1.1	1.2	3.8	4.8
		(cmol$_+$/kg)	0.23	0.09	<0.01	<0.01	0.17	0.05
	Exchangeable Hydrogen	(kg/ha)	5.1	2.1	<1	<1	3.8	1.2
		(mg/kg)	2.3	<1	<1	<1	1.7	<1
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	3.1	1.5	7.0	13	3.8	1.7
	Calcium (%)		54	59	49	34	66	66
	Magnesium (%)		16	18	38	47	18	16
	Potassium (%)	**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	12	5.1	3.6	1.8	7.4	6.2
	Sodium - ESP (%)		4.7	8.1	8.8	17	2.5	5.4
	Aluminium (%)		6.0	4.0	0.18	0.10	1.1	3.2
	Hydrogen (%)		7.4	6.3	0.00	0.00	4.5	3.1
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol$_+$/kg)	3.4	3.3	1.3	0.73	3.7	4.1
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	4.64	5.04	6.06	6.42	4.95	4.97
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10 YR 3/3 Dark Brown	10 YR 5/3 Brown	10 YR 6/1 Gray	5 Y 6/1 Gray	7.5 YR 3/2 Dark Brown	10 YR 6/2 Light Brownish Gray
	Mottles Munsell Colour		..	..	7.5 YR 5/8 Strong Brown	7.5 YR 6/8 Reddish Yellow	..	..
	Degree of Mottling (%)		..	..	30	80	..	..

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

15 samples supplied by SLR Consulting Australia Pty Ltd on 30/11/2020. Lab Job No.K1174
Analysis requested by Murray Fraser. Your Job: PO: SLR 630 30108; Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

			Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
		Sample ID:	BS 3 40-50	BS 3 65-75	BS 5 0-10	BS 5 30-40	BS 5 65-75	BS 6 0-10
		Crop:	Soil	Soil	Soil	Soil	Soil	Soil
		Client:	Elgin	Elgin	Elgin	Elgin	Elgin	Elgin
	Parameter	Method reference	K1174/7	K1174/8	K1174/9	K1174/10	K1174/11	K1174/12
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.98	7.25	5.09	6.61	6.22	5.40
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.030	0.076	0.057	0.016	0.020	0.072
		(cmol$_+$/kg)	2.9	5.1	2.0	0.55	2.4	2.6
	Exchangeable Calcium	(kg/ha)	1,308	2,307	881	247	1,099	1,170
		(mg/kg)	584	1,030	393	110	491	522
		(cmol$_+$/kg)	1.8	5.5	0.33	0.10	0.63	0.87
	Exchangeable Magnesium	(kg/ha)	486	1,500	89	27	172	238
		(mg/kg)	217	670	40	12	77	106
		(cmol$_+$/kg)	0.12	0.20	0.25	<0.12	0.17	0.58
	Exchangeable Potassium	(kg/ha)	<112	178	219	<112	146	511
		(mg/kg)	<50	79	98	<50	65	228
		(cmol$_+$/kg)	0.44	1.5	<0.065	<0.065	0.10	0.09
	Exchangeable Sodium	(kg/ha)	228	785	<33	<33	51	44
		(mg/kg)	102	350	<15	<15	23	20
		(cmol$_+$/kg)	0.02	0.01	0.08	<0.01	0.03	0.15
	Exchangeable Aluminium	(kg/ha)	3.3	2.5	16	1.7	6.3	29
		(mg/kg)	1.5	1.1	7.2	<1	2.8	13
		(cmol$_+$/kg)	<0.01	<0.01	0.16	<0.01	0.08	0.20
	Exchangeable Hydrogen	(kg/ha)	<1	<1	3.6	<1	1.9	4.4
		(mg/kg)	<1	<1	1.6	<1	<1	2.0
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	5.3	12	2.8	0.82	3.5	4.5
	Calcium (%)		55	41	69	67	71	58
	Magnesium (%)		34	44	12	12	18	19
	Potassium (%)	**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	2.3	1.6	8.8	13	4.8	13
	Sodium - ESP (%)		8.4	12	1.8	6.2	2.9	1.9
	Aluminium (%)		0.31	0.10	2.8	1.0	0.90	3.2
	Hydrogen (%)		0.00	0.00	5.7	0.00	2.4	4.4
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.6	0.93	6.0	5.6	3.9	3.0
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	5.68	6.00	4.50	5.90	5.26	4.58
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	2.5 Y 6/2 Light Brownish Gray	2.5 Y 6/1 Gray	7.5 YR 3/2 Dark Brown	10 YR 6/2 Light Brownish Gray	2.5 Y 6/2 Light Brownish Gray	7.5 YR 2.5/3 Very Dark Brown
	Mottles Munsell Colour		10 YR 5/6 Yellowish Brown	2.5 YR 4/8 Red	..	..	..	..
	Degree of Mottling (%)		10	60	..	..	..	..

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

15 samples supplied by SLR Consulting Australia Pty Ltd on 30/11/2020. Lab Job No.K1174
Analysis requested by Murray Fraser. Your Job: PO: SLR 630 30108; Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

	Parameter		Method reference	Sample 13	Sample 14	Sample 15	*Heavy Soil*	*Medium Soil*	*Light Soil*	*Sandy Soil*
	Sample ID:			BS 6 20-30	BS 6 40-50	BS 6 65-75				
	Crop:			Soil	Soil	Soil				
	Client:			Elgin	Elgin	Elgin	*Clay*	*Clay Loam*	*Loam*	*Loamy Sand*
				K1174/13	K1174/14	K1174/15	Indicative guidelines - refer to Notes 6 and 8			
	pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.19	6.07	8.23	*6.5*	*6.5*	*6.3*	*6.3*
	Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.032	0.084	0.134	*0.200*	*0.150*	*0.120*	*0.100*
	Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.1	6.5	8.4	*15.6*	*10.8*	*5.0*	*1.9*
		(kg/ha)		959	2,900	3,774	*7000*	*4816*	*2240*	*840*
		(mg/kg)		428	1,295	1,685	*3125*	*2150*	*1000*	*375*
	Exchangeable Magnesium	(cmol$_+$/kg)		1.2	9.0	12	*2.4*	*1.7*	*1.2*	*0.60*
		(kg/ha)		317	2,451	3,235	*650*	*448*	*325*	*168*
		(mg/kg)		142	1,094	1,444	*290*	*200*	*145*	*75*
	Exchangeable Potassium	(cmol$_+$/kg)		0.40	0.60	0.42	*0.60*	*0.50*	*0.40*	*0.30*
		(kg/ha)		351	530	369	*526*	*426*	*336*	*224*
		(mg/kg)		157	236	165	*235*	*190*	*150*	*100*
	Exchangeable Sodium	(cmol$_+$/kg)		0.09	1.3	2.3	*0.3*	*0.26*	*0.22*	*0.11*
		(kg/ha)		48	655	1,192	*155*	*134*	*113*	*57*
		(mg/kg)		21	292	532	*69*	*60*	*51*	*25*
	Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	0.03	0.27	0.01	*0.6*	*0.5*	*0.4*	*0.2*
		(kg/ha)		5.6	54	2.5	*121*	*101*	*73*	*30*
		(mg/kg)		2.5	24	1.1	*54*	*45*	*32*	*14*
	Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.03	0.25	<0.01	*0.6*	*0.5*	*0.4*	*0.2*
		(kg/ha)		<1	5.5	<1	*13*	*11*	*8*	*3*
		(mg/kg)		<1	2.5	<1	*6*	*5*	*4*	*2*
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	3.9	18	23	*20.1*	*14.3*	*7.8*	*3.3*
	Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	55	36	36	*77.6*	*75.7*	*65.6*	*57.4*
	Magnesium (%)			30	50	52	*11.9*	*11.9*	*15.7*	*18.1*
	Potassium (%)			10	3.4	1.8	*3.0*	*3.5*	*5.2*	*9.1*
	Sodium - ESP (%)			2.4	7.1	10	*1.5*	*1.8*	*2.9*	*3.3*
	Aluminium (%)			0.72	1.5	0.05	*6.0*	*7.1*	*10.5*	*12.1*
	Hydrogen (%)			0.75	1.4	0.00				
	Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.8	0.72	0.71	*6.5*	*6.4*	*4.2*	*3.2*
	pH		**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	5.27	4.98	7.09	..			
	Moist Munsell Colour		**Inhouse Munsell Soil Colour Classification	10 YR 4/4	10 YR 4/4	2.5 Y 4/1	..			
				Dark Yellowish Brown	Dark Yellowish Brown	Dark Gray	..			
	Mottles Munsell Colour			..	2.5 YR 3/6	7.5 YR 5/8	..			
				..	Dark Red	Strong Brown	..			
	Degree of Mottling (%)			..	50	5	..			

GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

15 soil samples supplied by SLR Consulting Pty Ltd on 30 November, 2020 - Lab Job No. K1174.
Analysis requested by Murray Fraser. Your Project: PO SLR 630 30108 Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

SAMPLE ID	Lab Code	MOISTURE CONTENT (% of water in air-dry sample)	TOTAL GRAVEL > 2 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 ISSS (% of total oven-dry equivalent)	CLAY < 2 µm (% of total oven-dry equivalent)	Total soil fractions (incl. Gravel)
BS 2 0-10	K1174/1	15.0%	51.1%	2.5%	30.5%	9.3%	6.6%	100.0%
BS 2 20-30	K1174/2	8.0%	46.8%	2.0%	34.7%	9.5%	6.9%	100.0%
BS 2 40-50	K1174/3	8.4%	31.4%	5.6%	29.7%	7.1%	26.3%	100.0%
BS 2 65-75	K1174/4	13.7%	24.9%	15.0%	16.2%	9.6%	34.3%	100.0%
BS 3 0-10	K1174/5	14.1%	46.7%	2.5%	34.9%	9.3%	6.5%	100.0%
BS 3 20-30	K1174/6	7.5%	50.1%	2.4%	33.2%	9.9%	4.4%	100.0%
BS 3 40-50	K1174/7	8.3%	42.3%	1.8%	24.6%	10.3%	20.9%	100.0%
BS 3 65-75	K1174/8	17.0%	23.9%	1.0%	21.5%	11.1%	42.4%	100.0%
BS 5 0-10	K1174/9	10.9%	50.5%	1.4%	35.1%	9.0%	4.0%	100.0%
BS 5 30-40	K1174/10	4.3%	54.4%	1.1%	32.5%	11.2%	0.8%	100.0%
BS 5 65-75	K1174/11	6.5%	56.9%	1.7%	23.1%	7.7%	10.5%	100.0%
BS 6 0-10	K1174/12	17.9%	47.7%	3.5%	32.3%	8.5%	8.1%	100.0%
BS 6 20-30	K1174/13	5.0%	40.1%	5.8%	31.4%	11.1%	11.7%	100.0%
BS 6 40-50	K1174/14	20.9%	13.1%	0.7%	15.2%	8.5%	62.5%	100.0%
BS 6 65-75	K1174/15	16.5%	17.1%	0.6%	25.1%	8.4%	48.9%	100.0%

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.

5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions.
These Terms and Conditions are available on the EAL website: scu.edu.au/eal, or on request.

6. This report was issued on 09/12/2020.

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

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

APPENDIX E

External Peer Review

MINESOILS
LAND & REHABILITATION SPECIALISTS

19th October 2022

SLR Consulting Australia Pty Ltd
10 Kings Road,
New Lambton NSW 2292

Attention: Murray Fraser

Dear Murray,

Re: Glanmire Solar Farm BSAL and LSC Assessments – Peer Review

Overview

Minesoils was engaged by SLR Australia Pty Ltd (SLR) to provide specialised technical advice in the form of a peer review of soil and land assessments undertaken for the proposed Glanmire Solar Farm Project, located 4823 Great Western Highway, Glanmire, NSW 2795.

SLR was commissioned to complete two assessments:

- Biophysical Strategic Agricultural Land (BSAL) Assessment; and
- Land & Soil Capability (LSC) Assessment.

Both assessments were undertaken to form part of the site due diligence and ultimately inform any Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act)

Minesoils is a specialist environmental consulting firm providing expertise and practical advice to the mining, infrastructure and power related industries in the areas of soils, agriculture and rehabilitation. Minesoils Director, Clayton Richards is a Certified Professional Soil Scientist (CPSS). Minesoils has reviewed the aforementioned assessments as provided by SLR. The findings of the review are presented in this report.

BSAL Assessment

The scope for work for the SLR BSAL assessment included the following:

- Detailed assessment of the site and soil characteristics as per the requirements of the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*. NSW Office of Environment and Heritage (2012)(the Interim Protocol);
- Completion of field work to obtain required level of field samples in accordance with the Interim Protocol);
- The assessment should identify areas of the Project Area that may be considered BSAL or otherwise including mapping at the appropriate scale;
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in the Interim Protocol

It is noted that solar farm projects do not require a BSAL Site Verification Certificate (SVC) prior to lodgement of a Development Application. SVC's are only required under *The State Environment Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment* 2013. Further, as per the revised *Large Scale Energy Guideline* (Department of Planning and Environment, 2022) solar farms are not required to verify BSAL. Nonetheless, Minesoils has reviewed SLRs assessment against the aforementioned scope of works.

Minesoils found that the BSAL assessment was generally undertaken as per the requirements of the *Interim Protocol.* The assessment identified the entire Project Area to be verified Non-BSAL, which Minesoils confirms to be accurate. However, Minesoils recent experience with the NSW Department of Planning, Industry and Environment - Environment, Energy and Science Division soils team across multiple projects during the early to mid-2022 period has clarified new expectations around subtleties of the BSAL assessment process. Therefore, based on our recent experience, and while Minesoils agrees with the outcome of the assessment, the following key notes are provided for your consideration.

- There is a degree of risk related to the mapping of sites 4 and 5. Site 5 is a verified Chromosol and site 4 is confirmed as a duplex soil and assumed to be sodic. As site 4 is not verified as sodic, it could be argued that the area through the middle of the Project Area may be significant enough to break it into two soil map units given it would be about half of the site. If samples were collected for site 4, our recommendation would be to get them tested for sodicity to bolster soil mapping. A recent example confirmed EEC did not accept check sites as a Sodosol, without lab tested ESP despite being within 100m of a lab tested verified Sodosol. Based on our recent experience, if this went to EEC, they may agree that it is not BSAL but they'd want another site confirming Sodosol or Chromosol.
- As per above, EEC did not accept check sites if they could not be allocated to a soil type. For duplex soils, laboratory data is required to determine weather soil is a Kurosol, Sodosol or a Chromosol. Therefore, for the site assessment nomenclature, only sites with laboratory data would be considered as 'detailed' sites. However, this feedback is only relevant if you were applying for an SVC through DPE and the EEC soil team, which is not required for this project.
- The A2 horizon of Site 5 is described as a bleached horizon but has a Munsell of 10YR 5/3 (Brown). Bleached soil is defined as any colour chip with a value of 7 or 8 and a chroma of 4 or less on the 5YR, 7.5YR or 10YR charts. Perhaps include a dry field Munsell colour to clarify.
- Soil types should be classified to the family level, as per *Interim Protocol*. Minesoils recommends updating Table 10 and the soil profile sheets accordingly.

For additional minor points and comments, please refer to BSAL assessment report attachment.

LSC Assessment

The scope for work for the SLR LSC assessment included the following:

- Detailed assessment of the site and soil characteristics as per the requirements of *The Land and Soil Capability Assessment Scheme; Second Approximation* (NSW Office of Environment and Heritage, 2012)(LSC Assessment Scheme).
- Completion of field work to obtain required level of field samples in accordance with the *LSC Assessment Scheme*.
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in *LSC Assessment Scheme*.

Minesoils found that the LSC assessment undertaken by SLR was generally undertaken as per the requirements of the *LSC Assessment Scheme,* with the exception of the following items:

- For the LSC assessment hazard criteria 2 (wind erosion hazard), if the assessment is assuming the site has high exposure to high wind (which the classifications of LSC 4 generally indicate), site 5 should have an LSC of 7 based on an estimated wind erodibility for loamy sand topsoil as high.
- For the LSC assessment hazard criteria 4 (soil acidification), site 5 should have a LSC class of 5 based on loamy sand topsoil having a very low estimated buffer capacity and a pH of 5.1.
- LSC classes for the soil acidification hazard of sites 1 and 4 could not be verified as laboratory or field pH data is not presented. Nonetheless, the overall LSC for these sites are assumed to be in line with representative sites based on shared hazard criteria limitations.
- For LSC assessment hazard criteria 6 (waterlogging hazard), all sites are allocated LSC 4 based on being 'imperfectly drained'. However, as per the soil descriptions and the BSAL report, these sites are noted to be 'poorly drained', which would result an LSC of 6 to be consistent between reports.

Based on the above items, Minesoils suggests the LSC for the site would be 6 for all areas except where the loamy sand topsoils associated with the subdominant Chromosols can be separated out, which would be LSC class 7.

Therefore, the classification of the Project Area as LSC 4 - 5 and having moderate to moderately low agricultural capability according to definitions given in the LSC Assessment Scheme should be considered conservative. There is evidence to suggest the site should be classified as LSC 6 – 7, which is low to very low capability land.

Minesoils acknowledges the conservative approach taken by SLR is likely based on a more practical understanding of the site and its present and historical land uses.

Contact

To further discuss Minesoils review of the SLR soil and land assessments undertaken at Glanmire, please feel free to contact me on the details provided below.

Yours sincerely,

Clayton Richards.
Principal Consultant & Director
Minesoils Pty Ltd

Mobile: 0408 474 248
E-mail: clayton@minesoils.com.au

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

APPENDIX B

Glanmire Solar Farm – Land & Soil Capability Assessment

GLANMIRE SOLAR FARM

Land & Soil Capability Assessment

Prepared for:

Elgin Energy

SLR Ref: 630.30108
Version No: v1.0
October 2022

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Elgin Energy (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 the Client. 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 SLR.

SLR 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	Checked	Authorised
630.30108 LSC	October 2022	Murray Fraser	Rod Masters	Rod Masters

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1 Introduction

SLR has been commissioned by Elgin Energy to complete a Land & Soil Capability (LSC) Assessment for the Glanmire Solar Farm Project (the Project). The purpose of this LSC Assessment is to form part of the site due diligence and ultimately inform any Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW Department of Planning and Environment (DP&E), 1979).

1.1 Background

Elgin Energy is a leading international solar developer with operations in Australia, UK, and Ireland. To date, Elgin have delivered 21 projects including the largest operational solar farms in Scotland (13MW) and Northern Ireland (46MW)

Elgin Energy are proposing to develop the Glanmire Solar Farm at 4823 Great Western Highway, Glanmire, NSW 2795. This site is located approximately 11 kilometres east of the township of Bathurst and approximately 4.5 kilometres east of Raglan. The development will have a capacity of approximately 60 megawatts and comprise approximately 18 inverters, with an additional 17 inverters co-located with the Battery Energy Storage System (BESS). The projects indicative infrastructure layout in show on **Figure 1**.

For reference a Region Locality and Study Area Plan is provided on **Figure 2**. The site has a total area of approximately 186 hectares and is currently used for grazing and for intermittent cropping. The general area comprises a range of farming properties and rural living properties.

The LSC Study Area comprises the entirety of Lot 141 DP1144786 (186 hectares), whilst the project will cover a development footprint of approximately 140 hectares and comprise single axis tracking solar photovoltaic technology laid out in north south rows and will also include ancillary infrastructure such as inverters, connection equipment and energy storage equipment.

Farm access gate

Temporary Construction Compound

Access point

66kV UG LINE

Waterway crossing 10m wide

Waterway crossing 10m wide

BESS AREA

66/33kV Substation

Glanmire Solar Farm
Indicative Site Layout Plan

Key

- F1 — Compound fence
- F2 — Stock Fence (retained or new)
- Retained Vegetation
- Landscape Area - 10m
- Landscape Area - 5m
- Waterway offset - Riparian vegetation
- Scattered Trees
- Retained Trees
- Trees to be removed
- 66 kV Connection Line
- Existing Transmission Line
- Project Boundary
- Gates
- Access Track
- Inverters
- Proposed substation and battery compound
- Temporary Construction Compound
- 10m Asset Protection Zone (measured from fence line to magenta line)
- Exclusion zone
- Full Length Tracker
- Half Length Tracker

Meters

100 0 100 200

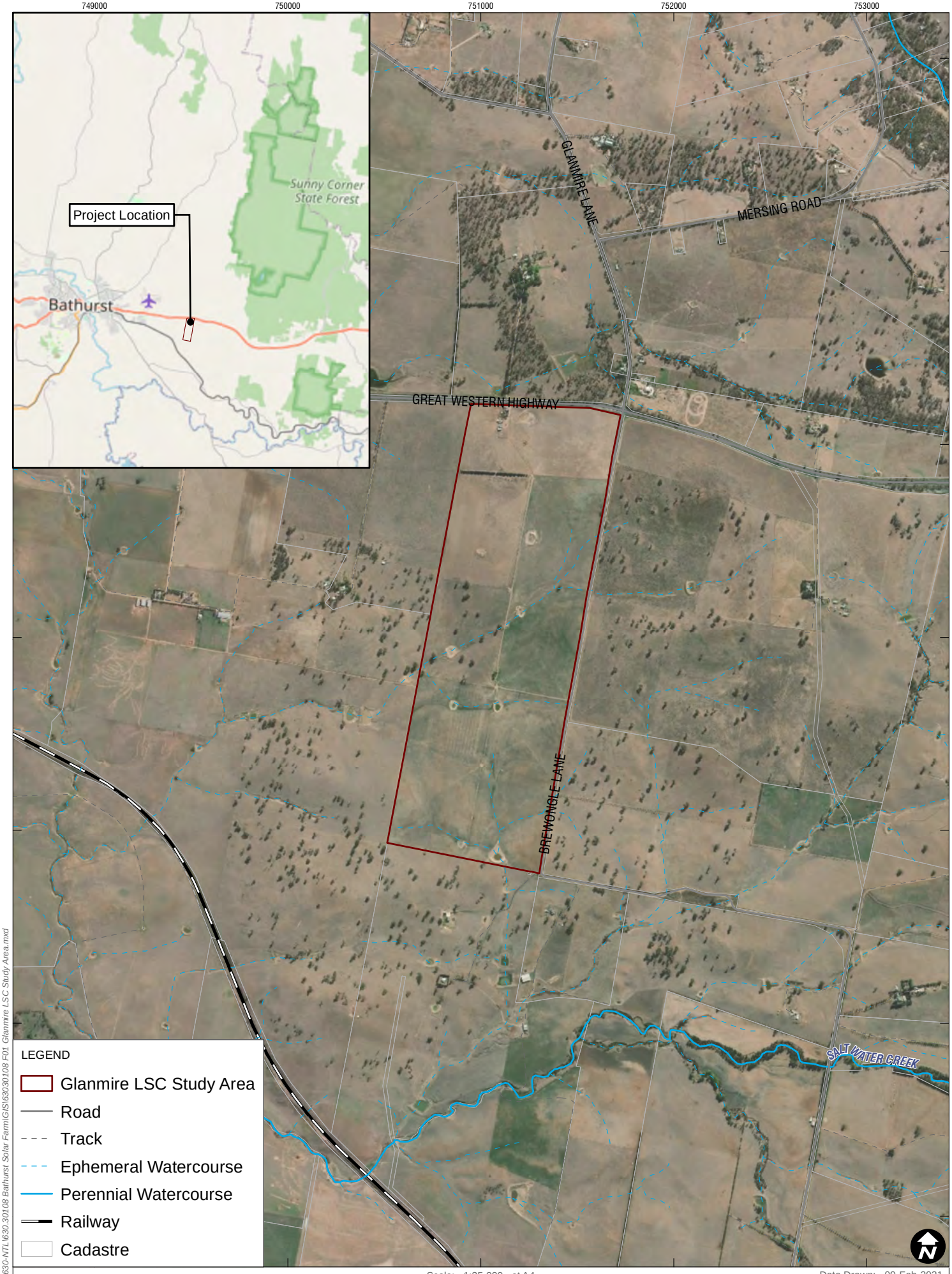
1:6500

Figure 1

Drawing	Site Layout Plan
Drawing Code	GLA-01
Drawn by	Davide Orio
Revised by	Christoph Pester
Version	V4.7
Revision Date	September 2022
Coordinate System	MGA/20-55
Notes	

N

ELGIN ENERGY



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 09-Feb-2021
Project Number: 630.30108

Data Source: © OpenStreetMap contributors

SLR

Study Area

FIGURE 2

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630.30108 F01 Glanmire LSC Study Area.mxd

1.2 Objective

The objective was to conduct an LSC Assessment for an area of land proposed for the Project to support any EIS/Development Application for the project.

1.3 Scope of Work

The LSC Assessment includes:

- Detailed assessment of the site and soil characteristics as per the requirements of *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012).
- Completion of field work to obtain required level of field samples in accordance with any relevant guidelines.
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012).

1.4 Study Area

Elgin Energy requires a LSC Assessment for the Area of Interest (the Study Area) as shown on **Figure 2**, to support the Project. **Table 1** shows the areas requiring soil survey for the LSC Study Area.

Table 1 Study Area

Assessment Component	Hectares
Development Footprint	140
Remaining Area Lot 141 DP1144786	46
Total LSC Study Area	**186**

1.5 Legislation and Standards

The Large-Scale Solar Energy Guideline (LSSEG) for State Significant Development was issued in December 2018 by the NSW Government (NSW Government, 2018). The guideline provides the community, industry, applicants and regulators with general guidance on the planning framework for the assessment and determination of State Significant large-scale energy projects under the Environmental Planning and Assessment Act 1979. Under Section 4 of the LSSEG one of the key site constraints identified for site selection is agriculture including Land and Soil Capability and BSAL.

The appropriate guideline for assessment of Land and Soil Capability is *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012)

A BSAL Verification Assessment has been previously undertaken by SLR (2022). This LSC Assessment and the BSAL Verification Assessment were externally peer reviewed by Minesoils Principal Consultant & Director, Clayton Richards (**Appendix E**).

2 LSC Assessment Methodology

The LSC classification applied to the Study Area was in accordance with the OEH guideline *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012). This 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 2** 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.

Table 2 Land & Soil Capability Assessment Classification

Class	Land and Soil Capability
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.
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.

2.1.1 Calculating LSC Classes

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform and more specifically: slope, landform position, acidity, salinity, drainage, rockiness; and climate.

The eight hazards associated with these biophysical features that are assessed by the 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; each hazard for the land is ranked from 1 through to 8 with the overall ranking of the land determined by its most significant limitation.

Hazard 1: Water Erosion

The Study Area lies within the Easter NSW Division, and the appropriate criteria for this division were used in the assessment. Assessment of water erosion hazard is almost solely dependent on the slope percentage of the land, based on each Soil Landscape Unit. The only exception is land which falls within the slope range of 10 to 20%, which may be designated LSC Class 4 or LSC Class 5 depending on the presence of gully erosion and/or sodic/dispersible soils. A slope analysis for the Study Area is shown on **Figure 3** while the slope analysis methodology is shown in **Appendix A**.

Hazard 2: Wind Erosion

There are four factors used to assess wind erosion hazard for each soil type. Three criteria were assessed to be consistent for each soil type:

- Average rainfall determines the capacity of the land to maintain vegetative cover and keep soil wet. The average rainfall for the region is 635 millimetres (BOM, 2021), and therefore the Study Area lies within the “greater than 500 millimetres rainfall” category for the purpose of assessing wind erosion hazard.

- Wind erosive power for the Study Area has been mapped as “Moderate” (NSW Department of Trade and Investment); and

- Exposure of the land to wind was also determined to be “Moderate” throughout the Study Area.

The determining factor with regard to wind erosion hazard was therefore the erodibility of each soil type as determined by soil texture according the LSC Guideline.

Hazard 3: Soil Structure Decline

Soil structure decline is assessed on soil characteristics, including surface soil texture, sodicity (laboratory tested) and degree of self-mulching (field tested). These parameters assess the soil structure, stability and resilience of the soil.

Hazard 4: Soil Acidification

The soil acidification hazard is assessed using three criteria, being soil buffering capacity, pH and mean annual rainfall. In this assessment, soil buffering capacity was based on soil Great Soil Group; surface soil pH and a regional mean annual rainfall range of 550 to 700 millimetres.

Hazard 5: Salinity

The salinity hazard is determined through a range of data and criteria. The recharge potential for the site was determined based on an average annual rainfall of 635 millimetres, with annual evaporation of 1,400 to 1,600 millimetres (BOM, 2021). This would suggest a low recharge potential.

Based on the annual rainfall data (635 millimetres) and an average annual evapotranspiration of 600 to 700 millimetres, a low discharge potential exists for the site due to a likely balanced rate of water flow. The Study Area according to the Salt Store Map of NSW, is located in an area of low salt store. However, due to the current available scale of this mapping, laboratory tested EC values were used to determine salt store, all of which were non-saline.

Hazard 6: Water Logging

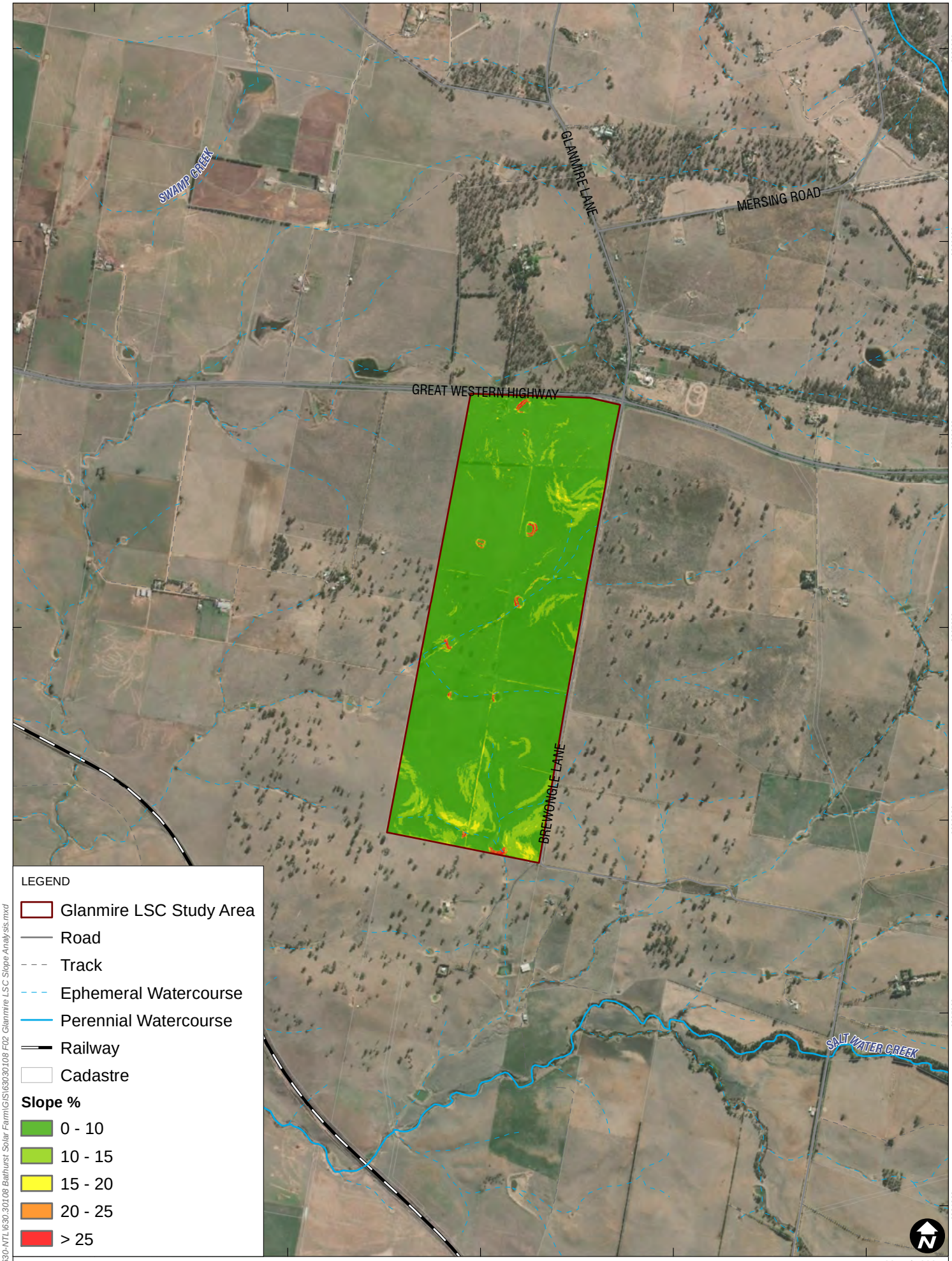
Water logging was determined by the soils drainage characteristics, specifically field sample evidence of mottling, soil texture attributes as well as slope and climate. Seasonal water logging, as indicated by strong mottling, was one of the major limitations for the Subnatric Grey-Brown Sodosol.

Hazard 7: Shallow Soils and Rockiness

The shallow soils and rockiness hazard is determined by an estimated exposure of rocky outcrops and average soil depth.

Hazard 8: Mass Movement

The mass movement hazard is assessed through a combination of three criteria; mean annual rainfall, presence of mass movement and slope class.



LEGEND

- Glanmire LSC Study Area
- Road
- Track
- Ephemeral Watercourse
- Perennial Watercourse
- Railway
- Cadastre

Slope %

- 0 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- > 25

0 0.5 1 km

Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 09-Feb-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F02 Glanmire LSC Slope Analysis.mxd

SLR

Slope Analysis

FIGURE 3

2.1.2 Risk Assessment

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

To identify the potential for a project to impact on agricultural resources and the appropriate level of soil survey required, an evaluation of risk to agricultural resources and enterprises has been undertaken. The risk assessment is based on the probability of occurrence and the consequence of the impact as described in the *Interim Protocol*. The potential impacts were assessed as:

- Level 5 – Very minor damage and minor impact to agricultural resources or industries. Probability: B – Likely, known to occur or it has happened. The risk matrix result was B5 which is considered a low risk. The Study Area requires an inspection density of 1:100,000.

Based on the Project only being temporary and having no permanent impact on the intrinsic properties of the soil, an inspection density of 1:100,000 was adopted across the Study Area.

2.1.3 Field Soil Survey

The field survey for the LSC Assessment was undertaken during November 2020 by SLR's Principal Agronomist Murray Fraser and overseen by SLR's Regional Sector Leader Rod Masters (CPSS-3).

To satisfy soil mapping requirements, although only a minimum of 3 sites were required, the field soil survey program comprised 14 described sites in total, as shown on **Figure 4**. A breakdown of the required soil survey density, as per *Interim Protocol* requirements, is provided in **Table 3**, which exceeds the requirements for an LSC Assessment.

Table 3 Assessment of Soil Survey Density

Category	LSC Study Area
Total Study Area Hectares	186
1:100,000 Survey Density Target	Minimum 3 Required Sites
Detailed Sites	8
Check Sites	6
Total Number Sites	**14**
Laboratory Analysed Sites	**4**

2.1.4 Soil Survey Observation Types

Soil profiles were assessed at 6 sites in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure was sampled with a hydraulic soil corer, either a depth of 1.2 metres, to equipment refusal, or to bedrock. Detailed soil profile morphological descriptions were prepared at all sites to record the information specified in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012) Information was recorded for the major parameters specified in **Table 4**.

Global Positioning System (GPS) readings was taken for all sites where soil descriptions are recorded. Vegetation type, landform and aspect were also noted. Soil exposures from pits were photographed during field operations.

Table 4 Field Assessment Parameters

Descriptor	Application
Horizon depth	Weathering characteristics, soil development
Field colour	Permeability, susceptibility to dispersion/erosion
Field texture grade	Erodibility, hydraulic conductivity, moisture retention, root penetration
Boundary distinctness and shape	Erosional/dispositional status, textural grade
Consistence force	Structural stability, dispersion, ped formation
Structure pedality grade	Soil structure, root penetration, permeability, aeration
Structure ped and size	Soil structure, root penetration, permeability, aeration
Stones – amount and size	Water holding capacity, weathering status, erosional/depositional character
Roots – amount and size	Effective rooting depth, vegetative sustainability
Ants, termites, worms etc.	Biological mixing depth

A total of 14 sites were evaluated. Of the 14 sites, 6 sites were detailed sites and 8 sites were check sites. Check sites are mapping observations examined in sufficient detail to allocate the site to a specific soil type and map unit. For detailed sites, soil was collected from each major soil horizon (soil layer).

Soil samples from 4 detailed sites were utilised in the LSC Assessment laboratory testing program. Samples were analysed in order to classify Australian Soil Classification (ASC) (Isbell, 2002) soil taxonomic class and enable LSC classification.

Soil collected from each major soil horizon (soil layer) was sent to a National Association of Testing Authorities Australia (NATA) accredited laboratory (EAL Laboratories) for analysis. The selected physical and chemical laboratory analysis properties and their relevant application are listed in **Table 5**.

Table 5 Laboratory Analysis Parameters

Property	Application
Coarse Fragments (>2mm)	Soil workability; root development
Particle-Size Distribution (<2mm)	Determine fraction of clay, silt, fine sand and coarse sand; nutrient retention; exchange properties; erodibility; workability; permeability; sealing; drainage; interpretation of most other physical and chemical properties and soil qualities
Soil Reaction (pH)	Nutrient availability; nutrient fixation; toxicities (especially aluminium and manganese); liming; Sodicity; correlation with other soil properties
Electrical Conductivity (EC)	Appraisal of salinity hazard in soil substrates or groundwater; total soluble salts
Cation Exchange Capacity (CEC) & Exchangeable Cations	Nutrient status; calculation of exchangeable cations including sodium, calcium, magnesium, potassium and exchangeable sodium percentage (ESP); assessment of other physical and chemical properties, especially dispersivity, shrink – swell, water movement, aeration
Munsell Colour Chart (Munsell)	Drainage, oxidation, fertility, correlation with other physical, chemical and biological properties

Soil salinity in the samples from the detailed sites was determined through measurement of the electrical conductivity (EC) of soil:water (1:5) suspensions. These values were converted to the EC of a saturated extract (EC_e) based on soil texture in accordance with the *Interim Protocol*.

3 Soil Assessment

One soil map unit was identified within the Study Area, a Subnatric Grey-Brown Sodosol, and was mapped according to the dominant ASC soil type (**Figure 4**) using a combination of the soil survey and laboratory analysis results. This soil unit and the observation sites associated with each are shown below in **Table 6**.

A description of one detailed representative site from the mapped soil unit follows **Table 6**, with the remaining detailed soil profile descriptions shown in **Appendix B** and check site descriptions in **Appendix C**. Laboratory certificates of analysis are shown in **Appendix D**.

Table 6 Soil Units within Study Area

SMU	ASC Soil Type	Soil Type Group	Detailed Site	Check Site	Hectares
1	Subnatric Grey-Brown Sodosol	Dominant	BS1, BS2, BS3, BS4, BS6	C1 – C8	186
	Eutrophic Grey Chromosol	Sub-Dominant	BS5	Nil	
				Total	**186**

3.1 Soil Unit 1: Subnatric Grey-Brown Sodosol

Subnatric Grey Sodosol

Table 7 Summary Subnatric Grey Sodosol (Site BS2)

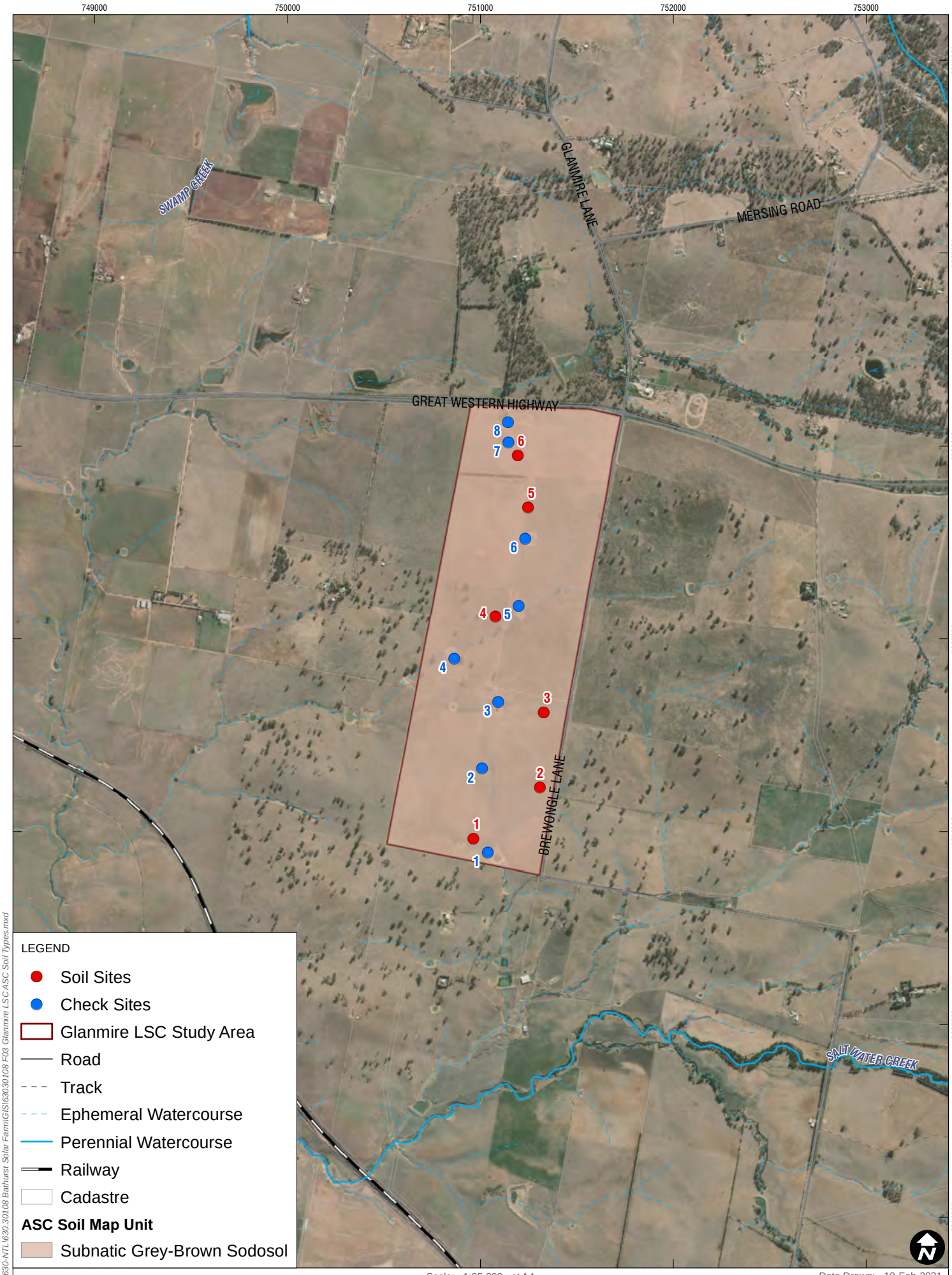
Overview	
Landscape Site BS2	
	
ASC Name	Subnatric Grey Sodosol
Representative Site	BS2
Other Mapped Sites	BS1, BS3, BS4, BS6
Survey Type	Detailed Lab
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South
LSC Class	4
Verified	Non-BSAL – Inherent Fertility, Poor Drainage & Sodicity

Table 8 Profile: Subnatric Grey Sodosol (Site BS2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (10YR 3/3) loam, weak structure of 5-10 mm crumb peds with a rough fabric and moderate consistence. Nil mottling; 50% gravel content <5 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.15 – 0.30	Brown (10YR 5/3) bleached loam, weak structure of 5-10 mm crumb peds with a rough fabric and moderate consistence. Nil mottling; 40% gravel content <5 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.20 – 0.30.
	B21 0.30 – 0.60	Grey (10YR 6/1) light clay, strong structure of 20-40 mm blocky peds with a rough fabric and moderate consistence. 30% distinct yellow mottling; 30% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.60	Grey (5Y 6/1) medium clay, strong structure of >40 mm blocky peds with a rough fabric and moderate consistence. 30% distinct yellow mottling; 25% gravel content 5-10 mm; 10% hard manganese nodules <10 mm; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sample depth.

Table 9 Chemical Parameters: Subnatric Grey Sodosol (Site BS2)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.3	Strongly Acidic	4.7	Non-Sodic	0.6	Non-Saline	3.4	Ca Low
A2	5.9	Moderately Acidic	8.1	Marginally Sodic	0.2	Non-Saline	3.3	Ca Low
B21	7.2	Neutral	8.8	Marginally Sodic	0.4	Non-Saline	1.3	Ca Low
B22	7.7	Mildly Alkaline	17.2	Strongly Sodic	0.7	Non-Saline	0.7	Ca Deficient



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 10-Feb-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F03 Glanmire LSC ASC Soil Types.mxd

SLR

ASC Soil Map Unit

FIGURE 4

4 Land & Soil Capability Assessment

All sites within the Study Area were classified as LSC Class 4, as listed in **Table 10**.The exception to these are all areas of greater than or equal to 10% slope which are classified as LSC Class 5, due to the presence of sodic subsoils (Hazard 1: Water Erosion).

Table 10 Land & Soil Capability Assessment

Site	Soil Type	Hazard Criteria								LSC
	ASC Great Group	1	2	3	4	5	6	7	8	
1	Brown Sodosol	3	4	3	4	2	4	1	1	**4**
2	Subnatric Grey Sodosol	3	4	3	4	2	4	1	1	**4**
3	Subnatric Grey Sodosol	3	4	3	3	2	4	1	1	**4**
4	Grey Sodosol	3	4	3	4	2	4	1	1	**4**
5	Eutrophic Grey Chromosol	3	4	3	4	2	4	1	1	**4**
6	Subnatric Brown Sodosol	3	4	3	4	2	4	1	1	**4**

Two LSC Classes were identified, dominated by 172 hectares of LSC Class 4 with the remaining 14 hectares LSC Class 5 (areas greater than or equal to 10% slope), and are summarised in **Table 11** and shown on **Figure 5**. The major assessment points are listed below.

LSC Class 4 is considered to have moderate agricultural capability with moderate to high limitations for high-impact land uses which restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. LSC Class 4 is associated with the Sodosol on areas of less than 10% slope and comprises 92% of the Study Area.

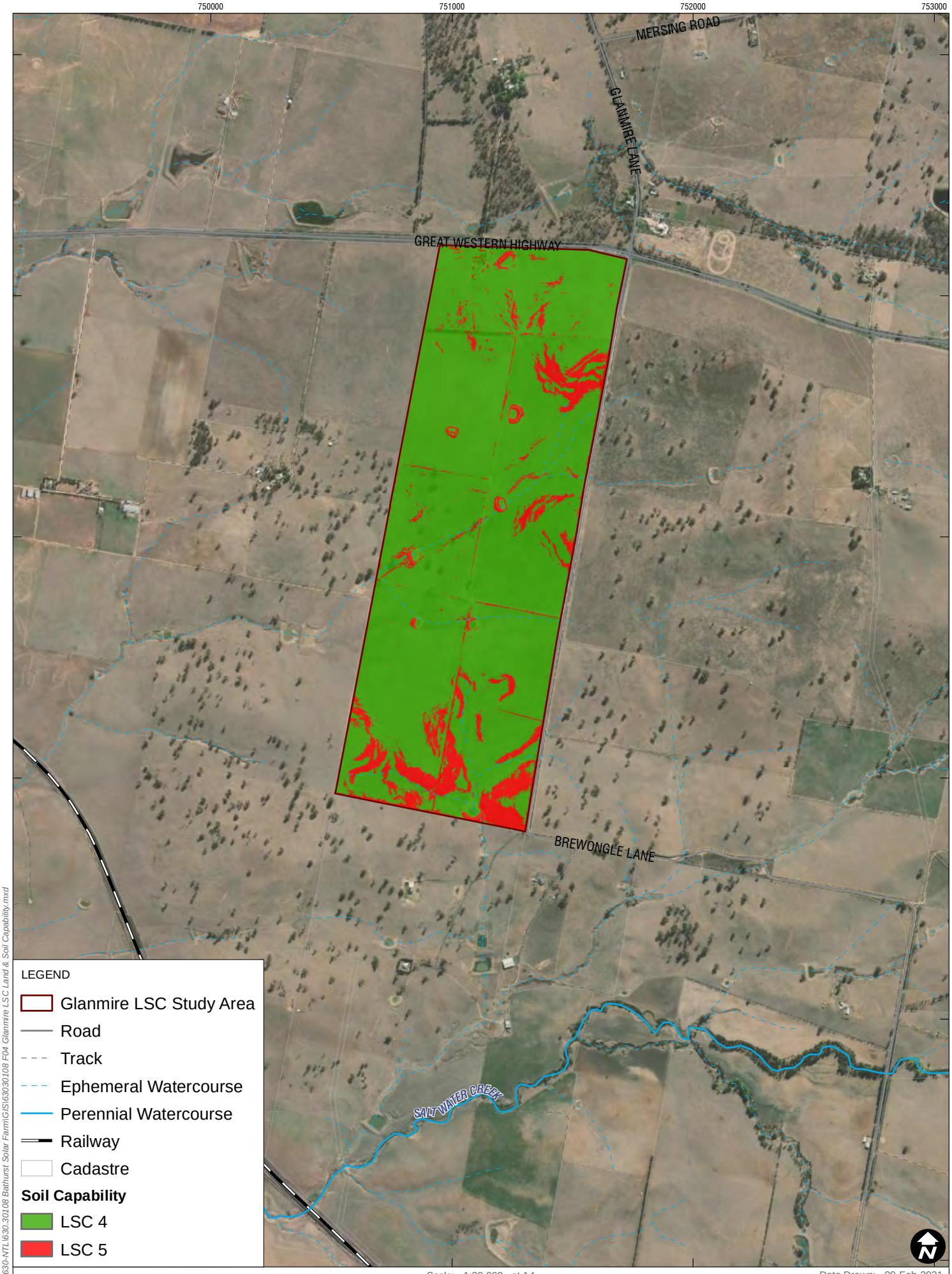
LSC Class 5 is considered to have moderate-low agricultural capability and has severe limitations for high impact land management uses such as cropping. This land is generally more suitable for grazing with some limitations or very occasional cultivation for pasture establishment. LSC Class 5 is associated with the Sodosols found on areas of greater than or equal to 10% slope and comprises 8% of the Study Area.

It should be noted that during the LSC Assessment the entire Study Area could have been classified as LSC Class 5 due to *Hazard 6: Water Logging*, however a conservative estimate was taken that the return period for waterlogging was “every 2 to 3 years” (LSC Class 4) rather than “every year” (LSC Class 5).

The entire Study Area is considered to have moderate to moderately low agricultural capability according to definitions given in *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2012).

Table 11 Land and Soil Capability

LSC	Site	Soil Type	Limitation	Agricultural Capability Rating	Hectares
4	1, 2, 3, 4, 5, 6	Sodosol	Water Logging	Moderate	172
5	Slope >10%	Sodosol	Water Logging & Water Erosion	Moderately Low	14
				Total	**186**



Scale: 1:20,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 09-Feb-2021
Project Number: 630.30108

H:\Projects-SLR\610-SnySYD\630-NTL\630.30108 Bathurst Solar Farm\GIS\630308 F04 Glanmire LSC Land & Soil Capability.mxd

SLR

Land & Soil Capability

FIGURE 5

5 Conclusion

SLR Consulting has completed an LSC Assessment according to *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2012) encompassing the proposed Glanmire Solar Farm, totalling 186 hectares.

The LSC Assessment found 172 hectares of LSC Class 4 (moderate capability land) and 14 hectares of LSC Class 5 (moderately low capability land) within the Study Area.

A previous BSAL assessment (SLR, 2022) found the entire Study Area (including a 100 metre buffer) is non-BSAL, comprising 24 hectares of BSAL exclusion area and one Soil Map Unit (a Subnatric Grey-Brown Sodosol), comprising the remaining 227 hectares. The Subnatric Grey-Brown Sodosol was verified as non-BSAL due to poor drainage and moderately low inherent fertility.

The Study Area is suited to grazing with occasional cultivation for the production of fodder crops and improved pastures. It is not considered highly productive agricultural land as defined in *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH 2012).

6 References

Bereau of Meteorology. (2021). Retrieved February 2021, from http://www.bom.gov.au/

Department of Natural Resources. (2005). *Land Capability Spatial Data.* Hunter Region: Resource Information Unit.

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

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 .* Australia: CSIRO Publishing.

NSW Department of Planning and Environment (DP&E). (1979). *Environmental Planning and Assessment Act. No* 203. Sydney: NSW Governement.

NSW Department of Planning and Infrastructure (DP&I). (2012). *Guideline for Agricultural Impact Statements*. Sydney.

NSW Department of Planning and Infrastructure (DP&I). (2012). *Strategic Regional Land Use Policy*. Sydney.

NSW Government. (2018). *Large Scale Solar Energy Guideline for State Significant Development.*

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

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

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment. (2013). NSW Government.

SLR (2022) *Elgin Energy Glanmire Solar Farm Biophysical Strategic Agricultural Land Verification*

APPENDIX A

Slope Analysis Methodology

11th February 2021

Elgin Energy
Glanmire Solar Farm
LSC Assessment
SLR Slope Analysis Methodology

1. Acquire appropriate elevation information.

2. Load Contours into ArcMap 10.3

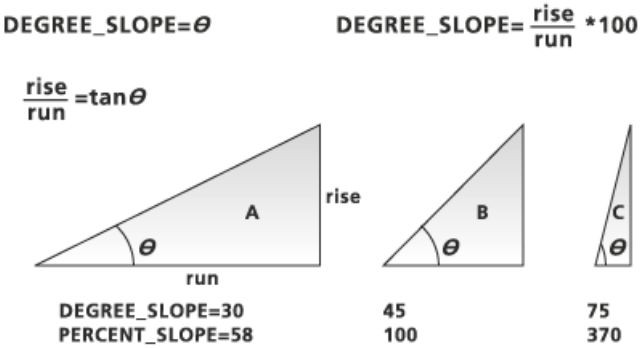
3. Using 3D Analyst Extension - Create a TIN Surface based on the contours (http://resources.arcgis.com/en/help/main/10.1/index.html#/Create_TIN/00q90000001v000000/)

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

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

The Surface Slope Tool

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



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

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

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

Table example:

break, code

10.0, 11

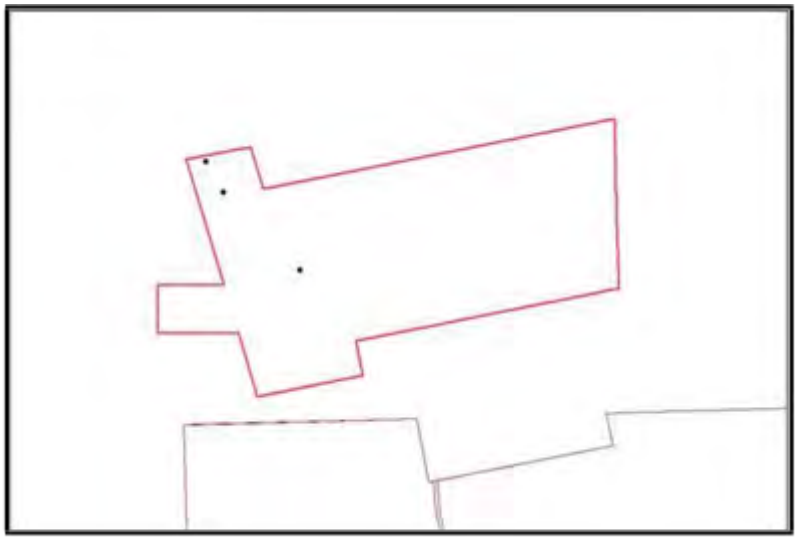
25.0, 22

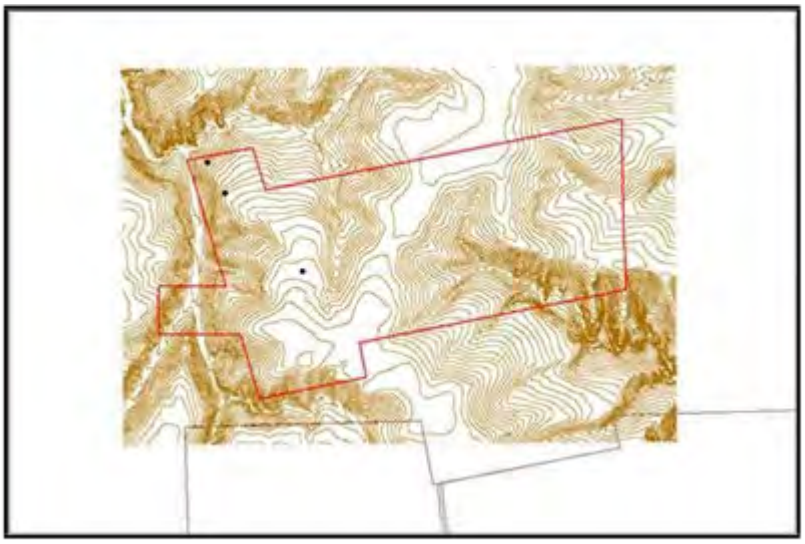
40.0, 33

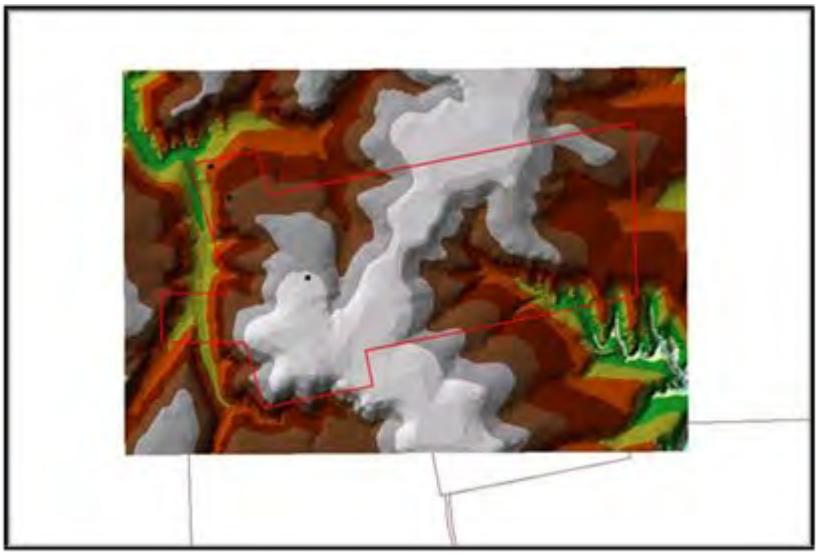
70.0, 44

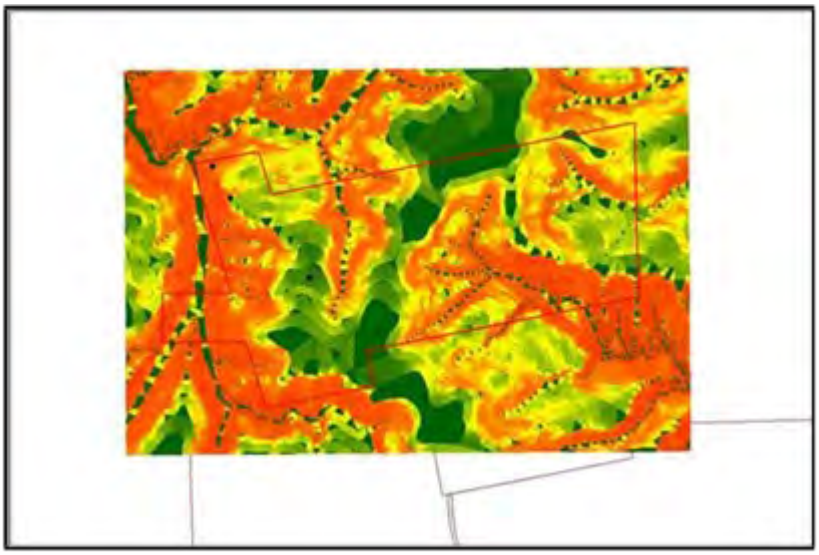
Note the comma delineation and use of decimals in the first field. Field names are needed but are ignored. The first field represents the breaks and values need to be decimal, the second field represents codes and values need to be integer. The units of the slope range are defined by the {units}. When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

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









APPENDIX B

Detailed Soil Profile Descriptions

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 1 Summary: Brown Sodosol (Site BS1)

Overview	
Landscape Site BS1	
	
ASC Name	Brown Sodosol
Representative Site	BS1
Other Mapped Sites	BS2, BS3, BS4, BS6
Survey Type	Detailed
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	19
Surrounding Slope (%)	<10
Aspect	South
LSC Class	4
Verified	Non-BSAL – Slope, Inherent Fertility & Poor Drainage

Table 2 Profile: Brown Sodosol (Site BS1)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Dark brown (7.5YR 3/4) loam, weak structure of 5-10 mm crumb peds with a rough fabric and weak consistence. Nil mottling; 20% gravel content 5-10 mm; nil segregations; well drained with a clear and wavy boundary. Sampled 0.0 – 0.10.
	B21 0.15 – 0.50	Dark yellowish-brown (10YR 4/6) medium clay, strong structure of 20-40 mm blocky peds with a rough fabric and strong consistence. 30% distinct yellow mottling; <10% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.20 – 0.30 and 0.40 – 0.50.
	B22 +0.50	Greyish brown (2.5Y 5/2) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 30% distinct yellow mottling; 10% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 3 Field Parameters: Brown Sodosol (Site BS1)

Layer	Field pH		Field Dispersion	Field Effervescence
	Unit	Rating	Rating	Rating
A1	5.5	Strongly Acidic	Nil	Nil
B21	6.5	Slightly Acidic	High	Nil
B22	7.0	Neutral	High	Nil

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 4 Summary: Subnatric Grey Sodosol (Site BS3)

Overview	
Landscape Site BS3 	
ASC Name	Subnatric Grey Sodosol
Representative Site	BS3
Other Mapped Sites	BS1, BS2, BS4, BS6
Survey Type	Detailed Lab
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	West
LSC Class	4
Verified	Non-BSAL – Inherent Fertility & Poor Drainage

Table 5 Profile: Subnatric Grey Sodosol (Site BS3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Dark brown (7.5YR 3/2) loam, weak structure of 5-15 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 50% gravel content <10 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.20 – 0.40	Light brownish-grey (10YR 6/2) bleached loamy sand, weak structure of <10 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 50% gravel content <10 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.20 – 0.30.
	B21 0.40 – 0.60	Light brownish-grey (2.5Y 6/2) clay loam, strong structure of 20-40 mm blocky peds with a rough fabric and moderate consistence. 20% distinct red mottling; 40% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.60	Gray (2.5Y 6/1) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 30% distinct red mottling; 25% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 6 Chemical Parameters: Subnatric Grey Sodosol (Site BS3)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.6	Moderately Acidic	2.5	Non-Sodic	0.6	Non-Saline	3.7	Ca Low
A2	5.9	Moderately Acidic	5.4	Non-Sodic	0.5	Non-Saline	4.1	Balanced
B21	7.0	Neutral	8.4	Marginally Sodic	0.3	Non-Saline	1.6	Ca Low
B22	7.3	Neutral	12.3	Sodic	0.4	Non-Saline	0.9	Ca Deficient

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 7 Summary: Grey Sodosol (Site BS4)

Overview	
Landscape Site BS4 	
ASC Name	Grey Sodosol
Representative Site	BS4
Other Mapped Sites	BS1, BS2, BS3, BS6
Survey Type	Detailed
Dominant Topography	Lower Slope
Dominant Land Use	Fodder Cropping
Vegetation	Wheat Stubble
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South
LSC Class	4
Verified	Non-BSAL – Inherent Fertility & Poor Drainage

Table 8 Profile: Grey Sodosol (Site BS4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.30	Very dark brown (7.5YR 2.5/2) loam, weak structure of 5-10 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 25% gravel content <10 mm; nil segregations; well drained with a gradual and even boundary. Sampled 0.0 – 0.10.
	A2 0.30 – 0.50	Greyish brown (10YR 5/2) bleached loamy sand, weak structure of <10 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 40% gravel content <10 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.30 – 0.40.
	B2 +0.50	Light brownish-grey (2.5Y 6/2) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 40% distinct yellow mottling; 10% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 9 Field Parameters: Grey Sodosol (Site BS4)

Layer	Field pH		Field Dispersion	Field Effervescence
	Unit	Rating	Rating	Rating
A1	6.0	Moderately Acidic	Nil	Nil
A2	6.0	Moderately Acidic	Nil	Nil
B2	7.0	Neutral	High	Nil

Soil Unit 1: Subnatric Grey-Brown Sodosol

Sub-Dominant Soil Type: Eutrophic Grey Chromosol

Table 10 Summary: Eutrophic Grey Chromosol (Site BS5)

Overview	
Landscape Site BS5 	
ASC Name	Eutrophic Grey Chromosol
Representative Site	BS5
Other Mapped Sites	Nil
Survey Type	Detailed Lab
Dominant Topography	Midslope
Dominant Land Use	Fodder Cropping
Vegetation	Grazing Canola
Inherent Soil Fertility	Moderately High
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	South-East
LSC Class	4
Verified	Non-BSAL –Poor Drainage

Table 11 Profile: Eutrophic Grey Chromosol (Site BS5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Dark brown (7.5YR 3/2) loamy sand, weak structure of 5-15 mm crumb peds with a sandy fabric and weak consistence. Nil mottling; 50% gravel content 5-10 mm; nil segregations; well drained with a clear and even boundary. Sampled 0.0- 0.10.
	A2 0.20 – 0.50	Light brownish-grey (10YR 6/2) bleached loamy sand, apedal structure with a sandy fabric and weak consistence. Nil mottling; 50% gravel content 5-10 mm; nil segregations; well drained with an abrupt and even boundary. Sampled 0.30 – 0.40.
	B21 +0.50	Light brownish-grey (2.5Y 6/2) clay loam, moderate structure of 10-30 mm blocky peds with a rough fabric and weak consistence. 20% distinct brown mottling; 60% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 12 Chemical Parameters: Eutrophic Grey Chromosol (Site BS5)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.1	Strongly Acidic	1.1	Non-Sodic	1.3	Non-Saline	6.0	Mg Low
A2	6.6	Neutral	3.7	Non-Sodic	0.4	Non-Saline	5.6	Balanced
B21	6.2	Slightly Acidic	2.9	Non-Sodic	0.2	Non-Saline	3.9	Ca Low

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 13 Summary: Subnatric Brown Sodosol (Site BS6)

Overview	
Landscape Site BS6 	
ASC Name	Subnatric Brown Sodosol
Representative Site	BS6
Other Mapped Sites	BS1, BS2, BS3, BS4
Survey Type	Detailed Lab
Dominant Topography	Upper Slope
Dominant Land Use	Grazing
Vegetation	Saffron Thistle, Paterson's Curse
Inherent Soil Fertility	Moderately Low
Slope (%)	1
Surrounding Slope (%)	1-2
Aspect	North-East
LSC Class	4
Verified	Non-BSAL – Inherent Fertility & Poor Drainage

Table 14 Profile: Subnatric Brown Sodosol (Site BS6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Very dark brown (7.5YR 2.5/3) loam, weak structure of 5-10 mm crumb peds with a rough fabric and weak consistence. Nil mottling; 50% gravel content <5 mm; nil segregations; well drained with a gradual and wavy boundary. Sampled 0.0 – 0.10.
	A2 0.10 – 0.20	Dark yellowish-brown (10YR 4/4) bleached loam, weak structure of 5-10 mm crumb peds with a rough fabric and weak consistence. Nil mottling; 40% gravel content <5 mm; nil segregations; well drained with a clear and wavy boundary. Sampled 0.10 – 0.20.
	B21 0.20 – 0.50	Dark yellowish-brown (10YR 4/4) heavy clay, strong structure of 20-40 mm blocky peds with a rough fabric and strong consistence. 30% distinct yellow mottling; 10% gravel content 5-10 mm; nil segregations; poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50.
	B22 +0.50	Dark grey (2.5Y 4/1) heavy clay, strong structure of >40 mm blocky peds with a rough fabric and strong consistence. 40% distinct yellow mottling; 20% gravel content 5-10 mm; nil segregations; poorly drained. Sampled 0.65 – 0.75. Layer continues beyond sampling depth.

Table 15 Chemical Parameters: Subnatric Brown Sodosol (Site BS6)

Layer	pH (1:5 water)		ESP		ECe		Ca:Mg	
	Unit	Rating	%	Rating	dS/m	Rating	Ratio	Rating
A1	5.4	Strongly Acidic	1.9	Non-Sodic	0.7	Non-Saline	3.0	Ca Low
A2	6.2	Slightly Acidic	2.4	Non-Sodic	0.3	Non-Saline	1.8	Ca Low
B21	6.1	Slightly Acidic	7.1	Marginally Sodic	0.5	Non-Saline	0.7	Ca Deficient
B22	8.2	Moderately Alkaline	10.0	Sodic	0.8	Non-Saline	0.7	Ca Deficient

APPENDIX C

Check Site Descriptions

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 1 Site C1 Grey Sodosol

Profile	Horizon	Description
	B2	Pale brown (10YR 6/3) heavy clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C1
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Lower Slope
Dominant Land Use	Dam Bank
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 2 Site C2 Brown Sodosol

Profile	Horizon	Description
	B2	Yellowish brown (10YR 5/4) medium clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C2
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Mid Slope
Dominant Land Use	Stock Laneway
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Mildly Alkaline

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 3 Site C3 Brown Sodosol

Profile	Horizon	Description
	B2	Yellowish brown (10YR 5/6) light-medium clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C3
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Midslope
Dominant Land Use	Dam Inflow
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Slightly Acidic

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 4 Site C4 Brown Sodosol

Profile	Horizon	Description
	B2	Brown (7.5YR 5/4) light-medium clay, strong structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C4
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Midslope
Dominant Land Use	Dam Inflow
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 5 Site C5 Grey Sodosol

Profile	Horizon	Description
	B2	Light brown (10YR 6/3) light-medium clay, moderate structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C5
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Lower Slope
Dominant Land Use	Dam Inflow
Vegetation	Grazing Canola
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 6 Site C6 Brown Sodosol

Profile	Horizon	Description
	B2	Brown (10YR 5/6) light-medium clay, moderate structure. Moderate field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C6
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Midslope
Dominant Land Use	Dam Inflow
Vegetation	Nil
Inherent Soil Fertility	Moderately Low
Field Dispersion	Moderate
Field pH	Neutral

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 7 Site C7 Brown Sodosol

Profile	Horizon	Description
	B2	Strong brown (7.5YR 5/8) light-medium clay, moderate structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C7
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Upper Slope
Dominant Land Use	Stock Laneway
Vegetation	Grass Pasture
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Mildly Alkaline

Soil Unit 1: Subnatric Grey-Brown Sodosol

Table 8 Site C8 Brown Sodosol

Profile	Horizon	Description
	B2	Brown (10YR 4/4) light clay, moderate structure. High field dispersion.

ASC Name	Grey-Brown Sodosol
Representative Site	C8
Other Mapped Detailed Sites	BS1, BS2, BS3, BS4, BS6
Survey Type	Check Site
Dominant Topography	Upper Slope
Dominant Land Use	Stock Laneway
Vegetation	Grass Pasture
Inherent Soil Fertility	Moderately Low
Field Dispersion	High
Field pH	Neutral

APPENDIX D

Laboratory Certificate 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

15 samples supplied by SLR Consulting Australia Pty Ltd on 30/11/2020. Lab Job No.K1174
Analysis requested by Murray Fraser. Your Job: PO: SLR 630 30108; Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
		Sample ID:	BS 2 0-10	BS 2 20-30	BS 2 40-50	BS 2 65-75	BS 3 0-10	BS 3 20-30
		Crop:	Soil	Soil	Soil	Soil	Soil	Soil
		Client:	Elgin	Elgin	Elgin	Elgin	Elgin	Elgin
	Parameter	Method reference	K1174/1	K1174/2	K1174/3	K1174/4	K1174/5	K1174/6
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.30	5.90	7.21	7.69	5.59	5.86
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.068	0.018	0.043	0.091	0.067	0.021
		(cmol$_+$/kg)	1.7	0.85	3.4	4.3	2.5	1.1
	Exchangeable Calcium	(kg/ha)	751	383	1,545	1,937	1,132	502
		(mg/kg)	335	171	690	865	505	224
		(cmol$_+$/kg)	0.49	0.26	2.6	5.9	0.69	0.27
	Exchangeable Magnesium	(kg/ha)	132	71	719	1,611	187	74
		(mg/kg)	59	32	321	719	83	33
		(cmol$_+$/kg)	0.36	<0.12	0.25	0.23	0.28	<0.12
	Exchangeable Potassium	(kg/ha)	312	<112	221	199	247	<112
		(mg/kg)	139	<50	99	89	110	<50
		(cmol$_+$/kg)	0.15	0.12	0.61	2.2	0.10	0.09
	Exchangeable Sodium	(kg/ha)	75	61	315	1,119	50	47
		(mg/kg)	33	27	141	500	22	21
		(cmol$_+$/kg)	0.19	0.06	0.01	0.01	0.04	0.05
	Exchangeable Aluminium	(kg/ha)	37	12	2.5	2.6	8.5	11
		(mg/kg)	17	5.2	1.1	1.2	3.8	4.8
		(cmol$_+$/kg)	0.23	0.09	<0.01	<0.01	0.17	0.05
	Exchangeable Hydrogen	(kg/ha)	5.1	2.1	<1	<1	3.8	1.2
		(mg/kg)	2.3	<1	<1	<1	1.7	<1
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	3.1	1.5	7.0	13	3.8	1.7
	Calcium (%)		54	59	49	34	66	66
	Magnesium (%)		16	18	38	47	18	16
	Potassium (%)	**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	12	5.1	3.6	1.8	7.4	6.2
	Sodium - ESP (%)		4.7	8.1	8.8	17	2.5	5.4
	Aluminium (%)		6.0	4.0	0.18	0.10	1.1	3.2
	Hydrogen (%)		7.4	6.3	0.00	0.00	4.5	3.1
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol$_+$/kg)	3.4	3.3	1.3	0.73	3.7	4.1
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	4.64	5.04	6.06	6.42	4.95	4.97
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10 YR 3/3 Dark Brown	10 YR 5/3 Brown	10 YR 6/1 Gray	5 Y 6/1 Gray	7.5 YR 3/2 Dark Brown	10 YR 6/2 Light Brownish Gray
	Mottles Munsell Colour		..	..	7.5 YR 5/8 Strong Brown	7.5 YR 6/8 Reddish Yellow	..	..
	Degree of Mottling (%)		..	..	30	80	..	..

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

15 samples supplied by SLR Consulting Australia Pty Ltd on 30/11/2020. Lab Job No.K1174
Analysis requested by Murray Fraser. Your Job: PO: SLR 630 30108; Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

			Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
		Sample ID:	BS 3 40-50	BS 3 65-75	BS 5 0-10	BS 5 30-40	BS 5 65-75	BS 6 0-10
		Crop:	Soil	Soil	Soil	Soil	Soil	Soil
		Client:	Elgin	Elgin	Elgin	Elgin	Elgin	Elgin
	Parameter	Method reference	K1174/7	K1174/8	K1174/9	K1174/10	K1174/11	K1174/12
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.98	7.25	5.09	6.61	6.22	5.40
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.030	0.076	0.057	0.016	0.020	0.072
		(cmol$_+$/kg)	2.9	5.1	2.0	0.55	2.4	2.6
	Exchangeable Calcium	(kg/ha)	1,308	2,307	881	247	1,099	1,170
		(mg/kg)	584	1,030	393	110	491	522
		(cmol$_+$/kg)	1.8	5.5	0.33	0.10	0.63	0.87
	Exchangeable Magnesium	(kg/ha)	486	1,500	89	27	172	238
		(mg/kg)	217	670	40	12	77	106
		(cmol$_+$/kg)	0.12	0.20	0.25	<0.12	0.17	0.58
	Exchangeable Potassium	(kg/ha)	<112	178	219	<112	146	511
		(mg/kg)	<50	79	98	<50	65	228
		(cmol$_+$/kg)	0.44	1.5	<0.065	<0.065	0.10	0.09
	Exchangeable Sodium	(kg/ha)	228	785	<33	<33	51	44
		(mg/kg)	102	350	<15	<15	23	20
		(cmol$_+$/kg)	0.02	0.01	0.08	<0.01	0.03	0.15
	Exchangeable Aluminium	(kg/ha)	3.3	2.5	16	1.7	6.3	29
		(mg/kg)	1.5	1.1	7.2	<1	2.8	13
		(cmol$_+$/kg)	<0.01	<0.01	0.16	<0.01	0.08	0.20
	Exchangeable Hydrogen	(kg/ha)	<1	<1	3.6	<1	1.9	4.4
		(mg/kg)	<1	<1	1.6	<1	<1	2.0
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	5.3	12	2.8	0.82	3.5	4.5
	Calcium (%)		55	41	69	67	71	58
	Magnesium (%)		34	44	12	12	18	19
	Potassium (%)	**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	2.3	1.6	8.8	13	4.8	13
	Sodium - ESP (%)		8.4	12	1.8	6.2	2.9	1.9
	Aluminium (%)		0.31	0.10	2.8	1.0	0.90	3.2
	Hydrogen (%)		0.00	0.00	5.7	0.00	2.4	4.4
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.6	0.93	6.0	5.6	3.9	3.0
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	5.68	6.00	4.50	5.90	5.26	4.58
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	2.5 Y 6/2 Light Brownish Gray	2.5 Y 6/1 Gray	7.5 YR 3/2 Dark Brown	10 YR 6/2 Light Brownish Gray	2.5 Y 6/2 Light Brownish Gray	7.5 YR 2.5/3 Very Dark Brown
	Mottles Munsell Colour		10 YR 5/6 Yellowish Brown	2.5 YR 4/8 Red	..	..	..	..
	Degree of Mottling (%)		10	60	..	..	..	..

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

15 samples supplied by SLR Consulting Australia Pty Ltd on 30/11/2020. Lab Job No.K1174
Analysis requested by Murray Fraser. Your Job: PO: SLR 630 30108; Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

	Parameter		Method reference	Sample 13	Sample 14	Sample 15	*Heavy Soil*	*Medium Soil*	*Light Soil*	*Sandy Soil*
	Sample ID:			BS 6 20-30	BS 6 40-50	BS 6 65-75				
	Crop:			Soil	Soil	Soil				
	Client:			Elgin	Elgin	Elgin	*Clay*	*Clay Loam*	*Loam*	*Loamy Sand*
				K1174/13	K1174/14	K1174/15	Indicative guidelines - refer to Notes 6 and 8			
	pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.19	6.07	8.23	*6.5*	*6.5*	*6.3*	*6.3*
	Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.032	0.084	0.134	*0.200*	*0.150*	*0.120*	*0.100*
	Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.1	6.5	8.4	*15.6*	*10.8*	*5.0*	*1.9*
		(kg/ha)		959	2,900	3,774	*7000*	*4816*	*2240*	*840*
		(mg/kg)		428	1,295	1,685	*3125*	*2150*	*1000*	*375*
	Exchangeable Magnesium	(cmol$_+$/kg)		1.2	9.0	12	*2.4*	*1.7*	*1.2*	*0.60*
		(kg/ha)		317	2,451	3,235	*650*	*448*	*325*	*168*
		(mg/kg)		142	1,094	1,444	*290*	*200*	*145*	*75*
	Exchangeable Potassium	(cmol$_+$/kg)		0.40	0.60	0.42	*0.60*	*0.50*	*0.40*	*0.30*
		(kg/ha)		351	530	369	*526*	*426*	*336*	*224*
		(mg/kg)		157	236	165	*235*	*190*	*150*	*100*
	Exchangeable Sodium	(cmol$_+$/kg)		0.09	1.3	2.3	*0.3*	*0.26*	*0.22*	*0.11*
		(kg/ha)		48	655	1,192	*155*	*134*	*113*	*57*
		(mg/kg)		21	292	532	*69*	*60*	*51*	*25*
	Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	0.03	0.27	0.01	*0.6*	*0.5*	*0.4*	*0.2*
		(kg/ha)		5.6	54	2.5	*121*	*101*	*73*	*30*
		(mg/kg)		2.5	24	1.1	*54*	*45*	*32*	*14*
	Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.03	0.25	<0.01	*0.6*	*0.5*	*0.4*	*0.2*
		(kg/ha)		<1	5.5	<1	*13*	*11*	*8*	*3*
		(mg/kg)		<1	2.5	<1	*6*	*5*	*4*	*2*
	Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	3.9	18	23	*20.1*	*14.3*	*7.8*	*3.3*
	Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	55	36	36	*77.6*	*75.7*	*65.6*	*57.4*
	Magnesium (%)			30	50	52	*11.9*	*11.9*	*15.7*	*18.1*
	Potassium (%)			10	3.4	1.8	*3.0*	*3.5*	*5.2*	*9.1*
	Sodium - ESP (%)			2.4	7.1	10	*1.5*	*1.8*	*2.9*	*3.3*
	Aluminium (%)			0.72	1.5	0.05	*6.0*	*7.1*	*10.5*	*12.1*
	Hydrogen (%)			0.75	1.4	0.00				
	Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.8	0.72	0.71	*6.5*	*6.4*	*4.2*	*3.2*
	pH		**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	5.27	4.98	7.09	..			
	Moist Munsell Colour		**Inhouse Munsell Soil Colour Classification	10 YR 4/4	10 YR 4/4	2.5 Y 4/1	..			
				Dark Yellowish Brown	Dark Yellowish Brown	Dark Gray	..			
	Mottles Munsell Colour			..	2.5 YR 3/6	7.5 YR 5/8	..			
				..	Dark Red	Strong Brown	..			
	Degree of Mottling (%)			..	50	5	..			

GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

15 soil samples supplied by SLR Consulting Pty Ltd on 30 November, 2020 - Lab Job No. K1174.
Analysis requested by Murray Fraser. Your Project: PO SLR 630 30108 Bathurst Solar
10 Kings Road NEW LAMBTON NSW 2305

SAMPLE ID	Lab Code	MOISTURE CONTENT (% of water in air-dry sample)	TOTAL GRAVEL > 2 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 ISSS (% of total oven-dry equivalent)	CLAY < 2 µm (% of total oven-dry equivalent)	Total soil fractions (incl. Gravel)
BS 2 0-10	K1174/1	15.0%	51.1%	2.5%	30.5%	9.3%	6.6%	100.0%
BS 2 20-30	K1174/2	8.0%	46.8%	2.0%	34.7%	9.5%	6.9%	100.0%
BS 2 40-50	K1174/3	8.4%	31.4%	5.6%	29.7%	7.1%	26.3%	100.0%
BS 2 65-75	K1174/4	13.7%	24.9%	15.0%	16.2%	9.6%	34.3%	100.0%
BS 3 0-10	K1174/5	14.1%	46.7%	2.5%	34.9%	9.3%	6.5%	100.0%
BS 3 20-30	K1174/6	7.5%	50.1%	2.4%	33.2%	9.9%	4.4%	100.0%
BS 3 40-50	K1174/7	8.3%	42.3%	1.8%	24.6%	10.3%	20.9%	100.0%
BS 3 65-75	K1174/8	17.0%	23.9%	1.0%	21.5%	11.1%	42.4%	100.0%
BS 5 0-10	K1174/9	10.9%	50.5%	1.4%	35.1%	9.0%	4.0%	100.0%
BS 5 30-40	K1174/10	4.3%	54.4%	1.1%	32.5%	11.2%	0.8%	100.0%
BS 5 65-75	K1174/11	6.5%	56.9%	1.7%	23.1%	7.7%	10.5%	100.0%
BS 6 0-10	K1174/12	17.9%	47.7%	3.5%	32.3%	8.5%	8.1%	100.0%
BS 6 20-30	K1174/13	5.0%	40.1%	5.8%	31.4%	11.1%	11.7%	100.0%
BS 6 40-50	K1174/14	20.9%	13.1%	0.7%	15.2%	8.5%	62.5%	100.0%
BS 6 65-75	K1174/15	16.5%	17.1%	0.6%	25.1%	8.4%	48.9%	100.0%

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.

5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions.
These Terms and Conditions are available on the EAL website: scu.edu.au/eal, or on request.

6. This report was issued on 09/12/2020.

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

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

APPENDIX E

External Peer Review

MINESOILS
LAND & REHABILITATION SPECIALISTS

19th October 2022

SLR Consulting Australia Pty Ltd
10 Kings Road,
New Lambton NSW 2292

Attention: Murray Fraser

Dear Murray,

Re: Glanmire Solar Farm BSAL and LSC Assessments – Peer Review

Overview

Minesoils was engaged by SLR Australia Pty Ltd (SLR) to provide specialised technical advice in the form of a peer review of soil and land assessments undertaken for the proposed Glanmire Solar Farm Project, located 4823 Great Western Highway, Glanmire, NSW 2795.

SLR was commissioned to complete two assessments:

- Biophysical Strategic Agricultural Land (BSAL) Assessment; and
- Land & Soil Capability (LSC) Assessment.

Both assessments were undertaken to form part of the site due diligence and ultimately inform any Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act)

Minesoils is a specialist environmental consulting firm providing expertise and practical advice to the mining, infrastructure and power related industries in the areas of soils, agriculture and rehabilitation. Minesoils Director, Clayton Richards is a Certified Professional Soil Scientist (CPSS). Minesoils has reviewed the aforementioned assessments as provided by SLR. The findings of the review are presented in this report.

BSAL Assessment

The scope for work for the SLR BSAL assessment included the following:

- Detailed assessment of the site and soil characteristics as per the requirements of the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*. NSW Office of Environment and Heritage (2012)(the Interim Protocol);
- Completion of field work to obtain required level of field samples in accordance with the Interim Protocol);
- The assessment should identify areas of the Project Area that may be considered BSAL or otherwise including mapping at the appropriate scale;
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in the Interim Protocol

It is noted that solar farm projects do not require a BSAL Site Verification Certificate (SVC) prior to lodgement of a Development Application. SVC's are only required under *The State Environment Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment* 2013. Further, as per the revised *Large Scale Energy Guideline* (Department of Planning and Environment, 2022) solar farms are not required to verify BSAL. Nonetheless, Minesoils has reviewed SLRs assessment against the aforementioned scope of works.

Minesoils found that the BSAL assessment was generally undertaken as per the requirements of the *Interim Protocol.* The assessment identified the entire Project Area to be verified Non-BSAL, which Minesoils confirms to be accurate. However, Minesoils recent experience with the NSW Department of Planning, Industry and Environment - Environment, Energy and Science Division soils team across multiple projects during the early to mid-2022 period has clarified new expectations around subtleties of the BSAL assessment process. Therefore, based on our recent experience, and while Minesoils agrees with the outcome of the assessment, the following key notes are provided for your consideration.

- There is a degree of risk related to the mapping of sites 4 and 5. Site 5 is a verified Chromosol and site 4 is confirmed as a duplex soil and assumed to be sodic. As site 4 is not verified as sodic, it could be argued that the area through the middle of the Project Area may be significant enough to break it into two soil map units given it would be about half of the site. If samples were collected for site 4, our recommendation would be to get them tested for sodicity to bolster soil mapping. A recent example confirmed EEC did not accept check sites as a Sodosol, without lab tested ESP despite being within 100m of a lab tested verified Sodosol. Based on our recent experience, if this went to EEC, they may agree that it is not BSAL but they'd want another site confirming Sodosol or Chromosol.
- As per above, EEC did not accept check sites if they could not be allocated to a soil type. For duplex soils, laboratory data is required to determine weather soil is a Kurosol, Sodosol or a Chromosol. Therefore, for the site assessment nomenclature, only sites with laboratory data would be considered as 'detailed' sites. However, this feedback is only relevant if you were applying for an SVC through DPE and the EEC soil team, which is not required for this project.
- The A2 horizon of Site 5 is described as a bleached horizon but has a Munsell of 10YR 5/3 (Brown). Bleached soil is defined as any colour chip with a value of 7 or 8 and a chroma of 4 or less on the 5YR, 7.5YR or 10YR charts. Perhaps include a dry field Munsell colour to clarify.
- Soil types should be classified to the family level, as per *Interim Protocol*. Minesoils recommends updating Table 10 and the soil profile sheets accordingly.

For additional minor points and comments, please refer to BSAL assessment report attachment.

LSC Assessment

The scope for work for the SLR LSC assessment included the following:

- Detailed assessment of the site and soil characteristics as per the requirements of *The Land and Soil Capability Assessment Scheme; Second Approximation* (NSW Office of Environment and Heritage, 2012)(LSC Assessment Scheme).
- Completion of field work to obtain required level of field samples in accordance with the *LSC Assessment Scheme*.
- Documentation of the results of the detailed assessment comprising of a written report and associated mapping to address specific items in *LSC Assessment Scheme*.

Minesoils found that the LSC assessment undertaken by SLR was generally undertaken as per the requirements of the *LSC Assessment Scheme,* with the exception of the following items:

- For the LSC assessment hazard criteria 2 (wind erosion hazard), if the assessment is assuming the site has high exposure to high wind (which the classifications of LSC 4 generally indicate), site 5 should have an LSC of 7 based on an estimated wind erodibility for loamy sand topsoil as high.
- For the LSC assessment hazard criteria 4 (soil acidification), site 5 should have a LSC class of 5 based on loamy sand topsoil having a very low estimated buffer capacity and a pH of 5.1.
- LSC classes for the soil acidification hazard of sites 1 and 4 could not be verified as laboratory or field pH data is not presented. Nonetheless, the overall LSC for these sites are assumed to be in line with representative sites based on shared hazard criteria limitations.
- For LSC assessment hazard criteria 6 (waterlogging hazard), all sites are allocated LSC 4 based on being 'imperfectly drained'. However, as per the soil descriptions and the BSAL report, these sites are noted to be 'poorly drained', which would result an LSC of 6 to be consistent between reports.

Based on the above items, Minesoils suggests the LSC for the site would be 6 for all areas except where the loamy sand topsoils associated with the subdominant Chromosols can be separated out, which would be LSC class 7.

Therefore, the classification of the Project Area as LSC 4 - 5 and having moderate to moderately low agricultural capability according to definitions given in the LSC Assessment Scheme should be considered conservative. There is evidence to suggest the site should be classified as LSC 6 – 7, which is low to very low capability land.

Minesoils acknowledges the conservative approach taken by SLR is likely based on a more practical understanding of the site and its present and historical land uses.

Contact

To further discuss Minesoils review of the SLR soil and land assessments undertaken at Glanmire, please feel free to contact me on the details provided below.

Yours sincerely,

Clayton Richards.
Principal Consultant & Director
Minesoils Pty Ltd

Mobile: 0408 474 248
E-mail: clayton@minesoils.com.au

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

APPENDIX C

Agricultural Productivity Gross Margin Sensitivity Analysis

MERINO EWES (20 micron) - Terminal Rams

Farm Enterprise Budget Series - 2020 (average wool and sheep price 1 Apr to 30 Sep)

NSW GOVERNMENT Department of Primary Industries

Flock size: 4348 ewes **Farm Size** 1000Ha
Ewe body weight: 59 kgs
DSE rating: 2.30 DSEs/ewe

						Standard Budget ($)	Your Budget ($)
INCOME							
Wool		**number**	**class**	**kg /hd**	**$/kg**		
Shear		4087	ewes	5.16	$7.35	$154,858	
		87	rams	3.50	$2.85	$868	
Crutch		4348	mixed ages	0.40	$5.78	$10,054	
		3883	xb lambs/rams	0.25	$2.22	$2,154	
Sheep Sales		**number**	**class**	**$ /hd**			
		720	CFA ewes	$164.66	(26.0 kg cwt)	$118,555	
		18	CFA rams	$160.81		$2,895	
	10 months	1898	mixed sex lambs	$164.40	(20.0 kg cwt)	$312,031	
	11 months	1898	mixed sex lambs	$172.94	(22.0 kg cwt)	$328,240	
Fodder		**tonnes**	**type**	**value per tonne**			
Graz/fodder crop		0 t	0	$0 /t		$0	
				A. Total Income:		**$929,654**	
VARIABLE COSTS							
Replacements		**number**	**class**	**cost ($)/hd**	**reps**		
		18	rams	$1,100.00		$19,800	
		980	ewes	$219.00		$214,620	
Cartage		980	ewes	$2.10		$2,058	
Cartage		18	rams	$51.00		$918	
Wool Harvesting & Selling Costs							
Shearing		4087	ewes	$7.42	1	$30,314	
		87	rams	$10.66	1	$927	
Crutching		4348	ewes	$1.56	1	$6,801	
		87	rams	$2.74	1	$239	
		3796	weaners	$1.56	1	$5,937	
Wool tax				1.50%		$2,519	
Commission, warehouse, testing charges				$40.50/ bale		$5,872	
Wool - cartage		145	bales	$11.00		$1,595	
- packs		145	packs	$10.75		$1,559	
Sheep Health		**number**	**class**				
Broadspectrum		4435	adults	$1.28	2	$11,354	
		3913	weaners	$0.60	3	$7,043	
Narrowspectrum		4435	adults	$0.72	1	$3,193	
		3913	weaners	$0.37	1	$1,448	
Lice control		4174	adults	$1.47	1	$6,136	
Fly control (long acting)		4435	adults	$1.89	1	$8,382	
Fly control (short acting)		3913	weaners	$0.41	1	$1,604	
Vaccination- 6 in 1		4435	adults	$0.36	1	$1,597	
		4044	lambs	$0.36	2	$2,912	
Mark		4044	lambs	$2.25	1	$9,099	
Scanning		4348	ewes	$0.80	1	$3,478	
Livestock Selling Costs							
Livestock cartage		4,534	sale sheep	$2.10		$9,521	
Commission on sheep sales				4.50%		$34,277	
Levies (Yard dues, MLA Transaction levy and LLS rates)						$13,594	
Pasture maintenance		1000 ha	@	$38 /ha		$38,000	
Fodder							
			Supplementary feed @ $315 /t				
Ewes/Rams		4174	3.5 kg/hd/week	$0.32 /kg	10 weeks	$45,492	
Mixed sex lambs		3796	5.0 kg/hd/week	$0.32 /kg	12 weeks	$71,744	
	Total feed		372,180 kg	@	$315 /t	**$117,237**	
Graz/fodder crop		0 ha	@	$200 /ha		$0	
				B. Total Variable Costs:		**$562,035**	

	excl. fodder	incl. fodder
GROSS MARGIN (A-B)	**$484,856.11**	**$367,619.28**
GROSS MARGIN /EWE	**$111.51**	**$84.55**
GROSS MARGIN /DSE	**$48.48**	**$36.76**
GROSS MARGIN /HA	**$484.84**	**$367.60**

ASSUMPTIONS MERINO EWES (20 micron) - Terminal Rams

1. Flock Parameters

Flock mortality	6%	Ram %	2%
Productive life	5 years	Marking %	93%
Ewe body weight	59 kg	Weaning %	90%
DSE rating /ewe	2.3	Weaning age	3 months
Stocking rate/ha	10 dse's		

Pasture maintenance = 90kg/ha single super @ $350t + $6.50/ha application

2. Flock Structure

Age	Number of ewes
1.5	980
2.5	922
3.5	866
4.5	814
5.5	765
6.5	0
Total	**4348**

Sheep numbers are modified to reflect mortality throughout the year.

980 **replacements bought**

4044 **lambs** → 3913 **weaners** → 3796 **mixed sex lambs sold**

720 **CFA's sold**

3. Wool Prices

Merino Ewe	Micron	AWEX Type	Clean price	Yield	Greasy price	Specifications (all 35n/ktex)	Proportion of Clip
- Fleece GTM	20	MF5B.	$12.39	65%	$8.08	1%VMB, 90mm	75%
- Skirtings/bellies	19	MP5B.	$10.13	56%	$5.65	4.8%VMB, 80mm	20%
- Cardings	20	MZ2B.	$6.20	52%	$3.22	2.9%VMB.	5%
					$7.35		used in budget

4. Sensitivity Tables - Changes in Gross Margin $/DSE (includes fodder)

Wool Cut kg/hd	Adult Greasy Wool Price $/Kg greasy				
	$5.15	$3.68	**$7.35**	$8.45	$9.56
3.61 kg	$29.21	$27.07	$32.41	$34.01	$35.61
4.38 kg	$30.70	$28.10	$34.58	$36.53	$38.47
5.16 kg	$32.18	$29.13	**$36.76**	$39.05	$41.34
5.93 kg	$33.68	$30.17	$38.94	$41.57	$44.20
6.70 kg	$35.17	$31.20	$41.12	$44.09	$47.07

Cast for age $/Hd	Replacement ewe cost $/Hd				
	$153.30	$186.15	**$219.00**	$251.85	$284.70
$115.26	$39.80	$36.58	$33.36	$30.14	$26.93
$139.96	$41.50	$38.28	$35.06	$31.84	$28.62
$164.66	$43.20	$39.98	**$36.76**	$33.54	$30.32
$189.36	$44.90	$41.68	$38.46	$35.24	$32.02
$214.06	$46.60	$43.38	$40.16	$36.94	$33.72

Domestic Lamb $/Hd	Weaning %				
	63%	77%	**90%**	104%	117%
$115.08	$15.68	$21.75	$27.82	$33.89	$39.96
$139.74	$18.81	$25.55	$32.29	$39.03	$45.76
$164.40	$21.94	$29.35	**$36.76**	$44.17	$51.57
$189.06	$25.07	$33.14	$41.23	$49.31	$57.38
$213.72	$28.20	$36.94	$45.70	$54.45	$63.19

Domestic Lamb $/Hd	Export Lamb $/Hd				
	121.06	147.00	**172.94**	198.88	224.82
$115.08	$18.42	$23.12	$27.82	$32.52	$37.22
$139.74	$22.89	$27.59	$32.29	$36.99	$41.69
$164.40	$27.36	$32.06	**$36.76**	$41.46	$46.16
$189.06	$31.83	$36.53	$41.23	$45.93	$50.63
$213.72	$36.30	$41.00	$45.70	$50.40	$55.10

Note: The above sensitivity tables vary price and quantities by +/- 15% and +/- 30%.

Feed m/sex lamb kg/Hd/wk	Feeding ewes kg/Hd/week				
	1.73 kg	2.60 kg	**3.46 kg**	4.33 kg	5.19 kg
2.50 kg	$42.62	$41.48	$40.35	$39.21	$38.07
3.75 kg	$40.83	$39.69	$38.55	$37.42	$36.28
5.00 kg	$39.03	$37.90	**$36.76**	$35.62	$34.49
6.25 kg	$37.24	$36.10	$34.97	$33.83	$32.69
7.50 kg	$35.45	$34.31	$33.17	$32.04	$30.90

Feed m/sex lamb kg/hd/wk	Grain price $/Tonne				
	$157.50	$236.25	**$315.00**	$393.75	$472.50
2.5 kg	$44.42	$42.38	$40.35	$38.31	$36.28
3.8 kg	$43.52	$41.04	$38.55	$36.07	$33.59
5.0 kg	$42.62	$39.69	**$36.76**	$33.83	$30.90
6.3 kg	$41.73	$38.35	$34.97	$31.59	$28.21
7.5 kg	$40.83	$37.00	$33.17	$29.35	$25.52

Note: The feeding sensitivity tables vary quantities/cost by +/- 25% and +/- 50%.

Sheep and wool prices thanks to MLA market reporting, AuctionsPlus and AWEX. Wool cuts based on wether trial data

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

NEWCASTLE CBD
Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Australia
T: +61 2 4940 0442

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
Level 4, 12 O'Connell Street
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628