SMK
CONSULTANTS
surveying – irrigation – environmental – planning
ABN 63 061 919 003

39 Frome Street
PO Box 774
Moree NSW 2400
Ph 02 6752 1021
Fax 02 6752 5070
admin@smk.com.au

www.smk.com.au

STATEMENT OF ENVIRONMENTAL EFFECTS

THUNDERBOLT COMMUNITY SOLAR FARM

152 Staces Road, Uralla NSW 2358
Lot 385 in Deposited Plan 755846

October 2020

SMK

CONSULTANTS

surveying – irrigation – environmental – planning

ABN 63 061 919 003

DOCUMENT CONTROL

Project Name	Thunderbolt Community Solar Farm at 152 Staces Road, Uralla
Proponent	Medam Holdings Pty Ltd
Project Reference	20-164
Report Number	20-164 Statement of Environmental Effects
Prepared for	Medam Holdings Pty Ltd (Meralli Projects) PO Box 302 Uralla NSW 2358 Contact: Methuen Morgan Ph: 0429 192 087 E: methuen@meralliprojects.com.au
Prepared by	SMK Consultants PO Box 774 39 Frome Street Moree NSW 2400
Contact	Hayley Bouliopoulos Ph: (02) 6752 1021 E: hayley@smk.com.au

Author	
	Hayley Bouliopoulos
Name	Hayley Bouliopoulos BB. BSc. Env
Position	Environment & Resource Consultant
Company	SMK Consultants

Reviewed *By*	
	Peter Taylor
Name	Peter Taylor BSc MEIANZ CIAg LAA
Position	Director
Company	SMK Consultants

Revision History			
Version Number	Date	Authority	Details
0	September 2020	Hayley Bouliopoulos	Initial Issue for Client review
1	October	Peter Taylor	For submission

EXECUTIVE SUMMARY

Applicant:	Medam Holdings Pty Ltd PO Box 302 Uralla NSW 2358
Subject Land:	152 Staces Road, Uralla NSW 2358 Lot 385 in Deposited Plan 755846 Owners: Kambo Developments Pty Ltd Zoning: IN1 – General Industrial
Proposed Development:	Application for approval of solar farm development
Permissibility:	The proposed development is permissible with consent under the State Environmental Planning Policy (Infrastructure) 2007
Type of Development:	Regional Development under the State Environmental Planning Policy (State and Regional Development) 2011
Capital Investment Value:	$11 million
Consent Authority:	The consent authority is the Northern Regional Planning Panel

Proposal Summary

The development encompasses the construction and operation of a solar farm with a maximum transfer capacity 4.95MW AC (~8.8MW DC). The development will consist of:

- Four solar arrays, 4 blocks wide (east-west) and 4 blocks long (north-south). Each block is made up of 336 PV modules arranged 14 PV modules long (north-south) and 24 PV modules wide (east-west). The PV module will be a Global Tier 1 panel.
- 2 combined Medium Voltage Power Stations (MVPS) Inverter/Transformers.
- 8 battery storage containers with a combined storage capacity of 20 MWh (2.5 MWh per container).
- Overhead 11kV line with MV pole mounted recloser.
- 1.8m surrounding chain wire fence with 3 x 6m double leaf gate.

Uralla Shire Council is the local government authority for the area and therefore the appropriate assessment manager for the proposed development. It is necessary for the Uralla Shire Council to consider the development application, undertake any necessary public notification and refer any matters to the relevant authorities (including the local traffic committee) as required, prior to exercising its delegated functions.

TABLE OF CONTENTS

1 Introduction

SMK Consultants has been engaged by the proponent, Medam Holdings Pty Ltd to prepare this Statement of Environmental Effects (SoEE). This report will accompany a Development Application (DA) to the Uralla Shire Council. The application seeks consent for the installation and operation of the proposed Thunderbolt Community Solar Farm to be located at 152 Staces Road, Uralla (Lot 385 in Deposited Plan 755846).

This statement has been prepared to address the proposed development in accordance with the *Uralla Local Environment Plan 2012* (Uralla LEP) and the *Uralla Development Control Plan 2012* (DCP). The SoEE addresses the matters for consideration outlined in Section 4.15 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This SoEE focuses on the key assessment requirements and recommends mitigation measures where possible to reduce potential environmental impacts.

1.1 Applicant Details

The proponent for the proposed Thunderbolt Community Solar Farm is Medam Holdings Pty Ltd (Meralli Projects). The applicant's contact details are summarised in Table 1. Meralli Projects is a locally based company that specialises in the construction of utility scale solar power stations. The company was established in 2017 and operates within regional NSW. The business is dedicated to generating economic growth within rural communities and building strong community relationships. It is part of the operational principles of Meralli Projects to source the labour component and consumable products from local suppliers wherever possible.

Table 1: Applicant Details

Organisation	**Medam Holdings Pty Ltd (Meralli Projects)**
ABN	59 635 435 700
Address	PO Box 302
	Uralla NSW 2358
Contact Name	Methuen Morgan
Phone Number	0429 192 087
Email	methuen@meralliprojects.com.au

1.2 Authors

This SOEE has been prepared by SMK Consultants. SMK Consultants is a well-established company operating out of Moree, NSW, and is a key player in providing for continued economic growth for many of NSW'S North-West Government areas. SMK Consultants has been actively involved in many developments in the commercial, industrial and retail sectors. Persons involved in the preparation of this SOEE and its appendices are:

- **Hayley Bouliopoulos** BB. BSc. Env
- **Peter Taylor** BSc MEIANZ CIAg LAA

2 Site Analysis

2.1 Site Location

The proposed development site is at 152 Staces Road, Uralla. The site is located approximately 2.8 kilometres south of Uralla in north-eastern New South Wales. A locality plan showing the site in relation to the township of Uralla has been included as Figure 1.

Figure 1: Locality Plan

2.2 Property Description

The real property description of the land is Lot 385 in Deposited Plan 755846. The property is owned by Kambo Developments Pty Ltd.

The subject lot is located within the Local Government Area of the Uralla Shire. The subject land is currently zoned IN1 'General Industrial' under the *Uralla Local Environmental Plan 2012*. The surrounding locality is bordered on all sides by land zoned as RU1 'Primary Production', which is primarily utilised for grazing and rural living.

The development footprint will cover approximately 6.7 hectares and is located on previously disturbed land. The proposed development will utilise an existing site access to the property from Staces Road. A plan outlining the solar farm site is presented below. The site slopes to the north-east.

Figure 2: Proposed Development Site

2.3 Site Constraints

There is an existing power line in close proximity to the property. This lines connects into Essential Energy's 11kV distribution network. The proximity of this line is important with respect to reducing the resources required to deliver power from the solar farm to the grid. The Essential Energy 11 kV distribution feeds back to the High Street Uralla Substation which is identified as URA3B1. There are no other services available to the site, but this does not constitute a constraint as no other services are required.

The subject site was historically utilised as a timber treatment plant known as the 'Koppers Timber Treatment Site' and as such was previously listed as a contaminated site. The site has since been remediated and removed from the formal list of contaminated sites. Further information, including a preliminary contamination assessment has been included within the relevant sections of this report.

2.4 Adjoining Properties

The development land is bordered on all sides by land zoned RU1 Primary production. The nearest sensitive receptor (rural residential dwelling) to the proposed development is located approximately 230 metres east of the subject site.

2.5 Site Suitability

The subject site is zoned IN1 – General Industrial and 'Electricity Generating Works' are permitted with consent under *State Environmental Planning Policy (Infrastructure) 2007*.

The specific site has been selected due to its proximity to Essential Energy's 11kV network. However, the area and region in general, is extremely well suited for solar farms due to the extremely high solar resource which increases solar PV electricity generation. The site also benefits from previous clearing which negates the need for significant disturbance to any greenfield areas with potential biodiversity value.

2.6 Climate

Global solar exposure is described on the Bureau of Meteorology website as being the total amount of solar energy falling on a horizontal surface. The daily global solar exposure is the total solar energy for a day. Typical values for daily global solar exposure range from 1 to 35 MJ/m^2 (megajoules per square metre). The values are usually highest in clear sun conditions during the summer, and lowest during winter or very cloudy days.

Figure 3 below shows average daily solar exposure for the 12-month period between the 1st of May 2019 and the 30th of April 2020. Uralla LGA has received on average between 18 and 20 MJ/m^2 each day, placing it within the second highest area receiving solar radiation in New South Wales.

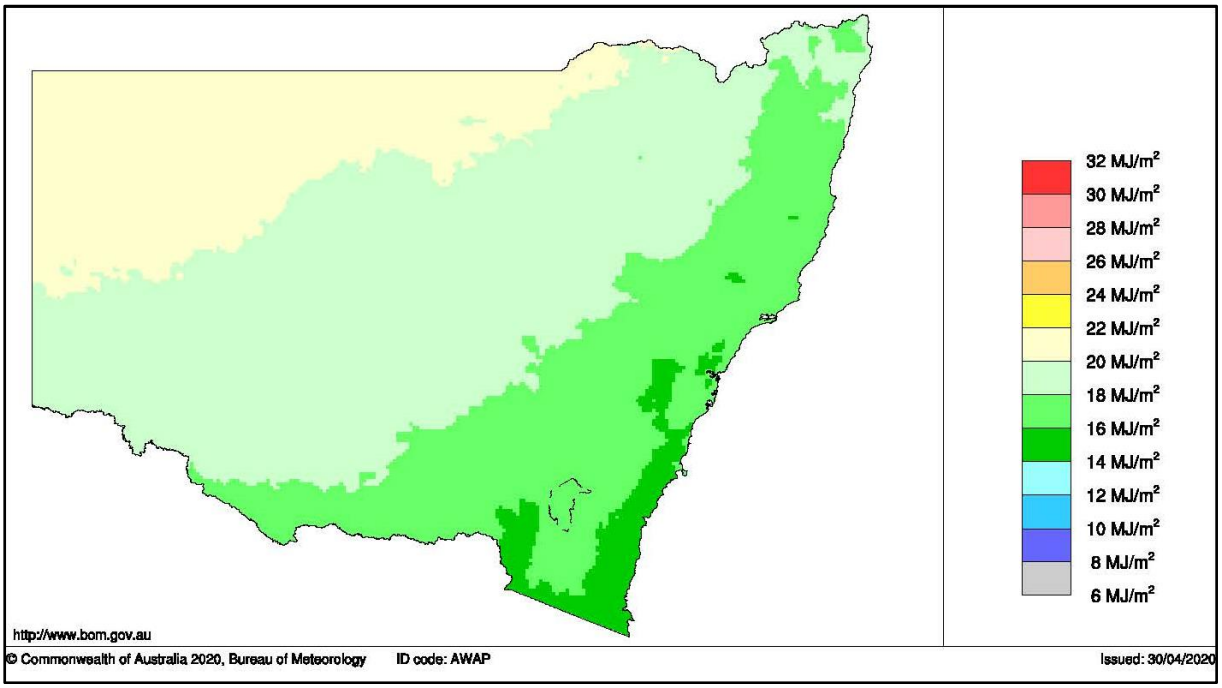


Figure 3: Average Daily Solar Exposure. Source: Australian Bureau of Meteorology (2020)

Table 2 provides the mean daily solar exposure measured at Uralla (Dumaresq Street) (Station number 056034), the closest measuring station to the proposed Thunderbolt Community Solar Farm site. The annual average is 18.2MJ/m^2 (1990-2020).

Table 2: Mean Daily Solar Exposure (MJ/m^2) at Uralla BOM Site

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
25.1	22.2	19.2	15.6	12.0	10.0	11.1	14.5	18.4	21.7	23.5	25.0

Source: Climate Statistics, BOM (May 2020).

The map below (Figure 4) shows the average daily hours of sunshine across Australia. Uralla LGA receives an average of 7 to 8 hours of sunshine each day.

Global solar exposure coincides with seasons – the longer the daylight hours the greater the solar radiation due to the tilt of the earth during summer months. Rainfall is spread relatively evenly across the year and as a result, does not appear to impact on the level of solar radiation.

Solar exposure estimates are important for a wide range of applications, including for agriculture, power generation and solar heating system design and use. This climatic information sourced from the Australian Bureau of Meteorology indicates that the global solar exposure, or solar radiation, is sufficient to support power generation in the proposed location which benefits from the presence of 11kV power lines transecting the development site.

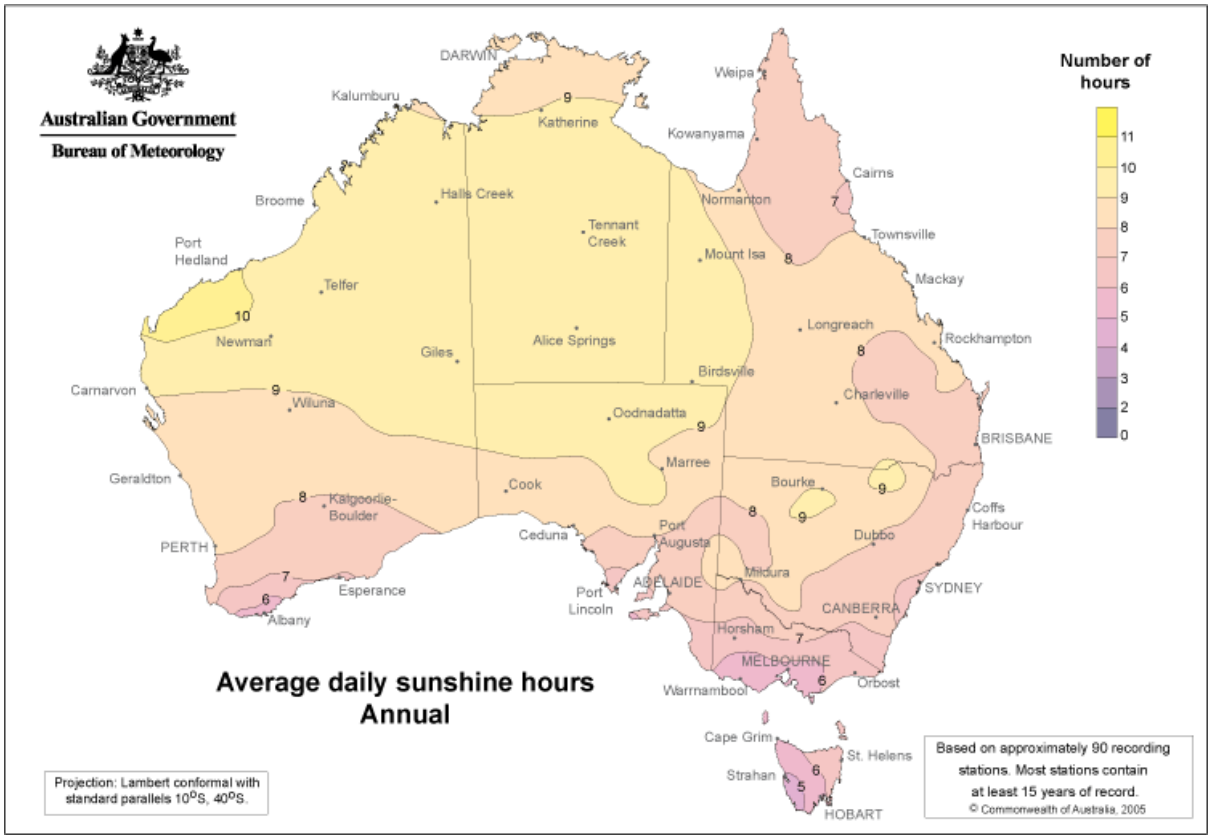


Figure 4: Average Daily Sunshine Hours. Source: Australian Bureau of Meteorology

3 Development Details

3.1 Proposal Description

The development encompasses the construction and operation of a solar farm with a maximum transfer capacity 4.95 MW AC (~8.8MW DC). The development will consist of:

- Four solar arrays, 4 blocks wide (east-west) and 4 blocks long (north-south). Each block is made up of 336 PV modules arranged 14 PV modules long (north-south) and 24 PV modules wide (east-west). The PV module will be a Global Tier 1 Panel.
- 2 combined Medium Voltage Power Stations (MVPS) Inverter/Transformers.
- 8 battery storage containers with a combined storage capacity of 20 MWh (2.5 MWh per container).
- Overhead 11kV line with MV pole mounted recloser.
- 1.8m surrounding chain wire fence with 3 x 6m double leaf gates.

The proposal has an estimated capital investment value of $11 million.

Figure 5 presents a preliminary layout of the proposal and associated infrastructure including the PV field, inverters, battery storage and fence. The PV field will cover an area of approximately 4.75 Ha over previously disturbed land that is currently utilised for grazing. The total footprint of the site including the external drains and security fence will be approximately 6.7 Ha. The infrastructure to convert the solar power is to be located central to the facility. This will include the inverter, transformer and battery storage facilities.

The proposal will utilise the existing site access to the property from Staces Road.

Adequate erosion and sediment control devices will be established prior to, during and after construction works in accordance with the requirements of Council.

The proposed development will also include additional vegetation screening and the construction of a wetland system with reed beds that are considered to improve the visual aesthetics and overall appearance of the site.

Figure 5: Solar Farm Layout

3.2 Infrastructure

The solar farm will utilise multi-crystalline solar photovoltaic (PV) panel technology and have a dual East/West fixed configuration to assist in maximising higher yields in the morning and afternoon. This is in contrast to a single angle fixed-tilt alternative that can only maximise yields in the middle of the day and also in contrast to single and multi-axis trackers which can result in higher running costs.

The power conversion from direct-current (DC) to alternating-current (AC) will be through central inverters which will generate 11 kV of power directly into Essential Energy's existing 11 kV distribution network that dissects the site. This approach offers high conversion efficiencies and reduced AC reticulation losses.

The farm will be designed in accordance with all applicable standards as well as the requirements of Essential Energy and the National Electricity Rules (NER).

Key infrastructure associated with the solar farm includes:

- Solar Photovoltaic (PV) panels on a dual East/West static configuration.
- Inverters and step-up transformers to convert direct current (DC) electricity produced by the solar PV panels into alternating current (AC) capable of being connected to the electrical grid.

- Above-ground and underground electrical conduits and cabling to connect the solar PV panels to the inverters and transformer.
- Internal access tracks to allow for on-going site maintenance will be formed on an as-required basis.
- Perimeter security fencing.

Full detailed drawings have been included as Appendix 1.

3.2.1 Photovoltaic Panels

The solar farm will utilise the latest solar panel and inverter technologies to ensure maximum efficiency and energy generation. The solar farm will utilise Tier 1 photovoltaic (PV) panels made of tempered glass with an anti-reflective coating.

On the lower edge, the PV modules will be approximately 800mm above ground and on the higher edge they will be approximately 950mm above ground. A structural certificate will be prepared and included as part of the Construction Certificate if approval is granted.

3.2.2 Combined Inverter and Transformer Stations

The two inverter stations convert DC power into AC power and feed into the attached sub-stations, which in-turn feeds into Essential Energy's 11kV distribution network. This is achieved by connecting multiple strings of PV panels together via DC combiner boxes which are then connected to the inverter at the required DC input voltage. A total of two MVPS skid and inverter stations will be installed. Each central inverter will attach directly to a step-up transformer which will increase the output voltage to 11 kV. The proposed combined inverter and transformer station will be similar to that displayed in Figure 6.

Figure 6: MVPS Skid and Inverter

The substations on-site will interface between the solar farm and Essential Energy's 11kV distribution network. The substation will include step-up transformers as well as protection equipment (such as circuit breakers).

The high voltage switch gear will be controlled through a data communication and monitoring network allowing the farm to be managed during periods of peak demand to better suit Essential Energy's network requirements.

3.2.3 Battery Storage Containers

There will be a total of 8-battery storage containers with a combined storage capacity of 20 MWh (2.5 MWh per container). The containers would each be standard 12m containers, and the batteries would be lead acid.

3.2.4 Security

All infrastructure associated with the Thunderbolt Community Solar Farm is to be enclosed within a 1.8 metre high security fence. This fence will be a chain link fence. An indicative security fence is displayed in Figure 7. Security lighting is not proposed to be installed. The fence is to be constructed to exclude public and animal access to the site.

Figure 7: Indicative Security Fence

3.3 Construction

3.3.1 Installation Philosophy

The solar farm installation philosophy will adopt a cascade approach of phases and utilise a standard block comprising solar PV panels and a central inverter. The intention of the standard blocks is to roll-out the installation in waves to maximise efficiency of installation activities.

3.3.2 Construction Timeline

Construction is estimated to take between 10-12 weeks. The intention is to maximise the use of local employment in various aspects of the construction subject to the required work health and safety (WHS) standards and technical requirements of voltage levels and components.

The key stages of the construction of the solar farm will include:

- Mobilisation/site establishment
- Construction (in phases with pre-commissioning)
- Commissioning (including final grid connection)
- Site restoration/demobilisation

The construction works will be phased, utilising a standard block approach which allows for the cascading of these blocks across the phases. A standard block allows for repetitive activities before rollout, such as footings, mounting systems, DC installation and inverters. There will be site establishment activities required to prepare the site before the phases commence. Site establishment activities include establishment of the construction compound and laydown area, perimeter fencing, formation of internal roads and the installation of erosion and sediment controls.

There will be six steps in a standard block including footings, trenches and DC cabling, mounting system assembly, string cabling and combiner boxes, module assembly and string connection and testing (pre-commissioning). In addition to these steps a separate step is required for the inverter delivery to site, this includes foundations, electrical interconnection and start-up testing prior to commissioning.

3.3.3 Construction Workforce

It is expected that there will be two dedicated teams to support the installation of the standard blocks, an assembly team and an electrical team.

- The assembly team specialises in the assembly of the components that connect to the foundations as well as the mounting and interconnection of the solar PV panels.
- The electrical team requires qualified electricians to manage low, medium and high voltage activities as well as unskilled labourers to support with cable layout and logistics aspects.

A separate civil team will be required for the construction of the cable trenches and foundation requirements for the inverters and transformer.

It is expected that the construction workforce at its peak will be around eighteen (18) workers on-site.

3.3.4 Construction Hours

Construction activity will be restricted to the Interim Construction Noise Guideline (DECC, 2009) recommended standard hours. Work would be limited to 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm Saturday, with no works on Sundays or Public Holidays.

3.3.5 Construction Traffic

The construction traffic will consist of a range of light vehicles (such as utes to transport construction workers to and from the site), up to standard heavy articulated vehicles. No over-mass or over-dimensional vehicle delivery will be required. The proposal will involve delivery of the equipment to be installed and transport of workers to and from the site on a daily basis. Additional detail regarding traffic data is contained within Section 5.14 of this report.

3.3.6 Site Preparation

Minimal earthworks will be required. The existing average ground level within the proposed footprint ranges from 1,035.5m AHD in the south-west corner to 1027.0m AHD in the north-east corner. At present, the site retains mounds to approximately 0.5m to 0.75m high which supported the previous development to improve drainage and provide flat surfaces for storages. The proposed earthworks will involve minimal cut and fill to level these mounds resulting in a final ground level to follow the natural slope from south-west to north-east. Any additional fill will be extracted from the existing borrow pit and/or storage dam on the site. This work will ensure that the site drainage directs runoff to the existing storage dam in the north-east corner of the property.

A 35mm layer of crusher dust will be added to the surface under the PV Field. This will provide a better working surface and reduce soil turmoil from rain.

3.4 Land Management

The development site is currently utilised for grazing. Grazing within the solar farm is not practical due to the infrastructure. The vegetation within the solar farm will need to be kept short as a fire control practice. Management will generally involve mowing where accessible and application of herbicide for weed management in areas not accessible by mowers or whipper-snippers. This management will be achieved through regular spraying, which is detailed within Section 5.1.5 of this report.

4 Planning Considerations

4.1 Required Approvals

The proposed development may be considered as regional development. Pursuant to Schedule 7 of the *State Environmental Planning Policy (State and Regional Development) 2011,* electricity generating works with a capital investment value of more than $5 million are a development category for which a Joint Regional Planning Panel (JRPP) may be authorised to exercise the consent authority functions of Council.

The development as proposed has an estimated capital investment value of $11 million and accordingly is considered "Regional Development". The Northern Regional Planning Panel (NRPP) is therefore authorised to exercise the consent authority functions of Council.

4.2 Commonwealth Legislation

4.2.1 Environment Protection and Biodiversity Conservation Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) requires the approval of the Commonwealth Minister for the Environment for actions on Commonwealth land or those that may have a significant impact on matters of national environmental significance. An Assessment of Significance on the Matters of National Environmental Significance has been included as Appendix 8. The conclusion of the assessment is that the proposal will have no significant impact on any listed Matters of National Environmental Significance.

4.3 State Legislation

4.3.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and associated *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) outline the overarching regulatory structure of environmental legislation within NSW. The EP&A Act and Regulation define development magnitude thresholds and outline assessment requirements for developments undertaken within the State. The following identifies the relevant consent and assessment requirements for the proposed development in accordance with this Act.

4.3.1.1 Designated Development

As is outlined in Schedule 3 of the EP&A Regulation, "Electricity generating stations" such as solar farms are considered designated development under the EP&A Act and associated regulations where the development generates more than 30 megawatts (MW) of electrical power.

The proposed development will generate a maximum of 4.95MW AC (~8.8MW DC). Therefore, the proposal is not considered designated development.

4.3.1.2 Integrated Development

The solar farm is not considered integrated development under Division 4.8 of the EP&A Act because the solar farm does not require any additional approval/permit/licence/ authorisation under the:

- Fisheries Management Act 1994;
- Heritage Act 1977;
- Coal Mine Subsidence Compensation Act 2017;
- Mining Act 1992;
- National Parks and Wildlife Act 1974;
- Petroleum (Onshore) Act 1991;
- Protection of the Environment Operations Act 1997;
- Roads Act 1993;
- Rural Fires Act 1997; or
- Water Management Act 2000.

4.3.1.3 Assessment Requirements

Clause 4.15 of Division 4.3 of the EP&A Act outlines matters for consideration which require assessment for developments requiring consent. These matters include:

the provisions of:

a) any environmental planning instrument, and

i. any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and

ii. any development control plan, and

iii. any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4, and

iv. the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and

v. any coastal zone management plan (within the meaning of the Coastal Protection Act 1979), that apply to the land to which the development application relates,

b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

c) the suitability of the site for the development,

d) any submissions made in accordance with this Act or the regulations,

e) the public interest.

This Statement of Environmental Effects is considered to satisfy the requirements outlined in the above matters for consideration.

4.3.2 Biodiversity Conservation Act

The BC Act outlines requirements in relation to the listing of threatened species, biodiversity impact assessment, offsetting and related offences. The assessment of biodiversity values on land and the impacts of activities on those biodiversity values are to be carried out in accordance with the Biodiversity Assessment Method (BAM). The objective of the BAM is to adopt a standard approach that will result in no net loss of biodiversity in NSW.

The Act also outlined the Biodiversity Offset Scheme (BOS). Development that is subject to the BOS scheme includes development needing consent under Part 4 of the EP&A Act (excluding complying development), activities under Part 5 of the EP&A Act, State significant development and State significant infrastructure.

Where development or an activity is, "likely to significantly affect threatened species", a Biodiversity Development Assessment Report (BDAR) must be prepared and consent authorities are required to consider the likely impact of the proposed development on biodiversity values before granting approval.

The threshold test of whether development or an activity is "likely to significantly affect threatened species" (and therefore whether a BDAR is required) is reached if:

- the test in section 7.3 of the BC Act identifies matters that may significantly impact threatened species, populations or endangered communities;
- the Biodiversity Offset Scheme (BOS) Threshold is exceeded; and
- the development is carried out in a declared area of outstanding biodiversity value.

The subject lot was assessed using the online Biodiversity Offsets Scheme Entry Tool, which determines whether any proposed clearing would be above or below the area thresholds or lies within an area mapped as having high biodiversity value. According to BOS, the area clearing threshold for the subject site would be 0.5 hectares of clearing of native vegetation. The site is not considered native vegetation as per the available mapping. The proposed development site is not located within a declared area of outstanding biodiversity value, and the proposal does not involve any clearing that would exceed the BOS Threshold.

Proponents are also required to carry out a 'test of significance' for all development proposals that do not exceed the Biodiversity Offset Scheme Threshold. The required test of significance (as outlined in Section 7.3 of the BC Act) is included in Appendix 7. It was determined that the proposal is not likely to significantly affect threatened species, and that further assessment under the BAM and the preparation of a BDAR is not required.

4.3.3 State Environmental Planning Policies

Table 3 presents a summary and comment on current State Environmental Planning Policies and identifies their relevance to the proposed development.

Table 3: State Environmental Planning Policies

SEPP No. & Codes	Title	Relevance
No. 1	Development Standards	Not Relevant
No. 19	Bushland in Urban Areas	Not Relevant
No. 21	Caravan Parks	Not Relevant
No. 33	Hazardous & Offensive Development	Not Relevant
No. 36	Manufactured Home Estates	Not Relevant
No. 47	Moore Park Showground	Not Relevant
No. 50	Canal Estate Development	Not Relevant
No. 55	Remediation of Land	Refer following section for review
No. 64	Advertising and Signage	Not Relevant
No. 65	Design & Quality Residential Flat Development	Not Relevant
No. 70	Affordable Housing (Revised Schemes)	Not Relevant
	Affordable Rental Housing 2009	Not Relevant
	Building Sustainability Index: BASIX 2004	Not Relevant
	Exempt and Complying Development Codes 2008	Not relevant
	Housing for Seniors or People with a Disability 2004	Not Relevant
	State Significant Precincts 2005	Not Relevant
	Infrastructure 2007	Refer following section for review
	Kosciuszko National Park – Alpine Resorts 2007	Not Relevant
	Mining, Petroleum Production and Extractive Industries 2007	Not Relevant
	State and Regional Development 2011	Refer following section for review
	Educational Establishments and Child Care Facilities 2017	Not Relevant
	State Environmental Planning Policy (Coastal Management) 2018	Not Relevant
	Primary Production and Rural Development 2019	Not Relevant

SEPP No. & Codes	Title	Relevance
	Koala Habitat Protection 2019	Refer to following section for review

4.3.3.1 State Environmental Planning Policy 55 - Remediation of Land

The Remediation of Land SEPP aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or other aspects of the environment. Under this SEPP, a consent authority must not consent to the carrying out of any development on land unless:

i. It has considered whether the land is contaminated, and
ii. If the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and
iii. If the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

The proposed development site is not currently considered as contaminated land, although it has historically been utilised as a timber treatment facility which is a listed contaminating activity. The land impacted by the timber treatment facility had been remediated to an extent that is considered suitable for industrial and commercial use. The remediation was subject to NSW EPA review during the work carried out and the final declaration of the contamination status.

As part of the new solar farm development proposal, a preliminary site contamination assessment was undertaken. The results of this investigation are included in Appendix 3. Seven soil samples were taken from the proposed development site and drainage lines and were screened for Arsenic, Chromium and Copper. The selection of test parameters was based on the previous landuse.

The results found contamination levels below selected Health Based Investigation Levels for Commercial and Industrial land uses. The lack of contamination present in the drainage lines has indicated that little to no site migration of contamination has occurred. Based on the results of this investigation, contamination levels in the soil poses an acceptable risk to human health for the current and proposed land use of this site.

The site is therefore considered suitable for the proposed development of a solar farm.

4.3.3.2 State Environmental Planning Policy (Infrastructure)

Permissibility

The Infrastructure SEPP (ISEPP) provides development controls for infrastructure and services. Clause 34 (7) of the SEPP provides provisions for development that is permitted with consent. It states:

"(7) Solar energy systems -
Except as provided by subclause (8), development for the purpose of a solar energy system may be carried out by any person with consent on any land."

Subclause (8) limits the use of photovoltaic electricity generating systems with a capacity to generate more than 100 kW in residential zones. The development footprint for the project is not within a residential zone and, therefore, is not affected by this subclause.

Accordingly, the proposed solar farm is permissible with development consent.

Grid Connection

Clause 45 of ISEPP relates to the determination of a development application that has the potential to affect an electricity transmission line. Before determining a development application which meets the relevant criteria provided by Clause 45, the consent authority must first notify the relevant electricity supply authority and take into consideration any comments made by the authority within 21 days of the notice.

Given the intention to connect the solar energy system to Essential Energy's existing 11kV line, Clause 45 is applicable. A connection application with Essential Energy has already been made, as such the electricity supply authority has been notified.

Traffic Generating Development

The subject proposal is not identified in Schedule 3 of the SEPP as traffic generating development to be referred to the Roads and Maritime Services as the proposal is defined as 'any other purpose' and will not generate 200 or more motor vehicle movements.

4.3.3.3 State Environmental Planning Policy (State and Regional Development) 2011

Pursuant to Schedule 7 of the State Environmental Planning Policy (State and Regional Development) 2011, electricity generating works with a capital investment value of more than $5 million in accordance with Part 5 'Private infrastructure and community facilities over $5 million' are considered as Regional Development, a development category for which a Joint Regional Planning Panel (JRPP) may be authorised to exercise the consent authority functions of Council.

The development as proposed has an estimated capital investment value of $11 million and accordingly may be assessed by the Uralla Shire Council and determined by the Northern

Regional Planning Panel (NRPP) under the State Environmental Planning Policy (State and Regional Development) 2011.

4.3.3.4 State Environmental Planning Policy (Koala Habitat Protection) 2019

The State Environmental Planning Policy (Koala Habitat Protection) 2019 was introduced on March 1, 2020. It replaces the SEPP 44 – Koala Habitat Protection (1995) and has been updated and improved to increase the level of protection of koala habitat within NSW. Overall, the Policy aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

The State Environmental Planning Policy (Koala Habitat Protection) 2019 includes the following key changes:

- An updated definition of koala habitat;
- Two new SEPP maps;
- An expanded list of tree species;
- New SEPP Guidelines; and
- A streamlined development assessment process

Habitat Definition and Feed Tree Species

The new SEPP no longer defines potential koala habitat. The definition of core koala habitat has been updated to allow areas with demonstrated koala presence in highly suitable habitat to be recognised, without the requirements of the previous definition which were difficult to meet. Core koala habitat will now be defined as:

a) An area of land where koalas are present, or
b) An area of land:
    i. Which has been assessed by a suitably qualified and experienced person in accordance with the Guideline as being highly suitable koala habitat; **and**
    ii. Where koalas have been recorded as being present in the previous 18 years.

The list of feed tree species has also been updated, increasing the number of species from 10 to 123 species. These 123 species were categorised into 9 distinct regions (Koala Management Areas), according to what trees koalas prefer to use in each area.

Mapping

Two new maps have been in introduced and are available for viewing:

a) **The Koala Development Application Map** – this identifies areas that have highly suitable koala habitat and are likely to be occupied by koalas. On land where there is no approved Koala Plan of Management, the map will be used to identify land where Council needs to consider the development application requirements in the Guideline.

b) **The Site Investigation area of Koala Plans of Management Map** – This identifies land that council are to focus their survey efforts on, particularly when identifying core koala habitat.

Development Assessment Process

Under SEPP 44, an initial flora survey was required to survey land within Development Applications, and, where potential koala habitat had been established, a koala survey was required. If land contained core koala habitat, the proponent had to prepare an Individual Plan of Management to manage any impacts on the resident koala population. Each Plan of Management required approval from the Secretary of the Department. The new Koala Development Application Map eliminates the need to conduct any surveys. Instead of preparing an Individual Plan of Management, proponents are required to prepare their development application in accordance with the criteria in the new Guideline, for council to consider when assessing the application.

Site Assessment

Land within the local government areas listed under Schedule 1 is subject to consideration under this Policy. The Uralla Shire is included in Schedule 1 of the SEPP and therefore an assessment is required. Uralla Shire is in the Northern Tablelands Koala Management Area. A list of feed tree species for this management area is provided in Schedule 2 of the SEPP. Feed tree species of this management area are listed in the following table:

Table 4: Koala Feed Tree Species based on Management Area

Northern Tablelands Koala Management Area	
Scientific Name	**Common Name(s)**
Allocasuarina littoralis	Black She-oak
Angophora floribunda	Rough-barked Apple
Callitris glaucophylla	White Cypress Pine
Eucalyptus acaciiformis	Wattle-leaved Peppermint
Eucalyptus albens	White Box
Eucalyptus amplifolia	Cabbage Gum
Eucalyptus biturbinata	Grey Gum
Eucalyptus blakelyi	Blakely's Red Gum
Eucalyptus bridgesiana	Apple Box
Eucalyptus brunnea	Mountain Blue Gum
Eucalyptus caleyi	Drooping Ironbark
Eucalyptus caliginosa	Broad-leaved Stringybark
Eucalyptus camaldulensis	River Red Gum
Eucalyptus campanulata	New England Blackbutt
Eucalyptus crebra	Narrow-leaved Ironbark

Northern Tablelands Koala Management Area	
Scientific Name	**Common Name(s)**
Eucalyptus dalrympleana	Mountain Gum
Eucalyptus dealbata	Tumbledown Red Gum
Eucalyptus eugenioides	Narrow-leaved Stringybark
Eucalyptus laevopinea	Silver-top Stringybark
Eucalyptus macrorhyncha	Red Stringybark
Eucalyptus melanophloia	Silver-leaved Ironbark
Eucalyptus melliodora	Yellow Box
Eucalyptus michaeliana	Brittle Gum
Eucalyptus microcorys	Tallowwood
Eucalyptus moluccana	Grey Box
Eucalyptus nicholii	Narrow-leaved Black Peppermint
Eucalyptus nobilis	Forest Ribbon Gum
Eucalyptus nova-anglica	New England Peppermint
Eucalyptus obliqua	Messmate
Eucalyptus pauciflora	White Sally / Snow Gum
Eucalyptus prava	Orange Gum
Eucalyptus radiata	Narrow leaved Peppermint
Eucalyptus saligna	Sydney Blue Gum
Eucalyptus sideroxylon	Mugga Ironbark
Eucalyptus stellulata	Black Sally
Eucalyptus subvelutina	Broad-leaved Apple
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus viminalis	Ribbon Gum
Eucalyptus williamsiana	Eucalyptus williamsiana
Eucalyptus youmanii	Youman's Stringybark

There are four paddock trees located within the proposed development footprint that will need to be removed to allow for the construction of the solar farm. These include Blakely's Red Gum (*Eucalyptus blakelyi*) and Broad-leaved Stringybark (*Eucalyptus caliginosa*), which are both listed as koala feed tree species for the management area. A survey of these feed trees did not find any koalas nor any scats or scratch marks that would suggest that koalas utilise these trees. It is noted that these trees would need to be removed for safety purposes relating to the solar farm. The security fence may also pose a limit to Koala access if these trees form part of an individual Koala's home range.

The NSW Department of Planning, Industry and the Environment's online mapping tool was searched to determine the assessment of koala habitat value within the proposal's footprint and its vicinity. The subject site and surrounding area are shown in relation to the Koala Development Application Map layer, in Figure 8. The map identified areas within both the Site

Investigation Area for Koala Plans of Management and the Koala Development Application layers area. However, the vegetation present along the northern and southern boundary identified as koala habitat appeared to be incorrectly mapped. The vegetation contained Radiata Pine (*Pinus radiata*), Aleppo Pine (*Pinus halepensis*) and Pencil Pine varieties (Cupressus sp.) which are not listed as Koala Feed Trees.

The paddock trees located within the proposed development footprint and the vegetation located along the eastern boundary included koala feed trees as listed in Table 4. The vegetation located along the eastern boundary will be retained and enhanced through plantings of similar species (additional detail provided in Section 5.6). The proposed removal of the four paddock trees within the development footprint is not considered to have a significant impact on koala habitat within the area.

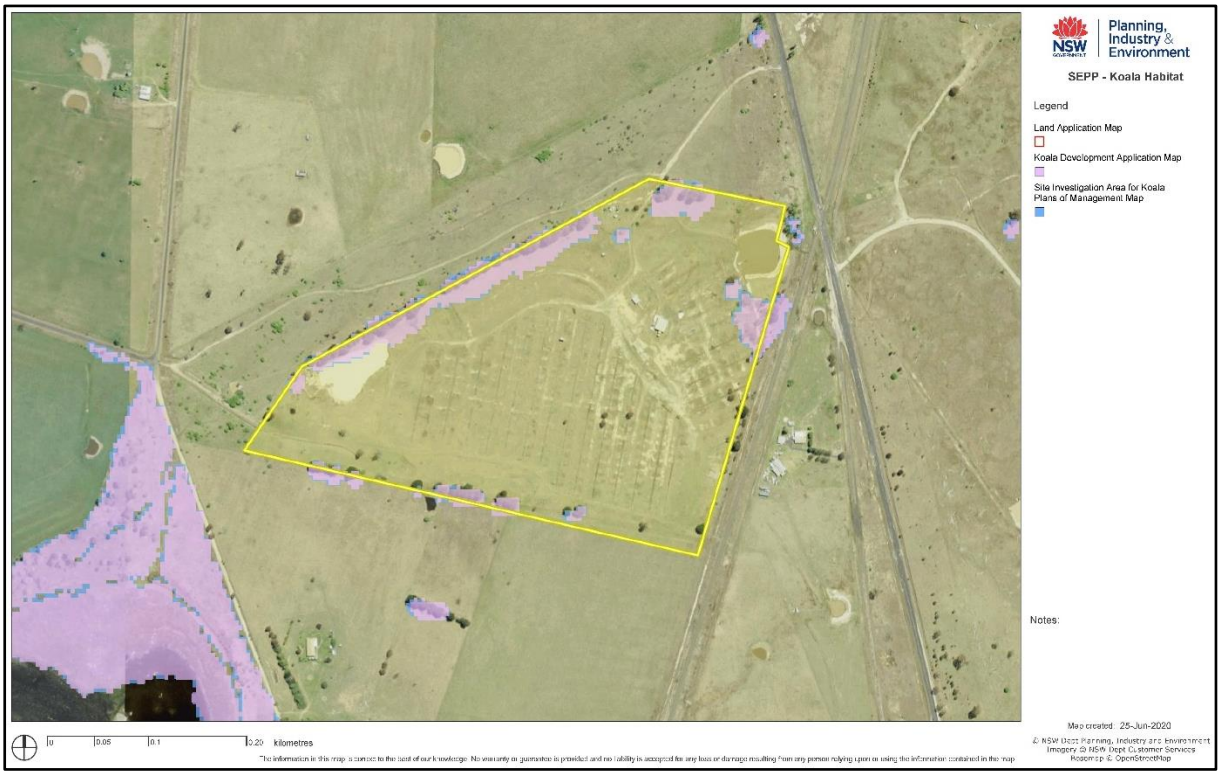


Figure 8: Koala Development Application Map

A consideration of existing records spanning the previous 18 years (3 koala generations) is required to determine if any koala records exist for the area. A site area is considered to contain habitat that meets the definition of core koala habitat, provided the site contains highly suitable koala habitat and where a record or records exist within the last 18 years, within 5 kilometres of the site (for Darling Riverine Plains, Far West, North West Slopes, Riverina and Northern Tablelands KMA's) within areas of contiguous habitat or between areas of habitat with connectivity. This distance reflects the estimated median home range of koalas within inland locations.

Figure 9 includes a map of all the recorded koala sightings within close proximity to the development site. The red triangles indicate recorded sightings. There are no sightings within, or in close proximity to the proposed development site. Whilst records exist within a 5-kilometre radius of the site, there is no contiguous habitat between the recorded locations and the development footprint. Therefore, it is considered that no recent or historical records (within 18 years) of a "resident population" for the project area.

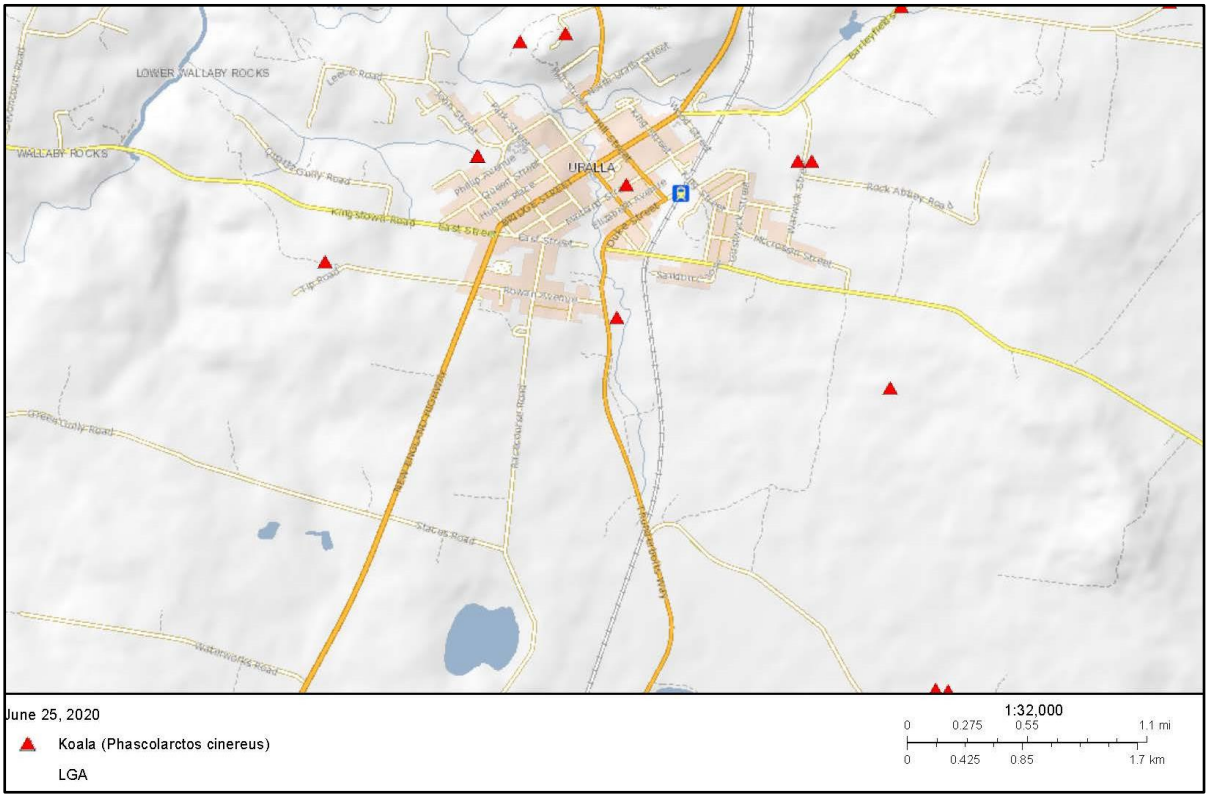


Figure 9: Koala Records within the Area

Given observations onsite, it was determined that no Core Koala Habitat is present within the development footprint. If Koalas were present in the area, it is likely that they would prefer the higher quality remnant vegetation to the east of the subject site. There is minimal vegetation removal proposed as part of this development application and it is therefore considered unlikely that the proposal would result in any adverse impacts on any local Koala population. On this basis, it is considered that the requirements of the SEPP do not need any further consideration.

4.4 Regional Plan

The New England North West Regional Plan 2036 (the Plan), published in 2017, recognises the potential for the growth of the renewable energy industry within the Uralla Shire and the surrounding region. The Plan outlines goals and directions for the New England North West region. Goal 1 is to create a 'strong and dynamic regional economy' with a focus on the future of renewable energy generation within the region. In particular Strategic Direction 5 is to

'Grow New England North West as the renewable energy hub of NSW'. The Plan encourages the following actions be taken to achieve this goal:

1. *Diversify the energy sector by identifying renewable energy resource precincts and infrastructure corridors with access to the electricity network; and*
2. *Facilitate appropriate smaller-scale renewable energy projects using biowaste, solar, wind, hydro, geothermal or other innovative storage technologies.*

The proposed development is considered to contribute to achieving the outcomes of Strategic Direction Number 5 of the Plan, as it will enable diversification and expansion of energy generation within the region by capitalising on high rates of regional solar penetration. The region can be a leader in renewable energy, thanks to potential sources of solar, bio-waste, hydro, wind and geothermal. It receives 18 to 20 megajoules daily of solar exposure, making it the second highest solar penetration region in NSW. A strategic and integrated approach to renewable energy projects will leverage new opportunities and help meet the NSW Government's goal of a carbon-neutral NSW by 2050.

The key priority outlined in the Plan for the Uralla LGA of relevance to this proposal includes the need to '*investigate the potential for wind and solar production and encourage renewable energy opportunities'*. The proposal is to establish a small-scale 4.95MW AC (~8.8MW DC) solar farm at the site which is consistent with the key priorities for the Uralla Shire whilst appropriately diversifying the energy sector and contributing to economic growth in the region.

4.5 Strategic Plan

The NSW Renewable Energy Action Plan (REAP), prepared by the NSW Government in 2013 guides NSW's renewable energy development and supports the achievement of national renewable energy targets. The NSW Government's vision is for a secure, reliable, affordable and clean energy future for the State. The REAP positions NSW to increase the use of energy from renewable sources.

The REAP sets out a number of actions to achieve its vision, under the following three goals:

- Goal 1 – attract renewable energy investment;
- Goal 2 – build community support; and
- Goal 3 – attract and grow renewable energy expertise.

The proposed development will assist in achieving the NSW Government's goals of increasing renewable energy generation in NSW to help achieve renewable energy targets. Through creating new solar employment opportunities, the proposal will contribute to growing expertise in renewable energy technologies.

4.6 Local Environmental Plan

The development site is zoned IN1 General Industrial under the *Uralla Local Environmental Plan 2012* (Uralla LEP). Under this local planning instrument, the development is defined as 'electricity generating works' which means a building or place used for the purpose of making or generating electricity or electricity storage. This use is considered permissible with development consent on Zone IN1.

Further, pursuant to cl.34(7) of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP), development for the purpose of a solar energy system may be carried out by any person with consent on any land.

Accordingly, the proposed solar farm (which is a photovoltaic electricity generating system) is permissible subject to securing development consent.

The proposal is consistent with the objectives as prescribed by the Uralla LEP for zone IN1 General Industrial which are:

- *To provide a wide range of industrial and warehouse land uses.*
- *To encourage employment opportunities.*
- *To minimise and adverse effect of industry on other land uses.*
- *To support and protect industrial land for industrial uses.*
- *To enable other land uses that provide facilities or services to meet the day to day needs of workers in the area.*

4.7 Development Control Plan

The *Uralla Development Control Plan 2011* (DCP) applies to this development. The proposal is considered under this DCP as 'Development in Commercial and Industrial Areas' and should be assessed under Chapter 5. Chapter 14 'Contaminated Land' is also relevant to this proposal as the development site is located on land known as the former Koppers Timber Treatment Site which is specifically addressed in this chapter. This development may also be subject to the Notification Chapter of the DCP. In accordance with this chapter Council Officers will use their discretion in determining if the proposed development requires notification and whom is to be notified.

Chapter 5: Development in Commercial and Industrial Areas

The Development in Commercial and Industrial Areas chapter applies to land zoned Industrial (IN1) under the Uralla LEP and therefore is relevant to the proposed development. The performance outcome is for the "development of existing and new businesses which contribute to the social and economic well-being of Uralla and which enhance the natural and built environments".

The proposal involves a change of use that is not considered exempt or complying development and as such a development application is required to be lodged with Council. This report has been prepared in support of a development application and is therefore considered to satisfy this requirement.

The proposal does not involve a subdivision or the provision of services such as reticulated water, telephone, sewerage infrastructure or disability access. During construction temporary amenity facilities will be provided.

The proposal complies with the height limit of 8 metres from the ground level for development within an industrial zone.

Access and carparking requirements are outlined in Table 6.1 in Chapter 6 'Access and Parking'. No specific rate is defined for a solar farm. The site will utilise an existing access and given the nature of the proposed development, the provision of dedicated onsite parking was not considered necessary. Additional information on access and parking is provided in Section 5.14 of this report.

Temporary onsite waste facilities will be provided during the construction phase of the development. This will include the provision of skip bins, as required. Additional information on waste management is provided in Section 5.16 of this report.

The requirements for development adjoining land zoned R1 and energy efficiency within buildings were not considered relevant to this proposal.

The proposal was considered to comply with the relevant acceptable solutions as outlined in Chapter 5.

Chapter 14: Contaminated Land

The proposed development site (Lot 385 DP 755846) is specifically listed within this section of the DCP as the former Koppers Timber Treatment Site. The DCP states the following:

"The Environment Protection Authority (EPA) have given specific regulatory advice to Council regarding this land known as the former Koppers Timber Treatment Site Lot 385 DP 755846. While the EPA considers that regulatory intervention on this former timber site is not warranted and that the site is suitable for industrial use in principle, this site is nevertheless a contaminated land. Council, as a development consent authority, is advised to observe State Environmental Planning Policy No.55 (SEPP 55) – Remediation of land. In this regard, the EPA offers the following specific advice:

1. Should any part of the land be redeveloped for a use more sensitive than commercial/industrial use, that specific area must be subject to a formal contaminated site assessment to confirm its suitability of the intended use.

2. There has been no groundwater assessment carried out on the site in the past. The EPA believes that the risk that the site will be subject to extensive groundwater contamination is relatively low. This potential risk should not predicate the in-principle suitability of the site for industrial use. However, we recommend that Council requires a preliminary groundwater assessment on the areas where the timber treatment facilities were located and were subsequently remediated to a soil standard suitable for industrial use. The general location of these areas can be found in the EES 1994 Validation Report. The findings may assist Council in determining whether an environmental management plan (EMP) is required in managing any residual contamination left on the site, for example, whether onsite extraction of groundwater for a particular use is permitted. The EPA should be provided with a copy of the findings.

Letter to Council from the NSW Environment Protection Authority dated 14 February 2012."

The proposed development of a solar farm is considered a commercial use of the subject site. A preliminary contamination assessment was undertaken in accordance with SEPP 55 of the proposed solar farm development site and within the existing drainage areas. This assessment determined that the levels of potential contaminants were below the relevant thresholds and that the site is considered suitable for the development of the proposed solar farm. The assessment is considered to satisfy this section of the DCP. No groundwater extraction is proposed as part of this development and therefore no groundwater assessment has been undertaken. Additional details in relation to the preliminary contamination assessment are included in the following sections of this report Section 4.3.3.3, Section 5.4 and Appendix 2.

4.8 Draft planning instruments

The draft *Amended Uralla Development Control Plan* (Amended DCP) is currently on exhibition and expected to be adopted in the near future. The Amended DCP includes Chapter 18 'Large Scale Renewable Energy Development' which is considered relevant to the proposed development and has been addressed below.

Chapter 18: Large Scale Renewable Energy Development

This chapter provides details about development standards for commercial renewable energy development and applies to development proposals where the generation capability of the development is in excess of 100 kilowatts. The proposed Thunderbolt Community Solar Farm will have a maximum generation capacity of 4.95MW AC (~8.8MW DC) and is therefore required to address this chapter.

The following lists the acceptable solutions for the development of renewable energy projects as outlined within the DCP and how the proposal has addressed these outcomes:

- The developer must assess the visual impact of the project including an assessment of the development on the scenic value and character of the locality. This assessment should consider how the proposal will maintain the unique local character of the area and all significant vistas;
    - Comment: The potential impacts on visual amenity as a result of the proposed development are included within Section 5.6 of this report. The proposal is not considered to have a significant adverse impact on the scenic value or local character of the area. Further, the proposal involves the planting of a vegetation screen along the eastern and western boundaries which aims to reduce the visibility of the site from any nearby vistas.
- Any infrastructure which forms part of the development must not occupy more than 30% of the view shed from any highway, regional road, or local road with a regional function;
    - Comment: Whilst the development will be partially visible from Thunderbolts Way (which is classified as Regional Road), it is not located within the direct line of sight for drivers traveling in either direction. Additional detail on the potential visual impacts of the proposal are included within Section 5.6 of this report.
- No development is permitted within 500 metres of a dwelling or business premises not associated with the project;
    - Comment: The closest dwelling is located approximately 230 metres from the proposed solar farm footprint. This dwelling is not associated with the project. The proposal includes the planting of a vegetation screen (including trees and shrubs) to enhance the future amenity of the residence. Preliminary discussions have been undertaken with the owners of the dwelling and at this stage no objections are foreseen.
- Development must not be within 200 metres of the access to a building or business premises not associated with the project;
    - Comment: The proposed development site is not located within 200 metres of any access to a building or business premises not associated with the project. The proposal is therefore considered to comply with this acceptable solution.
- No development is permitted forward of the average building line setback of the nearest adjacent properties;
    - Comment: The average building line setback of nearby properties is typically >25 metres from public roads. The proposed development is setback >240 metres from Thunderbolts Way and >400 metres from Staces Road. Additionally, the proposed solar farm is to be enclosed within a 1.8 metre high security fence setback a minimum of 10 metres from the southern boundary

and surrounding the array on other sides well within the development site. Solar arrays are to be setback at least 8 metres from the security fence giving a total setback to the southern boundary of 18 metres. The proposal is therefore considered to comply with this acceptable solution.

- All road accesses not within the development site are to be constructed according to current AustRoads standards;
    - Comment: The proposal involves utilising an existing access from Staces Road. This access is considered to meet current AustRoads standards and no upgrade is proposed as part of the development proposal. The proposal is therefore considered to comply with this acceptable solution.
- All infrastructure, including cabling, must be fully dismantled and removed from the site within 24 months of decommissioning.
    - Comment: In the event of decommissioning of the solar farm, all infrastructure would be appropriately dismantled and removed from the site. This is discussed in Section 5.17 of this report. The proposal is therefore considered to comply with this acceptable solution.

Section 18.6 of the DCP allows for a relaxation of the above listed development standards when a development is not State Significant Development. The proposed development of the Thunderbolt Community Solar Farm is not considered State Significant Development and is considered to comply with the solutions wherever possible given the site constraints associated with the small-scale nature of the development.

No other draft environmental planning instruments are known to affect the site.

5 Environmental Considerations

Items considered include matters set out under Clause 4.15 of Division 4.3 of the *Environmental Planning and Assessment Act 1979.* A summary of the major points of that consideration follows.

5.1 Biodiversity

5.1.1 Desktop Assessment

Initially, examination is required of the various threatened species databases to identify any known locations of threatened species, populations and ecological communities inside, or within close proximity to, the proposed impact area. This desktop assessment included searches of databases and a review of literature relevant to the site and local area, particularly:

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife database for records of threatened species and endangered ecological communities which have been recorded within a 10-kilometre radius (locality) of the subject site (accessed June 2020);
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool for Matters of National Environmental Significance (MNES) listed under the EPBC Act within a 20 km radius from the site (accessed June 2020); and
- NSW Vegetation Information System (VIS) classification database (OEH, accessed June 2020).
- NSW Sharing and Enabling Environmental Data (SEED) portal (NSW Government, accessed June 2020).

Satellite imagery is also used to determine the presence and extent of broad habitat types for these species. Where it is determined the habitat of a species, population or community is not present, this species is culled from the list of potential occurrences. This list is further refined based on the habitat features identified during field surveys.

Figure 10 includes the modelled plant community types expected to occur within the area based on desktop information available on the SEED portal for vegetation mapping within the Border Rivers Gwydir / Namoi region. The desktop assessment indicated that the property was likely to contain vegetation consistent with Plant Community Type (PCT) 510 “Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion” in the areas shown in yellow in the north-eastern corner of the block along the boundaries.

The remaining area of the property, including the proposed development footprint, was not considered to contain vegetation consistent with any native PCT’s.

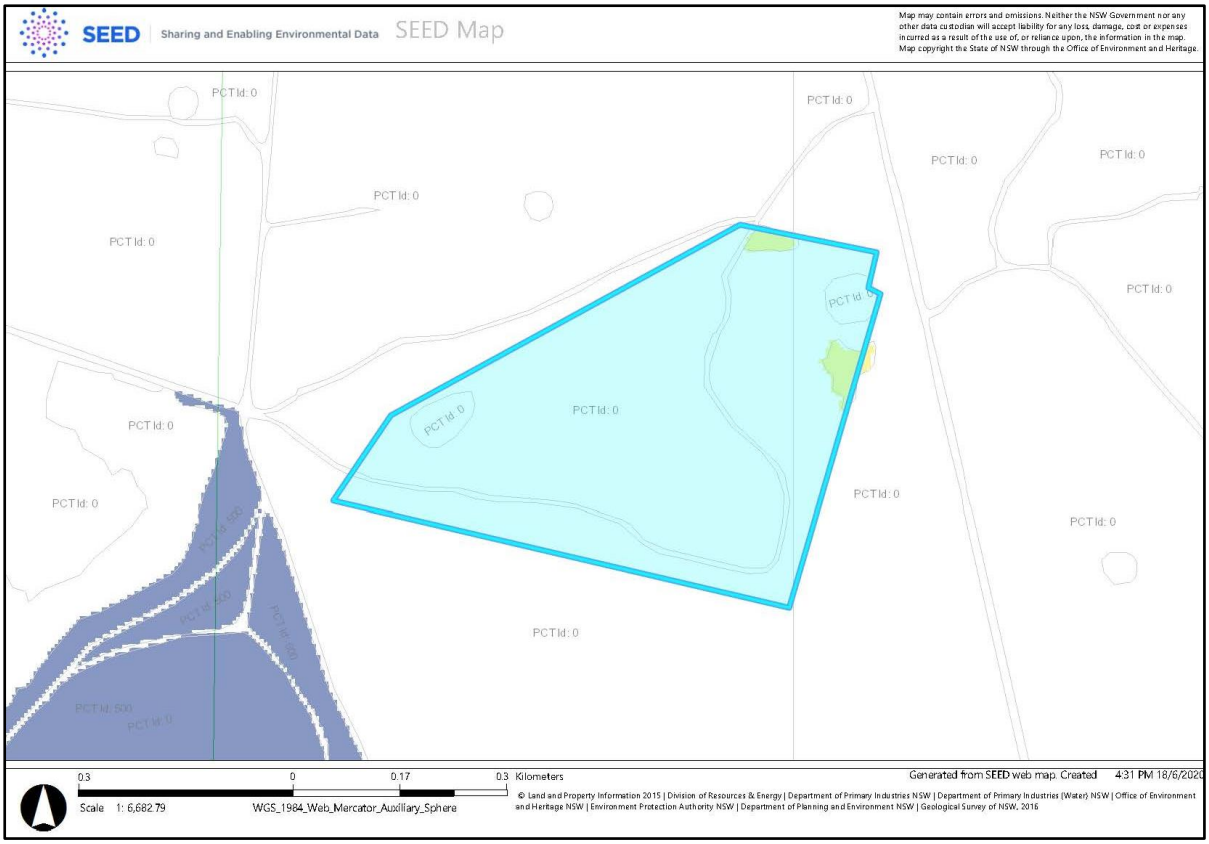


Figure 10: SEED Plant Community Types modelled for the area.

5.1.2 Field Assessment

The development footprint comprised previously cleared pasture and four mature paddock trees. The pasture included a combination of native and exotic grasses, with agricultural weeds clearly dominate. The site is currently grazed. The ground surface has been highly disturbed and is currently developed as rows of mounds following previous rehabilitation works on the site. The species present within the development footprint included, but was not limited to, the following:

- Blakley's Red Gum (*Eucalyptus blakelyi*)
- Broad-leaved Stringybark (*Eucalyptus caliginosa*)
- Snow Grass (*Poa sieberiana*)
- Windmill Grass (*Chloris truncata*)
- Kangaroo Grass (*Themeda triandra*)
- Paddock lovegrass (*Eragrostis leptostachya*)
- Common Paspalum (*Paspalum dilatatum*)
- Wallaby Grass (*Rytidosperma richardsonii*)
- Slender Rats Tail (*Sporobolus creber*)
- White Water Panic (*Panicum obseptum*)
- Common Tussock Grass (*Poa labillardierei*)
- Boar Thistle (*Cirsium vulgare*)
- Hairy Fleabane (*Erigeron bonariensis*)

- Goose Grass (*Eleusine tristachya*)
- Native Raspberry (*Rubus parvifolius*)
- Briar Bush (*Rosa rubiginosa*)

The vegetation present along the northern and southern boundary included planted varieties of conifers that provide a high level of screening. This included Radiata Pine (*Pinus Radiata*) along the northern fence line and Aleppo Pine (*Pinus halepensis*) along the southern boundary, with occasional Pencil Pine (*Cupressus Sempervirens*) located near the entrances.

Cleared land on adjoining properties is of similar cover, condition and current land use to that within the development footprint. Remnant native vegetation in the vicinity of the proposal comprises an isolated stand of remnant native trees along the eastern boundary of the property along the railway towards Thunderbolts Way. The area of vegetation present along the eastern boundary included species consistent with PCT 510 "Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion" as identified in the desktop mapping. PCT 510 forms part of the threatened ecological community (TEC) White Box, Yellow Box, Blakely's Red Gum Woodland. The conservation status of this community in NSW under the *Biodiversity Conservation Act 2016* is Endangered Ecological Community. It is listed as critically endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. This area is outside of the development footprint and the vegetation will be retained and undisturbed by the proposed development. Further, it is the Applicant's intention to increase the current extent of this community by planting similar species along the eastern boundary to provide additional screening and promote native species and habitat.

5.1.3 Native Vegetation Regulatory Map

The Native Vegetation Regulatory Map covers rural land in NSW and categorises land where management of native vegetation can occur without approval or where management of native vegetation may be carried out in accordance with Part 5A Land Management (native vegetation) of the *Local Land Services Act 2013*.

The categories are Category 1 (unrestricted management where clearing is exempt from the LLS Act), Category 2 is regulated land where the LLS Act applies to clearing as either code based, vulnerable or sensitive, and Excluded Land which is not regulated by the LLS Act.

The Native Vegetation Regulatory Map for Lot 385 DP 755846 is given as Figure 10 below. This land is mapped as excluded land (shown in grey). Uralla Creek (shown in orange) is vulnerable regulated land. It is not proposed to interfere with this watercourse and development will be setback a minimum of 100 metres from the top of the bank of the watercourse.

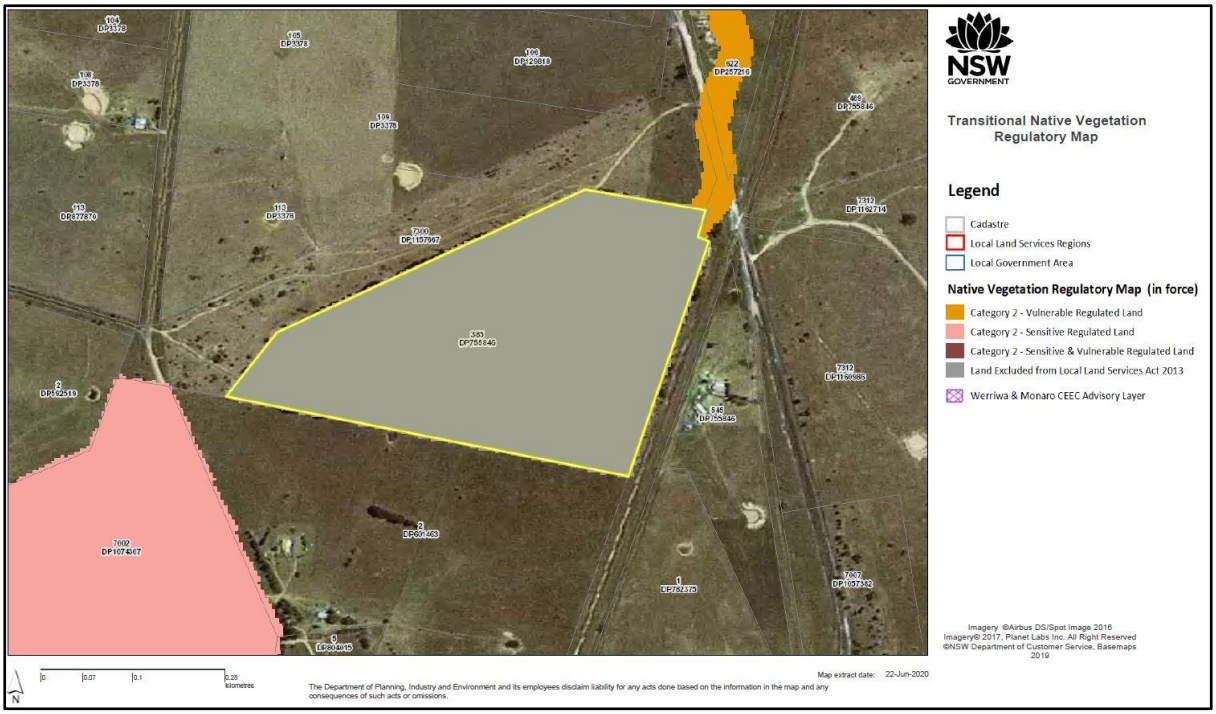


Figure 11: Native Vegetation Regulatory Map. Source: NSW Government, 2020.

5.1.4 Biodiversity Values Map

The Biodiversity Values Map is given in Figure 12 below. This map identifies land with high biodiversity value as defined by clause 7.3(3) of the Biodiversity Conservation Regulation 2017. The Biodiversity Offsets Scheme applies to all clearing of native vegetation and other biodiversity impacts prescribed by the regulation on land identified on the map.

The Biodiversity Offsets Scheme is used to determine whether the Biodiversity Assessment Method is to be used to assess the impacts of a development proposal and applies to local development. The scheme is triggered based on threshold levels of clearing comprising the land area to be cleared and whether the area is mapped on the Biodiversity Values Map. Uralla Creek (shown in purple) is located to the north of the development site and is mapped as being of high biodiversity value.

No minimum lot size applies to the development site. The threshold for clearing of native vegetation above which the Biodiversity Assessment Method applies for the site is 0.5 hectares or more of native vegetation. It is proposed to remove four (4) individual paddock trees and the groundcover was not consistent with native vegetation as per the available mapping; meaning the proposed clearing would involve less than 0.5 hectares. Therefore, it is not necessary to engage an accredited assessor to determine the offsets required to enable the project to proceed.

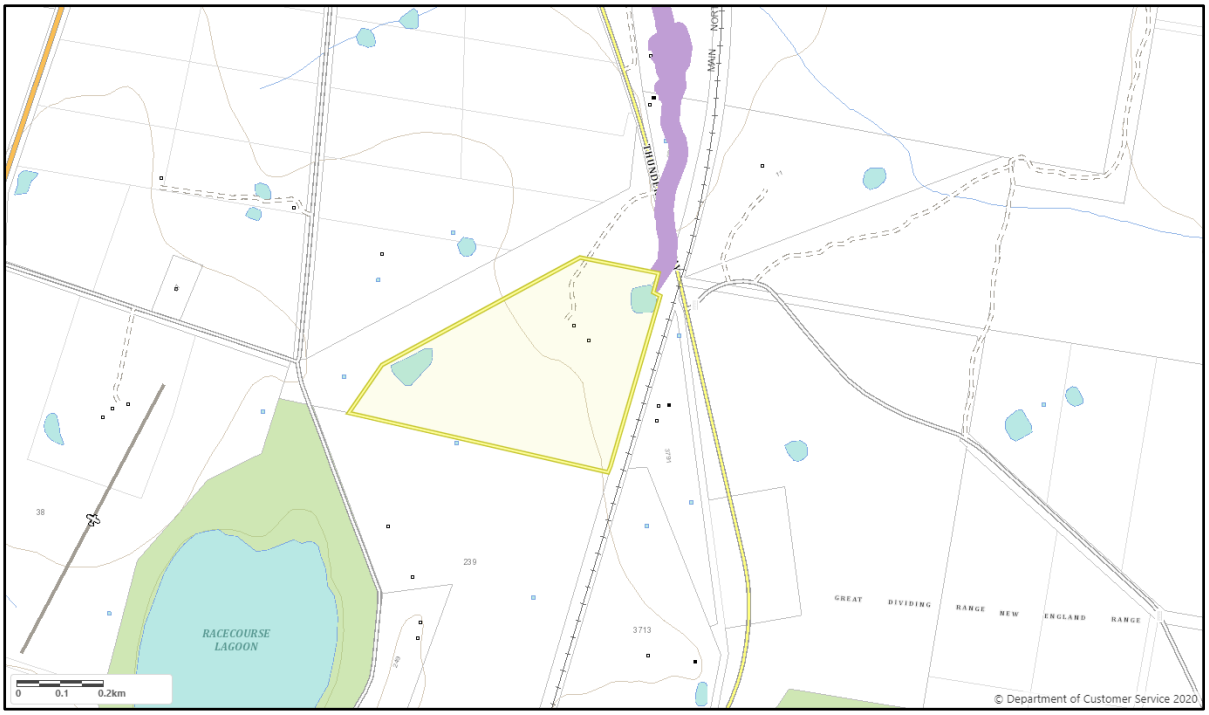


Figure 12: Biodiversity Values Map. Source: NSW Government, 2020.

A Test of Significance was undertaken to determine the potential impact of the proposal on threatened or endangered species, populations and habitat communities. The assessment is presented in Appendix 7. This assessment concluded that the proposal would be unlikely to have a significant impact on any threatened or endangered species and communities given the preferred siting of the development within a previously cleared and disturbed site.

An Assessment of Significance on the Matters of National Environmental Significance has also been included as Appendix 8. The conclusion of the assessment is that the proposal will have no significant impact on any listed Matters of National Environmental Significance.

5.1.5 Weed Management

The area under the solar panels will be permanently shaded. The reduced daytime temperatures and limited available sunlight will impede plant growth under the array. Reduced insolation and the wind protection offered by the solar panels is likely to result in retained soil moisture. The environment created underneath the solar panels would therefore not favour vegetation growth.

Weeds will be managed in accordance with the following principles:

- Prior to construction, the site will be prepared with an application of a knockdown herbicide with residual action to prevent the growth of any seeds that may germinate under the array. This application of a residual chemical is expected to inhibit growth over several seasons in the early life of the solar farm.

- All machinery, equipment and vehicles brought onto a property must be free of soil, seed or plant material. All soil and organic matter should be removed, including under the vehicle and in the cabin or trays.
- In areas outside of the immediate solar array footprint, stabilisation measures must be planned to optimise establishment of a healthy groundcover devoid of weeds.
- Spot spraying will also be used to control any weed species that emerge in the access lanes between the banks of panels.

5.2 Land Use Conflict

The development poses no potential land use conflict as it is permissible within the current zoning, pursuant to cl.34(7) of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP). The land use will change from grazing to electricity generation but due to the unobtrusive nature of solar power generation there are no land use conflict concerns.

5.3 Services

The solar farm does not require connection to reticulated water, telephone or sewerage infrastructure. Accommodation for construction workers will be off-site in Uralla. Post construction there will not be a permanent on-site presence or office building for amenities.

During the operation of the site, water will be procured as a service to clean the solar PV panel glass surfaces. It is anticipated that would be on an annual basis, however this will be monitored throughout the first year of operation and if necessary increased to a bi-annual basis.

5.4 Land Contamination

A site assessment was undertaken to identify potential issues concerning contaminated land. The objective of this assessment was to 'gather sufficient information for the site to characterise any soil contamination issues that may present a risk to human and environmental health.' A search of the current contaminated sites register was undertaken, and all the sites located within the Uralla Local Government Area are listed within Table 3. The proposed site for the solar farm is not identified as a contaminated site.

Table 5: Contaminated Sites List

Site Name	Address	Contamination Activity Type
Caltex Service Station	103 Bridge Street, Uralla	Service Station
Phoenix Foundry	44 Duke Street, Uralla	Metal Industry

However, the site was previously the Koppers Timber Treatment Site, which was historically listed as a contaminated site. Upon closure of the facility, remediation works were undertaken, and a validation report submitted to the EPA. In 2012, the EPA determined that

the contamination is no longer significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act) and that the site had been sufficiently remediated to be suitable for industrial / commercial activities to be undertaken on the site.

Due to the previous land use on site, SMK Consultants prepared a preliminary contamination assessment in accordance with SEPP 55. This assessment is attached to this report as Appendix 2. The results found contamination levels well below selected Health Based Investigation Levels for Commercial and Industrial land uses. As a result of the preliminary contamination assessment, SMK Consultants have concluded that the presence of any potential contamination residue would not impact on the proposed development of a solar farm, as it is not considered a sensitive land use. Accordingly, no further investigation is required, and the site is considered suitable for the proposed development of a solar farm. land use.

5.5 Noise

5.5.1 Assessment of Impacts

Several potential noise sensitive receptors were identified as shown in Figure 13 below and listed in Table 6. These 15 receptors comprise rural residential properties. Construction and operational noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities.

Table 6: Sensitive Receptors

Receptor ID	Address	Receptor Type	Direction	Distance (m)
R1	3791 Thunderbolts Way, Uralla	Rural Dwelling	East	230
R2	239 Racecourse Road, Uralla	Rural Dwelling	South-West	280
R3	249 Racecourse Road, Uralla	Rural Dwelling	South-South-West	460
R4	Staces Road, Uralla	Rural Dwelling	North-West	530
R5	3713 Thunderbolts Way, Uralla	Rural Dwelling	South-East	590
R6	3850 Thunderbolts Way, Uralla	Rural Dwelling	North-East	610
R7	47 Staces Road, Uralla	Rural Dwelling	West	720
R8	38 Staces Road, Uralla	Rural Dwelling	West	790
R9	3685 Thunderbolts Way, Uralla	Rural Dwelling	South-East	820
R10	289 Racecourse Road, Uralla	Rural Dwelling	South-West	860
R11	92 Racecourse Road, Uralla	Rural Dwelling	North-West	980

Receptor ID	Address	Receptor Type	Direction	Distance (m)
R12	88 Racecourse Road, Uralla	Rural Dwelling	North-West	1,040
R13	8421 New England Highway, Uralla	Rural Dwelling	West	1,260
R14	310 Racecourse Road, Uralla	Rural Dwelling	South-West	1,280
R15	The Gap Road, Uralla	Rural Dwelling	South-East	1,330
Uralla	Uralla, NSW	Small Rural Town	North	1,600

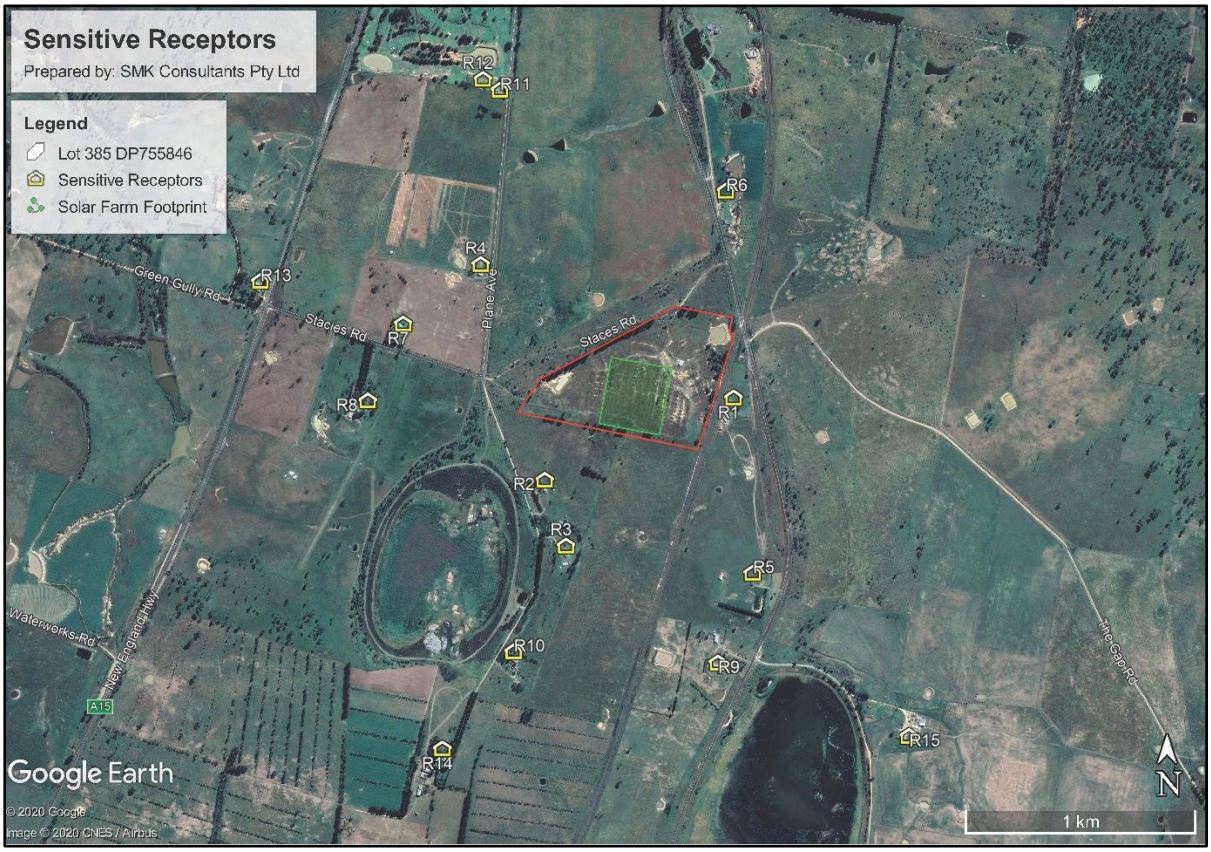


Figure 13: Location of Noise Sensitive Receptors

Construction of the facility will involve large machinery, but this will be removed once the site is operational. No large machinery will be active on the site once the solar farm is in operation. The solar farm will generate minor noise emissions from transformers.

Typical construction equipment noise levels, displayed in Table 7, have been obtained from:

- AS 2436 – 2010, Guide to noise and vibration control on construction, demolition and maintenance sites.
- BS 5228-1, Code of practice for noise and vibration control on construction and open sites. Noise.

- DEFRA—Department for Environment Food and Rural Affairs (United Kingdom), Update of noise database for prediction of noise on construction and open sites-Phase 3: Noise measurement data for construction plant used on quarries, July 2006.

Table 7: Typical Sound Levels of Construction Plant and Equipment

Plant Description	A-weighted sound power levels L_{wA} dB ref: 10^{-12} W		A-weighted sound pressure levels L_{pA} (mid-point) dB at 10m
	Typical Range	Typical (midpoint)	
Compactor	110-115	113	85
Compressor (silenced)	93-110	101	73
Crane (mobile)	95-113	104	76
Crane (tower) 10	105	105	77
Excavator	97-117	107	79
Forklift	106	106	78
Front end loader	110-115	113	85
Generator (diesel)	84-=113	99	71
Grader	105-115	110	82
Hand tools (electric)	95-110	102	74
Loader (wheeled)	99-111	105	77
Truck (>20 tonne)	107	107	79
Truck (water cart)	106-108	107	79
Vehicle (light commercial e.g. 4WD)	100-111	106	78
Welder	100-110	105	77

The magnitude of off-site noise impacts associated with construction would be dependent upon a number of factors:

- The intensity and location of construction activities
- The type of equipment used
- Existing local noise sources
- Intervening terrain
- The prevailing weather conditions

During any given period, the machinery items to be used in the study area would operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time and certain types of construction machinery would be present in the study area for only brief periods during construction.

Furthermore, all construction and operation of machinery would only occur during work hours and not during the evening or night periods, where sound can be potentially increased as a result of various factors, including inversion layers. Accordingly, the predictions should be considered as conservative estimates.

The NSW Noise Policy for Industry 2017 (NPI) presents a methodology for determining Project Noise Trigger Levels (PNTL) for industrial development. Ambient and background noise measurements are used to determine PNTL relevant to the proposed development. Table 8 provides the NPI minimum RBL for each period of the day, which were adopted for the site.

Table 8: Rating Background Noise Levels

Period	RBL dB(A)
Day	35
Evening	30
Night	30

Note: Day is defined as the period from 7am to 6pm (Monday to Saturday) and 8am to 6pm (Sundays and public holidays). Evening is defined as the period from 6pm to 10pm. Night is defined as the period from 10pm to 7am (Monday to Saturday), and 10pm to 8am (Sundays and public holidays).

Table 9 provides an analysis of both the intrusiveness and amenity noise levels for the purposes of establishing a PNTL for the proposed development.

Table 9: Assessment of PNTL in adjacent receiving environment

Metric	Day dB(A)	Evening dB(A)	Night dB(A)
Rating Background Level	35	30	30
Project Intrusiveness Criteria	40	35	35
Recommended Amenity Level	50	45	40
Project Amenity Level	45	40	35
Project Noise Trigger Level	**40**	**35**	**35**

These levels are considered acceptable guideline ambient noise levels that can received by sensitive receptors whilst being considered to protect environmental values, including health and well-being, for outside a dwelling.

Noise impacts associated with the project were estimated using the distance attenuation relationship described in the following equation:

$$L_2 = L_1 - 20\text{Log}(d_1/d_2)$$

(source: Noise Guide for Local Government - epa.nsw.gov.au)

Where: d_1 = distance (m) between source and receiver

d_2 = distance (m) at which Sound Pressure (L_{pa}) measured

L_2 = sound pressure level at the distance d_1 from the source

L_1 = sound pressure level at distance d_2 from the source

Propagation calculations take into account sound intensity losses due to hemispherical spreading, with additional losses such as atmospheric absorption, directivity, ground absorption and shielding ignored in the calculations.

The closest receptor is approximately 230 metres to the east of the project site. At this distance, the loudest activity (compacter) is predicted to be:

L_2 = 85 - 20log(230/10)
= 57.8 dB

Note that a compacter will most likely not be required. It has been used in this calculation as a 'worst-case scenario'.

This is considered as a potential exceedance of acceptable noise levels. Short periods of noise level exceedances of 17.8 dB may occur when machinery is closest to the receptor located at 230m from the construction site. This would potentially involve a short 2 to 3 minute period when the machine is at the closest point and then as the machine moves away, the noise level would become compliant. Minimal mitigation measures can be undertaken to reduce these short periods of exceedance, other than ensuring that the machine does not remain in the exceedance zone for extended periods. It is therefore recommended that movements of the compactor and other construction equipment that generates constant noise impacts, occurs back and forward (towards and then away) from the receptors rather than remaining parallel and within the receptor impact zone during construction activity.

5.5.2 Operational Noise

Sources of plant noise associated with the operation of the solar farm would be restricted to the 11kV substation and air-conditioned Inverter Stations / transformers. The MVPS units will be centrally located within the solar farm, providing an additional buffer distance from the source of the noise and the closest receiver, which would be R1.

Ongoing maintenance requirements would be negligible and is likely to require no more than one or two technicians in a light utility occasionally using hand tools.

Whilst some plant and equipment selection with preferred suppliers has yet to be finalised, typical manufacturer noise specifications for the plant to be used is available. The LAeq Sound Power Level (SWL) of all the proposed inverter to be used is identified in Table 10.

Table 10: Typical Operational Sound Power Levels

Equipment	L_{Aeq}SWL	Source
HEMK Inverter Transformer Station	79	HEMK (measured at 1m)

5.5.3 Predicted Noise Levels at Receptors

During operations, the noise source would be from the battery storage containers / inverter stations. The closest receptor (R1) is located approximately 260 metres to the east of the closest battery storage container/inverter station. At this distance, the loudest activity (HEMK Inverter Transformer Station) is predicted to be:

L_2 = 79 – 20 log(260/1)
= 30.7 dB

This level would be compliant with the project trigger noise levels during all periods of the day.

5.5.4 Conclusion

Sound pressure generated at the project site is considered compliant with the noise limits during the operation of the proposed development. The level of attenuation available over the distance between the source and the receptor is considered more than sufficient to ensure that the amenity of the receptor is not disturbed.

The assessment would therefore suggest that the environmental value associated with the sensitive receptors will be adequately protected from potential noise impacts generated by the development. The intensity and frequency of noise emissions from the site are not considered to be sufficiently significant to create additional impact above acceptable criteria.

Additionally, during construction, the proponent shall:

- Establish a construction noise and vibration control plan;
- Select plant and equipment where practical on acoustic performance;
- Use plant and equipment in a manner which minimises noise impacts; and
- Implement a noise monitoring program to ensure that noise levels are being controlled and that best possible practices are being implemented.

Provided the above-mentioned mitigation measures are implemented, the proposed development is considered to have minimal potential impact on the acoustic amenity of any nearby receptors.

5.6 Visual Amenity

5.6.1 Landscape Setting

The lands forming and surrounding the solar farm site are predominantly an open modified agricultural landscape that typically consists of hobby or small acreage farms. It is gently undulating with some remnant vegetation. The site itself is zoned industrial within a rural area and located south of the township of Uralla. The land is largely cleared and supports a range of infrastructure associated with a rural landscape. This includes fence lines, existing

overhead power lines, residences, yards, sheds and pockets/corridors of vegetation. The following images are of the existing site and structures, which are scattered across the site.

Figure 14: Existing landscape across the development site facing north-west.

Figure 15: Existing landscape across the development site facing east.

Figure 16: Existing dilapidated building on property (to be removed), view facing north.

Figure 17: Existing structures on the property, view facing east.

Figure 18: Existing powerlines across the property, view facing north.

Figure 19: Existing storage, powerlines and structures on the property, view facing north-east.

Figure 20: Existing storage, powerlines and structures on the property, view facing south-east.

Figure 21: Existing storage on the property, view facing west.

5.6.2 Landscape Values

Landscape value is concerned with the relative value that is attached to different landscapes. In a policy context the basis for recognising highly valued landscapes is through either registration or listing in a local, State or Commonwealth heritage register. Neither the development site nor any surrounding landscape is recognised through registration or listing as significant landscape value.

Notwithstanding, a landscape may be valued by different communities for many different reasons without any formal listing. There are intangible and emotive values associated with judgements about what makes the landscape important for different people and how sensitive it is to change. Whether the impact is considered acceptable or desirable is ultimately a subjective issue and opinions would differ between individuals. The values people place on the landscape varies, as will their opinions as to the significance of the visual impacts associated with the solar farm. It is assumed that neighbours and landowners in the immediate locality undoubtedly value the landscape.

The sensitivity of the neighbouring dwellings to landscape change is expected to decrease with distance so that visibility of the solar farm to dwellings and other structures outside of the immediate visual catchment would be negligible. The sensitivity of public places to landscape change would be higher in close proximity to a new development.

5.6.3 Visual Catchment and Impact

A variety of visual receptors can reasonably be anticipated to see the solar farm. This includes local residents and the occasional motorists.

5.6.3.1 Residents

It is generally accepted that local residents have a high level of sensitivity to changes in their landscape and visual environment. The most important views are those available from their own homes. Views from their own homes, whilst private, are judged to be the most sensitive as these are views which are consistently available, and they may be views that residents dwell upon for longer periods of time which defines their home in terms of personal appeal.

The closest sensitive receptor is located 230 metres east of the proposed development site. The site would be visible from the existing dwelling with limited current screening.

Figure 22: Looking towards R1 to the east of the development site.

5.6.3.2 Travelling Public

This category of visual receptor group includes local residents who pass through the area along Thunderbolts Way. Users of roads would vary in their level of sensitivity to the development, depending primarily upon the purpose for which they are travelling. For example, local residents may be more preoccupied with achieving their destination than in enjoying the scenery along their trip.

Figures 23 and 24 show the current visibility towards the development site from Thunderbolts Way. The site would be partially visible from the road, however it is located outside of the direct line of site for motorists travelling north or south along Thunderbolts Way. Further, given the speed limit along this section of road is 100km/hour it is likely that the solar farm would only be visible for a short amount of time.

Figure 23: Existing view northwest from Thunderbolts Way towards the development site.

Figure 24: Existing view southwest from Thunderbolts Way towards the development site.

5.6.4 Mitigation Measures

The Thunderbolt Community Solar Farm is to be enclosed within a 1.8-metre-high security fence setback a minimum of 10 metres from the southern boundary and surrounding the array on other sides well within the development site. Solar arrays are to be setback at least 8 metres from the security fence giving a total setback to the southern boundary of 18 metres. The proposed fence is to be chain mesh steel topped with a row of barbed wire.

The existing dilapidated structures within the development footprint will be demolished and removed as part of the proposal.

Existing vegetation along the northern and southern fence provide sufficient visual screening of the proposed development to minimise potential visual impacts to surrounding receptors. Additional vegetation screening is proposed along the full extent of the eastern and western fence lines to enhance the visible landscape and improve the available habitat on site for native species.

Vegetation will comprise native species endemic to the area as well as species that have been identified as koala feed tree species for the Northern Tablelands Koala Management Area. The following list includes the proposed shrubs and trees to be planted as part of the proposed vegetation screening. The proposal will include two rows of shrubs and two rows of trees to be sourced from the Kentucky Tree Nursery.

Shrubs

Crimson bottlebrush (*Callistemon citrinus*)
Alpine bottlebrush (*Callistemon pityoides*)
Lana bottlebrush (*Callistemon pungens*)
Stiff bottlebrush (*Callistemon rigidus*)
River bottlebrush (*Callistemon sieberi*)

Weeping bottlebrush (*Callistemon viminalis*)
Small fruit hakea (*Hakea microcarpa*)
Willow-leaved hakea (*Hakea salicifolia*)
Grey tea-tree (*Leptospermum brevipes*)
New England tea-tree (*Leptospermum nova anglicae*)

Trees
Silver wattle (*Acacia dealbata*)
Fern leaf wattle (*Acacia filicifolia*)
Blackwood (*Acacia melanoxylon*)
Rough-barked apple (*Angophora floribunda*)
Kurrajong (*Brachychiton populneus*)
River she-oak (*Casuarina cunninghamiana*)
Wattle-leaf peppermint (*Eucalyptus acaciiformis*)
Red gum (*Eucalyptus blakelyi*)
Apple box (*Eucalyptus bridgesiana*)
New England stringybark (*Eucalyptus caliginosa*)
Yellow box (*Eucalyptus melliodora*)
Hillgrove gum (*Eucalyptus michaeliana*)
New England peppermint (*Eucalyptus nova anglica*)
Snow gum (*Eucalyptus pauciflora*)
Black sally (*Eucalyptus stellulata*)
White gum (*Eucalyptus viminalis*)

The proposed development will also include the construction of a wetland system of reed beds that are considered to improve the visual aesthetics and overall appearance of the site.

The proposed solar farm would have a visual impact and add a new feature to the landscape. No landscape feature associated with an area of local or regional conservation significance would be impacted. While the solar farm would become a visible landscape feature, it would not result in the loss or major change to key elements, features or characteristics of the broader existing landscape such that the post development landscape character would be fundamentally changed. The solar farm would be partly visible to dwellings in close proximity on the eastern and southern side of the development and along Thunderbolts Way and to R1. Distance separation and proposed screening along the eastern and western fence lines would assist to mitigate the impact to this viewpoint. Roadside vegetation and the sloping undulating topography of the land would serve to minimise visual impacts to most observation points. These impacts are considered acceptable given the nature of the proposed development and that it will contribute to renewable energy generation. It is expected that acceptance of and adaptation to change will occur within a relatively short timeframe following completion of works.

5.7 Glare and Glint

Glare is defined as a continuous source of excessive brightness relative to ambient lighting. Glint is defined as a momentary flash of bright light. Solar photovoltaic (PV) panels are constructed of dark, light-absorbing material and covered with anti-reflective coating. In order to maximise the efficiency, the panels are designed to limit reflection and to absorb around 98% of the light received. The glare generated from solar panels is significantly lower than many other surfaces, including water, however, the glass panels and metal frames have the potential to generate glare and glint. An assessment of the potential glare and glint generated by the proposed solar farm is necessary to ensure visual receptors such as road users, air traffic control towers and pilots are not impacted by the development of solar farms.

The amount of light reflected by a PV panel depends on the amount of light hitting the surface, the time of year, amount of cloud cover, the surface reflectivity, and whether the array is fixed or tracking.

When the sun is at a right angle to a fixed PV array, the angle of incidence (AOI) is the lowest but increases as the angle of rays from the sun increase relative to the fixed panel angle.

The percentage of sunlight reflected by PV solar panels is similar to that of water and less than most other materials, as illustrated in Figure 25 and Figure 26. The low reflectivity design of the solar PV panels maximises the absorption of solar energy and therefore minimises the extent of solar energy reflected.

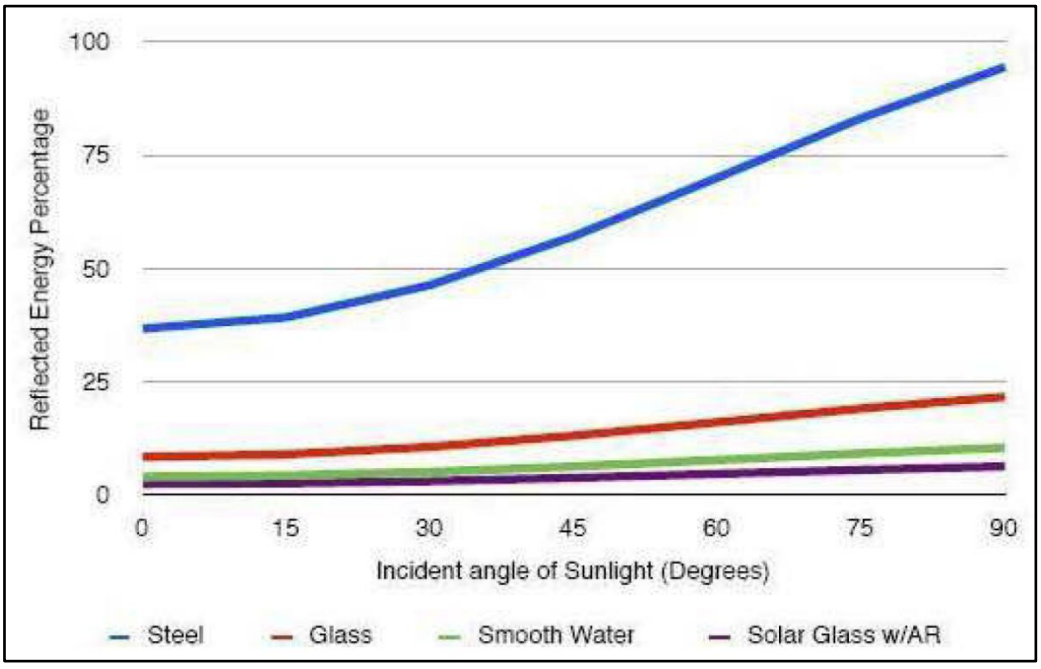


Figure 25: Typical Material Reflectivity with Sunlight Angle[1]

[1] Spaven Consulting, 2012. *Proposed Solar Energy Facility, Manston, Kent: Manston Airport 'Glint and Glare' Study*

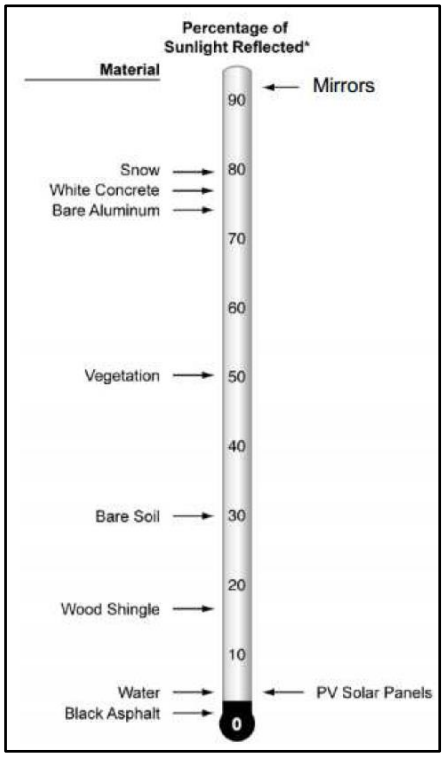


Figure 26: Comparative Reflection of PV Solar Panels[2]

5.7.1 Potential Impacts

Glare and glint are a potential hazard/nuisance generated by solar panels. Ho[3] defines glint as a momentary flash of light, and glare as a more continuous source of excessive brightness relative to ambient lighting.

Glint is produced as a direct reflection of the sun in the surface of a PV solar panel. Glare is not a direct reflection of the sun, but rather a reflection of the bright sky around the sun. Glare is significantly less intense than glint[4]. The difference between glint and glare is depicted in Figure 27.

[2] Sandia National Laboratories (Clifford K. Ho), n.d. *Overview Presentation of the Solar Glare Analysis Tool (SGHAT)* [ONLINE] Available at: http://share.sandia.gov/phlux/static/reference/glint-glare/SGHAT_Ho.pdf

[3] Ho, C.K., 2013, *Solar Glare Hazard Analysis Tool (SGHAT).* Sandia National Laboratories, Albuquerque, NM.

[4] Power Engineers, 2010, *Panoche Valley Solar Farm Project Glint and Glare Study,* SolarGen Energy, May 21 2010

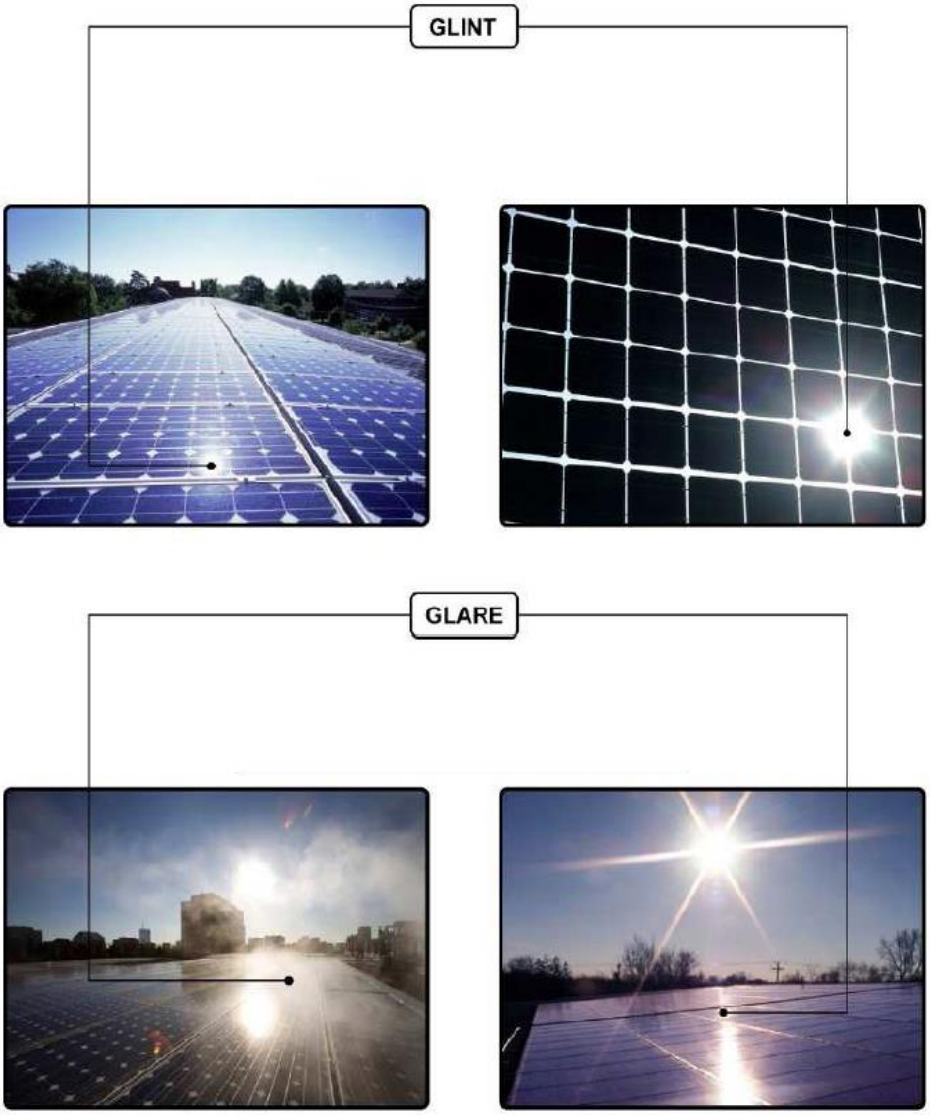


Figure 27: Visual Comparison of Glint and Glare[5]

5.7.2 Glare Hazard Analysis

Given the small nature of the development and based on the results of previous assessments for PV solar power projects and studies carried out in the USA and Europe, the potential for sun glint and glare would not be expected to have a significant impact.

SMK Consultants find it unlikely that sun glint or glare reflection from components of the project will have any significant impact on people residing in, or travelling through the landscape. The potential for reflectivity of sunlight from the PV panels is less than a number of commonly established materials in the surrounding rural landscape including bodies of water, steel and standard window glass.

[5] Power Engineers, 2010, *Panoche Valley Solar Farm Project Glint and Glare Study,* SolarGen Energy, May 21 2010

5.7.3 Civil Aviation Safety Authority

The Civil Aviation Safety Authority (CASA) has also advised that they have no objections or concerns in relation to aviation safety from the proposed development. A copy of CASA correspondence is provided in Appendix 4.

5.8 Air Quality

The NSW Department of Planning, Industry and Environment maintains air quality monitoring stations across rural NSW. The nearest monitoring station to the development site is located at Armidale. The instruments used at most rural network sites are low cost indicative particulate monitors that respond to all aerosols including smoke and fog.

Dust emissions are a source of air pollution in agricultural areas and can cause poor air quality. Particles are measured as PM10 and PM2.5. PM10 are particles less than 10 micrometres in diameter. Sources include crushing or grinding operations and dust stirred up by vehicles on roads. Particles less than 10 micrometres in diameter are measured as an hourly average reading of 0.5 at Armidale on Tuesday 23 June 2020. PM2.5 are fine particles less than 2.5 micrometres in diameter. Sources include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. Particles less than 2.5 micrometres in diameter are also measured as an hourly average reading of 0.1 at Armidale Tuesday 23 June 2020.

These are comparatively very good readings indicative of the winter climate of Armidale and the Northern Tablelands region. Visibility is measured by a Nephelometer. The higher the measurement the poorer the visibility conditions. The reading for visibility was 0.03 on Tuesday 23 June 2020 which is also assessed to be very good. There are not expected to be any health impacts with air quality and visibility readings in these ranges.

Activities that disturb the earth's surface and that are carried out with the use of machinery have the potential to generate dust emissions. This may be exacerbated by wind exposure to an exposed ground surface. The construction of the solar farm will not involve extensive earthworks and only pile driving for footings for the array framework and excavation for ancillary structures and access will be carried out. The area below the PV field will be layered with approximately 35mm of crusher dust that will reduce exposure of the soil to wind and rain. Along with the delivery of materials using heavy vehicles, the construction works may generate dust, however, once operational the change of use of the land to solar photovoltaic electricity generation is expected to reduce particulate emissions and lead to an improvement in local air quality. The solar farm will also service to reduce greenhouse gas (GHG) emissions.

5.8.1 Mitigation Measures

To minimise dust generation during the construction and operational phases the following mitigation measures are proposed:

During construction:

- Restrict vehicle movements to minimum areas necessary to deliver panels, ancillary structures and equipment;
- Suppress dust emissions using watering and cease works during dry and windy conditions;
- Ensure ground disturbance is limited to areas necessary to place footings or to be used for access;
- Ensure minimal handling of any excavated materials;
- Ensure stockpiles of excavated material is bunded and protected from wind and vehicle movements; and
- Re-establishing a groundcover vegetation on areas disturbed by construction but not needed post-construction, as soon as practicable.

It should be noted that the solar farm can be built without significant earthworks. No bulk earthworks of landform modifications are required.

During operation:

- Grade and add road base to internal accessways;
- Revegetate the site with suitable endemic native groundcover or pasture immediately once construction works are completed; and
- Ensure all plant and equipment operates in accordance with specifications.

5.9 Electromagnetic Fields

5.9.1 Potential Radiation Sources

The generation, distribution and use of electricity can produce extremely low frequency (ELF) electromagnetic fields (EMF) from electrically charged particles. The electric field is produced by the voltage whereas the magnetic field is produced by the current. The strength of the electric field is measured in units of volts per metre whilst the strength of the magnetic field is expressed in units of tesla (T), microtesla (µT), gauss (G) or milligauss (mG).

ELF EMF are present in a variety of natural and human-made sources. Naturally occurring ELF EMF is associated with atmospheric processes such as ionospheric currents, thunderstorms and lightning. Typical human-made equipment or appliance EMF sources include computers, refrigerators, mobile phones and televisions. The EMF strength varies according to the relative strength of both the voltage and current present in the source and degrades exponentially as the distance from the source increases. Artificial sources are the dominant sources of ELF EMF and are usually associated with the generation, distribution and use of electricity at the frequency of 50 or 60 Hz. The widespread use of electricity means that people are exposed to ELF EMF in the home, in the environment and in the workplace.

According to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), which maintains continual oversight of emerging research into the potential health effects of EMF exposure, there is no established evidence of health effects from exposure to electric and magnetic fields from powerlines, substations, transformers or other electrical sources, regardless of proximity.

5.9.2 Mitigation Measures

The location of the proposed Thunderbolt Community Solar Farm and the distance separation between nearby dwellings and the site mean that any impacts on health are mitigated. No additional mitigation measures are proposed.

5.10 Soil Resources

The subject site consisted of brown sandy clay loam soils consistent with a Kurosols, Natric as classified by the Australian Soil Classification. The land and soil capability class of the surrounding area is Class 4 and is typically considered capable of supporting grazing and occasional cultivation with moderate to high limitations. Salinity can be a moderate hazard on Class 4 land and as such land management practices should be adopted to prevent deep drainage that may cause salinity. The subject site is not considered to have any existing salinity issues and the development proposal, as designed, will not increase the risk of salinity on the property. There are no known acid sulphate soils present within the region and the area is not identified on acid sulfate soil risk mapping (eSPADE v2.1, 2020).

5.10.1 Geotechnical Investigation

The subsurface soils were generally consistent throughout the site, with silty sand underlain by very stiff to hard clays of intermediate plasticity. The site investigation, undertaken by Douglas Partners Pty Ltd, and laboratory test results indicated that the site be designated as Class ‘M’ (moderately reactive). This is defined in AS 2870:2011 ‘Residential Slabs and Footings’ as soils which would generally be expected to exhibit a moderate to high potential for volumetric changes (i.e. shrinkage and swelling) in response to variations in moisture content. Appendix 3 contains the Geotechnical Investigation of the subject site provided by Douglas Partners Pty Ltd with detailed recommendations to ensure construction occurs in accordance with the soil requirements. The site was considered Additional mitigation measures are proposed during earthworks and construction to reduce the potential for erosion and ensure the suitability of the site for the project. It was also recommended that the internal roads are covered with road base gravel material to ensure for long term use.

5.10.2 Dust Generation

There is potential for dust nuisance from earthmoving equipment during construction. Construction management will include visual monitoring of dust emissions and appropriate actions to mitigate potential issues. Internal dust management is a key construction measure to maintain good health of workers and maintenance of equipment and therefore dust

emission control through watering or other means of suppression will form a key component in daily operations.

5.10.3 Erosion and Sediment Control

Land slope on the property varies across the site but is essentially located on an undulating hill with drainage predominantly to the north-east. Erosion is considered a moderate risk in the area following heavy rain events. There is a very low risk of wind erosion. Given the nature of the proposed development, best practice drainage and sediment controls will be implemented on site. There is minimal physical alteration as result of this proposal and hence there is no chance of subsidence, slip or mass movement of the soil on site.

The following erosion control measures are recommended:
Compaction of fill to at least 98% Standard compaction as outlined below:

- Moisture conditioning of the clay materials within the 'borrow area' to the moisture content range;
- Fill material (i.e. silty sand and clays) are appropriately compacted, moisture conditioned and slopes battered at a maximum of 3H:1V;
- Fill bench with batter slopes of 3H:1V which will allow ease of access for maintenance of batter vegetation and drainage;
- Permanent batter slopes should be vegetated as soon as possible, to reduce the risk of significant soil erosion occurring;
- Topsoil (with minimum thickness of 100 mm and a maximum of 200 mm thickness) and vegetation to be provided on exposed batters or cuts. Hydro-mulching should be considered to promote growth;
- Adequate surface drainage is provided to reduce surface and seepage water flows;
- Contour drains along the crest of both cut and filling batters should be provided to reduce the potential for erosion. Such drains should be vegetated or gravel-lined, as appropriate for the expected flows;
- Erosion protection such as rip-rap or concrete at high flow drainage points; and
- Short term erosion measures such as silt fencing, hay bales etc., where required during construction.

5.11 Water Resources

5.11.1 Potential Surface Water Impacts

The proposed development site is located approximately 270 metres south-west of the Uralla Creek which flows into the Rocky Creek. The bywash of the existing north-eastern storage on the property flows through the northern part of the property towards Uralla Creek. The development area is undulating with a slope of approximately 10-20%. Uralla Creek is a third order stream. The development area is further than 100 metres from the top of the bank and works do not require approval from the NSW Office of Water as a controlled activity.

The development is located within the Water Sharing Plan for the Gwydir Unregulated and Alluvial Water Sources 2012 area. The site is also located within the area covered by the WSP for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011. The site is within the New England fold belt. No water extraction is proposed therefore neither of these WSPs is relevant to the proposed development.

The site is not considered flood prone and was not included within the flood planning areas outlined within the Uralla Local Environmental Plan 2012.

The existing site is currently used for grazing and previous land use has included timber treatment. The proposed development will include solar panels and transformers with residual areas allowed to revegetate naturally. No grazing of livestock is proposed within the development footprint with grassed areas being sprayed as required to reduce fire hazard. The proposed spraying is consistent with the herbicide application associated with the current land use.

Stormwater runoff at the site will be largely unchanged as a result of the proposed development. Although the water pattern hitting the ground will be altered slightly as each solar panel will divert the water into small channels running in-between each row, the volume of water hitting the existing footprint will remain unchanged.

A preliminary drainage plan has been included within Appendix 5. The preliminary drainage plan addresses the management of water in the event of stormwater runoff. The solar farm will include two external drains along the western and southern fenceline that have a top width of 4 metres with a variable depth of approximately 20cm with a 1 in 5 wall batter. The external east-west drain is 245 metres and has a slope of 2%, whilst the external north-south drain is 275m and has a slope of 1%. All incoming flows will be diverted around the solar farm onto existing/natural ground surface which drains to the north-east storage.

The internal drains are each 2 metres wide at the top and 20cm deep with a 1 in 5 wall batter, running north-south and east-west between the 4 solar arrays to drain surface water from the site. The internal east-west drain is 230 metres and has a slope of 2%, whilst the internal north-south drain is 260m and has a slope of 1%. The internal drains are intended to catch water moving over the array and divert it off the site half-way rather than run all the way across the site. This will reduce the total water volume coursing over the NE corner (i.e. the low point in the array) and reduce the potential erosion risk.

A cut and fill plan has also been included within Appendix 5. The drainage and cut and fill plans have been designed based on the detailed site survey undertaken on the site.

Minor construction impacts to run-off surface water are possible in relation to construction works for the solar energy system.

5.11.2 Potential Groundwater Impacts

The Groundwater Dependent Ecosystems (GDE) Atlas (BOM, June 2020) was reviewed to assess if any potential GDE's had been identified within the area. Racecourse Lagoon was identified as a Wetland with moderate potential to be a GDE. The proposed development site is located approximately 385 metres to the north-east upslope of the Racecourse Lagoon. No other potential GDE's were identified within the area.

No water is proposed to be extracted from groundwater sources for construction purposes for any project element. Accordingly, construction would not impact groundwater.

5.11.3 Mitigation Measures

The proposed works should not result in the pollution of land/waters so long as best management practices for erosion and sediment control are undertaken during construction, and appropriate remediation measures are implemented on a progressive basis. Priority will be given to achieving a high standard of erosion and sediment control and general site housekeeping throughout the construction period.

The way this is achieved is through developing and implementing construction activities in accordance with best practice[6] and the following principles:

1. At all times, in all locations, the area of ground disturbance should be limited to that which is the smallest possible footprint that is practicably possible.
2. Erosion and sediment controls must be suitably maintained, including regular monitoring to ensure the measures and controls in place are effective.
3. Immediate stabilisation of worked sections complemented by progressive rehabilitation.
4. Erosion and sediment control measures only to be removed once the area is successfully rehabilitated.

The proposal will also include the construction of a wetland system of reed beds within the existing drainage lines to the north-east storage that will allow sediment capture from within stormwater runoff.

Given the largely passive nature of the solar energy system, impacts to the local surface and groundwater environments in relation to ongoing operations is considered limited.

[6] Landcom, 2004. *Managing Urban Stormwater: Soils and Construction*, 4th Edition

5.12 Natural Hazards

The land is not subject to geological hazard such as volcanism, earthquake, or soil instability such as subsidence slip or mass movement.

5.12.1 Bushfire

The subject site is not located on land classified as bushfire prone land (Figure 28). Infrastructure comprising electricity generating works is not a habitable building and is not listed as a *special fire protection purpose* under Section 100B of the *Rural Fires Act 1997*.

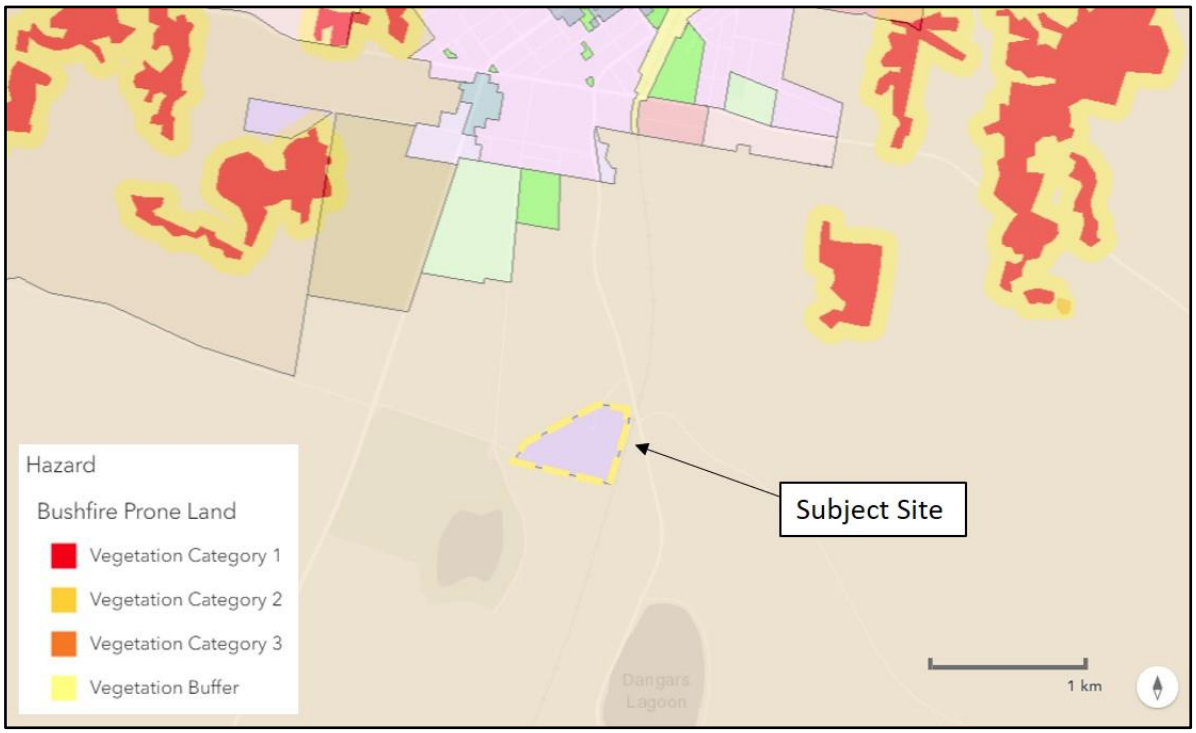


Figure 28: Site not located within Bushfire Prone Land

Whilst no specific bush fire prevention measures are required for the site, it is recommended that management ensure that grass is kept short and that any tree branches are kept out of the immediate area surrounding the proposed development site.

5.12.2 Flooding

The subject land is not within the identified flood planning areas as included in the Flood Planning Maps within the Uralla LEP 2012 (Figure 29). Any necessary flood mitigation and/or stormwater management measures have been considered in the Water Resources section of this report.

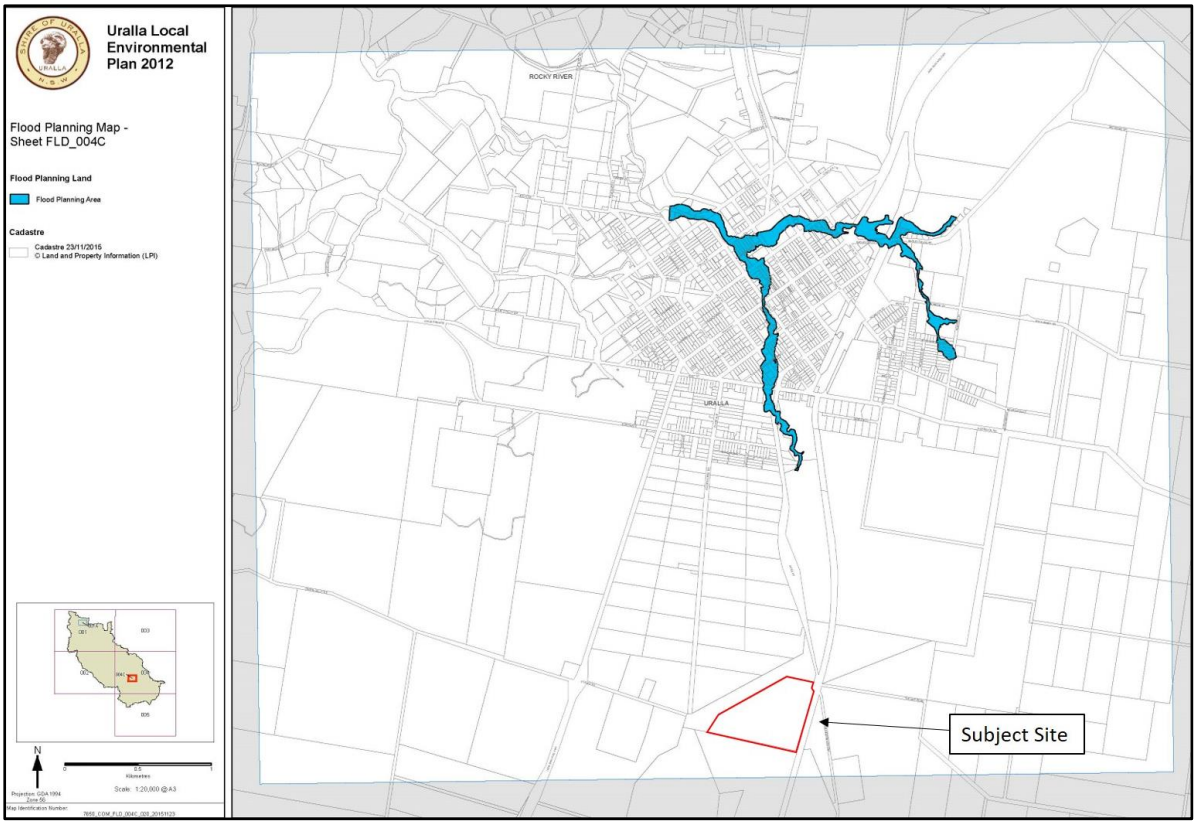


Figure 29: Site not located within designated Flood Planning Area

5.13 Cultural Heritage

5.13.1 Indigenous Heritage

The generic due diligence process outlined in the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW was implemented to ensure that an adequate due diligence process that addresses Aboriginal cultural heritage issues has been carried out. This process follows the following five steps:

1. *Will the activity disturb the ground surface?*

Earthworks will involve trenching which is required for cabling of each PV array/module to inverters and a substation. Other earthworks would be pile-driving to support module frames, and to enable the placement of concrete slabs and gravel accessways. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

2. *a) Search the AHIMS database*

The Aboriginal Heritage Information Management System (AHIMS) is a database operated by the Office of Environment and Heritage and regulated under section 90Q of the *National Parks and Wildlife Act 1974*. AHIMS contains information and records related to registered Aboriginal archaeological sites (Aboriginal objects, as defined under the Act) and declared Aboriginal places (as defined under the Act) in NSW.

A search of the AHIMS database was conducted on the 28th of May 2020 to identify registered (known) Aboriginal sites or declared Aboriginal places within or in the vicinity of the subject area. The search lot included Lot 385 DP 755846 with a buffer of 50 metres. The search revealed there were zero (0) known indigenous heritage places or sites at the proposed development site. A copy of this report is attached as Appendix 6. The search is part of the due diligence process and remains valid for 12 months.

It is noted that surveys for Aboriginal objects have not been carried out in all parts of NSW and Aboriginal objects may exist on a parcel of land even though they have not been recorded in AHIMS. Further, not all known Aboriginal sites are registered on the AHIMS database and not all sites consist of physical evidence or remains, e.g. dreaming and ceremonial sites.

The subject site has been heavily disturbed by previous land uses including substantial soil disturbance. Subsequently, the probability of Aboriginal archaeological artefacts being present on the site is minimal.

2. *b) Activities in areas where landscape features indicate the presence of Aboriginal objects*

The development area does not possess landscape features that indicate the presence of Aboriginal objects.

3. *Can you avoid harm to the object or disturbance of the landscape features?*

Not applicable as the development area has been previously heavily disturbed, does not possess significant landscape features and no known Aboriginal objects are listed in AHIMS.

4. *Desktop assessment and visual inspection*

The desktop assessment found that no known Aboriginal objects are listed in AHIMS. There was no evidence of any artefacts on the surface of the land found during the site visit in June 2020.

5. *Further investigations and impact assessment*

An extensive search of AHIMS records, is not necessary given that there are no recorded sites or places at Lot 385 DP 755846 152 Staces Road, Uralla. No further investigations are required at this stage and the development can proceed without an Aboriginal Heritage Impact Permit. Overall, it is considered that the proposed development is unlikely to impact upon indigenous cultural values.

However, Council may recommend a condition of consent to comply with provisions of the *National Parks and Wildlife Act 1974* should any evidence of Aboriginal occupation be found during site works. An *Aboriginal Heritage Impact Permit* may be required to be obtained if indigenous heritage objects are found.

5.13.2 Non-Indigenous Heritage

No non-indigenous heritage items have been found within the development site, nor is development site listed under Schedule 5: Environmental Heritage; of the LEP.

5.14 Traffic and Access

All project related traffic will utilise Staces Road to access the site. Traffic will include workers who will be accommodated in Uralla, components which will be trucked from either Sydney, Melbourne or Brisbane, and locally sourced construction equipment and materials that will come from either Uralla or Armidale.

The intended site construction hours are between 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm Saturday: with no works on Sundays or Public Holidays. The peak hourly traffic volumes are expected in the hour before and after the intended construction hours.

Due to the relatively small scale of the development, total vehicle movements are expected to be very modest.

There will be, on average, about ten-twelve (10-12) persons on site during the sixteen (16) week construction period. They will have transportable facilities on site and will not need to leave during the day. The workforce will carpool and as such only require ten (10) light-vehicle movements per day, on average five (5) in the morning, and five (5) in the afternoon.

Over the construction period, the development will require around thirty (30) heavy-vehicles to deliver the required material. Accordingly, over the estimated sixteen (16) week construction period, the development will require less than one (1) heavy vehicle movement per day.

No over-mass or over-dimensional vehicle delivery will be required.

Once operational, traffic would be limited to service personnel attending the site, with an average traffic volume of less than 1 light utility vehicle per day.

This volume of traffic is not expected to put any adverse stress on any local road network or traffic flows. Furthermore, no road upgrades or related works are required to accommodate construction traffic.

5.14.1 Access

The development will utilise the existing access to the property from Staces Road. Internal access roads will then be utilised to provide direct access to the site. Staces Road is a local

road and the existing access is considered suitable for the proposed development considering the limited construction timeframe.

Figure 30: Existing Access from Staces Road

Figure 31: Sight Distance – View South along Racecourse Road from Proposed Site Access. Sight distance of approximately 50 metres from a view point of 1.5 metres above ground.

Figure 32: Sight Distance – View North along Plane Avenue from Proposed Site Access. Sight distance >300 metres from a view point of 1.5 metres above ground.

Figure 33: Sight Distance – View West along Staces Road from Proposed Site Access. Sight distance >200 metres from a view point of 1.5 metres above ground.

No driveway upgrade is proposed as part of this development.

5.14.2 Parking

The site can accommodate sufficient parking and service areas for construction vehicles through as-required arrangements. There is no demand for parking facilities once the site is operational.

5.14.3 Local Traffic Committee

Roads and Maritime Services (RMS) is legislated as the organisation responsible for the control of traffic on all roads in New South Wales. RMS has delegated certain aspects of the control of traffic on regional and local roads to the Councils of each Local Government Area in the form of a Local Traffic Committee (LTC). The LTC has no decision-making powers and is

primarily a technical review committee. It only advises the Council on matters for which the Council has delegated authority, being certain prescribed traffic control devices and traffic control facilities. Uralla Shire Council must refer all traffic related matters to the LTC prior to exercising its delegated functions.

5.15 Community and Economy

5.15.1 The Population

The population of the Uralla township in 2016, as defined by the Australian Bureau of Statistics and which includes the development site and rural land surrounding the Uralla township, was 2,743 persons of which over 80% were born in Australia. The total population of the Uralla local government area in 2016 was 6,062 persons.

Occupied private dwellings accounted for 87.9% of dwellings in the Uralla urban centre and 12.1% were unoccupied. 93% of dwellings were separate houses and 4.3% were medium density dwellings.

Unemployment at the time of the 2016 Census of Population and Housing was 6.5% of the labour force comprising persons aged 15 years and over in Orange urban centre. More than 15% of employed people were technicians and trade workers with significant proportions employed as labourers, professionals, clerical and administrative workers, community and personal service workers, managers, sales workers and machinery operators and drivers. The top industries of employment were local government administration, education (higher, primary and secondary) and aged care.

5.15.2 Employment

During the initial planning phase Meralli Projects Pty Ltd commissioned local and regional professionals to carry out the land survey and environmental reports. This initial expenditure generates flow on effects through the local economy through income and employment.

It is anticipated that there will be 18 personnel directly involved in construction on site which is expected to take approximately four months. Varying levels of expertise will be required ranging from labourers to qualified electricians and project managers. In addition, personnel will be involved in transport and delivery of materials to the site. Some of this employment is to be sourced locally. This will bring direct economic benefits to the local economy through wages and salaries and indirect benefits through the need for accommodation and sustenance in the area for non-local employees.

Once operational the site will be unmanned, however, one to two personnel will be necessary to carry out maintenance every quarter or as required.

The skills required to be involved in the construction and ongoing maintenance of the Thunderbolt Community Solar Farm may require some personnel to undergo further training and education, leading to an upskilling of the local workforce and enhanced employment opportunities generally.

According to the most recent available visitor accommodation data made available by Visit NSW[7] there were 10 accommodation options including hotels, motels and serviced apartments, bed and breakfasts, short-term rentals and unoccupied private dwellings offering a range of accommodation options within the Uralla township. It is considered that there is adequate accommodation available to cater to the expected number of construction workers even if all are sourced from outside the Uralla area.

5.15.3 Summary and Mitigation Measures

- The development of the proposed solar farm will contribute to the electricity grid in a sustainable manner that reduces greenhouse gas emissions and will assist the transition of our economy from reliance on fossil fuels to renewable sources to decarbonise electricity production;
- The solar farm will assist Commonwealth and NSW Governments to achieve targets and objectives relating to emissions and addressing climate change;
- The solar farm will generate community economic benefits through local employment opportunities during the planning and construction phases as well as limited maintenance and inspection jobs once operational. The development of a solar farm will create a new market for local contractors and expand diversity of income for the land holder; and
- If necessary and practical in terms of security, the land surrounding panel arrays can continue to be utilised for the grazing of sheep during the operation of the solar farm.

5.16 Waste Management

A desktop assessment of the waste generated during construction and operation of the proposed Thunderbolt Community Solar Farm has been carried out to determine the appropriate means of waste disposal and recycling. The assessment takes into account the requirements of relevant legislation and policy including the *Protection of the Environment Operations (POEO) Act 1997, POEO (Waste) Regulation 2014* and the *Waste Avoidance and Resource Recovery Act 2001*.

The largest amount of waste will be generated during the construction and module assembly phase and be classified as general solid waste (non-putrescible). Wastes would predominantly include wooden pallets, cardboard, plastics, green waste and domestic waste. Construction of a solar farm would not generate any putrescible waste products. Minimal waste would be

[7] https://www.visitnsw.com/destinations/country-nsw/tamworth-area/uralla/accommodation

generated when the farm is operational other than small amounts of replacement parts and packaging required for maintenance and repair works.

It is expected that the solar farm will be operational for at least 25 to 30 years. Upon decommissioning all infrastructure, including cabling and panels and mounting frames including footings and inverters would be disassembled and removed from the site. There are currently limited opportunities to recycle the components of solar panels, however, it is anticipated that the waste recycling industry will expand and develop new technologies and uses for those components by the time decommissioning occurs.

The Uralla Landfill and Community Recycling Centre is located on Tip Road to the south-west of the Uralla CBD and is operated by the Uralla Shire Council. It is open Monday, Tuesday, Thursday and Friday from 8am – 4pm and on Saturday and Sunday from 9am to 2pm. The centre is closed to the public on Wednesdays. Recyclable materials are accepted free of charge. A disposal fee applies to waste that goes to landfill. There are also scrap metal businesses operating in the area.

It is recommended that a waste management plan be prepared following approval and prior to construction to specify precise volumes of each waste material, classify that waste material and identify appropriate management procedures including means of transport and the destination. Waste management should be predicated on the international hierarchy of waste management to avoid/reduce, reuse, recycle, recover, treat and dispose of waste products to avoid or reduce waste materials where possible, and to re-use, recycle and recover the majority of waste materials generated during each of the construction, operational and decommissioning phases.

5.17 Decommissioning

The Thunderbolt Community Solar Farm is intended to remain in operation indefinitely in order to contribute to the sustainable electricity power supply to the state of NSW. If, however, circumstances change and it is necessary to decommission the farm in around 30 to 35 years, then all infrastructure, panels, mounting frames including footings, inverters, cabling and other sub-surface materials would be disassembled and removed from the site to enable the site to be re-developed or left for grazing purposes. All gravel surfacing of accessways would be removed unless required for a future use. If necessary, a condition of consent may be imposed that requires a decommissioning plan to be prepared and approved prior to the event.

6 Suitability of Site for Development and Report Summary

- The proposed development involves the construction of a solar farm on Lot 385 DP 755846.
- The site is zoned IN1 General Industrial under the provisions of *Uralla Local Environmental Plan 2012.*
- The proposed solar farm has been preferentially sited on a previously cleared and heavily disturbed site that is considered suitable for the redevelopment to a renewable energy precinct.
- The subject site currently consists of desolate buildings and contour banks that typically provide a negative impact on the aesthetics and appearance of the site. The proposed development will include additional vegetation screening and the construction of a wetland system of reed beds that are considered to improve the visual aesthetics and overall appearance of the site.
- The total development footprint will be 6.7 hectares.
- Utility services are currently unavailable but are not required.
- Minimal vegetation removal is required to accommodate the proposal.
- As-required vehicle access and parking to the site will be adequate throughout the construction phase and during operation.
- A preliminary contamination assessment concluded the risk of site contamination is assessed to be low and the site is suitable for the proposed development.
- A Traffic Assessment Report is not required due to the brief and modest expected vehicle requirements.
- The development as proposed is considered to address the requirements of Sustainable Development being a key consideration under the provisions of the *Environmental Planning & Assessment Act 1979*.

6.1 Any submissions made in accordance with this Act or the Regulations

Consultation and concurrence is addressed under Section 4.13 of the Environmental Planning and Assessment Act, 1979 for consultation and concurrence. The consent authority must ensure a development application is appropriately notified in accordance with this clause and any relevant environmental planning instrument and/or development control plan.

6.2 Public and Public Authority Submissions

Where necessary for Integrated Development, Council must notify the appropriate authorities of the proposal, under the EP&A Act 1979. General Terms of Approval from notified government authorities should be included in the conditions of consent issued by the Council.

The proposed development is not identified as Integrated Development.

6.3 The Public Interest

The public's interest will not be compromised by the proposed development and it is understood the application will be appropriately notified in accordance with Clause 4.13 of the Environmental Planning and Assessment Act, 1979, any relevant environmental planning instrument and development control plan to ensure the public are notified accordingly and given their right to be heard.

6.4 Justification for Approving the Proposal

The Commonwealth Government has recognised that Australia's reliance on carbon-based fuels is not a viable means of securing energy production into the future and that renewable energy alternatives can play a significant role. These renewable energy alternatives may include solar PV, solar concentrated thermal, geo-thermal and wind.

Solar energy is energy created by the heat and light of the sun. Solar power is produced when this energy is converted into electricity or used to heat air, water, or other substances. Australia has the highest average solar radiation per square metre of any continent in the world. The development of solar photovoltaic power is well underway in NSW and across Australia. This growth in the local solar PV sector continues to provide a significant boost for Australia's regional economy with renewable infrastructure development estimated to create upwards of 2,300 direct jobs plus indirect employment.

Renewable electricity generation options including solar PV are already influencing the electricity market. The emergence of battery storage options will become more prevalent in the next decade as technology development improves, opening up the possibility to transition from reliance on centralised electricity generation to distributed energy generation and storage. Private infrastructure projects such as the proposed solar farm are required to provide reliable energy to Australian consumers, while at the same time helping to meet Australia's emission reduction targets.

According to the Australian Renewable Energy Agency (ARENA), the deployment of household solar PV that generates about 5 kW is expected to continue and at the same time an increase in rooftop solar PV installations on commercial premises generating around (10-100 kW) is expected. Large scale solar PV is also rapidly expanding in Australia with several solar farms being constructed that will have the capacity to generate over 100MW. The proposed Thunderbolt Community Solar Farm aims to fill the gap in the mid-sized plants. It will generate 4.95MW of AC power and contribute to renewable energy supply to supplement electricity generation from coal, oil and gas and assist to reduce reliance on these unsustainable means of supply.

The proposed development is in accordance with relevant objects of the *Environmental Planning and Assessment Act 1979* in that it will assist to generate power to be distributed to

the residents of NSW thereby promoting the social and economic welfare of the community in a manner that manages and conserves natural resources. The Thunderbolt Community Solar Farm will further the goals of sustainability, and the orderly and economic use of land. In conclusion, the proposed development will result in minimal environmental or amenity impacts and accordingly justifies a favourable determination by the consent authority.

Appendix 1 – Site Plans

Locality Plan

Prepared by: SMK Consultants

Legend

- 152 Staces Rd
- Lot 385 DP 755846
- Uralla


Staces Rd
The Gap Rd
Inverter 1
Inverter 2
Fence
Battery Storage Containers
PV Field
275 m
245 m

Appendix 2 – SEPP 55 – Preliminary Site Investigation

SMK

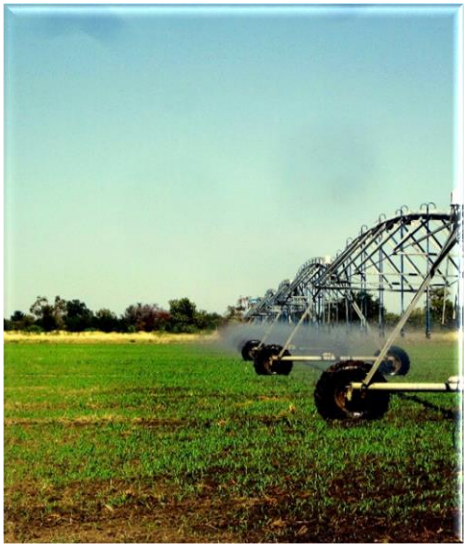
CONSULTANTS

surveying – irrigation – environmental – planning

ABN 63 061 919 003

39 Frome Street
PO Box 774
Moree NSW 2400
Ph 02 6752 1021
Fax 02 6752 5070
hayley@smk.com.au

www.smk.com.au



152 Staces Road, Uralla NSW 2358

PRELIMINARY CONTAMINATION ASSESSMENT

Medam Pty Ltd

PO Box 302, Uralla NSW 2358

July 2020

SMK

CONSULTANTS

surveying – irrigation – environmental – planning

ABN 63 061 919 003

DOCUMENT CONTROL

Project Name	Thunderbolt Community Solar Farm at 152 Staces Road, Uralla
Proponent	Medam Pty Ltd
Project Reference	20-164
Report Number	20-164 Preliminary Contamination Assessment
Prepared for	Medam Pty Ltd (Meralli Projects) PO Box 302 Uralla NSW 2358 Contact: Methuen Morgan Ph: 0429 192 087 E: methuen@meralliprojects.com.au
Prepared by	SMK Consultants PO Box 774 39 Frome Street Moree NSW 2400
Contact	Hayley Bouliopoulos Ph: (02) 6752 1021 E: hayley@smk.com.au

Author	
Name Position Company	Hayley Bouliopoulos Hayley Bouliopoulos BB. BSc. Env Environment & Resource Consultant SMK Consultants

Reviewed By	
Name Position Company	Peter Taylor Peter Taylor BSc. MEIANZ CIAg LAA Environment & Resource Consultant SMK Consultants

Revision History			
Version Number	Date	Authority	Details
0	July 2020	Hayley Bouliopoulos (SMK Consultants)	Initial Issue

TABLE OF CONTENTS

1 Introduction

SMK Consultants have been instructed by Medam Pty Ltd (Meralli Projects) to undertake a preliminary contamination assessment in accordance with SEPP 55 of the proposed Thunderbolt Community Solar Farm development site at 152 Staces Road, Uralla (Lot 385, DP755846). The site was previously registered as a contaminated site, known as the 'former Koppers Timber Treatment Plant'. The proposed land use is not considered a sensitive land use; however, the construction will involve some minor ground disturbance.

The Koppers Timber Treatment Plant operated from 1979 to 1984 using oil-based creosote preservative for approximately 75% of all treatments, with copper, chrome and arsenic (CCA) used for the remaining 25%. Creosote use was discontinued in 1984 and CCA was used until the site ownership changed and the plant ceased operations in 1988. Following the closure of the facility the site was subject to remediation works. The EPA issued a 'notice to repeal management order' in 2012 following assessment of a validation report that concluded the site had been remediated to a standard suitable for industrial use.

2 Scope and Methodology

The scope of the investigation was limited to the sampling of selected test pits within the proposed development footprint and drainage lines for laboratory analysis and further comparison with the relevant health guidelines.

3 Guideline Criteria for Threshold Levels

Appropriate threshold criteria have been adopted from the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) Amendment No. 1 (2013): Schedule B1. The NEPM provides a nationally consistent approach to the assessment of site contamination and presents parameters for a range of soil contaminants. These parameters are recommended contaminant levels in soil before they have potential to affect human health or the environment. The guideline values or site criteria are referred to as Health Based Investigation Levels (HIL's).

The Guidelines for maximum threshold levels are based on the existing or potential land use for the site investigation area. The chosen guideline levels should be based on criteria of land use and therefore risk of exposure to the contaminant material. In this case the site is zoned as Industrial (IN1 – General Industrial) and the proposed use is the construction and operation of a solar farm. Aside from minor excavations for the construction of the solar farm, the contact with soil on site is limited as a permanent 1.8m fence is to be constructed around the site. A higher risk of soil inhalation or digestion can be associated with children. The area is restricted and therefore the risk of ingestion by someone playing in the soil is considered extremely low.

Other risks associated with surface spillage of hazardous compounds, would include contamination from raised dust during dry conditions and workers during any demolition or reconstruction work on the site.

In consideration of the potential impact pathways and ongoing land use, the threshold criteria to be adopted on this site is for "Commercial-Industrial", mainly:

- ***HIL D (Commercial/Industrial)*** [Table 1A (1) of Schedule B1 – Guideline to Investigating Levels for Soil and Groundwater, National Environment Protection (Assessment of Site Contamination) Measure 2013]

The available threshold levels from this Guideline are presented with the results of sample analysis included in the Table 1.

4 Sampling and Analysis Plan

Sampling was undertaken in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 Amendment No. 1 (2013). Samples were analysed for Arsenic, Chromium and Copper as these contaminants are associated with the oil-based creosote preservative which was used at the Koppers Timber Treatment Plant. Additional parameters tested included pH and Electrical Conductivity.

Three test pit locations were chosen within the proposed development footprint. The applicant requested an additional four test pits to be excavated within the drains and bywash associated with the existing storage in the north-west of the property. This would indicate whether any significant contaminant migration had occurred onsite. Therefore, a total of seven test pits were sampled at the property. The locations of all sample sites are included within Figure 1.

Samples were taken in accordance with SMK Consultants standard sampling protocol as presented in Appendix 1. Each sample was taken from a depth of 300mm. The samples were cold-stored within laboratory provided, pre-treated and labelled glass containers, relevant to each testing parameter required. Samples were then forwarded on to a NATA registered laboratory for analysis.

Figure 1: Test Pit Locations

5 Laboratory Results and Analysis

The samples requiring testing were forwarded to Australian Laboratory Services in Sydney for analysis. A Certificate of Analysis was issued by the laboratory which outlined all test results. The Laboratory completed inhouse quality assurance procedures. The results of these procedures are also outlined in the Certificate of Analysis. A copy of this certificate is included as Appendix 2.

Table 1 presents a summary of laboratory results against NEPM 2013 HIL D, Commercial and Industrial Levels for soil.

Table 1: Summary of Results for Preliminary Soil Contamination Analysis

Analyte	Unit	LOR[1]	Guideline Value[2]	Test Pit 1	Test Pit 2	Test Pit 3	Bywash	Drain 1	Drain 2	Drain 3
pH 1:5 (Soils)	pH Unit	0.1	**N/A**	7.4	7.4	6.3	6.8	7.4	7.6	6.3
Conductivity	µS/cm	1	**N/A**	12	11	9	18	10	10	8
Moisture Content	**%**	0.1	**N/A**	14.6	16.2	13.8	18.2	14.1	10.0	12.4
Arsenic[3]	mg/kg	5	**3,000**	7	<5	50	14	<5	<5	22
Chromium (VI)	mg/kg	2	**3,600**	32	26	125	28	14	12	50
Copper	mg/kg	5	**240,000**	16	6	69	8	<5	<5	27

[1]LOR – Limit of Reporting

[2]Source: National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) Amendment No. 1 (2013): Schedule B1. Table 1A(1) Health investigation levels for soil contaminants.

[3]HIL for arsenic assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate.

6 Discussion

The Laboratory results indicate that the contamination levels in soils across site pose no risk to human health criteria. All concentrations across site were found to occur well below adopted HIL D – Commercial/Industrial threshold criteria. The results were generally consistent with natural soil background levels. With the exception of chromium levels in Test Pit 3, all contaminant levels occur at levels below HIL A – Residential. This is considered the most stringent classification based on the potential higher risk of soil inhalation and digestion associated with children.

The Chromium level in Test Pit 3 of 125 mg/kg is significantly lower than the HIL D threshold Level of 3600 mg/kg. Chromium, Arsenic and Copper in this location were considered to occur at levels slightly above naturally occurring background concentrations but do not present a risk to human health.

No visible signs of contamination, odours or discolouration were noted during the investigation. The vegetation and across site was in a healthy condition and ground cover was consistent with the exception of gravelled access tracks.

7 Conclusions and Recommendations

The historical operation of a The Koppers Timber Treatment Plant and use of oil-based creosote preservatives appears to have had minimal effect on the contamination status of the proposed solar farm site. Seven soil samples were taken from the proposed development site and drainage lines and were screened for Arsenic, Chromium and Copper. The results found contamination levels well below selected Health Based Investigation Levels for Commercial and Industrial land uses.

The lack of contamination present in the drainage lines has indicated that little to no site migration of contamination has occurred.

Based on the results of this investigation, contamination levels in the soil poses no risk to human health for the current and proposed land use of this site.

Limitations

This report is based on observation at the time of the investigation and history of the site. The conclusions and recommendations are based on the scope of works adopted, the methodology presented in this report and the results of any laboratory analysis undertaken for this investigation.

8 References

National Environment Protection (Assessment of Site Contamination) Measure 1999 – Amendment 2013

Appendix A: Procedures for Quality Control

SMK Consultants - Sampling, Storage, Transport and Laboratory Procedures

1. Field sampling

- Preparation of Equipment - All equipment to be utilised for the excavation, collection and storage of field samples is to be cleaned prior to entering the investigation site.
- Onsite Sampling – All equipment used for sample collection and excavation is to be cleaned between sampling action. Cleaning to be done using clean water and cleaning equipment to be dried prior to the next sampling action to ensure that all soil and water is removed from the sampling implement.
- Field Observations – The sampler is to record date of sampling, location of sampling, conditions of sampling (weather), observation of condition of soil, odours, potential contamination, level and type of contamination.
- Sampling Order – Where it is envisaged that parts of the investigation area are more contaminated than other parts, the less contaminated areas are to be sampled before contaminated areas.

2. Sample Storage

- All samples are to be placed in cold storage (esky, fridge) and chilled to approximately 3-4 C° as soon as practicable.
- All samples are to be documented and forwarded to the selected laboratory as soon as practicable.

3. Transport of Samples

- Chain of Custody forms are to be prepared for inclusion with samples for Transport. Forms are to include project reference, Client, date of sampling, listing of laboratory testing to be done on each sample, sample container description, date of transport, condition of samples at time of despatch.
- Laboratory to be advised by fax/email of pending arrival date for samples and type of testing to be done. (E.g. Forward a copy of COC form)
- Samples to be securely packed in esky with sufficient ice to maintain the sample temperature at the required level until received by the Laboratory.
- Courier to be contacted for pick-up of samples at latest possible time.

4. Laboratory Analysis

- The laboratory is to prepare a response COC to indicate that samples were delivered in suitable condition to maintain integrity of samples, a list of testing required was received and expected date for issue of results.
- The Laboratory is to undertake the required and documented QC/QA procedures as set out by the national Association of Testing Authorities (NATA).
- Where the Laboratory has its own procedures, these procedures are to be documented and noted on the test results.
- Laboratory to maintain their appropriate system of internal check samples, duplicates and external laboratory comparisons.

5. Correlation of Field Observations and Laboratory Results

- Field observations are to be correlated with laboratory results.
- Where a laboratory results does not correlate with a field observation, the investigation must consider re-sampling of the site to provide additional evidence to determine whether the contamination is present.

6. Laboratory Duplication Requirements

- Laboratory duplications are required during a detailed site investigation where the risk of contamination and the potential consequences of contamination are considered as significant to human health or the environment, or where the laboratory operates this procedure as part of standard quality assurance management practices.
- Duplications are to be in two forms when it is determined that duplications are required.
- Field duplications are to be undertaken at a rate of one sample per 10-field samples. The field duplicate preparation involves obtaining sufficient sample material from the randomly selected point to prepare two samples. The duplicate is to be identified with a reference known to the sampler to ensure that the laboratory is unaware of the field duplicate identification or reference. The duplicate sample is to be tested for the same parameters as the original sample and then results are to be compared once laboratory results are provided. The scientist/sampler is then required to assess the results for the duplicated sample to determine variations in laboratory results. If a significant variation is noted, the laboratory should be advised to enable retesting of the sample to determine whether the results are correct or whether procedural errors have occurred in the laboratory.
- Laboratory duplicates and external duplicates to be determined by the Laboratories QC/QA system. Laboratory to be advised of duplicate requirements prior to submission of samples.

Appendix B: Laboratory Certificate of Analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2021572**	Page	: 1 of 4
Client	: **SMK CONSULTANTS PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS HAYLEY GREENHAM	Contact	: Customer Services ES
Address	: P.O.Box 774 39 FROME STREET MOREE NSW, AUSTRALIA 2400	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 6752 1021	Telephone	: +61-2-8784 8555
Project	: 20-164 Uralla Solar Farm	Date Samples Received	: 23-Jun-2020 09:00
Order number	: ----	Date Analysis Commenced	: 25-Jun-2020
C-O-C number	: ----	Issue Date	: 30-Jun-2020 11:51
Sampler	: ----		
Site	: ----		
Quote number	: SYBQ/364/15		
No. of samples received	: 7		
No. of samples analysed	: 7		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	Bywash	Drain 1	Drain 2	Drain 3	Test Pit 1
				Client sampling date / time	19-Jun-2020 15:40	19-Jun-2020 15:45	19-Jun-2020 15:50	19-Jun-2020 15:55	19-Jun-2020 16:10
Compound	CAS Number	LOR	Unit		ES2021572-001	ES2021572-002	ES2021572-003	ES2021572-004	ES2021572-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**6.8**	**7.4**	**7.6**	**6.3**	**7.4**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**18**	**10**	**10**	**8**	**12**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**18.2**	**14.1**	**10.0**	**12.4**	**14.6**
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		**14**	<5	<5	**22**	**7**
Chromium	7440-47-3	2	mg/kg		**28**	**14**	**12**	**50**	**32**
Copper	7440-50-8	5	mg/kg		**8**	<5	<5	**27**	**16**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Test Pit 2	Test Pit 3	----	----	----
			Client sampling date / time	19-Jun-2020 16:02	19-Jun-2020 16:15	----	----	----
Compound	CAS Number	LOR	Unit	ES2021572-006	ES2021572-007	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**7.4**	**6.3**	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**11**	**9**	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**16.2**	**13.8**	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	**50**	----	----	----
Chromium	7440-47-3	2	mg/kg	**26**	**125**	----	----	----
Copper	7440-50-8	5	mg/kg	**6**	**69**	----	----	----

Appendix 3 – Geotechnical Investigation

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Community Solar Farm
152 Staces Road, Uralla

Prepared for
Meralli Projects Pty Ltd

Project 102139.00
September 2020

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	102139.00	Document No.	R.001.Rev0
Document title	Report on Geotechnical Investigation Proposed Community Solar Farm		
Site address	152 Staces Road, Uralla		
Report prepared for	Meralli Projects Pty Ltd		
File name	102139.00.R.001.Rev0.docx		

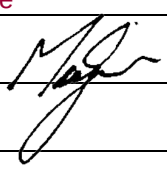
Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Michael Gawn	John Harvey	2 September 2020

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	David Mailler, Meralli Projects Pty Ltd

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		2 September 2020
Reviewer	pp 	2 September 2020

bsi. ISO 9001 Quality Management
FS 604853

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
15 Callistemon Close
Warabrook NSW 2304
PO Box 324
Hunter Region Mail Centre NSW 2310
Phone (02) 4960 9600

Table of Contents

Page

Report on Geotechnical Investigation
Proposed Community Solar Farm
152 Staces Road, Uralla

1. Introduction

This report presents the results of a geotechnical investigation undertaken for a proposed community solar farm at 152 Staces Road, Uralla. The investigation was commissioned in a signed service order dated 23 July 2020 from Meralli Projects Pty Ltd and was undertaken in accordance with Douglas Partners' proposal NCL200429 dated 21 July 2020.

It is understood that the proposed development is to consist of a photovoltaic (PV) solar generating plant, including electricity generating equipment, in addition to access roads, service trenching and drainage works. The details of the development are further described in Section 7 of this report.

The aim of the investigation was to assess the subsurface soil and groundwater conditions across the site, in order to provide comment on the following:

- Site description and geology;
- Subsurface conditions at the site;
- Site classification in accordance with AS2870;
- Suitable footing systems;
- Ultimate pile design parameters (up to a depth of 2 m);
- Trafficability of site soils;
- Site preparation and earthworks requirements; and
- Aggressivity of site soils to buried steel and concrete.

The investigation included the drilling of five boreholes and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

For the purposes of the investigation the client provided a drawing showing the proposed layout of the solar farm.

2. Site Description

The proposed solar farm is located at 152 Staces Road, Uralla and covers an area of approximately 5.5 hectares (refer Figure 1). It is understood that the site was formerly used to treat timber poles.

Figure 1: Image of proposed solar farm footprint (green area)

The footprint of the proposed solar farm is generally an open flat area, which is covered with grass. A number of existing gravel access roads are present throughout the site.

Figure 2 to Figure 4 show typical views of the site.

Figure 2: Drilling rig on Bore 2 location

Figure 3: Previous hardstand area on site

Figure 4: Typical view of site, near Bore 4

3. Desktop Data Review

A desktop review of available information was undertaken as part of the investigation. This included assessment of the following:

- Regional geology;
- Soil landscape mapping and Office of Water eSpade website;

- Acid sulfate soil mapping; and
- Previous nearby investigations by DP and NSW Office of Water registered bores.

The results of the desktop data review are discussed in more detail in Sections 3.1 to 3.4.

3.1 Regional Geology

Reference to the Seamless Geological Mapping of NSW State-wide Geodatabase indicates that the site is underlain by the Uralla Granodiorite, typically comprising coarse-grained, approximately equigranular, biotite-hornblende-(pyroxene) granodiorite, with minor monzogranite; finer-grained, porphyritic marginal variant.

3.2 Soil Landscape Mapping

Reference to the Central-Eastern NSW soil landscape mapping reveals that the mapping does not cover the site but reaches the eastern boundary. It is likely that the soils under the site are of the same soil landscape group as that to the east, and therefore would be of the Uralla Erosional Group. These soils are described as being present on level to gently undulating, occasionally undulating, plains and rises, on the Uralla Granodiorite. The limitations associated with this soil landscape group include rock outcrop, low general fertility (localised), dryland salinity (localised), sheet erosion risk, gully erosion risk, poor moisture availability (localised), groundwater pollution hazard (localised), dieback.

Reference to the NSW Office of Water eSpade website indicates that several previous soil samples were taken approximately 900 m to the north-east of the site (Uralla Creek). A review of the associated reports (Reports 1001020 [profile 72], 1003627 [profile 23]) indicate the following in relation to the near surface soils:

- The soils have a very high erosion hazard;
- There was no evidence of salting, which would be indicative of salinity; and
- pH levels ranging from around 5 to 7.5.

3.3 Acid Sulfate Soil Risk Mapping

No acid sulfate soil risk mapping by the Department of Land Water Conservation (DLWC) is available for the site. However, given the geographical position of the site and that acid sulfate soils is generally present in coastal areas where the elevation is below RL 10 AHD, but more generally below RL 5 AHD, DP does not consider ASS to be present at the site and they are not discussed further in this report.

3.4 Previous Nearby DP Investigations and NSW Registered Bores

DP has undertaken a number of projects within the Uralla area including extensive investigations over a large tract of land to the east of the site. The results of the previous investigation indicated that the soils are generally intermediate to highly plastic with moderate reactive characteristics. It is noted that the previous investigation was undertaken within an area mapped with different geology.

Reference to the Water NSW database of registered bores indicates that the closest registered bore is located approximately 270 m to the south of the site (GW068345). The work summary for this bore indicates the following:

- The bore was drilled to 52 m depth in 1990;
- Water was encountered at 15 m depth; and
- The subsurface conditions included clay soils to 3 m depth, underlain by weathered granite.

4. Field Work

4.1 Methods

The field work was undertaken on 14 August 2020 and comprised the drilling of five bores (Bore 1 to 5). The bores were drilled to 3 m depth using a purpose built geotechnical drilling rig fitted with solid flight augers. Standard penetration tests (SPT) were undertaken at about 1.5 m depth intervals in the soil.

Dynamic cone penetrometer (DCP) tests were carried out at the bore locations to depths ranging from 0.57 m to 1.2 m to allow an assessment of the strength of near surface soils and potential indication of depth to rock.

The test locations were set out by a DP engineer to provide a geographic spread across the site and where access allowed. GPS coordinates (MGA) were recorded on the logs at all test locations, and were measured using a handheld receiver, which has a nominal accuracy of about ±10 m. The test locations are shown in Drawing 1, attached in Appendix D.

The subsurface soil, rock and groundwater conditions were logged on site by DP personnel, who also recovered representative samples for identification purposes and laboratory testing.

4.2 Results

The subsurface conditions encountered in the test locations are presented within the detailed borehole logs in Appendix B, together with notes explaining classification methods and descriptive terms used on the logs. The results of the DCP tests are presented graphically on the logs and are reported on the attached dynamic penetrometer test result sheet.

The investigation yielded the presence of the following units:

- UNIT 1: Predominantly silty sand or sandy silt TOPSOIL to 0.1 m depth;
- UNIT 2: Medium dense to very dense SILTY SAND; and
- UNIT 3: Predominantly very stiff to hard, residual CLAY, trace sand and gravel.

The exceptions to this generalised profile included:

- Firm to stiff sandy silt in Bore 3 from 0.1 m to 0.8 m depth;
- Gravelly sand fill in Bore 4 from the surface to 0.3 m depth.

A summary of the subsurface conditions encountered can be further summarised, categorised into the above units as shown in Table 1 below.

Table 1: Summary of Subsurface Conditions

Borehole ID	Depth to Each Unit (m)		
	Unit 1 - Topsoil	Unit 2 -Silty Sand	Unit 3 - Residual Clay
1	0.0	0.1	0.8
2	0.0	0.1	0.8
3	0.0	NE[(b)]	0.8
4	NE[(a)]	0.3	1.2
5	0.0	0.1	0.75

Notes to Table 1:

NE = Not encountered

[(a)] Gravelly sand fill encountered to 0.3 m depth

[(b)] Firm to stiff sandy silt encountered from 0.1 m to 0.8 m depth

[(c)] All bores terminated at 3.0m depth

Groundwater

No free groundwater was observed in the bores during the period they remained opened. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

5. Laboratory Testing

Laboratory testing was carried out on samples retrieved from the bores at DP's NATA accredited laboratories. Each sample was submitted to the laboratory for one or more of the following:

- Atterberg Limits; or
- Soil aggressiveness / durability testing, comprising the following analytes:

- o pH;
- o Electrical conductivity (EC);
- o Sulphates (SO_4); and
- o Chlorides (Cl).

The detailed results are presented in Appendix C and are further summarised in Table 2 and Table 3, as follows.

Table 2: Results of Laboratory Testing – Atterberg Limits

Bore	Depth (m)	Description	LL (%)	PL (%)	PI (%)
1	0.8 – 1.0	Pale brown mottled grey CLAY	41	11	30
5	0.75 – 1.0	Pale brown mottled grey and red brown CLAY	47	13	34

Table 3: Results of Aggressivity Testing

Bore	Depth (m)	Description	Soil Condition	pH (concrete)	pH (steel)	Resistivity(1) (Ω.cm) (steel)	SO_4 (ppm) (concrete)	Cl (ppm) (steel)
2	0.4	Grey SILTY SAND	B	6	6	6803	38.1	110
2	1.0 - 1.45	Pale brown mottled grey and red brown CLAY	B	5.2	5.2	6250	16.5	170
2	2.5 - 2.95	Pale brown mottled grey and red brown CLAY	B	4.9	4.9	4184	40.1	250

Notes to Table

Non-aggressive
Mildly aggressive
Moderately aggressive
Severely Aggressive
Very Severe

NT

1 Resistivity calculated based on inverse of conductivity in aqueous solution results

Scale of aggressivity based on threshold values given in AS 2159 – 2009: Piling – Design and Installation.

6. Proposed Development

It is understood that the proposed development is to comprise a solar farm array over parts of the site. The farm will include photovoltaic solar generating plant, including electricity generating equipment, in addition to access roads, service trenching and drainage works.

No information in relation to the loads on piles has been provided to DP.

7. Comments

7.1 Appreciation of Site Conditions

The pertinent characteristics of the site and subsurface conditions are further summarised as follows:

- Groundwater was not encountered in the bores within the investigation depths. It is possible, however, that groundwater may rise during seasonal variations in climate;
- Given the previous development at the site, there is a risk of localised fill being present; and
- Testing of the clay soils indicates that it is of intermediate plasticity, and is likely to have moderate to high shrink-swell indices.

7.2 Soil Properties

Table 4, below, outlines the generalised material and strength properties for the different types of soil that were encountered in the field investigation or likely to be present.

Table 4: Suggested Material and Strength Parameters

Material	Unit Weight (kN/m^3)	Drained Cohesion, c' (kPa)	Drained Angle of Friction, ϕ' (degrees)	Undrained Shear Strength, Cu (kPa)
Unit 3 – Very Stiff to Hard Residual Clay	19 – 22	3 – 6	25 – 29	50 – 100(3)
Engineered Level 1 filling(2)	19 - 21	2 - 3	25 - 28	75 – 100

Note to Table 4

(1) Lower bound properties should be used (with the exception of Unit Weight) unless higher values can be substantiated by testing.
(2) Filling compacted under Level 1 testing and inspection to at least 98% Standard maximum dry density ratio
(3) The suggested undrained shear strength has been reduced owing to the appreciable softening expected to occur during the soaking phase of shrink-swell testing. It will be important to ensure that the foundation material is not allowed to be exposed to weather conditions prior to casting of footings

7.3 Soil Aggressiveness

The results of pH, chloride and sulphate ion concentration analyses (refer Table 3 of Section 5) indicate that, in general, the soils are classed either as a “non-aggressive to mildly aggressive” exposure classification for concrete piles and “non-aggressive” for steel piles with respect to resistivity. Reference should be made to Tables 6.4.3 of AS2159 (2009) to determine the minimum concrete cover to reinforcement required (for concrete piles), based on this exposure classification, and the minimum concrete strength appropriate for the indicated site conditions.

7.4 Soil Classification

The results of the laboratory testing indicate that the residual silty clay soils are generally intermediate plasticity clay (CI) soils, in accordance with the USCS, which would generally be expected to exhibit a moderate to high potential for volumetric changes (i.e. shrinkage and swelling) in response to variations in moisture content. Figure 5, below shows the results of the Atterberg limits testing.

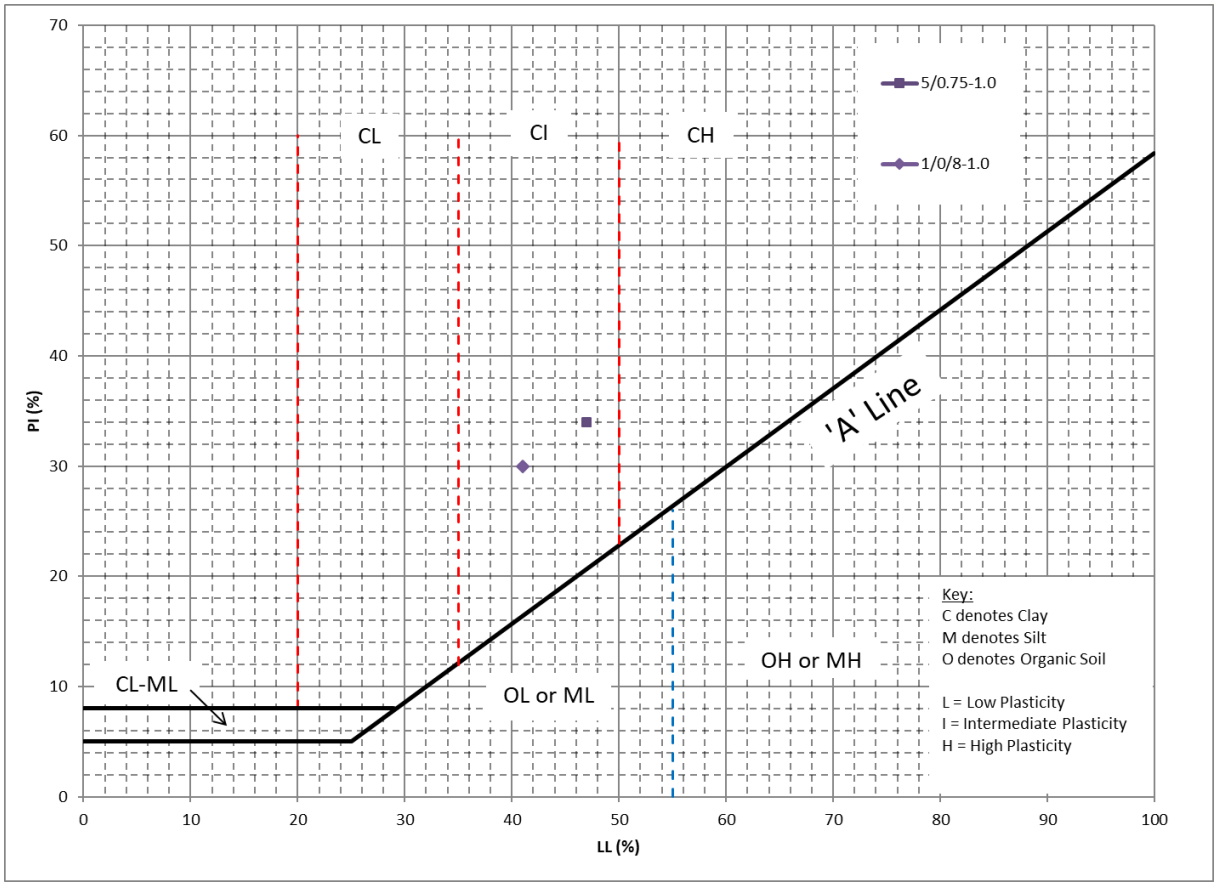


Figure 5: Results of Atterberg limit determinations

7.5 Soil Erosion Dispersion Potential

Testing for erosion potential was beyond the scope of the investigation, however, it is noted that the Uralla Erosional soil landscape has a very high erosion hazard.

The results of the electrical conductivity testing returned values ranging from 160 to 240 µS/cm. Using a textural classification conversion factor of 8 for light to medium clays, this converts to an ECe in the range of around 1 to 2 dS/m. Generally saline soils are defined as those having a ECe of greater than 4 dS/m. Therefore, the soils tested from the site are considered to be non-saline.

Therefore, unless further specific sampling and testing is undertaken to prove otherwise, it is recommended that the soils are considered to have a high propensity for erosion and appropriate erosion control measures should be implemented at the site. These should be devised specifically to the development and following further subsurface investigation and appropriate laboratory testing but as a guide could include:

- Compaction of fill to at least 98% Standard compaction as outlined below:
- Moisture conditioning of the clay materials within the 'borrow area' to the moisture content range;
- Fill material (i.e. silty sand and clays) are appropriately compacted, moisture conditioned and slopes battered at a maximum of 3H:1V;
- Fill bench with batter slopes of 3H:1V which will allow ease of access for maintenance of batter vegetation and drainage;
- Permanent batter slopes should be vegetated as soon as possible, to reduce the risk of significant soil erosion occurring;
- Topsoil (with minimum thickness of 100 mm and a maximum of 200 mm thickness) and vegetation to be provided on exposed batters or cuts. Hydro-mulching should be considered to promote growth;
- Adequate surface drainage is provided to reduce surface and seepage water flows;
- Contour drains along the crest of both cut and filling batters should be provided to reduce the potential for erosion. Such drains should be vegetated or gravel-lined, as appropriate for the expected flows;
- Erosion protection such as rip-rap or concrete at high flow drainage points; and
- Short term erosion measures such as silt fencing, hay bales etc., where required during construction.

7.6 Excavation Conditions

Based on the results of the test bores, it is considered that excavation of the soils are expected to be generally achievable using conventional machinery such as a 20 tonne hydraulic excavator to depths of investigation.

7.7 Geotechnical Reuse of Excavated Materials

The investigation encountered topsoil, silty sand and clay.

It is recommended that the grass vegetation and topsoil be stripped from the surface and stockpiled for re-use in landscaping, where required. It is suggested that topsoil contain at least 20% (by volume) organic materials, and fertilisers may be used to promote growth within topsoil.

The silty sand and clay are considered geotechnically suitable for re-use as engineered filling; however, depending on soil moisture conditions during construction moisture conditioning, either wetting up or drying back should be allowed for. Due to potential reactive movements of the clay and potential for poor trafficability when wet (i.e. exposed to moisture ingress) it is preferred that these materials be used at least 0.6 m below the finished site surface to reduce the surface heave movements of the fill platform and also due to poor trafficability when wet.

If excavated material is to be removed off the site, then a waste classification assessment will generally be required. The scope of the current geotechnical investigation did not include sampling and testing for waste classification or contamination assessment purposes, as it is expected that all excavated materials will be re-used on site. If required to be taken off site, all excavated materials will need to be disposed of in accordance with the current Waste Classification Guidelines (NSW EPA 2014).

No obvious signs of contamination were observed during the field work although it is noted that the site was previously used as a timber pole treatment area and hence there is a possibility of contamination within the soils which should be further investigated.

7.8 Site Preparation and Earthworks Procedures

The following site preparation and earthworks procedures are recommended for the placement of engineered filling across the site:

- Strip all vegetation, filling and topsoil which contains organic matter (generally less than 0.1 m encountered during this investigation) and grub out all significant roots;
- The exposed material surface should be inspected by a geotechnical engineer to check for excessively wet areas or weak zones, which may require removal and replacement. There is a high risk that the upper clay materials may soften in the event that they become wet;
- Approved filling should be placed in near-level, loose layer thicknesses not exceeding 300 mm and compacted to a range of 100% to 103% Standard dry density ratio, at a moisture content within the range from -4% OMC to OMC where OMC is the Standard optimum moisture content;
- Earthworks construction procedures should be subject to Level 2 geotechnical inspections and testing as detailed in AS 3798 – 2007, which requires field density testing within each layer of filling, together with careful control of moisture content, layer thickness, compaction achieve and material constituents. At this site, it is important to recognise that the site-won material will comprise a combination of residual silty sand and clay; and
- The success of the earthworks relies heavily upon the competency of the earthworks contractor and of the geotechnical testing and inspection authority (GITA).

Further comments on additional measures to reduce the risk of erosion across the site are provided in Section 7.5. Similarly, comments on site trafficability are provided in Section 7.9.

7.9 Site Trafficability

Owing to the presence of sand with a high silt content and the underlying clay, some softening of the near surface soils may occur following wet weather. Therefore, it would be prudent to allow for importation of roadbase gravel material for long term use within the internal roads.

7.10 Reactive Soil Considerations

7.10.1 Site Classification

Site classification of foundation soil reactivity indicates the propensity of the ground surface to move with 'normal' seasonal moisture variation. The magnitude of moisture related seasonal ground movements should be considered in design of structures. The site classification is based on procedures presented in AS 2870:2011 Residential Slabs and Footings, the typical soil profiles revealed at the test locations and the results of laboratory testing. It should be noted that standard designs within AS2870 (2011) for various site classifications are based on characteristic surface movements only and apply to structures of similar size and flexibility to residential buildings and do not apply to industrial structures or structures such as the proposed solar farm. Similar principles in design for reactivity / movement, however, should be incorporated into design, construction and maintenance.

Reference to the plasticity index testing indicates that the majority of the clay soils are of intermediate plasticity.

Based on the results of laboratory testing and past experience with similar soils, an Iss value of 2% has been adopted for analysis. Analysis was undertaken based on the methods outlined in AS2870 (2011) and information provided by (Barnett and Kingsland) which indicates that the site is located in a wet temperate zone and hence has a depth of design suction change (Hs) of 2.0 m. A design crack depth factor of 0.5 has been adopted.

As a guide for footing design, the range of characteristic surface movement, y_s value, for the site in its current condition is estimated to be about 25 mm (which is within the Class M range of characteristic soil movement) under normal seasonal moisture fluctuations without the influence of trees.

The site classification, as above, is based on the information obtained from the bores and on the results of laboratory testing, and has involved interpolation between data points. In the event that the conditions encountered on site are different to those presented in this report, it is recommended that advice be obtained from this office.

It should be noted that this classification is dependent on proper site maintenance, which should be carried out in accordance with the attached CSIRO Sheet BTF-18, "Foundation Maintenance and Footing Performance: A Homeowners Guide" in Appendix A and with AS 2870:2011. Whilst this is primarily for residential structures it provides useful advice for other types of structures.

The site classification should be revised if cutting or filling is undertaken, as required by AS 2870:2011. Clay soil, if used as fill in the building area, could have an adverse effect on shrink-swell movements, leading to a more severe site classification and increased characteristic surface movement, y_s.

7.10.2 Seasonal Soil Cracking

It is anticipated that shrink-swell related uplift pressures and movements could be more critical than the relatively light pile loads applied by the panels.

Published information consistently indicates that the pile portions founded within the 'active' zone of soil (2 m depth for this site) will experience uplift force and displacements during clay swelling phases. Information on the converse effects of soil shrinkage during drying on pile performance is less clear, although it is logical to assume a lesser impact on vertical pressures as the soil potentially shrinks away from the pile.

The magnitude of shrink-swell induced vertical pile movement will be largely governed by the depth of pile penetration, with increased penetration (ideally as deep as practicable below the 'active' zone) correspondingly reducing the predicted pile head movements relative to the predicted surface movements. For shallower piles, the vertical movement is likely to increase (relative to the predicted surface movements), together with a corresponding increased risk/rate of progressive pile jacking.

The relationship between pile penetration and reduction in vertical movement is difficult to predict, with limited information to develop relationships for predicting uplift forces and movement from soil swell, especially for piles founding entirely within the active zone. Variance in soil shear strength with depth as well as pile shape, weather patterns and hence seasonal soil moisture content variations also add to the complexity of predicting pile performance.

As discussed in Section 7.10.1, the estimated depth of design suction change (H_s) is 2 m and the crack depth factor is 0.5 (i.e. 1 m design crack depth for the purposes of AS2870 (2011)). Local variations in Thornthwaite Moisture Index (TMI) probably exist, and the mapping used by Barnett and Kingsland was broad scale. It is therefore possible that the depth of cracking at this site differs from the above value, but in the absence of more detailed monitoring, this value should be considered first and foremost for design purposes. The site is located in a wet temperate zone and is not anticipated to experience extreme seasonal fluctuations in climatic and soil moisture conditions which may occur in, for instance, the tropics. Therefore, considering the climatic conditions together with the presence of granitic-derived soils, it is suggested that separate design for "dry season" and "wet season" is not appropriate at this site.

In a low redundancy piling scenario, it would usually be recommended that no contribution to vertical or lateral load carrying capacity be considered for this 'design' crack depth. It is anticipated that the piles for the PV trackers would be a relatively high redundancy piling system and as such a less conservative approach could be adopted, provided that further precautions are taken for the variation in soil strength with moisture. This is further discussed in Section 7.12.2.

Elastic solutions are presented by Poulos and Davis (1980) for "piles in swelling and shrinking soils". The soil is treated as an overconsolidated clay and pile movement is estimated as a function of pile length, with respect to H_s, characteristic surface movement and of pile properties. It is recommended that analyses should be undertaken to predict pile movements in the reactive clay soils.

Another method of mitigating cracking and shrink-swell movement effects is surface sealing to reduce seasonal moisture variations, however this may not be economically feasible. Therefore, careful attention should be given to positive site drainage to minimise the potential for water ponding that would exacerbate the soil swelling as well as subgrade softening, followed by excessive cracking in dry weather.

7.10.3 Swelling Pressures

Soil jacking is a heave phenomenon that occurs in heavy clay profiles in areas with significant seasonal soil moisture variations. Uplift forces are generated on pile shafts in the upper soil profile due to swelling of the clay after soil cracks have closed and all volumetric strain is translated to vertical strain. When this occurs to piles that have been driven to insufficient depth, they can be 'jacked' upwards.

Swell pressure testing has not been carried out for this site and hence estimates of the likely swell pressures experienced by the piles is not able to be provided. It is noted that seasonal jacking is likely to be small, although over the design life of the project the cumulative movements could be significant.

7.11 High Level Footings

It is not known whether any structures, other than PV panels, are proposed for the site. Minor structures may be supported on high level footings. Strip and pad footings up to 1 m and 2 m wide respectively, founded at least 0.5 m deep below the finished ground surface may be sized using the allowable values indicated in Table 5.

Table 5: High Level Footing Design Bearing Pressure (Allowable)

Material	Maximum Allowable Bearing Pressure (kPa)[1]
Very Stiff to Hard clay	100
Engineered Level 1 filling[2]	150

Notes to Table 5:

[1] Bearing capacity based on conditions at time of field work and assuming no abnormal soil moisture conditions.

[2] Filling compacted under Level 1 testing and inspection to at least 98% Standard maximum dry density ratio

[3] The suggested allowable bearing pressure has been reduced owing to the appreciable softening during the soaking phase of shrink-swell testing. It will be important to ensure that the foundation material is not allowed to be exposed to weather conditions prior to casting of footings

It is noted that the previous development at the site included a timber treatment yard and hence some localised fill may be present. If encountered, the fill should be removed and replaced with approved engineered fill placed and compacted under a Level 2 inspection and testing regime as outlined in AS3798-2007.

Where limit state methods are used to design the high level footings, the above maximum allowable bearing pressures should be multiplied by the adopted safety factor of 2.5 to obtain an ultimate unfactored geotechnical strength ($R_{d,ug}$). The $R_{d,ug}$ is then multiplied by a suitable geotechnical strength reduction factor (ϕ_g) to obtain the design geotechnical strength ($R_{d,g}$).

For high level pad or strip footings founded in the materials as given in Table 5 above, it is considered that settlements under such applied loading will be less than about 1% of the footing width. Settlement is independent of, and possibly additional to, reactive clay movements.

Masonry wall, if proposed, should be articulated in accordance with (TN61).

7.12 Piles

7.12.1 Vertical Capacity

Driven steel piles are understood to be proposed to support the solar panels. It is anticipated that the piles would be driven to refusal. The capacity of the piles should be verified using recognised pile driving formulae, such as Hiley.

It is anticipated that the piles would be able to be driven relatively easily through the residual soils.

The ultimate parameters shown in Table 6 are suggested for the design of driven steel piles with length on diameter ratios of at least four, subject to vertical compressive and uplift loads. The shaft adhesion developed over the upper 1 m (estimated crack depth due to seasonal shrink-swell movement) should be ignored in compressive and tensile load capacity calculations due to seasonal soil cracking, unless the ground adjacent to the piles is paved and draining away from the structure (a fall of at least 2% for a distance of approximately 500 mm from the pile) in all directions.

Table 6: Ultimate Unfactored Driven Steel Pile Design Parameters – Vertical Load

Material	Ultimate Unfactored Pressure, $R_{d,ug}$ (kPa)		
	Shaft Adhesion		End Bearing
	Compression	Tension	
Controlled filling placed in accordance with this report	40		N/A
Very Stiff to Hard clay	70		1800

Notes to Table 6:

H_1 – depth to pile toe (in metres), limiting value of 15 MPa

– values are based on effective stress condition. Values quoted are for fully submerged conditions, for conservative estimation of contribution. Roughly double these values would apply for dry conditions.

* - the extent and condition of the weathered bedrock must be further investigated prior to design.

The pile parameters presented above are unfactored ultimate values. A factor of safety of 2.5 should be applied to all ultimate values for working stress analysis. Alternatively, a basic geotechnical strength reduction factor (ϕ_{gb}) is recommended for limit state design of piles in accordance with AS2159 (2009). The appropriate (ϕ_g) should be derived by the designer based on the data presented in this report, the method of soil strength assessment used in this investigation and after assessing the overall design average risk rating (ARR) for the site, design, level of redundancy and installation risk factors anticipated for the proposed piling system.

To assist with this process, individual risk ratings for the geotechnical components which affect the ARR for the site are shown in Table 7 below. The value of ϕ_g for pile design should be assessed from the ARR by the pile designer, having due regard to the principal loading conditions that could affect the piles.

The rationale for the suggested IRR values provided below for the geotechnical components is as follows:

- **Geological complexity of site** The results of the investigation show that the site is wholly within one geological unit, with similar soil conditions encountered in all bores. Therefore a low risk has been associated with this component;
- **Extent of ground investigation** The investigation was limited to five bores across the site. This is considered limited coverage for the broad scale investigation. Therefore a moderate risk has been associated with this component; and
- **Amount and quality of geotechnical data** The investigation programme included in-situ testing of strength (pocket penetrometer and dynamic penetrometer testing) together with atterberg limit determinations. Therefore, a moderate risk has been associated with this component.

Table 7: Derivation of Geotechnical Reduction Factor and Average Risk Rating

Risk Factor	Weighting factor (w_i)	Typical description of risk circumstances for individual risk rating (IRR)			Assigned Risk Factor (1 to 5)	w_i IRR$_i$
		1 (Very low risk)	3 (Moderate)	5 (Very high risk)		
Site						
Geological complexity of site	2	Horizontal strata, well-defined soil & rock Characterstics	Some variability over site, but without abrupt changes in stratigraphy	Highly variable profile or presence of karstic features or steeply dipping rock levels or faults present on site, or combinations of these	3	6
Extent of ground investigation	2	Extensive drilling investigation covering whole site to an adequate depth	Some boreholes extending at least 5 pile diameters below the base of the proposed foundation level	Very limited investigation with few shallow boreholes	3	6
Amount & quality of geotechnical data	2	Detailed information on strength & compressibility of the main strata	CPT probes over full depth of proposed piles or boreholes confirming rock as proposed founding level for piles	Limited amount of simple insitu testing (eg SPT) or index tests only	3	6

7.12.2 Lateral Capacity

Lateral capacity of the piles could be assessed using Broms method. The suggested design parameters are provided in Table 8.

Table 8: Soil / Rock Parameters for Pile Design (unfactored)

Soil Strata	Undrained Shear Strength (kPa)[(1)]	Youngs Modulus E' (MPa)	Ultimate Passive Pressure (kPa)
Crack depth	Ignore (see below for further comment)		
Unit 3 – Very Stiff to Hard clays	150	30	300

Notes to Table 8:

(1) The suggested undrained shear strength has been reduced owing to the appreciable softening during the soaking phase of shrink-swell testing. It will be important to ensure that the foundation material is not allowed to be exposed to weather conditions prior to casting of footings

The values shown in Table 8 are sections of the pile which are in full contact with the soil. It should be recognised that there is a possibility that shrinkage cracking could coincide with the soil/pile interface. The depth of such cracks could approach the design crack depth of 1 m for this site. Therefore, it would be prudent to ignore the upper 1 m of the soil profile for lateral pile capacities. Some reduction in the design depth of cracking to be ignored in the design may be possible depending on the sensitivity and criticality of the specific componentry supported by the pile. For instance, it would be prudent to assume the full design depth of cracking (i.e. 1 m at this site) where the effects of potential uplift and lateral movements cannot be tolerated.

Provided the following additional precautions are undertaken for the variation in soil strength with fluctuations in moisture content and a high level of redundancy is incorporated into the design (i.e. tolerance for potential movements), the ground from 0.65 m to 1 m (lower third of the design crack) could be included in the lateral loading calculations as the cracking would be minor and not sufficient to significantly impact soil performance:

- Adequate and maintained surface drainage;
- Careful backfill of service trenches (i.e. limited use of permeable backfill materials so as not to provide a conduit for groundwater or a high level of connectivity with surface water);
- No planting of trees close to structures; and
- No excessive or irregular watering close to structures.

Further comments on site maintenance, vegetation and drainage measures for reactive sites are provided in BTF18 (2003). These include measures which are possibly not relevant to this site given the proposed development but should be considered where relevant. This includes measures such as expedient repair of plumbing leaks.

8. References

AS1170. (2007). *Structual design actions, Part 4: Earthquake actions in Australia.* Standards Australia.

AS2159. (2009). *Piling - desig and installation.* Standards Australia.

AS2870. (2011). *Australian Standard AS2870-2011 "Residential Slabs and Footings".* Standards Australia.

Barnett and Kingsland. (n.d.). Assignment of AS2870 Soil Suction Change Profile Parameters to TMI Derived Climatic Zones for NSW. *8th Australia New Zealand Conference on Geomechanics.* Hobart: I.C. Barnett and R. I. Kingsland.

BTF18. (2003). *Foundation Maintanence and Footing Performance: A homeowner's Guide.* CSIRO.

Nelson and Miller. (2015). *Foundation Engineering for Expansive Soils.* John Wiley and Sons Inc.

Poulos and Davis. (1980). *Pile Foundation Analysis and Design.* John Wiley and Sons.

TN61. (n.d.). *Articulated Walling.* Cement Concrete and Aggregates Australia.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at Staces Road, Uralla in accordance with DP's proposal NCL200429 dated 21 July 2020 and a signed service order dated 23 July 2020 from Meralli Projects Pty Ltd. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Meralli Projects Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report
Sampling Methods
Soil and Rock Descriptions
Symbols and Abbreviations
CSIRO Sheet BTF 18

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

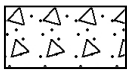
Symbols & Abbreviations

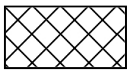
Graphic Symbols for Soil and Rock

General


Asphalt


Road base

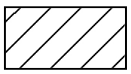

Concrete

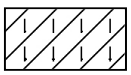

Filling

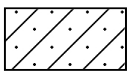
Soils


Topsoil

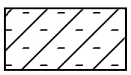

Peat

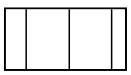

Clay

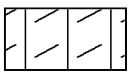

Silty clay

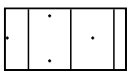

Sandy clay

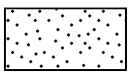

Gravelly clay

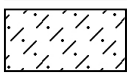

Shaly clay

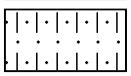

Silt


Clayey silt


Sandy silt

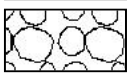

Sand

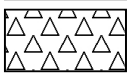

Clayey sand


Silty sand


Gravel

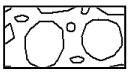

Sandy gravel


Cobbles, boulders

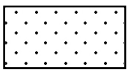

Talus

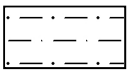
Sedimentary Rocks

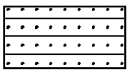

Boulder conglomerate

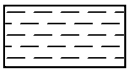

Conglomerate


Conglomeratic sandstone

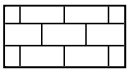

Sandstone


Siltstone

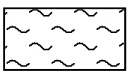

Laminite

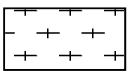

Mudstone, claystone, shale


Coal


Limestone

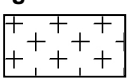
Metamorphic Rocks

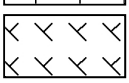

Slate, phyllite, schist

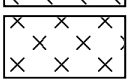

Gneiss

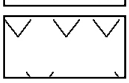

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- **Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.**
- **Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.**

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

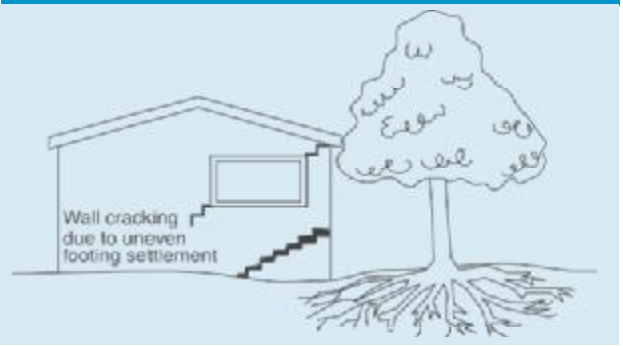
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

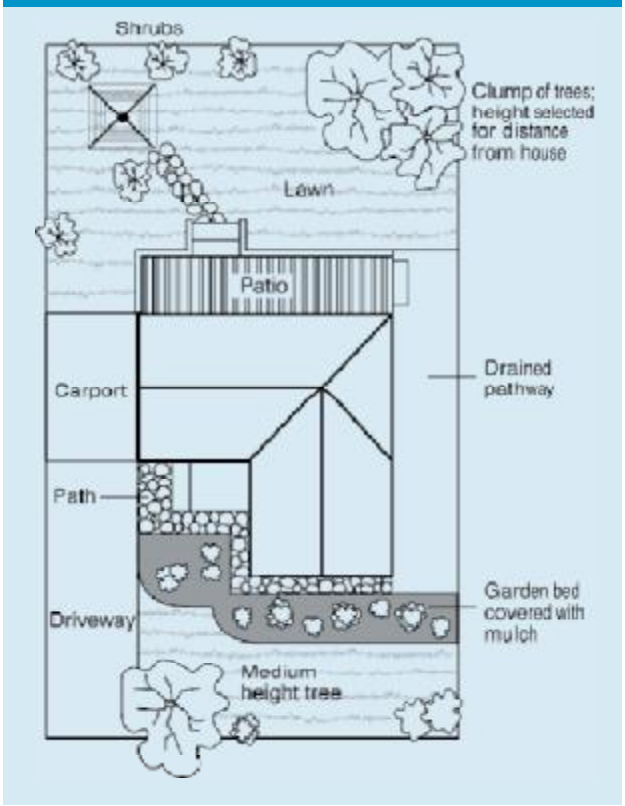
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

Distributed by

CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au

Appendix B

Borehole Logs (Bores 1 to 5)

BOREHOLE LOG

CLIENT: Meralli Projects Pty Ltd
PROJECT: Proposed Community Solar Farm
LOCATION: 152 Staces Road, Uralla

SURFACE LEVEL: --
EASTING: 356143
NORTHING: 6606316
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 102139.00
DATE: 14/8/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - Grey brown, fine to medium grained, sandy silt, abundant rootlets, M<Wp to M~Wp		D	0.05				
		SILTY SAND - Medium dense to dense, grey, fine grained, trace rootlets and clay, (alluvial), moist (dry)		D	0.5				
	0.8	CLAY - Very stiff to hard, pale brown mottled grey, with silt, trace fine grained sand, (possible residual), M<Wp			0.8				
	1			B	1.0		pp = 250		
				S	1.2		pp >400 3,9,12 N = 21		
					1.45				
	2	From 2.5m, hard, grey mottled pale brown			2.5				
				S			pp >400 7,14,24 N = 38		
	3				2.95				
	3.0	Bore discontinued at 3.0m, limit of investigation							
	4								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Meralli Projects Pty Ltd
PROJECT: Proposed Community Solar Farm
LOCATION: 152 Staces Road, Uralla

SURFACE LEVEL: --
EASTING: 356103
NORTHING: 6606138
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 102139.00
DATE: 14/8/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - Grey brown, fine to medium grained, silty sand, abundant rootlets, (possible disturbed natural), dry to moist		D	0.05				
		SILTY SAND - Medium dense to dense, grey, fine to medium grained, trace rootlets and clay, (alluvial), moist		D	0.4				
	0.8	CLAY - Stiff to very stiff, pale brown mottled grey and red brown, with silt, trace fine grained sand and gravel (gravel predominantly subrounded to rounded, up to 20mm in size), (possible residual), M~Wp		D	0.9				
	1	From 1.0m, very stiff to hard		S	1.0		pp >400 6,14,16 N = 30		
					1.45				
				B	1.5				
	2				2.0				
					2.5				
				S			pp >400 5,7,14 N = 21		
	3				2.95				
	3.0	Bore discontinued at 3.0m, limit of investigation							
	4								

RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Meralli Projects Pty Ltd
PROJECT: Proposed Community Solar Farm
LOCATION: 152 Staces Road, Uralla

SURFACE LEVEL: --
EASTING: 356269
NORTHING: 6606085
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 102139.00
DATE: 14/8/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - Dark grey, silty sand, abundant rootlets, moist		D	0.05				
		SANDY SILT - Firm to stiff, grey, with clay, trace rootlets, (alluvial), M~Wp to M>Wp		D	0.5				
	0.8	CLAY - Very stiff, pale brown mottled grey and red brown, with silt, trace fine to medium grained sand and gravel (gravel predominantly subangular, up to 10mm in size), (possible residual), M~Wp		B	0.8 1.0		pp = 150		
	1			S			pp >400 3,6,7 N = 13		
					1.45				
	2	From 2.5m, very stiff to hard		S	2.5		pp >400 5,8,11 N = 19		
	3				2.95				
	3.0	Bore discontinued at 3.0m, limit of investigation							
	4								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Meralli Projects Pty Ltd
PROJECT: Proposed Community Solar Farm
LOCATION: 152 Staces Road, Uralla

SURFACE LEVEL: --
EASTING: 356295
NORTHING: 6606288
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 102139.00
DATE: 14/8/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.3	FILL - Brown, fine to medium grained, gravelly sand, trace clay, (gravel predominantly subangular, up to 40mm in size), dry		D	0.05				
		SILTY SAND - Very dense, grey, fine grained, trace rootlets, (alluvial), dry		D	0.5				
	1				1.0				
	1.2	CLAY - Very stiff to hard, pale brown mottled grey and red brown, with silt, trace fine grained sand, (possible residual), M<Wp to M~Wp		S			pp >400 6,9,12 N = 21		
					1.45				
					1.5				
				B					
	2				1.7				
					2.5				
				S			pp >400 6,8,14 N = 22		
					2.95				
	3								
	3.0	Bore discontinued at 3.0m, limit of investigation							
	4								

RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Meralli Projects Pty Ltd
PROJECT: Proposed Community Solar Farm
LOCATION: 152 Staces Road, Uralla

SURFACE LEVEL: --
EASTING: 356204
NORTHING: 6606215
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 102139.00
DATE: 14/8/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - Grey brown, fine to medium grained, silty sand, trace gravel, abundant rootlets, (gravel predominantly subrounded, up to 10mm in size), moist		D	0.05				
		SILTY SAND - Dense to very dense, grey, fine to medium grained, trace rootlets, (alluvial), moist		D	0.5				
	0.75	CLAY - Stiff to very stiff, pale brown mottled grey and red brown, with silt, trace fine grained sand, (possible residual), M~Wp		B	0.75 1.0		pp = 300-350		
	1			S	1.05 1.45		pp >400 3,6,8 N = 14		
	2	From 2.5m, hard, grey mottled pale brown		S	2.5 2.95		pp >400 13,17,25 N = 42		
	3 3.0	Bore discontinued at 3.0m, limit of investigation							
	4								

RIG: DT100 **DRILLER:** Hickman **LOGGED:** Cudmore **CASING:** Nil

TYPE OF BORING: Solid flight auger to 3.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
15 Callistemon Close
Warabrook NSW 2304
PO Box 324
Hunter Region Mail Centre NSW 2310
Phone: (02) 4960 9600

Results of Dynamic Penetrometer Tests

Dynamic Cone Penetrometer - DCP

Client Meralli Projects Pty Ltd

Project Proposed Community Solar Farm

Location 152 Staces Road, Uralla

Project No. 102139.00

Date 14/08/20

Page No. 1 of 1

Test Location	1	2	3	4	5					
RL of Test (AHD)										
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 - 0.15	5	4	2	12	6					
0.15 - 0.30	8	5	5	14	9					
0.30 - 0.45	11	10	7	23	16					
0.45 - 0.60	11	14	3	25/120	25					
0.60 - 0.75	3	12	2	Ref	25/100					
0.75 - 0.90	8	5	7		Ref					
0.90 - 1.05	16	10	10							
1.05 - 1.20	15	12	12							
1.20 - 1.35										
1.35 - 1.50										
1.50 - 1.65										
1.65 - 1.80										
1.80 - 1.95										
1.95 - 2.10										
2.10 - 2.25										
2.25 - 2.40										
2.40 - 2.55										
2.55 - 2.70										
2.70 - 2.85										
2.85 - 3.00										
3.00 - 3.15										
3.15 - 3.30										

Test Method AS 1289.6.3.2, Cone Penetrometer ☑

AS 1289.6.3.3, Sand Penetrometer ☐

Tested By JSC

Checked By MPG

Remarks Ref = Refusal, 25/110 indicates 25 blows for 110 mm penetration

Appendix C

Results of Laboratory Testing

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: luke.hetherington@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Luke Hetherington
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **102139.00-1**
Issue Number: 1
Date Issued: 01/09/2020
Client: Meralli Projects Pty Ltd
Po Box 302, Uralla 2358
Contact: David Mailler
Project Number: 102139.00
Project Name: Proposed Community Solar Farm
Project Location: 152 Staces Road, Uralla
Work Request: 10267
Sample Number: PM-10267A
Date Sampled: 14/08/2020
Dates Tested: 25/08/2020 - 28/08/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH 1, Depth: 0.8 - 1.0**

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	41		
Plastic Limit (%)	11		
Plasticity Index (%)	**30**		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: luke.hetherington@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Luke Hetherington
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **102139.00-1**
Issue Number: 1
Date Issued: 01/09/2020
Client: Meralli Projects Pty Ltd
Po Box 302, Uralla 2358
Contact: David Mailler
Project Number: 102139.00
Project Name: Proposed Community Solar Farm
Project Location: 152 Staces Road, Uralla
Work Request: 10267
Sample Number: PM-10267B
Date Sampled: 14/08/2020
Dates Tested: 25/08/2020 - 28/08/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH 5, Depth: 0.75 - 1.0**

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	47		
Plastic Limit (%)	13		
Plasticity Index (%)	**34**		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: luke.hetherington@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Luke Hetherington
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **102139.00-1**
Issue Number: 1
Date Issued: 01/09/2020
Client: Meralli Projects Pty Ltd
Po Box 302, Uralla 2358
Contact: David Mailler
Project Number: 102139.00
Project Name: Proposed Community Solar Farm
Project Location: 152 Staces Road, Uralla
Work Request: 10267
Sample Number: PM-10267C
Date Sampled: 14/08/2020
Dates Tested: 25/08/2020 - 31/08/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH 2, Depth: 0.4**

Quantitative Determination of Chloride in Soil (AS 1012.20.2)		Min	Max
Method of Determination	Volhard titration		
Chloride Content (%)	0.011		

Determination of Chloride and Sulfate (AS 1012.20.1)		Min	Max
Determined By	Other Quantitative		
Method of Determination	RMS T1011		
Sulfate Content (ppM)	38.1		
Sulfate Content (%)*	0.00		
* Percentage not part of determination test method.			

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: luke.hetherington@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Luke Hetherington
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **102139.00-1**
Issue Number: 1
Date Issued: 01/09/2020
Client: Meralli Projects Pty Ltd
Po Box 302, Uralla 2358
Contact: David Mailler
Project Number: 102139.00
Project Name: Proposed Community Solar Farm
Project Location: 152 Staces Road, Uralla
Work Request: 10267
Sample Number: PM-10267D
Date Sampled: 14/08/2020
Dates Tested: 25/08/2020 - 31/08/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH 2, Depth: 1.0 - 1.45**

Quantitative Determination of Chloride in Soil (AS 1012.20.2)		Min	Max
Method of Determination	Volhard titration		
Chloride Content (%)	0.017		

Determination of Chloride and Sulfate (AS 1012.20.1)		Min	Max
Determined By	Other Quantitative		
Method of Determination	RMS T1011		
Sulfate Content (ppM)	16.5		
Sulfate Content (%)*	0.00		
* Percentage not part of determination test method.			

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: luke.hetherington@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Luke Hetherington
Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **102139.00-1**
Issue Number: 1
Date Issued: 01/09/2020
Client: Meralli Projects Pty Ltd
Po Box 302, Uralla 2358
Contact: David Mailler
Project Number: 102139.00
Project Name: Proposed Community Solar Farm
Project Location: 152 Staces Road, Uralla
Work Request: 10267
Sample Number: PM-10267E
Date Sampled: 14/08/2020
Dates Tested: 25/08/2020 - 31/08/2020
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH 2, Depth: 2.5 - 2.95**

Quantitative Determination of Chloride in Soil (AS 1012.20.2)		Min	Max
Method of Determination	Volhard titration		
Chloride Content (%)	0.025		

Determination of Chloride and Sulfate (AS 1012.20.1)		Min	Max
Determined By	Other Quantitative		
Method of Determination	RMS T1011		
Sulfate Content (ppM)	40.1		
Sulfate Content (%)*	0.00		
* Percentage not part of determination test method.			

Material Test Report

Report Number: **102139.00-1**
Issue Number: 1
Date Issued: 01/09/2020
Client: Meralli Projects Pty Ltd
Po Box 302, Uralla 2358
Contact: David Mailler
Project Number: 102139.00
Project Name: Proposed Community Solar Farm
Project Location: 152 Staces Road, Uralla
Work Request: 10267
Dates Tested: 25/08/2020 - 27/08/2020

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Port Macquarie Laboratory
Unit 2, 32 Geebung Drive Port Macquarie NSW 2444
Phone: (02) 6581 5992
Email: luke.hetherington@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Luke Hetherington
Laboratory Manager
NATA Accredited Laboratory Number: 828

pH Value of Soil AS 1289 4.3.1

Sample Number	Borehole No	Depth	pH	Electrical Conductivity (µS/cm)	Remarks
PM-10267C	BH 2	**	6.0	146.6	**
PM-10267D	BH 2	**	5.2	160.3	**
PM-10267E	BH 2	**	4.9	238.5	**

Notes:
For Conductivity - 1 dS/m = 1 mS/cm = 1000 µS/cm
EC Not Covered Under our Terms of Accreditation.

Appendix D

Drawing 1 – Test Location Plan

Site Location

Douglas Partners *Geotechnics / Environment / Groundwater*	CLIENT: Meralli Projects Pty Ltd	TITLE: **Test Location Plan** **Proposed Community Solar Farm** **Staces Road, Uralla**	Project: 102139.00
	OFFICE: Newcastle / DRAWN BY: MPG		DRAWING No: 1
	SCALE: 1:2500 @ A3 / DATE: 07.August.2020		REVISION: 0

Appendix 4 – CASA Correspondence

Hayley

From: Windebank, Matthew <Matthew.Windebank@casa.gov.au>
Sent: Friday, 10 July 2020 11:58 AM
To: Hayley
Cc: Airspace Protection
Subject: RE: Proposed Thunderbolt Solar Farm at Uralla [SEC=OFFICIAL]

OFFICIAL
Good morning Hayley,

There are no CASA registered or Certified Aerodromes in close proximity. In addition CASA is not aware of any airstrips in the Uralla area. Therefore, CASA has no objection or concern regarding the soalr farm proposal at Uralla, NSW.

Regards

Matthew Windebank
Aerodrome Engineer
Air Navigation, Airspace & Aerodromes Branch
CASA \ Aviation Group
GPO BOX 2005 CANBERRA ACT 2601

T – 0477 741 186

Australian Government
Civil Aviation Safety Authority

From: Hayley <hayley@smk.com.au>
Sent: Friday, 10 July 2020 11:48 AM
To: Windebank, Matthew <Matthew.Windebank@casa.gov.au>
Subject: Proposed Thunderbolt Solar Farm at Uralla

Hi Matthew,

We are applying for development approval for a 4.95MW AC (~8.8MW DC) solar farm in northern NSW, approximately 2.8 kilometres south of the township of Uralla. The site is 152 Staces Road, Uralla (Lot 385 DP755846). As part of the development approvals process, we are required to consult with CASA to confirm there is no issue from your perspective. The attached shows the proposed development site location in relationship to nearby localities and airports as well as a detailed design. The detailed designed may change slightly but will essentially be as is displayed within the attachments, that is a dual East-West fixed array.

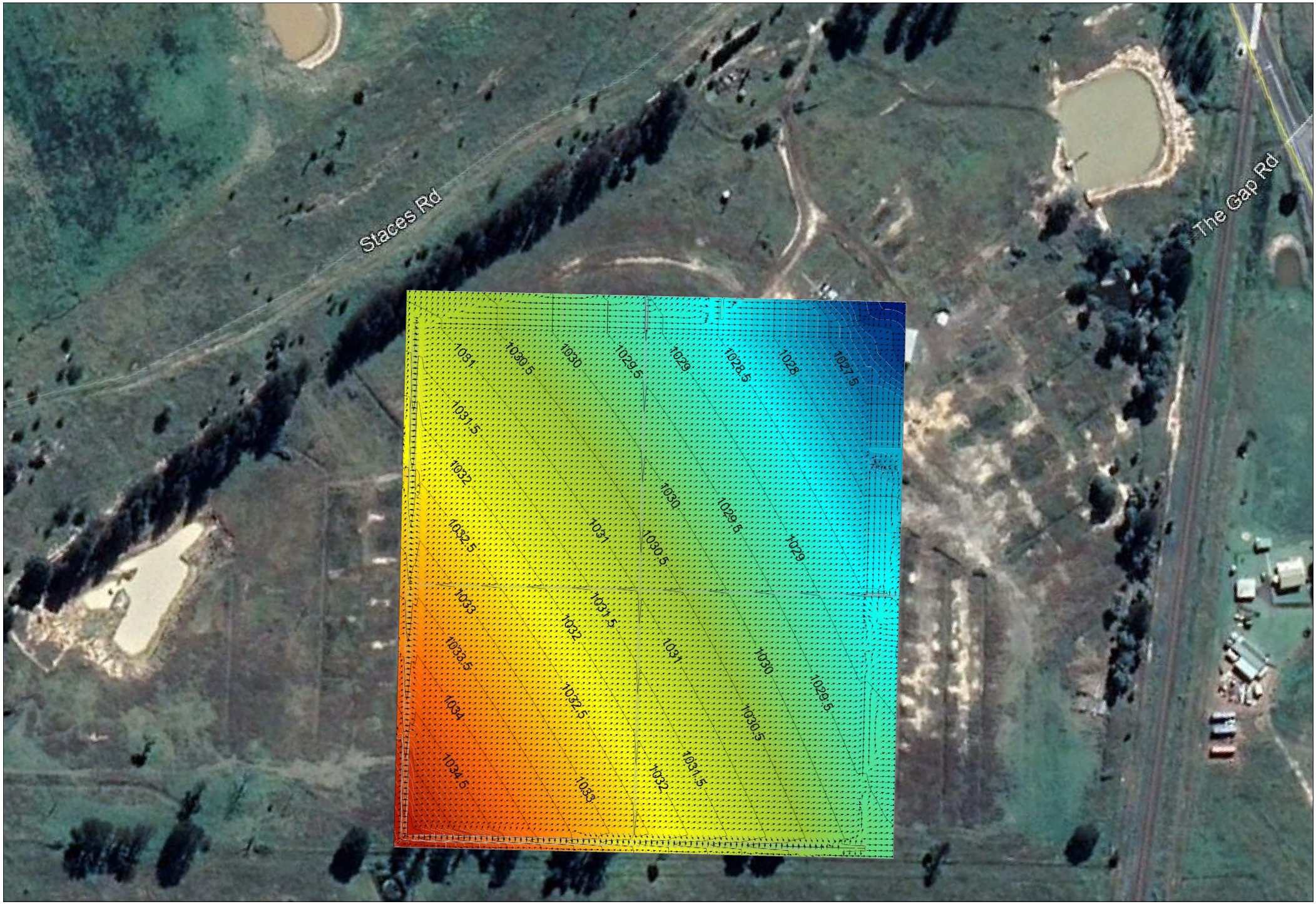
As you will see the proposed development is not located adjacent to any commercial airports. Given the relatively small size of the development, we envisage no issue with respect to pilot safety.

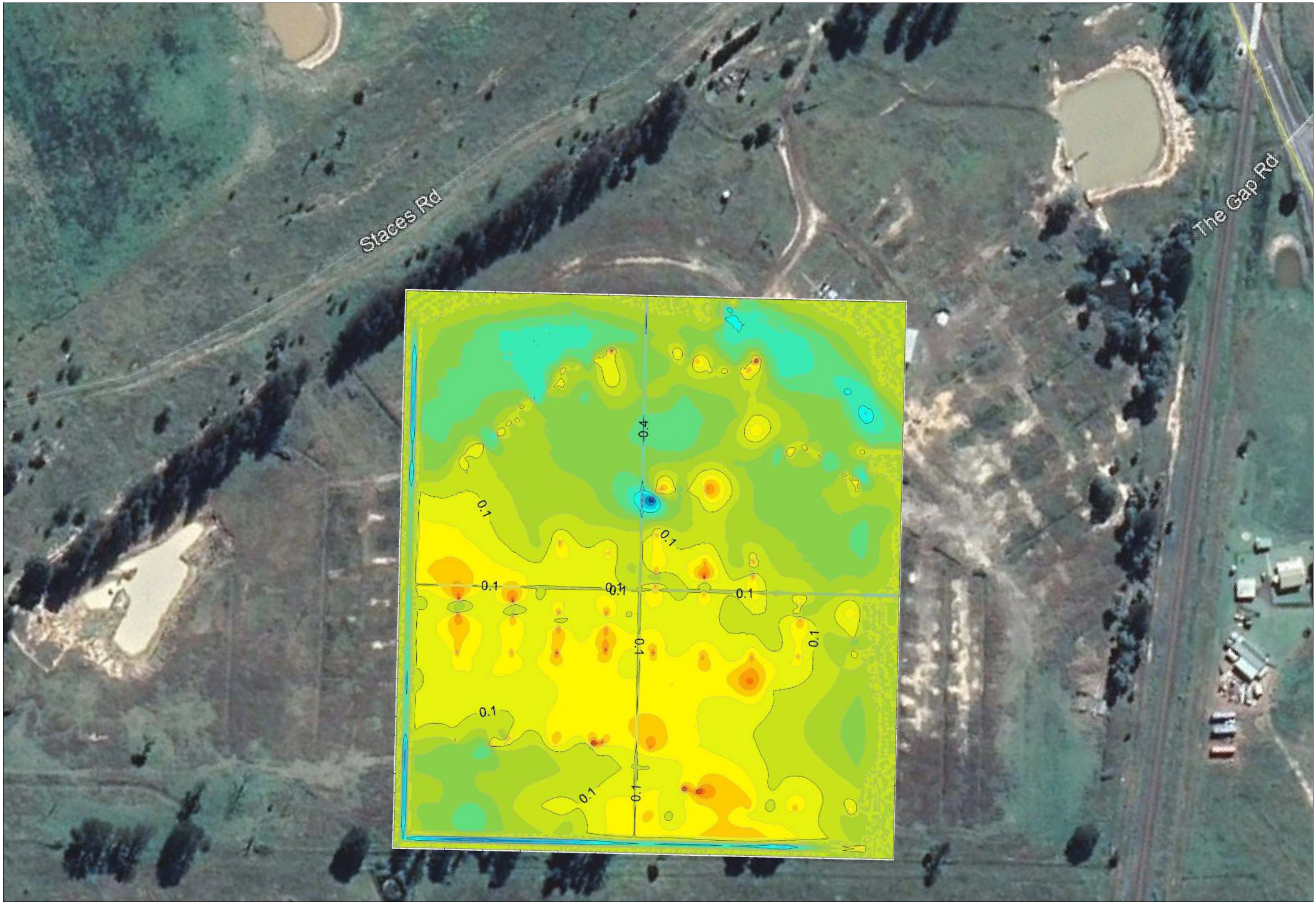
If there is anything further you require to assist, please do not hesitate to give me a call.

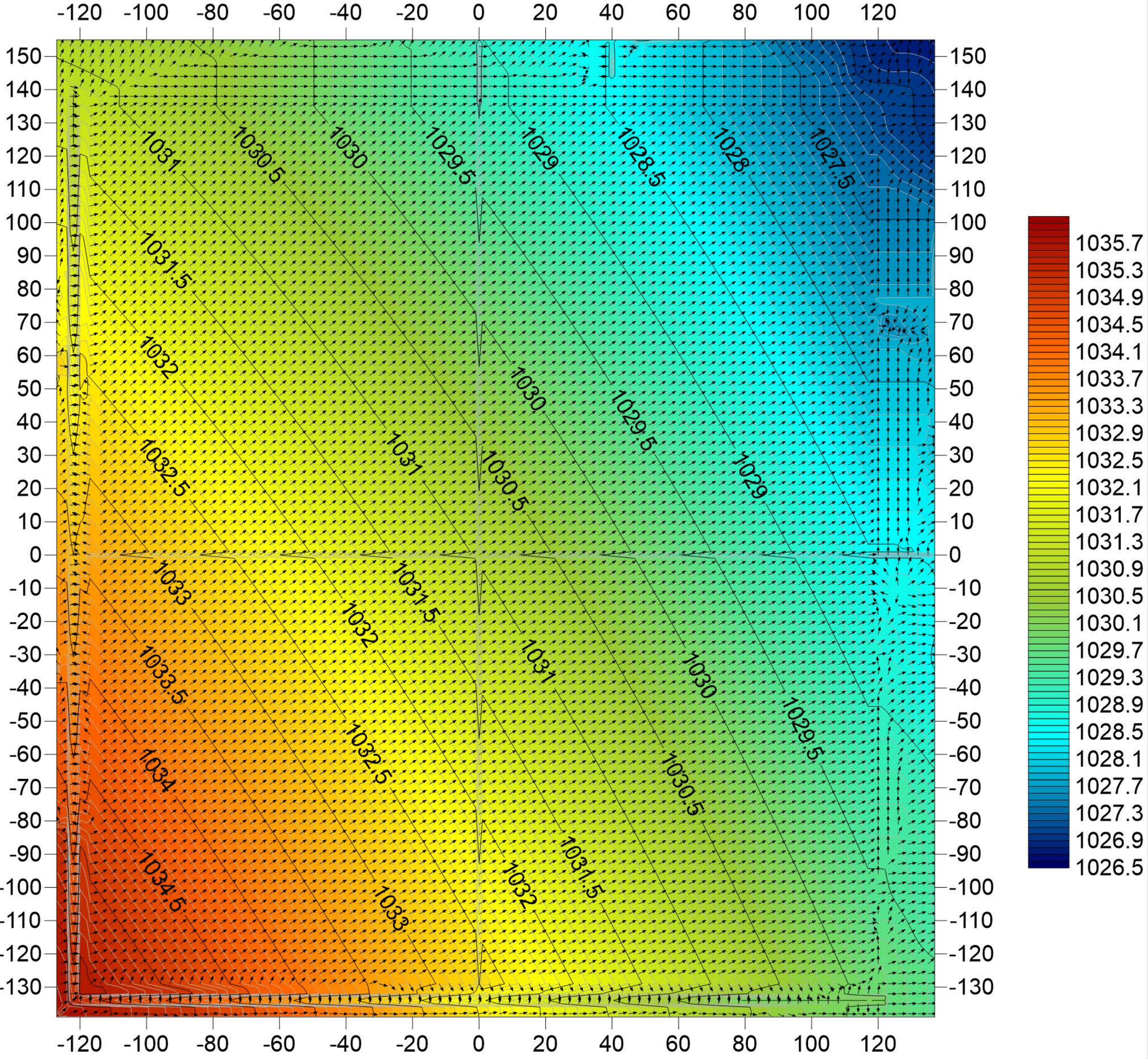
Kind regards,
Hayley

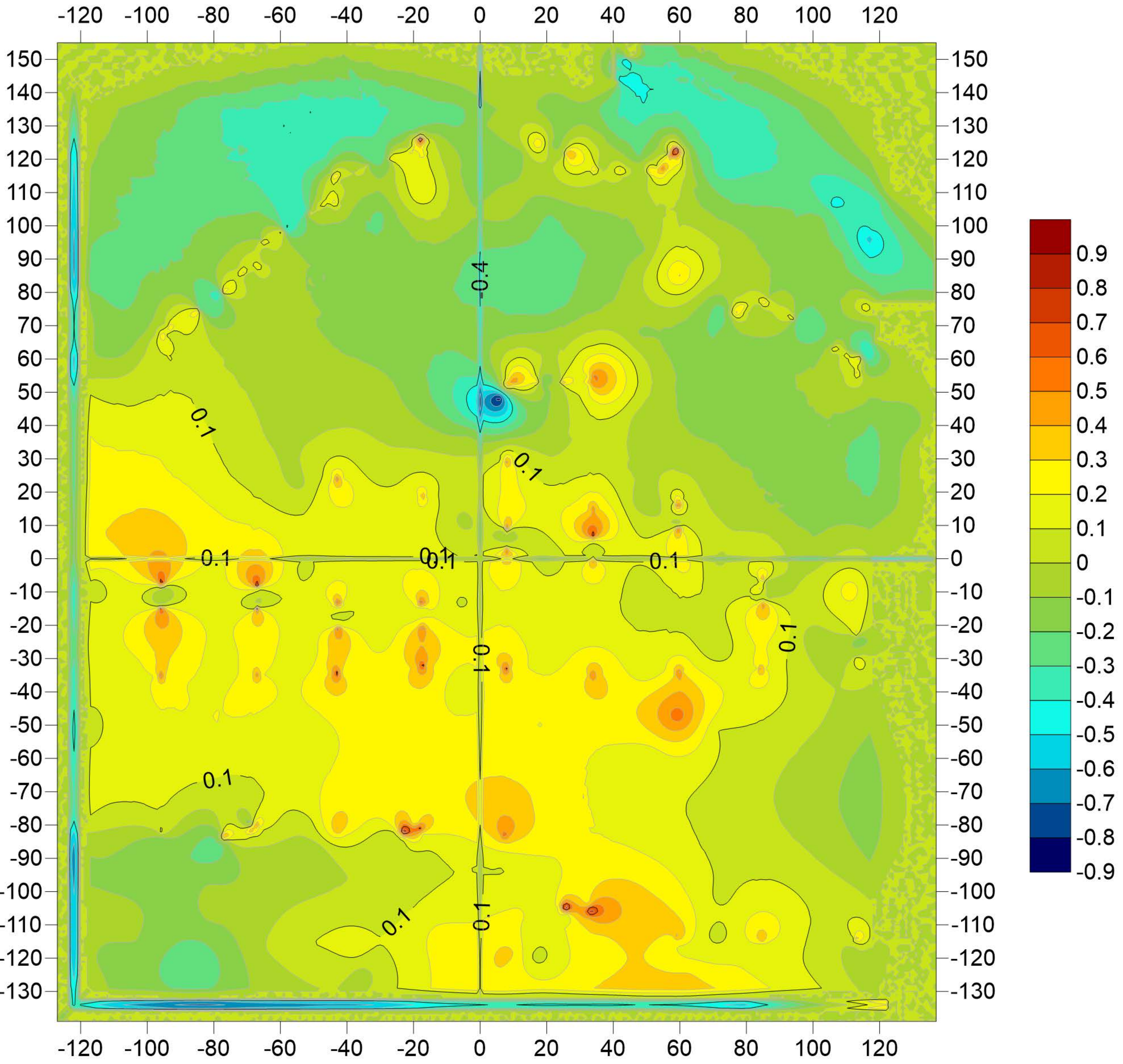
Hayley Bouliopoulos *B.Sc. Env, B.B.*
Environment and Resource Consultant
SMK CONSULTANTS
39 Frome Street │PO BOX 774
MOREE NSW 2400
T: (02) 6752 1021 │F: (02) 6752 5070
E: hayley@smk.com.au │Web: www.smk.com.au

Appendix 5 – Drainage Plan


Staces Rd
The Gap Rd
1027.5
1028
1028.5
1029
1029.5
1030
1030.5
1031
1031.5
1032
1032.5
1033
1033.5
1034
1034.5


Staces Rd
The Gap Rd
0.4
0.1
0.1
0.1
0.1
0.1
0.1
0.1
0.1
0.1
0.1
0.1
0.1


-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130
1031
1030.5
1030
1029.5
1029
1028.5
1028
1027.5
1031.5
1032
1032.5
1033
1033.5
1034
1034.5
1035.7
1035.3
1034.9
1034.5
1034.1
1033.7
1033.3
1032.9
1032.5
1032.1
1031.7
1031.3
1030.9
1030.5
1030.1
1029.7
1029.3
1028.9
1028.5
1028.1
1027.7
1027.3
1026.9
1026.5



-120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130
0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 -0.1 -0.2 -0.3 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9
-0.4
0.1

Appendix 6 – Aboriginal Heritage Information Management System Search Results

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 20-164

Client Service ID : 509178

SMK Consultants Pty Ltd - Moree

Date: 28 May 2020

P O Box 774
Moree New South Wales 2400
Attention: Hayley Greenham

Email: hayley@smk.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 385, DP:DP755846 with a Buffer of 50 meters, conducted by Hayley Greenham on 28 May 2020.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

Appendix 7 – Test of Significance

(Biodiversity Act 2016)

Introduction

Endangered Ecological Communities and threatened species that have the potential to be impacted by the proposed road upgrade have been assessed under the guidelines of Section 7.3 of the *Biodiversity Conservation Act 2016* and this is provided below in the form of a Test of Significance. The Test of Significance includes the assessment of the development against five parameters to determine whether there is likely to be a significant effect on the threatened species recorded at or likely to occur at the site. The assessment has been conducted in accordance with the Threatened Species Test of Significance Guidelines (OEH 2018).

The proposed development involves the construction of a solar farm within the Uralla Shire local government area. The subject site is located in Lot 385 on Deposited Plan 755846, approximately 2.8 kilometres south of the township of Uralla. The site is zoned for industrial use and is located within the Border Rivers Gwydir catchment area.

The subject site has been historically cleared and heavily disturbed as a result of previous business activities on the site. The site is currently utilised for grazing and includes grassland and a few paddock trees as well as derelict buildings which would be removed as part of the development. The development footprint will cover approximately 6.7 hectares and is restricted to land which has been previously disturbed.

The works will involve the minor clearing of groundcover and shrubs to facilitate construction, allowing for site establishment activities. Site establishment activities include establishment of the construction compound and laydown area, perimeter fencing, formation of internal roads and the installation of erosion and sediment controls. The proposal will require some cut and fill to provide a level surface for the installation of the solar arrays. A 35mm layer of crusher dust will be added to the surface under the PV Field. This will provide a better working surface and reduce soil turmoil from rain.

The development, once operational, will not pose an environmental risk to the locality as it will not act as a source of pollutants. A weed management program will be implemented, such that the site does not become a source of weed populations which may propagate out from the development site. Overall, the development is not predicted to interfere with habitat values adjacent to the subject site.

The vegetation within the proposed subject site was limited to grassland, there were few shrubs and four paddock trees. The groundcover species were generally in good condition, showing limited signs of drought-related stress, likely due to recent rainfall. The subject site was dominated by a mixture of grasses and weed species, both native and non-native. Species recorded included Blakley's Red Gum (Eucalyptus blakelyi), Broad-leaved Stringybark (Eucalyptus caliginosa), Snow Grass (Poa sieberiana), Windmill Grass (Chloris truncata),

Kangaroo Grass (Themeda triandra), Paddock lovegrass (Eragrostis leptostachya), Common Paspalum (Paspalum dilatatum), Wallaby Grass (Rytidosperma richardsonii), Slender Rats Tail (Sporobolus creber), White Water Panic (Panicum obseptum), Common Tussock Grass (Poa labillardierei), Boar Thistle (Cirsium vulgare), Hairy Fleabane (Erigeron bonariensis), Goose Grass (Eleusine tristachya), Native Raspberry (Rubus parvifolius), and Briar Bush (Rosa rubiginosa).

The remnant vegetation to the east of the subject site was identified as consistent with the Plant Community Type (PCT) 510 – 'Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion'.

Assessment of Potential Presence of Threatened Species

A search of the National Parks and Wildlife Atlas of NSW Wildlife (BioNet) identified seventeen (17) species with recorded sightings within a 10km radius of the proposed development site. The complete search result for listed species is presented in Appendix A.

The project site is located within the Yarrowyck-Kentucky Downs subregion of the New England Tablelands Bioregion. A broader search for species, populations and communities that may occur within the locality of the development site was therefore conducted through investigating known and predicted species' distributions within the New England Tablelands Bioregion (Yarrowyck-Kentucky Downs subregion). A copy of the search results for listed species is presented in Appendix B.

Species were considered with regards to their known distribution and habitat requirements, to assess whether the subject site is likely to serve as suitable habitat, and subsequently whether/how the development is likely to impact upon the species.

The availability of habitat on site was assessed using a number of factors including:

- Structural and floral diversity;
- Occurrence and extent of habitat types in the general vicinity;
- Continuity with similar habitat adjacent to the site, or connection with similar habitat off site by way of corridors;
- Key habitat features such as tree hollows, water bodies, crevices and rocky areas;
- Degree of disturbance and degradation; and
- Topographic features such as aspect and slope.

This information was used to evaluate the site as potential habitat for each of the threatened species considered and assign each species with a rating based on their likelihood to occur within the subject site. The 'likelihood of occurrence' categories are detailed in Table 1. The habitat assessment is provided in Appendix B. Species assigned with a rating of 'Moderate' or

higher and are considered potentially impacted by the proposed works have been considered further under relevant legislation within the assessment of significance provided below.

Table 1: Likelihood of Occurrence Criteria

Likelihood Rating	Criteria
Known	The species was recorded within the study area during site surveys.
High	It is likely that a species would inhabit or utilise habitat within the subject site. Criteria for this category may include: • Species recently and/or regularly recorded in contiguous or nearby habitat; • High quality habitat types or resources present within study area; • Species is known or likely to maintain a resident population surrounding the study area; and • Species is known or likely to visit during migration or seasonal availability of resources.
Moderate	Potential habitat for a species occurs within the subject site. Criteria for this category may include: • Species previously recorded in contiguous habitat albeit not recently (>10 years); • Poor quality, depauperate or modified habitat types and/or resources present within study area; • Species has potential to utilise habitat during migration or seasonal availability of resources; and • Cryptic flora species with potential habitat available within the subject site that have not been seasonally targeted by surveys.
Low	It is unlikely that the species inhabits the area and would likely be considered a transient visitor if ever encountered. Criteria for this category may include: • The subject site or study area lacks specific habitat types or resources required by the species; • The subject site is beyond the current distribution of the species or is isolated from known populations; • Non-cryptic flora species that were found to be absent during targeted surveys; and • The subject site only contains common habitat which would not be considered important for the local survival of a threatened species.
Unlikely	The habitat within subject site and study area is unsuitable for the species.

Only species that have the potential to be present within the available habitat are listed in Table 2 and assessed in this test of significance.

Table 2: Listed Species to be Assessed under the Test of Significance

Scientific Name	Common Name	Legal Status	Records
Ninox connivens	Barking Owl	BC Act: V,P,3	2
Ninox strenua	Powerful Owl	BC Act: V,P,3	1

Scientific Name	Common Name	Legal Status	Records
Tyto novaehollandiae	Masked Owl	BC Act: V,P,3	P
Phascolarctos cinereus	Koala	BC Act: V, P EPBC Act: V	33
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	BC Act: V, P	P
Thesium australe	Austral Toadflax	BC Act: V EPBC Act: V	P

The above-mentioned species will be considered within the assessment of significance.

Test of Significance - Assessment of Criteria and Discussion

The following is to be considered for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

A viable local population of a threatened terrestrial flora or fauna species in this assessment is defined as a population that occurs within the study area and the connected habitat within the area.

Flora Species

Austral Toadflax

The site inspection did not reveal the presence of a local population of Austral Toadflax. The cryptic nature of some threatened species, however, is such that the species may not have been visible during the time of the site visit, and therefore it must be assumed that viable populations of threatened flora species may be present within the region in accordance with the precautionary principle.

Potential habitat for the listed species is present in the footprint of the proposed works. The proposal development involves the removal of groundcover within the footprint on a small scale. Extensive areas of similar and higher-quality habitat are present within the connected vegetation. Should the above-mentioned species be present within the development footprint, they may be displaced in the short-term. However, given that adjoining vegetation retains the potential to support these species, it considered that the risk of a viable population being placed at risk of extinction is minimal.

Megachiropteran Bats

Yellow-bellied Sheath-tail Bat

The species may use the project area for foraging on occasion, however the foraging habitat within the subject site is not considered optimal, due to historical clearing and the effects of disturbance from previous land use. Similar and/or higher quality habitat is available in the area, including the small area of remnant vegetation located to the east of the development site. It is therefore considered that the subject site is unlikely to be regularly or heavily utilised by the Yellow-bellied Sheath-tail Bat. Additionally, no roosting and/or breeding habitat was identified within the proposed development footprint.

The risk to this species from the development is therefore limited to the loss of sub-optimal foraging habitat. It is therefore considered that no viable local population of any threatened species would be placed at risk of extinction due to the proposed development.

Birds of Prey

Barking Owl, Powerful Owl and Masked Owl

These highly mobile species have relatively large home ranges (generally >200 Ha). The removal of a small habitat area is therefore insignificant at a landscape scale and it is considered that the proposal is unlikely to have a significant impact on birds of prey. Furthermore, upon completion of the works, the subject site will revegetate naturally, with the surrounding habitat area acting as a seed source. The impact of the proposed development will therefore have short-medium term duration, with long-term impacts considered minor.

The proposal is therefore not deemed to pose a risk to viable local populations of the above-mentioned species.

Mammals

Koala

The proposed development site includes four mature trees, of which two listed feed tree species were identified, Blakely's Red Gum (Eucalyptus blakelyi) and Broad-leaved Stringybark (Eucalyptus caliginosa). These four paddock trees are not connected to any significant area of woodland or known koala habitat. The development footprint is therefore considered to only provide refuge koala habitat. This area would only be used by vagrant individuals as they travelled between suitable habitat areas within the wider region.

The removal of the four paddock trees within the development footprint is not considered likely to have an adverse effect on the lifecycle of the species such that a viable population would be placed at risk of extinction.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The subject site does not support an endangered ecological community or critically endangered ecological community.

The area of remnant vegetation located to the east of the development site was consistent with PCT 510, which is associated with an endangered ecological community. This area is not included within the development footprint and will be avoided during construction activities.

The development proposal is therefore considered unlikely to impact on the extent or composition of any of the listed endangered or critically endangered ecological communities.

c) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

No Endangered Ecological Community would be subject to vegetation removal or modification as part of the proposed development.

It is estimated that the proposed extent of vegetation removal of previously cleared and heavily disturbed native and non-native groundcover and four paddock trees is considered minimal at a local and regional scale, given the presence of similar and/or higher quality habitat in the wider area.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The subject site has been heavily cleared and disturbed as a result of historic land clearing and development of the site for previous activities. The site is currently utilised as grazing land. The development footprint does not currently support habitat deemed to be important for any threatened species or population. The proposed development of a small-scale solar farm is not predicted to cause or promote any fragmentation of species within the area. Fauna species which may periodically utilise the subject site would disperse into adjoining areas of similar quality habitat and/or into higher quality habitat which is widespread in the locality. Therefore, the small-scale removal of groundcover vegetation would not result in the fragmentation or isolation of these mobile species. Threatened flora species, whilst not identified in the area, may be displaced in the short-term, however, regeneration is likely to occur once construction is finalised and the similar adjoining vegetation is considered to provide sufficient germination so that these species are not at risk of extinction or long-term fragmentation.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The entire subject site was historically cleared in association with the original construction of a Timber Treatment Plant, which has since closed, and the site has been left to rehabilitate. The site is currently dominated by groundcover consisting of a mixture of native and non-native species. A small area of this vegetation will be cleared as part of the proposed works, and this habitat area is not considered to have any particular importance to the threatened species which may occur in the locality.

The site is surrounded by similar and/or higher-quality, contiguous vegetation, thus the small-scale removal of such habitat is highly unlikely to result in fragmentation or isolation to a degree that would impact the short or long-term survival of any species or population in the area. Therefore, it is considered that no habitat will be significantly modified as a result of the proposed project.

No endangered ecological community will be removed, modified or fragmented as part of the proposed works.

The proposed project is therefore not considered to remove, modify, fragment or isolate habitat essential for the survival of a threatened species within the area.

d) whether the proposed development is likely to have an adverse effect on critical any declared area of outstanding biodiversity value (either directly or indirectly),

The development proposal is not located in or near an area of outstanding biodiversity value. It is therefore considered that no areas of outstanding biodiversity value will not be adversely affected (either directly or indirectly) by the proposed development.

e) whether the proposed development or activity is or is part of a key threatening process or is likely or increase the impact of a key threatening process.

A total of 34 key threatening processes are listed for the New England Tablelands (Yarrowyck-Kentucky Downs) Bioregion by the Bionet search of the region. The following Table 3 presents a list of these processes and comment. Based on the number identification in the list, the following discussion is presented to assess the process.

Table 3: Key Threatening Processes

Listing of Key Threatening Processes for New England Tablelands - Yarrowyck-Kentucky Downs IBRA Subregion	Comment
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners (*Manorina melanocephala*)	No extensive woodland present.
Alteration of habitat following subsidence due to longwall mining	Not applicable

Listing of Key Threatening Processes for New England Tablelands - Yarrowyck-Kentucky Downs IBRA Subregion	Comment
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Not applicable
Anthropogenic Climate Change	Scale of development would result in limited or no impact and is a source of renewable energy which aims to reduce Australia's carbon footprint.
Bushrock removal	Not applicable
Clearing of native vegetation	Site has been previously cleared.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Rabbits not a pest at this location.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	No goats present.
Competition from feral honey bees, Apis mellifera L.	Any feral bees will be eradicated if present.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	No woodland remains on property. Majority of trees have been planted.
Herbivory and environmental degradation caused by feral deer	No deer present
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Fires excluded from existing and proposed development
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	No fire ants present.
Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	Not applicable
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Very limited frog habitat available.
Infection of native plants by Phytophthora cinnamomi	Phytophthora not observed to be present.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Not present
Invasion and establishment of exotic vines and scramblers	Not present
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Not present
Invasion and establishment of the Cane Toad (Bufo marinus)	No suitable habitat available at present.
Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.	Not present
Invasion of native plant communities by Chrysanthemoides monilifera	Not present
Invasion of native plant communities by exotic perennial grasses	Discussed below.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Not present
Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Not present
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Not present

Listing of Key Threatening Processes for New England Tablelands - Yarrowyck-Kentucky Downs IBRA Subregion	Comment
Loss of Hollow-bearing Trees	Land had been cleared approximately 40-years previously. The removal of four trees (of which no hollows were identified) will not increase the impact of this process.
Loss or degradation (or both) of sites used for hill-topping by butterflies	No hilltop sites present.
Predation and hybridisation by Feral Dogs, Canis lupus familiaris	The development would not increase the presence or impact of Feral Dogs.
Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	No watercourse within study area.
Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	The development would not increase the presence or impact of European Red Fox.
Predation by the Feral Cat Felis catus (Linnaeus, 1758)	The development would not increase the presence or impact of Feral Cats.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	The development would not increase the presence or impact of Feral Pigs.
Removal of dead wood and dead trees	No remnant woodland supporting dead wood present.

Invasion of Native Plant Communities by Exotic Perennial Grasses

Invasion of native plant communities by exotic species is listed as a key threatening process. Exotic perennial grasses have the capacity to invade native plant communities, competing with an excluding native species. The invasion of these grasses also reduces the habitat value for many native fauna species.

Whilst none of the listed species were identified during the site inspection, some patches of exotic perennial grasses may be present within the groundcover vegetation within the project area. The risk posed to native plant communities is the risk of these grasses spreading into areas with better quality native groundcover. The proposed works will include soil disturbance and vegetation clearance, which may include exotic perennial grass species.

Pathogen control protocols should be developed and implemented in accordance with the requirements of the *Biosecurity Act 2015*. Provided safeguards regarding weed management are implemented, the proposed works are unlikely to result in increased weed incursion. The proposed works are therefore considered unlikely to increase the impact of this key threatening process.

Conclusion

Flora, fauna and habitat studies have been undertaken to identify and assess the potential impacts resulting from the proposed project. The proposed project involves the construction of a solar farm. It is estimated that the total development footprint would be 6.7 hectares.

The proposal was assessed using the Test of Significance in accordance with the BC Act for the site which determined that given the limited extent of vegetation removal from the site (four paddock trees) within a heavily disturbed site, the project is not likely to significantly affect threatened species, ecological communities, or their habitats.

This assessment has determined that the potential adverse impacts of the proposed development on threatened species, populations or communities is considered minimal and no further investigation in the form of a Biodiversity Development Assessment Report is required.

Appendix A: Bionet Threatened Species, Populations and Communities Search Results for a 10-kilometre radius from the Subject Site

Scientific Name	Common Name	Legal Status	Records
Anseranas semipalmata	Magpie Goose	BC Act: V,P	3
Oxyura australis	Blue-billed Duck	BC Act: V,P	12
Stictonetta naevosa	Freckled Duck	BC Act: V,P	7
Hirundapus caudacutus	White-throated Needletail	BC Act: P EPBC Act: V,C,J,K	2
Circus assimilis	Spotted Harrier	BC Act: V,P	3
Haliaeetus leucogaster	White-bellied Sea-Eagle	BC Act: V,P	3
Hieraaetus morphnoides	Little Eagle	BC Act: V,P	5
Falco subniger	Black Falcon	BC Act: V,P	2
Rostratula australis	Australian Painted Snipe	BC Act: E1,P EPBC Act: E	1
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	BC Act: V,P	58
Daphoenositta chrysoptera	Varied Sittella	BC Act: V,P	1
Artamus cyanopterus cyanopterus	Dusky Woodswallow	BC Act: V,P	1
Petroica boodang	Scarlet Robin	BC Act: V,P	1
Dasyurus maculatus	Spotted-tailed Quoll	BC Act: V,P EPBC Act: E	1
Phascolarctos cinereus	Koala	BC Act: V,P EBPC Act: V	21
Pteropus poliocephalus	Grey-headed Flying-fox	BC Act: V,P EPBC Act: V	5
Lepidium hyssopifolium	Aromatic Peppercress	BC Act: E1 EPBC Act: E	1

Appendix B: Bionet Threatened Species, Populations and Communities Search Results for New England Tablelands Bioregion (Yarrowyck-Kentucky Downs IBRA Subregion)

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Amphibia					
Adelotus brevis Tusked Frog population in the Nandewar and New England Tableland Bioregions	BC Act – E	Rainforests, wet forests and flooded grassland and pasture. They are usually found near creeks, ditches and ponds, and call while hidden amongst vegetation or debris. The species breeds from Spring through to Summer, with a peak during late Spring. Eggs are deposited in nests under leaf litter or other cryptic sites such as old yabbie burrows near or in water.	P	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	No
Litoria booroolongensis Booroolong Frog	BC Act – E EPBC Act – E	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Shelter under rocks or amongst vegetation near the ground on the stream edge.	K	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	No
Reptilia					
Myuchelys bellii Western Sawshelled Turtle, Bell's Turtle	BC Act – E EPBC Act – V	Shallow to deep pools in upper reaches or small tributaries of major rivers in granite country. Occupied pools are most commonly less than 3 m deep with rocky or sandy bottoms and patches of vegetation. Most typically uses narrow stretches of rivers 30 - 40 m wide. Most surrounding habitat has	200	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		been converted to grazing land. Primarily a vegetarian, eating both aquatic plants and terrestrial leaves that fall into the watercourse. Also takes invertebrates ranging from insects to crayfish, other small animals and carrion.		used on occasion, this would only be considered refuge habitat.	
Hoplocephalus bitorquatus Pale-headed Snake	BC Act - V	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas.	P	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat.	No
Aves					
Anseranas semipalmata Magpie Goose	BC Act - V	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter.	3	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	No
Oxyura australis Blue-billed Duck	BC Act – V	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense	12	**Low**	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached.		The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	
Stictonetta naevosa Freckled Duck	BC Act – V	Prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates.	7	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	No
Circus assimilis Spotted Harrier	BC Act - V	In New South Wales, this species is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. Primarily inhabits woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. Generally, the understorey is	3	**Low** This species may hunt within the subject area, however the subject site is not considered important habitat for the species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		open with sparse eucalypt saplings, acacias and other shrubs, including heath.			
Haliaeetus leucogaster White-bellied Sea-Eagle	BC Act - V	The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.	3	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	No
Hieraaetus morphnoides Little Eagle	BC Act - V	The Little Eagle is found throughout the Australian mainland. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	7	**Low** This species may hunt within the subject area, however the subject site is not considered important habitat for the species.	No
Lophoictinia isura Square-tailed Kite	BC Act - V	In NSW, the species is a regular resident in the north, north-east and along the major west-flowing river systems. Found in a variety of timbered habitats including dry woodlands and open forests. It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km.	1	**Low** This species may hunt within the subject area, however the subject site is not considered important habitat for the species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Falco subniger Black Falcon	BC Act - V	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres.	3	**Low** This species may hunt within the subject area, however the subject site is not considered important habitat for the species.	No
Rostratula australis Australian Painted Snipe	BC Act – E EPBC Act - E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	1	**Low** The subject site is not considered important habitat for the species, given a paucity of suitable habitat. Whilst the storage dams may be used on occasion, this would only be considered refuge habitat.	No
Calyptorhynchus lathami Glossy Black-Cockatoo	BC Act - V	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak and Forest Sheoak are important foods. Inland populations feed on a wide range of sheoak. Belah is also utilised and may be a critical food source for some populations. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	P	**Low** No feed tree species were identified within the subject site. The site is therefore not considered important habitat for the species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Glossopsitta pusilla Little Lorikeet	BC Act – V	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards.	27	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No
Lathamus discolor Swift Parrot	BC Act – E EPBC - CE	Migrates to the Australian south-east mainland between February and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Forest Red Gum E. tereticornis, Mugga Ironbark E. sideroxylon, and White Box E. albens. Commonly used lerp infested trees include Inland Grey Box E. microcarpa, Grey Box E. moluccana, Blackbutt E. pilularis, and Yellow Box E. melliodora. Return to some foraging sites on a cyclic basis depending on food availability.	3	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Neophema pulchella Turquoise Parrot	BC Act - V	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December.	K	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No
Ninox connivens Barking Owl	BC Act - V	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils.	2	**Moderate** This species may hunt throughout the subject site.	Yes
Ninox strenua Powerful Owl	BC Act - V	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine Syncarpia glomulifera, Black She-oak Allocasuarina littoralis, Blackwood Acacia melanoxylon, Rough-	1	**Moderate** This species may hunt throughout the subject site.	Yes

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		barked Apple Angophora floribunda, Cherry Ballart Exocarpus cupressiformis and a number of eucalypt species.			
Tyto novaehollandiae Masked Owl	BC Act - V	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	P	**Moderate** This species may hunt throughout the subject site.	Yes
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	BC Act - V	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. When foraging in trees and on the ground, they peck and probe for insects, mostly ants, amongst the litter, tussocks and fallen timber, and along trunks and lateral branches. Hollows in standing dead or live trees and tree stumps are essential for nesting.	300	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Chthonicola sagittata Speckled Warbler	BC Act - V	The Speckled Warbler has a patchy distribution throughout the eastern half of NSW. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter.	2	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No
Anthochaera phrygia Regent Honeyeater	BC Act – E4A EPBC - CE	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include	7	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany.			
Grantiella picta Painted Honeyeater	BC Act – V EPBC Act - V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*.	1	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No
Melithreptus gularis gularis Black-chinned Honeyeater	BC Act - V	The Black-chinned Honeyeater has two subspecies, with only the nominate (*gularis*) occurring in NSW where it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares.	2	**Low** The subject site is not considered important habitat for the species given the paucity of suitable habitat.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Daphoenositta chrysoptera Varied Sittella	BC Act - V	Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy.	2	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No
Artamus cyanopterus cyanopterus Dusky Woodswallow	BC Act - V	Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. Primarily eats invertebrates, mainly insects, which are captured whilst hovering or sallying above the canopy or over water. Most breeding activity occurs on the western slopes of the Great Dividing Range.	9	**Low** The subject site contains only common habitat features which would not be considered important for the local survival of this species.	No
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	BC Act - V	The south-eastern form (subspecies *cucullata*) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies *picata*. Two other subspecies occur outside NSW. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	4	**Low** The subject site is not considered important habitat for the species given the paucity of suitable habitat.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Petroica boodang Scarlet Robin	BC Act - V	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude.	2	**Low** The subject site is not considered important habitat for the species given the paucity of suitable habitat.	No
Petroica phoenicea Flame Robin	BC Act - V	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). Often occurs in recently burnt areas; however, habitat becomes	K	**Low** The subject site lacks suitable habitat for this species. Therefore, the subject site is not considered important habitat for the species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		unsuitable as vegetation closes up following regeneration.			
Stagonopleura guttata Diamond Firetail	BC Act - V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Prefers clearings or areas with open understoreys. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	8	**Low** The species may occur within the subject area; however, the subject site is not considered important habitat for this species.	No
Mammalia					
Dasyurus maculatus Spotted-tailed Quoll	BC Act – V EPBC Act - E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares.	1	**Low** The species may travel through or rest within the site given its very large home range, however it is not considered important habitat for the species.	No
Phascolarctos cinereus	BC Act – V EPBC - V	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-	33	**Moderate**	Yes

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Koala		eucalypt species, but in any one area will select preferred browse species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.		The subject site contains two listed feed tree species Blakely's Red Gum (Eucalyptus blakelyi) and Broad-leaved Stringybark (Eucalyptus caliginosa). However, the site is a previously disturbed site with few paddock trees and existing remnant vegetation is predominantly non-native pine species. It is therefore considered that koalas would only occur within the subject site as a vagrant moving between suitable habitat areas.	
Petaurus australis Yellow-bellied Glider	BC Act – V	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	P	**Low** The subject site lacks suitable habitat for this species. Therefore, the subject site is not considered important habitat for the species.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Petaurus norfolcensis Squirrel Glider	BC Act – V	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	P	**Low** The subject site lacks suitable habitat for this species. Therefore, the subject site is not considered important habitat for the species.	No
Pteropus poliocephalus Grey-headed Flying-fox	BC Act – V EPBC - V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	3	**Low** There is no suitable habitat, including foraging and roosting habitat, for the species on the subject site. Therefore, the subject site is not considered important habitat for the species.	No
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	BC Act - V	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	P	**Moderate** The species may roost and/or forage within the subject area; it is therefore considered in this assessment.	Yes

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Scoteanax rueppellii Greater Broad-nosed Bat	BC Act - V	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.	P	**Low** The subject site lacks suitable habitat for this species. Therefore, the subject site is not considered important habitat for the species.	No
Miniopterus orianae oceanensis Large Bent-winged Bat	BC Act - V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Hunt in forested areas, catching moths and other flying insects above the tree tops.	1	**Low** The subject site lacks suitable habitat for this species. Therefore, the subject site is not considered important habitat for the species.	No
Flora					
Eucalyptus mckieana	BC Act – V EPBC Act - V	Eucalyptus mckieana is found in grassy open forest or woodland on poor sandy loams, most commonly on gently sloping or flat sites. Associated species at	2	**Unlikely** This species was not identified at the subject site at the time of the	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
McKie's Stringybark		Northern Tablelands sites include *Angophora floribunda, Eucalyptus amplifolia, Eucalyptus andrewsii, Eucalyptus bridgesiana, Eucalyptus youmanii, Eucalyptus nicholii, Eucalyptus blakelyi and Eucalyptus conica*, and at North Western Slopes sites *Eucalyptus andrewsii, Eucalyptus stannicola, Eucalyptus prava and Angophora floribunda*.		field survey. The species is therefore not considered in this assessment.	
Eucalyptus nicholii Narrow-leaved Black Peppermint	BC Act – V EPBC Act - V	Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock. Seedling recruitment is common, even in disturbed soils, if protected from grazing and fire. Tends to grow on lower slopes in the landscape.	P	**Unlikely** This species was not identified at the subject site at the time of the field survey. The species is therefore not considered in this assessment.	No
Diuris pedunculata Small Snake Orchid	BC Act – E EPBC Act - E	The Small Snake Orchid grows on grassy slopes or flats. Often on peaty soils in moist areas. Also on shale and trap soils, on fine granite, and among boulders. It flowers during August-October.	2	**Unlikely** The subject site is a heavily disturbed site with brown sandy clay loam soils. The habitat within the subject site is therefore considered unsuitable for the species.	No
Euphrasia collina subsp. muelleri Mueller's Eyebright	BC Act – E EPBC Act - E	Little is known about the habitat this species preferred, although there is a reference to "damp places" in an early von Mueller collection. Extant populations in Victoria occur in heathy woodland. Flowering has generally been recorded in spring and early summer, although the flowering collection	P	**Low** It is considered unlikely that this listed plant species would be found in the subject site given its history of disturbance and lack of local records. The species is	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		from Dorrigo in 1904 was made in July. The most recent collection in NSW (Tinderry Range and Tamworth area) were made with flowers and fruit in late December / early January.		therefore not considered in this assessment.	
Polygala linariifolia Native Milkwort	BC Act – E	North from Copeton Dam and the Warialda area to southern Queensland. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi, Eucalyptus dealbata* and *Callitris*, and in yellow podsolic soil on granite in layered open forest.	P	**Low** It is considered unlikely that this listed plant species would be found in the subject site given its history of disturbance and lack of local records. The species is therefore not considered in this assessment.	No
Thesium australe Austral Toadflax	BC Act – V EPBC Act - V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	P	**Moderate** Whilst not identified within the subject site during the field survey, associated species were present. The species will therefore be considered in this assessment due to the precautionary principle.	Yes
Communities					
Carex Sedgeland of the New England Tables, Nandewar, Brigalow Belt South and NSW	BC Act – EEC	Carex Sedgelands are fens dominated by sedges, grasses and semi-aquatic herbs. Dominant species are Carex appressa, Stellaria angustifolia, Scirpus polystachyus, Carex gaudichaudiana, Carex sp. Bendemeer, Carex tereticaulis and Isachne globosa, either as single species or in combinations.	K	**Low** This EEC does not occur on the site, and the site is thus not considered important habitat.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
North Coast Bioregions					
New England Peppermint (Eucalyptus nova-anglica) Woodland on Basalts and Sediments in the New England Tableland Bioregion	BC Act – CEEC EPBC Act - CE	This woodland community is dominated by trees of New England Peppermint Eucalyptus nova-anglica and occasionally Mountain Gum E. dalrympleana subsp. heptantha, and is usually 8-20 metres tall. The woodland has a predominantly grassy understorey with few shrubs. The species present at a site will vary according to recent rainfall or drought condition and the degree of disturbance (including fire).	K	**Low** This EEC does not occur on the site, and the site is thus not considered important habitat.	No
Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	BC Act – EEC	Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion is characterised by a tree layer that is usually 20 metres tall and reaches up to 30 metres in resource-rich sites, but is considerably shorter than 20 metres on exposed or damp sites or where past clearing has removed mature trees. Common overstorey species include Eucalyptus viminalis (Ribbon Gum), E. dalrympleana subsp. heptantha (Mountain Gum), E. pauciflora (Snow Gum or White Sallee) and occasionally E. stellulata (Black Sallee). The mid-layer and understorey comprise sparse layers of small trees and shrubs, including Acacia dealbata (Silver Wattle), Pultenaea microphylla and	K	**Low** This EEC does not occur on the site, and the site is thus not considered important habitat.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		Pimelea linifolia (Slender Rice-flower) and a dense to very dense grassy ground cover dominated by Poa sieberiana var. sieberiana (Snowgrass), P. labillardieri var. labillardieri (Tussock), Themeda australis (Kangaroo Grass) and Elymus scaber (Common Wheatgrass), with herbs such as Acaena spp. (Bidgee-widgees and Sheep's-burrs), Ammobium alatum (Tall Ammobium), Asperula conferta (Common Woodruff), Geranium solanderi (Native Geranium), Ranunculus lappaceus (Common Buttercup) and numerous other species. Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion provides important habitat for the nationally vulnerable plant species Thesium australe (Austral Toadflax).			
Upland Wetlands of the Drainage Divide of the New England Tableland Bioregion	BC Act – EEC	This community is composed of a series of high altitude wetlands in the New England Tablelands of Northern NSW. The wetlands have small local catchments, and range from shallow and temporary to near-permanent wetlands. Vegetation is usually a combination of sedges, rushes, spike-rushes, grasses and other aquatic plants, occurring either on the shores of open water or extending across shallow or dry wetland beds, and can die back during dry	P	**Low** This EEC does not occur on the site, and the site is thus not considered important habitat.	No

Species Name	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
		periods. These wetlands are important habitat for a range of native wildlife.			
White Box Yellow Box Blakely's Red Gum Woodland	BC Act – CEEC EPBC Act - CE	White Box Yellow Box Blakely's Red Gum Woodland is an open woodland, in which the most obvious species are one or more of the following: White *Box Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red *Gum E. blakelyi*. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. Shrubs are generally sparse or absent, though they may be locally common. Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant.	K	**Low** This EEC does not occur on the site, and the site is thus not considered important habitat.	No

Appendix 8 – MNES Assessment of Significance

(Environmental Protection and Biodiversity Conservation Act 1999)

EPBC Protected Matters Assessment

Matters of National Significance

The EPBC Act requires consideration of the effect of an action on the following 7 Matters of National Environmental Significance (MNES):

- World Heritage Properties
- National Heritage Places
- Ramsar wetlands of international importance
- Nationally threatened species and communities
- Migratory species protected under international agreements
- Nuclear actions, including uranium mining, and
- The Commonwealth marine environment.

The impact of an action on these matters is assessed under the criteria specified in: Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (DoE 2013).

Consideration of EPBC Matters

A search was undertaken using the EPBC Protected Matters Search Tool (PMST) (DoEE 2020) to generate a list of World Heritage Properties, National Heritage Places, Ramsar wetlands and nationally threatened species, communities and migratory species protected under international agreements that may occur on or within a 10 kilometre radius of the proposed development (Figure 1).

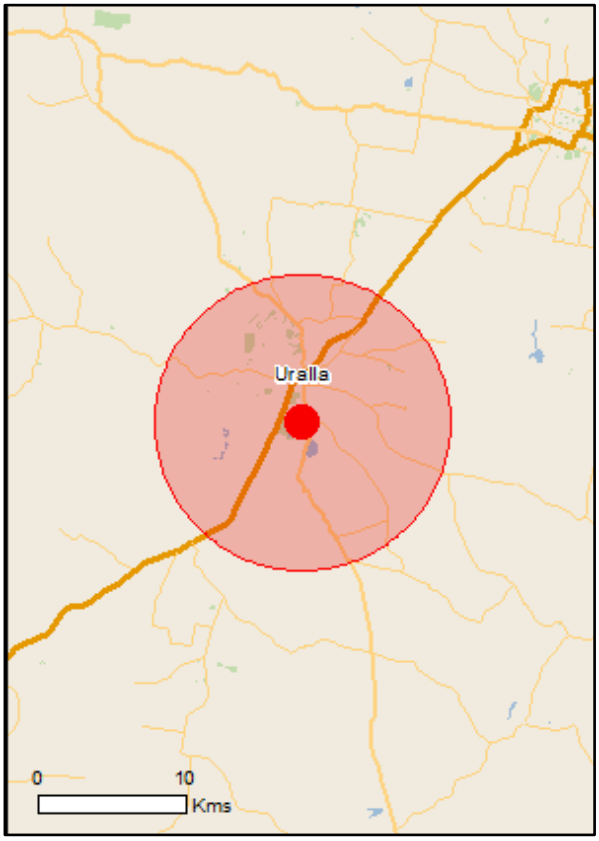


Figure 1: Region searched for MNES using the EPBC PMST

Results of Database Search

The EPBC PMST does not list any World Heritage Properties or National Heritage Places on or within the search area. The proposal is not considered to impact on this site or any other heritage matters. Further, the proposal does not involve nuclear actions or impact on the marine environment; consequently, these matters are also not relevant to this assessment.

Nationally threatened species and migratory species protected under international agreements have been initially defined within the search area outlined in Figure 1 using the PMST. These species are listed in Tables 1 and 2.

Table 1: Threatened flora and fauna species predicted or known to occur on the proposal area

Category	Scientific Name	Common Name	Legal Status
Birds	*Anthochaera phrygia*	Regent Honeyeater	Critically Endangered
	Botaurus poiciloptilus	Curlew Sandpiper	Critically Endangered
	Erythrotriorchis radiatus	Red Goshawk	Vulnerable
	Falco hypoleucos	Grey Falcon	Vulnerable
	Grantiella picta	Painted Honeyeater	Vulnerable
	Hirundapus caudacutus	White-throated Needletail	Vulnerable
	Rostratula australis	Australian Painted Snipe	Endangered as *Rostratula australis*; Listed Marine as *Rostratula benghalensis* (sensu lato)
Mammals	*Chalinolobus dwyeri*	Large-eared Pied Bat	Vulnerable
	Dasyurus maculatus	Spotted-tail Quoll	Endangered
	Phascolarctos cinereus (combined populations of NSW, QLD & ACT)	Koala (combined populations of NSW, QLD & ACT)	Vulnerable
Frogs	*Litoria castanea*	Yellow-spotted Tree Frog	Critically Endangered
Reptiles	*Uvidicolus sphyrurus*	Border Thick-tailed Gecko	Vulnerable
Plants	*Arthraxon hispidus*	Hairy-joint Grass	Vulnerable
	Callistemon pungens		Vulnerable
	Dichanthium setosum	Bluegrass	Vulnerable
	Diuris pedunculata	Small Snake Orchid	Endangered
	Eucalyptus mckieana	McKie's Stringybark	Vulnerable
	Eucalyptus nicholii	Narrow-leaved Peppermint	Vulnerable
	Thesium australe	Austral Toadflax	Vulnerable

CAMBA = China Australia Migratory Bird Agreement; JAMBA = Japan Australia Migratory Bird Agreement; ROKAMBA = Republic of Korea Australia Migratory Bird Agreement; Bonn = Convention on the Conservation of Migratory Species of Wild Animals

*Only species listed as likely or known to occur within the area have been listed above. Species listed as may occur have been discounted from the list.

Table 2: Migratory species predicted to occur on the proposal area

Category	Scientific Name	Common Name	Legal Status
Migratory Marine Birds	*Apus pacificus*	Fork-Tailed Swift	Listed Migratory (CAMBA, JAMBA, ROKAMBA); Listed Marine

Category	Scientific Name	Common Name	Legal Status
Migratory Terrestrial Species	*Hirundapus caudacutus*	White-throated Needletail	Vulnerable
	Monarcha melanopsis	Black-faced Monarch	Listed Migratory (Bonn); Listed Marine
	Myiagra cyanoleuca	Satin Flycatcher	Listed Migratory (Bonn); Listed Marine
	Rhipidura rufifrons	Rufous Fantail	Listed Migratory (Bonn); Listed Marine
Migratory Wetland Species	*Calidris acuminata*	Sharp-tailed Sandpiper	Listed Migratory (Bonn, CAMBA, JAMBA, ROKAMBA); Listed Marine
	Calidris ferruginea	Curlew Sandpiper	Critically Endangered; Listed Migratory (Bonn, CAMBA, JAMBA, ROKAMBA); Listed Marine

CAMBA = China Australia Migratory Bird Agreement; JAMBA = Japan Australia Migratory Bird Agreement; ROKAMBA = Republic of Korea Australia Migratory Bird Agreement; Bonn = Convention on the Conservation of Migratory Species of Wild Animals

*Only species listed as likely or known to occur within the area have been listed above. Species listed as may occur have been discounted from the list.

The PMST also identified a range of threatened ecological communities which have the potential to be present within the study area. However, no threatened ecological communities were identified within the proposed development site during site inspection and therefore it is considered that the proposed development will not pose a risk to ecological communities protected under the EPBC Act.

The PMST identified four Ramsar wetlands downstream of the proposed development:

- Banrock Station Wetland Complex located 1100-1200km downstream;
- Gwydir Wetlands: Gingham and Lower Gwydir (Big Leather) Watercourses located 200-300km upstream;
- Riverland located 1000-1100km downstream; and
- The Coorong, Lake Alexandrina and Albert wetland located 1200-1300km downstream from the subject site.

The distance between the source and receptor is considerable, in particular when taking the small-scale nature of the proposed into account. The proposal has minimal potential for impact on these wetlands.

Study Area Delineation

The potential impacts of the proposed development are predicted to be minimal. The proposed works will be undertaken in accordance with best practice work methods to protect environmental values, which will include measures such as minimising the footprint of site disturbance, retaining mature trees as much as possible, and the implementation of erosion and silt control measures. A weed management program will also be implemented to ensure that the site does not become a source of weed populations which may propagate out from

the development site. Overall, the development is not predicted to interfere with habitat values adjacent to the site.

Therefore, it is considered that the extent of impact of the proposed development is limited to the footprint of disturbance on site (i.e. the subject site).

Assessment of Significance

Vulnerable Species

An action has, or will have, or is likely to have a significant impact on a vulnerable species if it does, will or is likely to:

- ***Lead to a long-term decrease in the size of an important population of species***

The proposed development will involve the removal of four paddock trees and the associated clearance of a small area of ground cover. The site has been preferentially selected due to its history of clearing and disturbance. The subject site is not considered to constitute preferred habitat for any of the listed vulnerable species. It should be noted that no vulnerable flora species were observed on site during the site inspection. It is possible that a range of fauna species may forage or otherwise utilise the site. However, the habitat value of the subject site is not considered to be significant, as the site is heavily disturbed, with existing weed presence. The long-term impact of the proposed development upon threatened flora and fauna species is therefore considered to be minimal, as there would be no long-term decrease in habitat availability or quality for these species.

- ***Reduce the area of occupancy of an important population***

Overall, the total area to be disturbed by the road development will be small and occur on a previously disturbed site. The disturbance associated with the development is therefore not considered to pose a risk to the long-term survival of any threatened species or ecological community within the locality.

- ***Fragment an existing important population into two or more populations***

The study area of the proposed development consists of land which has been previously cleared and heavily disturbed. The habitat value of this land for threatened species is considered to be limited and is already considered to contribute to the fragmentation of the landscape by having been historically cleared.

- ***Adversely affect habitat critical to the survival of a species***

It is unlikely that the habitat area to be impacted consists of critical habitat for any of the species identified above. The groundcover to be impacted by the proposed development is considered heavily disturbed, with the area either cleared or a mix of native and non-native species, including the presence of invasive weed species. Therefore, the site is not considered to be critical habitat for any of the listed vulnerable species.

Further, implementation of management plans during the construction period (including a erosion and sediment controls) will minimise the risk of any off-site impacts which may occur in association with the proposed development.

- ***Disrupt the breeding cycle of an important population***

The study area does not offer any critical habitat features, such as water bodies or tree hollows, which are of ecological significance for the breeding cycle of the identified threatened species. None of the listed threatened species are likely to breed or reside long-term within the subject site and are only predicted to utilise the area during times of duress (i.e. when food cannot be found in more suitable habitats). Therefore, given the modified nature of the site and the small area of vegetation to be impacted, the proposal is not considered likely to disrupt the breeding cycle of any important population within the study area.

- ***Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

The footprint of the proposed works is deemed to be minor. Disturbance of such a limited area of habitat is not predicted to result in a decline of vulnerable species populations within the locality and/ or region.

- ***Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***

Weed seeds are carried onto and distributed by vehicles along road corridors. Construction machinery may also transport weed seeds onto and off-road works sites. Weed management strategies will be implemented on site to minimise the risk of weed establishment and proliferation as a result of construction activities on site. Examples of weed management strategies include adoption of proper hygiene procedures to minimise the potential for seed transport onto and off the work site.

Once the site is operational, the site will be regularly maintained to minimise the occurrence of weeds within the disturbance footprint of the site. The site is therefore not considered to increase the risk of establishment of invasive species.

- ***Introduce disease that may cause the species to decline, or***

The development relates to the construction of a solar farm and therefore does not involve introduction of disease vectors into the locality, the development is not considered to pose a disease risk to native species.

- ***Interfere substantially with the recovery of the species***

Ensuring the recovery of a species generally involves the protection and enhancement of existing populations and habitat, by preventing further clearing and modification of native vegetation communities and protecting water quality values.

The proposed development footprint is located on an area which consists of previously cleared and disturbed native and non-native groundcover. Given the small scale nature of the proposed works and the availability of similar and/or higher quality habitat with the area, the proposal is not considered to have the potential to cause significant impacts on existing flora and fauna populations or habitat.

Overall, the development is not considered to pose a risk to the recovery of vulnerable species within the region.

Critically Endangered and Endangered Ecological Communities

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- ***Reduce the extent of an ecological community***
- ***Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines***
- ***Adversely affect habitat critical to the survival of an ecological community***
- ***Modify or destroy abiotic (non-living) factors (such as water, nutrients or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns***
- ***Cause substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting***
- ***Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:***
    - ***Assisting invasive species, that are harmful to the listed ecological community, to become established, or***
    - ***Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or***
- ***Interfere with the recovery of an ecological community***

No Endangered Ecological Communities (EECs) were identified within the proposed development site, such that no direct impacts shall occur to EECs. The impacts of the proposed development will be limited to the proposed development footprint (as discussed above), through the implementation of best practice management measures such as silt and erosion measures and weed management measures. As a result, the proposed development

will not impact upon threatened ecological communities which may be present within the region.

The area of remnant vegetation located to the east of the development site was consistent with PCT 510, which is associated with a threatened ecological community. This area is not included within the development footprint and should be avoided during construction activities.

Critically Endangered and Endangered Species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- ***Lead to a long-term decrease in the size of a population***

Similarly, to vulnerable species, the proposed development site is not considered to constitute preferred habitat for endangered or critically endangered species. It should be noted that no endangered or critically endangered flora species were observed on site during the site inspection. It is possible that a range of fauna species may forage or otherwise utilise the site. However, the habitat value of the subject site is not considered to be significant, as the site is heavily disturbed, with existing weed presence. Therefore, it is unlikely that the proposed development will lead to a long-term decrease in populations of endangered or critically endangered species within the region.

- ***Reduce the area of occupancy of the species***

Overall, the total area to be disturbed by the solar farm development will be small and has been preferentially located on a previously cleared and disturbed site. Modification of the site as a result of the proposed development is therefore unlikely to reduce the area of occupancy of identified species.

- ***Fragment an existing population into two or more populations***

As outlined above, the development will not result in habitat fragmentation, and is therefore not considered to pose a risk of fragmenting populations of endangered or critically endangered species which may be present within the locality.

- ***Adversely affect habitat critical to the survival of a species***

There is no critical habitat for identified endangered and critically endangered species on the proposed development site. Further, implementation of management plans during the construction works (including a weed management program and erosion and sediment control measures) will minimise the risk of any off-site impacts which may occur in association with the proposed development.

- ***Disrupt the breeding cycle of a population***

The subject site is not considered to contain suitable breeding habitat for endangered or critically endangered species. Therefore, the proposed development is not considered to pose a risk to breeding cycles of populations of endangered or critically endangered species within the locality.

- ***Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

Whilst modification of potential habitat may occur as a result of the proposed development, this modification will occur on a small scale. Further, the habitat values within the zone of impact of the proposed works are considered limited due to the previous historical clearing. The development is therefore not predicted to result in a decline of endangered or critically endangered species within the region.

- ***Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat***

Weed seeds are carried onto and distributed by vehicles along road corridors. Construction machinery may also transport weed seeds onto and off-road works sites. Weed management strategies will be implemented on site to minimise the risk of weed establishment and proliferation as a result of construction activities on site. Examples of weed management strategies include adoption of proper hygiene procedures to minimise the potential for seed transport onto and off the work site.
Once the site is operational, the site will be regularly maintained to minimise the occurrence of weeds within the disturbance footprint of the site. The site is therefore not considered to increase the risk of establishment of invasive species.

- ***Introduce disease that may cause the species to decline, or***

The development relates to the construction of a solar farm and therefore does not involve introduction of disease vectors into the locality, the development is not considered to pose a disease risk to native species.

- ***Interfere substantially with the recovery of the species***

Ensuring the recovery of a species generally involves the protection and enhancement of existing populations and habitat, by preventing further clearing and modification of native vegetation communities and protecting water quality values.

The proposed development footprint is located on an area which consists of previously cleared and disturbed native and non-native groundcover. Given the small scale nature of the proposed works and the availability of similar and/or higher quality habitat with the area, the proposal is not considered to have the potential to cause significant impacts on existing flora and fauna populations or habitat.

Overall, the development is not considered to pose a risk to the recovery of vulnerable species within the region.

Listed Migratory Species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- ***Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for migratory species***

Important habitat for a migratory species is defined as habitat which is:

- Utilised by migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Of critical importance to the species at particular life cycle stages, and/or
- Utilised by a migratory species which is at the limit of the species range, and/or
- Within an area where the species is declining.

The definition of an ecologically significant proportion of a migratory species varies depending on the characteristics of each species. Factors which should be considered in determining an ecologically significant proportion include the species' population status, genetic distinctiveness and species-specific behavioural patterns (such as site fidelity and dispersal rates).

The subject site is heavily cleared and does not offer important habitat features for migratory species (such as suitable trees for roosting, or water-based habitats such as swamps or marshes for foraging). It is therefore unlikely that migratory species would utilise habitat available within the study area.

Whilst it is possible that migratory species could forage at the subject site whilst enroute during migration, this is considered to be unlikely.

Overall, the subject site is not considered to incorporate important habitat for migratory species. The development will therefore not negatively impact upon migratory species.

- ***Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or***

As outlined above, weed management strategies will be implemented prior to and upon completion of the proposed works to minimise the risk of weed establishment and proliferation as a result of soil disturbance and movements on site. Provided these measures are implemented in an appropriate manner, the proposed development is unlikely to result

in the establishment of an invasive species on the site. The proposed development will therefore not impact upon important habitat for migratory species, either directly or indirectly.

- ***Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species***

The proposal is not considered a risk to the lifecycle of the listed migratory species.

Assessment of Significance Conclusions

The proposed development site is not considered to constitute important habitat for identified species. Disturbance of such a small area is considered unlikely to have a significant impact on flora and fauna, given the presence of similar and/or higher quality vegetation within the area.

It is the conclusion of this assessment that there will be no significant long term impacts on any listed ecological community, threatened or migratory species of national environmental significance as a consequence of the proposed development, providing:

- No clearing of vegetation is carried out outside of the proposed development footprint, and the area of adjacent remnant vegetation consistent with PCT 510 is avoided;
- The construction and operation of the proposed solar farm are carried out in accordance with best management practices and relevant guidelines;
- Appropriate erosion and sediment controls are implemented during construction, to ensure that construction works occur in accordance with environmental best practice and that off-site impacts are minimised; and
- Environmental management measures, such as a weed management program and erosion and sediment control measures, are implemented throughout the project life cycle to minimise adverse impacts and to ensure that works are conducted in accordance with environmental best practice.