APPLICATION ON NOTIFICATION – CROWN DEVELOPMENT

Type of development:	SECTION 49 - Public Infrastructure
Development Number:	830/V001/18
Applicant:	Rise Renewables Pty Ltd
Nature of Development:	Baroota Pumped Hydro & Solar Project
Subject Land:	Various land holdings: Reservoir Road and Boundary Track, Baroota Reservoir, Baroota; and Cattle Track and Baroota Road, Baroota
Development Plan:	Mount Remarkable Council Development Plan
Zone / Policy Area:	Primary Production Zone, Rural Landscape Protection Zone & Water Protection Zone
Contact Officer:	Simon Neldner
Phone Number:	08 7109 7058
Consultation Start Date:	19 September 2018
Consultation Close Date:	19 October 2018

During the notification period, hard copies of the application documentation can be viewed at the Department of Planning, Transport and Infrastructure, Level 5, 50 Flinders St, Adelaide, during normal business hours. Application documentation may also be viewed during normal business hours at the local Council office (if identified on the public notice).

Written representations must be received by the close date (indicated above) and can either be posted, hand-delivered, faxed or emailed to the State Commission Assessment Panel (SCAP). A representation form is provided as part of this document.

Any representations received after the close date will not be considered.

Postal Address:
The Secretary
State Commission Assessment Panel
GPO Box 1815
ADELAIDE SA 5001

Street Address:
Development Division
Department of Planning, Transport and Infrastructure
Level 5, 50 Flinders Street
ADELAIDE

Email Address: scapreps@sa.gov.au

Government of South Australia

Department of Planning, Transport and Infrastructure

DEVELOPMENT ACT 1993

NOTICE OF APPLICATION FOR CONSENT TO DEVELOPMENT

SECTION 49 – PUBLIC INFRASTRUCTURE

Notice is hereby given that an application has been made by **Rise Renewables Pty Ltd** (sponsored as 'public infrastructure' by the Department of Energy and Mining under Section 49 of the *Development Act 1993*) for the Baroota Pumped Hydro & Solar Project. **Development Application No: 830/V001/18.**

The project will comprise: (a) a pumped hydro component to provide up to 270MW of grid connected power (storage up to 8hrs), consisting of an upper and lower storage connected by 1.2km water pipeline, including powerhouse building, switch yard / substation, ancillary equipment and civil/bulk earthworks; and (b) a solar farm component to provide up to 300MW of solar pv generation capacity (single axis tracking arrays), internal access tracks, operational facilities, inverters, substation and ancillary works. The development will be connected to a local 275kV transmission line.

The development site comprises land adjacent to Reservoir Road and Boundary Track, Baroota Reservoir, Baroota (pumped hydro: Section 263, HP330200: CL 6194/674; Section 214, HP330200: CR 5757/872; Section 201, HP330200: CR 5759/905); and Cattle Track and Baroota Road, Baroota (solar farm: Section 54N, HP330200: CT 5639/780; Section 54S, HP330200: CT 5673/709; Section 38, HP330200: CT 5673/710; Section 89, HP330200: CT 5673/710; Section 37W, HP330200: CT 5673/711; Section 106, HP330200: CT 5673/712).

A transmission line from the pumped hydro component will also traverse the following land: Section 225, HP330200: CL 6194/660; A91, FP170763: CT 5330/490; with an electrical reticulation and substation area situated on the following land: Section 88, HP330200: CT 5576/38; Allotment 297, DP38564: CT 5245/609).

The subject land is located within the Primary Production Zone, and Rural Landscape Protection Zone and Water Protection Zone of the Mount Remarkable Council Development Plan (Consolidated 5 September 2013).

The application may be examined during normal office hours at the office of the State Commission Assessment Panel (SCAP), Level 5, 50 Flinders Street, Adelaide, and the office of the District Council of Mount Remarkable, 3 - 5 Stuart Street, Melrose. Application documentation may also be viewed on the SCAP website: https://www.saplanningcommission.sa.gov.au/scap/public_notices

Any person or body who desires to do so may make representations concerning the application by notice in writing delivered to the Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide 5001 **NOT LATER THAN FRIDAY 19 OCTOBER 2018.** Submissions may also be made via email to scapreps@sa.gov.au

Each person or body making a representation should state the reason for the representation and whether that person or body wishes to be given the opportunity to appear before the SCAP to further explain the representation.

Submissions may be made available for public inspection.

Should you wish to discuss the application and the public notification procedure please contact **Simon Neldner** on **(08) 7109 7058** or simon.neldner@sa.gov.au.

Alison Gill
SECRETARY
STATE COMMISSION ASSESSMENT PANEL

PN3213

www.sa.gov.au

PN3213
30x2 (63mm)
Flinders News, Adelaide Advertiser -
19 September 2018
Port Pirie Recorder - 20 September 2018
APPROVAL REQUIRED BY COB THURS 13.09

DEVELOPMENT ACT, 1993
S49/S49A – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Rise Renewables Pty Ltd
Development Number:	830/V001/18
Nature of Development:	Baroota Pumped Hydro & Solar Project
Zone / Policy Area:	Primary Production Zone, Rural Landscape Protection Zone & Water Protection Zone
Subject Land:	Various labd holdings: Reservoir Road and Boundary Track, Baroota Reservoir, Baroota; and Cattle Track and Baroota Road, Baroota.
Contact Officer:	Simon Nelder
Phone Number:	08 7109 7058
Close Date:	19 October 2018

My Name: _____ My phone number: _____

Primary method(s) of contact: Email: _____

Postal Address: _____ Postcode: _____

_____

You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.

My interests are: *(please tick one)*

- ☐ owner of local property
- ☐ occupier of local property
- ☐ a representative of a company/other organisation affected by the proposal
- ☐ a private citizen

The address of the property affected is: _____

_____ Postcode _____

My interests are: *(please tick one)*

- ☐ I support the development
- ☐ I support the development with some concerns
- ☐ I oppose the development

The specific aspects of the application to which I make comment on are: _____

_____

_____

_____

_____

I: *(please tick one)*

- ☐ wish to be heard in support of my submission
- ☐ do not wish to be heard in support of my submission *(Please tick one)*

By: *(please tick one)*

- ☐ appearing personally
- ☐ being represented by the following person *(Please tick one)*

Signature: _____

Date: _____

Return Address: The Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 /or
Email: scapadmin@sa.gov.au

SECTION 49 & 49A – CROWN DEVELOPMENT
DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

COUNCIL: District Council of Mount Remarkable

APPLICANT: Rise Renewables Pty Ltd

ADDRESS: PO Box 2480, Bondi Junction NSW 1355

CROWN AGENCY: DEM

FOR OFFICE USE

DEVELOPMENT No: _____

PREVIOUS DEVELOPMENT No: _____

DATE RECEIVED: / /

CONTACT PERSON FOR FURTHER INFORMATION

Name: Brer Adams

Telephone: 0401 124 463 [work] _____ [Ah]

Fax: n/a [work] _____ [Ah]

Email: brer@riserenewables.com

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds $100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008.* Proposals over $4 million (excl. fit-out) will be subject to an advertising fee. (2) Three copies of the application should also be provided.

☐ Complying	Decision: _____
☐ Merit	Type: _____
☐ Public Notification	Finalised: / /
☐ Referrals	

	Decision required	Fees	Receipt No	Date
Planning:	_____	_____	_____	_____
Land Division:	_____	_____	_____	_____
Additional:	_____	_____	_____	_____
Minister's Approval				

EXISTING USE: Primary production/grazing

DESCRIPTION OF PROPOSED DEVELOPMENT: Pumped hydro (up to 270MW) and solar (up to 300 MW) project incorporating: reversible pump/turbine generators, penstock, powerhouse, switchyard, solar panels on tracker cables, inverter station, underground cabling and combiner boxes. A shared connection infrastructure to the existing 275 kV ElectraNet transmission line. Office and maintenance buildings.

LOCATION OF PROPOSED DEVELOPMENT: Approximately 40km north-east of Port Pirie

House No: _____ Lot No: 263 (full) Street: _____ Town/Suburb: Baroota

Section No [full/part] 201,204 (full) Hundred: Baroota Volume: 5330,5759, 5757 Folio: 490, 905, 872

Section No [full/part] 37W,38,89,54N,54S,88,106,297 (full) Hundred: Baroota Volume: 5673,5673,5673, 5639,5673,5576, 5673,5245 Folio: 711,710,710,780, 709,38,712,609

LAND DIVISION:

Site Area [m^2] 10,471,697 m^2 approx. Reserve Area [m^2] _____ No of existing allotments _____

Number of additional allotments [excluding road and reserve]: _____ Lease: **YES** ☒ **NO** ☐

DEVELOPMENT COST [do not include any fit-out costs]**:** $ 700,000,000 (combined)

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from sa.gov.au.

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993* and meet the requirements for lodgement under s.49 of the Development Act 1993.

SIGNATURE: _____ Dated: 31 / 07 /2018

DEVELOPMENT REGULATIONS 2008
Form of Declaration (Schedule 5 clause 2A)

Government of South Australia

To: Development Assessment Commission

From: Rise Renewables Pty Ltd
PO Box 2480
Bondi Junction NSW 1355

Date of Application: 31 / 07 / 2018

Location of Proposed Development: Baroota, 40km NE of Pt Pirie

House No: _____ Lot No: _____ Street: _____

Town/Suburb: Baroota

Section No (full/part): 201, 204 (Full) 37W,38,89,54N,54S, 88,106,297 (Full) Hundred: Baroota

Volume: 5330,5673, 5639,5576 Folio: 490,711,710,780,709,38,712

Nature of Proposed Development:

Baroota Pumped Hydro and Solar Project - Pumped Hydro Project (up to 270 MW) incorporating reversible pump/turbine generators, penstock, powerhouse and switchyard.
Solar Project (up to 300 MW) incorporating solar panels on tracker cables, inverter station, underground cabling and combiner boxes.
The Project will include access tracks, drainage works, car parking, fencing, buildings (eg. office facilites and maintenenace buildings).
The two projects will share combined connection infrastructure to the existing 275 kV ElectraNet Bungama to Davenport transmission line.

I Brer Adams **being the applicant for the development described above declare that the proposed development will involve the construction of a building which would, if constructed in accordance with the plans submitted, not be contrary to the regulations prescribed for the purposes of section 86 of the Electricity Act 1996. I make this declaration under clause 2A(1) of Schedule 5 of the Development Regulations 2008.**

Signed: _____ **Date:** 31 / 07 / 2018

Government of South Australia

Note 1

This declaration is only relevant to those development applications seeking authorisation for a form of development that involves the construction of a building (there is a definition of 'building' contained in section 4(1) of the Development Act 1993), other than where the development is limited to –

a) an internal alteration of a building; or
b) an alteration to the walls of a building but not so as to alter the shape of the building.

Note 2

The requirements of section 86 of the Electricity Act 1996 do not apply in relation to:

a) an aerial line and a fence, sign or notice that is less than 2.0 m in height and is not designed for a person to stand on; or
b) a service line installed specifically to supply electricity to the building or structure by the operator of the transmission or distribution network from which the electricity is being supplied.

Note 3

Section 86 of the Electricity Act 1996 refers to the erection of buildings in proximity to powerlines. The regulations under this Act prescribe minimum safe clearance distances that must be complied with.

Note 4

The majority of applications will not have any powerline issues, as normal residential setbacks often cause the building to comply with the prescribed powerline clearance distances. Buildings/renovations located far away from powerlines, for example towards the back of properties, will usually also comply.

Particular care needs to be taken where high voltage powerlines exist; or where the development:

- is on a major road;
- commercial/industrial in nature; or
- built to the property boundary.

Note 5

An information brochure: 'Building Safely Near Powerlines' has been prepared by the Technical Regulator to assist applicants and other interested persons.

This brochure is available from council and the Office of the Technical Regulator. The brochure and other relevant information can also be found at **sa.gov.au/energy/powerlinesafety**

Note 6

In cases where applicants have obtained a written approval from the Technical Regulator to build the development specified above in its current form within the prescribed clearance distances, the applicant is able to sign the form.

Government of South Australia
Department for Energy and Mining

B219998
DPC16/3528

GPO Box 320
Adelaide SA 5001
DX 541
Tel 08 8303 2298
www.energymining.sa.gov.au

6 July 2018

Mr Brer Adams
Director
Rise Renewables Pty Ltd
PO Box 2480
BONDI JUNCTION NSW 1355

Email: brer@riserenewables.com

Dear Mr Adams

CROWN SPONSORSHIP BAROOTA PUMPED HYDRO AND SOLAR PROJECT

Thank you for your letter of 24 May 2018 requesting Crown Sponsorship under section 49 of the *Development Act 1993* to assist with Rise Renewables Pty Ltd's (Rise) proposed Baroota Pumped Hydro and Solar Project (Project).

This Project has been considered within the South Australian Department for Energy and Mining (DEM) with input from the Department of Planning, Transport and Infrastructure, the Department of Environment and Water, the Environmental Protection Agency and the Technical Regulator. In principle, the Project is supported, recognising the possible environmental and community issues that will need to be addressed through the development assessment process.

On balance, the development of Rise's Project has the potential to benefit South Australia and can be considered public infrastructure. Accordingly I, as Chief Executive of the DEM, will support the development and specifically endorse the Development Application to construct the Project comprising up to 270 MW of pumped hydro energy storage (PHES) capacity and up to 300MW of solar PV capacity as a development of public infrastructure as required by section 49 of the *Development Act 1993* (the Act). My support under this Crown Sponsorship also extends separately to the individual PHES and solar components and remains valid in the event that Rise decide to proceed with one of these Project components without the other.

It is the responsibility of Rise to prepare all documentation as required by section 49 of the Act. All costs in the preparation of the development application, lodgement and any other subsequent action in relation to this application are the responsibility of Rise.

The DEM makes no representations or gives no warranties in relation to the outcome of the Development Application or time that it takes to secure a planning outcome. It is Rise's responsibility to obtain all other statutory approvals, licences, connection agreements and permits from relevant authorities, manage community expectations and to fund the project. The State Government makes no commitment to purchase any product or service related to the project.

A Development Application under this Crown sponsorship must be lodged with the State Planning Commission and is valid for 12 months from the date of this letter. If this is not achieved by that time, my support under Section 49(2)(c) of the *Development Act 1993* for Rise's Project will lapse.

If you have any questions regarding the preparation of the material to support this section 49 application, please contact Mr Mark Jackson on (08) 8429 2722 or via email: mark.jackson@sa.gov.au.

Yours sincerely

Dr Paul Heithersay
CHIEF EXECUTIVE

Simon Neldner

From: Agnes Cantin <acantin@jbsg.com.au>
Sent: 31 July, 2018 9:34 AM
To: DPTI:State Commission Assessment Panel
Subject: Submission - Rise Renewables Baroota Pumped Hydro and Solar Project- s49 Crown Development / Public Infrastructure
Attachments: Rise - Crown Sponsorship - Approved.pdf; Rise Renewables-Signed Electricity Act Declaration Form-signed.pdf; Rise Renewables-Crown Development Application Form-signed.pdf

Please find attached the development application for the Baroota Pumped Hydro and Solar Project, which we are submitting on behalf of Rise Renewables Pty Ltd.

The project has been sponsored under the Section 49 Crown Development and Public Infrastructure provisions of the Development Act by the Department of Energy and Mining (as per the attached letter, which is also included as an appendix to the Development Application Report). We have also recently provided a project briefing to DPTI staff including Rob Kleeman and Simon Neldner.

Attached are:

- A completed Crown Development Application Form
- A completed Electricity Act Declaration
- Crown Sponsorship letter from DEM

A support letter for the submission of the Report from the Department of Energy and Mining will be provided shortly.

The full Development Application report (including appendices) is too large to email, so we have uploaded it to this Sharepoint link:
https://jbsg-my.sharepoint.com/:f:/g/personal/nationaldrive_jbsg_com_au/EuDVGZRTK85OsaDj7HYWO_UBSB-vMu-UI7G1FiPgRNws6A?e=zqqZyI

Please let me know if you have any issues downloading it.

We will also lodge a hard copy at your offices, along with a USB containing the documents.

If you have any queries, please do not hesitate to contact either me, or Brer Adams (Managing Director of Rise Renewables) on 0401 124 463 or brer@riserenewables.com.

Regards,

Agnès Cantin

Agnès Cantin | Senior Environmental Consultant | JBS&G
Sydney | Melbourne | Adelaide | Perth | Brisbane | Canberra | Darwin | Wollongong
38 Dequetteville Terrace, Kent Town SA 5067
T: 08 8431 7113 | M: 0427 183 734| E: acantin@jbsg.com.au | W: www.jbsg.com.au
Contaminated Land | Groundwater Remediation | Environmental Approvals | Auditing and Compliance | Hygiene and Hazardous Materials | Due Diligence and Liability | Stakeholder and Risk Management

Rise Renewables

BAROOTA PUMPED HYDRO AND SOLAR PROJECT

Development Application

July 2018

Prepared by:

JBS&G Australia Pty Ltd
ABN 62 100 220 479

38 Dequetteville Terrace
Kent Town SA, 5067
T: +61 8 8431 7113
F: +61 8 8431 7115

www.jbsg.com.au

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Executive Summary

Rise Renewables Pty Ltd (Rise) proposes to develop a large-scale energy storage and renewable energy project, in the Mid-North region at Baroota. The Baroota Pumped Hydro and Solar Project (the Project) is located approximately 40 km from Port Pirie and 250 km north of Adelaide and located in the District Council of Mount Remarkable. The Project comprises two components, the Baroota Pumped Hydro Project (Pumped Hydro Project) and Bridle Track Solar Project (Solar Project), which could be developed separately or as an integrated facility. The Pumped Hydro Project will deliver approximately 2,000 MW hours of stored energy that can be dispatched as required for up to eight consecutive hours during peak demand. The Solar Project of the Project will generate up to 300 MW of electricity supplied either to the pumped hydro facility, or directly to the electricity network.

The Project will strengthen the State's electrical system and increase power supply during peak periods.

These benefits to system reliability and affordability will endure over the long-term given an asset life of at least 50 – 70 years.

The Pumped Hydro Project provides a new function for the existing Baroota Reservoir, which ceased to be part SA Water's active network in the 1990s. The Baroota Reservoir provides the lower reservoir, with the proposed upper reservoir to be constructed approximately 1 km to the east, topographically 240 m higher on the upgradient hills. The Solar Project site was identified as an appropriate location due to the high quality solar resource, highly suitable flat or slightly undulating topography, and opportunity to share a new electricity connection point.

Plate 0-1: Location of the proposed upper reservoir (Source: JBS&G)

Plate 0-2: Proposed Solar Project Site (Source: JBS&G)

The development of electricity infrastructure is essential to meeting the current and future electricity requirements of South Australia and achieving socio-economic sustainability of communities. The Project will be a significant opportunity for local employment and suppliers in an underutilised and experienced labour market.

Rise has undertaken a range of stakeholder engagement activities over the past two years and has received positive and supportive feedback for the Project. Rise has received support from the South Australian government through the Renewable Technology Fund and has gained sponsorship for this Application from the Department of the Premier and Cabinet (DPC). Rise will continue its stakeholder engagement through ongoing meaningful consultation with the landowners, the regional community and other key stakeholders. An ongoing program of engagement in close consultation with the Council throughout construction and operation of the Project will be maintained, should the Project receive final approval.

The proposed development constitutes a renewable energy facility of a similar nature to land uses envisaged within the Primary Production and Rural Landscape Protection Zones (Solar site) and Water Protection Zone

(Pumped Hydro site) of the Development Plan. It is considered that the Project exhibits sustainable planning merit and is consistent with the intention for the locality outlined in the Development Plan. In particular:

- It represents establishment of a renewable energy facility, as supported and envisaged by National and State strategic policy as well as the Mount Remarkable Development Plan.
- The location of the Pumped Hydro Project is ideally sited to maximise the topographic characteristics of the hills area.
- The location of the Solar Project site is highly suited for the efficient generation of renewable energy.
- The native vegetation on the site is degraded and no flora or fauna species or communities of conservation significance will be significantly impacted.
- Aboriginal cultural heritage surveys have been undertaken and have informed concept design.
- Construction and operation of the Project will not result in significant air or noise emissions and there will be negligible impact on receptors (which are at a significant distance from the site).
- Impacts associated with visual amenity are not expected to be significant as the site's topography, separation distances and vegetation significantly limit views of the site from any key receptors.
- Traffic volumes will be within the capacity of heavy vehicle routes. A Traffic Management Plan will be developed to address and manage potential impacts in close consultation with the appropriate authorities and local community.
- Based on the environmental risk assessment, no potential impacts have been identified that would preclude development of the Baroota Pumped Hydro and Solar Project.

The Project aligns with the State's strategic priorities including the development of electricity infrastructure to meet the current and future electricity requirements of South Australia. The Project will deliver improved grid stability with additional energy storage of up to 2,000 MW hours and increase supply of electricity during peak periods. The Project provides an important opportunity to improve the security of the State's power system, provide direct economic benefits to the regional economy and develop a world-leading renewable energy generation and storage facility, with only minor and manageable predicted impacts. Consequently, the proposed development is not at significant variance with the overall intent of the Mount Remarkable Development Plan and merits Development Approval.

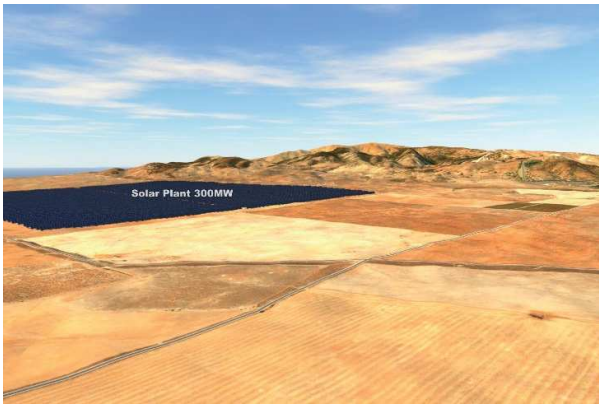

Plate 0-3: Indication of view of Solar Project, looking north-east (Source: SNC-Lavalin)

Plate 0-4: Indication of view of upper reservoir, looking east (Source: SNC-Lavalin)

1. Introduction

1.1. Background to the Baroota Pumped Hydro and Solar Project

Rise Renewables Pty Ltd (Rise) proposes to develop a large scale combined pumped hydro and solar project (Project) within the District Council of Mount Remarkable (Council) area of South Australia, at a site located approximately 12 km north-east of Port Germein (Figure 1-1 and Figure 1-2). For the purpose of this Development Application, the overall Project will be discussed as two elements, namely the Baroota pumped hydro electrical storage project (herein referred to as the Pumped Hydro Project), and the Bridle Track Solar Project (herein referred to as the Solar Project).

The Pumped Hydro Project includes the construction of an upper reservoir approximately 1 km upstream from the lower and existing SA Water Baroota Reservoir. The associated powerhouse and other infrastructure will result in a generating capacity of up to 270 MW for a continuous 8-hour period. The Solar Project will comprise the construction and operation of up to 300 MW photo-voltaic (PV) solar farm which will be located on approximately 680 ha of freehold land. Both projects are located adjacent to an existing 275 kV ElectraNet transmission line. The electricity generated by the Solar Project will be supplied either to the Pumped Hydro Project or directly to the electricity network.

1.2. The Development Application Process

This Development Application Report has been prepared for submission to the State Commission Assessment Panel (SCAP), and relevant referral bodies. The application has been prepared in accordance with the public infrastructure provisions of Section 49 of the *Development Act 1993* (SA) (Development Act) for the approval of the construction and operation of the proposed Project and ancillary infrastructure, together with the guidance provided in the *Guide to the Assessment of Crown Development and Public Infrastructure* (Planning SA 2002).

1.3. Details of the Application

The details of the proponent for this Development Application are summarised in Table 1-1.

Table 1-1: Applicant's details

Applicant:	Rise Renewables Pty Ltd
Contact:	Brer Adams
Address:	PO Box 2480 Bondi Junction NSW 1355
Phone:	0401 124 463
Email:	brer@riserenewables.com
ABN:	53 621 541 348

1.3.1. About Rise Renewables

Rise was established in 2017 by experts in renewable infrastructure development with experience in electricity markets and project development in Australia and internationally. As the Project raises finance for construction the proponent will require the ability to transfer approval of this application to a nominee entity for the purposes of implementing the Project.

Rise has appointed SNC-Lavalin as technical partner under an Early Contractor Involvement model.

1.4. Purpose of this Report

The purpose of this report is to present all relevant information on the Project for the SCAP to assess the Development Application under Section 49 of the Development Act and for the assessment manager, referral agencies and other stakeholders to assess potential impacts of the development and their management.

The assessment contained in this report covers the construction, operation and decommissioning phases of the Project. It also addresses direct and indirect impacts on the environment and community.

1.5. Structure of this Report

The structure and content of this Development Application is shown in Table 1-2.

Table 1-2: Report structure

Chapter	Contents
Development Application Report	
Chapter 1: Introduction	Contextual chapters that provide background to the Project and outline stakeholder engagement.
Chapter 2: Project Description	
Chapter 3: Project Rationale and Benefits	
Chapter 4: Legislative Framework	
Chapter 5: Stakeholder Engagement	
Chapter 6: Physical Environment Assessment	Describes the characteristics of the Project area and presents the predicted impacts from the Project and proposed mitigations.
Chapter 7: Biological Environment Assessment	
Chapter 8: Socio-Economic Environment Assessment	
Chapter 9: Environment, Health and Safety Management	
Chapter 10: References	Lists the sources of information used.
Chapter 11: Glossary	Lists the definitions of terms and abbreviations
Development Application Report	
Appendix A: Certificate of Title	Presents the certificate of title for the land secured for the proposed Project.
Appendix B: Surface Water Assessment	Presents the technical details of assessments carried out by the specialists for the proposed Project.
Appendix C: Ecology	
Appendix D: Noise	
Appendix E: Visual Impact Assessment	
Appendix F: Traffic	
Appendix G: Development Plan Assessment	Presents an assessment of the Project against the objectives and principles set out in the Mount Remarkable Development Plan.
Appendix H: Section 49 Endorsement	Provides a copy of the letter of support and endorsement by the Department of the Premier and Cabinet under Section 49 of the Development Act.
Appendix I: Certificate from the Technical Regulator	Provides a copy of the certification that the development complies with the Technical Regulator's requirements in relation to the security and stability of the State's power system.
Appendix J: Letters of Support	Provides copies of letters of support for the Project.

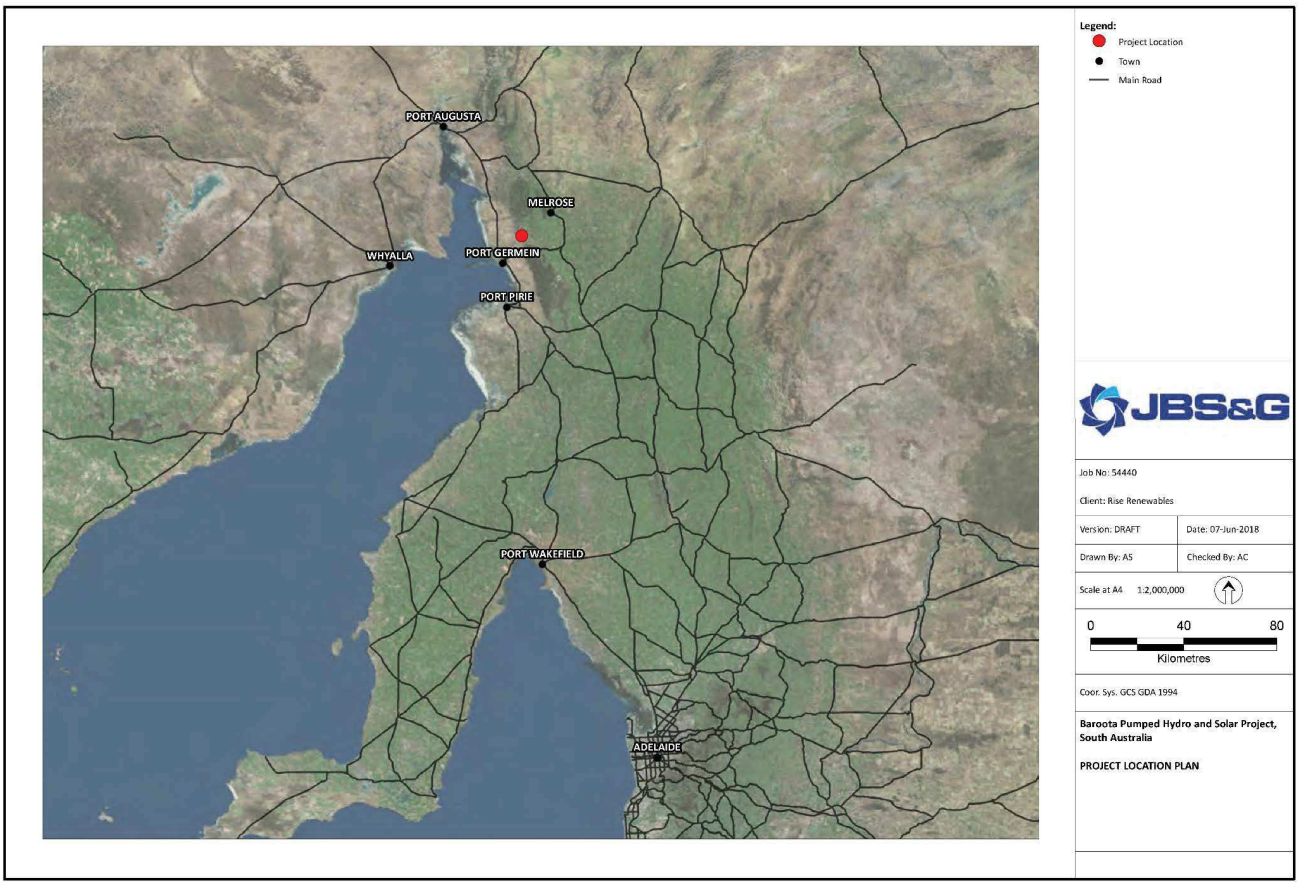

Figure 1-1: Regional map showing the location of the Project site

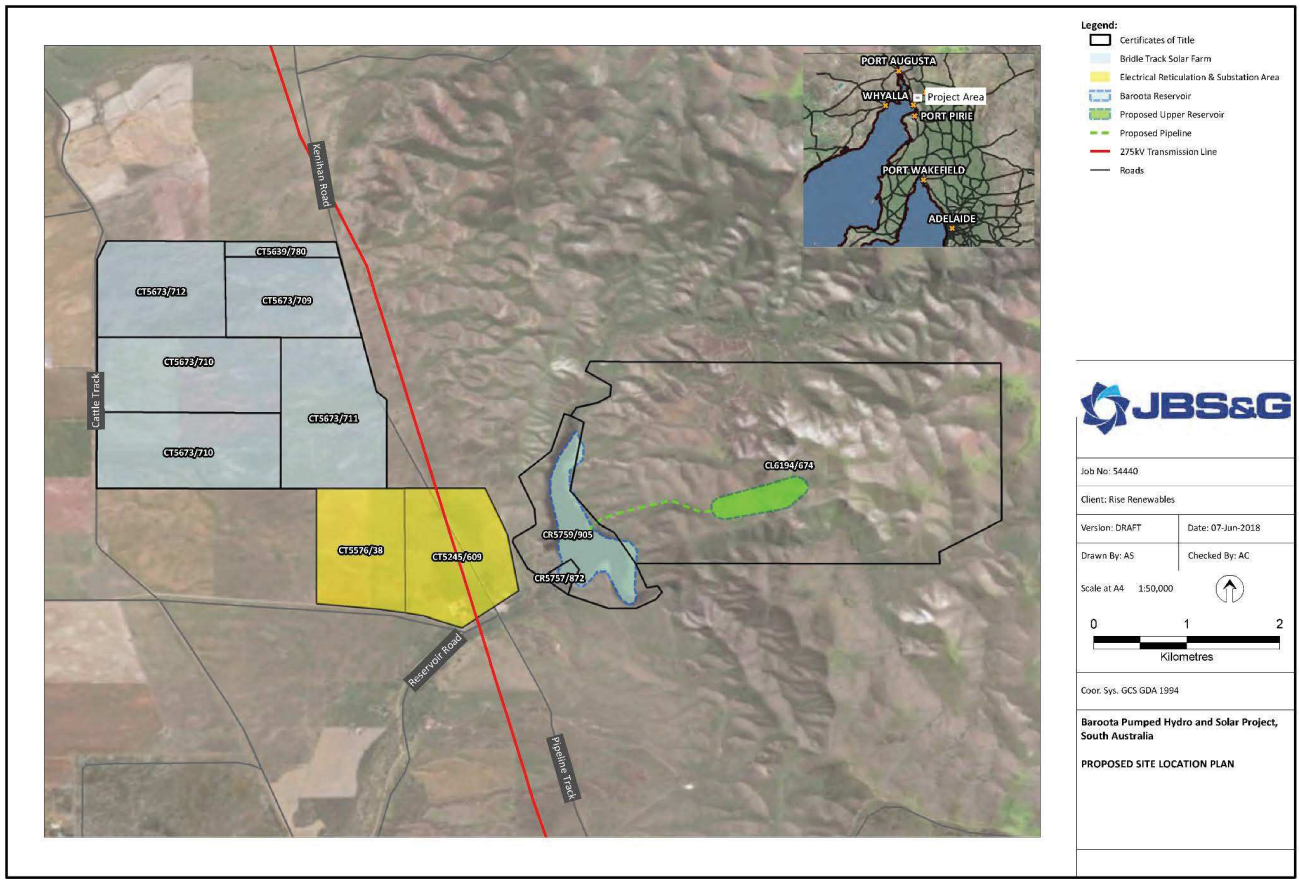

Figure 1-2: Location of the proposed Pumped Hydro Project and Solar Project

2. Project Description

2.1. Introduction

This chapter provides separate descriptions for the Pumped Hydro Project and Solar Project (together forming the Project), associated phases and activities, and ancillary infrastructure. The information provided in this section is based on preliminary Project designs which will be refined during the detailed design phase.

The Project will construct a significant fresh water pumped hydro storage system utilising the existing Baroota Reservoir to deliver up to 270 MW of installed capacity for up to eight continuous hours. Energisation is expected in first half of 2021 and the project has a design life of at least 50 years. The Solar Project will have up to 300 MW installed capacity, with a design life of 25 years, and will supply power to the Pumped Hydro Project or direct to the electricity network (or a combination of both). The Project will connect to the existing ElectraNet 275 kV line. Each aspect of the Project has been designed to be developed either separately or jointly.

The Project is located on both freehold land and leasehold land as outlined below.

2.2. Pumped Hydro Project

2.2.1. Project Overview

The Pumped Hydro Project will provide 200 to 270 MW of grid connected electrical storage for up to eight hours (i.e. 1,600 – 2,400 MWh), consisting of an upper and lower reservoir connected by 1.2 km water conveyance pipeline (penstock), as well as a powerhouse building specifically designed to house the pumps, turbines, generators, transformers, inverters and ancillary equipment. The turbines will connect to inverters, a switchyard and a combined substation, which will feed the electricity to ElectraNet's existing 275 kV line between Davenport and Bungama.

The Pumped Hydro Project will act as a reversible pumped hydroelectricity energy storage (PHES) system whereby water is pumped from the lower reservoir to the upper reservoir during non-peak electricity usage times (i.e. during the middle of the night) and released from the upper reservoir to the lower reservoir, via the powerhouse, during peak demand periods (i.e. during morning and evening). The elevation difference between the two reservoirs of 240 m, referred to as the head height, creates the necessary velocity to drive the turbines for electricity generation.

The Pumped Hydro Project will include:

- Civil / earthworks for the upper reservoir (saddle dams) and concrete intake / headrace[1] infrastructure;
- Civil / earthworks for the lower reservoir intake / tailrace[2] infrastructure;
- Civil / earthworks including internal access roads and security fencing;
- Civil / earthworks for the powerhouse, switchyard and combined substation;
- Civil / earthworks for penstock;
- Two 100-135 MW reversible turbine-pumps;
- Operational facilities including a site office, maintenance building with on-site sewage management system, parking area, material laydown area, undercover storage area and waste storage area;
- Switchyard and substation – A switchyard/substation adjacent the powerhouse, with electrical connection to the combined switchyard/substation, located adjacent to the existing ElectraNet infrastructure;
- National Energy Market (NEM) compliant metering arrangements for all energy exported into the grid as well as internal metering to measure turbine output; and

[1] The 'headrace' may act at the 'tailrace' in the context of pumping water from the lower reservoir to the upper reservoir. For the purpose of this DA, the 'headrace' refers to the section of conveyance pipe connecting the upper reservoir intake structure to the penstock.
[2] The 'tailrace' may act at the 'headrace in the context of pumping water from the lower reservoir to the upper reservoir. For the purpose of this DA, the 'tailrace' refers to the section of conveyance piping connecting the lower reservoir intake structure to the powerhouse.

- Connection into the existing Bungama to Davenport 275 kV line running to the west of the lower reservoir, the final design of which, is being developed in conjunction with ElectraNet.

Figure 2-1 shows a preliminary site layout which is indicative of the likely layout of infrastructure on the site, and on which impact assessments and the information presented in this Development Application has been based. Refinement of the layout and other PHES Project details will be ongoing throughout the planning and detailed design phases. However, the upper reservoir will remain generally in the alignment shown, based on the topographical elevation requirements needed to maximise the energy generation potential. The location of the penstock is expected to be the area shown in Figure 2-2 and final layout will be decided pending detailed geological investigations. Impact assessments related to potential changes to elements of the layout of the Pumped Hydro Project will be undertaken, if required.

The total development footprint of the upper reservoir is expected to be approximately 40 ha. This will be refined during detailed design when the final location of the penstock, site infrastructure and access tracks will be determined. The final design will be balanced to minimise environmental impact and ensure optimum design efficiency.

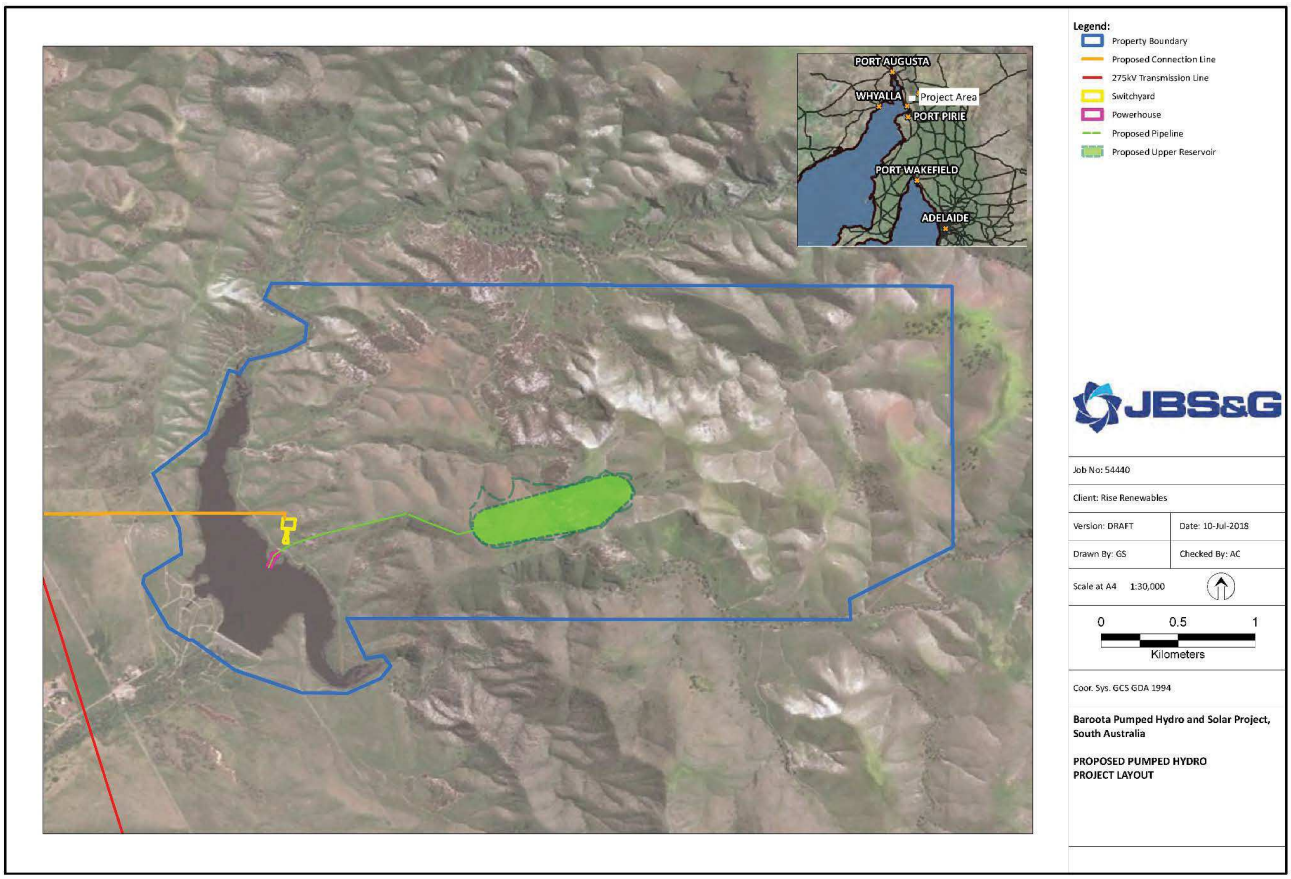

Figure 2-1: Preliminary Pumped Hydro Project site layout

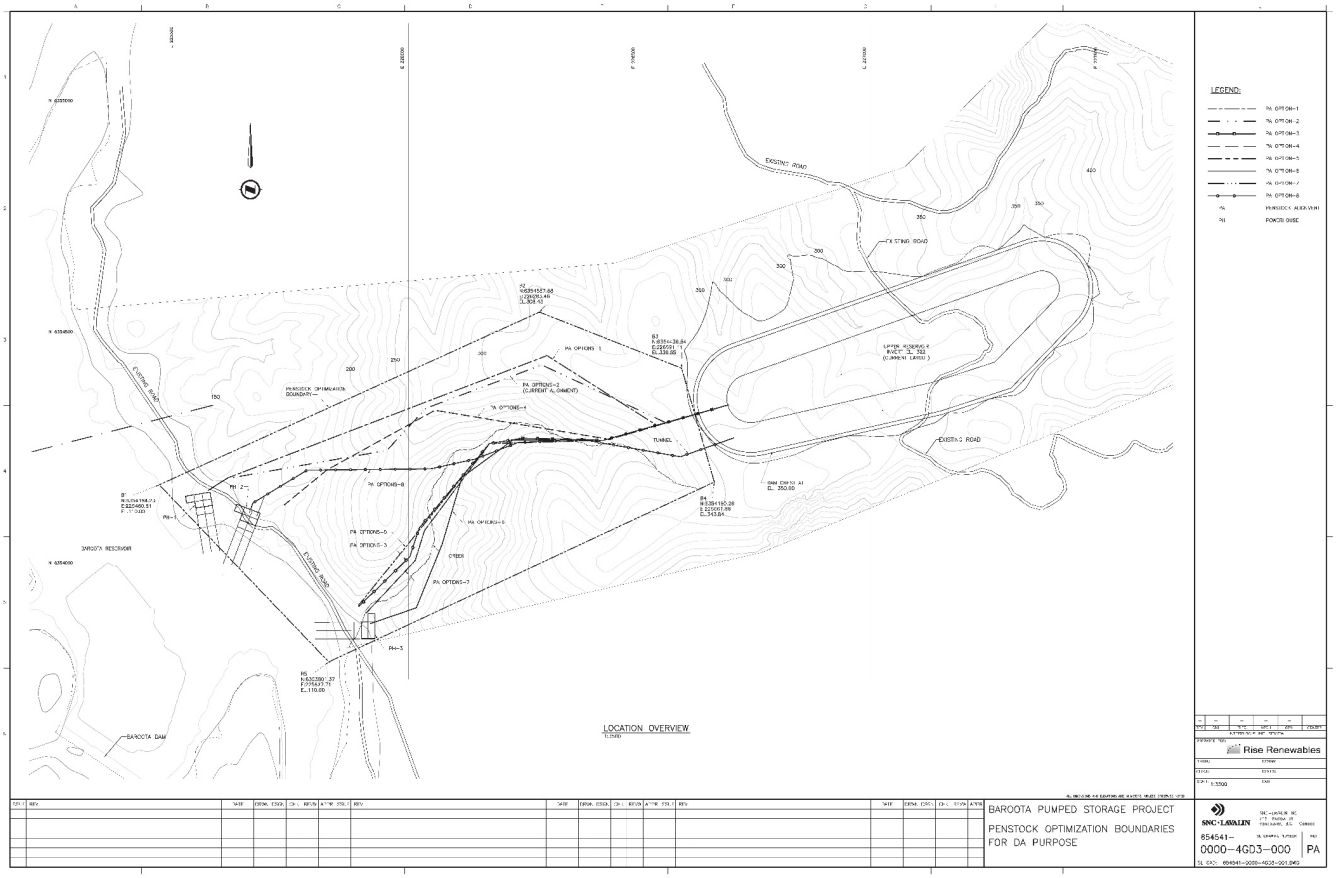

Figure 2-2: Current penstock alignment and broader area for other potential alignment options

2.2.2. Project Site

The Pumped Hydro Project site is located on land held by the Wongi-Ahrah Aboriginal Association Inc. and SA Water, approximately 40 km north-east of Port Pirie. The site includes the existing Baroota Reservoir (SA Water); the escarpment and upper plateau to the east which forms the western boundary of the Southern Flinders Ranges (Wongi-Ahrah); as well as freehold land to the north-west of the Baroota Reservoir where the combined substation will be located. A summary of the property details is provided in Table 2-1. Rise will lease the land from SA Water under a 50-year lease which will cover the majority of Section 201, and Section 214 will be subject to a long-term access licence, in the Hundred of Baroota. The Wongi-Ahrah lease covers Section 263, in the Hundred of Baroota.

Table 2-1: Pumped Hydro Project site property details

Property Description	Certificate of Title	Ownership Details
Section 263, Hundred of Baroota	Volume 5330 Folio 490	Wongi-Ahrah Aboriginal Association Inc.
Sections 201, Hundred of Baroota	Volume 5759 Folio 905	SA Water Corporation
Sections 214, Hundred of Baroota	Volume 5757 Folio 872	SA Water Corporation

The Pumped Hydro Project has three main areas, being the upper and lower reservoirs and the powerhouse/switchyard, and will share a combined substation with the Solar Project.

The lower reservoir is owned by SA Water and occupies a total area of approximately 63 ha. The upper reservoir will be located approximately 1 km to the east of the existing reservoir, utilising a naturally occurring topographic 'bowl'. The upper reservoir will have a footprint of approximately 40 ha located on Wongi-Ahrah land.

The powerhouse is proposed for the approximate mid-point along the eastern boundary of the lower reservoir on SA Water owned land. The penstock runs between the lower and upper reservoir, traversing both SA Water owned land adjacent the lower reservoir, as well as Wongi-Ahrah land to the east of the powerhouse to the upper reservoir. A switch yard is connected to the powerhouse, located immediately to the north of the building on SA Water land. The switchyard connects directly to the combined substation located to the south-east of the Solar Project, west of Kenihan Road.

The proposed Pumped Hydro Project site is shown in Figure 2-3.

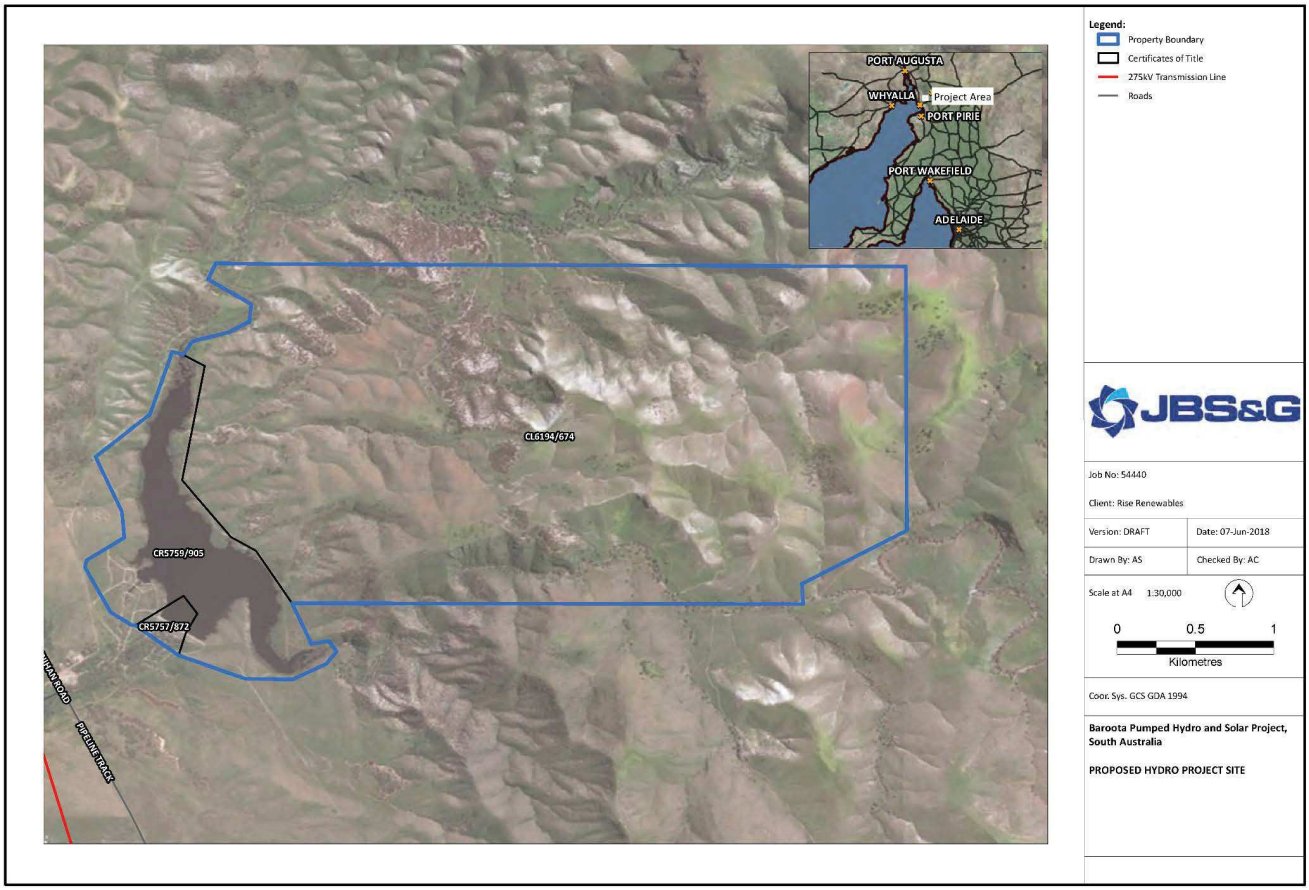

Figure 2-3: Proposed Pumped Hydro Project site

The Baroota Reservoir ceased to provide potable water to SA Water's network in the late 1990s and remains inactive, with the exception of supplying a local farmer with minor volumes of water for agricultural use and being maintained as stand-by water storage for emergency provisions (i.e. firefighting use). The upper reservoir area is relatively degraded with generally sparse native vegetation cover. Multiple access roads are present around the reservoir and fenced compound of the lower reservoir, with access from the Kenihan Road and Pipeline Track intersection at the western (and only) site entry, as well as on Wongi-Ahrah land within the location of the proposed penstock and upper reservoir.

ElectraNet's Bungama to Davenport 275 kV overhead transmission line runs north to south to the west of Kenihan Road, south-east of the Solar Project. Overhead lines will connect the switchyard to the shared substation, which will join the transmission line.

Plate 2-1, Plate 2-2 and Plate 2-3 show typical views of the lower reservoir.

Plate 2-4, Plate 2-5 and Plate 2-6 show typical views of the upper reservoir.

Plate 2-1: View of the lower reservoir from existing viewing platform, looking north-east (Source: Rise Renewables)

Plate 2-2: View of the lower reservoir from existing viewing platform, looking east, showing the proposed location of the powerhouse (Source: Rise Renewables)

Plate 2-3: View of the lower reservoir from the access track, looking south-east, showing the proposed location of the powerhouse (middle) (Source: Rise Renewables)

Plate 2-4: View of the upper reservoir from the location of the proposed dam wall, looking north-east (Source: JBS&G)

Plate 2-5: View of the upper reservoir from the top of the north-eastern extent of the proposed reservoir, looking south-west towards the location of the proposed dam wall and intake structure (Source: JBS&G)

Plate 2-6: View of the upper reservoir looking north from the northern extent of the proposed dam wall (Source: JBS&G)

2.2.3. Key Infrastructure Components

Site configuration for the upper reservoir, penstock, powerhouse and associated infrastructure has been outlined in the concept designs below. All dimensions provided in this section are therefore preliminary and may vary depending on the final design and site configuration.

2.2.3.1. Lower Reservoir

The lower reservoir has an existing capacity of 6.14 million cubic metres (Mm^3) and covers an area of approximately 63 ha. The dam comprises shoulders of earth fill with a central puddle clay core. The embankment and its appurtenant works were constructed between 1916 and 1921 to supply water to Port Pirie and to serve as an irrigation source for downstream areas. The embankment is approximately 30.5 m high, approximately 300 m long, with a 6 m wide crest. The nominal water level of the lower reservoir is 108 m above sea level, while the crest level of the embankment reported to be 120 m Australian Height Datum (AHD).

An intake structure will be constructed on the eastern central portion of the lower reservoir, connecting the tailrace pipes and the powerhouse (described further below). The tailrace will be installed on the base of the lower reservoir, with an installed depth below the average nominal water level (final depth to be determined during detailed design). The tailrace will be installed with a combined filter sock and trash rack to prevent the ingress of sediment and gross pollutants, if present, from entering the powerhouse. The intake structure will consist of a concrete headwall, installed into the existing walls of the reservoir. Any potential impacts to the lower reservoir, especially in regard to water retention and maintenance, will be assessed during final design. Subject to further detailed bathymetric studies, potential works to reduce silting and / or improve basin integrity may include application of a liner.

2.2.3.2. Upper Reservoir and Intake

The upper reservoir will be constructed on the plateau above the lower reservoir to the east, using the natural topography, where possible, to minimise earthmoving and blasting requirements (Figure 2-4). The reservoir will be approximately 800 m long and with a maximum depth of approximately 40 m. The reservoir will consist of the main embankment earth fill dam, or saddle dams, giving a 20 m operating range and an overall water storage capacity of approximately 4 Mm^3, subject to the final location of the intake structures to be determined during detailed design (Figure 2-5).

Based on the local geology and field observations, blasting will be required for most of the excavation. Any requirement for a waterproof liner at the invert of the upper reservoir will be defined after geotechnical investigations have been completed. If permeability of the local geology is not sufficient, a high-density polyethylene (HDPE) liner (or suitable equivalent) will be installed where appropriate. This will be determined during detailed design. The top of the embankment will be approximately 350 m AHD with an average operating water level at 340 m AHD, equating to a nominal operating head between the upper and lower reservoir of 240 m.

A 50 m concrete intake with connecting bridge, gates and trash-racks will be constructed at the western extent of the upper reservoir, within the centre of the main dam wall. The requirement for stop logs at the intake will be confirmed during the detailed design phase. The diameter of the intake shaft will be 4 – 5 m, connecting directly to the headrace tunnel for a length of 10 m, prior to connecting to the penstock at approximately 300 m AHD (i.e. 10 m below the foundation level of the reservoir). The headrace will be steel lined and grouted into the foundation at the connection point.

The upper reservoir will be designed to meet requirements of relevant Australian Standards (AS/NZS 1170 Structural Design Actions) and requirements of Australian National Committee on Large Dams (ANCOLD).

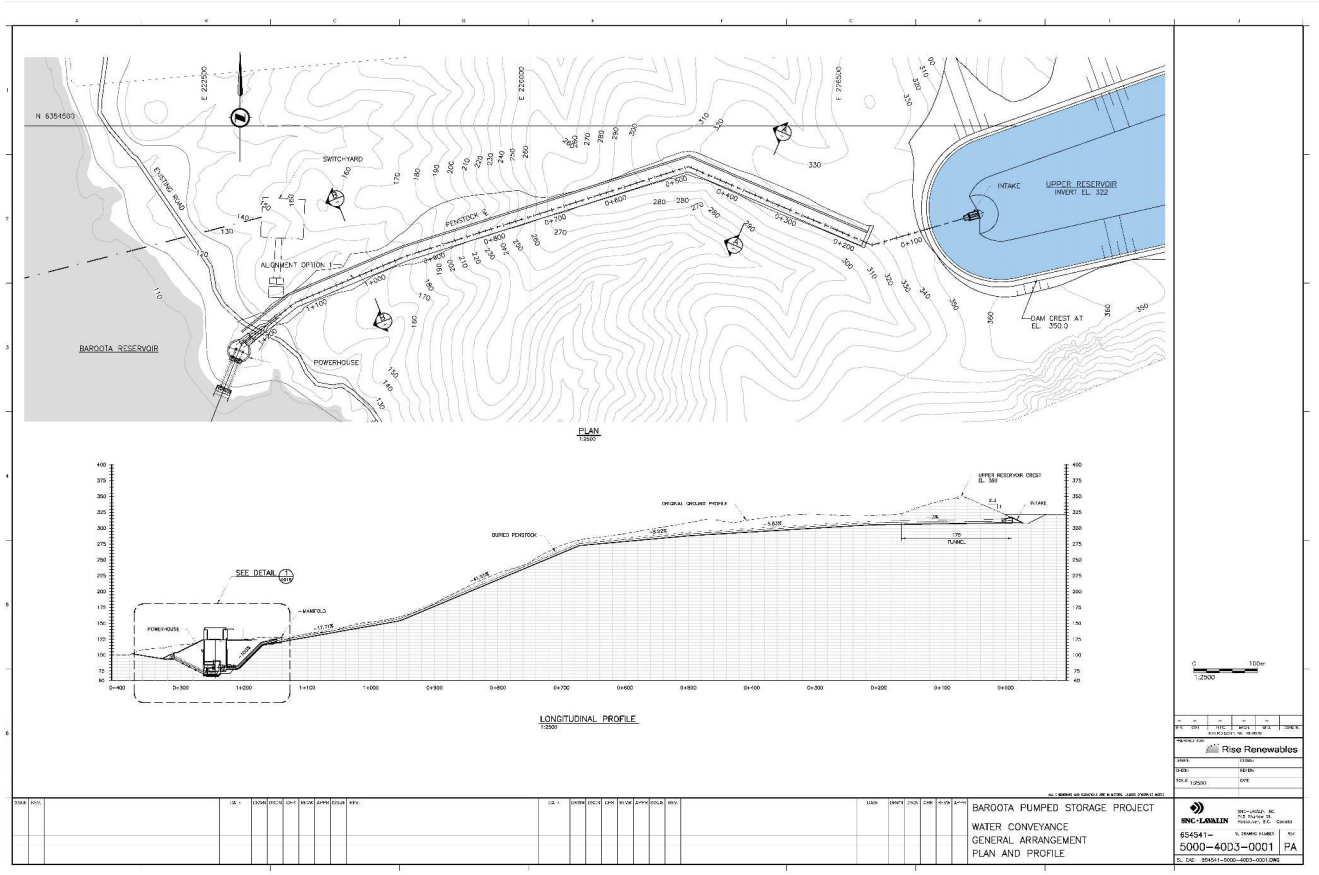

Figure 2-4: Profile view of the upper reservoir, penstock and powerhouse

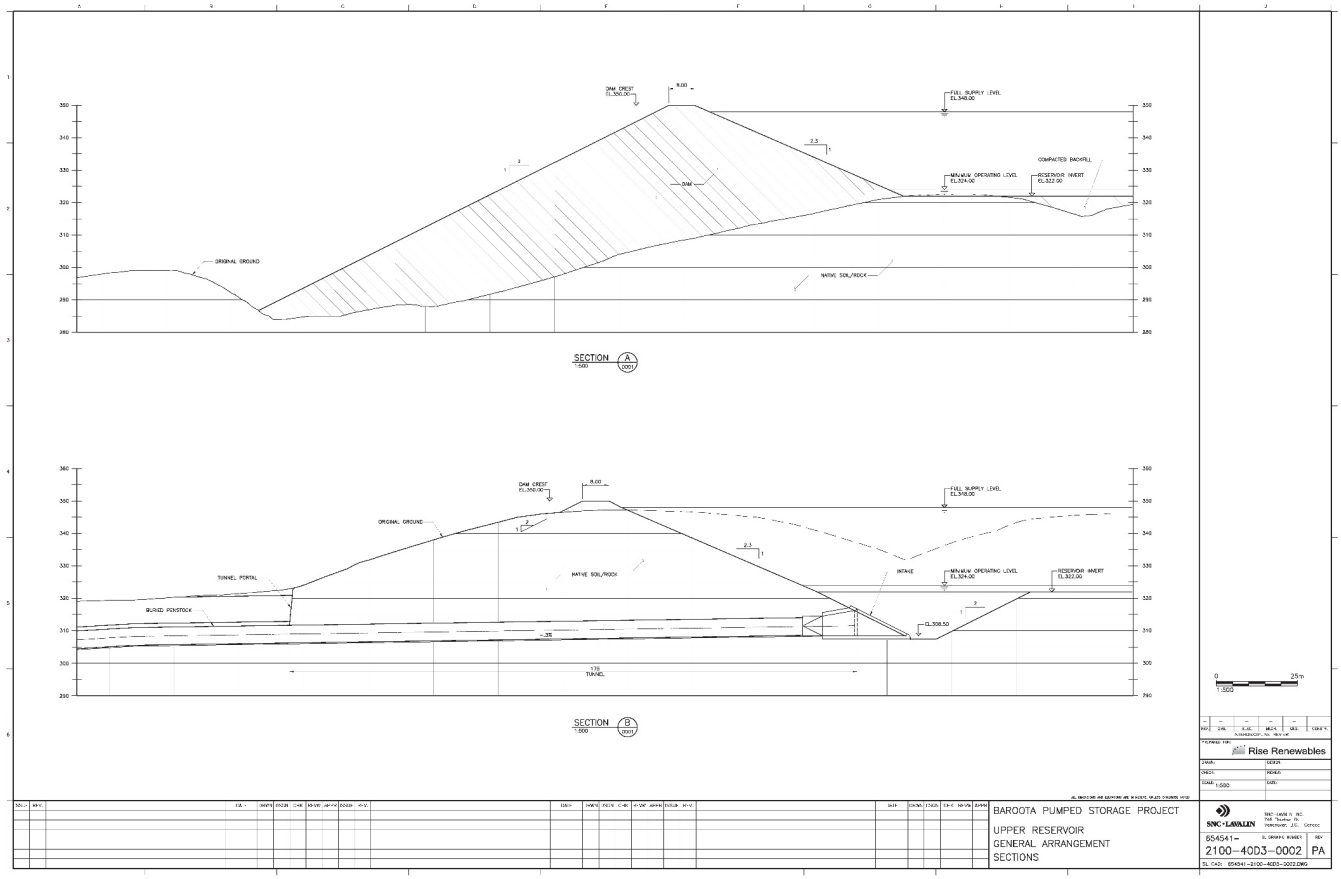

Figure 2-5: Cross-section view of upper reservoir

2.2.3.3. Conveyance Pipeline (Penstock)

Water will be conveyed between the upper and lower reservoirs, by approximately 1,200 m of above-ground penstock and, where required, tunnelled piping (Figure 2-6). The preference is for all conveyance piping to be shallow buried. The requirement for tunnelling will be determined during detailed design.

Water will be conveyed from the upper reservoir via the concrete intake structure, via a short headrace pipe (approximately 10 m) which connects directly to the penstock.

The penstock trench (and tunnel where required) will be shotcrete lined and up to 6 – 8 m in diameter (to be confirmed during final design). The penstock will consist of a single 5 – 6 m diameter steel and concrete lined pipe, with limited turns to reduce friction losses. The pipe will be buried with a maximum depth of approximately 20 m. The penstock will connect directly to the powerhouse through concrete bifurcated pipes, connected to the internal conveyance pipes within the powerhouse, and ultimately, to each of the turbine pumps.

Plate 2-7 to Plate 2-9 provide examples of similar methods for the installation of a penstock which will be used for the Project.

The powerhouse will be connected to the lower reservoir via a 100 m tailrace pipe, approximately 5 m in diameter. The tailrace pipes will be concreted into an intake structure complete with trash racks and sediment socks (as discussed above).

Plate 2-7: Example of a penstock installation (Source: SNC-Lavalin)

Plate 2-8: Example of methods used to bury penstock (Source: SNC-Lavalin)

Plate 2-9: Example of reclaiming the surrounding land after penstock installation (Source: SNC-Lavalin)

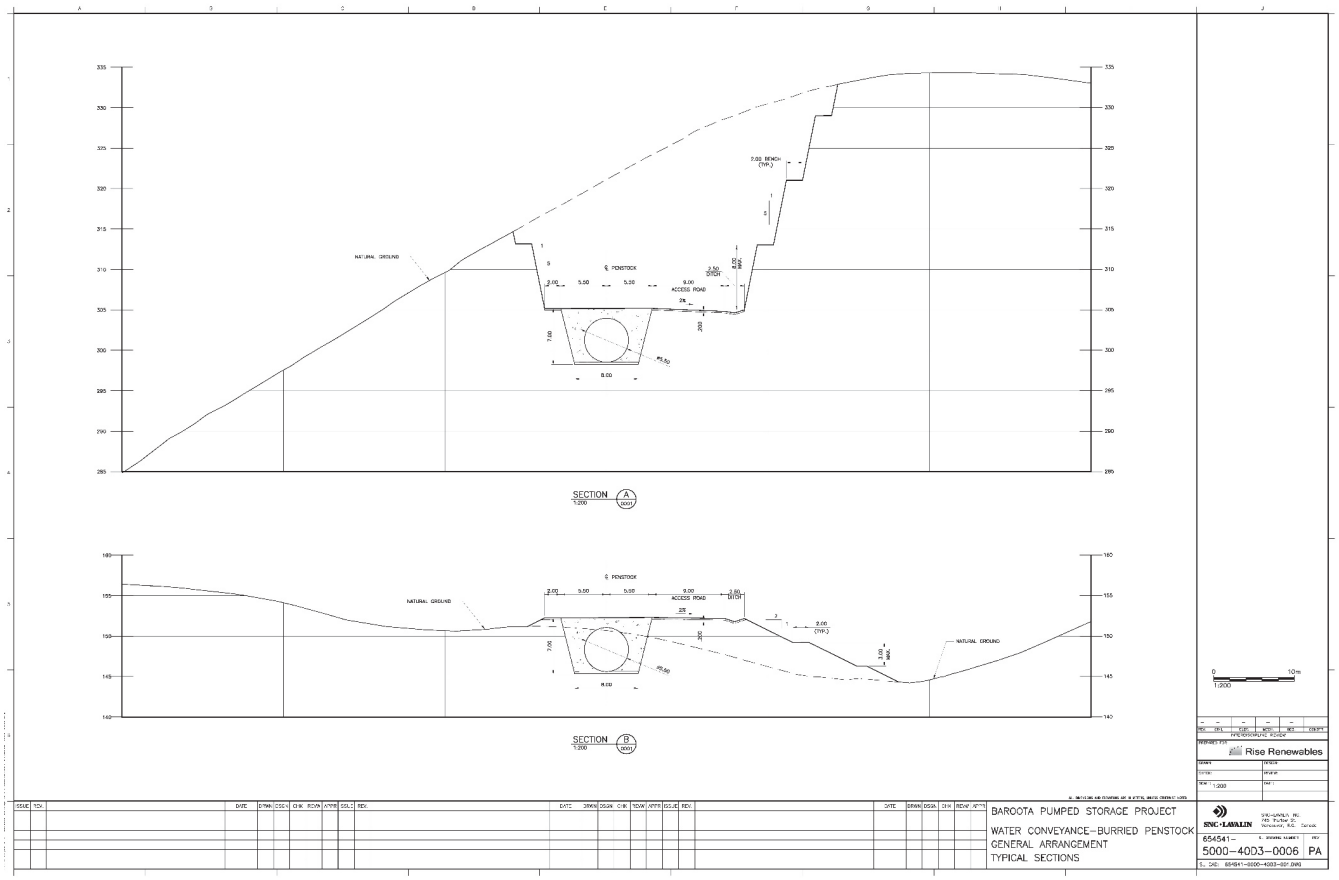

Figure 2-6: General arrangement and cross-section view of the buried penstock

2.2.3.4. Powerhouse

The powerhouse shaft and building will be located on the central eastern edge of the lower reservoir, connected to the upper reservoir by the penstock and to the lower reservoir by the tailrace pipe. The powerhouse building will be a concreted building approximately 60 m by 60 m, with a shaft radius of approximately 30 – 40 m, excavated to approximately 60 m below ground level (Figure 2-7). The powerhouse building will likely extend from the excavated pit approximately 5 m above the exiting ground level and be completed with ColourBond corrugated iron roof cladding, or similar.

The powerhouse will contain two 100 – 135 MW reversible turbine pumps, connected to two vertical shaft generators. The reversible turbine pumps will be connected (via internal piping) to the penstock and tailrace pipes on the upgradient and downgradient sides respectively.

The powerhouse building will house a control room and combined switchboards and include ancillary equipment such as heating, ventilation, air conditioning (HVAC); a bridge/gantry crane to assist in servicing internal equipment including the turbines; a lift and stair access; a station for equipment maintenance; and the balance of plant equipment. The building will also include office space and site amenities for workers during operation. Rainwater from the building will either be captured for re-use in site amenities or directed straight into the reservoir.

As required, a perimeter dewatering system will be installed to reduce hydrostatic pressure from regional groundwater on the powerhouse shaft.

Revenue metering will be provided to meet NEM requirements.

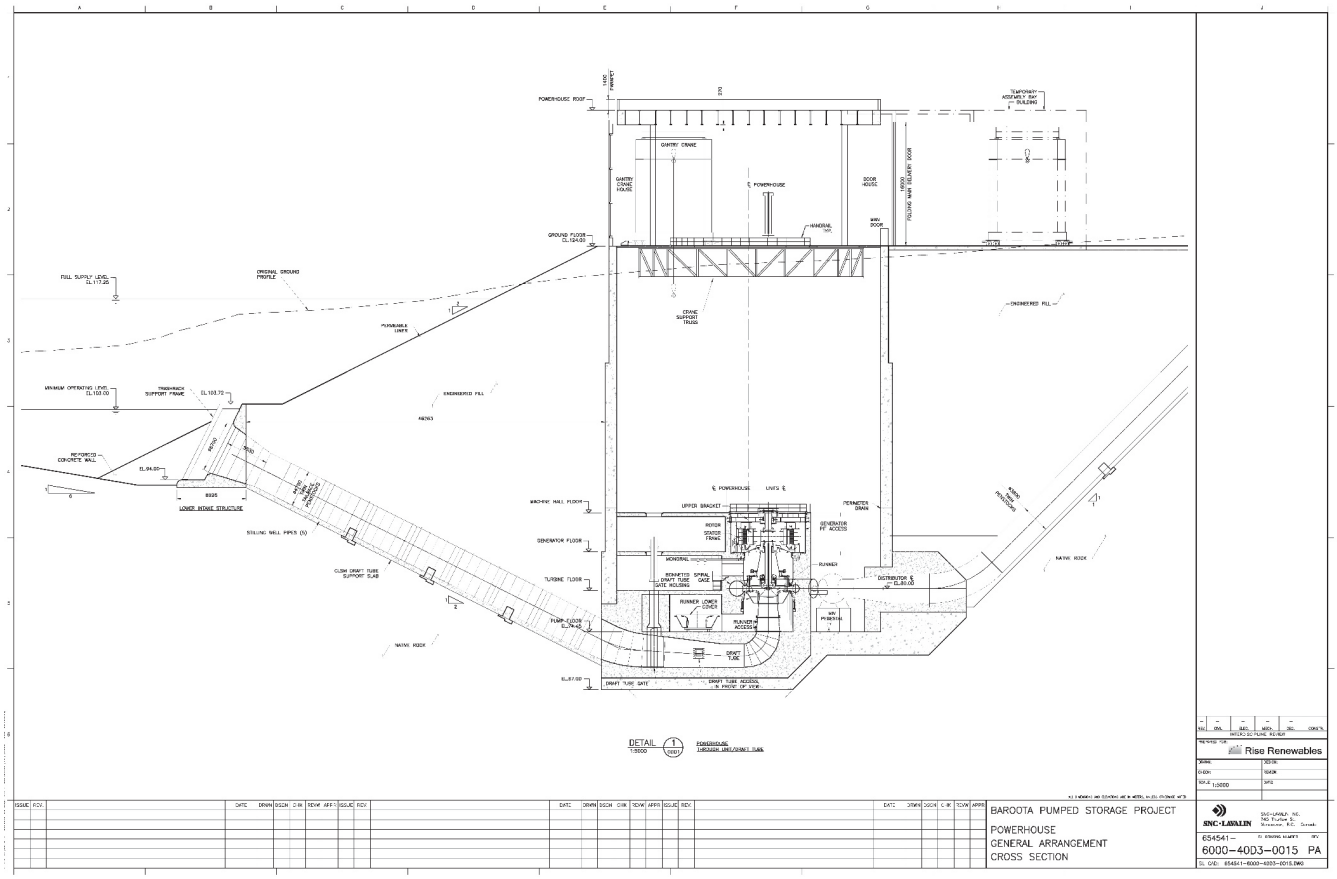

Figure 2-7: Cross-section view of the powerhouse

2.2.3.5. Switchyard and Substation

An air insulated switchyard / substation will be constructed to the north of the powerhouse. Site equipment will be serviced in isolation from the network with generation voltage of 16 kV or 33 kV stepped up to the connection voltage of 275 kV. Overhead lines will run in a westerly direction from this switchyard / substation, either over the existing lower reservoir, or around the lower reservoir to the shared ElectraNet switching station facilitating connection into the existing ElectraNet Bungama to Davenport 275 kV transmission line. The switchyard / substation will be constructed on benched foundations with engineered concrete footings and suitable bunds.

Structural towers will be located on both sides of the reservoir capable of supporting the static load required for the wires.

The final placement of the substation, switchyard, associated transfer infrastructure and the ElectraNet switching station will be subject to refinement during the detailed design phase.

2.2.3.6. Transmission Lines

The connection to the ElectraNet network system will be provided by short transmission lines from the substation to the existing Bungama to Davenport 275 kV line that run north-south along the Project site. The new transmission lines may be up to several hundred metres long, depending on the final substation location.

2.2.3.7. Underground Cabling

Minimal underground cabling is proposed for the Pumped Hydro Project. Generated electricity may be transferred from the powerhouse to the switchyard via underground cabling (subject to final design), however this distance will be short and underground cabling may not be required. In addition, communications and power will be transferred between the lower reservoir and upper reservoir, conveyed within the proposed penstock service trench.

2.2.3.8. Other Operational Facilities

Operational facilities will largely be associated with the powerhouse shaft and building, including offices and an ablution block, as well as maintenance facilities. A material laydown area, loading bay and waste storage area will be constructed adjacent to the powerhouse.

Staff parking will likely be within the fenced compound adjacent the powerhouse, serviced by a site access road.

A temporary construction compound and laydown areas will also be established during construction which is discussed in Section 2.2.4.4.

2.2.3.9. Communications and Power

Telecommunications will be installed at the site and may utilise existing locally available wired networks or may utilise wireless data networks. The lower and upper reservoirs will be connected by optic cables and power which will be run within the penstock trench.

Portable diesel generators will be used to supply power during construction.

Power during operations may be obtained from the Solar Project or direct from the main transmission line. A small diesel-powered generator will be installed for use in emergencies at the lower reservoir.

2.2.3.10. Site Access and Internal Access Tracks

Access to the powerhouse will be via existing access roads which in places will be upgraded to facilitate ease of access and ensure safety to site personnel. Other existing access roads around the lower reservoir will be upgraded, as required, to ensure suitable surface water conveyance and to minimise erosion during construction and operation phases.

Access to the upper reservoir will be facilitated by an existing service road which will be extended to the east to a proposed parking area, the final location of which will be determined during the detailed design. Where required, the track will be upgraded by excavating small portions of the existing land, providing safe access to the upper reservoir during construction and operations. All Project site access tracks will be gravel or native material (unsealed), designed for all weather conditions and be approximately 5 – 6 m in width.

The location of the main construction access will be determined during detailed design.

A detailed traffic management plan to address site access will be developed in consultation with the District Council of Mount Remarkable (Council) and DPTI and is further discussed within Section 8.5.

2.2.3.11. Perimeter Fencing

The existing entry gate to the lower reservoir will be upgraded and integrated into the perimeter fencing. The existing site fence around the lower reservoir will be upgraded within the area of the powerhouse, consisting of a 2.5 m high chain link fence. A similar chain-link fence will be installed at the upper reservoir. There will be a buffer of approximately 10 – 20 m between buildings, the upper and lower reservoir and the fence.

A security gate at the lower and upper reservoir site entrance will allow controlled access. The site will be permanently monitored for security purposes by alarms and cameras.

2.2.3.12. Water Management

Construction

During construction, untreated water will be sourced from the lower reservoir. Water will be trucked to the upper reservoir and used for dust suppression. The same water will be utilised for use in portable toilets and for other purposes as required.

Potable water will be imported in bottle form (or similar) for consumption.

Operations

Potable water will be required for worker facilities during operations, however quantities required will be relatively low due to the small number of employees likely to be on-site.

Water is planned to be harvested from the roof of the service building and stored in tanks on-site for use within site amenities. If water requirements exceed available rainwater, water will be sourced from potable water sources.

2.2.3.13. Wastewater

Wastewater generated during construction will be captured in septic tanks / portable water closets and removed from site by a licensed waste contractor.

Operational wastewater management may utilise a small sewage treatment system, or alternatively use septic tanks with removal by a licensed waste contractor. The sewage treatment system would be designed with a peak capacity adequate for the expected number of staff and visitors at the site. The requirement for a sewage treatment facility will be assessed during detailed design.

2.2.3.14. Waste Management

Soil material will be generated from excavation works at the upper reservoir. Surplus soil will be used to contour the dam wall face and associated saddle dam embankments and to contour surrounding valleys, minimising trucking off-site. The surplus soil will be sprayed with a vegetation cover immediately following placement and will be sited in a manner that minimises potential erosion and sedimentation.

A range of general waste products will be generated during the construction phase and, to a lesser extent, the operational phase. These will include wooden pallets, plastic wrapping, cans, bottles, and metal offcuts. A dedicated waste storage and handling area will be provided during construction and operation.

Waste will be managed in accordance with the waste management hierarchy shown in Figure 2-8 and the requirements of the *Environment Protection Act 1993 (SA)*.

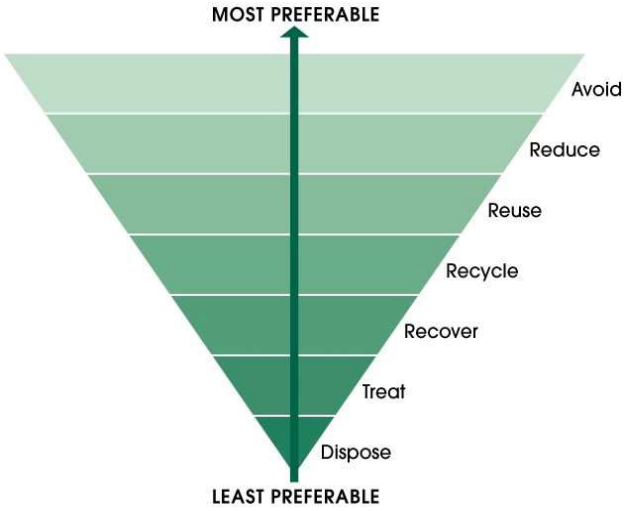

Figure 2-8: Waste management hierarchy (SA EPA 2017)

All waste will be disposed of through appropriately licensed facilities in accordance with legislative requirements. Unused or excess chemicals and material will be removed and disposed of correctly, in accordance with safety data sheets (SDS) and waste disposal guidelines.

Licensed waste transporters will be used to collect and dispose of waste and waste tracking forms and receipts will be used in accordance with legislative requirements.

2.2.4. Construction

2.2.4.1. Construction Activities

The main construction activities will include:

- Establishment of a temporary construction compound;
- Site establishment and preparation for construction (vegetation removal, preliminary civil works and drainage);
- Fencing;
- Civil earthworks associated with the upper reservoir, including excavation, construction of embankments, placement of the liner (as required), construction of the intake structure;
- Construction of the penstock pipe system;
- Construction of the powerhouse and turbine-pump;
- Construction of the lower reservoir intake structure;
- Construction of the switchyard and substation;
- Installation of cabling and other equipment and connection of communications equipment;
- Construction of other permanent operational facilities (e.g. service building, parking, access tracks); and
- Removal of temporary construction facilities and rehabilitation of disturbed areas.

Construction activities will be sequential but will overlap where possible. The powerhouse represents the critical path, and as such, it is expected that work would first commence at the powerhouse, as well as the upper reservoir. The lower reservoir will be lowered as far as is practicable, to reduce dewatering requirements during construction.

Mechanical, structural and electrical works will commence once site preparation is completed for the relevant part of the site.

The construction is expected to take approximately 30 months.

2.2.4.2. Construction Workforce, Accommodation and Hours

It is expected that approximately 200 construction personnel will be required on-site during periods of peak construction activity. Most of the positions will be temporary and likely to be filled by contractors. The construction labour force will be sourced locally as far as practicable. Where specific skills are not available locally, workers will be sourced from further afield.

It is anticipated that most workers will be accommodated at existing accommodation within the local area including Port Germein and nearby towns. Bus transport will be provided to minimise traffic volumes and transit risks during construction. A dedicated construction camp is not proposed given the Project's close proximity to nearby towns.

Accommodation requirements will be addressed in consultation with the Council, which is facilitating local engagement through the establishment of a registration of interest process.

Construction hours will typically follow 12-hour shifts, from 6 am to 6 pm daily with crews to rotate through the roster to ensure appropriate leave breaks are incorporated. The construction workforce would typically assemble at site at 6 am for briefings (often referred to as 'prestart briefings'), with construction activities commencing by 7 am and daily site pack-up around 5.30 pm. Depending on construction scheduling, work may need to be undertaken at night (e.g. for critical path activities). However, noisier activities will be scheduled, wherever possible, during business hours.

2.2.4.3. Machinery and Equipment

Machinery and equipment used during construction will include earth-moving equipment for civil works, concrete trucks, diesel generators, trucks and cranes. Subject to the suitability of the site soil and rock, a temporary concrete batching plant may be installed during construction activities. The equipment likely be used during construction includes:

- Dozer, excavator, grader, backhoe, roller, scraper, vibrating plate;
- Concrete batching plant and pumping trucks;
- Mulcher;
- Loader;
- Dump trucks and water truck;
- Pile driver;
- Forklift and telehandler;
- Crane; and
- Generator.

Bulk materials that are expected to be transported to the site for construction include road base, concrete, sand and cement. These materials will be sourced wherever possible from local quarries, otherwise from other regional towns.

Blasting is expected to be required within the upper reservoir to increase the overall capacity. Blast plans will be communicated with relevant stakeholders prior to being setup to ensure the safety of workers and relevant stakeholders, as well as to maintain the integrity of existing SA Government owned infrastructure.

2.2.4.4. Temporary Construction Facilities

Two construction compounds are expected to be required, one at each of the reservoirs. It is noted that the lower reservoir compound will operate as the main construction hub for the Pumped Hydro Project, with the upper reservoir compound designed as a smaller operational hub. The compounds will primarily provide:

- Temporary site offices and lunch room;
- Temporary ablutions block;
- Mechanical workshop;
- Material laydown areas;
- Equipment stores;

- Waste storage area;
- Parking;
- Hazardous materials storage; and
- Fuel storage and refuelling area (self-bunded diesel tank).

Additional laydown and truck parking / turning areas may be established in another area of the site to manage equipment delivery and logistics, depending on final access and site layout configurations.

2.2.5. Operations

Once operational, routine activities would include:

- Pumping water from the lower reservoir to the upper reservoir during times of low energy demand (typically overnight or in the middle of the day);
- Water release from the upper reservoir to the lower reservoir during times of peak energy demand (typically morning, late afternoon and early evening);
- Operation, monitoring and ongoing maintenance of the Pumped Hydro Project components;
- Routine visual inspections and general maintenance / housekeeping, with potential use of 'drone' technology to enhance maintenance operations;
- Management of vegetation including routine weed control where required and rehabilitation of disturbed areas;
- Security management including site monitoring; and
- Replacement of equipment and infrastructure, as required.

The operational workforce is expected to be between 2 and 5 people with additional personnel where required (e.g. for scheduled maintenance operations).

Maintenance would typically be undertaken during standard working hours (e.g. Monday – Friday 7 am to 6 pm and Saturday 8 am – 1 pm). Except for breakdowns or emergencies or infrequent large-scale maintenance, night works or work on Sundays or public holidays are unlikely to be required.

2.2.6. Decommissioning

The Pumped Hydro Project has a minimum 50-70 year design life. During decommissioning, the upper reservoir would be drained with all water flowing via the penstock to the lower reservoir. The main dam wall of the upper reservoir would be removed, with spoil used to recontour the natural topography in a similar fashion to that present prior to construction. Given a deficit of soil would be present at the time of decommissioning (compared to pre-construction levels), the final topography of the landform may not exactly resemble the pre-construction topography. However, the soil material would be placed to maximise vegetation regrowth, helping to minimise potential erosion issues.

Key elements of project decommissioning would also include:

- Penstock disconnected from the upper and lower reservoirs but would remain in-situ (subject to agreement with the landowner);
- The generation infrastructure would be disconnected from the substation and switchyard;
- The turbine and pumps removed. Materials sorted and packaged for removal from the site for recycling or reuse;
- Cabling removed and recycled (some infrastructure below ground may be left in place subject to agreement with the landowner);
- The powerhouse building removed and materials recycled or reused, wherever possible, unless there is an acceptable alternative use for the building;
- The substation and all other site amenities and equipment removed and materials recycled or reused, wherever possible; and
- Fencing removed (some fencing may be retained if requested by the landowner).

2.2.7. Project Schedule

An indicative schedule for the Pumped Hydro Project is outlined in Table 2-2.

Table 2-2: Indicative Pumped Hydro Project schedule

Phase	Approximate number of months to completion
Detailed Design	3
Construction	30
Commissioning	3
Removal of temporary construction facilities/rehabilitation of disturbed areas	3

2.3. Solar Project

2.3.1. Project Overview

The Solar Project will provide up to 300 MW of solar PV generation capacity, consisting of arrays of tracking solar panels. The solar PV arrays will connect to inverters and a substation which will feed the electricity into the national electricity grid.

Once fully complete, the Solar Project will contain approximately 941,500 solar panels to provide additional grid capacity into the South Australian energy market.

The Solar Project will include:

- Civil / earthworks for the solar farm including internal access roads, security fencing on the boundary and site access off Kenihan Road;
- Solar farm comprising of PV modules on tracker tables, piles, direct current (DC) and alternating current (AC) reticulation and inverter stations;
- Operational facilities including a site office, maintenance building, ablution block with on-site sewage treatment system, parking area, material laydown area, undercover storage area and waste storage area;
- Installation of solar arrays consisting of circa 941,500 x 385-watt solar panels mounted on single axis trackers;
- 64 x 4.2 MVA 33 kV inverters;
- Underground cabling and electrical connections between solar arrays, panel inverters and the 33 kV substation;
- 275 / 33 kV substation interconnection, associated switchgear and control room;
- Internal access tracks between solar arrays to provide access for construction, maintenance and inspection services;
- NEM compliant metering arrangements for all energy exported into the grid as well as internal metering to measure solar output; and
- Connection into the existing north south 275 kV lines with final design to be developed in conjunction with ElectraNet.

Figure 2-9 shows a preliminary site layout which is indicative of the likely layout of infrastructure on the site. Refinement of the layout and other project details will be ongoing throughout the planning and detailed design phases and the site layout will change throughout this process. However, the Solar Project will remain generally in the alignment shown based on the topographical elevation requirements needed to maximise the energy generation potential.

Several areas have been prioritised for avoidance in the preliminary layout, including culturally sensitive areas. These areas will continue to be prioritised for mitigation and avoidance as the design progresses.

The total development footprint of the solar farm and associated infrastructure is expected to be up to 678 ha. This will be refined in detailed design when the final location of solar panels, site infrastructure and access tracks will be determined. The final design will be balanced to minimise environmental impact and ensure optimum design efficiency.

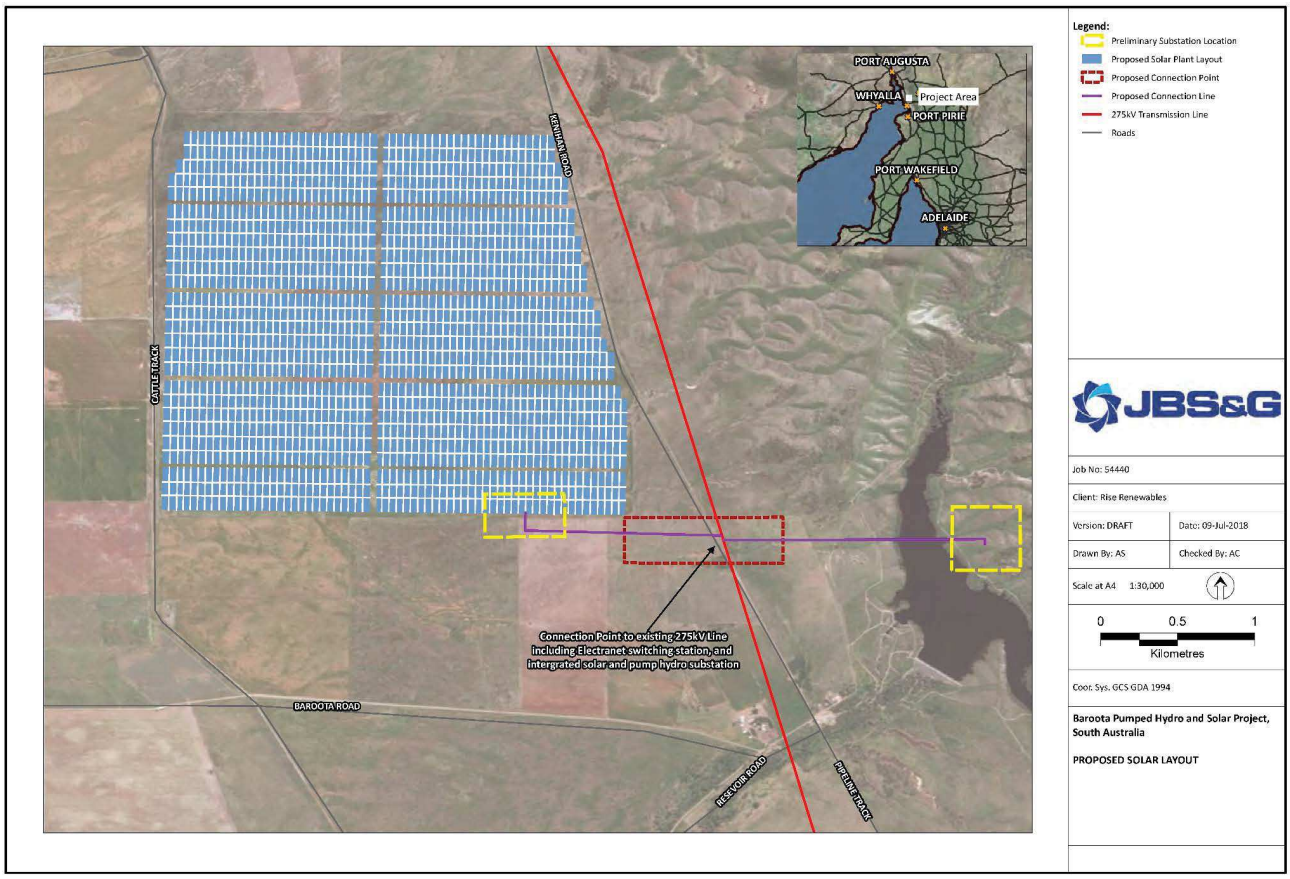

Figure 2-9: Preliminary Solar Project site layout

2.3.2. Project Site

The Solar Project site is located 1 km to the north-west of the existing Baroota Reservoir. The proposed site is on freehold land owned by a single landholder who has entered into lease agreements with Rise to support the Project, including a 25-year lease. A summary of the property details is provided in Table 2-3.

Table 2-3: Solar Project site property details

Property Description	Certificate of Title
Section 37W, Hundred of Baroota	Volume 5673 Folio 711
Sections 38 and 89, Hundred of Baroota	Volume 5673 Folio 710
Section 54N, Hundred of Baroota	Volume 5639 Folio 780
Section 54S, Hundred of Baroota	Volume 5673 Folio 709
Section 88, Hundred of Baroota	Volume 5576 Folio 38
Section 106, Hundred of Baroota	Volume 5673 Folio 712
Section 297, Hundred of Baroota	Volume 5245 Folio 609

The six land parcels that make up the PV solar site comprise a total area of approximately 636 ha. The switchyard / substation and other associated infrastructure will be located on the northern end of the two land parcels south of the solar panel area comprising a total area of approximately 230 ha. The total development footprint is expected to be approximately 670 ha, depending on the final layout.

The PV solar panels will be located on Sections 54N, 106, 54S, 89, 38 and 37W. An electrical reticulation area will be located along the southern boundary of the PV modules area and northern boundary of Section 88. Another electrical reticulation with a construction laydown area will be located along the northern boundary of Section 297. The proposed switchyard and substation will be in the north-west corner of Section 297.

The Solar Project site is shown in Figure 2-10.

The property is currently used for cropping and livestock grazing and is relatively degraded with generally sparse native vegetation cover. Cattle Track runs along the western perimeter of the site and Kenihan Road along the eastern perimeter. Access to the site is planned to be from Kenihan Road.

A 275 kV high voltage overhead transmission line that runs generally north to south is located to the east of the PV modules area.

Plate 2-10 to Plate 2-11 show typical views of the site.

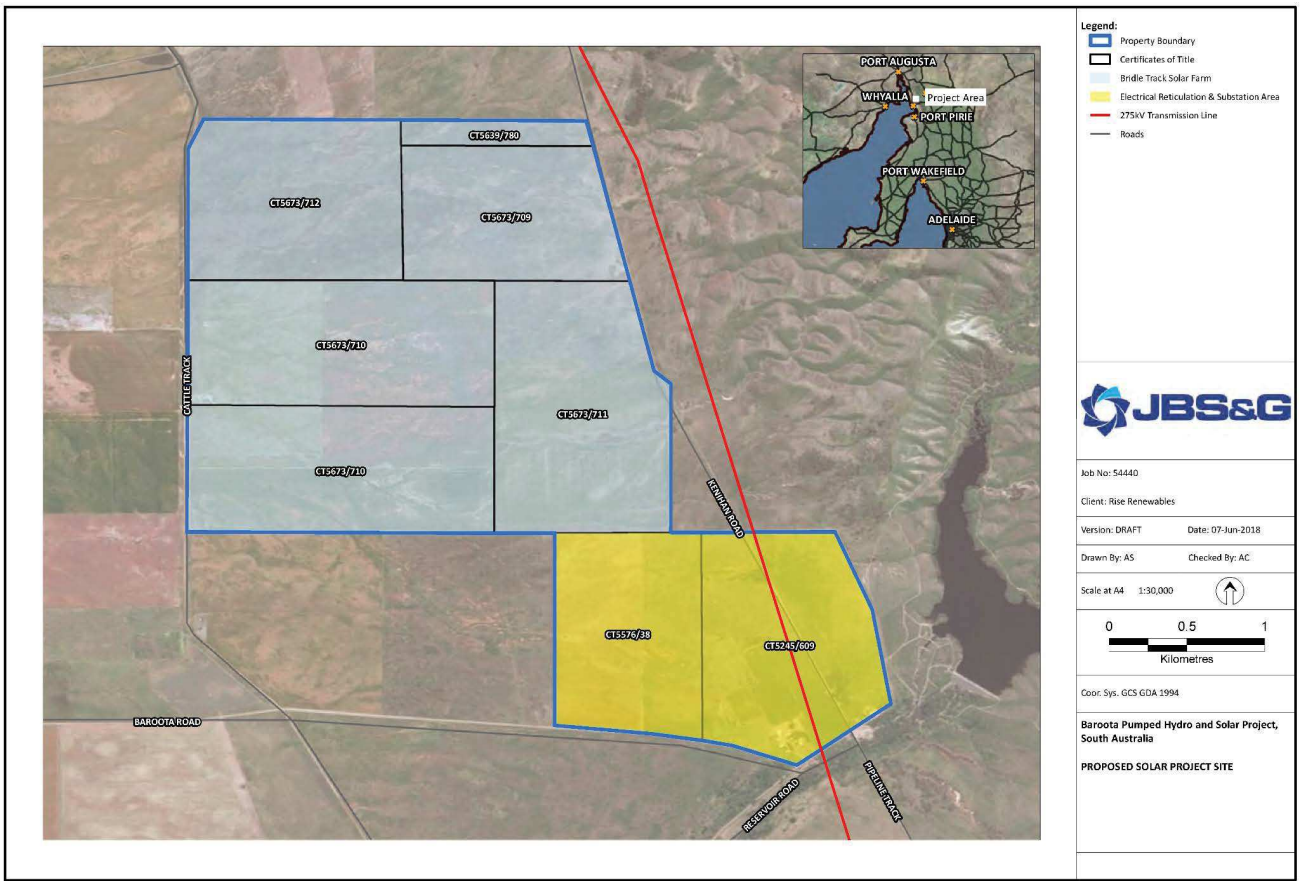

Figure 2-10: Proposed Solar Project site

Plate 2-10: View of the Solar Project site from the south-eastern boundary, looking north-west (Source: JBS&G)

Plate 2-11: View of the Solar Project site from the south-eastern boundary, looking south-west (Source: JBS&G)

2.3.3. Key Infrastructure Components

Rise is currently finalising the site configuration for the solar panel array and associated infrastructure. All dimensions provided in this section are therefore preliminary and may change depending on the final design and site configuration.

2.3.3.1. Solar Arrays

The solar farm will have approximately 941,500 individual PV panels (or solar panels). These solar panels will typically be 2 m long and 1 m wide (depending on final equipment selection). The panels will be installed over the subject land in consistent alignments known as 'arrays'. Figure 2-9 provides an indicative site plan for the array arrangement.

The proposed solar panels for this project consist of monocrystalline silicon technology and will have a maximum power output of 385 watts.

The solar panels are attached on a single axis tracking system (Plate 2-12) to track the sun's path along an axis with an east to west orientation, allowing the solar PV array to increase the energy produced. There is 120 degrees of rotation of the trackers.

The panels and mounting system will be installed on approximately 30,000 mounting posts which will be direct pile driven into the ground (Plate 2-13)**.** The tracking system is then bolted to the top of the posts. The final height of the centre of the panels off the ground will be approximately 1.5 m. Some variations in height may be required due to the undulations in the land.

Groupings of 29 panels will be linked together to form a 'string'. The strings are then connected through a DC combiner box before it is wired to the inverters.

Approximately 10 m internal access tracks will be provided between arrays throughout the development to allow vehicle and machinery movement as required for maintenance and repairs.

Plate 2-14 shows an example of solar arrays.

Plate 2-12: Typical photovoltaic panel with a single axis tracking system (Source: SNC-Lavalin)

Plate 2-13: Typical piling operation to install mounting poles (Source: SNC-Lavalin)

Plate 2-14: Example of large solar farm (Source: SNC-Lavalin)

2.3.3.2. Combiner Boxes

A DC combiner box will be installed for each PV panel string (Plate 2-15). Combiner boxes collect the individual string circuits from the PV panels and combine them into a single larger circuit. They also provide overcurrent protection for the string circuits.

Plate 2-15: Typical single axis tracking racking system and combiner box (Source: SNC-Lavalin)

2.3.3.3. Inverter Stations

Inverters convert the low voltage DC electricity that the solar modules produce into low voltage AC which can then be transformed to higher voltages. Inverter transformers step up the voltage from the 1500 V_{DC} supplied by the PV panels and converts the energy to 33 kV so that it can be injected into the Grid.

The project will use 64 x 4.2 MW_{AC} 33 kV inverters which will be spaced throughout the development as required.

Inverter stations are similar in appearance to large shipping containers and will be approximately 12.2 m in length, 2.4 m in width and 2.9 m in height. Plate 2-16 shows an example of a typical inverter. A concrete slab or bored piers are likely to be used as foundations for the inverters.

Plate 2-16: Example of an inverter (Source: SNC-Lavalin)

2.3.3.4. Underground Cabling

The proposed underground cabling will comprise low voltage wiring from panels to the inverters, and from high voltage AC cables to the substation.

Cabling will be laid in trenches of depths to approximately 300 mm and backfilled and compacted to match the adjacent ground level.

Underground cabling for DC cables and 33 kV cables will be installed in accordance with Australian and international standards and established practice.

2.3.3.5. Switchyard and Substation

A switchyard / substation will be constructed immediately adjacent to the southern boundary of the PV modules facilitating servicing of site equipment in isolation from the network and stepping up the generation voltage of 33 kV to the connection voltage of 275 kV. Overhead lines will run in an easterly direction from this switchyard / substation to the shared ElectraNet switching station facilitating connection into the existing ElectraNet Bungama to Davenport 275 kV transmission line. The switchyard / substation will be constructed on benched foundations with engineered concrete footings and suitable bunds.

The final placement of the substation, switchyard, associated transfer infrastructure and ElectraNet switching station will be subject to refinement during the detailed design phase.

Plate 2-17 shows the existing ElectraNet 275 kV transmission line running across the site.

Plate 2-17: Existing 275 kV lines running across the Project site (Source: JBS&G)

2.3.3.6. Switchgear Building and Operations Office

A small building is to be constructed adjacent to the proposed substation. The building will house the control room for the facility, monitoring its operation and function, as well as battery backup supplies and the switching gear.

The infrastructure in the building will support the substation and management of the facility generally.

An operations area and desk are to be installed within the building for personnel to cover the function of the facility. A kitchen, toilets, washroom and eyewash facilities will also be provided within the building.

2.3.3.7. Maintenance

Once operational, the facility will involve daily monitoring of the plant and all associated infrastructure. Personnel employed to manage the facility will utilise the operations building when on-site.

Where required, minor repairs and maintenance of components of the facility will be undertaken by on-site personnel.

Contractors may be required from time to time to conduct more complex repairs or maintenance on the facility.

2.3.3.8. Other Operational Facilities

Other operational facilities will be located on hardstand (constructed from compacted earth or crushed rock) and include:

- Office block and ablution block, which may be prefabricated buildings;
- Maintenance building and workshop;
- Parking area for staff and visitors;
- Material laydown area and an undercover storage area;
- Waste storage area; and
- Tanks for the harvesting of rainwater from roofs (i.e. battery storage building) and provision of firefighting water.

A temporary construction compound and laydown areas will also be established during construction and are discussed in Section 2.2.4.4.

2.3.3.9. Communications and Power

Telecommunications will be installed at the site and may utilise existing wired networks in the region or wireless data networks.

Portable diesel generators will be used to supply power during construction. Power during operations will be obtained from the solar farm and batteries. A small diesel-powered generator will be installed for use in emergencies.

2.3.3.10. Site Access and Internal Access Tracks

Two access points are expected to be utilised: direct access from Kenihan Road to the east of the site and via the Cattle Track to the west of the site. Potential access locations are shown in Figure 2-10.

A detailed traffic management plan to address site access will be developed in consultation with DPTI and the Council and will cover all relevant issues including line of sight, slip lanes, surface suitability and maintenance, vehicle management and other road safety matters.

Internal tracks will be constructed to allow vehicular access. An internal perimeter track will also be constructed along the fence line. These internal access tracks will be gravel (unsealed) and approximately 10 m in width.

Solar PV module rows will be spaced accordingly to allow access for service and optimum operation. The spaces between module rows will generally not be gravelled and be mostly untreated.

A security fence, expected to be a 2.5 m high, 25 mm chain link fence, will be installed around the entire perimeter (excluding the access road) in accordance with Australian Standards (AS) 1725 Chain-link Fabric Security Fencing and Gates. A security gate at the site entrance will allow controlled access. The site will be permanently monitored for security purposes by alarms and cameras.

There will be a buffer of approximately 20 m between buildings or solar panels and the fence, which is expected to be maintained as a firebreak (i.e. fuel loads will be controlled in this zone).

2.3.3.11. Water Management

Construction

Water is expected to be trucked to site for use in construction, dust suppression, equipment washing, worker facilities and potable use. Water tanks are likely to be installed in the temporary construction compound.

Operations

Water will be required for worker facilities and potable use during operations, however quantities required will be relatively low due to the small number of employees likely to be on-site.

High-tech coating on the PV panels reduces cleaning requirements. Water will be required for solar panel cleaning and rainwater will be used wherever possible.

Water is planned to be harvested from the roof of the maintenance building and stored in tanks on-site for operational use and as a fire fighting reserve. If additional water is needed to meet project requirements, it is expected that it would be trucked to site.

2.3.3.12. Wastewater

Wastewater generated during construction will be captured in septic tanks and removed from site by a licensed waste contractor.

Operational wastewater management may utilise a small sewage treatment system, or alternatively it may also use septic tanks with removal by a licensed waste contractor. The sewage treatment system would be designed with a peak capacity adequate for the expected number of staff and visitors at the site.

2.3.3.13. Waste Management

A range of general waste products will be generated during the construction phase and, to a lesser extent, the operational phase. These will include wooden pallets, plastic wrapping, cans, bottles and metal offcuts. A dedicated waste storage and handling area will be provided during construction and operation.

Similar to Section 2.2.3.14, waste will be managed in accordance with the waste management hierarchy and the requirements of the *Environment Protection Act 1993 (SA)*.

Recyclable materials are expected to constitute a large proportion of the waste generated, including timber pallets used to transport the solar panel modules. Components such as batteries and solar panels will be recycled (typically by the manufacturer) when they reach the end of their operational life.

All waste will be disposed of through appropriately licensed facilities in accordance with legislative requirements. Unused or excess chemicals and material will be removed and disposed of correctly, in accordance with safety data sheets (SDS) and waste disposal guidelines.

Licensed waste transporters will be used to collect and dispose of waste and waste tracking forms and receipts will be used in accordance with legislative requirements.

2.3.4. Construction

2.3.4.1. Construction Activities

The main construction activities will include:

- Removing existing fences and any internal trees (as identified on plans);
- Establishment of the temporary construction compound, including secured site office and storage areas, loading and delivery zones;
- Erection of temporary construction signage and directional signage for delivery access along Kenihan Road and the Cattle Track, whichever minimises disruptions to local traffic;
- Site establishment and preparation (e.g. vegetation removal, preliminary civil works and drainage);
- Fencing around project site;
- Construction of the substation and connection to the existing transmission line;
- Direct piling and installation of steel post support system for the solar panels;
- Installation of underground cabling (trenching), installation of PV arrays, inverters containers and delivery station, connection of communications equipment;
- Grading and material placement of internal road creation;
- Construction of other permanent operational facilities (e.g. site office, ablutions block, parking and access tracks);
- Removal of temporary construction facilities and rehabilitation of disturbed areas; and
- Possible ripping to establish any planting strips.

Construction activities will be sequential and overlapping. Activities will commence with site preparation, involving grading and minimal earthworks for the access tracks, solar module areas, temporary facilities, excavations for foundations for inverters, buildings and the substation. Vegetation removal will aim to minimise soil disturbance, with the soil surface and groundcover left intact as far as possible.

Mechanical, structural and electrical works will commence once site preparation is completed for the relevant part of the site.

The construction and commissioning phase is expected to last approximately 12 – 20 months.

2.3.4.2. Construction Workforce, Accommodation and Hours

It is expected that approximately 300 temporary construction personnel would be required on-site during periods of peak construction activity. The construction labour force will be sourced locally as far as practicable. Where specific skills are not available locally, workers will be sourced from further afield.

It is anticipated that most workers would be accommodated at existing accommodation within the local area (i.e. towns within a 50 km radius of the site). Bus transport would be provided to minimise traffic volumes and transit risks during construction. A dedicated construction camp is not proposed given the close proximity to nearby towns.

Accommodation requirements will be addressed in consultation with the Council, who are facilitating local engagement through the establishment of a registration of interest process.

Construction hours are typically 12-hour shifts, from 6 am to 6 pm daily. Crews will rotate through the roster to ensure appropriate leave breaks are incorporated. The construction workforce would typically assemble at site at 6 am for briefings (often referred to as 'prestart briefings'), with construction activities typically commencing by 7 am and daily site pack-up around 5.30 pm. Depending on construction scheduling, work may need to be undertaken at night (e.g. for critical path activities). However, noisier activities will be scheduled, wherever possible, to coincide with business hours.

2.3.4.3. Machinery and Equipment

Machinery and equipment used during construction will include earth-moving equipment for civil works, diesel generators, trucks and cranes, all with similar noise outputs to farm machinery. Pile driving of the solar panel foundations would be undertaken using a machine which screws or hammers poles into the ground, similar to that used for driving farm fence poles into the ground.

The equipment likely to be used during construction includes:

- Dozer, excavator, grader, backhoe, roller, scraper, vibrating plate;
- Mulcher;
- Loader;
- Dump trucks, water truck;
- Pile driver;
- Forklift, telehandler;
- Crane; and
- Generators.

Bulk materials expected to be transported to the site for construction include road base, concrete, sand and cement. These materials will be sourced from local quarries wherever possible, otherwise from regional towns.

2.3.4.4. Temporary Construction Facilities

Two construction compounds in the order of 120 m by 200 m are expected to be required in the western and southern parts of the Solar Project site. The compounds will be used during the construction phase and depending on location, one of these may partially be converted to an operational compound following the completion of construction. The compounds will primarily provide:

- Temporary site offices and lunch room;
- Temporary ablutions block;
- Mechanical workshop;
- Material laydown areas;
- Equipment stores;
- Waste storage area;
- Parking;
- Hazardous materials storage; and
- Fuel storage and refuelling area (self-bunded diesel tank).

Additional laydown and truck parking / turning areas may be established in another area of the site to manage equipment delivery and logistics, depending on final access and site layout configurations.

2.3.5. Operations

Once operational, routine activities would include:

- Operation, monitoring and ongoing maintenance of the electrical components of the solar array and battery system;
- Routine visual inspections and general maintenance / housekeeping, with potential use of 'drone' technology to enhance maintenance operations;
- Management of vegetation including maintenance of ground cover vegetation beneath panels to minimise potential for erosion and weed growth. Monitoring would be undertaken to identify and address any issues. Slashing vegetation or spraying would be undertaken where required;
- Security management including site monitoring; and
- Replacement of equipment and infrastructure, as required.

The operational workforce is expected to be up to 5, with additional personnel where required (e.g. for scheduled maintenance operations).

Daily operations and maintenance would typically be undertaken during relatively standard working hours (e.g. Monday – Friday 7 am to 6 pm and Saturday 8 am – 1 pm). Except for breakdowns, emergencies or very infrequent large-scale maintenance, night works or work on Sundays or public holidays are unlikely to be required.

2.3.6. Decommissioning

During decommissioning, all above ground infrastructure would be removed. Key elements of project decommissioning would include:

- The generation infrastructure would be disconnected from the metering point;
- The solar arrays would be removed. Materials would be sorted and packaged for removal from the site for recycling or reuse. Much of the solar array panels would be recyclable;
- Posts and cabling would be removed and recycled (some infrastructure below ground may be left in place subject to agreement with the landowner);
- The substation and all other site amenities and equipment would be removed and materials recycled or reused, wherever possible; and
- Fencing would be removed (some fencing may be retained if requested by the landowner).

The level of traffic required for decommissioning would be similar in type but of shorter duration than that required for the construction phase.

2.3.7. Project Schedule

An indicative schedule for the Solar Project is outlined in Table 2-4.

Table 2-4: Indicative Solar Project schedule

Phase	Approximate number of months to completion
Detailed Design	3
Construction	12-20
Commissioning	3
Removal of temporary construction facilities/rehabilitation of disturbed areas	3

3. Project Rationale and Benefits

The Project aligns with South Australia's strategic priorities, will improve the security of the State's power system and provide direct economic benefits, particularly to the Mid North region.

3.1. Alignment with South Australian Strategic Priorities

South Australia's mix of electricity supply sources continues to change with an increasing share of intermittent renewable generation. Since the closure of coal fired power generation in South Australia and the increase in electricity generated from wind or solar resources, there has been a need for higher levels of dispatchable generation (AEMO 2016). The Project will be a timely addition of 'on demand' dispatchable power that will significantly assist in balancing variable renewable generation. The Project will increase supply of electricity generation during peak power demand thereby reducing the risk of supply and demand imbalances during these times. Furthermore, the additional supply will put downward pressure on wholesale electricity prices during peak demand periods.

The Project is aligned with, and will assist in, achieving State Government priorities focused on affordability, reliability and security of power. The energy capacity of the Project, along with providing clean and reliable energy, will improve the South Australian power system in the following ways. The Project will:

Affordable energy

- Result in higher levels of electricity being supplied from generation within South Australia through the dispatchable nature of the Project, than would otherwise occur during peak demand periods thereby contributing to a lower cost of wholesale electricity periods during high demand periods when prices are typically highest.
- Use pumped hydro generation, the lowest cost form of long-hours energy storage. The Project will contribute significant energy storage which will assist in balancing the continued growth or low-cost variable renewable generation.
- Provide an additional source of large scale solar supply contributing to lowest cost new renewable generation.

A reliable grid

- Expand the installed capacity of synchronous generation in South Australia.
- Provide a new form of synchronous generation in pump hydro with significant diversification benefits to the network (both in technology type and location).
- Improve the supply of dispatchable energy, particularly during peak times.
- Contribute to system reliability, affordability and security over a long-term with an asset life of at least 50 – 70 years.

Power System Security

- Provide a critical back up including fast track and black start services to safeguard the South Australian network.
- Support the variability of renewable generation including by providing load during low demand periods thereby assisting with network voltage control.
- Support system security and thereby enabling continued investment in new renewable energy generation
- Enable South Australia to continue its leadership in the transition to a low carbon electricity system however with improved long-term system security.

3.2. Economic Benefits

Rise intends to seek approximately $700 million to fund the capital expenditure of the Project. Approximately half of that investment is forecast to occur locally delivering significant immediate and long-term economic and employment benefits.

Rise anticipates that approximately 500 construction personnel will be required for the Project during the construction phases, with approximately 5 – 10 full-time equivalent ongoing roles during the operational phase. A significant proportion of the construction phase workforce will be sourced locally.

Indirect economic spinoffs would benefit local businesses in the area throughout the construction and operational phases due to the sourcing of local products, materials and services (such as accommodation, food, fuel, and construction supplies and materials).

4. Legislative Framework

This section provides a summary of the legislative framework and approval process for the Project and provides an overview of other planning and environmental approvals that are likely to be required.

4.1. Development Act 1993

The *Development Act 1993* (SA) provides the framework establishing the State's planning and development system and its statutory procedures. It is the key legislation for approval of the Project.

4.1.1. Development Approval

The Project has been sponsored by Department of the Premier and Cabinet (DPC) as a public infrastructure project (Appendix H) and will be assessed under the public infrastructure provisions of Section 49 of the Development Act.

The Development Application prepared by Rise will be provided to DPC for lodgement with the SCAP. The process undertaken by SCAP involves notification, given in the form of a public advertisement, with an invitation for any person to make written comment within the prescribed timeframe (15 business days). The Development Application is also provided to Council and other government agencies for comment (E.g. DPC, DEW, EPA and DPTI). The SCAP assesses the application, considers any comments made by the public, Council and other referral bodies and prepares a report to the Minister for Planning (Minister) who may approve or refuse the application. The process is outlined in Figure 4-1.

Figure 4-1: Section 49 public infrastructure approval process

This application has been prepared in accordance with the guidance provided in the *Guide to the Assessment of Crown Development and Public Infrastructure* (Planning SA 2002). The *Development Regulations 2008* also require that prescribed particulars be contained in an application under Section 49, including:

(a) a description of the nature of the proposed development;

(b) details of the location, siting, layout and appearance of the proposed development; and

(c) a certificate from the Technical Regulator certifying that the proposed development complies with the requirements of the Technical Regulator (if the proposed development is electricity generation over 5 MW that is to be connected to the State's power system).

This report provides information on (a) and (b). A certificate from the Technical Regulator is attached to this report (Appendix I).

4.1.2. Building Rules Certification

The Development Act requires public infrastructure projects involving building work to be assessed and certified as complying with the Building Rules (to the extent that is appropriate in the circumstances) by a private certifier or by a person determined for this purpose by the Minister. The Building Rules include the Building Code of Australia and cover issues such as structural adequacy, fire safety, health and amenity, equitable access for people with disabilities and energy efficiency.

The assessment and certification against the Building Rules will be undertaken by the Council or a private certifier.

4.1.3. Development Plan Considerations

The Mount Remarkable Council Development Plan (Development Plan), established under the Development Act, sets out the policies against which development applications are to be assessed, as well as a number of objectives or principles relating to economic, environmental and social matters which should be complied with.

The Pumped Hydro Project site is within the Water Protection Zone and the Solar Project within both the Rural Landscape Protection Zone and Primary Production Zone of the Development Plan. The Project as a whole has been assessed against the objectives and principles set out in the Development Plan (see Appendix G) and indicates that the development of a pumped hydro and solar farm project is not at variance with the Development Plan. The key points noted in the assessment are:

- The project is not identified as a non-complying development.
- Renewable energy facilities, such as the proposed Project, are an envisaged form of development as defined by the Development Plan. Relevant objectives and principles include:
  - *Renewable Energy Facilities, Objective 1 - Development of renewable energy facilities that benefit the environment, the community and the State.*
  - *Renewable Energy Facilities, Objective 2 - The development of renewable energy facilities, such as wind farms and ancillary development, in areas that provide opportunity to harvest natural resources for the efficient generation of electricity.*
  - *Renewable Energy Facilities, Objective 3 - Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment and other land uses.*
  - *Renewable Energy Facilities, Principle 1 - Renewable energy facilities, including wind farms and ancillary development, should be located in areas that maximize efficient generation and supply of electricity and designed and sited so as not to impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips.*
- The desired character of the Rural Zone and Primary Production Zone (Solar Project site) does not include or mention impacts of renewable energy facilities. The solar farm will be constructed on land which is currently used for cropping and grazing and is not expected to impact on the natural and rural character of the zone.

- The Water Protection Zone (the Pumped Hydro Project) covers the Baroota Reservoir catchment. The desired character of this zone states that developments should avoid contributing to the pollution of surface water resources. The Pumped Hydro Project will be situated in the Baroota Reservoir catchment and the construction of an additional reservoir is consistent with the existing reservoir and guidelines. No impact on water quality is expected.

The Project is consistent with other objectives and associated principles in the Development Plan, including those relevant to the prevention of conflict between land uses, protection of scenically attractive areas, protection of natural resources (including surface water and soil), air quality, noise pollution and hazards, flood protection and bushfires.

4.2. Other Key Legislation

A range of other legislation is potentially relevant for Project approvals, including:

- Commonwealth:
  - *Environmental Protection and Biodiversity Conservation Act 1999*
  - *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
  - *Native Title Act 1993*
- South Australian:
  - *Aboriginal Heritage Act 1988*
  - *Electricity Act 1996*
  - *Environment Protection Act 1993*
  - *Fire and Emergency Services Act 2005*
  - *Heritage Places Act 1993*
  - *Local Government Act 1999*
  - *National Parks and Wildlife Act 1972*
  - *Native Title (South Australia) Act 1994*
  - *Native Vegetation Act 1991*
  - *Natural Resource Management Act 2004*
  - *Roads (Opening and Closing) Act 1991*
  - *South Australian Public Health Act 2011 and South Australian Public Health (Wastewater) Regulations 2013.*

Key legislation relevant to Project approvals is discussed further below.

4.2.1. *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

Approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for activities that will, or are likely to, impact matters of national environmental significance. These matters include World Heritage properties, National Heritage places, Ramsar wetlands of international importance, listed threatened species and ecological communities, listed migratory species and, in relation to coal seam gas development and large coal mining development, a water resource.

When a person proposes to take an action that will, or is likely to, impact matters of national environmental significance, they must refer the proposal to the Minister for Environment and Energy for a decision about whether the proposed action is a 'controlled action' and needs approval under the EPBC Act.

At the request of Rise, JBS&G Australia has undertaken an assessment of likely impact by the Project on EPBC Act matters and concluded that there are no matters of national environmental significance that are either present or likely to be significantly impacted. There are no World Heritage properties, National Heritage Places, Wetlands of International Importance or Commonwealth Marine Areas in the vicinity. As indicated in Section 7 and Appendix C, there are no threatened ecological communities or threatened species likely to be present or impacted, and there are no likely impacts to migratory species.

Consequently, Rise is confident that a requirement for assessment under the EPBC Act would not be triggered and a referral under this Act is therefore not proposed.

4.2.2. *Native Title Act 1993* (Cth) and *Native Title Act 1994* (SA)

The *Native Title Act 1993* and the *Native Title (South Australia) Act 1994* provide for the recognition and protection of native title. These rights may include: living on the area, access to the area for traditional purposes, to visit and protect important places and sites, to hunt, fish and gather food or traditional resources, and to teach law and custom on country. Native title can be claimed on some areas of land or water (e.g. on vacant or unallocated Crown land) but is extinguished by freehold land tenure and certain other forms of land title.

The Traditional Owners of the immediate area have a registered native claim (Federal Court file number SAD6012/1998) over land covered by the Project. The claim was registered by the National Native Title Tribunal on the Register of Native Title Claims on 10 April 1996. The date for a decision of the claim is unknown.

4.2.3. *Aboriginal Heritage Act 1988* (SA)

The *Aboriginal Heritage Act 1988* is administered by the Minister for Aboriginal Affairs and Reconciliation and provides protection for any Aboriginal sites, objects or remains (whether previously recorded or not).

A cultural heritage survey has been undertaken with the Traditional Owners as discussed in Section 8.2. Five (unrecorded) indigenous sites and scattered artefacts were identified near the Project. Rise will work with the Traditional Owners and Aboriginal Affairs and Reconciliation (where relevant) as the Project progresses through detailed design and construction to ensure that activities comply with the requirements of the Aboriginal Heritage Act.

Rise have consulted with Wongi-Ahrah and have an agreement in place with respect to the management of heritage sites and artefacts. Proposed management measures have considered Project design in relation to the heritage sites and artefacts identified during the cultural heritage survey.

4.2.4. *Heritage Places Act 1993* (SA)

The *Heritage Places Act 1993* provides for the identification and conservation of places and related objects of State heritage significance and also provides protection for archaeological artefacts of heritage significance. It is an offence to damage a Heritage Place.

A desktop assessment of all State and Commonwealth databases has revealed that there are no known Heritage Places or objects within the Project area.

4.2.5. *Environment Protection Act 1993* (SA)

The *Environment Protection Act 1993* provides a regulatory framework for the protection of South Australia's environment, including land, air and water. It imposes a general environmental duty not to undertake an activity that pollutes or might pollute the environment unless all reasonable and practicable measures have been taken to prevent or minimise any resulting environmental harm. It also imposes an obligation to report incidents causing or threatening serious or material harm to the Environment Protection Authority (EPA), where applicable.

The Environment Protection Act also defines prescribed activities of environmental significance, which require authorisation and licensing under this Act. The Project may involve an EPA licence for concrete batching which is a prescribed activity.

A number of Environmental Protection Policies operate under this Act which are relevant to the project, including the *Environment Protection (Noise) Policy 2007* and the *Environment Protection (Water Quality) Policy 2015* and all of which will be complied with.

4.2.6. *National Parks and Wildlife Act 1972* (SA)

The *National Parks and Wildlife* Act (NPW) establishes the system of conservation reserves in South Australia and provides protection for native plants and animals. Under the NPW Act, it is an offence to take protected plants or animals without approval.

Part 5 of the NPW Act provides for the conservation of native animals and Schedule 9 lists protected species and their protection status. The NPW Act applies to the Project site for the purposes of determining protected species of plant or animals, which influences offset requirements under the *Native Vegetation Act 1991*.

4.2.7. *Native Vegetation Act 1991* (SA)

The *Native Vegetation Act 1991* and *Native Vegetation Regulations 2017* apply to the management and clearance of native vegetation on private and public land in South Australia.

The Project will fall under Regulations 12 and 16 of the Native Vegetation Regulations, under the Infrastructure provisions of Schedule 1, Part 6 (clause 34).

The Regulations permit clearance for infrastructure approved under the Development Act where the Minister has declared that the clearance is in the public interest or if it is required in connection with the provision of infrastructure to a building or proposed building, or to any place.

The clearance requires written approval from the Native Vegetation Council (NVC) and under Regulation 16 will be subject to a condition that:

- Clearance is undertaken in accordance with an approved management plan that results in a Significant Environmental Benefit (SEB), or
- A payment is made into the Native Vegetation Fund of an amount considered by the Native Vegetation Council as being sufficient to achieve a SEB.

As discussed in Section 7.1, an application to the Native Vegetation Council for approval to clear vegetation will be submitted prior to the commencement of construction and an environmental offset in the form of a Significant Environmental Benefit (SEB) will be achieved (e.g. in the form of a Credit SEB area established by a third party, an on-ground SEB or a payment into the Native Vegetation Fund) as required under the *Native Vegetation Act 1991*.

4.2.8. *Natural Resources Management Act 2004* (SA)

The *Natural Resources Management Act 2004* (NRM Act) applies to a range of aspects of natural resources management. Of particular relevance to the Project are provisions addressing activities which affect surface water and groundwater resources, as well as management of pest plants and animals.

Both the NRM Act and the Northern and Yorke Natural Regional Resources Management Plan (NYNRM 2009) set out a number of 'water affecting activities' that must not be undertaken without a permit, including construction of buildings or structures in a watercourse, lake or floodplain and depositing solid material in a watercourse or lake. However, previous advice from the Department of Environment and Water (DEW) is that a separate water affecting activity permit will not be required as this matter is covered by the development approval process[3].

The NRM Act also regulates the taking and use of water in Prescribed Wells Areas or Prescribed Water Resources Areas (PWRA). The Project falls within the Baroota PWRA which was prescribed in 2008 and incorporates surface and underground water (DEWNR 2017b). The PWRA is a local-scale resource for which groundwater, surface water and watercourse water are prescribed under the NRM Act. Groundwater extractions are limited under a Notice of Prohibition, pending the development and adoption of a water allocation plan that will provide for sustainable management of the resource (DENWR 2017b).

The Northern and Yorke Natural Resources Management Board has developed a *Concept Statement for the Water Allocation Plan for the Baroota Prescribed Water Resources Area* (DEWNR 2009). The necessary permits / licences required under the draft water allocation plan will be obtained prior to construction. Any assessment and the necessary permitting documentation will be completed in consultation with Natural Resources Northern and Yorke.

4.2.9. Other Approvals

There may be other approvals required prior to any construction activities commencing on the Project, such as authorisation to place infrastructure and access tracks across road reserves under the *Local Government Act 1999* and possibly *the Roads (Opening and Closing) Act 1991.*

Electricity generation licensing under the *Electricity Act 1996* and registration with the Australian Energy Market Operator are being undertaken outside this development application.

[3] Under Section 129(1)(e) of the Act, a water affecting activity permit is not required for activities that have been authorised by a development authorisation under the *Development Act 1993.*

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5. Stakeholder Engagement

This section provides an overview of Rise's stakeholder and community engagement undertaken for the Project. It also provides a summary of how Rise plans to manage engagement with stakeholders during all phases of the Project.

The Project provides significant employment and economic opportunities for nearby communities, particularly during the 30-month construction period. Rise will engage with relevant suppliers to utilise, as far as practicable, local resources. Community sessions will provide information for individuals and organisations to identify, and be considered for, available Project opportunities, including employment and procurement.

5.1. Approach

In accordance with Section 49(7)(d) of the Development Act, this Development Application will undertake a public exhibition of at least 15 business days. A notice will be published in a newspaper advising the type of development and its location, and copies of the documentation will be made available for public access at the District Council of Mount Remarkable office, State Government offices and SA Planning Portal.

Rise has implemented a fit for purpose program which has focused on local community engagement to ensure stakeholders are informed and have opportunity to provide comment on the Project.

Feedback received has been addressed in this document and, where practicable, will be incorporated into the Project management plans.

Rise has identified an initial list of stakeholders for engagement (see Table 5-1) and this will be updated as the Project progresses.

Table 5-1: Key stakeholders

Group	Stakeholders
Landholders (Directly Impacted)	The Solar Project is located on freehold title owned by a single owner. The Pumped Hydro Project and proposed upper reservoir is on land held under a perpetual lease by the Wongi-Ahrah Aboriginal Association. The existing lower reservoir is owned by SA Water.
Local Community	Communities of Melrose, Port Germein, and adjoining areas
Local Government	District Council of Mt Remarkable Colin Nottle, Mayor Wayne Hart, Chief Executive Officer Hayley Trott, Community Engagement Officer
Native Title / Cultural Heritage Groups	Traditional Owners of the immediate area Wongi-Ahrah Aboriginal Association
Industry	ElectraNet SA Water Potential suppliers
Media	Regional, state and national media organisations
State Government	Department of Premier and Cabinet Department of State Development (former) Department of Environment and Water Northern and Yorke Natural Resources Management Native Vegetation Council Department of Planning, Transport and Infrastructure State Planning Commission and State Commission Assessment Panel Country Fire Service Office of the Technical Regulator

Group	Stakeholders
State, Federal and Local Political Representatives	State Members of Parliament Federal Members of Parliament Local Elected Officials
Regional Development	Regional Development Australia Yorke and Mid North

5.2. Engagement Program

From the initial Project stages, Rise has focused on building local connections through stakeholder meetings and presentations, including with Council, elected members and landowners. In particular Rise has worked with landowners of the Solar Project site, and Wongi-Ahrah Association and Heritage representatives of the Traditional Owners, to undertake cultural heritage surveys. Rise is committed to continuing to engage with the Traditional Owners and local indigenous community.

One-on-one meetings have been undertaken with key stakeholders with subsequent communications as required. These meetings have introduced the Project and provided an opportunity for stakeholders to express potential concerns and support for the Project. The feedback received through engagement has been positive. Importantly, no significant concerns have been raised by any party during the consultation process. Stakeholders engaged to date have raised positive feedback regarding the economic benefits the project will bring to the local community and region.

Rise's engagement approach has included a particular focus on stakeholders who have a direct interest in the Project. Rise has engaged with SA Water, the Wongi-Ahrah Aboriginal Association (Pumped Hydro site), Landholders (Solar site) and the Council.

Table 5-2: Stakeholder engagement undertaken

Stakeholder Groups	Brief Description
SA Water	• Rise have undertaken ongoing one-on-one, face to face meetings with SA Water. • Rise and SA Water have identified key personnel to assist with project delivery. SA Water will provide ongoing access to, and maintenance of, the Baroota Reservoir.
Wongi-Ahrah Aboriginal Association (Pumped Hydro site)	• Rise have undertaken ongoing one-on-one, face to face meetings with Wongi-Ahrah Aboriginal Association. Wongi-Ahrah have assisted with cultural heritage surveys and have been consulted regarding cultural heritage management recommendations. • Rise has an access licence and option to lease agreement with the Wongi-Ahrah. • Rise is committed to working with the Wongi-Ahrah across the lifecycle of the Project. This includes working with the Wongi-Ahrah during the detailed design phase to gain understanding and feedback on design considerations and identifying opportunities for mutual collaboration with regards to local economic development opportunities.
Landholders (Solar site)	• Rise have undertaken ongoing one-on-one, face to face meetings with the landholders. • The landholders have provided long-term support for the Project through an access licence and option to lease agreement. • Rise will continue working with the landholders during the detailed design phase to gain understanding and feedback on design considerations.
Council	• Rise have undertaken one-on-one, face to face meetings with the Council. • Rise have engaged with Council on a range of specific themes including business and economic benefits for the District and employment opportunities for the community. • Rise will continue engaging with the Council as the Project progresses.

Regular meetings have been undertaken with the South Australian Government (the former Department of State Development, DEW and DPTI) and targeted technical meetings held to secure feedback from entities within government agencies including the Office of the Technical Regulator (OTR) and Native Vegetation Council (NVC). In addition, meetings have been held with ElectraNet and the Country Fire Service. Feedback received at the meetings has been considered and incorporated into relevant sections of the Development Application, particularly in relation to a SEB for native vegetation clearance.

Discussions will continue to be held be held with other stakeholders, including licensing authorities that may have a regulatory interest in the Project, such as the EPA and Australian Rail Track Corporation (ARTC).

Rise will utilise the Industry Capability Network (ICN) Gateway to engage with local, regional and state based suppliers and to ensure they are provided full, fair and equal opportunity to participate in the procurement process.

5.2.1. Community Engagement

Rise held a drop-in Community and Stakeholder Information Session on Thursday, July 19th at the Port Germein Bowling Club regarding the development application. This provided an opportunity to inform the community of the development assessment process, opportunities available and provide clear next steps information in relation to the progress of the Project. The community session was publicised by Rise using the following methods:

- Newspaper advertisement – in the Flinders News;
- Targeted – emails to key stakeholders; and
- Council website.

Approximately 40 people attended. Attendees were predominantly from the surrounding area including Port Pirie, Baroota and Port Germein. Overall feedback and conversations were positive and community members expressed interest in:

- Employment opportunities;
- Economic benefits for the region;
- Supplier/services opportunities;
- Construction timeline; and
- Technical aspects of the Project.

Plate 5-1: Community session presentation

Representations made about the Project during the statutory notification period will be formally addressed by Rise within ten business days as part of the development application assessment process. Relevant feedback captured through that process, including from government agencies and the planned community information session, may be considered by Rise during detailed design and when preparing management plans.

5.3. Ongoing Engagement

Rise will undertake an ongoing program of engagement during construction and operation of the Project. Rise will have continued and ongoing work with the Traditional Owners of the immediate area including to establish a Cultural Heritage Management Plan. Liaison with Council regarding the progress of the Project will be ongoing.

Rise will continue to provide information to stakeholders through the Rise Renewables Website.

Should the Minister approve the development, Rise will review stakeholder engagement activities and develop a program appropriate for engagement during construction and operation.

6. Physical Environment Assessment

6.1. Geology and Soil

6.1.1. Existing Environment

6.1.1.1. Pumped Hydro Project

The topography of Baroota Reservoir Reserve is characterised by rolling hills and ranges from 120-200 m above sea level. The topography of the broader Separation Creek Land System, within which the Project sits, consists of steep to very steep hills east of Baroota Reservoir, ranging in elevation between 100 m AHD at the reservoir dam wall to 780 m AHD at the top of the catchment in the north-east (DEWNR 2017a).

The 1:250,000 Geology Survey of South Australia Orroroo Map (Sheet SI 54-01) and South Australian Resources Information Gateway (SARIG) shown on Figure 6-1 provide a summary of the regional geology, which is complex, associated with the Palaeozoic folding of Neoproterozoic sedimentary rocks. The area of the lower reservoir is characterised by the Tapley Hill formation (Nnt) described by the Geology Survey of South Australia as siltstone, grey, dolomitic and pyritic grading upwards to calcareous, thinly laminated, locally cross-bedded; dolomite, grey flaggy to massive; limestone conglomerate, intraformational; greywacke. Thin areas of shale and thinly laminated beds and lenses of grey dolomite were also noted, consistent with the Tindepina Shale Member (Nntt) formation. The access track and upper reservoir area lie within an area defined by the Angepena Formation (Nia), characterised by thinly bedded, reddish siltstone; interbeds of dolomite and minor grey-green shale; as well as pisolitic and algal limestone, and the Appila Tillite (Nya) formation, characterised by tillite; quartzite, siltstone. Massive, grey.

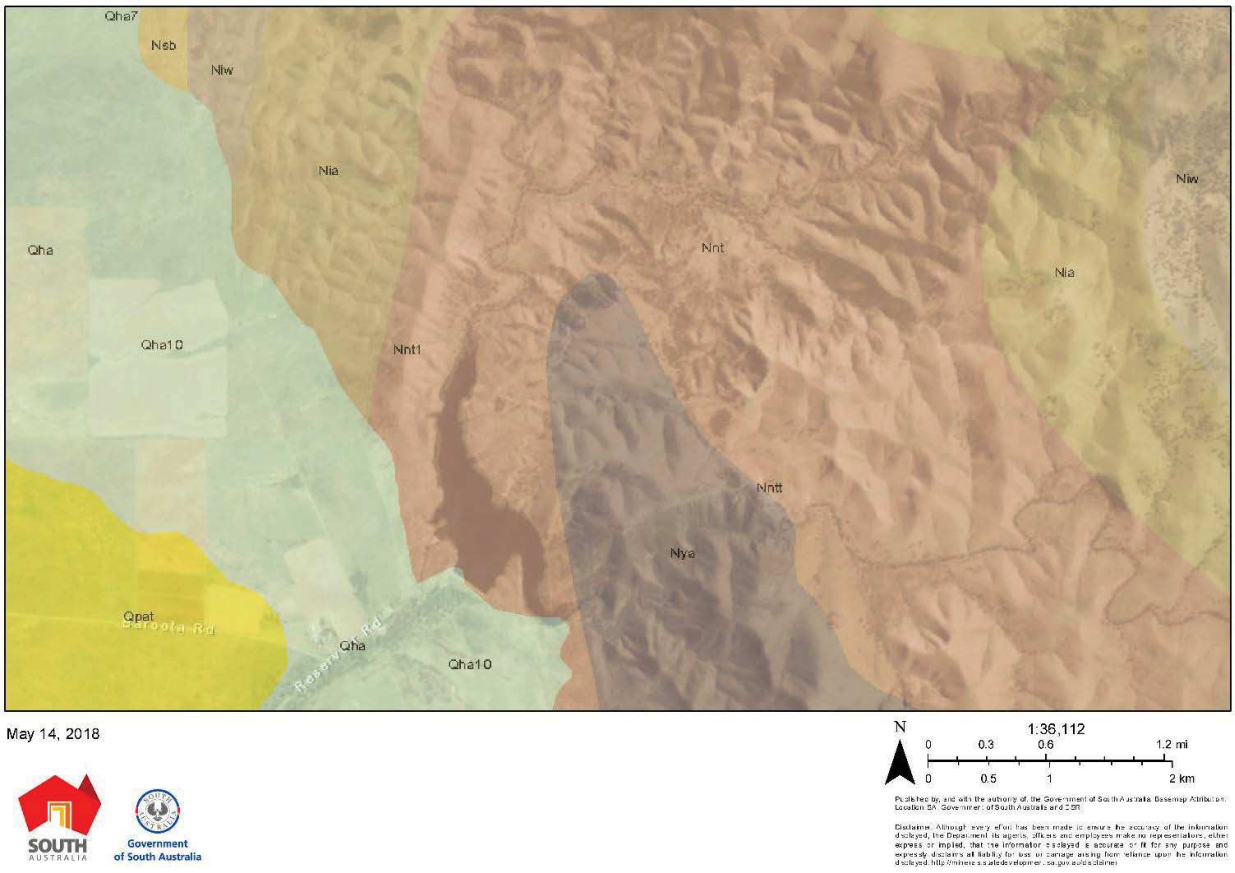

Figure 6-1: Baroota regional geology

Two Neoproterozoic - Ordovician faults are identified within the broader Project area; one beneath the Solar Project, and one approximately 6 km to the east extending in a north-east direction towards Melrose (Figure 6-2). However, it is noted that the 1:250,000 *Orroroo* Geology Map referenced above did not identify any faults within the broader Project area. No registered earthquakes were noted within the Pumped Hydro Project footprint, although it is noted that a 4.5 magnitude earthquake was reported to the north-east of the area on 15 September 1853. Multiple smaller earthquakes were noted within a 10 km radius of the site, predominantly to the east of the Project area within the Flinders Ranges. The upper reservoir will be designed to meet the relevant Australian National Committee on Large Dams (ANCOLD) guidelines, based on the local geological and seismic conditions at the site. It is noted that Australia (and the Project site) sits within the Indo-Australian Plate, which is considered a Stable Continental Region in terms of seismicity, hosting 0.2% of the worlds seismic releases (Clark *et. al.* 2014). For comparison purposes, the province of British Columbia in Canada sits adjacent the Cascadia subduction zone, which may generate earthquakes up to magnitude 9 on the Richter Scale (BC Hydro 2012). Hydroelectric dams in British Columbia produce 87% of that provinces electricity supply (EnergyBC 2016), indicating that with the proper design considerations, hydroelectric dams can be installed and operated successfully in seismically active areas.

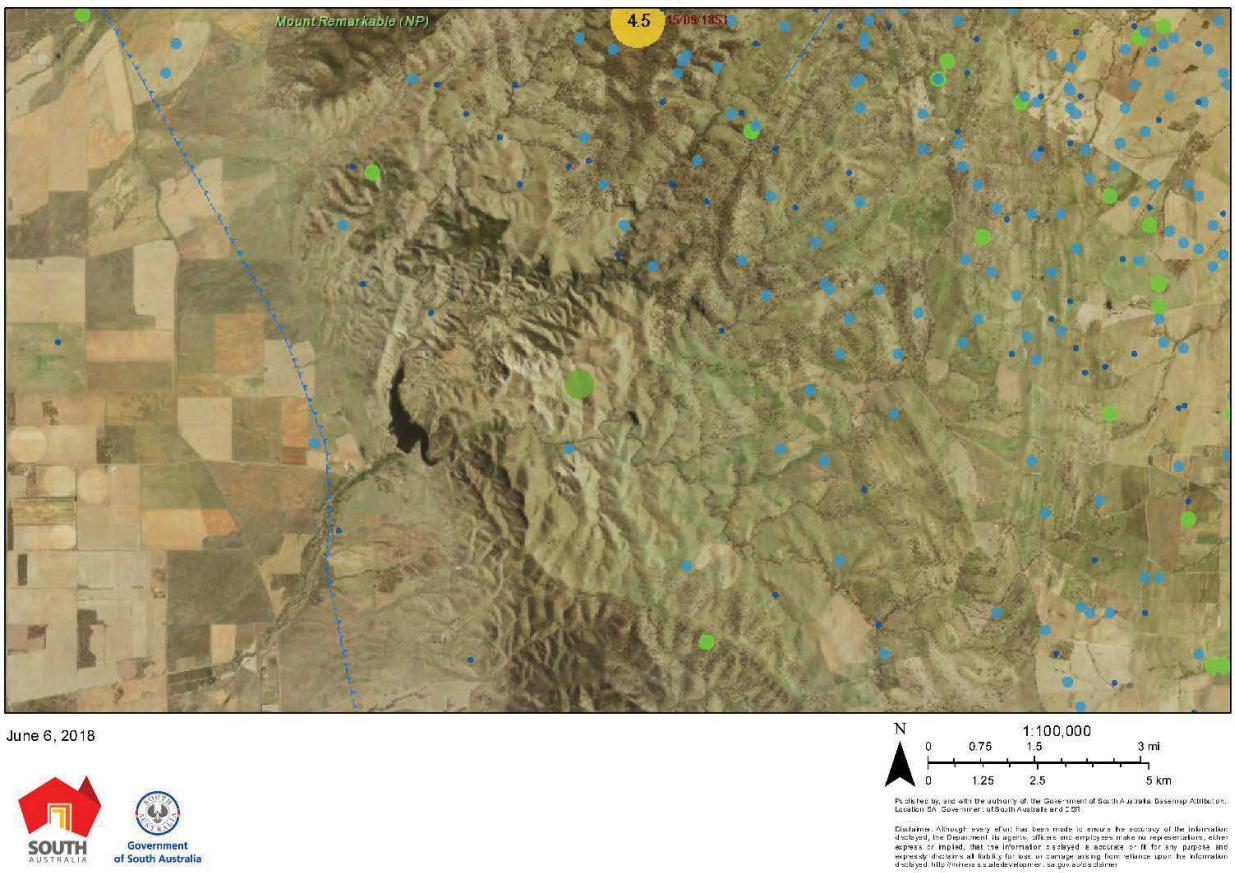

Figure 6-2: Faults and registered earthquakes surrounding the Project area

The upper reservoir area and a portion of the broader Separation Creek Land System drain directly into the Baroota Reservoir via the main (Separation and Waterfall Creeks) or smaller tributaries, which occupy narrow valleys with a strongly pronounced v-shaped cross section. Most soil is shallow over basement rock, which outcrops consistently throughout the regional area (Plate 6-1), however there is also deeper soil with red or brown clayey subsoil formed in weathering rock (DEWNR 2017a), typically associated with depositional areas at the base of slopes or tributaries.

Based on the steep, precipitous hill country, this area is virtually non-arable and mostly inaccessible to implements (Plate 6-2). As such, use is restricted to grazing (DEWNR 2017a).

Plate 6-1: Inclined sedimentary Tapley Hill formation outcrop above the proposed upper reservoir (Source: JBS&G)

Plate 6-2: Rolling hills within the surrounding area of the proposed upper reservoir, looking east (Source: JBS&G)

6.1.1.2. Solar Project

The Solar Project site lies within the Nelshaby Land System (DEWNR 2017a) which is a gently sloping outwash fan abutting the Southern Flinders Ranges with deep, inherently fertile but often poorly structured soil. The Geology Survey of South Australia and SARIG indicate the underlying geology consists of undefined Holocene alluvial fluvial sediments (Qha), with areas of high to low angle slope deposits, as well as colluvium and alluvium (Qha10). Soil in the area is characterised by gravelly and sandy clays, displaying soft carbonate associated with windblown coastal particles leaching into the soil.

The topography of the site and surrounding land consists of alluvial plains and fans occurring as a band up to 5 km wide along the western side of the Southern Flinders Ranges (Plate 6-3, Plate 6-4 and Plate 6-5). The slopes are traversed by watercourses, most of which originate from the frontal escarpment and are closely spaced (approximately 500 m apart). Several larger streams from further east in the ranges also cross the Nelshaby land system. These include Mt. Gullet Creek, Mambray Creek, Baroota Creek and Telowie Creek. Watercourses are eroded in places, particularly on the steeper slopes adjacent to the ranges.

The elevation along the base of the escarpment varies from 240 m in the south (near Crystal Brook) to 20 m in the north. The proposed location of the Bridle Track Solar site has a minimum elevation of approximately 52 m within the south-western portion of the site, and a maximum elevation of approximately 114 m within the north-eastern portion of the site.

The site has a moderate to high water erosion (non-arable) potential. Wind erosion is classified as low across the site (indicating 'no special management needed'; DEWNR 2009a, b). Baroota Creek and the land immediately to the south has been mapped as moderately low water erosion potential ('modified surface management needed') (DEWNR 2009a).

The predominant past land use across the site (grazing) is not likely to have resulted in widespread site contamination. While there is always potential for small-scale localised contamination if fuel or chemicals have been spilled on the site, this is not considered likely. A search of the South Australian Contamination Site Index has identified that no contaminated sites are located in the Project area (EPA 2018). A Construction Environmental Management Plan (CEMP) will be developed to manage any contaminated land related issues that may arise during construction.

Plate 6-3: Overall topography of the Solar Project site near the centre of the site, looking south-west (Source: Alluvium)

Plate 6-4: Gentle slopes leading to the ranges from the eastern boundary of the Solar Project, looking east (Source: BS&G)

Plate 6-5: Alluvial plains looking from the Solar Project location towards the ranges, looking south-east (Source: JBS&G)

6.1.2. Potential Impacts and Proposed Mitigation Measures

6.1.2.1. Pumped Hydro Project

Construction and Decommissioning

Construction and decommissioning activities may result in impacts to soil, including erosion and sedimentation, soil compaction, soil inversion and soil contamination. These are discussed further in the following paragraphs. Construction activities can also result in dust generation which is discussed further in Section 6.3.

Erosion and Sedimentation

Excavation and earthworks carried out during construction will disturb the ground surface and have the potential to cause soil erosion and subsequent sedimentation of surface water. Excavation and earthworks will be required for the construction of the upper reservoir, penstock trench, access tracks, powerhouse, construction compound, substation and switchyard, site offices, lay down and parking areas. It is noted that the location of the upper reservoir has been chosen based on an existing 'bowl' like topography, which will minimise the volume of rock and soil requiring management during the construction.

The most significant earthworks will be associated with the construction of the upper reservoir, the penstock trench and the powerhouse. These earthworks involve the removal of vegetation cover and disturbance of soil which will increase the potential for erosion, especially on sloped areas around the edge of the reservoir and the penstock trench. Due to the nature of the excavation works, there is limited potential for off-site impacts due to the internal nature of the drainage. However, measures such as installation of berms or drainage controls, stockpile management and maintenance of sediment/erosion controls will be implemented during all excavation works. The penstock trenches will be backfilled and compacted to a level consistent with surrounding soil to minimise the potential for subsidence and erosion and to promote revegetation.

Soil Compaction and Inversion

The structure of the soil and particularly the underlying lithology will influence the final design construction methodology across the entire Project footprint. Detailed geotechnical investigations will be carried out to inform the detailed design.

Compaction of soil in areas of temporary disturbance (such as equipment and machinery laydown areas or areas of heavy vehicle traffic) can change local drainage patterns and prevent effective plant growth following completion of construction. Soil compaction impacts will generally be limited to defined areas. Heavy vehicle traffic will generally be restricted to constructed access tracks on the site. Activities causing excessive rutting or soil compaction will be restricted in wet or boggy conditions. Areas of temporary disturbance (e.g. laydown areas) will be ripped or scarified where appropriate to alleviate compaction. Areas of temporary disturbance will be located within the final / permanent disturbance footprint where possible.

The mixing of different soil layers during excavation (soil inversion) can adversely affect plant growth after backfilling of the excavation. In locations where the natural surface cover will be reinstated following excavation (e.g. penstock trench), topsoil will be stockpiled separately for use in reinstatement to minimise this impact.

Soil Contamination

The storage and use of chemicals on-site has the potential to result in localised soil contamination if a spill occurs and could result in off-site contamination if the spill is not appropriately managed. Chemicals on-site would include fuel, lubricants and herbicides in relatively limited quantities. The risk of contamination will be minimised by storage and handling of fuel and chemicals in accordance with relevant standards and guidelines and the implementation of procedures to contain and clean up spills should they occur.

Contaminated soil can potentially be encountered during excavation activities. Although relatively unlikely at this site, measures to respond to this situation will be included in the CEMP.

Operation

The potential impacts to soil during operation are likely to be very limited. Maintenance activities and vehicle movements would generally be confined to the access tracks.

Erosion and runoff

The slopes of the upper reservoir may create sheet flow from surface water runoff during initial stages of operation. These areas will be rehabilitated following the completion of construction. Monitoring will be undertaken to identify whether any areas of erosion emerge and further mitigation measures would be implemented where required.

Drainage features or structures associated with the penstock, permanent access tracks, hardstand areas, buildings and other site infrastructure will be designed to minimise the potential for erosion or transport of sediment off the site. Where possible, vegetation cover will be retained at the site and construction works will be phased to minimise soil disturbance.

Soil Contamination

Soil contamination could potentially occur as a result of a spill of fuel or chemicals (e.g. lubricants or herbicides) however the volumes used will generally be low. The risk of contamination will be minimised by storage and handling of fuel and chemicals in accordance with relevant standards and guidelines and the implementation of procedures to contain and clean up spills should they occur.

6.1.2.2. Solar Project

Construction and Decommissioning

Similar to the Pumped Hydro Project, construction and decommissioning activities for the Solar Project may result in impacts to soil, including erosion and sedimentation, soil compaction, soil inversion and soil contamination. These are discussed further below. Construction activities can also result in dust generation which is discussed further in Section 6.3.

The poorly structured, alluvial soil will likely influence the installation method and depth of the support poles for the solar arrays. Geotechnical investigations, such as shallow trenches, will be carried out to inform the detailed design.

Erosion and Sedimentation

Excavation and earthworks will be required for the construction of new access tracks, the construction compound, substation, site offices, lay down and parking areas, however large-scale bulk earthworks will not generally be required due to the relatively flat terrain.

Installation of the support posts for the solar arrays by pile driving or screwing uses light equipment and involves very limited disturbance to soil. The areas of disturbance have a small and discrete footprint and are sparsely distributed and groundcover is retained as far as possible.

The relatively flat terrain, limited drainage network and low susceptibility of the soil to erosion indicate that any impacts are likely to be relatively minor and localised. The larger areas of excavation (e.g. the substation) are located in the eastern part of the site where there is no potential for off-site impacts due to the internal nature of the drainage. Measures such as installation of berms or drainage controls, stockpile management and maintenance of sediment/erosion controls will be implemented for excavations such as cable trenches that cross or are in the vicinity of the ephemeral watercourse that traverses the site, as discussed in Section 6.2. Trenches will be backfilled and compacted to a level consistent with surrounding soil to minimise the potential for subsidence and erosion.

Soil Compaction and Inversion

Compaction of soil in areas of temporary disturbance (such as equipment and machinery laydown areas or areas of heavy vehicle traffic) can change local drainage patterns and prevent effective plant growth following completion of construction. Soil compaction impacts will generally be limited to defined areas. Heavy vehicle traffic will generally be restricted to constructed access tracks on the site. Activities causing excessive rutting or soil compaction will be restricted in wet or boggy conditions. Areas of temporary disturbance (e.g. laydown areas) will be ripped or scarified where appropriate to alleviate compaction. Areas of temporary disturbance will be located within the final / permanent disturbance footprint where possible.

The mixing of different soil layers during excavation (soil inversion) can adversely affect plant growth after backfilling of the excavation. In locations where the natural surface cover will be reinstated following excavation (e.g. trenches for cables), topsoil will be stockpiled separately for use in reinstatement to minimise this impact.

Soil Contamination

Similar to the Pumped Hydro Project, soil contamination will be managed through the CEMP and will have the same level of mitigation and control measures.

Operation

The potential impacts to soil during operation are likely to be very limited. Maintenance activities and vehicle movements would generally be confined to the access tracks.

Erosion and runoff

The potential for wind erosion will be low, given the nature of site soil and the stabilisation provided by vegetation that will be allowed to remain (or regenerate) across the site. Areas that are temporarily disturbed (e.g. laydown areas) will be rehabilitated following the completion of construction. Drainage features or structures associated with permanent access tracks, hardstand areas, buildings and other site infrastructure to minimise potential for erosion or transport of sediment off the site.

Concentrated runoff from the solar panels could result in increased soil erosion below the solar arrays during significant rainfall events. The potential for significant erosion from rainfall runoff is relatively low given the low rainfall and relatively flat nature of the site, and is further reduced by retaining vegetation cover and minimising soil disturbance. Monitoring will be undertaken to identify whether any areas of erosion develop, and further mitigation measures would be implemented where required.

Soil Contamination

Soil contamination could potentially occur because of a spill of fuel or chemicals (e.g. lubricants or herbicides), however the volumes used will generally be low. The risk of contamination will be minimised by storage and handling of fuel and chemicals in accordance with relevant standards and guidelines and the implementation of procedures to contain and clean up spills should they occur.

6.1.3. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 6-1. These measures will be captured in the CEMP or Operational Environmental Management Plan (OEMP).

Table 6-1: Soil - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Minimise disturbance to soil surface and retain ground cover as much as possible, prior to and during construction, to minimise areas exposed to erosion.	✓		
Hydro Solar	Stockpile topsoil separately from subsoil, particularly in areas where the natural surface will be reinstated.	✓		
Hydro Solar	Minimise the area of soil disturbance (e.g. excavation) where possible.	✓		
Hydro Solar	Locate areas of temporary disturbance within the final / permanent disturbance footprint where possible.	✓		
Hydro Solar	Rehabilitate areas of disturbed soil promptly and progressively during construction.	✓		
Hydro Solar	Implement appropriate sediment and erosion controls during construction such as installation of berms or drainage controls, stockpile management and maintenance of sediment/erosion controls.	✓		
Hydro Solar	Change in surface water drainage pathways causing erosion to be included in the CEMP and mitigated during construction	✓		

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Design to consider surface water drainage and possible erosion and install appropriate permanent soil erosion and drainage management measures.		✓	
Hydro Solar	Backfill and compact trenches to a level consistent with surrounding soils or in line with final facility design to minimise the potential for subsidence and erosion.	✓		
Hydro Solar	Design any drainage features or structures associated with permanent access tracks, hardstand areas, buildings and other site infrastructure to minimise potential for erosion or transport of sediment off-site.	✓	✓	
Hydro Solar	Rip or scarify areas of temporary disturbance (e.g. laydown areas) where appropriate to promote revegetation.	✓		
Hydro Solar	Undertake monitoring for erosion and implement further mitigation measures where required.	✓	✓	
Hydro Solar	Restrict activities causing excessive rutting or soil compaction in wet or boggy conditions.	✓	✓	✓
Hydro Solar	Undertake storage and handling of fuel and chemicals in accordance with relevant standards and guidelines (e.g. EPA bunding guidelines and AS 1940).	✓	✓	✓
Hydro Solar	Undertake refuelling and maintenance of plant and machinery with appropriate spill containment measures in place (e.g. use of drip trays or in lined, bunded areas).	✓	✓	✓
Hydro Solar	Regularly inspect machinery for leaks and maintain in good working order.	✓	✓	✓
Hydro Solar	Locate transformers in the substation on self-bunded pads to contain potential leaks and spills.		✓	
Hydro Solar	Maintain incident procedures to contain and clean up spills should they occur.	✓	✓	✓
Hydro Solar	Develop protocol for dealing with potential contaminants (e.g. pesticide containers) if discovered during construction.	✓		

6.2. Water

A surface water and groundwater assessment has been undertaken for the Project by Alluvium (2018). This assessment is provided in Appendix B and forms the basis of the information in this section.

6.2.1. Existing Environment

The Project is located entirely within the Baroota Prescribed Water Resources Area (PWRA), which was prescribed in 2008. The PWRA is a local-scale resource for which groundwater, surface water and watercourse water are prescribed under South Australia's NRM Act. Groundwater extractions are limited under a Notice of Prohibition, pending the development and adoption of a water allocation plan that will provide for sustainable management of the resource (DENWR 2017b).

A requirement of the Baroota PWRA is the development of a Baroota Water Allocation Plan (WAP). The WAP is being developed by the Northern and Yorke Natural Resources Management Board in collaboration with key stakeholders (DEWNR 2009). The WAP aims to:

- Protect the resource for all water users and water dependent ecosystems, now and into the future; and
- Provide greater certainty for water users.

6.2.1.1. Pumped Hydro Project

Surface Water

The site falls within the Baroota Creek catchment located in the Southern Flinders Ranges within the Mambray Coast drainage basin in the North St Vincent-Spencer Gulf region. The existing reservoir has been described in detail within Section 2.2.3.1. The reservoir receives runoff directly from the broader Baroota Creek catchment, including Waterfall Creek and Baroota Creek, fed by Separation Creek, as well as smaller tributaries draining directly from the area around the upper reservoir.

Analysis of stream flows was undertaken to consider potentially affected watercourses. Stream ordering provides an indication of the relative size of a watercourse within a climatic and geomorphic setting. Stream ordering is a simple method of classifying stream segments based on the number of tributaries upstream. A stream with no tributaries (headwater stream) is considered a first order stream. A segment downstream of the confluence of two first order streams is a second order stream. Thus, a n^{th} order stream is always located downstream of the confluence of two $(n-1)^{th}$ order streams (Strahler 1952).

The stream orders for the Project area are shown in Figure 6-3. The largest order is 3rd. All mapped watercourses are ephemeral, reacting quickly when sufficient rainfall occurs to generate runoff and with flows ceasing rapidly upon cessation of rainfall. As a guide, all the 1st and 2nd order streams are robust due to bedrock confinement, requiring few special management measures. The 3rd order watercourses transport larger flows and may require some additional management actions as detailed in Table 6-2 to minimise erosion risk.

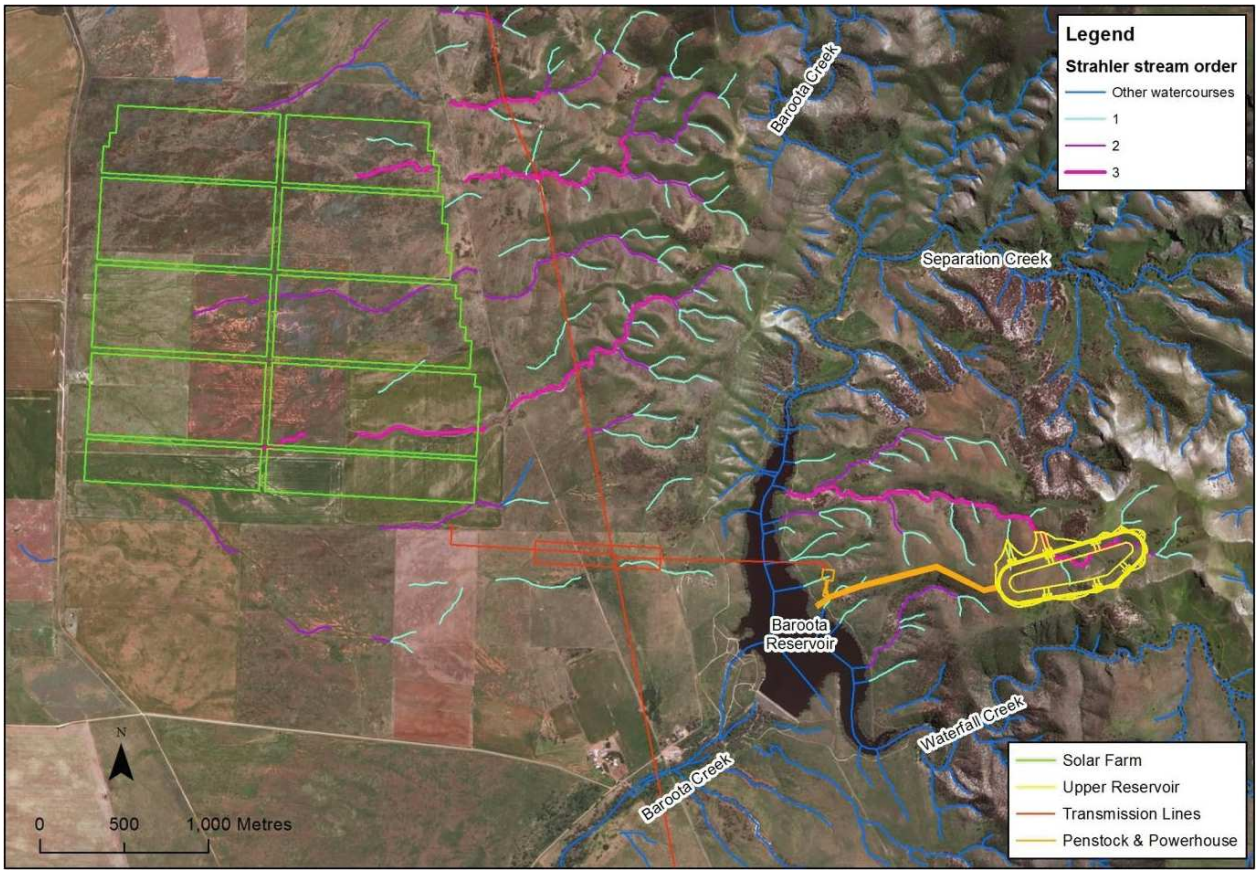

Figure 6-3: Stream orders within the study area and surrounds

Watercourses were also characterised by geomorphic type (Table 6-2). This describes the physical attributes of watercourses reaches and is useful to understand how robust the streams are that may interact with Project activities. Different geomorphic types require different management approaches, particularly in regard to erosion control. Four types of geomorphic category have been assigned to the watercourses that could interact with project components.

Table 6-2: Watercourse geomorphic categories, attributes and management implications

Geomorphic Category	Attributes	Management Implications
Headwaters	Steep flowing upper catchment watercourses that are usually erosion resistant due to bedrock controls and small catchment areas.	Robust streams with some historical incision but limited potential for further erosion. If track crossing of these watercourses is required, then bed level crossing should be constructed.
Confined	90% or greater of these channels are confined by rock at the valley margins. They are highly robust with no potential to migrate laterally.	Very robust watercourses largely with rock bed and banks and very limited potential for erosion.
Partly confined	These watercourses are intermittently confined on at least one side of their valley margins, which limits the potential to migrate laterally.	Robust watercourses largely on rock bed and rock at the margins. Some potential for erosion.
Floodout	These watercourses have a low gradient and when flowing across the alluvial fans and plains floodout or dissipate completely to no defined channel. They are generally robust but can be susceptible to erosion if disturbed.	Some of the drainage lines inspected exhibit erosion over time with some deepening prior to the points where they floodout and dissipate. Erosion is episodic and related to large, infrequent rainfall events. Any project access tracks should avoid channelization of flows and install bed level crossings where crossing of these watercourses is required.

The geomorphic stream types for the study area are shown in Figure 6-4. Photographs of each stream type are shown in Plate 6-6, Plate 6-7 and Plate 6-8.

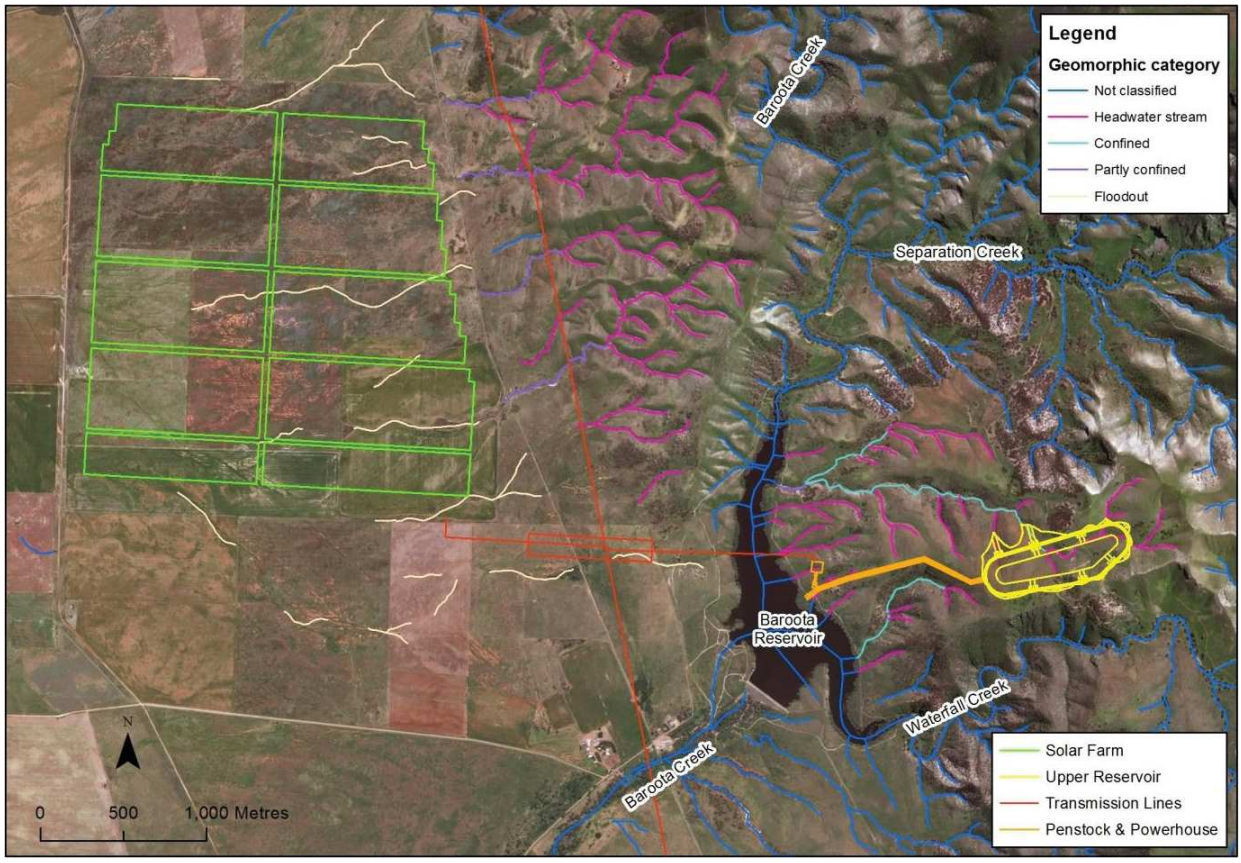

Figure 6-4: Geomorphic stream types within the Project area and surrounds

Plate 6-6: Headwater streams in the un-named upper reservoir catchment (Source: Alluvium)

Plate 6-7: Confined reach of the un-named catchment watercourse (Source: Alluvium)

Plate 6-8: Partly confined reach with some lateral movement (Source: Alluvium)

All of the watercourses that could interact with the Project are ephemeral, ungauged, 1st to 3rd order streams. They are robust with limited erosion risk due to disturbance, have low environmental values due to lack of aquatic habitat values and are common stream types within the region.

Information provided by SA Water indicates that water quality within the Baroota Reservoir is broadly consistent with storages in temperate regions of Australia, with moderately low turbidity values and metals concentrations, low concentrations of nutrients and pesticides but with the presence of cyanobacteria and phytoplankton. Samples were taken on a periodic basis since 1997 from various locations across the reservoir footprint including leakage from the dam wall (Sample ID 2773) (Figure 6-5). Total dissolved solid (TDS) values were reported up to 1,000 mg/L.

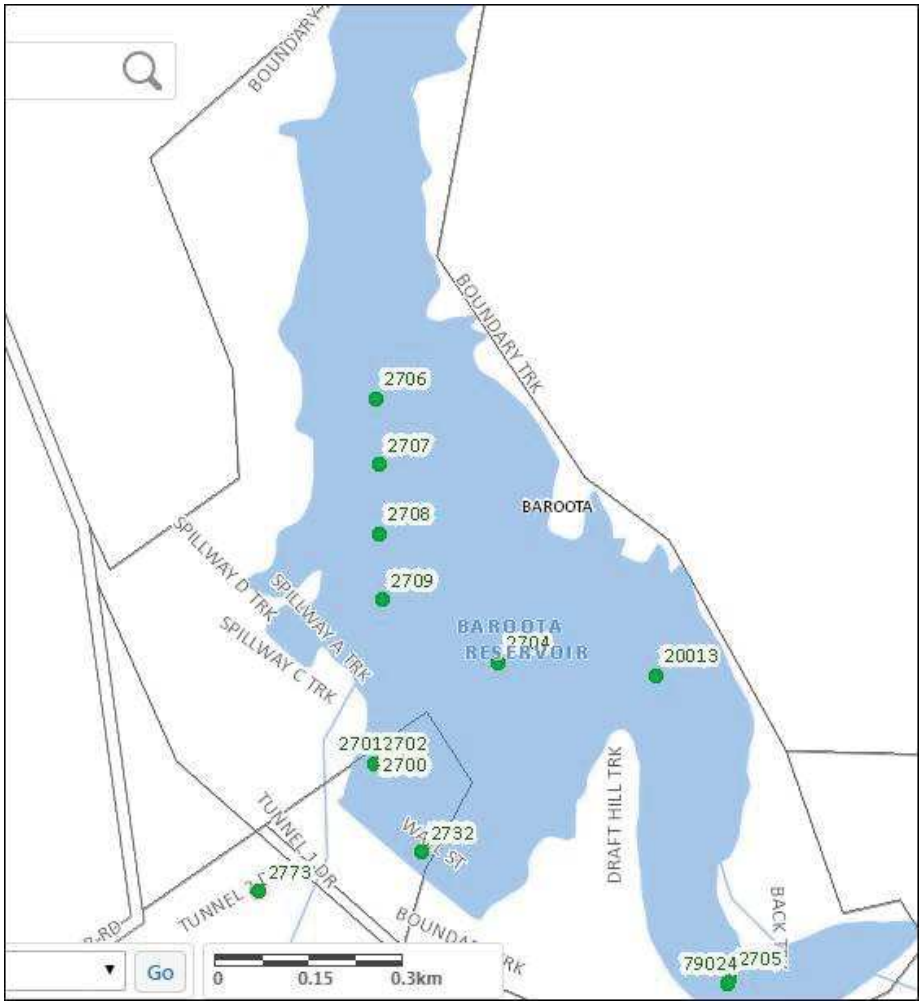

Figure 6-5: SA Water sampling locations and sample IDs

Groundwater

Groundwater within the Pumped Hydro Project area has been identified, as occurring within fractured Cambrian and Precambrian rocks, consisting of quartzite, sandstone, limestone, dolomite, slate, marble, siltstone, phyllite, schist and gneiss (SARIG 2017).

Information on a range of groundwater attributes is available for the region on the SARIG map database. The closest water drill holes to the Project site are approximately 800 m and 1,400 m south in the Waterfall Creek catchment, where historical data (1962 and 1936 respectively) identifies TDS as 2,256 and 2,241 mg/L, respectively, which is in the brackish range suitable for some stock and irrigation of salt-tolerant crops (Harington and Cook 2014). Depth of the bores and depth to groundwater are not recorded. Drill hole locations and TDS for the surrounding area are illustrated on Figure 6-6. It is noted that the groundwater results to the east of the reservoir are higher than those observed downgradient within the Baroota Creek floodplain area.

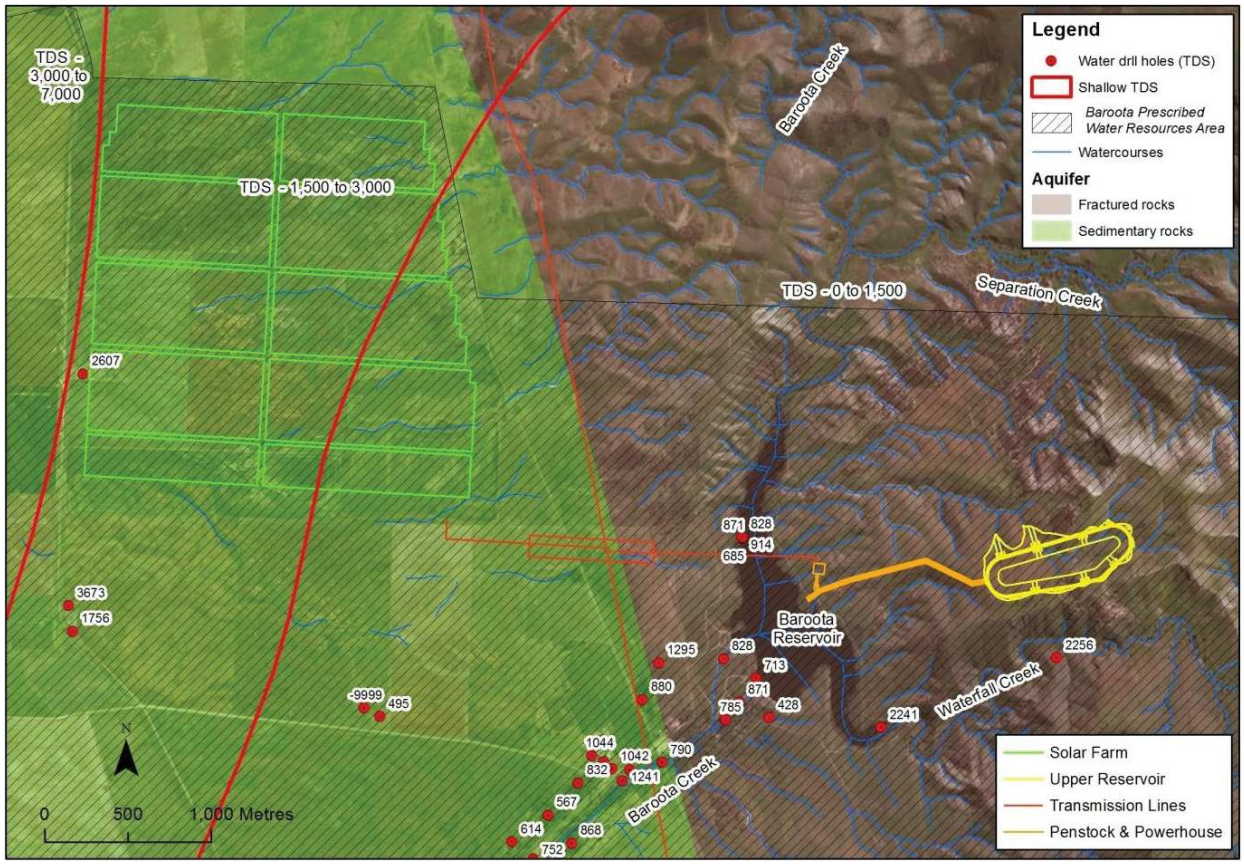

Figure 6-6: Aquifers, water drill holes and measured TDS

Connections between surface water bodies and groundwater may also affect groundwater levels and salinity in the Baroota PWRA. Groundwater flows through the fractured rock aquifer can be expected to be low based on the SARIG recorded water drill hole logs, which show a yield range of 0.5 to 3 L/s. Leakage from the Baroota Reservoir manifests as streamflow along Baroota Creek and may contribute recharge to the groundwater system, especially when the reservoir is full and overflow occurs. Further information on geology and groundwater will be obtained during geotechnical investigations proposed for the site. Groundwater conditions and the potential for interaction with the project components will be further investigated at the detailed design stage.

6.2.1.2. Solar Project

Surface Water

The Solar Project is also located within the Mambray Coast drainage basin but falls to the north of the Baroota Creek catchment, located within an area defined as floodout creeks catchment. These unnamed, short run catchments have a length of between 1 and 3 km, containing only ephemeral watercourses that run off the ranges before flooding out on the adjacent alluvial fans and plains, where they lose their defined channels and dissipate. These types of watercourse channels are called floodouts and are shown clearly in Plate 6-9 and Plate 6-10. The current landowner indicated (P Dennis 2018, personal communication, 18 May) that he had never seen them flowing for much more than a day as they respond quickly to rainfall, with watercourse flows ceasing a short time after cessation of rainfall.

Watercourse characterisations for the Solar Project area are shown on Figure 6-3 and Figure 6-4. Consistent with the Pumped Hydro Project, all of the watercourses that could interact with the Solar Project are, ephemeral, ungauged, 1st to 3rd order streams. They are robust with limited erosion risk due to disturbance; have low environmental values due to lack of aquatic habitat values; and are common stream types within the region. A typical floodout creek at the Solar Project site is shown in Plate 6-9 (upstream) and Plate 6-10 (downstream).

Plate 6-9: Typical floodout creek at the Solar Project site (looking upstream) (Source: Alluvium)

Plate 6-10: Typical floodout creek at the Solar Project site (looking upstream) (Source: Alluvium)

Groundwater

As shown in Figure 6-6, groundwater in the Solar Project area is present within the sedimentary rock aquifer, consisting of limestone, often cavernous, sandstone, sand shale and clay.

Groundwater levels in 2015-2016 were reported to have increased at 8 of 15 groundwater monitoring wells within the broader Baroota PWRA area, likely the result of above average rainfall recorded in 2015-2016. Conversely, below-average rainfall between 2002 and 2009 saw lower surface water inflows to the reservoir and consequently, recharge to the aquifers that underlie Baroota Creek was reduced (DENWR 2017).

TDS contours shown on Figure 6-6 suggest that TDS increases from east to west as you approach the coastline. However, the irregular frequency of salinity monitoring in the past make the interpretation of groundwater salinity data across the Baroota PWRA difficult. However, in the five years to 2016, four wells have data that is suitable for trend analysis, with three of these showing stable salinities and the remaining well showing a rise in trend (DENWR 2017).

6.2.2. Potential Impacts and Proposed Mitigation Measures

All project components will be designed and constructed in accordance with the Code of Practice for the Building and Construction Industry (EPA, 1999), a Soil Erosion and Drainage Management Plan (SEDMP) will be prepared for the construction phase of the Project to specify erosion and sediment management controls. The SEDMP will include soil and erosion control best practice as detailed in the IECA (2008) guidelines "Best Practice Erosion and Sediment Control".

6.2.2.1. Pumped Hydro Project

Construction and Decommissioning

Civil / earthworks required for the construction of the Pumped Hydro Project and associated components and infrastructure will create soil disturbance which has the potential to cause soil erosion if not managed appropriately. The main components where earthworks and excavation are required include upper reservoir and concrete intake and headrace infrastructure, lower reservoir intake and tailrace infrastructure, internal access roads and security fencing, powerhouse, switchyard and combined substation and the penstock.

Upper Reservoir

Based on the nature of the rock formation (to be confirmed during geotechnical investigations), the upper reservoir may not require an engineered synthetic liner to prevent losses to groundwater. However, if the permeability of the local geology is not deemed sufficient during detailed design, a high-density polyethylene (HDPE) liner (or suitable equivalent) will be installed where appropriate.

During construction phase of the upper reservoir, erosion, sediment and drainage controls will be established and works avoided during wetter periods. Given that the shape and size of the upper reservoir, project design will consider using the storage as a temporary sediment basin during the construction and decommissioning phases and then discharge to land or use flocculation agents to settle it prior to commissioning and decommissioning as a hydropower storage. Works will be progressed on the saddle dams to minimise the requirement for construction dewatering, as the more surface water that can be retained within the upper reservoir, the sooner the system can be fully commissioned. Design considerations will be made to manage surface water runoff from the catchment hydraulically above the upper reservoir (1st order and headwater streams), as well as the management of the existing 3rd order stream, which will be slightly modified by the construction of the upper reservoir (Figure 6-3).

Soil material will be generated as a result of the excavation works at the upper reservoir. Soil material will be used to contour the dam wall face and associated saddle dam embankments. Surplus soil material will be used as far as practicable on-site (e.g. to create and maintain access roads and erosion controls), minimising trucking off-site. The surplus soil will be sprayed with a vegetation cover following placement, and will be placed in a manner that minimises potential erosion and sedimentation (Plate 6-11).

Plate 6-11: Example of possible method to be used on surplus soil (Source: Spray Grass)

During construction and into the operational phase the overflow from the reservoir will be managed with a culvert type outlet, which will be integrated into the downstream natural channel with appropriate erosion control.

Penstock

Interaction with groundwater is expected to be limited during construction of the penstock. It is possible that shallow groundwater could be encountered in some sections and dewatering of the trench to complete construction may be required. Upon completion of construction, which will include some backfilling of the trench and rehabilitation of the surface, no further interaction should be expected with the possible exception of ingress of shallow groundwater into the filled trench which may require localised management.

The penstock will be mostly trenched and require appropriate rehabilitation of the backfilled trench using standard industry practice stabilisation measures to manage erosion during construction and operation. One minor watercourse may be crossed depending upon detailed design. If a significant watercourse is to be crossed, consideration will be taken into account to bury the pipeline below any mobile bed material into rock to avoid risk of scour damage and to maintain geomorphic processes.

Powerhouse and switchyard

To drill the powerhouse shaft, it will be necessary to dewater the drill hole temporarily. Some groundwater drawdown can be expected associated with dewatering for the powerhouse shaft. The drawdown is expected to be short-term subject to details of the perimeter dewatering system. Further consideration of potential impacts to groundwater flow will be undertaken at the detailed design stage, following geotechnical investigations, which will inform assessment of potential groundwater impacts.

Detailed design will avoid placement of infrastructure within drainage lines and above 1 in 100-year Average Recurrence Interval (ARI) flood level or provision of flood protection to at least 1 in 100-year ARI flood level.

The building will also include office space and site amenities for workers during operation. Rainwater from the building will either be captured for re-use in site amenities, or directed straight into the reservoir. Disturbance during construction will be managed with standard industry practice erosion and sediment control measures.

The switchyard will have a small footprint with no expected impacts to groundwater.

Tracks and track crossings

If not managed and maintained appropriately, soil disturbance during construction and decommissioning may impact water quality. Design of all tracks and track crossings will include, where relevant, the Guide to Road Design (Austroads 2009).

Lower Reservoir

The potential for the release of contaminated and anoxic sediments will be investigated prior to operations commencing. and appropriate management strategies developed in consultation with SA Water where relevant.

No impacts to groundwater are expected during construction works of the intake structure at the lower reservoir. Potential effects to downstream riparian ecosystems will be considered during the detailed design. The lower reservoir works will have a small footprint with limited disturbance. Standard industry practice erosion and sediment control measures will be applied during construction.

Operation

Sedimentation

The potential for sedimentation of watercourses or other surface water features during operation is low, given the nature of the soils, the stabilisation provided by vegetation that will be allowed to regenerate across the site. Monitoring will be undertaken to identify whether any areas of increased erosion develop (e.g. along the penstock and surrounding the upper reservoir during significant rainfall events erosion) and further mitigation measures would be implemented where required.

Water Quality

Water quality impacts from the changes in reservoir operation with the inclusion of the pumped hydropower storage are expected to be confined to changes in temperature and possibly turbidity due to turbulence from the major water exchange. It may be that changes in the average depth of both storages due to distributing water across them may result in slight increases in temperature if the depths are shallower, but given both storages are relatively deep, the reductions in depth are not anticipated to result in significant shallow areas for heating. Given the existing presence of cyanobacteria and phytoplankton in Baroota Reservoir, these would also be expected in the pumped hydropower storage. The transfer between the two reservoirs will limit the potential for strong thermoclines to establish and anoxic conditions developing within both reservoirs.

Alteration to Water Flows

Vegetation downstream of the existing reservoir is not expected to be significantly impacted by the Project. There will be no direct disturbance and water balance modelling indicates that a large surplus of water (and overflow from the reservoir) will still occur.

A water balance model was developed to examine the changes in the Baroota Reservoir as a result of the operation of the proposed Pumped Hydro Project (Appendix B). The modelling indicates that during operation of the Project, a surplus of water and overflow from the reservoir to the downstream environment will still occur. This surplus will be reduced due to increases in evaporation and infiltration loss, which are not completely offset by increased direct rainfall on the dams and increased potential recharge.

Currently, there is a reasonable level of groundwater flow near the base of the Baroota Dam Wall, and this is largely expected to be as a result of the infiltration out of the existing reservoir. Given the current profile of infiltration losses which increase significantly during heavy rainfall or flood events, any overall reductions would not be expected to have a significant effect.

Contamination

The risk of off-site contamination or shallow groundwater contamination will be minimised by storage and handling of fuel and chemicals in accordance with relevant standards and guidelines and the implementation of procedures to contain and clean up spills should they occur. The volumes of fuel or chemicals used will generally be low.

Transformers in the substation will be located on self-bunded pads to contain potential leaks and spills.

Herbicide use will be minimised during operation and if vegetation control is required, other control methods (e.g. slashing) would preferentially be used. Herbicide use near watercourses would be avoided or strictly controlled.

If an on-site wastewater treatment system is installed, it would be designed and operated in accordance with the On-site Wastewater Systems Code and the *South Australian Public Health (Wastewater) Regulations 2013* to ensure that potential impacts are appropriately managed.

6.2.2.2. Solar Project

Construction and Decommissioning

Sedimentation

As discussed above, excavation and earthworks carried out during construction have the potential to cause soil erosion and subsequent sedimentation of surface water. The main areas where earthworks and excavation are required include new access tracks, substation, the construction compound, site offices, laydown and parking areas and trenches for underground cabling. As noted above, large scale bulk earthworks will not generally be required across the site. Installation of support posts for the solar arrays involves limited disturbance at locations with a small and discrete footprint.

The relatively flat terrain and limited drainage network indicate that any impacts are likely to be relatively minor and localised. The surface water features on-site are highly degraded and have limited ecological value.

Measures will be implemented to minimise the sedimentation risks from excavations such as cable trenches that cross the floodout creeks. These measures may include installation of berms or drainage controls, careful placement and management of soil stockpiles out of potential flow paths and maintenance of sediment/erosion controls. Trenches or other earthworks (e.g. access tracks) that cross the floodout creeks will be completed and reinstated in the shortest time practicable and construction will not be undertaken when water is flowing, or is likely to do so.

As noted above, flow in the floodout creeks is rare and is not prolonged. However, given the poor quality of soil and absence of dense vegetation within the broader catchment, it is likely that turbidity and sediment loads upstream to the east of the Project site would be relatively high during rain events. Based on the relatively flat topography of the Project site, as well as the implementation of the measures discussed above, the risk of significant sedimentation impacting the broader catchment to the west of the Solar Project site as a result of project activities will be low.

Alteration to Water Flows

The Project will have very limited impact on natural water flows. With the exception of the built infrastructure such as the substation and site buildings, the natural topography of the site will generally be maintained. Access tracks will be constructed at or close to natural grade, and trenches will be backfilled to natural surface level.

A detailed hydrological study will be undertaken for detailed design, to refine the understanding of site drainage and confirm design requirements (e.g. height above ground) for solar arrays or other infrastructure that are located in areas of potential inundation. Specific stormwater design will be undertaken where required.

Contamination

The risk of contamination will be minimised by storage and handling of fuel and chemicals in accordance with relevant standards and guidelines and the implementation of procedures to contain and clean up spills should they occur. Refuelling would not be undertaken near watercourses.

Much of the site, including the area where the substation and site buildings will be located has little to no off-site drainage, which further minimises the risk.

Operation

Sedimentation

The potential for sedimentation of watercourses or other surface water features during operation is low, given the nature of the soils, the stabilisation provided by vegetation that will be allowed to regenerate across the site and the limited off-site drainage of much of the site. As discussed under *Soil* in Section 6.1.2, monitoring

will be undertaken to identify whether any areas of increased erosion develop (e.g. below the solar arrays during significant rainfall events erosion) and further mitigation measures would be implemented where required.

Alteration to Water Flows

Surface profiles and natural drainage patterns will largely be maintained, as discussed under *Construction* above. There will be a small increase in impervious area across the site from access tracks, hardstand and roofs. Rainwater will be captured from building roofs. Solar panel arrays result in a very small increase in impervious area as water can infiltrate beneath adjacent (downslope) panels and it is only the panels at the top of slopes where no infiltration occurs under the panels.

Drainage for much of the site terminates internally and there is likely to be minimal change to off-site runoff volumes.

Contamination

The risk of off-site contamination or shallow groundwater contamination will be managed and mitigated as that outlined in Section 6.2.2.1: Contamination.

Water Affecting Activity Permits

Where an activity diverts water, or alters flows from a natural watercourse within a region or potentially impacts on the landscape in a way that threatens the health, a Water Affecting Activity Permit (WAAP) is required under the NRM Act 2004.

Activities likely to require a WAAP include excavation of the upper reservoir and watercourse crossings (tracks or pipeline). The drainage infrastructure and any other water affecting activities proposed will be reviewed during detailed design and Natural Resources Northern and Yorke (the relevant NRM Board) consulted regarding any activities that will required a permit.

Particular consideration of potential impacts (if any) to groundwater recharge will be considered as part of the detailed design to ensure that that any relevant requirements of the Baroota WAP are met.

Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 6-3. These measures will be captured in the CEMP or operational environmental management documentation.

Table 6-3: Water - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Design and construct all project components with regard to the Code of Practice for the Building and Construction Industry (EPA, 1999).	✓		
Hydro Solar	Prepare and implement a Soil Erosion and Drainage Management Plan (SEDMP) and to include soil and erosion control with regard to measures as detailed in the IECA (2008) guidelines "Best Practice Erosion and Sediment Control".	✓		
Hydro Solar	Avoid placement of infrastructure within drainage lines and above 1 in 100-year ARI flood level or provision of flood protection to at least 1 in 100-year ARI flood level.	✓		
Hydro Solar	Design tracks and track crossings in accordance with the Guide to Road Design (Austroads 2009)	✓		
Hydro	Undertake sediment quality analyses of the lower reservoir prior to construction and operation.	✓	✓	
Hydro Solar	Implement measures to minimise erosion and sedimentation outlined under *Soil* (Table 6-1).	✓	✓	✓

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Undertake stormwater design where required (e.g. for buildings and impermeable areas) and ensure that outcomes identified in the Development Plan (e.g. for rate of discharge, flood protection and protection of water quality) are addressed.	✓	✓	
Hydro Solar	Complete and reinstate trenches or other earthworks (e.g. access tracks and drainage paths) in the shortest time practicable. Avoid impeding water flows in the watercourses.	✓		
Hydro Solar	Implement measures for storage and handling of fuel and chemicals, and spill management outlined under *Geology and Soil* (Table 6-1).	✓	✓	✓
Hydro Solar	Implement strict controls on herbicide use (if required) near watercourses (e.g. restrictions on type, application, timing and proximity).		✓	
Hydro Solar	Ensure that sewage treatment and disposal is in accordance with South Australian Public Health (Wastewater) Regulations.	✓	✓	✓

6.3. Climate and Air Quality

6.3.1. Existing Environment

The region's climate is characterised by warm to hot, dry summers, with cool wet winters. Climate information has been sourced from the Bureau of Meteorology (BoM) for the Port Pirie Recording Stations (BoM 2017). The Port Pirie Nyrstar Comparison station was shut in September 2012 but has been referenced to provide long term historical information. Details of these stations are shown in Table 6-4 and the data are summarised in Table 6-5.

Table 6-4: Weather station details

Station Details	Port Pirie Aerodrome AWS	Port Pirie Nyrstar Comparison
Station No:	021139	021043
Status:	Open (2000 -)	Closed 1 September 2012
Latitude:	33.24° S	33.17° S
Longitude:	138.00° E	138.01° E
Elevation (m):	12	2
Approx. distance from project site:	~ 35 km	~ 35 km

The hottest months are between December and March and the coolest are from June to August. Mean daily maximum temperatures range from 16.4°C in July to 32.0°C in January. The mean daily solar exposure from 1990 to 2017 peaked at 27.6 MJ/m^2 in January with a minimum recorded at 8.96 MJ/m^2 in June, contributing to an annual average of 18.5 MJ/m^2 per day. The dominant winds are from the south and north.

Average annual rainfall recorded at Port Pirie Aerodrome AWS is 371.3 mm, with the highest recorded monthly rainfall is 69.8 mm occurring in September 2016.

Average annual rainfall recorded at Port Pirie Nyrstar Comparison is 345.6 mm, with the highest recorded monthly rainfall of 187.7 mm occurring in May 1893.

Table 6-5: Climate records for the Port Pirie area (based on Port Pirie Nyrstar Comparison station)

	J	F	M	A	M	J	J	A	S	O	N	D
Mean Daily Max (°C)	32.0	31.8	29.4	24.8	20.4	17.1	16.4	18.1	21.3	24.5	27.7	30.0
Mean Daily Min (°C)	17.7	17.9	16.0	13.2	10.7	8.4	7.7	8.2	9.8	11.9	14.4	16.3
Mean Monthly Rainfall (mm)	18.6	17.8	18.6	27.5	38.2	40.7	33.9	34.9	35.5	33.3	24.1	23.0

The air quality in the Project area and surrounds is generally expected to be good and typical of that found in a rural setting in South Australia, due to low population numbers and limited industrial activities immediately adjacent the Project area. The nearest long-term ambient air quality monitoring site is at Port Pirie which is on average classified as very good (EPA 2018b). Existing sources of air pollution within the broader project area are expected to include vehicle emissions and dust generated by traffic on unsealed roads and agricultural.

The closest residence to the proposed Hydro Project site is 1.9 km north-east, and 1.5 km south of the Solar Project boundary.

6.3.2. Potential Impacts and Proposed Mitigation Measures

The construction of the Project is not expected to have a significant impact on air quality. There is a risk of dust generation during the construction phase which can be effectively managed by standard measures. There are no significant sources of emissions during operations.

Construction and Decommissioning

The potential exists for the creation of dust through Pumped Hydro Project construction activities including vegetation clearance, earthworks (where required), tunnelling for the above ground and in-tunnel conveyance piping, localised blasting, and the movement of vehicles along unpaved roads and access tracks. Some of the major activities will include site establishment and preparation for construction (vegetation removal, preliminary civil works and drainage) and earthworks associated with the upper reservoir, including excavation, construction of embankments and construction of the upper reservoir intake structure.

The potential exists for the creation of dust through construction of the solar farm including vegetation clearance, earthworks (where required), installation of piers for the solar arrays, trenching for cabling and the movement of vehicles along unpaved roads and access tracks. Earthworks associated with construction would be relatively minor and mostly involve foundations for buildings (substations, inverter stations, maintenance building), trenching for cables and new access tracks. Supports for the solar arrays would be pile driven, therefore resulting in a very small impact area.

Vehicles accessing the site would include the construction labour force, largely using shared (bus) transport and haulage components is expected to occur over 12 – 18 months. Construction of the Pumped Hydro Project is expected to occur over approximately 30 months. Peak periods are likely to occur in the middle and later stages of the construction program for the respective Projects.

Dust control measures will be implemented during construction where required. The unsealed Baroota, Reservoir and Kenihan Roads are likely to require ongoing dust control during Project construction where these roads are used for access.

Construction of the Project is thus expected to have a negligible impact on air quality and is unlikely to impact any sensitive receptors. No air quality impacts in addition to those mentioned for construction are anticipated during the decommissioning phase. Traffic requirements would be similar in type but of shorter duration than that required for the construction phase.

Mitigation strategies include a community consultation and engagement system and complaints mechanism, whereby the sources of complaints are promptly identified and addressed, and appropriate application of a suite of dust and emission reduction measures as outlined below. These measures will be captured in the CEMP.

Operation

Operation of the Hydro Energy Project will have negligible impact on air quality with minimal emissions.
The generation of solar energy during the operation of the Project would generate negligible air quality impacts and emissions.

Maintenance activities during operation would result in some minor, localised vehicle emissions and potentially some generation of dust from vehicles travelling on the unsealed access roads and tracks. The impacts on local and regional air quality are expected to be negligible during normal operation. Operational phase mitigation measures for air quality are outlined below. These measures will be captured in the CEMP and OEMP as relevant

Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 6-6. These measures will be captured in the CEMP or OEMP.

Table 6-6: Air quality - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Air quality management to be included in the CEMP.	✓		
Hydro Solar	Measures to reduce greenhouse gas emissions as much as practicable will be included in the CEMP.	✓		
Hydro Solar	Limit stockpiling of soil and stabilise, if required.	✓		
Hydro Solar	Undertake progressive rehabilitation of disturbed areas during the construction phase.	✓		
Hydro Solar	Implement dust control (e.g. water truck) on access roads and exposed dusty surfaces in response to visual cues, as required. Where possible, stabilising techniques and/or environmentally acceptable dust treatments will be utilised in lieu of wetting controls.	✓		✓
Hydro Solar	Avoid undertaking earthworks during high wind conditions.	✓		✓
Hydro Solar	Maintain suitable surfacing (e.g. gravel) of high traffic areas.	✓	✓	✓
Hydro Solar	Visually monitor dust control measures regularly for effectiveness.	✓	✓	✓
Hydro Solar	Develop a procedure to promptly identify and respond to issues generating complaints.	✓	✓	✓

6.4. Fire

6.4.1. Existing Environment

The surrounds of the Mount Remarkable district exhibit wide extremes of landform with flat plains in the east and west rising to the rugged Southern Flinders Ranges with deeply dissected terrain.

Project sites are in the Flinders Fire Ban District, where fire danger season occurs between 1 November and 15 April each year. The Pumped Hydro and Solar Project sites both fall within the Bushfire Protection Area in the Development Plan's Bushfire Protection Area mapping with a high bushfire risk rating (DPTI 2013). Rise have begun preliminary discussions with the CFS to discuss the Project and ensure all appropriate levels of fire protection are incorporated into the Project design. The High Bushfire Risk area is subject to several of objectives and principles related to bushfire protection, including that:

- Development in a Bushfire Protection Area should be in accordance with those provisions of the *Minister's Code: Undertaking development in Bushfire Protection Areas* that are designated as mandatory for Development Plan Consent purposes;
- Buildings and structures are required to undergo an individual site assessment to determine the level of bushfire attack applicable to the site;
- Buildings and structures should be developed ensuring they are located away from areas that pose an unacceptable bushfire risk and minimise threat of fire spread;
- Buildings and structures should be designed and configured to reduce the impact of bushfire through using simple designs that reduce the potential for trapping burning debris against the building or structure, or between the ground and building floor level in the case of transportable buildings; and

- Vehicle access and driveways to properties and public roads created by land division should be designed and constructed to facilitate safe and effective operational use for firefighting and other emergency vehicles and residents.

6.4.1.1. Pumped Hydro Project

As noted in more detail in Section 7.1.1.1, the Pumped Hydro Project site is characterised by sparse shrublands occurring across areas which were previously cleared for pastoral purposes. Native vegetation is present as a fringe around the reservoir. This vegetation type to the east of the Baroota Reservoir is considered more fire prone with the last recorded bushfire in 1988.

6.4.1.2. Solar Project

As noted in more detail in Section 7.1.1.2, the eastern boundary of the Solar Project site is characterized by mid open tussock grassland (*Austrostipa* species). Tall shrublands (mixed *Acacia* species) cover the lower areas of the ranges to the east of the Project site. Most of the Solar Project site and wider surrounds are primarily used for agricultural purposes. This vegetation type is generally not prone to fire.

6.4.2. Potential Impacts and Proposed Mitigation Measures

Construction and Decommissioning

Construction and decommissioning involve activities that have the potential to increase the risk of bushfire, including hot works such as welding, cutting or soldering (although design minimises these processes), activities such as mowing or slashing and operation of vehicles and equipment.

Activities with a risk of fire ignition will be strictly controlled, particularly during the fire danger season and any permits required (e.g. for hot work on days of total fire ban) would be obtained where necessary. Measures for fire prevention, fire-fighting, site access and emergency response procedures will be developed in consultation with the South Australian Country Fire Service (CFS) and incorporated into the CEMP. It is expected that fire-fighting equipment would be maintained on-site during the fire danger season. Fuel reduction around the site boundary or in other areas would also be undertaken where necessary.

Given the nature of the vegetation at the site and the measures that will be in place, the bushfire hazard associated with construction is manageable. Potential impacts from decommissioning activities would be similar to those for construction and any bushfire risk would also be highly manageable.

Operation

Standard operations including activities such as mowing or slashing could increase bushfire risk. Activities with a risk of fire ignition will be strictly controlled, particularly during the fire danger season, with procedures in place to minimise the risk of fire.

Uncontrolled fires from adjacent off-site areas also pose a risk to workers and infrastructure on the site during operations. Rise will continue to engage and work with the CFS and Council to ensure that the Project incorporates appropriate levels of fire protection, which would likely include:

- Maintenance of perimeter firebreaks around the solar farm in the order of 50 m, with fuel reduction carried out where required;
- Provision of water tanks at every access gate located around the Solar Project boundary;
- Control of fuel loads near solar panels and all other infrastructure (including substation, powerhouse, switchyard) where necessary;
- Establishment of asset protection zones around buildings and facilities and maintenance of these areas to prevent fuel build up;
- Appropriate design and construction of buildings to reduce the impact of bushfire, in accordance with the provisions of the Minister's Code: Undertaking development in Bushfire Protection Areas, the Building Code of Australia and relevant Australian Standards;
- Provision of adequate supplies of water for fire-fighting on-site; and
- Provision of appropriate fire suppression systems and fire-fighting equipment.

Fire risks during operation of the Project are considered highly manageable.

The Baroota Reservoir will continue to be a stand-by water storage for emergency provisions.

6.4.2.1. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 6-7. These measures will be captured in the CEMP and OEMP.

Table 6-7:Fire - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Develop and implement procedures for control of activities with a risk of fire ignition.	✓	✓	✓
Hydro Solar	Develop measures for fire prevention, fire-fighting, site access and emergency response in consultation with the CFS.	✓	✓	✓
Hydro Solar	Obtain any permits required (e.g. for hot work on days of total fire ban) where necessary.	✓	✓	✓
Hydro Solar	Diesel powered heavy machinery only to be used on-site, not petrol.	✓	✓	✓
Hydro Solar	Undertake fuel reduction (vegetation) around the site boundary or in other areas where necessary.	✓	✓	✓
Hydro Solar	Work with the CFS and Council to ensure that the Project incorporates appropriate levels of fire protection including: • establishment of asset protection zones and firebreaks. • appropriate design and construction of buildings to reduce the impact of bushfire, in accordance with the provisions of the Minister's Code: Undertaking development in Bushfire Protection Areas, the Building Code of Australia and relevant Australian Standards. • provision of supplies of water for fire-fighting on-site. • provision of appropriate fire suppression systems and fire-fighting equipment.	✓	✓	
Hydro Solar	Consult with SafeWork SA to ensure that any design, notification and documentation requirements relevant to fire response and fire suppression are met.	✓	✓	✓
Hydro Solar	Liaise with the local CFS to ensure that fire hazards, fire-fighting resources and fire response plans are clearly understood by both parties.	✓	✓	✓
Hydro Solar	Consult with CFS prior to decommissioning to ensure access to the site is appropriate, a water source is available and appropriate controls are in place.			✓

7. Biological Environment Assessment

This section summarises the vegetation and habitat values of the Project sites, identifies potential impacts and mitigation measures.

The assessment is based on a desktop review of flora and fauna species of significance (within a 10 km buffer of the site) and a field assessment, undertaken by T&M Ecologists in April 2018. The field assessment investigated the likely footprint for the Solar Project. Field assessments for the Pumped Hydro Project included a wider area than the likely footprint to allow for contingency to cover uncertainty in final placement of infrastructure. The results of the ecology surveys have increased the knowledge of flora and fauna distributions in the area.

The ecological assessment report is provided in Appendix C.

7.1. Flora

7.1.1. Existing Environment

The proposed Project falls within the Flinders Lofty Block bioregion and is in the Southern Flinders subregion, as defined by the Interim Biogeographic Regionalisation for Australia (IBRA). This subregion is characterised by open shrublands on the plains with open mallee and shrublands in the hills area.

7.1.1.1. Pumped Hydro Project

The Pumped Hydro Project site shows a broad array of vegetation condition, ranging from poor to moderate / good. The site is principally open shrubland composed of Elegant Wattle (*Acacia victoriae*), Shrubby Riceflower (*Pimelea microcephala*), Bardi bush (*Acacia victoriae*), Fragrant Saltbush (*Rhagodia parabolica*), and Small-Leaf Bluebush (*Maireana brevifolia*). The vegetation in the best condition was in vegetation communities 5 and 6, which were both found on steep, stony ground in the central parts of the Pumped Hydro Project site (Figure 7-1). Most of the vegetation found in the eastern part of the site is in a poor condition from a native vegetation perspective.

The vegetation community surrounding the SA water reservoir is restricted to a thin band of trees around the edges and is generally a continuation of species found in nearby shrublands, such as Bardi Bush (*Acacia victoriae ssp. victoriae*), Shrubby Riceflower (*Pimelea microcephala ssp. microcephala*), Fragrant Saltbush (*Rhagodia parabolica*) and Rosemary Bush (*Cassinia laevis*).

The wider area of the proposed Pumped Hydro Project is exposed to sheep grazing, but steep, rocky sections in the central and western parts of this site retain a dense native shrub layer, with emergent trees in some locations.

Vegetation Communities

Vegetation mapping of the Pumped Hydro Project site was based upon existing SA Vegetation mapping boundaries and current aerial photography, which was then supplemented by field observations. Eleven different vegetation communities were recorded in the area that are likely to be impacted by the Project (see Table 7-1).

Vegetation communities mapped across the Pumped Hydro Project site are shown in Figure 7-1. Typical views of each of the vegetation communities are shown in Plate 7-1 to Plate 7-11. Full descriptions of all vegetation communities are provided in Appendix C.

Table 7-1: Vegetation communities present within the proposed Pumped Hydro Project site

No.	Description
1.	*Eucalyptus gracilis, E. socialis* ssp. Mallee / Open mallee
2.	*Eucalyptus oleosa* ssp. *ampliata, E. socialis* ssp. *viridans*+/- *E. leptophylla, E. gracilis* mallee
3.	*Acacia victoriae* shrubland / open shrubland
4.	*Triodia scariosa* grassland with scattered emergent shrubs
5.	*Cassinia laevis, Xanthorrohea quadrangulata* shrubland with scattered emergent *Allocasuarina verticillata, Callitris gracilis*

No.	Description
6.	*Eucalyptus socialis, E. gracilis* +/- *E. cajuputea* (patchy) mallee over *Cassinia laevis, Xanthorrhea quadrangulata*
7.	*Pimelea microcephala*, *Acacia victoriae, Rhagodia parabolica, Maireana brevifolia* open shrubland
8.	*Solanum cleistogamum* very open low shrubland +/- *Austrostipa* sp., *Rytidosperma* sp. with scattered emergent *Acacia victoriae, Pimelea microcephala*
9.	*Alectryon oleifolius* low woodland
10.	*Eucalyptus oleosa* +/- *E. socialis, E. gracilis* open mallee
11.	*Eucalyptus camaldulensis* (Red Gum) woodland

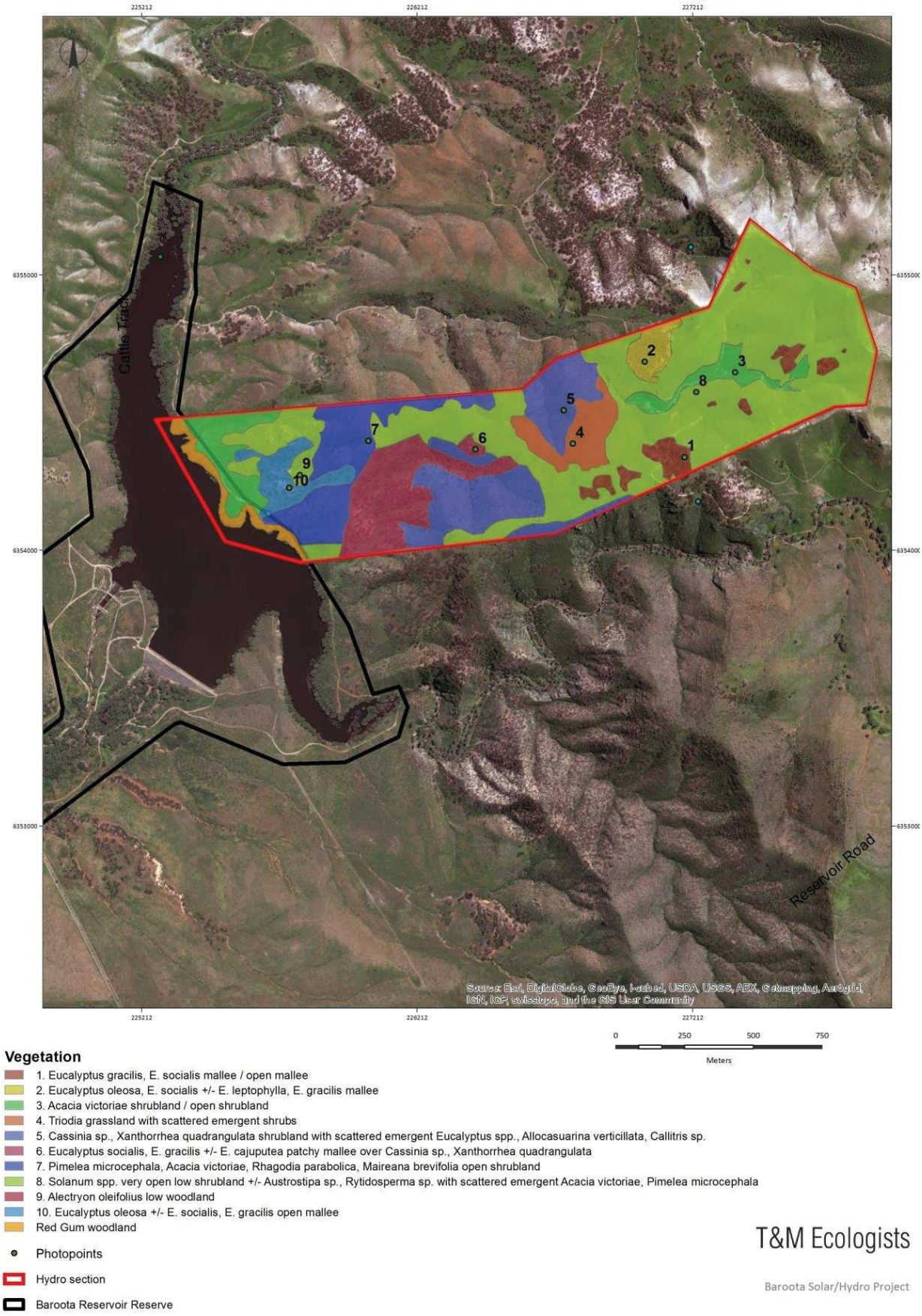

Figure 7-1: Vegetation communities mapped on the Pumped Hydro Project site

Plate 7-1: Vegetation community 1 (Source: T&M Ecologists)

Plate 7-2: Vegetation community 2 (Source: T&M Ecologists)

Plate 7-3: Vegetation community 3 (Source: T&M Ecologists)

Plate 7-4: Vegetation community 4 (Source: T&M Ecologists)

Plate 7-5: Vegetation community 5 (Source: T&M Ecologists)

Plate 7-6: Vegetation community 6 (Source: T&M Ecologists)

Plate 7-7: Vegetation community 7 (Source: T&M Ecologists)

Plate 7-8: Vegetation community 8 (Source: T&M Ecologists)

Plate 7-9: Vegetation community 9 (Source: T&M Ecologists)

Plate 7-10: Vegetation community 10 (Source: T&M Ecologists)

Plate 7-11: Vegetation community 11 (Source: T&M Ecologists)

Rare or Threatened Plant Species

A total of 68 native plant species were recorded in the Pumped Hydro Project site that are likely to be impacted. Full plant and weed lists for each of the assessed areas are provided in Appendix C.

No plant species of national (EPBC) conservation significance were observed. Four plant species considered Rare at a regional level (NPWSA-National Parks and Wildlife South Australia) were observed:

- Flinders Ranges Wattle (*Acacia iteaphylla*) (Community 6);
- Cane Spear-grass (*Austrostipa breviglumis*) (Community 6);
- Green Mallee (*Eucalyptus cajuputea*) (Community 6); and
- Rohrlach's Bluebush (*Maireana rohrlachii*) (Communities 1, 3, 4, 7).

The highest species richness (27) was recorded in Community 6 (*Eucalyptus socialis*, *E. gracilis +/- E. cajuputea* (patchy) Mallee over *Cassinia laevis*, *Xanthorrhea quadrangulate*), with lowest richness (6) in Community 9 (*Alectryon oleifolius* Low woodland).

The likelihood of the presence of State and Nationally listed flora species across the Pumped Hydro Project site is summarised in Table 7-2. This table is based on a comparison of known habitat preferences and the habitat values for the site which is detailed in Appendix C. Based on the habitats present, there are only two species of National conservation status that might possibly be present – all other species identified in the literature review are considered unlikely. Both species, *Olearia pannosa ssp. pannosa* (Silver Daisy-bush) and *Senecio megaglossus* (Superb Groundsel), may be considered as possibly present in the steep, rocky areas where the vegetation is in moderate to good condition (i.e. community types 5 and 6 Figure 7-1). However, based on a significant impact assessment, there is no predicted impact of the Pumped Hydro Project on the flora species of national conservation significance.

Table 7-2: Likelihood of occurrence of flora of conservation significance in vegetation present in the Pumped Hydro Project site

*Conservation Status: R=Rare, V=Vulnerable, E=Endangered
N/A-Species does not have EPBC Status

Scientific Name	Common Name	EPBC Status	NPWS Status	Present	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessments
Acacia gracilifolia	Graceful Wattle		R			✓ Hydro	Suitable habitat is present	N/A
Acacia iteaphylla	Flinders Ranges Wattle		R	✓ Hydro			Species recorded during this survey.	N/A
Acacia montana	Mallee Wattle		R			✓ Hydro	Suitable habitat is present.	N/A
Anogramma leptophylla	Annual Fern		R		✓ Hydro		Suitable habitat is present in habitats 5 and 6.	N/A
Anthocercis angustifolia	Narrow-leaf Ray-flower		R			✓ Hydro	Suitable habitat is present in habitats 5 and 6.	N/A
Asperula syrticola	Southern Flinders Woodruff		R			✓ Hydro	Suitable habitat is present in habitats 5 and 6.	N/A
Austrostipa breviglumis	Cane Spear-grass		R	✓ Hydro			Species recorded during this survey.	N/A
Austrostipa densiflora	Fox-tail Spear-grass		R			✓ Hydro	Scattered records are present in the region, and habitats are likely to be suitable, especially habitats 5 and 6.	N/A
Caladenia flaccida	Drooping Spider-orchid		V			✓ Hydro	Some habitats present are possibly suitable. Would require survey during the flowering period.	N/A
Choretrum chrysanthum	Yellow Sour-bush		R			✓ Hydro	Less grazed habitats in the Hydro site (communities 5,6) may be suitable.	N/A
Cryptandra campanulata	Long-flower Cryptandra		R			✓ Hydro	Habitat types 5 and 6 may be suitable.	N/A
Eremophila subfloccosa ssp. glandulosa	Green-flower Emubush		R			✓ Hydro	Scattered records are present in the region, and habitats are likely to be suitable.	N/A
Eucalyptus albens	White Box		R			✓ Hydro	Possibly present in difficult to access areas of habitat type 6.	N/A
Eucalyptus cajuputea	Green Mallee		R	✓ Hydro			Species recorded during this survey.	N/A
Eucalyptus percostata	Ribbed White Mallee		R			✓ Hydro	Could possibly be present in difficult to access sections of habitat type 6.	N/A
Lepidium pseudotasmanicum	Shade Peppercress		V			✓ Hydro	Suitable habitat is present, especially in habitats 5 and 6. Would require survey work following good rains.	N/A

Scientific Name	Common Name	EPBC Status	NPWS Status	Present	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessments
Logania saxatilis	Rock Logania		R			✓ Hydro	Scattered records are present in the region, and habitats 5 and 6 are possibly suitable.	N/A
Olearia pannosa ssp. pannosa	Silver Daisy-bush	V	V			✓ Hydro	Habitats are possibly suitable on-site, however there is only one record within a 20km radius. Only considered possible in areas of better condition in the hills – namely habitats 5 and 6.	No significant impact
Ozothamnus scaber	Rough Bush-everlasting		V			✓ Hydro	Preferred habitat may be present on the site.	N/A
Philotheca angustifolia ssp. angustifolia	Narrow-leaf Wax-flower		R			✓ Hydro	Habitat types 5 and 6 may be suitable.	N/A
Phyllangium sulcatum	Rock Mitrewort		V			✓ Hydro	Preferred habitat may be present on the site.	N/A
Rytidosperma tenuius	Short-awn Wallaby-grass		R			✓ Hydro	Preferred habitat may be present on the site.	N/A
Santalum spicatum	Sandalwood		V			✓ Hydro	Suitable habitat is present, but would likely have been observed if present in Solar Farm area.	N/A
Senecio megaglossus	Superb Groundsel	V	E			✓ Hydro	Suitable habitat may be present, however only considered likely in habitat types 5 and 6.	No significant impact
Thelymitra grandiflora	Great Sun-orchid		R			✓ Hydro	Some habitats present are possibly suitable, but only those where condition is moderate or better. Would require survey during the flowering period	N/A
Veronica decorosa	Showy Speedwell		R			✓ Hydro	Suitable habitat is present. Would require survey work following good rains. Only suitable areas are habitats 5 and 6.	N/A

Weeds

Twenty-one introduced species were recorded at the Pumped Hydro Project site (Table 7-3). The least number of weed species was recorded in Community 9 – *Alectryon oleifolius* Low woodland, and the highest number of weeds was in Community 3 - *Acacia victoriae* Shrubland. No Weeds of National Significance (WONS) were recorded within the Pumped Hydro Project site.

Four Declared plant species were recorded (Table 7-3). Salvation Jane, Boxthorn and Horehound were widespread but generally of low cover through habitats in the site. Bathurst Burr was noted in one specific location along a drainage line at the eastern end of the Pumped Hydro Project site.

Table 7-3: Introduced plant species recorded across the Pumped Hydro Project site

Species Name	Common Name	Declared Species[4], Weed of National Significance
Avena barbata	Bearded Oat	
Brassica sp.		
Bromus sp.	Brome	
Carrichtera annua	Ward's Weed	
Carthamus lanatus	Saffron Thistle	
Citrullus lanatus	Bitter Melon	
Echium plantagineum	Salvation Jane	Declared
Galenia secunda/pubescens var. pubescens	Galenia	
Gramineae sp.		
Heliotropium europaeum	Common Heliotrope	
Hordeum sp.		
Lycium ferocissimum	African Boxthorn	Declared
Marrubium vulgare	Horehound	Declared
Nicotiana sp.		
Rapistrum sp.		
Rosa sp.		
Salvia verbenaca var. verbenaca	Wild Sage	
Solanum linnaeanum	Apple of Sodom	
Sonchus sp.	Sow-thistle	
Vulpia sp.	Fescue	
Xanthium spinosum	Bathurst Burr	Declared

7.1.1.2. Solar Project

The Solar Project site contains a significant proportion of cropped land with the patches of remnant vegetation generally being in a poor condition, with some patches being in a poor to moderate condition.

The flat land in the proposed Solar Project site is mostly low shrubland community comprised of satiny bluebush (*Maireana georgei)*, short-leaf bluebush (*Maireana brevifolia)*, black bluebush (*Maireana pyramidata)*, and shrubby twinleaf *(Reopera aurantiaca)*. These communities are in poor and degraded condition due to grazing and agriculture activities.

A widespread vegetation community in the northern half of the proposed Solar Project site is dominated by drought and stock resistant chenopod shrubs i.e. the vegetation has been fundamentally modified by long term grazing.

[4] Under the *Natural Resources Management Act 2004*.

Vegetation Communities

Six different vegetation communities were recorded in the areas that are likely to be impacted by the Solar Project (Table 7-4). The condition of the vegetation present was generally relatively poor.

Vegetation communities mapped on the Solar Project site are shown in Figure 7-2. Typical views of each of the vegetation communities are shown in Plate 7-12 to Plate 7-17. Full descriptions of all vegetation communities are provided in Appendix C.

Table 7-4: Vegetation communities present within the proposed Solar Project site

No.	Description
A.	*Maireana georgei, M. brevifolia* +/- *M. pyramidata, Reopera aurantiaca* Low shrubland with scattered emergent *Acacia victoriae*
B.	*Acacia victoriae* +/- *A. oswaldii* Shrubland
C.	*Maireana brevifolia* +/- *M. pyramidata* Open shrubland
SF1.	*Maireana pyramidata* +/- *M. brevifolia* Shrubland
SF2.	*Maireana brevifolia* +/- *M. pyramidata* Shrubland
SF3.	+/- *Maireana pyramidata* +/- *M. aphylla, M. turbinata, M.brevifolia* Open shrubland

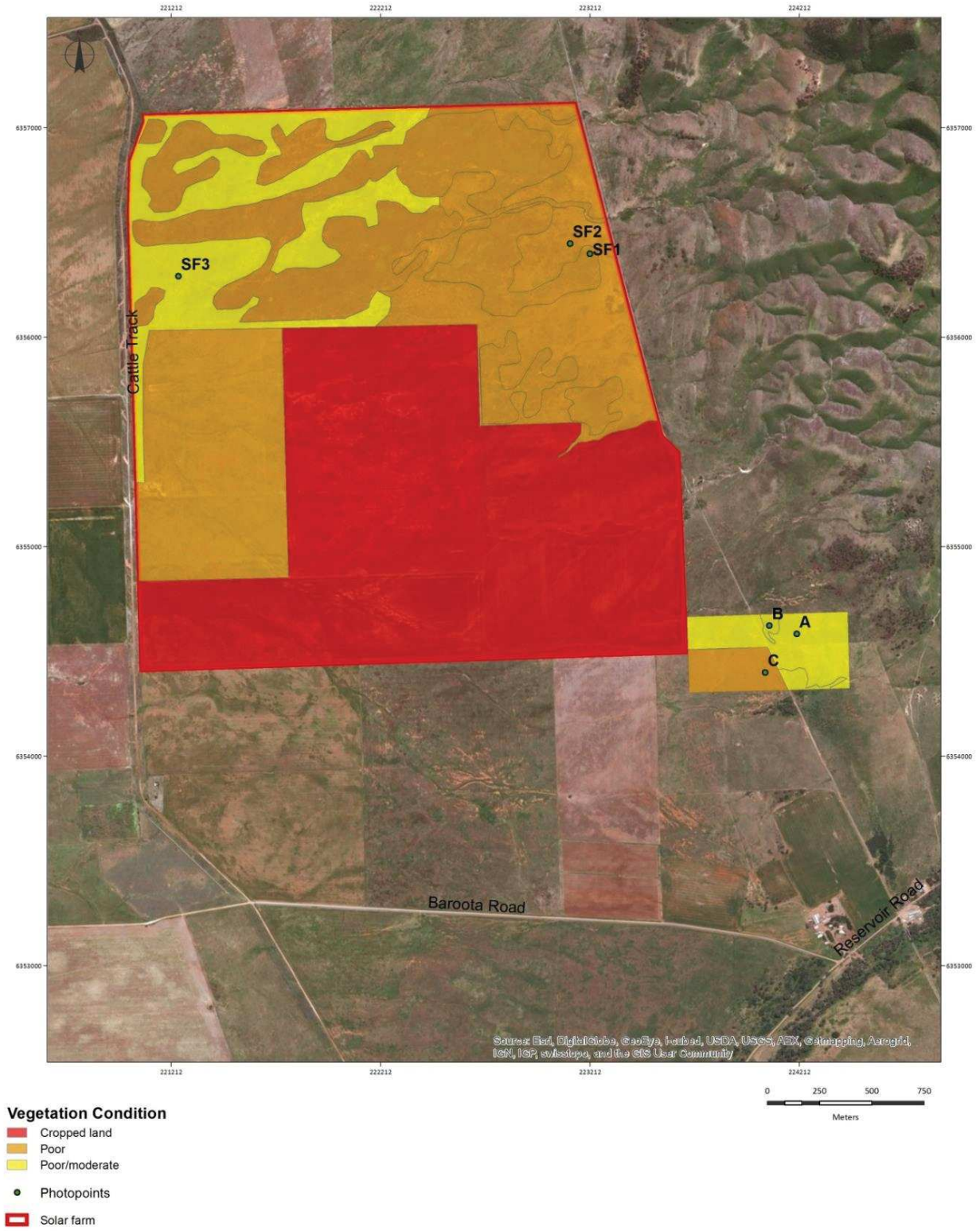

Figure 7-2: Vegetation communities mapped on the Solar Project site

Plate 7-12: Vegetation community A (Source: T&M Ecologists)

Plate 7-13: Vegetation community B (Source: T&M Ecologists)

Plate 7-14: Vegetation community C (Source: T&M Ecologists)

Plate 7-15: Vegetation community SF1 (Source: T&M Ecologists)

Plate 7-16: Vegetation community SF2 (Source: T&M Ecologists)

Plate 7-17: Vegetation community SF3 (Source: T&M Ecologists)

Rare or Threatened Plant Species

A total of 39 native plant species were recorded in the Solar Project site that are likely to be impacted. Full plant and weed lists for each of the assessed areas are provided in Appendix C.

No plant species of national (EPBC) conservation significance were observed. One plant species was considered Rare at a regional level (NPWSA):

- Rohrlach's bluebush (*Maireana rohrlachii*) (Communities B and SF1)

The highest species richness (18) was recorded in Community SF3 (+/- *Maireana pyramidata* +/- *M. aphylla, M. turbinata, M.brevifolia* open shrubland), with lowest richness (7) in Community C (*Maireana brevifolia* +/- *M. pyramidata* open shrubland).

Based on the relatively degraded nature of the habitats present on the site, it is considered unlikely that there are any species of National conservation status present. It is also considered unlikely that there are any additional species of State conservation significance present (other than Rohrlach's Bluebush). A significant impact assessment for flora of conservation significance within the Solar Project site identified that it is unlikely any of the potential flora species would be found at the site (Appendix C).

Weeds

Six introduced species were recorded at the Solar Project site (Table 7-5). Three weed species were recorded (Sites A, B, C and SF3), with the highest number of weeds in Community SF1 - *Maireana pyramidata* +/- *M. brevifolia* Shrubland. No Weeds of National Significance (WONS) were recorded within the study area.

Two Declared plant species were recorded (Table 7-5). Boxthorn and Horehound were widespread but generally of low cover through habitats in the Solar Project site.

Table 7-5: Introduced plant species recorded

Species Name	Common Name	Declared Species[5], Weed of National Significance
Carrichtera annua	Ward's Weed	
Gramineae sp.		
Lycium ferocissimum	African Boxthorn	Declared
Marrubium vulgare	Horehound	Declared
Medicago sp.		
Solanum linnaeanum	Apple of Sodom	

7.1.2. Potential Impacts and Proposed Mitigation Measures

7.1.2.1. Pumped Hydro Project

Clearance of native vegetation will be required to undertake development associated with the Pumped Hydro Project. The Pumped Hydro Project will result in the clearance of approximately 50-60 ha of native vegetation (Figure 7-3). The overall vegetation impact is expected to be small given the generally sparse condition of the existing landscape and the scale of the project (large project investment in a relatively small project footprint).

As part of the Pumped Hydro Project, *Solanum* sp. very open shrubland, *Acacia victoriae* shrubland and Triodia grassland will be the predominant native vegetation removed (Figure 7-3). These vegetation communities are heavily grazed, with sparse native species and overall condition is considered poor to moderate. These vegetation types are commonly present throughout the region and many examples occur in better condition. None of the vegetation communities present in the Pumped Hydro Project area are considered Rare, Vulnerable or Endangered at a State or national level. The *Eucalyptus socialis* vegetation community (Community 6) which is described as in moderate to good vegetation with high plant diversity will be mostly avoided (Figure 7-3).

An application to the Native Vegetation Council for approval to clear vegetation will be submitted prior to the commencement of construction and an environmental offset in the form of a Significant Environmental Benefit (SEB) will be achieved (e.g. in the form of a Credit SEB area established by a third party, an on-ground SEB or a payment into the Native Vegetation Fund) as required under the *Native Vegetation Act 1991*.

[5] Under the *Natural Resources Management Act 2004*.

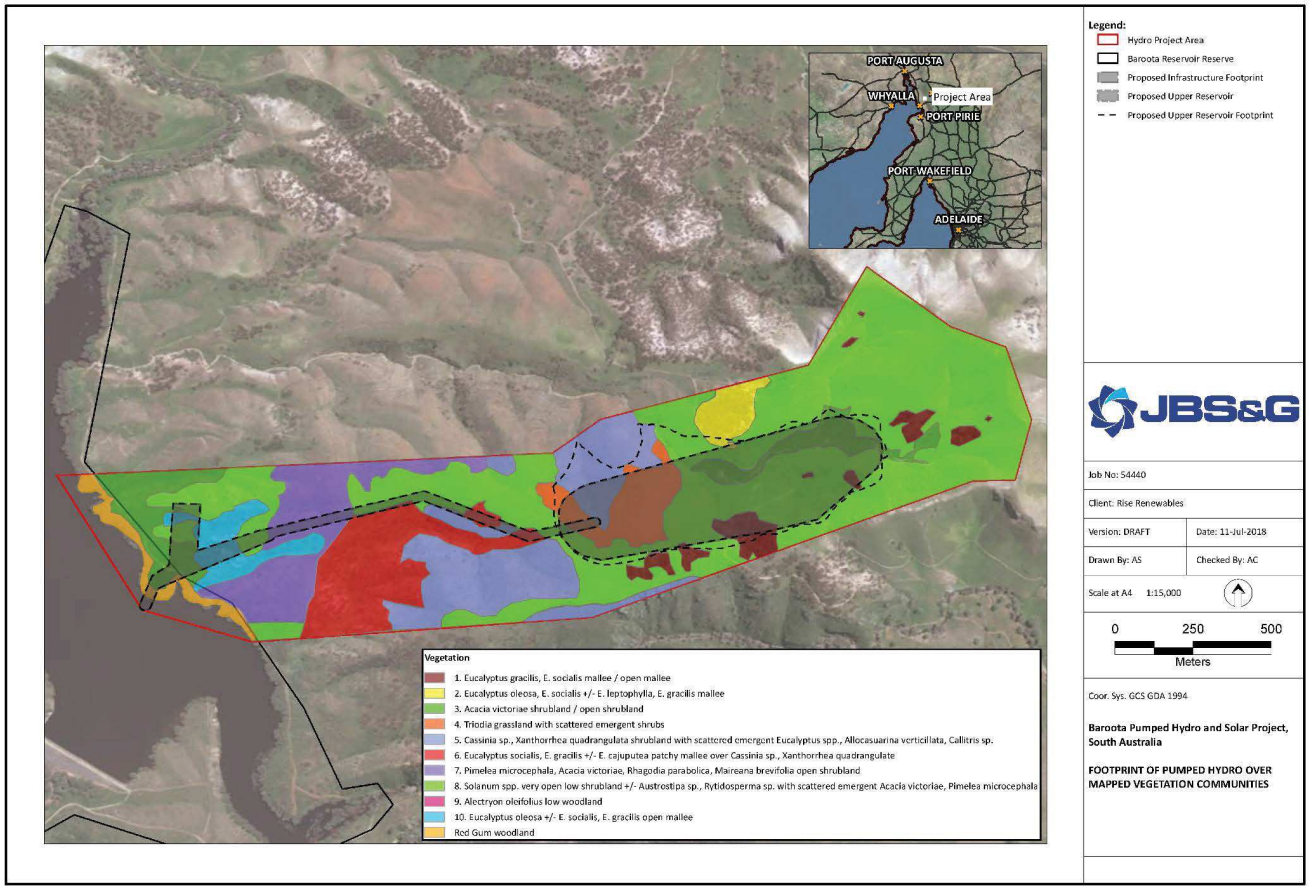

Figure 7-3: Preliminary footprint of the Pumped Hydro Project over the mapped vegetation communities

7.1.2.2. Solar project

The Solar Project will result in clearance of up to 678 ha of native vegetation. The site includes a significant proportion of cropped land with native vegetation generally quite degraded and in poor condition. Areas where native vegetation remain are predominantly chenopod shrublands, with taller Elegant Wattle (*Acacia victoriae*) shrublands along drainage lines.

Vegetation will not be completely cleared for some Solar Project components with significant trees and small shrubs left in place as far as is practicable. The final design footprint will be assessed to enable accurate SEB calculations and a native vegetation clearance report and application completed and an SEB achieved, as discussed above.

The spread of environmental weeds through construction activities can potentially inhibit the regeneration of indigenous species on the disturbed construction sites, forming a longer term, perhaps permanent, weed cover and can result in the invasion of adjoining, non-disturbed vegetation, particularly by species not currently present. Weed hygiene protocols will be implemented during construction activities to minimise the risk of weed spread and ongoing weed management will be undertaken where required, in consultation with the landowner and NRM Board where relevant.

7.1.2.3. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 7-6. These measures will be captured in the CEMP and / or OEMP.

Table 7-6: Vegetation - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Minimise vegetation clearance as far as practicable through design, layout and controls during construction.	✓		
Hydro Solar	Retain significant trees, across the site where possible.	✓	✓	
Hydro Solar	Locate areas of temporary disturbance within the final / permanent disturbance footprint where possible.	✓		
Hydro Solar	Restrict vegetation clearance to the area approved for clearance.	✓		
Hydro Solar	Avoid works beyond the boundaries of the approved area including vehicle entry, personnel entry, storage of goods and materials and stockpiling of topsoil or cleared vegetation.	✓	✓	✓
Hydro Solar	Clean earthmoving/construction equipment of soil and vegetation prior to entering the site and before moving off-site.	✓	✓	✓
Hydro Solar	Avoid importing weed affected soil, mulch, fill or other material to the site.	✓	✓	
Hydro Solar	Dust suppression to minimise dust settling on vegetation.	✓	✓	
Hydro Solar	Rehabilitate areas of temporary disturbance (e.g. laydown areas) where appropriate to encourage native vegetation regeneration.	✓		✓
Hydro Solar	Temporarily fence rehabilitated areas to reduce livestock grazing pressure.	✓	✓	
Hydro Solar	Minimise vegetation clearance during maintenance (if required) as far as practicable.		✓	✓
Hydro Solar	Avoid vegetation clearing in new areas once construction is completed unless necessary approvals are in place.		✓	✓

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Undertake ongoing weed management where required, in consultation with the landowner and NRM Board where relevant.		✓	
Hydro Solar	Achieve an appropriate SEB to offset vegetation clearance in accordance with the requirements of the Native Vegetation Act 1991.	✓		

7.2. Fauna

7.2.1. Existing Environment

7.2.1.1. Pumped Hydro Project

The shrublands, woodlands and Triodia hummock grasslands of the Pumped Hydro Project area support a range of fauna species, including reptiles, small-terrestrial mammals, bats, larger mammals such as wombats and kangaroos and a suite of bird species.

Habitat values across the site are variable, with heavily disturbed open areas providing limited habitat for fauna. The high native biomass and diverse array of native plant life forms found in vegetation communities 5 and 6, may provide habitat for many reptile and bird species. The shrublands and low woodlands (communities 5, 6 and 10) contain habitats such as trees with hollows, which can be a resource for native fauna to use for shelter, nesting or breeding, including birds, mammals (bats), and reptiles.

Introduced mammal species observed within the Pumped Hydro site include feral sheep and observations of rabbit warrens were noted during the surveys. Cats and foxes would also be present. Introduced animals such as goats, deer, hares, and mice have been recorded within the surrounding area.

Rare or Threatened Fauna Species

A thin band of Red Gum (*Eucalyptus camaldulensis*) woodland around the reservoir may provide habitat for the State listed Rare Common Brushtail Possum (*Trichosurus vulpecula*). No signs were observed of this species in mallee vegetation communities, and whilst containing hollows that could house this species, these relatively degraded mallee areas are considered to have few resources to support a population of Brushtail Possums.

The open water and fringing habitats of the reservoir area may also provide habitat for waterbirds of State or national significance. Some of the mallee areas contain trees with hollows that are likely to be a key habitat component for nesting and shelter for bats and birds.

Species of National or State conservation significance identified as potentially occurring, likely to occur or know to occur within the Pumped Hydro Project site are identified in Table 7-7.

Assessment of likelihood of the presence of threatened fauna, based on known distribution, the ecology of the species, and the habitats present, indicated that there is no predicted significant impact of the hydro proposed development on any animal species of national conservation significance that were identified by desktop and field assessment. Details of this assessment can be found in Appendix C.

7.2.1.2. Solar Project

The habitat value across the Solar Project site is poor to moderate, with the heavily disturbed shrubland areas providing limited habitat for fauna. The Solar Project site contains a significant proportion of cropped land with the patches of remnant vegetation generally being in a poor condition, with some patches being in a poor to moderate condition.

Western Grey Kangaroos (*Macropus fuliginosus*) are observed utilising the area and it is likely that Euros (*Macropus robustus*) are present at times, although this species is more frequent in hilly country. No signs of Echidnas (*Tachyglossus aculeatus*) were observed, although this species is likely to be present in all habitat types. The small insectivorous/carnivorous Narrow-nosed Planigale (*Planigale tenuirostris*) and Fat-tailed Dunnart (*Sminthopsis crassicaudata*) are possibly present, most likely in the areas in better condition (A, B, SF3).

Sightings and records of introduced mammal species within the Solar Project site is similar to that detailed in Section 7.2.1.1.

Rare or Threatened Fauna Species

Two species of birds of State Conservation significance, the State listed Rare Elegant Parrot (*Neophema elegans*) and the State listed Vulnerable Blue-winged Parrot (*Neophema chrysostoma*), may occasionally utilise the open shrubland areas of the Solar site for feeding. The site is considered unlikely to provide critical habitat for any fauna species of State or national conservation significance.

Species of National or State conservation significance identified as potentially occurring, likely to occur or know to occur within the Solar Project site are identified in Table 7-7.

Assessment of likelihood of the presence of threatened fauna, based on known distribution, the ecology of the species, and the habitats present across the Solar Project site, indicated that there is no predicted significant impact of the proposed Solar Project development on any animal species of national conservation significance that were identified by desktop and field assessment. Details of this assessment can be found in Appendix C.

Table 7-7: Likelihood of occurrence of fauna of conservation significance in habitats present

*The notation Reservoir-Hydro means the species may be found in association with the Baroota Reservoir, which may be impacted by the Pumped Hydro project
*Conservation Status: Ma-Marine, Mg-Migratory, R = Rare, V = Vulnerable, E = Endangered
N/A – species does not have EPBC status

Scientific Name	Common Name	EPBC Status	NPWS Status	Present[6]	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessment[7]
BIRDS								
Actitis hypoleucos	Common Sandpiper	Ma,Mg	R			✓ Reservoir - Hydro	The species is usually found along the shoreline in rocky areas or mudflats. However, it can also be found on inland saline or inland wetlands (Birdlife Australia Bird Profiles 2018). It is possible the species could use the muddy areas exposed by the receding waterline of the reservoir.	No significant impact
Apus pacificus	Fork-tailed Swift	Mg			✓		This is a species recorded from widespread areas. They are highly mobile aerial birds feeding on flying insect, usually ahead of storms (T. Croft pers. ob). The species would likely be observed overhead in the area but would not likely use the ground habitat.	No significant impact
Ardea alba/modesta	Great Egret	Ma			✓ Reservoir - Hydro		Usually feeds wading in shallow water for fish, frogs, crustaceans (Birdlife Australia Bird Profiles 2018). The species could use the edge of the reservoir, as water receded.	N/A
Ardea ibis	Cattle Egret	Ma				✓	The species is usually observed stalking in pasture, accompanying grazing animals, especially cattle, feeding on disturbed insects (Birdlife Australia Bird Profiles 2018). It is less common in drier areas but could possibly be found in the open areas with domestic stock or around the reservoir. There are some sparse records in the area (Atlas of Living Australia).	N/A

[6] Based upon the April 2018 survey.
[7] Based upon criteria provided within "Matters of National Environmental Significance Significant impact guidelines 1.1, *Environment Protection and Biodiversity Conservation Act 1999*".

Scientific Name	Common Name	EPBC Status	NPWS Status	Present[6]	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessment[7]
Ardeotis australis	Australian Bustard		V			✓	It more readily observed inland in more undisturbed sparsely timbered pastoral habitats (Carpenter & Reid 1988, Atlas of Living Australia). Could occur in the area at times, although not prime tussock grassland habitat. At best a rare visitor to the area, after a population build-up following good inland rains.	N/A
Bizuria lobata	Musk Duck		R	✓ Reservoir - Hydro			Several birds have been observed on the deeper reservoir water in 2016, 2017 and 2018. They are not expected to be observed away from the reservoir.	N/A
Calidris acuminata	Sharp-tailed Sandpiper	Ma, Mg				✓ Reservoir - Hydro	No birds have been observed around the reservoir, but it is possible the species could use the muddy area of the reservoir, as water recedes.	No significant impact
Corcorax melanoramphos	White-winged Chough		R		✓ Hydro		The species could possibly occur in the *Eucalyptus camaldulensis* Woodland and Mallee areas as suitable habitat.	N/A
Coturnix ypsilophora	Brown Quail		V			✓	It is mostly recorded from the South-East region of SA, where there is more suitable habitat (Carpenter & Reid 1988). The species may occur at times around the edge of the reservoir where there is limited habitat.	N/A
Falco peregrinus	Peregrine Falcon		R	✓ Hydro			The species has been recorded in the vicinity of the dam and reservoir, where there is suitable nesting areas and prey (e.g. Rock Pigeons) occur.	N/A
Hamirostra melanosternon	Black-Breasted Buzzard		R			✓ Hydro	The species is largely found along tree-lined creeks surrounded by open country in the semi-arid and arid pastoral areas. However, the species could occur along the *Eucalyptus camaldulensis* Woodland along the creek in the project area.	N/A
Melanodryas cucullata cucullata	Hooded Robin (south-east subspecies)		R			✓ Hydro	In South Australia they inhabit *Eucalyptus oleosa, E. gracilis, E. socialis Mallee*, and drier non-eucalypt Low Woodlands. The species could possibly occur in the Project area Mallee however the patches are small, and degraded from a long history of domestic stock grazing. This would limit their use as Hooded Robin habitat.	N/A

Scientific Name	Common Name	EPBC Status	NPWS Status	Present[6]	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessment[7]
Merops ornatus	Rainbow Bee-eater	Ma, Mg		✓ Hydro			The species has been recorded in the *Eucalyptus camaldulensis* Woodland surrounding the reservoir, and along Baroota Creek. The species could also occur in the deep gulies of the project area.	No significant impact
Myiagra inquieta	Restless Flycatcher		R			✓ Hydro	The species has been recorded from Mallee, *Eucalyptus leucoxylon* and box Woodland in the region (Carpenter & Reid 1988). The project area Mallee surrounded by open areas could provide habitat for the species, but the degraded nature of the area from grazing has limited its habitat value.	N/A
Neophema chrysostoma	Blue-Winged Parrot	Ma	V	✓			While breeding in the State's South East and adjacent areas of western Victoria, when non-breeding, birds thinly disperse west and north, primarily to coastal salt marsh and dunes Carpenter & Reid 1988). They also disperse more widely to various other habitats. One bird was flushed from the ground along the track through Maireana Shrubland. They often associate with Elegant Parrots when dispersed. It is likely occasional non-breeding birds will occur in the project area, from time to time.	N/A
Neophema elegans	Elegant Parrot		R	✓			Whilst non-breeding, the species widely disperses, particularly to the coastal dunes of the Coorong. It also disperses elsewhere to various open habitats including Maireana Shrublands (Carpenter & Reid 1988). Few to several birds have been observed each year from 2016, primarily in the vicinity of the reservoir.	N/A
Oxyura australis	Blue-billed Duck		R	✓ Reservoir - Hydro			The species can be found on open freshwater. Birds have been observed regularly on the reservoir over the last few years.	N/A
Pandion haliaetus	Osprey	Ma, Mg	E			✓ Reservoir-Hydro	In South Australia, the species is restricted to the coast, and along the River Murray. Although unlikely the species would use the reservoir area, it is possible the bird could occasionally occur.	No significant impact

Scientific Name	Common Name	EPBC Status	NPWS Status	Present[6]	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessment[7]
Plegadis falcinellus	Glossy Ibis	Ma, Mg	R		✓ Reservoir - Hydro		As the species prefers open muddy swamps (Carpenter & Reid 1988), it could likely occur around the edge of the reservoir, especially as water recedes.	No significant impact
Porzana tabuensis	Spotless Crake	Ma	R			✓ Reservoir - Hydro	In South Australia, the species is mostly recorded along the River Murray, the Lower Lakes, and the Mount Lofty Ranges, where there is more suitable habitat. While it is possible the species could occur around the reservoir, it is considered suitable habitat is limited and isolated from other suitable areas.	N/A
Stagonopleura guttata	Diamond Firetail		V		✓Reservoir - Hydro		This species was observed in the vicinity of Baroota Reservoir in 2017 and 2018 by the Port Augusta birdwatchers. However, it is only likely to be found in association with the Red Gum habitats in the Reservoir and adjacent creeklines.	N/A
Sterna hirundo	Common Tern	Ma, Mg	R			✓ Reservoir - Hydro	The species is largely confined to the coast in Australia, where the majority of records occur. It occasionally occurs in sub-coastal freshwater and saline wetlands and could possibly occur around the reservoir.	No significant impact
Sternula nereis nereis	Australian Fairy Tern	V	E			✓ Reservoir - Hydro	Mostly found in coastal and sub-coastal wetlands (Birdlife Australia Bird Profiles 2018). However, it is possible the species may be found at times in the vicinity of the reservoir. One record only within 20km, approximately 18km WSW from the site, in the Spencer Gulf.	N/A
Stictonetta naevosa	Freckled Duck		V	✓ Reservoir - Hydro			The reservoir provides permanent freshwater non-breeding habitat for the species. Six were observed on the reservoir in February 2016, and another two in January 2018.	N/A
Tringa nebularia	Common Greenshank	Ma, Mg				✓ Reservoir - Hydro	The receding water and exposed mud of the reservoir may provide feeding opportunity for the species.	No significant impact

Scientific Name	Common Name	EPBC Status	NPWS Status	Present[6]	Likely	Possible	Likelihood Justification	EPBC Significant Impact Assessment[7]
MAMMALS								
Trichosurus vulpecula	Common Brushtail Possum		R			✓ Reservoir - Hydro	The large Red Gums associated with Baroota Reservoir may suit this species. Unlikely in other areas of the site as either too degraded or habitat is unsuitable.	N/A
REPTILES								
Aprasia pseudopulchella	Flinders Ranges Worm Lizard	V				✓ Hydro	This species is possibly present in the sloping hills and valleys in the eastern part of the area associated with vegetation type 8.	No significant impact

7.2.2. Potential Impacts and Proposed Mitigation Measures

7.2.2.1. Pumped Hydro Project

Construction of the Pumped Hydro Project will result in clearance of habitat of varying quality across the site. Most of the vegetation found in the eastern part of the Pumped Hydro Project site (where impacts from the retention dam are most likely) is considered to be in a poor condition from a native vegetation perspective, due to impacts of long term (and ongoing) grazing as well as past clearance.

The Pumped Hydro Project site layout has been designed to avoid areas with higher habitat value as far as possible, such as patches of mallee containing old trees with hollows.

As discussed above, vegetation clearance will be minimised and satisfying the significant environmental benefit requirement under the Native Vegetation Act will provide an offset for this clearance.

There are no nationally threatened species considered likely to be using the site as a favoured habitat. Construction of the Pumped Hydro Project is not expected to have a significant impact on any animal species of national conservation significance.

Some of the mallee areas contain trees with hollows that are likely to be a key habitat component for nesting and shelter for bats and birds. As suitable habitat for this species is relatively common in the region, and the areas representing potential habitat will be largely avoided, impacts are not expected to be significant. Design and construction of the Project will aim to avoid removal of large trees.

Some direct mortality of fauna such as lizards and small mammals may occur during construction, from collision with machinery or vehicle or entrapment in trenches and excavations. Where excavations are planned to be left open and represent a fauna entrapment risk, escape routes for fauna will be provided or alternatively they will be checked regularly for trapped fauna.

7.2.2.2. Solar Project

The native vegetation at the Solar Project site is generally degraded. Two bird species of State conservation significance, the State Rare Elegant Parrot (*Neophema elegans*) and the State Vulnerable Blue-winged Parrot (*Neophema chrysostoma*), may occasionally utilise the open shrublands of the Solar Project site for feeding. Impact assessment of fauna potentially using the Solar Project site has considered that it is unlikely to provide critical habitat for any fauna species of State or national conservation significance. Large amount of similar habitat exists adjacent to the Solar Project site and in the greater region.

Interaction with Birds

In addition to the impacts of physical habitat loss discussed above, the potential impacts of the physical structure of the solar facility have also been considered. The main direct impact is likely to be related to collision-related fatalities resulting from the direct contact of the bird with a project structure(s). This type of fatality has been documented at solar projects of all technology types.

Water-dependent bird species may be vulnerable to fatality at PV installations because of the potential for them to confuse arrays for bodies of water and collide with structures when attempting to land (referred to as the 'lake effect'). However, based on existing knowledge, it is considered too speculative to make any conclusions about the influence, if any, of the lake effect on water-dependent birds (Walston *et al.* 2015).

The impacts on water-dependent species near solar facilities may depend on other site-specific factors; for example, at one PV site where ponds were present on-site, waterbirds were commonly recorded in incidental collections of fatalities (Kagan *et al.* 2013). Other hypothesized contributing factors to collision impacts include an abundance of insectivorous birds attracted to the site to feed on insects drawn by polarised light and night lighting. Glare and increased illumination from solar panels may also disorient birds and contribute to collisions.

Walston *et al.* (2016) analysed currently available avian mortality data at utility-scale solar facilities, and used these data to contextualise impacts of these facilities relative to other sources of avian mortality. The California Valley Solar Ranch (CVSR), a 250 MW photovoltaic facility, was the only similar facility to the proposed Project facility for which suitable comprehensive data was available at that time. A mortality rate of 0.5 birds per MW per year was attributed to the facility, and with an overall mortality rate (i.e. deaths that could not be associated directly with the facility) of 10.2 birds per MW per year. However, it is noted that the CVSR facility covered an

area of 1902 hectares, approximately three times the area per MW of the proposed Project site. Visser (2016) extrapolated a mortality estimate of 4.53 birds per MW per year at a 180 ha PV facility in South Africa, but found that "the few bird fatalities that were recorded might suggest that there is no significant link with collision-related mortality at the study site".

Walston *et al.* (2016) contextualised avian mortality figures associated with utility scale solar energy developments and found that at both regional and national scale, avian mortalities were considerably lower than for most other human activities. Visser (2016) noted that the impact of PV facilities on birds is likely to differ on a case-by-case basis depending on the quality of the habitat and surrounding landscapes. Degraded landscapes will be likely to have a lesser degree of negative impacts than pristine landscapes.

Possible mitigation measures proposed include reducing night lighting to minimum possible levels.

This Project will integrate with existing power lines, so there will be no major new impacts expected from this source.

Monitoring will be undertaken by operational personnel to identify whether there are issues with bird activity or fatality, and more detailed investigations and specific mitigation measures would be implemented if required.

7.2.2.3. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 7-8. These measures will be captured in the CEMP or operational environmental management documentation.

Table 7-8: Fauna - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Implement measures to minimise vegetation clearance, as discussed under 'Flora' above.	✓		
Hydro Solar	Ensure that where excavations are to be left open and represent a fauna entrapment risk, escape routes are provided or the excavations are checked regularly to release trapped fauna.	✓		
Hydro Solar	Minimise the level of lighting needed for the site at night to minimise increased insect activity and possible attraction of insectivorous birds and bats.		✓	
Hydro Solar	Develop and implement a rehabilitation and revegetation program	✓	✓	✓
Solar	Undertake monitoring by operations personnel for bird activity / carcasses. Undertake more detailed investigation/mitigation if this detects issues.		✓	
Hydro Solar	Provide exit points in development site fencing for fauna escape during site clearance.	✓		
Hydro Solar	Record observations, incidents and associated details related to incidents involving fauna and observation of pest fauna.	✓	✓	✓
Hydro Solar	Implement environmental awareness training to the workforce.	✓	✓	✓

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8. Socio-Economic Environment Assessment

This chapter presents an overview of the social receiving environment within the site of the Pumped Hydro and Solar Project.

8.1. Land Use

8.1.1. Existing Environment

Most of the land in the broader area is used for dryland agriculture and plantations for cereals, cropping and livestock grazing. Areas of residual native vegetation cover are predominantly located to the north-east and south-east of the site.

The closest township is Port Germein located approximately 7 km north-east of the southern boundary of the Project site. The closest residence to the Project site is located approximately 1.5 km south-east of the Project site's southern boundary, located on Reservoir Road.

There are no protected areas within close proximity to the Project site. There is one National Park and one Conservation Park established under the *National Parks and Wildlife Act* in the broader area: Mt Remarkable National Park, approximately 6.5 km south-west of the Project site boundary and Telowie Gorge Conservation Park, approximately 12 km south-east of the Project site boundary. There are several Vegetation Heritage Agreements under the *Native Vegetation Act* in the broader area, the closest of which is approximately 8.4 km from the site (between Wauchope Rd and Gribble Rd).

The hills area is reportedly used by recreational dirt bike riders.

8.1.1.1. Pumped Hydro Project

The Pumped Hydro Project site for the proposed upper reservoir is located within land held under perpetual lease by Wongi-Ahrah.

The lower reservoir is located within the Baroota Reservoir Reserve, which covers approximately 145 ha and is controlled by SA Water. A buffer of 88 ha surrounds the reservoir. SA Water will retain ownership of the maintenance of the current lower reservoir. Water from the Baroota Reservoir is currently supplied to a nearby landholder for agricultural use and this arrangement is expected to be maintained during Project construction and operation phases.

The land surrounding the proposed upper and current lower reservoir has been previously cleared for pastoral purposes. Stock access to the Pumped Hydro Project site can be an issue when fencing is down. Based on the steep, precipitous hill country, this area is virtually non-arable and mostly inaccessible to implements. As such, use is restricted to grazing (DEWNR 2017).

8.1.1.2. Solar Project

The Solar Project is located on freehold land currently used for cropping. Several creek lines traverse the site from ranges to the east. The Solar Project site is bordered to the west by Cattle Track and to the east by Kenihan Road. Cropping land borders the north and south of the Solar Project site.

8.1.2. Potential Impacts and Proposed Mitigation Measures

8.1.2.1. Construction

Inadvertent damage to the transmission lines that cross the Project site could impact power supplies and stability of the grid in the region or possibly the State. Standard measures for working safely near transmission lines will be implemented to avoid any damage, including buffer zones, temporary fencing and defined crossing points. With the exception of the connection infrastructure, solar farm infrastructure will not be located in close proximity to the transmission lines.

Traffic management strategies will be implemented to minimise potential impacts to local landholders along Reservoir Road, Baroota Road and Pipeline Track. Traffic is discussed further in Section 8.5.

Access along the existing transmission lines will be maintained during operations. It is expected that the final site layout will include a buffer around these lines that is wider than their existing easement.

Any construction impacts to off-site land use would be temporary and standard mitigation strategies will reduce the level of risk to surrounding landholders.

The Project site will be progressively rehabilitated as soon as practicable after an area is no longer required for construction activities. Roads and hardstand areas that are no longer required will be deep-ripped to ensure water infiltration and facilitate successful plant establishment. Rehabilitation will be undertaken in accordance with good practice and applicable guidelines, including the use of local native species, protection from livestock grazing and actively managed against weeds.

Pumped Hydro Project

During construction, access and livestock present on or in the immediate areas to the site will be restricted until fencing is erected. No significant land use conflicts are foreseen with surrounding land uses during construction and the impact is considered to be negligible. Signage will be installed near the access gate and site boundaries to warn of site activities and access restrictions to minimise the risk of impact to third parties.

Solar Project

During construction, grazing and / or cropping activities that are currently taking place on the property will cease on the Project site and may be restricted on immediately adjacent parts of the property until fencing is modified. No significant land use conflicts are foreseen with surrounding land uses during construction and the impact to surrounding land use is considered to be negligible. Signage will be installed near the access gate and site boundaries to warn of site activities and access restrictions to minimise the risk of impact to third parties (e.g. dirt bike riders).

8.1.2.2. Operation

Pumped Hydro Project

During operation, the Pumped Hydro Project site will change from rural land use to power generation. Other than SA Water, which will retain maintenance of the existing reservoir, the site will not have any other users. Infrastructure (e.g. switchyard and powerhouse) will be fenced to minimise damage.

Signage will be installed to warn of site dangers and to restrict access by third parties.

The overall impact to land use during the operational phase is considered to be negligible.

Solar Project

During operation, the Solar Project site will change from agricultural land use to power generation. Grazing and / or cropping will not continue during the operational phase of the Project as the presence of stock could potentially result in damage to the solar arrays and tracking mechanisms. Grazing in adjacent areas on the property and on adjacent land could continue unchanged.

There are extensive tracts of similar grazing land in the region and the loss of this amount of grazing land for the life of the Project is not considered significant. Further, the change in land use is reversible as at the end of the Project all above ground infrastructure will be removed and current pastoral land use activities could resume, or other land uses could be considered.

The installation of infrastructure such as buried cables, tracks or fences across the sites will not impact any users. Any necessary authorisations (e.g. under the Local Government Act and other relevant legislation) will be obtained.

The overall impact to land use during the operational phase is considered to be negligible.

Potential land use impacts will be addressed via the mitigation and management measures summarised in Table 8-1.

8.1.2.3. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 8-1. These measures will be captured in the CEMP and / or OEMP.

Table 8-1: Land Use - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Consult with landholders, surrounding landholders and local community to identify and manage any potential impacts to land use.	✓		✓
Hydro Solar	Install signage near the access gate and site boundaries to warn of site activities and access restrictions to minimise the risk of impact to third parties (e.g. dirt bike riders).	✓	✓	
Hydro Solar	Implement measures for working safely near transmission lines to avoid any damage, including buffer zones, temporary fencing and defined crossing points.	✓	✓	✓
Hydro Solar	Obtain any necessary authorisations (e.g. under the Local Government Act) for infrastructure installation in the undeveloped road reserves.	✓		
Hydro	Site to be rehabilitated with appropriate vegetation as soon as practicable where infrastructure is removed.			✓
Solar	Rehabilitate the site at the end of its operational life to allow a return to pastoral or alternate use.			✓

8.2. Cultural Heritage

The following chapter outlines the Indigenous and non-Indigenous cultural heritage values that exist at the Project site and surrounding area. It does this within the context and requirements of Commonwealth, State and Local regulatory frameworks. The results of the cultural heritage surveys have substantially increased the knowledge of the Traditional Owner occupation of the area and their use of the land.

8.2.1. Existing Environment

The Project area is within the Traditional Owners Native Title Claim area, registered on 10 April, 1996.

A robust regulatory framework is applicable to the protection of Indigenous and non-Indigenous cultural heritage at the Project site and surrounding area. The primary state legislation concerning Indigenous cultural heritage in South Australia is the *Aboriginal Heritage Act 1988* (with Amendments 2017), while the *Heritage Places Act 1993* is primary legislation concerning the protection of non-Indigenous historic heritage. The Commonwealth Government also has a role in the protection of nationally significant cultural heritage through the EPBC Act and the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*, which is generally only applied in exceptional circumstances.

A cultural heritage study has been undertaken for the Project by Blackwood Heritage Consulting (BHC) (Ebbs and Lower 2018). While the survey report is confidential at the request of Wongi-Ahrah, a summary of the survey results has been set out below. The study included a review of historic and archival sources, together with a pedestrian survey conducted over the proposed development area with representatives of the Traditional Owners Wongi-Ahrah heritage group (WHC).

A total area of approximately 7.5 km^2 of the preliminary Project layout was subjected thorough pedestrian survey coverage. This included the upper reservoir footprint, the substation footprint and the solar array site. Targeted surveys were also undertaken for the penstock route and pumped hydro infrastructure (including switchyard, powerhouse and intake structure).

8.2.1.1. Pumped Hydro Project

Cultural material was not identified within the footprint of the proposed upper reservoir, penstock route, and infrastructure areas. The survey report notes that absence of this material does not preclude intangible culture heritage, such as the existence of song lines or cultural landscapes or preclude the potential for subsurface archaeology not observed during the initial survey.

8.2.1.2. Solar Project

The results of the solar site suggest that Aboriginal occupation was primarily confined to the flat land west of the mountainous regions. This conclusion is cautiously predicated based on the incidence of material culture found within the footprint of the substation and solar array.

Heritage sites were defined based on a variety of criteria set out by BHC, dependent on-site type. In the case of artefact scatters, this is defined as any concentration of stone artefacts having a density of at least five artefacts in 100 m^2 (0.05 / m^2). Any other artefacts were documented as isolated pieces.

Five archaeological sites were located, consisting of four artefact scatters, one associated with a quarry and one (very likely) burial. The burial site is located within the greater proposed substation footprint and was identified as such by the Traditional Owners present. Isolated artefacts were recorded across both the substation and solar array footprints.

The scattered artefacts consisted primarily of flaked silcrete and quartzite with occasional tools and cores present. The likely burial site identified by Traditional Owners is marked by an arrangement of stones piled into a rectangular mound 2 m long by 1 m wide ("Burial Site"). Ethnographic records relating to burial practices in the wider mid-north region conform to the finding.

8.2.2. Potential Impacts and Proposed Mitigation Measures

Rise will undertake all practicable measures in consultation with the Traditional Owners to preserve and protect the Burial Site. Rise will work closely with the Traditional Owners and AAR to undertake mitigation and management measures for the scattered artefacts and sites and, based on Traditional Owner advice, steps will be taken to collect certain artefacts or leave *in situ* within the Project areas. Rise will comply with all laws, regulations and commitments in relation to Native Title and Aboriginal heritage during construction, operation and decommissioning of the Project.

A Cultural Heritage Management Plan (CHMP) will be developed in consultation with the Traditional Owners of the immediate area prior to construction which will make provisions relating to:

- The discovery and protection of objects, sites and remains;
- Consultation about any application made by Rise pursuant to the *Aboriginal Heritage Act 1988* (SA); and
- The provision of cross-cultural training to relevant project employees and contractors.

Should the development require any areas of ground disturbance outside of the survey coverage, additional heritage assessment will be undertaken for these areas.

In the unlikely event that cultural materials are uncovered during excavation works, work directly affecting those materials would cease immediately and advice would be sought from expert heritage advisers.

8.2.2.1. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 8-2. These measures will be captured in the CEMP and / or OEMP.

Table 8-2: Cultural heritage - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Conduct additional heritage assessment in any areas where ground disturbance is required outside of the survey coverage.	✓		
Hydro Solar	Create and implement a CHMP in conjunction with a qualified heritage practitioner and with the Traditional Owners.	✓		
Hydro Solar	Key personnel involved in on-site construction works should undertake a cultural heritage induction (i.e. site workers, contractors, sub-contractors).	✓	✓	✓

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Develop protocols for collection of a representative sample of isolated artefacts within the Project site by Traditional Owner representatives.	✓		
Hydro Solar	Develop and implement procedures for accidental discovery of cultural heritage materials located within the Project site, which will include ceasing work, that would directly impact such discoveries, immediately at the location and seeking advice.	✓		
Hydro Solar	Ensure that the Burial Site that is likely to represent a site of archaeological significance under the *Aboriginal Heritage Act 1988* is avoided.	✓	✓	✓
Hydro Solar	If items of non-Indigenous heritage significance are identified during Project activities, works directly affecting will be immediately stopped. All legal and cultural requirements outlined in the CHMP will be followed	✓	✓	✓

8.3. Noise

A noise impact assessment has been undertaken for the Project by Sonus (2018). This assessment is provided in Appendix D and forms the basis of the information in this section.

8.3.1. Existing Environment

The Project is located within the Primary Production Zone (Solar Project), Rural Landscape Protection Zone (Solar Project) and Water Protection Zone (Pumped Hydro Project) of the Development Plan. Given the rural nature of the Project site, noise levels are generally low. The Pumped Hydro Project is situated approximately 9 km, and the Solar Project is situated approximately 4.5 km to a major road (Augusta Highway). The Average Annual Daily Traffic (AADT) along Augusta Highway is estimated at 3500 vehicles daily.

The closest potential noise sensitive receptors surrounding the Project are six existing residences (Figure 8-3). The two residences in closest proximity are more than 1.0 km south of the Project site. A third dwelling is 1.7 km north of the Project site, while the three other existing dwellings are more than 1.9 km west of the Project site. The three closest dwellings are generally located in a primary production area where existing noise levels are expected to be low and typical of a rural setting. The three dwellings further from the Project site are also within the primary production area, however are closer to the nearby main road (Augusta Highway).

8.3.2. Potential Impacts and Proposed Management Measures

8.3.2.1. Construction and Decommissioning

Noise would be generated by a range of equipment used during construction, including earth-moving equipment for civil works, diesel generators, trucks and cranes. These would have similar noise outputs to farm machinery such as tractors. Pile driving of the solar panel foundations would be undertaken using a machine which screws or hammers poles into the ground, similar to that used for driving farm fence poles into the ground.

The majority of noise-generating construction activities will predominantly be undertaken during the daytime with key activities including:

- Excavation and earth moving;
- Blasting (expected to occur periodically during the exaction of the upper reservoir);
- Vegetation clearance, earthworks and removal of excess materials;
- Road traffic associated with the delivery of construction materials;
- Piling of piers and construction of solar arrays; and
- Construction of site infrastructure.

Depending on construction scheduling, some work may occasionally need to be undertaken at night (e.g. for critical path activities where there needs to be minimal personnel or other activities on-site). However, noisier activities will be scheduled, wherever possible, to coincide with business hours.

The *Environment Protection (Noise) Policy* restricts construction activities resulting in noise with an adverse impact on amenity to between 7 am and 7 pm, Monday to Saturday. Noise-generating activities will generally be scheduled within these times.

Given the distances of nearby closest residences from the Project site (1.2 km – 3.3 km), construction noise from the Project is unlikely to adversely impact amenity.

Ongoing consultation will be carried out with the community (particularly the closest neighbours) regarding timing of construction noise to identify any issues and, where possible, identify measures to minimise disruption.

8.3.2.2. Operation

Noise Criteria

In relation to the Development Plan, the proposed Solar Project is located on land within the Primary Production Zone and Rural Landscape Protection Zone and the Pumped Hydro Project within the Water Protection Zone. The closest dwellings to the Project are located within the Primary Production Zone and Rural Landscape Protection Zone.

The Development Plan contains a number of provisions aimed at minimising the negative impacts of noise from development on existing and future land uses and achieving consistency with the *Environment Protection (Noise) Policy 2007.*

The *Environment Protection (Noise) Policy 2007* establishes goal noise levels (L_{eq}) to be achieved at noise receptors (the residences), based on the Development Plan locality in which the noise source (the Project) and the noise receptors are located, and the land use that these localities principally promote.

For developments and dwellings in an area which principally promotes *rural industry*, the *Environment Protection (Noise) Policy 2007* establishes the following goal noise levels at the dwellings:

- An average noise level (L_{eq},15min) of 52 dB(A) during the day (7 am until 10 pm); and
- An average noise level (L_{eq},15min) of 45 dB(A) during the night (10 pm until 7 am).

Even though the solar component might only operate during the night period for a limited duration, the 'night' goal noise level is the most relevant criterion for the combined noise from the operation of the Project.

Further, when measuring or predicting noise levels for comparison with the goal noise levels of the *Environment Protection (Noise) Policy*, penalty adjustments are made for any 'annoying' dominant characteristic of tone (i.e. low frequency, modulation or impulsiveness). A 5 dB(A) is applied if the noise exhibits one characteristic; 8 dB(A) is added for two characteristics and 10 dB(A) is added for three or four characteristics. In order to apply a penalty, the characteristic must be dominant when considered within the context of the existing acoustic environment at the noise receptors.

Noise Assessment

Noise predictions were made using the Conservation of Clean Air and Water in Europe (CONCAWE) noise propagation model and SoundPLAN noise modelling software. The assessment was conducted based on 'worst-case' weather conditions (i.e. highest noise propagation). Such conditions are most likely to occur on a clear night with a light breeze from the Project site towards residences. These conditions are conservative given the typical daytime operation of the inverters, and the unlikely occurrence of these worst-case conditions occurring during typical operation.

The noise assessment considered the following main noise sources that are likely to be incorporated as part of the project:

- Solar Inverters; 64 units of 4.2 MVA 33 kV inverter stations;
- Solar farm substation transformer; 1 unit of 275/33 KV, 345 MVA rated transformer;
- Hydro energy pump – 2 units of 150 MW turbine-pumps; and
- Hydro energy substation transformer – 2 units of 132/33 kV, 180 MVA rated transformers.

The solar panels installed on the tracker system do not produce significant noise and therefore were excluded from further assessment. Sound data used for each of these noise sources is provided in Appendix E.

Predicted Noise Levels

The predicted noise level is no greater than 32 dB(A) at the closest dwelling (Figure 8-3). These results are shown in Appendix D.

Some of the equipment proposed for the Project may have audible tones in close proximity although the potential for it to be a dominant characteristic at the residences is diminished by the masking effect of other noise sources at the Project site or in the wider environment. Notwithstanding, even if a correction of 5 dB(A) is added to the predicted level, the 45 dB(A) criterion is easily achieved.

8.3.2.3. Summary of Key Mitigation Measures

The predicted noise levels at the closest sensitive receptors (during operation) achieved the assessment criteria. It was therefore considered that the Project satisfies all relevant provisions of the Development Plan.

Key mitigation and management measures are summarised in Table 8-3. These measures will be captured in the CEMP and / or OEMP.

Table 8-3: Noise - key mitigation management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Ensure that plant and equipment are properly maintained.	✓	✓	✓
Hydro Solar	Avoid unnecessary noise when carrying out manual operations and when operating plant.	✓	✓	✓
Hydro Solar	Switch off any equipment not in use for extended periods.	✓		✓
Hydro Solar	Review equipment specification and location during detailed design to ensure that operational noise requirements continue to be met.	✓	✓	
Hydro Solar	Schedule noisier activities where this could impact receptors to coincide with business hours wherever possible.	✓	✓	✓
Hydro Solar	Undertake ongoing consultation with the community to identify any construction noise issues and where possible identify measures to minimise disruption.	✓		

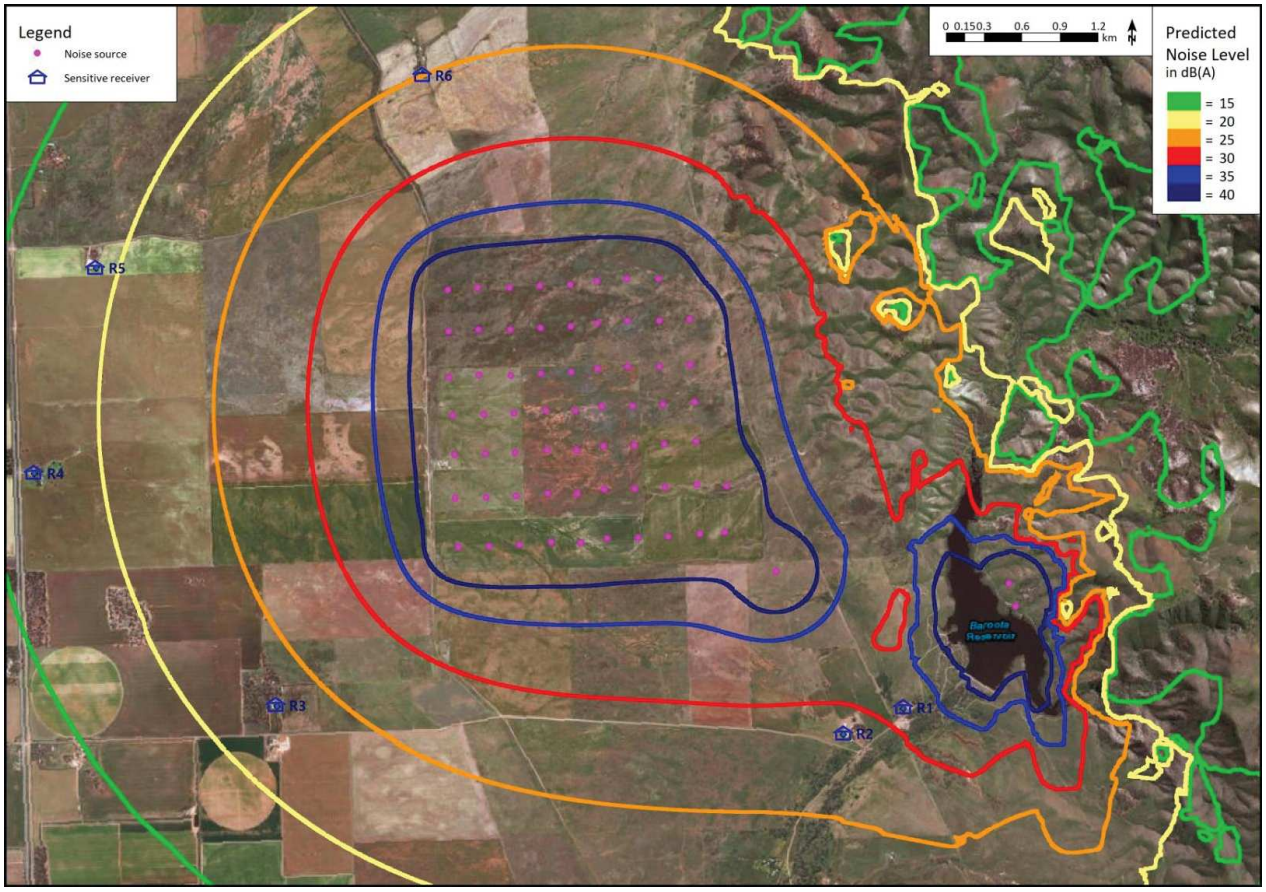


Figure 8-1: Predicted noise levels during operation (house symbols show closest residences). (Source: Sonus 2018)

8.4. Visual

A visual impact assessment has been undertaken for the project by JBS&G Australia. This assessment is provided in Appendix E and forms the basis of the information in this section.

8.4.1. Existing Environment

The area surrounding the Project site is predominantly rural in nature and sparsely populated.

8.4.1.1. Pumped Hydro Project

Land for the development of the Pumped Hydro Project is located just over 1 km east of the existing Baroota Reservoir. The proposed upper reservoir will be approximately 1.5 km in length with a dam wall at the south-west edge. The proposed upper reservoir will be located within a valley 1 km to the east on the upgradient hills and at an elevation of approximately 230 m from the Baroota Reservoir. Proposed infrastructure which may be visible to nearby receptors include the upper reservoir, penstock, switchyard and powerhouse.

The topography surrounding the site consists of strongly dissected steep to very steep hills of the Baroota, Separation and Waterfall Creek catchments. The system also includes the steep frontal slopes and rocky outcrops of the ranges to the south of Baroota Reservoir. Watercourses across the system occupy narrow valleys with a strongly pronounced V-shaped cross sections. Vegetation cover bounding the site to the comprises of tussock grasslands and scattered acacia shrublands covering the steeply inclined slopes.

Key sensitive receptors were identified for the Pumped Hydro Project and a visual impact assessment was undertaken for the viewpoints that are visible from the upper (Figure 8-2) and lower reservoirs (Figure 8-3).

8.4.1.2. Solar Project

The area of land proposed for the Solar Project facility is comprised of entirely agricultural land with little development other than cropped fields. The site is located directly east of a cattle track used as a local access point for property owners and west of Kenihan Road, a secondary minor access road running parallel to the Princes Highway connecting to recreational facilities of Baroota.

The Ruins campground and Mambray Creek campground are located 5.3 km to the north. The Augusta Highway, a major arterial road running north / south connecting Port Augusta (54 km to the north) and Port Pirie (73 km to the south), lies 3.2 km west of the site boundary. A 275 kV ElectraNet transmission line runs northwest to southeast between the existing Baroota Reservoir and the proposed solar facility. Reservoir Road located is 1.6 km south-east of the lower reservoir boundary and runs parallel to Baroota Creek, which connects Baroota Reservoir to Port Germein to the south-west.

The coastal plain between the ranges and ocean is characterised as dry and arid cropping land with very sparse vegetation limited to isolated patches of gum trees and tussock grasslands.

Key sensitive receptors were identified for the Solar Project and a visual impact assessment was undertaken for the viewpoints that are visible from Solar Project site (Figure 8-4).

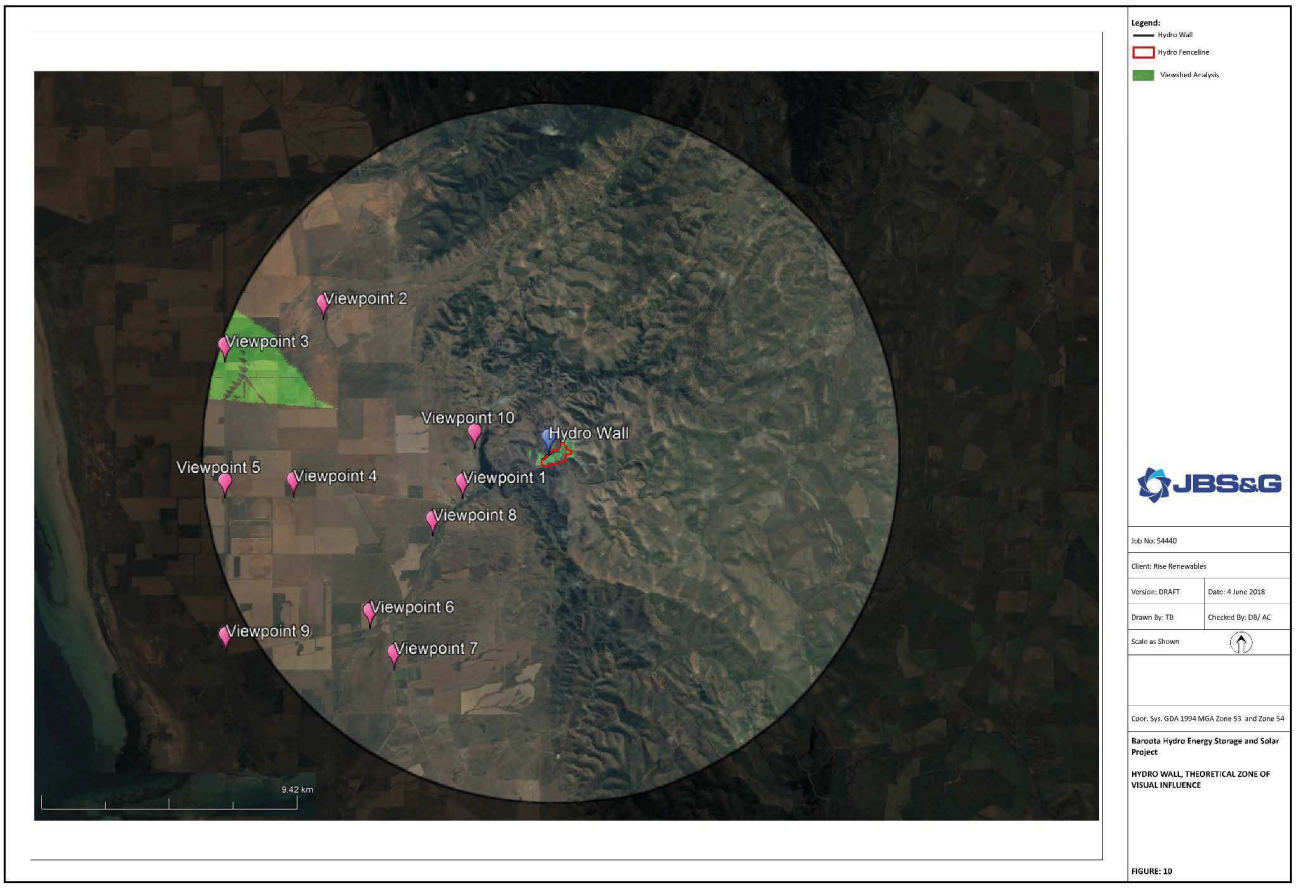


Figure 8-2: Visual viewpoints surrounding the upper reservoir site

Figure 8-3: Visual viewpoints surrounding the lower reservoir site

Figure 8-4: Visual viewpoints surrounding the Solar Project site

8.4.2. Potential Impacts and Proposed Mitigation Measures

There is potential for landscape and visual amenity impacts from the Project during the construction phases. These impacts will primarily be due to activities and infrastructure including:

- Clearing of existing vegetation;
- Dust generation;
- Stockpiling of infrastructure components and machinery in laydown areas;
- Temporary construction workshops and offices;
- The construction of perimeter fencing;
- The construction of solar arrays across the site; and
- The construction of the switchyard, powerhouse, penstock and upper reservoir.

During the operational phase, potential impacts will be associated with a change in the visual landscape due to the placement of the solar arrays, Pumped Hydro Project infrastructure, project offices and fencing.

A viewshed analysis was undertaken for all Project components which included:

- Identification of the Project site specific infrastructure with detailed reference to the various Project elements and existing environmental and public (residential properties, lookout points and road intersections) (herein referred to as 'viewpoints') surrounding the site that can potentially 'see' the site infrastructure;
- Use of Geographical Information Systems (GIS) and applications of ESRI ArcGIS and Google Earth Pro have allowed for Project data, aerial photographs and government datasets to be overlaid and generate a theoretical zone of visual influence (TZVI) from the site infrastructure. This has allowed for the identification of the viewpoints within the Projects' surrounding area (in a 20km diameter) that can potentially be seen;
- The viewshed analysis and viewpoint photograph description was conducted for relevant viewpoints identified:
    - Viewshed analysis was conducted by adopting a conservative eyeline height of approximately 2.00m based and extending on a best line to the site considering the elevation variation to the visible site infrastructure based on a 30 m resolution digital elevation model (DEM);
    - The height of the proposed infrastructure was not modelled in the viewshed analysis; and
    - The viewpoint photograph description allows for the viewshed to be referenced against an approximate visual perspective and allows for vegetation screening.

Sensitive receptors were selected within the TZVI to include the following categories:

- Towns;
- Tourism areas, campsites, hiking trails, viewpoints;
- Transport infrastructure; and
- Farm residences.

Potential visual impacts are discussed below for each of the areas where the Project is potentially visible.

8.4.2.1. Pumped Hydro Project-Upper Reservoir

The TZVI was based on the limit of discernibility of the most visually prominent project elements and was defined as a 10 km radius around the project area. The primary visual impact of the upper reservoir site is the dam wall located on the north-west side of the dam.

Aside from the ridgeline surrounding the upper reservoir to the north, east and south, the primary areas of potential visual impact as identified by viewshed analysis within line of sight of the dam wall are through the valley of the Baroota Creek. These areas include the ridgeline to the west of the existing Baroota Reservoir and agricultural land as far to the northwest as the TZVI boundary 10 km to the northwest.

The only identified viewpoints within these areas is Viewpoint 3 which will be from various points along the Augusta Highway (Figure 8-5).

8.4.2.2. Pumped Hydro Project-Lower Reservoir and Associated Infrastructure

The elevation profile across the TZVI increases in altitude by 115 m from south-west to north-east with gentle undulations over the agricultural land west of Baroota Creek and Baroota Reservoir. These topographical undulations prevent direct line of sight to many of the identified receptors to the south-west. Receptors to the west and north are largely shielded from the powerhouse due to the elevated topography of the ridgeline associated with the western and northern margin of the Baroota Reservoir.

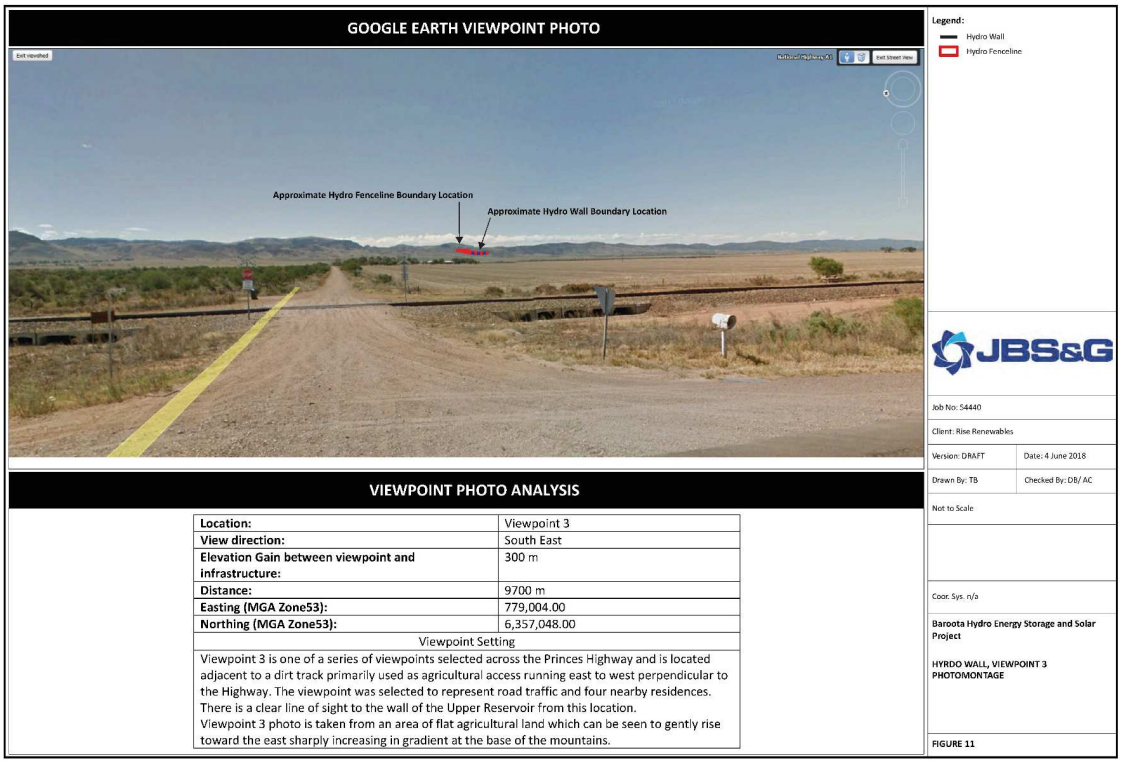
The identified viewpoints within the TZVI include:

- Viewpoint 6 (located on a dirt road associated with access to agricultural land from local properties owners) (Figure 8-6);
- Viewpoint 9 taken from the Augusta Highway (Figure 8-7); and
- Viewpoint 10 (taken from a lookout point situated on the northwest bank of the Baroota Reservoir adjacent to a public foot path (Figure 8-8).

8.4.2.3. Solar Project

The majority of sensitive receptors identified within the TZVI are rural residential properties widely distributed across the agricultural land west of Flinders Ranges. The undulating nature of this terrain has led to patches of land outside of the viewshed where natural plateaus are shadowed by topographical inclines.

A sensitive receptor within the TZVI is 4.3 km to the west of the site has been identified as the Augusta Highway running north-south and parallel to a regional railway track. The viewpoints identified as having a direct line of site with the Solar Project are Viewpoint 3 (Figure 8-9) and Viewpoint 5 (Figure 8-10), both of which have been taken from the Augusta Highway.

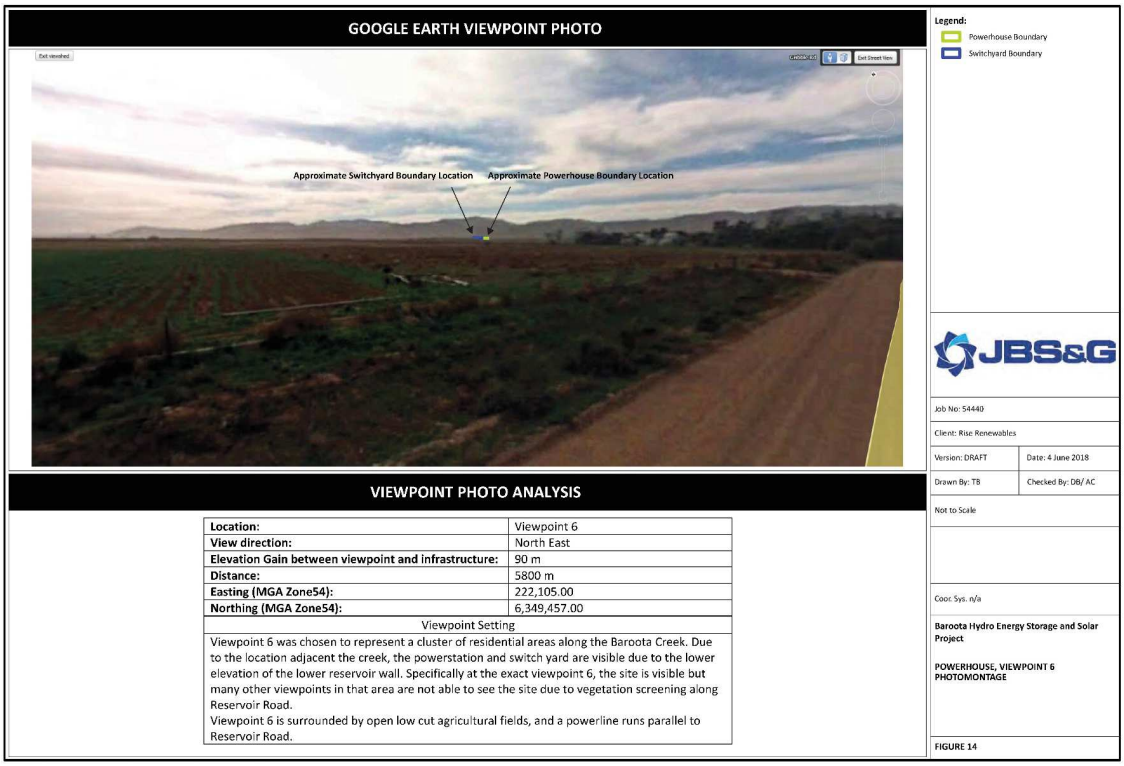


VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 3
View direction:	South East
Elevation Gain between viewpoint and infrastructure:	300 m
Distance:	9700 m
Easting (MGA Zone53):	779,004.00
Northing (MGA Zone53):	6,357,048.00
Viewpoint Setting	
Viewpoint 3 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricultural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and four nearby residences. There is a clear line of sight to the wall of the Upper Reservoir from this location. Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.	

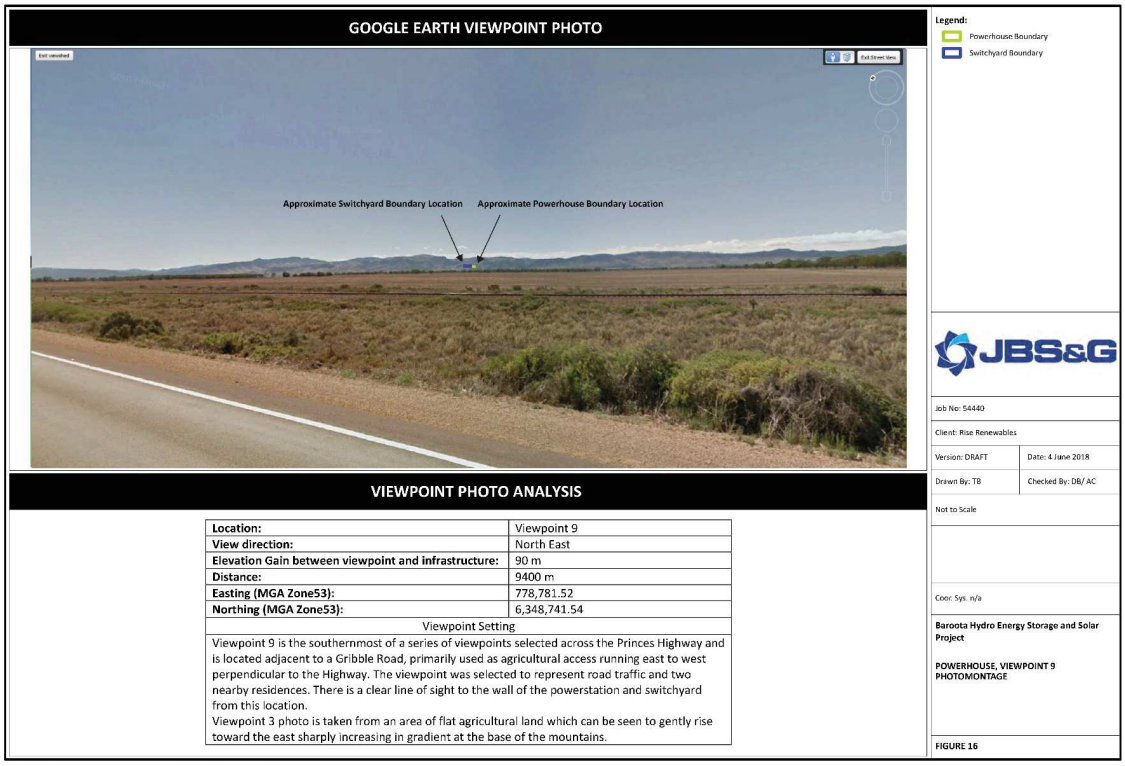
Potential Visual Impact
Low
The undulating ground to the east prevents direct line of sight across much of the agricultural land until the break of slope and steep topographic rise. The proposed dam lies beneath the ridgeline of Flinders Ranges, shadowing it from standing out against the skyline.

Figure 8-5: Viewpoint 3 for the upper reservoir and overall impact



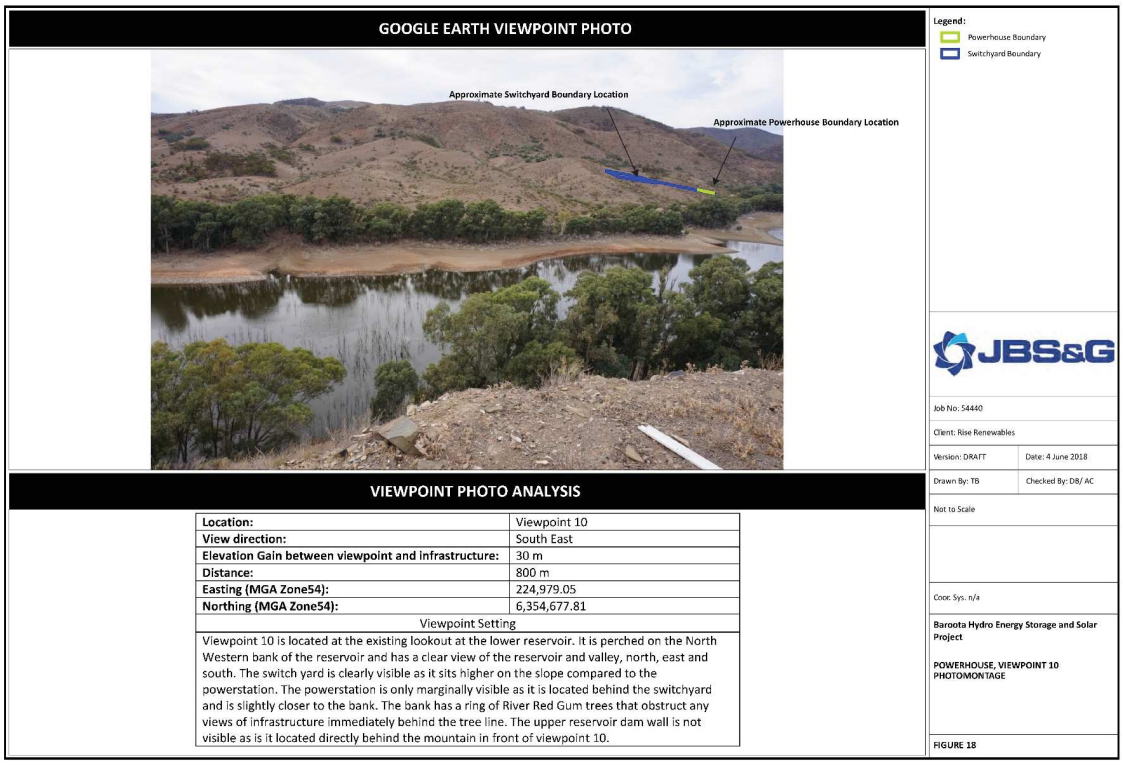
Potential Visual Impact
Moderate-Low
Although the proposed infrastructure can be seen, the distance and shadowing ridge line makes it a challenge for a casual observer to see.

Figure 8-6: Viewpoint 6 for the lower reservoir and overall impact



Potential Visual Impact
Moderate-Low
The undulating ground to the east prevents direct line of sight across much of the agricultural land until the break of slope and steep topographic rise which marks the foothills of the Flinders Ranges. Views from Viewpoint 9 are likely to be users of the Augusta Highway and therefore likely to be transient in nature.

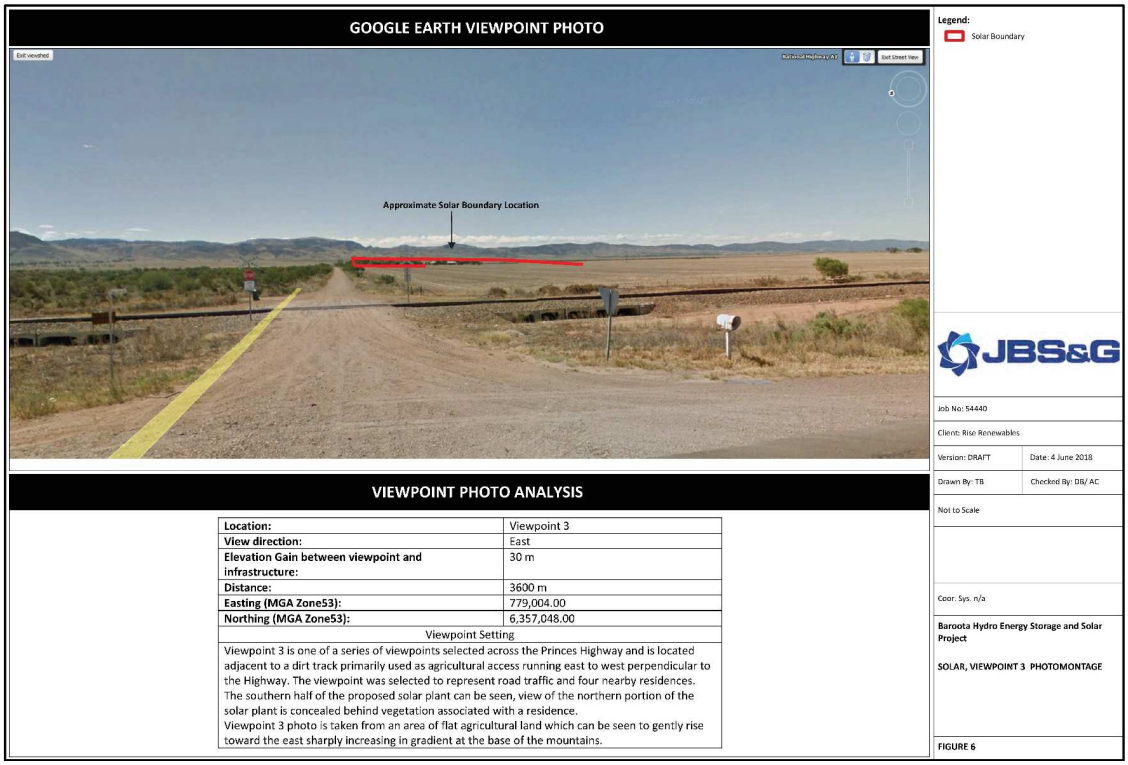
Figure 8-7: Viewpoint 9 for the lower reservoir and overall impact



Potential Visual Impact
High

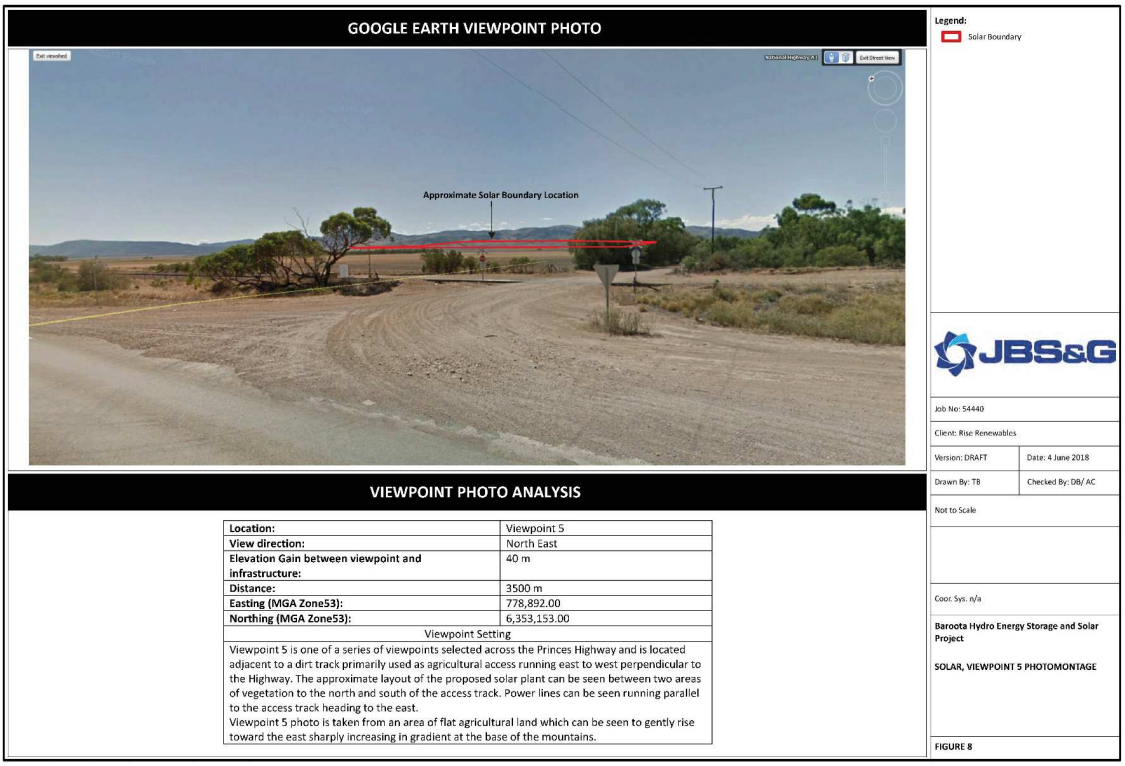
Viewpoint 10 shows a clear line of sight to the powerhouse and associated infrastructure. The viewpoint is approximately 800 m to the northwest of the powerhouse taken from a lookout point adjacent to a walking path which follows the circumference of the existing Baroota Reservoir. The majority of the surface area beneath the line of sight is within the topographic low of the existing Baroota Reservoir resulting in limited topographic shielding.

Figure 8-8: Viewpoint 10 for the lower reservoir and overall impact



Potential Visual Impact
Moderate
Viewshed analysis from Viewpoint 3 towards the Solar Project shows a clear line of sight to roughly 40% of the site. Gentle topographical undulations create topographical shadows which would hide the southern and western portions of the proposed solar site from Viewpoint 3.

Figure 8-9: Viewpoint 3 for the Solar Project



Potential Visual Impact
Moderate
Viewshed analysis from Viewpoint 5 towards the Solar Project show a clear line of sight to roughly 60% of the Solar Project area. Topographical undulations create topographical shadows which hide the southern and western portions of the solar plan area from view.

Figure 8-10: Viewpoint 5 for the Solar Project

8.4.2.4. Summary of Key Mitigation Measures

The likely visual impact from the proposed Pumped Hydro Project, associated powerhouse / switchyard and Solar Project on sensitive receptors was assessed using an impact matrix to score the visual impact for each receptor. The overall Project visual impact is considered moderate-low. The visual impact assessment concluded the following:

- Neither the Solar Project or Pumped Hydro Project and associated powerhouse / switchyard scored more than moderate-low when assessed against the criteria selected;
- The natural topography of the region is largely effective in minimising direct line of sight to the Pumped Hydro Project from identified receptors;
- Although the Solar Project is more visually accessible than the Pumped Hydro Project due to the flatter topography of the coastal plains, the undulating nature of the localised relief is effective in reducing the visual impact at all the identified sensitive receptors so that only partial areas of the site can be seen; and
- The powerhouse / switchyard are also largely hidden from observers due to the natural topography.

The assessment indicates that the Project is not visible to a significant portion of the public in the region and the topography and surrounding vegetation will limit the direct line of sight to residents. Given the relatively low scenic quality of the Project site and adjacent land, it is not expected that the Project will result in significant visual impacts. The sensitive receptors identified throughout the area were found to either be local residents living in sparsely distributed properties, or users of the Augusta Highway and adjacent railway line. Residents with partial views of the proposed Project will be mitigated by the distance to infrastructure and not be significantly affected.

In addition, users of the Augusta Highway or adjacent rail line would be exposed to the proposed developments for a few minutes at a time as they would be transient receptors, and therefore not significantly affected.

Rise will, however, implement appropriate mitigation measures as presented in Table 8-4. These measures will be captured in the CEMP and / or OEMP.

Table 8-4: Visual impact – key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Specify materials and colour of on-site infrastructure, (including the offices, workshops etc) that are, where practicable, non-reflective and of a colour that will blend with the landscape.	✓	✓	
Hydro Solar	Review material and equipment specification to ensure that potential for glare along Augusta Highway and Reservoir Road is not significant.	✓	✓	
Hydro Solar	Retain existing vegetation on the western and southern boundary of the Project, as far as practicable to provide some natural screening along the road and break up views of the Project from the road.	✓		
Hydro Solar	If possible, position construction equipment laydown areas away roads and highly visible areas.	✓	✓	
Hydro Solar	Arrange lighting to avoid direct light spill and unnecessary sky glow over the Project area, as far as practicable.	✓	✓	✓
Hydro Solar	Implement dust suppression measures including water sprays during construction and decommissioning to limit potential visual impacts of dust	✓		✓

8.5. Traffic

A road impact assessment has been undertaken for the Project by Point8 (2018). This assessment is provided in Appendix F and forms the basis of the information in this section.

8.5.1. Existing Environment

8.5.1.1. Road Network

The road network in the vicinity of the Project consists of the Augusta Highway, Germein Gorge Road, Baroota Road and Reservoir Road (Figure 8-11).

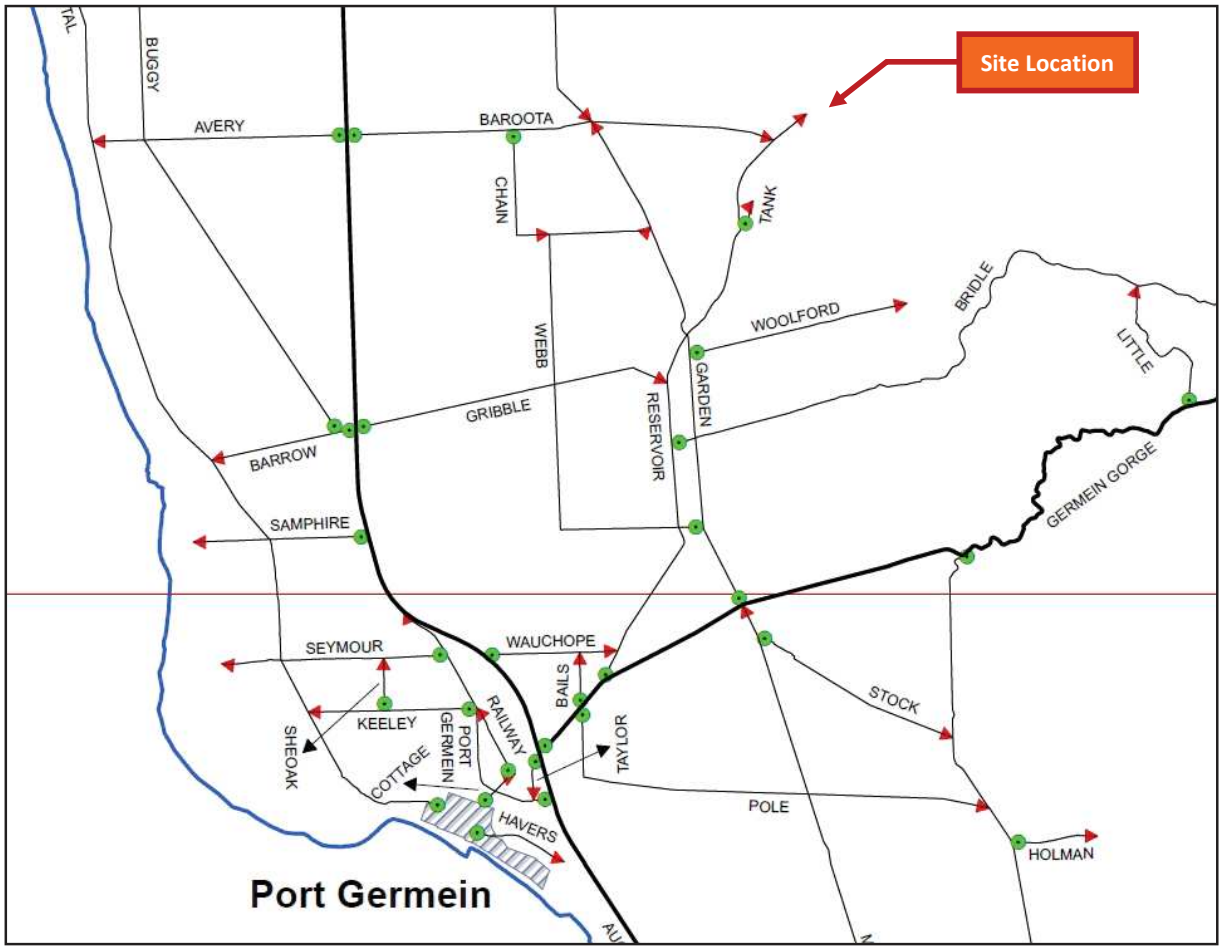


Figure 8-11: Rural and State road access to the Project site
Source: DC Mount Remarkable Rural Road RACK PLAN 876, October 2017

The Augusta Highway is a State-controlled (i.e. DPTI) road. It is a two-lane, two-way road, with 3.7 m wide lanes with 1.3 m sealed shoulders. A section of Augusta Highway (northbound) approaching Baroota Road is shown in Plate 8-1.

Germein Gorge Road is also a State-controlled road. It is a two-lane, two-way road, with a 5.5 m carriageway and with 1-1.5 m gravel shoulders. A section of Germein Gorge Road between Reservoir Road and Augusta Highway is shown in Plate 8-2.

Baroota Road and Reservoir Road are public roads controlled by the Council and provide access to the existing Baroota Reservoir and the proposed Project. Both roads are well graded and have a wide carriageway suitable for heavy vehicles. Baroota Road runs directly off Augusta Highway and is a generally flat and straight road providing a direct access to the Project site. A typical section of Baroota Road is shown in Plate 8-3. Reservoir Road is a longer and winding (in sections towards the northern end) unsealed road providing direct access from Germein Gorge Road to the Project site. A section of Reservoir Road is shown in Plate 8-4.

Plate 8-1: Augusta Highway (northbound) approaching Baroota Road (Source: Point8)

Plate 8-2: Germain Gorge Road (between Reservoir Road and Augusta Highway) (Source: Point8)

Plate 8-3: Baroota Road (Source: Point8)

Plate 8-4: Reservoir Road (Source: Point8)

8.5.1.2. Traffic Volumes

Existing traffic volumes have been obtained from SA Open Source traffic estimation of the Average Annual Daily Traffic[8] (AADT) estimates for 24-hour two-way flows. Augusta Highway carries a total of approximately 3,500 vehicles daily. Germein Gorge Road carries a total of 190 vehicles daily. During the site inspection, only one vehicle was observed to use Reservoir Road, with no vehicles using Baroota Road. Minimal traffic volumes are expected overall for Baroota Road and Reservoir Road given the existing land uses (farms and small number of rural residential properties) that they provide access to.

Peaks in weekday am and pm traffic volume for the intersection of Augusta Highway and Baroota Road occurred at 9:30 am– 10:30 am, 11:45 pm – 12:45 pm respectively. It is assumed that traffic volume at this intersection will be highest during the construction phase, with am and pm peaks occurring at approximately 6:00 am – 7:00 am and 5:00 pm – 6:00 pm in line with the anticipated 12-hour shift schedules.

8.5.2. Potential Impacts and Proposed Mitigation Measures

8.5.2.1. Construction and Decommissioning

Site Access

Access to the existing Baroota Reservoir and to the Project occurs via the eastern end of Reservoir Road where it transitions from a public road to a private road (Figure 8-12). At this location a gate is installed. Reservoir Road is straight and has sufficient width between the gate posts to accommodate heavy vehicle access at this location. Approximately 260 m beyond the gate, Reservoir Road intersects with Kenihan Road and Pipeline Track (Figure 8-12). Kenihan Road, Pipeline Track and Norwest Track are gated with SA Water signage.

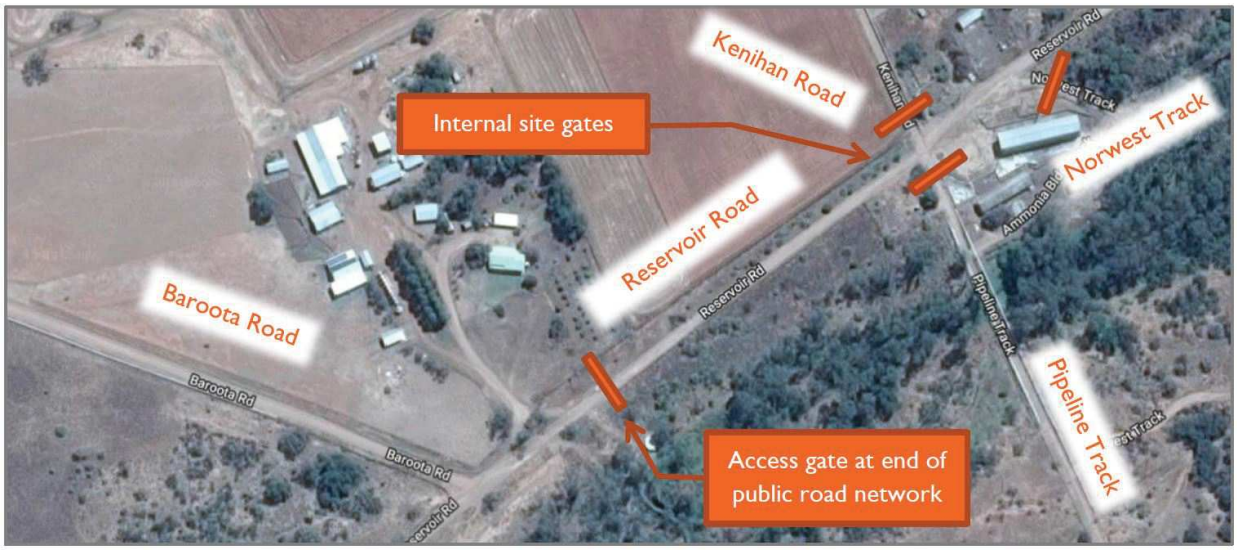
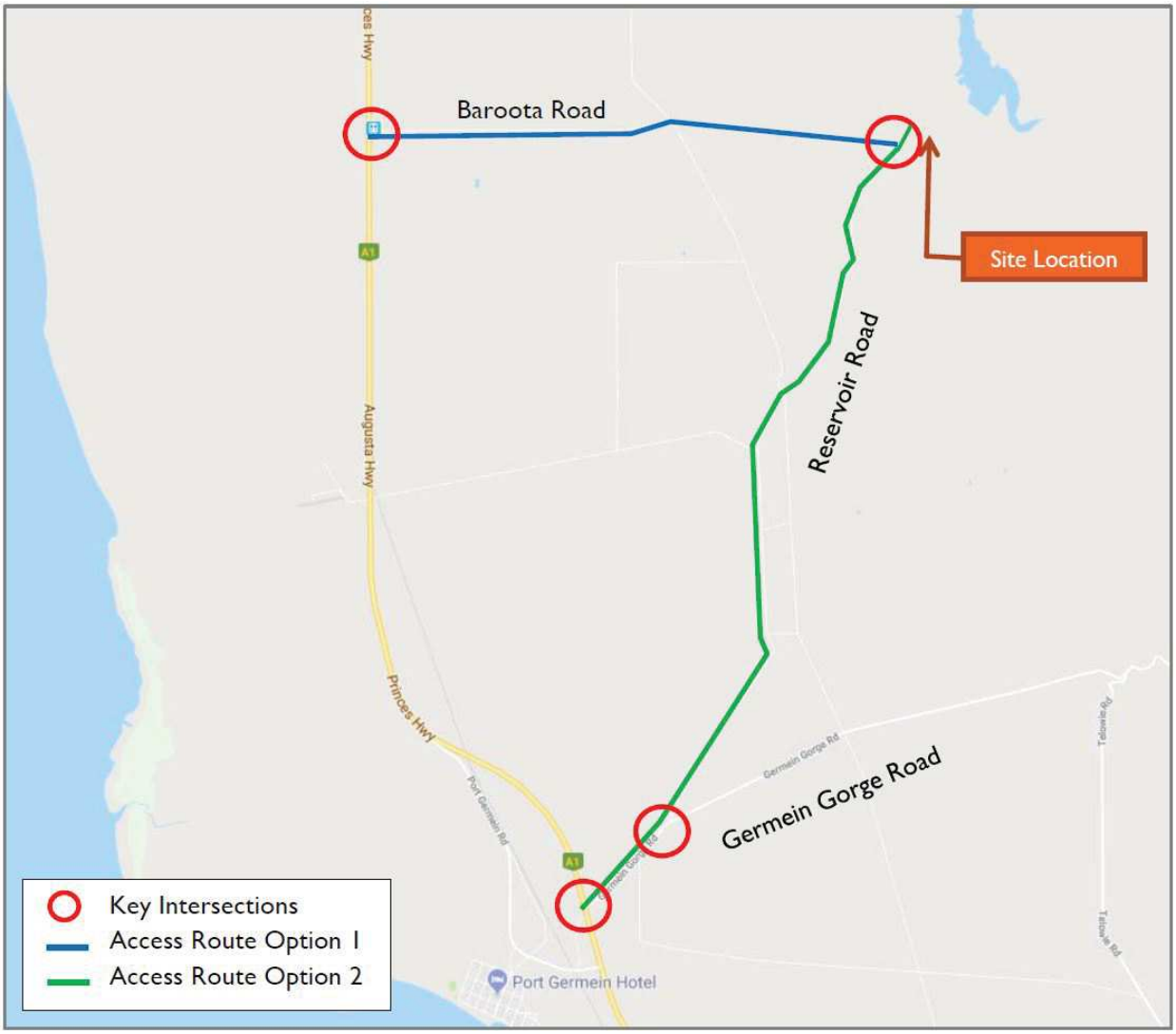


Figure 8-12: Site access

[8] Annual Average Daily Traffic is the sum of traffic travelling in both directions on a two-way road passing a roadside observation point over the period of a full year divided by the number of days in the year.

Route Options

There are two route options for vehicle access to the site from Augusta Highway; firstly, Baroota Road and secondly Germein Gorge Road/Reservoir Road (Figure 8-13).



Base Image Source: Google Maps

Figure 8-13: Potential route access and key intersections

Baroota Road is generally flat and straight and the most direct route from the Project to the nearest sealed, high order road (Augusta Highway). The intersection between Augusta Highway and Baroota Road further offers sufficient sight distance in all directions and with sufficient width for heavy vehicles.

In comparison, the intersection between Germein Gorge Road and Reservoir Road has substandard geometry, likely resulting in drivers having difficulty in observing approaching vehicles. Furthermore, the northern section of the Reservoir Road route is windy and within close proximity to trees with large trunk diameters. As such, the recommended access route is via Baroota Road. Some traffic may still end up using the Reservoir Road route however, where practicable, the Baroota route is the preferred option.

Vehicle Types

Project-related traffic will include a range of vehicle types. These are expected to include:

- Bus (12 seater) – transport of workforce;
- Light vehicles – management / supervisory; and
- Heavy vehicles (including, but not limited to, B-doubles, semi-trailers, dump trucks and water trucks).

Traffic Generation

Preliminary estimates of traffic generation for the construction and operational phases of the Pumped Hydro Project and Solar Project have been developed, based on calculated material take-offs and estimates of traffic generation for typical construction and operational activities (see Appendix F for details).

The traffic movement profile has been estimated, based on an assumed distribution of Project activities over a 35-month Project duration (Figure 8-14). This profile takes into account the overlap of activities to determine the peak daily movements associated with the Project. The profile indicates that the peak in total daily vehicles trips (to 933) would occur in month 11 (August 2019).

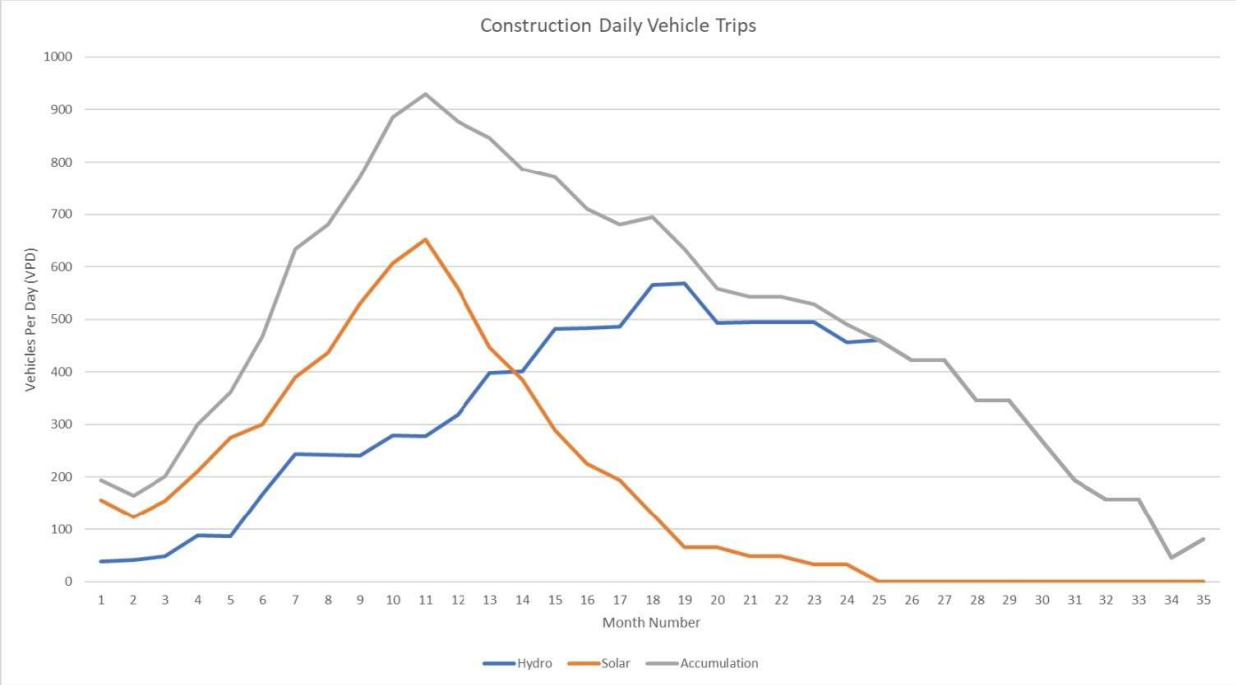


Figure 8-14: Construction daily vehicle trips for each month of construction of the hydro and solar facility

A summary of the typical daily and peak hour volumes predicted for August 2019 during the construction phase of the Project are further summarised further in Table 8-5. The peak is associated with the arrival and departure of construction personnel each day. Heavy vehicles contributed a relatively minor proportion (5.7%) to daily total vehicles trips during the peak period.

These estimates are preliminary and will be refined during development of the Traffic Management Plan with improved design definition and confirmation of construction scheduling.

Table 8-5: Estimated construction traffic generation for August 2019

Vehicle Type	Daily Trips	Peak Hours Trips (VPH)			
		AM Peak		PM Peak	
		IN	OUT	IN	OUT
Light Vehicles	880	440	0	0	440
Heavy Vehicles	53	4	4	4	4
Total Vehicles	**933**	**444**	**4**	**4**	**444**

Estimated traffic generation during operations of the Project are further summarised in Table 8-6, with an estimated 44 daily total vehicles trips.

Table 8-6: Estimated traffic generation during operation

Vehicle Type	Daily Trips	Peak Hours Trips (VPH)			
		AM Peak		PM Peak	
		IN	OUT	IN	OUT
Light Vehicles	40	20	0	0	20
Heavy Vehicles	4	1	1	1	1
Total Vehicles	**44**	**21**	**1**	**1**	**21**

Traffic Distribution

It is expected that travel to and from the Project site will occur via Augusta Highway (accessed via Baroota Road). The predicted dispersal percentage of construction related vehicles during the construction and operational phases are provided in Table 8-7. During the construction phase, the origin of most vehicles is expected to be from Adelaide (south), Port Pirie (south) and Port Augusta (north). It is expected that during the operations phase, the origins of most vehicles come are from local towns.

Table 8-7: Traffic distribution during construction and operation of the Project

Activity	Distribution	North	South
Construction	Workers (passenger vehicles)	50%	50%
	Workers (12-seater bus)	0%	100%
	Assorted material deliveries	25%	75%
	General Service Vehicles	50%	50%
Operation	Workers (passenger vehicles)	50%	50%
	General Service Vehicles	50%	50%

Crash Analysis

For a 5-year period (2012 - 2016) there were no crashes recorded at key intersections on Baroota Road or in the immediate vicinity of the Project site. There was one crash recorded on Reservoir Road. No apparent road deficiencies are indicated for the road network in the vicinity of the Project site.

Specific Locations

The presence of a vertical crest situated on Baroota Road (on the western approach) makes the intersection between Baroota Road and Reservoir Road not visible to drivers until they reach the top of the crest. Both roads are unsigned. It is recommended that with the increase in the number of vehicles during peak construction, a side road intersection on a Curve (W2-9(L)) advisory signage be installed on the western approach (Baroota Road) to the intersection, and that a Give Way sign (R1-2) be installed on the southern (Reservoir Road) approach to define the instruction priority to Baroota Road.

While existing signage for the Baroota Road level crossing was deemed suitable for current traffic volumes, with the anticipated increase in vehicle volumes during the peak construction phase, the exposure and associated risk level also increases. As such, a review of the existing crossing may be required through engagement with both DPTI and the rail operator (Australian Rail Track Corporation) (ARTC) to determine what, if any, measures may need to be implemented (e.g. warning lights, boom gates).

With Baroota Road the preferred access route to the Project site, the intersection with the Augusta Highway was assessed for its safety performance and to determine whether higher order treatments for this intersection are required. Without development and under normal operations following construction, no higher order treatments are warranted. However, a Channelised Right (CHR) form (i.e. right turn lane on the southern Augusta Highway approach to the intersection) is warranted under peak construction traffic volumes. It is recommended that a construction-phase Traffic Management Plan be developed to determine appropriate mitigation measures. The provision of a short-form Channelised Right (CHR[S]) treatment, which provides an intermediate level of safety performance at a reduced cost is an alternate potential measure compared to the

CHR treatment. Additional potential measures include the provision of temporary signage, speed limit reductions and / or active control, and additional bus / coach services for construction personnel based in Port Pirie.

Road Capacity

The overall volume of traffic currently using both sides of the roads is very low, with reasonably low AADT of the major road (<4000 vehicles per day) during peak construction. As such, the Augusta Highway and Baroota intersection can be expected to operate within practical capacity limits for an unsignalised intersection, with or without the development. Delays anticipated at the intersection are expected to be limited to construction related traffic only (turning onto the Augusta Highway). Therefore, a detailed operational capacity assessment has not been used to assess intersection operation.

Estimated daily traffic volumes on the Augusta Highway north and south of Baroota Road are 13% and 14% higher respectively than background during the construction phase of the Project. During operations, the estimated daily traffic volumes are 0 – 1% higher than background. Under all scenarios, daily volumes are well below carrying capacity of a two-lane highway, which is commonly accepted to be approximately 15,000 vehicles per day. Therefore, the proposed development is not expected to have any significant impact on link performances along the Augusta Highway.

Baroota Road Condition

Baroota Road is currently unsealed and currently carrying minimal traffic volumes (i.e. 21 vehicles recorded in a 12-hour period). Under peak construction it is estimated that the AADT on Baroota Road will temporarily increase to approximately 900 – 1000 vehicles per day. Sealing of roads is typically warranted for an AADT greater than 25 (*The Australian Road Research Board's Unsealed Roads Manual: Guidelines to Good Practice*). Given the temporary nature of the increased traffic volumes on Baroota Road, sealing of the road may not be required. However, the temporary increase in traffic volume is likely to require increased maintenance / intervention of the unsealed surface and responsibility for this will be discussed / negotiated with Council.

Mitigation

A Traffic Management Plan will be prepared during the detailed design phase and implemented during construction. Rise will work in close contact with DPTI and the Council in the preparation of the Traffic Management Plan and development of mitigation and management measures. The *Manual of Legal Responsibilities and Technical Requirements for Traffic Control Devices* (DPTI 2017) will be used as a basis for developing relevant aspects of the Traffic Management Plan.

The Traffic Management Plan will consider the following aspects:

- Routes to be used by Project construction traffic (e.g. Baroota Road);
- The provision of a Channelised Right (CHR) or short-form Channelised Right (CHR[S]) treatment for intersection of Augusta Highway and Baroota Road;
- Assessment of road condition prior to construction;
- Traffic controls (e.g. speed limits, signage) where appropriate;
- Procedures to monitor traffic impacts and adapt controls (where required) to reduce impacts;
- Community consultation regarding traffic impacts for nearby residents;
- Maintenance of road pavement conditions during construction e.g. removal of gravel / dirt from the sealed road surface at the main site access; and
- A program for monitoring road condition and to repair damage exacerbated by construction traffic.

8.5.2.2. Operation

For the operation of the Project, there is minimal increase in traffic volume (1% increase from background). During normal operation, only a small number of standard vehicles are likely to access the site on a regular basis. Standard work hours would be maintained for standard operational activities.

8.5.2.3. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 8-8. These measures will be captured in the CEMP and / or the OEMP.

Table 8-8: Traffic - key mitigation and management measures

Project	Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Design the intersection treatment (Augusta Highway/Baroota Road) for the access route to the Project site during detailed design, in accordance with Austroads standards and DPTI requirements, using refined traffic movement estimates.	✓		
Hydro Solar	Erect signage at the Baroota Road / Reservoir Road intersection.	✓	✓	
Hydro Solar	Use traffic control / signage / management to ensure safe site access during the peak construction phase.	✓		
Hydro Solar	Increased vehicle traffic across the existing rail level crossing on Baroota Road may result in the need to engage with DPTI and ARTC to conduct an Australian Level Crossing Assessment Model review to determine if / what measures are required.	✓		
Hydro Solar	Determine the responsibility (negotiated with the Council) and frequency of maintenance to existing gravel road (Baroota Road).	✓		
Hydro Solar	Use buses to transport workers to and from the site during the peak construction period.	✓		
Hydro Solar	Develop and implement site protocols for on-site traffic management, which may include speed restrictions and access restrictions to minimise collisions with and disturbance to fauna.	✓		
Hydro Solar	Develop a Traffic Management Plan prior to the commencement of construction, with input from DPTI and Council.	✓		

8.6. Socio-Economic

8.6.1. Existing Environment

The Project is located within the District Council of Mount Remarkable which covers an area of approximately 3,413 km^2. The key industries for the region include primary production and construction.

The nearest residential townships to the Project are Port Germein (approximately 12 km west of the site boundary), Melrose (approximately 14 km east of the site) and Port Pirie (approximately 40 km south-west of the site boundary).

8.6.1.1. Population

The population for the Council area is estimated at 2,864 people with the median age of persons residing in the region being 53 (ABS 2016). Approximately 3.2% of the region's population identified as being of Aboriginal and / or Torres Strait Islander people descent (ABS 2016).

Port Germein has a population of approximately 369 people and Melrose approximately 347 people, which equates to 12.8% and 12.1% of the region's population respectively (ABS 2016).

Port Pirie, which is in the Port Pirie Regional Council, is home to approximately 17,754 people with 3.6% of the population identifying as being of Aboriginal and/or Torres Strait Islander people descent.

8.6.1.2. Employment and Industry

The Project has already engaged and employed local suppliers and contractors to undertake preliminary geotechnical investigations, cultural heritage and noise assessments. Rise will continue to firstly engage, where possible, with local and/or regional services.

The labour force in the Council area has been estimated to be 1,325 with an approximate labour force of 152 in Port Germein and 173 in Melrose. The level of unemployment in the Council area was 5.7% (ABS 2016). The unemployment rate for Port Germein is estimated to be 9.2% and for Melrose 2.3%.

Major employment in the region is linked to primary production (broadacre grains and livestock), health and community services, education, manufacturing and retail. Manufacturing, retail and health services are the main industries of employment in the Port Germein area while agriculture is the main industry in the Melrose area.

8.6.1.3. Income

In 2016, the median total personal income in the Council area (applicable to persons aged 15 years and over) was estimated at $497 per week, with the median total family income at $1,217 a week and the median total household income at $940 a week (ABS 2016). This compares with a median total personal income of $898 per week in Adelaide and $769 for all of South Australia.

8.6.2. Potential Impacts and Proposed Mitigation Measures

8.6.2.1. Construction and Decommissioning

Employment and Suppliers

The local region experiences above average unemployment and has traditionally relied on substantial heavy industries in nearby towns (e.g. Port Pirie and Port Augusta). There exists, therefore, significant underutilised skills and experience among the local labour force which would likely benefit substantially from the employment and economic impacts created by the Project.

It is expected that up to 500 personnel for the Project would be required during periods of peak construction activity. The construction labour force will be sourced locally as far as practicable, however there will be a requirement to source workers externally (e.g. where specific skills are not available locally).

The Project will result in direct creation of jobs, as well as flow-on effects related to provision of services such as accommodation, food, fuel and transport during the construction phase. This will benefit the local economy and provide opportunities for members of the local community to build experience in a new industry.

Local suppliers will be used where possible and the Project team will continue to engage with Council and other organisations where appropriate (e.g. the Industry Capability Network) to ensure that opportunities created by the Project are able to be accessed by local, regional and South Australian businesses.

Accommodation

The demand for accommodation for non-local workers during construction would benefit the local economy, but could also place pressure on local accommodation services, particularly at times of the year when tourist visitation is highest.

It is anticipated that most non-local workers would be accommodated at existing accommodation within the local area (e.g. towns within an hour's drive of the site), with bus transport provided to minimise traffic volumes and transit risks during construction.

The Project team will work with the Council and local community to identify and finalise three to four main areas where workers will be accommodated. This will ensure accommodation requirements are spread out in the broader region with the aim of minimising potential impact on available accommodation for tourism or other seasonal events upon which the region relies economically.

Accommodation requirements will be addressed in consultation with the Council which is facilitating local engagement through the establishment of a registration of interest process.

Public Health Facilities and Services

The temporary population increase during construction has the potential to place pressure on local public health services, if not appropriately managed. Ongoing consultation will be undertaken with the Council and local health service providers to identify any issues and develop appropriate mitigation strategies where required.

Public Amenity

The increase in non-local workers during the construction period has the potential to increase demand on recreational services and facilities such as hotels and shops. While this will result in direct economic benefit, it also has the potential to adversely affect community safety, amenity and wellbeing if not appropriately managed. Noise generated by the workforce, particularly early in the morning when leaving for the Project site, could also impact amenity values in areas where personnel are accommodated.

The Project team will work closely with local authorities and the community to identify and manage impacts arising from significant additional local economic activity and employment. Regular drug and alcohol testing of all workers will be undertaken to monitor alcohol and drug use and ensure workplace safety. The locations of assembly points for bus transport will be selected to minimise the potential to disturb local residents. A community consultation and engagement system and complaints mechanism will be implemented to ensure that any issues are promptly identified and addressed.

8.6.2.2. Operation

During operation, approximately 5 – 10 direct jobs are expected to be created for the life of the Project. Additional personnel may also be required for scheduled maintenance or refurbishment operations. This would directly benefit the local economy and regional employment.

8.6.2.3. Summary of Key Mitigation Measures

Key mitigation and management measures are summarised in Table 8-9. These measures will be captured in the CEMP and / or OEMP.

Table 8-9: Socio-economic - key mitigation and management measures

Project	Management / Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Actively work with local and regional employment services and businesses to maximise opportunities for suitably qualified local and regional workers.	✓	✓	
Hydro Solar	Identify opportunities for training and skills development.	✓	✓	
Hydro Solar	Engage with the Council and other organisations where appropriate (e.g. the Industry Capability Network) to maximise local access to supply opportunities.	✓	✓	
Hydro Solar	Address accommodation requirements in consultation with local businesses and the Council and other bodies where appropriate (e.g. local tourism industry representatives).	✓		
Hydro Solar	Ensure that measures are in place to provide appropriate medical support during construction and minimise the potential for impact on local health services.	✓		
Hydro Solar	Undertake consultation with Council and local health service providers to identify impacts to local health services and develop appropriate mitigation strategies where required.	✓		
Hydro Solar	Liaise with local health and emergency service providers during development of emergency response procedures.	✓	✓	✓
Hydro Solar	Work closely with local authorities and the community to identify and manage impacts of increased workforce on community safety, amenity and wellbeing.	✓		

Project	Management / Mitigation Measure	Construction Phase	Operational Phase	Decommissioning Phase
Hydro Solar	Develop induction procedures and information for staff and contractors that include an orientation into the values and expectations of the local community.	✓		
Hydro Solar	Require contractors implement industry standard drug and alcohol testing of workers to monitor alcohol and drug use and ensure workplace safety.	✓	✓	✓
Hydro Solar	Ensure strict compliance with and monitoring against Zero Harm Policy requirements.	✓	✓	✓
Hydro Solar	Select locations of assembly points for bus transport to minimise potential disturbance of local residents.	✓		
Hydro Solar	Implement a community consultation and engagement system mechanism to ensure that any issues and ideas are promptly identified and addressed.	✓	✓	✓

9. Environment, Health and Safety Management

Environment, Health and Safety Management Plans will be developed for the Project as discussed below. These plans will form part of the overall project management framework.

9.1. Health and Safety Management

The *Work Health and Safety Act 2012* governs health and safety management requirements. The Project will be constructed and operated under a work health and safety framework which meets the requirements of the Work Health and Safety Act. The framework will be aligned with the requirements of AS/NZS 4801:2001 *Occupational Health and Safety Management Systems* and other relevant Australian Standards.

A Project-specific Safety Management Plan will be developed for construction which will comply with legislative requirements and contractor systems and processes.

Rise will ensure that the contractors engaged for the construction period for the Project have objectives and targets to ensure that all identified, as well as potential, health and safety risks that could reasonably be expected to occur throughout the execution of the Project, are managed so far as is reasonably practicable.

9.2. Environmental Management

The environmental management measures that will be implemented for the Project will be documented in Project-specific environmental management plans for the construction and operational phases. These plans are discussed further below.

9.2.1. Construction Environmental Management Plan

A CEMP will be developed prior to construction. This plan will capture the mitigation and management measures summarised in Sections 6, 7 and 8 of this document and any relevant conditions of approval. The CEMP will cover:

- Environmental policy;
- Environmental objectives;
- Environmental management measures and procedures;
- Roles and responsibilities;
- Induction and training;
- Monitoring and auditing; and
- Reporting.

A number of other plans will operate in parallel to the CEMP as part of the overall project management framework. These will provide detailed guidance on specific aspects such as traffic management, stakeholder communication and emergency response.

All personnel and contractors will be required to comply with the requirements of the CEMP. Periodic audits and inspections will be undertaken during construction to assess compliance with the CEMP and approval requirements.

9.2.2. Operational Environmental Management Plan

Operational management measures summarised in Sections 6, 7 and 8 will be captured in an OEMP together with relevant procedures. The principal focus is to ensure that the management measures are being implemented and are effective. They will include adaptive management mechanisms to encourage continuous improvement.

The OEMP, management plans and operational procedures will cover the elements identified for the CEMP.

9.2.3. Decommissioning Environmental Management Plan

Prior to decommissioning, an environmental management plan will be developed to address the environmental management measures summarised in Sections 6, 7 and 8 and the relevant legislative requirements at the time.

9.2.4. Roles and Responsibilities

All personnel involved in the Project, including Rise employees, contractors and sub-contractors, will be required to undertake works in accordance with the CEMP, OEMP, management plans and procedures. Key roles and responsibilities are outlined in Table 9-1.

Table 9-1: Indicative project roles and responsibilities

Position	Responsibilities
Senior Project Manager / Site Manager	• Ensuring that employees and contractors understand their obligations under the relevant environmental management plans • Ensuring that all the on-site safeguards and controls are in place • Compliance monitoring • Maintenance and inspections • Reporting
Environmental Representative	• Compliance monitoring • Environmental internal reporting and incident investigation • Reporting to authorities (if required)
Engineering Representative	• Understanding and complying with the requirements of the environmental management plans when providing design advice
Staff and Contractors	• Understanding and complying with the requirements of the environmental management plans • Undertaking inductions where necessary • Understanding and complying with emergency procedures and responses (if required)

9.2.5. Training and Induction

All personnel directly involved in site activities will undergo site inductions covering the key environmental issues and controls. Other communication methods will also be used to ensure personnel remain informed of environmental requirements including:

- Sub-contractor's kick-off meeting;
- Contractor and client site kick-off meeting;
- Risk workshops and Project and steering meetings;
- Site inductions;
- Daily pre-start meetings and / or toolbox meetings; and
- Incident bulletins.

9.2.6. Monitoring

Ongoing monitoring and auditing will be undertaken to determine whether environmental protection measures are being implemented and performing effectively. Monitoring programs will be designed to assess aspects including:

- Compliance with environmental commitments and approval conditions;
- Appropriate storage and bunding of fuel and chemicals;
- Specific issues including traffic and dust generation, particularly during construction;
- Site reinstatement following construction; and
- Presence of weeds or pest animals.

Regular inspections carried out by site personnel will be the principal form of monitoring of site activities.

9.2.7. Records and Reporting

During all phases of the Project, an appropriate and auditable record system will be maintained. Environmental records will include:

- Non-conformance reports;
- Remedial actions taken following incident reports;
- Inspection reports and monitoring results;
- Training and induction attendance;
- Consultation records and complaints register; and
- Audit reports.

Environmental reporting will be conducted in accordance with commitments contained in this document and relevant approval conditions.

9.3. Emergency Response Plan

Emergency response plans (ERPs) will be developed for each Project phase (i.e. construction, operation and decommissioning) to guide actions to be taken to minimise the impacts of accidents and incidents. ERPs will be reviewed and updated on a regular basis to incorporate new information arising from any incidents, near misses and hazards and emergency response simulation training sessions. These plans will also include the facilitation of fire danger season restrictions and requirements.

Emergency response drills will also be undertaken at regular intervals to ensure that personnel are familiar with the plans and the types of emergencies to which it applies, and that there will be a rapid and effective response in the event of a real emergency occurring.

The ERPs will address all potential risks associated with the Project and will outline:

- Identification of appropriate emergency services;
- Measures to undertake consultation with local emergency services;
- Protocol for notification of appropriate authorities; and
- Detailed incident and emergency procedures.

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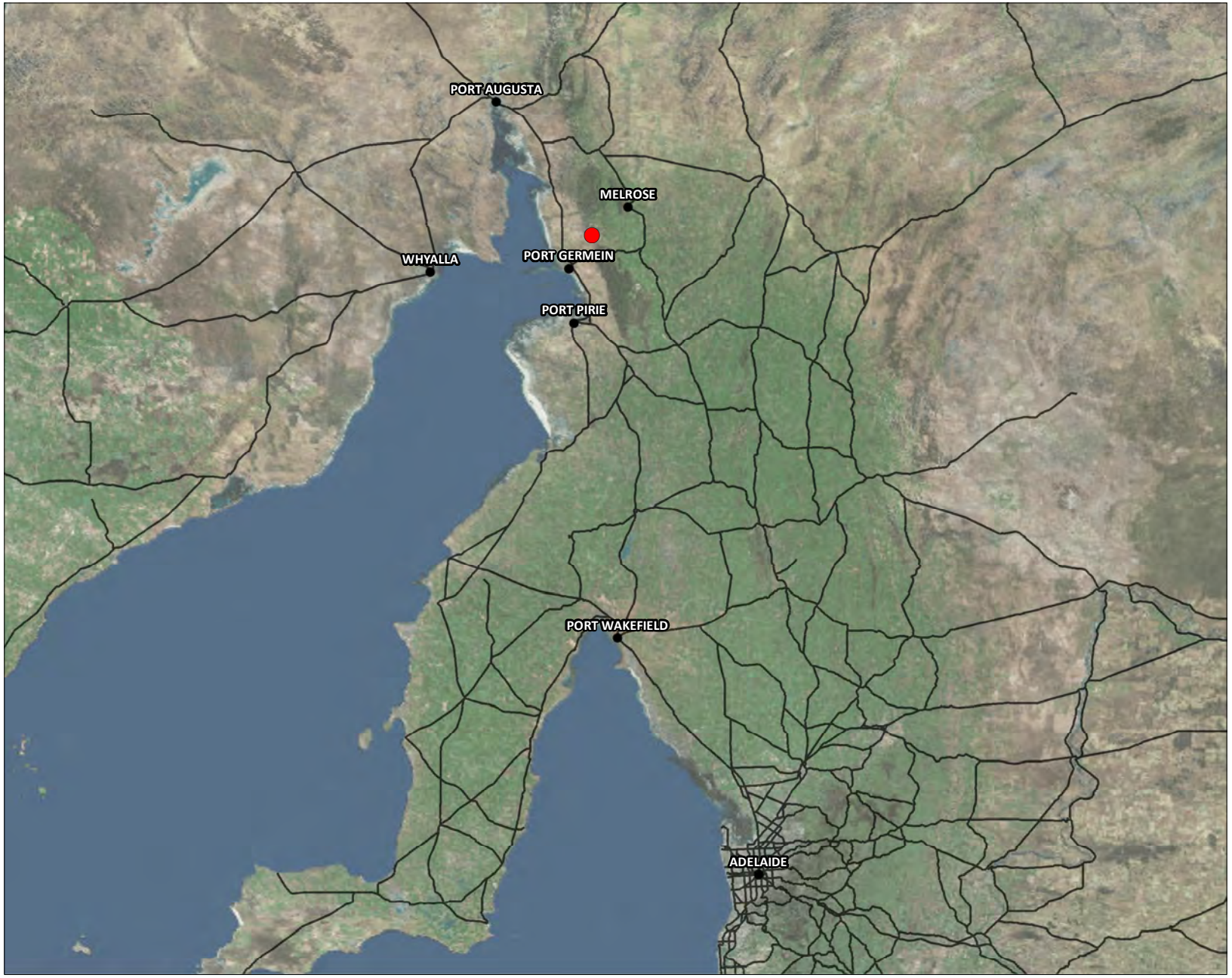
11. Glossary

Term	Description
AADT	Annual Average Daily Traffic
AAR	Aboriginal Affairs and Reconciliation
ABS	Australian Bureau of Statistics
AC	Alternating Current
AHD	Australian Height Datum
ANCOLD	Australian National Committee on Large Dams Inc.
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
AS	Australian Standards
AS/NZS	Australian Standards/New Zealand Standards
BHC	Blackwood Heritage Consulting
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CFS	Country Fire Service
CHMP	Cultural Heritage Management Plan
CHR	Channelized Right
CHR[S]	Short-form Channelized Right
CONCAWE	Conservation of Clean Air and Water in Europe
Council	Mount Remarkable District Council
CVSR	California Valley Solar Ranch
Cth	Commonwealth
dB	Un-weighted (or linear) noise or sound power level in decibels
dB(A)	A-weighted noise or sound power level in decibels
DC	Direct Current
DEM	Digital elevation model
Development Plan	Mount Remarkable Council Development Plan (consolidated 5 September 2013)
DEW	Department of Environment and Water (formally Department of Environment, Water and Natural Resources (DEWNR))
DPC	Department of the Premier and Cabinet
DPTI	Department of Planning, Transport and Infrastructure
DSD	Department of State Development
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
ephemeral	Short-lived or lasting a short time
ERP	Emergency Response Plan
GIS	Geographical Information Systems

Term	Description
ha	Hectare
HVAC unit	Heating, Ventilation and Air Conditioning unit
HDPE	High-Density Polyethylene
Heavy vehicle	Vehicle with a gross vehicle mass (GVM) greater than 4.5 tonnes
IBRA	Interim Biogeographic Regionalisation for Australia
IECA	International Erosion Control Association
ILC	Indigenous Land Corporation
ILUA	Indigenous Land Use Agreement
ICN Gateway	Industry Capability Network Gateway
km	Kilometre
km^2	Square kilometre
kV	Kilovolt
L_{eq}	Equivalent noise level
L/s	Litres per second
M	metre
Minister	Minister for Planning
Mm3	Million cubic metres
MVA	Mega Volt Amp
MW	Mega Watt
MW_{AC}	Megawatt Alternating Current
NEM	National Electricity Market
NPWSA	National Parks and Wildlife South Australia
NRM	Natural Resource Management
NRM Act	Natural Resources Management Act 1994
NVC	Native Vegetation Council
NPW	National Parks and Wildlife
OEMP	Operational Environmental Management Plan
OTR	Office of the Technical Regulator
Penstock	Conveyance water pipeline
PHES	Pumped hydroelectricity energy storage
PV	Photovoltaic
PWRA	Prescribed Water Resources Area
Qha	Holocene alluvial fluvial sediments
Qha10	Colluvium and alluvium
SARIG	South Australian Resources Information Gateway
SCAP	State Commission Assessment Panel (a Committee of the State Planning Commission)
SEB	Significant Environmental Benefit

Term	Description
SEDMP	Soil Erosion and Drainage Management Plan
SDS	Safety data sheet
SPC	State Planning Commission (formerly known as the Development Assessment Commission)
TDS	Total dissolved solids
TZVI	Theoretical zone of visual influence
V_{DC}	Volts Direct Current
WAAP	Water Affecting Activity Permit
WAP	Water Allocation Plan
Wongi-Ahrah	Wongi-Ahrah Aboriginal Association
WONS	Weeds of National Significance



Legend:

- Project Location
- Town
- Main Road

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 07-Jun-2018
Drawn By: AS	Checked By: AC
Scale at A4 1:2,000,000	

0 40 80

Kilometres

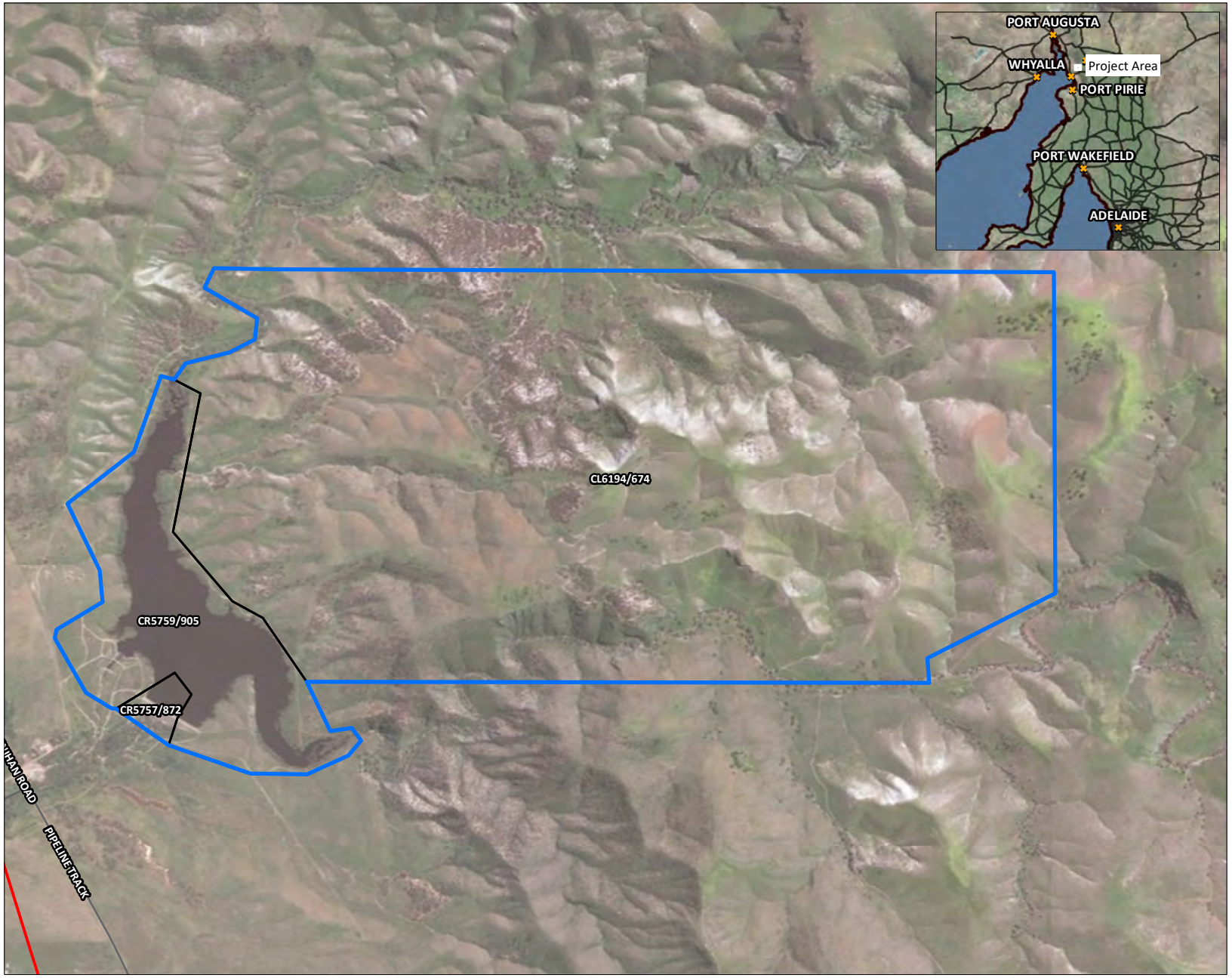
Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

PROJECT LOCATION PLAN

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Preliminary\Project Location Plan.mxd

Image Reference: Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend:

- Property Boundary
- Certificates of Title
- 275kV Transmission Line
- Roads

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 07-Jun-2018
Drawn By: AS	Checked By: AC
Scale at A4 1:30,000	

0 0.5 1
Kilometres

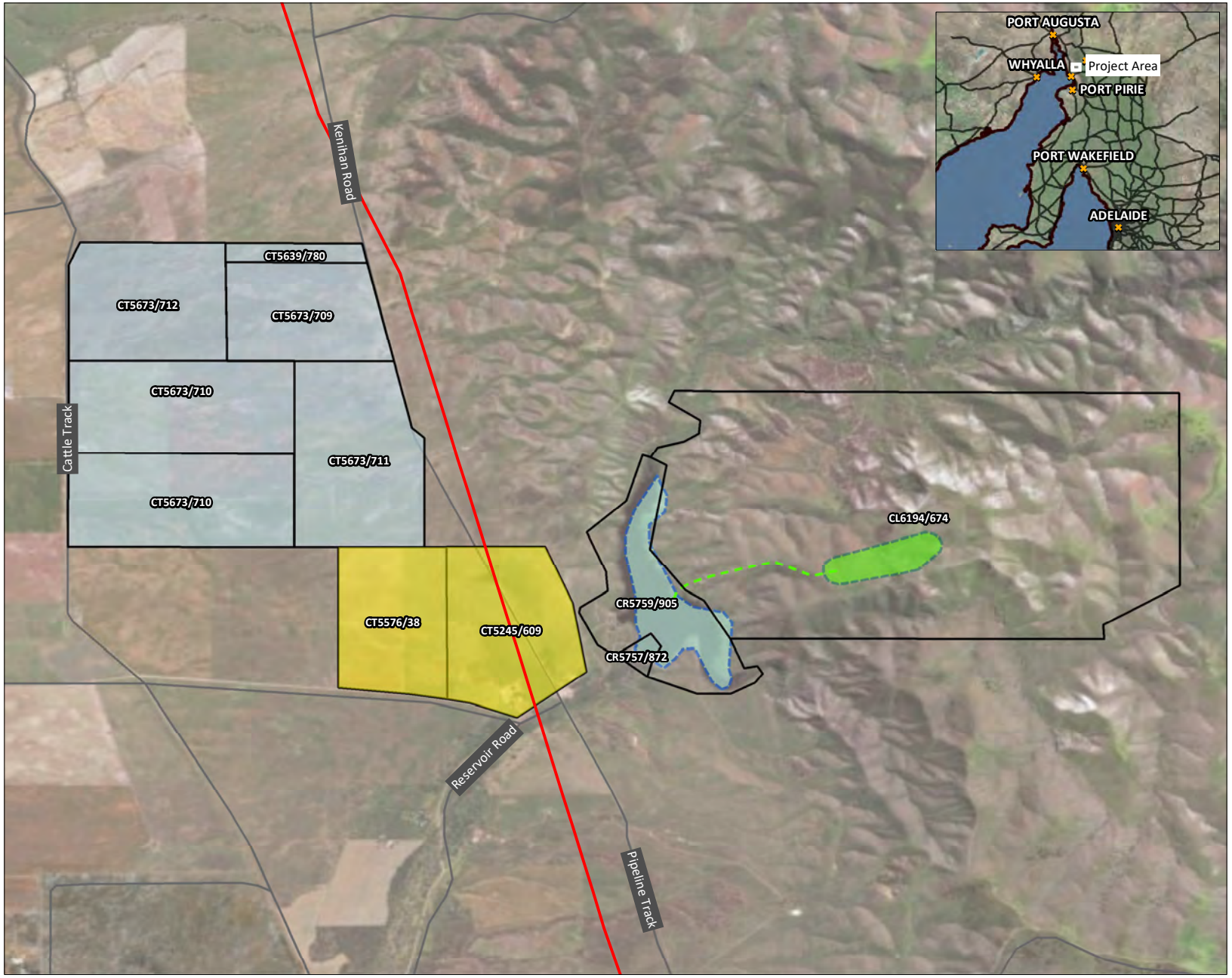
Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

PROPOSED HYDRO PROJECT SITE

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Preliminary\Proposed Hydro Project Site.mxd
Image Reference: Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PRIVILEGED AND CONFIDENTIAL



Legend:

- Certificates of Title
- Bridle Track Solar Farm
- Electrical Reticulation & Substation Area
- Baroota Reservoir
- Proposed Upper Reservoir
- Proposed Pipeline
- 275kV Transmission Line
- Roads

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT	Date: 07-Jun-2018
Drawn By: AS	Checked By: AC

Scale at A4 1:50,000

0 1 2

Kilometres

Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

PROPOSED SITE LOCATION PLAN

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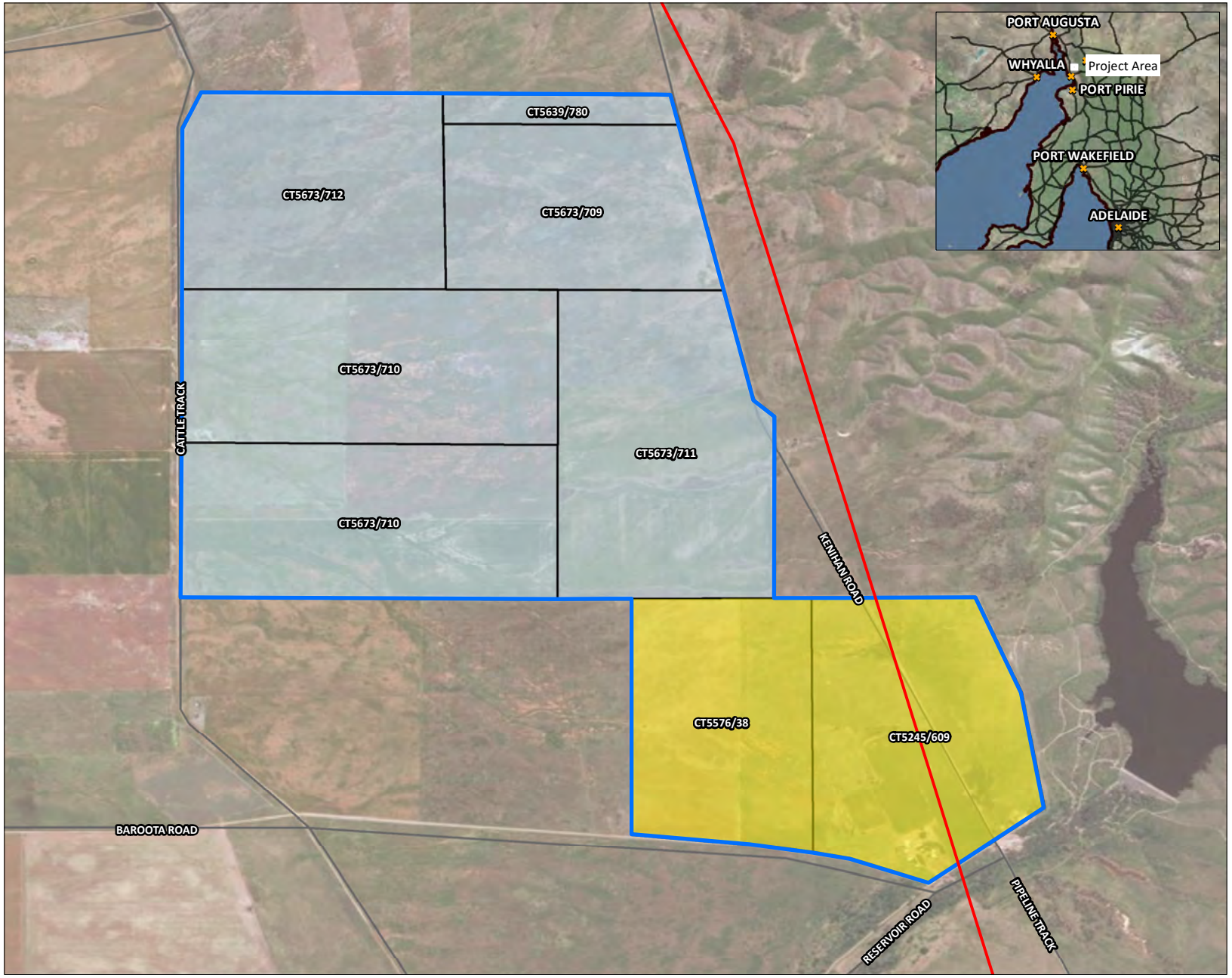

Legend:

- Property Boundary
- Certificates of Title
- Bridle Track Solar Farm
- Electrical Reticulation & Substation Area
- 275kV Transmission Line
- Roads

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 07-Jun-2018

Drawn By: AS | Checked By: AC

Scale at A4 1:30,000

0 0.5 1

Kilometres

Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

PROPOSED SOLAR PROJECT SITE

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Preliminary\Proposed Solar Project Site.mxd

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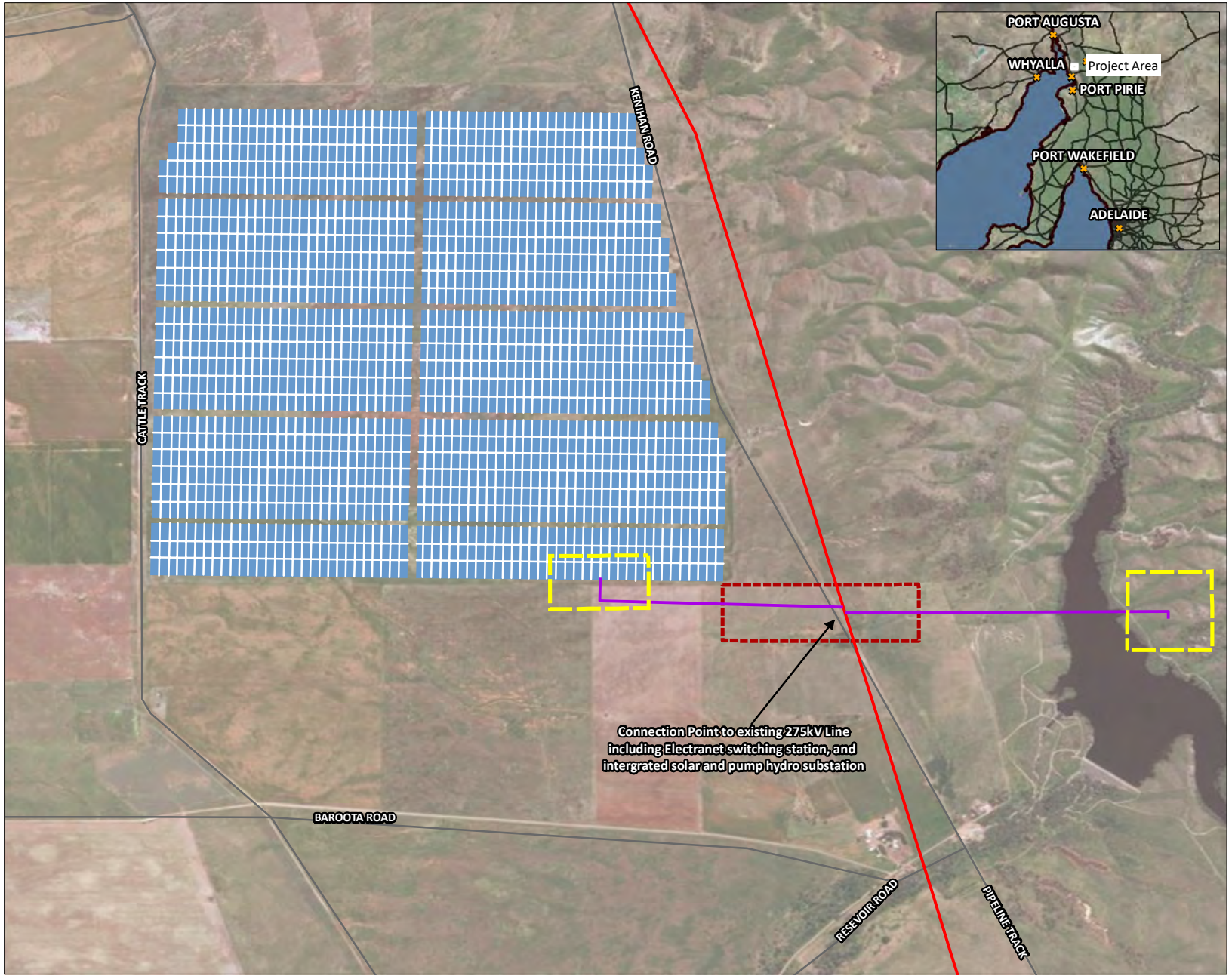


Legend:

- Preliminary Substation Location
- Proposed Solar Plant Layout
- Proposed Connection Point
- Proposed Connection Line
- 275kV Transmission Line
- Roads

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT	Date: 09-Jul-2018
Drawn By: AS	Checked By: AC

Scale at A4 1:30,000

0 0.5 1

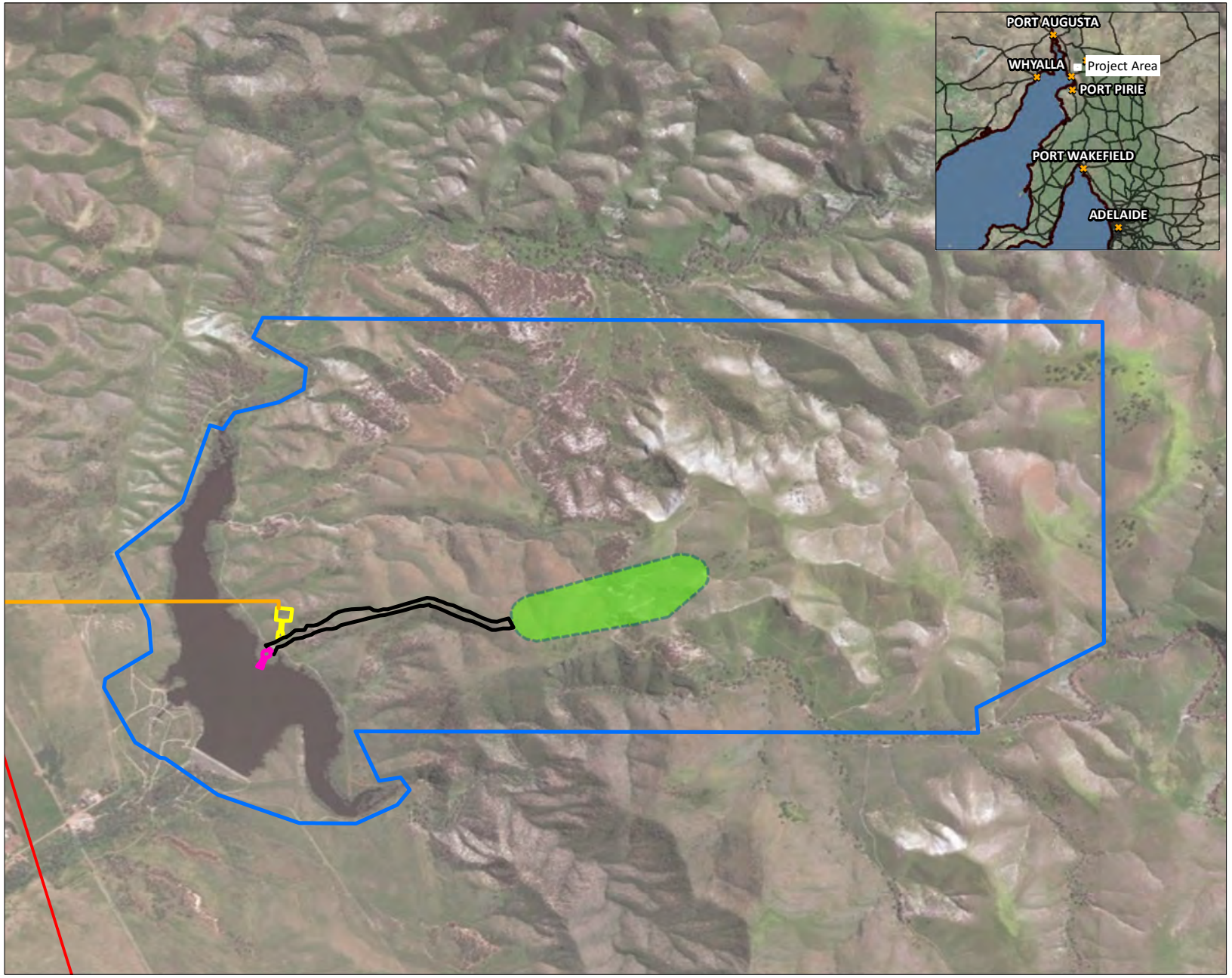
Kilometres

Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

PROPOSED SOLAR LAYOUT

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Preliminary\Proposed Solar Site Layout.mxd



Legend:

- Property Boundary
- Proposed Connection Line
- 275kV Transmission Line
- Proposed Upper Reservoir
- Penstock Alignment
- Switchyard
- Powerhouse

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT	Date: 26-Jun-2018
Drawn By: JC	Checked By: AC

Scale at A4 1:30,000

0 0.5 1

Kilometres

Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

PROPOSED HYDRO LAYOUT

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Preliminary\Proposed Hydro Site Layout edited.mxd

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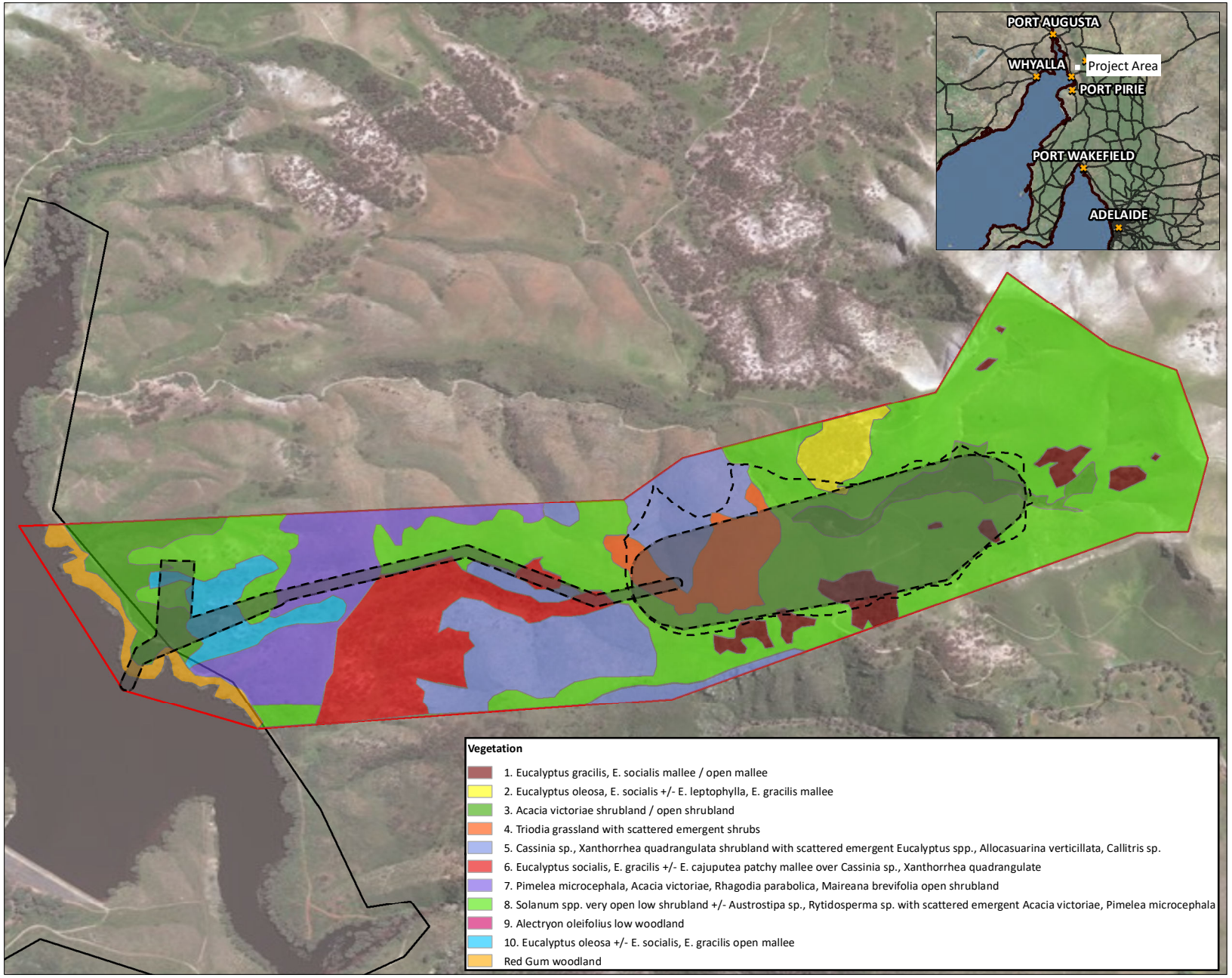


Legend:

- Hydro Project Area
- Baroota Reservoir Reserve
- Proposed Infrastructure Footprint
- Proposed Upper Reservoir
- Proposed Upper Reservoir Footprint

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT	Date: 11-Jul-2018
Drawn By: AS	Checked By: AC

Scale at A4 1:15,000

0 250 500

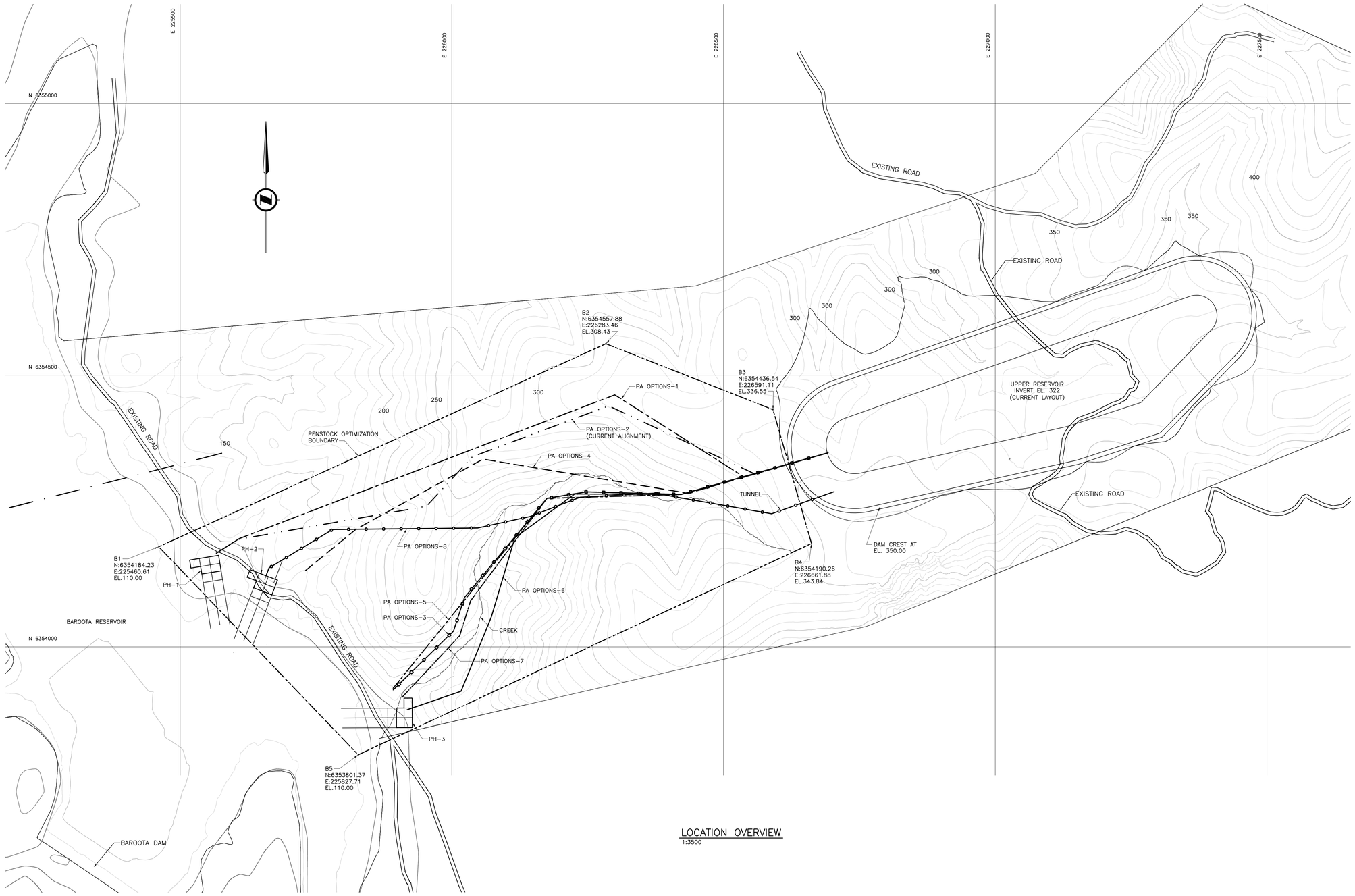
Meters

Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

FOOTPRINT OF PUMPED HYDRO OVER MAPPED VEGETATION COMMUNITIES

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Preliminary\Vegetation Communities.mxd



LOCATION OVERVIEW
1:3500

LEGEND:

- PA OPTION–1
- PA OPTION–2
- PA OPTION–3
- PA OPTION–4
- PA OPTION–5
- PA OPTION–6
- PA OPTION–7
- PA OPTION–8
- PA — PENSTOCK ALIGNMENT
- PH — POWERHOUSE

ALL DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS OTHERWISE NOTED.

ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR
ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR
ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR

–	–	–	–	–	
REV.	CIVIL	ELEC.	MECH.	GEO.	CONSTR.

INTERDISCIPLINE REVIEW

PREPARED FOR: Rise Renewables

DRAWN:	DESIGN:
CHECK:	REVIEW:
SCALE: 1:3500	DATE:

BAROOTA PUMPED STORAGE PROJECT

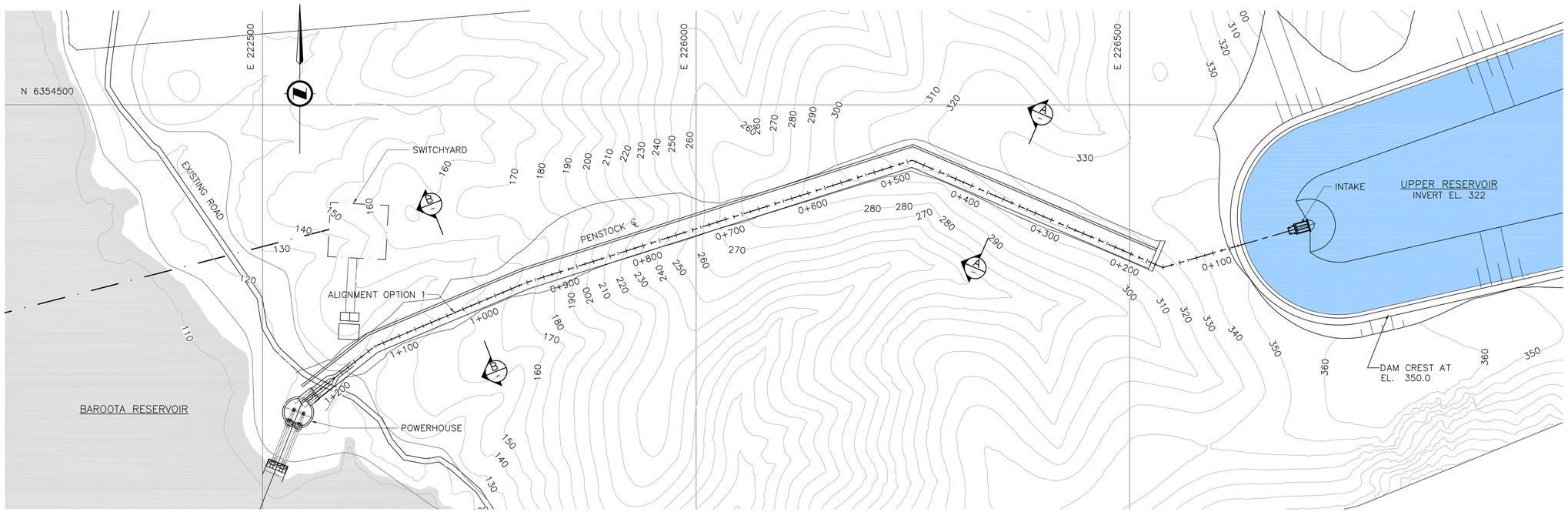
PENSTOCK OPTIMIZATION BOUNDARIES FOR DA PURPOSE

SNC·LAVALIN
SNC–LAVALIN INC.
745 Thurlow St.
Vancouver, B.C. Canada

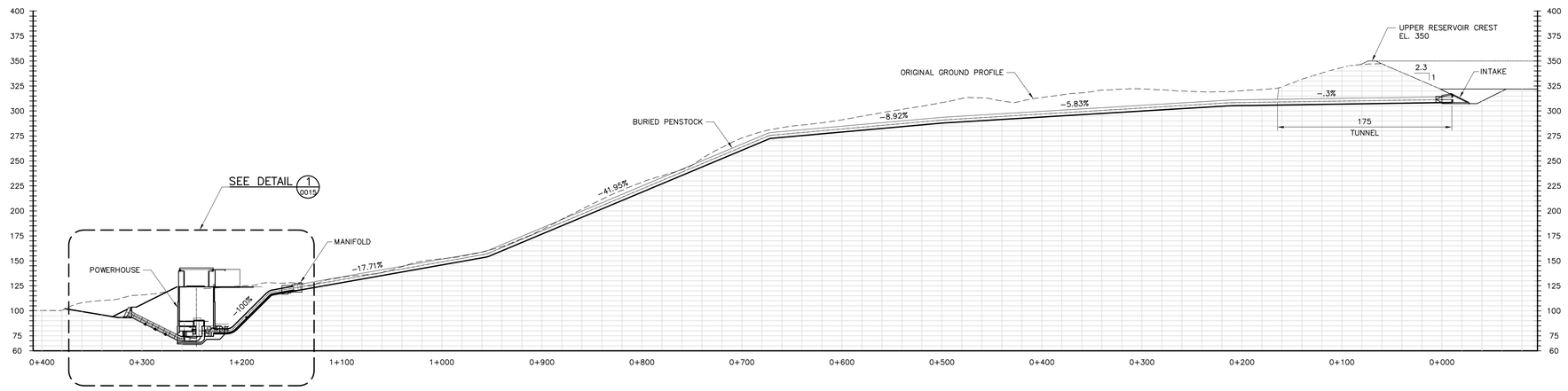
654541–0000–4GD3–000 | REV: PA

SL CAD: 654541–0000–4GD3–001.DWG

DATE: 2018/07/24 – 2:53pm
PATH: C:\Users\jtorres\Desktop\LAVAL–Boundaries Penstock Optimization–Model.dwg



PLAN
1:2500



LONGITUDINAL PROFILE
1:2500

0 100m
1:2500

ALL DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS OTHERWISE NOTED

ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR

REV.	CIVIL	ELEC.	MECH.	GEO.	CONSTR.
–	–	–	–	–	

INTERDISCIPLINE REVIEW

PREPARED FOR: Rise Renewables

DRAWN:	DESIGN:
CHECK:	REVIEW:
SCALE: 1:2500	DATE:

BAROOTA PUMPED STORAGE PROJECT

WATER CONVEYANCE
GENERAL ARRANGEMENT
PLAN AND PROFILE

SNC·LAVALIN
SNC-LAVALIN INC.
745 Thurlow St.
Vancouver, B.C. Canada

654541–5000–40D3–0001 | PA

SL DRAWING NUMBER | REV

SL CAD: 654541-5000-40D3-0001.DWG

DATE: 2018/05/24 – 4:06pm
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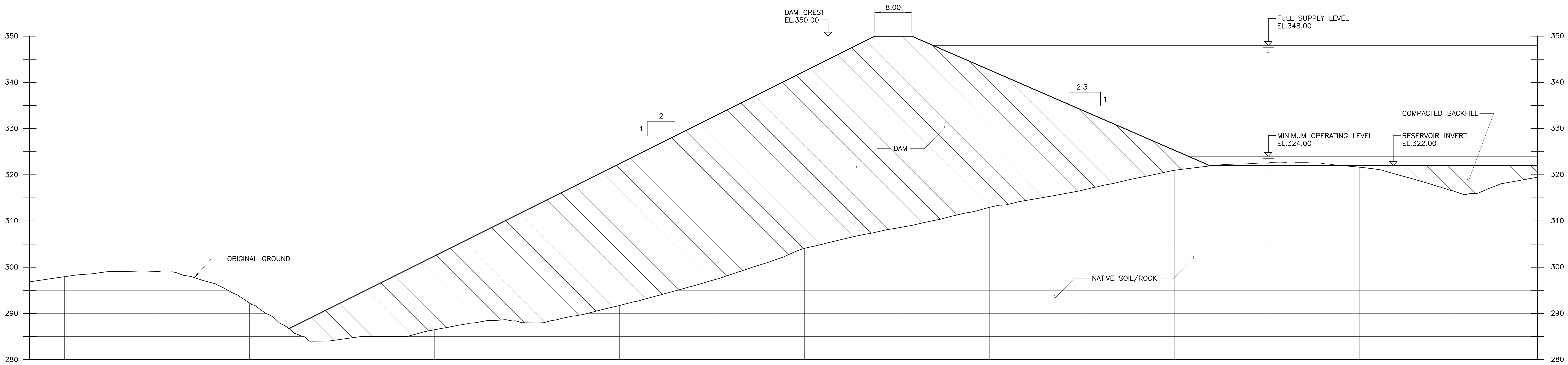
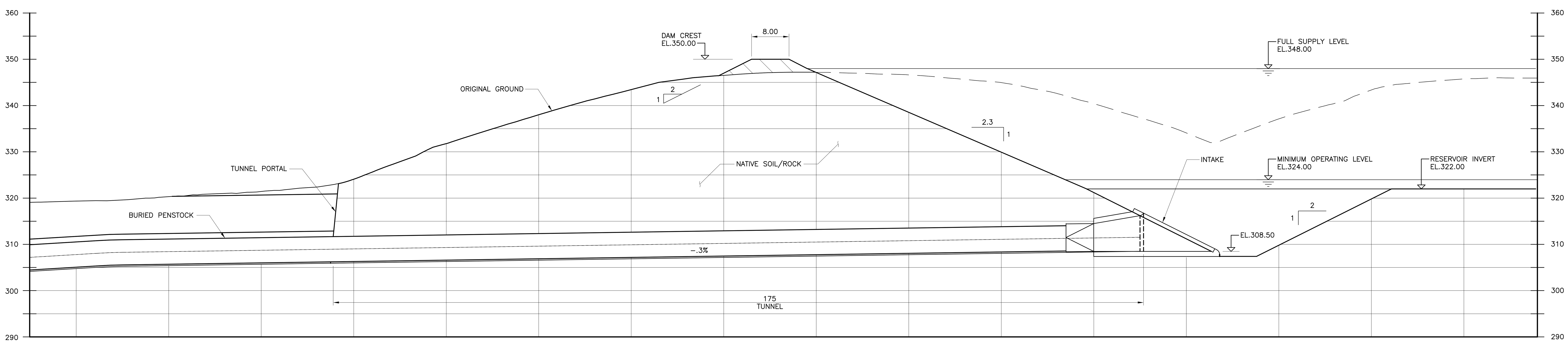


SECTION A
1:500 0001



SECTION B
1:500 0001

0 25m
1:500

REV.	CIVIL	ELEC.	MECH.	GEO.	CONSTR.
–	–	–	–	–	–

INTERDISCIPLINE REVIEW

PREPARED FOR: Rise Renewables

DRAWN: DESIGN:
CHECK: REVIEW:
SCALE: 1:500 DATE:

ALL DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS OTHERWISE NOTED

ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR	ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR	ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR

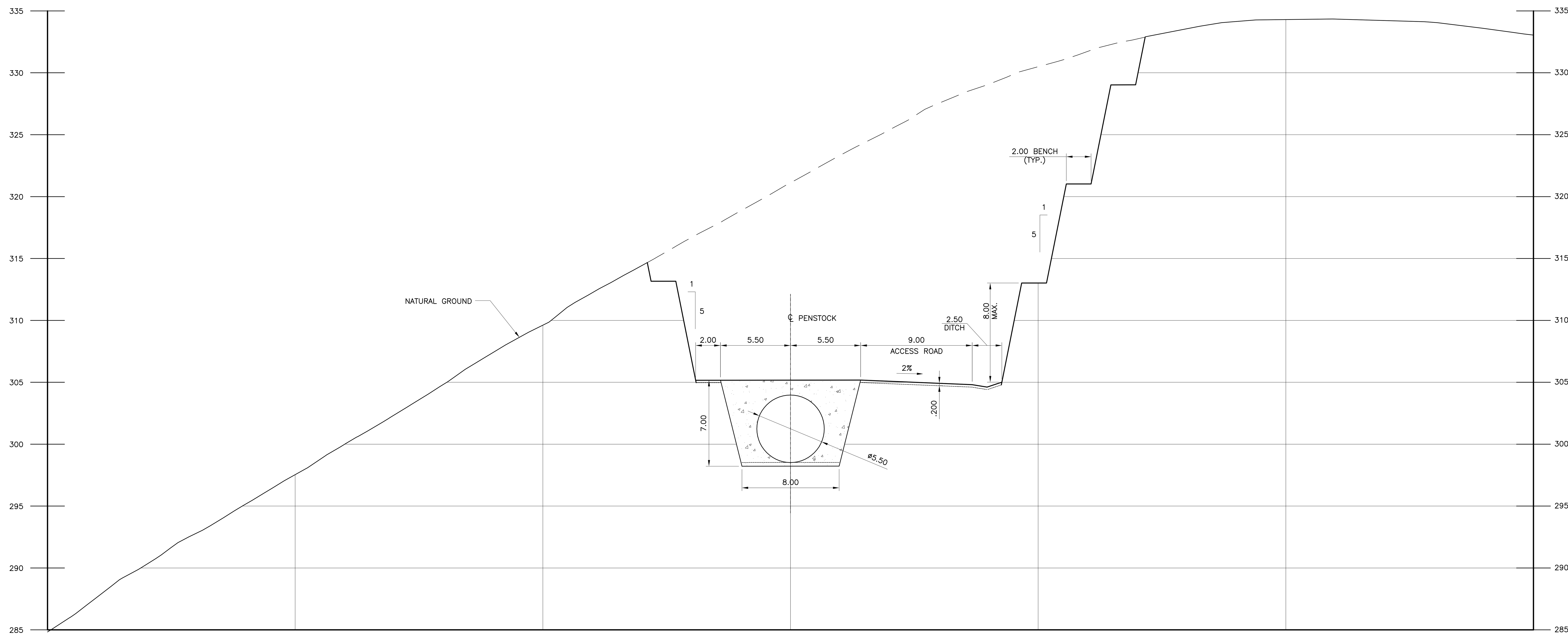
BAROOTA PUMPED STORAGE PROJECT

UPPER RESERVOIR
GENERAL ARRANGEMENT
SECTIONS

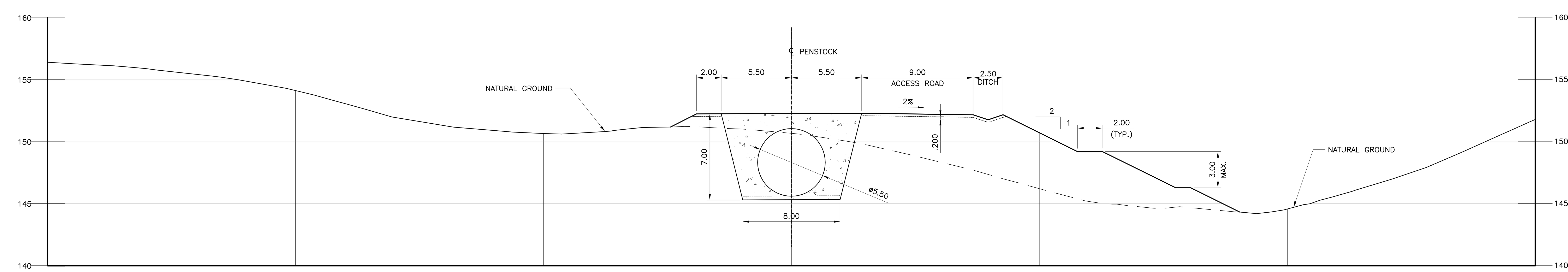
SNC·LAVALIN
SNC–LAVALIN INC.
745 Thurlow St.
Vancouver, B.C. Canada

654541– SL DRAWING NUMBER REV
2100–40D3–0002 PA

SL CAD: 654541–2100–40D3–0002.DWG



SECTION (A / 0001)
1:200



SECTION (B / 0001)
1:200

0 10m
1:200

–	–	–	–	–	
REV.	CIVIL	ELEC.	MECH.	GEO.	CONSTR.

INTERDISCIPLINE REVIEW

PREPARED FOR: Rise Renewables

DRAWN:	DESIGN:
CHECK:	REVIEW:
SCALE: 1:200	DATE:

ALL DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS OTHERWISE NOTED

ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR	ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR

BAROOTA PUMPED STORAGE PROJECT

WATER CONVEYANCE–BURRIED PENSTOCK
GENERAL ARRANGEMENT
TYPICAL SECTIONS

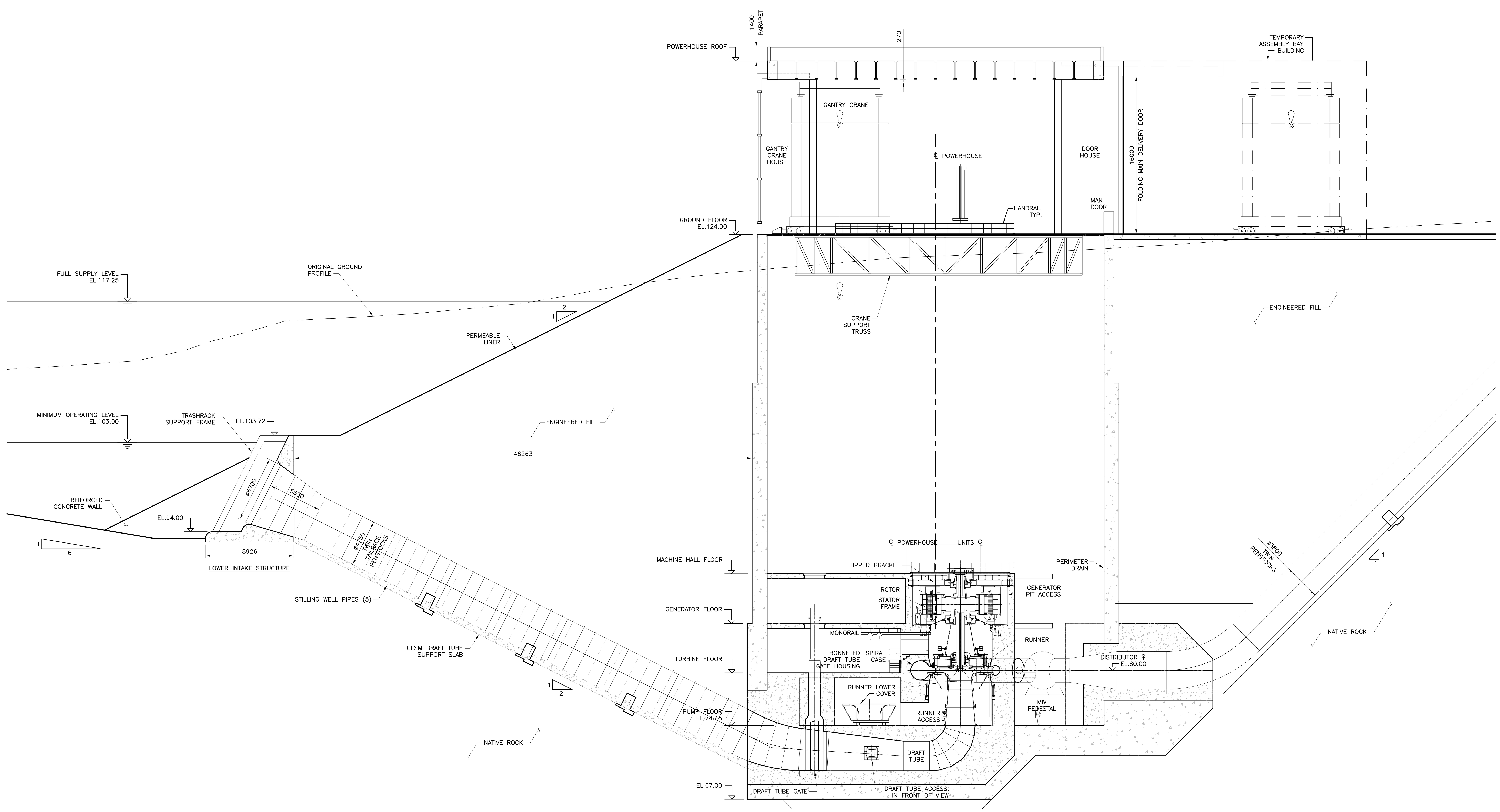
SNC·LAVALIN
SNC–LAVALIN INC.
745 Thurlow St.
Vancouver, B.C. Canada

654541– SL DRAWING NUMBER 5000–40D3–0006 REV PA

SL CAD: 654541–0000–4GD3–001.DWG

DATE: 2018/05/24 – 4:25pm
PATH: X:\654541– Baroota Development Phase\DWGS\40\\5000-40D3-0006.dwg

BORDER: BAROOTA SNC BORD D.DWG (INCO METRIC 'D' CUT FRAME 863.6x558.8)



DETAIL 1 / 0001
1:5000

POWERHOUSE THROUGH UNIT/DRAFT TUBE

ALL DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS OTHERWISE NOTED

REV.	CIVIL	ELEC.	MECH.	GEO.	CONSTR.
–	–	–	–	–	

INTERDISCIPLINE REVIEW

PREPARED FOR: Rise Renewables

DRAWN:	DESIGN:
CHECK:	REVIEW:
SCALE: 1:5000	DATE:

ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR	ISSUE	REV.		DATE	DRWN	DSGN	CHK	REVW	APPR

BAROOTA PUMPED STORAGE PROJECT

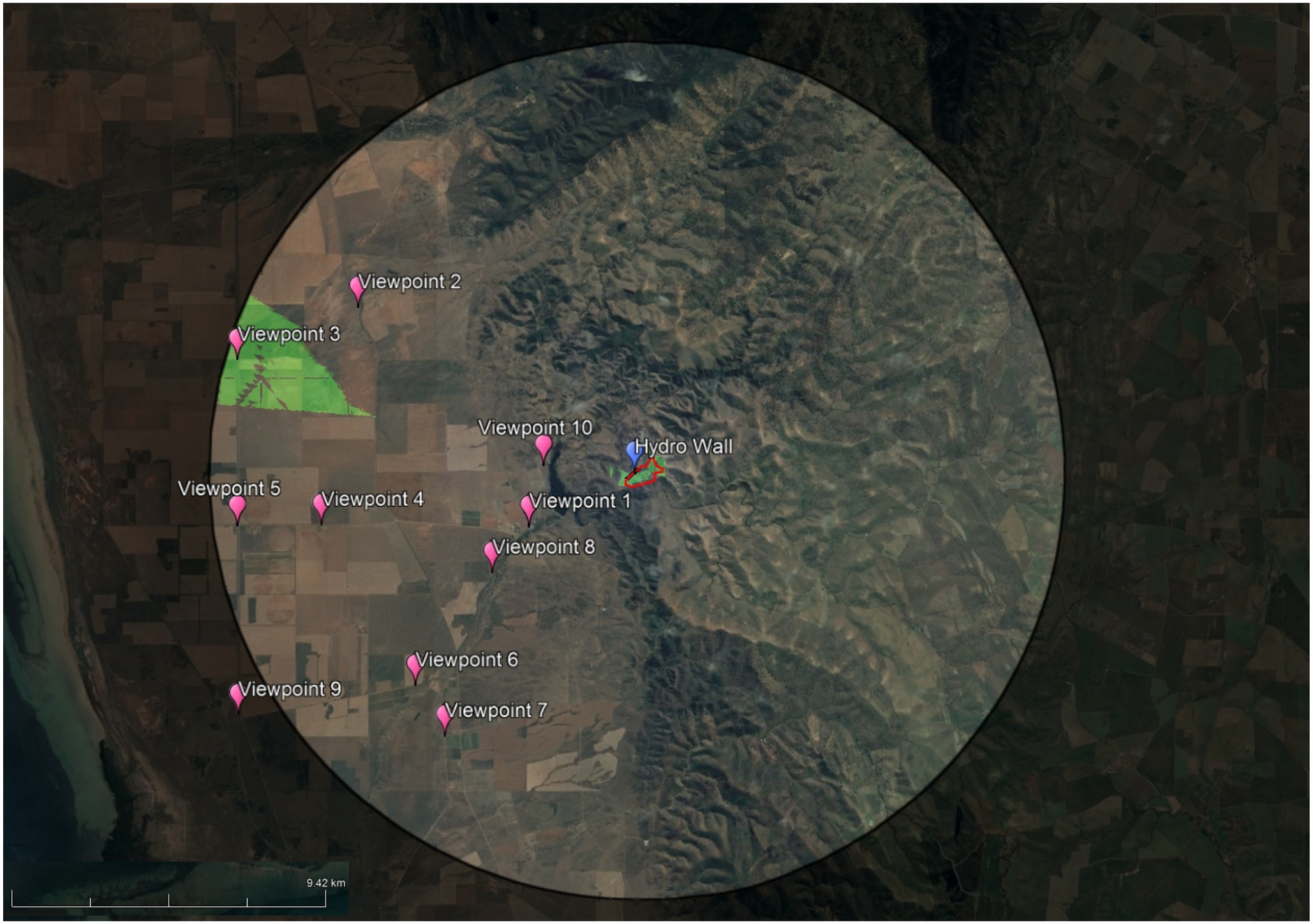
POWERHOUSE
GENERAL ARRANGEMENT
CROSS SECTION

SNC·LAVALIN
SNC–LAVALIN INC.
745 Thurlow St.
Vancouver, B.C. Canada

654541–
SL DRAWING NUMBER
6000–40D3–0015
REV PA

SL CAD: 654541–6000–40D3–0015.DWG

COMMERCIAL IN CONFIDENCE



Legend:

- Hydro Wall
- Hydro Fenceline
- Viewshed Analysis

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT	Date: 4 June 2018
Drawn By: TB	Checked By: DB/ AC

Scale as Shown

Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54

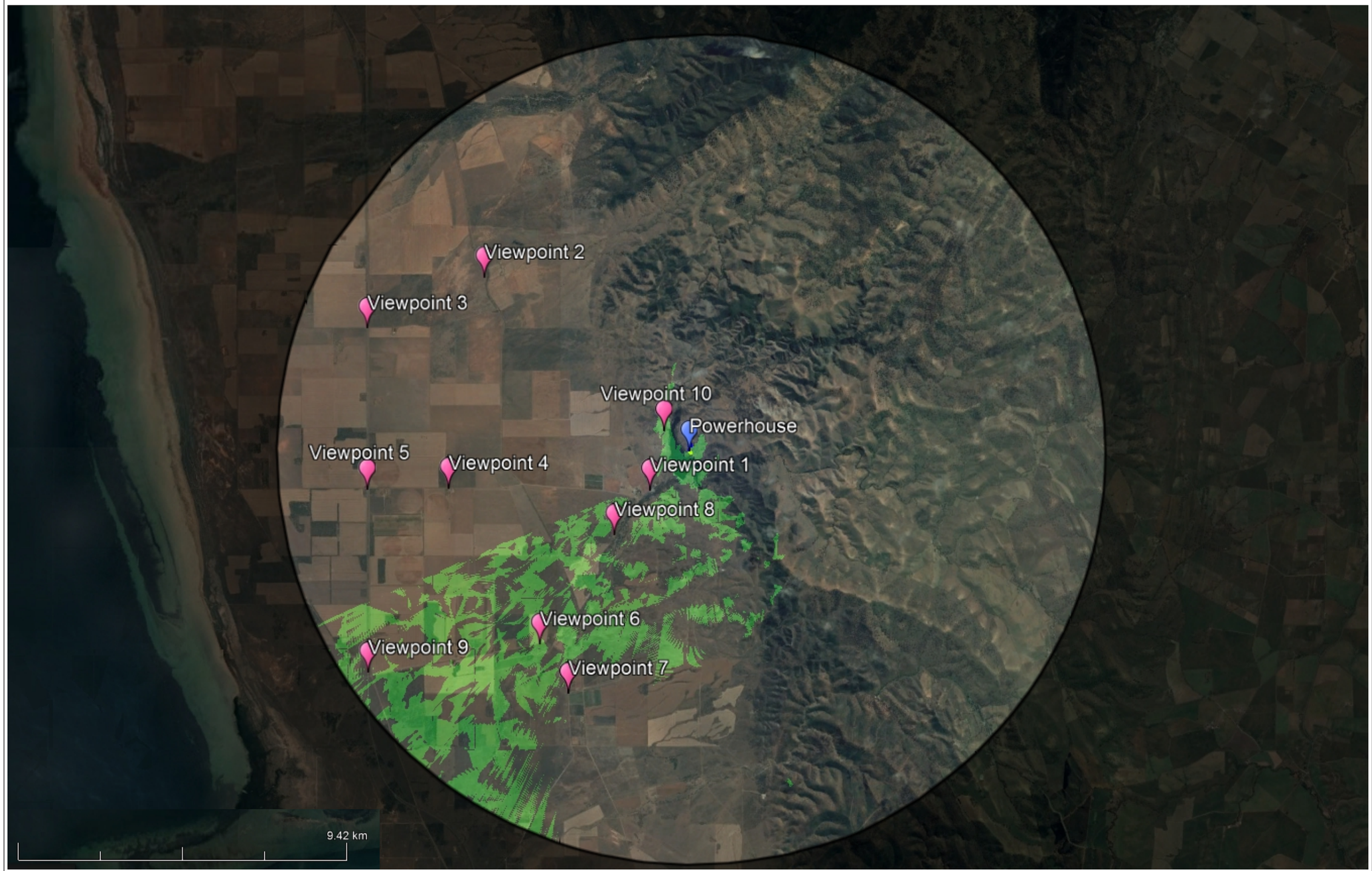
Baroota Hydro Energy Storage and Solar Project

HYDRO WALL, THEORETICAL ZONE OF VISUAL INFLUENCE

FIGURE: 10

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis

COMMERCIAL IN CONFIDENCE



Legend:

- Powerhouse Boundary
- Switchyard Boundary
- Viewshed Analysis

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 4 June 2018
Drawn By: TB	Checked By: DB/ AC
Scale as Shown	
Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54	

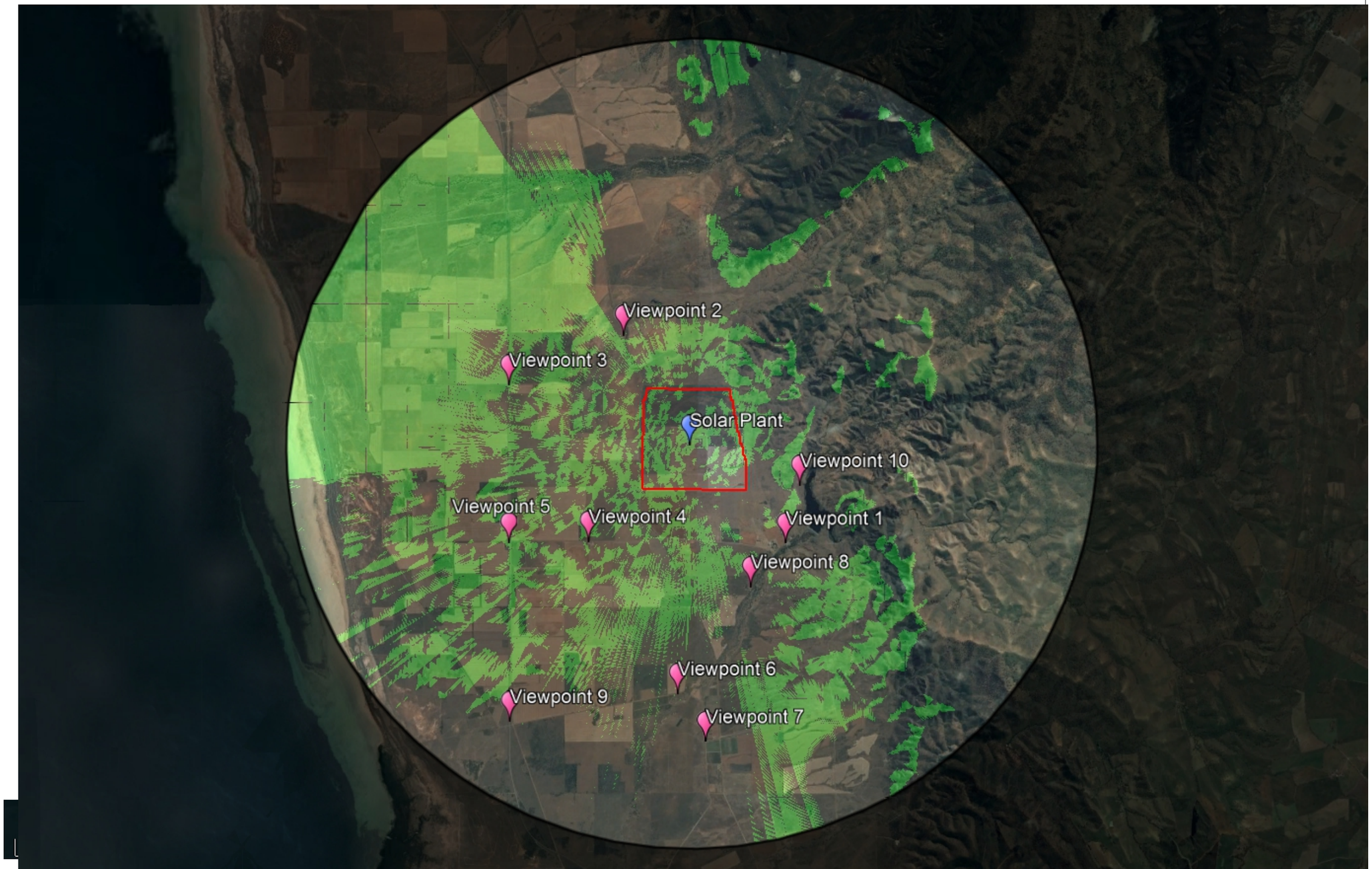
Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, THEORETICAL ZONE OF VISUAL INFLUENCE

FIGURE: 13

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

COMMERCIAL IN CONFIDENCE



Legend:

- Solar Boundary
- Viewshed Analysis

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 4 June 2018
Drawn By: TB	Checked By: DB/ AC
Scale as Shown	
Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54	

Baroota Hydro Energy Storage and Solar Project

SOLAR, THEORETICAL ZONE OF VISUAL INFLUENCE

FIGURE: 5

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis

GOOGLE EARTH VIEWPOINT PHOTO

Legend:

- Powerhouse Boundary
- Switchyard Boundary

JBS&G

Job No: 34441

Client: Ace Renewables

Version: 34441 | Date: 7 June 2018

Drawn By: TD | Checked By: TJ/ AC

Not to Scale

Doc. No: VP

Barcoota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 10 PHOTOMONTAGE

FIGURE 18

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 10
View direction:	South East
Elevation Gain between viewpoint and infrastructure:	30 m
Distance:	800 m
Easting (MGA Zone54):	224,979.05
Northing (MGA Zone54):	6,354,677.81

Viewpoint Setting

Viewpoint 10 is located at the existing lookout at the lower reservoir. It is perched on the North Western bank of the reservoir and has a clear view of the reservoir and valley, north, east and south. The switch yard is clearly visible as it sits higher on the slope compared to the powerstation. The powerstation is only marginally visible as it is located behind the switchyard and is slightly closer to the bank. The bank has a ring of River Red Gum trees that obstruct any views of infrastructure immediately behind the tree line. The upper reservoir dam wall is not visible as is it located directly behind the mountain in front of viewpoint 10.

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 3
View direction:	East
Elevation Gain between viewpoint and infrastructure:	30 m
Distance:	3600 m
Easting (MGA Zone53):	779,004.00
Northing (MGA Zone53):	6,357,048.00
Viewpoint Setting	
Viewpoint 3 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricultural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and four nearby residences. The southern half of the proposed solar plant can be seen, view of the northern portion of the solar plant is concealed behind vegetation associated with a residence. Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.	

Legend:

Solar Boundary

Job No: [illegible]

Client: Rise Renewables

Version: [illegible] | Date: [illegible] June 2018

Drawn By: [illegible] | Checked By: [illegible]

Not to Scale

Coord. Sys: n/a

Baroota Hydro Energy Storage and Solar Project

SOLAR, VIEWPOINT 3 PHOTOMONTAGE

FIGURE 6

[illegible]

Image Reference: Google Earth © 2018

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 5
View direction:	North East
Elevation Gain between viewpoint and infrastructure:	40 m
Distance:	3500 m
Easting (MGA Zone53):	778,892.00
Northing (MGA Zone53):	6,353,153.00

Viewpoint Setting

Viewpoint 5 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricultural access running east to west perpendicular to the Highway. The approximate layout of the proposed solar plant can be seen between two areas of vegetation to the north and south of the access track. Power lines can be seen running parallel to the access track heading to the east.

Viewpoint 5 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.

Legend:

Solar Boundary

JBS&G

Job No: 34441

Client: Ace Renewables

Version: 34441 | Date: 7 June 2018

Drawn By: TD | Checked By: TJ/AC

Not to Scale

Doc. Status:

Baroota Hydro Energy Storage and Solar Project

SOLAR, VIEWPOINT 5 PHOTOMONTAGE

FIGURE 8

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 3
View direction:	South East
Elevation Gain between viewpoint and infrastructure:	300 m
Distance:	9700 m
Easting (MGA Zone53):	779,004.00
Northing (MGA Zone53):	6,357,048.00

Viewpoint Setting

Viewpoint 3 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricu tural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and four nearby residences. There is a clear line of sight to the wall of the Upper Reservoir from this location.
Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.

Legend:

- Hydro Wall
- Hydro Fenceline

JBS&G

Job No: 34441

Client: Ace Renewables

Version: 34441 | Date: 7 June 2018

Drawn By: TD | Checked By: TJ/ AC

Not to Scale

Doc. No: N/A

Baroota Hydro Energy Storage and Solar Project

HYRDO WALL, VIEWPOINT 3 PHOTOMONTAGE

FIGURE 11

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

Legend:

- Powerhouse Boundary
- Switchyard Boundary

JBS&G

Job No: 34441

Client: Ace Renewables

Version: 34441 | Date: 7 June 2018

Drawn By: TD | Checked By: TJ/AC

Not to Scale

Doc. No: VP6

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 6 PHOTOMONTAGE

FIGURE 14

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 6
View direction:	North East
Elevation Gain between viewpoint and Infrastructure:	90 m
Distance:	5800 m
Easting (MGA Zone54):	222,105.00
Northing (MGA Zone54):	6,349,457.00

Viewpoint Setting

Viewpoint 6 was chosen to represent a cluster of residential areas along the Baroota Creek. Due to the location adjacent the creek, the powerstation and switch yard are visible due to the lower elevation of the lower reservoir wall. Specifically at the exact viewpoint 6, the site is visible but many other viewpoints in that area are not able to see the site due to vegetation screening along Reservoir Road.

Viewpoint 6 is surrounded by open low cut agricultural fields, and a powerline runs parallel to Reservoir Road.

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 9
View direction:	North East
Elevation Gain between viewpoint and infrastructure:	90 m
Distance:	9400 m
Easting (MGA Zone53):	778,781.52
Northing (MGA Zone53):	6,348,741.54

Viewpoint Setting

Viewpoint 9 is the southernmost of a series of viewpoints selected across the Princes Highway and is located adjacent to a Gribble Road, primarily used as agricultural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and two nearby residences. There is a clear line of sight to the wall of the powerstation and switchyard from this location.

Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.

Legend:

- Powerhouse Boundary
- Switchyard Boundary

JBS&G

Job No: 34401

Client: Ace Renewables

Version: 34401

Date: 7 June 2018

Drawn By: TD

Checked By: TJ/AC

Not to Scale

Doc. No: N/A

Barcoota Hydro Energy Storage and Solar Project

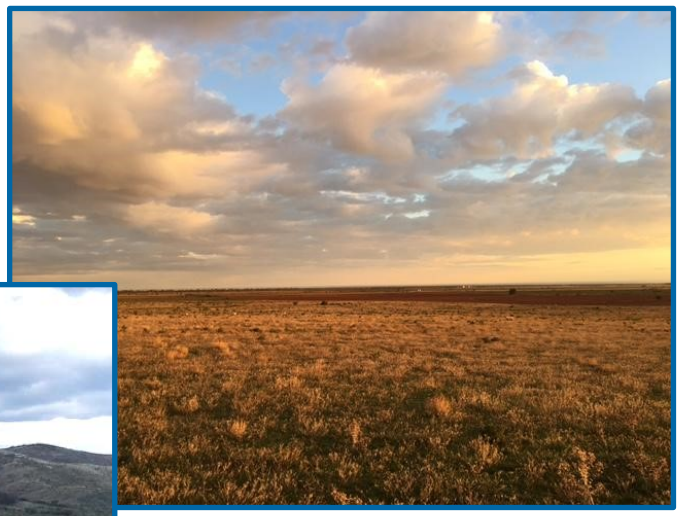
POWERHOUSE, VIEWPOINT 9 PHOTOMONTAGE

FIGURE 16

Rise Renewables

BAROOTA PUMPED HYDRO AND SOLAR PROJECT

Development Application – Addendum for Solar Project



September 2018

Prepared by:

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DISCLAIMER

CONTENTS

List of Figures

1. Solar Project

1.1. Additional Project Overview

The Solar Project addendum provides additional information relating to the Solar Project layout and associated infrastructure. Rise Renewables will, prior to the commencement of construction, provide the following additional specifications to the Minister for Planning for approval:

- the final design, specification and layout of the substation - including all buildings, infrastructure, fencing, earthworks, landscaping, proposed access points to the local road network, and any other relevant matters.
- the final design, specification and layout of any office/control building, storage facility, monitoring stations, maintenance, construction and temporary facilities.
- the final alignment and design of any above-ground transmission lines.

The updated site layout included in the addendum has been updated to show:

- the preliminary location and dimensions of the substation/switching station.
- dimensions and layout of a solar block array

Internal and perimeter access roads within the solar site will be 5 metre width; this has been accounted for in the layout.

Additional information provided in the addendum includes:

- Typical designs which will be considered for the switching station control room and O&M building.
- Perimeter fencing drawings and details.
- Manufacturer specifications for typical solar tracker system, megawatt station and PV modules (final specifications to be confirmed).

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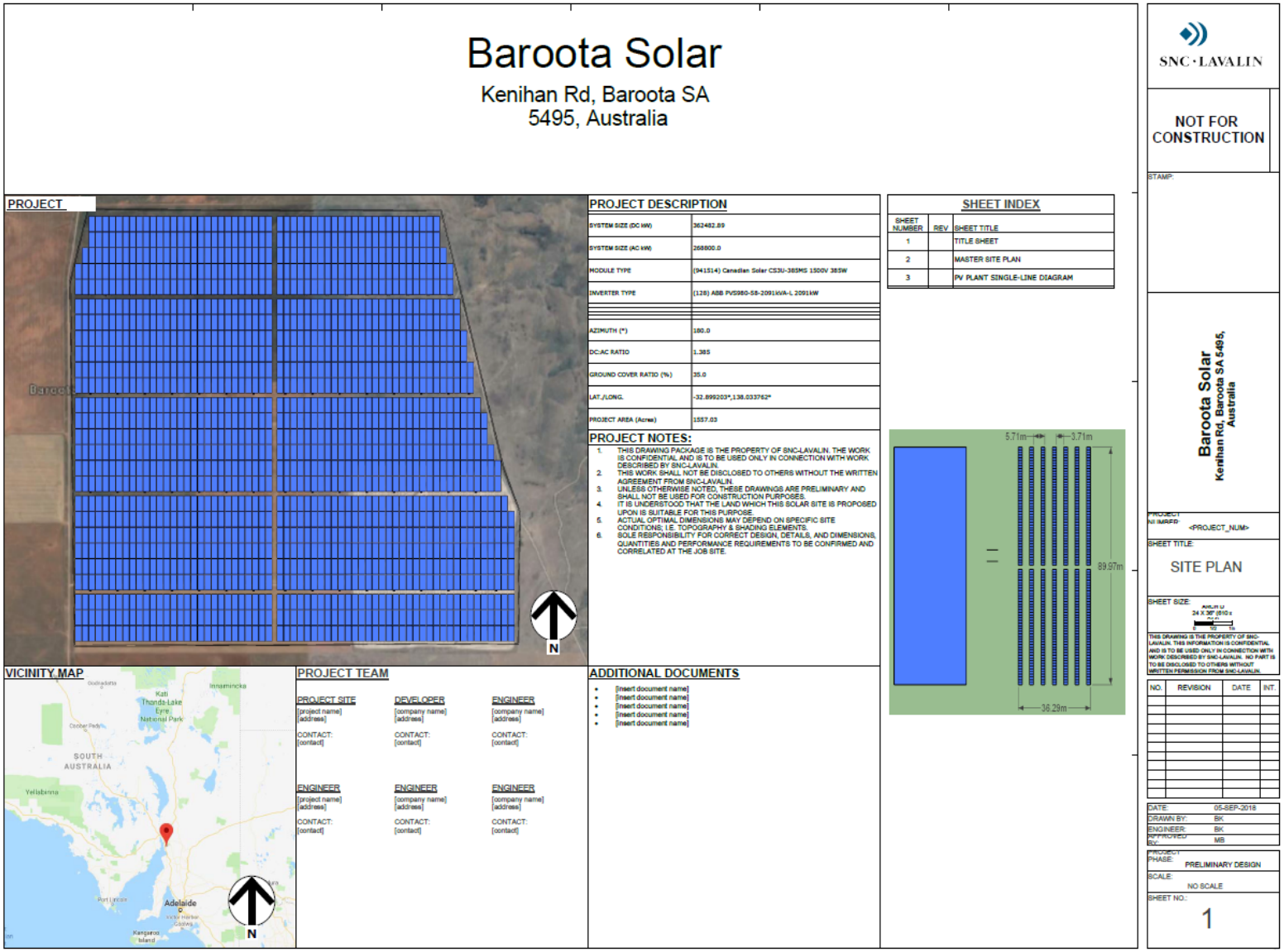


Figure 1. Baroota Solar Project site plan and solar array layout

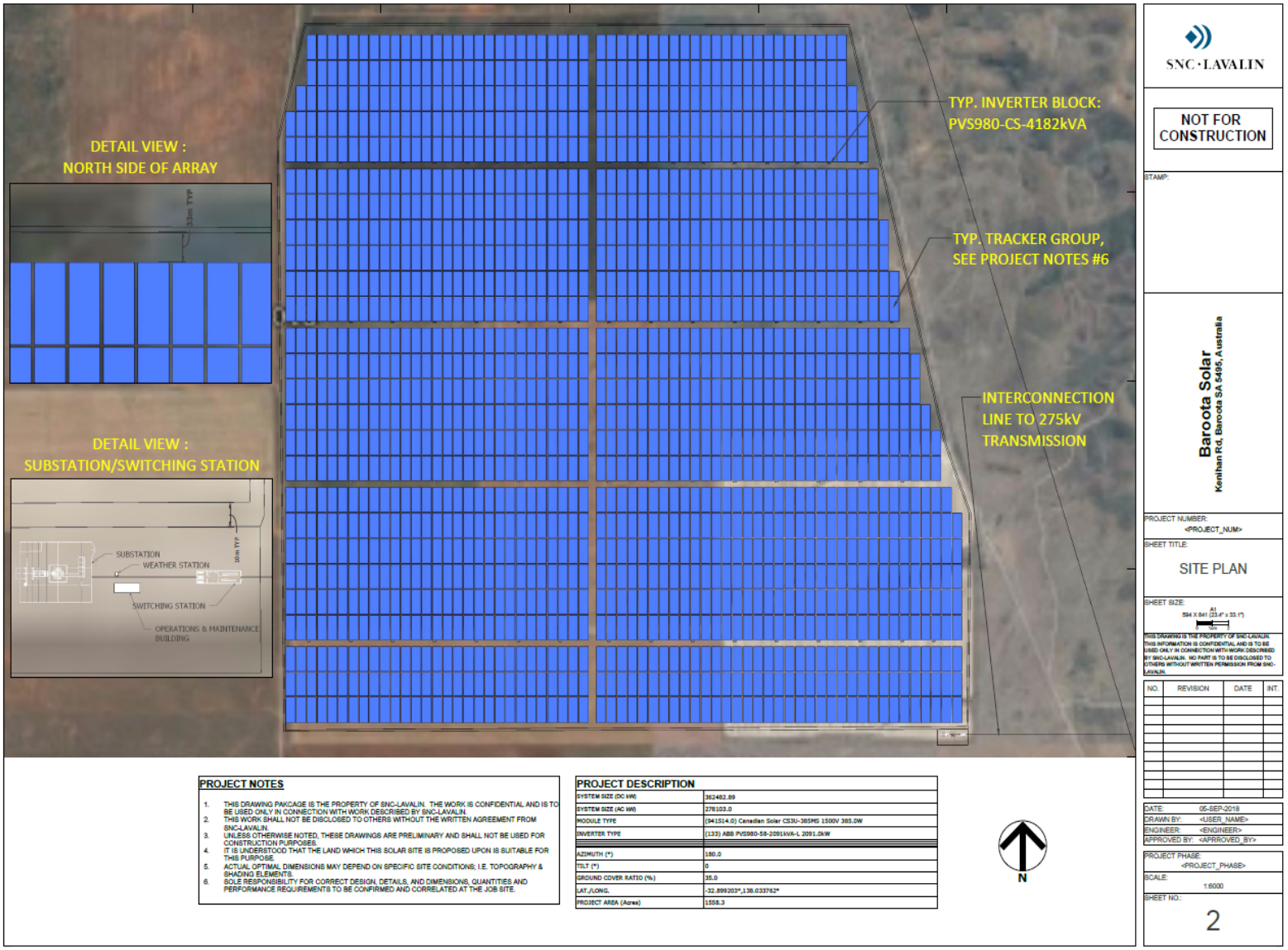
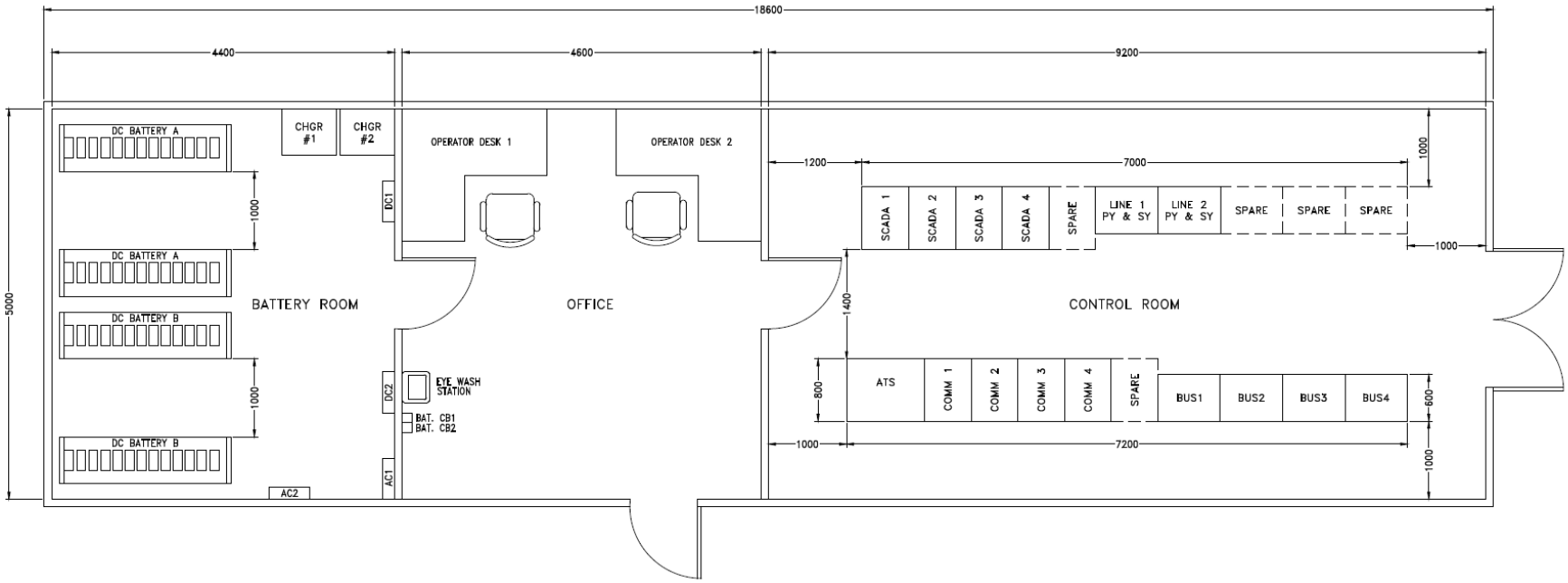


Figure 2. Baroota Solar Project preliminary infrastructure layout and connection to transmission line



SWITCHING STATION CONTROL ROOM

NOTE:

1. BUILDING DIMENSIONS WILL BE CONFIRMED DURING DETAILED DESIGN.

Figure 3. Typical Design for a Switching Station Control Room Layout

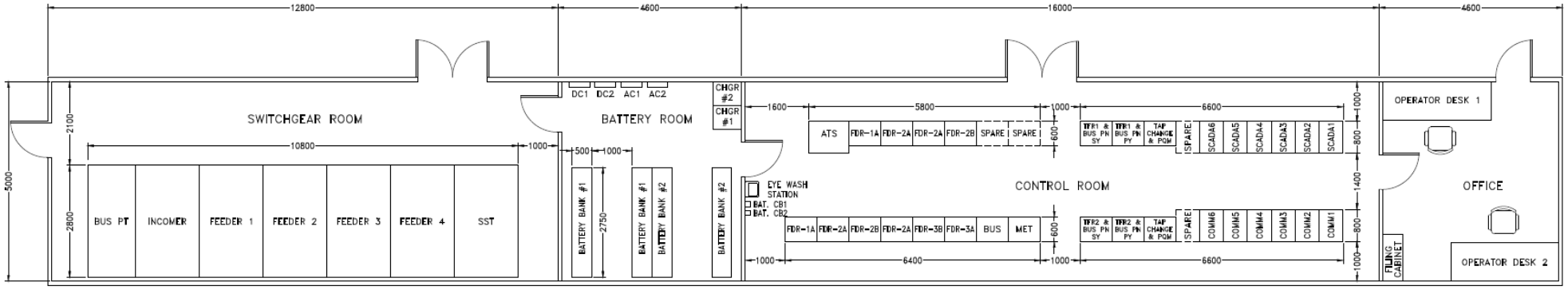
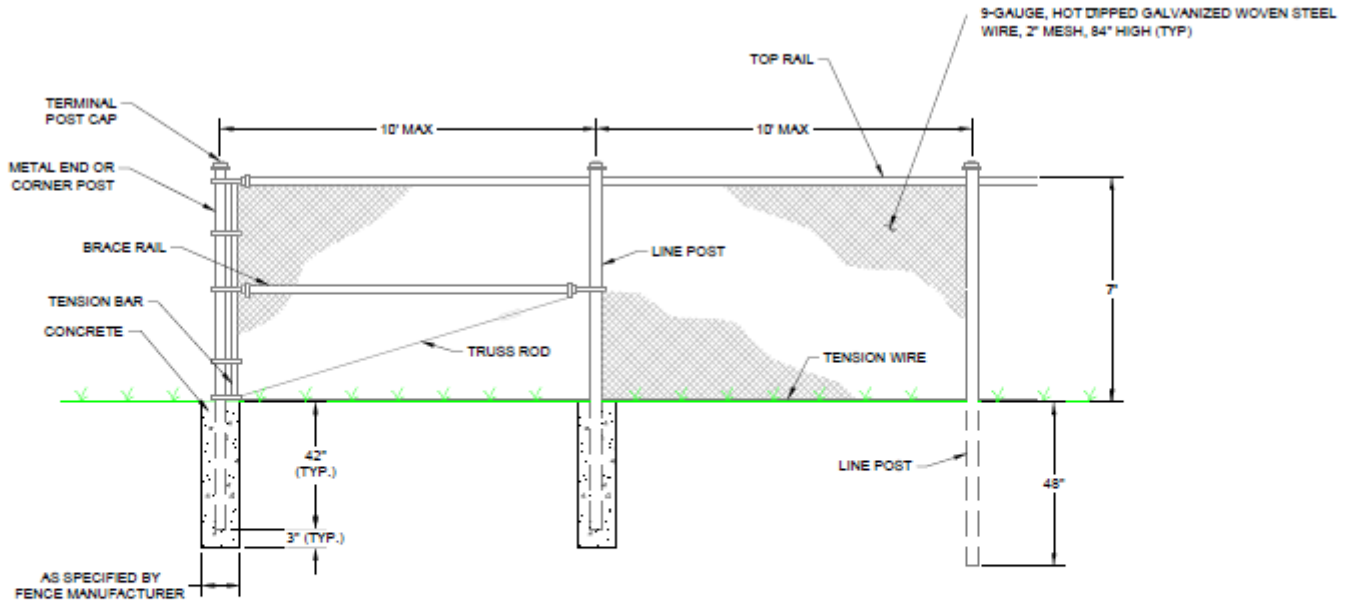


Figure 4. Typical Switchgear and Control Room



NOTES:

1. ALL FENCE SECTIONS NEED TO BE EXTENDED TO GROUND SURFACE.
2. PROVIDE CONCRETE FOR POSTS ADJACENT TO CORNER AND GATE POSTS AS SPECIFIED BY FENCE MANUFACTURER.
3. CONTRACTOR TO CONFIRM WITH FENCE INSTALLER/MANUFACTURER THAT FENCE POST DEPTHS AND ANCHORING ARE ADEQUATE PRIOR TO INSTALLATION.
4. IF SOIL SEPARATES FROM FENCE POST PENETRATION, CONTRACTOR SHALL PLACE BENTONITE OR A BENTONITE SLURRY AROUND THE PENETRATION.

2 C09 DRIVEN POST CHAIN LINK FENCE DETAIL

NOT TO SCALE

Figure 5. Perimeter Fencing Details

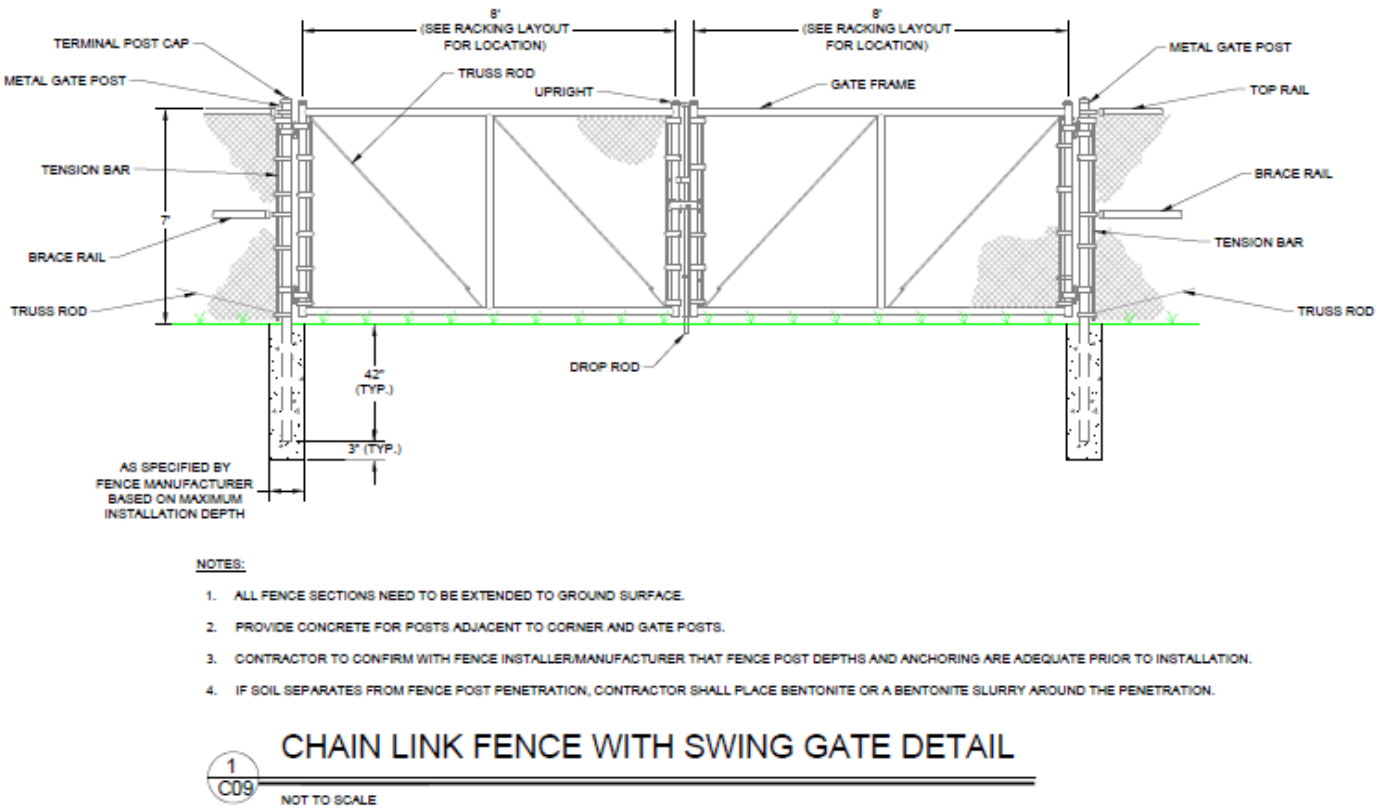


Figure 6. Perimeter fencing and swing gate detail

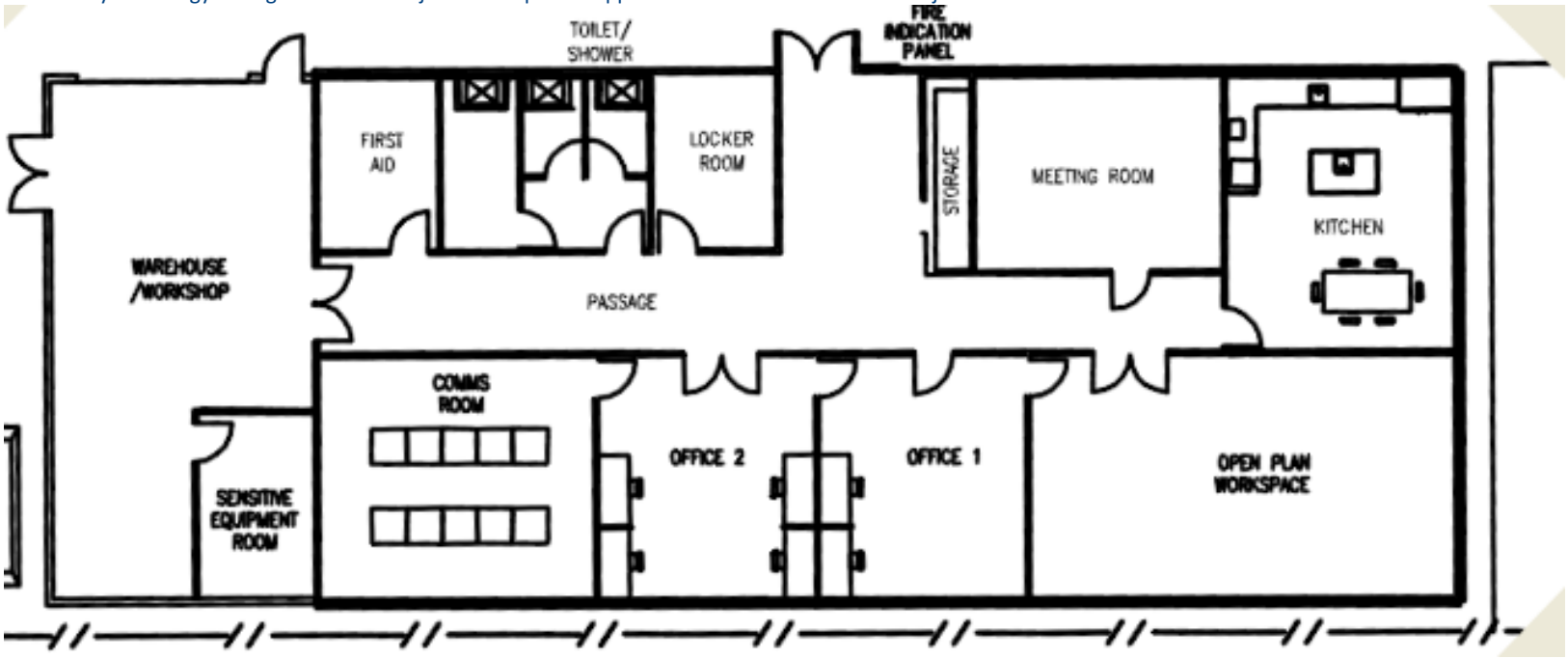


Figure 7. Typical O&M building

Appendix A. Tracker Specification

NEXTracker
a flex company

POWER ON.

NX Horizon Self-Powered Tracker

Our most amazing tracker yet.

In our mission to make solar a mainstream energy source, NEXTracker has engineered the most intelligent and flexible tracking technology yet. Using sustainable design methods with outcomes that benefit people and the planet, we bring you: NX Horizon™.

NX Horizon (formerly referred to as the Self-Powered Tracker or SPT), brings self-contained motor power to each row, eliminating power wiring and trenching. Our advanced horizontal tracker ihas the widest rotational range available, lowest O&M costs, and requires far less power to operate than other trackers. By offering more powerful systems at a greater value, NEXTracker enables greater deployment of renewable energy worldwide.

NX Horizon key features and benefits include:

– Self-powered system with smart performance communications: Self-contained units on each row include a dedicated PV panel toprovide power to the controller which drives themotor and hosts intelligent control electronics to position each tracker. With smart communications built in, NX Horizon systems can be accessed remotely, providing customers with a granular view to optimize tracker performance, operations and maintenance.

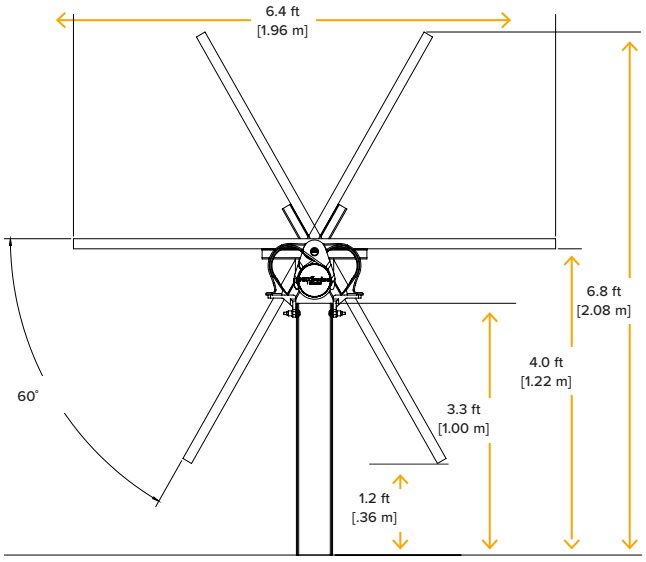
– Independent balanced rows with 120 degree rotational range: Each NX Horizon row has its own controlled motor with rotational range that delivers up to 2% more energy than typical linked row trackers. These agile, independent rows stow in less than 90 seconds to reduce wind forces on the array, protecting the PV modules in harsh environments. NX Horizon solar trackers also have a mechanically balanced row design that align PV panels with the tracker's axis of rotation – which greatly reduces row torque, using less energy from the motor to track throughout the day.

– Self-grounded system with theft-proof fasteners: NX Horizon is the world's first horizontal tracker with an entirely self-grounded design. This means no separate bonding hardware is required. You save on material and associated costs by eliminating grounding washers, braided straps, bare copper wire, and grounding rods. What's more, we've designed our own fasteners that can only be removed with special tools – deterring PV theft.

NX Horizon Specifications

Tracking Technology	Horizontal single-axis balanced-mass tracker with independently-driven rows
Tracking Range	Up to 120° (± 60°)
Control System	1 Self-Powered Controller (SPC) per tracker; 1 Network Control Unit (NCU) per 100 SPCs
Communications	Wireless ZigBee® mesh network/SCADA; no communication wiring required
Drive System	One slew gear, 24 VDC motor and self-powered controller w/dedicated solar panel per row
DC Capacity	23-35kWp per tracker row, depending on panel type. Row length up to 90 panels.
System Voltage	1,500 volt or 1,500 volt
Power Consumption	No grid power required
Ground Coverage Ratio	Fully configurable by customer; typical range 33%-50%
Installation Method	Rapid field assembly, no welding required
Foundation Types	Compatible with all major foundation types (driven pier, concrete foundation, ground screw)
Standard Wind Design	100 mph/161 kph, 3 second gust per ASCE7-10; configurable for higher wind speeds
Safety Stowing	Automated wind and snow stowing with self-contained backup power; no external power required
Torsional Limiter	Included at each foundation/bearing for additional wind and snow load protection
Principal Materials	Galvanized and stainless steel
Grounding Method	Self-grounding structure; separate materials and labor not required
Compliance	Grounding/bonding: UL2703; structural design: ASCE7-10
Other Available Options	Snow and flood sensors
Warranty	10 years on structural components; 5 years on drive and control systems
Typical Dimensions	Height 2.1 m/6.8 ft (@ 60°), Width 2.0 m/6.4 ft, Length 85 m/283 ft

Typical 72-cell c-Si configuration: 85 m row with 80 panels mounted in portrait:



NEXTracker
6200 Paseo Padre Parkway
Fremont, CA 94555 USA
+1 510 270 2500
nextracker.com

printed on post-consumer waste paper

Appendix B. Solar Inverter Specification

SOLAR INVERTERS

ABB megawatt station

PVS980-MWS – 3.6 to 4.6 MW

—
01

The ABB megawatt station is a compact plug-and-play solution designed for large-scale solar power generation. It houses all the electrical equipment that is needed to rapidly connect a photovoltaic (PV) power plant to a medium voltage (MV) electricity grid. All the components within the ABB megawatt station are from ABB's product portfolio.

—
01 ABB megawatt station, PVS980-MWS, with two PVS980 central inverters, MV transformer and MV switchgear

Turnkey-solution for PV power plants
The ABB megawatt station design capitalizes on ABB's long experience in developing and manufacturing secondary substations for utilities and major endusers worldwide in conventional power transmission installations.

A station houses two outdoor 1500 V_{DC} ABB central inverters, an optimized ABB dry type- or oil immersed transformer, MV switchgear, a monitoring system and DC connections from solar array. The ABB megawatt station is used to connect a PV power plant to a MV electricity grid easily and rapidly. To meet the PV power plant's demanded capacity, several ABB megawatt station can be used.

Compact design eases transportation
The station has standard, 40-feet High Cube shipping container dimensions. The small inverter footprint makes the station compact and easy to lift via a standard crane. The total package weighs less than 30 metric tons. The standardized shipping dimensions ensures cost-effective and safe transportability to the site even overseas. The station's optimized air circulation and filtering system together with thermal insulation for dry type transformer or open air design for oil immersed transformer enable installations to various ambient conditions, from harsh desert temperatures to cold and humid environments. The ABB megawatt station is designed for at least 25 years of operation.

Highlights
- Proven technology and reliable components
- Compact and robust design
- Outstanding endurance for outdoor use
- High DC input voltage up to 1500 V_{DC}
- High total efficiency
- Extensive DC and AC side protection
- Self-contained cooling system for inverters
- Modular and serviceable system
- Embedded auxiliary power distribution system
- Extendable manufacturing footprint with fast deliveries
- Global life cycle services and support

PVS980-MWS

Solar inverters
Like other ABB central inverters, the PVS980 has been developed on the basis of decades of experience in the industry and proven technology platform. Unrivalled expertise from the world's market and technology leader in frequency converters is the hallmark of this solar inverter series. The PVS980 inverter is one of the most efficient and cost-effective ways of converting the direct current (DC) generated by solar modules into high quality and CO_2-free alternating current (AC) that can be fed into the power distribution network. Two ABB central inverters are used in the ABB megawatt station. The inverters provide high conversion efficiency with low auxiliary power consumption with very low maintenance need.

Transformer
The ABB megawatt station includes an ABB vacuum cast coil dry-type- or alternatively ABB oil immersed transformer. The transformer is designed to meet the reliability, durability, and efficiency required in PV applications. It is specifically designed and optimized for ABB solar inverters to provide the best performance throughout the lifetime of the plant.

As a major global transformer manufacturer, ABB offers a wide range of transformers. Alternate power transformers are available to meet customer requirements. All ABB's transformers are manufactured in accordance with the most demanding industry and international standards.

Switchgear
ABB offers a complete range of medium voltage switchgear for secondary distribution, including air-insulated and gas-insulated switchgear.

The ABB megawatt station is equipped, as standard, with the widely proven ABB SafeRing, SF_6 -insulated switchgear.

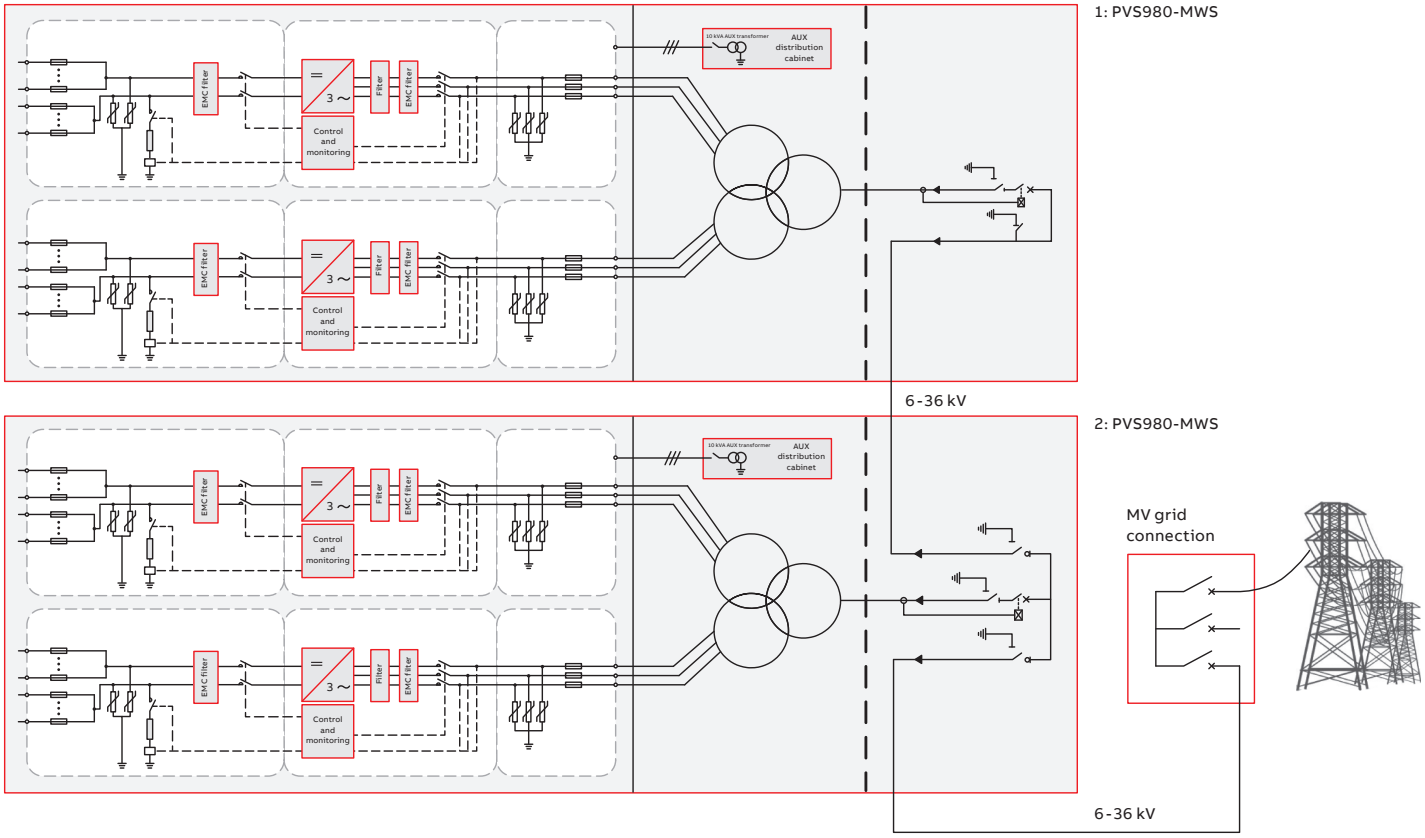
A sealed steel tank with constant atmospheric conditions ensures a high level of reliability as well as personnel safety. The virtually maintenance-free system comes in a compact and flexible design that allows for a versatile switchgear configuration. As an option ABB's gas-insulated SafePlus and air insulated Unisec switchgear are also available.

Technical data and types

Type designation [1] **PVS980-MWS-**	**-3636kVA-I-xx-zzz**	**-3818kVA-J-xx-zzz**	**-4000kVA-K-xx-zzz**	**-4182kVA-L-xx-zzz**
Maximum rating	4000 kVA	4200 kVA	4400 kVA	4600 kVA
Input (DC)				
Maximum input power ($P_{PV, max}$)	2x2909 kWp	2x3056 kWp	2x3200 kWp	2x3346
DC voltage range, mpp ($U_{DC, mpp}$) @ 35 °C (122°F)	850…1500 V	893…1500 V	935…1500 V	978…1500 V
(@ S_{nom}) @ 50 °C (122°F)	850…1100 V	893…1100 V	935…1100 V	978…1100 V
Maximum operational DC voltage ($U_{DC, max}$)	1500 V			
Number of protected DC inputs (parallel)	2x8 (up to 24 as option)			
Number of mppt trackers	2			
Output (AC)				
Inverter type (2x ABB central inverter)	PVS980-58-1818kVA-I	PVS980-58-1909kVA-J	PVS980-58-2000kVA-K	PVS980-58-2091kVA-L
Nominal AC output power ($S_{N(AC)}$) @ 50 °C (122°F)	3636 kVA	3818 kVA	4000 kVA	4182 kVA
Maximum AC output power ($S_{MAX(AC)}$) @ 35 °C (122°F)	4000 kVA	4200 kVA	4400 kVA	4600 kVA
Medium voltage range ($U_{N(AC)}$)	12 kV to 36 kV [2]			
Output frequency	50/60 Hz			
Harmonic distortion, current [3]	< 3%			
Power factor compensation (cosφ)	Yes			
Transformer type	ABB Vacuum cast coil dry type (AF), or ABB Oil immersed type (ONAN)			
Medium voltage switchgear type [4]	ABB SafeRing, SF_6-insulated, DeV, CV or CCV			
Enclosure	Painted steel outdoor enclosure, IP54, C4 corrosion protection			
Efficiency				
Maximum (inverter only)	98.8%			
Euro-eta (inverter only)	98.6%			

[1] Where xx-medium voltage level, zzz-transformer type, oil or dry
[2] Nominal voltage 12 kV to 36 kV, from 6 kV on as option
[3] At nominal power
[4] Other ABB switchgear types available as an option

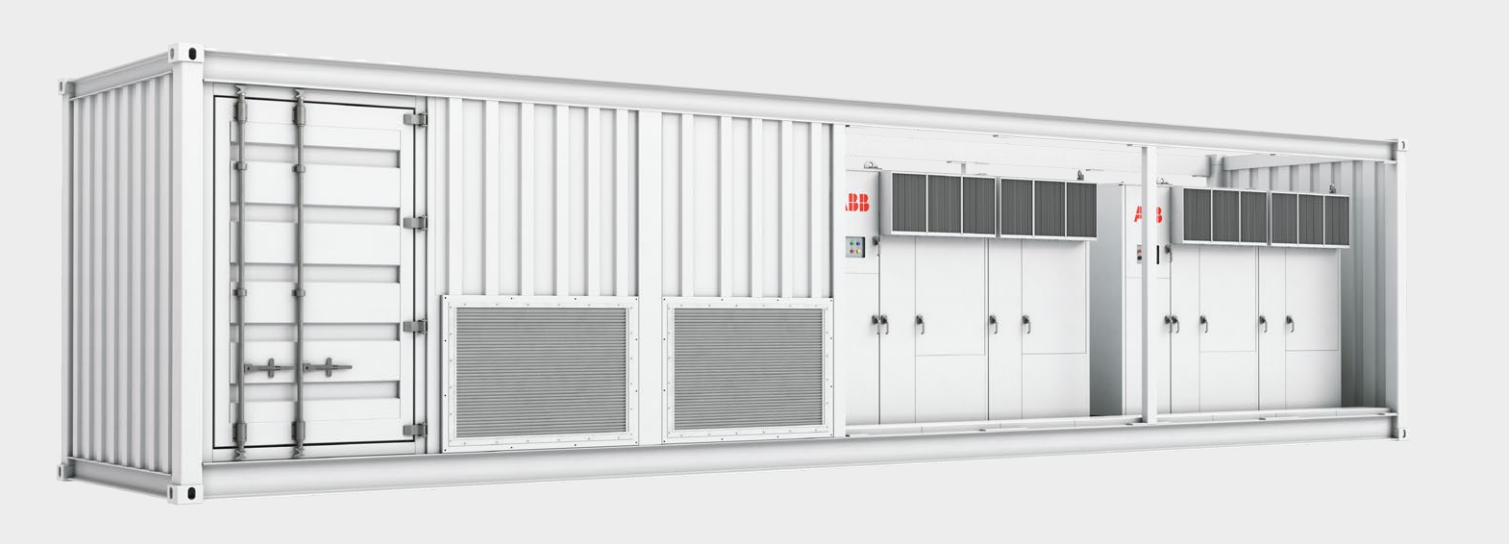
ABB megawatt station design and grid connection



Technical data and types

Type designation [1] **PVS980-MWS-**	**-3636kVA-I-xx-zzz**	**-3818kVA-J-xx-zzz**	**-4000kVA-K-xx-zzz**	**-4182kVA-L-xx-zzz**
Maximum rating	4000 kVA	4200 kVA	4400 kVA	4600 kVA
Power consumption				
Own consumption in operation	1500...5500 W			
Standby operation consumption	600 W			
Auxiliary voltage for customer use	3 ~ 400 V/50 Hz, up to 40 kVA			
Dimensions and weight				
Width/Height/Depth, mm	12190 mm/2900 mm/2440 mm (40' HC container dimensions)			
Weight approx.	< 30 t			
Environmental limits				
Degree of protection	Inverter IP56/IP66, UL Type 3R. IP44/54 RMU and dry type transformer housing			
Ambient temperature range (nominal ratings) [5]	-20 °C to +50 °C			
Maximum altitude (above sea level) [6]	1000 m			
Relative humidity, non condensing	5% to 95%			
User interface and communications				
Local user interface	Inverter´s control panel and PC intefrace through ABB Drive Studio			
Fieldbus connectivity	Modbus RTU, -TCP, Ethernet IP, Profinet			
Product compliance				
Conformity	IEC 60364, IEC 61936-1, IEC 60502-1			
Grid support	Reactive power compensation [7], Power reduction, LVRT, HVRT, FqRT			

[5] Extended range upon request
[6] Higher altitude upon request
[7] Also during the night



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02

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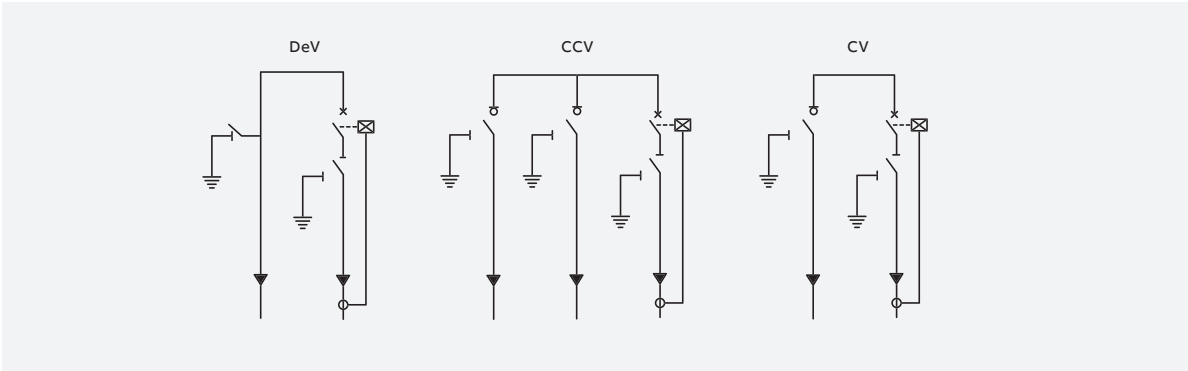
02 ABB megawatt station, PVS980-MWS - a compact plug-and-play solution for utility-scale PV plants

—
MV switchgear standard configurations for ABB megawatt station



Accessories

- Solar array junction boxes with string monitoring
- Remote monitoring solutions
- Warranty extensions
- Solar inverter care contracts

Options

- MV AC output voltages (6 to 36 kV)
- Different MV switchgear configurations
- I/O extensions
- DC grounding, positive
- Floating DC
- Fieldbus and Ethernet connections
- Auxiliary power supply from main power connections
- C5M enclosure corrosion protection

Support and service

ABB supports its customers with a dedicated service network in more than 60 countries and provides a complete range of life cycle servicesfrom installation and commissioning to preventative maintenance, spare parts, repairs and recycling.

—
For more information please contact your local ABB representative or visit:

www.abb.com/solarinverters
www.abb.com

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3AXD50000042986 EN 24.05.2017

Appendix C. PV Module Specification

NEW

Preliminary Technical Information Sheet

CanadianSolar

KuMax

HIGH EFFICIENCY POLY MODULE

CS3U-350|355|360|365P (1000 V / 1500 V)

With Canadian Solar's industry leading poly cell technology and the innovative LIC (Low Internal Current) module technology, we are now able to offer our global customers high power poly modules up to 365 W.

The KuMax poly modules with a dimension of 2000 × 992 mm, close to our 72 cell MaxPower modules, have the following unique features:

- **Higher** power classes for equivalent module sizes
- **High** module efficiency up to 18.40 %
- **LOW** hot spot temperature risk
- **LOW** temperature coefficient (Pmax): -0.37 % / °C
- **LOW NMOT** (Nominal Module Operating Temperature): 43 ± 2 °C

More power output thanks to low NMOT: 43 ± 2 °C

Low power loss in cell connection

Safer: lower hot spot temperature

Heavy snow load up to 5400 Pa, wind load up to 2400 Pa

Low BoS cost with 1500 VDC system voltage

High PTC rating of up to: 92.26 %

linear power output warranty

product warranty on materials and workmanship

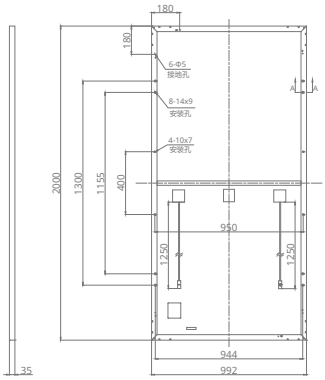
PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: VDE / CE (pending)

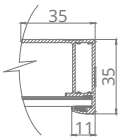
* If you need specific product certificates, and if module installations are to deviate from our guidance specified in our installation manual, please contact your local Canadian Solar sales and technical representatives.

ENGINEERING DRAWING (mm)

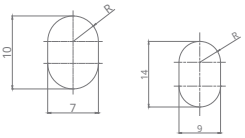
Rear View



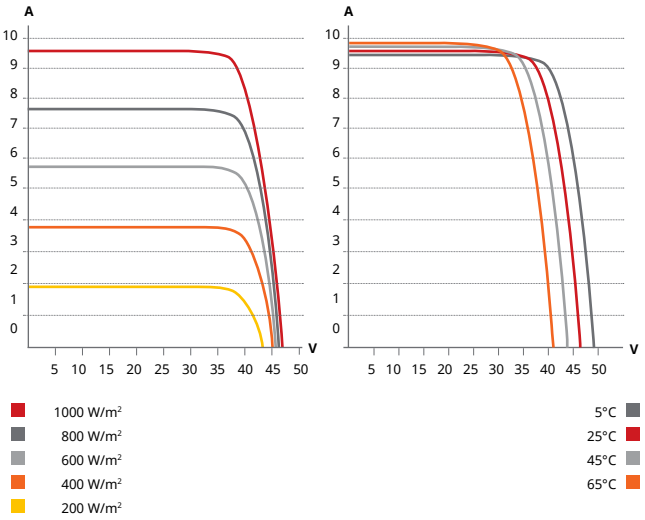
Frame Cross Section A-A



Mounting Hole



CS3U-355P / I-V CURVES



ELECTRICAL DATA | STC*

CS3U	350P	355P	360P	365P
Nominal Max. Power (Pmax)	350 W	355 W	360 W	365W
Opt. Operating Voltage (Vmp)	39.2 V	39.4 V	39.6 V	39.8 V
Opt. Operating Current (Imp)	8.94 A	9.02 A	9.10 A	9.18 A
Open Circuit Voltage (Voc)	46.6 V	46.8 V	47.0 V	47.2 V
Short Circuit Current (Isc)	9.51 A	9.59 A	9.67 A	9.75 A
Module Efficiency	17.64%	17.89%	18.15%	18.40%
Operating Temperature	-40°C ~ +85°C			
Max. System Voltage	1500V (IEC/UL) or 1000V (IEC/UL)			
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC 61730)			
Max. Series Fuse Rating	30 A			
Application Classification	Class A			
Power Tolerance	0 ~ + 5 W			

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25°C. Measurement uncertainty: ±3 % (Pmax).

ELECTRICAL DATA | NMOT*

CS3U	350P	355P	360P	365P
Nominal Max. Power (Pmax)	259 W	263 W	267 W	270 W
Opt. Operating Voltage (Vmp)	36.1 V	36.2 V	36.4 V	36.6 V
Opt. Operating Current (Imp)	7.19 A	7.25 A	7.32 A	7.38 A
Open Circuit Voltage (Voc)	43.6 V	43.7 V	43.9 V	44.1 V
Short Circuit Current (Isc)	7.68 A	7.74 A	7.80 A	7.87 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

MECHNICAL DATA

Specification	Data
Cell Type	Poly-crystalline, 156.75 X 78.38 mm
Cell Arrangement	144 [2 X (12 X 6)]
Dimensions	2000 X 992 X 35 mm (78.7 X 39.1 X 1.38 in)
Weight	22.5 kg (49.6 lbs)
Front Cover	3.2 mm tempered glass
Frame	Anodized aluminium alloy, crossbar enhanced
J-Box	IP68, 3 diodes
Cable	4 mm² (IEC), 12 AWG (UL)
Cable Length	1250 mm (49.2 in), 1670 mm (65.7 in) is optional for single tracking system with leap-frog connection
Connector	T4 series or MC4 series
Per Pallet	30 pieces
Per Container (40' HQ)	660 pieces

TEMPREATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.37 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	43 ± 2°C

PARTNER SECTION

* The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. Canadian Solar Inc. reserves the right to make necessary adjustment to the information described herein at any time without further notice.

CANADIAN SOLAR INC.
Canadian Solar MSS (Australia) Pty Ltd., 44 Stephenson St, Cremorne VIC 3121, Australia
support@canadiansolar.com, www.canadiansolar.com/au

Appendix A Certificate of Title

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Government of South Australia
Department of Planning, Transport and Infrastructure

Product	Title Details
Date/Time	04/02/2018 08:55AM
Customer Reference	property search
Order ID	20180204000190
Cost	$10.00

Certificate of Title

Title Reference	CT 5330/490
Status	CURRENT
Easement	YES
Owner Number	80199629
Address for Notices	POST OFFICE BOX 107, PORT AUGUSTA, SA 5700
Area	40.87HA (CALCULATED)

Estate Type

Fee Simple

Registered Proprietor

WONGI-AHRAH ABORIGINAL ASSOCIATION INC.
OF PO BOX 107 PORT AUGUSTA SA 5700

Description of Land

ALLOTMENT 91 FILED PLAN 170763
IN THE AREA NAMED BAROOTA
HUNDRED OF BAROOTA

Last Sale Details

Dealing Reference	Transfer (T) 8435606
Dealing Date	22/12/1997
Sale Price	$0
Sale Type	Change of ownership for no monetary consideration or undisclosed consideration

Constraints

Encumbrances

NIL

Stoppers

Dealing Type	Dealing Number	Beneficiary
CAVEAT	8435607	INDIGENOUS LAND CORPORATION

Valuation Numbers

Valuation Number	Status	Property Location Address
8303599504	CURRENT	Lot 190 PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Product	Title and Valuation Package
Date/Time	02/07/2018 02:10PM
Customer Reference	54440
Order ID	20180702007356
Cost	$14.80

Crown Record

Title Reference	CR 5759/905
Status	CURRENT
Easement	NO
Owner Number	90000652
Address for Notices	ADELAIDE SA 5000
Area	112.9HA (CALCULATED)

Estate Type

Crown Land (Alienated)

Owner

The Crown

Custodian

THE CROWN
OF ADELAIDE SA 5000

Description of Land

SECTION 201
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

TOTAL AREA: 112.9HA (CALCULATED)

Constraints

Encumbrances

NIL

Stoppers

NIL

Conditions

LAND DEDICATED FOR WATER WORKS PURPOSES PURSUANT TO THE CROWN LANDS ACT, 1929 BY GAZETTE 18/11/1937

Valuation Numbers

Valuation Number	Status	Property Location Address
8303603008	CURRENT	Lot 201 RESERVOIR ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

NIL

Administrative Interests

NIL

Valuation Record

Valuation Number	8303603008
Type	Site & Capital Value
Date of Valuation	01/01/2018
Status	CURRENT
Operative From	01/07/1978
Property Location	Lot 201 RESERVOIR ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	SOUTH AUSTRALIAN WATER CORPORATION
Owner Number	90004901
Address for Notices	ADELAIDE, SA 5000
Zone / Policy / Precinct	WP - Water Protection\\
Water Available	No
Sewer Available	No
Land Use	6290 - Water Utility Operation / Irrigation Or Sewage Disposal N.E.C.
Description	WATER UTILITY
Local Government Description	Other

Parcels

Plan/Parcel	Title Reference(s)
H330200 SECTION 201	CR 5759/905

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$19,000	$22,000			
Previous	$19,000	$22,000			

Building Details

Valuation Number	8303603008
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Product	Title and Valuation Package
Date/Time	02/07/2018 02:12PM
Customer Reference	54440
Order ID	20180702007390
Cost	$14.80

Crown Record

Title Reference	CR 5757/872
Status	CURRENT
Easement	NO
Owner Number	90004442
Address for Notices	ADELAIDE, SA 5000
Area	28.0HA (APPROXIMATE)

Estate Type

Crown Land (Alienated)

Owner

The Crown

Custodian

MINISTER FOR INFRASTRUCTURE
OF ADELAIDE SA 5000

Description of Land

SECTION 214
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

TOTAL AREA: 28.0HA (APPROXIMATE)

Constraints

Encumbrances

NIL

Stoppers

NIL

Conditions

LAND DEDICATED FOR WATER WORKS PURPOSES PURSUANT TO THE CROWN LANDS ACT, 1929 BY GAZETTE 14/07/1983

Valuation Numbers

Valuation Number	Status	Property Location Address
8303609004	CURRENT	964 RESERVOIR ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

NIL

Administrative Interests

NIL

Valuation Record

Valuation Number	8303609004
Type	Site & Capital Value
Date of Valuation	01/01/2018
Status	CURRENT
Operative From	01/07/1978
Property Location	964 RESERVOIR ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	SOUTH AUSTRALIAN WATER CORPORATION
Owner Number	90004901
Address for Notices	ADELAIDE, SA 5000
Zone / Policy / Precinct	RULP - Rural Landscape Protection\\2 - Conservation
Water Available	No
Sewer Available	No
Land Use	6290 - Water Utility Operation / Irrigation Or Sewage Disposal N.E.C.
Description	PUMPINGSTATION
Local Government Description	Other

Parcels

Plan/Parcel	Title Reference(s)
H330200 SECTION 214	CR 5757/872

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$8,600	$13,000			
Previous	$8,600	$13,000			

Building Details

Valuation Number	8303609004
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Product	Title and Valuation Package
Date/Time	10/08/2017 04:57PM
Customer Reference	Baroota
Order ID	20170810012101
Cost	$14.50

Certificate of Title

Title Reference	CT 5673/711
Status	CURRENT
Easement	YES
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	146HA (APPROXIMATE)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
OF BAROOTA SA 5495

Description of Land

SECTION 37W
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

Last Sale Details

There are no sales details recorded for this property

Constraints

Encumbrances

Dealing Type	Dealing Number	Beneficiary
ENCUMBRANCE	3819297	RASMINE ESTHER DENNIS

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303521467	CURRENT	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Valuation Record

Valuation Number	8303521467
Type	Site & Capital Value
Date of Valuation	01/01/2017
Status	CURRENT
Operative From	01/07/2000
Property Location	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	PETER ROBERT DENNIS
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Zone / Policy / Precinct	PRPRO - Primary Production\\
Water Available	No
Sewer Available	No
Land Use	9150 - Cereals And Sheep
Description	L
Local Government Description	Primary Production

Parcels

Plan/Parcel	Title Reference(s)
H330200 Section 41S	CT 5590/97
H330200 Section 38	CT 5673/710,CT 6111/452
H330200 Section 53	CT 5760/852
H330200 Section 183	CT 5675/837,CT 6111/452
H330200 Section 41N	CT 5590/97
H330200 Section 37W	CT 5673/711,CT 6108/973
H330200 Section 54S	CT 5673/709,CT 6108/973
H330200 Section 54N	CT 5639/780,CT 6108/973
H330200 Section 106	CT 5673/712,CT 6111/452
H330200 Section 184	CT 5675/837

Plan/Parcel	Title Reference(s)
H330200 Section 185	CT 5675/837
H330200 Section 89	CT 5673/710,CT 6111/452

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$660,000	$720,000			
Previous	$590,000	$650,000			

Building Details

Valuation Number	8303521467
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Product	Title Details
Date/Time	10/08/2017 05:07PM
Customer Reference	
Order ID	20170810012202
Cost	$10.00

Certificate of Title

Title Reference	CT 5639/780
Status	CURRENT
Easement	YES
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	16.6HA (APPROXIMATE)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
OF BAROOTA SA 5495

Description of Land

SECTION 54N
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

Last Sale Details

There are no sales details recorded for this property

Constraints

Encumbrances

Dealing Type	Dealing Number	Beneficiary
ENCUMBRANCE	3819297	RASMINE ESTHER DENNIS

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303521467	CURRENT	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Product	Title and Valuation Package
Date/Time	10/08/2017 05:04PM
Customer Reference	Baroota
Order ID	20170810012164
Cost	$14.50

Certificate of Title

Title Reference	CT 5673/709
Status	CURRENT
Easement	YES
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	95.90HA (CALCULATED)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
OF BAROOTA SA 5495

Description of Land

SECTION 54S
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

Last Sale Details

There are no sales details recorded for this property

Constraints

Encumbrances

Dealing Type	Dealing Number	Beneficiary
ENCUMBRANCE	3819297	RASMINE ESTHER DENNIS

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303521467	CURRENT	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Valuation Record

Valuation Number	8303521467
Type	Site & Capital Value
Date of Valuation	01/01/2017
Status	CURRENT
Operative From	01/07/2000
Property Location	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	PETER ROBERT DENNIS
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Zone / Policy / Precinct	PRPRO - Primary Production\\
Water Available	No
Sewer Available	No
Land Use	9150 - Cereals And Sheep
Description	L
Local Government Description	Primary Production

Parcels

Plan/Parcel	Title Reference(s)
H330200 Section 41S	CT 5590/97
H330200 Section 38	CT 5673/710,CT 6111/452
H330200 Section 53	CT 5760/852
H330200 Section 183	CT 5675/837,CT 6111/452
H330200 Section 41N	CT 5590/97
H330200 Section 37W	CT 5673/711,CT 6108/973
H330200 Section 54S	CT 5673/709,CT 6108/973
H330200 Section 54N	CT 5639/780,CT 6108/973
H330200 Section 106	CT 5673/712,CT 6111/452
H330200 Section 184	CT 5675/837

Plan/Parcel	Title Reference(s)
H330200 Section 185	CT 5675/837
H330200 Section 89	CT 5673/710,CT 6111/452

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$660,000	$720,000			
Previous	$590,000	$650,000			

Building Details

Valuation Number	8303521467
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Product	Title and Valuation Package
Date/Time	05/05/2017 09:29AM
Customer Reference	
Order ID	20170505001724
Cost	$14.15

Certificate of Title

Title Reference	CT 5576/38
Status	CURRENT
Easement	NO
Owner Number	1155296*
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	104HA (APPROXIMATE)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
BEVERLEY LORAINE DENNIS
OF PO BOX 31 PORT GERMEIN SA 5495
WITH NO SURVIVORSHIP

Description of Land

SECTION 88
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

Last Sale Details

Dealing Reference	Transfer (T) 8701775
Dealing Date	09/06/1999
Sale Price	$0
Sale Type	Change of ownership for no monetary consideration or undisclosed consideration

Constraints

Encumbrances

NIL

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303552503	CURRENT	Lot 88 BAROOTA ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

NIL

Administrative Interests

NIL

Valuation Record

Valuation Number	8303552503
Type	Site & Capital Value
Date of Valuation	01/01/2016
Status	CURRENT
Operative From	01/07/1999
Property Location	Lot 88 BAROOTA ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	PETER ROBERT DENNIS BEVERLEY LORAINE DENNIS
Owner Number	1155296*
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Zone / Policy / Precinct	RULP - Rural Landscape Protection\\1 - Agriculture
Water Available	No
Sewer Available	No
Land Use	9301 - Vines - Irrigated
Description	VINES/CROP
Local Government Description	Primary Production

Parcels

Plan/Parcel	Title Reference(s)
H330200 Section 88	CT 5576/38

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$115,000	$250,000			
Previous	$115,000	$310,000			

Building Details

Valuation Number	8303552503
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Product	Title and Valuation Package
Date/Time	10/08/2017 05:00PM
Customer Reference	Baroota
Order ID	20170810012127
Cost	$14.50

Certificate of Title

Title Reference	CT 5673/710
Status	CURRENT
Easement	YES
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	261HA (APPROXIMATE)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
OF BAROOTA SA 5495

Description of Land

SECTIONS 38 AND 89
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

Last Sale Details

There are no sales details recorded for this property

Constraints

Encumbrances

Dealing Type	Dealing Number	Beneficiary
ENCUMBRANCE	3819297	RASMINE ESTHER DENNIS

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303521467	CURRENT	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Valuation Record

Valuation Number	8303521467
Type	Site & Capital Value
Date of Valuation	01/01/2017
Status	CURRENT
Operative From	01/07/2000
Property Location	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	PETER ROBERT DENNIS
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Zone / Policy / Precinct	PRPRO - Primary Production\\
Water Available	No
Sewer Available	No
Land Use	9150 - Cereals And Sheep
Description	L
Local Government Description	Primary Production

Parcels

Plan/Parcel	Title Reference(s)
H330200 Section 41S	CT 5590/97
H330200 Section 38	CT 5673/710,CT 6111/452
H330200 Section 53	CT 5760/852
H330200 Section 183	CT 5675/837,CT 6111/452
H330200 Section 41N	CT 5590/97
H330200 Section 37W	CT 5673/711,CT 6108/973
H330200 Section 54S	CT 5673/709,CT 6108/973
H330200 Section 54N	CT 5639/780,CT 6108/973
H330200 Section 106	CT 5673/712,CT 6111/452
H330200 Section 184	CT 5675/837

Plan/Parcel	Title Reference(s)
H330200 Section 185	CT 5675/837
H330200 Section 89	CT 5673/710,CT 6111/452

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$660,000	$720,000			
Previous	$590,000	$650,000			

Building Details

Valuation Number	8303521467
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Government of South Australia
Department of Planning, Transport and Infrastructure

Product	Title Details
Date/Time	10/08/2017 05:09PM
Customer Reference	Baroota
Order ID	20170810012225
Cost	$10.00

Certificate of Title

Title Reference	CT 5673/712
Status	CURRENT
Easement	YES
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	116HA (APPROXIMATE)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
OF BAROOTA SA 5495

Description of Land

SECTION 106
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

Last Sale Details

There are no sales details recorded for this property

Constraints

Encumbrances

Dealing Type	Dealing Number	Beneficiary
ENCUMBRANCE	3819297	RASMINE ESTHER DENNIS

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303521467	CURRENT	Lot 37W PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Crown Lease

Title Reference	CL 784/39
Status	CURRENT
Easement	YES
Owner Number	80199629
Address for Notices	PO BOX 2247 PORT AUGUSTA 5700
Area	195.9HA (CALCULATED)

Estate Type

Crown Lessee

Owner

THE CROWN

Crown Lessee

WONGI-AHRAH ABORIGINAL ASSOC INC
OF PO BOX 2247 PORT AUGUSTA SA 5700

Description of Land

SECTION 225
HUNDRED OF BAROOTA
IN THE AREA NAMED BAROOTA

TOTAL AREA: 195.9HA (CALCULATED)

Lease Details

Lease Number	OP014553
Lease Type	PERPETUAL
Commencing On	01/02/1931

IN PERPETUITY

Last Sale Details

Dealing Reference	Transfer (T) 8435606
Dealing Date	22/12/1997
Sale Price	$0
Sale Type	Change of ownership for no monetary consideration or undisclosed consideration

Constraints

Encumbrances

NIL

Stoppers

Dealing Type	Dealing Number	Beneficiary
CAVEAT	8435607	INDIGENOUS LAND CORPORATION

Valuation Numbers

Valuation Number	Status	Property Location Address
8303599504	CURRENT	Lot 190 PIPELINE ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

NIL

Administrative Interests

NIL

Valuation Record

Valuation Number	8303599504
Type	Site & Capital Value
Date of Valuation	01/01/2016
Status	CURRENT
Operative From	01/07/1997
Property Location	Lot 190 PIPELINE ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	WONGI-AHRAH ABORIGINAL ASSOCIATION INC.
Owner Number	80199629
Address for Notices	PO BOX 2247 PORT AUGUSTA 5700
Zone / Policy / Precinct	RULP - Rural Landscape Protection\\2 - Conservation
Water Available	No

Sewer Available	No
Land Use	9150 - Cereals And Sheep
Description	L
Local Government Description	Primary Production

Parcels

Plan/Parcel	Title Reference(s)
H330200 Section 261	CL 460/3
H330200 Section 190	CL 460/3
H330200 Section 262	CL 460/3
H330200 Section 264	CL 460/3
H330200 Section 266	CL 460/3
H330200 Section 265	CL 460/3
H330200 Section 225	CL 784/39
H330200 Section 260	CL 460/3
F170763 Allotment 91	CT 5330/490
H330200 Section 263	CL 460/3

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$630,000	$750,000			
Previous	$630,000	$750,000			

Building Details

Valuation Number	8303599504
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Product	Title and Valuation Package
Date/Time	02/07/2018 01:52PM
Customer Reference	54440
Order ID	20180702006984
Cost	$14.80

Certificate of Title

Title Reference	CT 5245/609
Status	CURRENT
Easement	YES
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Area	126HA (APPROXIMATE)

Estate Type

Fee Simple

Registered Proprietor

PETER ROBERT DENNIS
OF BAROOTA VIA PORT GERMEIN SA 5495

Description of Land

ALLOTMENT 297 DEPOSITED PLAN 38564
IN THE AREA NAMED BAROOTA
HUNDRED OF BAROOTA

Last Sale Details

There are no sales details recorded for this property

Constraints

Encumbrances

Dealing Type	Dealing Number	Beneficiary
ENCUMBRANCE	3819297	RASMINE ESTHER DENNIS
ENCUMBRANCE	7791968	RASMINE ESTHER DENNIS
LEASE	7791969	MINISTER FOR INFRASTRUCTURE

Stoppers

NIL

Valuation Numbers

Valuation Number	Status	Property Location Address
8303520106	CURRENT	931 RESERVOIR ROAD, BAROOTA, SA 5495

Notations

Dealings Affecting Title

NIL

Notations on Plan

NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 37/2003

Administrative Interests

NIL

Valuation Record

Valuation Number	8303520106
Type	Site & Capital Value
Date of Valuation	01/01/2018
Status	CURRENT
Operative From	01/07/2000
Property Location	931 RESERVOIR ROAD, BAROOTA, SA 5495
Local Government	MOUNT REMARKABLE
Owner Names	PETER ROBERT DENNIS
Owner Number	00946832
Address for Notices	PO BOX 31 PORT GERMEIN 5495
Zone / Policy / Precinct	RULP - Rural Landscape Protection\\1 - Agriculture
Water Available	No
Sewer Available	No
Land Use	9150 - Cereals And Sheep
Description	2HSESSPSS MS HS
Local Government Description	Primary Production

Parcels

Plan/Parcel	Title Reference(s)
H330200 SECTION 257	CT 5426/941,CT 5481/848
H330200 SECTION 35	CT 5673/708,CT 5803/119,CT 6078/103
D38564 ALLOTMENT 297	CT 5245/609
H330200 SECTION 34	CT 5673/708,CT 5803/119,CT 6078/103,CT 6108/973

Values

Financial Year	Site Value	Capital Value	Notional Site Value	Notional Capital Value	Notional Type
Current	$220,000	$520,000			
Previous	$200,000	$500,000			

Building Details

Valuation Number	8303520106
Building Style	Not available
Year Built	Not available
Building Condition	Not available
Wall Construction	Not available
Roof Construction	Not available
Equivalent Main Area	Not available
Number of Main Rooms	Not available

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Appendix B Surface Water Assessment

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alluvium

TECHNICAL REPORT:

Baroota Solar Hydro Project: Surface Water and Groundwater Assessment

July 2018

JBS&G

Document history

Revision:

Revision no.	FINAL
Author/s	Jason Carter Tony Weber James Teague
Checked	Misko Ivezich
Approved	Jason Carter

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Contents

Figures

Tables

Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
ARI	Average Recurrence Interval
PV	Photo-voltaic
PWRA	Baroota Prescribed Water Resources Area
WAAP	Water Affecting Activity Permit
WAP	Water Allocation Plan

Glossary

ephemeral	A watercourse that does not have a permanent flow. Flows are during and shortly after rainfall.
penstock	Water conveyance pipe

1 Introduction

Alluvium Consulting Australia Pty Ltd (Alluvium) has been engaged by JBS&G to provide an assessment of groundwater and surface water relevant to a proposed combined Pumped Hydro Electric Storage (PHES) project and Solar Farm project (together referred to in this report as the Project) near the Baroota reservoir, in the Southern Flinders Ranges of South Australia. This report documents a high level desktop assessment and targeted field assessment to assess groundwater and surface water relevant to the proposed Project.

1.1 Location

Rise Renewables Pty Ltd proposes to develop a pumped hydro and solar project in the District Council of Mt Remarkable area of South Australia, at a site located approximately 12 km north-east of Pt Germein. The proposed project is located entirely within the Baroota Prescribed Water Resources Area and includes the construction of an approximately 40 ha upper reservoir approximately 1 km from the lower and existing reservoir, which has an existing 63 ha footprint. The upper reservoir will be connected to a generator, with 75% of the transfer pipeline underground and the remaining 25% above ground. The solar component of the project will include a 300 MW photo-voltaic (PV) solar farm plant, anticipated to be located in a 600 ha land parcel W-NW from the Baroota Reservoir. The location of the project is shown in Figure 1.

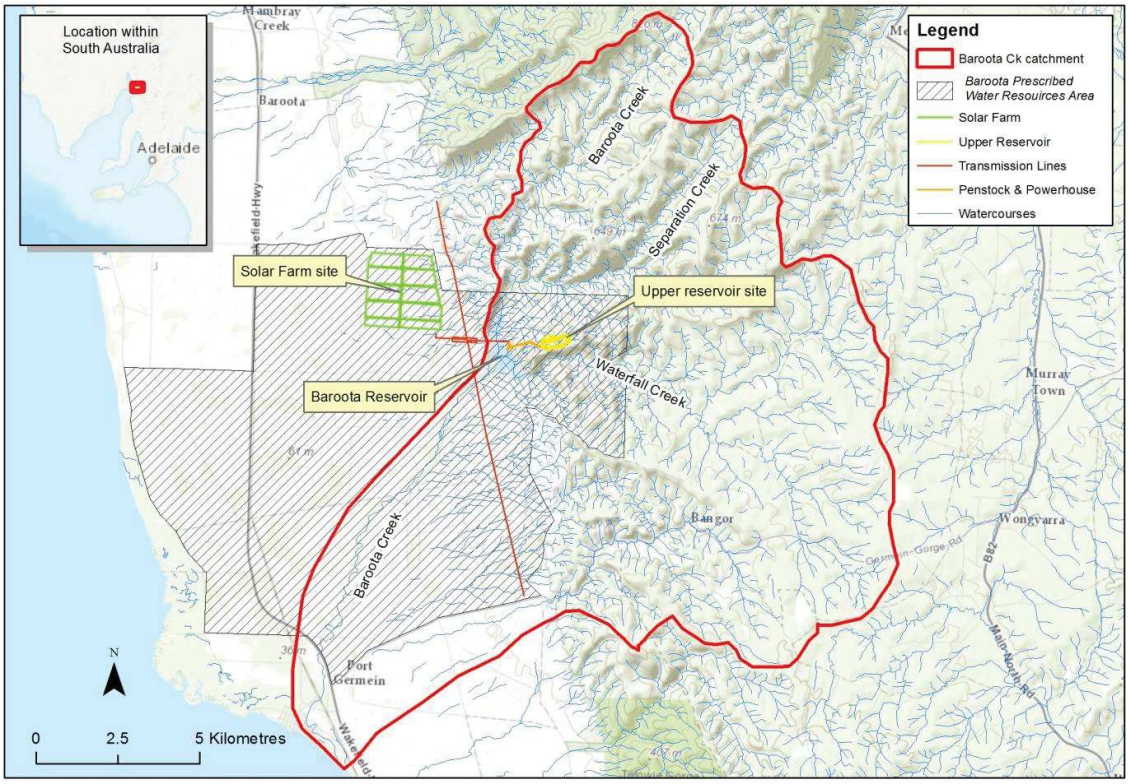

Figure 1. *Location of the Project*

1.2 Project description and main components

A full description of the preliminary Project design, which will be refined during the detailed design phase, is provided in JBS&G (2018). A summary of the key components is provided below.

The Project is within a region that has been determined as being Native Title of the Nukunu People. The site identified for the PHES Project is located within land held under perpetual lease by the Wongi-Ahrah Aboriginal Association (Wongi-Ahrah), which is the heritage -branch of the Nukunu People's Council Inc. The majority of the PHES project site is located on land held the Wongi-Ahrah and SA Water, approximately 30 km

north-east of Port Pirie. The project site includes the existing Baroota Reservoir (SA Water); the escarpment and upper plateau to the east which forms the western boundary of the Southern Flinders Ranges (Wongi-Ahrah); as well as freehold land to the north west of the existing Baroota Reservoir, where the combined substation will be located.

The PHES Project has three main areas, being the upper and lower reservoirs, as well as the powerhouse/switchyard. The project shares a combined substation with the Solar Project.

The upper reservoir will be located approximately 1 km to the east of the existing reservoir, excavated into a naturally occurring topographic 'bowl'. The upper reservoir will have a footprint of approximately 40 hectares

The powerhouse is proposed for the approximate mid-point along the eastern boundary of the lower reservoir, on SA Water owned land. The water conveyance pipe (penstock) runs between the lower and upper reservoir, traversing both SA Water owned land adjacent the lower reservoir, as well as Wongi-Arah land to the east of the power house to the upper reservoir. A switch yard is connected to the powerhouse, located immediately to the north of the building on SA Water land. The switchyard connects directly to the combined substation located to the south east of the Solar Project, west of Kenihan Road

The project will include:

- Civil / earthworks for the upper reservoir (saddle dams) and concrete intake / headrace infrastructure;
- Civil / earthworks for the lower reservoir intake / tailrace infrastructure;
- Civil / earthworks including internal access roads and security fencing;
- Civil / earthworks for the powerhouse, switchyard and combined substation;
- Civil / earthworks for penstock;
- Two 100-135 MW reversible turbine-pumps;
- Operational facilities including a site office, maintenance building with on-site sewage management system, parking area, material laydown area, undercover storage area and waste storage area;
- A substation (combined with Solar Project) with 275kV step-up transformers and control room;
- NEM compliant metering arrangements for all energy exported into the grid as well as internal metering to measure turbine output; and
- Connection into the existing Bungama to Davenport 275 kV line running to the west of the lower reservoir.

The Project's main components have been considered as a whole where they have the potential to interact with surface water and groundwater, which are the focus of consideration of this report. They are:

- a Solar Plant including substation located on farm land on the alluvial fan below the range;
- a new upper reservoir located in the upper part of a small catchment of an ephemeral, unnamed tributary of Baroota Reservoir.
- Penstock
- Powerhouse, switchyard and combined substation
- Existing Baroota Reservoir
- Internal access roads and powerline infrastructure

The location of the Project components is shown in Figure 2.

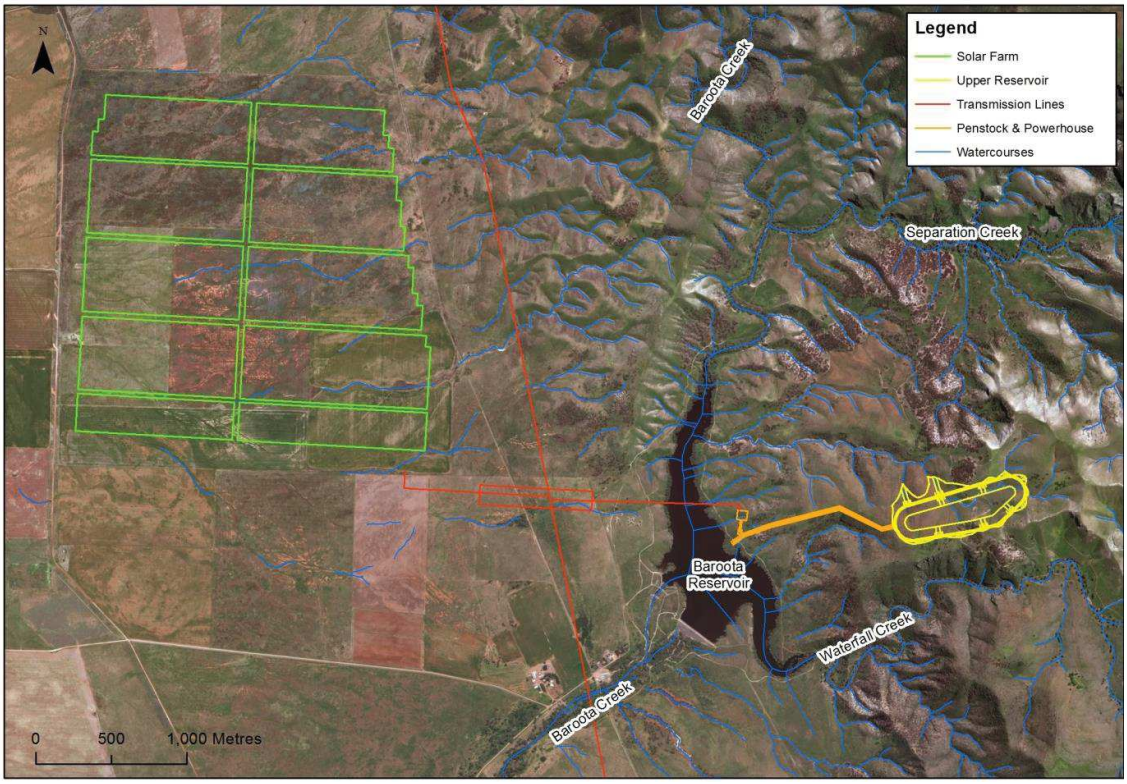

Figure 2. *Project components*

1.3 Assessment Methodology

This assessment has been undertaken as a desktop study, supported with a one day field review. The report details aspects groundwater and surface water as follows:

- Groundwater: aquifer types, water quality and potential for interaction with the project.
- Surface water: climate, hydrology, soils, water quality, water balance and interactions with the project.

An assessment is provided of potential impacts together with identification of avoidance, mitigation and management measures to manage those impacts.

2 Groundwater

2.1 Geology

The underlying geology, as mapped by the Geological Survey of South Australia is shown on the 1:250,000 scale Orroroo map sheet (Department for Manufacturing Industry, Trade, Resources and Energy, 2012). The section underlying the project components is shown in Figure 3.

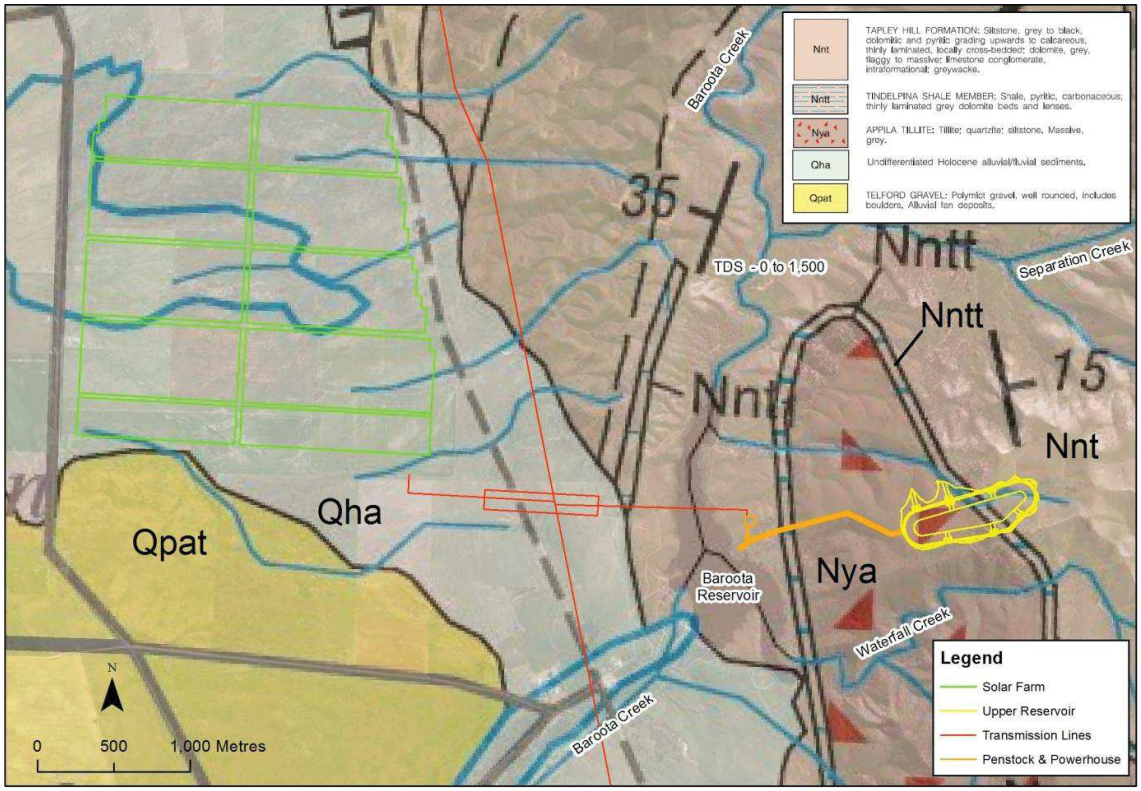

Figure 3. *1:250,000 Geology (Department for Manufacturing Industry, Trade, Resources and Energy, 2012)*

The upper reservoir site is located across the Tapley Hill Formation, Tindelpina Shale Member and the Appila Tillite, which are described as follows:

- **Nnt**- Tapley Hill Formation: Siltstone, grey to black, dolomite and pyric grading upwards to calcareous, thinly laminated, locally cross-bedded; dolomite, grey, flaggy to massive; limestone conglomerate. Intraformational, greywacke.
- **Nntt** - Tindelpina Shale Member
- **Nya** - Appila Tillite: Tillite; quartzite; siltstone. Massive grey.

The geology mapping also identifies inclined sedimentary bedding in the Tapley Hill Formation, which is clearly evident in the surface expression of rock in the unnamed catchment above the site of the upper reservoir, as shown in Figure 4.

No faulting is identified on the 1:250 000 scale mapping at the site of the upper reservoir.

Figure 4. *Inclined sedimentary rocks of the Tapley Hill Formation (photo: R Porter)*

The Solar Plant site is located on:

- **Qha** - undifferentiated Holocene alluvial/fluvial sediments and Telford Gravel: Polymict gravel, well rounded, includes boulders
- **Qpat** - alluvial fan deposits.

2.2 Groundwater

The project is located entirely within the Baroota Prescribed Water Resources Area and as such requires consideration of any activities that could result in impacts to groundwater.

There are two aquifers identified for the project site (see Figure 5):

- **Solar Plant**: Sedimentary Rocks - basins include limestone, often cavernous, sandstone, sand shale and clay
- **Upper Reservoir**: Fractured Rocks - Cambrian and Precambrian rocks - quartzite, sandstone, limestone, dolomite, slate, marble, siltstone, phyllite, schist and gneiss

The SARIG map database provides information on a range of groundwater attributes, however detailed information is not currently available for the site of the proposed upper reservoir. The closest water drill holes are approximately 800 m and 1,400 m in the Waterfall Creek catchment, where historical data (1962 and 1936 respectively) identifies Total Dissolved Solids (TDS) as 2,256 and 2,241 mg/L. Depth of the bores and depth to groundwater are not recorded. Drill hole locations and TDS for the surrounding area are illustrated in Figure 5.

As stated in the previous section, no faulting is identified on the 1:250 000 geology mapping. With no faulting, groundwater flows through the fractured rocks aquifer can be expected to be low based on the SARIG recorded water drill hole logs, which show a yield range of 0.5 to 3 L/s. At the time of preparing this report, exploration bores were planned as part of project investigations. Further information on geology and groundwater can be expected to be obtained once that drilling is completed. Groundwater conditions and the potential for interaction with the project components will be further investigated at the detailed design stage.

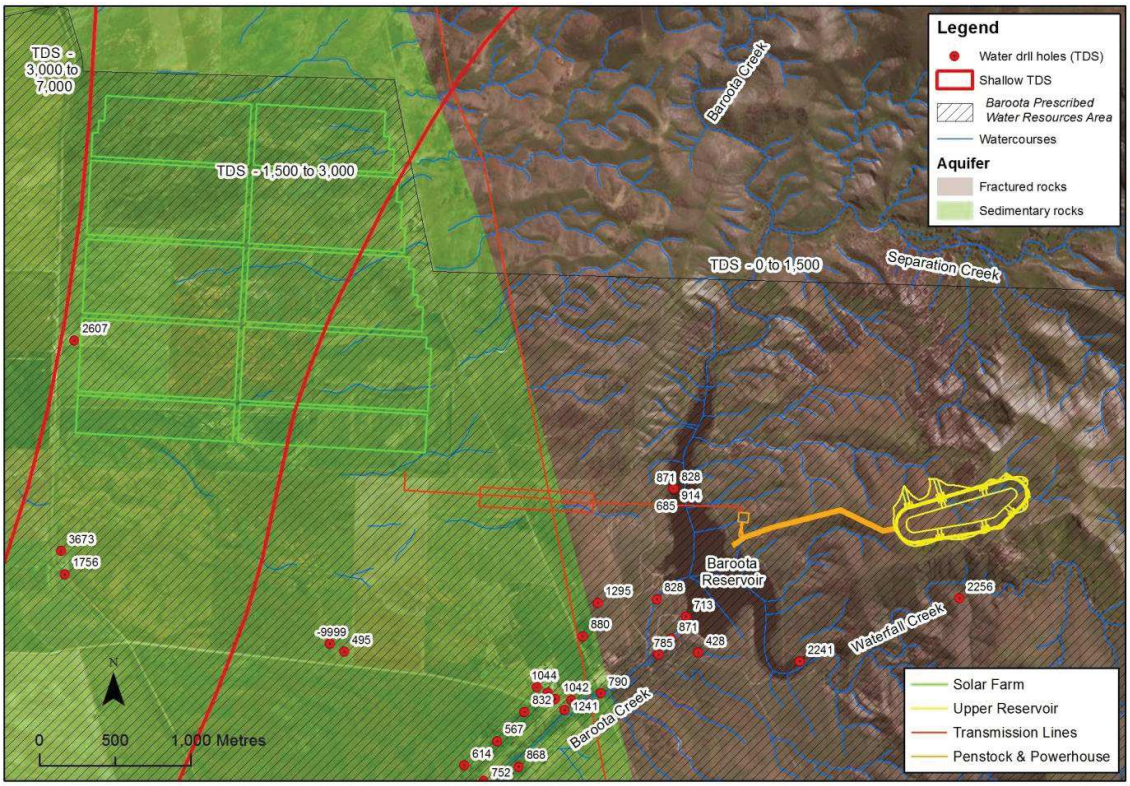

Figure 5. *Aquifers, water drill holes and TDS*

Evidence of the potential interaction between the upper reservoir and groundwater can be seen by considering current groundwater discharge below the Baroota Reservoir, where constant spring flow is evident below the dam wall (Figure 6) and is monitored by SA Water (M. Williams (SA Water), pers. comm). Consideration has also been given to the lower reservoir and powerhouse, which includes the pump shaft, installed to 60m below ground level (discussed in Section 5).

Baroota Prescribed Water Resources Area

The project is located entirely within the Baroota Prescribed Water Resources Area (PWRA), which was prescribed in 2008. The PWRA is a local-scale resource for which groundwater, surface water and watercourse water are prescribed under South Australia's *Natural Resources Management Act 2004*. Groundwater extractions are limited under a Notice of Prohibition, pending the development and adoption of a water allocation plan that will provide for sustainable management of the resource (DNWR, 2017).

Groundwater extractions in the Baroota PWRA occur from the Quaternary aquifer, which is comprised of clay and gravel sediments that were deposited as outwash from the Flinders Ranges, and can have thickness up to 100 m. These shallow sediments are underlain by a deeper Tertiary sand aquifer.

Variations in rainfall and rates of groundwater extraction are important factors in groundwater level and salinity changes in the Baroota PWRA. Below-average rainfall may result in a reduction in recharge to the aquifers. Below-average summer rainfall can also result in increasing irrigation extractions, and these two elements can cause the groundwater levels to fall and salinity to increase. Conversely, increases in rainfall may

result in increases in recharge, decreases in irrigation extractions and groundwater levels may rise and salinity may stabilise or decrease.

Connections between surface water bodies and groundwater may also affect groundwater levels and salinity in the Baroota PWRA. Leakage from the Baroota Reservoir manifests as streamflow along Baroota Creek and may contribute recharge to the groundwater system, especially when the reservoir is full and overflow occurs. Below-average rainfall between 2002 and 2009 saw lower surface water inflows to the reservoir and consequently, recharge to the aquifers that underlie Baroota Creek was reduced (DNWR, 2017).

In 2009 the Department of Water, Land and Biodiversity Conservation published a "Technical Note: Groundwater Resource Assessment of the Baroota Prescribed Water Resources Area" (Barnett, S.R., 2009), which states that soon after the Baroota Dam was completed "*it was noted the dam was leaking, with the amount of seepage in Baroota Creek below the dam proportional to the reservoir water level (Clarke, 1990). In 1942, collection of the seepage began by pumping from a system of ditches in the streambed. A more recent investigation (Warneke, 1979), found that although the amount recovered varied between 0.5 and 6 ML/day (depending on the reservoir level), an average of 2 ML/day was not recovered and would have contributed to groundwater recharge*".

Figure 6. *Spring flow and gauging weir below Baroota Reservoir wall. (photo: J Carter)*

The Baroota Water Allocation Plan (WAP) is being prepared as a requirement of the Baroota PWRA. The WAP aims to:

- protect the resource for all water users and water dependent ecosystems, now and into the future
- provide greater certainty for water users.

The WAP is being developed by the Northern and Yorke Natural Resources Management Board in collaboration with key stakeholders (Natural Resources Northern and Yorke: http://www.naturalresources.sa.gov.au/northernandyorke/water/water-allocation-plans/baroota-wap -

accessed 27 May 2018). The project can be expected to be required to demonstrate no negative impacts to groundwater.

3 Surface Water – Baseline Assessment

3.1 Climate

The BOM weather station at Port Pirie Nyrstar Comparison (Latitude: 33.17 °S Longitude: 138.01 °E), operated from 1877 to 2012 and recorded annual average rainfall as 345.9 mm. Mean monthly rainfall is illustrated in Figure 7, showing the wettest months as May to October. For the Nelshaby Land System (see Section 5.3), DEWNR Soil and Land Program reports the average rainfall to be 290-485 mm, whilst for the Separation Land System it is reported as 400-550 mm. There is a difference in average rainfall between the Solar Plant site and the Upper Reservoir site due to the increase in elevation.

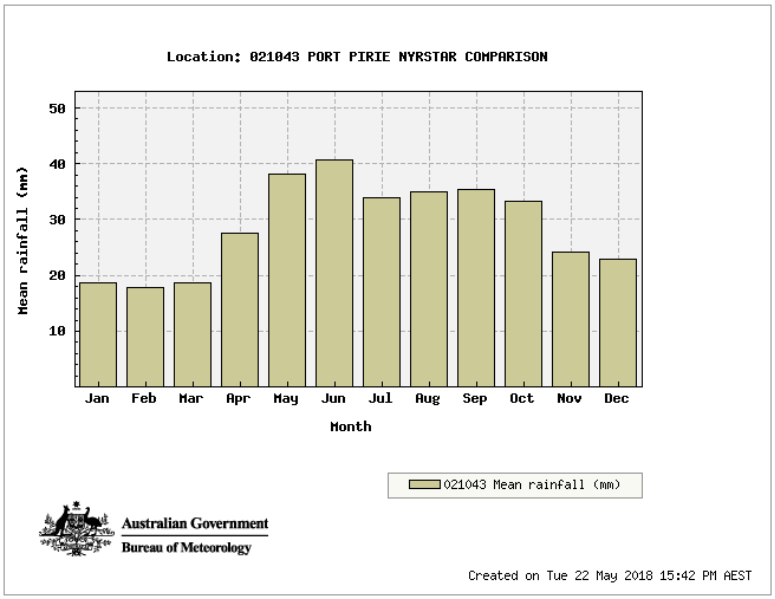

Figure 7. *Port Pirie mean monthly rainfall*

The Port Germein rainfall station (BoM Station 19037) shows annual (July-June) and monthly rainfall for the years 2011-2016 and the long-term averages, which are illustrated in Figure 8.

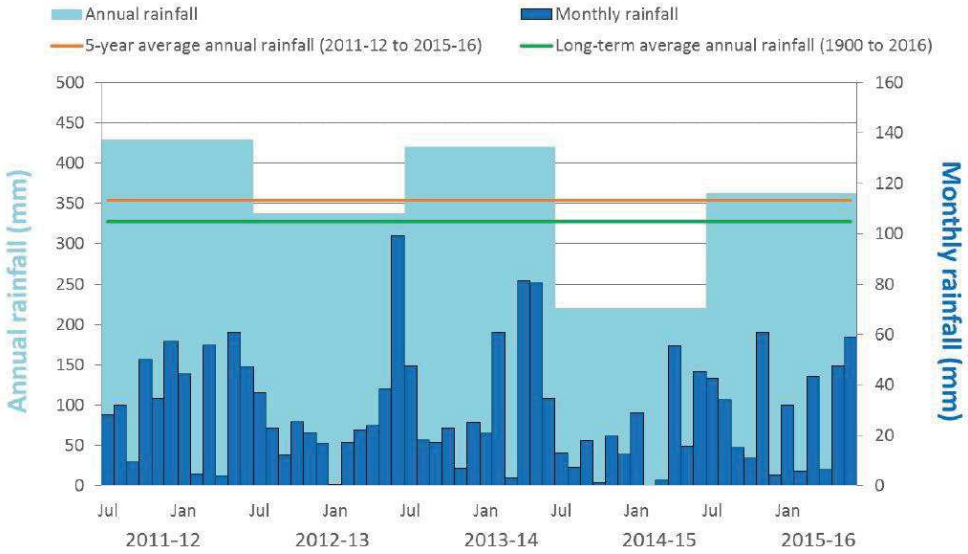

Figure 8. *Annual (July–June) and monthly rainfall for the past five water-use years, and the five-year and long-term average annual rainfall recorded at Port Germein (BoM Station 19037) (DEWNR, 2017)*

Mean temperature and mean humidity at 3 pm are shown in Figure 9 and Figure 10 respectively.

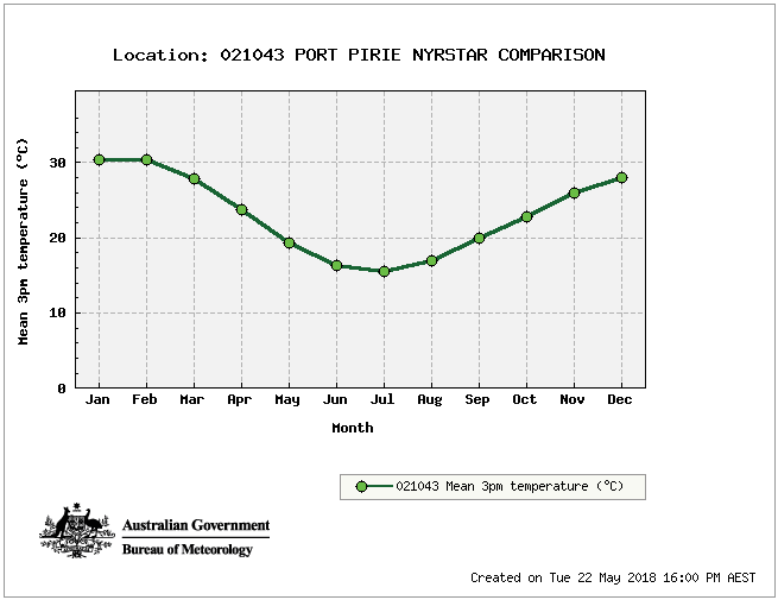

Figure 9. *Port Pirie mean 3pm temperature (1946 to 2010)*

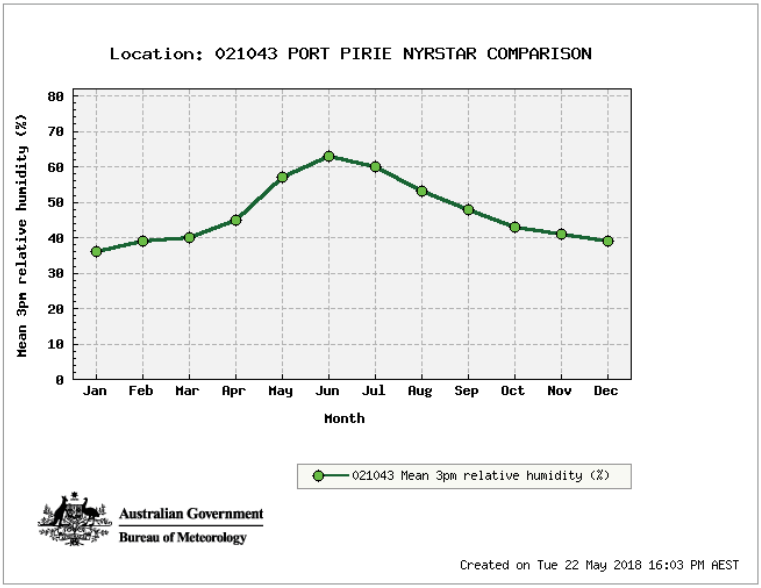

Figure 10. *Port Pirie mean 3pm relative humidity (1946 to 2010)*

Evaporation
Average monthly class A pan evaporation data was obtained from the BOM for the Port Pirie Township, Latitude -33.1791, Longitude 138.0083 (Tonkin 2014) as is shown in Table 1. The annual average evaporation across the project area is 1,600-1,800 mm.

Table 1. Monthly Evaporation (mm/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9.01	8.74	6.54	4.39	2.72	1.95	2.14	2.82	3.86	5.34	7.09	8.29

3.2 Hydrology

Landform and drainage
The two main components of the projects, the PHES Project and the Solar Plant are located in separate catchments, illustrated in Figure 1 and described as follows.

Baroota Creek catchment (PHES Project site)
The Baroota Creek catchment is located in the Southern Flinders Ranges, within the Mambray Coast drainage basin in the North St Vincent-Spencer Gulf region.

Floodout creeks catchments (Solar Plant site)
Also located in the Southern Flinders Ranges, within the Mambray Coast drainage basin in the North St Vincent-Spencer Gulf region. These unnamed, short run catchments have a length of between 1 and 3 kilometres , containing only ephemeral watercourses that run off the ranges before flooding out on the adjacent alluvial fans and plains, where they lose their defined channels and dissipate. These types of watercourse channels are called floodouts and are shown clearly in Figure 1. Matt Dennis (pers comm) observed that he had never seen them flowing for much more than a day as they respond quickly to rainfall, with watercourse flows ceasing a short time after cessation of rainfall.

Watercourse categorisation
It can be useful for projects to categorise watercourses that could potentially be impacted by projects activities and operations. Different types of watercourses respond differently to disturbance and require different

management approaches. The categories that have been applied to this study are stream order and geomorphic stream type, which are described in the following sections.

Stream ordering

The SARIG "TOPO_Watercourses" layer was refined by the project team to include Strahler stream ordering for the potentially affected watercourses. Stream ordering provides an indication of the relative size of a watercourse within a climatic and geomorphic setting.

Strahler's (1952) stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. A stream with no tributaries (headwater stream) is considered a first order stream. A segment downstream of the confluence of two first order streams is a second order stream. Thus, a n^{th} order stream is always located downstream of the confluence of two $(n-1)^{th}$ order streams[1]. An example is shown in Figure 11. The stream order was manually applied, within the study area, for all stream orders potentially interacting with the project components, the largest being 3rd order.

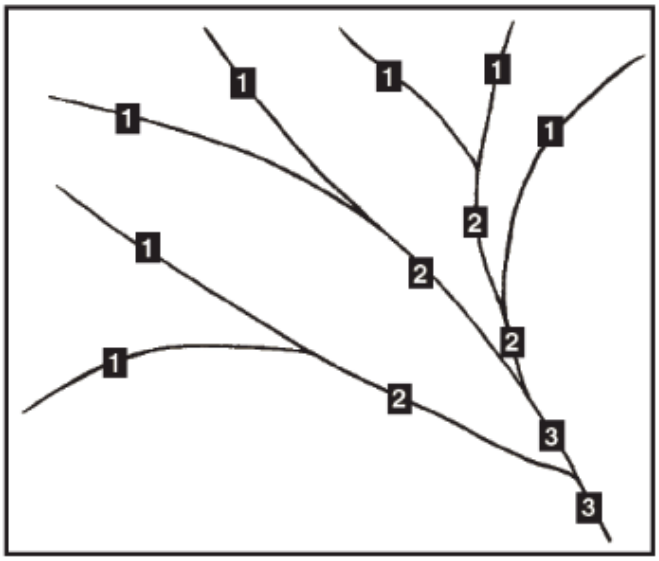

Figure 11. *Strahler stream ordering example* (NSW office of Water, 2012)

The stream orders for the project area are shown in Figure 12. The largest order is 3rd. All watercourses of the stream ordered mapped watercourses are ephemeral, reacting quickly when sufficient rainfall occurs to generate runoff and with flows ceasing rapidly upon cessation of rainfall. As a guide all the 1st and 2nd order streams are robust due to bedrock confinement, requiring few special management measures. The 3rd order watercourses transport larger flows and may require some additional management actions to minimise erosion risk.

[1] http://www.geog.soton.ac.uk/users/WheatonJ/Definitions/QD0109.htm - accessed 18 July 2017. Strahler, A. N. (1952). Dynamic basis of geomorphology. Geological Society of America Bulletin, 63, 923-938.

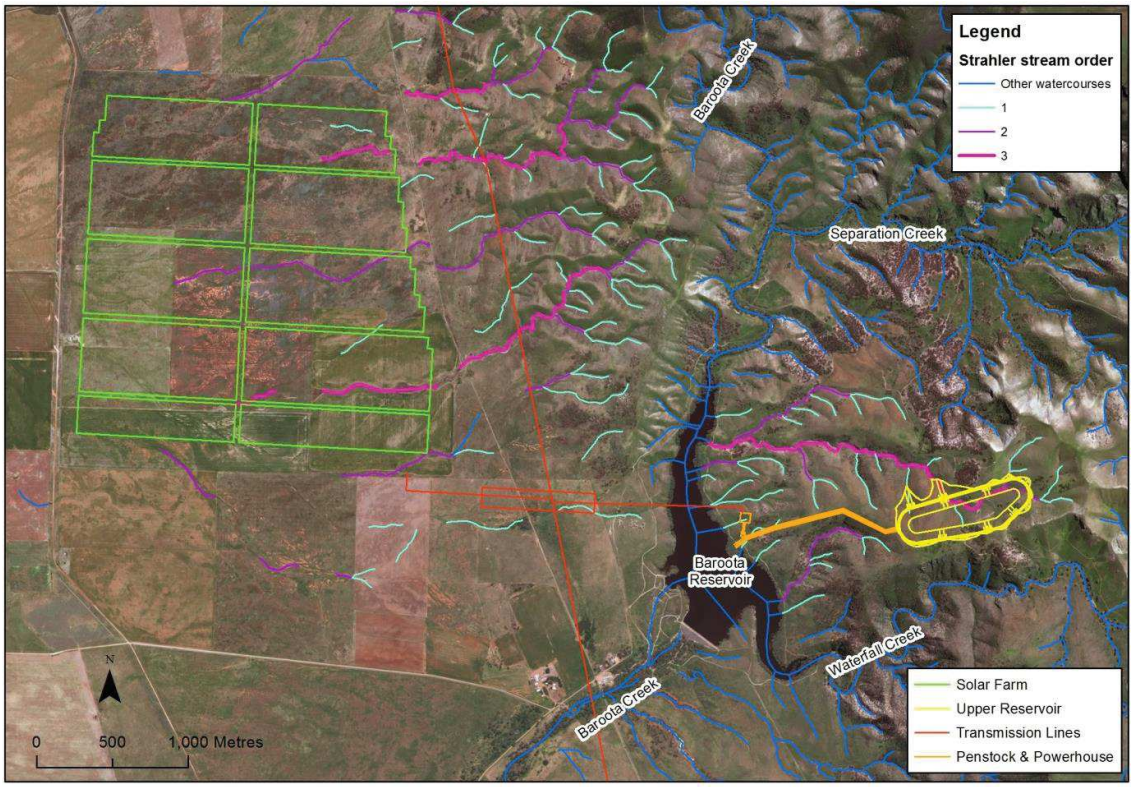

Figure 12. *Stream orders within the study area*

Geomorphic categorisation

Another useful method of categorising watercourses is by geomorphic type. This describes the physical attributes of watercourses reaches and is useful in order to understand how robust streams are that may interact with project activities. Different geomorphic types require different management approaches, particularly in regard to erosion control.

Four types of geomorphic category have been assigned to the watercourses that could interact with project components. They are shown in Figure 13 and listed in the following table together with discussion of their attributes and management considerations. Some photographic of each stream type are shown in Figure 14, Figure 15, Figure 16 and Figure 17.

Table 2. Watercourse geomorphic categories, attributes and management implications

Geomorphic category	Attributes	Management implications
Headwaters	Steep flowing upper catchment watercourses that are usually erosion resistant due to bedrock controls and small catchment areas.	Robust streams with some historical incision but limited potential for further erosion. If track crossing of these watercourses is required, then bed level crossing should be constructed.
Confined	90% or greater of these channels are confined by rock at the valley margins. They are highly robust with no potential to migrate laterally.	Very robust watercourses largely with rock bed and banks and very limited potential for erosion.
Partly confined	These watercourses are intermittently confined on at least one side of their valley margins, which limits the potential to migrate laterally.	Robust watercourses largely on rock bed and rock at the margins. Some potential for erosion.
Floodout	These watercourses have a low gradient and when flowing across the alluvial fans and plains floodout or dissipate completely to no defined channel. They are generally robust but can be susceptible to erosion if disturbed.	Some of the drainage lines inspected exhibit erosion over time with some deepening prior to the points where they floodout and dissipate. Erosion is episodic and related to large, infrequent rainfall events. Any project access tracks should avoid channelization of flows and install bed level crossings where crossing of these watercourses is required.

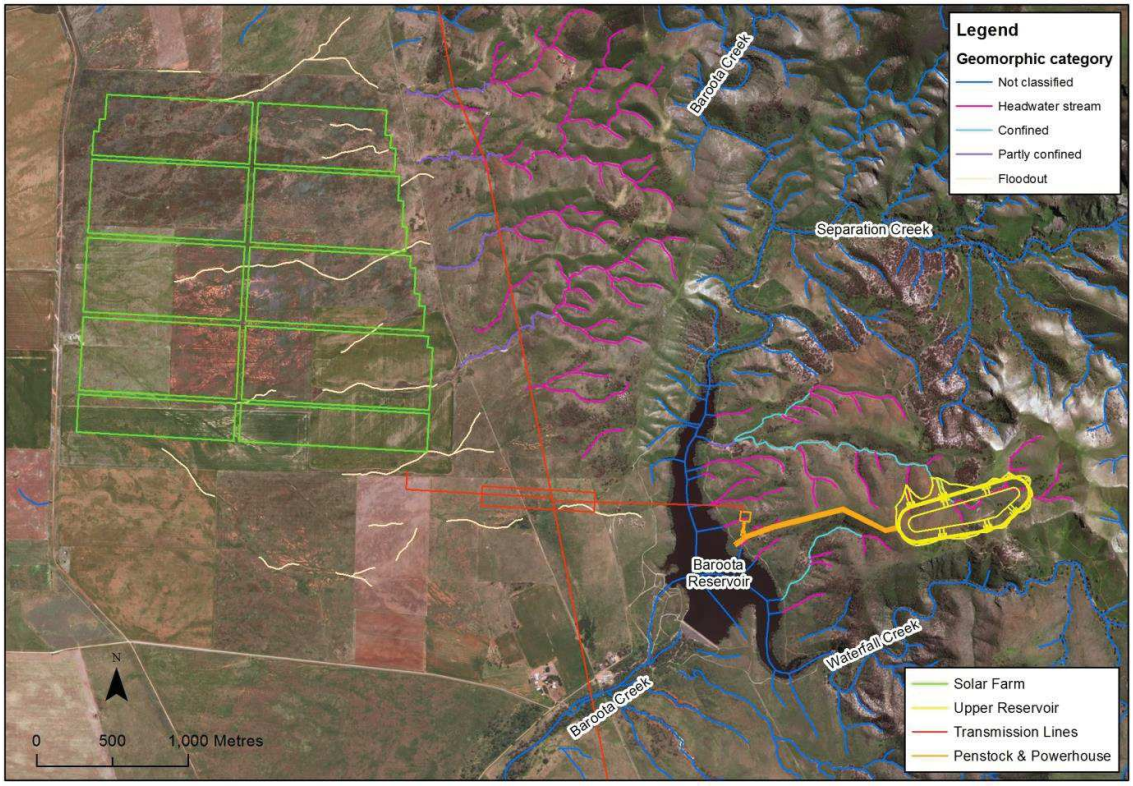

Figure 13. *Geomorphic stream types within the study area*

Figure 14. *Headwater streams in the unnamed upper reservoir catchment (photo: R Porter)*

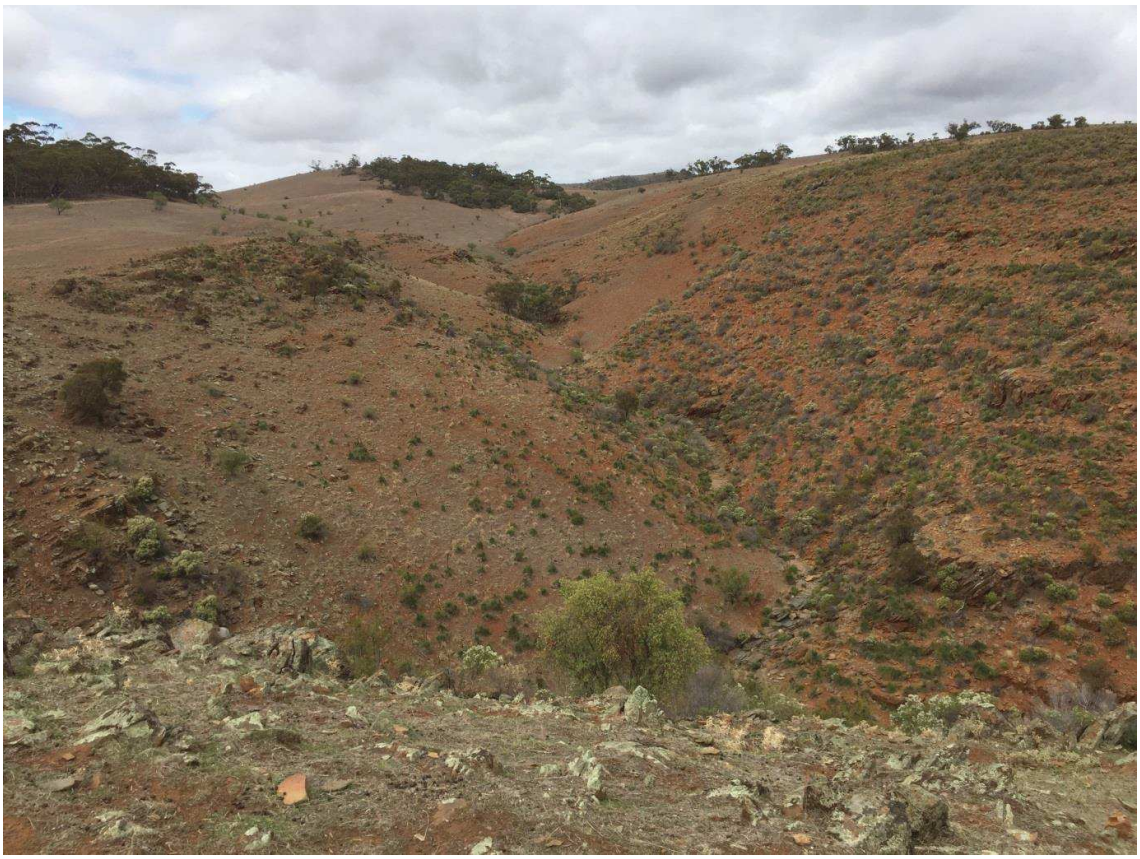

Figure 15. *Confined reach of the unnamed catchment watercourse (photo: J Carter)*

Figure 16. *Partly confined reach with some lateral movement (photo: J Carter)*

Upstream

downstream

Figure 17. *A floodout at the Solar Plant site (upstream and downstream views) (photos: J Carter)*

Summary of watercourse values
All of the watercourses that could interact with the Project are, ephemeral, ungauged, 1st to 3rd order streams. They are robust with limited erosion risk due to disturbance; have low environmental values due to lack of aquatic habitat values; and are common stream types within the region.

3.3 Soils

Soils information has been gathered from the DEWNR Soil and Land Program (undated). The two main site components (Solar Plant and PHES Project) are located on different land systems. The Solar Plant will be located on the Separation Creek Land System and the PHES Project on the Nelshaby Land System as shown in Figure 20. Details of these land systems follow.

Separation Creek Land System
This is the steep to very steep hills east of Baroota Reservoir.

Geology
The Separation Creek Land System is comprised of siltstones, sandstones, tillites and dolomites of the Willochra, Appila and Skillogalee Formations. In the higher rainfall eastern parts these rocks are freshly weathered and in the west they are commonly capped by soft windblown carbonates. There is very little alluvial deposition in the system.

Topography
Strongly dissected steep to very steep hills of the Baroota, Separation and Waterfall Creek catchments. The unnamed watercourse where the upper reservoir will be located lies between the Separation and Waterfall Creek catchments. The Separation Creek Land System also includes the steep frontal slopes of the ranges to the south of Baroota Reservoir. These slopes drain directly on to the plains to the west, where the Solar Plant will be located. Slopes vary from 20% to over 100% and there are areas of precipitous cliffs. Watercourses occupy very narrow valleys with a strongly pronounced V-shaped cross section. Rock outcrop is extensive, up to 50% in places, and surface stones are abundant.

Figure 18. *Unnamed watercourse catchment looking down towards the location of the upper reservoir (photo: R Porter)*

The Separation Creek Land System is steep to precipitous hill country. It is virtually all non-arable and mostly inaccessible to implements. Although many of the soils are moderately deep and inherently fertile, use is restricted to grazing.

Soils

Most soils are shallow over basement rock, but there are also deeper soils with red or brown clayey subsoils forming in weathering rock. The site of the upper reservoir is mapped as soil subgroup L1 – shallow soil on rock including calcareous loam on rock and gradational loam on rock. Soil subgroups and Soil Landscape Units (SLU) are illustrated in and described in Figure 21.

Nelshaby Land System

This is the gently sloping outwash fans abutting the Southern Flinders Ranges.

Geology

Gravelly and stony clays, sandy clays and less commonly clayey sands, eroded from the ranges to the east and deposited by streams in a more or less uniform apron abutting the range. The sediments are mantled by soft carbonate which has blown in from the west over time and has leached into the soil.

Topography

Alluvial plains and fans occurring as a band up to 5 km wide along the western side of the Southern Flinders Ranges. Slopes range from 12% near the ranges to 1% on the flatter western side. There are isolated bands of short steeper slopes to 20% abutting the ranges. The slopes are traversed by watercourses most of which originate on the frontal escarpment and are closely spaced (about 500 m apart). Several larger streams from further east in the ranges also cross the Nelshaby land system including Baroota Creek. Watercourses are eroded in places, particularly on the steeper slopes adjacent to the ranges. Where the watercourses cross the flatter land they often “floodout”, losing their defined channel.

The land surface is characterized by a variable cover of quartzite stones, usually less than 20 cm across. These tend to be more concentrated (up to 20% cover), nearer the ranges.

Figure 19. *Alluvial plain and fans looking from the location of the Solar Plant towards the ranges (photo: J Carter)*

Soils

Most soils are deep loamy texture contrast or gradational types with red clayey subsoils. There are limited calcareous loams and minor stony sandy loams. Soil subgroups and Soil Landscape Units (SLU) are illustrated in and described in Figure 21. The Nelshaby Land System is characterized by broad gently inclined outwash fans with deep, inherently fertile but often poorly structured soils. Hard setting surfaces are very common, causing excessive runoff and associated erosion, sub optimal workability and patchy emergence. Waterholding capacity is also reduced. Very stony (quartzite) soils are also a feature of the land. Heavy stone reduces waterholding capacity and abrades implements.

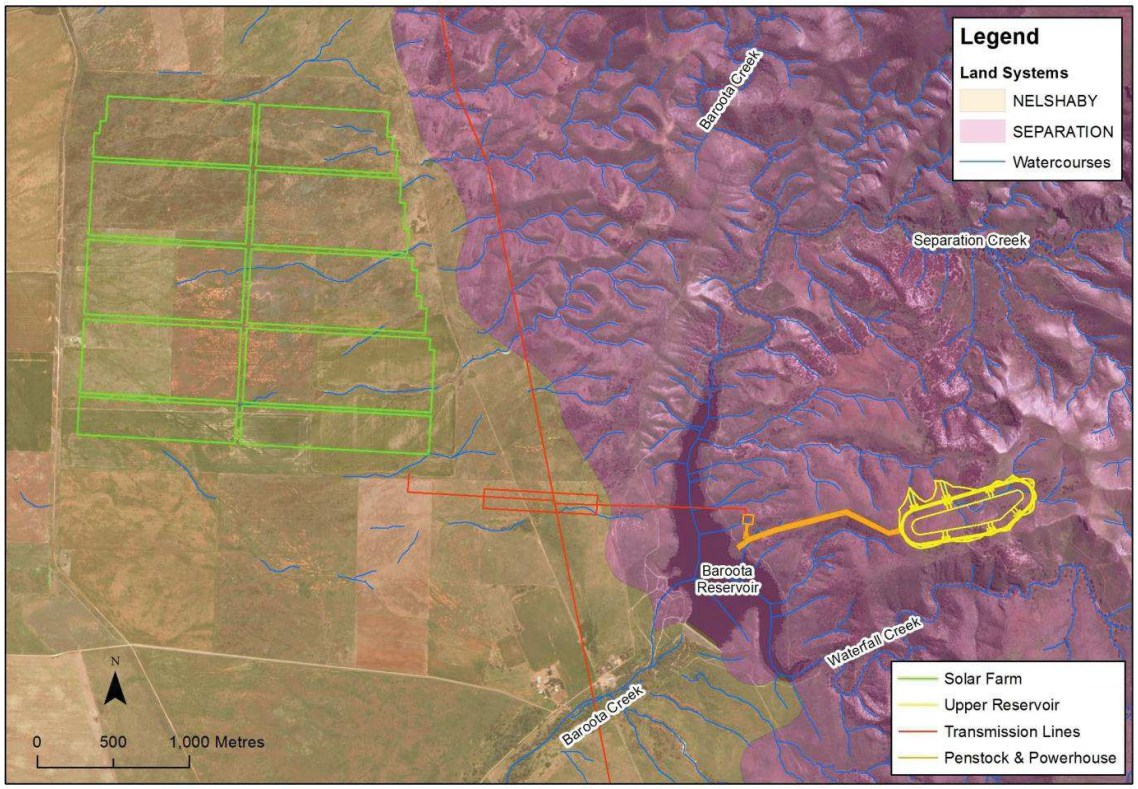

Figure 20. *Land systems within the study area*

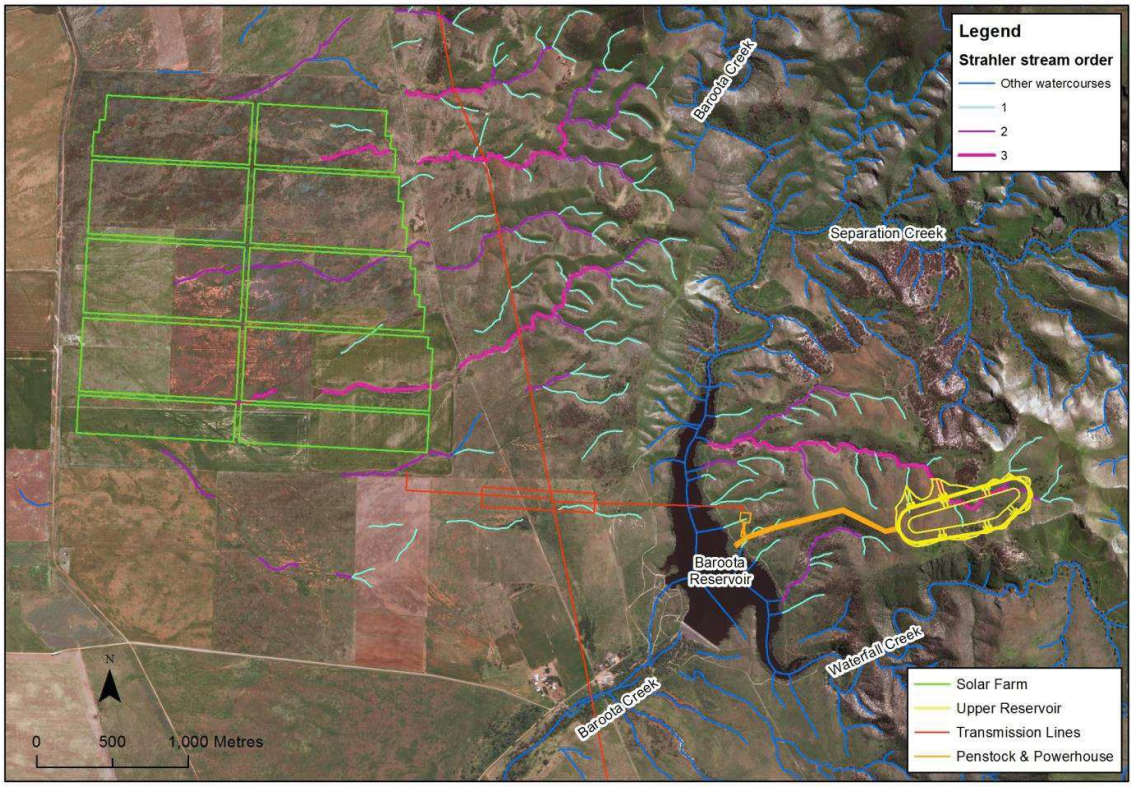

Figure 21. *Soil Landscape Units within the study area*

The following table describes the attributes of the SLUs.

Table 3. Attributes of the Soil Landscape Units

SLU	Main features
Separation Creek Land System	
SEPAAE SEPAAF	**AAE** - Steep hillslopes of 30-60% with relief to 150 m. There is 10-20% rock outcrop and 20-50% surface stone. **AAF** - Very steep slopes of more than 60% and relief to 450 m. There is 10-20% rock outcrop and 20-50% surface stone. Main soils: shallow stony loam - **L1b** (E) and shallow stony loam over calcareous rock - **L1a** (E) with shallow calcareous loam - **A2** (L) and gradational loam - **C2** (L). These hills are non arable and largely inaccessible with some extremely steep and rocky slopes. Soils are generally very shallow with very limited water holding capacity. There is a high to severe erosion potential.
SEPAGE	Steep rocky hills with slopes of 30-100% and relief of 100 m to 200 m, formed on fine grained rocks. There is 5-10% rocky outcrop and 20% or more surface siltstone and quartzite fragments. There are sporadic landslips. Main soils: shallow stony loam - **L1b** (E) and loam over red clay - **K2** (E), with sandy loam over brown clay - **K4** (L) and shallow calcareous loam - **A2** (L). This land is too steep for cropping but has high pasture production potential with inherently fertile, moderately deep soils, although accessibility is limited on the steeper slopes.
SEPAYC	Rolling low hills with slopes of 20-40% and relief to 80 m. There is extensive rock outcrop and surface stone. Main soils: shallow calcareous loam - **A2** (V) and shallow stony loam over calcareous rock - **L1a** (E). The hills are mostly steep and rocky with shallow stony calcareous soils and occur in the lowest rainfall part of the Land System. Use is restricted to rough grazing.
SEP-R	Reservoir.
Nelshaby Land System	
NELEPC	Undulating rises with slopes of 5-10% and relief to 20 m formed on calcareous rocks. Main soil: shallow calcareous loam - **A2** (D). The shallowness of the soil is the main limitation on this land; fertility problems caused by high carbonate contents, and erosion potential are less significant.
NELJFK NELJFU NELJFV NELJFW	**JFK -** Level to very gently inclined plains with slopes of 1-2% and occasional low sandy rises. There is up to 10% surface quartzite stone. Subsoil salinity is moderate to high. **JFU -** Level to very gently inclined plains with slopes of 1-2%. There is 5-10% scalding, particularly adjacent to weakly defined watercourses. There is up to 10% surface quartzite stone. **JFV -** Very gentle slopes of 2-4% and 5-10% scalding particularly adjacent to weakly defined watercourses. There is up to 10% surface quartzite stone. **JFW -** Gently inclined slopes of 4-12% crossed by well defined, generally stable watercourses. 5-10% of the land is scalded. There is 10-20% surface quartzite stone.
NELXGS	Drainage depressions comprising watercourses and adjacent flood out flats formed on coarse textured sediments with extensive boulder beds – surface quartzite rocks are common. Main soils: stony alluvial sandy loam - **M3** (E) and deep sandy loam - **M1** (C), with gradational loam - **C3** (L) and gradational sandy loam - **M4** (L). The land has variable potential as some of the stonier areas are non-arable, while other areas have moderately deep, fertile soils with good cropping potential. However, the fragility of the watercourses combined with the potential for flooding and erosion restrict land use options on this land.

4 Surface water – Quantity and Quality Impacts

To examine the impact of the pumped hydropower storage on the existing water infrastructure within the Baroota Prescribed Water Resource Area (PWRA), an analysis was undertaken of the water fluxes in the Baroota Reservoir as they currently exist and with the addition of the hydropower storage. The changes in runoff within the Solar Plant have also been considered.

4.1 Water balance

Baroota Reservoir and Hydropower Storage
The existing Baroota Reservoir was used as a balancing storage for the River Murray pipeline up until 1997. Since that time it has not been in active use and exists as an emergency storage only (DEWNR 2014). Downstream, most rural users access groundwater supplies and there are a myriad of farm dams that are also available for stock and domestic supply. Given the importance of groundwater systems in the PWRA, and that there is existing evidence of groundwater infiltration and expression in the vicinity of the storage (DEWNR 2017), changes to the hydrology of the catchment may have an impact on downstream users.

As part of this study, a water balance model was developed to examine the changes in Baroota Reservoir as a result of the operation of the proposed hydropower storage. This storage lies within the existing Baroota Reservoir catchment and will be operated on a pump/drawdown cycle as part of the nearby Solar Plant energy storage.

The result of this infrastructure is therefore expected to be confined to changes in the areas available for evaporation of stored water. Ultimately, the pumped hydropower reservoir will only be able to operate with water stored within Baroota Reservoir. The additional storage volume available from the hydropower dam is there only on a temporary basis, it will fill and drain frequently and therefore the need to retain "headspace" in the storage will mean that the total new storage actually available will only be that currently provided by Baroota Reservoir.

Given that the pumped hydro storage will be filled during daytime periods when the Solar Plant is producing electricity, there will be additional surface area available for evaporation, albeit offset by partial drawdown of Baroota Reservoir.

To establish the model, data from the Bureau of Meteorology site A5080500 Baroota Creek at Baroota Reservoir was used for rainfall inputs, with evaporation taken from site 200912 Snowtown Rayville Park as indicative of evaporation at Baroota Reservoir. As noted in previous reports (DEWNR 2014), there is a lack of stream gauging and other hydrologic data for the storage, so values for the model parameters such as runoff coefficients, infiltration and recharge were taken from literature or based on previous values.

The model was established over the time period 2009-2017 as this was the only period where there was daily rainfall and evaporation data available with which to run the model. The model simulates catchment runoff, evaporation, direct rainfall, groundwater infiltration and groundwater recharge for a reservoir of known surface area and depth/volume. For each day, the inflows and losses are summed and a daily change in storage calculated. From this, estimates of changes in storage volume, spills and losses can be assessed over the climatic period used. To calibrate the model, adjustments to infiltration rates, runoff coefficients and recharge were made until a stable reservoir volume was obtained (not continuously filling or draining), consistent with observations in recent hydrologic studies (DEWNR 2014).

Results from running the model with the current configuration of Baroota Reservoir, and in the future case with the hydropower storage are shown below.

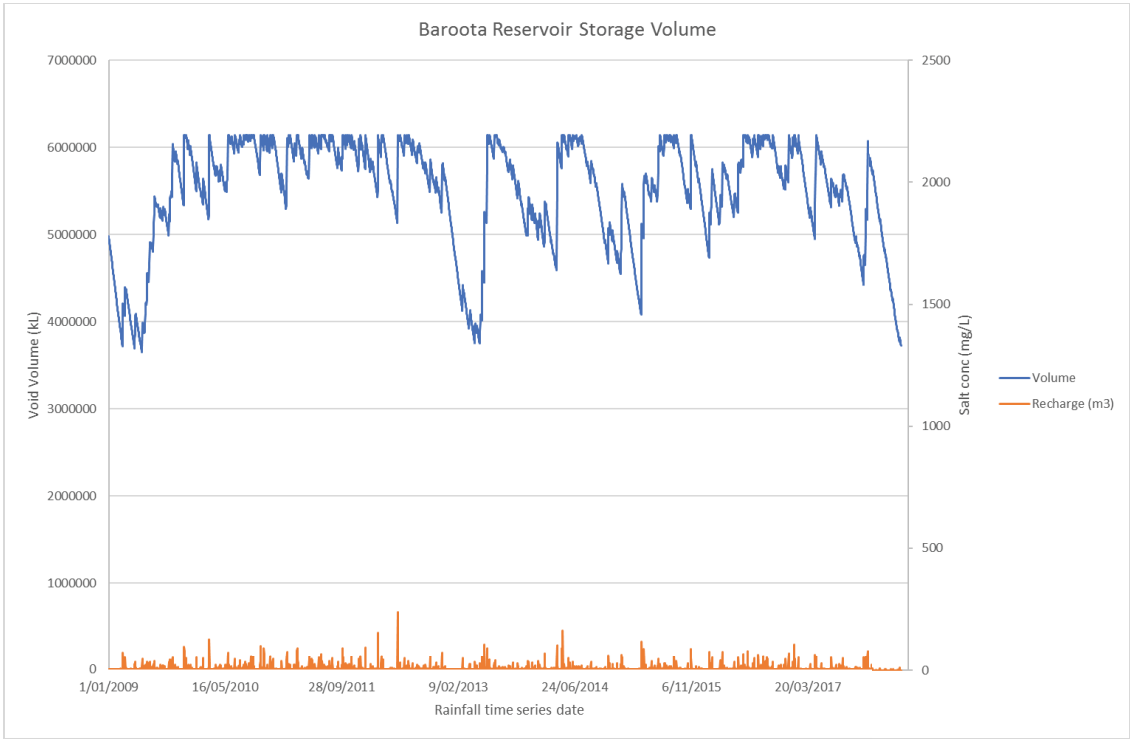

Figure 22. *Simulation of existing Baroota Reservoir*

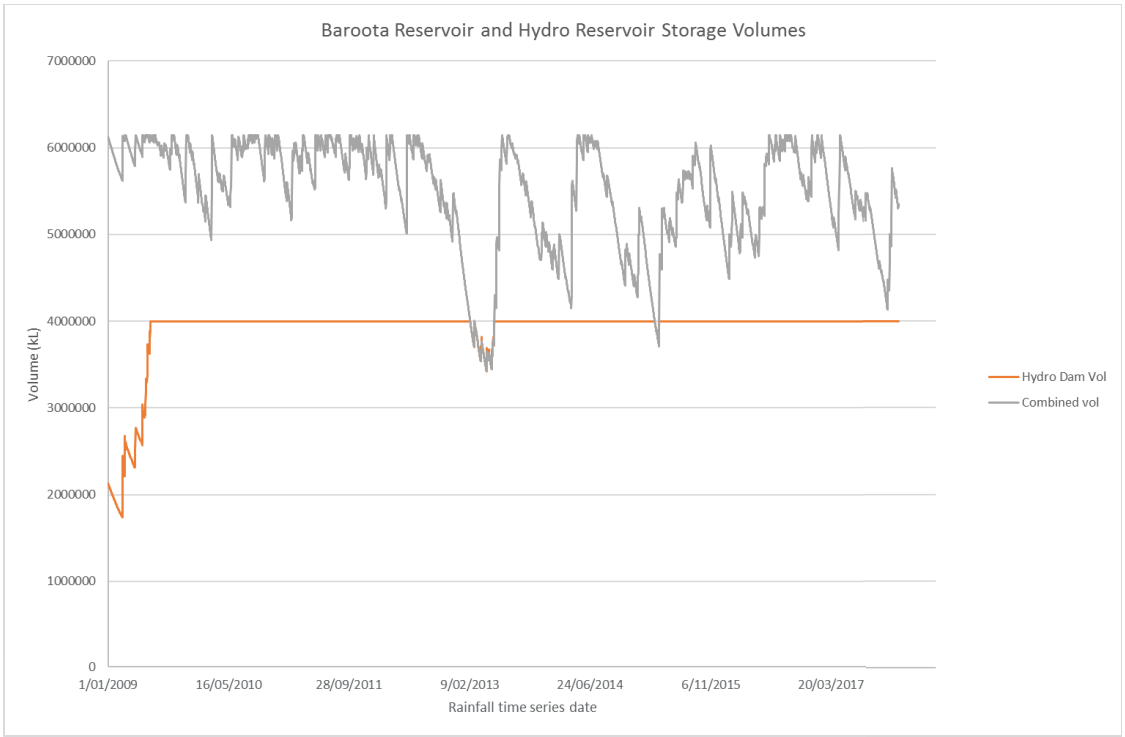

Figure 23. *Simulation of future combined operations*

In the above charts, it can be seen that currently, without any significant extractions, Baroota Reservoir is likely to overtop occasionally but can also draw down considerably in dry conditions. The period of modelling is representative of wetter conditions across the catchment, so it would be expected that the reservoir will occasionally spill and the results of the existing case showed agreement with previous observations (note that no current observed data was available that covered the time periods used in this analysis).

When the hydropower storage is then simulated, the combined storage volume (Baroota Reservoir plus the pumped hydropower storage), follows similar patterns to the existing reservoir, but it also shows that increasing the area available for evaporation results in the overall combined volume being lower than Baroota Reservoir in isolation. This is to be expected, as a greater surface area of evaporation would be available, in addition to a similar increase in the area of water available to infiltrate out of the combined storages.

To represent this, conceptual diagrams of the existing and future water balances are shown below. These have been determined by running the model over the same climatic period (1/1/2009 – 31/12/2017).

What the two previous figures show is that the future increases in evaporation and infiltration loss, while slightly offset by increased direct rainfall on the dams and increased potential recharge, results in a lower surplus of water.

These results are highly dependent on the amount of water volume being exchanged between the pumped hydropower storage and Baroota Reservoir. For the simulations above, the exchange volume has been assumed as 4000 ML per day.

Currently, there is also a reasonable level of groundwater flow near the base of the Baroota Dam Wall, and this is largely expected to be as a result of the infiltration out of the existing reservoir. In calibrating the model, stable reservoir volumes were only able to be achieved with relatively high infiltration rates, indicating that there are likely to be significant losses already from the storage through this pathway. In the future case, this is not expected to change to any great degree, in fact the overall infiltration rate increases due to the increase in surface area of the combined dams, though there may be reductions at Baroota Reservoir if lower storage volumes result from the increased evaporation. Given the current infiltration losses though, any reductions would not be expected to be significant. I

Solar Plant

While no modelling has been conducted of the hydrology of the Solar Plant area, examination of the rainfall, infiltration rates and changes in perviousness were reviewed from the proposed drawings. The introduction of solar panels will result in increased imperviousness from the panels themselves and any access roads and buildings, however it is anticipated that the ground below the panels will remain as exposed soils. Therefore, any additional runoff created from increased imperviousness of the panels themselves would still run off onto the existing ground and infiltrate. The net change in runoff and infiltration is expected to be very minor for the Solar Plant area.

4.2 Water quality

PHES Project

Existing water quality in Baroota Reservoir is indicative of storages in the temperate regions of Australia, with low turbidity values, low concentrations of nutrients, but presence of cyanobacteria and phytoplankton. What is of interest is the relatively high levels of salinity for a water storage, with conductivities in the order of 1,000mg/L. This would indicate that the storage is nearing the limit of usability for irrigation due to high salt content impacting on sodium absorption ratios of irrigated soils.

Water quality impacts from the changes in reservoir operation with the inclusion of the pumped hydropower storage are expected to be confined to changes in temperature and possibly turbidity due to turbulence from the major water exchange. It may be that changes in the average depth of both storages due to distributing water across them may result in slight increases in temperature if the depths are shallower, but given both storages are relatively deep, the reductions in depth are not anticipated to result in significant shallow areas for heating. Given the existing presence of cyanobacteria and phytoplankton in Baroota Reservoir, these would also be expected in the pumped hydropower storage. An advantage of the large volumes of water that are expected to be transferred between the existing reservoir and future storage is that this may result in much better mixing of both storages, therefore limiting the potential for strong thermoclines to establish and anoxic conditions developing within both reservoirs. The existing condition of sediments within Baroota Reservoir is unknown but given that the exchange volume will be greater than 50% of the total volume of the existing reservoir, there will be some disturbance of those sediments. It would therefore be recommended that analysis of the sediments be conducted prior to operations commencing, as there may be liberation of sulphides if the sediments are anoxic, and release of porewaters which may contain higher concentrations of bioavailable nutrients. If the sediments are anoxic, the increase in oxygen demand as a result of their disturbance may cause a significant decrease in dissolved oxygen concentrations within Baroota Reservoir for short periods initially, and dependent on the amount of aquatic fauna in the reservoir, this may result in significant impacts. A second recommendation would be that the system be worked up gradually to maximum exchange volumes, to limit disturbance of sediments or at least allow them to slowly move with the new water exchange regime.

Solar Plant Project

For the Solar Plant, again, the water quality impacts are likely to be minimal as the existing site has very low vegetative ground cover and low rainfall. Increased imperviousness from the solar panels would result in some runoff occurring immaediately at the base of the panels, however based on the existing soil conditions, this is unlikely to produce concentrated runoff and therefore not liberate sediments through erosion, except in extreme events where this would be occurring across the catchment anyway.

Other project components

Potential water quality impacts could occur during the construction phase or decommissioning phase if works were to occur during a significant runoff event. Disturbed areas such as access roads and storage areas could also be sources of soil erosion if not maintained adequately during the operational phase. If the construction sites and access roads are well managed with appropriate drainage and erosion controls, these impacts could be minimised or avoided. This is discussed further in Section 6.

Project components with the potential to impact water quality are described in Table 4.

Table 4. Project components with the potential to impact water quality

Component	Potential water quality impact pathway
Civil / earthworks for the upper reservoir (saddle dams) and concrete intake / headrace infrastructure	Soil disturbance during construction and decommissioning. Soil erosion during operation if not treated appropriately.
Civil / earthworks for the lower reservoir intake / tailrace infrastructure	Soil disturbance during construction and decommissioning. Soil erosion during operation if not treated appropriately.

Civil / earthworks including internal access roads and security fencing	Soil disturbance during construction and decommissioning. Soil erosion during operation if not maintained appropriately.
Civil / earthworks for the powerhouse, switchyard and combined substation	Soil disturbance during construction and decommissioning. Soil erosion during operation if not treated appropriately.
Civil / earthworks for penstock	Soil disturbance during construction and decommissioning. Soil erosion during operation if filled trenched surface is not treated appropriately.
Operational facilities including a site office, maintenance building with on-site sewage management system, parking area, material laydown area, undercover storage area and waste storage area	Soil disturbance during construction and decommissioning. Soil erosion during operation if not maintained appropriately. On-site sewage treatment disposal. Material and chemical storage.
Substation (combined with Solar Project) with 275kV step-up transformers and control room	Soil disturbance during construction and decommissioning.
Connection into the existing Bungama to Davenport 275 kV line running to the west of the lower reservoir	Soil disturbance at tower sites and access road during construction and decommissioning.

Cumulative impacts

There are no other projects under development in the catchments where the PHES project and Solar Project are located, therefore there will be no cumulative impacts.

5 Groundwater – Quantity and Quality Impacts

The potential for groundwater interaction with the project is limited but some project components do require consideration.

Upper reservoir
JBS&G (2018) have identified that "based on the nature of the rock formation (to be confirmed during geotechnical investigations), it considered unlikely that the upper reservoir will require an engineered synthetic liner to prevent losses to groundwater following commissioning. If determined that the permeability of the local geology is not sufficient during detailed design, a high-density polyethylene (HDPE) liner (or suitable equivalent) will be installed where appropriate. The top of the embankment will be approximately 350 m AHD with an average operating water level at 340 m AHD, equating to a nominal operating head between the upper and lower reservoir of 242 m" If there is loss from the upper reservoir to groundwater it could potentially reduce salinity, which may be a beneficial effect for users if the zone of influence extends to extraction points.

Powerhouse shaft
The powerhouse shaft and building will be located on the central eastern edge of the lower reservoir, connected to the upper reservoir by the penstock, and to the lower reservoir by the tailrace pipe. The powerhouse building will be a concreted building approximately 60 x 60 m, with an approximately 30-40 m radius shaft, excavated to approximately 60 m below ground level. As required, a perimeter dewatering system will be installed to reduce hydrostatic pressure from regional groundwater on the powerhouse shaft (JBS&G, 2018).

To drill the powerhouse shaft, it will be necessary to dewater the drill hole temporarily. Some groundwater drawdown can be expected associated with dewatering for the powerhouse shaft. The drawdown is expected to be short-term subject to details of the perimeter dewatering system, which were not known at the time of preparing this report: further consideration of potential impacts to groundwater flow will be undertaken at the detailed design stage, following geotechnical investigations, which will inform assessment of potential groundwater impacts.

Switchyard
An air insulated switchyard will be constructed to the north of the powerhouse, connecting the powerhouse to the substation. A small footprint with no expected impacts to groundwater.

Penstock
JBS&G (2018) have identified that "Water will be conveyed between the upper and lower reservoir, by approximately 1,200 m of above-ground, and as required, tunnelled, pipe. The preference is for all conveyance piping to be shallow buried, rather than installed within conventional tunnels. The requirement for tunnelling will be determined during detailed design.

Water will be conveyed from the upper reservoir via the concrete intake structure, via a short headrace pipe (approximately 10 m), which connects directly to the penstock.

The penstock trench (and tunnel, as required) will be shotcrete lined, and up to 6-8 m in diameter (to be confirmed during final design). The penstock will consist of a single 5-6 m diameter steel and concrete lined pipe, with limited turns to reduce friction losses. The pipe will be shallow buried, with a maximum depth of approximately 20 m. The penstock will connect directly to the powerhouse through concrete bifurcated pipes, connected to the internal conveyance pipes within the powerhouse, and ultimately, to each of the turbine pumps.

The powerhouse is connected to the lower reservoir via a 100 m tailrace pipe, approximately 5 m in diameter. The tailrace pipes will be concreted into an intake structure, complete with trash racks and sediment socks."

Interaction with groundwater is expected to be limited. It is possible that shallow groundwater could be encountered in some sections and dewatering of the trench to complete construction may be required. Upon completion of construction, which will include backfilling of the trench and rehabilitation of the surface, no further interaction should be expected with the possible exception of ingress of shallow groundwater into the filled trench, which may require management. However, further consideration will be undertaken at the detailed design stage and following geotechnical investigations, which will provide a more informed basis for assessment

Lower Reservoir water level
The alteration of the levels of the Lower Reservoir due to pumping to the upper reservoir could potentially result in the groundwater gradient with the Lower reservoir being altered. Groundwater could therefore be impacted to some extent but with the level of exchange between the Upper Reservoir and the existing Lower Reservoir, such impacts would need to be confirmed with further investigation. The downstream users of the groundwater resource lie some distance away from the reservoir itself, and given it is likely that the groundwater table in the mountainous area around the existing reservoir is elevated, the fluxes between the reservoir and the existing groundwater system are likely to be greater (i.e. there will be more variability), but the overall impact on downstream users may not be as significant (the average will remain relatively similar).

Lower Reservoir intake structure
An intake structure will be constructed on the eastern central portion of the lower reservoir, connecting the tailrace pipes and the powerhouse (described further below). The tailrace will be installed on the base of the lower reservoir, with an installed depth below the average nominal water level (final depth to be determined during detailed design). The tailrace will be installed with a combined filter sock and trash rack to prevent the ingress of sediment and gross pollutants, if present, from entering the powerhouse. The intake structure will consist of a concrete headwall, installed into the existing walls of the reservoir (JBS&G, 2018). No impacts to groundwater are expected but will be considered when undertaking the detailed design.

Other PHES Project components
In terms of potential impacts to groundwater the other PHES Project components are considered not to have the potential to impact groundwater due to their surface configuration and limited footprint. This includes transmission lines, underground cabling (which may not be included in the final design), telecommunications and power, access roads, perimeter fencing and material laydown areas.

Wastewater generated during construction will be captured in septic tanks / portable water closets and removed from site by a licensed waste contractor. Operational wastewater management may utilise a small sewage treatment system, or alternatively it may also use septic tanks with removal by a licensed waste contractor. The sewage treatment system would be designed with a peak capacity adequate for the expected number of staff and visitors at the site (JBS&G, 2018).

Solar Project
The six land parcels that make up the PV solar site have a total area of approximately 636 ha. The substation and other associated infrastructure will be located on two land parcels south of the solar panel area, which have a total area of approximately 230 ha. There will be additional infrastructure including:

- Operational facilities including a site office, maintenance building, ablution block with on-site sewage treatment system, parking area, material laydown area, undercover storage area, waste storage area;
- Underground cabling and electrical connections between solar arrays, panel inverters and the 33 kV substation;
- 275/33 kV substation interconnection, associated switchgear and control room;
- Internal access tracks between solar arrays to provide access for construction, maintenance and inspection services.

Whilst there will be an increase in impervious area, the solar panels will be installed off the ground, and infiltration will still be high in the alluvial soils and no increase in runoff from the property or reduction in infiltration is expected. Therefore no impacts to groundwater are expected from the Solar Project.

6 Mitigation measures to minimise impacts to water quantity and quality

Management measures will be fully documented at the detailed design stage. As a general guide a number of design and construction principles will be applied to minimise risk to impacts upon water quality.

PHES Project

Upper Reservoir
Construction phase erosion, sediment and drainage controls established and works avoided during wetter periods. Given that the storage will be acting as a sediment basin regardless, it may be appropriate to use the storage as a temporary sediment basin during the construction and decommissioning phases and then discharge to land or use flocculation agents to settle it prior to commissioning and decommissioning as a hydropower storage.

Soil material will be generated as a result of the excavation works at the upper reservoir. Surplus soil will be used to contour the dam wall face and associated saddle dam embankments. Surplus soil material will be used to contour surrounding valleys, minimising trucking offsite. The surplus soil will be sprayed with a vegetation cover immediately following placement, and will be placed in a manner that minimises potential erosion and sedimentation (JBS&G, 2018).

During construction and into the operational phase the overflow form the reservoir will be managed with a culvert type outlet, which will be integrated into the downstream natural channel with appropriate erosion control.

Further details will be documented once details of the final infrastructure are available.

Lower Reservoir
The Lower Reservoir works have a small footprint with limited disturbance. Standard industry practice erosion and sediment control measures will be applied during constriction works.

Transmission powerlines
Designed to avoid placement of infrastructure within drainage lines.

Penstock (Water conveyance pipeline)
The penstock will be mostly trenched and will require appropriate rehabilitation of the backfilled trench using standard industry practice stabilisation measures to manage erosion during construction and operation. One minor watercourse may be crossed depending upon detailed design. If a watercourse is to be crossed the pipeline will be buried below any mobile bed material into rock to avoid risk of scour damage and to maintain geomorphic processes.

Powerhouse and switchyard
Detailed design to avoid placement of infrastructure within drainage lines and above 1 in 100 year ARI flood level or provision of flood protection to at least 1 in 100 year ARI flood level. The building will also include office space and site amenities for workers during operation. Rainwater from the building will either be captured for re-use in site amenities, or directed straight into the reservoir. Disturbance during construction will be managed with standard industry practice erosion and sediment control measures.

Tracks and track crossings
Design will include, where relevant, the Guide to Road Design (Austroads, 2015).

Solar Project
Construction phase erosion, sediment and drainage controls established and works avoided during wetter periods. Given the flatness of the terrain and existing low cover on the proposed site, drainage controls that divert water around the construction area would be recommended, with sediment basin/s to collect any fugitive runoff.

During the operation phase, ensure that any runoff from solar panels is able to infiltrate into soils around and below the panels themselves to avoid concentrating any runoff.

Substation, transmission lines, underground cabling, communications, power and other operational facilities will be managed with standard industry practice erosion and sediment control measures.

Further details will be included once details of the final infrastructure are available.

Potential erosion and sediment impacts
All project components will be designed and constructed in accordance with the Code of Practice for the Building and Construction Industry, (Environment Protection Agency Government of South Australia, 1999), a Soil Erosion and Drainage Management Plan (SEDMP) will be prepared for the construction phase of the Project to specify erosion and sediment management controls. The SEDMP will include soil and erosion control best practice as detailed in the IECA (2008) guidelines "Best Practice Erosion and Sediment Control".

Wastewater
Wastewater generated during construction will be captured in septic tanks / portable water closets and removed from site by a licensed waste contractor. Operational wastewater management may utilise a small sewage treatment system, or alternatively it may also use septic tanks with removal by a licensed waste contractor. The sewage treatment system would be designed with a peak capacity adequate for the expected number of staff and visitors at the site (JBS&G, 2018).

Water Affecting Activity Permits

Where an activity diverts water or alters flows from a natural watercourse within a region or potentially impacts on the landscape in a way that threatens the health, a Water Affecting Activity Permit (WAAP) is required under the NRM Act (2004).

Activities likely to require a WAAP include excavation of the upper reservoir and watercourse crossings (tracks or pipeline). The drainage infrastructure and any other water affecting activities proposed will be reviewed during detailed design and Natural Resources Northern and Yorke (the relevant NRM Board) consulted regarding any activities that will required a permit.

Particular consideration of potential impacts (if any) to groundwater recharge will be required as part of the detailed design to ensure that that any relevant requirements of the Baroota WAP are met.

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Appendix C Ecology Assessment

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Flora and Fauna Evaluation:
Baroota Pumped Hydro and Solar Project



April 2018

T&M Ecologists

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Certain assumptions have been made in the preparation of this report. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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1. Contents

Executive Summary

This report details the flora and fauna within the area that may be impacted by the Baroota Pumped Hydro and Solar Project. Two areas were assessed, the area that may be impacted by the solar farm and substation on flattish land to the west of the existing SA Water Baroota Reservoir (Solar Farm block), and the area that may be impacted by the hydro development on generally steep slopes to the east of the SA Water Baroota Reservoir (Hydro Block).

The native vegetation in the Solar Farm block is generally quite degraded. There are some sections that have been recently ploughed and have no remnant vegetation. Areas where native vegetation remain are predominantly chenopod shrublands. These shrublands have been exposed to long-term grazing, and have been substantially modified by this impact.

Two bird species of State Conservation significance, the state Rare Elegant Parrot (*Neophema elegans*) and the state Vulnerable Blue-winged Parrot (*Neophema chrysostoma*), may occasionally utilise these open shrubland areas for feeding. The Solar Farm block is considered unlikely to provide **critical** habitat for any fauna species of state or national conservation significance. One plant species of conservation significance, Rohrlach's Bluebush (*Maireana rohrlachii*), was present in the Solar Farm area. This species is a dominant overstorey component in the south-east corner of the block, in an area that may be impacted by construction of a substation, and is also present as scattered plants in other vegetation types in the Solar Farm area.

The native vegetation in the Hydro Block encompasses a diversity of vegetation types in a variety of different conditions. The whole area is exposed to sheep grazing, but steep, rocky sections in the central and western parts of this block still retain a dense native shrub layer, with emergent trees in some locations. These areas (Habitat Types 5 and 6) also contained three plants rated as Rare at a state level, and were considered the most likely areas to contain other plant species of conservation significance. The remainder of the Hydro Block was considered to be in generally poor condition overall.

With regard to fauna in the area that may be impacted by the Hydro development, the thin band of Red Gum (*Eucalyptus camaldulensis*) woodland around the reservoir may provide habitat for the state Rare Common Brushtail Possum (*Trichosurus vulpecula*). The open water and fringing habitats of the reservoir area also provide habitat for a number of waterbirds of state or national significance. Some of the mallee areas contain trees with hollows that are likely to provide nesting resources and shelter for bats and birds. Overall the Hydro block is considered unlikely to provide **critical** habitat for any fauna species of state or national conservation significance.

In addition to the project receiving development approval under the *Development Act 1993*, it will also require approval to clear native vegetation on the site under *Regulation 12(34) – Infrastructure* of the *Native Vegetation Act 1991*. This Regulation allows for clearance of vegetation incidental to the construction or expansion of a building or infrastructure (and associated services) where the Minister has declared that the clearance is in the public interest. Data collected for this assessment report will be used to prepare an application for clearance under this Regulation.

1. Introduction

The following document details the flora, fauna and habitats that occur within the vicinity of a proposed Baroota Pumped Hydro and Solar Project near the SA Water Baroota Reservoir, in the Southern Flinders Ranges of South Australia. The project involves two key components – a Hydro component that will require construction of a dam and associated pipework to the east of the SA Water Baroota Reservoir, and a solar farm that is proposed for west of the SA Water Baroota Reservoir. Expected impacts include clearance and shading associated with the Solar farm, and clearance associated with dam wall construction and the flooded area in the hydro part of the project.

This report also provides an assessment of the proposed clearance area with reference to listed threatened species and ecological communities, and migratory species protected under international agreements under the Environment Protection and Biodiversity Conservation Act 1999.

2. Study Area

The study area is located in the vicinity of Baroota Reservoir Reserve, approximately 12-13km north-east of Port Germein in the Southern Flinders Ranges region of South Australia (Figure 1). It includes two separate 'blocks':

- the 'Hydro Block' is located on hills and ranges immediately to the east of Baroota Reservoir Reserve.
- The 'Solar Farm Block' is situated on flatter country to the west of Baroota Reservoir Reserve.

The following Sections may be impacted by the development:

Hydro Block: Hundred of Baroota Section 263 (principally), and Section 201 (small area only adjacent Baroota Reservoir)

Solar Farm Block: Hundred of Baroota Sections 37W, 38, 54N, 54S, 89, 106 in their entirety, and parts (depending on final design) of Section 88, D38564 A297 and F170763 A91

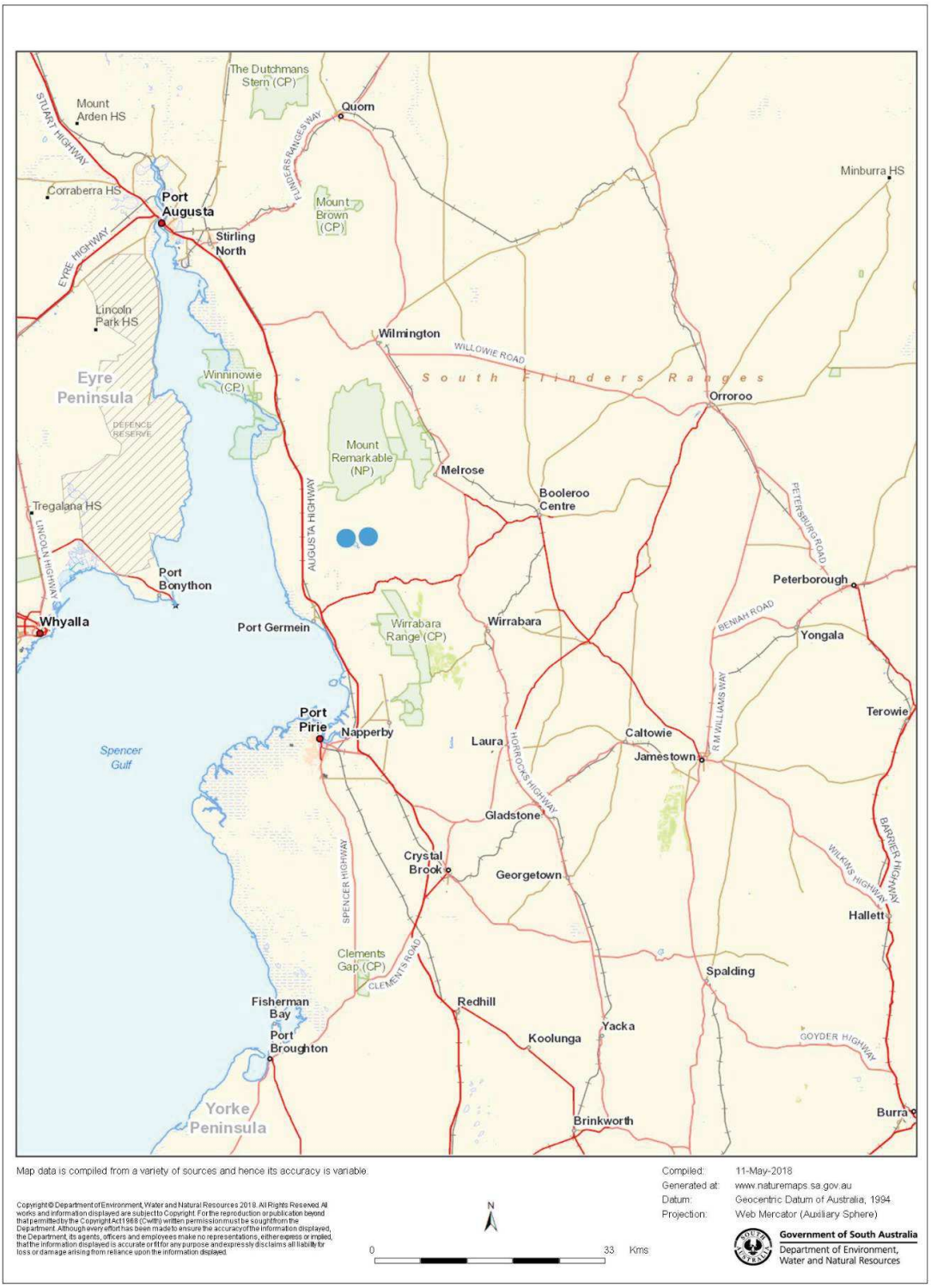


FIGURE 1: LOCATION OF THE PROPOSED SOLAR AND HYDRO PROJECT (The proposed Solar Farm is indicated by the left blue dot, the Hydro area is to the right).

3. Methodology

3.1 Literature Review

A desktop review was undertaken to determine fauna and flora species that have been recorded in proximity to the site. A 20 kilometre buffer was allowed from centroid of the site and the following resources were utilised:

- the Atlas of Living Australia database;[1]
- South Australian Department of Environment, Water and Natural Resources Biological Database of South Australia search[2]; and
- Commonwealth Department of Environment and Energy (DoEE) Protected Matters Search Tool (PMST);[3]

Marine species were excluded from the review, as this project will not impact on any marine environments.

3.2 Field methodology

A variety of field methods were employed from 9th to 12th April 2018 to gain an understanding of the flora, fauna and habitats present across the study area. Initial site survey, examining the type and extent of habitats present within the project area, was undertaken on 9th April. This reconnaissance, along with vegetation mapping data from the literature review, formed the basis for identification of 16 distinct habitat types which formed the basis for bird survey, floristic assessment and opportunistic fauna sightings. Table 1 summarises the habitat types that were present.

3.2.1 Vegetation mapping

Vegetation mapping was based upon existing SA Vegetation mapping boundaries and current aerial photography. This was supplemented by field observations, including using tracking on a hand-held GPS whilst walking the boundaries of vegetation associations that were difficult to detect on aerial photography. Final shapefiles were digitised based upon field notes and tracks, photographs and attributes that could be detected on the aerial photography.

[1] Atlas of Living Australia occurrence download at http://www.ala.org.au. Spatially valid records only. Accessed .
[2] Department of Environment and Natural Resources, Biological Databases of SA (BDSA). This data has been sourced from the South Australian Department of Environment, Water and Natural Resources Biological Database of SA. Recordset number .
[3] Australian Government (2018). http://www.environment.gov.au/epbc/protected-matters-search-tool accessed 21/3/2018.

TABLE 1: SUMMARY OF HABITAT TYPES PRESENT IN THE ASSESSED AREA

Habitat type
Hydro Block
1. *Eucalyptus gracilis, E. socialis* ssp. Mallee / Open mallee
2. *Eucalyptus oleosa* ssp. *ampliata*, *E. socialis* ssp. *viridans*+/- *E. leptophylla, E. gracilis* Mallee
3. *Acacia victoriae* Shrubland / Open shrubland
4. Triodia scariosa Grassland with scattered emergent shrubs
5. *Cassinia laevis*, *Xanthorrhoea quadrangulata* Shrubland with scattered emergent *Eucalyptus* spp., *Allocasuarina verticillata*, *Callitris gracilis*
6. Eucalyptus socialis, E. gracilis +/- E. cajuputea (patchy) Mallee over Cassinia laevis, Xanthorrhea quadrangulata
7. *Pimelea microcephala, Acacia victoriae, Rhagodia parabolica, Maireana brevifolia* Open shrubland
8. Solanum cleistogamum Very open low shrubland +/- *Austrostipa sp., Rytidosperma sp.* with scattered emergent *Acacia victoriae, Pimelea microcephala*
9. Alectryon oleifolius Low woodland
10. Eucalyptus oleosa +/- E. socialis, E. gracilis Open mallee
11. Eucalyptus camaldulensis woodland
Solar Farm Block
A. Maireana rohrlachii, M. brevifolia +/- M. pyramidata, Reopera aurantiaca Low shrubland with scattered emergent *Acacia victoriae*
B. Acacia victoriae +/- A. oswaldii Shrubland
C. Maireana brevifolia +/- M. pyramidata Open shrubland
SF1. *Maireana pyramidata +/- M. brevifolia* Shrubland
SF2. Maireana brevifolia +/- M. pyramidata Shrubland
SF3. +/- *Maireana pyramidata +/- M. aphylla, M. turbinata, M.brevifolia* Open shrubland

3.2.2 Vegetation Survey

Vegetation survey was undertaken in each of the habitats listed in Table 1. Individual species cover/abundance data was based upon categorisation used by the Biological Survey of South Australia (Table 2). Data were gathered from a representative one-hectare area (100m by 100m), based upon locations (photopoints) shown in Figure 1. However, these data were also supplemented by opportune sightings or observations in that habitat type more generally. Where required, plant specimens were taken and subsequently identified using the resources of the South Australian Herbarium.

TABLE 2: COVER/ABUNDANCE SCALE USED IN VEGETATION ASSESSMENT

Code	Description
N	Not many, 1-10 individuals. Where large shrubs or trees involved a category was chosen which reflected the cover rather than the number of individuals
T	Sparsely or very sparsely present; cover very small
1	Plentiful but of small cover (less than 5%)
2	Any number of individuals covering 5-25% of the area
3	Any number of individuals covering 25-50% of the area
4	Any number of individuals covering 50-75% of the area
5	Any number of individuals covering more than 75% of the area

To provide a broad indication of condition of remnant vegetation across the site, each habitat type was assessed against the following condition criteria[4] to allocate a condition score.

Condition	General Description	Indicated by:
Very Poor	Weed-dominated with only scattered areas or patches of native vegetation	• Vegetation structure no longer intact (eg. removal of one or more vegetation strata) • Scope for regeneration, but not to a state approaching good condition without intensive management • Dominated by very aggressive weeds • Partial or extensive clearing (> 50% of area) • Evidence of heavy grazing (tracks, browse lines, species changes, no evidence ofsoil surface crust)
Poor	Native vegetation with considerable disturbance	• Vegetation structure substantially altered (eg. one or more vegetation strata depleted) • Retains basic vegetation structure or the ability to regenerate it • Very obvious signs of long-term or severe disturbance • Weed dominated with some very aggressive weeds • Partial clearing (10 – 50% of area) • Evidence of moderate grazing (tracks, browse lines, soil surface crust extensively broken)
Moderate	Native vegetation with some disturbance	• Vegetation structure altered (eg. one or more vegetation strata depleted) • Most seed sources available to regenerate original structure • Obvious signs of disturbance (eg. tracks, bare ground) • Minor clearing (<10% of area) • Considerable weed infestation with some aggressive weeds • Evidence of some grazing (tracks, soil surface crust patchy)
Good	Native vegetation with little disturbance	• Vegetation structure intact (eg. all strata intact) • Disturbance minor, only affecting individual species • Only non-aggressive weeds# present • Some litter build-up
Excellent	Intact vegetation	• All strata intact and botanical composition close to original • Little or no signs of disturbance • Little or no weed infestation • Soil surface crust intact • Substantial litter cover

[4] Based upon condition assessment used in Native Vegetation Council (2005). Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the clearance of native vegetatopm associated with the minerals and petroleum industry.

3.3.3 Anabat recording

Anabat Express recorders, which gather acoustic data to help identify bat species present, were used to provide some baseline data on bats that may be present in the site. Bat calls were recorded between sunset and sunrise. Bat detectors offer significant advantages over capture techniques because they can be operated without specialist training, they are non-invasive and they do not require an operator to be present once they are set. Bat detectors also have limitations because the analysis of calls is complex and not all bat species can be distinguished by their calls.

Bats were recorded over two nights in two vegetation types that were considered to represent key areas that may be impacted. Table 3 shows the locations and time of sampling. Anabat data were analysed by Dennis Matthews, an independent expert on echolocation call analysis. The analysis follows standards for reporting bat detector surveys developed by the Australasian Bat Society Inc[5]. The detailed results of the anabat assessment are provided in Appendix 1, and the data are included in the results of this survey.

TABLE 3: LOCATIONS AND DATES OF ANABAT RECORDINGS (WGS 84, ZONE 54)

Habitat type	Date start	Date Finish	Easting	Northing
1. *Eucalyptus gracilis, E. socialis* ssp. Mallee / Open mallee	9th April	11th April	227160	6354337
3. *Acacia victoriae* Shrubland / Open shrubland	9th April	11th April	227311	6354360

3.3.4 Bird Survey

Bird data was collected at each of the habitat types assessed, as described in Table 1. At least one hour was spent during the early morning and late afternoon recording bird species present in each assessment area. Identification was either visual or by call. Opportune observations were also gathered outside the assessment sites, as and when they arose.

3.3.5 Reptile Survey

At least one hour was spent gathering opportunistic observations in each habitat type (Table 1). This searching included examining in and under suitable substrate that was present in each area, such as rocks or logs.

[5]Australasian Bat Society (Inc.) (undated). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. ausbats.org.au/download /i/mark_dl/u/.../ABS_Anabat_survey_standards.pdf accessed 8/1/2018.

4. Results

4.1 Weather and climate at the time of survey

Data from the closest weather station (Port Pirie) shows the climate in the region is typically temperate with warm to hot, dry summers and cool, wet winters. The average rainfall is 345 mm/year and mainly falls between the months of May and October. Characteristics of the climate in this region are given below from the Bureau of Meteorology (BOM) monthly averages for station 021043 Port Pirie Nyrstar Comparison. Climatic averages are shown in Figure 2 and summarised as follows:

- The median (5th decile) monthly rainfall, suggested by BOM to be the most representative of rainfall, is 339.8 mm/yr at Port Pirie Nyrstar Comparison.
- The highest rainfall is in June and August (33.2 mm) and the most raindays in July and August (10.5 d).
- The lowest rainfall is in January (8.6 mm) and least number of raindays are in February (1.8 d).
- The mean daily maximum temperature is greatest in January (32 °C) and lowest in July (16.4 °C).
- The mean daily minimum temperature is highest in February (17.9 °C) and lowest in July (7. °C).
- Wind speed is highest in October (13.6 km/hr) and lowest in April (8.7 km/hr).

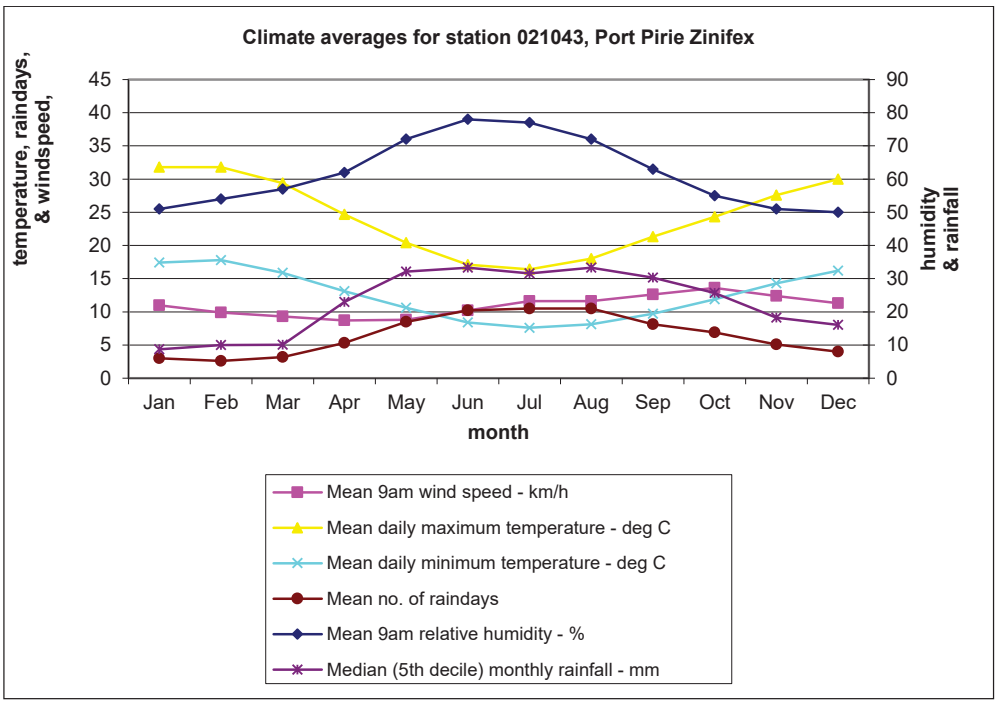


FIGURE 2: CLIMATE AVERAGES FOR STATION 021043, PORT PIRIE NYRSTAR COMPARISON

The weather at the time of survey was hot, dry and windy, with daily maximum temperatures exceeding 35°C, and moderate to strong winds from the north (Table 4). From January to March 2018, only 20.8mm of rain had fallen, compared to the long-term average of 55mm. Given the

conditions prior to and during the survey, along with the time of year, many annual plant species were not detectable. The windy weather would also have impacted on the number and variety of birds observed.

TABLE 4: WEATHER CONDITIONS AT THE TIME OF SURVEY

Date	Maximum (°C)	Minimum (°C)	Rainfall (mm)	9am wind direction and speed	3pm wind direction and speed
8/4/2018	37.6	13.2	0	NNW 26	NNW 28
9/4/2018	38.2	17.1	0	N 24	N 31
10/4/2018	39.0	24.3	0	NNW 31	N 28
11/4/2018	37.6	13.6	0	N 19	NNW 50
April average[6]	24.8	13.2	0.9[7]	8.6	14.6

4.2 Site Overview

4.2.1 Hydro Block

The Hydro Block is located in hilly country to the east of Baroota Reservoir. Rainfall is approximately 520 mm per annum[8]

The broader area that may be impacted by the suite of activities (dam walls, flooded area, pipework) has been assessed, with the highest degree of impact likely at the eastern end where it is proposed to construct the retention dam (shown in Figure 3A as the shaded area). This dam construction area is principally moderate to steep slopes with no large rocky outcrops, forming an amphitheatre around a drainage line. The vegetation (which is discussed comprehensively in Section 4.3.1) is predominantly very open low shrub and grassy vegetation, with scattered mallee (*Eucalyptus spp*.) on hillslopes, with two larger patches on the northern and southern sides. Shrubs (mostly *Acacia victoriae*) occur along the drainage line, and are also scattered throughout this area. This area is exposed to sheep grazing, and overall condition is generally poor.

The central sections of the assessed area (west of the proposed dam) have a ridgeline that runs generally north-east. On the ridgeline itself it is principally open low shrub and grassy vegetation of relatively poor quality. Steep slopes and gullies on each side of this ridge contain rocky outcrops, and dense shrubby vegetation with mallee (*Eucalyptus sp.)* in patches, particularly on both sides of the drainage line in the south western corner of the assessed area. This dense shrubby vegetation is generally less impacted by sheep grazing and is in moderate to good condition. The site then slopes facing generally westwards towards the Baroota Reservoir. These westward facing slopes above the SA Water Reservoir are mostly open shrubland, with scattered mallee and bullock bush along drainage lines. These areas have been substantially impacted by grazing.

[6] Note Nyrstar comparison no longer operative. Daily temperatures from Pt Pirie Aerodrome, which has only been open since 2015. Long term averages from Nyrstar comparison, situated <5km away.
[7] Based on average April total of 27.5mm.
[8] Based on mean annual rainfall 1976-2005. www.naturemaps .sa.gov.au accessed 12/5/2018.

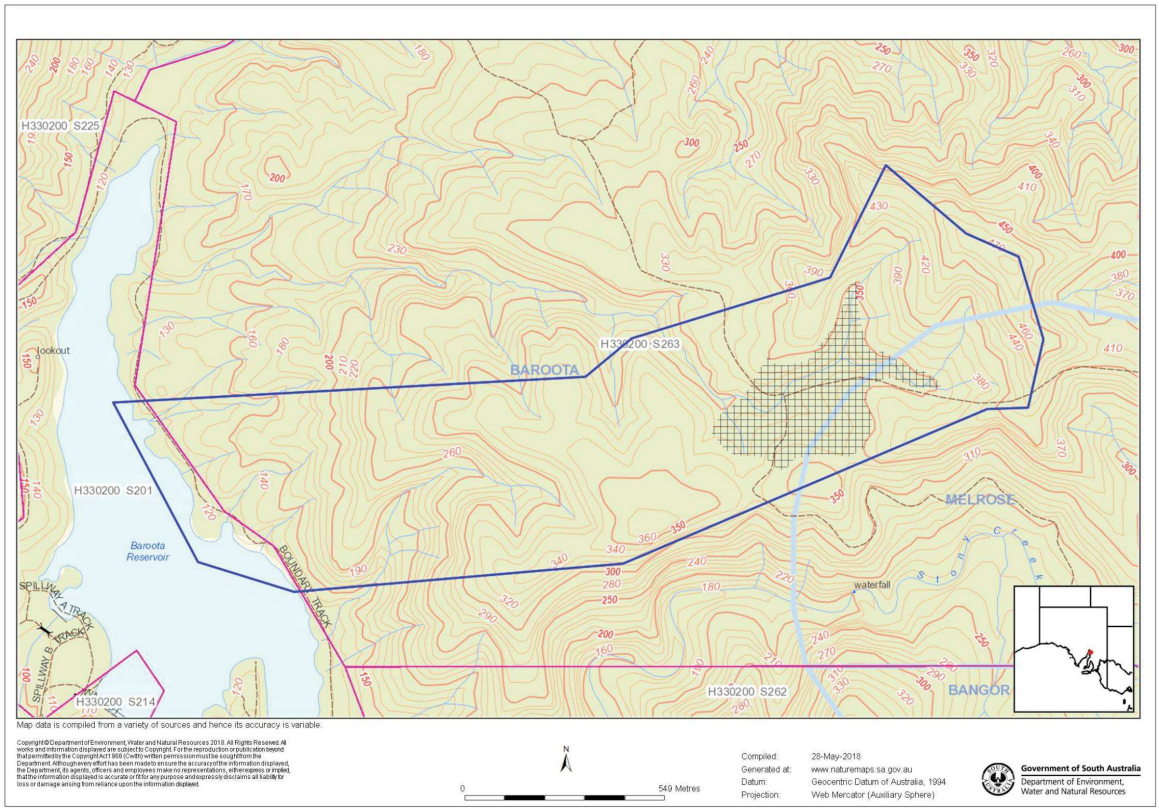


FIGURE 3A: EXTENT OF AREA ASSESSED AND TOPOGRAPHY OF HYDRO BLOCK

4.2.2 Solar Farm

The Solar Farm area is on westward facing gentle slopes to the west of the SA Water Baroota Reservoir. Rainfall at this site is much lower than in the Hydro section, estimated at around 350mm per year[9]. The site has sections of cropped land in the south, with broad areas of chenopod shrubland in the north and west. Minor drainage lines traverse the site from west to east, which generally have a cover of moderate sized shrubs (mostly *Acacia victoriae*).

[9] Based on mean annual rainfall 1976-2005. www.naturemaps .sa.gov.au accessed 12/5/2018.

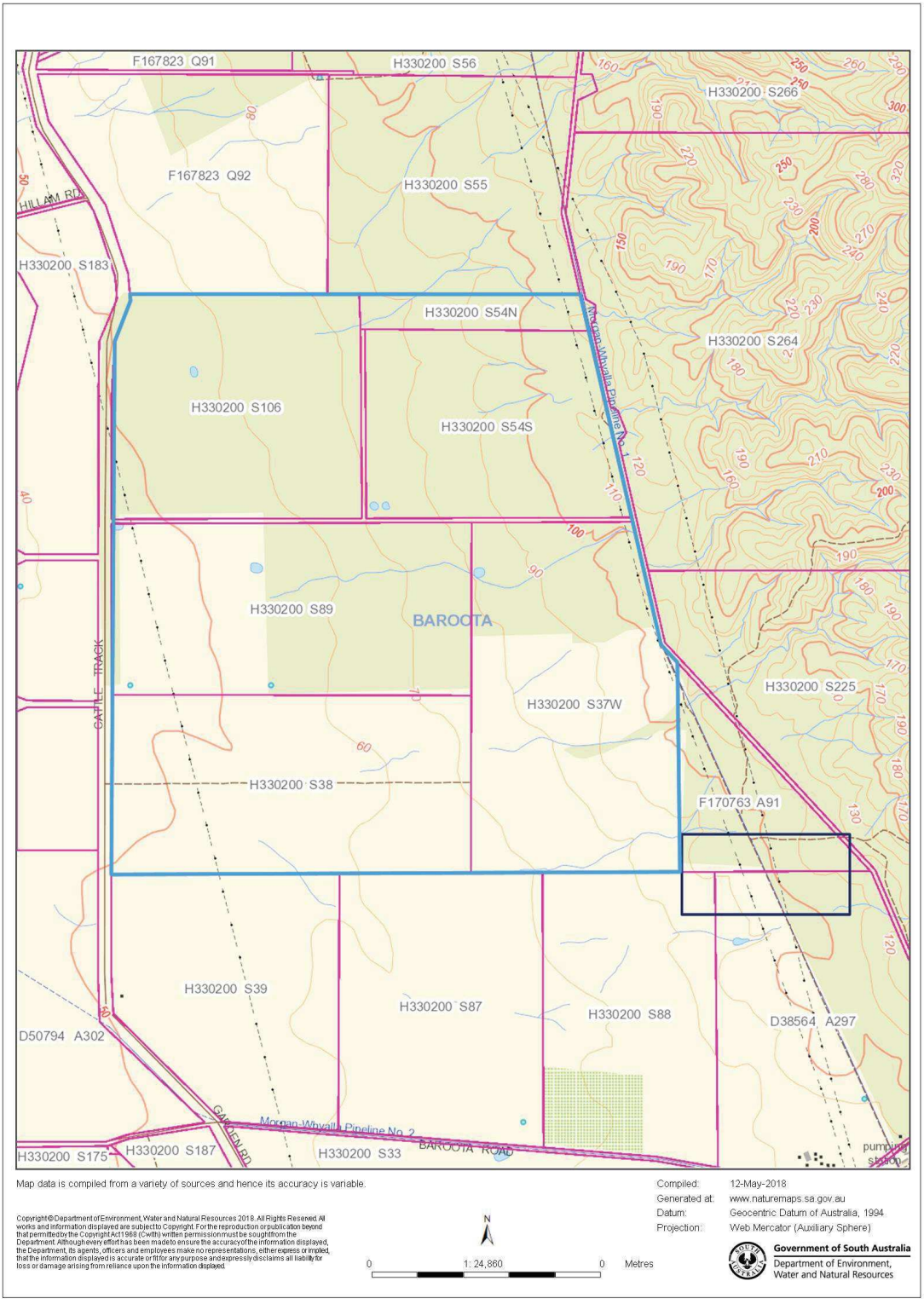


FIGURE 3B: BOUNDARIES AND TOPOGRAPHY OF THE SOLAR FARM AREA (The blue line shows the extent of the Solar Farm area, with the black line marking potential substation location.)

4.3 Vegetation

4.3.1 Vegetation communities/habitats in the Hydro Block

The native vegetation in the Hydro Block encompasses a diversity of vegetation types in a variety of different conditions. A total of eleven vegetation types were mapped in this area (Figure 4A). Indicative photographs and descriptions for each of these communities are provided in the following section, with Table 5 providing a brief summary of each of the vegetation types present. The whole area is exposed to sheep grazing, but steep, rocky sections in the central and southern areas have been less impacted by grazing and retain a dense shrub understorey, with patchy emergent trees (Vegetation types 5 and 6). The remainder of the Hydro Block was considered to be in generally poor condition overall, principally due to ongoing grazing impacts.

TABLE 5: SUMMARY OF VEGETATION/HABITAT TYPES PRESENT IN THE HYDRO BLOCK

Habitat type	Brief Summary
1. *Eucalyptus gracilis, E. socialis* ssp. Mallee / Open mallee	In eastern sections of the Hydro Block. Low, mixed mallee canopy over a very open understorey, significantly impacted by grazing. There are many hollows in the trees, ranging in size from small (<5cm) to large (>10cm). Considered as poor/moderate condition.
2. *Eucalyptus oleosa* ssp. *ampliata*, *E. socialis* ssp. *viridans*+/- *E. leptophylla, E. gracilis* Mallee	One patch in north eastern section. Low, mixed mallee canopy over negligible understorey, significantly impacted by grazing. Contains scattered larger trees with hollows. Considered as poor/moderate condition. A rabbit warren was noted in this area.
3. *Acacia victoriae* Shrubland / Open shrubland	These shrublands occur on gently to moderately sloping lower areas and open plains, both at the eastern end of the Hydro block and adjacent to Baroota Reservoir. Condition of the understorey would generally be described as poor, with low cover of native grasses and low shrubs.
4. Triodia scariosa Grassland with scattered emergent shrubs	Occurs on a flatter, elevated central area of the Hydro block. Triodia grassland with scattered emergent shrubs, including Elegant Wattle (*Acacia victoriae*), Thorn Wattle (*A. continua*), Curry Bush (*Cassinia laevis*), Narrow-leaf Hop-bush (*Dodonaea viscosa*) and Rock Grass-tree (*Xanthorrhoea quadrangulata*). Signs of grazing are abundant, and overall condition considered poor/moderate.
5. *Cassinia laevis*, *Xanthorrhoea quadrangulata* Shrubland with scattered emergent *Eucalyptus* spp., *Allocasuarina verticillata*, *Callitris gracilis*	Occurs on steep slopes and rocky outcrops in central and western parts of the Hydro block. Dense shrub understorey with some emergent trees. Grazing pressure high near edge but decreasing within interior. Considered to be in moderate condition.
6. Eucalyptus socialis, E. gracilis +/- E. cajuputea (patchy) Mallee over Cassinia laevis, Xanthorrhea quadrangulata	On steep slopes at the western end of the Hydro block. Moderate to dense shrub understorey with patches of mallee present. Three State Rare plant species noted. Some grazing impacts around edges, but generally considered to be in moderate to good condition.
7. *Pimelea microcephala, Acacia victoriae, Rhagodia parabolica, Maireana brevifolia* Open shrubland	On upper slopes at the western end and along the northern boundary of the Hydro block. Generally a sparse shrub layer, with scattered, heavily grazed understorey. Considered to be in poor condition.

Habitat type	Brief Summary
8. *Solanum cleistogamum* Very open low shrubland +/- *Austrostipa sp., Rytidosperma sp.* with scattered emergent *Acacia victoriae, Pimelea microcephala*	On crests and gently sloping areas throughout the Hydro site, and principal habitat to be effected by the proposed retention dam. Very heavily grazed, sparse native species only, and likely to be predominantly weedy annual grasses in springtime. Poor condition overall, with some rabbit warrens present.
9. *Alectryon oleifolius* Low woodland	One patch on lower, west facing slopes near the SA Water Baroota Reservoir. Considered to be in poor condition due to grazing pressure, with a sparse understorey and substantial patches of bare ground.
10. *Eucalyptus oleosa* +/- *E. socialis, E. gracilis* Open mallee	On lower west facing slopes and gullies at the western end of the Hydro block. Open mallee woodland with a sparse medium and low shrub layer. Substantially impacted by ongoing grazing pressure, with overall condition being poor/moderate. Hollow-bearing trees present.
11. *Eucalyptus camaldulensis* (Red Gum) woodland	Restricted to a thin band of trees around the edges of the SA Water Baroota Reservoir. Moderately dense mdium to tall shrub understorey. Less grazing pressure than adjacent areas, and considered to be in moderate condition. Some larger trees with hollows present, although patchy.

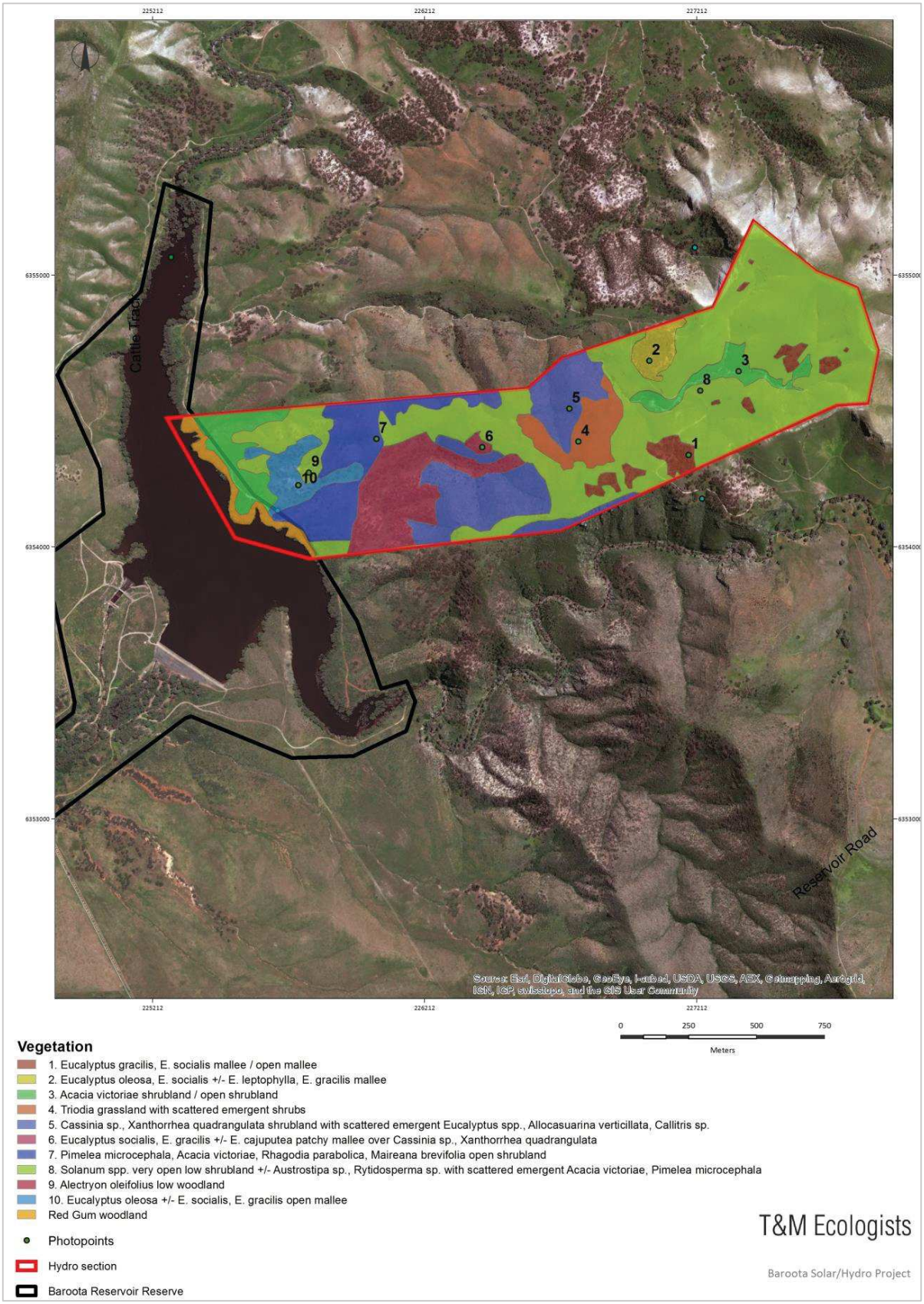


FIGURE 4A: VEGETATION COMMUNITIES PRESENT: HYDRO BLOCK

1. *Eucalyptus gracilis, E. socialis* ssp. Mallee / Open mallee

Small patches of this vegetation type are scattered across more southern hillslopes in the Hydro block, with one larger patch present near the southern edge of the area assessed. This vegetation has been exposed to significant grazing pressure, and the understorey is in generally poor condition. The community comprises a generally low, mixed canopy over a very open understorey which is characterised by a sparse layer of both sclerophyll and chenopod shrubs. Shrubby Riceflower (*Pimelea microcephala*) is the most abundant tall shrub in the understorey. The State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) is present as very scattered, heavily grazed plants. There are relatively large areas of open ground between shrubs and the ground layer includes native grasses and chenopod herbs. There are many hollows in the trees, ranging in size from small (<5cm) to large (>10cm). Weeds of concern include a few African Boxthorn (**Lycium ferocissimum*), scattered Horehound (**Marrubium vulgare*) and Saffron Thistle (**Carthamus lanatus*).

Representative photograph of habitat type 1, taken facing south at 227184E, 6354338N.

2. *Eucalyptus oleosa* ssp. *ampliata, E. socialis* ssp. *viridans*+/- *E. leptophylla, E. gracilis* Mallee

One patch of this vegetation type occurs on a west-facing hillslope on the northern boundary of the Hydro block. The structure of this community is similar to Community 1, although species diversity is lower. Scattered larger trees with hollows are present. *Eucalyptus oleosa ssp. ampliata, E. socialis ssp. viridans* are more prominent through central sections, with *E. gracilis* mostly confined to edges. As with community 1, this area has been exposed to significant grazing pressure which means the understorey is in a generally poor condition. A rabbit warren was noted in this area. Weeds of concern include scattered African Boxthorn (**Lycium ferocissimum*) and Saffron Thistle (**Carthamus lanatus*).

Representative photograph of habitat type 2, taken facing south at 227039E, 6354684N.

3. *Acacia victoriae* Shrubland / Open shrubland

These shrublands occur on lower slopes and open plains within the Hydro block. Elegant Wattle (*Acacia victoriae*) is persistent throughout this habitat type, but ranges in density from >40% cover to only scattered individuals. Shrubby Riceflower (*Pimelea microcephala*) is also patchily present. The understorey includes very scattered chenopod shrubs typical of the adjoining plains vegetation, but generally only in areas where grazing impact is less, such as along the creekline. Ground strata, such as grasses and herbaceous species, have been significantly impacted by grazing, and the diversity and abundance of understorey species has been reduced by this long tem impact. Condition of the understorey would generally be described as poor. The State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) is present as very scattered, heavily grazed plants along the creekline. A total of 16 native plant species were recorded in this habitat type. Weeds of concern include a few African Boxthorn (**Lycium ferocissimum*) and Rose (**Rosa* sp.), and scattered Saffron Thistle (**Carthamus lanatus*).

Representative photograph of habitat type 3, taken facing south at 227367E, 6354646N.

4. *Triodia scariosa* Grassland with scattered emergent shrubs

Occurs on a flatter, elevated central area of the Hydro block. Whilst Triodia is the dominant 'overstorey' species, a number of very scattered emergent shrubs occur within this habitat type, including Elegant Wattle (*Acacia victoriae*), Thorn Wattle (*A. continua*), Curry Bush (*Cassinia laevis*), Narrow-leaf Hop-bush (*Dodonaea viscosa*) and Rock Grass-tree (*Xanthorrhoea quadrangulata*). Lemon-grass (*Cymbopogon ambiguus*) is a prominent species in this vegetation type and signs of grazing are abundant. The State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) is present as very scattered, heavily grazed plants. Triodia forms habitat for many reptile and bird species that would not be found in adjoining more open areas (Community type 8). Weeds of concern include scattered Saffron Thistle (**Carthamus lanatus*).

Representative photograph of habitat type 4, taken facing south at 226778E, 6354387N.

5. *Cassinia laevis, Xanthorrohea quadrangulata* Shrubland with scattered emergent *Allocasuarina verticillata, Callitris gracilis*

These shrublands occur on slopes and rocky outcrops in the more central parts of the Hydro block. A total of 17 native plant species was recorded in this vegetation community, and the ratio of native:exotic understorey biomass was estimated to be >76%. The dominant overstorey is medium sized shrubs, principally Curry Bush (*Cassinia laevis*) and Rock Grass-tree *(Xanthorrhoea quadrangulata*), but several other medium sized shrubs are present in places but seldom dominant. There are scattered emergent trees, including Golden Wattle (*Acacia pycnantha*), Drooping Sheoak (*Allocasuarina verticillata*) and Southern Cypress Pine (*Callitris gracilis*), with the latter present on patches in the southern portion of the site. Hard Mat-rush (*Lomandra multiflora* ssp. *dura*) is prominent in the understorey, however it has been heavily grazed, especially near edges of the vegetation. The high native biomass and diverse array of native plant life forms would mean this area provides habitat for many reptile and bird species, and condition ranges from poor/moderate around the edges to moderate/good in the centre of patches. Weeds of concern include scattered Saffron Thistle (**Carthamus lanatus*).

Representative photograph of habitat type 5, taken facing south at 226744E, 6354508N.

6. *Eucalyptus socialis, E. gracilis +/- E. cajuputea* (patchy) Mallee over *Cassinia laevis, Xanthorrhea quadrangulata*

This community generally occurs on steep slopes at the western end of the Hydro block. This vegetation type recorded the highest number of native plant species (27). It is characterised by a mixed canopy, including Green Mallee (*Eucalyptus cajuputea*) which is listed as Rare in South Australia. The understorey comprises a variety of medium to tall shrubs. Some grazing impacts around edges, but mostly in a moderate to good condition. The State Rare species Cane Spear-grass (*Austrostipa breviglumis*) Flinders Ranges Wattle (*Acacia iteaphylla*) were also recorded in this area. Weeds of concern include a few Apple of Sodom (**Solanum linnaeanum*), scattered Horehound (**Marrubium vulgare*) and Saffron Thistle (**Carthamus lanatus*).

Representative photograph of habitat type 6, taken facing south at 226425E, 6354366N.

7. *Pimelea microcephala, Acacia victoriae, Rhagodia parabolica, Maireana brevifolia* Open shrubland

This more degraded community generally occurs on upper slopes at the western end and along the northern boundary of the Hydro block. Understorey species are sparse and heavily grazed. The State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) is present as very scattered, heavily grazed plants. Weeds of concern include Horehound (**Marrubium vulgare*), Saffron Thistle (**Carthamus lanatus*) and widely scattered Apple of Sodom (**Solanum linnaeanum*).

Representative photograph of habitat type 7, taken facing south at 226036E, 6354397N.

8. *Solanum cleistogamum* Very open low shrubland +/- *Austrostipa* sp., *Rytidosperma* sp. with scattered emergent *Acacia victoriae, Pimelea microcephala*

This vegetation occurs on crests and gently sloping areas throughout the Hydro site. This is also the vegetation type that occurs through most of the potential upper retention dam area. Very heavily grazed, with bare ground was estimated to be 31-50% and native:exotic understorey biomass was estimated to be 5-40%. Whilst there is still a diversity of plant species present, including grasses and low and medium shrubs, these native species are generally widely spaced. In spring grass cover is expected to be more prominent, although would likely be dominated by introduced annuals. Poor condition overall, with some rabbit warrens present. Weeds of concern include Saffron Thistle (**Carthamus lanatus*), Salvation Jane (**Echium plantagineum*) and widely scattered Apple of Sodom (**Solanum linnaeanum*).

Representative photograph of habitat type 8, taken facing south at 227226E, 6354574N.

9. *Alectryon oleifolius* Low woodland

A patch of this vegetation type occurs on lower, west facing slopes near the Baroota Reservoir. It supports the lowest number of species (8) of any community in the Hydro block. Considered to be in poor condition due to grazing pressure. Shrubby Riceflower (*Pimelea microcephala*) is the dominant tall shrub understorey, with Short-leaf Bluebush (*Maireana brevifolia*) and Ruby Saltbush (*Enchylaena tomentosa*) comprising the low shrub layer. Weeds of concern include Horehound (**Marrubium vulgare*).

Representative photograph of habitat type 9, taken facing south at 225787E, 6354273N.

10. *Eucalyptus oleosa +/- E. socialis, E. gracilis* Open mallee

Occurs on lower west facing slopes and gullies at the western end of the Hydro block. Dominant overstorey species is Red Mallee (*Eucalyptus oleosa*), with scattered Yorrell (*Eucalyptus gracilis*) and Beaked Red Mallee (*Eucalyptus socialis ssp. socialis*). Eighteen native species recorded in this area, mostly scattered medium (*Eremophila scoparia, Acacia oswaldii*, *Rhagodia spp*.) and low (*Maireana spp., Enchylaena tomentosa)* shrubs. Considered to be substantially impacted by ongoing grazing pressure, with overall condition being poor/moderate. Hollow-bearing trees present. Weeds of concern include Horehound (**Marrubium vulgare*) and African Boxthorn (**Lycium ferocissimum*).

Representative photograph of habitat type 10, taken facing south at 225750E, 6354226N.

11. *Eucalyptus camaldulensis* (Red Gum) woodland

This vegetation community is restricted to a thin band of trees around the edges of the Baroota Reservoir. The understorey is generally a continuation of shrubs species found in nearby shrublands, such as *Acacia victoriae ssp. victoriae, Pimelea microcephala ssp. microcephala, Rhagodia parabolica* and *Cassinia laevis.* Scattered African Boxthorn (*Lycium ferocissimum*) is the most threatening woody weed present. Some larger trees with hollows present, although patchy.

Representative photograph of Red Gum woodland that forms a narrow band around Baroota Reservoir. Photo facing SW at 225595, 6354153.

4.3.2 Vegetation communities/habitats in the Solar Farm Block

The native vegetation in the Solar Farm block is generally quite degraded, and is different to the vegetation in the hydro area due to topography, rainfall and soils. There are some sections that have been recently ploughed and have no remnant vegetation. A total of six vegetation types were mapped in this area (Figure 4B).

Areas where native vegetation remain are predominantly chenopod shrublands, with taller Elegant Wattle (*Acacia victoriae*) shrublands along drainage lines. These shrublands have been exposed to long-term grazing, and have been substantially modified by this impact. Vegetation types A, B and C are found in areas that may be impacted by construction of a substation associated with the solar farm, with areas SF1, SF2 and SF3 in the broader area that will be impacted by the solar farm. Table 6 provides an overall summary of these six different vegetation types. One plant species of conservation significance, Rohrlach's Bluebush (*Mairena rohrlachii*) was present as scattered plants in the Solar Farm area, but of higher cover (5-25%) in the area that may be impacted by the substation as part of the Solar Farm development.

TABLE 6: SUMMARY OF VEGETATION/HABITAT TYPES PRESENT IN THE SOLAR FARM BLOCK

Habitat type	Brief Summary
A. *Maireana rohrlachii, M. brevifolia* +/- *M. pyramidata, Reopera aurantiaca* Low shrubland with scattered emergent *Acacia victoriae*	Occurs on relatively flat land in an area that may be impacted by construction of a substation. It has a moderate diversity of native plant species, and is considered in a poor to moderate condition. Bluebush species (*Maireana spp*.) and, in patches, Shrubby Twinleaf (*Roepera aurantiaca ssp. aurantiaca*) are the dominant medium shrub overstorey, with Fan Saltbush (*Atriplex angulata*) and the grass species Bottle Washers (*Enneapogon spp.)* the main understorey. State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) has cover of 5-25%.
B. *Acacia victoriae* +/- *A. oswaldii* Shrubland	Generally, along drainage lines. Elegant Wattle (*Acacia victoriae*) is the dominant overstorey, with scattered Umbrella Wattle (*Acacia oswaldii*) also present. Understorey shrubs include Short-leaf Bluebush (*Maireana brevifolia*), Bitter Saltbush (*Atriplex stipitata*). Poor to moderate condition in substation patch, whereas poor condition in broader Solar Farm area, with significant impacts from grazing.
C. *Maireana brevifolia* +/- *M. pyramidata* Open shrubland	Degraded low shrubland community on north western side where a substation may be built associated with the solar farm. Short-leaf Bluebush (*Maireana brevifolia*) the dominant overstorey. Low species diversity (7 species) and low shrub density and considered in poor condition due to long term grazing impacts.
SF1. *Maireana pyramidata* +/- *M. brevifolia* Shrubland	Widespread community in the northern half of the Solar Farm block, on slightly lower lying areas, and away from grazing points. Retains a moderate species diversity of 16 species, with Black Bluebush (Maireana pyramidata) the main overstorey plant. The State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) is present as very scattered, heavily grazed plants. Overall considered to be in poor condition due to long term grazing impacts.

Habitat type	Brief Summary
SF2. Maireana brevifolia +/- *M. pyramidata* Shrubland	Patches occur throughout the unploughed sections of the proposed Solar Farm block, along with a large block along the western side. On disturbed land near grazing points or where past clearance has occurred, and on slightly more elevated ground than community SF1. Short-leaf Bluebush (*Maireana brevifolia*) is the dominant oversotrey shrub. Low species diversity (8 species) and low shrub density, and as such considered to be in poor condition.
SF3. +/- *Maireana pyramidata* +/- *M. aphylla, M. turbinata, M.brevifolia* Open shrubland	Occurs in the north-west section of the proposed Solar Farm section, in the lowest lying part of the proposed development area. Moderate species diversity, with a variety of different Bluebush (*Maireana spp.)* species in the overstorey, and Saltbush (*Atriplex spp.*) also present in patches. Native grasses are more prominent in the understorey than in other parts of the proposed solar farm area, forming 5-25% cover in sections. Rated as poor to moderate condition, with less grazing impacts than SF1 and SF2.

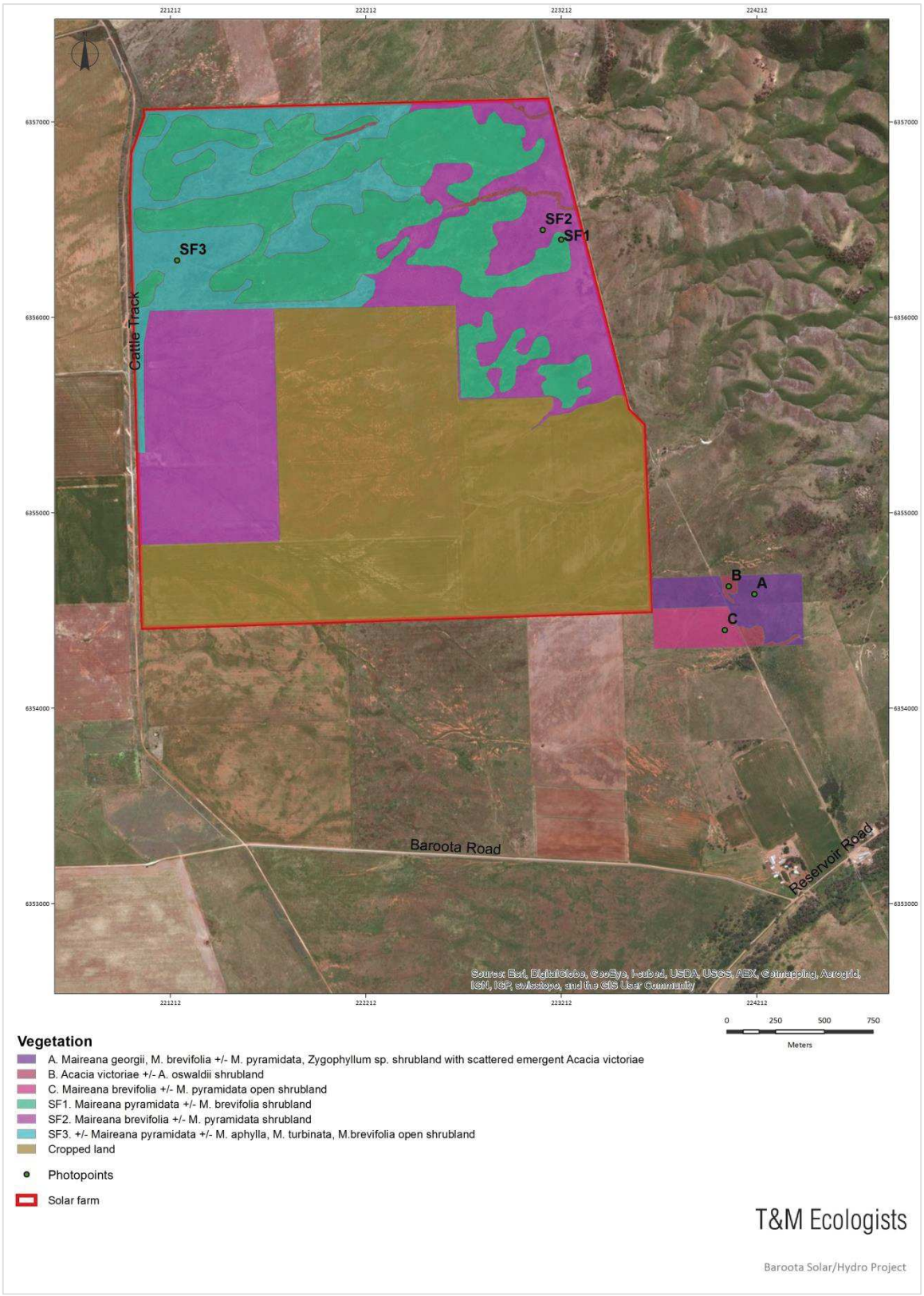


FIGURE 4B: VEGETATION COMMUNITIES PRESENT: SOLAR FARM BLOCK

A. *Maireana rohrlachii, M. brevifolia +/- M. pyramidata, Reopera aurantiaca* Low shrubland with scattered emergent *Acacia victoriae*

This low shrubland community occurs on relatively flat land in an area that may be impacted by construction of a substation. It has a moderate diversity of native plant species, and whilst grazing impacts are present, this area generally seems to have been exposed to less grazing pressure than vegetation in the Solar Farm area. Bluebush species (*Maireana spp*.) (including the State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) at cover 5-25%) and, in patches, Shrubby Twinleaf (*Roepera aurantiaca ssp. aurantiaca*) are the dominant medium shrub overstorey, with Fan Saltbush (*Atriplex angulata*) and the grass species Bottle Washers (*Enneapogon spp.)* the main understorey. Bare ground was estimated to be 11-20%, with Ward's Weed (**Carrichtera annua*), whilst dead at the time of inspection, likely to be a significant ground cover, especially in years of above average rainfall. Weeds of concern include scattered Apple of Sodom (**Solanum linnaeanum*).

Representative photograph of habitat type A, taken facing south at 224201E, 6354398N.

B. *Acacia victoriae* +/- *A. oswaldii* Shrubland

Scattered patches of this community occur in the proposed Solar Farm section of the study area, generally along drainage lines. Elegant Wattle (*Acacia victoriae*) is the dominant overstorey, with scattered Umbrella Wattle (*Acacia oswaldii*) also present. Other taller shrubs in this community include Shrubby Riceflower (*Pimelea microcephala*) and prominent low shrubs include Short-leaf Bluebush (*Maireana brevifolia*) and Bitter Saltbush (*Atriplex stipitata*). Scattered plants of the the State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) are found around the verges of this community in the patch at the south of the Block (the substation area). Ward's Weed (**Carrichtera annua*), whilst dead at the time of inspection, is likely to be a significant ground cover, especially in years of above average rainfall. The patches of this vegetation type present in the potential substation area are of poor to moderate condition, whereas in the broader solar farm area they are generally in poor condition, with significant impacts from grazing. Weeds of concern include widely scattered African Boxthorn (**Lycium ferocissium)*.

Representative photograph of habitat type B, taken facing south at 224069E, 6354623N.

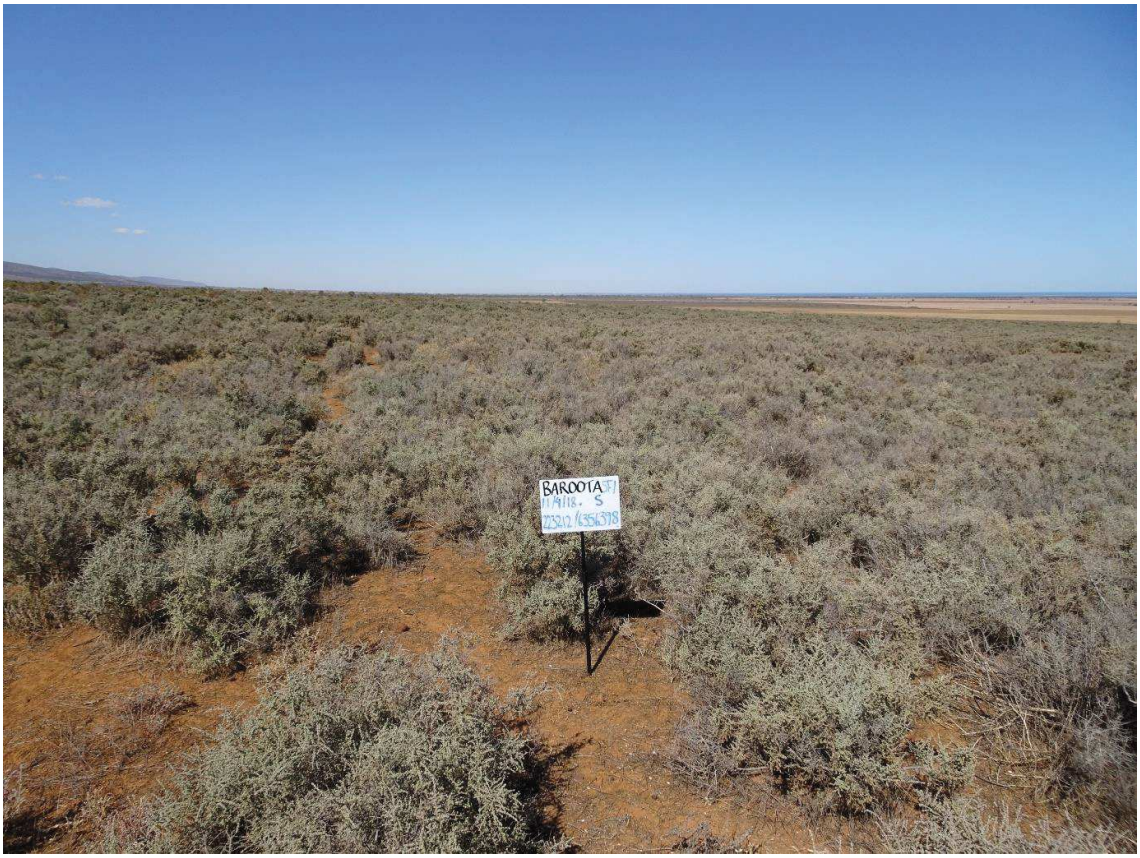
C. *Maireana brevifolia +/- M. pyramidata* Open shrubland

A more degraded low shrubland community which occurs in the area where a substation may be built associated with the solar farm. This area is open shrubland, with Short-leaf Bluebush (*Maireana brevifolia*) the dominant overstorey. Shrub cover It has been significantly impacted by grazing, with low species diversity (7 species) and low shrub density compared to an area in better condition. Ward's Weed (*Carrichtera annua*) is likely to be a significant understorey weed in spring, and there are substantial patches of bare ground (estimate d to be >50% cover). African Boxthorn (**Lycium ferocissimum*) is also scattered through this area. Ward's Weed (**Carrichtera annua*), whilst dead at the time of inspection, likely to be a significant ground cover, especially in years of above average rainfall.

Representative photograph of habitat type C, taken facing south at 224049E, 6354398N.

SF1. *Maireana pyramidata* +/- *M. brevifolia* Shrubland

A widespread community in the northern half of the proposed Solar Farm block, it is dominated by drought and stock resistant chenopod shrubs ie the vegetation has been fundamentally modified by long term grazing, and as such is considered overall to be in poor condition (compared to its original, pre-disturbance state). It is principally found on slightly lower lying areas, and away from grazing points (where vegetation type SF2 is prominent). Despite long term grazing, it still retains a moderate species diversity of 16 species. The State Rare Rohrlach's Bluebush (*Maireana rohrlachii*) is present as very scattered, heavily grazed plants. Weeds of concern include widely scattered African Boxthorn (**Lycium ferocissimum*) and Horehound (**Marrubium vulgare*). Ward's Weed (**Carrichtera annua*), whilst dead at the time of inspection, likely to be a significant ground cover, especially in years of above average rainfall.



Representative photograph of habitat type SF1, taken facing south at 223212E, 6356398N.

SF2. *Maireana brevifolia +/- M. pyramidata* Shrubland

This community has been differentiated from SF1 because of its generally poorer and more degraded condition. It was generally found on land that was slightly elevated, and also near watering points, with patches occurring throughout the proposed Solar Farm block, along with a large block along the western side where past clearance and grazing has impacted. These areas have low species diversity (8 species) and low shrub density, and as such are considered to be in poor condition. Ward's Weed (**Carrichtera annua*), whilst dead at the time of inspection, is likely to be a significant ground cover, especially in years of above average rainfall. Weeds of concern include widely scattered African Boxthorn (**Lycium ferocissimum*) and Horehound (**Marrubium vulgare*).

Representative photograph of habitat type SF2, taken facing south at 223119E, 6356446N.

SF3. *+/- Maireana pyramidata +/- M. aphylla, M. turbinata, M. georgii, M. brevifolia* Open shrubland

This low shrub community occurs in the north-west section of the proposed Solar Farm section of the study area, in the lowest lying part of the proposed development area. A total of 17 native plant species was recorded in this habitat type, representing a moderate species diversity. A variety of different Bluebush (*Maireana spp.)* species are found in the overstorey, with Saltbush (*Atriplex lindleyi ssp. inflata, Atriplex vesicaria*) also present in patches. Grasses, especially Umbrella Grass (*Enteropogon acicularis*) are more prominent in the understorey than in other parts of the proposed solar farm area, forming 5-25% cover in sections. This vegetation has been impacted by grazing, but considered to be less compromised than other solar farm areas, and is rated as poor to moderate condition. Ward's Weed (**Carrichtera annua*), whilst dead at the time of inspection, is likely to be a significant ground cover, especially in years of above average rainfall.

Representative photograph of habitat type SF3, taken facing south at 221248E, 6356290N.

4.3.3 Vegetation condition

Figures 5A and 5B show overall indicative maps of native vegetation condition.

Hydro Block

The Hydro area shows a broader range of condition, from poor to moderate/good (Figure 5A). The vegetation considered to be in the best condition was in Habitat Types 5 and 6, which were both found on steep, stony ground in the central parts of the Hydro block. Most of the vegetation found in the eastern part of the Hydro Block (where impacts from the retention dam are most likely) is considered to be in a poor condition from a native vegetation perspective, due to impacts of long term (and ongoing) grazing as well as past clearance.

Solar Farm Block

The Solar Farm area contains a significant proportion of cropped land (Figure 5B), with the patches of remnant vegetation generally being assessed as being in a poor condition (Habitat Types C, SF1 and SF2), with some patches assessed as being in a poor to moderate condition (Habitat Types A, B and SF3). Most of the north-eastern section of the block is considered to be in poor condition, as are patches in the north-west corner (vegetation type SF3) and areas in the south-western corner, within the area assessed for the substation (vegetation type C). Differences in condition relate to past and present grazing practices, topography, watering points and possibly past clearance in some areas (eg the block of vegetation type SF2 on the western side of the Solar Farm block).

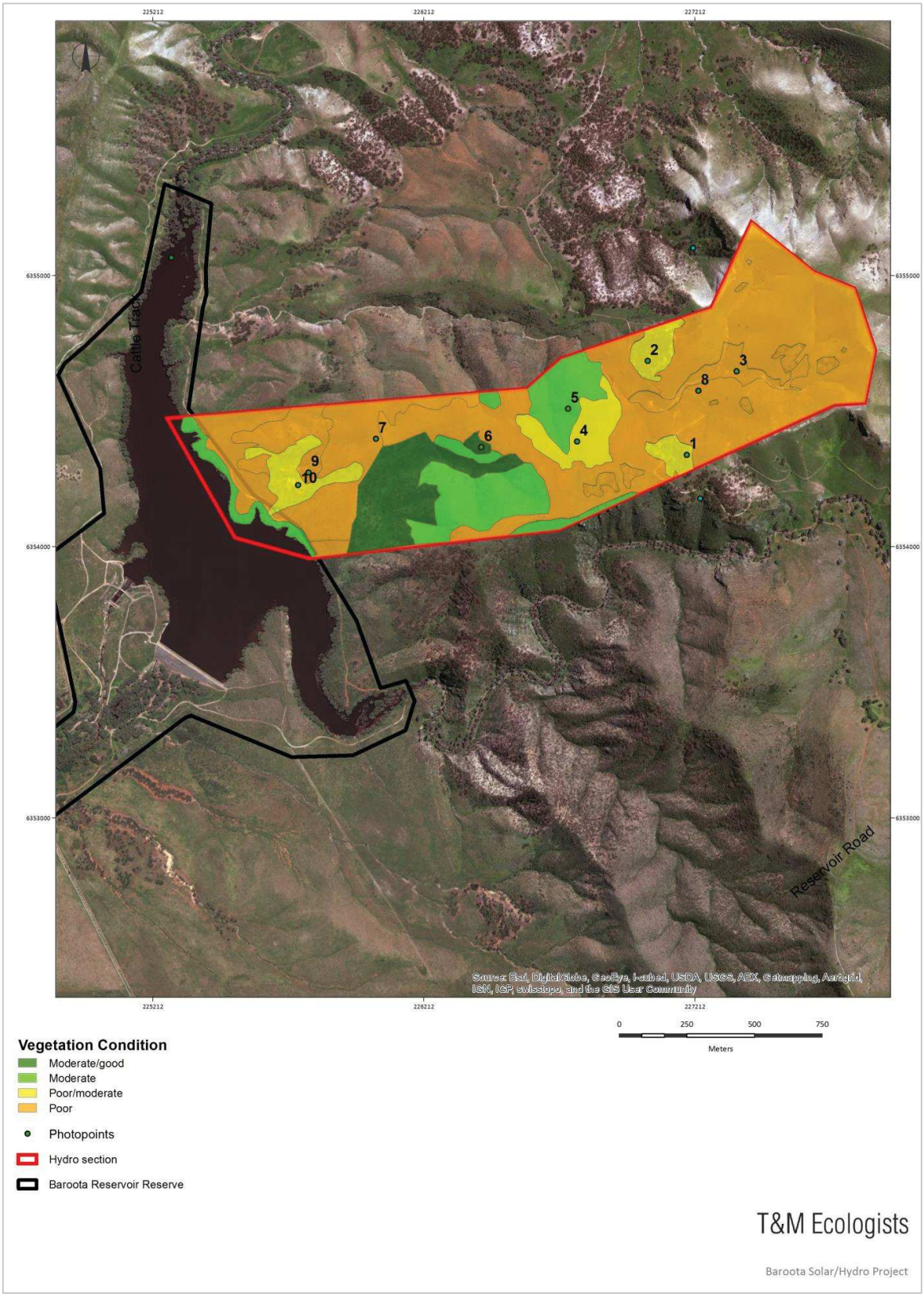


FIGURE 5A: ASSESSED CONDITION OF VEGETATION IN THE HYDRO BLOCK

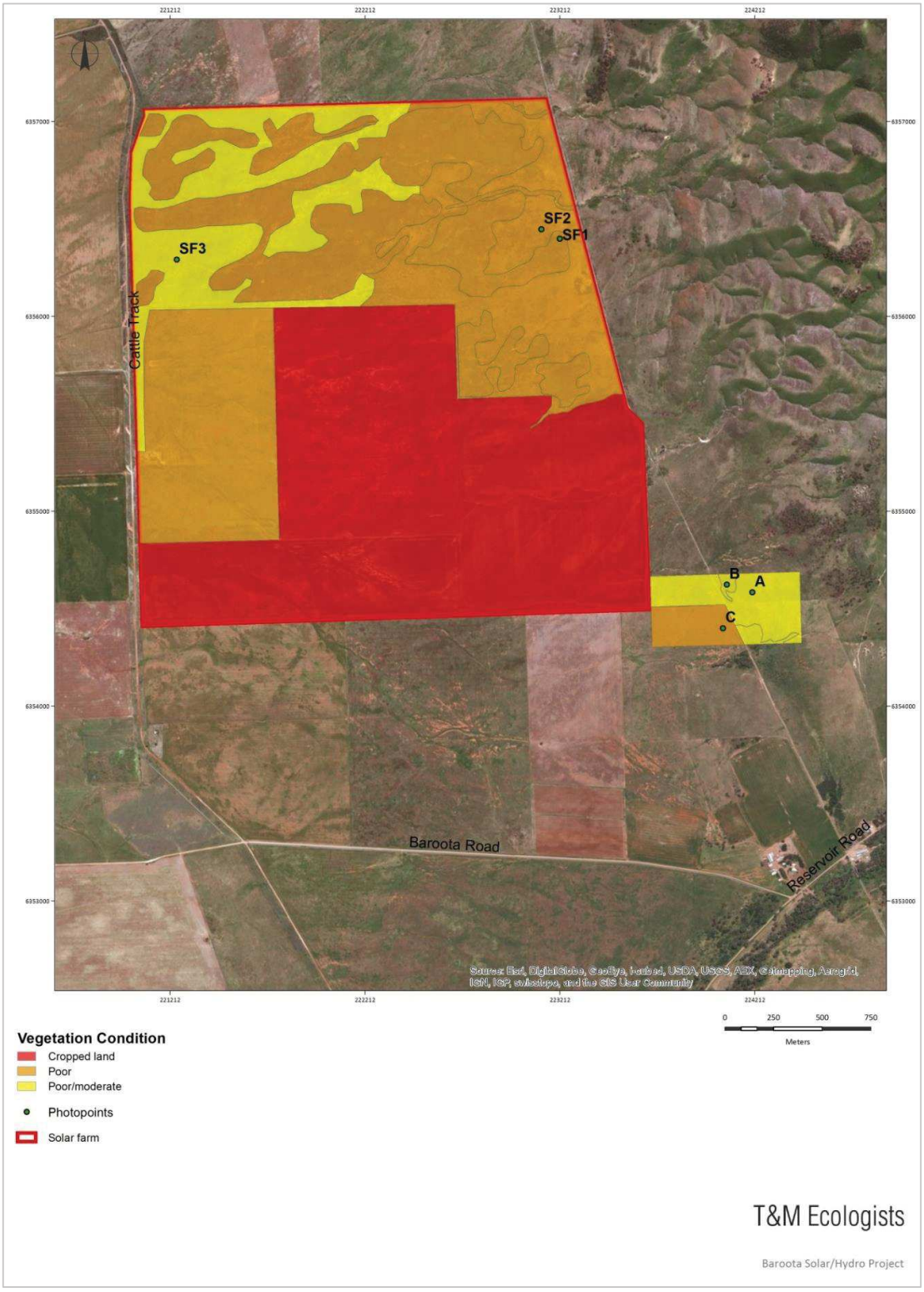


FIGURE 5B: ASSESSED CONDITION OF VEGETATION IN THE SOLAR FARM BLOCK

4.3.4 Native Plant Species

A total of 89 species was observed during the assessment undertaken as part of this project (Table 7A). However, both the timing (autumn) and weather conditions during and prior to the survey would mean that many plants, particularly seasonally evident species, may not have been detected. For this reason, all threatened plant species found within 20km of the site have been assessed for the likelihood of presence, based on the habitat types present in the assessment area. The results of this assessment are provided in Section 4.4.

Hydro area

Sixty-eight native plant species were observed in the hydro block section (Table 7A). Species richness was highest in the mallee community 6 (*Eucalyptus socialis*, *E. gracilis* +/- *E. cajuputea* (patchy) Mallee over *Cassinia laevis, Xanthorrhea quadrangulata)* where 27 native plant species were recorded. The lowest species richness of eight was recorded in community 9, the Bullock Bush (*Alectryon oleifolius*) Low woodland.

No plant species of conservation significance at a national level (EPBC) were recorded at the time of the survey. Four plant species rated as Rare in South Australia (NPWSA) were recorded. These were:

- Flinders Ranges Wattle (*Acacia iteaphylla*)
- Cane Spear-grass (*Austrostipa breviglumis*)
- Green Mallee (*Eucalyptus cajuputea*)
- Rohrlach's Bluebush (*Maireana rohrlachii*)

Solar Farm area

A total of 39 native plant species were observed in the solar farm area (Table 7B). Diversity was highest in vegetation community SF3 (+/- *Maireana pyramidata* +/- *M. aphylla, M. turbinata, M.brevifolia* Open shrubland), where seventeen species were recorded and was lowest in Community C (*Maireana brevifolia* +/- *M. pyramidata* Open shrubland) where seven native plant species were recorded.

No plant species of conservation significance at a national level (EPBC) were recorded at the time of the survey. One plant species rated as Rare in South Australia (NPWSA) was recorded, Rohrlach's Bluebush (*Maireana rohrlachii*), which was found as an overstorey dominant species (with 5-25% cover) in vegetation community A, and as scattered plants in vegetation community B and SF1. It may possibly occur in other vegetation community types in this area.

Threatened flora is discussed further in Section 4.4.

TABLE 7A: PLANT SPECIES RECORDED ON SITE – VEGETATION COMMUNITIES 1-10 (PROPOSED HYDRO SECTION)

		*Conservation Status			Vegetation Community									
Name	**Common_Name**	**EPBC**	**NPWSA**	**NY**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Site 9**	**Site 10**
Acacia calamifolia	Wallowa			RA					R L					
Acacia continua	Thorn Wattle			NT				R N	R N	R N				
Acacia iteaphylla	Flinders Ranges Wattle		R	RA						L N				
Acacia oswaldii	Umbrella Wattle			LC									L N	L N-T
Acacia pycnantha	Golden Wattle			LC	L N r				L N r					
Acacia victoriae ssp. victoriae	Elegant Wattle			LC			R 2	R N		R N	R 2 r	R N r		
Alectryon oleifolius ssp. canescens	Bullock Bush			LC						L N gr			R 3 suckering	L N
Allocasuarina verticillata	Drooping Sheoak			LC					R N	R T r				
Amaranthus mitchellii	Boggabri Weed						R T							
Amyema miquelii	Box Mistletoe			NT	S N	S N				S T				S T
Atriplex angulata	Fan Saltbush			LC										
Atriplex eardleyae	Eardley's Saltbush			LC										
Atriplex lindleyi ssp. inflata	Corky Saltbush			LC										
Atriplex semibaccata	Berry Saltbush			LC			L N							
Atriplex stipitata	Bitter Saltbush			LC										
Atriplex vesicaria	Bladder Saltbush													
Austrostipa acrociliata	Graceful Spear-grass			NT	L N									
Austrostipa breviglumis	Cane Spear-grass		R	NT						R 2				
Austrostipa sp.					L N	L N	L T	R T	R T	R 1	R 1 gr	R 1	L T	R N
Boerhavia dominii	Tar-vine			RA	R T		R 1				R 1 gr	R 1 r		
Calotis hispidula	Hairy Burr-daisy			LC										
Cassinia laevis	Curry Bush			LC	L N gr		R T	R 2	W 2 r	W 2 r	R T gr			
Cheilanthes lasiophylla	Woolly Cloak-fern			LC					L N					
Chenopodium curvispicatum	Cottony Goosefoot			LC	L N									
Convolvulus microsepalus	Small-flower Bindweed			NE				L T						
Convolvulus remotus	Grassy Bindweed			LC	L N		L N		L N	L N		R N		
Cullen australasicum	Tall Scurf-pea			RA										
Cymbopogon ambiguus	Lemon-grass			LC			L T	R 1-2	R 1-2	R 2	R 2 gr	R N		
Dianella revoluta var. revoluta	Black-anther Flax-lily			LC	L N									
Dichondra repens	Kidney Weed			RA	L N gr									

		*Conservation Status			Vegetation Community									
Name	**Common_Name**	**EPBC**	**NPWSA**	**NY**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Site 9**	**Site 10**
Dissocarpus paradoxus	Ball Bindyi			LC										
Dodonaea lobulata	Lobed-leaf Hop-bush			NT				L N						
Dodonaea viscosa ssp. angustissima	Narrow-leaf Hop-bush			LC				L N r gr		R N				
Einadia nutans ssp. nutans	Climbing Saltbush			LC	L N	L N			L T					
Enchylaena tomentosa var. tomentosa	Ruby Saltbush			LC	L N	L N					L T		L 2	L 2
Enneapogon avenaceus	Common Bottle-washers			LC										
Enneapogon cylindricus	Jointed Bottle-washers			LC										
Enneapogon nigricans	Black-head Grass			LC				L T						
Enteropogon acicularis	Umbrella Grass			LC										
Eremophila deserti	Turkey-bush			LC					R N	L N				
Eremophila scoparia	Broom Emubush			LC										L T r gr
Eucalyptus cajuputea	Green Mallee		R	NE						L 2				
Eucalyptus gracilis	Yorrell			NT	W 3	L 2				L 2				R T
Eucalyptus leptohylla	Narrow-leaf Red Mallee			RA		L 2								
Eucalyptus oleosa ssp. ampliata	Red Mallee			LC		W 2-3				L 2				R 2
Eucalyptus pososa	Mallee Box			LC						L 2				
Eucalyptus socialis ssp. socialis	Beaked Red Mallee			NT	R 2					L 2				R 2
Eucalyptus socialis ssp. viridans	Beaked Red Mallee				R 2	W 3								
Euphorbia dallachyana	Caustic Weed				L N	L N				L N		R T		
Glycine rubiginosa	Twining Glycine			NT							L N			
Lomandra multiflora ssp. dura	Hard Mat-rush			LC				R N gr	R 2 gr					
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe			LC										S N
Maireana aphylla	Cotton-bush			LC										
Maireana brevifolia	Short-leaf Bluebush			LC	L T					L 1	R 2		R 3	R T-2
Maireana enchylaenoides	Wingless Fishure-plant			LC	L 1	R N	R T							
Maireana georgei	Satiny Bluebush			LC										L T
Maireana pentatropis	Erect Mallee Bluebush			LC		R N r								
Maireana pyramidata	Black Bluebush			LC		R N r								
Maireana rohrlachii	Rohrlach's Bluebush		R	VU	R N		R N	R N gr			R T gr			

		*Conservation Status			Vegetation Community									
Name	**Common_Name**	**EPBC**	**NPWSA**	**NY**	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Site 9**	**Site 10**
Maireana turbinata	Top-fruit Bluebush			LC										
Myoporum platycarpum ssp. platycarpum	False Sandalwood			LC										
Osteocarpum salsuginosum	Inland Bonefruit			DD										
Pimelea microcephala ssp. microcephala	Shrubby Riceflower			LC	W 2	R T-2	L 2	L N		L 2	R 2	R N r	R 2	R N
Pittosporum angustifolium	Native Apricot			LC	L N	L N				L N				
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris			LC						R 2 r				
Portulaca oleracea	Common Purslane			LC										
Ptilotus obovatus	Silver Mulla Mulla			LC		R N	R T					R N gr		
Ptilotus spathulatus	Pussy-tails			LC			R T					R N		
Rhagodia parabolica	Mealy Saltbush			LC						L T	L T		L T	L 2
Rhagodia spinescens	Spiny Saltbush			LC										L N
Roepera aurantiaca ssp. aurantiaca	Shrubby Twinleaf			RA	R N		R T				L T		R 2	R T-2
Roepera confluens	Forked Twinleaf			LC										
Roepera crenata	Notched Twinleaf			NT										R T
Rytidosperma sp.					L N		L T	L 2		W 2		R N		
Salsola australis	Buckbush			LC			R N							
Scaevola humilis	Inland Fanflower			NT				R 1						
Sclerolaena brachyptera	Short-wing Bindyi			LC										
Sclerolaena divaricata	Tangled Bindyi			LC										
Sclerolaena obliquicuspis	Oblique-spined Bindyi			LC										
Sclerolaena patenticuspis	Spear-fruit Bindyi			LC										
Senecio quadridentatus	Cotton Groundsel			LC				L T						
Solanum cleistogamum	Shy Nightshade			VU	L T gr		L T	L T		L T	R 2-3	L 1-2		L T
Themeda triandra	Kangaroo Grass			LC					L T					
Triodia scariosa	Spinifex			EN				W 3-4 r	R T					
Vittadinia sp.	New Holland Daisy				L N			R N	R T	L 1				
Wahlenbergia communis	Tufted Bluebell			LC				L N	L N					
Wahlenbergia luteola	Yellow-wash Bluebell			LC							L N			
Xanthorrhoea quadranglulata	Rock Grass-tree			NT				R N gr	W 2 r					

TABLE 7B: PLANT SPECIES RECORDED ON SITE – VEGETATION COMMUNITIES A-C AND SF1 – SF3 (PROPOSED SOLAR FARM)

		*Conservation Status			Vegetation Community					
Name	**Common_Name**	**EPBC**	**NPWSA**	**NY**	**A**	**B**	**C**	**SF1**	**SF2**	**SF3**
Acacia oswaldii	Umbrella Wattle			LC		L N				
Acacia victoriae ssp. victoriae	Elegant Wattle			LC	R N	R 2-3 r	L N	R N		
Atriplex angulata	Fan Saltbush			LC	L T-2					
Atriplex eardleyae	Eardley's Saltbush			LC			R 1			
Atriplex lindleyi ssp. inflata	Corky Saltbush			LC						R 2
Atriplex stipitata	Bitter Saltbush			LC	L T	R 2				
Atriplex vesicaria	Bladder Saltbush									W 2-3
Austrostipa sp.						R T			L T	R 1
Calotis hispidula	Hairy Burr-daisy			LC				W 1		
Convolvulus remotus	Grassy Bindweed			LC	L T	L T		L T	L T	
Cullen australasicum	Tall Scurf-pea			RA				L 2	L N	L N
Dissocarpus paradoxus	Ball Bindyi			LC				R N		
Enchylaena tomentosa var. tomentose	Ruby Saltbush			LC	R T	R T	R N	L T		L T
Enneapogon avenaceus	Common Bottle-washers			LC	R T-1					
Enneapogon cylindricus	Jointed Bottle-washers			LC	L N					
Enteropogon acicularis	Umbrella Grass			LC						R 1-2
Maireana aphylla	Cotton-bush			LC		R N	L N			L 2
Maireana brevifolia	Short-leaf Bluebush			LC	R 2	R 2	R 2 gr	R T	W 2	W 1
Maireana georgei	Satiny Bluebush			LC						L 2
Maireana pyramidata	Black Bluebush			LC	R T	R T		R 3	L T	W 2
Maireana rohrlachii	Rohrlach's Bluebush		R	VU	R 2	R T		R T		
Maireana turbinata	Top-fruit Bluebush			LC						R 2
Myoporum platycarpum ssp. platycarpum	False Sandalwood			LC	L N					
Osteocarpum salsuginosum	Inland Bonefruit			DD				L 1		L T
Pimelea microcephala ssp. microcephala	Shrubby Riceflower			LC		L 2 r	L T			
Portulaca oleracea	Common Purslane			LC				L T		
Ptilotus obovatus	Silver Mulla Mulla			LC		L N				

		*Conservation Status			Vegetation Community					
Name	**Common_Name**	**EPBC**	**NPWSA**	**NY**	**A**	**B**	**C**	**SF1**	**SF2**	**SF3**
Rhagodia parabolica	Mealy Saltbush			LC		R N				
Rhagodia spinescens	Spiny Saltbush			LC		L N		L T-2	R N	L N
Roepera aurantiaca ssp. aurantiaca	Shrubby Twinleaf			RA	R T-2 r	R T				
Roepera confluens	Forked Twinleaf			LC				L T		
Rytidosperma sp.										L T
Salsola australis	Buckbush			LC		L T r				L T
Sclerolaena brachyptera	Short-wing Bindyi			LC				R T		R T
Sclerolaena divaricata	Tangled Bindyi			LC						R T
Sclerolaena obliquicuspis	Oblique-spined Bindyi			LC				L T	R T	
Sclerolaena patenticuspis	Spear-fruit Bindyi			LC			R 2			
Sida intricata	Twiggy Sida			NT						R T
Solanum cleistogamum	Shy Nightshade			VU	L T			L T	LT	

***Conservation Status**

EPBC = Environment Protection and Biodiversity Conservation Act 1999

NPWSA = Schedules of the National Parks and Wildlife Act 1972 accessed April 2018

NY = Gillam, S. and Urban, R. (2008) Species Risk Assessment Pilot Project Phase 1 Report: Regional Species Conservation Assessments, Northern and Yorke Region. Department for Environment and Heritage, South Australia.

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, RA = Rare, NT = Near Threatened, LC = Least Concern

Vegetation Community Cover Abundance Codes (adapted from the Biological Survey of SA):

N = Not many (1-10 plants and <5%)
T = sparsely present; cover small (<5%)
1 = plentiful, but of small cover (<5%)
2 = any number of individuals covering 5-25% of area
3 = any number of individuals covering 25-50% of area
4 = any number of individuals covering 50-75% of area
5 = covering more than 75% of area

Manner of Distribution:

L = Localised
S = Skewed
C = Clumped
R = Random
Re = Regular (eg planted)
W = Widespread

Additional codes:

r = regenerating
gr = grazed

4.3.5 Introduced plant species

Note that as with native plants, the timing of the survey may have meant that some seasonally evident species could not be detected. Some species could not be indentified (eg grasses) for similar reasons – the timing of the survey meant that required material for identification (such as seed) was not present.

Hydro Block

All sites contained two or more introduced (weed) species (Table 8A). The least number of weed species was recorded in Community 9 – *Alectryon oleifolius* Low woodland, and the highest number of weeds was in Community 3 - *Acacia victoriae* Shrubland.

No Weeds of National Significance (WONS) were recorded within the Hydro Block. Five Declared plant species were recorded:

- Salvation Jane (*Echium plantagineum*)
- African Boxthorn (*Lycium ferocissimum*)
- Horehound (*Marrubium vulgare*)
- Bathurst Burr (*Xanthium spinosum*)
- Apple of Sodom (*Solanum linnaeanum*)

Salvation Jane, Boxthorn and Horehound were widespread but generally of low cover throughout most habitats in the proposed project area. Bathurst Burr was noted in one specific location, shown in Figure 6, along the drainage line at the eastern end of the Hydro site. Apple of Sodom was generally detected as scattered individuals across a variety of habitats (shrubland, woodland and low shrubland). Grassy and herbaceous weeds were common through most of the assessment areas, probably reflecting the impacts of long term grazing.

Solar Farm Block

All sites contained two or more introduced (weed) species (Table 8B). Ward's Weed was estimated at in excess of 5% cover in all sites, with this cover likely to increase in spring when these plants are more evident. As noted previously, a higher diversity of weed species is likely to be present (and identifiable) in spring, but notwithstanding this, the highest number of weeds (five species) was observed in SF1 (*Maireana pyramidata* +/- *M. brevifolia* Shrubland), with three species observed in vegetation communities A (*Maireana rohrlachii, M. brevifolia* +/- *M. pyramidata, Reopera aurantiaca* Low shrubland with scattered emergent *Acacia victoriae*) and SF3 (+/- *Maireana pyramidata* +/- *M. aphylla, M. turbinata, M.brevifolia* Open shrubland). These areas were also generally considered to be amongst the best condition areas in the solar farm block (see Section 4.3.3).

No Weeds of National Significance (WONS) were recorded within the Solar Farm Block. Three Declared plant species were recorded (although note that is is highly likely that Salvation Jane (*Echium plantagineum*) is also present but was not identifiable at the time of survey):

- African Boxthorn (*Lycium ferocissimum*)
- Horehound (*Marrubium vulgare*)
- Apple of Sodom (*Solanum linnaeanum*)

Boxthorn and Horehound were widespread but generally of low cover through habitats in the site. Apple of Sodom was detected as scattered individuals in vegetation community A (*Maireana rohrlachii, M. brevifolia* +/- *M. pyramidata, Reopera aurantiaca* Low shrubland with scattered emergent *Acacia victoriae*).

Whilst not observeved within the survey area, Buffel Grass (*Cenchrus ciliaris*) has been recorded on nearby roadsides. Buffel Grass is a perennial tussock grass from Africa and Asia and it has the capacity to spread widely and dominate arid and semi-arid zone habitats. It is an erect, deep-rooted, tussock forming, summer-growing perennial grass (summer growing grasses are known as C4 grasses) that forms dense single-species stands that displace native species and change fire regimes[10]. This species was introduced for rangeland improvement, and is now widespread across northern Australia where its control has proved to be highly problematic. It is recommended that hygiene procedures are implemented, if future works proceed, to ensure that this species (along with other problematic weeds) does not become established in the project area.

[10] Government of South Australia (2014). Declared Plant Policy under the *Natural Resources Management Act 2004*; Buffel Grass (*Cenchrus ciliaris* and *C. pennisetiformis).*

TABLE 8A: INTRODUCED PLANT SPECIES RECORDED IN DIFFERENT HABITATS – PROPOSED HYDRO BLOCK

Name	Common Name	Declared Species[11], Weed of National Significance	Habitat Type/Vegetation Community Cover/Abundance									
			1	2	3	4	5	6	7	8	9	10
Avena barbata	Bearded Oat		1a		1	1		1a		1a		
Brassica sp.			1a	1a								
Bromus sp.	Brome		1									
Carrichtera annua	Ward's Weed			1a				1a	2		2	2
Carthamus lanatus	Saffron Thistle		2	1	2	1a	1a	1a	2	2		
Citrullus lanatus	Bitter Melon									1		
Echium plantagineum	Salvation Jane	Declared							1a	2		
Galenia secunda/pubescens var. pubescens	Galenia								1			1
Gramineae sp.					2		1a	1a	1a	2		
Heliotropium europaeum	Common Heliotrope		1a		1				1a	1a		
Hordeum sp.			1a		1a							
Lycium ferocissimum	African Boxthorn	Declared	1	1a	1							1
Marrubium vulgare	Horehound	Declared	1a					1a	2		1	1
Nicotiana sp.					1							
Rapistrum sp.			1a									1a
Rosa sp.					1							
Salvia verbenaca var. verbenaca	Wild Sage				1	1				1a		
Solanum linnaeanum	Apple Of Sodom	Declared			1			1	1	1		
Sonchus sp.	Sow-thistle				1							
Vulpia sp.	Fescue					1	1a					
Xanthium spinosum	Bathurst Burr	Declared			1							

TABLE 8B: INTRODUCED PLANT SPECIES RECORDED IN DIFFERENT HABITATS – PROPOSED SOLAR FARM BLOCK

Name	Common Name	Declared Species[12], Weed of National Significance	Habitat Type/Vegetation Community Cover/Abundance					
			A	B	C	SF1	SF2	SF3
Carrichtera annua	Ward's Weed		2	3	3	2	4	2
Gramineae sp.			2	2	2	1a	1a	1a
Lycium ferocissimum	African Boxthorn	Declared		1	1	1		
Marrubium vulgare	Horehound	Declared				1	1	
Medicago sp.						2	2	1a
Solanum linnaeanum	Apple Of Sodom	Declared	1					

[11] Under the *Natural Resources Management Act 2004*.
[12] Under the *Natural Resources Management Act 2004*.

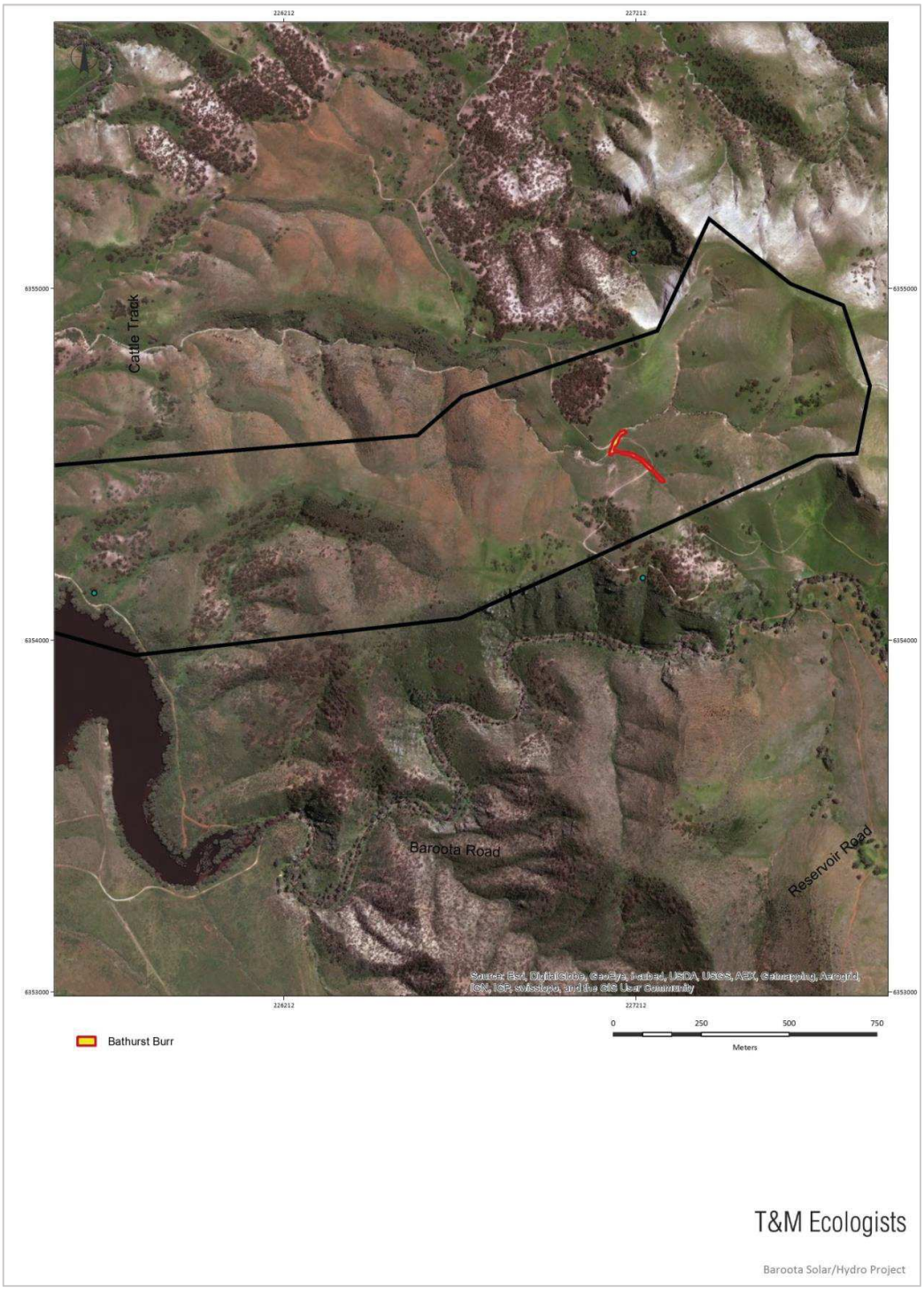


FIGURE 6: SPECIFIC LOCATION OF BATHURST BURR OBSERVED IN THE HYDRO BLOCK

4.4 Fauna

4.4.1 Reptiles

Five reptile species were observed during fieldwork (Table 9). One reptile species was observed in the Solar Farm block and four reptile species in the Hydro Block. All of these species are considered to be widespread and common. An additional six reptile species have previously been observed in the potential impact area and a further 40 reptile species could potentially be present in the impact area. This represents the generally broad diversity of the reptile fauna of the region, rather than any unique habitats in the impact area. By minimising impacts to shrublands, woodlands and Triodia hummock grasslands in the proposed Hydro Block, particularly communities 4,5,6 and 10, impacts on reptiles would be minimised. Reptiles of conservation significance are discussed in Section 4.5.3.

TABLE 9: REPTILE SPECIES OBSERVED ON-SITE, OR PREVIOUSLY RECORDED WITHIN 20KM OF THE SITE

Scientific name	Common name	Source	Observed this survey	Habitat type	Recorded previously in area	Notes
Acanthophis antarcticus	Common Death Adder	1,2				Usually in sandy, coastal soils in this region. Unlikely to be present.
Anilios bicolor	Southern Blind Snake	1,2				Burrowing species usually only seen above ground on warm, humid nights. Possibly present.
Anilios bituberculatus	Rough-nosed Blind Snake	1,2			✓	Burrowing species usually only seen above ground on warm, humid nights. Possibly present.
Aprasia inaurita	Red-tailed Worm-lizard	1,2				Burrowing species that prefers sandy soil types. Unlikely to be present in the site.
Aprasia pseudopulchella	Flinders Worm-lizard	1,2				Occurs in open woodland, native tussock grassland, riparian habitats and rocky isolates. It prefers stony soils or clay soils with a stony surface, and can be found sheltering in soil beneath stones and rotting stumps. Possibly present, especially on eastern hillslopes of habitat type 8.
Brachyurophis australis	Coral Snake	1,2				Nocturnal burrowing snake, usually found under logs and other ground shelter during the day. Sparse records in this region and considered unlikely to be present.
Christinus marmoratus	Marbled Gecko	1,2	✓ Hydro	5		Probably present in most treed or rocky habitats.
Cryptoblepharus pannosus	Speckled Wall Skink	1,2				Prefers areas with some dead standing timber present. Possibly present in mallee areas.
Ctenophorus decresii	Tawny Dragon	1,2	✓ Hydro	5,6		Observed to be common in rocky outcrops.

Scientific name	Common name	Source	Observed this survey	Habitat type	Recorded previously in area	Notes
Ctenophorus pictus	Painted Dragon	2				Usually found in sandy soils, in mallee or coastal shrubland. Unlikely to be present in the site.
Ctenotus regius	Eastern Desert Ctenotus	1,2				Likely to be present, especially in *Maireana spp*. shrubland.
Ctenotus spaldingi	Straight-browed Ctenotus	1,2	✓Solar Farm	SF3		Probably present, in most shrubland vegetation types in the site.
Cyclodomorphus venustus	Saltbush Slender Blue-Tongue	2				Recorded from samphire flats and gibber/chenopod associations on heavy clay soils. Possibly present.
Delma australis	Barred Snake-lizard	1,2				Usually found in Triodia grasslands on sandy soils. Possibly present.
Delma butleri	Spinifex Snake-lizard	1,2			✓	Highly likely to be present in the spinifex (Triodia) vegetation type (Habitat 4).
Delma molleri	Adelaide Snake-lizard	1,2				Prefers grassland/woodland vegetation types.
Demansia psammophis	Yellow-faced Whipsnake	1,2				Found in a wide range of habitats. Possibly present.
Diplodactylus furcosus	Ranges Stone Gecko	1,2				Possibly present, especially in areas where rocky strew is abundant.
Diporiphora nobbi	Nobbi Dragon	1,2				Very scant records in this region. Considered unlikely to be present.
Egernia stokesii	Gidgee Skink	1,2				Possibly present in rocky outcrops in the south-western corner of the hydro block survey area (habitat type 5,6).
Egernia striolata	Eastern Tree Skink	1,2				Possibly present in mallee woodlands and shrublands that have a rocky component (eg habitats 5,6).
Eremiascincus richardsonii	Broad-banded Sandswimmer	1,2				Unlikely to be present, as usually found in sandy soils.
Furina diadema	Red-naped Snake	1,2			✓	Possibly present in habitats 5,6 /mallee – more prevalent in woodland in hilly country.
Gehyra lazelli	Purple Dtella	1,2				Possibly present in shrubland and woodland areas.
Gehyra versicolor	Dtella	1,2				Possibly present in shrubland and woodland areas.
Hemiergis decresiensis	Three-toed Earless Skink	1,2				Likely to be present in most habitat types.
Heteronotia binoei	Bynoe's Gecko	1,2				Likely to be present, especially in/near rocky outcrops.
Lampropholis guichenoti	Garden Skink	1,2				Generally common when present. Prefers higher rainfall woodlands.
Lerista bougainvillii	Bougainville's Skink	1,2			✓	Shelters under surface rocks and logs. Prefers grassland and woodland vegetation.

Scientific name	Common name	Source	Observed this survey	Habitat type	Recorded previously in area	Notes
Lerista dorsalis	Southern Four-toed Slider	1,2				Found in coastal and chenopod shrublands. Possibly present in solar farm and substation areas.
Lerista edwardsae	Myall Slider	1,2				Possibly present, but would prefer mallee woodland with a chenopod shrub understorey.
Lerista frosti	Centralian Slider	2				Likely a spurious record – generally found near the South Australia – Northern Territory border.
Lerista punctatovittata	Eastern Robust Slider	2				Unlikely – prefers deep leaf litter in broad areas of mallee woodland. The small, degraded patches in the site would be unlikely to support a population of this species.
Lerista timida	Dwarf Three-toed Slider	1,2				Possible in *Acacia victoriae* shrublands.
Lialis burtonis	Burton's Legless Lizard	1,2				Highly likely to be present in the spinifex (*Triodia*) vegetation type.
Liopholis margaretae	Masked Rock Skink	1,2				Possibly present in rocky outcrops.
Liopholis whitii	White's Skink	2				Unlikely – generally found in higher rainfall areas south of here.
Menetia greyii	Dwarf Skink	1,2	✓ Hydro	10	✓	Probably present in most habitat types in the area.
Morelia spilota	Carpet Python	1,2				Unlikely, but if present would be in rocky outcrops in the south western corner of the hydro block survey area (habitat type 5,6), or Red Gums around Baroota Reservoir and adjacent drainage lines.
Morethia adelaidensis	Adelaide Snake-eye	1,2				Likely to be present
Morethia boulengeri	Common Snake-eye	1,2	✓ Hydro	10		Probably present in most habitats.
Notechis scutatus	Tiger Snake	1,2				Possibly present in association with Baroota Reservoir.
Parasuta nigriceps	Mitchell's Short-tailed Snake	1,2				Possiby present in mallee woodlands.
Parasuta spectabilis	Mallee Black-headed Snake	1,2				Possiby present in mallee woodlands.
Pogona barbata	Bearded Dragon	2				Likely to be present in most habitat types.
Pogona vitticeps	Central Bearded Dragon	1,2				Likely to be present in most habitat types.
Pseudechis australis	Mulga Snake	1,2			✓	Possibly present.
Pseudonaja aspidorhyncha	Patch-nosed Brown Snake	1,2			✓	Likely to be present.
Pseudonaja textilis	Eastern Brown Snake	1,2				Likely to be present in most habitat types.
Pygopus lepidopodus	Common Scaly-foot	1,2				Possibly present in areas of more structurally complex habitat, such as vegetation types 5&6.

Scientific name	Common name	Source	Observed this survey	Habitat type	Recorded previously in area	Notes
Pygopus schraderi	Hooded Scaly-foot	1,2				Possibly present in areas of more structurally complex habitat, such as vegetation types 5&6.
Simoselaps bertholdi	Desert Banded Snake	1,2				Generally found in sandier soils. Possibly present.
Strophurus intermedius	Southern Spiny-tailed Gecko	1,2				Possibly present, although would only be in Acacia victoriae shrublands or Red Gum woodlands.
Suta suta	Curl Snake	1,2				Possibly present, although there is a lack of suitable shelter sites (rocks, logs) on the ground.
Tiliqua occipitalis	Western Bluetongue	1,2				Possibly present in shrubland areas.
Tiliqua rugosa	Sleepy Lizard	1,2	✓			Will be present in most habitats in both the Solar Farm and Hydro Blocks.
Tiliqua scincoides	Eastern Bluetongue	1,2				Likely to be present.
Tympanocryptis lineata	Lined Earless Dragon	2				Very few records nearby, and none verified with a specimen. Unlikely.
Tympanocryptis tetraporophora	Eyrean Earless Dragon	1,2				Possibly present in clay sols on western side of the solar farm area.
Underwoodisaurus milii	Common Barking Gecko	1,2				Likely to be present, especially in areas were rocks or fallen timber are present.
Varanus varius	Lace Monitor	1,2				Possibly present in area around Baroota Reservoir.
Vermicella annulata	Common Bandy Bandy	1,2				Unlikely. Very few records exist for this species in the area.

4.4.2 Amphibians

No amphibians have been recorded in the impact area, and none were heard to be calling at the time of site inspection. However, it is considered likely that up to six species *may* be present (Table 10). Five of these would primarily be associated with Baroota Reservoir and associated creeks, and consequently would be unlikely to be impacted by works associated with this project. Only one species, the widespread and common Burrowing Frog (*Neobatrachus pictus)* would be expected to be present, in both the Hydro and Solar Farm Blocks. This frog requires only temporary water to breed, and burrows in the soil to survive extended dry periods. This species *may* potentially be impacted by works associated with this project.

TABLE 10: AMPHIBIAN SPECIES OBSERVED ON-SITE, OR PREVIOUSLY RECORDED WITHIN 20KM OF THE SITE

Scientific name	Common name	Source	Observed this survey	Habitat type	Recorded previously in area	Notes
Crinia riparia	Southern Flinders Ranges Froglet	1,2		Reservoir - Hydro		Likely to be present in association with Baroota Reservoir and associated waterways.
Crinia signifera	Common Froglet	1,2		Reservoir - Hydro		Likely to be present in association with Baroota Reservoir and associated waterways.
Limnodynastes dumerilii	Banjo Frog	1,2		Reservoir - Hydro		Likely to be present.
Limnodynastes tasmaniensis	Spotted Grass Frog	1,2		Reservoir - Hydro		Likely to be present in association with Baroota Reservoir and associated waterways.
Litoria ewingii	Brown Tree Frog	1,2		Reservoir - Hydro		Likely to be present in association with Baroota Reservoir and associated waterways.
Neobatrachus pictus	Burrowing Frog	1,2		Hydro and Solar Farm		Likely to be present. A burrowing species that only needs temporary water.
Pseudophryne bibronii	Brown Toadlet	1,2				Unlikely. Usually found in higher rainfall areas.

4.4.3 Native Terrestrial Mammals

Hydro Block

Western Grey Kangaroos (*Macropus fuliginosus*) and, to a lesser extent Euros (*Macropus robustus*), were frequently observed during field survey. Echidna (*Tachyglossus aculeatus*) scratchings were observed in a number of the woodland and shrubland habitats. A further three species of native terrestrial mammals may be present (Table 11). The small insectivorous/carnivorous Fat-tailed Dunnart (*Sminthopsis crassicaudata*) is more likely to be present in more complex shrubland/woodland habitat types, particularly communities 4,5,6 and 10. The Brush-tailed Possum (*Trichosurus vulpecula*) is probably present in Red Gums around Baroota Reservoir and associated creeklines. No signs were observed of this species in mallee vegetation communities, and whilst containing hollows that could house this species, these relatively degraded mallee areas are considered to have few resources to support a population of Brushtail Possums.

Solar Farm Block

Western Grey Kangaroos (*Macropus fuliginosus*) were observed during field survey and it is likely that Euros (*Macropus robustus*) are present at times, although this species is more frequent in hilly country. No signs of Echidnas (*Tachyglossus aculeatus*) were observed, although this species is likely ot be present in all habitat types. The small insectivorous/carnivorous Narrow-nosed Planigale (*Planigale tenuirostris*) and Fat-tailed Dunnart (*Sminthopsis crassicaudata*) are possibly present, most likely in the areas in better condition (A, B, SF3).

TABLE 11: MAMMAL SPECIES OBSERVED ON-SITE, OR PREVIOUSLY RECORDED WITHIN 20KM OF THE SITE

Scientific name	Common name	Source	Observed this survey	Habitat type	Recorded previously in area	Notes
Hydromys chrysogaster	Water Rat	1,2				Needs permanent water. No recent records and has not been observed in Baroota Reservoir so is considered unlikely to be present.
Leggadina forresti	Central Short-tailed Mouse (Forrest's Mouse)	1,2				Unlikely. Most records for this species are much further north.
Macropus fuliginosus	Western Grey Kangaroo	1,2	✓	All		Abundant.
Macropus robustus	Euro	1,2	✓	3,4,5,6,7,8	✓	Several specimens sighted, but not as common as Western Grey. Prefers hilly / rocky areas.
Osphranter rufus	Red Kangaroo	1,2				Possible, but more likely in flatter country associated with the solar farm.
Petrogale xanthopus xanthopus	Yellow-footed Rock Wallaby	1,2				Inhabits rocky outcrops in semi-arid country, ranging from sandstones, limestones and conglomerates in the Flinders Ranges, to granites in the Gawler Ranges and Olary Hills. Unlikely to be impacted by the development.
Planigale tenuirostris	Narrow-nosed Planigale	1,2				Recent (2014) records within 20km. Possibly present, but more likely in Solar Farm area as this species prefers open plains shrubland habitats[13].
Pseudocheirus peregrinus	Common Ringtail Possum	1,2				Generally associated with higher rainfall areas. Unlikely to be present.
Pseudomys bolami	Bolam's Mouse	2				One nearby record only – unlikely to be present.
Pseudomys desertor	Desert Mouse	1,2				Numerous specimens captured nearby in 2011. An irruptive species that responds to rainfall – unlikely to be present on the site at the current time.
Sminthopsis crassicaudata	Fat-tailed Dunnart	1,2				Likely to be present in both Solar Farm and Hydro areas as the species is found in a wide variety of habitat types.
Tachyglossus aculeatus	Short-beaked Echidna	1,2	✓	1,2,6,9,10		Echidna scratchings were observed in a number of habitats in the Hydro area. They are also likely to be present in the Solar Farm area.
Trichosurus vulpecula	Common Brushtail Possum	1,2			✓	Probably present in Red Gums around Baroota Reservoir and up creeklines. No signs observed in mallee vegetation communities, and whilst containing hollows that could house this species, these relatively degraded mallee areas have few resources to support a population of Brushtail Possums.

[13] Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia Third Edition. Oxford Press, South Melbourne.

4.4.4 Bats

Table 12 includes bats that are likely to be present in the broader region. No bats have previously been recorded in the impact area. Two sites in the Hydro area were surveyed using the Anabat recorder, with five bat species detected, all of which are considered to be widespread and common. These species may also forage over the Solar Farm block, although there is no suitable hollows or refuges for the species to use in the area. It should be noted that the calls of the genus *Ozimops* cannot be distinguished by echolocation analysis, however it is considered likely that the calls recorded were from the Little Mastiff Bat (*Ozimops petersi*)[14].

TABLE 12: BAT SPECIES RECORDED IN SITE, OR CONSIDERED POSSIBLY PRESENT IN THE BROADER REGION[15]

Scientific name	Common name	Source	Observed this survey	Habitat type*	Recorded previously in area	Notes
Austronomus australis	White-striped Freetail-bat	1,2	✓	1,3		Occurs in a wide variety of habitats through temperate and arid Australia.
Chalinolobus gouldii	Gould's Wattled Bat	1,2	✓	1,3		Widespread throughout Australia in a variety of habitat types.
Chalinolobus morio	Chocolate Wattled Bat	1,2	✓	1		Not previously recorded within 20km, but considered likely to be present in the broader area[7].
Nyctophilus geoffroyi geoffroyi	Lesser Long-eared Bat	1,2	✓	1,3		Widespread and abundant across much of the Australian continent.
Ozimops petersi	Inland Free-tailed Bat					Not previously recorded within 20km, but considered likely to be present in the broader area.
Ozimops planiceps	Little Mastiff-bat	1,2				Widespread throughout southern Australia. Can nest in small cracks and hollows in trees.
Ozimops sp.	Free-tailed Bat	1	✓	1,3		Ozimps sp can not be separated with Anabat, but most likely all calls were *Ozimops planiceps*, as they were 30khz or lower calls[16].
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat					Widespread across Australia. Not previously recorded within 20km, but considered likely to be present in the broader area. Rare under the *National Parks and Wildlife Act 1972*.
Scotorepens balstoni	Inland Broad-nosed Bat					Arid zone species, often found in Red Gum woodland habitats near water sources. Not previously recorded within 20km, but considered likely to be present in the broader area.
Vespadelus baverstocki	Inland Forest Bat	1,2				Occurs widely in mainland Australian states, generally in woodland areas with rainfall less than 400mm.
Vespadelus darlingtoni	Large Forest Bat					Generally observed further south in higher rainfall areas, but may possibly be present in the broader area.
Vespadelus regulus	Southern Forest Bat	1,2				Widespread across temperate and semi arid environments.

[14] Dennis Matthews pers. comm.
[15] Based upon Dennis Matthew's report see Appendix 1
[16] Dennis Matthews pers. comm.

4.4.5 Birds

Twenty-three (23) species of bird were observed across the whole project site during the survey. The number of birds that have previously been recorded in the project area (based on Biological Database of SA, Atlas of Living Australia and local Bird Life Australia records) is 94. The weather conditions at the time of survey were hot, dry and windy, which would have reduced the number of bird species seen.

Hydro Block

Sixteen bird species were observed in the Hydro Block. The highest number of species was recorded in the *Eucalyptus gracilis, E. socialis ssp*. Mallee / Open mallee, with nine species recorded. No species were recorded in the relatively degraded open areas of community 8, *Solanum cleistogamum* Very open low shrubland +/- *Austrostipa sp., Rytidosperma sp.* with scattered emergent *Acacia victoriae, Pimelea microcephala*. The most commonly observed species was the Singing Honeyeater (*Gavicalis virescens*).

Solar Farm Block

Eleven species were recorded in the Solar Farm Block. The highest number of species was observed in vegetation community A. *Maireana rohrlachii, M. brevifolia* +/- *M. pyramidata, Reopera aurantiaca* Low shrubland with scattered emergent *Acacia victoriae*, with the lowest number recorded in the relatively degraded habitat C *Maireana brevifolia* +/- *M. pyramidata* Open shrubland. The most commonly recorded species was the Australian Pipit (*Anthus australis*). Two species of State Conservation Significance were sighted: the Vulnerable Blue-Winged Parrot (*Neophema chrysostoma*) was flushed from habitat A. *Maireana rohrlachii, M. brevifolia* +/- *M. pyramidata, Reopera aurantiaca* Low shrubland, and the Rare Elegant Parrot (Neophema elegans) was observed in habitat B *Acacia victoriae* +/- *A. oswaldii* Shrubland. These species are discussed further in Section 4.6.1.

Table 13 lists bird species recorded during field survey. A comprehensive overview of the habitat preferences of birds recorded within the local region (within 20km) is provided in Appendix 2. Species of conservation significance known from the region are discussed further in Section 4.6.1. The presence or habitat that is suitable for threatened bird species has implications under the Native Vegetation Act 1991 and the Environment Protection and Biodiversity Conservation Act 1999, as discussed in Section 5.1 and 6.1 respectively.

TABLE 13: BIRD SPECIES IDENTIFIED DURING FIELD SURVEY

Common name	Scientific name	HYDRO BLOCK										SOLAR FARM BLOCK					
		1	2	3	4	5	6	7	8	9	10	A	B	C	SF1	SF2	SF3
Australian Magpie	*Gymnorhina tibicen*			X		X	X								X		
Australian Pipit	*Anthus australis*											X		X	X	X	X
Australian Raven	*Corvus coronoides*	X	X												X	X	X
Blue-Winged Parrot	*Neophema chrysostoma*											X					
Crested Pigeon	*Ocyphaps lophotes*											X					
Elegant Parrot	*Neophema elegans elegans*												X				
Fairy Martin	*Petrochelidon ariel*											X					
Galah	*Eolophus roseicapillus*	X	X	X		X	X					X					
Grey Butcherbird	*Cracticus torquatus*					X	X				X						
Grey Fantail	*Rhipidura albiscapa*	X															
Grey Shrike-thrush	*Colluricincla harmonica harmonica*	X															
Kookaburra	*Dacelo novaeguineae*	X															
Nankeen Kestrel	*Falco cenchroides*											X			X		
Peaceful Dove	*Geopelia striata/placida*										X						
Rock Pigeon	*Columba livia**					X	X										
Singing Honeyeater	*Gavicalis virescens*	X	X	X			X			X	X						
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*					X	X	X		X			X				
Wedge-tailed Eagle	*Aquila audax*			X	X	X											
Weebill	*Smicrornis brevirostris*	X															
White-winged Fairy-wren	*Malurus leucopterus*											X			X	X	X
Willie Wagtail	*Rhipidura leucophrys*			X													
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	X			X												
Yellow-throated Miner	*Manorina flavigula flavigula*						X										

4.4.6 Introduced Mammals

Signs of two introduced mammals, were recorded in both the Hydro and Solar Farm blocks as part of this survey. Both the Solar Farm and Hydro area are currently grazed by sheep. Rabbit warrens were present in habitat types 2 and 8 in the Hydro Block, and scats were observed in the Solar Farm Block. Cats and foxes, both predatory animals that are known to impact on native animal populations, would be present in the site.

Table 14 lists introduced mammal species observed on-site and/or previously recorded within the study area.

TABLE 14: INTRODUCED MAMMAL SPECIES OBSERVED ON-SITE, OR PREVIOUSLY RECORDED FROM THE SURROUNDING AREA

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Notes
Capra hircus	Goat	1,2			
Cervus dama	Fallow Deer	1,2			
Felis catus	Cat	1,2			
Lepus europaeus	European Brown Hare	1,2			
Mus musculus	House Mouse	1,2			
Oryctolagus cuniculus	Rabbit	1,2	✓		Warrens observed in Habitat 2 and Habitat 8, and traces through most other habitats.
Ovis aries	Feral sheep	1,2	✓		Currently grazing in both the Solar Farm and Hydro area
Rattus rattus	Black Rat	1,2			
Vulpes vulpes	Fox	1,2	✓		Scat sighted in Habitat 3.

4.5 Threatened Flora

Table 15 lists flora species of conservation status that have been observed within a 20km radius of the boundary of the site, or were identified by the EPBC Protected Matters Search Tool (PMST).

Hydro Block

Four species that are considered of State conservation significance were noted during the survey, namely;

- Flinders Ranges Wattle (*Acacia iteaphylla*)
- Cane Spear-grass (*Austrostipa breviglumis*)
- Green Mallee (*Eucalyptus cajuputea*)
- Rohrlach's Bluebush (*Maireana rohrlachii*)

These species are all classified as "Rare" at a State level.

Based on the habitats present on the site, there are only two species of National conservation status that might possibly be present – all other species identified in the literature review are considered unlikely. Both of these species, *Olearia pannosa ssp. pannosa* (Silver Daisy-bush) and *Senecio megaglossus* (Superb Groundsel) might possibly be present in the steep, rocky areas where the vegetation is in moderate to good condition (ie Habitat Types 5 and 6). Only one other plant species of state conservation significance is considered likely to be present, namely Annual Fern (*Anogramma leptophylla*), which is found in rocky crevices in the southern Flinders Ranges, and

would only be likely in Habitat Types 5 and 6, ie shrublands and mallee woodlands in the Hydro area. There are many species of State conservation significance that may possibly be present in the site, although most of these species, if present, would belkely in Habitat Types 5 and 6.

Solar Farm Block

One species considered of State conservation significance was noted during the survey, namely;

- Rohrlach's Bluebush (*Maireana rohrlachii*) - listed as "Rare" at a State level.

Based on the relatively degraded nature of the habitats present on the site, it is considered unlikely that there are any species of National conservation status present. It is also considered unlikely that there are any additional species of State conservation significance present (other than Rohrlach's Bluebush).

TABLE 15: FLORA OF CONSERVATION SIGNIFICANCE IDENTIFIED THROUGH LITERATURE REVIEW

A tick in a likelihood category means that is considered the likelihood for both the Hydro and Solar Farm components of the project. Where a species has a different likelihood for the hydro and solar farm blocks it is flagged in the table. The notation Reservoir-Hydro means the species may be found in association with the Baroota Reservoir, which may be impacted by the Hydro part of the project.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Acacia gracilifolia	Graceful Wattle	2,3	O(20)		R	Endemic to South Australia and restricted to the southern Flinders Ranges and northern Mount Lofty Ranges, growing on rocky hillsides and in gorges in open woodland scrub on shallow compact loam soil.[18] Nearest records associated with Telowie Gorge/ Wirrabara Forest and Mount Remarkable National Park.			✓ Hydro	✓ Solar Farm	Suitable habitat is present.
Acacia iteaphylla	Flinders Ranges Wattle	2,3	O(20)		R	Grows on hillsides amongst rocky outcrops or in valleys along rocky creek banks.[19] Nearest record approximately 6km south along a drainage line, but also found in Telowie Gorge/ Wirrabara Forest and Mount Remarkable National Park.	✓ Hydro			✓ Solar Farm	Species recorded during this survey.
Acacia montana	Mallee Wattle	2,3	O(20)		R	Grows in open scrub on hard alkaline red duplex and grey-brown calcareous loamy soils.[20] Nearest record approximately 10km south, near Telowie Gorge Conservation Park.			✓ Hydro	✓ Solar Farm	Suitable habitat is present.
Acacia quornensis	Quorn Wattle	2,3	O(20)		R	Restricted to two locations in the Flinders Ranges, around Quorn and Hawker, growing in low woodland vegetation associated with Callitris, along rocky creeks or on to the lower slopes of the ranges in shallow calcareous loamy soil.[21]				✓	One record only within 20km, about 200m from the northern boundary of the site, but this record has been allocated a low location reliability (>25km).

[17] Based upon this survey.
[18] http://saseedbank.com.au/species_information.php?rid=151 accessed 27/3/2018.
[19] http://saseedbank.com.au/species_information.php?rid=164 accessed 27/3/2018.
[20] http://saseedbank.com.au/species_information.php?rid=183 accessed 27/3/2018.
[21] http://saseedbank.com.au/species_information.php?rid=207 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Acacia spilleriana	Spiller's Wattle	2	O(20)	E	E	Spiller's Wattle is endemic to South Australia and is currently only known from the northern Mount Lofty Ranges and the ranges around Burra and Auburn. The species grows on rocky hills, commonly along watercourses and roadsides.[22]				✓	One record only ~18km SSE of site on edge of Wirrabara Forest from 1999.
Acanthocladium dockeri	Spiny Everlasting / Spiny Daisy	1,2,3	O(20)	CE	E	A low shrub to about 0.5m in height. Habitat of the known subpopulations is remnant grassland on low hills and plains. Soils range from sandy loam to brown light clay. Specific information on the historic habitat of the species is limited to notes included with herbarium specimens (low sand hills near Darling River and Overland Corner, River Murray) and soil attached to the roots of one specimen (reddish sand). This information suggests that the species may have occurred in landscapes of a different soil type and rainfall from those currently occupied.[23] Nearest records on Top Track roadside near Telowie Gorge Conservation Park, approximately 14km south. This is the only known population within 20km.				✓	Only one population recorded in a 20km radius of the study area. The extensive grazing pressure would preclude this species.
Amphibromus archeri	Pointed Swamp Wallaby-grass	2,3	O(20)		R	Grows in damp areas such as lagoons, waterholes and swamps, often on predominantly sandy soils.[24]				✓	One record only within 20km, in Mount Remarkable National Park, about 15km NNE from the site, but this record has been allocated a low location reliability (>25km).
Anogramma leptophylla	Annual Fern	2,3	O(20)		R	Common on damp banks amongst grasses or in rocky crevices.[25] Nearest records associated with Wirrabara Forest and Mount Remarkable National Park.		✓ Hydro		✓ Solar Farm	Suitable habitat is present in habitats 5 and 6.

[22] Department of the Environment, Water, Heritage and the Arts (2009). Approved Conservation Advice for Acacia spilleriana (Spiller's Wattle). Canberra, ACT: Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/biodiversity/threatened/species/pubs/34123-conservation-advice.pdf.
[23] Clarke, A., M.A. Robertson & A. Pieck (2013). Recovery Plan for *Acanthocladium dockeri* (Spiny Daisy). Department of Environment, Water and Natural Resources, Clare, South Australia.
[24] http://saseedbank.com.au/species_information.php?rid=377 accessed 27/3/2018.
[25] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Anogramma_leptophylla accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Anthocercis angustifolia	Narrow-leaf Ray-flower	2,3	O(20)		R	Found in the Flinders Ranges and the southern Mount Lofty Ranges growing on steep rocky slopes on clay-loam; prolific particularly after fires.[26] Nearest record on drainage line about 10km SE from the site, and several records associated with Wirrabara Forest and Mount Remarkable National Park.			✓ Hydro	✓ Solar Farm	Suitable habitat is present in habitats 5 and 6.
Asperula syrticola	Southern Flinders Woodruff	2,3	O(20)		R	Restricted to Flinders Ranges and western Murray Darling Basin region in South Australia. Existing records from hillslopes, with mallee or *Triodia* and surface strew/rock present.[27] Nearest record about 9km SSE of the site.			✓ Hydro	✓ Solar Farm	Suitable habitat is present in habitats 5 and 6.
Austrostipa breviglumis	Cane Spear-grass	2,3	O(20)		R	Found in the Flinders Ranges and the Mount Lofty Ranges in South Australia growing in hills and ridges on sandy loam soils.[28] Nearest record on plains about 10km west of the site, and numerous records in Wirrabara Forest and Mount Remarkable National Park.	✓ Hydro			✓ Solar Farm	Species recorded during this survey.
Austrostipa densiflora	Fox-tail Spear-grass	2,3	O(20)		R	Found in the Flinders Ranges, southern Mount Lofty Ranges and Kangaroo Island, growing in rocky sites on sandy, shallow rock or low-fertility soils.[29] All nearby records are in Mount Remarkable National Park, about 10km north.			✓ Hydro	✓ Solar Farm	Scattered records are present in the region, and habitats are likely to be suitable, especially habitats 5 and 6.
Austrostipa gibbosa	Swollen Spear-grass	2,3	O(20)		R	Found growing on rich loamy soil along creeks and seasonally wet areas in woodland and grassland.[30] Two records only, nearest is 18km north in Mount Remarkable National Park.				✓	There is no matching habitat for this species in the study area.
Austrostipa tenuifolia		2,3	O(20)		R	Found growing in sandy soils in grassland or grassy woodland associated with *Callitris* or *Allocasuarina*.[31] One record only within 20km, about 18km NE in Mount Remarkable National Park.				✓	There is no matching habitat for this species in the study area.

[26] http://saseedbank.com.au/species_information.php?rid=65 accessed 27/3/2018.
[27] http://flora.sa.gov.au/cgi-bin/specimens_map_gd.cgi?genus=Asperula&species=syrticola&infraname=&region=SA accessed 27/3/2018.
[28] http://saseedbank.com.au/species_information.php?rid=587 accessed 27/3/2018.
[29] http://saseedbank.com.au/species_information.php?rid=589 accessed 27/3/2018.
[30] http://saseedbank.com.au/species_information.php?rid=596 accessed 27/3/2018.
[31] http://saseedbank.com.au/species_information.php?rid=620 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Bothriochloa macra	Red-leg Grass	2,3	O(20)		R	Found mainly in the southern part of South Australia (from Port Augusta) but with a few scattered records further north in grasslands and grassy woodland communities but often in degraded sites.[32] Scattered records in the area, nearest being about 8km south of the site.				✓	Habitat is not considered to be suitable for this species.
Brachyscome ciliaris var. subintegrifolia		2	O(20)		R	One nearby record has the following habitat notes: "*Eucalyptus porosa* low woodland over scattered *Rhagodia parabolica, Olearia decurrens and Dodonaea viscosa ssp. angustissima*. Flat area at top of main ridge, loam. Immediately below rocky buttress of summit."[33]. The only record within 20km is about 10km north in Mount Remarkable National Park.				✓	Ulikely given that there is only one record within a 20km radius.
Caladenia arenaria		3	O(20)	E		This species is confined to central western New South Wales. May be a record of *Arachnorchis flindersica,* the Flinders Range Spider Orchid, which has no state or national conservation rating, but is found in open heathy woodland, forest and scrubs, in better soils and usually associated with Sugar gums (*Eucalyptus cladocalyx*). [34]				✓	NA
Caladenia flaccida	Drooping Spider-orchid	2	O(20)		V	In woodland and low scrub, in gorges of the Flinders Ranges including rocky soils; and perhaps near the River Murray. [35] Three records associated with Telowie Gorge Conservation Park, nearest being about 10km away.			✓ Hydro	✓ Solar Farm	Some habitats present are possibly suitable. Would require survey during the flowering period.

[32] http://saseedbank.com.au/species_information.php?rid=720 accessed 27/3/2018.
[33] http://flora.sa.gov.au/cgi-bin/specimens_map_list.cgi?key=AD_995_33_011_ accessed 5/4/2018.
[34] Bates, R.J. (2011). South Australia's Native Orchids. Native Orchid Society of South Australia Incorporated, Unley.
[35] Bates, R.J. (2011). South Australia's Native Orchids. Native Orchid Society of South Australia Incorporated, Unley.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Caladenia gladiolata	Bayonet Spider-orchid	1,2,3	O(20)	E	E	The Bayonet Spider-orchid is known to grow in South Australian Blue Gum (*Eucalyptus leucoxylon*)/Sugar Gum (*E. cladocalyx*), and South Australian Blue Gum/Pink Gum (*E. fasciculosa*) Woodland. Understorey vegetation includes Golden Wattle (*Acacia pycnantha*), Graceful Wattle (*A. gracilifolia*), Cough Bush (*Cassinia laevis*), Scented Bush-pea (*Pultenaea graveolens*), Dusty Miller (*Spyridium parvifolium*), Cranberry Heath (*Astroloma humifusum*) and Common Raspwort (*Gonocarpus tetragynus*). All extant subpopulations grow on slopes (moderate to steep) in sandy loam soils with scattered shale and quartzite.[36] Records exist in both Telowie Gorge / Wirrabara Forest (approximately 11km south) and Mount Remarkable CP (approximately 13km north).				✓	No suitable habitat is present within the study area.
Caladenia macroclavia	Large-club Spider Orchid	1,2,3	O(20)	E	E	The Large-club Spider-orchid grows in fertile shallow loams in mallee-boombrush woodland in sandy loam over limestone[37]. Mallee species such as Yorrel (*Eucalyptus gracilis*), Red Mallee (*E. socialis*) and the Ridge Fruited Mallee (*E. incrassata*) dominate the canopy at all sites.[38] Two records in Telowie Gorge CP, approximately 15km south.				✓	Suitable habitats have been extensively degraded by grazing and so it is considered unlikely that this species is present.
Caladenia saxatilis	Star Spider-orchid	2	O(20)		R	Grows mostly around rocky mountain ridges, under yaccas *(Xanthorrhoea* sp.) and sugar gums (*Eucalyptus cladocalyx*); once locally common. Also found in open woodlands of *Eucalyptus* and *Callitris.* [39] Nearest record just north of Telowie Gorge CP, with only one other record within 20km within Mount Remarkable NP.				✓	Some habitats present are possibly suitable. Would require survey during the flowering period

[36] Quarmby, J.P. (2010). Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia 2010. Department of Environment and Natural Resources, South Australia.
[37] Bates, R.J (2011). South Australia's Native Orchids. Compact disc. Native Orchid Society of South Australia.
[38] Quarmby, J.P. (2010). Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia 2010. Department of Environment and Natural Resources, South Australia.
[39] Bates, R.J. (2011). South Australia's Native Orchids. Native Orchid Society of South Australia Incorporated, Unley.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Caladenia tensa	Greencomb Spider-orchid	1,2,3	O(20)	E		This species occurs in *Callitris spp*. (cypress pine), *Eucalyptus leucoxylon* (yellow gum) woodland and *Melaleuca uncinata* (broombush) mallee on Tertiary and Quaternary Aeolian sandy loams in the Murray-Darling Depression bioregion.[40] Several records in both Telowie Gorge/ Wirrabara Forest (nearest being 11km SSE) and Mount Remarkable NP approximately 12km north.				✓	There is no matching habitat for this species in the study area.
Caladenia woolcockorium	Woolcock's Spider-orchid	1,2,3	O(20)	V	E	Typically grows in *Eucalyptus cladocalyx, E. goniocalyx*, *E. leucoxylon* subsp. *pruinosa* open forest or woodland with an understorey of *Acacia pycnantha*, *Cassinia laevis*, *Hibbertia exutiacies*, *Lomandra densiflora*, *Bulbine bulbosa*, *Caesia vittata*, and *Plantago* spp. *C. woolcockiorum* grows on the mid to lower slopes of steep gullies, in relatively open, herbaceous understorey vegetation with loam soils. *Caladenia woolcockiorum* also grows in *Eucalyptus leucoxylon* subsp. *pruinosa, Allocasuarina verticillata* woodland over *Acacia pycnantha*, *A. gracilifolia*, *Pultenaea graveolens* and *Cassinia laevis*. In this habitat type *C. woolcockiorum* grows on gentle south facing slopes and flats with clay loam soils. Historically *Caladenia woolcockiorum* also grew in *Eucalyptus microcarpa* woodland over *Acacia pycnantha*, *Bursaria spinosa*, and *Cassinia laevis* on mossy rock ledges and rocky slopes with shallow dark loam soil in Mambray Creek. [41] Numerous records, but restricted (within nearest 20km) to Mount Remarkable National Park, approximately 11km north.				✓	There is no matching habitat for this species in the study area.

[40] Threatened Species Scientific Committee (2016). Approved Conservation Advice for *Caladenia tensa* (rigid spider-orchid). Canberra: Department of the Environment and Energy. http://www.environment.gov.au/biodiversity/threatened/species/pubs/24390-conservation-advice-16122016.pdf.
[41] Quarmby, J.P. (2010). Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia 2010. Department of Environment and Natural Resources, South Australia.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Caladenia xantholeuca	White Rabbits	1,2,3	O(20)	E	E	Occurs in *Callitris glaucophylla* woodland, often on south-facing slopes in heavily shaded areas, where it grows on mossy rock ledges and red-brown loam soils. Observed in Mount Remarkable following fire in 2011. All native vegetation within five-hundred metres of historical sub-populations is considered to be habitat critical to the survival of the species[42]. Records exist in both Telowie Gorge / Wirrabara Forest (approximately 11km south) and Mount Remarkable CP (approximately 10 km north).				✓	No matching habitat was found in the site.
Callitriche umbonata	Water Starwort	2,3	O(20)		V	Found growing in damp and swampy places[43]. One records only, in Wirrabara Forest about 12km SSE.				✓	There is no matching habitat for this species in the study area.
Calotis lappulacea	Yellow Burr-daisy	2,3	O(20)		R	Perennial herb or undershrub to 50 cm high with hairy, erect, much-branched, wiry stems, becoming woody in the lower part[44]. Occurs on loamy sand to clay loam red earths. Found in all mainland States. One record only, about 12km north of the site in Mount Remarkable NP.				✓	Sparse records and generally degraded habitats in the site mean this species is considered unlikey to be present.
Carex gunniana	Mountain Sedge	2,3	O(20)		R	Grows in wet places in the South East, Mount Lofty Ranges and southern Flinders Ranges.[45] One record only, about 12km north of the site in Mount Remarkable NP.				✓	Ulikely given that there is only one record within a 20km radius and no suitable habitats are present.
Choretrum chrysanthum	Yellow Sour-bush	2,3	O(20)		R	Many-stemmed virgate shrub to 1-3 m high. Found in the southern part of South Australia from the west coast to the lower South-east.[46] Several records, about 12km north of the site in Mount Remarkable NP.			✓ Hydro	✓ Solar Farm	Less grazed habitats in the Hydro site (communities 5,6) may be suitable.
Christella dentata	Soft Shield-fern	2,3	O(20)		R	Found mainly along the Murray River in South Australia, with a few records from the southern Flinders Ranges and the upper Eyre Peninsula, growing on damp banks or in hollows in the limestone cliffs.[47] Two records, about 16km NNE of the site in Mount Remarkable NP.				✓	There is no matching habitat for this species in the study area

[42] Quarmby, J.P. (2010). Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia 2010. Department of Environment and Natural Resources, South Australia.
[43] http://saseedbank.com.au/species_information.php?rid=906 accessed 27/3/2018.
[44] Government of South Australia (2018). Seeds of South Australia: *Calotis lappulacea* Yellow Burr-daisy. South Australian Seed Conservation Centre, Botanic Gardens of South Australia
[45] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Carex_gunniana accessed 27/3/2018.
[46] http://saseedbank.com.au/species_information.php?rid=4870 accessed 27/3/2018.
[47] http://saseedbank.com.au/species_information.php?rid=1116 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Citrus glauca	Desert Lime	2,3	O(20)		V	Desert lime is usually restricted to heavy brown clays, desert loams or red earths, and usually occurs as small trees or as shrubs in dense thickets.[48] One record about 9km NNW of the site, just outside Mount Remarkable NP.				✓	Unlikely given that there is only one record within a 20km radius and habitats are not really suitable.
Cladium procerum	Leafy Twig-rush	2,3	O(20)		R	Found in the northern and southern Flinders Ranges, southern Mount Lofty Ranges and the lower South-east in South Australia, growing in coastal swamps and margins of creeks.[49] One record from 1994 about 4km NNW of the site, with 3 other records in or in close proximity to Mount Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Crassula peduncularis	Purple Crassula	2,3	O(20)		R	Grows in marshy areas which are rarely flooded; occurring mainly in south-eastern Australia.[50] Nearest record on drainage line about 15km ENE of the site, with one other record in Wirrabara Forest.				✓	There is no matching habitat for this species in the study area.
Cryptandra campanulata	Long-flower Cryptandra	2,3	O(20)		R	Generally found in rocky clay loams on low hills and ranges. Nearest record about 14km south in Telowie Gorge CP, also found in Mount Remarkable NP and one record in hills about 18km east.			✓ Hydro	✓ Solar Farm	Habitat types 5 and 6 may be suitable.
Cullen parvum	Small Scurf-pea	2,3	O(20)		V	Found in the southern Flinders Ranges to the Mount Lofty Ranges in South Australia, growing in grasslands, grassy woodland or open forest vegetation dominated by *Eucalyptus* species on alluvial plains, creeks, ephemeral pools and river channels.[51] One record only on drainage line 14km NE of the site, near Mount Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Cyperus sanguinolentus	Dark Flat-sedge	2	O(20)		R	Found in the southern Flinders Ranges and the southern Mount Lofty Ranges in South Australia, growing in wet areas around swamps and on stream-banks.[52] One records only, about 17km north of the site in Mount Remarkable National Park.				✓	There is no matching habitat for this species in the study area.

[48] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Eremocitrus_glauca accessed 27/3/2018.
[49] http://saseedbank.com.au/species_information.php?rid=4881 accessed 27/3/2018.
[50] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Crassula_peduncularis accessed 27/3/2018.
[51] http://saseedbank.com.au/species_information.php?rid=1299 accessed 27/3/2018.
[52] http://saseedbank.com.au/species_information.php?rid=1362 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Dianella longifolia var. grandis	Pale Flax-lily	2	O(20)		R	Recorded from the southern Flinders Ranges, Mount Lofty Ranges and the South-east in South Australia, growing in grassy woodland.[53] Three records in Mount Remarkable National Park, nearest being about 15km north.				✓	There is no matching habitat for this species in the study area.
Diuris behrii	Behr's Cowslip Orchid	2,3	O(20)		V	Grows in native grassland, open woodland and grassy forest on more fertile soils, especially amongst Kangaroo Grass and *Triodia* on gentle slopes and flats[54]. Two records in the hills about 18km west, but also recorded in Mount Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Diuris chryseopsis		3	O(20)		E	Extinct in the Mt Lofty Ranges and found only between Naracoorte and Mount Gambier in South Australia, growing in damper grassy patches in woodland around waterholes along creeks, on cooler slopes, in rich, moist soils.[55] One undated record from about 10km south, just north of Telowie Gorge CP.				✓	One (undated) record only within a 20km radius and there is no matching habitat for this species in the study area.
Echinopogon ovatus	Rough-bearded Grass	3	O(20)		R	This species needs grassy woodlands; comes back after fire.[56] Nearest record about 11km NE in Mount Remarkable National Park, with records also in Wirrabara Forest.				✓	There is no matching habitat for this species in the study area.
Elatine gratioloides	Waterwort	2,3	O(20)		R	Found scattered across South Australia except for Kangaroo Island, growing in or on the margins of stationary or slow-flowing water to 40 cm deep.[57] Two records in Mount Remarkable NP and one in Telowie Gorge RP, closest being about 12km south.				✓	There is no matching habitat for this species in the study area.
Eremophila subfloccosa ssp. glandulosa	Green-flower Emubush	2	O(20)		R	Broom-like shrub to 3 m tall; Loam, gravelly clay loam in gently undulating plains and disturbed roadsides.[58] Nearest records associated with Telowie Gorge/ Wirrabara Forest and Mount Remarkable National Park.			✓ Hydro	✓ Solar Farm	Scattered records are present in the region, and habitats are likely to be suitable.
Eucalyptus albens	White Box	2,3	O(20)		R	Found in the southern Flinders Ranges, growing in undulating to hilly terrain on loam to clay soils.[59] Nearest record about 1km west of site boundary, with numerous records north, south and west of the site.			✓ Hydro	✓ Solar Farm	Possibly present in difficult to access areas of habitat type 6.

[53] http://saseedbank.com.au/species_information.php?rid=1424 accessed 27/3/2018.
[54] http://saseedbank.com.au/species_information.php?rid=1492 accessed 27/3/2018.
[55] http://saseedbank.com.au/species_information.php?rid=1494 accessed 5/4/2018.
[56] http://saseedbank.com.au/species_information.php?rid=1557 accessed 5/4/2018.
[57] http://saseedbank.com.au/species_information.php?rid=1579 accessed 27/3/2018.
[58] https://florabase.dpaw.wa.gov.au/browse/profile/14633 accessed 27/3/2018.
[59] http://saseedbank.com.au/species_information.php?rid=1782 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Eucalyptus behriana	Broad-leaf Box	3	O(20)		R	Found on southern Eyre Peninsula, southern Flinders Ranges, northern Mount Lofty Ranges and upper South-east in South Australia, growing on heavy soils in slight depressions or in gently undulating terrain[60]. One record from 1879, about 12km SSE from the site, near Wirrabara Forest Reserve.				✓	One record only from 1879 within a 20km radius.
Eucalyptus cajuputea	Green Mallee	2,3	O(20)		R*	Found growing on rocky hillslopes and ridges and deeper soils on the footslopes and undulating plains.[61] Nearest record is approximately 7.5km north of site boundary in Mount Remarkable National Park.	✓ Hydro			✓ Solar Farm	Species recorded during this survey.
Eucalyptus percostata	Ribbed White Mallee	2,3	O(20)		R	Found growing on well-drained clay-loams in woodland and mallee on slopes and foot of rocky hills[62]. Nearest record is approximately 6km north of site boundary in Mount Remarkable National Park.			✓ Hydro	✓ Solar Farm	Could possibly be present in difficult to access sections of habitat type 6.
Eucalyptus polybractea	Flinders Ranges Box	2,3	O(20)		R	Found in the northern Flinders Ranges in South Australia, growing on slopes and ridges of rocky hills and ranges in mallee shrubland.[63]One record from 1946, approximately 16km SSE of the site boundary.				✓	One record only from 1946 within a 20km radius.
Festuca benthamiana	Bentham's Fescue	2,3	O(20)		R	Flinders Ranges specimens appear to be in Long-leaved Box (*Eucalyptus goniocalyx*) or Red Gum (*Eucalyptus camaldulensis*) communities on loams and clay loams.[64] Nearest record is approximately 10km NNE of site boundary in Mount Remarkable National Park.				✓	There is no matching habitat for this species in the study area.
Frankenia cupularis		2,3	O(20)		R	Small much-branched shrub. Found on the north and north-eastern parts of South Australia, growing on sand flats and salt pans[65]. One record from 1993, approximately 19.5km NW of the site boundary.				✓	There is no matching habitat for this species in the study area.

[60] http://saseedbank.com.au/species_information.php?rid=1787
[61] http://saseedbank.com.au/species_information.php?rid=1879 accessed 27/3/2018.
[62] http://saseedbank.com.au/species_information.php?rid=1858 accessed 27/3/2018.
[63] http://saseedbank.com.au/species_information.php?rid=1864 accessed 27/3/2018
[64] http://flora.sa.gov.au/cgi-bin/specimens_map_list.cgi?key=AD_999_26_212_,AD_995_30_294_ accessed 27/3/2018
[65] Government of South Australia (2018). Seeds of South Australia: *Frankenia cupularis* Cupped Sea-heath. South Australian Seed Conservation Centre, Botanic Gardens of South Australia.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Glycine latrobeana	Clover Glycine	2,3	O(20)	V	V	The Clover Glycine occurs mainly in grassland and grassy woodland habitats, less often in dry forests, and only rarely in heathland. South Australian sites include low lying, seasonally inundated grassy woodlands dominated by *Eucalyptus viminalis* subsp. *cygnetensis* (Manna Gum) and/or *E. leucoxylon* subsp. *leucoxylon* (Yellow Gum) or *E. obliqua* (Messmate Stringybark). [66] One record only within 20km, approximately 15km SSE in Wirrabara Forest Reserve.				✓	There is no matching habitat for this species in the study area.
Glycine tabacina	Variable Glycine	2,3	O(20)		V	Found in three disjunct population in South Australia, in the southern Flinders Ranges, southern Mount Lofty Ranges and the lower Southeast, growing in *Eucalyptus camaldulensis* woodland, more often in shady or moist gullies on sandy loam soils.[67] Nearest record is approximately 12km NNE of site boundary on the bank of the Willochra Creek at Melrose.				✓	There is no matching habitat for this species in the study area.
Hovea purpurea	Tall Hovea	2,3	O(20)		R	Erect shrub 2-3 m high that grows on rocky ridges and by streams on various substrates in forest, woodland and riparian scrub.[68] Nearest record is approximately 10.5km NNE of site boundary in Mount Remarkable.				✓	There is no matching habitat for this species in the study area.
Juncus homalocaulis	Wiry Rush	2,3	O(20)		V	Found growing in damp sites in grassland, woodland and dry sclerophyll forests.[69] Nearest record is approximately 7.6km west of site boundary in Baroota Gorge.				✓	There is no matching habitat for this species in the study area.
Juncus radula	Hoary Rush	2,3	O(20)		V	Found growing on seasonally damp areas in depressions and along drainage lines in woodland and open grassland.[70] One record from the Melrose Railway Station in 1972 – approximately 15km NNE of the site boundary.				✓	There is no matching habitat for this species in the study area.
Lachnagrostis robusta	Salt Blowngrass	3	O(20)		R	Herbarium records indicate this species is found on poorly drained clay soils in association with species that tolerate temporary inundation.[71]				✓	There is no matching habitat for this species in the study area.

[66] Carter, O. & G. Sutter (2010). National Recovery Plan for the Clover Glycine Glycine latrobeana. Department of Sustainability and Environment, Melbourne.
[67] http://saseedbank.com.au/species_information.php?rid=2081 accessed 27/3/2018.
[68] http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Hovea~purpurea accessed 27/3/2018.
[69] http://saseedbank.com.au/species_information.php?rid=2481 accessed 27/3/2018.
[70] http://saseedbank.com.au/species_information.php?rid=2488 accessed 27/3/2018.
[71] http://flora.sa.gov.au/cgi-bin/specimens_map_gd.cgi?genus=Agrostis&species=billardieri&infraname=&region=SA accessed 5/4/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Lepidium pseudotasmanicum	Shade Peppercress	2,3	O(20)		V	Found in the southern Flinders Ranges, Mid-North and along the Murray River in South Australia, growing in rocky areas.[72] Nearest record is approximately 2km south of the site boundary in Baroota Gorge.			✓ Hydro	✓ Solar Farm	Suitable habitat is present, especially in habitats 5 and 6. Would require survey work following good rains.
Leptorhynchos elongatus	Lanky Buttons	3	O(20)		R	Found in the southern Flinders Ranges, the Mount Lofty Ranges and the northern Yorke Peninsula in South Australia, growing in woodland and grassland on sandy to sandy loam soils[73].				✓	There is no matching habitat for this species in the study area.
Logania saxatilis	Rock Logania	2,3	O(20)		R	Endemic to South Australia and found in the Flinders Ranges and the Mount Lofty Ranges, growing on steep-sided sandstone gorges in open woodland community and in crevices of rocky outcrops in shallow sandy or clay-rich soils.[74] Nearest record is just outside the southern site boundary, above the waterfall in Waterfall Creek at Baroota.			✓ Hydro	✓ Solar Farm	Scattered records are present in the region, and habitats 5 and 6 are possibly suitable.
Maireana excavata	Bottle Bluebush	3	O(20)		V	A grassland species, found in hilly areas.[75]				✓	There is no matching habitat for this species in the study area.
Maireana rohrlachii	Rohrlach's Bluebush	2,3	O(20)		R	Intricately branched shrub to 1 m high found in heavy soil.[76] Nearest record is approximately 9km north of the site boundary in Mt Remarkable National Park.	✓				Species recorded during this survey.
Mentha satureioides	Native Pennyroyal	2,3	O(20)		R	Found scattered from the Gammon, Flinders and Mount Lofty Ranges, southern Eyre Peninsula and the upper South-east in South Australia, growing on heavy, seasonally wet soils.[77] Nearest record is approximately 12.5km north of the site boundary, adjacent to Mt Remarkable NP on disused rail reserve between Melrose-Wilmington Road and Mt Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Olearia glutinosa	Sticky Daisy_bush	3	O(20)		E	Found only in the Naracoorte Coastal Plain region[78] – likely to be a spurious record.				✓	NA

[72] http://saseedbank.com.au/species_information.php?rid=2590 accessed 27/3/2018.
[73] http://saseedbank.com.au/species_information.php?rid=2630 accessed 5/4/2018.
[74] http://saseedbank.com.au/species_information.php?rid=2718 accessed 27/3/2018.
[75] http://saseedbank.com.au/species_information.php?rid=2796 accessed 5/4/2018.
[76] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Maireana_rohrlachii accessed 27/3/2018.
[77] http://saseedbank.com.au/species_information.php?rid=2918 accessed 27/3/2018.
[78] http://saseedbank.com.au/species_information.php?rid=3104 accessed 5/4/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Olearia pannosa ssp. cardiophylla	Velvet Daisy-bush	2	O(20)		R	Known from dry open-forest, on shallow rocky soils[79]. Nearest record is approximately 14.4km north of site boundary in Mt Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Olearia pannosa ssp. pannosa	Silver Daisy-bush	1,2	O(20)	V	V	A spreading undershrub or shrub growing up to 1.5 m high. The silver daisy-bush occurs in sandy, flat areas and in hilly, rocky areas in woodland or mallee. Hilly area soil types include hard pedal mottled-yellow duplex and hard pedal red duplex.[80] One record only within 20km, approximately 18km north in Mount Remarkable National Park.			✓ Hydro	✓ Solar Farm	Habitats are possibly suitable on site, however there is only one record within a 20km radius. Only considered possible in areas of better condition in the hills – namely habitats 5 and 6.
Olearia picridifolia	Rasp Daisy-bush	2,3	O(20)		R	Found mainly in mallee and heath on alkaline soils derived from limestone or dunes.[81]Nearest record is approximately 7km south-west of the site boundary.				✓	There is no matching habitat for this species in the study area.
Ottelia ovalifolia ssp. ovalifolia	Swamp Lily	2	O(20)		R	Found growing in still water such as dams, lakes, billabongs and slow-moving rivers.[82] One record approximately 19km north-east of site boundary in Mt Remarkable NP				✓	There is no matching habitat for this species in the study area.
Ozothamnus scaber	Rough Bush-everlasting	2,3	O(20)		V	Endemic to South Australia and found in the Flinders Ranges. Nearest record is approximately 10km NNE of site boundary in Mt Remarkable NP.			✓ Hydro	✓ Solar Farm	Preferred habitat may be present on the site.
Phlegmatospermum eremaeum	Spreading Cress	3	O(20)		R	Scattered distributions on the Nullarbor and in the north-eastern and central parts of South Australia, growing in open mallee on calcareous clay or loam[83].				✓	Outside known range of the species, and preferred habitat does not match habitats present in the site.
Philotheca angustifolia ssp. angustifolia	Narrow-leaf Wax-flower	2	O(20)		R	Found in rocky areas in ranges. Nearest record is approximately 15km south of site boundary in Telowie Gorge Conservation Park.			✓ Hydro	✓ Solar Farm	Habitat types 5 and 6 may be suitable.
Phyllangium sulcatum	Rock Mitrewort	2,3	O(20)		V	Found growing in sheltered, rocky areas on shallow soils overlaying rock.[84] Nearest record is approximately 9km south of site boundary in Telowie Gorge Conservation Park.			✓ Hydro	✓ Solar Farm	Preferred habitat may be present on the site.

[79] https://vicflora.rbg.vic.gov.au/flora/taxon/95c7be76-c6db-4373-aa1c-e37824ff43f2 accessed 27/3/2018.
[80] Department of the Environment (2013). Approved Conservation Advice for *Olearia pannosa subsp. pannosa* (silver daisy-bush). Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/12348-conservation-advice.pdf.
[81] http://saseedbank.com.au/species_information.php?rid=3117 accessed 27/3/2018.
[82] http://saseedbank.com.au/species_information.php?rid=3171 accessed 27/3/2018.
[83] http://saseedbank.com.au/species_information.php?rid=3303 accessed 5/4/2018.
[84] http://saseedbank.com.au/species_information.php?rid=3316 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Poa umbricola	Shade Tussock-grass	3	O(20)		R	This species occurs in rocky seeps in the Mount Lofty Ranges.[85]				✓	Outside known range of the species, and preferred habitat does not match habitats present in the site.
Podolepis muelleri	Button Podolepis	2,3	O(20)		V	Occurs on coastal cliffs and on stony sites further inland.[86] One record from 1906, approximately 8km west of site boundary.				✓	One record only from 1906 within a 20km radius.
Prasophyllum pallidum	Pale Leek-orchid	1,2,3	O(20)	V	R	Pale Leek-orchid is known singly or in groups in well-grassed open forests from the Flinders Ranges to the Northern and Southern Lofty regions of South Australia.[87] Habitats recorded include: • *Eucalyptus leucoxylon* open forest, low open forest, and low woodland • *E. goniocalyx* woodland • *E. fasciculosa* low woodland, and low open woodland • *E. microcarpa* woodland • *Callitris gracilis/Eucalyptus fasciculosa* low open forest • *Allocasuarina verticillata* over *Lissanthe strigosa, Amphipogon strictus* and *Tricoryne elatior*.[88] Records in both Telowie Gorge Conservation Park, 12km south, and Mount Remarkable National Park (15km north).				✓	There is no matching habitat for this species in the study area.
Prasophyllum validum		1,2,3	O(20)	V	V	Little is known of the ecology or biology of the species, although it seems to prefer relatively dry woodland habitats. In South Australia, this species occurs in *Eucalyptus cladocalyx* woodland with porcupine grass *Triodia* species understorey, on loamy soils.[89] Records in both Telowie Gorge Conservation Park, 14km south, and Mount Remarkable National Park (12km north-east).				✓	No Eucalyptus cladocalyx woodland is present in the site, so no preferred habitat is present.

[85] http://saseedbank.com.au/species_information.php?rid=3431 accessed 5/4/2018.
[86] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Podolepis_muelleri accessed 27/3/2018.
[87] Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for Prasophyllum pallidum (Pale Leek-orchid). Canberra: Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/biodiversity/threatened/species/pubs/20351-conservation-advice.pdf.
[88] Department for Environment and Heritage (2008). Threatened Species Profile: *Prasophyllum pallidum*. Department for Environment and Natural Resources, Adelaide.
[89] Duncan, M. (2010). National Recovery Plan for the Sturdy Leek Orchid Prasophyllum validum. Department of Sustainability and Environment, Melbourne.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Pterostylis chlorogramma		3	O(20)	V	E	In South Australia this species is confined to the South East region[90]. Likely a spurious record.				✓	NA
Pterostylis curta	Blunt Greenhood	2	O(20)		R	Forms small to extensive colonies in fertile loams in deeply shaded gullies and along creeks in high rainfall areas.[91] One record approximately 14km north of site boundary in Mt Remarkable NP.				✓	There is only one record within a 20km radius and suitable habitat is not present in the study area.
Pycnosorus globosus	Drumsticks	2,3	O(20)		V	On clay soils in woodland, grassland and saltbush steppe, forming dense colonies.[92] One record from 1915, approximately 12km NE of site boundary.				✓	One record only from 1915 within a 20km radius.
Rhodanthe anthemoides		3	O(20)		E	Only specimens in South Australian Herbarium comes from the top of Mount Bryan[93].				✓	.
Rytidosperma tenuius	Short-awn Wallaby-grass	2,3	O(20)		R	Often grows in dry sclerophyll forest on sandy soils.[94] One record approximately 12km south of site boundary in Telowie Gorge CP.			✓ Hydro	✓ Solar Farm	Preferred habitat may be present on the site.
Santalum spicatum	Sandalwood	2,3	O(20)		V	Tall shrub to 5 m high and semi-parasitic on other plants. Found throughout the arid to semi-arid zone. In the eastern part of its range in South Australia it occurs in clayey soils on stony hillsides and flats in gullies, and along watercourses. Nearest record approximately 13km south of site boundary in Telowie Gorge CP.			✓ Hydro	✓ Solar Farm	Suitable habitat is present, but would likely have been observed if present in Solar Farm area.
Scutellaria humilis	Dwarf Skullcap	2,3	O(20)		R	Found in moist sheltered places such as along creeks or ravines.[95] Recorded at the southern end of the site, in Baroota Gorge.				✓	There is no matching habitat for this species in the study area.
Senecio macrocarpus	Large-fruit Fireweed	3	O(20)	V	V	In South Australia, Large-fruit Fireweed occurs most commonly in depressions in low-lying closed sedgeland but may occur in sedgeland, herbland, low shrubland to low open woodland where competition from understorey plants is low. The soils range from clay to loamy sand.[96]				✓	Suitable habitat may be present.

[90] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=56510 accessed 4/4/2018.
[91] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Pterostylis_curta accessed 27/3/2018.
[92] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Craspedia_globosa accessed 27/3/2018.
[93] http://saseedbank.com.au/species_information.php?rid=3773 accessed 5/4/2018.
[94] http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Rytidosperma~tenuius accessed 27/3/2018.
[95] http://flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Scutellaria_humilis accessed 27/3/2018.
[96] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16333 accessed 5/4/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Senecio megaglossus	Superb Groundsel	1		V	E	This species is a perennial shrub, usually erect but much-branched, growing up to 80 cm high. It primarily inhabits rocky gorges and valley slopes and has been recorded from a number of vegetation types including grasslands; tall open shrublands with Native Apricot (*Pittosporum angustifolium*), Bullock Bush (*Alectryon oleifolius*), and Emu Bush (*Eremophila longifolia*); in association with Spinifex (*Triodia irritans*); and in association with White Cypress-pine (*Callitris columellaris*) and River Red Gum (*Eucalyptus camaldulensis*). [97]			✓ Hydro	✓ Solar Farm	Suitable habitat may be present, however only considered likely in habitat types 5 and 6.
Swainsona behriana	Behr's Swainson-pea	2,3	O(20)		V	Scattered throughout sandy soils, loamy earths or heavy clay, in flood-plains or gibber-plains[98]. Nearest record is approximately 13.5km north-east of site boundary in Mt Remarkable NP.				✓	Habitat types present do not align well, and the habitats present on the plains are depapuperate in species due to long term grazing.
Swainsona procumbens	Broughton Pea	2,3	O(20)		V	Found in heavy soil prone to waterlogging.[99] One record approximately 13km north-east of site boundary in Mt Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Swainsona pyrophila	Yellow Swainson-pea	1		V	R	The Yellow Swainson-pea occurs in mallee vegetation communities on a variety of soil types including well-drained sands, sandy loams and heavier clay loams. The only detailed habitat information is from South Australia, where the species was recorded from mallee woodland with Eucalyptus species including *E. brachycalyx, E. calycogona, E. dumosa, E. gracilis, E. incrassata, E. leptophylla, E. oleosa* and *E. socialis*, sometimes with Broombush *Melaleuca uncinata* tall shrubland.[100]				✓	Mallee habitats present on site are generally quite degraded.

[97] Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for *Senecio megaglossus* (Superb Groundsel). Canberra: Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/biodiversity/threatened/species/pubs/13374-conservation-advice.pdf.
[98] Department of Environment, Water and Natural Resources (2007). Electronic Flora of South Australia species Fact Sheet *Swainsona oroboides*. http://www.flora.sa.gov.au/cgi-bin/speciesfacts_display.cgi?form=speciesfacts&name=Swainsona_oroboides accessed 22/4/2017.
[99] http://saseedbank.com.au/species_information.php?rid=4368 accessed 27/3/2018.
[100] Tonkinson, D. & G. Robertson (2010). National Recovery Plan for Yellow Swainson-pea *Swainsona pyrophila*. Melbourne, Victoria : DSE.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Swainsona sericea	Silky Swainson-pea	3	O(20)		E	This species is considered to be regionally extinct in the Flinders Lofty Block.[101] New South Wales specimens have generally been in grassland and grassy woodland habitats.[102]				✓	Unlikley given that is considered to be extinct in the region.
Thelymitra batesii		2	O(20)		R	In fertile soils in grassy well drained woodland sites, often on ridges in shallow red earths.[103] Nearest record is 10km north of site boundary in Mt Remarkable. NP.				✓	There is no matching habitat for this species in the study area.
Thelymitra grandiflora	Great Sun-orchid	2	O(20)		R	Forest clearings, woodland and scrub in well drained gravelly clay soils which may be laterite or podsols, or mixed with sand, extending to dry rocky ridges in better soils.[104] Nearest record is approximately 10.5km north-east of site boundary.			✓ Hydro.	✓ Solar Farm	Some habitats present are possibly suitable, but only those where condition is moderate or better. Would require survey during the flowering period
Thelymitra peniculata	Blue Star Sun-orchid	2	O(20)		V	Restricted to damper, heathy, often sandy sites or under tea-tree. [105] One record approximately 18km north of the site boundary in Mt Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Thysanotus tenellus	Grassy Fringe-lily	2,3	O(20)		R	Found in a wide variety of soil types in open grassy woodland and grassland habitats (pers. obs.). Nearest record is approximately 12km north-east of site boundary in Mt Remarkable NP.				✓	There is no matching habitat for this species in the study area.
Veronica decorosa	Showy Speedwell	2,3	O(20)		R	Bushy short lived perennial shrub to 1 m tall. Endemic to South Australia and found in rocky gullies and ridges mainly in the Flinders Ranges.[106] Nearest record is approximately 7km south of site boundary.			✓ Hydro	✓ Solar Farm	Suitable habitat is present. Would require survey work following good rains. Only suitable areas are habitats 5 and 6.

[101] http://saseedbank.com.au/species_information.php?rid=4371 accessed 5/4/2018.
[102] http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10783 accessed 5/4/2018.
[103] Bates, R.J. (2011). South Australia's Native Orchids. Native Orchid Society of South Australia Incorporated, Unley.
[104] Bates, R.J. (2011). South Australia's Native Orchids. Native Orchid Society of South Australia Incorporated, Unley.
[105] Bates, R.J. (2011). South Australia's Native Orchids. Native Orchid Society of South Australia Incorporated, Unley.
[106] http://saseedbank.com.au/species_information.php?rid=52 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description and nearest record (within 20km)	Present [17]	Likely	Possible	Unlikely	Likelihood justification
Veronica parnkalliana	Port Lincoln speedwell	1,2,3	O(20)	E	E	This species is a short-lived perennial herb with erect to ascending branches to 20cm tall. It is a fire ephemeral whereby the plant's seeds germinate following fire events, rapidly producing flowers and setting seed and then dying off and remaining dormant in the soil seed bank until the next fire or disturbance event. The Mt Remarkable National Park population of the Port Lincoln Speedwell is growing in *Eucalyptus goniocalyx* (Long-leaved Box) woodland on sandy loam flats amongst scattered strewn sandstone rocks with *Xanthorrhoea quadrangulata* (Mt Lofty grass-tree), *Gonocarpus elatus* (hill raspwort), *Calytrix tetragona* (common fringe-myrtle), *Pomaderris paniculosa* (mallee pomaderris) and *Hibbertia sp*. (guinea flower). [107] Several records in Telowie Gorge Conservation Park (11km south) and one record in Mount Remarkable National Park approximately 15km north east.				✓	Considered unlikely, as the site is generally heavily grazed and degraded aside from steep, rocky areas.
Viminaria juncea	Native Broom	2,3	O(20)		R	Found growing in swampy depressions in heathland or woodland.[108] One record approximately 17-18km SSE of site in Telowie Gorge CP.				✓	There is no matching habitat for this species in the study area.

Key to Codes

Source: 1: Department of Environment and Energy (DoEE) Protected Matters Search Tool (PMST), 2: South Australian Department of Environment, Water and Natural Resources Biological Database of SA search. This data has been sourced from the South Australian Department of Environment, Water and Natural Resources Biological Database of SA. Record set number DEWNRBDBSA180112-1

Record status: P = Species flagged by the Protected Matters Search Tool (PMST), O = previously observed in site, O(20) = previously observed within 20km of the site, S = observed this survey

Conservation Status: R = Rare, V = Vulnerable, E = Endangered

[107] Threatened Species Scientific Committee (2016). Conservation Advice Veronica parnkalliana Port Lincoln speedwell. Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/17458-conservation-advice-05052016.pdf.

[108] http://saseedbank.com.au/species_information.php?rid=4694 accessed 27/3/2018.

4.6 Threatened Fauna and Fauna with international obligations

4.6.1 Birds

Table 16 lists the birds of state or national conservation significance, and those species covered by international obligations. Two birds of state conservation significance were observed during the survey, the Vulnerable Blue-winged Parrot (*Neophema chrysostoma*), and the Rare Elegant Parrot (*Neophema elgans elegans*). Both these species were found in association with *Maireana* Shrubland and generally more open habitats where they feed on the ground.

A further five species of state conservation significance have had confirmed recent sightings in the adjacent Baroota Reservoir Reserve[109], mainly in association with the water body and adjacent Red Gum Woodland. These species are:

- Musk Duck (*Bizuria lobata*) – Rare in South Australia
- Peregrine Falcon (*Falco peregrinus*) – Rare in South Australia
- Blue-billed Duck (*Oxyura australis*) – Rare in South Australia
- Diamond Firetail (*Stagonopleura guttata*) – Vulnerable in South Australia
- Freckled Duck (*Stictonetta naevosa*) – Vulnerable in South Australia

The State Rare White-winged Chough, *Corcorax melanoramphos*, may also use woodland and mallee areas in the Hydro Block. No listed Migratory bird species were observed during the field survey. Only one listed Migratory species, the Rainbow Bee-eater (*Merops ornatus*), has been previously observed, in association with the creeklines wihin Baroota Reservoir Reserve, although this species could potentially also be present in deep gullies of the study area.

Ten other Migratory species are considered as **possible** occasional visitors, mainly to the reservoir and associated habitats. These include:

- Common Sandpiper (*Actitis hypoleucos*)
- Great Egret (*Ardea alba/modesta*)
- Cattle Egret (*Ardea ibis*)
- Sharp-tailed Sandpiper (*Calidris acuminata*)
- Osprey (*Pandion haliaetus*)
- Black-faced Cormorant (*Phalacrocorax fuscescens*)
- Glossy Ibis (*Plegadis falcinellus*)
- Spotless Crake (*Porzana tabuensis*)
- Common Tern (*Sterna hirundo*)
- Common Greenshank (*Tringa nebularia*)

No other species of state or national conservation significance are considered likely to be using the site as habitat.

[109] Birdlife Australia, Port Augusta

TABLE 16: BIRDS OF CONSERVATION SIGNIFICANCE, OR PROTECTED UNDER INTERNATIONAL OBLIGATIONS

A tick in a likelihood category means that is considered the likelihood for both the Hydro and Solar Farm components of the project. Where a species has a different likelihood for the hydro and solar farm blocks it is flagged in the table. The notation Reservoir-Hydro means the species may be found in association with the Baroota Reservoir, which may be impacted by the Hydro part of the project.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
Actitis hypoleucos	Common Sandpiper	1		Ma,Mg	R	This species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats[111].			✓ Reservoir - Hydro	✓ Solar Farm	The species is usually found along the shoreline in rocky areas or mudflats. However, it can also be found on inland saline or inland wetlands [1] (Birdlife Australia Bird Profiles 2018). It is possible the species could use the muddy areas exposed by the receding waterline of the reservoir.
Amytornis merrotsyi merrotsyi	Flinders Ranges Short-tailed Grasswren	1		V		Short-tailed grasswrens inhabit rocky (quartzitic) hillsides and hilltops, steep-sided gullies, stony rises and ridge-crests and, less often, foothills. The vegetation is spinifex (*Triodia*) tussock grassland, usually with scattered low shrubs, particularly *Acacia* spp., *Daviesia genistifolia, Xanthorrhoea quadrangulata* and *Cassia spp*., and occasionally an open overstorey of Cypress pine (*Callitris spp*.) or mallee (*Eucalyptus spp*.).[112]				✓	The area lies outside the area to likely or may have suitable species habitat (Aust. Gov. Dept of the Environment and Energy, Short-tailed Grasswren (Flinders Ranges) SPRAT Profile). There is a small isolated area of *Triodia* habitat present. However, the habitat is considered too small an area and isolated to provide enough viable habitat.
Amytornis striatus striatus	Striated Grasswren	3	O(20)		R	The habitat of Striated Grasswrens is *Triodia* including open mallee over a sparse layer of shrubs and a ground layer dominated by spinifex (Triodia),				✓	The subspecies primarily occurs in *Triodia* on rocky hillsides of at least one hectare. However, the habitat here is considered too small an area and isolated to

[110] Based upon this survey.
[111] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Actitis hypoleucos* Common Sandpiper. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59309 accessed 24/4/2017.
[112] Department of the Environment (2014). Conservation Advice *Amytornis merrotsyi merrotsyi* short-tailed grasswren (Flinders Ranges). Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/86269-conservation-advice.pdf.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						though they are sometimes found in other vegetation types[113].					provide enough viable habitat (Carpenter and Reid 1988).
Apus pacificus	Fork-tailed Swift	1	P	Mg		Known to use many habitat types, including coastal, arid and urban areas, migrating across broad regions of Australia.[114]		✓			This is a species recorded from widespread areas. They are highly mobile aerial birds feeding on flying insect, usually ahead of storms (T. Croft pers. ob). The species would likely be observed overhead in the area, but would not likely use the ground habitat.
Ardea alba/modesta	Great Egret	1		Ma		Eastern Great Egrets are widespread in Australia. It has been reported in a wide range of wetland habitats. The species may retreat to permanent wetlands or coastal areas when other wetlands are dry.[115]		✓ Reservoir - Hydro		✓ Solar Farm	Usually feeds wading in shallow water for fish, frogs, crustaceans (Birdlife Australia Bird Profiles 2018). The species could use the edge of the reservoir, as water receded.
Ardea ibis	Cattle Egret	1,3	O(20) P	Ma		This species is found in grasslands, woodlands and wetlands, and is not common in arid areas[116].			✓		The species is usually observed stalking in pasture, accompanying grazing animals, especially cattle, feeding on disturbed insects (Birdlife Australia Bird Profiles 2018). It is less common in drier areas, but could possibly be found in the open areas with domestic stock or around the reservoir. There are some sparse records in the area (Atlas of Living Australia).
Ardeotis australis	Australian Bustard	2,3	O(20)		V	This species mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses;			✓		It more readily observed inland in more undisturbed sparsely timbered pastoral habitats

[113] Department for Environment and Heritage (2009). Threatened Species of the South Australian Murray-Darling Basin. Striated Grasswren (sandplain subspecies) *Amytornis striatus striatus*. South Australian Murray-Darling Basin Natural Resources Management Board.

[114] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Apus pacificus* — Fork-tailed Swift. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=678

[115] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Ardea modesta* — Eastern Great Egret. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82410

[116] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/Cattle-Egret accessed 3/1/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams. Dispersive, with irregular widespread movements over long distances[117]. Nearest record is approximately 14.6km south-east of project area.					(Carpenter & Reid 1988, Atlas of Living Australia). Could occur in the area at times, although not prime tussock grassland habitat. At best a rare visitor to the area, after a population build-up following good inland rains.
Arenaria interpres	Ruddy Turnstone	1,2,3	O(20)	Ma,Mg	R	It is found in most coastal regions, with occasional records of inland populations. It strongly prefers rocky shores or beaches where there are large deposits of rotting seaweed[118]. Nearest record is approximately 14.4km south-east of project area.				✓	Restricted to the coastline where rocky shores and at times beaches (Birdlife Australia Bird Profiles 2018). No habitat for the species in the area.
Bizuria lobata	Musk Duck	3,4	O(20)		R	Musk Ducks tend to be found in deep freshwater lagoons, with dense reed beds[119].	✓ Reservoir - Hydro			✓ Solar Farm	Several birds have been observed on the deeper reservoir water in 2016, 2017 and 2018. They are not expected to be observed away from the reservoir.
Burhinus grallarius	Bush Stonecurlew	2,3	O(20)		R	This species inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber[120]. Nearest record is approximately 14km north-east of project area in Mount Remarkable National Park.				✓	This species prefers open forest and woodland with a grassy understory, lacking in the project area. As the area is disturbed through grazing of domestic stock, it is not considered prime suitable habitat for the species.
Calamanthus pyrrhopygius pedleri	Chestnut-rumped Heathwren (Flinders Ranges subspecies)	2,3	O(20)		V	Prefers heath habitats with dense undergrowth[121]. Nearest record is approximately 9.2km north of project area in Mount Remarkable National Park.				✓	The subspecies primarily occurs in *Eucalyptus goniocalyx* and *E. cladocalyx* Woodland over a shrub understorey in the Alligator- Mt Remarkable NP area (Carpenter & Reid 1988). The project area

[117] NSW Government Office of Environment and Heritage (2016). Australian Bustard – profile. http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx ?id=10063 accessed 21/4/2017.
[118] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=872 accessed 22-3-18.
[119] https://australianmuseum.net.au/musk-duck-biziura-lobata accessed 21/4/2017.
[120] http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10113 accessed 21/4/2017.
[121] Simpson, K. and Day, N. (2010). Field Guide to the Birds of Australia. Penguin, Camberwell.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
											contains no suitable habitat for the species, and it is not expected to occur in the area.
Calidris acuminata	Sharp-tailed Sandpiper	1		Ma, Mg		This species prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.[122]			✓ Reservoir - Hydro	✓ Solar Farm	No birds have been observed around the reservoir, but it is possible the species could use the muddy area of the reservoir, as water recedes.
Calidris alba	Sanderling	1		Ma,Mg	R	The Sanderling occurs in coastal areas around Australia. Inland records have occurred in most states of singles or small groups, birds probably on migration. It is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed[123].				✓	In Australia, the Sanderling is primarily found on ocean beaches (Birdlife Australia Bird Profiles 2018). It is unlikely the species would use the reservoir habitat, even on migration, due to its proximity to the coast.
Calidris canutus	Red Knot	1,2,3	O(20)	E, Ma, Mg		The red knot is common in all the main suitable habitats around the coast of Australia, is less numerous in south-west Australia and is occasionally recorded inland in all regions. It mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts and sometimes on sandy ocean beaches or shallow pools on exposed rock platforms. [124]				✓	In Australia, the species can be found on intertidal coastal mud flats and estuaries (Birdlife Australia Bird Profiles 2018). The nearest record is a single bird within 20km, approximately 18km WSW from the site, in the Spencer Gulf. It is unlikely the species would use the reservoir habitat, even on migration, due to its proximity to the coast.
Calidris ferruginea	Curlew Sandpiper	1,2,3	O(20)	Ma, Mg, CE		Primarily coastal, although when inland they are found around ephemeral and permanent lakes, dams, waterholes and				✓	In Australia, the species can be found on intertidal coastal mud flats and estuaries (Birdlife

[122] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Calidris acuminata* Sharp-tailed Sandpiper. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=874 accessed 24/4/2017.
[123] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=875 accessed 22-3-2018.
[124] Threatened Species Scientific Committee (2016). Conservation Advice Calidris canutus Red knot. Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/855-conservation-advice-05052016.pdf.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						bore drains, usually with bare edges of mud or sand[125]. Nearest record is 12.5km west of the project area.					Australia Bird Profiles 2018). Nearest record on the coastline approximately 14km west. It is unlikely the species would use the reservoir habitat, even on migration, due to its proximity to the coast.
Calidris melanotos	Pectoral Sandpiper	1		Ma, Mg		This species is usually found in coastal or near coastal habitat but is occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire[126].				✓	In Australia, the species can be found in coastal and sub-coastal Samphire shrubland. In South Australia it is primarily found east of Yorke Peninsula, and not so elsewhere in the State. The area does not provide suitable habitat for the species, even on migration.
Calidris ruficollis	Red-necked Stint	1		Ma, Mg		This species "is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in salt flats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry				✓	The species can usually be found on intertidal coastal mud flats and estuaries (Birdlife Australia Bird Profiles 2018). Although the species could use the muddy reservoir floor, it would more likely use prime habitat on the coast.

[125] Threatened Species Scientific Committee (TSSC) (2015). Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper). Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice.pdf accessed 22/4/2017.

[126] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Calidris melanotos* Pectoral Sandpiper. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=858 accessed 21/4/2017.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						gibber plains, with little or no perennial vegetation."[127]					
Calidris tenuirostris	Great Knot	1,2,3	O(20)	Ma, Mg, CE	R	This species prefers "sheltered coastal habitats with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, salt lakes and non-tidal lagoons. The species rarely occurs on inland lakes and swamps. "[128]One record only within 20km, approximately 18km WSW from the site, in the Spencer Gulf.				✓	In Australia, the species can be found on intertidal coastal mud flats and estuaries (Birdlife Australia Bird Profiles 2018). It is unlikely the species would use the reservoir habitat, even on migration, due to its proximity to the coast.
Charadrius ruficapillus	Red-capped Plover	1		Ma		The Red-capped Plover is widespread throughout Australia, and is found in wetlands, especially in arid areas, preferring saline and brackish waters.[129]				✓	Mostly found around saline and brackish wetlands, especially along the coast (Birdlife Australia Bird Profiles 2018). It has been occasionally found on edges of freshwater wetlands, but less likely. It is possible at times the species could use the muddy areas around the reservoir, but has not so been observed in the area.
Cladorhynchus leucocephalus	Banded Stilt	2,3	O		V	Nomadic and often in dense flocks. Banded Stilts are found mainly in saline and hypersaline (very salty) waters of the inland and coast, typically large, open and shallow. Banded Stilts breed only in the arid inland when wetlands appear after rain or flooding and not much is known about their breeding				✓	The species prefers saline areas to freshwater, and is unlikely to use the reservoir freshwater.

[127] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=860 accessed 22-3-2018.
[128] Threatened Species Scientific Committee (2016). Conservation Advice *Calidris tenuirostris* Great knot. Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/862-conservation-advice-05052016.pdf
[129] Birdlife Australia Bird Profiles (2018). Red Capped Plover. http://www.birdsinbackyards.net/species/Charadrius-ruficapillus

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						habits[130]. Nearest record is approximately 13km west of project area in the Spencer Gulf.					
Corcorax melanoramphos	White-winged Chough	2,3	O(20)		R	White-winged Choughs are found in open forests and woodlands. Nearest record is approximately 8-9km north of project area in Mount Remarkable National Park.		✓ Hydro		✓ Solar Farm	The species could possibly occur in the *Eucalyptus camaldulensis* Woodland and Mallee areas as suitable habitat.
Coturnix ypsilophora	Brown Quail	2,3	O(20)		V	The Brown Quail prefers dense grasslands, often on the edges of open forests, and bracken. May sometimes be seen alongside roads[131]. Nearest record is approximately 13km south-west of project area in the Spencer Gulf.			✓		It is mostly recorded from the South-East region of SA, where there is more suitable habitat (Carpenter & Reid 1988). The species may occur at times around the edge of the reservoir where there is limited habitat.
Egretta garzetta	Little Egret	2,3	O(20)		R	The Little Egret frequents tidal mudflats, saltwater and freshwater wetlands, and mangroves. Nearest record is approximately 13km south-west of project area in the Spencer Gulf.				✓	The species prefers coastal mudflats and saline areas, but also occurs in freshwater wetlands. The species could at times occur on the muddy floor of the reservoir as the water recedes, but would prefer other areas.
Egretta sacra	Eastern Reef Egret	3	O(20)	Ma	R	This species lives on beaches, rocky shores, tidal rivers and inlets, mangroves, and exposed coral reefs[132].				✓	The species usually only occurs along the coast and shoreline, and is not expected to use the project area habitat.
Elanus scriptus	Letter-winged Kite	2	O(20)		R	Found mostly in northern SA and adjacent semi-arid and arid areas in open Grassland with tree-lined watercourses. Usually hunts at twilight for primarily Long-tailed Rats and Mice[133]. Nearest record is				✓	Although there are records of the species in the district, it could be mis-identified with Black-shouldered Kite. It is mostly recorded in the northern semi-arid and arid pastoral areas of the State. It is possible the species

[130] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/banded-stilt accessed 3/1/2018.
[131] Birdlife Australia Bird Profiles (2017). http://birdlife.org.au/bird-profile/brown-quail accessed 21/4/2017.
[132] http://www.birdsinbackyards.net/species/Egretta-sacra accessed 4/4/2018.
[133] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/spiny-cheeked-honeyeater accessed 16/1/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						approximately 17km south-west of project area in the Spencer Gulf.					could occur at times in open habitat and treed creekline, the project area is not preferred habitat.
Falco hypoleucos	Grey Falcon	2,3	O(20)		R	The Grey Falcon inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses. Grey Falcons use standing dead trees as lookout posts[134]. Nearest record is approximately 8.5km south-east of project area.				✓	Most reliable records of the species are from the semi-arid and arid pastoral areas of the State, primarily in *Acacia* Low Woodlands. Occasionally the species has been sighted in more southern areas. The species could occur at times in the project area, but is not considered prime habitat.
Falco peregrinus	Peregrine Falcon	2,3,4	O(20)		R	This species requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water[135]. Nearest record is approximately 6.5km north of project area.	✓ Hydro			✓ Solar Farm	The species has been recorded in the vicinity of the dam and reservoir, where there is suitable nesting areas and prey (eg. Rock Pigeons) occur.
Falcunculus frontatus frontatus	Eastern Shriketit	2,3	O(20)		R	Occurs predominantly in Eucalypt woodlands and forests. This species has a predilection for Eucalypts with decorticating bark, their preferred foraging substrate, however they will occupy a wide range of woodland/forest communities, including those dominated by stringybarks.[136] Nearest record is approximately 12km north-east of project area.				✓	Found primarily in younger *Eucalyptus camaldulensis* Open Woodland, but also in other eucalypt Woodlands not present in the project area. However, the habitat is likely too small, isolated and has limited young trees to provide sufficient habitat.
Gallinago hardwickii	Latham's Snipe	1		Ma, Mi	R	This species usually occurs in open, freshwater wetlands that have some form of shelter (usually low and dense				✓	Most SA records are in more suitable tea-tree shrubby freshwater wetland habitat in the

[134] NSW Scientific Committee (2009). Grey Falcon *Falco hypoleucos*. Review of current information in NSW. http://www.environment.nsw.gov.au/resources/nature/schedules/GFalcon.pdf accessed 21/4/2017.
[135] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/peregrine-falcon accessed 21/4/2017.
[136] Department for Environment and Heritage (2008). Threatened Species Profile: *Falcunculus frontatus frontatus* Crested Shrike-tit. Biodiversity Conservation Unit, Adelaide Region.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						vegetation) nearby. They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters[137].					SE, MLR, KI, along the River Murry. It is considered the habitat surrounding the reservoir is largely unsuitable for the species, lacking a sedge dominated fringe and dense shrubs to 1.5m tall.
Grantiella picta	Painted Honeyeater	1		V	R	The species utilises mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and river red gum, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens. The species prefers woodlands which contain a higher number of mature trees, as these host more mistletoes[138].				✓	The species is largely confined to eastern Australia. At best it may be vagrant to South Australia. The species is highly unlikely to occur in the project area.
Haliaeetus leucogaster	White-bellied Sea-eagle	1		Ma	E	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats[139].				✓	The species is largely confined to the coast and along the River Murray in South Australia.It primarily feeds on fish caught in the water. It is unlikely the species would occur in the project area.
Haemotopus fuliginosus	Sooty Oystercatcher	2,3	O(20)		R	The Sooty Oystercatcher is strictly coastal, usually within 50 m of the ocean. It prefers rocky shores, but will be seen on coral reefs or sandy beaches				✓	The species is largely restricted to the shoreline, especially rocky shores. Here it feeds on molluscs, crustaceans, marine worms,

[137] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Gallinago hardwickii* Latham's Snipe, Japanese Snipe. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=863 accessed 24/4/2017.
[138] Threatened Species Scientific Committee (TSSC) (2015). Approved Conservation Advice for *Grantiella picta* (Painted Honeyeater). Canberra: Department of the Environment.
[139] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Haliaeetus leucogaster* White-bellied Sea-Eagle. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=943 accessed 24/4/2017.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						near mudflats.[140] Nearest record is approximately 11km south-west of project area in the Spencer Gulf.					starfish sea urchins, and small fish. It is highly unlikely the species would be use the area as habitat.
Haemotopus longirostrus	(Australian) Pied Oystercatcher	2,3	O(20)		R	The Pied Oystercatcher prefers mudflats, sandbanks and sandy ocean beaches and is less common along rocky or shingle coastlines. Although rarely recorded far from the coast, the Pied Oystercatcher may occasionally be found in estuarine mudflats and short pasture. [141] Nearest record is approximately 11km south-west of project area in the Spencer Gulf.				✓	The species is largely restricted to the shoreline, especially coastal mudflats, sandbanks and sandy ocean beaches, and less so rocky shoreline. Here it feeds on on bivalve molluscs, but also worms, crustaceans and insects. It is highly unlikely the species would be use the area as habitat.
Hamirostra melanosternon	Black-Breasted Buzzard	3	O(20)		R	Found in lightly timbered plains, open country and tree-lined waterways through inland Australia and in semi-arid or arid regions.[142]			✓ Hydro		The species is largely found along tree-lined creeks surrounded by open country in the semi-arid and arid pastoral areas. However, the species could occur along the *Eucalyptus camaldulensis* Woodland along the creek in the project area.
Heteroscelcus brevipes	Grey-tailed Tattler	1		Ma		The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves.[143]				✓	The species is largely restricted to the coast. It is considered unlikely it would occur in the project area.

[140] Birdlife Australia Bird Profiles (2018). http://birdlife.org.au/bird-profile/sooty-oystercatcher accessed 27/3/2018/
[141] Birdlife Australia Bird Profiles (2018). http://birdlife.org.au/bird-profile/australian-pied-oystercatcher accessed 27/3/2018/
[142] Birdlife Australia Bird Profiles (2018). http://www.birdlife.org.au/bird-profile/black-breasted-buzzard accessed 4/4/2018.
[143] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59311 accessed 22-3-2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
Ixobrychus dubius	Australian Little Bittern	3	O(20)		E	Favours reedbeds, dense freshwater swamps and well-fringed watercourses, including thick reedbeds [144]				✓	The species is largely found around freshwater swamps in eastern Australia, with fewer records in South Australia in the South East and Mount Lofty Ranges. It prefers swamps with a dense Reed and Bulrush cover. The species is considered unlikely to occur around the reservoir due to lack, and isolation of prime habitat.
Limosa lapponica	Bar-tailed Godwit	1,2	O(20)	V,Ma, Mg	R	This species is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips One record only within 20km, approximately 18km WSW from the site, in the Spencer Gulf.				✓	The species is largely restricted to intertidal areas of the coast. It is unlikely the species would use the reservoir habitat, even on migration, due to its proximity to the coast.
Melanodryas cucullata cucullata	Hooded Robin (south east subspecies)	2,3	O(20)		R	This species is found in Eucalypt woodland and mallee and Acacia shrubland. A remnant size of >50 hectares is required. There are three key components to their habitat; (1) the presence of relatively open areas, (2) patches of young Eucalypts or shrubs for nest-sites, and (3) the presence of suitable perches for foraging. They are often found near clearings or more open areas, such as paddocks. Nearest record is approximately 12km north-east of project area.			✓ Hydro	✓ Solar Farm	In South Australia they inhabit *Eucalyptus oleosa, E. gracilis, E. socialis* Mallee, and drier non-eucalypt Low Woodlands. The species could possibly occur in the Project area Mallee, however the patches are small, and degraded from a long history of domestic stock grazing. This would limit their use as Hooded Robin habitat.
Melithreptus gularis gularis	Black-chinned Honeyeater	2,3	O(20)		V	Occupy dry Eucalypt woodland with an annual rainfall range of 400-700 mm,				✓	The subspecies inhabits *Eucalyptus camaldulesis, E.*

[144] https://www.hbw.com/species/australian-little-bittern-ixobrychus-dubius accessed 4/4/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
	(south eastern subspecies)					particularly associations containing ironbark and box Favoured habitats incorporate a mixture of mature and regenerating woodland Eucalypts, although adjacent scattered paddock trees are also used.[145] Nearest record is approximately 19km south of project area in Wirrabara Forest Reserve.					*leucoxylon. E. fasciculosa*, and particularly drier areas *E. microcarpa* and *E. odorata* Woodlands (Carpenter & Reid 1988). However, the species is extremely rare in the southern Flinders Ranges, and is only listed for the Mount Lofty Ranges and South-East State regions in the State Vertebrate census (Owens & Graham 2018). It is not expected to occur in any of the project habitats, including the *E. camaldulensis* Woodland, due to small habitat area and isolation from other habitat.
Merops ornatus	Rainbow Bee-eater	1,2,3,4		Ma, Mg		A widespread species most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. Nests in sand banks or sloping sandy soil.[146]	✓ Hydro			✓ Solar Farm	The species has been recorded in the *Eucalyptus camaldulensis* Woodland surrounding the reservoir, and along Baroota Creek. The species could also occur in the deep gulies of the project area.
Motacilla cinerea	Grey Wagtail	1	P	Ma, Mg		Extremely uncommon migrant to Australia. This species has a strong association with water, particularly rocky substrates along water courses but also lakes and marshes[147].				✓	Extremely rare migrant to Australia, with no records from the region.
Motacilla flava	Yellow Wagtail	1	P	Ma, Mg		Included in international agreements but extremely uncommon migrant. Mostly well-watered open grasslands and the fringes of wetlands. Roosts in				Y	Rare migrant to mainly northern Australia, with one or two vagrant records in South Australia. No records exist in the region, and the project area does provide habitat for the species.

[145] Department for Environment and Heritage (2008). Threatened Species Profile: *Melithreptus gularis gularis* Black-chinned Honeyeater. Biodiversity Conservation Unit, Adelaide Region.
[146] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Merops ornatus* — Rainbow Bee-eater. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=670
[147] Australian Government Department of the Environment (2015). Draft Referral Guideline for 14 Migratory Birds Listed under the EPBC Act.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						mangroves and other dense vegetation[148].					
Myiagra cyanoleuca	Satin Flycatcher	1		Mg		This species inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands or watercourses.				✓	In South Australia, the species is a spring-summer visitor, primarily to stringybark open forest in the South East and to a lesser degree the Mount Lofty Ranges. The species is unlikely to use the project area.
Myiagra inquieta	Restless Flycatcher	2,3	O(20)		R	Occurs in *Eucalyptus camaldulensis, E. leucoxylon* and box woodlands and open mallee (*E. oleosa, E. gracilis*) low woodland to low open forest[149] Nearest record is approximately 7km north on the edge of Mount Remarkable NP.			✓ Hydro	✓ Solar Farm	The species has been recorded from Mallee, *Eucalyptus leucoxylon* and box Woodland in the region (Carpenter & Reid 1988). The project area Mallee surrounded by open areas could provide habitat for the species, but the degraded nature of the area from grazing has limited its habitat value.
Neophema chrysogaster	Orange-bellied Parrot	1		Ma, CE	E	The habitat used by this species varies throughout the year, with birds inhabiting salt marshes, coastal dunes, pastures, shrub lands, estuaries, islands, beaches and moorlands generally within 10 km of the coast. The species' current mainland distribution, which covers approximately 1000 km of coastline, is from the mouth of the Murray River in South Australia, along the coast, to the east of Jack Smith Lake in South Gippsland, Victoria[150]				✓	The species is a non-breeding visitor from Tasmania to mainland Australia, along the coast of Victoria and South Australia to the River Murray mouth. However, a bird was observed in the Upper Gulf area in the 1990s. This is considered irregular, and the bird likely travelled north with Elegant Parrots, rather than flying its regular path.
Neophema chrysostoma	Blue-Winged Parrot	3	O(20), S	Ma	V	The Blue-winged Parrot inhabits a range of habitats from coastal, sub-coastal and inland areas, right through to semi-	✓				While breeding in the State's South East and adjacent areas of western Victoria, when non-

[148] Australian Government Department of the Environment (2015). Draft Referral Guideline for 14 Migratory Birds Listed under the EPBC Act.
[149] Department for Environment and Heritage (2008). Threatened Species Profile *Myiagra inquieta* (Restless Flycatcher). Department for Environment and Heritage, Adelaide.
[150] Threatened Species Scientific Committee (2006). Commonwealth Listing Advice on *Neophema chrysogaster*. http://www.environment.gov.au/biodiversity/threatened/species/neophema-chrysogaster.html.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						arid zones. Throughout their range they favour grasslands and grassy woodlands. They are often found near wetlands both near the coast and in semi-arid zones.[151]					breeding, birds thinly disperse west and north, primarily to coastal salt marsh and dunes Carpenter & Reid 1988). They also disperse more widely to various other habitat. One bird was flushed from the ground along the track through *Maireana* Shrubland. They often associate with Elegant Parrots when dispersed. It is likely occasional non-breeding birds will occur in the project area, from time to time.
Neophema elegans	Elegant Parrot	2,3,4	O(20). S		R	This species can be found in a wide variety of habitats, including grasslands, shrublands, mallee, woodlands and thickets, bluebush plains, heathlands, saltmarsh and farmland. They feed on the seeds of grasses and low growing shrubs[152]. Nearest record is approximately 7km south of project area.	✓				Whilst non-breeding, the species widely disperses, particularly to the coastal dunes of the Coorong. It also disperses elsewhere to various open habitats including *Maireana* Shrublands (Carpenter & Reid 1988). Few to several birds have been observed each year from 2016, primarily in the vicinity of the reservoir.
Numenius madagascariensis	Eastern Curlew	1,2	O(20)	Ma, Mg,CE	V	During the non-breeding season in Australia, the Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae). Occasionally, the species occurs on ocean beaches (often near				✓	In South Australia, records of the species are restricted to the coast, where it feeds on the mud and sand flats. It is considered unlikely the species would occur in the project area, as it prefers prime habitat available elsewhere. There is one record only, approximately 14km west, on the coast.

[151] http://www.birdsinbackyards.net/species/Neophema-chrysostoma accessed 4/4/2018.
[152] Birdlife Australia Bird Profiles (2017). http://birdlife.org.au/bird-profile/elegant-parrot accessed 21/4/2017.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						estuaries), and coral reefs, rock platforms, or rocky islets[153].					
Oxyura australis	Blue-billed Duck	2,3,4	O(20)		R	The Blue-billed Duck is almost wholly aquatic, and is seldom seen on land[154]. Nearest record is in Baroota Reservoir Reserve on the western edge of the project area.	✓ Reservoir - Hydro			✓ Solar Farm	The species can be found on open freshwater. Birds have been observed regularly on the reservoir over the last few years.
Pachycephala inornata	Gilbert's Whistler	2,3	O(20)		R	This species usually inhabits semi-arid mallee or box–ironbark eucalypt, acacia, cypress-pine or Belah shrublands and woodlands (or mixed assemblages of these), usually with a dense, continuous or patchy understorey of shrubs such as acacias, *Eremophila, Dodonaea* or *Senna*; they inhabit these shrubs in the understorey[155]. Nearest record is approximately 12km south in Telowie Gorge Conservation Park				✓	In South Australia, habitat includes *Eucalyptus oleosa, E. gracilis, E. socialis* Mallee over a taller shrub understorey, and *Dodonaea* and *Acacia* Shrubland on steep rocky hills in the Southern Flinders Ranges. It is considered the species is unlikely to occur, due to largely unsuitable habitat.
Pandion haliaetus	Osprey	1,2,3	O(20)	Ma, Mg	E	This species mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging[156] Nearest record is approximately 11.5km north-west of project area.			✓ Reservoir-Hydro	✓ Solar Farm	In South Australia, the species is restricted to the coast, and along the River Murray. Although unlikely the species would use the reservoir area, it is possible the bird could occasionally occur.
Parvipsitta pusilla	Little Lorikeet	2,3	O(20)		E	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[157]. Nearest record is				✓	The species is highly mobile following the flowering of eucalypts. Within South Australia, it is primarily recorded from the South East, and now, less so, the Mount Lofty Ranges. Although the species will use flowering

[153] Threatened Species Scientific Committee (TSSC) (2015). Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew). Canberra: Department of the Environment.
[154]Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/blue-billed-duck accessed 3/1/2018.
[155] http://www.birdlife.org.au/bird-profile/gilberts-whistler accessed 21/4/2017.
[156] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=952 accessed 22/3/2018.
[157] http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20111 accessed 27/3/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						approximately 9.5km south-west of project area.					*Eucalyptus camaldulensis*, the habitat in the area is considered too small and patchy. The are no reliable records of the species in the region.
Pedionomus torquatus	Plains-wanderer	1	P	CE	E	Plains-wanderers inhabit sparse grasslands with about 50% bare ground, with most vegetation less than 5 cm in height and some widely spaced plants up to 30 cm high[158]				✓	In South Australia, the species is now considered confined to the northern pastoral area. It has largely disappeared from the agricultural areas. Although there are open grassy areas within the project area, these are considered too disturbed by domestic stock grazing.
Petroica boodang boodang	Scarlet Robin	2,3	O(20)		R	Occurs predominantly in Eucalypt woodlands and forests. Good leaf litter, perches in the height range 1-2 m, and fallen logs are important components of habitat.[159] Nearest record is approximately 7.5km south of project area.				✓	In the region, the species primarily occurs in *Eucalyptus cladocalyx* Woodland (Carpenter & Reid 1988). It is unlikely to occur in the project area, due to absence of suitable habitat.
Pezoporus occidentalis	Night Parrot	1	P	E	E	Most habitat records are of Triodia (Spinifex) grasslands and/or chenopod shrublands in the arid and semi-arid zones[160]. May also inhabit samphire habitats. Recent sightings in Great Sandy Desert in Western Australia and western Queensland and a feather found in a finch nest northern Lake Eyre.				✓	Although there is a small patch of *Triodia* in the project area, it is considered too small and isolated to provide habitat for this secretive species. Although there was a collection of a Night Parrot feather further north recently, there has been no positive sighting in the State for some time.
Phalacrocorax fuscescens	Black-faced Cormorant	1		Ma		The Black-faced Cormorant is found along the southern coasts of mainland				✓	The species distribution is largely confined to the coastline.

[158] Threatened Species Scientific Committee (TSSC) (2015). Approved Conservation Advice for *Pedionomus torquatus* (Plains-wanderer). Canberra: Department of the Environment.
[159] Department for Environment and Heritage (2008). Threatened Species Profile *Petroica boodang boodang* Scarlet Robin. Department for Environment and Heritage, Adelaide.
[160] Australian Government Department of the Environment and Energy Species Profile and Threats Database. Pezoporus occidentalis — Night Parrot. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59350

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						Australia and Tasmania, and is common in Bass Strait and in Spencer Gulf, South Australia. Black-faced Cormorants frequent coastal waters and are found in flocks in large bays, deep inlets, rocky headlands and islands.[161]					However, it is possible from time to time, it may use the reservoir waters, but it is not its prime habitat.
Plectorhyncha lanceolata	Striped Honeyeater	3	O(20)		R	Found in forests and woodlands, often along rivers, as well as mangroves and in urban gardens.[162]				✓	In South Australia, the species is mostly observed in the River Murray Woodlands, and adjacent Mallee. Isolated populations also occur in northern Yorke Peninsula and Mid North, where it prefers. Mallee, *Eucalyptus porosa, Myoporum platycarpum,* and *Melaleuca lanceolata* Woodlands The species is considered unlikely to occur in the project area, due to lacking or limited prime habitat.
Plegadis falcinellus	Glossy Ibis	3	O(20)	Ma, Mg	R	Preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons.[163]		✓ Reservoir - Hydro		✓ Solar Farm	As the species prefers open muddy swamps (Carpenter & Reid 1988), it could likely occur around the edge of the reservoir, especially as water recedes.
Pluvialis fulva	Pacific Golden Plover	2	O(20)	Ma, Mg	R	This species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands, such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins				✓	In South Australia, most records occur along the coast, with a few along the River Murray. It usually feeds on mudflats. The species is considered unlikely to occur around the reservoir, even as a

[161] http://www.birdsinbackyards.net/species/Phalacrocorax-fuscescens accessed 22/3/2018.
[162] http://www.birdsinbackyards.net/species/Plectorhyncha-lanceolata accessed 4/4/2018.
[163] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=991 accessed 4/4/2018.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						and often with submerged vegetation or short emergent grass. [164] One record only within 20km, on the coastline approximately 12km west of project area.					stopover on migration, due to its proximity to the coast, and more limited habitat. Few records of the species occur in the upper gulf region.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (south east subspecies)	2,3	O(20)		E	The Grey-crowned Babbler is found in open forests and woodlands, favouring inland plains with an open shrub layer, little ground cover and plenty of fallen timber and leaf litter.[165] Only one record within 20km, 15km north of the project area in Mount Remarkable NP.				✓	This sub-species has been only recorded in the South East of South Australia, where its population has suffered a major decline to near extinction. The area provides no suitable habitat for the species. The record for Mt Remarkable NP is likely a mis-identification. The northern subspecies, is only recorded in the vicinity of the Northern Territory border in different habitat.
Porzana tabuensis	Spotless Crake	3	O(20)	Ma	R	Found in well vegetated freshwater wetlands with rushes, reeds and cumbungi. Will also frequent muddy areas, reedbeds or wetlands[166].			✓ Reservoir - Hydro	✓ Solar Farm	In South Australia, the species is mostly recorded along the River Murray, the Lower Lakes, and the Mount Lofty Ranges, where there is more suitable habitat. While it is possible the species could occur around the reservoir, it is considered suitable habitat is limited and isolated from other suitable areas.
Rostratula australis	Australian Painted Snipe	1		E, Ma	V	This species occurs in shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, such as lakes, swamps, claypans, inundated or waterlogged grassland/saltmarsh, dams, rice crops, sewage farms and bore drains, generally				✓	In South Australia the species is primarily recorded in the South East, Mount Lofty Ranges and along the River Murray where suitable habitat occurs. The species is not considered to occur outside the above regions. The

[164] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25545
[165] http://www.birdsinbackyards.net/species/Pomatostomus-temporalis accessed 27/3/2018.
[166] Department for Environment and Heritage (2008). Threatened Species Profile: Spotless Crake *Porzana tabuensis*. Government of South Australia, Adelaide.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
						with a good cover of grasses, rushes and reeds, low scrub, *Disa* spp. (lignum), open timber or samphire [167]					habitat around the reservoir was not considered prime habitat. The species is not likely to occur in the project area.
Stagonopleura guttata	Diamond Firetail	2,3,4	O(20)		V	Diamond Firetails are found in open grassy woodland, heath and farmland or grassland with scattered trees[168].Nearest record is approximately 9km north of the project area in Mount Remarkable NP.		✓Reservoir - Hydro		✓ Solar Farm	This species was observed in the vicinity of Baroota Reservoir in 2017 and 2018 by the Port Augusta birdwatchers. However, it is only likely to be found in association with the Red Gum habitats in the Reservoir and adjacent creeklines.
Sterna hirundo	Common Tern	2,3	O(20)	Ma, Mg	R	Common Terns are marine, pelagic and coastal. In Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters. Occasionally they are recorded in coastal and near-coastal wetlands, either saline or freshwater, including lagoons, rivers, lakes, swamps and saltworks.[169] One record only within 20km, on the coastline approximately 18km south-west of project area.			✓ Reservoir - Hydro	✓ Solar Farm	The species is largely confined to the coast in Australia, where the majority of records occur. It occasionally occurs in sub-coastal freshwater and saline wetlands, and could possibly occur around the reservoir.
Sternula nereis nereis	Australian Fairy Tern	1,2,3	O(20)	V	E	Fairy Terns utilise a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands, beaches and spits.[170] One record only within 20km, on the coastline approximately 18km south-west of project area.			✓ Reservoir - Hydro	✓ Solar Farm	Mostly found in coastal and sub-coastal wetlands (Birdlife Australia Bird Profiles 2018). However, it is possible the species may be found at times in the vicinity of the reservoir. One record only within 20km, approximately 18km WSW from the site, in the Spencer Gulf.

[167] Threatened Species Scientific Committee (TSSC) (2013). Commonwealth Conservation Advice on *Rostratula australis* (Australian Painted Snipe). Canberra: Department of Sustainability, Environment, Water, Population and Communities.
[168] Birdlife Australia Bird Profiles (2017). http://birdlife.org.au/bird-profile/diamond-firetail accessed 21/4/2017.
[169] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=795 accessed 27/3/2018.
[170] Department of Sustainability, Environment, Water, Population and Communities (2011). Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern). Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. http://www.environment.gov.au/biodiversity/threatened/species/pubs/82950-conservation-advice.pdf.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
Stictonetta naevosa	Freckled Duck	3,4	O(20)		V	Prefers permanent fresh water swamps and creeks with heavy growth of cumbungi (bullrushes), lignum or tea-tree. During drier times, the Freckled Duck moves from ephemeral (not permanent) breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewerage ponds.[171]	✓ Reservoir - Hydro			✓ Solar Farm	The reservoir provides permanent freshwater non-breeding habitat for the species. 6 were observed on the reservoir in February 2016, and another 2 in January 2018.
Thalasses bergii	Crested Tern	1		Ma, Mg		The Crested Tern is usually a strictly coastal species, although there are occasional records in the arid interior of Australia, possibly as a result of severe weather events.[172]				✓	The species is usually restricted to its varied coastal habitat. It is not expected to use the reservoir area.
Tringa brevipes	Grey-tailed Tattler	1		Ma, Mg		This species "is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves."[173]				✓	In Australia, the species is primarily found on the sheltered coastline, especially intertidal mudflats (Birdlife Australia Bird Profiles 2018). It is unlikely the species would use the reservoir habitat, even on migration, due to its proximity to the coast.
Tringa nebularia	Common Greenshank	1		Ma, Mg		This species is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats.[174]			✓ Reservoir - Hydro	✓ Solar Farm	The receding water and exposed mud of the reservoir may provide feeding opportunity for the species.

[171] Birdlife Australia Bird Profiles (2018). http://www.birdlife.org.au/bird-profile/freckled-duck. Accessed 4/4/2018.
[172] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/crested-tern 22/3/2018.
[173] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=851 accessed 22/3/2018.
[174] Australian Government Department of the Environment and Energy Species Profile and Threats Database. *Tringa nebularia* — Common Greenshank, Greenshank. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=832

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Present[110]	Likely	Possible	Unlikely	Likelihood justification
Turnix varius	Painted Buttonquail	2,3	O(20)		R	Temperate and eastern tropical forests and woodlands form the habitats of this species. They appear to prefer closed canopies with some understorey and deep leaf litter on the ground. Nearest record is approximately 8.5km north of the project area in Mount Remarkable NP.[175]				✓	Scattered records are found through the district in eucalypt Woodland and Mallee. However, the area surveyed has limited mallee habitat, and the area has been heavily grazed by sheep, feral goats and kangaroos, disturbing the soil and diminishing leaf litter presence.
Zoothera lunulata halmaturina	Bassian Thrush	1,2,3	O(20)	V	R	The subspecies mostly inhabits damp eucalypt forest or woodland. Densely forested areas and gullies are favoured, usually with a thick canopy overhead, a thick understorey of small trees and tall shrubs, and leaf-litter below.[176]				✓	Scattered records in Telowie Gorge and Mount Remarkable Conservation Parks, nearest being located 14km south and 15km north respectively. Most recent records are from 1999.

Key to Codes

Source: 1: Department of Environment and Energy (DoEE) Protected Matters Search Tool, 2: South Australian Department of Environment, Water and Natural Resources Biological Database of SA search, 3: Atlas of Living Australia Search, 4= Birdlife Australia Port Augusta Group

Record status: P = Species flagged by the Department of Environment and Energy (DoEE) Protected Matters Search Tool (PMST), O = previously observed in site, O(20) = previously observed within 20km of the site, S = observed this survey

Conservation Status: R = Rare, V = Vulnerable, E = Endangered

[175] http://www.birdsinbackyards.net/species/Turnix-varius accessed 27/3/2018.

[176] Department of the Environment (2015). Conservation Advice Zoothera lunulata halmaturina Bassian thrush (South Australian). Canberra: Department of the Environment. http://www.environment.gov.au/biodiversity/threatened/species/pubs/67121-conservation-advice.pdf.

4.6.2 Mammals

Only two mammal species of conservation significance were noted from desktop review, the Yellow-footed Rock-wallaby (*Petrogale xanthopus xanthopus*), and Plains Rat (*Pseudomys australis*). Neither of these species was observed during field survey. Based on the known habitat preferences and distribution of these two species, it is considered unlikely that either would be present in either the Hydro or Solar Farm blocks (Table 17).

TABLE 17: MAMMALS OF CONSERVATION SIGNIFICANCE, OR PROTECTED UNDER INTERNATIONAL OBLIGATIONS

A tick in a likelihood category means that is considered the likelihood for both the Hydro and Solar Farm components of the project. Where a species has a different likelihood for the hydro and solar farm blocks it is flagged in the table. The notation Reservoir-Hydro means the species may be found in association with the Baroota Reservoir, which may be impacted by the Hydro part of the project.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Likely	Possible	Unlikely	Likelihood justification
Petrogale xanthopus xanthopus	Yellow-footed Rock-wallaby	1,2	O(20)	V	V	Inhabits rocky outcrops in semi-arid country, ranging from sandstones, limestones and conglomerates in the Flinders Ranges, to granites in the Gawler Ranges and Olary Hills. Surrounding topography is generally low, with isolated rocky outcrops rising steeply from the surrounding landscape, consisting of mulga scrub as the dominant vegetation. These rocky outcrops provide shelter sites that enable the wallabies to escape predators[177].			✓	Numerous records in Telowie Gorge and Mount Remarkable Conservation Parks, nearest being located 12km south and 10km north respectively. Local farmer has not observed them in this area, and most of the site is not rocky enough for this species.
Trichosurus vulpecula	Common Brushtail Possum	2	O(20)		R	Common Brushtail Possums are found in Eucalyptus and Sheoak woodlands. They make their dens in tree hollows or other dark confined spaces such as hollow logs or dense vegetation.[178]		✓ Reservoir - Hydro	✓ Solar Farm, all other Hydro areas	The large Red Gums associated with Baroota Reservoir may suit this species. Unlikely in other areas of the site as either too degraded or habitat is unsuitable.

Key to Codes

Source: 1: Department of Environment and Energy (DoEE) Protected Matters Search Tool, 2: South Australian Department of Environment, Water and Natural Resources Biological Database of SA search

[177] Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for *Petrogale xanthopus xanthopus* (Yellow-footed Rock-wallaby (SA and NSW)). Canberra: Department of the Environment, Water, Heritage and the Arts.

[178] Natural Resources Adelaide and Mount Lofty Ranges (2016). Common Brushtail Possum *Trichosurus vulpecula*. Government of South Australia, Adelaide.

Record status: P = Species flagged by the Protected Matters Search Tool (PMST), O = previously observed in site, O(20) = previously observed within 20km of the site, S = observed this survey
Conservation Status: R = Rare, V = Vulnerable, E = Endangered

4.6.3 Reptiles

Table 18 lists the threatened reptile species which have been recorded in the wider area and the likelihood of their presence within the study area.

Hydro Block

The genetic work of Keogh et al. (2005) confirms earlier studies that the mainland and black tiger snake populations are conspecific, and all are treated as a single binomial, *Notechis scutatus*.[179] The Flinders Ranges population (referred to as *N. scutatus ater* in EPBC Act) is considered Vulnerable, but is not considered a distinct subspecies. Both the Tiger Snake (*Notechis scutatus*) and Lace Monitor (*Varanus varius*), if present, would only be found in association with the Baroota Reservoir and associated creeklines containing Red Gums (*Eucalyptus camaldulensis*). The nationally Vulnerable Flinders Ranges Worm Lizard (*Aprasia pseudopulchella*) may possibly be present in open areas where rocky strew is present on the ground. Note that recent survey work has resulted in many new records and significant areas of suitable habitat for this species being found, such that the species has been removed from the National Parks and Wildlife Schedules (ie it is not considered to be threatened at a state level). As such, the site would not form **critical** habitat for this species.

Solar Farm Block

It is considered unlikely that any reptile of conservation significance is using the Solar Farm Block as habitat.

[179] Owens, H. and Graham, A. (eds.) (2009) Census of South Australian Vertebrates. (Department of Environment and Natural Resources, South Australia andSouth Australian Museum.)

TABLE 18: REPTILES AND AMPHIBIANS OF CONSERVATION SIGNIFICANCE, OR PROTECTED UNDER INTERNATIONAL OBLIGATIONS

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Likely	Possible	Unlikely	Likelihood justification
Aprasia pseudopulchella	Flinders Ranges Worm Lizard	1,2	O(20)	V		This is a very small, worm-like, burrowing lizard. It occurs in open woodland, native tussock grassland, riparian habitats and rocky isolates. It prefers stony soils or clay soils with a stony surface, and has been found sheltering in soil beneath stones and rotting stumps. [180] Nearest record approximately 8km north in Mount Remarkable National Park.		✓ Hydro	✓ Solar Farm	This species is possibly present in the sloping hills and valleys in the eastern part of the area associated with vegetation type 8.
Morelia spilota	Carpet Python	2	O(20)		R	This species is often associated with mature River Red Gum habitat, but can also be found in rocky areas and other habitats. [181]			✓	Scant records for this species in this area. Considered unlikely to be present.
Notechis scutatus ater	Krefft's Tiger Snake	1,2	O(20)	V		Krefft's Tiger Snake (Flinders Ranges) is restricted to the rocky, often steep margins of watercourses that often dry to become isolated pools during the summer. Typical riparian vegetation consists of woodland dominated by River Red Gum (*Eucalyptus camaldulensis*) and Sugar Gums (*E. cladocalyx*). Valley slope vegetation is dominated by Long-leafed Box (*E. goniocalyx*) with an understorey of Mustard Bush (*Cassinia sp*.) and *Hymenanthera angustifolia*.[182] Nearest record approximately 5km northwest, along drainage line that ultimately ends in Baroota Reservoir.			✓	Habitats present in the potential impact area are not suited to this species.

[180] Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for *Aprasia pseudopulchella* (Flinders Ranges Worm-lizard). Canberra: Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/biodiversity/threatened/species/pubs/1666-conservation-advice.pdf.
[181] Natural Resources Adelaide and Mount Lofty Ranges (2016). Carpet Python *Morelia spilota*. Government of South Australia, Adelaide.
[182] Department of the Environment, Water, Heritage and the Arts (2008). Approved Conservation Advice for Notechis ater ater (Krefft's Tiger Snake (Flinders Ranges)). Canberra: Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/biodiversity/threatened/species/pubs/82287-conservation-advice.pdf.

Scientific Name	Common name	Source	Record status	EPBC status	NPWS status	Preferred habitat description	Likely	Possible	Unlikely	Likelihood justification
Pseudophryne bibronii	Brown Toadlet	2	O(20)		R	Generally found singularly or in low numbers under rocks and logs and in grassy areas beside creeks in forest, heath and grassland habitats.[183]			✓	Generally found in higher rainfall habitats.
Varanus varius	Lace Monitor	2	O(20)		R	The Lace Monitor has a restricted distribution in South Australia, occurring in the upper reaches of the SA Murray-Darling Basin and an isolated population in the southern Flinders Ranges. The Lace Monitor prefers wooded areas with larger eucalypt trees with hollows.[184]		✓ Reservoir - Hydro	✓ Solar Farm	Possibly (but not likely) present in Red Gum woodland areas along creeks and associated with Baroota Reservoir.
Vermicella annulata	Common Bandy Bandy	2	O(20)		R	A nocturnal, burrowing snake found in a wide variety of habitats from wet coastal forests, savannah woodland, mallee, mulga and other Acacia scrubs to spinifex covered desert sandhills.[185]			✓	Unlikely – extremely few records for this species and generally associated with sandier soils than present in the site.

Key to Codes

Source: 1: Department of Environment and Energy (DoEE) Protected Matters Search Tool, 2: South Australian Department of Environment, Water and Natural Resources Biological Database of SA search

Record status: P = Species flagged by the Protected Matters Search Tool (PMST), O = previously observed in site, O(20) = previously observed within 20km of the site, S = observed this survey

Conservation Status: R = Rare, V = Vulnerable, E = Endangered

[183] Department for Environment and Heritage (2008). Threatened Species Profile *Pseudophryne bibronii* Brown Toadlet. Department for Environment and Heritage, Adelaide.
[184] Government of South Australia (2015). Help save the Heath Goanna. www.naturalresources.sa.gov.au/files/sharedassets/eyre/heath-goanna-fact.pdf accessed 21/4/2017.
[185] Cogger, H. (2014). Reptiles and Amphibians of Australia. CSIRO publishing, Collingwood.

5. Initial Significant Impact Assessment:

The EPBC Act Significant Impact Guidelines[186] provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance. The following sections discuss these matters as they relate to the Baroota Pumped Hydro and Solar Project.

5.1 Listed Migratory Species

The EPBC Act Significant Impact Guidelines define 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 a 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
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

It is considered that there is no predicted significant impact of either component of the proposed development on migratory species that were identified by desktop and field assessment (Table 19).

TABLE 19: SIGNIFICANT IMPACT ASSESSMENT FOR MIGRATORY SPECIES

Scientific Name	Common name	EPBC status	Likelihood of occurrence			Significant Impact Assessment[187]
			Likely	Possible	Unlikely	
Actitis hypoleucos	Common Sandpiper	Ma,Mg		X		No significant impact
Apus pacificus	Fork-tailed Swift	Mg	X			No significant impact
Arenaria interpres	Ruddy Turnstone	Ma,Mg			X	No significant impact
Calidris acuminata	Sharp-tailed Sandpiper	Ma, Mg		X		No significant impact
Calidris alba	Sanderling	Ma,Mg			X	No significant impact
Calidris canutus	Red Knot	E, Ma, Mg			X	No significant impact
Calidris ferruginea	Curlew Sandpiper	Ma, Mg, CE			X	No significant impact
Calidris melanotos	Pectoral Sandpiper	Ma, Mg			X	No significant impact
Calidris ruficollis	Red-necked Stint	Ma, Mg			X	No significant impact
Calidris tenuirostris	Great Knot	Ma, Mg, CE			X	No significant impact
Gallinago hardwickii	Latham's Snipe	Ma, Mi			X	No significant impact
Limosa lapponica	Bar-tailed Godwit	V,Ma, Mg			X	No significant impact
Merops ornatus	Rainbow Bee-eater	Ma, Mg	X			No significant impact
Motacilla cinerea	Grey Wagtail	Ma, Mg			X	No significant impact
Motacilla flava	Yellow Wagtail	Ma, Mg			X	No significant impact
Myiagra cyanoleuca	Satin Flycatcher	Mg			X	No significant impact
Numenius madagascariensis	Eastern Curlew	Ma, Mg,CE			X	No significant impact
Pandion haliaetus	Osprey	Ma, Mg		X		No significant impact
Plegadis falcinellus	Glossy Ibis	Ma, Mg	X			No significant impact

[186] Australian Government Department of the Environment (2013). Matters of National Environmental Significance Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Australian Government, Canberra.

[187] Based upon criteria provided within "Matters of National Environmental Significance Significant impact guidelines 1.1, *Environment Protection and Biodiversity Conservation Act 1999*".

Scientific Name	Common name	EPBC status	Likelihood of occurrence			Significant Impact Assessment[187]
			Likely	Possible	Unlikely	
Pluvialis fulva	Pacific Golden Plover	Ma, Mg			X	No significant impact
Sterna hirundo	Common Tern	Ma, Mg		X		No significant impact
Thalasses bergii	Crested Tern	Ma, Mg			X	No significant impact
Tringa brevipes	Grey-tailed Tattler	Ma, Mg			X	No significant impact
Tringa nebularia	Common Greenshank	Ma, Mg		X		No significant impact

5.2 Listed Threatened Species

Extinct in the wild species - Significant impact criteria

An action is likely to have a significant impact on extinct in the wild species if there is a real chance or possibility that it will:

- adversely affect a captive or propagated population or one recently introduced/reintroduced to the wild; or
- interfere with the recovery of the species or its reintroduction into the wild.

Critically endangered and endangered species - Significant impact criteria

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;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

Vulnerable species - Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

Table 20 show that there is no predicted significant impact of either the Hydro or Solar Farm components of the proposed development on any animal species of national conservation significance that were identified by desktop and field assessment.

TABLE 20: SIGNIFICANT IMPACT ASSESSMENT FAUNA OF NATIONAL CONSERVATION SIGNIFICANCE (HYDRO AND SOLAR FARM BLOCKS)

Scientific Name	Common name	EPBC status	Likelihood of occurrence in remnant vegetation			Significant Impact Assessment[188]
			Likely	Possible	Unlikely	
Amytornis merrotsyi merrotsyi	Flinders Ranges Short-tailed Grasswren	V			X	No significant impact
Calidris canutus	Red Knot	E			X	No significant impact
Calidris ferruginea	Curlew Sandpiper	CE			X	No significant impact
Calidris tenuirostris	Great Knot	CE			X	No significant impact
Grantiella picta	Painted Honeyeater	V			X	No significant impact
Limosa lapponica	Bar-tailed Godwit	V			X	No significant impact
Neophema chrysogaster	Orange-bellied Parrot	CE			X	No significant impact
Numenius madagascariensis	Eastern Curlew	CE			X	No significant impact
Pedionomus torquatus	Plains-wanderer	CE			X	No significant impact
Pezoporus occidentalis	Night Parrot	E			X	No significant impact
Rostratula australis	Australian Painted Snipe	E			X	No significant impact
Sternula nereis nereis	Australian Fairy Tern	V		X Hydro - Reservoir	X Solar Farm	No significant impact
Zoothera lunulata halmaturina	Bassian Thrush	V			X	No significant impact
Aprasia pseudopulchella	Flinders Ranges Worm Lizard	V		X Hydro	X Solar Farm	No significant impact
Notechis scutatus ater	Krefft's Tiger Snake	V			X	No significant impact
Petrogale xanthopus xanthopus	Yellow-footed Rock Wallaby	V			X	No significant impact

Table 21 shows the significant impact assessment for flora for the proposed development. It should be noted that Habitat Types 5 and 6 in the Hydro area, particularly the steep, rocky slopes with dense shrub cover, showed the greatest potential for the presence of both state and nationally threatened flora species (as discussed in Table 13).

[188] Based upon criteria provided within "Matters of National Environmental Significance Significant impact guidelines 1.1, *Environment Protection and Biodiversity Conservation Act 1999*".

TABLE 21: SIGNIFICANT IMPACT ASSESSMENT FLORA OF CONSERVATION SIGNIFICANCE

Scientific Name	Common name	EPBC status	Likelihood of occurrence			Significant Impact Assessment[189]
			Likely	Possible	Unlikely	
Acacia spilleriana	Spiller's Wattle	E			X	No significant impact
Acanthocladium dockeri	Spiny Everlasting / Spiny Daisy	CE			X	No significant impact
Caladenia arenaria		E			X	No significant impact
Caladenia gladiolata	Bayonet Spider-orchid	E			X	No significant impact
Caladenia macroclavia	Large-club Spider Orchid	E			X	No significant impact
Caladenia tensa	Greencomb Spider-orchid	E			X	No significant impact
Caladenia woolcockorium	Woolcock's Spider-orchid	V			X	No significant impact
Caladenia xantholeuca	White Rabbits	E			X	No significant impact
Glycine latrobeana	Clover Glycine	V			X	No significant impact
Olearia pannosa ssp. pannosa	Silver Daisy-bush	V		X Hydro	X Solar Farm	No significant impact
Prasophyllum pallidum	Pale Leek-orchid	V			X	No significant impact
Prasophyllum validum		V			X	No significant impact
Pterostylis chlorogramma		V			X	No significant impact
Senecio macrocarpus	Large-fruit Fireweed	V			X	No significant impact
Senecio megaglossus	Superb Groundsel	V		X Hydro	X Solar Farm	No significant impact
Swainsona pyrophila	Yellow Swainson-pea	V			X	No significant impact
Veronica parnkalliana	Port Lincoln Speedwell	E			X	No significant impact

6. Discussion

This report details the flora and fauna within the area that may be impacted by the Baroota Solar/Hydro project. Two areas were assessed, the area that may be impacted by the solar farm and substation on flattish land to the west of Baroota Reservoir (Solar Farm block), and the area that may be impacted by the hydro development on generally steep slopes to the east of Baroota Reservoir (Hydro block).

The native vegetation in the Solar Farm block is generally quite degraded. There are some sections that have been recently ploughed and have no remnant vegetation. Areas where native vegetation remain are predominantly chenopod shrublands. These shrublands have been exposed to long-term grazing, and have been substantially modified by this impact.

Two bird species of State conservation significance, the state Rare Elegant Parrot (*Neophema elegans*) and the state Vulnerable Blue-winged Parrot (*Neophema chrysostoma*), may occasionally utilise these open shrubland areas for feeding. The Solar Farm block is considered unlikely to provide **critical** habitat for any fauna species of state or national conservation significance. One plant species of conservation significance, Rohrlach's Bluebush (*Mairena rohrlachii*) was present in the Solar Farm area. This species is a dominant overstorey component in the south-east corner of the block, in an area that may be impacted by construction of a substation, and is also present as scattered plants in other vegetation types in the Solar Farm area.

[189] Based upon criteria provided within "Matters of National Environmental Significance Significant impact guidelines 1.1, *Environment Protection and Biodiversity Conservation Act 1999*".

The native vegetation in the Hydro block encompasses a diversity of vegetation types in a variety of different conditions. The whole area is exposed to sheep grazing, but steep, rocky sections in the central and western parts of this block still retain a dense native shrub layer, with emergent trees in some locations. These areas (Habitat Types 5 and 6) also contained three plant species rated as Rare at a state level, and were considered the most likely areas to contain other plant species of conservation significance – it is likely that these species could only be detected during winter/spring. The remainder of the Hydro Block was considered to be in generally poor condition overall.

With regard to fauna in the Hydro area, the thin band of Red Gum (*Eucalyptus camaldulensis*) woodland around the reservoir may provide habitat for the state Rare Common Brushtail Possum (*Trichosurus vulpecula*). The open water and fringing habitats of the reservoir area also provide habitat for a number of waterbirds of state or national significance. Some of the mallee areas contain trees with hollows that are likely to be a key habitat component for nesting and shelter for bats and birds.

In addition to the project receiving development approval under the *Development Act 1993*, it will also require approval to clear native vegetation on the site under *Regulation 12(34) – Infrastructure* of the *Native Vegetation Act 1991*. This Regulation allows for clearance of vegetation incidental to the construction or expansion of a building or infrastructure (and associated services) where the Minister has declared that the clearance is in the public interest. Data collected for this assessment report will be used to prepare an application for clearance under this Regulation.

Appendix 1: Echolocation call identification report

Client: T & M Ecologists Pty Ltd

Contact: Tim Milne

Date: 16/04/2018

Project: Baroota Reservoir

Important information about the call identifications presented in this report.

Echolocation call analysis is complex and many species cannot be identified by call alone. It is highly recommended for most surveys that echolocation call recording be accompanied by trapping.

Call analysis is affected by many factors, these include the suite of species present, the quality of calls recorded (equipment settings, microphone quality, background noise from wind, insects, echoes), the quality of the reference call database for the region and the experience of the analyst.

The time taken to identify calls depends on the above and the needs of the client. Deriving a simple species inventory for each detector night is much quicker than attempting to identify every call for each detector night.

In many projects, a very low proportion of all calls recorded may be of sufficient quality to allow identification. It is a sign of the competence of the analyst to reject calls based on poor quality.

The identifications in this report are based on a combination of manual and automated methods using either reference calls from the region or from species calls recorded outside the region if they are likely to represent the calls from species in the survey region. Any doubt on species' identifications is always explained.

Species identified per night is at a very high standard and is only identified if I am sure that a species occurs in the recordings for that night. This data in no way represents abundance of species per night. The bat detector microphone will record a bat file when it is loud enough to trigger the electronics. The volume of space sampled by the microphone varies, due to loudness of the call, frequency of the call, temperature and humidity. Additionally one bat may feed around a detector many times or not. Additionally the detection of Anabat detectors varies between detectors due to the sensitivity setting.

There is NO abundance data from a Anabat Detector.

This report includes the recommendations set out in the reporting standards for echolocation call analysis developed by the Australasian Bat Society.

Dennis Matthews – dennis.matthews@bigpond.com - **0885621666**

Data

Species expected to be present in the greater area of Mid Flinders Ranges

Austronomus australis
Chalinolobus gouldii
Chalinolobus morio
Nyctophilus geoffroyi
Ozimops petersi (Mormopterus sp3*)*
Ozimops planiceps (Mormopterus sp4*)*
Saccolaimus flaviventris
Scotorepens balstoni
Vespadelus baverstocki – just outside this species range
Vespadelus darlingtoni
Vespadelus regulus
Vespadelus vulturnus – just outside this species range

Species present in the Anabat files

Austronomus australis
Chalinolobus gouldii
Chalinolobus morio
Nyctophilus geoffroyi
Ozimops sp

Identification

	AUAU	CHGO	CHMO	NYGE	OZsp
Acacia victoriae shrubland 2018-04-09		X			
Acacia victoriae shrubland 2018-04-10	X	X		X	X
Eucalyptus gracilis socialis mallee 2018-04-09	X	X	X	X	X
Eucalyptus gracilis socialis mallee 2018-04-10	X	X	X	X	X

CODES

CHGO	*Chalinolobus gouldii*	CHMO	*Chalinolobus morio*
OZsp	*Ozimops* sp	NYGE	*Nyctophilus geoffroyi*
AUAU	*Austronomus australis*		

Discussion

There were about 669 Anabat files in the data set. Most had bat calls in the files (>99%).

I could not see any calls looking like *Scotorepens* sp. or *Vespadelus* sp.

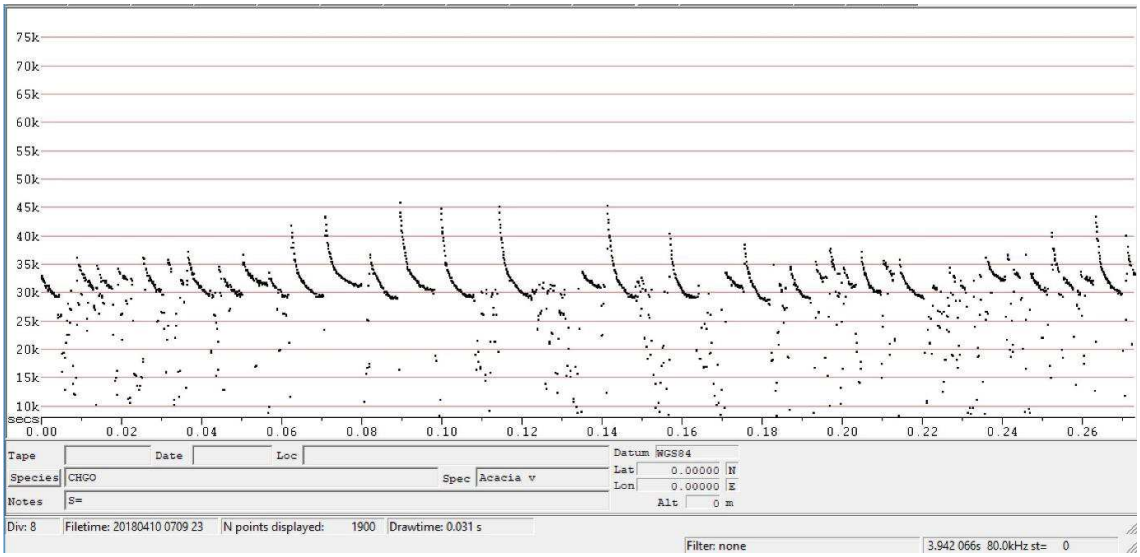
Ozimps sp can not be separated with Anabat, BUT most likely all calls were *Ozimops planiceps,* as they were 30khz or lower calls.

Trapping is the best method to separate these species.

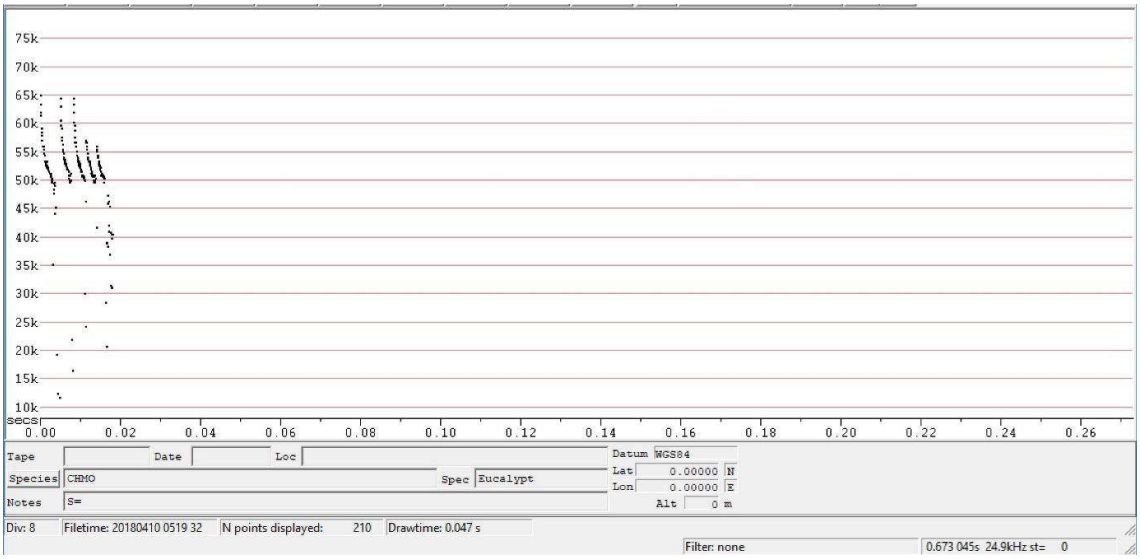
The most common calls were *Chalinolobus gouldii*, then *Ozimops* sp, *Nytophilus, Austronomus* and then *Chalinolobus morio*

Example calls from the survey for each species recorded.

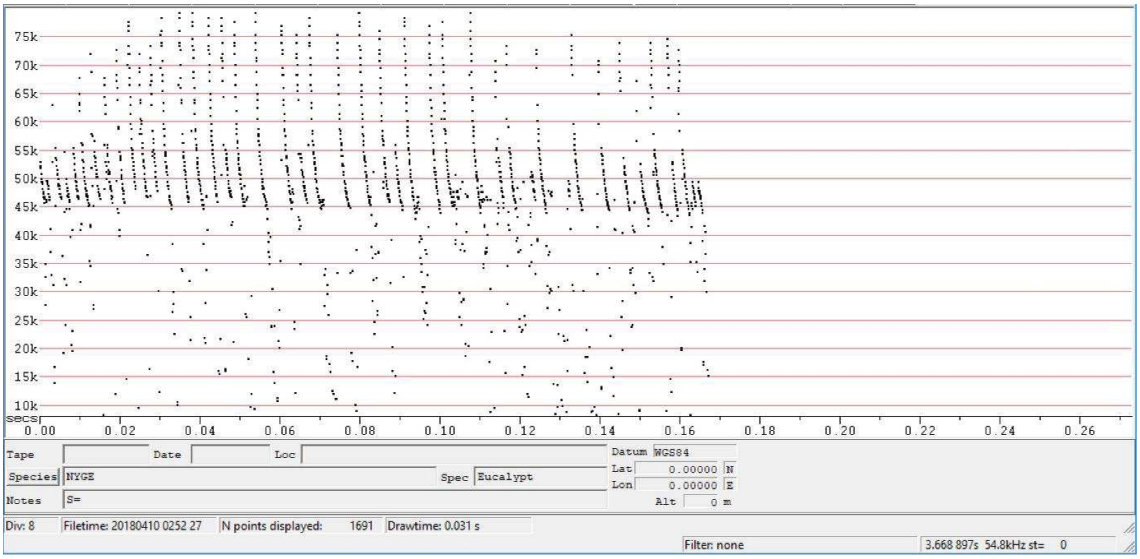
Chalinolobus gouldii



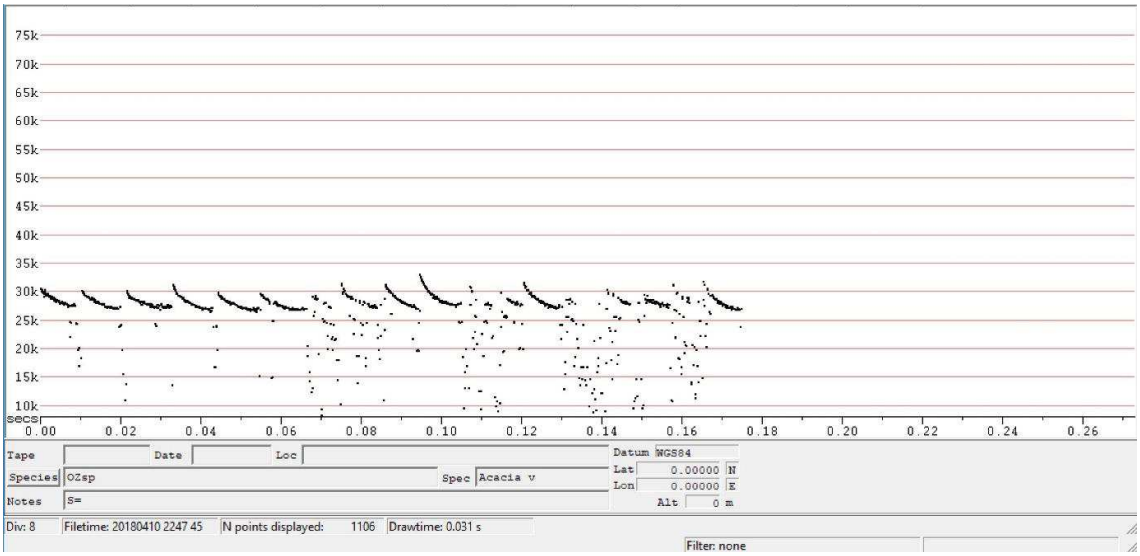
Chalinolobus morio



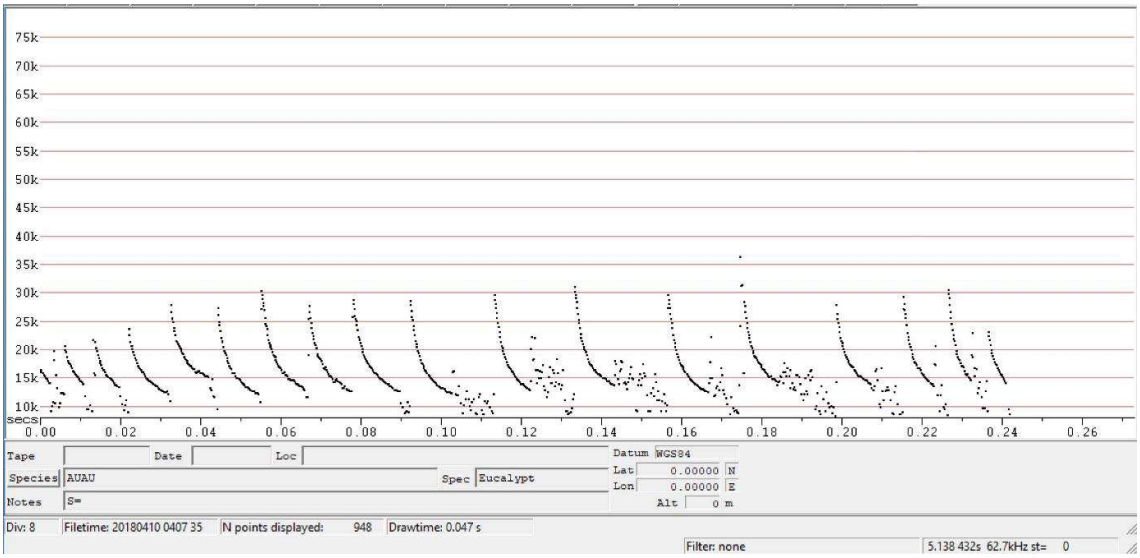
Nyctophilus geoffroyi



Ozimpos sp



Austronomus australis



Appendix 2: Habitat preference of bird species previously recorded and/or recorded as part of this survey within 20km of the proposed project area

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	1,2,3	✓	✓	River Red Gum Woodland, Acacia victoriae Shrubland.	Resident (sedentary)	Woodland along creeks and rivers and Acacia spp. Shrublands are typical habitat [191].
Acanthiza apicalis	Inland Thornbill	1,2,3		✓ (2 observed around dam 2016)	Mallee, Maireana Shrubland	Resident (sedentary)	Occurs in drier 1m tall *Maireana* shrublands, open Mallee.
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	1,2,3	✓	✓	Mallee, Gully Shrubland	Resident (sedentary)	Open woodlands and shrublands. Largely ground-feeding in open areas.
Acanthiza iredalei	Slender-Billed Thornbill	2			Maireana Shrubland	Resident (sedentary)	Sparsely occurs in Maireana and Atriplex Shrubland in the area. No recent (<20 years) nearby records.
Acanthiza lineata	Striated Thornbill	2			Mallee River Red Gum Woodland along Baroota Creek and fringing reservoir.	Resident (sedentary)	Usually found in eucalypt open forests and woodland. With a shrubby understorey. Feeds on insects in tree canopy, but at times on the ground.
Acanthiza nana	Yellow Thornbill	1,2,3		✓ (2 observed around dam 2018)	Likely Acacia shrubs and trees fringing the reservoir.	Resident (sedentary)	Frequents various Woodlands and Low Woodlands, including *Eucalyptus porosa* Woodland; *Allocasuarina verticillata*, *Acacia* spp. along watercourses and rivers, Callitris Low Woodlands; *Acacia longifolia sophorae* Shrubland (Coorong).
Acanthiza pusilla	Brown Thornbill	2			Gully Shrublands	Resident (sedentary)	Usually found in dense shrub including understorey of Open Forest and Woodland, including along watercourses. Usually feeds on insects in shrub layer, but also on ground and in tree canopy

[190] Carpenter G. A and Reid J. (1988) The Conservation Status of Birds of the Agricultural Regions (unpublished). Department for Environment and Heritage, Adelaide.

[191] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/spiny-cheeked-honeyeater accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Acanthiza uropygialis	Chestnut-rumped Thornbill	1,2,3		✓	Callitris Low Woodland. (4 observed around dam 2017)	Resident (sedentary)	Ground feeder of drier woodlands (eg *Casuarina pauper, Callitris* spp.)
Acanthorhynchus tenuirostris halmaturinus	Eastern Spinebill	1,2			Gully Shrubland, but unlikely in area due to lack of suitable habitat.	Mobile, at times sedentary.	Usually found in eucalypt Open Forest and Woodland, sclerophyll (heath) Shrubland. Feeds on insects and nectar, particularly from tubular flowers such as epacrids.
Accipiter cirrocephalus	Collared Sparrowhawk	1,2,3		✓	River Red Gum Woodland	Resident	Sparse population in woodlands.
Accipiter fasciatus	Brown Goshawk	1,2,3		✓	River Red Gum Woodland	Resident	Sparse population in woodlands.
Acrocephalus australis	Australian Reed Warbler	1,2,3		✓	Reeds and Rushes around reservoir edge.	Can be migratory between SE Australia in Spring and north and north west in Autumn.	Usually found in wetland thick tall reeds and rushes. It feeds on insects [192].
Aegotheles cristatus	Australian Owlet-nightjar	1,2			River Red Gum Woodland	Resident (sedentary)	Nocturnal species of most woodlands and forest which provide nesting and roosting hollows.
**Alauda arvensis*	Eurasian Skylark	2			Cropland	Mobile	Introduced species found in cultivated grasslands, crops, and coastal dunes
Amytormis striatus	Striated Grasswren	2			Triodia. However the habitat present likely too small and isolated.	Sedentary	Locally found in mostly undisturbed areas of Triodia on rocky hillsides. Feeds on ground on invertebrates and seeds.
Anas castanea	Chestnut Teal	2			Reservoir	Mobile	Found in wetlands and estuaries along coast. Can tolerate high salinity. Will also use freshwater lakes, reservoirs, sewerage ponds. Mainly feeds on water edge on seeds and crustaceans.
Anas gracilis	Grey Teal	1,2,3		✓	Deeper water of reservoir	Non-resident, nomadic, responding to rainfall events.	Can occur in any wetland type. Nests anywhere near water from the ground to trees [193].

[192] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australian-reed-warbler accessed 16/1/2018.

[193] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/grey-teal accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Anas superciliosa	Pacific Black Duck	1,2,3		✓	Deeper water of reservoir	Non-resident, nomadic visiting various wetlands.	Can occur in any wetland type. Several observed on deeper water[194].
Anthochaera carunculata	Red Wattlebird	1,2,3		✓	River Red Gum Woodland	mobile	Usually in woodland, forest, urban gardens. Feeds on nectar, and some insects[195].
Anthochaera chrysoptera	Little Wattlebird	2			Gully Shrubland	mobile	Various habitats including Open Forest, Woodland, Shrublands, urban gardens with plants producing ample nectar such as *Callistemon, Banksia*. Also feeds on insects.
Anthochaera lunulata	Westerm Wattlebird	2			n/a	Miss ID or taxanomic issue with Little Wattlebird, which it is very similar.	Endemic to SW Western Australia.
Anthus australis	Australian Pipit	1,2,3	✓	✓	Solanum open area, Maireana Shrubland	Resident (sedentary)	Usually found in open areas of a range of habitats, including chenopod shrublands. Feeds on ground on invertebrates and seeds [196].
Aphelocephala leucopsis	Southern Whiteface	1,2			Mallee	Resident (sedentary)	Ground feeder of drier open woodlands (eg. open mallee, *Casuarina pauper, Callitris* spp.)
Aphrodroma brevirostris	Kerguelen Petrel	1			Gulf shoreline	Mobile	Ocean bird occasionally sighted along the southern coast during storms. Occasional dead bird washed up along the coastline.
Apus pacificus	Fork-tailed swift	1,2			All overhead	Migratory, breeding in the Northern Hemisphere. flying to Australia Oct.to May	Widespread, highly mobile aerial birds feeding on flying insect, usually ahead of storms.
Aquila audax	Wedge-tailed Eagle	1,2,3	✓ (1 observed overhead)	✓	All. Likely nests in large River Red Gums along Baroota Ck, fringing reservoir.	Resident	Singular birds observed in various habitats overhead or perched on rocks and dead trees.

[194] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/pacific-black-duck accessed 16/1/2018.

[195] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/red-wattlebird accessed 16/1/2018.

[196] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australian-pipit accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Ardea ibis	Cattle Egret	2			Around reservoir edge and along Baroota creek.	Partially migratory, with a winter population movement	Found in grasslands, woodlands, wetlands, poorly drained pastures and cropland. Often seen with stock, especially cattle. Originally from Eurasia & Africa, but made its wat from Asia to Australia. Feeds on grasshoppers, frogs, reptiles.
Ardea modesta	Great/Eastern White Egret	1,2			Muddy reservoir edge	Nomadic non-resident, visiting various wetlands.	Usually prefer shallow, often flowing water, feeding on fish, frogs, invertebrates [197].
Ardea pacifica	Pacific Heron	1,2			Muddy reservoir edge	Nomadic non-resident	Various wetlands.
Ardeotis australis	Australian Bustard	1,2			Maireana Shrubland, Mallee	Highly mobile irregular visitor.	Open grassy and open woodland areas of inland Australia. Omnivorous feeding on a wide range of foods[198].
Arenaria interpres	Ruddy Turnstone	1,2			No suitable habitat	Migratory, breeding in northern Hemisphere, and over-summering in southern Hemishere.i	Found along shorelines on rocks, reefs and beaches. They typically turn over stones and seaweed to find insects, crustaceans, molluscs and spiders.
Artamus cinereus	Black-faced Woodswallow	1,2			No suitable habitat	Mobile	Widespread in inland areas in shrubland, open woodland, and around lakes and swamps. It feeds on insects [199].
Artamus cyanopterus	Dusky Woodswallow	1,2,3		✓	River Red Gum Woodland, Mallee	Mobile	Usually found in woodlands and forest [200].
Artamus minor	Little Woodswallow	2			Range of habitats	Mobile	Various habitats, with a preference for rugged inland ranges. Feeds on insects.
Artamus leucorynchus	White-Breasted Woodswallow	2			River Red Gum Woodland, Mallee	Mobile	Usually found in eucalypt forests and woodlands, often near water. Feeds on insects.

[197] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/great-egret accessed 16/1/2018.

[198] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australian-bustard accessed 16/1/2018.

[199] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-faced-woodswallow accessed 16/1/2018.

[200] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/dusky-woodswallow accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Artamus personatus	Masked woodswallow	1,2			Acacia victoriae Shrubland	Nomadic	Widespread in arid and semi-arid inland in shrubland, open woodland. It feeds on insects.
Artamus superciliosus	White-browed Woodswallow	1,2			Acacia victoriae Shrubland	Mobile	Found in a wide range of inland habitats: woodlands, shrublands, *Triodia*[201].
Aythya australis	Hardhead	1,2,3		✓	Deeper water of reservoir	Nomadic non-resident.	Most breeding occurs interstate in the Murray-Darling system.
Barnardius zonarius	Australian Ringneck	1,2,3		✓	River Red Gum Woodland	Resident or mobile.	Usually found in open woodlands, including tree lined watercourses. Tree hollow nester. Feeds largely on the ground on various food, including seed and fruit, but also nectar and invertebrates [202].
Bizuria lobata	Musk Duck	2,3		✓	Deeper water of reservoir.	Nomadic	Widespread where water found, including off the coast (pers. obs.). They feed by diving for invertebrates, crustaceans, frogs (Birdlife Australia, 2017).
Burhinus grallarius	Bush Stonecurlew	1,2			No suitable habitat.	Largely sedentary.	Widespread. Inhabits a range of Woodland habitats with an open grassy understorey. Feeds mainly on insects, molluscs, small lizards, seeds and occasionally small mammals.
Cacatua galerita	Sulphur-crested Cockatoo	1,2,3		✓	River Red Gum Woodland fring reservoir and along Baroota Creek.	Sedentary	Found in a variety of timbered habitats and common around human settlement. Feeds on berries, seeds, nuts and roots.
Cacatua sanguinea	Little Corella	1,2,3		✓	River Red Gum Woodland	Mobile	Widespread, especially along watercourses. Mainly feed on the ground on grass seeds and bulbs. They also need to drink daily. They nest in tree hollows[203].

[201] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-browed-woodswallow accessed 16/1/2018.

[202] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profileaustralian-ringneck/ accessed 16/1/2018.

[203] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/little-corella accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Cacomantis flabelliformis	Fan-tailed Cuckoo	1,2,3		✓	River Red Gum Woodland	Mobile & migratory	Usually found in woodlands and forest[204].
Cacomantis pallidus	Pallid Cuckoo	1,2			River Red Gum Woodland	Mobile	Widespread in woodland to forest and farmland. Parasitic nester on Honeyeaters, Woodswallows, Whistlers[205].
Calamanthus campestris	Rufous Fieldwren	2			Maireana Shrubland	Sedentary	Usually found in Shrublands. In this area found in *Maireana* Shrublands
Calamanthus (Hylacola) pyrrhopygius	Chestnut-rumped Heathwren	1,2			No suitable habitat.	Largely sedentary	Usually found in eucalypt Open Forest and Woodland over dense shrubs. Isolated population in southern Flinders Ranges in *Eucalyptus goniocalyx, E. cladocalyx* Woodland.
Calidris acuminata	Sharp-tailed Sandpiper	1,2			Reservoir edge.	Migratory, breeding in northern Hemisphere, and over-summering in southern Hemishere.	Found in grassy edges of shallow inland freshwater wetlands, sewage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. Feeds on aquatic insects worms, molluscs, crustaceans
Calidris canutus	Red Knot	1,2			No suitable habitat	Migratory, breeding in northern Hemisphere, and over-summering in southern Hemishere.	Usually found on tidal sandy and mudflats along the coast. Probe soft sand and mud for worms, bivalves, invertebrates.
Calidris ferruginea	Curlew Sandpiper	1,2			Reservoir edge, but mainly coastal	Migratory, breeding in northern Hemisphere, and over-summering in southern Hemishere.	Usually found on intertidal mudflats of estuaries, lagoons, mangroves, beaches, rocky shores and around lakes, dams and floodwaters. Feeds on invertebrates.
Calidris ruficollis	Red-necked Stint	1,2			No suitable habitat	Migratory, breeding in northern Hemisphere, and over-summering in southern Hemishere.	Usually found on coastal intertidal mudflats and protected sandy or coralline shores.

[204] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/fan-tailed-cuckoo accessed 16/1/2018.

[205] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/pallid-cuckoo accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Calidris tenuirostris	Great Knot	1,2			No suitable habitat	Migratory, breeding in northern Hemisphere, and over-summering in southern Hemishere.	Usually found on coastal intertidal mudflats and sandflats. Feeds on bivalve molluscs, snails, worms, crustaceans.
Caligavis chrysops samueli	Yellow-faced Honeyeater (MLR, southern FR)	1,2,3		✓	River Red Gum Woodland of reservoir edge and Baroota Creek.	Migratory within Australia.	Usually found in open forests and woodlands, often near water and wetlands. Also urban areas.
**Carduelis carduelis*	European Goldfinch	2			Cropland and around farm house.	Mobile	Introduced bird found in urban and agricultural areas. Feeds on seeds (especially Scotch Thistle) and at times insects.
Certhionyx variegatus	Pied Honeyeater	1,2			No suitable habitat	Mobile. Usually found further north, but at times come south as far as agricultural areas.	Usually found in semi-arid and arid areas dominated by *Eremophila* and *Grevillea* shrubland and woodland[206].
Charadrius ruficapillus	Red-Capped Dotterel	1,2			No suitable habitat	Sedentary	Found in along the shoreline and inland saline and brackish wetlands. Forages for molluscs, small crustaceans usually on mudflats, sandy beaches and salt-marsh.
Chrysococcyx basalis	Horsfield's Bronze-cuckoo	1,2,3		✓	River Red Gum Woodland	Mobile	Widespread, usually found in wooded habitats. Parasitic nester, particularly on Fairy-wrens and Thornbills [207].
Chalcites lucidus	Shining Bronze Cuckoo	1,2			River Red Gum fringing reservoir and Baroota Creek.	Migratory spring-summer visitor.	Usually found in stringybark Open Forest, *Eucalyptus viminalis, E. cladocalyx* Woodland, *E. diversifolia* Mallee, coastal Shrubland.

[206] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/pied-honeyeater accessed 16/1/2018.

[207] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/horsfields-bronze-cuckoo accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Chenonetta jubata	Australian Wood Duck	2,3		✓	Around reservoir	Mobile	Widespread found in grasslands, open woodlands, wetlands, flooded pastures, along the coast in inlets and bays, farm dams. Feeds on grass, clover and other herbs, and occasionally, insects (Birdlife Australia, 2017).
Chenonetta jubata	Maned Duck	1,2					See above
Cheramoeca leucosterna	White-backed Swallow	1,2,3		✓	River Red Gum of Baroota Creek. Open areas.	Mobile	Prefers open areas such as Grasslands and Shrublands.At breeding time prefer creek beds. It feeds on insects in flight.
Chroicocephalus novaehollandiae	Silver Gull	1,2			Reservoir	Highly mobile	Widespread in any watered habitat (Birdlife Australia, 2017). One observed inshore on lake.
Chrysococcyx osculans	Black-eared Cuckoo	1,2			No suitable habitat	Mobile	Widespread, especially in Mulga and mallee particularly along creek beds. Parasitic nester, particularly on Redthroat nests in inland areas [208].
Chrysococcyx lucidus	Shining Bronze-Cuckoo	2					See ***Chalcites lucidus***
Chrysococcyx osculans	Black-Eared Cuckoo	2			Mallee	Mobile	Widespread, especially in Mulga and Mallee particularly along creek beds. Parasitic nester, particularly on Redthroat nests in inland areas (Birdlife Australia, 2017).
Cincloramphus cruralis	Brown Songlark	1,2		✓	Maireana Shrubland	Mobile	Widespread where grassy open habitats and farmland. Feeds on invertebrates and seeds [209].

[208] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-eared-cuckoo accessed 16/1/2018.

[209] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/brown-songlark accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Cincloramphus mathewsi	Rufous Songlark	1,2			Mallee, Solanum open area	Migratory Spring & Summer breeding visitor to southern areas.	Usually found in lightly timbered grasslands, farmland and Mulga areas. Feeds on invertebrates [210].
Circus approximans	Swamp Harrier	2			Reservoir and surrounds	Migratory	Usually found around terrestrial fresh and salt wetlands often with reeds and open areas. They feed on other birds and their eggs, large insects, frogs, reptiles and small mammals including hares and rabbits (Birdlife Australia, 2017).
Circus assimilis	Spotted Harrier	1,2		✓	River Red Gum Woodland	Sedentary	Widespread, particularly in arid and semi-arid open wooded areas. It feeds on quail, pipits and also mice, rats, rabbits and lizards [211].
Cladorhynchus leucocephalus	Banded Stilt	1,2			Reservoir, but prefers saline wetlands.	Highly mobile	Mainly saline and highly saline large open shallow inland and coastal water.
Climacteris picumnus	Brown Treecreeper	1,2			River Red Gum Woodland	Resident (sedentary)	Searches bark of trees and ground for invertebrates. Inhabits drier open woodlands (eg. open mallee, *Casuarina pauper, Myoporum platycarpum*) and River Red Gum
Climacteris rufa	Rufous Treecreeper	2			Mallee areas	Sedentary	Found in open *Eucalyptus gracilis, E. oleosa, E. socialis* Mallee.
Colluricincla harmonica harmonica	Grey Shrike-thrush	1,2,3	✓ (1 observed in Area 1 Mallee)	✓	River Red Gum Woodland, Mallee	Sedentary	Widespread in various woodlands and forest. Feeds on invertebrates, small mammals and frogs [212].

[210] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/rufous-songlark accessed 16/1/2018.

[211] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/spotted-harrier accessed 16/1/2018.

[212] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/grey-shrike-thrush accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
*Columba livia**	Rock Pigeon	1,2,3	✓	✓	River Red Gum Woodland around reservoir, dam, and along Baroota Creek.	Sedentary	Usually found near human settlement (cities, large towns). Mostly feeds on seeds. Nests on cliffs and buildings [213].
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1,2,3		✓	River Red Gum Woodland	Mobile	Widespread in various wooded habitat. Feeds on invertebrates [214].
Corcorax melanorhamphos	White-winged Chough	1,2			River Red Gum Woodland, Mallee	Largely sedentary and colonial.	Found in eucalypt Open Forest, Woodland and taller Mallee. Feeds on ground raking through leaf litter primarily for insects.
Cormobates leucophaea	White-throated Treecreeper	2			No habitat in area.	Sedentary	Usually found in stringybark Open Forest, and at times *Eucalyptus goniocalyx, E. microcarpa* Woodland.
Corvus bennetti	Little Crow	1,2			All	Mobile	Found in arid and semi-arid areas
Corvus coronoides	Australian Raven	1,2,3	✓	✓	All	Mobile	Found in various habitats. Several birds observed in all habitats at various times.
Corvus mellori	Little Raven	1,2,3		✓	All	Mobile	Lightly wooded open areas, mostly in the agricultural areas.
Coturnix pectoralis	Stubble Quail	1,2			Maireana Shrubland, cropland	Mobile	Usually found in more southern grassland, stubble, shrubland of agricultural areas. Will move into semi-arid areas after floods. Feeds on seed including grain.
Coturnix ypsilophora	Brown Quail	1,2			Unlikely but maybe sedges fringing reservoir.	Mobile	Reported from crops, overgrown grassy areas, irrigated pasture, and sedges bordering swamps. In SE in *Melaleuca* Shrubland.
Cracticus nigrogularis	Pied Butcherbird	2			Mallee	Sedentary	Widespread in drier Woodlands. Feed on small birds, frogs, lizards and insects (Birdlife Australia, 2017).
Cracticus tibicen telonocua	Eyre Peninsula Australian Magpie	3					See *Gymnorhina tibicen*

[213] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/rock-pigeon accessed 16/1/2018.

[214] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/vlack-faced-cuckoo-shrike accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Cracticus torquatus	Grey Butcherbird	1,2,3	✓	✓	River Red Gum Woodland, Mallee Box Woodland, Mallee	Sedentary	Usually found in a range of wooded habitats. Feed on small animals, including birds, lizards and insects, as well as some fruits and seeds [215].
Cygnus atratus	Black Swan	1,2			Deeper water of reservoir	Resident in permanent water, but generally mobile.	Widespread wherever there are open water wetlands from the coast to inland. Feeds on algae and plants [216].
Dacelo novaeguineae	Kookaburra	1,2,3	✓ (2 observed in Area 1 Mallee)	✓	River Red Gum Woodland, Mallee	Sedentary	Usually found in wooded areas. Feed on small reptiles, mammals and nestlings. Nest in tree hollows [217].
Daphoenositta chrysoptera	Varied Sittella	1,2			River Red Gum Woodland, Mallee	Mobile	Found in eucalypt, usually rough-barked woodland and forest. Feed on invertebrates on tree trunks [218].
Dicaeum hirundinaceum	Mistletoebird	1,2,3		✓	River Red Gum Woodland, Mallee (where Mistletoe)	Resident or mobile	Widespread wherever there is Mistletoe. Usually feed on Mistletoe berries [219].
Dromaius novaehollandiae	Emu	1,2			All	Highly mobile	Widespread through all habitats, but probably more common on the plain.
Drymodes brunneopygia	Southern Scrub Robin	1,2			Mallee and adjacent gully Shrubland	Sedentary	Usually found in Mallee with a prominent shrub understorey (eg. *Melaleuca* spp., *Callistemon, Eremophila scoparia*). Feeds on ground on invertebrates.
Drymodes superciliaris	Northern Scrub Robin	2			Unlikely to be in the area.	Sedentary	Strictly a northern Queensland tropical rain forest species, there are records in the area.
Egretta garzetta	Little Egret	1,2			Limited suitable habitat.	mobile	Usually found in various salt and freshwater wetlands including coastal tidal flats. Feeds in shallow water on fish, frogs, invertebrates [220].

[215] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/grey-butcherbird accessed 16/1/2018.

[216] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-swan accessed 16/1/2018.

[217] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/kookaburra accessed 16/1/2018.

[218] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/varied-sitella accessed 16/1/2018.

[219] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/mistletoebird accessed 16/1/2018.

[220] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/little-egret accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Egretta novaehollandiae	White-faced Heron	1,2,3		✓	Reservoir muddy edge	Mobile, visiting various wetlands.	Very widespread on various wetlands, including the coast and inland, including farm dams. Feeds on fish, frogs, invertebrates [221].
Egretta sacra	Eastern Reef Egret	2			Reservoir muddy edge	Mobile	Usually inhabit rocky shorelines and reefs, foraging for fish, crustaceans and molluscs.
Elanus axillaris	Black-shouldered Kite	1,2			Open areas eg Solanum, Maireana Shrubland.	Sedentary, at times mobile following mice plagues.	Usually inhabits treed grasslands, farmland, other open areas. Feeds primarily on rodents, with house mice have become a major part of their diet [222].
Elanus scriptus	Letter-winged Kite	1			Open areas	Only rare here when pop. builds up in rodent plagues.	Found mostly in northern SA and adjacent semi-arid and arid areas in open Grassland with tree-lined watercourses. Usually hunt at twilight for primarily Long-tailed Rats and Mice.
Elseyornis melanops	Black-fronted Dotterel	1,2,3		✓	Muddy reservoir edges.	Mobile	Widespread, but usually inhabits muddy terrestrial freshwater wetland margins, rivers, sewage farms. Feeds in soft mud on small invertebrates.
Eolophus roseicapillus	Galah	1,2,3	✓	✓	River Red Gum Woodland, Mallee, Gully Shrubland	Mobile	Abundant and widespread usually in timbered habitats near water. Feeds on seeds mostly on the ground [223].
Eopsaltria australis	Eastern Yellow Robin	2			Mis ID as only recorded in SA in SE.	Sedentary	Usually found in stringybark Open Forest, *Eucalyptus diversifioia* and Tall Shrubland in the SE of SA.
Epthianura albifrons	White-fronted Chat	1,2,3		✓	No suitable habitat	Likely resident	Usually found in saltmarshes (Samphire). They feed primarily on insects [224].

[221] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-faced-heron accessed 16/1/2018.

[222] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-shouldered-kite accessed 16/1/2018.

[223] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/galah accessed 16/1/2018.

[224] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-fronted-chat accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Epthianura aurifrons	Orange Chat	2			Maireana Shrubland	Resident at times, but nomadic leaving droughted areas.	Usually found in arid and semi-arid chenopod Shrublands, Grassland including gibber plains. Feeds on insects on ground and in shrubs.
Epthianura tricolor	Crimson Chat	2			Maireana Shrubland.	Mobile, at times nomadic.	Usually found in semi-arid and arid areas dominated by open chenopod Shrublands on dunes, plains or grasslands.
Erythrogonys cinctus	Red-kneed Dotterel	1			Muddy reservoir edge	Mobile	Usually found on wet mud flats on margins of terrestrial freshwater wetlands [225].
Eurostopodus argus	Spotted Nightjar	1,2			River Red Gum Woodland, Mallee and Shrublands	Resident (sedentary) but at times nomadic.	Nocturnal, ground roosting and nesting species. Requires a good leaf litter cover, although found in various open habitats including open woodlands to gibber plains.
Falco berigora	Brown Falcon	1,2		✓	chenopod Shrubland	Sedentary, at times mobile.	Widespread, but mostly found around Grassland, shrublands, farmland, and also woodlands. Usually feed on reptiles, small mammals and insects [226].
Falco cenchroides	Nankeen Kestrel	1,2,3	✓	✓	Open areas, including chenopod Shrublands	Sedentary, at times mobile following mice plagues.	Widespread, but mostly found around Grassland, shrublands, farmland, and also open woodlands. Usually feed on lizards, small mammals (mice), small birds and insects [227].
Falco hypoleucos	Grey Falcon	1,2			Limited suitable habitat	Mobile, but likely rare here.	Usually found in semi-arid and arid areas with open Acacia woodland and *Triodia*[228].
Falco longipennis	Australian Hobby	1,2,3		✓	River Red Gum Woodland	Nomadic non-resident	Prefers open woodlands, usually near water.
Falco peregrinus	Peregrine Falcon	1,2,3		✓	River Red gum Woodland	Possible resident	Sparse in woodland and forest, usually near water, or where cliffs are present.

[225] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/red-kneed-dotterel accessed 16/1/2018.

[226] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/brown-falcon accessed 16/1/2018.

[227] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/nankeen-kestrel accessed 16/1/2018.

[228] South Australian Arid Lands NRM Board (undated). Grey Falcon *Falco hypoleucos.*

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Falco subniger	Black Falcon	1,2			River Red Gum Woodland	Mobile	Usually found along tree-lined watercourses of drier semi-arid and arid areas. Feed on birds, small mammals, insects and sometime carrion [229].
Falcunculus frontatus frontatus	Eastern Shriketit	1,2			River Red Gum Woodland.	Sedentary	Found in primarily younger *Eucalyptus camaldulensis* Open Woodland, but also E. *leucoxylon* (& *E. viminalis*) Woodland.
Fulica atra	Australian Coot	1,2,3		✓	Reservoir edge	Mobile and nomadic	Common in wetland fringed with vegetation. Feed largely on aquatic vegetation by diving in water, or grazing on water's edge, but also invertebrates [230].
Gallinula tenebrosa	Dusky Moorhen	1,2			Reservoir edge	Mobile	Found in various wetland habitats with open water, often fringed with reeds, rushes. Feeds on algae, water plants and grasses, molluscs and invertebrates [231].
Gallirallus philippensis mellori	Buff-banded Rail	1,2			Reservoir edge	Mobile	Usually found in thick vegetation around a range of terrestrial and coastal wetlands. Feeds on crustaceans, molluscs, insects, seeds, fruit, frogs, carrion and refuse [232].
Gavicalis virescens	Singing Honeyeater	1,2,3	✓	✓	Gully Shrubland. Acacia victoriae Shrubland	Resident	Widespread, usually found in various shrub habitats, especially Acacia, from coastal dunes to the inland. Feeds on nectar and insects [233].
Geopelia cuneata	Diamond Dove	1,2			River Red Gum Woodland	Resident	Widespread in arid and semi-arid grasslands, Mulga low woodlands, and open tree-lined water-courses. Feeds on ground on herb and grass seeds [234].

[229] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-falcon accessed 16/1/2018.

[230] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australian-coot accessed 16/1/2018.

[231] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/dusky-moorhen accessed 16/1/2018.

[232] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/banded-rail accessed 16/1/2018.

[233] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/singing -honeyeater accessed 16/1/2018.

[234] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/diamond-dove accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Geopelia striata/placida	Peaceful Dove	1,2,3	✓	✓	River Red Gum Woodland	Resident	Open woodlands such as River Red Gum woodland along watercourses.
Gliciphila melanops	Tawny-crowned Honeyeater	1,2			Gully Shrubland	Mobile	Usually found in Shrublands including rocky slopes of Southern Flinders Ranges.
Glossopsitta concinna	Musk Lorikeet	1,2			No suitable habitat.	Mobile	Usually found in eucalypt Woodlands such as *Eucalyptus leucoxylon, E. cladocalyx* Woodlands.
Grallina cyanoleuca	Magpie-lark	1,2,3		✓	River Red Gum Woodland around the reservoir	Resident	Widespread in various habitats with trees and open areas. Feeds on ground on insects and their larvae [235].
Gymnorhina tibicen	Australian Magpie	1,2,3	✓	✓	Various/all	Resident	Widespread in various habitats with trees and open areas. Feeds on ground on insects and their larvae [236].
Haematopus fuliginosus	Sooty Oystercatcher	1,2			No suitable habitat.	mobile	Found along the coast, usually along rocky shores. Feeds on molluscs, crustaceans, marine worms, starfish sea urchins, and small fish.
Haematopus longirostris	(Australian) Pied Oystercatcher	1,2			No suitable habitat.	Mobile	Prefers coastal mudflats, sandbanks and sandy ocean beaches, and less so rocky shoreline. Feeds primarily on bivalve molluscs, but also worms, crustaceans and insects.
Haliastur sphenurus	Whistling Kite	1,2,3		✓	River Red Gum Woodland fringing reservoir.	Resident	Typically found around woodlands (especially *Eucalyptus camldulensis*) near water.
Hamirostra melanosternon	Black-Breasted Buzzard	2			River Red Gum Woodland of Baroota Creek	Resident as suitable habitat.	Usually found in arid and semi-arid tree-lined watercourses. Feeds on rabbits, lizards, ground birds and carrion. Will nest in the River Red Gums (Birdlife Australia, 2017).
Hieraaetus morphnoides	Little Eagle	1,2			River Red Gum Woodland	Resident	Widespread in woodlands and forest.

[235] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/magpie-lark accessed 16/1/2018.

[236] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australian-magpie accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Himantopus leucocephalus	White-headed Stilt	1,2,3		✓	Muddy edge of reservoir.	Mobile	Prefer mudflats, and shallow edges of fresh and saltwater marshes, lakes and rivers.
Hirundo neoxena	Welcome Swallow	1,2,3		✓	River Red Gum Woodland around the reservorir	Resident	Widespread in various habitats. Feeds on flying insects [237].
Hydroprogne caspia	Caspian Tern	1,2			Reservoir	Mobile	Widespread along most of Australia's coastline, and also major rivers inland, especially the Murray–Darling and Lake Eyre drainage basins. Prefers wetlands with clear water so they can detect their prey primarily fish).
Ixobrychus dubius	Australian Little Bittern	2			Reservoir fringe	Migratory	Found in tall rushes, reeds, *Typha*, shrub thickets or other dense cover inundated by at least 30 cm of water. It feeds on small animals, including eels, frogs, fish and yabbies. In SA mostly observed along the River Murray.
Lalage tricolor	White-winged Triller	1,2			River Red Gum Woodland	Mobile species, but could nest in area.	Usually found in open woodland and forest, and tree-lined watercourses in semi-arid areas. Feeds on invertebrates on ground or in low shrubs [238].
Larus pacificus	Pacific Gull	1,2			None	Highly mobile	Prefers sandy beaches, and less often, rocky coasts. Rarely observed inland.
Lichenostomus cratitius	Purple-Gaped Honeyeater	2			No suitable habitat	Mostly sedentary	Usually found in Mallee over heathy shrubs (*Melaleuca uncinata, Callitris* spp.)
Lichenostomus penicillatus	Eastern White-plumed Honeyeater	3		✓	River Red Gum Woodland	Sedentary	Usually found in Open Forest and Woodland, especially *Eucalyptus camaldulensis* Woodland, often near water

[237] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/welcome-swallow accessed 16/1/2018.

[238] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-winged-triller accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Limosa lapponica	Bar-tailed Godwit	1			No suitable habitat	Breeds in northern Hemisphere, and over-summers in southern Hemishere.	Inhabit coastal estuarine mudflats, beaches and mangroves
Malacorhynchus membranaceus	Pink-Eared Duck	2,3		✓	Reservoir	Nomadic following floods.	Usually found in timbered areas near shallow ephemeral or open water. Feeds on microscopic plants and animals in shallow waters (Birdlife Australia, 2017).
Malurus cyaneus	Superb Fairy-Wren	2			Gully Shrubland	Sedentary	Various habitats with a dense cover of low shrubs It feeds on invertebrates.
Malurus lamberti	Variegated Fairywren	1,2,3		✓	Vegetation around the reservoir	Resident	Usually found in mallee with a shrub understory. Mainly feed on insects.
Malurus leucopterus	White-winged Fairy-wren	1,2	✓	✓	Chenopod shrublands	Resident (sedentary)	Usually found on plains dominated by *Maireana, Atriplex* (and *Nitraria*) shrubland.
Malurus pulcherrimus	Blue-Breasted Fairy-Wren	2			Not recorded in area, as restricted to EP, and also no suitable habitat	Sedentary	Inhabits Mallee over heathy shrubs (eg. *Melaleuca uncinata, Callistemon*), Coastal Shrubland, Woodland over dense shrubs. It feeds on insects.
Malurus splendens	Splendid Fairy-wren	1,2			Mallee?	Resident (sedentary)	Usually found in drier woodlands with a shrub understory, such as open mallee, and *Casuarina pauper, Myoporum platycarpum* over chenopods.
Manorina flavigula flavigula	Yellow-throated Miner	1,2,3	✓	✓	Mallee and gully Mallee	Resident	Widespread in drier wooded habitats, especially mallee. Feeds primarily on insects, but also nectar [239].
Manorina melanocephala	Noisy Miner	2			River Red Gum Woodland, but not found in FR. Likely misID.	Sedentary	Usually found in Woodlands, Open Forest, and urban areas (Birdlife Australia, 2017).

[239] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/yellow-throated-miner accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Megalurus gramineus	Little Grassbird	2			Reservoir fringe	Sedentary	Usually found in margins of wetlands among dense growth of grass, rushes, reeds and sedges, as well as saltmarsh and clumps of lignum. Feeds on invertebrates (Birdlife Australia, 2017).
Melanodryas cucullata	Hooded Robin	1,2			Mallee	Mobile species.	Thinly distributed usually found in drier woodlands such as open mallee, *Casuarina pauper, Myoporum platycarpum*
Melithreptus affinis	Black-Headed Honeyeater	2			Miss-ID	Sedentary	Endemic to Tasmania, where it prefers forests with a dense shrubby understorey.
Melithreptus brevirostris	Brown-headed Honeyeater	1,2			River Red Gum and Mallee Box Woodland, Mallee.	Mobile	Widespread preferring eucalypt Open Forest and Woodland.
Melithreptus gularis	Black-chinned Honeyeater	1,2			River Red Gum Woodland	Mobile	Found in eucalypt Woodlands such as *Eucalyptus leucoxylon*, *E. fasciculosa*, *E. camaldulensis*, *E. microcarpa*, *E. odorata*.
Melithreptus lunatus	White-Naped Honeyeater	2			River Red Gum woodland	Mobile	Found in eucalypt stringybark Open Forest, and Woodland such as *Eucalyptus leucoylon, E. viminalis, E. microcarpa*.
Melopsittacus undulatus	Budgerigar	1,2,3		✓	Open areas, River Red Gum Woodland	Mobile species.	Widespread, but mainly in the semi-arid area. Feed on ground on seeds. Needs to drink daily. Nests in tree hollows [240].
Merops ornatus	Rainbow Bee-eater	1,2,3		✓	River Red Gum Woodland, gully shrubland and mallee	Migratory, moving north during Winter.	Usually found in various woodlands, forest and shrublands, often near water. Feeds on flying insects such as bees and wasps [241]. Nests in sandy banks and cliffs.
Microcarbo melanoleucos	Little Pied Cormorant	1,2,3		✓	Reservoir	Mobile	Sometimes found in coastal inlets, they are more common in terrestrial fresh or salt wetlands. Feeds on fish and crustaceans [242].

[240] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/budgerigar accessed 16/1/2018.

[241] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/rainbow-bee-eater accessed 16/1/2018.

[242] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/little-pied-cormorant accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Microeca fascinans	Jacky Winter	1,2			River Red Gum Woodland	Mobile	Widespread in open woodlands over sparse shrubs. Feed on flying insects[243].
Milvus migrans	Black Kite	1,2,3		✓	River Red Gum Woodland and surrounding open areas.	Mobile species.	Usually found in various habitats from timbered watercourses to open plains. Feeds on lizards, small mammals and insects, carrion [244].
Mirafra javanica	Horsfield's Bush Lark	1,2		✓	Open habitats such as Solanum, cropland.	Mobile	Found in grasslands, Open Woodlands, and cereal crops.It feeds on grass seed and insects.
Myiagra inquieta	Restless Flycatcher	1,2			Mallee	Mobile	Usually found in mallee, woodland and open forest. Feeds on invertebrates [245].
Neochmia temporalis	Red-Browed Finch	2			Reservoir fringe	Mobile	Usually found in grassy areas interspersed with dense vegetation, often along creek lines.
Neophema chrysostoma	Blue-Winged Parrot	2	✓		Open areas Maireana Shrubland	Mobile & nomadic. Disperses in Winter to northern and western areas.	Breeds SE of SA (Carpenter & Reid 1988), and adjacent areas of Vic, Tas. Prefers grasslands and grassy woodlands as feeds on ground on grass seeds etc. (Birdlife Australia 2017). One flushed from pipeline track in Maireana Shrubland.
Neophema elegans elegans	Elegant Parrot	1,2,3	✓	✓	Maireana Shrubland	Mobile & nomadic. Disperses in Winter widely.	Breeds in the Mount Lofty Ranges, Murray Mallee and Kangaroo Island regions of South Australia. Prefers grasslands, Samphire of coastal areas, and grassy woodlands as it feeds on ground on grass seeds etc.[246].
Nesoptilotis leucotis	White-Eared Honeyeater	2			Mallee	Mobile	Usually found in dry eucalypt woodlands, with a well-developed understorey, and Shrublands, including urban gardens.

[243] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/jacky-winter accessed 16/1/2018.

[244] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-kite accessed 16/1/2018.

[245] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/restless-flycatcher accessed 16/1/2018.

[246] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/elegant-parrot accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Ninox boobook	Southern Boobook	1,2			River Red Gum Woodland, Mallee	Resident	Prefers wooded areas as provides nesting and roosting hollows eg River Red Gum woodland.
Northiella haematogaster	Bluebonnet	2			Maireana Shrubland	Sedentary, but at times mobile	Usually found in arid and semi-arid *Maireana* and *Atriplex* Shrublands, at times Acacia woodlands. Feeds on seeds (Birdlife Australia, 2017).
Numenius madagascariensis	Far Eastern Curlew	1,2			No suitable habitat.	Breeds in northern Hemisphere, and over-summers in southern Hemishere.	Found on coastal intertidal mudflats and sandflats, in sheltered areas such as, estuaries, mangroves, and bays. Feeds mainly on small crabs and molluscs.
Nycticorax caledonicus	Nankeen Night-Heron	2,3		✓	Reservoir and its fringe.	Usually nomadic.	Associated with permanent water. Breeds in dead trees over open water. Feeds in shallow water on invertebrates (Birdlife Australia, 2017).
Nymphicus hollandicus	Cockatiel	1,2			River Red Gum Woodland	Migratory	Prefers treed areas such as mallee, woodland. Populations fluctuate with climatic conditions. Breeds in Spring & Summer in agricultural areas.
Ocyphaps lophotes	Crested Pigeon	1,2,3	✓	✓	River Red Gum, chenopod shrublands, gully shrubland.	Resident	Lightly wooded habitats especially near water as needs to drink everyday. Feeds on seeds on ground [247].
Oreoica gutturalis	Crested Bellbird	2			Open Mallee	Resident (sedentary)	Largely feeds on ground. Thinly distributed in drier Open Woodlands such as tall Open Mallee, *Casuarina pauper, Melaleuca lanceolata.*
Oxyura australis	Blue-billed Duck	1,2,3		✓	Reservoir	Nomadic non-resident	Unlikely to breed here, as needs dense cover of tea-tree and *Gahnia filum/trifida* fringing deep waters.

[247] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/crested-pigeon accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Pachycephala inornata	Gilbert's Whistler	1,2			Mallee?	Sedentary	Usually found in semi-arid mallee *Casuarina pauper, Myoporum platycarpum* woodlands, and Acacia shrublands [248].
Pachycephala pectoralis	Australian Golden Whistler	1,2			River Red Gum Woodland, Mallee	Mobile	Widespread in various wooded habitats. Feeds on invertebrates [249].
Pachycephala rufiventris	Rufous Whistler	1,2,3		✓	Mallee	Mobile	Usually found in drier woodlands such as open mallee, *Casuarina pauper, Myoporum platycarpum.* Primarily feeds on invertebrates.
Pandion haliaetus	Osprey	1,2			No suitable habitat, although could fish in reservoir.	Sedentary	Found along rocky coasts with cliffs, and occasionally along the River Murray. Feeds on fish.
Pardalotus punctatus	Spotted Pardalote	1,2			No suitable habitat	Mobile, but not found in region.	Usually found in stringybark Open Forest.
Pardalotus rubricatus	Red-Browed Pardalote	2			River Red Gum Woodland, but not recorded for the area, as range restricted to the north of the State.	Sedentary	Found in semi-arid and arid areas with eucalypt woodlands lining watercourses (eg. *Eucalyptus camaldulensis, E. coolabah*). Recorded for norther SA. Forages in tree canopy for primarily psyllid insects.
Pardalotus striatus	Striated Pardalote	1,2,3		✓	River Red Gum Woodland, Mallee	Resident or migratory.	Feeds on insects in the upper canopy of trees [250].
Parvipsitta porphyrocephala	Purple-crowned Lorikeet	1,2			River Red Gum Woodland, Mallee	mobile following flowering eucalypts.	Feeds on nectar of flowering eucalypts. Usually found in open woodlands [251].
Parvipsitta pusilla	Little Lorikeet	1,2			River Red Gum Woodland, but not recorded for the area.	Highly mobile.	Follows flowering of primarily *Eucalyptus camaldulensis* and *E. leucoxylon.*
*Passer domesticus**	House Sparrow	1,2,3		✓	Around dam and farm buildings.	Sedentary	Usually found around human habitation, at times wooded areas [252].

[248] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/gilberts-whistler accessed 16/1/2018.

[249] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australian-golden-whistler accessed 16/1/2018.

[250] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/striated-pardalote accessed 16/1/2018.

[251] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/purple-crowned-lorikeet accessed 16/1/2018.

[252] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/house-sparrow accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Pelecanus conspicillatus	Australian Pelican	1,2			Reservoir	Highly mobile	Widespread on any wetland throughout Australia, including ephemeral inland lakes that fill after heavy rains. Feed on fish.
Peltohyas australis	Inland Dotterel	1			Chenopod Shrublands.	Resident	Usually found in semi-arid and arid Chenopod Open Shrubland, clay pans, stony gibber plains. Feed on insects and seeds.
Petrochelidon ariel	Fairy Martin	1,2,3	✓	✓	Maireana Shrubland	Resident	Usually found in open areas, near water. Has mud nests made in culvets, cliffs. Feeds on insects [253]. Nesting on pylons underneath pipeline over shallow gullies.
Petrochelidon nigricans	Tree Martin	1,2,3		✓	River Red Gum Woodland, Mallee	Resident	Usually nest in tree hollows. Feeds on insects usually above tree canopies. Found in various habitats, but needs trees for nesting [254].
Petroica boodang boodang	Scarlet Robin (SE, MLR, FR, EP)	1,2			No suitable habitat	Mobile	Breeds in eucalypt stringybark Open Forest, and *Eucalyptus cladocayx* Woodland in FR, EP, KI.
Petroica goodenovii	Red-capped Robin	1,2			Mallee	Mobile species	Usually found in drier woodlands such as open mallee, *Casuarina pauper, Myoporum platycarpum.*
Phalacrocorax carbo	Great Cormorant	1			Reservoir and surrounds.	Highly mobile	Prefers extensive permanent freshwater areas, but also frequently observed on coastal inlets and estuaries.
Phalacrocorax fuscescens	Black-faced Cormorant	1,2			No suitable habitat. Coastal only.	Mobile	Largely confined to the coastal waters in large bays, deep inlets, rocky headlands and offshore islands Common along the gulf.
Phalacrocorax melanoleucos	Little Cormorant	2			Reservoir and surrounds.	Mobile	Found around the coasts, islands, estuaries, and inland swamps, lakes, lagoons.

[253] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/fairy-martin accessed 16/1/2018.

[254] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/tree-martin accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Phalacrocorax sulcirostris	Little Black Cormorant	1,2			Reservoir and surrounds.	Mobile	Widespread, mainly found on freshwater wetlands, at times sheltered coastal water. Feeds on fish, crustaceans and aquatic insects [255].
Phalacrocorax varius	Great Pied Cormorant	1,2			Reservoir and surrounds.	Mobile	Found mostly in marine estuaries, harbours and bays, mangroves and large inland wetlands.
Phaps chalcoptera	Common Bronzewing	1,2,3		✓	River Red Gum Woodland, Mallee	Resident	Prefers treed areas of mallee, woodland and forest.
Phaps elegans	Brush Bronzewing	1,2			No suitable habitat	Resident, but unlikely here.	More likely found along the coast and sub-coastal areas in dense shrublands. Inland can occur in dense mallee and woodlands [256].
Phylidonyris novaehollandiae	New Holland Honeyeater	1,2			Gully Shrubland.	Mobile	Widespread and common in heath, forests, woodland, gardens, mainly where grevilleas and banksias are found.
Platalea flavipes	Yellow-billed Spoonbill	1			Muddy reservoir edge	Nomadic non-resident	Inhabits freshwater wetlands. Breeds in River Red Gum swamps.
Platycercus elegans	Crimson Rosella	1,2,3		✓	River Red Gum Woodland, Mallee.	Mobile	Commonly associated with tall eucalypt Open Forest and Woodland.
Plectorhyncha lanceolata	Striped Honeyeater	2			River Red Gum, Mallee Box Woodlands, Mallee,	Mobile	Usually found in *Eucalyptus camaldulensis, E. largiflorens* and adjacent Mallee along the River Murray. Elsewhere in drier areas, Mallee, *Eucalyptus porosa, Myoporum platycarpum, Melaleuca lanceolata* Woodlands.
Pledagis falcinellus	Glossy Ibis	2			Muddy reservoir edge	Nomadic non-Resident	Prefers open swamps. Opportunistic in nesting.

[255] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/little-black-cormorant accessed 16/1/2018.

[256] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/brush-bronzewing accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Pluvialis fulva	Pacific Golden Plover	1			Muddy reservoir edge.	Breeds in northern Hemisphere, and over-summers in southern Hemishere.	Usually found on muddy, rocky and sandy wetlands, shores, paddocks, saltmarsh, coastal golf courses, estuaries and lagoons. Feeds on molluscs, insects, worms, crustaceans, lizards.
Pluvialis squatarola	Grey Plover	1,2			No suitable habitat (coastal species)	Breeds in northern Hemisphere, and over-summers in southern Hemishere.	Found in coastal inlets, estuaries and lagoons with large tidal mudflats or sandflats. Feeds on molluscs, insects, crustaceans, polychaete worms.
Podargus strigoides	Tawny Frogmouth	1,2			River Red Gum Woodland	Resident (sedentary)	Nocturnal species of woodlands and forests. One observed perched on tree branch, while spotlighting.
Poliocephalus poliocephalus	Hoary-headed Grebe	1,2,3		✓	Reservoir	Mobile	Usually found on large open estuarine, brackish or freshwater areas.
Pomatostomus ruficeps	Chestnut-Crowned Babbler	2			Gully Shrublands	Sedentary	Usually found in semi-arid and arid Woodlands and Shrublands (Birdlife Australia, 2017).
Pomatostomus superciliosus	White-browed Babbler	1,2,3		✓	Acacia victoriae Shrubland	Resident (sedentary)	Usually found in areas of shrubs, including drier woodlands, such as *Casuarina pauper, Myoporum platycarpum, Acacia*, mallee. Feeds on invertebrates [257].
Pomatostomus temporalis	Grey-crowned Babbler	1,2			Not recorded for area. Likely miss-ID.	Sedentary	Formerly found in stringybark Open Forest and Woodland in the SE; and sparingly in the Far North of SA.
Poodytes gramineus gouburni	Eastern Little Grassbird	3		✓	Reservoir edge where reeds and rushes occur.	Mobile	Found in swamps and marshes, usually with thick reed beds. Can occur in temporary wetlands following rains.
Porphyrio porphyrio	Purple Swamphen	2			Reservoir edge where reeds and rushes occur.	Mobile	Freshwater wetlands fringed with reeds and rushes.

[257] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-browed-babbler accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Porzana fluminea	Australian Crake (Australian Spotted Crake)	1,2			Reservoir edge where reeds and rushes occur.	Mobile	Found in well vegetated margins of saline, brackish or freshwater wetlands with areas of mud nearby. Feeds on molluscs, crustaceans and insects.
Porzana pusilla	Baillon's Crake	2			Reservoir edge where reeds and rushes occur.	Mobile	Found in vegetated margins of fresh or brackish wetlands, including reservoirs and temporarily inundated areas. They prefer wetlands with floating aquatic vegetation.
Porzana tabuensis	Spotless Crake	2			Reservoir edge where reeds and rushes occur.	Mobile	Found in well vegetated margins of permanent or temporary freshwater or saline wetlands. I
Psephotus haematonotus	Red-rumped Parrot	1,2,3		✓	River Red Gum Woodland, Mallee.	Mobile	Usually found in Open Woodlands with a grassy understory. Feeds mostly on ground on seeds (Birdlife Australia, 2017).
Psephotus varius	Mulga Parrot	1,2			Mallee, Acacia victoriae Shrubland	Resident (sedentary) but also at times nomadic. Not preferred habitat, but will use River red Gum woodland.	Prefers drier open mallee and woodlands (eg *Acacia* spp., *Casuarina pauper*).
Psophodes cristatus	Chirruping Wedgebill	1,2			Acacia victoriae Shrubland, Maireana Shrubland	Resident (sedentary)	Ground feeding. Usually found in arid shrublands including *Maireana* shrublands, *Nitraria billardierei*, *Acacia victoriae*, *A. tetragonophylla* shrublands.
Ptilotula fusca	Fuscous Honeyeater	2			No suitable habitat. Eastern Australia, occasionally observed in winter in SE SA	Migratory, rare autumn-winter visitor to SE SA.	Occasionally observed in SE in *Eucalyptus leucoxylon* and *E. fasciculosa* Woodlands.
Ptilotula ornata	Yellow-plumed Honeyeater	1,2			Mallee	Sedentary	Usually associated with mallee [258].

[258] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/yellow-plumed-honeyeater accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Ptilotula penicillata	White-plumed Honeyeater	1,2,3		✓	River Red Gum Woodland	Resident	Usually found in open woodland and forest with water often nearby, often in River Red Gums[259]..
Ptilotula plumula	Grey-fronted Honeyeater	1,2			Mallee possibly	Mostly sedentary	Usually found in drier mallee and *Callitris* woodland usually associated with *Triodia*.
Purnella albifrons	White-fronted Honeyeater	1,2,3		✓	Mallee, Acacia victoriae Shrubland.	Mobile	Primarily found in semi-arid and arid areas in mallee, *Acacia* and *Melaleuca* shrublands. Feeds on nectar and some insects [260].
Pyrrholaemus brunneus	Redthroat	1,2			Maireana Shrubland	Resident (sedentary)	Usually found in drier open woodlands such as *Casuarina pauper, Myoporum platycarpum* over *Maireana* spp. and *Maireana* spp. shrublands. Shrub cover needs to be relatively dense.
Rhipidura albiscapa	Grey Fantail	1,2	✓		River Red Gum, Mallee	Can be mobile and migratory, or sedentary.	Usually found in most treed habitats. Feeds on flying insects [261].
Rhipidura leucophrys	Willie Wagtail	1,2,3	✓	✓	River Red Gum, Mallee, Gully Shrubland.	Likely sedentary, but can be mobile.	Found in widespread habitats. Feeds on insects [262].
Sericornis frontalis	White-browed Scrubwren	1,2			Reservoir edge and creeks with dense undergrowth.	Sedentary	Found in Mangroves, Samphire, *Melaleuca halmaturorum* Shrubland, coastal Mallee and Shrubland, densely vegetated creeks, and swamp verges, as long as has dense undergrowth.
Smicrornis brevirostris	Weebill	1,2,3	✓	✓	River Red Gum, Mallee	Resident	Found in mostly eucalypt wooded habitats. Feeds on insects, such as scale insects, on outer tree canopy [263].
**Spilopelia chinensis*	Spotted Dove	1,2		✓	Around farm and cropland.	Resident	Usually found around human habitation, in parks, gardens, agricultural areas. Feeds mostly on ground on seeds.

[259] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-plumed-honeyeater accessed 16/1/2018.

[260] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/white-fronted-honeyeater accessed 16/1/2018.

[261] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/grey-fantail accessed 16/1/2018.

[262] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/willie-wagtail accessed 16/1/2018.

[263] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/weebill accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Stagonopleura guttata	Diamond Firetail	1,2,3		✓ few in vicinity of dam summer of 2017 & 2018	Gullies with E. porosa, A. verticillata & Callitris; E camaldulensis Woodland	Sedentary	Usually found in box Woodlands (*Eucalyptus porosa, E. odorata, E. microcarpa); E. leucoxylon, E camaldulensis* Woodland; *Allocasuarina verticillata, A. luehmannii, Callitris* Low Woodlands with grassy understorey in various agricultural regions of the State.
Sterna hirundo	Common Tern	1,2			Reservoir	Breeds in northern Hemisphere, and over-summers in southern Hemishere.	Occurs mainly on the coast when not breeding, on offshore waters, ocean beaches, estuaries and large lakes. Occasionally seen in freshwater swamps, floodwaters, sewage farms and brackish and saline lakes inland. Feeds on small marine fish, but also aquatic insects and crustaceans.
Sternula nereis	Fairy Tern	1,2,3		✓	Reservoir	Mobile	Found on coastal beaches, inshore and offshore islands, sheltered inlets, sewage farms, harbours, estuaries and lagoons. It favours both fresh and saline wetlands.
Stictonetta naevosa	Freckled Duck	2,3		✓ several in summer of 2016 & 2018	Deep water (reservoir)	Nomadic non-resident	Visits various freshwater wetlands and lakes.
Strepera versicolor	Grey Currawong	1,2			River Red Gum Woodland, Mallee	Sedentary	Widespread including arid areas, in woodlands, mallee, shrublands. Feeds on small animals such as birds, rodents, frogs as well as eggs, insects, seeds, fruits and carrion water [264].
Struthidea cinerea	Apostlebird	1,2			No suitable habitat.	Mobile, colonial species.	Found in open *Casuarina pauper, Callitris* Woodland near water; *Eucalyptus largiflorens* Woodland along the River Murray. Feeds on ground on invertebrates, seeds.

[264] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/grey-currawong accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
**Struthio camelus*	Ostrich	2			All	Mobile	Some feral birds have been observed in the district.
**Sturnus vulgaris*	Common Starling	1,2,3		✓	Around farm and cropland.	Highly mobile forming Winter flocks.	Widespread, usually near human habitation. Usually feeds on the ground [265].
Sugomel niger	Black Honeyeater	1,2			No suitable habitat.	Mobile	Usually found in semi-arid and arid areas where flowering *Eremophila's, Correa, Grevillea*. Occasionally breeds in southern areas following high rainfall years inland.
Tachybaptus novaehollandiae	Australasian Grebe	1,2,3		✓	Deep water (reservoir)	Mobile	Usually found in freshwater dams and waterways. Feeds on small fish and invertebrates [266].
Taeniopygia guttata	Zebra Finch	1,2		✓	Acacia victoriae Shrubland	Resident	Inhabits a range of drier woodlands and tall shrublands.
Thalasseus bergii	Greater Crested Tern	1,2			No suitable habitat.	Mobile	Usually a strictly coastal species, found all along the coast, very occasionally inland.
Threskiornis molucca	Australian White Ibis	2			Muddy reservoir edge	Highly mobile	Widespread, usually found in grasslands (including crops), swamps and lagoon margins. Usually feeds on terrestrial invertebrates (eg grasshoppers) (Birdlife Australia, 2017). Few birds observed on the edge of the lake on mud flats.
Todiramphus pyrrhopygius	Red-backed Kingfisher	1,2			River Red Gum Woodland	Migratory & nomadic. Spring-Summer visitor to SA.	Found in various drier woodlands.
Todiramphus sanctus	Sacred Kingfisher	1,2,3		✓	River Red Gum Woodland	Migratory & nomadic Spring-Summer breeding visitor to SA.	Usually found in eucalypt forest and woodlands. Where it breeds, often near water.

[265] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/common-starling accessed 16/1/2018.

[266] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/australasian-grebe accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Tribonyx ventralis	Black-tailed Native-hen	1,2,3		✓	Muddy reservoir edge	Highly mobile following rain events.	Usually found around permanent and ephemeral wetlands, both freshwater and brackish. Feeds on plant material and insects. Nests on edge of water[267].
Trichoglossus haematodus	Rainbow Lorikeet	1,2,3		✓	River Red Gum and Mallee Box Woodland	Mobile	Frequents flowering eucalypts, particularly *Eucalyptus leucoxylon, E. cladocalyx, E. odorata, E. microcarpa, E. porosa, E. camaldulensis, E, viminalis*, and *Banksia*.
Tringa nebularia	Common Greenshank	1,2			Muddy reservoir edge	Migratory between Siberia and Australia (late Spring to early Autumn).	Usually found in the mud flats of coast and wetlands, where they feed on invertebrates [268].
**Turdus merula*	Common Blackbird	1,2,3		✓	Around buildings and farm house.	Sedentary	Mostly found in urban areas, orchards, vineyards [269].
Turnix varius	Painted Buttonquail	1,2			Mallee	Mobile	Found sparsely in a range of eucalypt habitats (Forest, Woodland, Mallee) with a good leaf litter cover. Feeds on ground.for seed and insects in the leaf litter. Unlikely in Mallee here, as heavy sheep grazing has reduced the leaf litter.
Turnix velox	Little Button-quail	1,2			Solanum open area.	Sedentary some mobile.	Widespread in woodlands and grasslands of arid and semi-arid areas, into the agricultural areas. Feeds on seeds [270].
Tyto javanica	Eastern Barn Owl	1,2			Mallee for nesting. All for hunting.	Resident, but also mobile chasing mice plagues.	Widespread mainly in open areas (eg grassland and farmland) and open grassy woodlands. Feeds on rodents. Need tree hollows for nesting [271].

[267] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/black-tailed-native-hen accessed 16/1/2018.

[268] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/common-greenshank accessed 16/1/2018.

[269] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/common-blackbird accessed 16/1/2018.

[270] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/little-button-quail accessed 16/1/2018.

[271] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/eastern-barn-owl accessed 16/1/2018.

Scientific name	Common name	Source	Observed this survey	Recorded previously in area	Preferred habitat type	Residency	Notes (after Carpenter & Reid, 1988[190] except where otherwise stated)
Vanellus miles	Masked Lapwing	1,2,3		✓	Muddy reservoir edge	Sedentary	Usually found on marshes, mudflats, beaches, grasslands, including urban areas [272].
Zoothera lunulata halmaturina	Bassian Thrush (KI, MLR and southern FR)	1,2			No suitable habitat	Sedentary	Usually found in wetter stringybark open forest. *E. goniocalyx* Woodland and adjacent pine forest in higher rainfall areas of SA. Isolated population has been recorded in Mt Remarkable CP, Telowie Gorge CP. Surveyed drier vegetation highly unsuitable habitat.
Zosterops lateralis	Silvereye	1,2,3		✓	Mallee	Mobile and/or resident	Various wooded habitats, orchards, urban parks. Feed on insects, fruit, nectar [273].

* denotes introduced species. Source: 1= Biological Data Base of South Australia search, 2 = Atlas of Living Australia search, 3= Birdlife Australia Port Augusta Group records 2016, 2017, 2018

[272] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/masked-lapwing accessed 16/1/2018.

[273] Birdlife Australia Bird Profiles (2017). http://www.birdlife.org.au/bird-profile/silvereye accessed 16/1/2018.

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Appendix D Noise Assessment

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Baroota Pumped Hydro and Solar Project

Environmental Noise Assessment

S5598C2

May 2018

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Date	:	May 2018
Prepared for	:	JBS&G Australia Pty Ltd
Author	:	Chris Turnbull
Reviewer	:	Jason Turner

EXECUTIVE SUMMARY

An environmental noise assessment has been made to determine the potential noise impact of the proposed Baroota Pumped Hydro and Solar Project (the Project) on noise sensitive receivers located in its vicinity.

The assessment has established the appropriate environmental noise criteria for the Project, and then predicted and evaluated the noise from the operation of the Project at the closest sensitive receivers.

The established assessment criteria for the Project have been based on the relevant provisions of Mount Remarkable District Council Development Plan and the requirements of the *Environment Protection (Noise) Policy 2007.* The environmental noise criteria are summarised below:

- an average noise level ($L_{eq,15min}$) of 52 dB(A) during the day (7am to 10pm); and,
- an average noise level ($L_{eq,15min}$) of 45 dB(A) during the night (10pm to 7am).

Achieving the assessment criteria above also ensures that the Project satisfies the requirements of the *Environment Protection Act 1993.*

The noise from the operation of the Project has been predicted using the CONCAWE noise propagation model, which takes into account topography, ground absorption, air absorption and meteorological conditions. The prediction considers the worst-case scenario of all main plant and equipment operating continuously and simultaneously, and under meteorological conditions that are most conducive for the propagation of sound.

The predicted noise levels at the closest sensitive receivers achieve the assessment criteria. The noise level at all other sensitive receivers which are located further away from the Project will be lower than the predicted noise level at the closest sensitive receivers and will easily achieve the assessment criteria.

Therefore, it is considered that the Project is *located and designed to prevent adverse impact and conflict between land uses* and *does not detrimentally affect the amenity of the locality*, thus satisfying all relevant provisions of the Mount Remarkable District Council Development Plan.

GLOSSARY AND ABBREVIATIONS

Term	Definition
A weighting	Frequency adjustment representing the response of the human ear
Ambient noise level	The noise level of all existing noise sources in the environment (in the absence of the Project)
CONCAWE	Conservation of Clean Air and Water in Europe
CONCAWE noise propagation model	The CONCAWE noise propagation model is a model which takes into account topography, ground absorption, air absorption and meteorological conditions. It is used around the world and is widely accepted as an appropriate model for predicting noise over significant distances. The CONCAWE noise propagation model can be implemented in a noise modeling software such as SoundPlan
Daytime	The period between 7am and 10pm
dB(A)	A weighted noise or sound pressure or power level in decibels
Development Plan	Mount Remarkable District Council Development Plan
Average noise level	Energy averaged noise level (sound pressure)
JBS&G	JBS&G Australia Pty Ltd
$L_{eq,15min}$	Average noise level measured over a 15-minute period
$L_{eq,inside}$	Internal average noise level
L_W	Sound power level
Night-time	The period between 10pm and 7am
Policy	*Environment Protection (Noise) Policy 2007*
Project	Baroota Pumped Hydro and Solar Project
Rise Renewables	Rise Renewables Pty Ltd
Sensitive receiver	A location in the vicinity of the proposed development, where noise may affect the amenity of the land use. For the proposed development, sensitive receivers are generally dwellings
Sonus	Sonus Pty Ltd
Sound power level	A measure of the sound energy emitted from a source of noise
Weather category 6	The CONCAWE weather conditions which is most conducive for the propagation of noise, resulting in highest predicted noise levels
WHO	World Health Organisation
Worst-case	Conditions resulting in the highest noise level at sensitive receivers Worst-case meteorological conditions can be characterised as no cloud at night with wind from the Project site to the sensitive receivers.

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1 INTRODUCTION

Sonus Pty Ltd (Sonus) has been engaged by JBS&G Australia Pty Ltd (JBS&G), on behalf of Rise Renewables Pty Ltd (Rise Renewables), to conduct an environmental noise assessment of the proposed Baroota Pumped Hydro and Solar Project (the Project).

The objectives of the assessment were:

- to identify the closest noise sensitive receivers to the Project;
- to establish environmental noise criteria for the Project;
- to predict the noise levels at the noise sensitive receivers from the operation of the Project; and,
- to evaluate the noise impact on noise sensitive receivers based on the predicted noise levels and the established environmental noise criteria.

2 PROJECT DESCRIPTION

The Project is a large scale pumped hydro and solar facility in the District Council of Mount Remarkable, at a site located approximately 12km northeast of Port Germein, in South Australia.

The Project includes the construction of an upper reservoir approximately 1km from the lower and existing Baroota Reservoir, covering an approximate area of 63 ha, and operation of a 300 MW photovoltaic (PV) solar farm. The upper reservoir will be connected to a turbine generator, with 75% of the transfer pipeline located underground and the remaining 25% located above ground. The solar farm is proposed to be constructed on a 600ha land parcel that is located west-northwest of the Baroota Reservoir.

The nominal areas for the solar farm and associated substation; the powerhouse (housing the turbine-pumps) and associated switchyard; and the upper reservoir are shown on Figure 1 in Appendix A.

The design of the Project consists of the following main plant and equipment:

- Solar farm component:
    - 941,500 x 385W solar panels mounted on single axis trackers;
    - 64 x 4.2MVA 33kV inverter stations;
    - 1 x 275/33kV transformer;
- Pumped hydro component:
    - 2 x 150MW turbine pumps;
    - 2 x 132/33kV transformers.

3 ASSESSMENT METHODOLOGY

To assess the impact of environmental noise from the Project, the following methodology was implemented:

1. Identify the closest noise sensitive receivers to the Project.
2. Determine the relevant provisions and requirements of the Mount Remarkable District Council Development Plan related to environmental noise.
3. Establish assessment criteria in accordance with the *Environment Protection (Noise) Policy 2007* and the relevant provisions of the Development Plan.
4. Identify the main noise sources associated with the operation of the Project.
5. Establish a noise prediction model that takes into account all of the identified main noise sources, topography, ground absorption, air absorption, and meteorological conditions.
6. Predict the noise levels at the noise sensitive receivers from the operation of the Project.
7. Compare the predicted noise levels with the established assessment criteria.
8. Determine the residual environmental noise impact on the noise sensitive receivers.

4 NOISE SENSITIVE RECEVERS

The potential noise sensitive receivers surrounding the Project have been identified using an aerial photographic map of the Project area, available within the *NatureMaps* online database and accessible on the Department for Environment and Water website[1].

The aerial photographic map, which was acquired between January and March 2017, has an image resolution which enables existing noise sensitive receivers in the area to be clearly identified.

To identify any potential new noise sensitive receivers since the production of the map, the Development register on Mount Remarkable District Council's website[2] for all applications since January 2017 have been reviewed.

Based on the above, the identified closest noise sensitive receivers to the Project are existing dwellings as listed in Table 1 and shown on Figure A2.

Table 1: Closest sensitive receptors.

Receiver ID	Coordinates (WGS84 UTM z54H)		Approximate Distance (m)
	Easting	Southing	
R1	224761	6353360	1190
R2	224287	6353154	1370
R3	219816	6353378	1900
R4	217906	6355206	3320
R5	218394	6356822	2780
R6	220968	6358341	1700

It is noted that the list of dwellings above only includes the closest dwellings to the Project. The noise level at all other dwellings surrounding the Project will be lower than the assessed noise level at the closest dwellings.

The dwellings surrounding the Project are generally located in the primary production area where it can be expected that the existing noise levels in the environment to be low and typical of a rural setting, except where there is a nearby major road (such as at R3, R4 and R5 which are located near to Princes Highway).

1 Available at https://data.environment.sa.gov.au/NatureMaps/Pages/default.aspx, accessed on 14 May 2018.
2 Available at http://www.mtr.sa.gov.au/page.aspx?u=315, accessed on 14 May 2018.

5 DEVELOPMENT PLAN

The proposed project is located on land that is within the Primary Production Zone, Rural Landscape Protection Zone and Water Protection Zone in the Mount Remarkable District Council Development Plan (consolidated 5 September 2013).

The closest dwellings to the project are located in the Primary Production Zone and Rural Landscape Protection Zone in the same Development Plan.

The Development Plan has been reviewed and particular regard has been given to the following provisions relevant to environmental noise:

General Section - Interface Between Land Uses

OBJECTIVES

1. *Development located and designed to prevent adverse impact and conflict between land uses.*
2. *Protect community health and amenity and support the operation of all desired land uses.*

PRINCIPLES OF DEVELOPMENT CONTROL

1. *Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:*
   …
   (b) noise
   …
2. *Development should be sited and designed to minimise negative impacts on existing and potential future land uses considered appropriate in the locality.*
6. *Development should be sited, designed and constructed to minimise negative impacts of noise and to avoid unreasonable interference.*
7. *Development should be consistent with the relevant provisions in the current Environment Protection (Noise) Policy.*

General Section – Renewable Energy Facilities

OBJECTIVE

3. *Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment and other land uses.*

6 ASSESSMENT CRITERIA

The General Section Interface between Land Uses Principle of Development Control 7 of the Mount Remarkable District Council Development Plan makes reference to the *Environment Protection (Noise) Policy 2007* (the Policy).

The Policy provides objective environmental noise criteria which are based on the World Health Organisation Guidelines to prevent annoyance, sleep disturbance and unreasonable interference on the amenity of a locality. Therefore, compliance with the Policy is considered to satisfy all relevant provisions of the Development Plan related to environmental noise. Compliance with the Policy also ensures that the requirements of the *Environment Protection Act 1993* are satisfied.

The Policy establishes goal noise levels to be achieved at the noise sensitive receivers (the dwellings), based zoning of the area in the Development Plan and the land uses that are "principally promoted" by those zones.

For development and dwellings in an area which principally promotes *rural industry*, the Policy establishes the following goal noise levels at the dwellings:

- an average noise level ($L_{eq,15min}$) of 52 dB(A) during the day (7am to 10pm); and,
- an average noise level ($L_{eq,15min}$) of 45 dB(A) during the night (10pm to 7am).

The "night" goal noise level is the most relevant criterion for the combined noise from the operation of the Project, even though the solar component might only operate for a limited duration during the night period.

When measuring or predicting noise levels for comparison with the average goal noise levels of the Policy, a penalty adjustment may be applied if the noise exhibits any of the "annoying" characteristics of tone, impulse, low frequency and modulation. A 5 dB(A) penalty is applied if the noise exhibits one characteristic; 8 dB(A) for two characteristics; and 10 dB(A) for three or four characteristics.

In order to apply a penalty, the characteristic must be dominant when considered within the context of the existing acoustic environment at the sensitive receptors. Where applicable, the penalty is added to the measured or predicted noise levels.

7 ASSESSMENT

7.1 Closest Noise Sensitive Receivers

The closest noise sensitive receivers to the Project are the existing dwellings identified in Table 1 and on Figure A2. The assessment considers the noise impact at these closest dwellings. At other dwellings surrounding the Project which are located further away, the noise levels from the Project will be lower and therefore, the noise impact at those dwellings will be no greater than the noise impact at the closest dwellings.

7.2 Main Noise Sources and Noise Data

At this stage of the development, the plant and equipment to be used for the Project is yet to be finalised. Therefore, the assessment has been made based on indicative plant and equipment selections, and noise level data based on available data of similar plant and equipment acquired from other similar projects.

The main noise sources identified at the Project site are as following:

- solar inverters – 64 units of 4.2MVA 33kV inverter stations;
- solar farm substation transformer – 1 unit of 275/33kV, 345MVA rated transformer;
- hydro energy pumps – 2 units of 150MW turbine-pumps; and,
- hydro energy substation transformers – 2 units of 132/33kV, 180MVA rated transformers.

The solar panels installed on the tracker system do not produce significant noise and therefore has been excluded for further assessment.

The locations of the noise sources are described below with reference to the areas indicated on Figure A1:

- solar inverters – spaced throughout the Solar Farm area;
- solar farm substation transformer – within the designated substation area;
- hydro energy pumps – inside a masonry building; and,
- hydro energy substation transformers – within the designated switchyard area.

The noise data associated with the main noise sources which have been considered in the assessment are summarised in Table 2.

.

Table 2: Noise level of main noise sources.

Noise Source	Noise Level	Total (dB(A))	Octave Band (Hz) Noise Level (dB(A))						
			63	125	250	500	1000	2000	4000
Solar inverter – *4.2MVA 33kV inverter station with transformer (64 off)*	L_W	97 [1]	69	77	87	91	90	88	93
Solar farm substation transformer – *275/33kV, 345MVA rated transformer (1 off)*	L_W	102 [2]	81	89	96	99	91	88	81
Hydro energy pump – *150MW turbine-pump (2 off) inside powerhouse*	$L_{eq,inside}$	107 [3]	79	95	102	102	101	94	91
Hydro energy substation transformer – 132*/33kV, 180MVA rated transformer (2 off)*	L_W	98 [2]	77	85	92	95	87	84	77

Notes:

L_W sound power level;

$L_{eq,inside}$ internal average noise level;

[1] derived (upscaled) based on available data for a 2.2MW inverter unit (SMA Sunny Central 2200);

[2] derived from the Australian/New Zealand Standard *AS/NZS 60076.10:2009, Power transformers - Part 10:Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD),* based on 1.15MVA capacity for each 1MW generation capacity*;*

[3] derived (upscaled) based on available data for a 1.9MW turbine generator, 85 dB(A) measured noise level inside the turbine enclosure.

7.3 Noise Prediction Model

The noise from the Project has been modelled using the Conservation of Clean Air and Water in Europe (CONCAWE)[3] noise propagation model in the SoundPlan noise modelling software.

The CONCAWE noise propagation model takes into account the following factors that influence sound propagation:

- location of noise sources and their noise level input;
- separation distances between noise sources and dwellings;
- local topography;
- ground surface absorption;
- air absorption; and,
- meteorological conditions.

[3] The oil companies' international study group for conservation of clean air and water in Europe, "The propagation of noise from petrochemical complexes to neighbouring communities".

The CONCAWE system divides meteorological conditions into six separate "weather categories", depending on wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the "lowest" propagation of noise (wind blowing from the receiver to the noise source), whilst Weather Category 6 provides "worst-case" (i.e. highest noise level) conditions (clear night sky and a light wind blowing form the noise source to the receiver). Weather Category 4 provides "neutral" weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

For a conservative assessment, the noise model has considered meteorological conditions corresponding to Weather Category 6, resulting in the highest predicted noise level at the dwellings. Under other weather conditions, the noise levels will be less, and in some cases significantly less, than the noise levels presented in this assessment.

7.4 Noise Prediction Model Input and Assumptions

The input and assumptions of the noise model are summarised in Table 3. These input and assumptions represent a conservative assessment (i.e. the highest noise level being considered).

Table 3: Noise prediction model input and assumptions.

Model Parameter	Input and Assumptions
Noise sources	As detailed in Section 7.2.
Sensitive receptors	At locations identified in Section 4. 1.5m above ground level.
Topography	Digital ground model based on elevation data points extracted from Google Earth.
Ground type	Acoustically hard ground for infrastructure area and water surface. Acoustically soft ground for other surfaces.
Atmospheric conditions	80% relative humidity, 10°C relative temperature (conducive to propagation)
Meteorological conditions	CONCAWE weather category 6 (conducive to propagation)
Operational scenario	All plant and equipment operating simultaneously and continuously at full load.

7.5 Predicted Noise Level

The noise from operation of the Project has been predicted to the closest existing dwellings based on the inputs and noise model detailed above.

The predicted noise levels at the dwellings are provided in Table 4. A predicted noise level contour has also been generated and provided in Appendix C.

Table 4: Predicted noise level at the closest existing dwellings.

Receiver ID	Criterion, dB(A)	Predicted Noise Level, dB(A)	Compliance
R1	45	32	Yes
R2	45	29	Yes
R3	45	23	Yes
R4	45	18	Yes
R5	45	19	Yes
R6	45	25	Yes

Table 4 shows that the predicted noise level from the Project is no greater than 32 dB(A) at the closest dwelling, therefore easily achieves the 45 dB(A) criterion. The noise level at other dwellings located further away from the Project will be lower and well below the 45 dB(A) criterion.

Some of the equipment proposed for the Project has the potential to have audible tones in close proximity, although the potential for it to be a dominant characteristic at the dwellings is diminished by the masking effect of other noise sources at site or in the environment. Notwithstanding, even if a 5 dB(A) penalty adjustment is added to the predicted noise level for tonality, the 45 dB(A) criterion would still be achieved.

8 CONCLUSION

An environmental noise assessment has been made of the proposed Baroota Pumped Hydro and Solar Project (the Project).

The assessment predicted the noise levels at the closest existing dwellings from the operation of the Project and compared them with criteria established in accordance with the *Environment Protection (Noise) Policy 2007*.

Based on the predictions, the noise levels at the dwellings will be no greater than 32 dB(A) and therefore easily achieve the 45 dB(A) night-time criteria of the the *Environment Protection (Noise) Policy 2007*.

In doing so, it is considered that the proposal is *located and designed to prevent adverse impact and conflict between land uses* and *does not detrimentally affect the amenity of the locality*, thus satisfying all relevant provisions of the Mount Remarkable District Council Development Plan.

APPENDIX A: PROJECT AREA

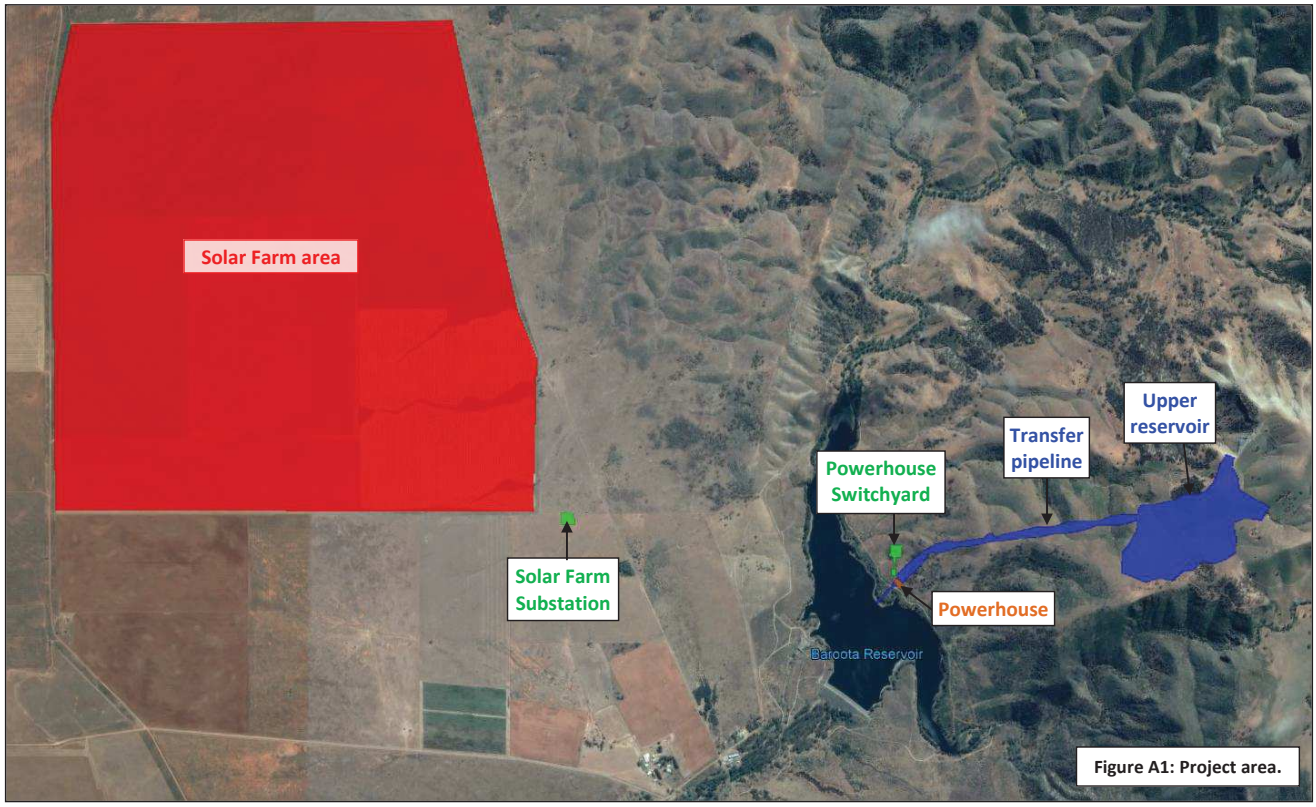


Figure A1: Project area.

APPENDIX B: CLOSEST NOISE SENSITIVE RECEIVERS

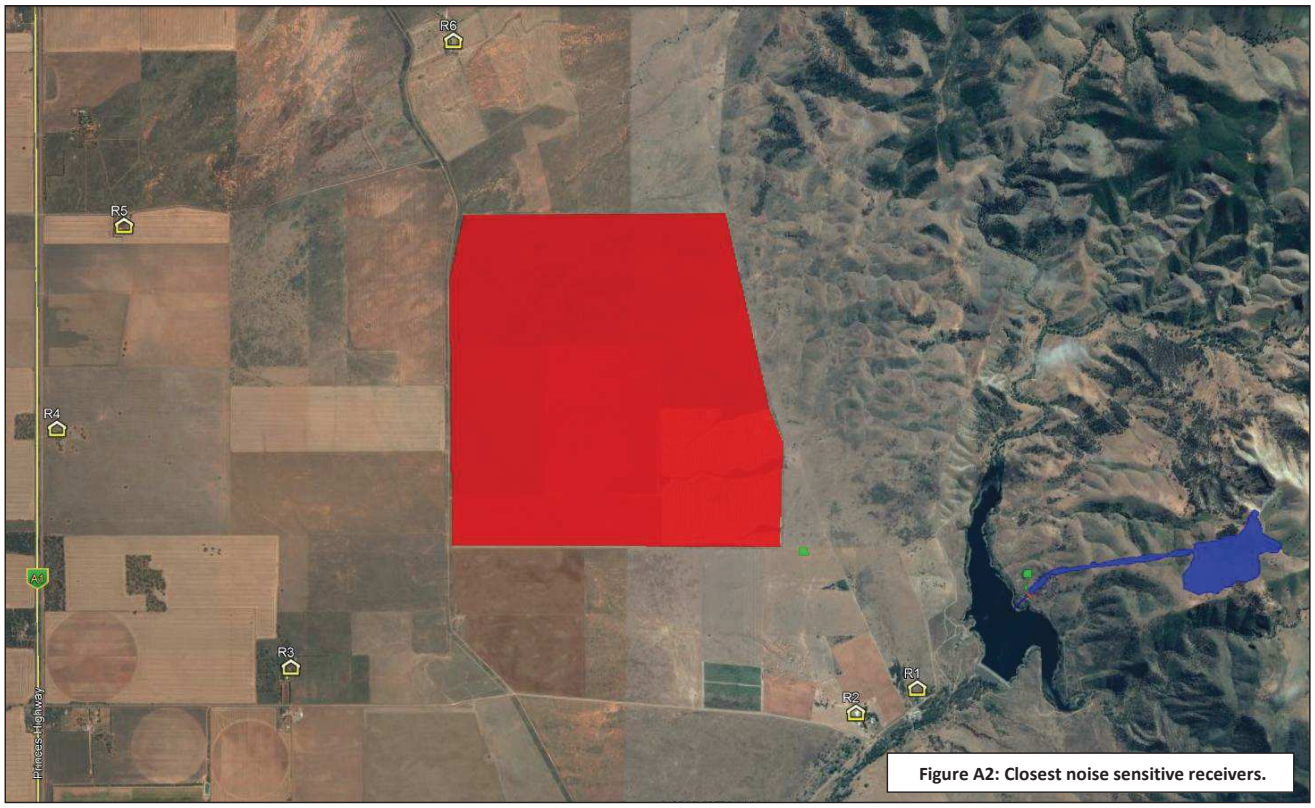
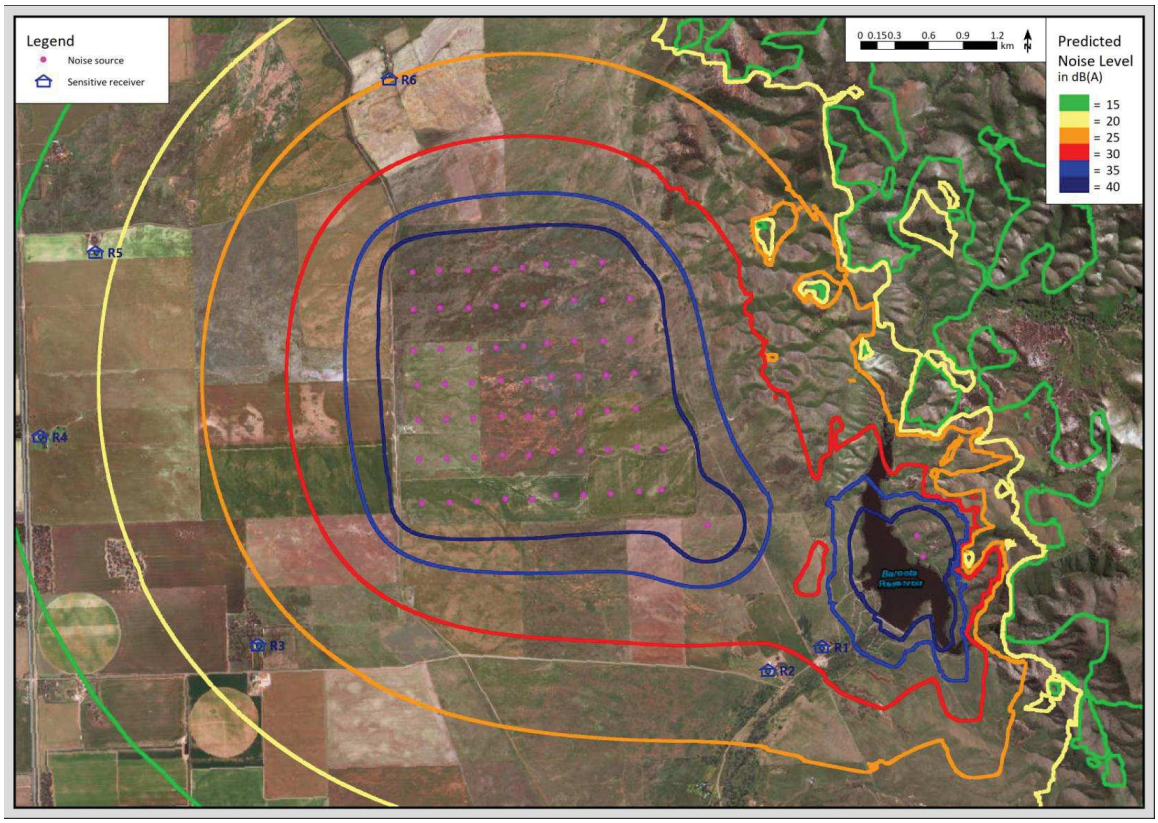


Figure A2: Closest noise sensitive receivers.

APPENDIX C: PREDICTED NOISE LEVEL CONTOUR



Appendix E Visual Impact Assessment

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Rise Renewables
Baroota Pumped Hydro and Solar Project

Visual Impact Assessment Report

04th June 2018
115,905 (Rev 0)
JBS&G

www.jbsg.com.au

Rise Renewables
Baroota Pumped Hydro and Solar Project

Visual Impact Assessment Report

04th June 2018
Baroota Pumped Hydroelectric and Solar
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JBS&G

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List of Abbreviations

Term	Definition
PV	Photovoltaic
PHES	Hydroelectrical energy storage system
MW	Mega Watts
km	Kilometres
m	Meters
ha	Hectares
kv	Kilovolts
EPA	Environmental Protection Act
SA	South Australia
WA	Western Australia
CLGR	Central Local Government Region
DEWNR	Department of Environment, Water and Natural Resources
LI	Landscape Institute
IEMA	Institute of Environmental Management and Assessment
TZVI	Theoretical Zone of Visual Influence
GIS	Geographical Information Systems
DEM	Digital elevation model
H	High
M	Moderate
L	Low
N	Negligible
DTM	Digital terrain model
DSM	Digital surface model
VAC	Visual absorption capacity

Executive Summary

A Visual Impact Assessment (VIA) was been undertaken as part of the Development Application for the proposed Baroota Pumped Hydro-electrical Storage (PHES) Project and the Bridle Track Solar Project (Solar Project).

A viewshed was generated using a Digital Elevation Model (DEM) from the proposed development elements to determine the Theoretical Zone of Visual Influence (TZVI) for the three visual project component locations, (the upper reservoir, the lower reservoir and the solar project), to select sensitive receptor viewpoints for Google Earth Pro viewshed analysis. Viewshed analysis was conducted to determine the viewpoints that were visible from the site, using the logic that viewpoints that can be seen *from* the site can also *see* the site. Viewshed analysis was then conducted from identified viewpoints to determine the impact of the project according to a range of criteria.

Sensitive receptor points within the TZVI were determined to be predominantly from agricultural residences and travellers on the Augusta Highway. Most views were determined to be incidental and the project is unlikely to form a dominant part of the final landscape.

Due to the topography of the site area, and the nature of the development, the visual impact assessment has demonstrated that the project is likely to have a low to moderate impact on the visual receptors within the TZVI. Visual receptors are limited to the west of the Flinders Ranges.

The visual impact of the proposed development is largely mitigated by the natural topography of the Flinders Ranges which allows visual shielding of the upper reservoir dam wall, penstock, powerhouse and switchyard. Further mitigation is provided by the fact that the penstock will be buried at ground level and will therefore not be visually obvious. The switch yard and powerhouse will be largely shielded by the immediate surrounding topography. Views of the dam wall will extend to the edge of the TZVI, predominately due to the elevation of the dam wall of the upper reservoir. The dam will be located below natural topographic elements of the surrounding landscape and will not be visually obvious.

The visual impact of the panels will largely be contained to partial views, of portions of the solar panels. The low elevation of the solar components, and the mitigating factors of the gentle undulations of the coastal plains assist in reducing the visual impact of this aspect of the project.

1. Introduction

1.1 Project Background

JBS&G has been engaged by Rise Renewables Pty Ltd as part of a consortium of Rise Renewables and SNC Lavalin to undertake a Visual Impact Assessment of the proposed photovoltaic (PV) Bridle Track Solar Project (hereafter referred to as the Solar Project) and hydroelectrical energy storage system (PHES) located 12 km north east of Port Germein (40 km north east of Port Pirie) adjacent to the existing Baroota Reservoir. The project is designed for large scale, long-duration energy storage and expected to deliver up to 300 MW and 270 MW of solar and hydroelectric power respectively.

1.2 Project Elements

1.2.1 PHES Project

The Baroota PHES project will utilise the existing Baroota Reservoir as a lower reservoir component with the proposed upper reservoir to be located approximately 230 m higher and 1 km laterally to the east within the adjacent hills. The lower reservoir covers an area of approximately 63 ha and the proposed upper reservoir will cover an area of 40 ha. The crest of the dam wall will be at an elevation of 106 m and the centre of the reservoir will have an elevation of 95 m. The dam wall extends 50 m higher than the immediate surrounding topography. A security fence will be constructed around the upper reservoir and there is an existing fence around the lower reservoir. The transfer pipeline (penstock) which will connect both reservoirs is proposed to be largely buried. The penstock will extend 1.4 km from the upper reservoir dam wall to the powerhouse. A switchyard will be located immediately beside the powerhouse which will transmit power to the Baroota substation along a 1.4 km 66 kV transmission line. The substation will be located on Kenihan Road and will act as a step-up transformer to utilise the existing 275 kV transmission lines. This transformer will also connect the Solar Project to the west.

The existing 275 kV Electranet transmission line will connect to both facilities via a combined transformer, the transmission line runs north west/south east and bisects the PHES project to the east and Solar Project to the west.

1.2.2 Solar Project

The proposed Solar project will be located approximately 1 km to the north west of the existing Baroota Reservoir.

The design plans supplied by the project engineers indicate a site area of approximately 666 ha. The key project elements will include:

- Landscaping where required including removal of existing trees;
- Significant subsurface intrusive works including trenching to establish and install inverter and solar panel connecting cables;
- A concrete slab on top of which a 275/33 kV substation will be installed;
- Access tracks will be required between the solar panels for the purposes of maintenance and inspection; and
- Replacement of any existing fencing with perimeter fencing surrounding the entire site.

1.3 Legislative Context

The *Environmental Protection Act* (SA) 1993 does not directly contain a framework to account for potential impacts to visual amenities when considering proposals under the *Environmental Protection Act 1993*. It states that the Authority can give notice to the owner to alter proposed variations if the proposed variation will 'result in any adverse effects on adjoining land or on the amenity value of the adjoining land' (SA EPA 1993). Relevant guidance used for visual impact assessment is described within the Environmental Assessment Guideline for Environmental factors and objectives (WA EPA 2013), related to visual impacts states the following:

- For Landforms: "To maintain the variety, integrity, ecological functions and environmental values of landforms and soils";
- For amenities: "To ensure that impacts to amenities are reduced as low as reasonably practicable".

There are no guidelines specific to visual impact within current South Australian legislation, however aspects of the Wind Farm Development Guidelines prepared by the Central Local Government Region of South Australia (SA CLGR 2014) are relevant to the project. Best practice information within the Wind Farm Development Guidelines relating to visual impacts states that 'the degree of visual impact depends on the extent of the change to the landscape caused by the development', taking into account*:*

- *the overall visibility of the development,*
- *the locations and distances from which the development can be viewed*
- *the significance of the landscape and proximity to sensitive areas*
- *landscape values associated with nearby public parks, conservation areas or Ramsar wetlands*
- *landscape values associated with nearby land, specified areas of landscape and environmental significance, specified coastal locations and areas identified to accommodate future urban growth*
- *the sensitivity of the landscape features to change.*

1.4 Scope

The scope of works addressed during this Visual Impact Assessment includes the following:

- Review of all current information related to the visual environment surrounding the areas of proposed development including identifying any sensitive receptors, key landforms, areas of vegetation, vantage points and land use;
- Create viewshed analysis to examine the current visual environment from key sensitive receptors identifying which receptors have a clear line of sight to the proposed development;
- Assessment of post development visual impact from identified receptors; and,
- Evaluation and discussion regarding the significance of the identified impacts.

1.5 Objectives

The objectives of the Visual Impact Assessment Report are:

- Describe the visual environment in which the Project is set;
- Identify key sensitive receptors within and surrounding the proposed development; and
- Assess the potential impacts to the visual environment as a result of activities and the presence of infrastructure associated with the proposed Project.

1.6 Project Area Definition

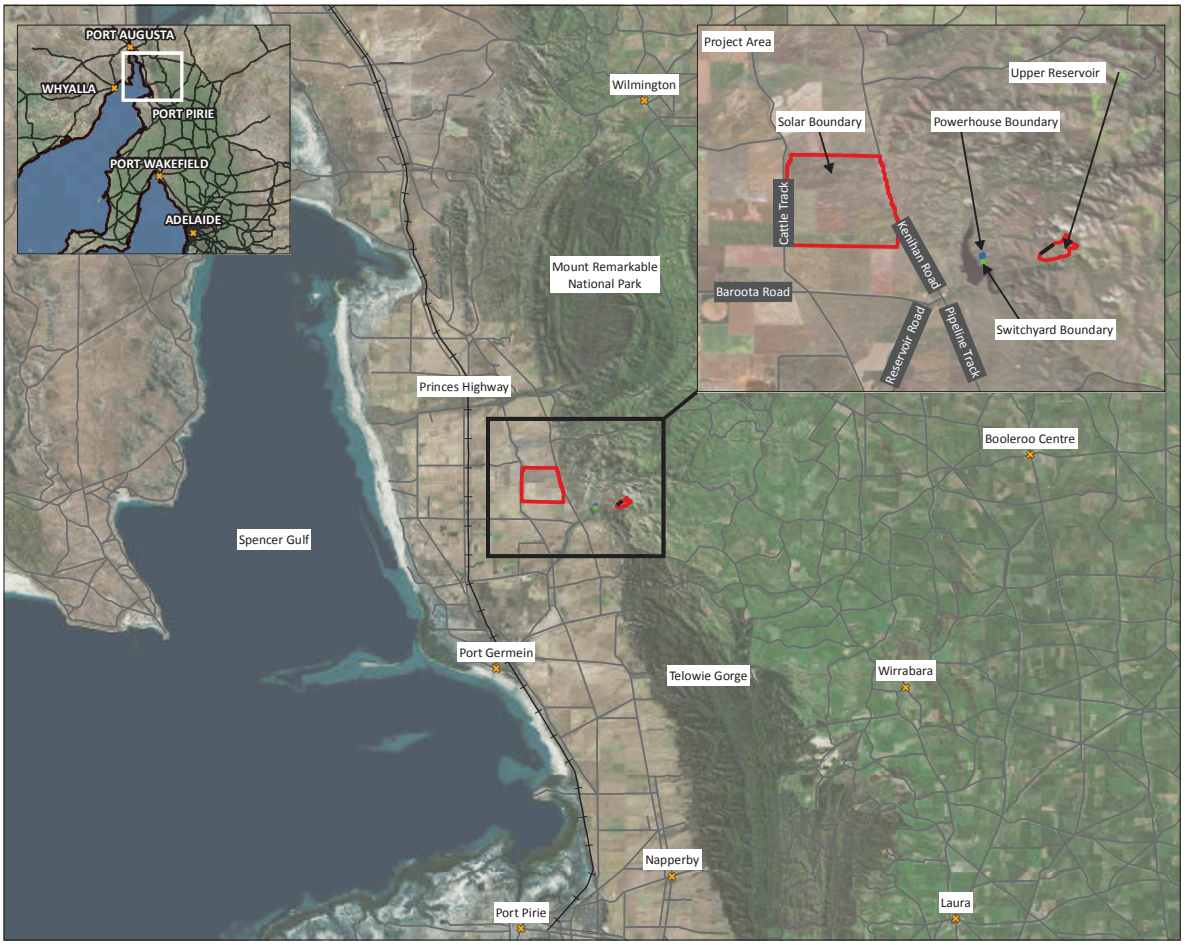
The project area is located at the foothills of the Flinders Ranges and extends to the coast of Spencer Gulf between Port Augusta and Port Pirie in South Australia (**Figure 1**). The site is located approximately 7 km south of Mount Remarkable National Park and approximately 12 km to the north west of Telowie Gorge. The Augusta Highway runs approximately 7 km to the west of the Baroota Reservoir which is at the approximate centre of the project area. The proposed PHES is located to the east within the western margin of Flinders Ranges and the Solar Project is situated to the west on the coastal plains.

The topography of the project area is can be grouped into two visual components:

- rugged terrain of the southern Flinders Ranges to the east,
- Coastal plain of flat agricultural land extending to the coastal shoreline of Spencer Gulf. From the beach to the far east edge of the mountains surrounding the site area there is a maximum elevation gain of approximately 500 m.

Figure 1. Site Location Context

PRIVILEGED AND CONFIDENTIAL



Legend:

- Populated Places
- Selected Roads
- Railway Track

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 04-Jun-2018
Drawn By: TB	Checked By: DB/ AC
Scale at A4 1:400,000	

0 7.5 15
Kilometres

Coor. Sys. GCS GDA 1994

Baroota Pumped Hydro and Solar Project, South Australia

SITE LOCATION PLAN

FIGURE 1

Document Path: S:\Projects JBSG\Adelaide\2. ENVIRONMENT PROJECTS BY CLIENT\Rise Renewables\54440-Baroota Hydro Project\7. PROJECT DATA\Maps\ArcGIS\Maps\Visual Impact\Site Location and Layout.mxd
Image Reference: Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2. The Existing Environment

2.1 Environmental Setting

2.1.1 Solar Project

The Solar Project is located within the Nelshaby Land System (DEWNR 2018) which is characterised by a broad gently inclined fanning outwash with deep, inherently fertile but often poorly structured soils. The area has hard setting surfaces due to the very low water infiltration rates due to the clayey nature of the soils. The land where the solar site will be situated is therefore prone to excessive runoff and associated erosion, suboptimal workability and patchy emergence. A prominent land feature is the red arid aesthetic of the soil as result of the underlying stoney quartzite based soils. The coastal plain between the ranges and ocean is characterised as dry and arid cropping land with very sparse vegetation limited to isolated patches of gum trees and tussock grasslands (**Figure 2**).

The area of land proposed for the Solar Project facility is comprised of entirely agricultural land with little development other than cropped fields. The site is located directly east of a cattle track used as a local access point for property owners and west of Kenihan Road, a secondary minor access road running parallel to the Princes Highway connecting to recreational facilities of Baroota

Ruins Camp grounds and Mambray Creek Campground are located 5.3km to the north. The Augusta Highway, a major arterial road running north/south connecting Port Augusta 54 km to the north and Port Pirie 73 km to the south, lies 3.2 km west of the site boundary. A 275 kV Electranet transmission line runs northwest to southeast lies between the existing Baroota Reservoir and the proposed solar facility. Reservoir Road located is 1.6 km south east of the lower reservoir boundary and runs parallel to Baroota Creek which connects Baroota Reservoir to Port Germein to the south west.

Figure 2. View looking north west towards beach from the eastern boundary of the Solar Site.

2.1.2 PHES Project

The PHES site is located within the Separation Creek Land System (DEWNR 2018). This system is composed of steep to precipitous hill country which although fertile, is largely not arable and mostly inaccessible and is used for primarily grazing purposes. The topography surrounding the site consists of strongly dissected steep to very steep hills of the Baroota, Separation and Waterfall Creek catchments. The system also includes the steep frontal slopes and rocky outcrops of the ranges to the south of Baroota reservoir. Watercourses across the system occupy narrow valleys with a strongly pronounced V-shaped cross sections. Vegetation cover bounding the site to the comprises of tussock grasslands and scattered acacia shrublands covering the steeply inclined slopes (**Figure 3**).

Figure 3. View from the approximate top of the upper reservoir looking west towards dam wall and beach.

2.1.3 PHES Project

The proposed land for the development of the PHES is located just over 1 km east of the existing Baroota Reservoir. The proposed upper reservoir will be approximately 1.5 km in length with a dam wall at the south west edge. The proposed upper reservoir will be located within a valley adjacent to Stony Creek running into Baroota Lower Reservoir.

3. Methodology for Visual Impact Assessment

The methodology outlined is based on the Guidelines for Landscape and Visual Impact Assessment 3rd edition (LI and IEMA 2001) co-authored by the UK Landscape Institute and the Institute of Environmental Management and Assessment (IEMA) and other widely used Visual Impact Assessment (VIA) techniques.

3.1 Objectives

This report will determine the visual impact associated with both the proposed PHES and Solar Project. Fundamental objectives include:

- identifying key sensitive receptors within and surrounding the proposed development;
- determine representative viewpoints to capture sensitive receptors
- conduct a visual impact assessment at the viewpoints that are visible from the key visual project components; the PHES (the upper reservoir, the powerhouse and lower reservoir) and the Solar Project.

These objectives were addressed by firstly classifying the Theoretical Zone of Visual Influence (TZVI) for three visual project component locations:

- upper reservoir and associated infrastructure;
- lower reservoir and associated infrastructure; and
- solar project and associated infrastructure.

These infrastructure elements were used to select corresponding sensitive receptor viewpoints for Google Earth Pro viewshed analysis. Viewshed analysis was conducted to determine the viewpoints that were visible from the site, using the logic that viewpoints that can be seen *from* the site can also *see* the site. Viewshed analysis was then conducted from identified viewpoints to determine the impact of the project according to a range of criteria.

3.2 Desktop Assessment

The following steps were conducted to remotely establish the visual environment surrounding the Baroota Project area. The desktop assessment was conducted by using a range of data sources and programs such as Google Earth Pro, topographic maps and aerial satellite photography. Existing literature and reports were additional sources of information on which the desktop assessment was based.

3.3 Site Assessment

A site assessment was conducted to support the desktop study and establish further site details. Photographs were taken of key landscapes and vegetation cover to help identification of any further sensitive receptors which could not be located during the desktop study. Photographs were taken from a number of topographical high points in a range of view directions to develop regional site context.

3.4 Viewshed analysis

The following methodology was utilised to generate the viewshed data:

- Identification of the Project's site specific infrastructure with detailed reference to the various project elements and existing environmental and public (residential properties, lookout points and

road intersections) (herein referred to as “viewpoints”) surrounding the site that can potentially “see” the site infrastructure;

- Use of Geographical Information Systems (GIS) and applications of ESRI ArcGIS and Google Earth Pro have allowed for client provided data, aerial photographs and government dataset to be overlaid and generate a theoretical zone of visual influence (TZVI) from the site infrastructure. This has allowed for the identification of the viewpoints within the Projects’ surrounding area (in a 20km diameter) that can potentially be seen;
- These TZVIs were generated from the three project infrastructure elements with the assumption that the observer height 2m from the following locations:
    - Upper reservoir dam wall centre at the 350m contour (ground level)
    - Lower reservoir – powerhouse at the ground level
    - Solar array centre at ground level
- The viewshed analysis and viewpoint photograph description was conducted for relevant viewpoints identified;
    - Viewshed analysis from the receptor to the project infrastructure was conducted by adopting a conservative eyeline height of approximately 2.00m based and extending on a best line to the site considering the elevation variation to the visible site infrastructure based on a 30-meter resolution digital elevation model (DEM);
    - The height of the proposed infrastructure was not modelled in the viewshed analysis;
    - The viewpoint photograph description allows for the viewshed to be referenced against an approximate visual perspective and allows for vegetation screening.

3.5 Limitations of the Software

The following limitations and assumptions are considered as part of the GIS visual impact assessment:

- It is noted that the DEM combines multiple remote sensing dataset and is used generate a montage and some overlap maybe present;
- The DEM is ‘Bare-Earth’ and as such vegetation height is not considered, compared to remote sensing Light Detection and Ranging (LiDAR) which does consider vegetation height;
- Rapid changes in the DEM terrain are smaller than scale (e.g. some rises) and will likely be smoothed over as an average elevation;
- Detailed final construction and construction process of the Project’s infrastructure has not been considered during the viewshed analysis;
- Weather effects such as sunlight, dust, lighting and rain have not been considered; and
- It is noted that Viewpoint 3, Viewpoint 5 and Viewpoint 9 are located in MGA Zone 53 and the remaining Viewpoints and Project site are within MGA Zone 54, as such there maybe be some minor distortion in the viewshed analysis being completed across MGA Zones.

3.6 Sensitive Receptors

Sensitive receptors were selected within the TZVI to include the following categories:

- Towns
- Tourism areas, campsites, hiking trails, viewpoints
- Transport infrastructure
- Farm residences

Viewpoints used in the Google Earth Pro viewshed analysis were selected according to the location of sensitive receptors identified during the desktop study. These 14 individual receptor locations were grouped into 10 locations surrounding the Site from which viewsheds were then generated using Google Earth Pro. Photos from Google Earth street views combined with ground level Google Earth Pro images taken from each sensitive receptor were used to support the viewshed findings by giving detail to each viewpoint location.

3.7 Visual Impact Rating

Following the above methodology, a cumulative assessment of two measures of visual impact was completed for each relevant viewpoint:

1. The extent of visual change, and;
2. The extent of visibility of the site from the viewpoint.

Criteria were ranked from High (H) to Negligible (N) and a corresponding numerical score for each measure were used to generate a cumulative impact score (**Table 1**). The cumulative impact score for each measure were then input into the Visual Impact Matrix (**Figure 4**) to quantify the degree of visual impact the project will have from each viewpoint. The visual impact score at each viewpoint will then be added to generate an overall impact rating of the project.

Table 1: Impact Matrix Components

Visual Impact Matrix Components				Impact Matrix Input
Distance	**Visual Absorption Capacity**	**Topography**	**Percent of site visible**	
High: 0-2500m	High: No screening by topography or vegetation	High: 0-50m	High: 75-100%	15-12
Medium: 2500-5000m	Medium: Partial screening by topography and vegetation	Medium: 50-100m	Medium: 50-75%	8-11
Low: 5000-7500m	Low: Almost entirely screened by topography and vegetation	Low: 100-250m	Low: 25-50%	4-7
Negligible: 7500m-10000m	Negligible: Entirely screened by topography and vegetation	Negligible: 250-400m	Negligible: 0-25%	0-3

			Extent of Visual Change			
			High	Moderate	Low	Negligible
		Indicator	Returned a sensitivity score of 15-12	Returned a sensitivity score of 8-11	Returned a sensitivity score of 4-7	Returned a sensitivity score of 0-3
Extent of Visibility	High	75-100% of Site area visible to receptor (12-15)	**High impact**	**High-moderate**	**Moderate**	**Negligible**
	Moderate	50-75% of Site area visible to receptor (8-11)	**High-moderate**	**Moderate**	**Moderate-low**	**Negligible**
	Low	25-50% of Site area visible to receptor (4-7)	**Moderate**	**Moderate-low**	**Low**	**Negligible**
	Negligible	0-25% of Site area visible to receptor (0-3)	**Negligible**	**Negligible**	**Negligible**	**Negligible**

Figure 4: Visual Impact Matrix

4. Results

4.1 TZVI of The Solar Project

This section describes the TZVI of the Solar Project component of the Assessment. The TZVI was based on the limit of discernibility of the most visually prominent project elements and was defined as a 10 km radius around the project area due to the relatively low height of solar arrays, which will be nominally 1.5 m in height. The TZVI was determined based on the DTM viewshed analysis.

The majority of sensitive receptors identified within the TZVI are rural residential properties widely distributed across the agricultural land west of Flinders Ranges. The undulating nature of this terrain has led to patches of land outside of the viewshed where natural plateaus are shadowed by topographical inclines.

Approximately 5.3 km to the north of the proposed Solar Project are Mambray and Baroota Ruins campground adjacent to a residential property. Viewshed analysis suggests that these locations sit within a natural valley associated with Mambray Creek and although within the TZVI, they therefore cannot be seen from the proposed Solar Project.

Vegetation within the TZVI varies considerably dependent on the environment, level of habitation and elevation all of which change considerably with lateral movement from west to east across the TZVI. The areas of agricultural land across the coastal plain east of the tussock grasslands associated with the slopes of Flinders Ranges, are primarily crop fields with some areas of Eucalyptus forest and woodland which have the potential to act as functions of visual absorption for any of the aforementioned residential properties.

A sensitive receptor within the TZVI is 4.3 km to the west of the site has been identified as the Augusta Highway running north-south and parallel to a regional railway track. The Viewpoints identified as having a direct line of site with the Solar Project are Viewpoint 3 and Viewpoint 5, both of which have been taken from the Augusta Highway.

Figure 5: TZVI of Solar Project

COMMERCIAL IN CONFIDENCE

Legend:

- Solar Boundary
- Viewshed Analysis

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 4 June 2018
Drawn By: TB	Checked By: DB/ AC
Scale as Shown	
Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54	

Baroota Hydro Energy Storage and Solar Project

SOLAR, THEORETICAL ZONE OF VISUAL INFLUENCE

FIGURE: 5

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

4.2 Solar Project Viewshed and Viewpoints

Figure 6: Viewpoint 3 Photo Analysis

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 3
View direction:	East
Elevation Gain between viewpoint and infrastructure:	30 m
Distance:	3600 m
Easting (MGA Zone53):	779,004.00
Northing (MGA Zone53):	6,357,048.00

Viewpoint Setting

Viewpoint 3 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricultural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and four nearby residences. The southern half of the proposed solar plant can be seen, view of the northern portion of the solar plant is concealed behind vegetation associated with a residence.
Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.

Legend:

Solar Boundary

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Not to Scale

Coor. Sys. n/a

Baroota Hydro Energy Storage and Solar Project

SOLAR, VIEWPOINT 3 PHOTOMONTAGE

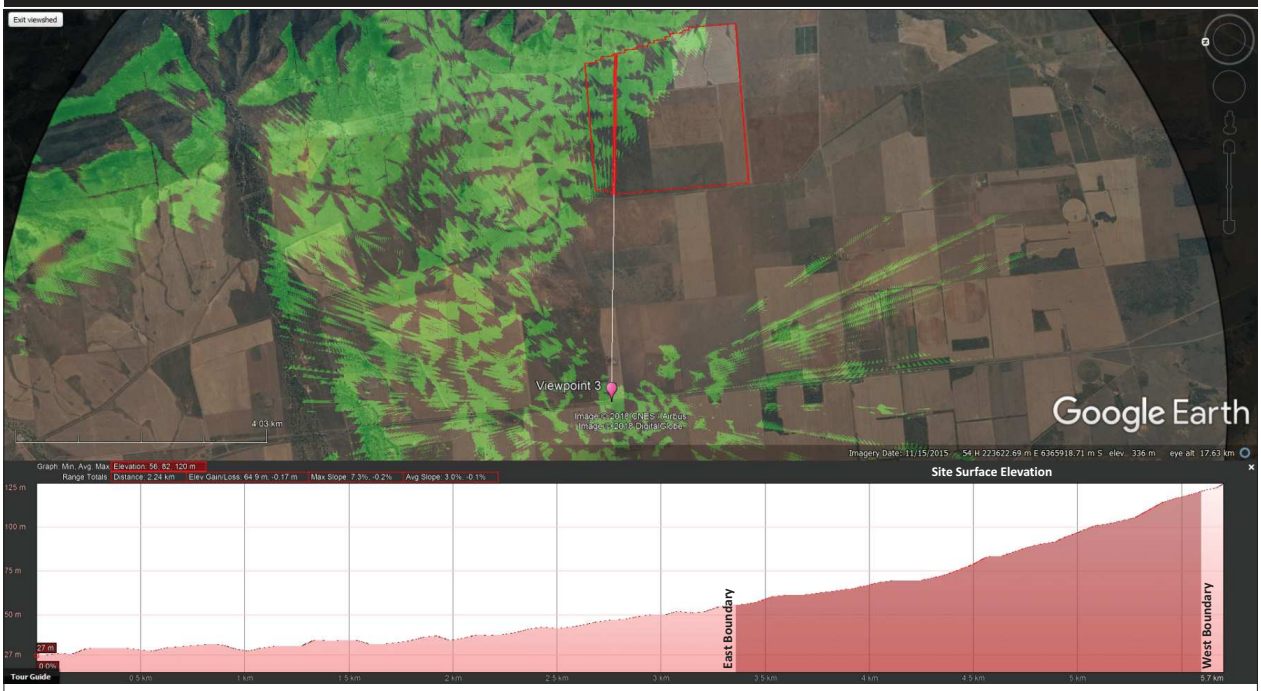
FIGURE 6

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis

Figure 7: Viewpoint 3 Viewshed Assessment

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWSHED



Legend:

- Solar Boundary
- Viewshed Analysis

VIEWSHED CHARACTERISATION

Extent of Visual Change	Criteria	Score
Distance	M: 2500-5000m	3
Visual Absorption Capacity	M: Partial screening by topography and vegetation	3
Topography	H: 0-50	5
Cumulative score:		**11: Moderate**
Extent of Visibility	**Criteria**	
Percent of polygon visible	L: 25-50	5
Cumulative score:		**5: Low**

Overall Impact Score Rating: **Moderate**

Refer to Figure 4 Visual Impact Matrix

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Scale as Shown

Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54

Baroota Hydro Energy Storage and Solar Project

SOLAR, VIEWPOINT 3 VIEWSHED CHARACTERISATION

FIGURE 7

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 8: Viewpoint 5 Photo Analysis

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 5
View direction:	North East
Elevation Gain between viewpoint and infrastructure:	40 m
Distance:	3500 m
Easting (MGA Zone53):	778,892.00
Northing (MGA Zone53):	6,353,153.00
Viewpoint Setting	
Viewpoint 5 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricultural access running east to west perpendicular to the Highway. The approximate layout of the proposed solar plant can be seen between two areas of vegetation to the north and south of the access track. Power lines can be seen running parallel to the access track heading to the east. Viewpoint 5 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.	

Legend:

Solar Boundary

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Not to Scale

Coor. Sys. n/a

Baroota Hydro Energy Storage and Solar Project

SOLAR, VIEWPOINT 5 PHOTOMONTAGE

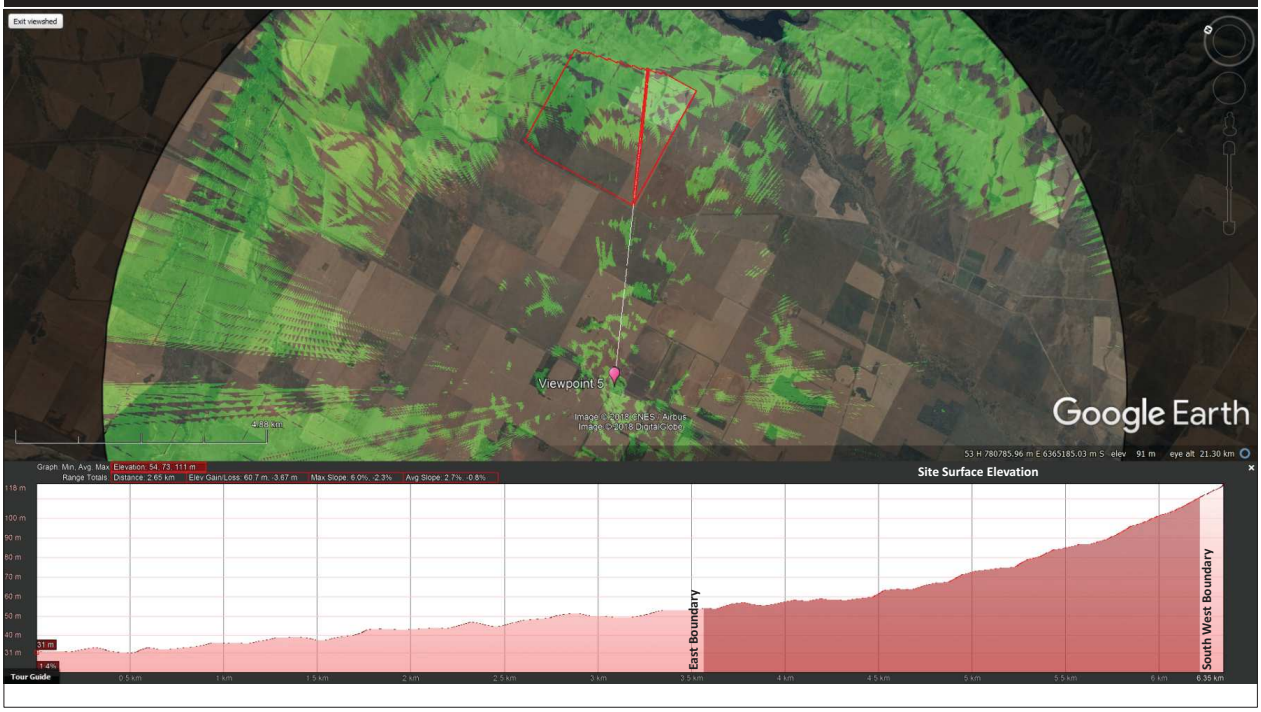
FIGURE 8

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 9: Viewpoint 5 Viewshed Assessment

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWSHED



VIEWSHED CHARACTERISATION

Magnitude	Criteria	Score
Distance	M: 2500-5000m	3
Visual Absorption Capacity	M: Partial screening by topography and vegetation	3
Topography	H: 0-50	5
Cumulative score:		11: Moderate
Sensitivity	**Criteria**	
Percent of polygon visible	M: 50-75	9
Cumulative score:		**9: Moderate**

Overall Impact Score Rating

Moderate

Refer to Figure 4 Visual Impact Matrix

Legend:

- Solar Boundary
- Viewshed Analysis

JBS&G

Job No: 54440

Client: Rise Renewables

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Scale as Shown

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Baroota Hydro Energy Storage and Solar Project

SOLAR, VIEWPOINT 5 VIEWSHED CHARACTERISATION

FIGURE 9

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

4.3 TZVI from Upper Reservoir

This section describes the TZVI of the upper reservoir of the PHES component of the Project. The TZVI was based on the limit of discernibility of the most the visually prominent project elements and was defined as a 10km radius around the project area. The primary visual impact of the hydro plant is the dam wall located on the north-west side of the dam. The TZVI was determined based on the DSM viewshed analysis.

The TZVI from the centre of the PHES site extends 12km east of the transmission line which lies 3.5 km to the west of the proposed dam wall.

The elevation profile across the TZVI has a highly varied topographical profile which increases in elevation to peak at 410 m within the Flinders Range. This variation in profile has had a significant impact on the TZVI by reducing the views associated with the upper reservoir. The upper reservoir is also located in a valley, thereby further limiting the visual envelope.

Vegetation within the TZVI varies considerably dependent on the topography and land type. The areas of agricultural land west of the eastern margin of Flinders ranges are primarily crop fields with some areas of Eucalyptus forest and woodland which have the potential to provide visual absorption for any of the residential properties located in these areas. Acacia shrubland forms a band of vegetation from the break in slope that marks the base of the Flinders Ranges to an altitude consistent with the western boundary of the current Baroota Reservoir. West of this point the rugged terrain and higher altitudes are consistent with tussock grasslands which cover the slopes of the Flinders Ranges as far east as Bangor minimising visual adsorption capacity.

Aside from the ridgeline surrounding the upper reservoir to the north, east and south, the primary areas of potential visual impact as identified by viewshed analysis within line of sight of the dam wall, are through the valley of the Baroota Creek. These areas include the ridgeline to the west of the existing Baroota reservoir and agricultural land as far to the northwest as the TZVI boundary 10 km to the northwest.

The only identified viewpoints within these areas is Viewpoint 3 which will be from various points along the Augusta Highway.

Figure 10: Upper Reservoir TZVI

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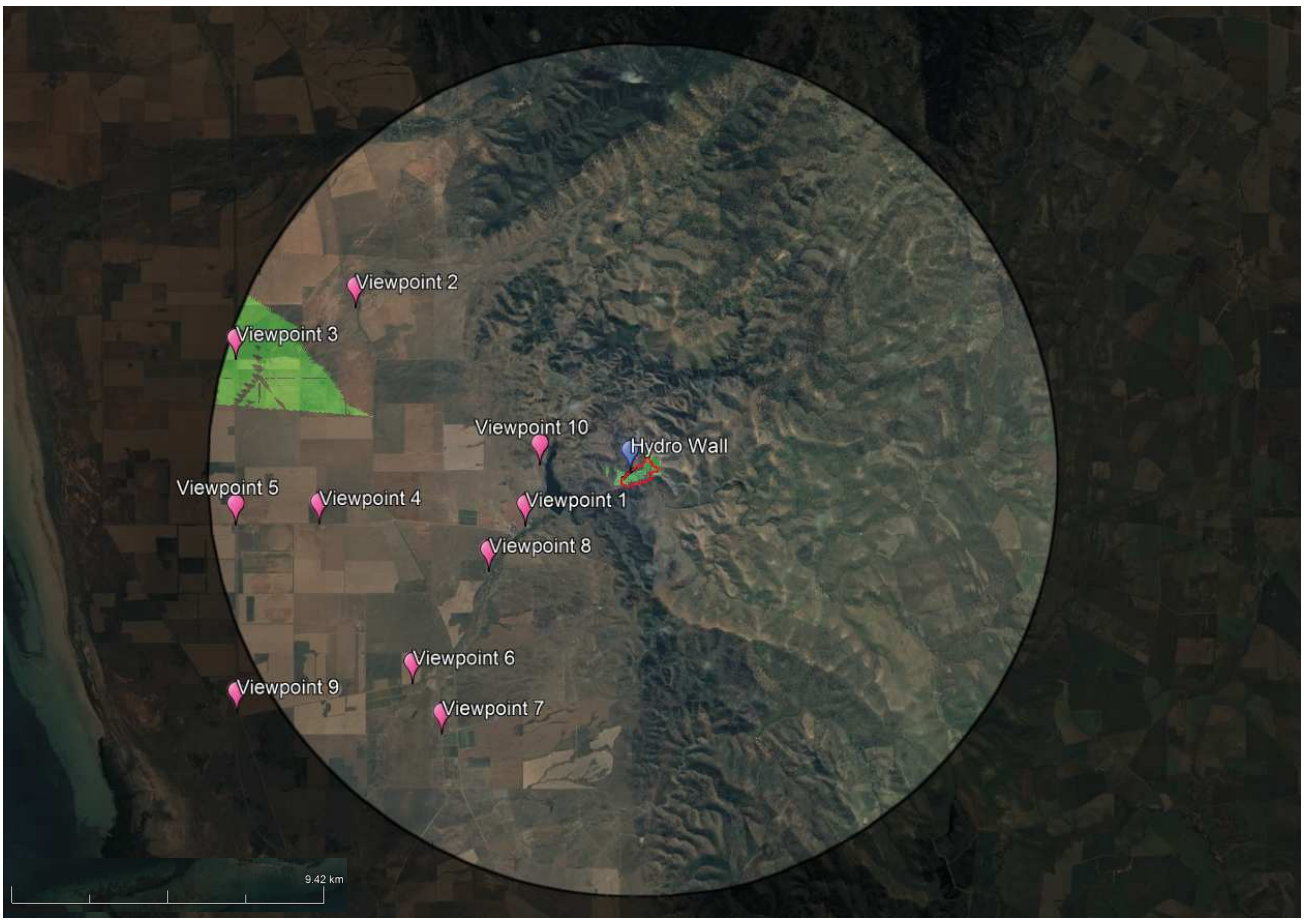


Legend:

- Hydro Wall
- Hydro Fenceline
- Viewshed Analysis

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 4 June 2018
Drawn By: TB	Checked By: DB/ AC
Scale as Shown	
Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54	

Baroota Hydro Energy Storage and Solar Project

HYDRO WALL, THEORETICAL ZONE OF VISUAL INFLUENCE

FIGURE: 10

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

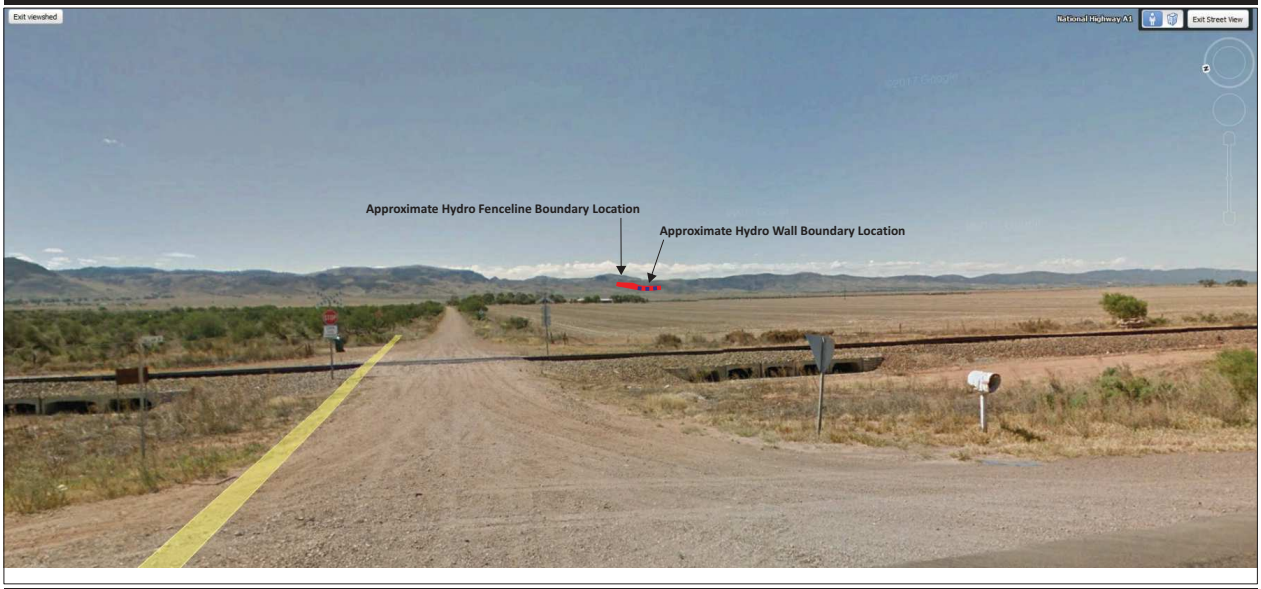
Aside from the ridgeline surrounding the site to the north east and south, the primary areas of potential visual impact as identified by viewshed analysis within the TZVI fall within line of sight of the dam wall through the valley entrance following the Baroota Creek. These areas include the ridgeline to the west of the existing Baroota reservoir and agricultural land as far to the northwest as the TZVI boundary 10km to the northwest. The only identified Viewpoint within these areas is Viewpoint 3 which has been taken as part of a selection of evenly spaced viewpoints along the Augusta Highway. The large distance between the identified visually impacted areas to the northwest and the Site is directly associated with the elevated position of the dam.

4.4 Upper reservoir viewshed and viewpoint

Figure 11: Viewpoint 3 Photo Analysis

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO



VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 3
View direction:	South East
Elevation Gain between viewpoint and infrastructure:	300 m
Distance:	9700 m
Easting (MGA Zone53):	779,004.00
Northing (MGA Zone53):	6,357,048.00

Viewpoint Setting

Viewpoint 3 is one of a series of viewpoints selected across the Princes Highway and is located adjacent to a dirt track primarily used as agricultural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and four nearby residences. There is a clear line of sight to the wall of the Upper Reservoir from this location.
Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.

Legend:
- Hydro Wall
- Hydro Fenceline

JBS&G

Job No: 54440

Client: Rise Renewables

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Drawn By: TB | Checked By: DB/ AC

Not to Scale

Coor. Sys. n/a

Baroota Hydro Energy Storage and Solar Project

HYRDO WALL, VIEWPOINT 3 PHOTOMONTAGE

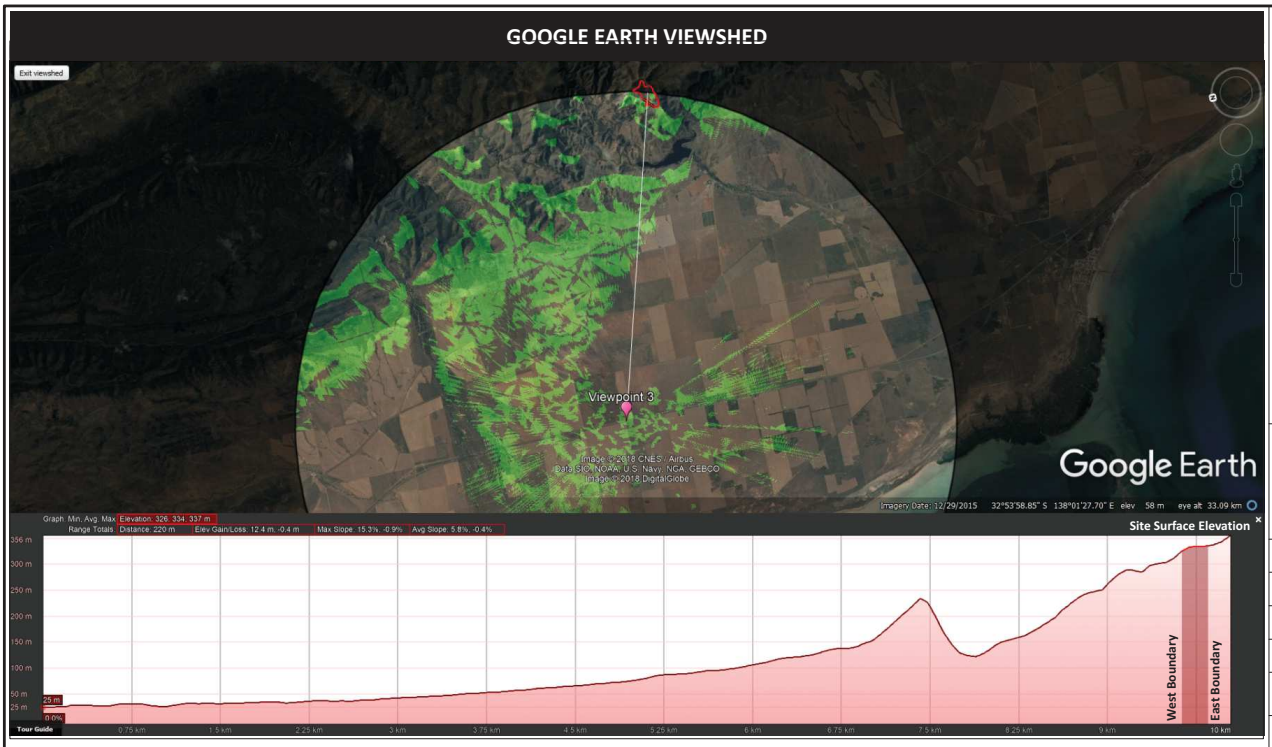
FIGURE 11

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 12: Viewpoint 3 Viewshed Assessment

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWSHED



VIEWSHED CHARACTERISATION

Extent of Visual Change	Criteria	Score
Distance	N: 7500m-10000m	0
Visual Absorption Capacity	M: Partial screening by topography and vegetation	3
Topography	N: 250-400	0
Cumulative score:		3: Negligible
Extent of Visibility	**Criteria**	
Percent of polygon visible	L: 25-50	5
Cumulative score:		5: Low

Overall Impact Score Rating
Low

Refer to Figure 4 Visual Impact Matrix

Legend:

- Hydro Wall
- Hydro Fenceline
- Viewshed Analysis

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT	Date: 4 June 2018
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Scale as Shown

Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54

Baroota Hydro Energy Storage and Solar Project

HYDRO WALL, VIEWPOINT 3 VIEWSHED CHARACTERISATION

FIGURE 12

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

4.5 TZVI from Lower Reservoir

This section describes the TZVI of the lower reservoir of the PHES component of the Project. The TZVI was based on the limit of discernibility of the most the visually prominent project elements and was defined as a 10km radius around the project area. The TZVI was determined based on the DSM viewshed analysis. The TZVI from the centre of the PHES site extends approximately 10 km to the west.

Vegetation within the TZVI includes crops and some areas of Eucalyptus forest and woodland lining the banks of Baroota Creek and sporadically distributed throughout the agricultural land. The band of Acacia shrubland at the base of the Flinders Range bounds the western margin of the Baroota Reservoir and therefore provides significant visual absorption capacity.

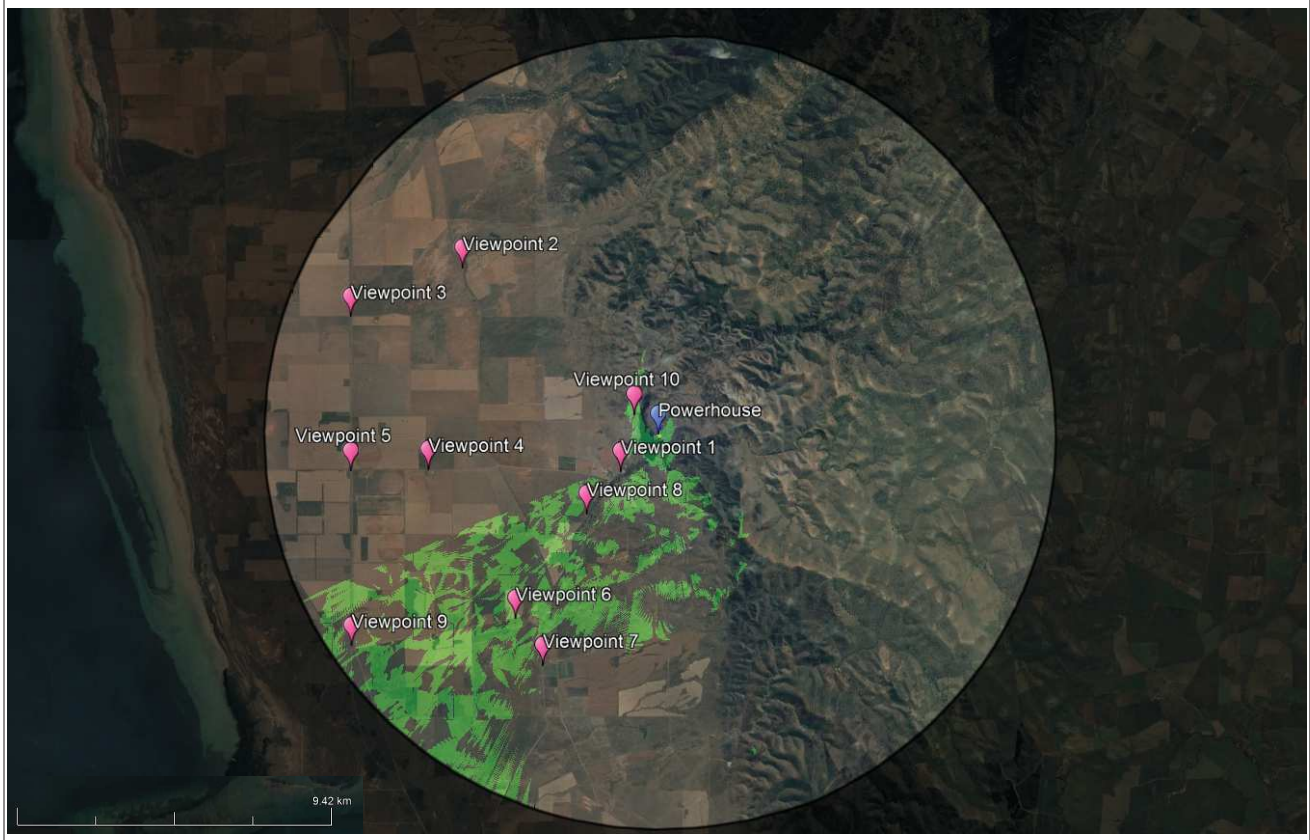
The elevation profile across the TZVI increases in altitude by 115 m from south west to north east with gentle undulations over the agricultural land west of Baroota Creek and Baroota Reservoir. These topographical undulations prevent direct line of sight to many of the identified receptors to the south west. Receptors to the west and north are largely shielded from the powerhouse due to the elevated topography of the ridgeline associated with the western and northern margin of the Baroota Reservoir. In addition, the steeply inclined topography of Flinders Range to the east marks the boundary of any further receptors to the east and south.

The identified viewpoints within the TZVI include:

- Viewpoint 6 (located on a dirt road associated with access to agricultural land from local properties owners)
- Viewpoint 9 taken from the Augusta Highway,
- Viewpoint 10 (taken from a lookout point situated on the northwest bank of the Baroota Reservoir adjacent to a public foot path.

Figure 13: Lower Reservoir TZVI

COMMERCIAL IN CONFIDENCE



Legend:

- Powerhouse Boundary
- Switchyard Boundary
- Viewshed Analysis

JBS&G

Job No: 54440	
Client: Rise Renewables	
Version: DRAFT	Date: 4 June 2018
Drawn By: TB	Checked By: DB/ AC
Scale as Shown	
Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54	

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, THEORETICAL ZONE OF VISUAL INFLUENCE

FIGURE: 13

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

4.6 Lower Reservoir Viewshed and Viewpoint

Figure 14: Viewpoint 6 Photo Analysis

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 6
View direction:	North East
Elevation Gain between viewpoint and infrastructure:	90 m
Distance:	5800 m
Easting (MGA Zone54):	222,105.00
Northing (MGA Zone54):	6,349,457.00

Viewpoint Setting

Viewpoint 6 was chosen to represent a cluster of residential areas along the Baroota Creek. Due to the location adjacent the creek, the powerstation and switch yard are visible due to the lower elevation of the lower reservoir wall. Specifically at the exact viewpoint 6, the site is visible but many other viewpoints in that area are not able to see the site due to vegetation screening along Reservoir Road.
Viewpoint 6 is surrounded by open low cut agricultural fields, and a powerline runs parallel to Reservoir Road.

Legend:
- Powerhouse Boundary
- Switchyard Boundary

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Not to Scale

Coor. Sys. n/a

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 6 PHOTOMONTAGE

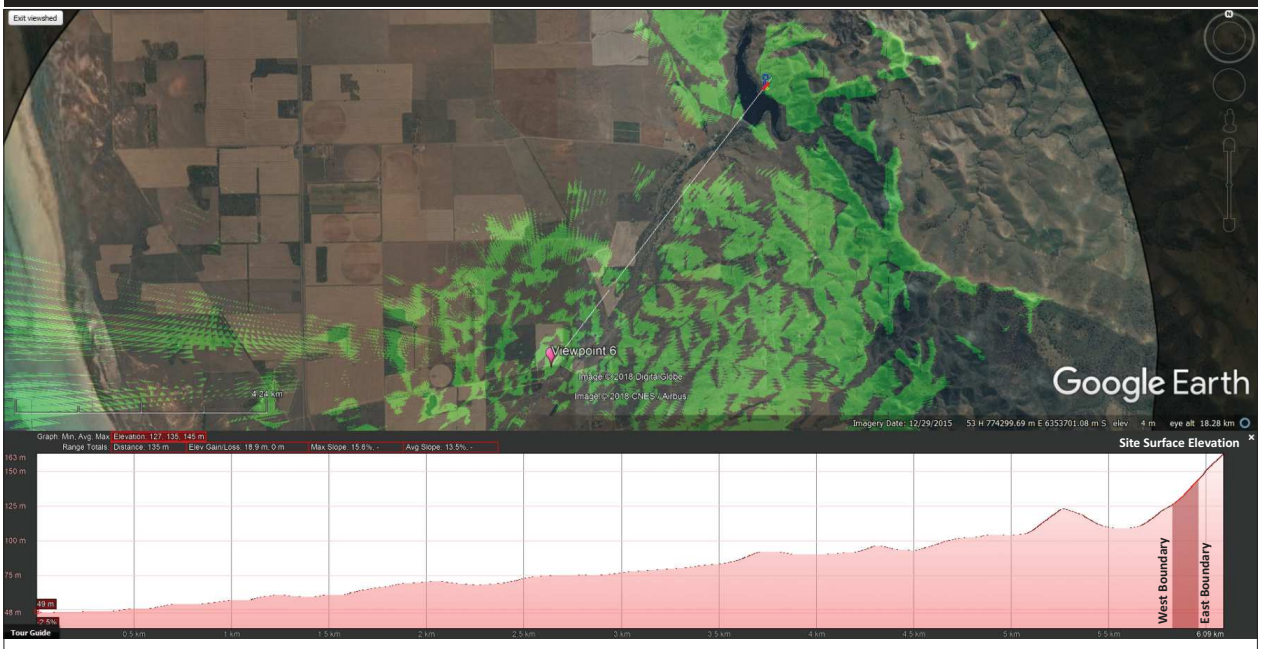
FIGURE 14

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 15: Viewpoint 6 Viewshed Assessment

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWSHED



VIEWSHED CHARACTERISATION

Extent of Visual Change	Criteria	Score
Distance	L: 5000-7500m	1
Visual Absorption Capacity	M: Partial screening by topography and vegetation	3
Topography	M: 50-100	0
Cumulative score:		4: Low
Extent of Visibility	**Criteria**	
Percent of site visible	M: 50-75	9
Cumulative score:		9: Moderate

Overall Impact Score Rating
Moderate-low

Refer to Figure 4 Visual Impact Matrix

Legend:
- Powerhouse Boundary
- Switchyard Boundary
- Viewshed Analysis

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Scale as Shown

Coor. Sys. GDA 1994 MGA Zone 54

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 6 VIEWSHED CHARACTERISATION

FIGURE 15

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 16: Viewpoint 9 Photo Analysis

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 9
View direction:	North East
Elevation Gain between viewpoint and infrastructure:	90 m
Distance:	9400 m
Easting (MGA Zone53):	778,781.52
Northing (MGA Zone53):	6,348,741.54

Viewpoint Setting

Viewpoint 9 is the southernmost of a series of viewpoints selected across the Princes Highway and is located adjacent to a Gribble Road, primarily used as agricultural access running east to west perpendicular to the Highway. The viewpoint was selected to represent road traffic and two nearby residences. There is a clear line of sight to the wall of the powerstation and switchyard from this location.

Viewpoint 3 photo is taken from an area of flat agricultural land which can be seen to gently rise toward the east sharply increasing in gradient at the base of the mountains.

Legend:

- Powerhouse Boundary
- Switchyard Boundary

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Not to Scale

Coor. Sys. n/a

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 9 PHOTOMONTAGE

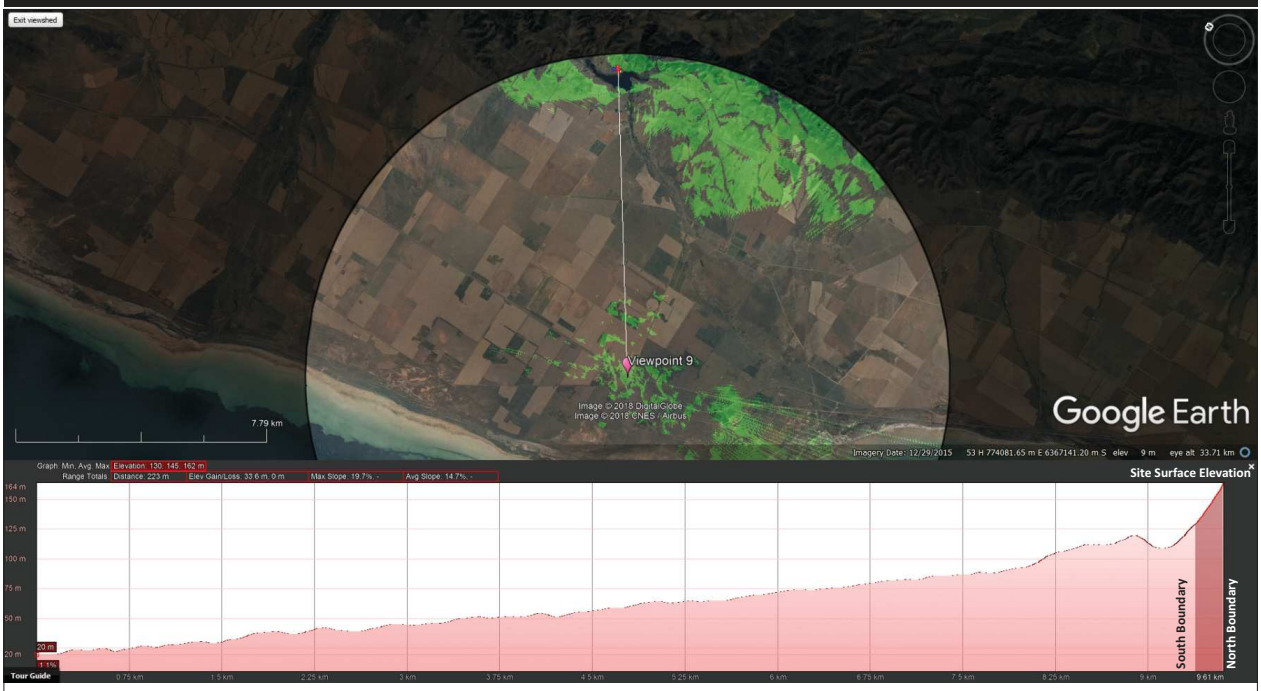
FIGURE 16

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 17: Viewpoint 9 Viewshed Assessment

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWSHED



Legend:

- Powerhouse Boundary
- Switchyard Boundary
- Viewshed Analysis

VIEWSHED CHARACTERISATION

Extent of Visual Change	Criteria	Score
Distance	L: 5000-7500m	1
Visual Absorption Capacity	M: Partial screening by topography and vegetation	3
Topography	N: 250-400	0
Cumulative score:		**4: Low**
Extent of Visibility	**Criteria**	
Percent of polygon visible	M: 50-75	9
Cumulative score:		**9: Moderate**

Overall Impact Score Rating
Moderate-low

Refer to Figure 4 Visual Impact Matrix

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Scale as Shown

Coor. Sys. GDA 1994 MGA Zone 53 and Zone 54

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 9 VIEWSHED CHARACTERISATION

FIGURE 17

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

Figure 18: Viewpoint 10 Photo Analysis

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWPOINT PHOTO

VIEWPOINT PHOTO ANALYSIS

Location:	Viewpoint 10
View direction:	South East
Elevation Gain between viewpoint and infrastructure:	30 m
Distance:	800 m
Easting (MGA Zone54):	224,979.05
Northing (MGA Zone54):	6,354,677.81

Viewpoint Setting

Viewpoint 10 is located at the existing lookout at the lower reservoir. It is perched on the North Western bank of the reservoir and has a clear view of the reservoir and valley, north, east and south. The switch yard is clearly visible as it sits higher on the slope compared to the powerstation. The powerstation is only marginally visible as it is located behind the switchyard and is slightly closer to the bank. The bank has a ring of River Red Gum trees that obstruct any views of infrastructure immediately behind the tree line. The upper reservoir dam wall is not visible as is it located directly behind the mountain in front of viewpoint 10.

Legend:

- Powerhouse Boundary
- Switchyard Boundary

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Not to Scale

Coor. Sys. n/a

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT 10 PHOTOMONTAGE

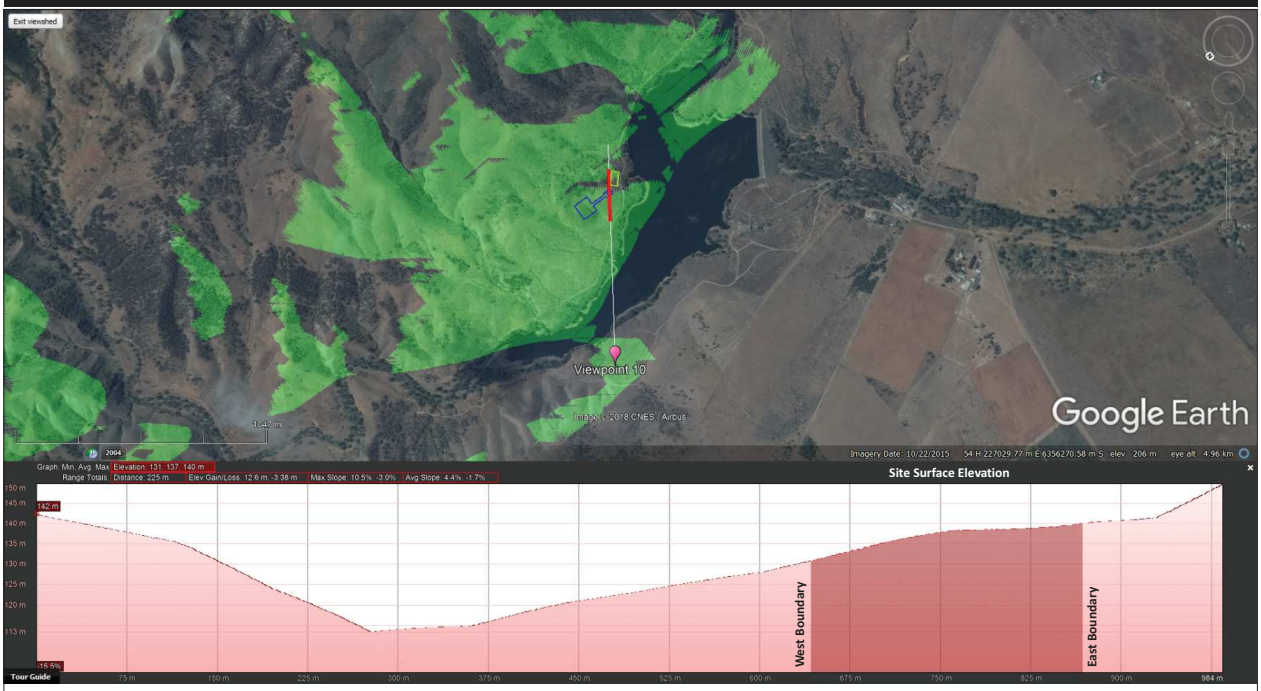
FIGURE 18

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Site Inspection Photograph

Figure 19: Viewpoint 10 Viewshed Assessment

COMMERCIAL IN CONFIDENCE

GOOGLE EARTH VIEWSHED



Legend:

- Powerhouse Boundary
- Switchyard Boundary
- Viewshed Analysis

VIEWSHED CHARACTERISATION

Extent of Visual Change	Criteria	Score
Distance	H: 0-2500m	5
Visual Absorption Capacity	M: Partial screening by topography and vegetation	3
Topography	H: 0-50	5
Cumulative score:		**13: High**
Extent of Visibility	**Criteria**	
Percent of polygon visible	H: 75-100	13
Cumulative score:		**13: High**

Overall Impact Score Rating

High

Refer to Figure 4 Visual Impact Matrix

JBS&G

Job No: 54440

Client: Rise Renewables

Version: DRAFT | Date: 4 June 2018

Drawn By: TB | Checked By: DB/ AC

Scale as Shown

Coor. Sys. GDA 1994 MGA Zone 54

Baroota Hydro Energy Storage and Solar Project

POWERHOUSE, VIEWPOINT10 VIEWSHED CHARACTERISATION

FIGURE 19

Document Path: V:\05 Projects\Rise Renewables\54440-Baroota Hydro Project\Viewshed Analysis
Image Reference: Google Earth © 2018

5. Discussion

5.1 Impacts on Visual Amenity – Upper Reservoir

5.1.1 Viewpoint 3

Viewshed analysis of the TZVI identified only one viewpoint, Viewpoint 3, has a direct line of site to the dam wall. This viewpoint was selected as part of a series of evenly spaced viewpoints along the Augusta Highway to define the visual impact on the Highway users for the proposed development as a major sensitive receptor. This viewpoint also includes two additional adjacent sensitive receptors which are residential properties to the north east and the east.

Viewshed analysis directly from Viewpoint 3 (**Figure 12**) shows that the undulating ground to the east prevents direct line of sight across much of the agricultural land until the break of slope and steep topographic rise.

The corresponding photo of Viewpoint 3 **(Figure 11**) supports the viewshed analysis. The sharp topographical incline of Flinders Ranges can be seen in the distance running north to south.

The distance from Viewpoint 3 to the proposed dam wall is enough to prevent significant impact to a casual observer. In addition, the proposed dam lies beneath the ridgeline of Flinders Ranges, shadowing it from standing out against the skyline. Aside from local agricultural workers and property owners, most users of the Augusta Highway or the parallel railway line are likely to be transient in nature and are therefore unlikely to view the proposed development for more than a few minutes at a time.

5.2 Impacts on Visual Amenity - Hydro Power house and associated infrastructure

Viewshed analysis of the TZVI identified only three viewpoints (Viewpoint 6, 9 and 10) with a direct line of site to the dam wall.

5.2.1 Viewpoint 6

Viewpoint 6 was selected to represent the view from two sensitive receptors identified as residential properties located northwest of the Baroota Creek and the dirt interconnecting road which might be used by local residents for agricultural purposes.

Viewshed analysis directly from Viewpoint 6 (**Figure 15**) shows that vegetation lining the banks of Baroota Creek may provide visual absorption for areas of a similar elevation, however the proposed dam wall is situated north of any riparian vegetation associated with Baroota Creek preventing any vegetation absorption capacity.

The corresponding photo of Viewpoint 6 (**Figure 14**) supports the viewshed analysis displaying the vegetation associated with Baroota Creek to the east. It is evident from Viewpoint 6 photo that although the entire area of the proposed infrastructure can be seen, the distance and shadowing ridge line makes it challenging to see for a casual observer. In addition, the location of Viewpoint 6 is a small dirt access track and is therefore unlikely to be used by more than the occasional local agricultural worker or property owner.

5.2.2 Viewpoint 9

Viewpoint 9 has been selected as to represent sensitive receptors utilising the Augusta Highway.

Viewshed analysis from Viewpoint 9 (**Figure 17**) shows that the undulating ground to the east prevents direct line of sight across much of the agricultural land until the break of slope and steep topographic rise which marks the foothills of the Flinders Ranges. Viewpoint 9 has views up the valley associated with Baroota Creek and over the existing dam wall on to the site situated on the eastern bank of the Baroota Reservoir. Much of the field of view of the base of Flinders Ranges is obscured by vegetation lining the banks of the Baroota Creek.

The site photo (**Figure 16**) shows the agricultural land is generally featureless between the Augusta Highway and base of Flinders Range, however there is a tree line running north to south from the margin of Baroota Creek to the north. Viewpoint 9 photo suggests the elevation change of 115 m between the proposed dam wall and viewpoint would position the site above this tree line.

Views from Viewpoint 9 are likely to be users of the Princes Highway and therefore likely to be transient in nature.

5.2.3 Viewpoint 10

Viewshed analysis from Viewpoint 10 (**Figure 19**) shows a clear line of sight to the power house and associated infrastructure. The viewpoint is approximately 800 m to the northwest of the power house taken from a lookout point adjacent to a walking path which follows the circumference of the existing Baroota Reservoir. Despite a small elevation difference of only 8m between Viewpoint 10 and the powerhouse, the majority of the surface area beneath the line of sight is within the topographic low of the existing Baroota Reservoir resulting in limited topographic shielding.

The likelihood of vegetation with a high visual absorption capacity is considered low as most of the taller trees and shrubs within the line of sight are associated with the perimeter of the existing Baroota Reservoir below the power house elevation (**Figure 18**). Above this the dominant vegetation is generally grasslands which would not impede line of sight.

5.3 Impacts on Visual Amenity - Solar Project

Viewshed analysis of the TZVI identified only two viewpoints (Viewpoint 3 and 5) with a direct line of site to the solar infrastructure.

5.3.1 Viewpoint 3

Viewshed analysis from Viewpoint 3 (**Figure 7**) towards the Solar Project shows a clear line of sight to roughly 40% of the site. Gentle topographical undulations create topographical shadows which would hide the southern and western portions of the proposed solar plant from Viewpoint 3.

The photo from Viewpoint 3 (**Figure 6**) shows a dirt access road travelling east directly towards the proposed site. Shrubland is located from the northern margin of the dirt track extending north, however the agricultural land south of this track appears to be a ploughed field with little visual impedance.

5.3.2 Viewpoint 5

Viewshed analysis from Viewpoint 5 (**Figure 9**) towards the Solar Project show a clear line of sight to roughly 60% of the Solar Project area. The general direction of incline across the region is from west to east towards Flinders Range, however the topography undulates considerably as seen in the line of sight cross section attached to viewshed analysis. These undulations create topographical shadows which hide the southern and western portions of the solar plan area from view.

The photo from Viewpoint 5 (**Figure 8**) shows a dirt access road travelling east directly south of the proposed Site. The proposed Solar Project is situated between two sections of trees which line the dirt track and is intersected by a railway line. Neither of these areas of trees impede the direct line of sight the proposed Solar Project. Overhead low voltage distribution powerlines run parallel to the dirt road towards the east. Aside from the stated vegetation the agricultural field within the line of sight to the proposed Solar Project only contain crops and will therefore have minimal visual adsorption capacity.

6. Conclusion

6.1 Summary of Impacts

The visual impact assessment carried out by JBS&G used a combination of field work and desktop study to identify the sensitive receptors across the TZVI. The likely visual impact from the proposed PHES, associated powerhouse/switchyard and Solar Project on these receptors was assessed using an impact matrix to score the visual impact for each receptor.

The following table provides a summary of the visual impact assessment.

Table 2: Summary of Impacts

Component	Viewpoint	Viewpoint Impact	Component Impact	Project Visual Impact
Solar Project	3	Moderate	Moderate	**Moderate-Low**
	5	Moderate		
Lower Reservoir	6	Moderate-Low	Moderate	
	9	Moderate-Low		
	10	High		
Upper Reservoir	3	Low	Low	

The investigation came to the following conclusion:

- Neither the Solar Project or PHES and associated powerhouse/switchyard scored more than moderate-low when assessed against the criteria selected for purpose this investigation;
- The natural topography of the region is largely effective in minimising direct line of sight to the PHES Project from identified receptors;
- Although the Solar Project is more visually accessible than the PHES Project due to the flatter topography of the coastal plains, the undulating nature of the localised relief is effective in reducing the visual impact at all the identified sensitive receptors so that only partial areas of the site can be seen; and
- The powerhouse/switchyard are also largely hidden from observers due to the natural topography.

In addition to the above points, the sensitive receptors identified throughout the area were found to either be local residents living in widely distributed agricultural properties, or users of the Augusta Highway and adjacent railway line. It is likely that local residents may have, at most, partial views of the proposed development which will be further mitigated by the distance to the Project.

In addition, it was found that users of the Augusta Highway or adjacent rail line would be exposed to the proposed developments for a few minutes at a time as they would be transient receptors, and therefore not significantly affected.

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Appendix F Traffic Assessment

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Point8
traffic engineering and transport planning

Traffic Assessment

Baroota Solar and Hydro Project

JBS&G
P18057

May 2018

About Us

Our Focus

Point8 provides professional services in the field of traffic engineering and transport planning. Our objective is to provide services that add value to our client's organisations.

Quality Assurance

Point8 is committed to providing expert traffic engineering and transport planning services. We aim to exceed our clients' expectations by consistently delivering excellent outcomes. Point8's Quality Management System is certified to ISO 9001:2008.

Document Control

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Revision	Author(s)	Reviewer	Date	Comments
A	Rachael Amies, Michael Pickerill	Mark Plattz	8/05/2018	Draft
B	Rachael Amies	Michael Pickerill	9/05/2018	Final

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Table of Contents

1.0 Introduction

1.1 Overview

Point8 has been commissioned by JBS&G to prepare a Traffic Assessment for a proposed commercial pumped hydro and solar facility in Baroota, South Australia. The project involves the construction and operation of a large scale pumped hydro and solar project, including a 300MW solar farm and an additional (upper) reservoir near the existing Baroota reservoir operated by SA Water. The project is proposed to be developed by Rise Renewables Pty Ltd within the District Council of Mount Remarkable (Council) area.

1.2 Project Location

The project site is located in Baroota, approximately 230 kilometres north of Adelaide and 12km north-east of Port Germein, South Australia as shown in Figure 1.1.

Figure 1.1 – Locality Figure

Base map source: Google Earth

1.3 Scope

The purpose of the traffic assessment is to define baseline conditions as part of an analysis of the development application.

The project is in the early stages of design and this traffic assessment considers both the construction and operation phases of the project. Specific this assessment considers the:

- suitability/feasibility of site access locations
- quantification of vehicle volumes likely to be generated by the proposed Project
- assessment of the current condition of the identified access points, identifying hazards
- impediments to heavy vehicle movements and associated management options where required.

Point8's consideration of traffic impacts has been prepared to facilitate a development assessment. The assessments herein do not include:

- SIDRA Intersection analysis
- preparation of concept designs
- assessment of pavement impacts
- rail level crossing (ALCAM) assessments
- consideration of potential impediments to heavy movements on the state-controlled network beyond the relevant intersections to local roads accessing the site.

It is understood that this traffic assessment will be submitted to the South Australia Department of Planning, Transport and Infrastructure (DPTI) as part of a Development Application for the project.

2.0 Project Profile

2.1 Overview

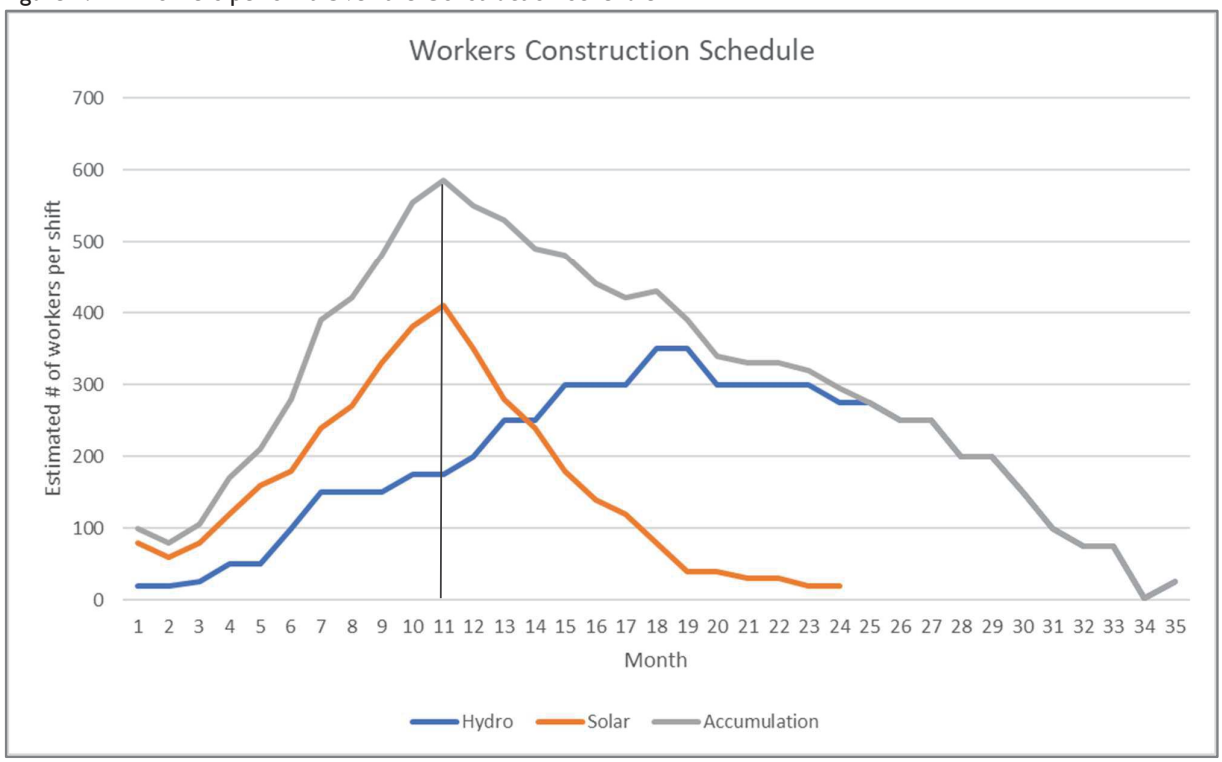
The development proposes two facilities; a pumped hydro facility and a solar facility. Both the construction and operational phases for development have been considered.

2.2 Project Timing

2.2.1 Construction Phase

The construction of both the hydro and solar facilities are expected to start in October 2018, with the hydro facility expected to be constructed over 36 months and the solar facility 18-24 months. The construction schedule of both facilities has been provided by JBS&G showing the estimated number of workers per shift for each month of construction. From the data it was determined that the peak construction month is predicted to be during August 2019 (month 11) as shown in Figure 2.1. During this month the total number of workers per shift is expected to be 585.

Figure 2.1 – Workers per Shift Over the Construction Schedule



2.2.2 Operation Phase

The operation of the solar facility is expected to commence in 2021 and the hydro facility in 2022. During the operation phase both facilities are expected to have a workforce of 5-10 workers each. During this time, it is predicted that 6 service vehicles will travel to the site each week.

3.0 Existing Road Network

3.1 Key Roads

The key roads in the vicinity of the development site are the Augusta Highway, Germein Gorge Road, Baroota Road and Reservoir Road. Details of the form and function of each of these roads is provided in Table 3.1.

Table 3.1 – Description of Key Roads

ROAD	ROAD AUTHORITY	FORM	CLASSIFICATION	SPEED LIMIT
Augusta Highway	DPTI	• Two-lane, two-way • 3.7m wide lanes with 1.3m sealed shoulders • Centreline and edge lines	Class 1(1)	110km/h
Germein Gorge Road	DPTI	• Two-lane, two-way • 5.5m Sealed carriageway with 1-1.5m gravel shoulders • Centreline • Gravel shoulders	Class 3(1)	100km/h
Baroota Road	District Council of Mount Remarkable	• Gravel with 7m wide formation, well graded • Generally straight and flat	Unsealed Access Road	Default rural (100km/h)
Reservoir Road	District Council of Mount Remarkable	• Gravel with 6-7m wide formation, well graded • Winding geometry through sections	Unsealed Access Road	Default rural (100km/h)

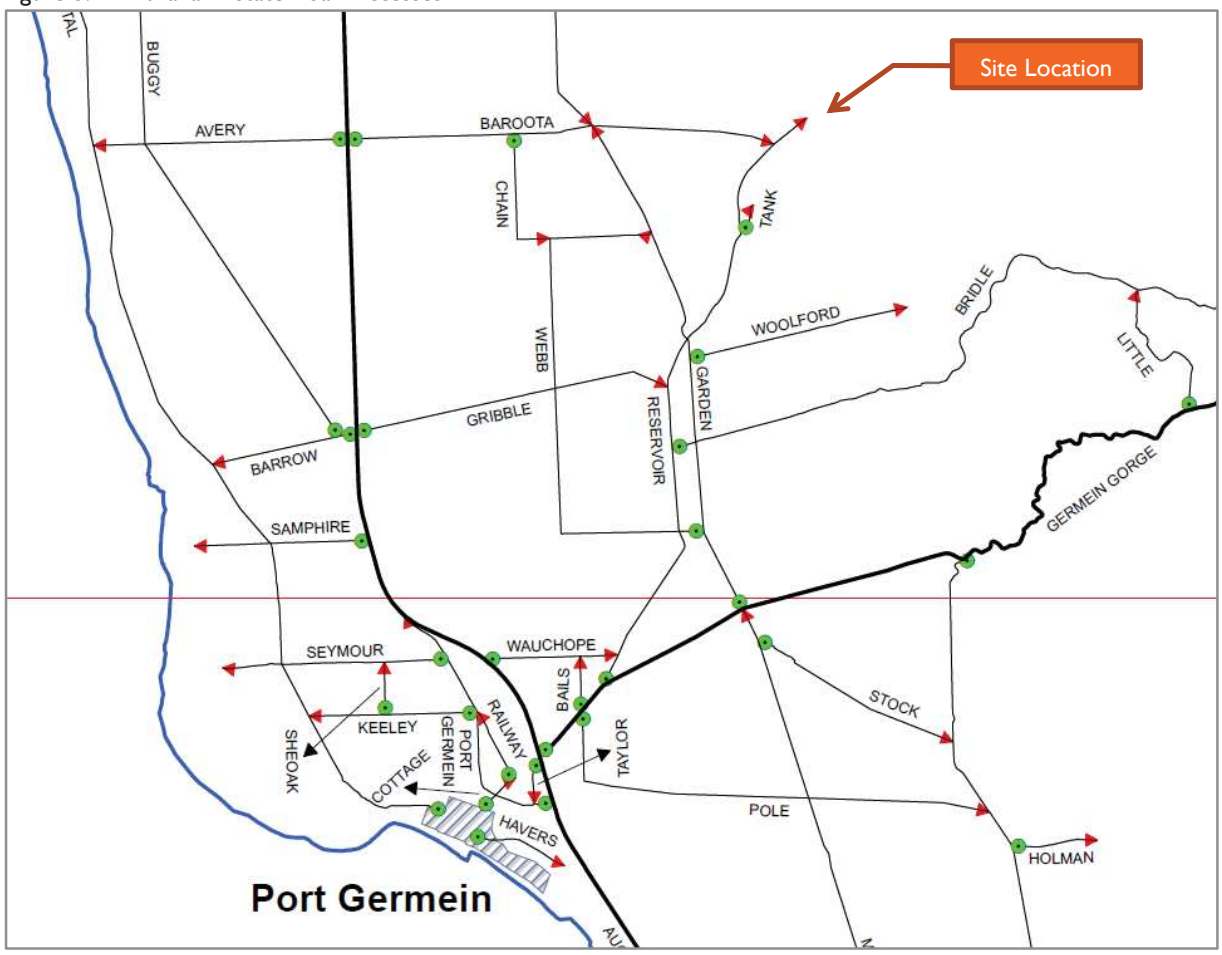
(1) Source: DPTI, AADT Estimates Map, 2015

Both Baroota Road and Reservoir Road are public roads which provide access to the existing Baroota reservoir and development site. From the site inspection, both roads were observed to be well graded and have a wide carriageway suitable for heavy vehicles.

Baroota Road is generally flat and straight which provides a direct access route to the site from Augusta Highway, whilst Reservoir Road is a longer unsealed road with a curvilinear alignment at the northern end. Reservoir Road also has fronting properties and large gum trees within close proximity to the carriageway.

As shown in Figure 3.1, the public road network terminates shortly after the intersection of the two roads which, forms the entrance to the existing Baroota Reservoir and to the development site. The private road network beyond this point is outside the scope of this assessment.

Figure 3.1 – Rural and State Road Accesses



Source: DC Mount Remarkable Rural Road RACK PLAN 876, October 2017

Site photos of the general form of the four key roads are shown in Figure 3.2, Figure 3.3, Figure 3.4 and Figure 3.5.

Figure 3.2 – Augusta Highway (northbound) approaching Baroota Road

Figure 3.3 – Germein Gorge Road (between Reservoir Road and the Augusta Highway)

Figure 3.4 – Baroota Road

Figure 3.5 – Reservoir Road

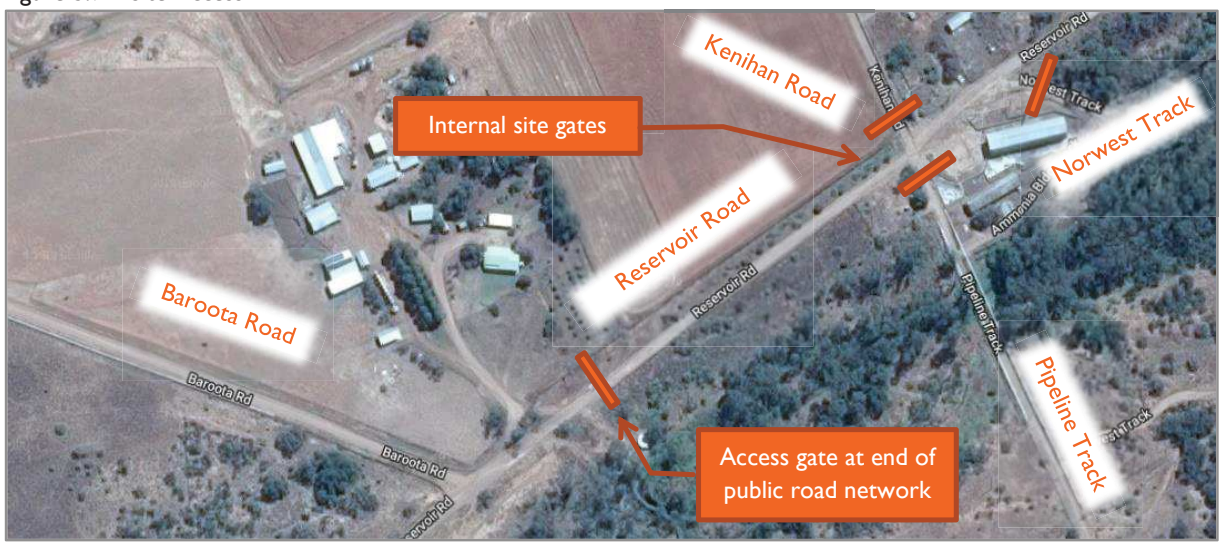
3.1.1 Eastern end of Reservoir Road (Site Access Location)

As discussed earlier and shown in Figure 3.1, the public road network approaching the site terminates approximately 100m east of the Baroota Road/Reservoir Road intersection. It was observed that a gate (open at the time of the site inspection) is installed at this location, as shown on Figure 3.6.

Figure 3.6 – Gate on Reservoir Road (end of public road network)

Approximately 260 metres beyond the gate, Reservoir Road intersects with Kenihan Road and Pipeline Track as shown in Figure 3.7. It was observed that Kenihan Road, Pipeline Track and Norwest Track were gated with "SA Water" signage.

Figure 3.7 – Site Access



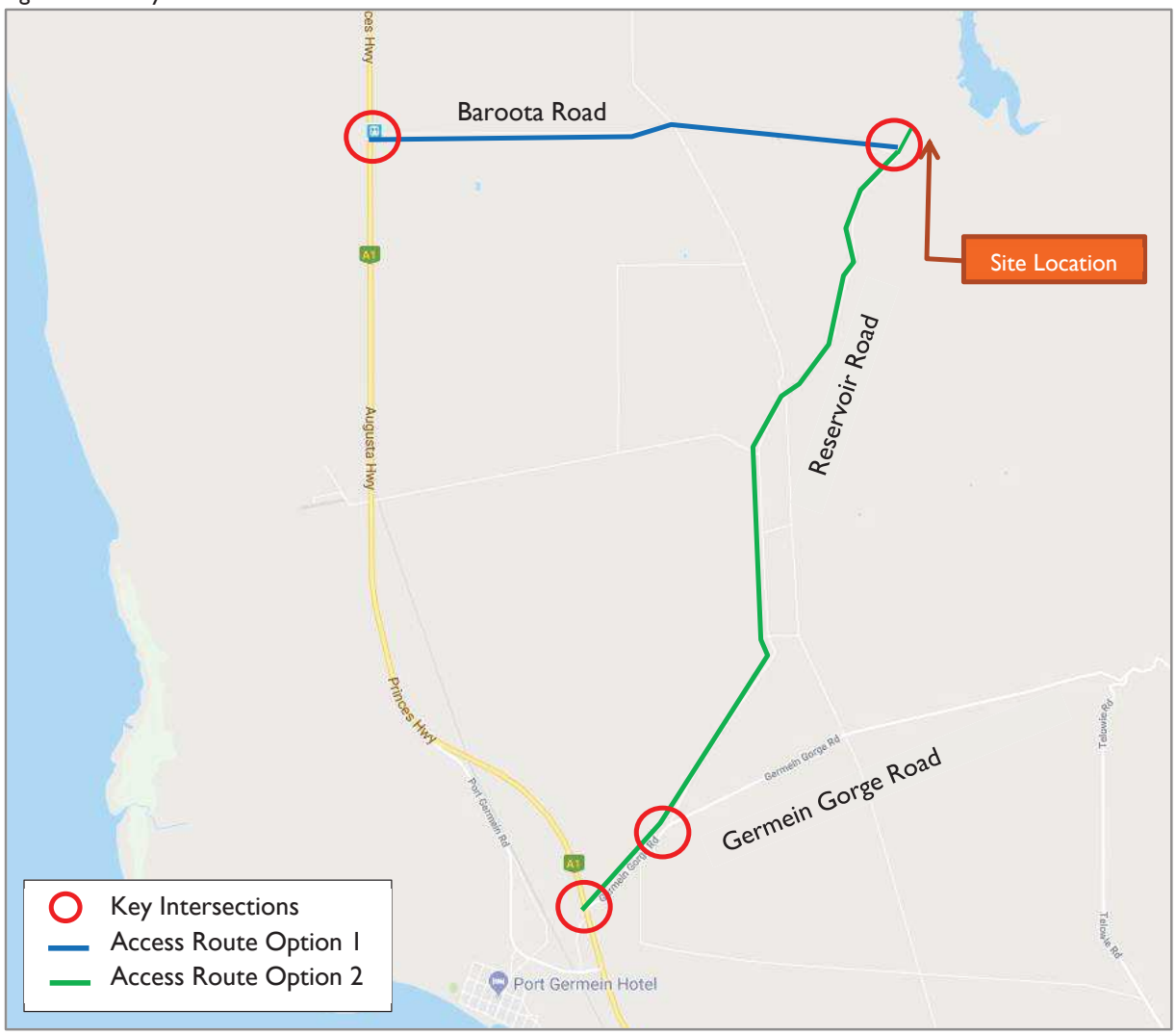
Access to the site, as far as the public is concerned, is therefore at the gated location on Reservoir Road. At this location Reservoir Road has a straight alignment, with sufficient width provided between the gate posts to accommodate heavy vehicle access.

3.2 Key Intersections

There are two potential access routes linking Augusta Highway to the site. The first is via Baroota Road and the second is via Germein Gorge Road and Reservoir Road, as shown in Figure 3.8. The key intersections which may potentially be impacted by to the construction/operation of the facilities are:

- Augusta Highway/Baroota Road
- Baroota Road/Reservoir Road
- Germein Gorge Road/Reservoir Road
- Augusta Highway/Germein Gorge Road

Figure 3.8 – Key Intersections and Potential Access Routes



Base Image Source: Google Maps

3.2.1 Augusta Highway/Baroota Road Intersection

The Augusta Highway/Baroota Road intersection is a four-way, priority (Give Way) controlled junction with the highway forming the major legs. A rail line (operated by Australian Rail Track Corporation [ARTC]) runs parallel to the Augusta Highway on the eastern side of the road reserve, approximately 32 metres from the edge of the highway carriageway. There is an open level crossing with priority (stop) control where the rail line intersects with Baroota Road, as shown in Figure 3.10. Other notable features and observations of the intersection are that there:

- are no turn pockets
- is sufficient sight distance in both directions along Augusta Highway given the speed limit
- appears to be sufficient sight distance in both directions along rail line
- is sufficient access width for heavy vehicle swept paths
- is sufficient width to store heavy vehicles between the highway and level crossing

Figure 3.9 - Augusta Highway and Baroota Road Intersection

Figure 3.10 – Baroota Road Level Crossing (eastbound)

3.2.2 Germein Gorge Road/Reservoir Road Intersection

The Germein Gorge Road/Reservoir Road intersection is a three-way, priority (Give Way) controlled junction with Germein Gorge Road forming the major legs, as shown in Figure 3.11. Reservoir Road intersects with Germein Gorge Road at an acute (<45 degree) angle, which is likely to result in drivers on the Reservoir Road approach having difficulty in observing vehicles approaching from the left on Germein Gorge Road.

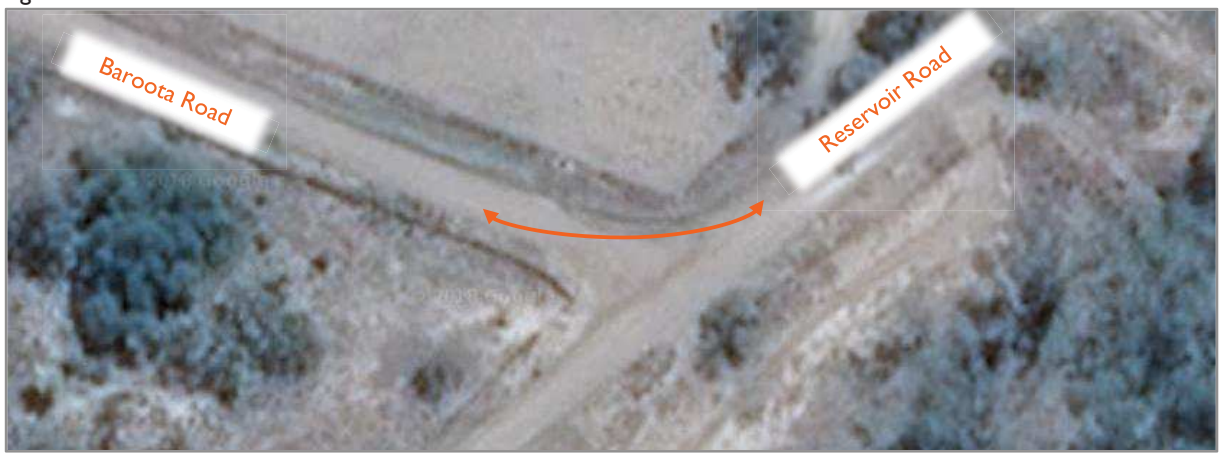
Figure 3.11 – Germein Gorge Road/Reservoir Road Intersection

3.2.3 Baroota Road/Reservoir Road Intersection

The intersection of Baroota Road and Reservoir Road is a three-way, uncontrolled junction. It is unclear which approach and movement has priority. From aerial imagery Reservoir Road appears to form the major legs; however, it was observed during the site inspection that the road formation indicated that the major movements occur between Baroota Road and the eastern section of Reservoir Road, as shown in Figure 3.12.

During site inspection it was observed that Baroota Road has a crest on approach to Reservoir Road, restricting site distance at the intersection between the western and southern legs.

Figure 3.12 – Baroota Road/Reservoir Road Intersection



3.2.4 Augusta Highway/Germein Gorge Road Intersection

The Augusta Highway/Germein Gorge Road intersection is a three-way, priority (Give Way) controlled junction with the highway forming the major legs as shown in Figure 3.13.

Figure 3.13 – Augusta Highway/Germein Gorge Road Intersection

3.3 Existing Vehicle Volumes

The historic Average Annual Daily Traffic (AADT) volumes for the Augusta Highway and Germein Gorge Road are shown in Table 3.2. The traffic volumes for Baroota Road and Reservoir Road are expected to be minimal given the land uses (farms and a small number of rural residential properties) that they provide access to. During the site inspection (middle of a weekday), only one vehicle was observed to use Reservoir Road and none along Baroota Road.

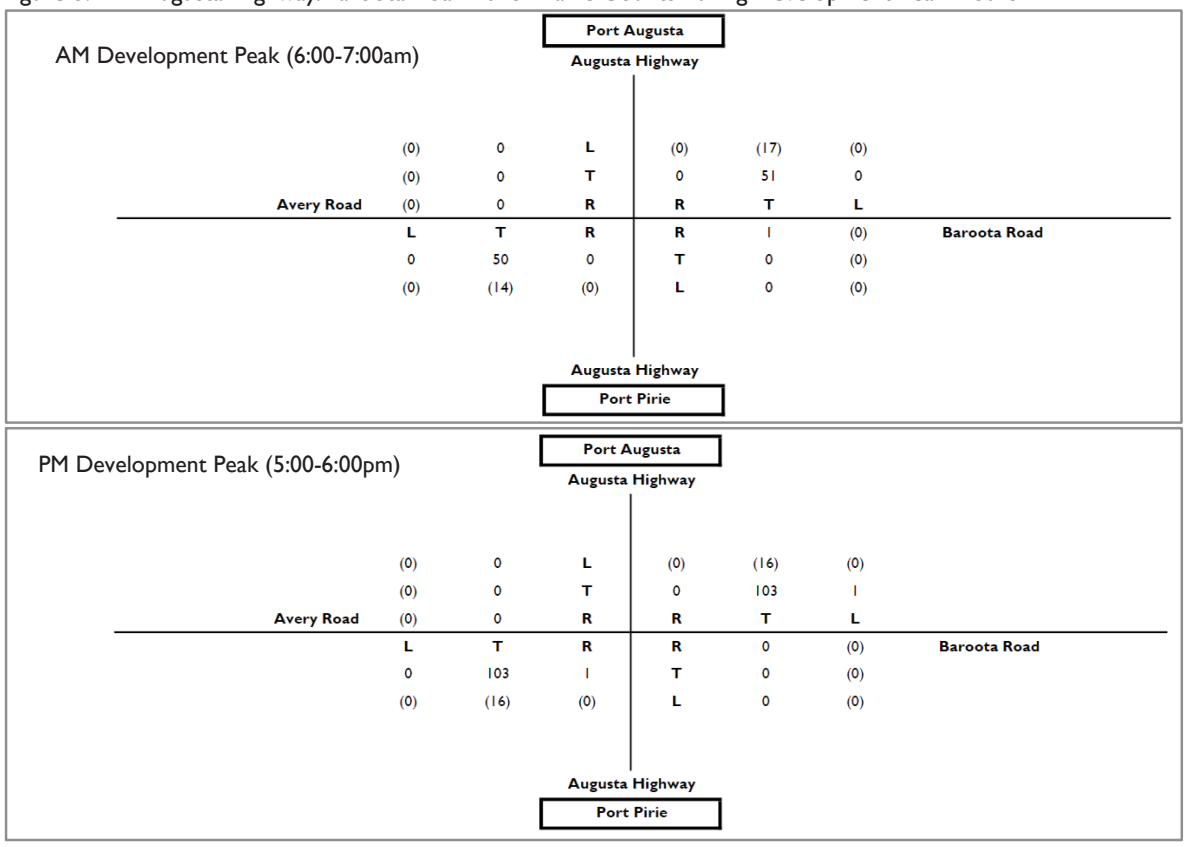
Table 3.2 – Estimated AADT for Key Roads

ROAD	YEAR	AADT	SOURCE
Augusta Highway	2017	3,500	SA Open Data
Germein Gorge Road	2013	190	SA Open Data

At the intersection of Augusta Highway and Baroota Road, twelve (12) hour turning movement counts were undertaken by Austraffic on Monday, 9 April 2018. From the recorded data it is noted that weekday AM and PM traffic peaks occurred at 9:30-10:30am and 11:45-12:45pm respectively.

For the purposes of this assessment, it is assumed that the development will have its highest traffic impacts during the construction stage. The construction peak hour is assumed to be 6:00-7:00 (AM peak for the development) and 5:00-6:00 (PM peak for the development) due to the 12-hour shift schedules. The surveyed traffic volumes at this Augusta Highway/Baroota Road intersection during these periods are shown in Figure 3.14. On this figure, "L", "T" and "R" represent the left, through and right turning movement volumes respectively on each intersection approach.

Figure 3.14 – Augusta Highway/Baroota Road 2018 Traffic Counts during Development Peak Hours



4.0 Inputs and Assumptions

4.1 Inputs Provided by Client

A data request was prepared by Point8 for JBS&G which requested project details and time profiles relating to the construction and operational phase of the project.

Key information received that has been used to estimate development trip generation is outlined in Table 4.1.

Table 4.1 – Received Data

RECEIVED DATA	HYDRO FACILITY	SOLAR FACILITY
CONSTRUCTION PHASE		
Commencement of Construction phase	October 2018	October 2018
Duration of construction phase	36 months	18-24 months
Construction workforce during periods of peak activity	300	400
Heavy vehicle movements for deliveries	Max 300 per day during peak periods of construction	
Regular servicing	Estimated once a fortnight	
Origin of deliveries and times of day	Expected to be mostly from Adelaide with some from Port Pirie and Port Augusta, spread across daylight hours.	
Workers location	Based in local towns, no workers camp proposed.	
Workers travel	Potential for a 12-seater bus to be provided where the majority of workers are based, estimated to be Port Pirie.	
Workers hours	Assumed that all activities will be undertaken over a 12-hour schedule over 7 days per week.	
Anticipated vehicle routes	Augusta Highway	
OPERATION PHASE		
Commencement of operations phase	2022	2021
Operational workforce	5-10	5-10
Operational traffic	14-20 vehicle movements per day	
Service vehicles	6 service vehicles a week	

4.2 Assumptions

As noted herein, there are two options for vehicle access to site from the Augusta Highway; Baroota Road and Reservoir Road. It is recommended that the designated access route for construction and operation traffic be the former rather than the latter considering:

- The directness of the route from the site location to the nearest sealed, higher order road (i.e. the Augusta Highway).
- The substandard geometry of the Germein Gorge Road/Reservoir Road intersection.
- Potential amenity (noise, dust) impacts on rural residential properties fronting the southern section of Reservoir Road
- The curvilinear alignment of the northern section of Reservoir Road coupled with the close proximity of trees with large diameter trunks (versus the generally straight and flat alignment of Baroota Road).

While some development traffic may still end up using the Reservoir Road route, assessing all development traffic turning through the Baroota Road and Augusta Highway will represent a worst case scenario on the road network (in terms of concentrating development traffic) – therefore there is a higher confidence placed on the conclusions found.

Other assumptions determined from the received data used for the calculation of development traffic generation are outlined in Table 4.2.

Table 4.2 – Generation Assumptions

GENERATION ASSUMPTION	VALUE
Proportion of construction workers travelling by bus	10%
Proportion of construction workers travelling by car	90%
Peak hour proportion of daily deliveries	8%
Construction worker light vehicle occupancy	1.2 persons/vehicle
Operations worker light vehicle occupancy	1 person/vehicle

For the purposes of this assessment, a background traffic growth rate of 1.5% per annum (linear) has been applied to the 2018 surveyed volumes to estimate future year traffic volumes on the Augusta Highway.

5.0 Development Impact

5.1 Traffic Generation

The proposed hydro and solar facility construction and operation phase traffic assumptions used to inform this assessment are based on information provided by JBS&G. Full background traffic counts and development trip generation calculations are attached in Appendix A.

5.1.1 Construction Generated Traffic Volumes

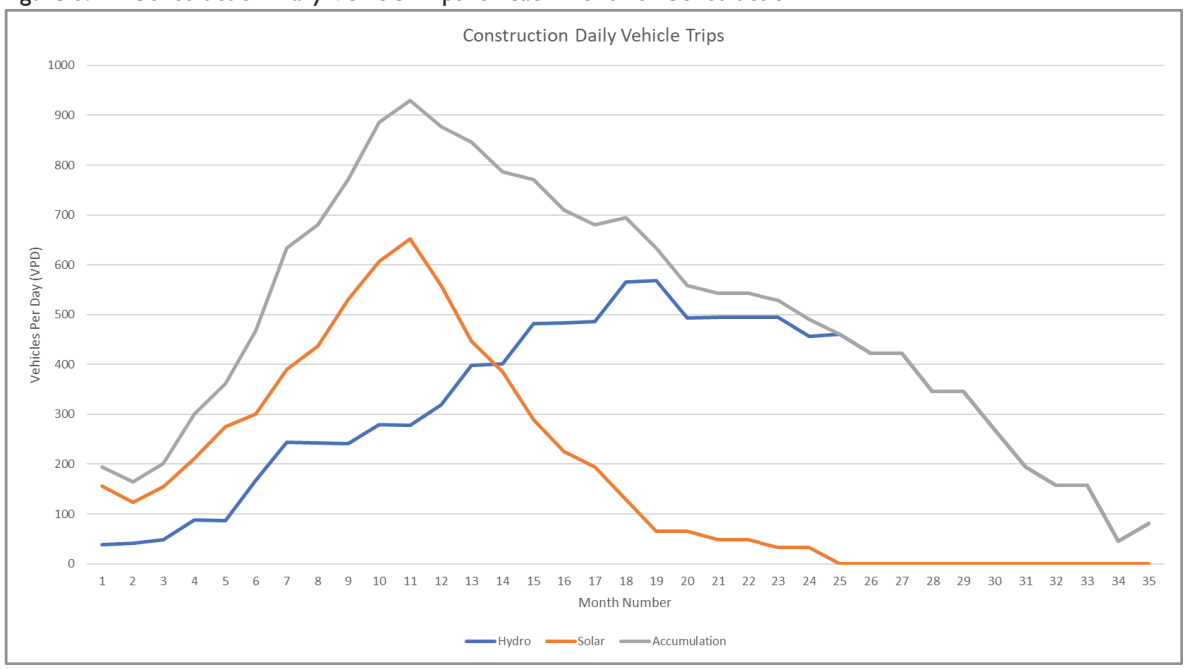
Using the received data, estimates of the traffic generated by the proposed hydro and solar facility in the construction phase have been determined.

Figure 5.1 shows the daily vehicle trips predicted for each month of construction for both the hydro and solar facilities showing month 11 (August 2019) is the peak construction period. A summary of the typical daily and peak hour volumes predicted for August 2019 is provided in Table 5.1.

Table 5.1 – Traffic Generation During Construction

VEHICLE TYPE	DAILY TRIPS (VPD)	PEAK HOUR TRIPS (VPH)			
		AM PEAK		PM PEAK	
		IN	OUT	IN	OUT
Light Vehicles	880	440	0	0	440
Heavy Vehicles	53	4	4	4	4
Total	933	444	4	4	444

Figure 5.1 – Construction Daily Vehicle Trips for each Month of Construction



5.1.2 Operational Generated Traffic Volumes

Using the received data, estimates of the traffic generated by the proposed hydro and solar facility when both are in the operations phase (2022) have been determined, with a summary of the typical daily and peak hour volumes provided in Table 5.2.

Table 5.2 – Traffic Generation During Operations

VEHICLE TYPE	DAILY TRIPS (VPD)	PEAK HOUR TRIPS (VPH)			
		AM PEAK		PM PEAK	
		IN	OUT	IN	OUT
Light Vehicles	40	20	0	0	20
Heavy Vehicles	4	1	1	1	1
Total	44	21	1	1	21

5.2 Traffic Distribution

In general, trips to/from the development are expected to either travel north or south from the development site on the Augusta Highway (accessed via Baroota Road). The origins of the vehicle generation for the construction phase are expected to be mostly from Adelaide (south), Port Pirie (south) and Port Augusta (north). The origins of the vehicle generation for the operations phase are expected to be from local towns.

The predicted dispersal percentage of construction vehicles is outlined in Table 5.3.

Table 5.3 – Constructions Traffic Distribution

DISTRIBUTION	NORTH	SOUTH
Workers (passenger vehicles)	50%	50%
Workers (12-seater bus)	0%	100%
Assorted materials deliveries	25%	75%
General service vehicles	50%	50%

The predicted dispersal percentage of operational vehicles is outlined in Table 5.4.

Table 5.4 – Operational Traffic Distribution

DISTRIBUTION	NORTH	SOUTH
Workers (passenger vehicles)	50%	50%
General service vehicles	50%	50%

As noted earlier, it is assumed that no vehicles will travel via Reservoir Road and Germein Gorge Road to/from the development.

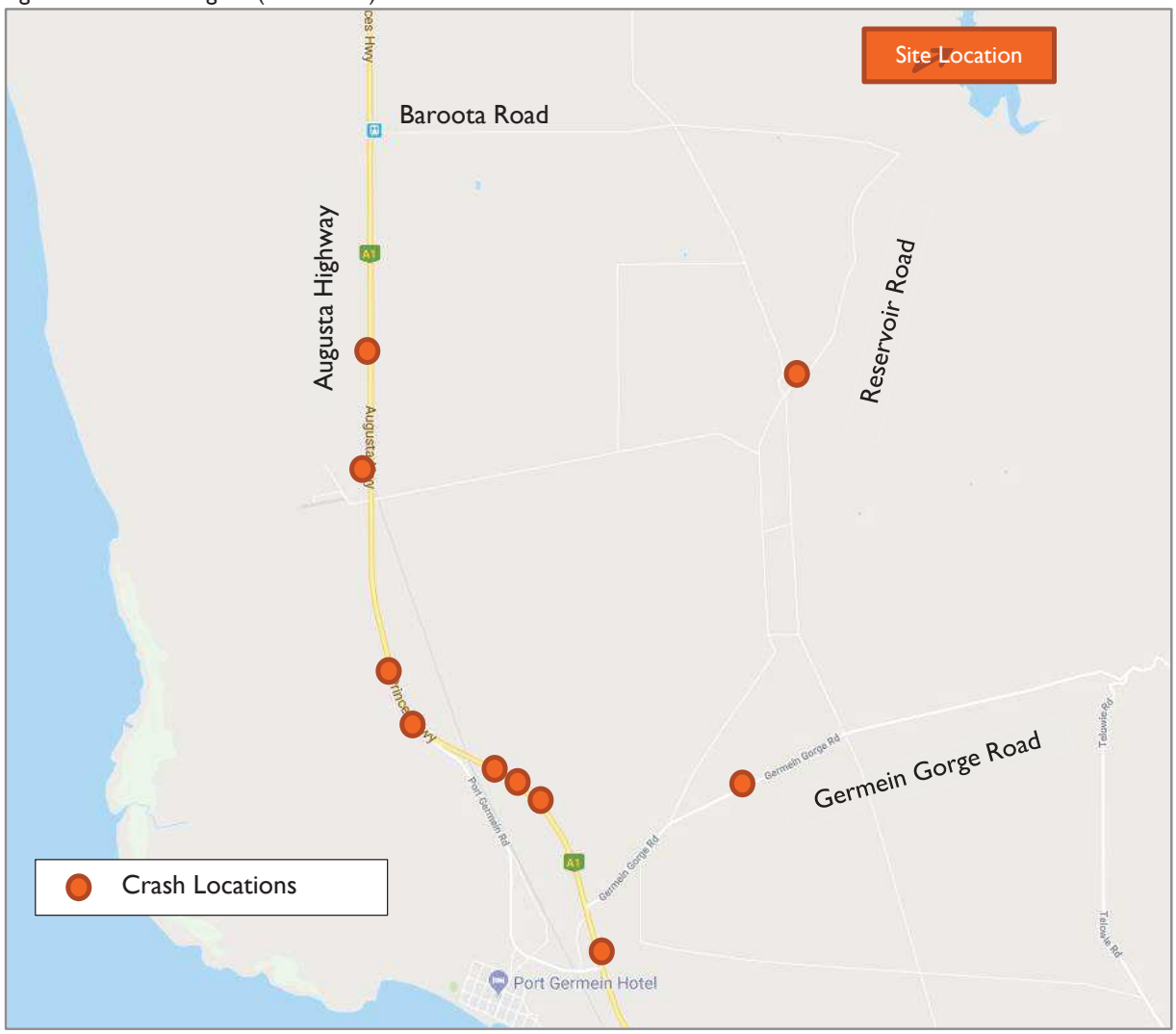
6.0 Safety Considerations

6.1 Crash Analysis

Traffic crashes recorded over a five-year period (2012-2016) were extracted from the Location SA Map Viewer and are presented in Figure 6.1. As shown, there were no crashes recorded at the key intersections, on Baroota Road or in the immediate vicinity of the development site. Only one crash was recorded on Reservoir Road. The figure below presents all crashes within the region for completeness; however, these crashes are not relevant to the development proposal.

The data provides no evidence of apparent road deficiencies that indicate a reoccurring road safety issue on Baroota Road or at key intersections.

Figure 6.1 – Crash Figure (2012-2016)



Data Source: LocationSAMapViewer (Government of South Australia)
Base Image Source: Google Maps

6.2 Specific Locations

6.2.1 Location 1 – Baroota Road/Reservoir Road Intersection

A vertical crest curve is located on Baroota Road on the western approach to the Reservoir Road intersection, as shown in Figure 6.2.

Figure 6.2 – Baroota Road Vertical Crest

During the site inspection, the available sight distance to the west from Reservoir Road was measured to be 160m. In addition, on approach to the intersection, eastbound on Baroota Road, the intersection is not visible until drivers have reached the top of the crest as shown Figure 6.3.

Figure 6.3 – Baroota Road Approach (Top of Crest)

As both roads are unsigned (and the default rural speed limit is 100km/h), vehicles may approach the intersection and crest at high speeds and not see oncoming traffic. Due to the blind spot over the crest, natural driver reaction is to slow on approach; however, there is a risk that drivers will maintain unsuitable speeds through the crest curve.

Due to the number of vehicles expected during peak construction periods this presents a safety concern. It is recommended that a:

- Side Road Intersection on a Curve [W2-9(L)] advisory sign is installed on the western (Baroota Road) approach to the intersection.
- Give Way sign [R1-2] is installed on the southern (Reservoir Road) approach to define intersection priority to Baroota Road.

From the site inspection, it appears that the pipe located on the southern side of Baroota Road passes underground, therefore earthworks to flatten the crest are not considered practicable.

6.2.2 Location 2 – Baroota Road Level Crossing

The form and level of control at level crossing on Baroota Road is considered appropriate given the existing usage of Baroota Road. During the site inspection the following observations were noted:

- Two warning signs are provided on the highway approaches to Baroota Road intersection, as shown in Figure 6.4.
- Queue storage length of approximately 32m is available between the level crossing and the Augusta Highway.
- The Baroota Road carriageway over the level crossing is approximately 10m wide
- Sight distance along the rail line in both directions appears to be unobstructed, though a vertical crest curve in the line is present some distance to the south.
- No trains were observed.

Figure 6.4 – Augusta Highway approach to Baroota Road intersection

Figure 6.5 – Baroota Road Approach to Augusta Highway

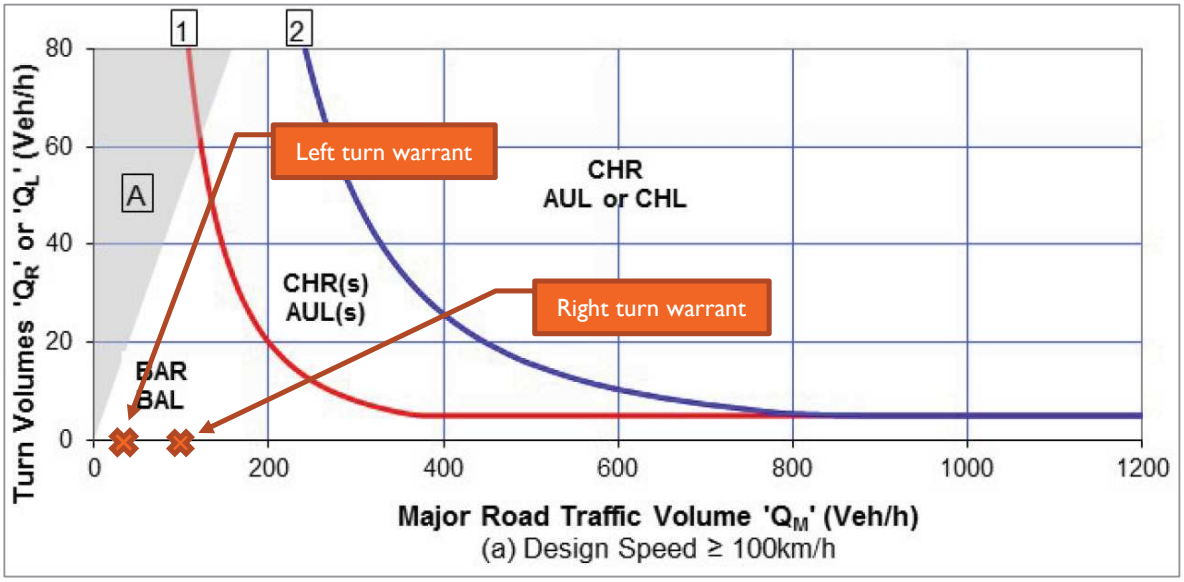
While the existing passive (signage only) crossing arrangements may be suitable for current traffic volumes, with the increase in vehicle volumes the exposure of conflict and associated risk level is increased. The rail operator (ARTC) may need to be engaged to undertake a review of the existing crossing under the peak development (construction stage) traffic volume conditions using the Australian Level Crossing Assessment Model (ALCAM) to ascertain whether active control (e.g. warning light, boom gates) is warranted.

6.2.3 Location 3 – Augusta Highway/Baroota Road Intersection

As the Augusta Highway/Baroota Road intersection is a priority-controlled intersection, as significant factor in its safety performance is the provisions for turning vehicles from the major (through) road. The current intersection form provides Basic Right (BAR) and Basic Left (BAL) treatments for the turns into Baroota Road. Peak hour turn warrant assessments (as outlined within Austroads' *Guide to Traffic Management Part 6*) have been used to assess the safety performance of the intersection and determine whether higher order turn treatments are required.

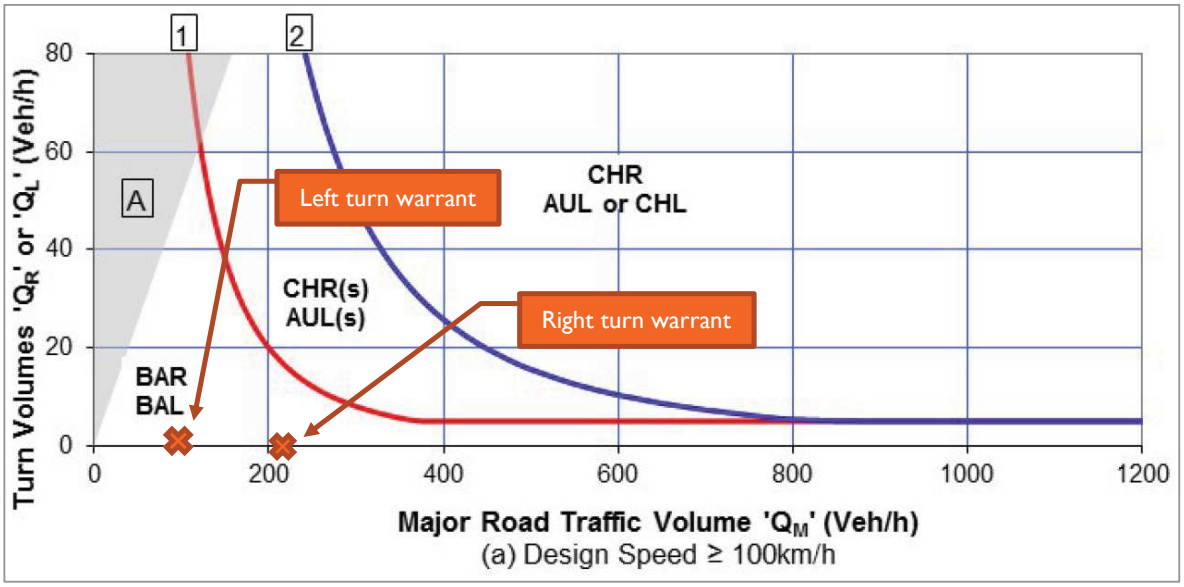
As shown on Figure 6.6 and Figure 6.7, based on the projected future background traffic volumes during the development peak hours, no higher order turning treatments are warranted without the development.

Figure 6.6 – Background Traffic Turn Warrant Assessment (2019 AM Development Peak)



Base Image Source: Austroads Guide to Traffic Management Part 6 (2017)

Figure 6.7 – Background Traffic Turn Warrant Assessment (2019 PM Development Peak)



Base Image Source: Austroads Guide to Traffic Management Part 6 (2017)

The addition of construction and operation traffic will increase the traffic volume accessing Baroota Road. In terms of the turn warrant assessment, the critical peak is the AM peak as this is when the left and right turns into Baroota Road will experience an increase in volumes (turn warrant assessments do not apply to turning movements out of the minor/side road).

Application of the warrants has been undertaken for:

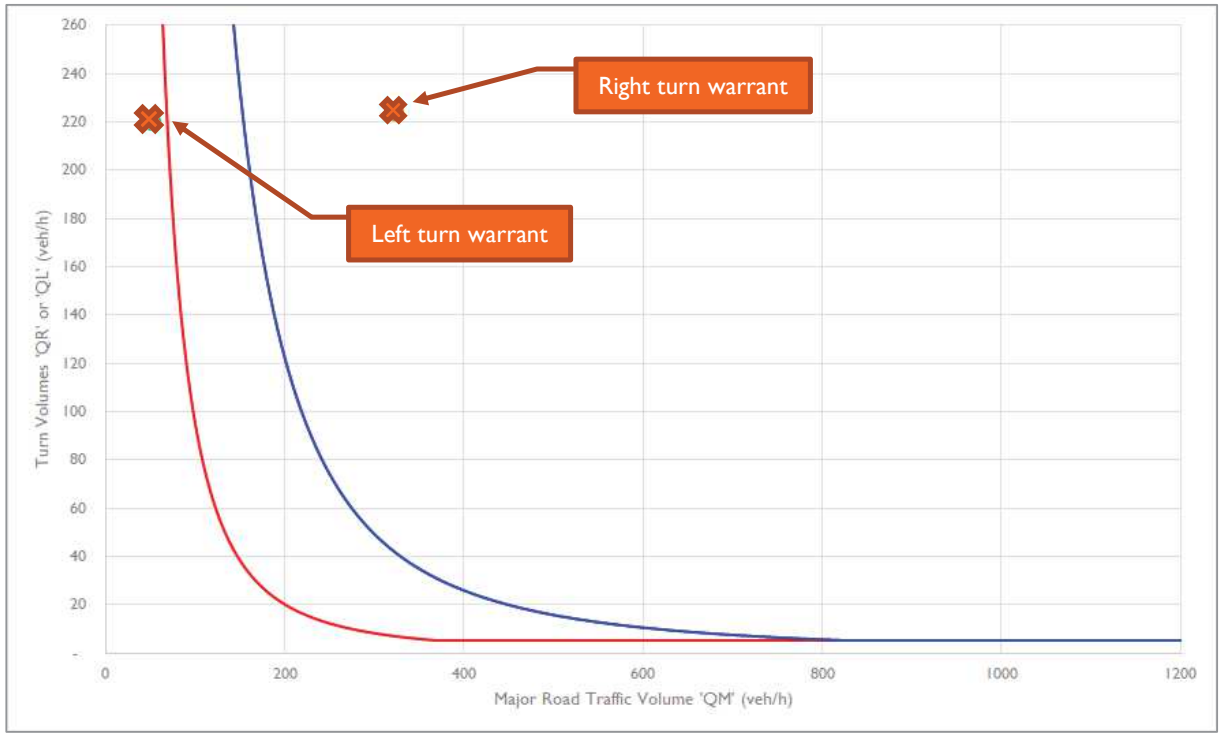
- Peak construction traffic volumes, in the 2019 AM Development Peak
- Operation traffic volumes, in the 2032 AM Development Peak (i.e. 10 years beyond the commencement of operations)

These warrants are presented on Figure 6.8 and Figure 6.9 respectively. As shown, while no higher order turn treatments are warranted under the operation traffic scenario, a Channelised Right (CHR) form (i.e. right turn lane on the southern Augusta Highway approach to the intersection) is warranted under peak construction traffic volumes.

It is noted that the turning warrants published by Austroads are based on a design life of 10 years; however, in this instance construction activities will cease after 3 years and so application of the warrants is conservative. Nonetheless, the development will introduce significant peak hour turning traffic at this location and it is recommended that a construction-phase Traffic Management Plan be developed to determine appropriate mitigation measures. Potential measures include the provision of:

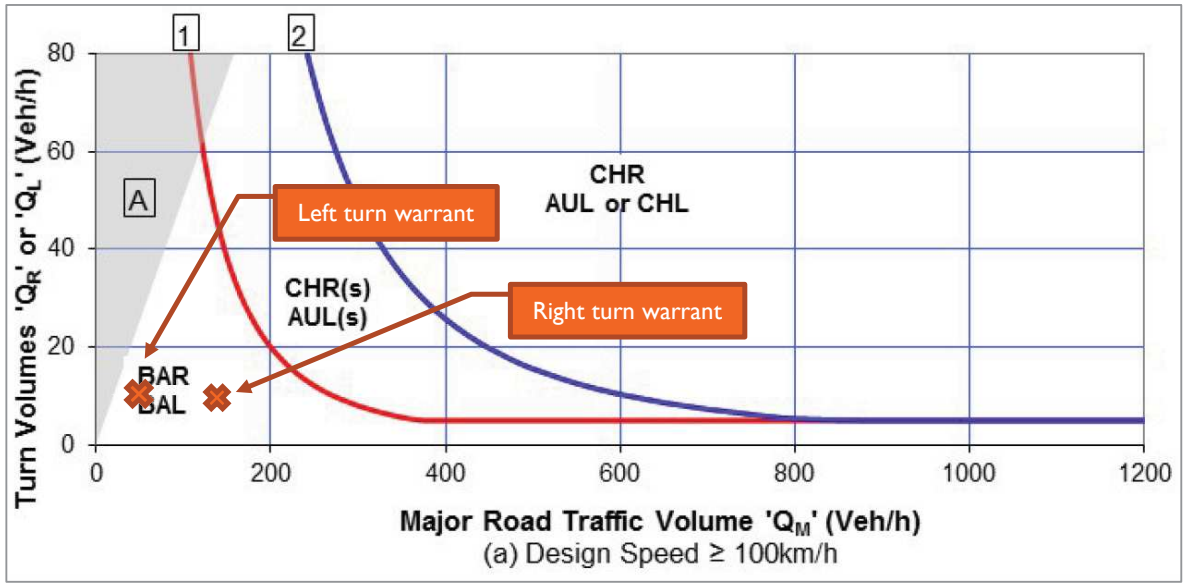
- The aforementioned Channelised Right (CHR) treatment.
- A short-form Channelised Right (CHR[S]) treatment (which provides an intermediate level of safety performance at a reduced cost, in comparison to a full CHR treatment).
- Temporary signage, speed limit reductions and/or active traffic control.
- Additional bus/coach services (to increase the proportion of staff trips made by bus from the 10% assumed in this assessment) for construction personnel based in Port Pirie to reduce the number of private vehicles accessing site and therefore the peak traffic accessing Baroota Road.

Figure 6.8 – Construction Traffic Turn Warrant Assessment (2019 AM Development Peak)



Base Image Source: Expanded Turn Warrant Graph prepared by Point8 using Austroads formulae (design speed >=100km/h)

Figure 6.9 – Operation Traffic Turn Warrant Assessment (2032 AM Development Peak)



Base Image Source: Austroads Guide to Traffic Management Part 6 (2017)

7.0 Assessment of Road Network

7.1 Intersection Performance

Given the very low volume of traffic currently using both side roads and the reasonably low AADT of the major road (<4,000vpd), the peak hour operation of the Augusta Highway/Baroota intersection can be reasonably expected to operate within practical capacity limits for an unsignalised intersection, with or without the development. Delays anticipated at the intersection are expected to be limited to development traffic only (turning onto the Augusta Highway). Therefore, a detailed operational capacity assessment has not been used to assess intersection operation.

7.2 Link Performance on Augusta Highway

A summary of two-way daily volumes on the Augusta Highway with and without development traffic is provided in Table 7.1.

Table 7.1 – Estimated Daily Traffic Volumes on the August Highway north and south of Baroota Road

PHASE	YEAR	BACKGROUND CONDITIONS (VPD)(1)	WITH DEVELOPMENT CONDITIONS (VPD)		PERCENTAGE INCREASE(2)	
		NORTH AND SOUTH OF BAROOTA ROAD	NORTH OF BAROOTA ROAD	SOUTH OF BAROOTA ROAD	NORTH OF BAROOTA ROAD	SOUTH OF BAROOTA ROAD
Construction	2019	3,553	4,003	4,035	13%	14%
Operations	2022	3,710	3,731	3,731	1%	1%
Operations	2032	4,235	4,256	4,256	0%	0%

(1) Applying 1.5% linear growth rate to existing AADT of 3,500
(2) Proportions are for the two-way AADT on either side of the intersection, not individual turning movements

The daily volumes under all scenarios are well below the capacity of a two-lane highway, which is commonly accepted to be in the order of 15,000 vehicles per day. As such, the proposed development is not expected to have any significant impact on link performance along the Augusta Highway.

7.3 Baroota Road Condition

Baroota Road is currently unsealed and carries minimal traffic volumes (the 12-hour turning movement count at the August Highway intersection recorded 21 vehicles on Baroota Road). During the peak of construction, under the inputs and assumptions used for this assessment the AADT on Baroota Road will temporarily increase to approximately 900-1,000 vehicles per day.

While the reasons for sealing a road are varied, the Australian Road Research Board's *Unsealed Roads Manual: Guidelines to Good Practice* notes that sealing of roads is typically warranted (without requiring economic benefit assessment) for an AADT greater than 250.

The temporary nature of the increased traffic volumes on Baroota Road may mean that sealing of the road is not in the best interests of the asset owner (Council), who would bear increased future cost of maintaining a sealed road. Nonetheless, the temporary increase in traffic is likely to require increased maintenance/intervention of the unsealed surface and the responsibility for this should be negotiated with Council.

8.0 Conclusion

This report documents a Traffic Assessment of a proposed solar farm and pumped hydro project in Baroota, South Australia. The key findings of this assessment are:

- The development is estimated to generate up to 448 and 22 peak hour vehicle trips in the construction and operation stages respectively. Workforce movements represent the majority of these vehicle trips.
- Access to the site will occur via the eastern end of Reservoir Road (where it transitions from a public road to a private road). The access arrangement appears to be appropriate.
- Two routes (via local unsealed roads) are available between the site access and the State-controlled road network, being Baroota Road and Reservoir Road. The Baroota Road route is considered to be preferential, particularly during the construction phase, due to:
  - The directness of the route from the site location to the nearest sealed, higher order road (i.e. the Augusta Highway).
  - The substandard geometry of the Germein Gorge Road/Reservoir Road intersection.
  - Potential amenity (noise, dust) impacts on rural residential properties fronting the southern section of Reservoir Road.
  - The curvilinear alignment of the northern section of Reservoir Road coupled with the close proximity of trees with large diameter trunks (versus the generally straight and flat alignment of Baroota Road).
- There is an existing sight distance deficiency at the Baroota Road/Reservoir Road intersection. It is recommended that minor signage installation works be undertaken to mitigate this deficiency.
- The development will temporarily result in a significant increase in vehicular traffic using an existing rail level crossing on Baroota Road. ARTC may need to be engaged to conduct an ALCAM review to determine if/what measures are required to address this situation.
- The development is not anticipated to impact on the general performance/function of the Augusta Highway (in terms of link capacity) during construction or operations.
- During the construction phase, the development will substantially increase turning movement volumes to/from Baroota Road at the Augusta Highway intersection. While provision of a Channelised Right turn treatment on the southern highway may mitigate the associated safety risks, the turning warrants are based on a 10-year design life. Given the temporary nature of the impacts it is recommended that a construction-phase Traffic Management Plan be developed to determine appropriate mitigation measures. Potential measures include the provision of:
  - The aforementioned Channelised Right (CHR) treatment.
  - A short-form Channelised Right (CHR[S]) treatment (which provides an intermediate level of safety performance at a reduced cost, in comparison to a full CHR treatment).
  - Temporary signage, speed limit reductions and/or active traffic control.
  - Additional bus/coach services (to increase the proportion of staff trips made by bus from the 10% assumed in this assessment) for construction personnel based in Port Pirie to reduce the number of private vehicles accessing site and therefore the peak traffic accessing Baroota Road.
- The temporary increase in traffic volumes utilising Baroota Road (during the construction phase) may necessitate more frequent maintenance of the existing gravel surface and the responsibility for this should be negotiated with the District Council of Mount Remarkable.

Appendix A

Client Inputs

Baroota Pumped Storage Project

Construction Equipment List

Eqpt Description	Quantity
10,000 PSI Water Blaster	2
100 Ton RT Crane	1
110 Ton Crawler Crane From Maxim	1
150 Ton Crawler Crane	1
275 Ton Manitowoc 999	1
35tn Pecco Sk355 Tower Crane	1
60TN Crane	1
Metso ST358 Tracked Screen Deck W/Conveyors	1
Cat D10 Dozer w/ Ripper	2
Cat D5 Dozer	1
Cat D6 LGP Dozer	1
CAT D8 Dozer w/ Ripper	1
Cat D9 Dozer w/ Ripper	2
Cat 312BL Excavator	1
Cat 315 Excavator W/Comp Wheel	1
Cat 345/349 Excavator	1
Cat 385/390 Excavator	1
Cat 430 4x4 Extendahoe	1
Komatsu PC1250 Excavator	1
Komatsu PC2000 Excavator	1
Cat 14 Grader	1
Cat 16 Grader	2
100 CFM Compressor W/O Fuel	1
150 Kva Genset With Fuel + Maint.	1
185KW Genset Double Shift W/O Fuel	2
20' Conex Box	15
25-40KW Genset Single Shift W/O Fuel	1
450 KW Genset Triple Shift W/O Fuel	2
600 CFM Compressor	1
750 KW Genset Single Sift W/O Fuel	1
Baker Tank	1
Bus	2
Crew Trailer	2
JLG 80 Ft Man Lift	2
JILG 120 Ft Manlift	1
Light Plant	50
Pump - 4" Trash	2
Rented Forklift - With Fuel	2
Wacker Compactor	3
Water Tower - 10 MG	1
All Terrain Forklift - 10,000lb	1
Cat 262 Skidsteer Loader	2
Cat 966 Loader w/ Forks	2
Boom Tower Placer	1
Concrete Trailer Pump	1
JV Pickup Rate	1
Cat 825 Roller	1
Cat CS56 Compactor	1
Cat CS583 Compactor	1
Baum Mulcher For Excavator Mx 748	1
Ironwolf Mulcher	1
Rock Drill 2.5"-4" (ECM-370)	2
Stress Jack For Rock Bolts 400 TN	1
John Deere 7710 4x4 Tractor	1
Bucket Truck - 93' 6x6	2
Boom Truck-15 Ton	1
Cat 740 Articulated Truck	3
Cat 740 Water Truck	3
Cat 777 100T Hauler	7
Large Lube Truck	1
Owner Operated Belly Dump	3
Pickup - 1 Ton Flatbed	10
Pickup - Engineer No Fuel	15
Pickup - Foreman No Fuel	20
Pickup - PM Or Supt No Fuel	5
Semi Tractor And High Deck Trailer	1
Vacuum Truck With Fuel	1
2 Boom Jumbo (No Elec) (EO Rate)	1
3.5 CY LHD {EO Rate}	1
6 CY LHD Used (EO Rate)	1
Large Heading Shotcrete Robot W/Pump	1

	Month																																	
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
Construction of:																																				
Road Grader	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Batch plant	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5															
Rock processing	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5															
Mechanics	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Civil earthworks associated with the upper reservoir, including excavation, placement of the liner, construction of embankments, construction of the upper reservoir intake structure.							20	20	20	20	20	20	20																							
Construction of the conveyance pipe system														20	20	20	20	20	20	20	20															
Construction of the turbine-pump house														50	50	50	50	50	50	50	50															
Construction of the lower reservoir intake structure														15	15	15	15	15	15	15	15															
Construction of the substation.														10	10	10	10	10	10	10	10															
Installation of underground cabling (trenching) and other equipment (inverters?), connection of communications equipment.																						10	10	10	10											
Construction of other permanent operational facilities (e.g. site office, ablutions block, parking, access tracks)																						10	10	10	10											
Commissioning																										30	30	30	30	30						
Removal of temporary construction facilities and rehabilitation of disturbed areas.																															20	15	10	5	5	
Estimated number of workers	20	20	25	50	50	100	150	150	150	175	175	200	250	250	300	300	300	350	350	300	300	300	300	275	275	250	250	200	200	150	100	75	75	2	25	

BAROOTA HYDRO PROJECT

Construction and commissioning phase expected to last approximately 36 months

Construction workforce up to 300 personnel during periods of peak activity

Operational workforce 5-10

Timing for commencement of construction October 2018, expected to last 36 months

Time for commencement of operations 2022

CONSTRUCTION PHASE

1. **Construction activities**

- Establishment of the temporary construction compound.
- Site establishment and preparation for construction (vegetation removal, preliminary civil works and drainage).
- Fencing.
- Civil earthworks associated with the upper reservoir, including excavation, placement of the liner, construction of embankments, construction of the upper reservoir intake structure.
- Construction of the conveyance pipe system
- Construction of the turbine-pump house
- Construction of the lower reservoir intake structure
- Construction of the substation.
- Installation of underground cabling (trenching) and other equipment (inverters?), connection of communications equipment.
- Construction of other permanent operational facilities (e.g. site office, ablutions block, parking, access tracks)
- Removal of temporary construction facilities and rehabilitation of disturbed areas.

2. **Regular servicing**

Wastewater captured in septic tanks and removed from site by licensed waste contractor

Estimate once a fortnight during construction

Estimate once a month during operation

3. **Origin of deliveries**

Expected to be mostly from Adelaide with some from Pt Pirie & Pt Augusta

4. **Times of day for deliveries**

Spread across daylight hours

5. **Anticipated vehicle routes**

Expected to be mostly from Pt Pirie, Adelaide, Pt Augusta

6. **Workers**

- # of worker per shift – see excel spreadsheet
- Based in local towns, no workers camp anticipated

- If possible 12-seater bus will be provided where the majority of workers are based, estimate Pt Pirie
- Assumed that all activities will be undertaken over a 12-hour schedule over 7 days per week.

7. Machinery & Equipment

Equipment used during construction would include earth-moving equipment for civil works, diesel generators, trucks and cranes.

Pile driving for foundations would be undertaken using a machine which screws or hammers poles into the ground.

The equipment likely be used during construction includes:

- dozer, excavator, grader, backhoe, roller, scraper, vibrating plate
- mulcher
- loader
- dump trucks, water truck
- pile driver
- forklift, telehandler
- crane
- generator.

Bulk materials that are expected to be transported to the site for construction include road base, concrete, sand and cement.

OPERATIONAL PHASE

<u>Deliveries/Servicing</u>

No regular deliveries anticipated

Refuse collection as scheduled by Mt Remarkable council

Origin of vehicles– expected to be mainly from Pt Pirie & Pt Augusta

<u>Workers</u>

5-10 operational workforce

Based in local towns

Self-drive during operational phase

Assumed that all activities will be undertaken over a 12-hour schedule over 7 days per week

BAROOTA SOLAR PROJECT

Construction and commissioning phase expected to last approximately 18-24 months

Construction workforce 400 personnel during periods of peak activity

Operational workforce up to 10

Timing for commencement of construction October 2018, expected to last 18-24 months

Time for commencement of operations 2021

Total of approx. 941,500 PV modules, 30,000 mounting posts

CONSTRUCTION PHASE

1. **Construction activities**

- Removing existing fences
- Removing any internal trees (as identified on plans)
- Establishing secured site office and storage areas, loading and delivery zones and the like;
- Erection of temporary construction signage and directional signage for delivery access along Kenihan Road and Cattle Track (whichever minimizes disruptions to local traffic)
- Direct piling for installation of mounting poles
- Excavation and open trenching for cable installation
- Slab on ground for substation installation
- Grading and material placement for internal road creation
- Connection of substation to existing transmission line
- Planting of perimeter landscaping (including possible ripping to establish planting strip)

2. **Regular servicing**

Wastewater captured in septic tanks and removed from site by licensed waste contractor

Estimate once a fortnight during construction

Estimate once a month during operation

3. **Origin of deliveries**

Expected to be mostly from Adelaide with some from Pt Pirie & Pt Augusta

4. **Times of day for deliveries**

Spread across daylight hours

5. **Anticipated vehicle routes**

Expected to be mostly from Pt Pirie, Adelaide, Pt Augusta

6. **Workers**

- # of worker per shift – see excel spreadsheet
- Based in local towns, no workers camp anticipated
- If possible 12-seater bus will be provided where the majority of workers are based, estimate Pt Pirie
- Assumed that all activities will be undertaken over a 12-hour schedule over 7 days per week.

7. Machinery & Equipment

Light vehicles

B-Double

Semi-Trailer

12 seater bus

Light vehicle

a) The highest dead load that the roads would need to carry is the power transformer. It is estimated that the total weight of this transformer would be approximately 110 – 130 T. It is estimated that the width of the transformer would be within the allowed 5.5 m transportable width on Australian Highways. (Quantity 2)

b) The total size of the Switchgear and Control Building is 37.8 m L x 5.4 m W x 3.5 m H. It is expected that this building would be transported in 3 sections to be joined at site. The largest length would be approximately 10 m. (Quantity 1)

c) All roads/bridge would need to designed/strengthened to take these loads. In addition, the roads would need to be less than 12 deg grade, with bending radii suitable for 10 m (plus vehicle front).

d) PV Panel Mechanical Data

MECHNICAL DATA

Specification	Data
Cell Type	Poly-crystalline, 156.75 X 78.38 mm
Cell Arrangement	144 [2 X (12 X 6)]
Dimensions	2000 X 992 X 35 mm (78.7 X 39.1 X 1.38 in)
Weight	22.5 kg (49.6 lbs)
Front Cover	3.2 mm tempered glass
Frame	Anodized aluminium alloy, crossbar enhanced
J-Box	IP68, 3 diodes
Cable	4 mm^2 (IEC), 12 AWG (UL)
Cable Length	1250 mm (49.2 in), 1670 mm (65.7 in) is optional for single tracking system with leap-frog connection
Connector	T4 series or MC4 series
Per Pallet	30 pieces
Per Container (40' HQ)	660 pieces

Estimated to have a total of 941500 panels = approx. 1427 x 40’ containers

e) Inverter Mechanical Data

Dimensions and weight	
Width/Height/Depth, mm	12190 mm/2900 mm/2440 mm (40' HC container dimensions)
Weight approx.	< 30 t

Estimated to have a total of 64 inverters

Preliminary construction planning indicates a peak of about 300 heavy vehicle movements (i.e. to and from site is two movements) would be required per week throughout the construction period.

This estimate is based on materials being delivered vehicle up to semitrailer in size and could be lower is vehicles such as B-doubles are able to be used.

A maximum of 250 light vehicle movements per day would be required during peak periods of construction.

Other oversized vehicles such as a heavy lift crane may also need to access the site to place the photovoltaic boxes or skids on site.

During operation, the impacts of operational traffic is likely to be negligible. Projected staff and service vehicles expected to include:

a) 5-10 daily staff vehicles
b) 5 weekly general service vehicles
c) 1 weekly waste truck (where applicable)

Total = 14-20 vehicle movements per day

OPERATIONAL PHASE

<u>Deliveries/Servicing</u>

No regular deliveries anticipated

Refuse collection as scheduled by Mt Remarkable council

Origin of vehicles– expected to be mainly from Pt Pirie & Pt Augusta

<u>Workers</u>

5-10 operational workforce

Based in local towns

Self-drive during operational phase

Assumed that all activities will be undertaken over a 12-hour schedule over 7 days per week

Security - The facility will be manned 24 hours per day, 7 days per week

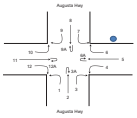
	Month																							
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Establishing secured site office and storage areas, loading and delivery zones	20																							
Erection of temporary construction signage and directional signage for delivery access along Kenihan Road and Cattle Track (whichever minimizes disruptions to local traffic)	20																							
Removing existing fences	20	30	40	40	40	40	40	40	40	40	40	20												
Site clearing	20	30	40	40	40	40	40	40	40	40	40	20												
solar farm construction (piling, trackers, inverters PV modules installation)				40	60	80	120	150	150	150	150	120	100	100	80	60	40							
Excavation and open trenching for cable installation					20	20	40	40	80	80	80	80	80	60	40	20								
Electrical cabling & conduit installation											20	30	20	20	20	20	20	20						
Other Civil Works (e.g. roads, O&M building)										30	60	60	60	60	40	40	40	40	20	20				
Slab on ground for substation installation									20	20														
Substation construction										20	20	20	20											
Commissioning Activities																	20	20	20	20	10	10		
Removal of temporary construction facilities and rehabilitation of disturbed areas.																					20	20	20	20
Total Onsite	80	60	80	120	160	180	240	270	330	380	410	350	280	240	180	140	120	80	40	40	30	30	20	20

Appendix B

Intersection Turning Movement Survey Summary

austraffic

Client : Pointit
Job : Augusta Hwy & Bairnsta Road & Avery Rd
Day/Date : Monday, 9 April 2018
Survey Location : Augusta Hwy & Bairnsta Rd & Avery Rd
Weather : Fine



Time Period	Movement 1			Movement 2			Movement 3			Movement 3A			Movement 4			Movement 5			Movement 6			Movement 6A			Movement 7			Movement 8			Movement 8A			Movement 9			Movement 10			Movement 11			Movement 12			Movement 12A			Total all all Movements	Peak Hour Volume Determination	
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total			
6:00 - 6:15	0	0	0	8	4	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	6:00 - 7:00	116
6:15 - 6:30	0	0	0	12	3	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	6:15 - 7:15	142
6:30 - 6:45	0	0	0	13	1	14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	3	0	3	15	5	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	6:30 - 7:30	161
6:45 - 7:00	0	0	0	17	6	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	16	9	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	6:45 - 7:45	187
7:00 - 7:15	0	0	0	27	7	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	9	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	7:00 - 8:00	209
7:15 - 7:30	0	0	0	23	1	24	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	5	0	5	16	2	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	7:15 - 8:15	214
7:30 - 7:45	0	0	0	23	3	26	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	3	0	3	22	5	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	7:30 - 8:30	239
7:45 - 8:00	0	0	0	28	6	34	1	0	1	0	0	0	1	1	2	0	0	0	2	0	2	0	0	0	5	0	5	20	3	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	7:45 - 8:45	262
8:00 - 8:15	0	0	0	29	5	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	16	3	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	8:00 - 9:00	260
8:15 - 8:30	0	0	0	28	3	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	23	4	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	8:15 - 9:15	283
8:30 - 8:45	0	0	0	29	6	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	19	4	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	8:30 - 9:30	276
8:45 - 9:00	0	0	0	30	5	35	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	20	3	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	8:45 - 9:45	283
9:00 - 9:15	0	0	0	38	10	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	28	1	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	9:00 - 10:00	316
9:15 - 9:30	0	0	0	40	11	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	26	2	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	9:15 - 10:15	320
9:30 - 9:45	0	0	0	39	9	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	4	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	9:30 - 10:30	329
9:45 - 10:00	0	0	0	40	7	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	7	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	9:45 - 10:45	319
10:00 - 10:15	0	0	0	39	9	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	5	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	10:00 - 11:00	319
10:15 - 10:30	0	0	0	43	7	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	6	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89	10:15 - 11:15	321
10:30 - 10:45	1	0	1	40	8	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	3	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	10:30 - 11:30	321
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11:00 - 11:15	0	0	0	51	3	54	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	23	5	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83	11:00 - 12:00	326
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13:00 - 13:15	0	0	0	52	6	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	4	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	13:00 - 14:00	362
13:15 - 13:30	0	0	0	52	7	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	7	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87	13:15 - 14:15	361
13:30 - 13:45	0	0	0	34	6	40	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	5	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	13:30 - 14:30	357
13:45 - 14:00	0	0	0	41	3	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	4	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	13:45 - 14:45	362
14:00 - 14:15	0	0	0	34	7	41	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	4	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	14:00 - 15:00	362
14:15 - 14:30	0	0	0	39	3	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	6	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	14:15 - 15:15	381
14:30 - 14:45	0	0	0	44	10	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	6	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	14:30 - 15:30	382
14:45 - 15:00	0	0	0	33	5	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	12	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	14:45 - 15:45	384
15:00 - 15:15	0	0	0	43	6	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	5	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	15:00 - 16:00	379
15:15 - 15:30	0	0	0	36	7	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	5	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	15:15 - 16:15	371
15:30 - 15:45	0	0	0	41	2	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	7	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	15:30 - 16:30	369
15:45 - 16:00	0	0	0	39	1	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	7	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	15:45 - 16:45	369
16:00 - 16:15	0	0	0	23	5	28	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	3	32	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	63	16:00 - 17:00	368
16:15 - 16:30	0	0	0	27	4	31	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	29	1	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62	16:15 - 17:15	351
16:30 - 16:45	0	0	0	37	6	43	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	28	6	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	16:30 - 17:30	354
16:45 - 17:00	0	0	0	29	3	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	6	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	16:45 - 17:45	339
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17:15 - 17:30	0	0	0	20	3	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	5	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	AM Peak	323
17:30 - 17:45	0	0	0	18	4	22	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	6	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	PM Peak	389
17:45 - 18:00	0	0	0	24	5	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	11	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42		
Total	1	0	1	1591	416	1966	4	1	4	2	0	2	5	2	7	4	0	4	4	0	4	0	0	0	3	1	4	1049	222	1321	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	2211		
AM Peak	0	0	0	164	22	186	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	22	137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	325		
PM Peak	0	0	0	174	37	211	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	19	158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	389		

Appendix C

Traffic Volume Calculations and Summaries

Input Assumptions

INPUT	VALUE	SOURCE
Proportion of construction workers travelling by bus	10%	Assumption
Proportion of construction workers travelling by car	90%	Assumption
Daily construction workforce (solar)	410	Client input
Daily construction workforce (hydro)	175	Client input
Peak hour proportion of daily deliveries:	8%	Assumption
Construction worker light vehicle occupancy	1.2 persons/veh	Assumption
Daily operations workforce	20	Client input
Bus capacity	12	Client input
Operations worker light vehicle occupancy:	1	Assumption
Heavy vehicle movemnets per week	300	Client input
Light vehicle movements per day	250	Client input

Construction Traffic Distribution

DISTRIBUTION	NORTH	SOUTH
Workers (passenger vehicles)	50%	50%
Workers (12-seater bus)	0%	100%
Assorted materials deliveries	25%	75%

Operational Traffic Distribution

DISTRIBUTION	NORTH	SOUTH
Workers (passenger vehicles)	50%	50%
General service vehicles	50%	50%

Traffic Generation

COMPONENT	QUANTITY	UNIT	FREQUENCY (DAYS)	ORIGIN/DESTINATION	VEHICLES		DAILY MOVEMENTS		DAILY TRIPS IN PEAK		PEAK HOUR TRIPS (VPH)		PEAK HOUR SPLITS				PEAK HOUR TRIPS (VPH)				COMMENTS
					TYPE	CATEGORY	VEHICLES	TRIPS (VPD)	AM	PM	AM	PM	AM PEAK IN	AM PEAK OUT	PM PEAK IN	PM PEAK OUT	AM PEAK IN	AM PEAK OUT	PM PEAK IN	PM PEAK OUT	
Construction Phase																					
Workers travelling to site via Bus (solar)	41	persons	1	Port Pirie	Bus	HV	3	6	50%	50%	3	3	50%	50%	50%	50%	2	2	2	2	12 hr day shift (Mon to Sun)
Workers travelling to site via car (solar)	369	persons	1	Port Pirie, Adelaide, Port Augusta	Passenger vehicle	LV	308	616	50%	50%	308	308	100%	0%	0%	100%	308	0	0	308	12 hr day shift (Mon to Sun)
Workers (hydro)	18	persons	1	Port Pirie	Bus	HV	2	4	50%	50%	2	2	50%	50%	50%	50%	1	1	1	1	12 hr day shift (Mon to Sun)
Workers (hydro)	158	persons	1	Port Pirie, Adelaide, Port Augusta	Passenger vehicle	LV	132	264	50%	50%	132	132	100%	0%	0%	100%	132	0	0	132	12 hr day shift (Mon to Sun)
Assorted materials	150	vehicles	7	Adelade with some from Port Pirie and Port Augusta	19m semi-trailer	HV	21	43	8%	8%	3	3	50%	50%	50%	50%	2	2	2	2	
Construction Total (light vehicles)						LV	440	880			440	440					440	0	0	440	
Construction Total (heavy vehicles)						HV	26	53			8	8					4	4	4	4	
Construction Total							466	933			448	448					444	4	4	444	
Operations Phase																					
Workers	20	persons	1	Local towns	Passenger vehicle	LV	20	40	50%	50%	20	20	100%	0%	0%	100%	20	0	0	20	
General service vehicles	6	vehicles	7	Port Pirie, Adelaide, Port Augusta	Passenger vehicle	HV	1	2	50%	50%	1	1	50%	50%	50%	50%	1	1	1	1	
Operations Total (light vehicles)						LV	20	40			20	20					20	0	0	20	
Operations Total (heavy vehicles)						HV	1	2			1	1					1	1	1	1	
Operations Total							21	42			21	21					21	1	1	21	

Other Site Traffic (infrequent - not included in daily/peak volumes)

COMPONENT	QUANTITY	UNIT	FREQUENCY	ORIGIN/DESTINATION	VEHICLES	
					TYPE	CATEGORY
Construction Phase						
Wastewater removal	1	vehicle	fortnightly	Adelaide	19m semi-trailer	HV
Heavy lift crane (solar)	1	vehicle	fortnightly	Adelaide	Overdimension	HV
Operations Phase						
Wastewater removal	1	vehicle	monthly	Adelaide	19m semi-trailer	HV
Council refuse collection	1	vehicle	weekly	Adelaide	Refuse vehicle	HV

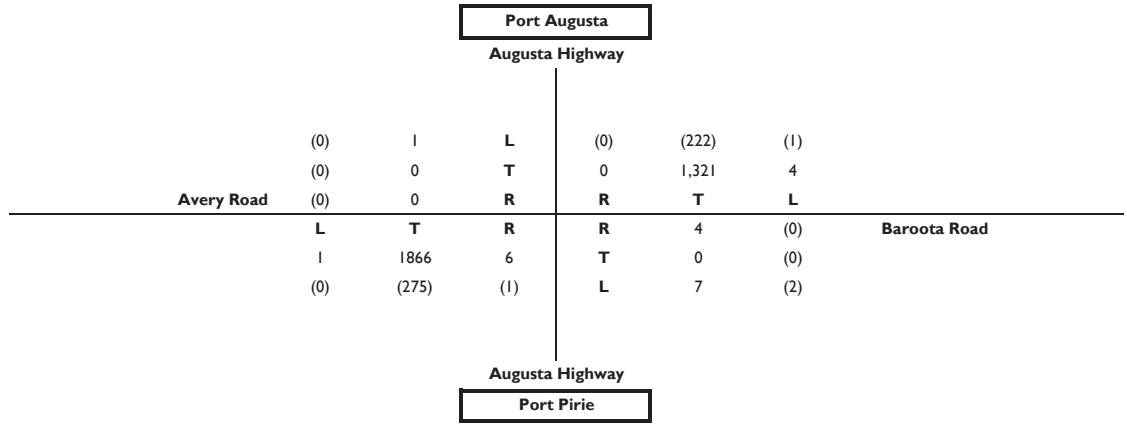
P18057 Baroota Solar Hydro TIA

2018 Traffic Volumes

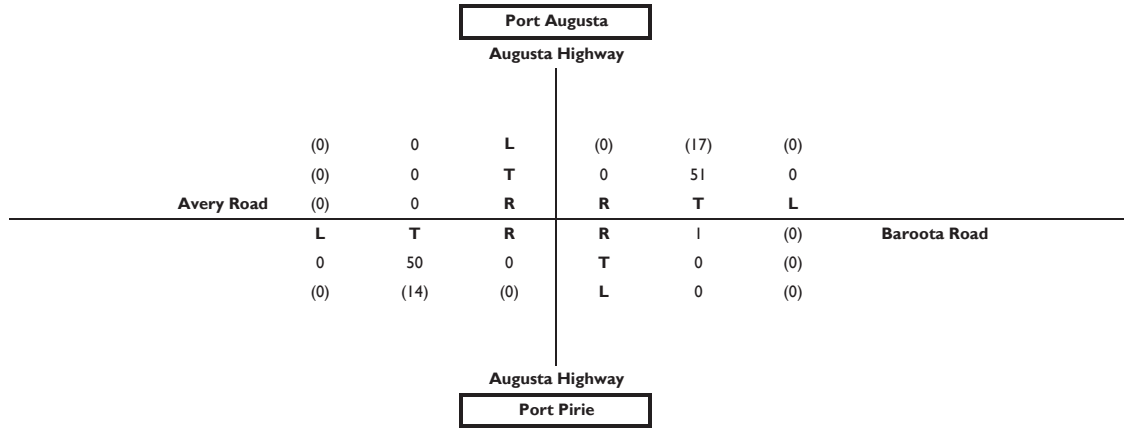
Augusta Highway/Baroota Road/Avery Road

Legend	
#	Total Veh
(#)	HV

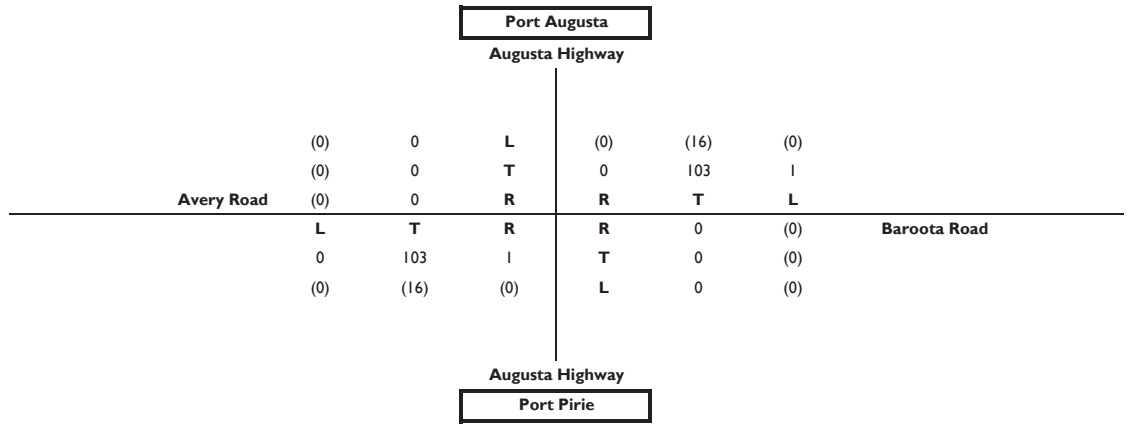
12 hour Vehicle Volumes



Weekday AM Delevopment Peak (6:00-7:00am)



Weekday PM Delevopment Peak (5:00-6:00pm)



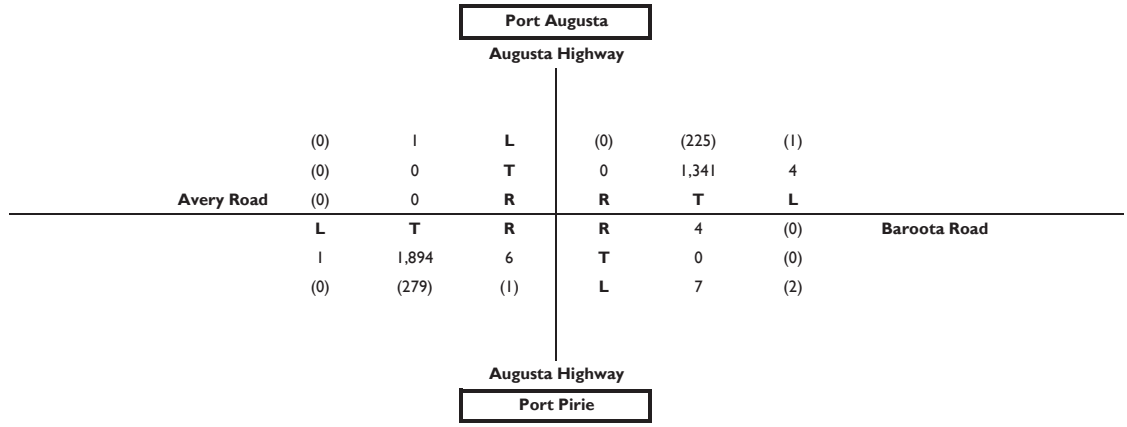
P18057 Baroota Solar Hydro TIA

2019 Background Traffic Volumes

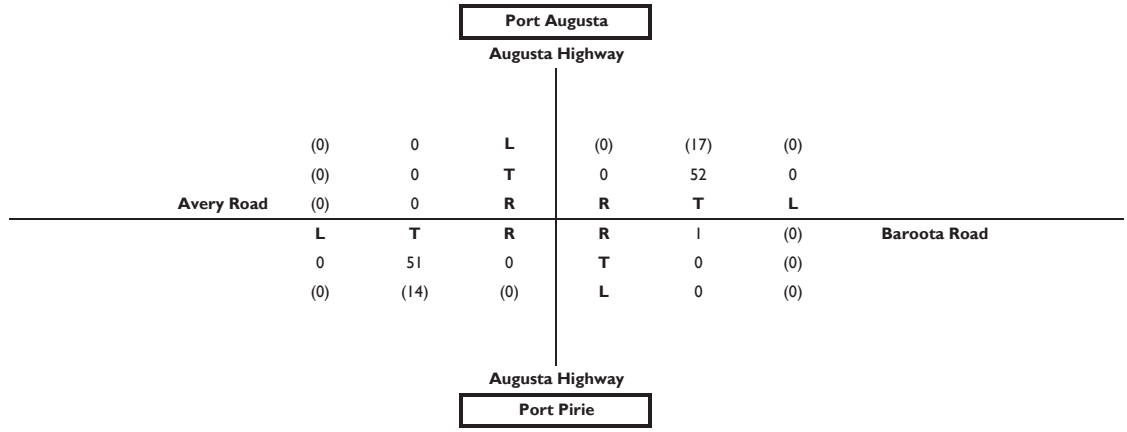
Augusta Highway/Baroota Road/Avery Road

Legend	
#	Total Veh
(#)	HV

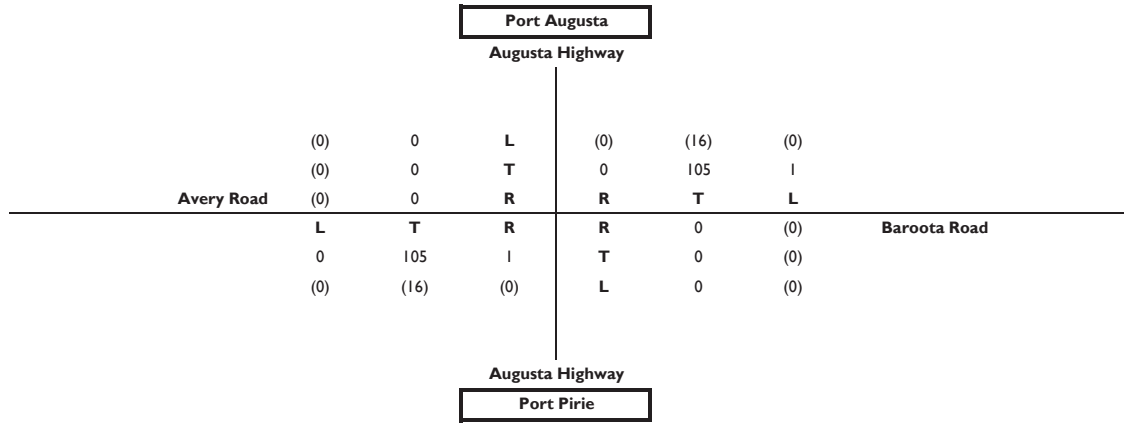
12 hour Vehicle Volumes



Weekday AM Delevopment Peak (6:00-7:00am)



Weekday PM Delevopment Peak (5:00-6:00pm)



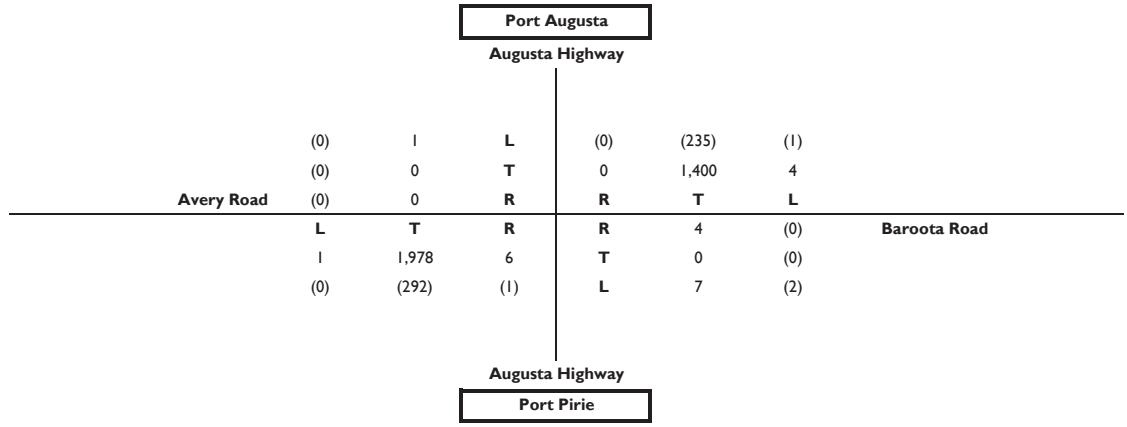
P18057 Baroota Solar Hydro TIA

2022 Background Traffic Volumes

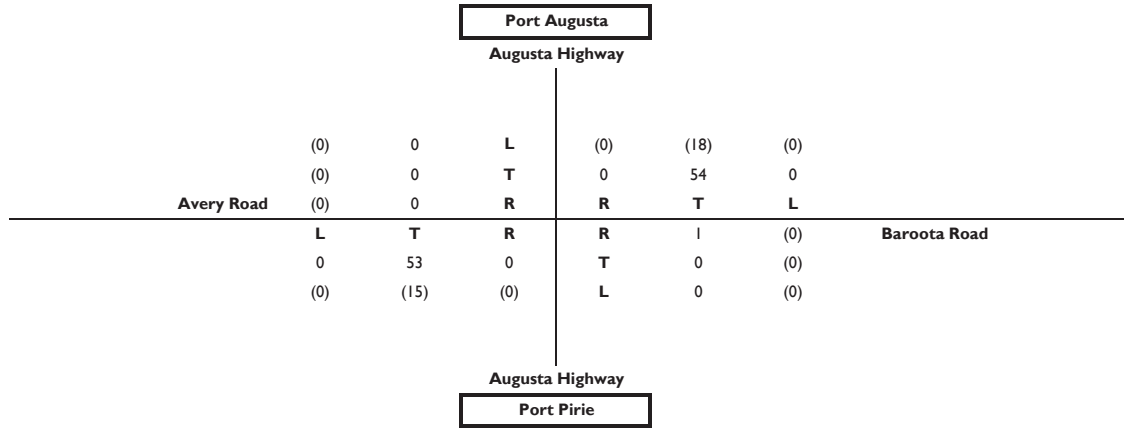
Augusta Highway/Baroota Road/Avery Road

Legend	
#	Total Veh
(#)	HV

12 hour Vehicle Volumes



Weekday AM Delevopment Peak (6:00-7:00am)



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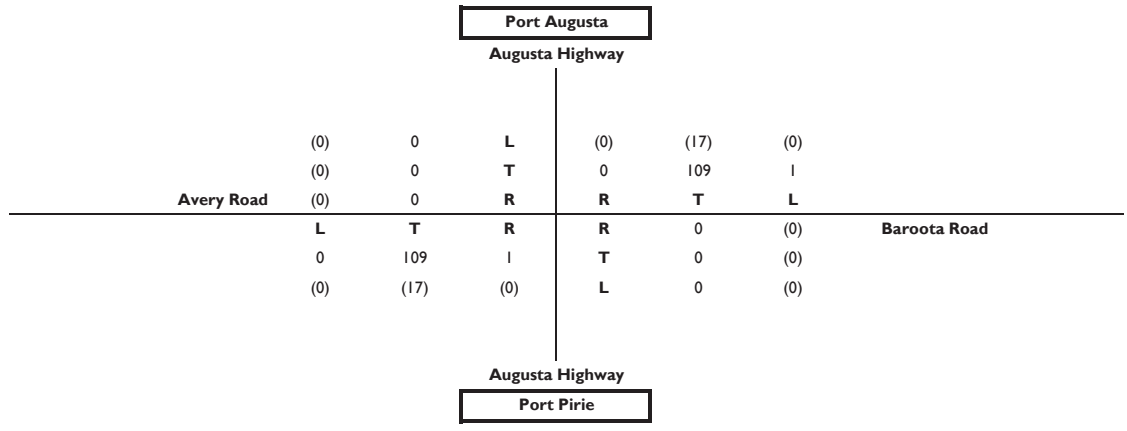


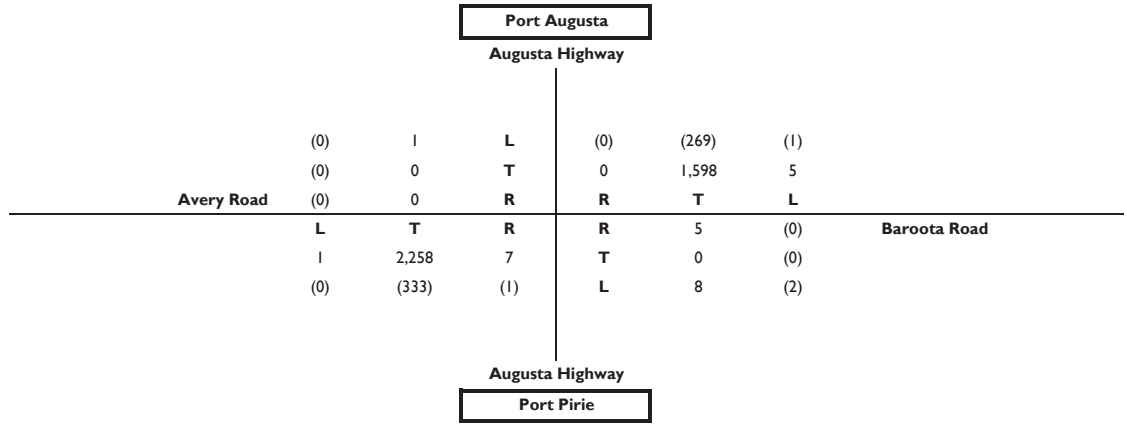
P18057 Baroota Solar Hydro TIA

2032 Background Traffic Volumes

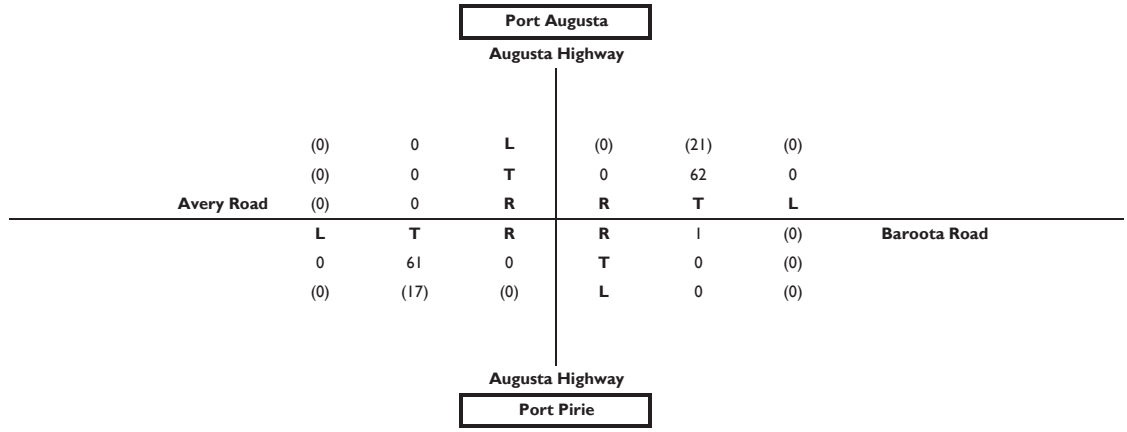
Augusta Highway/Baroota Road/Avery Road

Legend	
#	Total Veh
(#)	HV

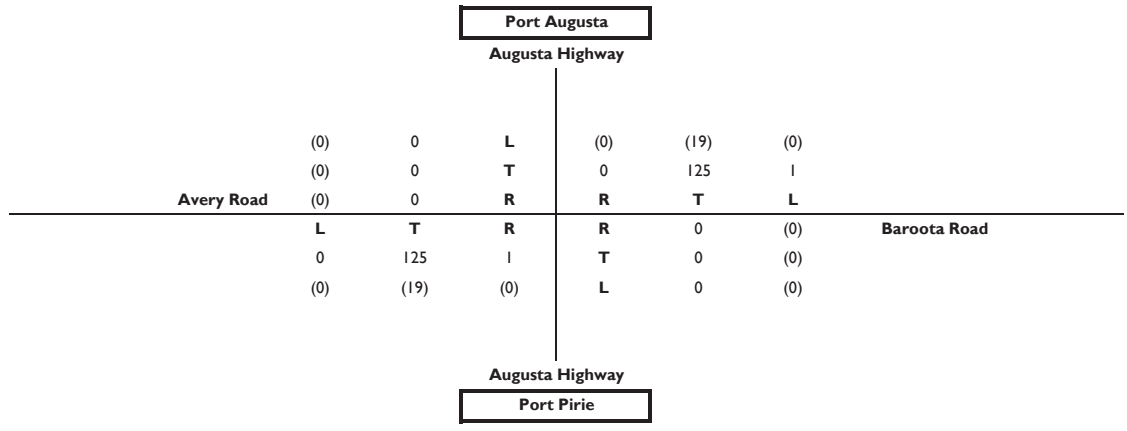
12 hour Vehicle Volumes



Weekday AM Delevopment Peak (6:00-7:00am)



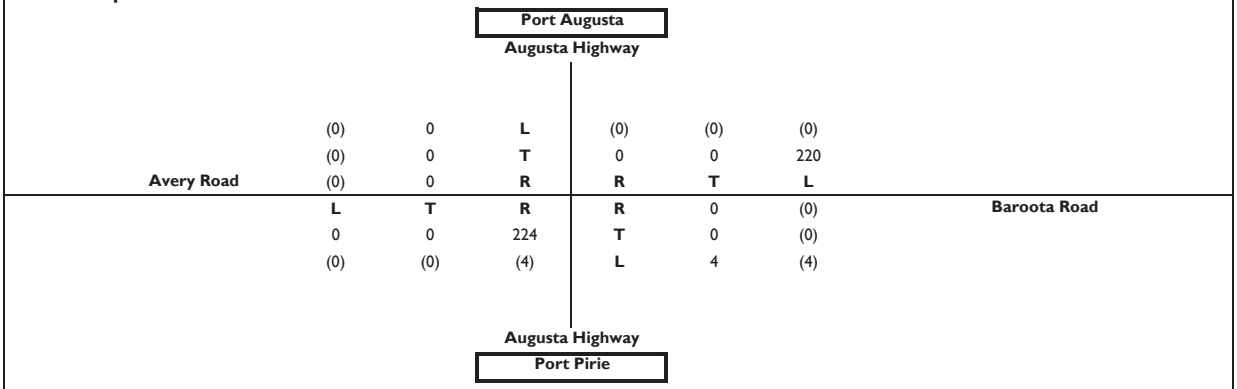
Weekday PM Delevopment Peak (5:00-6:00pm)



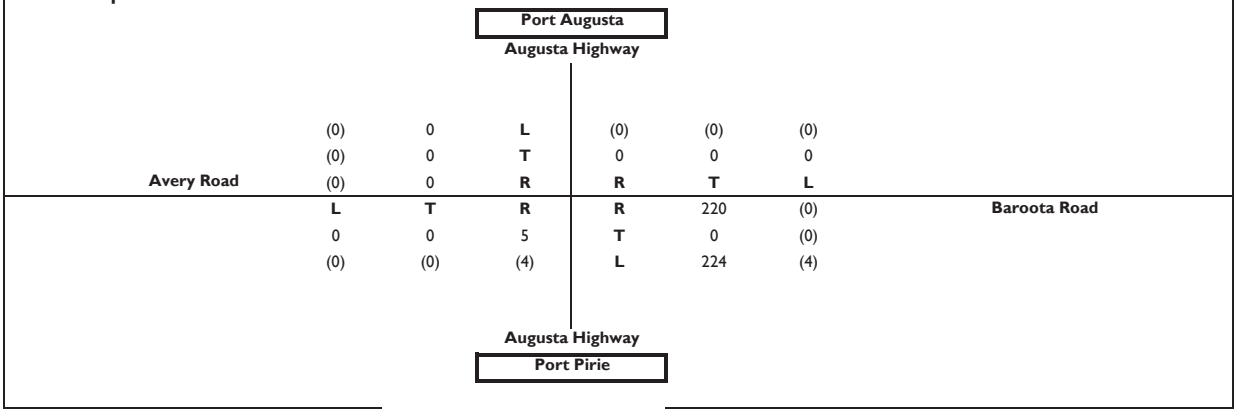
P18057 Baroota Solar Hydro TIA
Construction Traffic Volumes

Legend	
#	Total Vehicles
(#)	Heavy Vehicles

AM Delevopment Peak



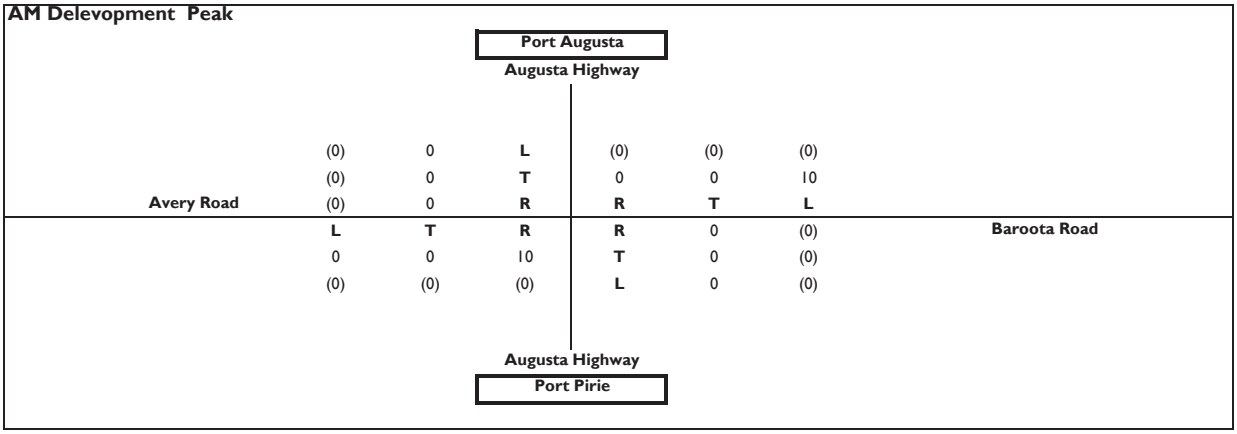
PM Delevopment Peak



P18057 Baroota Solar Hydro TIA
Operations Traffic Volumes

Legend	
#	Total Vehicles
(#)	Heavy Vehicles

AM Delevopment Peak



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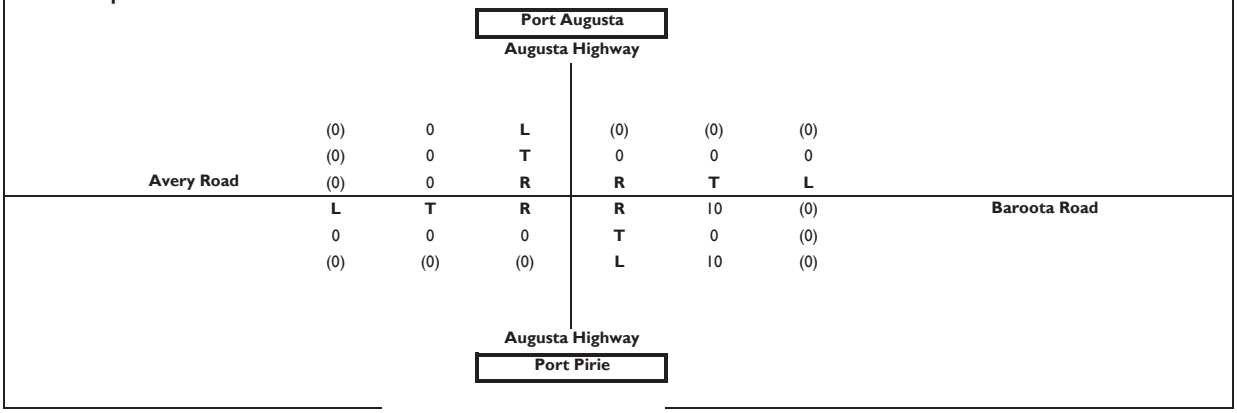
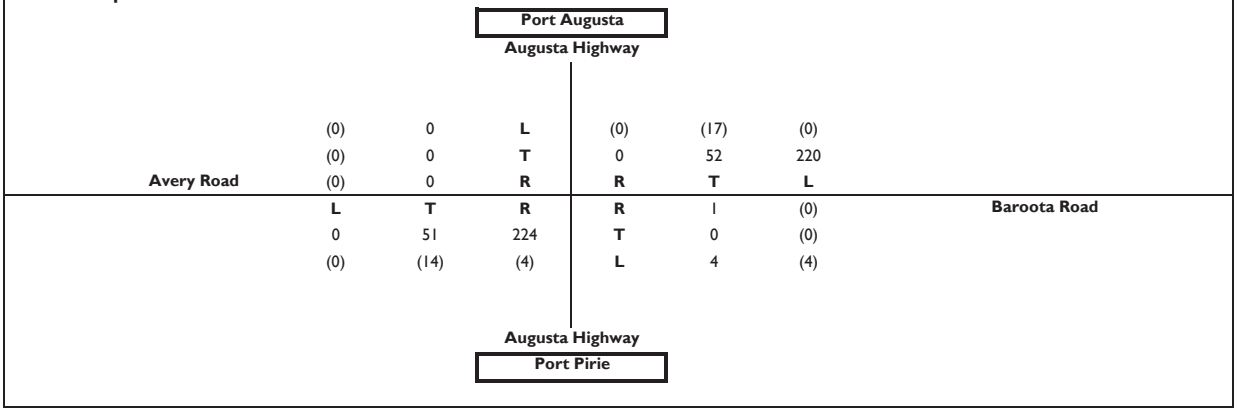


P18057 Baroota Solar Hydro TIA

Construction + 2019 Background Traffic Volumes

Legend	
#	Total Vehicles
(#)	Heavy Vehicles

AM Delevopment Peak



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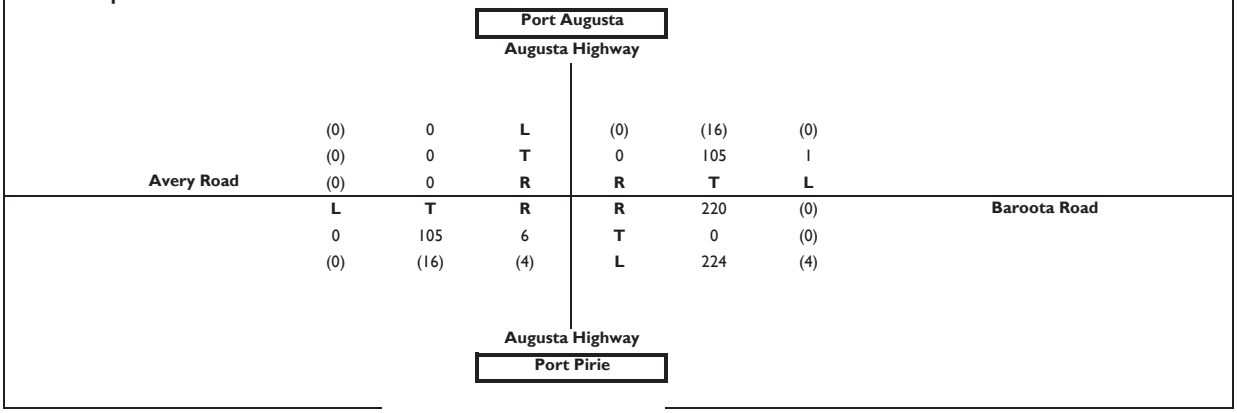
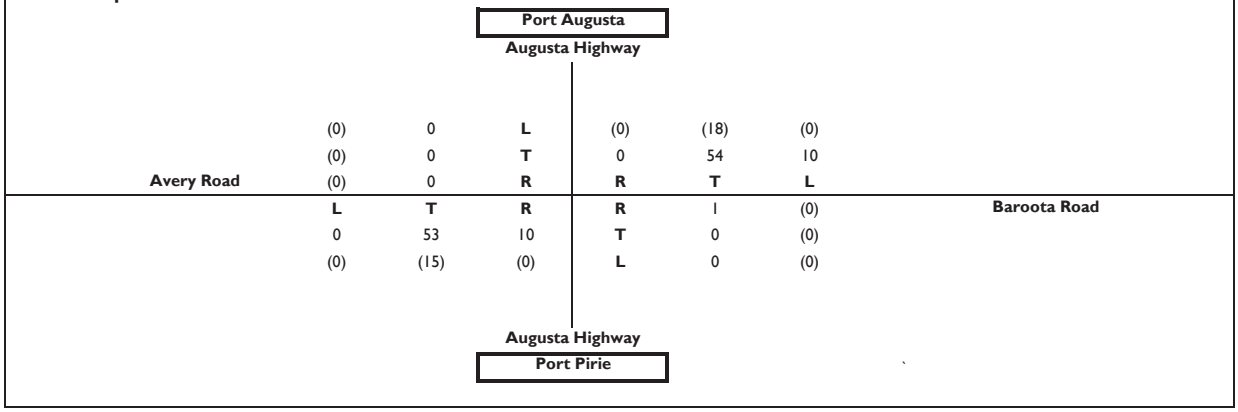


P18057 Baroota Solar Hydro TIA

Operations + 2022 Background Traffic Volumes

Legend	
#	Total Vehicles
(#)	Heavy Vehicles

AM Delevopment Peak



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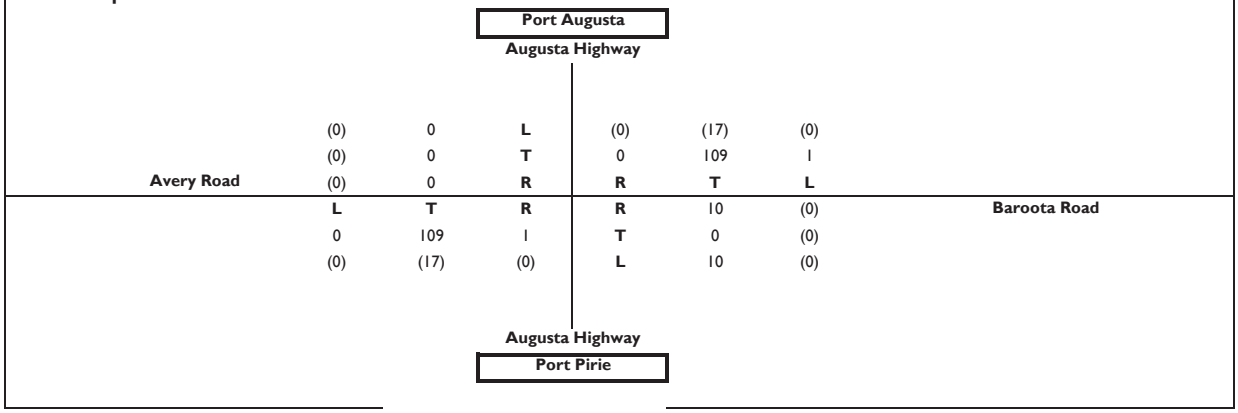
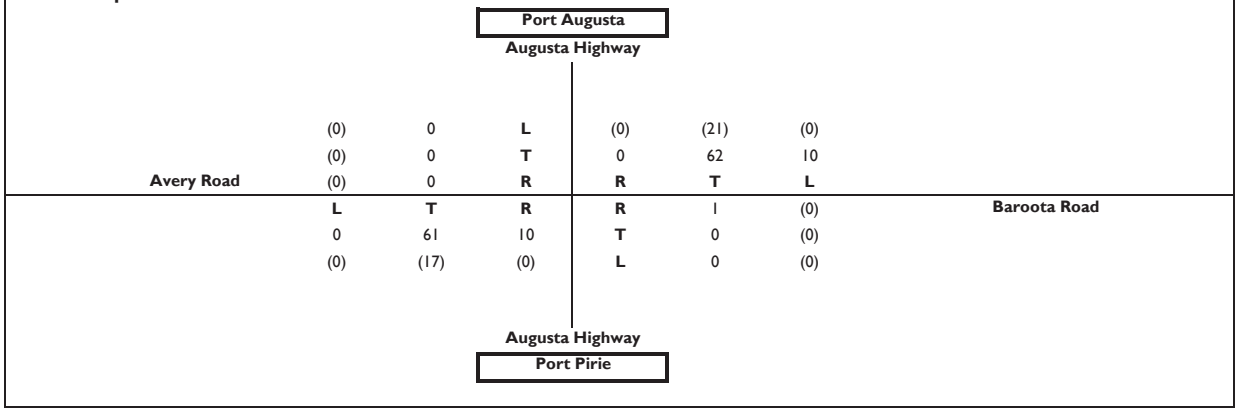


P18057 Baroota Solar Hydro TIA

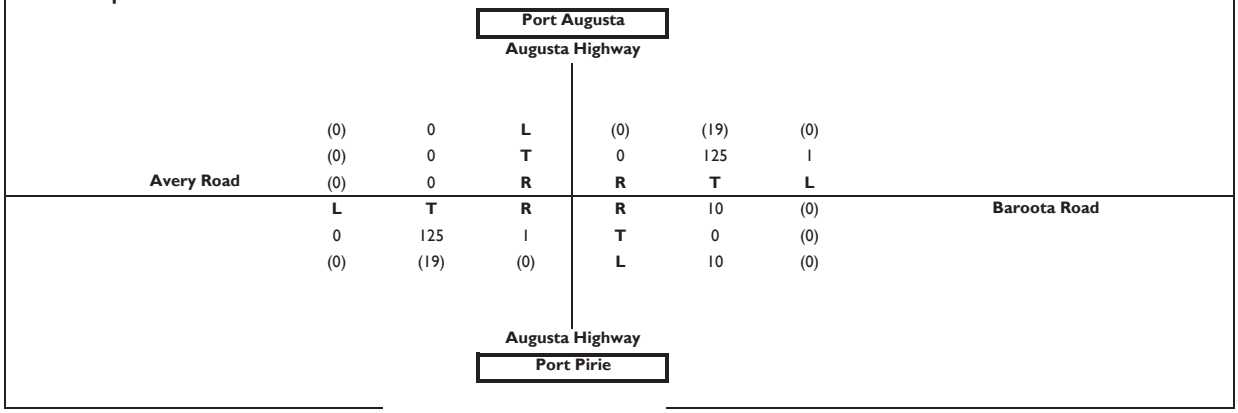
Operations + 2032 Background Traffic Volumes

Legend	
#	Total Vehicles
(#)	Heavy Vehicles

AM Delevopment Peak



PM Delevopment Peak



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Appendix G Development Plan Assessment

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Baroota Pumped Hydro and Solar Project – Development Plan Assessment

The following tables assess whether the Baroota Pumped Hydro and Solar Project is at variance with the objectives and principles contained in the Mount Remarkable Council Development Plan (consolidated 5 September 2013). The tables address the objectives and principles of development control that apply to the entire council area, the Agriculture and Conservation Precincts of the Rural Landscape Protection and Primary Production Zones (Solar Project site) and Water Protection Zone (Pumped Hydro Project site).

Where appropriate a combined assessment against the objectives and principles of the Development Plan has been provided for the pumped hydro and solar components of the Project. Conversely, where it was necessary, each component of the Project was assessed individually against objectives and principles of the Development Plan.

1 Mount Remarkable Council Development Plan – Objectives / Principles

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
Advertisements				
N/A – This has been excluded as the Project does not involve or relate to outdoor advertising.				
Animal Keeping				
N/A – This has been excluded as the Project does not involve or relate to animal keeping.				
Building near Airfields				
N/A – This has been excluded as the Project is not located near an airfield.				
Bulk Handling and Storage Facilities				
N/A – This has been excluded as the Project does not involve or relate to bulk handling and storage facilities.				
Centres and Retail Development				
N/A – This has been excluded as the Project does not involve or relate to any retail and business activities.				
Coastal Areas				
N/A – This has been excluded as the Project does not involve or relate to coastal areas. The Project is not located in a coastal area.				
Community Facilities				
N/A – This has been excluded as the Project does not involve or relate to community facilities.				
Crime Prevention				

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
O1.	A safe, secure, crime resistant environment where land uses are integrated and designed to facilitate community surveillance.	✓	2.2.3 2.3.3	Solar Project Site A permanent 2.5 m high wire fence will be installed around the entire perimeter of the solar project site. A security gate will allow access to the Project site. Alarms and cameras will be used to monitor the Project facilities 24 hours a day, 7 days a week. Security lighting will be utilised in certain locations, such as around the access gate and carparks. A minimum of 8 m will be provided between the perimeter fence and the solar panel blocks. Pumped Hydro Project Site The existing site fence around the lower reservoir will be upgraded within the area of the powerhouse, to a 2.5 m high chain link fence. A similar chain link fence will be installed at the upper reservoir. A security gate at the lower and upper reservoirs will allow controlled access to the site. The site will be permanently monitored for security purposes by alarms and cameras. A buffer of 10-20 m will exist between buildings, the upper and lower reservoir and then fence.
P1.	Development should be designed to maximise surveillance of public spaces through the incorporation of clear lines of sight, appropriate lighting and the use of visible permeable barriers wherever practicable.	✓	2.2.3 2.3.3	The Project location will not be publicly accessible.
P2.	Buildings should be designed to overlook public and communal streets and public open space to allow casual surveillance.	✓	2.2.3 2.3.3	The Project location will not be publicly accessible.
P3.	Development should provide a robust environment that is resistant to vandalism and graffiti.	✓	2.2.3 2.3.3	Refer to the response to O1.
P4.	Development should provide lighting in frequently used public spaces including those: (a) along dedicated cyclist and pedestrian pathways, laneways and access routes (b) around public facilities such as toilets, telephones, bus stops, seating, litter bins, automatic teller machines, taxi ranks and car parks.	✓	2.2.3 2.3.3	Refer to the response to O1.
P5.	Development, including car park facilities should incorporate signage and lighting that indicate the entrances and pathways to, from and within sites.	✓	2.2.3 2.3.3	The sites will include appropriate signage to indicate access points and access requirements. Lighting will be utilized in carparks and other areas.
P6.	Landscaping should be used to assist in discouraging crime by: (a) screen planting areas susceptible to vandalism (b) planting trees or ground covers, rather than shrubs, alongside footpaths (c) planting vegetation other than ground covers a minimum distance of 2 metres from footpaths to reduce concealment opportunities.	✓	2.2.4 2.3.4	The Pumped Hydro and Solar Project sites are approximately 6.2 km to the east of the Augusta Highway. There will be minimal lines of sight to the facilities. Landscaping, where required, will be established around the perimeter.
P7.	Site planning, buildings, fences, landscaping and other features should clearly differentiate public, communal and private areas.	✓		The site will be closed to the public with access only to authorised personnel.
P8.	Buildings should be designed to minimise and discourage access between roofs, balconies and windows of adjoining dwellings.	✓		The Project will involve minimal buildings which will not have balconies. There are no other adjoining buildings or any dwellings in the vicinity of the Project.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P9.	Public toilets should be located, sited and designed: (a) to promote the visibility of people entering and exiting the facility (eg by avoiding recessed entrances and dense shrubbery that obstructs passive surveillance) (b) near public and community transport links and pedestrian and cyclist networks to maximise visibility.	N/A		The site will be closed to the public with access only to authorised personnel. The Project does not include public toilets.
P10.	Development should avoid pedestrian entrapment spots and movement predictors (eg routes or paths that are predictable or unchangeable and offer no choice to pedestrians).	N/A		The site will be closed to the public with access only to authorised personnel. Only site workers and approved visitors will have access to the Project area, which will be fenced.
Design and Appearance				
The design and appearance objectives and principles have been reviewed. The Project will involve minimal buildings and infrastructure. The Project will predominately comprise of solar panels and infrastructure for the upper reservoir. A Landscape and Visual Amenity Assessment has been prepared and is available in Section 8.4 of the Development Application.				
Energy Efficiency				
The Project will provide a crucial non-renewable energy source. The energy efficiency objectives and principles have been reviewed, which predominately consider the siting and location of buildings and public infrastructure, and therefore a thorough assessment has not been provided.				
Forestry				
N/A – This has been excluded as the project does not involve or relate to forestry.				
Hazards				
O1.	Maintenance of the natural environment and systems by limiting development in areas susceptible to natural hazard risk.	✓	6.4	The Project is not considered to be located in an area that is susceptible to significant hazard risk. The level of risk is considered to be highly manageable with the implementation of the measures outlined in section 6.4 of the DA.
O2.	Development located away from areas that are vulnerable to, and cannot be adequately and effectively protected from the risk of natural hazards.	✓	6.4	
O3.	Critical community facilities such as hospitals, emergency control centres, major service infrastructure facilities, and emergency service facilities located where they are not exposed to natural hazard risks.	N/A		The site will be closed to the public with access only to authorised personnel. Project does not involve critical community facilities
O4.	Development located and designed to minimise the risks to safety and property from flooding.	✓	2.2.3	The construction of the upper reservoir will be carried out in accordance with ANCOLD Guidelines.
O5.	Development located to minimise the threat and impact of bushfires on life and property.	✓	6.4	The Project is located in a high bushfire risk zone of the Bushfire Protection Area. The Project will employ fire response measures to mitigate the risk and prevalence of bushfires. This has been discussed in Section 6.4 of the DA.
O6.	Expansion of existing non-rural uses directed away from areas of high bushfire risk.	✓	6.4	The Project is located in a high bushfire risk zone of the Bushfire Protection Area. The Project will comply with Development Plan requirements and will be retaining an 8 m wide buffer between the perimeter fence and any significant Project infrastructure. A track will be provided within the buffer to enable maintenance and emergency vehicular access if required.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
O7.	The environmental values and ecological health of receiving waterways and marine environments protected from the release of acid water resulting from the disturbance of acid sulphate soils.	✓	6.1	The Project is not expected to result in the release of acid water. According to the Mt Remarkable Development Plan mapping, the Project is not within an area identified as containing Coastal Acid Sulfate Soils. Furthermore, the potential for acid sulfate soils was assessed using the ASRIS, which identified the Project area being in a location with 'Extremely low probability' of acid sulfate soils. If acid sulfate soils are encountered during construction, they will be managed to avoid impacts to environmental values.
O8.	Protection of human health and the environment wherever site contamination has been identified or suspected to have occurred.	✓	6.1	The Project site is not on the South Australian Contamination Site Index. Site investigations have not discovered any site contamination issues or risks.
O9.	Appropriate assessment and remediation of site contamination to ensure land is suitable for the proposed use and provides a safe and healthy living and working environment.	✓	6.1	The Project site is not on the South Australian Contamination Site Index. Site investigations have not discovered any site contamination issues or risks.
O10.	Minimisation of harm to life, property and the environment through appropriate location of development and appropriate storage, containment and handling of hazardous materials.	✓	6.1	Storage, containment and handling of hazardous materials will be carried out in accordance with Australian Standards.
P1.	Development should be excluded from areas that are vulnerable to, and cannot be adequately and effectively protected from, the risk of hazards.	N/A		The Project is not in an area that is at risk of any considerable natural hazard.
P2.	Development located on land subject to hazards as shown on the *Overlay Maps - Development Constraints* should not occur unless it is sited, designed and undertaken with appropriate precautions being taken against the relevant hazards.	N/A		The Project is not located on land subject to hazards as shown on the *Overlay Maps-Development Constraints.*
P3.	There should not be any significant interference with natural processes in order to reduce the exposure of development to the risk of natural hazards.	✓		The Project will not significantly impact natural processes. The Project will maintain flow paths, with limited clearing and earthworks to be undertaken only where needed.
Flooding				
P4.	Development should not occur on land where the risk of flooding is likely to be harmful to safety or damage property.	✓	2.2.3	The Pumped Hydro Project will be constructed in the Baroota Catchment, above the existing Baroota Reservoir. The reservoir will be constructed to meet requirements of relevant Australian Standards and the requirements of ANCOLD. Flood events will be accounted for in the design and management of the facility.
P5.	Development should not be undertaken in areas liable to inundation by tidal, drainage or flood waters unless the development can achieve all of the following: (a) it is developed with a public stormwater system capable of catering for a 1-in-100 year average return interval flood event (b) buildings are designed and constructed to prevent the entry of floodwaters in a 1-in-100 year average return interval flood event.	✓	6.2	A surface water and hydrology assessment has been prepared for the Development Assessment (Section 6.2). Project infrastructure will not be place in drainage lines and will be above 1 in 100-year ARI flood levels. The Project is not likely to result in a worsening of the impact of flooding events. Onsite stormwater management measures have been identified in the chapter.
P6.	Development, including earthworks associated with development, should not do any of the following: (a) impede the flow of floodwaters through the land or other	✓	6.2	The Solar Project will result in minimal earthworks, only where required for piling and levelling for cabling and trenching related with the solar panels and other associated infrastructure.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	surrounding land (b) increase the potential hazard risk to public safety of persons during a flood event (c) aggravate the potential for erosion or siltation or lead to the destruction of vegetation during a flood (d) cause any adverse effect on the floodway function (e) increase the risk of flooding of other land (f) obstruct a watercourse.			A surface water and hydrology assessment has been prepared for the Development Application. The Project is not likely to result in the worsening of flooding events and will generally continue to enable existing flow paths and surface sheet flow/infiltration beneath the PV panels. All of the watercourses that could interact with the Project are ephemeral and ungauged. They are robust with limited erosion risk due to disturbance; have low environmental values due to lack of aquatic habitat values; and are common stream types within the region.
Bushfire				
P7.	The following bushfire protection principles of development control apply to development of land identified as General, Medium and High bushfire risk areas as shown on the *Bushfire Protection Area BPA Maps - Bushfire Risk*.	✓	6.4	The Project is located in a high bushfire risk zone of the Bushfire Protection Area. The Project will employ fire response measures to mitigate the risk and prevalence of bushfires. This has been discussed in Section 6.4 of the DA.
P8.	Development in a Bushfire Protection Area should be in accordance with those provisions of the *Minister's Code: Undertaking development in Bushfire Protection Areas* that are designated as mandatory for Development Plan Consent purposes.	✓	6.4	The Project is located in a high bushfire risk zone of the Bushfire Protection Area. All construction will be in accordance to the Minister's Code and will undergo an individual site assessment.
P9.	Buildings and structures should be located away from areas that pose an unacceptable bushfire risk as a result of one or more of the following: (a) vegetation cover comprising trees and/or shrubs (b) poor access (c) rugged terrain (d) inability to provide an adequate building protection zone (e) inability to provide an adequate supply of water for firefighting purposes.	✓	6.4	The Project is located in a high bushfire risk zone of the Bushfire Protection Area. The Project will retain an 8 m wide buffer between the perimeter fence. The site is dominated by low shrubs, a range of larger shrubs and trees occur throughout the site. Direct clearing for the solar farm is expected to encompass access tracks, construction of concrete footings for erecting solar panels and service trenches for wiring. Similarly, for the hydro site, clearing will be required for the reservoir, penstock, pumphouse and access tracks.
P10.	Residential, tourist accommodation and other habitable buildings should: (a) be sited on the flatter portion of allotments and avoid steep slopes, especially upper slopes, narrow ridge crests and the tops of narrow gullies, and slopes with a northerly or westerly aspect (b) be sited in areas with low bushfire hazard vegetation and set back at least 20 metres from existing hazardous vegetation (c) have a dedicated and accessible water supply available at all times for firefighting.	N/A		The Project site will be closed to the public with access only to authorised personnel. The Project does not involve tourist accommodation or habitable buildings.
P11.	Extensions to existing buildings, outbuildings and other ancillary structures should be sited and constructed using materials to minimise the threat of fire spread to residential, tourist accommodation and other habitable buildings in the event of bushfire.	✓	6.4	Suitable materials will be used to minimise the threat of fire spread.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P12.	Buildings and structures should be designed and configured to reduce the impact of bushfire through using simple designs that reduce the potential for trapping burning debris against the building or structure, or between the ground and building floor level in the case of transportable buildings.	✓	6.4	The Project is located in the Flinders Mid-North Bushfire Management Area Plan area. Section 6.4 of the Development Application identifies health, safety and fire responses. A number of practices and measures to prevent the likelihood or prevalence of fires have been identified in the chapter. Some of these practices include: • Smoking will not be permitted on site, other than in designated smoking areas; • Fire extinguishers will be provided in all buildings and construction vehicles; • Prohibition of onsite burning of any material; and • Regular maintenance of onsite fire-fighting equipment and adequate staff training.
P13.	Land division for residential or tourist accommodation purposes within areas of high bushfire risk should be limited to those areas specifically set aside for these uses.	N/A		The Project does not involve land division.
P14.	Where land division does occur, it should be designed to: (a) minimise the danger to residents, other occupants of buildings and firefighting personnel (b) minimise the extent of damage to buildings and other property during a bushfire (c) ensure each allotment contains a suitable building site that is located away from vegetation that would pose an unacceptable risk in the event of bushfire (d) ensure provision of a fire hazard separation zone isolating residential allotments from areas that pose an unacceptable bushfire risk by containing the allotments within a perimeter road or through other means that achieve an adequate separation.	N/A		The Project does not involve land division.
P15.	Vehicle access and driveways to properties and public roads created by land division should be designed and constructed to: (a) facilitate safe and effective operational use for firefighting and other emergency vehicles and residents (b) provide for two-way vehicular access between areas of fire risk and the nearest public road.	N/A		The Project does not involve land division.
P16.	Olive orchards should be located and developed in a manner that minimises their potential to fuel bushfires.	N/A		The Project does not involve olive orchards.
Salinity				
P17.	Development should not increase the potential for, or result in an increase in, soil and water salinity.	✓	6.1	An Erosion and Sediment Control Plan (ESCP) will be developed for the Project prior to the commencement of construction activities and will detail the construction particulars, control measures to be implemented, and the expected outcomes and staging of erosion and sediment control measures once construction is complete.
P18.	Preservation, maintenance and restoration of locally indigenous plant species should be encouraged in areas affected by dry land salinity.	✓	7	The Project will require the clearing of vegetation; however, this will be kept to a minimum.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P19.	Irrigated horticulture and pasture should not increase groundwater-induced salinity.	N/A		The Project does not involve irrigated horticulture.
Acid Sulfate Soils				
P20.	Development and activities, including excavation and filling of land, that may lead to the disturbance of potential or actual acid sulfate soils should be avoided unless such disturbances are managed in a way that effectively avoids the potential for harm or damage to any of the following: (a) the marine and estuarine environment (b) natural water bodies and wetlands (c) agricultural or aquaculture activities (d) buildings, structures and infrastructure (e) public health.	✓	6.1	According to the Mt Remarkable Council Development Plan mapping, the Project is not within an area identified as containing Coastal Acid Sulfate Soils. Furthermore, the potential for acid sulfate soils was assessed using the ASRIS, this identified the Project area being in a location with 'No Known Occurrence' of acid sulfate soils.
P21.	Development, including primary production, aquaculture activities and infrastructure, should not proceed unless it can be demonstrated that the risk of releasing acid water resulting from the disturbance of acid sulfate soils is minimal.	N/A		The Project does not involve primary production or aquaculture activities and infrastructure.
Site Contamination				
P22.	Development, including land division, should not occur where site contamination has occurred unless the site has been assessed and remediated as necessary to ensure that it is suitable and safe for the proposed use.	✓	6.1	The Project site is not on the South Australian Contamination Site Index. Site investigations have not discovered any site contamination issues or risks. However, spill kit(s) will be located onsite and spills will be immediately cleared to avoid any potential land contamination. If unexpected contaminated land is found management measures will be implemented to avoid, contain, remediate or otherwise manage the potential spread of contamination as required.
Containment of Chemical and Hazardous Materials				
P23.	Hazardous materials should be stored and contained in a manner that minimises the risk to public health and safety and the potential for water, land or air contamination.	✓	6.1	Storage, containment and handling of hazardous materials will be carried out in accordance with Australian Standards.
P24.	Development that involves the storage and handling of hazardous materials should ensure that these are contained in designated areas that are secure, readily accessible to emergency vehicles, impervious, protected from rain and stormwater intrusion and other measures necessary to prevent: (a) discharge of polluted water from the site (b) contamination of land (c) airborne migration of pollutants (d) potential interface impacts with sensitive land uses.	✓	6.1	Storage, containment and handling of hazardous materials will be carried out in accordance with Australian Standards.
Landslip				

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P25.	Land identified as being at risk of landslip should not be developed.	N/A		The Project site is not susceptible to landslip. Geotechnical works will be undertaken to further investigate the nature of the soils at the Pumped Hydro Project site.
P26.	Development, including associated cut and fill activities, should not lead to an increased danger from land surface instability or to the potential of landslip occurring on the site or on surrounding land.	N/A		The Project does not involve any 'cut and fill' activities to the scale of causing landslip on surrounding land.
P27.	Development on steep slopes should promote the retention and replanting of vegetation as a means of stabilising and reducing the possibility of surface movement or disturbance.	✓		The solar farm Project site is relatively flat. There are no steep slopes located on the Project site. Construction on the steeper slopes of the hydro Project will primarily be for the penstock between the lower and upper reservoir. The penstock will be buried to a maximum depth of approximately 20m. This will then be covered with dirt and revegetated.
P28.	Development in areas susceptible to landslip should: (a) incorporate split level designs to minimise cutting into the slope (b) ensure that cut and fill and heights of faces are minimised (c) ensure cut and fill is supported with engineered retaining walls or are battered to appropriate grades (d) control any erosion that will increase the gradient of the slope and decrease stability (e) ensure the siting and operation of an effluent drainage field does not contribute to landslip (f) provide drainage measures to ensure surface stability is not compromised (g) ensure natural drainage lines are not obstructed.	N/A		The Project site is not susceptible to landslip. Geotechnical works will be undertaken to further investigate the nature of the soils at the Pumped Hydro Project site. All measures required will be employed to minimise erosion during construction and operation phases.
Heritage Places				
O1.	The conservation of State and local heritage places.	✓	8.2	The Project will conserve areas and places of Indigenous and non-Indigenous cultural significance. A site walkover with Traditional Owners discovered several sites and artefacts of Indigenous cultural significance (refer to Section 8.2 of the Development Application. Consultation with the Traditional Owners has been undertaken to develop management and mitigation measures to protect the sites. Rise will comply with all relevant legislation. There are no non-Indigenous Heritage Places within close proximity to the Project, with the closest heritage places located in the township of Pt Germein, approximately 13 km to the south-east of the Project area.
O2.	The continued use, or adaptive re-use of State and local heritage places that supports the conservation of their cultural significance.	✓	4.2	Refer to the response to O1.
O3.	Conservation of the setting of State and local heritage places.	✓	4.2	Refer to the response to O1.
P1.	A heritage place spatially located on *Overlay Maps – Heritage* and more specifically identified in *Table MtR/3 - State Heritage Places* should not	✓	4.2	The identified heritage places in *Table MtR/3 – State Heritage Places* are not located within close proximity to the Project, with the closest heritage places

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	be demolished, destroyed or removed, in total or in part, unless either of the following apply: (a) that portion of the place to be demolished, destroyed or removed is excluded from the extent of the places identified in the *Table(s)* (b) the structural condition of the place represents an unacceptable risk to public or private safety.			located in the township of Pt Germein, approximately 13 km to the south-east of the Project area.
P2.	Development of a State or local heritage place should retain those elements contributing to its heritage value, which may include (but not be limited to): (a) principal elevations (b) important vistas and views to and from the place (c) setting and setbacks (d) building materials (e) outbuildings and walls (f) trees and other landscaping elements (g) access conditions (driveway form/width/material) (h) architectural treatments (i) the use of the place.	N/A		The Project will not impact on any identified heritage places.
P3.	Development of a State or local heritage place should be compatible with the heritage value of the place.	N/A		The Project will not impact on any identified heritage places.
P4.	Original unpainted plaster, brickwork, stonework, or other masonry of existing State or local heritage places should be preserved, unpainted.	N/A		The Project does not involve plaster, brickwork, stonework, or other masonry.
P5.	New buildings should not be placed or erected between the front street boundary and the façade of existing State or local heritage places.	N/A		The Project is not located in proximity of existing State or local heritage places.
P6.	Development that materially affects the context within which the heritage place is situated should be compatible with the heritage place. It is not necessary to replicate historic detailing, however design elements that should be compatible include, but are not limited to: (a) scale and bulk (b) width of frontage (c) boundary setback patterns (d) proportion and composition of design elements such as rooflines, openings, fencing and landscaping (e) colour and texture of external materials.	N/A		The Project does not involve historic places.
P7.	The introduction of advertisements and signage to a State or local heritage place should: (a) be placed on discrete elements of its architecture such as parapets and wall panels, below the canopy, or within fascias and infill end panels and windows (b) not conceal or obstruct historical detailing of the heritage place	N/A		The Project does not involve historic places.

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No	Objective / Principle	Not at variance	DA Ref.	Response
	(c) not project beyond the silhouette or skyline of the heritage place (d) not form a dominant element of the place.			
P8.	The division of land adjacent to or containing a State or local heritage place should occur only where it will: (a) create an allotment pattern that maintains or reinforces the integrity of the heritage place and the character of the surrounding area (b) create an allotment or allotments of a size and dimension that can accommodate new development that will reinforce and complement the heritage place and the zone or policy area generally (c) be of a size and dimension that will enable the siting and setback of new buildings from allotment boundaries so that they do not overshadow, dominate, encroach on or otherwise impact on the setting of the heritage place (d) provide an area for landscaping of a size and dimension that complements the landscape setting of the heritage place and the landscape character of the locality (e) enable the State or local heritage place to have a curtilage of a size sufficient to protect its setting.	N/A		The Project does not involve land division.
Industrial Development				
N/A – This has been excluded as the project is not located in an industrial zone.				
Infrastructure				
O1.	Infrastructure provided in an economical and environmentally sensitive manner.	✓	8.0	The Project has accounted for several economic and environmental considerations during its planning stage. The Project is being undertaken to ensure that impacts on the natural environment and economy are reduced, where possible.
O2.	Infrastructure, including social infrastructure, provided in advance of need.	N/A		The Project does not involve social infrastructure. Worker amenities and facilities will be provided as part of the Project. Appropriate amenities (such as toilets) will be in place when construction commences.
O3.	Suitable land for infrastructure identified and set aside in advance of need.	✓	2.0	A concept Project layout has been produced. This has been carefully considered and provides for the best use of land to minimise the footprint.
O4.	The visual impact of infrastructure facilities minimised.	✓	8.4	The visual amenity of the Project has been considered in the Development Application. This takes into consideration viewpoints and potential impacts of the Project on the amenity of the area.
O5.	The efficient and cost-effective use of existing infrastructure.	✓	2.0	There is a 275 kV high voltage overhead transmission line that traverses between the solar farm and pumped hydro site. The Project will maximise on this and will connect directly to this transmission line. The Pumped Hydro Project will maximise on the existing SA Water reservoir and has proposed to construct an upper reservoir to create the pumped hydroelectric

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
				system.
P1.	Development should not occur without the provision of adequate utilities and services, including: (a) electricity supply (b) water supply (c) drainage and stormwater systems (d) waste disposal (e) effluent disposal systems (f) formed all-weather public roads (g) telecommunications services (h) social infrastructure, community services and facilities (i) gas services.	✓	2.0	The Project will provide several utilities, facilities and services. a) During the construction phase, electricity will be supplied by generators. The Project will operate off site generated power during operation. b) Water will be supplied during construction and operation. Several water supply options are currently being considered. c) Site drainage and stormwater systems will be implemented and installed. d) A waste storage area will be provided to allow for effective and proper waste disposal. e) Wastewater generated during construction will be captured in septic tanks and removed from site by a licensed waste contractor. A small sewage treatment system or use of septic tanks may be used for the operational phase. f) Site access roads and tracks will be suitable for all-weather. g) Telecommunication facilities will be provided. This will be provided through established, remote or wireless networks. h) The Project will include a site office, lunch rooms and an ablution block for operational staff. i) The Project is not expected to require connection to gas services.
P2.	Development should only occur only where it provides, or has access to, relevant easements for the supply of infrastructure.	✓	2.0	Easements will be created as required.
P3.	Development should incorporate provision for the supply of infrastructure services to be located within common service trenches where practicable.	✓	2.0	Electricity required for the project will connect to the 275 kV Bugama to Davenport ElectraNet transmission line.
P4.	Development should not take place until adequate and coordinated drainage of the land is assured.	✓	6.2	As required, drainage measures will be established.
P5.	Development in urban areas should not occur without provision of an adequate reticulated domestic quality mains water supply and an appropriate waste treatment system.	N/A		The Project is not located in an urban area.
P6.	In areas where no reticulated water supply is available, buildings whose usage is reliant on a water supply should be equipped with an adequate and reliable on-site water storage system.	✓	2.0	Untreated water will be supplied during construction from the existing lower reservoir for use in dust suppression and portable toilets. Drinking water will be supplied in bottled form. During operation, water will be harvested from roof tops or sourced from the lower reservoir.
P7.	Urban development should not be dependent on an indirect water supply.	N/A		The Project is not located in an urban area.
P8.	Electricity infrastructure should be designed and located to minimise its visual and environmental impacts.	✓	8.4	The visual impact of the Solar Project infrastructure has been assessed in Section 8.4 of the Development Application. The upper reservoir will not be visible from public roads. The penstock between the lower and upper reservoir is not expected to be a negative visual impact.

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No	Objective / Principle	Not at variance	DA Ref.	Response
P9.	In urban areas, electricity supply serving new development should be installed underground.	N/A		The Project is not located in an urban area.
P10.	Utilities and services, including access roads and tracks, should be sited on areas already cleared of native vegetation. If this is not possible, their siting should cause minimal interference or disturbance to existing native vegetation and biodiversity.	✓	7.1	Clearance of native vegetation will be minimized as much as practicable.
P11.	Utility buildings and structures should be grouped with non-residential development where possible.	N/A		The Project is not within proximity to residential development.
P12.	Development in proximity to infrastructure facilities should be sited and be of a scale to ensure adequate separation to protect people and property.	N/A		The proposed infrastructure associate with the Project are not in close proximity to existing infrastructure.
Interface between Land Uses				
O1.	Development located and designed to prevent adverse impact and conflict between land uses.	✓		The Land Use surrounding the majority of the Project is classified as 'Agriculture' and that surrounding the SA Water Reservoir it is classified as 'Utilities-Infrastructure' under Land Use Generalised 2017 mapping obtained via SA Location Viewer (Government of South Australia 2017). The Project will not create significant impacts on surrounding land uses.
O2.	Protect community health and amenity and support the operation of all desired land uses.	✓		Due to the nature of the Project and the location, it is highly unlikely that the facility would negatively impact on community health and amenity or the operation of all desired land uses.
P1.	Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following: (a) the emission of effluent, odour, smoke, fumes, dust or other airborne pollutants (b) noise (c) vibration (d) electrical interference (e) light spill (f) glare (g) hours of operation (h) traffic impacts.	✓	6.1, 6.2, 6.3, 8.3, 8.4, 8.5, 8.6	Potential impacts and mitigation are addressed in the DA.
P2.	Development should be sited and designed to minimise negative impact on existing and potential future land uses considered appropriate in the locality.	✓	2, 8.1, 8.4	The Project will not adversely impact adjacent land uses and will be restricted to the Project area.
P3.	Development adjacent to a **Township Zone** should be designed to minimise overlooking and overshadowing of nearby residential properties.	N/A		The Project is not adjacent to a Township Zone.
P4.	Residential development adjacent to non-residential zones and land uses should be located, designed and/or sited to protect residents from potential adverse impacts from non-residential activities.	N/A		The Project does not involve residential development.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P5.	Sensitive uses likely to conflict with the continuation of lawfully existing developments and land uses considered appropriate for the zone should not be developed or should be designed to minimise negative impacts.	N/A		The Project does not involve sensitive land uses.
Noise				
P6.	Development should be sited, designed and constructed to minimise negative impacts of noise and to avoid unreasonable interference.	✓	8.3	The predicted noise levels at the closest sensitive receivers (during operation) achieved the assessment criteria.
P7.	Development should be consistent with the relevant provisions in the current *Environment Protection (Noise) Policy*.	✓	8.3	The predicted noise levels at the closest sensitive receivers (during operation) achieved the assessment criteria. Development will be in line with existing legislation.
Rural Interface				
P8.	The potential for adverse impacts resulting from rural development should be minimised by: (a) not locating horticulture or intensive animal keeping on land adjacent to townships (b) maintaining an adequate separation between horticulture or intensive animal keeping and townships, other sensitive uses and, where desirable, other forms of primary production.	N/A		The Project does not involve horticulture or intensive animal keeping.
P9.	Traffic movement, spray drift, dust, noise, odour, and the use of frost fans and gas guns associated with primary production activities should not lead to unreasonable impact on adjacent land users.	N/A		The Project does not involve primary production activities.
P10.	Existing primary production uses and mineral extraction should not be prejudiced by the inappropriate encroachment of sensitive uses such as urban development.	N/A		The Project does not involve urban development.
P11.	Development within 300 metres of facilities for the handling, transportation and storage of bulk commodities should: (a) not prejudice the continued operation of those facilities (b) be located, designed, and developed having regard to the potential environmental impact arising from the operation of such facilities and the potential extended operation of activities.	N/A		The Project is not located within any facilities for the handling, transportation and storage of bulk commodities.
Land Division				
N/A – This has been excluded as the project does not involve or relate to land division.				
Landscaping, Fences and Walls				
N/A – This has been excluded as this relates to landscaping, fences and walls for residential development.				
Marinas and Maritime Structures				

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
N/A – This has been excluded as the Project does not involve or relate to marinas and maritime structures				
Mineral Extraction				
N/A – This has been excluded as the Project does not involve or relate to mineral extraction activities.				
Natural Resources				
O1.	Retention, protection and restoration of the natural resources and environment.	✓	7.1 7.2	The Project will aim to protect natural resources by minimizing vegetation clearance, locating temporary disturbance areas within the final footprint, ensuring clearances is restricted within designated boundaries.
O2.	Protection of the quality and quantity of South Australia's surface waters, including inland, marine and estuarine and underground waters.	✓	6.2	Surface water and groundwater resources will be protected by utilising the following: • stormwater from the site will be collected and managed • hazardous materials will be stored in accordance with Australian Standards and spills will be cleaned up immediately. • Erosion, sediment and drainage controls will be established • Infrastructure will not be located in drainage lines • A Soil Erosion and Drainage Manage Plan will be prepared
O3.	The ecologically sustainable use of natural resources including water resources, including marine waters, ground water, surface water and watercourses.	✓	6.1, 6.2	Soil and water resources will be protected. Rainwater from buildings will be harvested for use on site and underground water use is not proposed. Water use is described in Section 6.2 of the DA. Existing water movement of Separation Creek through the Pumped Hydro Project site will be restricted by the construction of an additional reservoir, however it is not expected that this will impact on the overall catchment hydrology.
O4.	Natural hydrological systems and environmental flows reinstated, and maintained and enhanced.	✓	6.2	Surface profiles and natural drainage patterns will largely be maintained. The Project will have very limited impact on natural water flows. Measures outlined in the DA to protect water quality will be implemented. All project components will be designed and constructed in accordance with the Code of Practice for the Building and Construction Industry, (Environment Protection Agency Government of South Australia, 1999), a Soil Erosion and Drainage Management Plan (SEDMP) will be prepared for the construction phase of the Project to specify erosion and sediment management controls. The SEDMP will include soil and erosion control best practice as detailed in the IECA (2008) guidelines "Best Practice Erosion and Sediment Control".
O5.	Development consistent with the principles of water sensitive design.	✓	6.2	
O6.	Development sited and designed to: (a) protect natural ecological systems (b) achieve the sustainable use of water (c) protect water quality, including receiving waters (d) reduce runoff and peak flows and prevent the risk of downstream flooding (e) minimise demand on reticulated water supplies (f) maximise the harvest and use of stormwater (g) protect stormwater from pollution sources.	✓	6.1, 6.2	
O7.	Storage and use of stormwater which avoids adverse impact on public health and safety.	✓	2.4.11	Rain water will be harvested from the roof of buildings for on-site use.
O8.	Native flora, fauna and ecosystems protected, retained, conserved and restored.	✓	7.1, 7.2	Clearance of degraded native vegetation will be required however this will be offset by achieving a 'significant environmental benefit' under the Native Vegetation Act.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
O9.	Restoration, expansion and linking of existing native vegetation to facilitate habitat corridors for ease of movement of fauna.	✓	7.1, 7.2	
O10.	Minimal disturbance and modification of the natural landform.	✓	6.1	The upper reservoir will be constructed maximizing on the natural valley land formation existing at the site.
O11.	Protection of the physical, chemical and biological quality of soil resources.	✓	6.1	Disturbance and modification of the natural landform will be minimised, soil resources will be protected, and the area is not prone to erosion
O12.	Protection of areas prone to erosion or other land degradation processes from inappropriate development.	✓	6.1	
O13.	Protection of the scenic qualities of natural and rural landscapes.	✓	8.4	The scenic quality of the sites is relatively low.
P1.	Development should be undertaken with minimum impact on the natural environment, including air and water quality, land, soil, biodiversity, and scenically attractive areas.	✓	6,7,8	The project will not result in significant impacts to the natural environment, biodiversity will be enhanced through a 'significant environmental benefit' and no sensitive ecological areas will be impacted. Refer to Chapters 6, 7 and 8 of the DA for a discussion of all potential impacts and the proposed mitigation measures.
P2.	Development should ensure that South Australia's natural assets, such as biodiversity, water and soil, are protected and enhanced.	✓	6,7,8	
P3.	Development should not significantly obstruct or adversely affect sensitive ecological areas such as creeks, wetlands, estuaries and significant seagrass and mangrove communities.	✓	6,7,8	
P4.	Development should be appropriate to land capability and the protection and conservation of water resources and biodiversity.	✓	6,7,8	
Water Sensitive Design				
P5.	Development should be designed to maximise conservation, minimise consumption and encourage re-use of water resources.	✓	2.4.11	Rainwater will be harvested for on-site use and water conservation measures will be implemented. The project does not involve unsustainable use of surface or underground water resources. Natural drainage patterns will largely be maintained. The project will have very limited impact on natural water flows. Measures outlined in the DA to protect water quality will be implemented. All Project components will be designed and constructed in accordance with the Code of Practice for the Building and Construction Industry, (Environment Protection Agency Government of South Australia, 1999), a Soil Erosion and Drainage Management Plan (SEDMP) will be prepared for the construction phase of the Project to specify erosion and sediment management controls. The SEDMP will include soil and erosion control best practice as detailed in the IECA (2008) guidelines "Best Practice Erosion and Sediment Control".
P6.	Development should not take place if it results in unsustainable use of surface or underground water resources.	✓	6.2	
P7.	Development should be sited and designed to: (a) capture and re-use stormwater, where practical (b) minimise surface water runoff (c) prevent soil erosion and water pollution (d) protect and enhance natural water flows (e) protect water quality by providing adequate separation distances from watercourses and other water bodies (f) not contribute to an increase in salinity levels (g) avoid the water logging of soil or the release of toxic elements (h) maintain natural hydrological systems and not adversely affect: (i) the quantity and quality of groundwater (ii) the depth and directional flow of groundwater (iii) the quality and function of natural springs.	✓	6.1, 6.2	
P8.	Water discharged from a development site should: (a) be of a physical, chemical and biological condition equivalent to or	✓	6.2	Appropriate stormwater management measures will be implemented. The project will have very limited impact on natural water flows. Drainage for much of the site

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	better than its pre-developed state (b) not exceed the rate of discharge from the site as it existed in pre-development conditions.			terminates internally and there is likely to be minimal change to off-site runoff volumes
P9.	Development should include stormwater management systems to protect it from damage during a minimum of a 1-in-100-year average return interval flood.	✓	6.2	
P10.	Development should have adequate provision to control any stormwater over-flow runoff from the site and should be sited and designed to improve the quality of stormwater and minimise pollutant transfer to receiving waters.	✓	6.2	
P11.	Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure the carrying capacities of downstream systems are not overloaded.	✓	6.2	
P12.	Development should include stormwater management systems to minimise the discharge of sediment, suspended solids, organic matter, nutrients, bacteria, litter and other contaminants to the stormwater system.	✓	6.2	
P13.	Stormwater management systems should preserve natural drainage systems, including the associated environmental flows.	✓	6.2	
P14.	Stormwater management systems should: (a) maximise the potential for stormwater harvesting and re-use, either on-site or as close as practicable to the source (b) utilise, but not be limited to, one or more of the following harvesting methods: (i) the collection of roof water in tanks (ii) the discharge to open space, landscaping or garden areas, including strips adjacent to car parks (iii) the incorporation of detention and retention facilities (iv) aquifer recharge.	✓	6.2	
P15.	Where it is not practicable to detain or dispose of stormwater on site, only clean stormwater runoff should enter the public stormwater drainage system.	✓	6.2	
P16.	Artificial wetland systems, including detention and retention basins, should be sited and designed to: (a) ensure public health and safety is protected (b) minimise potential public health risks arising from the breeding of mosquitoes.	N/A		There are no artificial wetlands in close proximity to the Project site.
Water Catchment Areas				

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P17.	Development should ensure watercourses and their beds, banks, wetlands and floodplains are not damaged or modified and are retained in their natural state, except where modification is required for essential access or maintenance purposes.	✓	6.2	Degraded ephemeral watercourses on site will not be significantly modified.
P18.	No development should occur where its proximity to a swamp or wetland will damage or interfere with the hydrology or water regime of the swamp or wetland.	✓	6.2	Surface profiles and natural drainage patterns will largely be maintained. No significant swamps or wetlands are present. Areas subject to inundation on the site are highly degraded and do not provide significant habitat.
P19.	A wetland or low-lying area providing habitat for native flora and fauna should not be drained, except temporarily for essential management purposes to enhance environmental values.	✓	6.2, 7.1, 7.2	
P20.	Along watercourses, areas of remnant native vegetation, or areas prone to erosion, that are capable of natural regeneration should be fenced off to limit stock access.	✓	6.2	Stock will not be able to access the site
P21.	Development such as cropping, intensive animal keeping, residential, tourism, industry and horticulture, that increases the amount of surface run-off should include a strip of land at least 20 metres wide measured from the top of existing banks on each side of a watercourse that is: (a) fenced to exclude livestock (b) kept free of development, including structures, formal roadways or access ways for machinery or any other activity causing soil compaction or significant modification of the natural surface of the land (c) revegetated with locally indigenous vegetation comprising trees, shrubs and other groundcover plants to filter run-off so as to reduce the impacts on native aquatic ecosystems and to minimise soil loss eroding into the watercourse.	✓	6.2	There will be increased impervious surfaces, primarily associated with infrastructure such as the substation and switchyard. This may result in increased runoff volumes and velocities within drains and surrounding environment. The Project will employ measures to minimize erosion which will include exclusion of livestock from the Project area and revegetation of cleared areas as soon as practicable.
P22.	Development resulting in the depositing of an object or solid material in a watercourse or floodplain or the removal of bank and bed material should not: (a) adversely affect the migration of aquatic biota (b) adversely affect the natural flow regime (c) cause or contribute to water pollution (d) result in watercourse or bank erosion (e) adversely affect native vegetation upstream or downstream that is growing in or adjacent to a watercourse.	✓	6.2	The Solar Project is not located in close proximity to a watercourse and is not expected to contribute to water pollution or bank erosion. The Pumped Hydro Project is situated in a highly modified watercourse environment. Rise will take all practicable measures to minimize pollution through development and implementation of the CEMP; minimize bank erosion with stabilization measures and re-vegetation where required; undertake aquatic fauna monitoring if needed.
P23.	The location and construction of dams, water tanks and diversion drains should: (a) occur off watercourse (b) not take place in ecologically sensitive areas or on erosion-prone sites (c) provide for low flow by-pass mechanisms to allow for migration of	✓		The Pumped Hydro Project involves the construction of a reservoir in hills above an existing SA Water reservoir. The area is not considered to be ecologically sensitive or erosion prone. Activities are not expected to impact on the overall catchment hydrology and therefore any impact on downstream users will be minimal. Some vegetation will be inundated by the reservoir; however, any vegetation impacts will be subject to an SEB.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	aquatic biota (d) not negatively affect downstream users (e) minimise in-stream or riparian vegetation loss (f) incorporate features to improve water quality (eg wetlands and floodplain ecological communities (g) protect ecosystems dependent on water resources.			
P24.	Irrigated horticulture and pasture should not increase groundwater-induced salinity.	N/A		The Project does not involve irrigated horticulture and pasture.
P25.	Development should comply with the current *Environment Protection (Water Quality) Policy*.	✓	6.2	The Project will comply with water quality criteria that is specified in the policy. The Project will also comply with general obligations to avoid discharge of pollutants to receiving water.
Biodiversity and Native Vegetation				
P26.	Development should retain existing areas of native vegetation and where possible contribute to revegetation using locally indigenous plant species.	✓	7.1, 7.2	Native vegetation present on the site is relatively degraded and higher value areas have been prioritized for avoidance. A 'significant environmental benefit' will be achieved to offset clearance. Refer to Sections 7.1 and 7.2 of the DA for a discussion of the fauna and flora present on site and the proposed mitigation measures to ensure their protection and conservation.
P27.	Development should be designed and sited to minimise the loss and disturbance of native flora and fauna, including marine animals and plants, and their breeding grounds and habitats.	✓	7.1, 7.2	
P28.	The provision of services, including power, water, effluent and waste disposal, access roads and tracks should be sited on areas already cleared of native vegetation.	✓	7.1, 7.2	
P29.	Native vegetation should be conserved and its conservation value and function not compromised by development if the native vegetation does any of the following: (a) provides an important habitat for wildlife or shade and shelter for livestock (b) has a high plant species diversity or includes rare, vulnerable or endangered plant species or plant associations and communities (c) provides an important seed bank for locally indigenous vegetation (d) has high amenity value and/or significantly contributes to the landscape quality of an area, including the screening of buildings and unsightly views (e) has high value as a remnant of vegetation associations characteristic of a district or region prior to extensive clearance for agriculture (f) is growing in, or is characteristically associated with a wetland environment.	✓	7.1, 7.2	
P30.	Native vegetation should not be cleared if such clearing is likely to lead to, cause or exacerbate any of the following: (a) erosion or sediment within water catchments (b) decreased soil stability	✓	7.1, 7.2	

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	(c) soil or land slip (d) deterioration in the quality of water in a watercourse or surface water runoff (e) a local or regional salinity problem (f) the occurrence or intensity of local or regional flooding.			
P31.	Development that proposes the clearance of native vegetation should address or consider the implications that removing the native vegetation will have on the following: (a) provision for linkages and wildlife corridors between significant areas of native vegetation (b) erosion along watercourses and the filtering of suspended solids and nutrients from run-off (c) the amenity of the locality (d) bushfire safety (e) the net loss of native vegetation and other biodiversity.	✓	7.1, 7.2	
P32.	Where native vegetation is to be removed, it should be replaced in a suitable location on the site with locally indigenous vegetation to ensure that there is not a net loss of native vegetation and biodiversity.	✓	7.1, 7.2	
P33.	Development should be located and occur in a manner which: (a) does not increase the potential for, or result in, the spread of pest plants, or the spread of any non-indigenous plants into areas of native vegetation or a conservation zone (b) avoids the degradation of remnant native vegetation by any other means including as a result of spray drift, compaction of soil, modification of surface water flows, pollution to groundwater or surface water or change to groundwater levels (c) incorporates a separation distance and/or buffer area to protect wildlife habitats and other features of nature conservation significance.	✓	7.1, 7.2	
P34.	Development should promote the long-term conservation of vegetation by: (a) avoiding substantial structures, excavations, and filling of land in close proximity to the trunk of trees and beneath their canopies (b) minimising impervious surfaces beneath the canopies of trees (c) taking other effective and reasonable precautions to protect both vegetation and the integrity of structures and essential services.	✓	7.1, 7.2	
P35.	Horticulture involving the growing of olives should be located at least: (a) 500 metres from: (i) a national park (ii) a conservation park (iii) a wilderness protection area	N/A		The Project does not include any horticultural activities.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	(iv) the edge of a substantially intact stratum of native vegetation greater than 5 hectares in area (b) 50 metres from the edge of stands of native vegetation 5 hectares or less in area.			
P36.	Horticulture involving the growing of olives should have at least one locally indigenous tree that will grow to a height of at least 7 metres sited at least every 100 metres around the perimeter of the orchard.	N/A		The Project does not include any horticultural activities.
Soil Conservation				
P37.	Development should not have an adverse impact on the natural, physical, chemical or biological quality and characteristics of soil resources.	✓	6.1	Development is not expected to have an adverse impact on soil resources. Generally, the area is not prone to erosion. Disturbance during construction will be minimized and storm water from the Project site will be captured to ensure erosion does not occur.
P38.	Development should be designed and sited to prevent erosion.	✓	6.1	
P39.	Development should take place in a manner that will minimise alteration to the existing landform.	✓	6.1	
P40.	Development should minimise the loss of soil from a site through soil erosion or siltation during the construction phase of any development and following the commencement of an activity.	✓	6.1	
Open Space and Recreation				
N/A – This has been excluded as the Project does not involve or relate to open space or recreation.				
Orderly and Sustainable Development				
N/A – This has been excluded as this relates to urban development.				
Renewable Energy Facilities				
O1.	Development of renewable energy facilities that benefit the environment, the community and the state.	✓	8.1	The Project involves development of a renewable energy facility and will benefit the environment, the community and the state.
O2.	The development of renewable energy facilities, such as wind farms and ancillary development, in areas that provide opportunity to harvest natural resources for the efficient generation of electricity.	✓	8.1	The Project is located in an area that maximises the generation and supply of electricity. It will have access to existing power transmission infrastructure, and SA water reservoir allowing for efficient generation of electricity.
O3.	Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment and other land uses.	✓	8.1	The Project site is located in an area of degraded native vegetation and the layout prioritises vegetation of higher habitat value for avoidance. The project will not have a significant adverse impact on adjacent land uses.
P1.	Renewable energy facilities, including wind farms and ancillary development, should be: (a) located in areas that maximize efficient generation and supply of electricity; and (b) designed and sited so as not to impact on the safety of water or air	✓	8.1	The Project is located in an area that maximises the generation and supply of electricity. It will have access to existing power transmission infrastructure, and SA Water reservoir allowing for efficient generation of electricity. The site is distant from any ports, airfields or landing strips and will not impact on their operation or safety.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	transport and the operation of ports, airfields and designated landing strips.			
Wind Farms and Ancillary Development				
P2	The visual impacts of wind farms and ancillary development (such as substations, maintenance sheds, access roads and wind monitoring masts) should be managed through: (a) wind turbine generators being: (i) setback at least 1000 metres from non-associated (non-stakeholder) dwellings and tourist accommodation (ii) setback at least 2000 metres from defined and zoned township, settlement or urban areas (including deferred urban areas) (iii) regularly spaced (iv) uniform in colour, size and shape and blade rotation direction (v) mounted on tubular towers (as opposed to lattice towers) (b) provision of vegetated buffers around substations, maintenance sheds and other ancillary structures.	N/A		The Project does not involve wind farms and ancillary development.
P3.	Wind farms and ancillary development should avoid or minimise the following impacts on nearby property owners / occupiers, road users and wildlife: (a) shadowing, flickering, reflection or glint (b) excessive noise (c) interference with television and radio signals and geographic positioning systems (d) interference with low altitude aircraft movements associated with agriculture (e) modification of vegetation, soils and habitats (f) striking of birds and bats.	N/A		The Project does not involve wind farms and ancillary development.
P4.	Wind turbine generators should be setback from dwellings, tourist accommodation and frequently visited public places (such as viewing platforms) a distance that will ensure that failure does not present an unacceptable risk to safety.	N/A		The Project does not involve wind farms and ancillary development.
Residential Development				
N/A – This has been excluded as the Project does not relate to or involve residential development.				
Short-Term Workers Accommodation				
N/A – This has been excluded as the Project does not relate or involve temporary accommodation.				
Siting and Visibility				

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
O1.	Protection of scenically attractive areas, particularly natural, rural and riverine landscapes.	✓	8.4	The Project is not located in a scenically attractive area and will utilize existing power transmission infrastructure.
P1.	Development should be sited and designed to minimise its visual impact on: (a) the natural, rural or heritage character of the area (b) areas of high visual or scenic value, particularly rural and coastal areas (c) views from the coast, near-shore waters, public reserves, tourist routes and walking trails (d) the amenity of public beaches.	✓	8.4	The Project is not located in an area of high visual or scenic value. The project is not visible from areas with high sensitivity to visual impacts and the Morgan-Renmark Road is not identified as a scenic route. Visual impact will be moderate-low.
P2.	Buildings should be sited in unobtrusive locations and, in particular, should: (a) be grouped together (b) where possible, be located in such a way as to be screened by existing vegetation.	✓	8.4	Buildings are grouped together and are several kilometres from the highway. They will be visible from some locations however roadside vegetation has been prioritized to be encouraged to provide some screening. Infrastructure associated with the Pumped Hydro Project (powerhouse and switchyard) will be located to the east of the current SA Water reservoir and visibility from public roads is minimal.
P3.	Buildings outside of urban areas and in undulating landscapes should be sited in unobtrusive locations and in particular should be: (a) sited below the ridgeline (b) sited within valleys or behind spurs (c) sited in such a way as to not be visible against the skyline when viewed from public roads (d) set well back from public roads, particularly when the allotment is on the high side of the road.	✓	8.4	
P4.	Buildings and structures should be designed to minimise their visual impact in the landscape, in particular: (a) the profile of buildings should be low and the rooflines should complement the natural form of the land (b) the mass of buildings should be minimised by variations in wall and roof lines and by floor plans which complement the contours of the land (c) large eaves, verandas and pergolas should be incorporated into designs so as to create shadowed areas that reduce the bulky appearance of buildings.	✓	8.4	Building height will be the minimum required to serve their required purpose. Colours and finishes will blend with the landscape as far as possible. No significant buildings are proposed. The Solar Project is sited to maximise the harvesting of the sun's energy. Solar panels will be approximately 1.5 to 2m in height above the ground. The upper reservoir will not be visible from sensitive receptors. Once complete, the penstock will be shallow buried and not be visible. Other infrastructure of the Pumped Hydro Project will be located in close proximity to the Baroota Reservoir and not visible from roads or sensitive receptors.
P5.	The nature of external surface materials of buildings should not detract from the visual character and amenity of the landscape.	✓	8.4	See response to P4.
P6.	The number of buildings and structures on land outside of urban areas should be limited to that necessary for the efficient management of the land.	✓	2.0	Infrastructure will be kept to the minimum required to meet the objectives of the Project.
P7.	Driveways and access tracks should be designed and surfaced to blend sympathetically with the landscape and to minimise interference with	✓	2, 6.1, 7.1	Access roads and tracks will be designed to follow the natural land surface as far as possible, minimise cut and fill and avoid more significant areas of native vegetation

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	natural vegetation and landforms.			/ habitat as far as possible.
P8.	Development should be screened through the establishment of landscaping using locally indigenous plant species: (a) around buildings and earthworks to provide a visual screen as well as shade in summer, and protection from prevailing winds (b) along allotment boundaries to provide permanent screening of buildings and structures when viewed from adjoining properties and public roads (c) along the verges of new roads and access tracks to provide screening and minimise erosion.	✓	2.0	Landscaping and screening will largely be provided by existing native vegetation that will either be retained or allowed to regenerate. Extensive landscaping is not proposed.
Sloping Land				
O1.	Development on sloping land designed to minimise environmental and visual impacts and protect soil stability and water quality.	✓	6.1, 6.2	Land identified for the solar farm is flat to gently undulating. Soil stability and water quality will be protected. The hills area of the Pumped Hydro Project includes slopes. Soil stability and water quality will be integrated into the Project design.
P1.	Development and associated driveways and access tracks should be sited and designed to integrate with the natural topography of the land and minimise the need for earthworks.	✓	6.1, 6.2	Access tracks will be situated as close as possible to infrastructure, and will be constructed to allow all weather access and will be sufficient in width to allow access by emergency services and maintenance crews. Access tracks will be designed to consider the natural topography of the land and minimize erosion
P2.	Development and associated driveways and access tracks, including related earthworks, should be sited, designed and undertaken in a manner that: (a) minimises their visual impact (b) reduces the bulk of the buildings and structures (c) minimises the extent of cut and/or fill (d) minimises the need for, and the height of, retaining walls (e) does not cause or contribute to instability of any embankment or cutting (f) avoids the silting of watercourses (g) protects development and its surrounds from erosion caused by water run-off.	✓	6.1, 6.2	
P3.	Driveways and access tracks across sloping land should be accessible and have a safe, all-weather trafficable surface.	✓	6.1, 6.2	
P4.	Development sites should not be at risk of landslip.	✓	6.1, 6.2	
P5.	Development on steep land should include site drainage systems to minimise erosion and avoid adverse impacts on slope stability.	✓	6.1, 6.2	
P6.	Steep sloping sites in unsewered areas should not be developed unless the physical characteristics of the allotments enable the proper siting and operation of an effluent drainage field suitable for the	N/A		No sewage infrastructure will be located on steep slopes.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	development intended.			
P7.	The cutting and/or filling of land outside townships and urban areas should: (a) be kept to a minimum and be limited to a maximum depth or height no greater than 1.5 metres so as to preserve the natural form of the land and the native vegetation (b) only be undertaken in order to reduce the visual impact of buildings, including structures, or in order to construct water storage facilities for use on the allotment (c) only be undertaken if the resultant slope can be stabilised to prevent erosion (d) result in stable scree slopes which are covered with top soil and landscaped so as to preserve and enhance the natural character or assist in the re-establishment of the natural character of the area.	✓	6.1, 6.2	See above, P1
Supported Accommodation and Housing for Seniors				
N/A – This has been excluded as the Project does not involve or relate to supported accommodation and housing for seniors.				
Telecommunications Facilities				
O1.	Telecommunications facilities provided to deliver communication services to the community.	N/A		The Project does not relate to provision of telecommunications facilities.
O2.	Telecommunications facilities sited and designed to minimise visual impact on the amenity of the local environment.	N/A		Any telecommunications infrastructure installed for the project would not be expected to impact visual amenity.
P1.	Telecommunications facilities should: (a) be located in a coordinated manner to deliver communication services efficiently (b) use materials and finishes that minimise visual impact (c) have antennae located as close as practical to the support structure (d) be located primarily in industrial, commercial, business, office, centre and rural zones (e) where technically feasible, be co-located with other telecommunications facilities (f) incorporate landscaping to screen the development, particularly equipment shelters and huts (g) be designed and sited to minimise the visual impact on the character and amenity of the local environment, in particular visually prominent areas, main focal points and significant vistas.	N/A		The Project does not specifically relate to telecommunications, nor, is it sited in a residential zone.
P2.	Telecommunications facilities in areas of high visitation and community use should use innovative design techniques (eg sculpture and other artworks) where possible and where the resulting design would	N/A		

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	positively contribute to the character of the area.			
P3.	Telecommunications facilities should be located in residential zones only if sited and designed to minimise visual impact by: (a) using existing buildings and vegetation for screening (b) incorporating the facility within an existing structure that may serve another purpose (c) taking into account the size, scale, context and characteristics of existing structures, landforms and vegetation so as to complement the local environment.	N/A		
P4.	Telecommunications facilities should not have a direct or significant effect on the amenity, character and settings of Historic Conservation Areas, local heritage places, State heritage places or State Heritage Areas.	N/A		
Tourism Development				
N/A – This has been excluded as the Project does not relate or involve any tourism development.				
Transportation and Access				
O1.	A comprehensive, integrated, affordable and efficient air, rail, sea, road, cycle and pedestrian transport system that will: (a) provide equitable access to a range of public and private transport services for all people (b) ensure a high level of safety (c) effectively support the economic development of the State (d) have minimal negative environmental and social impacts (e) maintain options for the introduction of suitable new transport technologies.	✓	8.5	Construction and operational vehicles will use the existing road network and will enter the Project site from Reservoir Road.
O2.	Development that: (a) provides safe and efficient movement for all motorised and non-motorised transport modes (b) ensures access for vehicles including emergency services, public infrastructure maintenance and commercial vehicles (c) provides off street parking (d) is appropriately located so that it supports and makes best use of existing transport facilities and networks.	✓	8.5	Site access, the internal access network and provision of onsite parking will be designed to meet project requirements.
O3.	A road hierarchy that promotes safe and efficient transportation in an integrated manner throughout the State.	✓	8.5	The Project supports the road hierarchy.
O4.	Provision of safe, pleasant, accessible, integrated and permeable pedestrian and cycling networks.	N/A		The Project will not be open to the public. The Project will provide adequate walkways within the facility to allow safe movement by pedestrians. Cyclists will not be allowed onsite.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
O5.	Safe and convenient freight movement throughout the State.	✓	8.5	Freight movement associated with the Project will comply with all relevant road laws and ensure safe freight movement throughout the State.
Land Use				
P1.	Land uses arranged to support the efficient provision of sustainable transport networks and encourage their use.	✓	8.5	The Project will not affect existing transport networks. There will be an increase in traffic during construction, with a minor increase during the operation phase.
Movement Systems				
P2.	Development should be integrated with existing transport networks, particularly major rail and road corridors as shown on *Location Maps* and *Overlay Maps - Transport*, and designed to minimise its potential impact on the functional performance of the transport networks.	✓	8.5	According to *Overlay Map MtR/6-Transport*, the roads to the Project site are not identified as either primary or secondary arterial roads.
P3.	Transport corridors should be sited and designed so as to not unreasonably interfere with the health and amenity of adjacent sensitive land uses.	N/A		The Project does not involve a transport corridor.
P4.	Roads should be sited and designed to blend with the landscape and be in sympathy with the terrain.	✓	8.5	The access road and internal access tracks will generally blend with the landscape. Where possible they will be non-intrusive.
P5.	Land uses that generate large numbers of visitors such as shopping centres and areas, places of employment, schools, hospitals and medium to high density residential uses should be located so that they can be serviced by existing transport networks and encourage walking and cycling.	N/A		The Project does not relate to provision of these types of facilities.
P6.	Development generating high levels of traffic, such as schools, shopping centres and other retail areas, entertainment and sporting facilities, should incorporate passenger pick-up and set down areas. The design of such areas should ensure interference to existing traffic is minimised and give priority to pedestrians, cyclists and public and community transport users.	N/A		The Project does not relate to provision of these types of facilities.
P7.	The location and design of public and community transport set-down and pick-up points should maximise safety and minimise the isolation and vulnerability of users.	N/A		The Project does not relate to provision of these types of facilities.
P8.	Development should provide safe and convenient access for all anticipated modes of transport including cycling, walking, public and community transport, and motor vehicles.	N/A		Access roads and carparks will be constructed to safely meet the requirements of the Project.
P9.	Development at intersections, pedestrian and cycle crossings, and crossovers to allotments should maintain or enhance sightlines for motorists, cyclists and pedestrians to ensure safety for all road users and pedestrians.	✓	8.5	Traffic management measures will be implemented to ensure that traffic impacts during construction are minimised. Traffic during operation will be very low.
P10.	Driveway cross-overs affecting pedestrian footpaths should maintain the level of the footpath.	N/A		There are no public pedestrian footpaths. Access between buildings for Project personnel will be provided as required and maintained.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P11.	Development should discourage commercial and industrial vehicle movements through residential streets and adjacent other sensitive land uses such as schools.	N/A		The Project is not located in proximity to residential streets or sensitive uses.
P12.	Industrial/commercial vehicle movements should be separated from passenger vehicle car parking areas.	✓	8.5	Car-parking will be provided within the Project area. Where possible, industrial/commercial vehicles will be separated from passenger vehicle parking areas.
P13.	Development should make sufficient provision on site for the loading, unloading and turning of all traffic likely to be generated.	✓	8.5	Traffic management measures will be implemented to ensure that traffic impacts during construction are minimised. Traffic during operation will be very low.
Cycling and Walking				
P14.	Development should ensure that a permeable street and path network is established that encourages walking and cycling through the provision of safe, convenient and attractive routes with connections to adjoining streets, paths, open spaces, schools, public transport stops and activity centres.	N/A		The Project does not involve a street or path network. It will not be publicly accessible and no specific cycle or pedestrian facilities or networks are proposed.
P15.	Development should provide access, and accommodate multiple route options, for cyclists by enhancing and integrating with open space networks, recreational trails, parks, reserves and recreation areas.	N/A		
P16.	Cycling and pedestrian networks should be designed to be permeable and facilitate direct and efficient passage to neighbouring networks and facilities.	N/A		
P17.	New developments should give priority to and not compromise existing designated bicycle routes.	N/A		
P18.	Where development coincides with, intersects or divides a proposed bicycle route or corridor, development should incorporate through-access for cyclists.	N/A		
P19.	Developments should encourage and facilitate cycling as a mode of transport by incorporating end-of-journey facilities including: (a) showers, changing facilities, and secure lockers (b) signage indicating the location of bicycle facilities (c) secure bicycle parking facilities.	N/A		
P20.	Pedestrian facilities and networks should be designed and provided in Accordance with relevant provisions of the *Australian Standards and Austroads Guide to Traffic Engineering Practice Part 13*.	N/A		
P21.	Cycling facilities and networks should be designed and provided in accordance with the relevant provisions of the Australian Standards and *Austroads Guide to Traffic Engineering Practice Part 14*.	N/A		
Access				
P22.	Development should have direct access from an all-weather public road.	✓	8.5	The main access point to the Project site will be along Reservoir Road, which is an all-weather public road.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P23.	Development should be provided with safe and convenient access which: (a) avoids unreasonable interference with the flow of traffic on adjoining roads (b) accommodates the type and volume of traffic likely to be generated by the development or land use and minimises induced traffic through over-provision (c) is sited and designed to minimise any adverse impacts on the occupants of and visitors to neighbouring properties.	✓	8.5	The Project will be accessible via Reservoir Road. Traffic management measures will be implemented to ensure that traffic impacts during construction are minimised. Traffic during operation will be very low.
P24.	Development should not restrict access to publicly owned land.	✓	8.5	The Project will not restrict access to publicly owned land.
P25.	The number of vehicle access points onto arterial roads shown on *Overlay Maps - Transport* should be minimised, and where possible access points should be: (a) limited to local roads (b) shared between developments.	✓	8.5	No new access points onto arterial roads are proposed.
P26.	The number of access points for cyclists and pedestrians onto all adjoining roads should be maximised.	N/A		The Project is not expected to provide cycling and pedestrian provisions or facilities, aside from pedestrian facilities onsite to allow movement between the carpark and buildings/infrastructure. The Project is located in a rural area not within close proximity to residential areas.
P27.	Development with access from arterial roads or roads as shown on *Overlay Maps - Transport* should be sited to avoid the need for vehicles to reverse on to the road.	✓	8.5	Traffic Impact Assessment has been undertaken for the Project. Vehicles will not be required to reverse on to the road at any time.
P28.	Driveways, access tracks and parking areas should be designed and constructed to: (a) follow the natural contours of the land (b) minimise excavation and/or fill (c) minimise the potential for erosion from run-off (d) avoid the removal of existing vegetation (e) be consistent with *Australian Standard AS 2890 Parking facilities*.	✓	2.0, 6.1, 7.1	Access roads and tracks will be designed to follow the natural land surface as far as possible, minimising cut and fill and avoiding more significant areas of native vegetation / habitat as far as possible. Parking facilities will be consistent with Australian Standard AS 2890.
Access for People with Disabilities				
P29.	Development should be sited and designed to provide convenient access for people with a disability.	✓	4.1.1	Any site access features and buildings will be designed in accordance with Australian Building Code requirements.
P30.	Where appropriate and practical, development should provide for safe and convenient access to the coast and beaches for disabled persons.	N/A		The Project is not located in a coastal location and therefore this does not apply to the application.
Vehicle Parking				
P31.	Development should provide off-street vehicle parking and specifically marked disabled car parking places to meet anticipated demand in accordance with *Table MtR/1 - Off Street Vehicle Parking Requirements*.	✓	8.5	On-site parking will be provided in accordance with these requirements. Car park surfacing will be fit for purpose.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
P32.	Development should be consistent with *Australian Standard AS 2890 Parking facilities*.	✓	8.5	Parking facilities will be consistent with *Australian Standard AS 2890 Parking facilities*.
P33.	Vehicle parking areas should be sited and designed in a manner that will: (a) facilitate safe and convenient pedestrian linkages to the development and areas of significant activity or interest in the vicinity of the development (b) include safe pedestrian and bicycle linkages that complement the overall pedestrian and cycling network (c) not inhibit safe and convenient traffic circulation (d) result in minimal conflict between customer and service vehicles (e) avoid the necessity to use public roads when moving from one part of a parking area to another (f) minimise the number of vehicle access points to public roads (g) avoid the necessity for backing onto public roads (h) where reasonably possible, provide the opportunity for shared use of car parking and integration of car parking areas with adjoining development to reduce the total extent of vehicle parking areas and the requirement for access points (i) not dominate the character and appearance of a centre when viewed from public roads and spaces (j) provide landscaping that will shade and enhance the appearance of the vehicle parking areas.	✓	8.5	Vehicle parking areas will be provided in accordance with these requirements, where applicable.
P34.	Vehicle parking areas should be designed to reduce opportunities for crime by: (a) maximising the potential for passive surveillance by ensuring they can be overlooked from nearby buildings and roads (b) incorporating walls and landscaping that do not obscure vehicles or provide potential hiding places; (c) being appropriately lit (d) having clearly visible walkways.	✓	8.5	The Project area will not be publicly accessible. Security measures such as CCTV and perimeter fencing will be installed. Parking areas will be visible from site offices.
P35.	Where parking areas are not obviously visible or navigated, signs indicating the location and availability of vehicle parking spaces associated with businesses should be displayed at locations readily visible to customers.	✓	8.5	All parking areas will be known to employees and appropriately signed for visitors.
P36.	Parking areas that are likely to be used during non-daylight hours should provide floodlit entrance and exit points and site lighting directed and shaded in a manner that will not cause nuisance to adjacent properties or users of the car park.	✓	8.4	Lighting will be provided for parking areas.
P37.	Parking areas should be sealed or paved in order to minimise dust and	✓	2.2,	The final form of parking areas will be determined during the final design phase.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	mud nuisance.		2.3	
P38.	To assist with stormwater detention and reduce heat loads in summer, vehicle parking areas should include soft (living) landscaping.	✓	2.2, 2.3	Car parking area will be designed and landscaped to minimise stormwater runoff and reduce heat loads.
P39.	Parking areas should be line-marked to indicate parking bays, movement aisles and direction of traffic flow.	✓	2.2, 2.3	Parking areas will be designed to standards.
Waste				
O1.	Development that, in order of priority, avoids the production of waste, minimises the production of waste, reuses waste, recycles waste for reuse, treats waste and disposes of waste in an environmentally sound manner.	✓	2.4.13	Waste will be managed in accordance with the waste management hierarchy.
O2.	Development that includes the treatment and management of solid and liquid waste to prevent undesired impacts on the environment including, soil, plant and animal biodiversity, human health and the amenity of the locality.	✓	2.4.13	Treatment and management of solid and liquid wastes will prevent undesired impacts on the environment.
P1.	Development should be sited and designed to prevent or minimise the generation of waste (including wastewater) by applying the following waste management hierarchy in the order of priority as shown below: (a) avoiding the production of waste (b) minimising waste production (c) reusing waste (d) recycling waste (e) recovering part of the waste for re-use (f) treating waste to reduce the potentially degrading impacts (g) disposing of waste in an environmentally sound manner.	✓	2.4.13	Waste will be managed in accordance with the waste management hierarchy and an environmental management plan. Treatment and management of solid and liquid wastes will prevent undesired impacts on the environment. Any waste will be disposed of safely in accordance with South Australian regulations and spill kits will be provided in hazardous material storage areas.
P2.	The storage, treatment and disposal of waste materials from any development should be achieved without risk to health or impairment of the environment.	✓	2.4.13	
P3.	Development should avoid as far as practical, the discharge or deposit of waste (including wastewater) onto land or into any waters (including processes such as seepage, infiltration or carriage by wind, rain, sea spray, stormwater or by the rising of the water table).	N/A		Waste generated during the construction or operational phase is not anticipated to be discharged or deposited onto land or into any waters. Any waste will be disposed of safely in accordance with South Australian regulations and spill kits will be provided in hazardous material storage areas.
P4.	Untreated waste should not be discharged to the environment, and in particular to any water body.	✓	2.2.3 2.3.3	A waste storage area will be located in the Project area, where waste will be stored and removed by licenced waste contractors.
P5.	Development should include appropriately sized area to facilitate the storage of receptacles that will enable the efficient recycling of waste.	✓	2.2.3 2.3.3	The waste storage area will include an area for recyclable material only.
P6.	Development that involves the production and/or collection of waste and/or recyclable material should include designated collection and storage area(s) that are: (a) screened and separated from adjoining areas	✓	2.2.3 2.3.3	Appropriate management measures will be implemented for designated waste storage and collection areas.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	(b) located to avoid impacting on adjoining sensitive environments or land uses (c) designed to ensure that wastes do not contaminate stormwater or enter the stormwater collection system (d) located on an impervious sealed area graded to a collection point in order to minimise the movement of any solids or contamination of water (e) protected from wind and stormwater and sealed to prevent leakage and minimise the emission of odours (f) stored in such a manner that ensures that all waste is contained within the boundaries of the site until disposed of in an appropriate manner.			
Wastewater				
P7.	The disposal of wastewater to land should only occur where methods of wastewater reduction and reuse are unable to remove the need for its disposal, and where its application to the land is environmentally sustainable.	✓	2.2.3 2.3.3	Operational wastewater management is expected to use septic tanks, but may use an approved on-site wastewater treatment system if appropriate.
P8.	Wastewater lagoons should not be sited in any of the following areas: (a) within land subject to a 1-in-100-year average return interval flood event (b) within 50 metres of the top of the bank of a watercourse (c) within 500 metres of the coastal high-water mark (d) where the base of the lagoon would be below any seasonal water table.	N/A		No wastewater lagoons are proposed.
P9.	Artificial wetland system for the storage of treated wastewater, such as wastewater laggons, should be: (a) sufficiently separated from adjoining sensitive uses to minimise potential adverse odour impacts. (b) sited and designed to minimise potential public health risks arising from the breeding of mosquitoes.	N/A		No wastewater treatment on site is proposed.
Waste Treatment Systems				
P10.	Development that produces any sewage or effluent should be connected to a waste treatment system that complies with (or can comply with) the relevant public and environmental health legislation applying to that type of system.	✓	2.2.3 2.3.3	Operational wastewater management is expected to use septic tanks, but may use an approved on-site wastewater treatment system if appropriate.
P11.	The methods for, and siting of, effluent and waste storage, treatment and disposal systems should minimise the potential for environmental harm and adverse impacts on: (a) the quality of surface and groundwater resources	✓	2.2.3 2.3.3	If an approved on-site wastewater treatment system is used, these criteria will be met

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	(b) public health (c) the amenity of a locality (d) sensitive land uses.			
P12.	Waste treatment should only occur where the capacity of the treatment facility is sufficient to accommodate likely maximum daily demands including a contingency for unexpected high flows and breakdowns.	✓	2.2.3 2.3.3	
P13.	Any on-site wastewater treatment system/ re-use system or effluent drainage field should be located within the allotment of the development that it will service.	✓	2.2.3 2.3.3	
P14.	A dedicated on-site effluent disposal area should not include any areas to be used for, or could be reasonably foreseen to be used for, private outdoor open space, driveways, car parking or outbuildings.	✓	2.2.3 2.3.3	If an approved on-site wastewater treatment system is used, it will not be located in any of the listed areas.
P15.	The spreading or discharging of treated liquid or solid waste onto the ground should only occur where the disposal area consists of soil and vegetation that has the capacity to store and use the waste without contaminating soil or surface or ground water resources or damaging crops.	N/A		Operational wastewater management is expected to use septic tanks, but may use an approved on-site wastewater treatment system if appropriate. It is not known at this time if spreading or discharge of solids will be required.
P16.	Stock slaughter works, poultry processors, saleyards, piggeries, cattle feedlots, milking sheds, milk processing works, fish processing works, wineries, distilleries, tanneries and fellmongeries, composting works and concrete batching works should have a wastewater management system that is designed so as not to discharge wastes generated by the premises: (a) into any waters (b) onto land in a place where it is reasonably likely to enter any waters by processes such as: (i) seepage (ii) infiltration (iii) carriage by wind, rain, sea spray, or stormwater (iv) the rising of the watertable.	N/A		The project does not relate to provision of these types of facilities.
P17.	Winery waste management systems should be designed to ensure: (a) surface runoff does not occur from the wastewater irrigation area at any time (b) wastewater is not irrigated onto waterlogged areas, land within 50 metres of a creek, or swamp or domestic or stock water bore, or land subject to flooding, steeply sloping land, or rocky or highly permeable soil overlaying an unconfined aquifer (c) wastewater is not irrigated over an area which is within 50 metres of any residence on neighbouring land or 10 metres of any type of publicly	N/A		The project does not relate to provision of these types of facilities.

Table 1 – Response to the Mount Remarkable Council Development Plan – General Section

No	Objective / Principle	Not at variance	DA Ref.	Response
	owned land (d) wastewater is released using low trajectory low pressure sprinklers, drip irrigators or agricultural pipe, and is not sprayed more than 1.5 metres into the air or in fine droplets if there is a potential for the spread of diseases from the wastewater (e) stormwater run-off from areas which are contaminated with grape or grape products is drained to winery waste management systems during vintage periods (f) stormwater from roofs and clean hard paved surfaces is diverted away from winery waste management systems and disposed of in an environmentally sound manner or used for productive purposes.			
Waste Management Facilities				
N/A – The proposal does not constitute a waste management facility.				

Table 2 – Response to the Mount Remarkable Council Development Plan – Rural Landscape Protection Zone (Agriculture and Conservation)

No	Objective / Principle	Not at variance	DA Ref.	Response
Rural Landscape Protection Zone				
Objectives				
O1.	Preservation of the natural and rural character and scenic features of the zone.	✓	2.2, 2.3	The solar farm will be constructed on land which is currently used for cropping and grazing. It is not expected to impact on the natural, rural character and scenic features of the zone.
O2.	Low-intensity rural activities on large land holdings.	✓	2.2, 2.3, 8.1	The Project is not expected to significantly impact on existing rural activities or land holdings.
O3.	Tourist facilities, attractions, and accommodation that are secondary to farming and blend with the natural environment.	N/A		The Project does not include the construction of these types of facilities.
O4.	Development that contributes to the desired character of the zone.	✓	2.2, 2.3	The Project will take advantage of existing infrastructure in the area and further develop this to establish a renewable energy source for South Australia.
Desired Character				
DC	Because of their soils and rainfall, the South Flinders Ranges feature an intensive pattern of traditional land uses. The ranges support a mixture of primary production including, grazing, mixed farming, cropping, forestry, horticulture and agriculture, with potential for other crops, depending on rural economics. There are extensive water catchments in the zone which require careful management.	✓	2.2, 2.3	The Project will utilize one of the water catchments in the zone, installing an additional reservoir which will enable the operation of a pumped hydro plant which will provide South Australia with a low impact renewable source of electricity. It is not expected to influence other land uses within the zone.
DC	The land settlement pattern based on this mixed land use has resulted in generally freehold land, small holdings and some demand for land division, as well as a demand for a range of buildings and structures associated with established rural activities.	✓	2.2, 2.3	This Project is not expected to impact on the land settlement pattern for this zone.
DC	Although tourists frequent the parks and established caravan parks in the zone, the extent of freehold land minimises the problems of tourist trespass.	N/A		This Project is not expected to influence current tourism issues in the zone.
DC	The conservation of the scenic, scientific and heritage features of the South Flinders Ranges environment is intended as the paramount objective when assessing future development proposals in the zone. There has been a long-standing, harmonious balance between the needs of conservation and rural activities in this part of the ranges and it is intended that this continues and not be put at risk by new forms of development.	✓	2.2, 2.3	This Project intends to capitalize on existing infrastructure in the zone and further develop this to provide a clean source of energy for the region and South Australia.
DC	It is important that policies determined for the zone recognise that ongoing primary production is a worthy and integral component of the South Flinders Ranges environment.	N/A		This Project does not propose to alter any existing policies or develop new ones.
Desired Character-Precinct 1 Agriculture				
DC	This precinct comprises predominantly farming areas east of the uplands which has been mainly cleared for rural production, includes the foothills and open range hills which provide an attractive	✓	2.3	The Solar Project will be located in this zone. It will not impact on any of the current land uses of the precinct. The Project is small scale and will support existing activities through the supply of electricity.

Table 2 – Response to the Mount Remarkable Council Development Plan – Rural Landscape Protection Zone (Agriculture and Conservation)

No	Objective / Principle	Not at variance	DA Ref.	Response
	foreground to the more spectacular ranges behind. The area is characterised by a mixture of rural activities such as cropping and grazing, horticulture, and forestry, which reflect the superior soils and rainfall of this part of the Flinders Ranges.			
Desired Character-Precinct 2 Conservation				
DC	This precinct comprises scenic uplands and grazing lands is of high environmental value and includes outstanding scenery. It embraces scenic lookouts, gorges and includes some large grazing properties in freehold ownership. In preserving the environment of this precinct, development needs to be sensitive to its landscape, scientific and heritage features.	✓	2.2	The Pumped Hydro Project will be located in this zone. No changes in scenic values scientific or heritage features is expected. The Project is small scale and will support existing activities through the supply of electricity.
Principles of Development Control				
Land Use				
P1.	The following forms of development are envisaged in the zone: ▪ detached dwelling and a building associated with farming activities ▪ low intensity farming and grazing ▪ recreation and tourist infrastructure for the interpretation and appreciation of the natural features of the zone ▪ supplementation of existing farming activities through small scale tourist accommodation: - in the form of hikers' huts and associated facilities for no more than 5 persons - eco-style accommodation for no more than 5 persons - within an existing building, or - in the form of farm stay, guesthouse, rural or nature retreat or bed and breakfast accommodation as an integral part of a group of farm buildings.	N/A		The Project is not included in the list of envisaged activities for the Zone, however it is not expected to impact on any of the listed activities.
P2.	Development listed as non-complying is generally inappropriate.	N/A		Solar farms and hydro plants are not included in the list of non-complying Development.
P3.	A shop should: (a) be ancillary to primary production or processing uses, or tourist accommodation or other tourist development (b) be located on the same site as the primary use (c) have a gross leasable area that does not exceed 20 square metres.	N/A		The Project does not include the construction of a shop.
P4.	A dwelling should only be developed if: (a) there is a demonstrated connection with farming or other primary production or ancillary to a tourist related use (b) the location of the dwelling will not inhibit the continuation of farming, other primary production or other development that is in	N/A		The Project does not include the construction of a dwelling.

Table 2 – Response to the Mount Remarkable Council Development Plan – Rural Landscape Protection Zone (Agriculture and Conservation)

No	Objective / Principle	Not at variance	DA Ref.	Response
	keeping with the provisions of the zone (c) it is located more than 500 metres from an existing intensive animal keeping operation unless used in association with that activity (d) it does not result in more than one dwelling per allotment.			
P5.	Borrow pits should be unobtrusively sited to retain the scenic amenity and natural qualities of the zone.	N/A		The Project will not involve the construction of borrow pits
Form and Character				
P6.	Development should not be undertaken unless it is consistent with the desired character for the zone.	✓		Solar farms and hydro plants are not described in the desired character for the zone, however it is not expected that the development of these facilities will impact on the Desired Character.
P7.	The excavation and/or filling of land should: (a) be no greater than 1.5 metres from natural ground level (b) (b) only be undertaken in order to reduce the visual impact of buildings or structures or to construct water storage facilities for use on the allotment (c) (c) result in stable scree slopes that are covered with topsoil and landscaped so as to preserve and enhance or assist in the re-establishment of, the natural character of the locality.	✓		The Solar Project does not involve excavation and /or filling of land.
P8.	Re-vegetation and screen planting proposed as part of development should use locally indigenous native species.	✓		Re-vegetation will be undertaken with locally indigenous species as required.
Land Division				
P9.	Land division should not be undertaken except where it will facilitate the retention of native vegetation on a single allotment and provided no additional allotments are created.	N/A		The Project does not include the division of land.
Precinct Specific Provision				
Precinct 1 Agriculture				
P10.	Development should not be undertaken unless it is consistent with the desired character for the precinct.	✓		Solar farms and hydro plants are not described in the desired character for the zone, however it is not expected that the development of these facilities will impact on the Desired Character.
P11.	Development should ensure the conservation of the scenic landscape and rural character, and the scientific and heritage features of the precinct.	✓		The Project is not expected to impact on the scenic landscape, rural character or other features of the landscape.
Precinct 2 Conversation				
P12.	Development should not be undertaken unless it is consistent with the desired character for the precinct.	✓		Solar farms and hydro plants are not described in the desired character for the zone, however it is not expected that the development of these facilities will impact on the Desired Character.
P13.	Development that is not a necessary part of conservation or pastoral activities should not be undertaken to ensure that the natural character and the scenic, scientific, and heritage features of the area are maintained.	✓		Solar farms and hydro plants are not described in the desired character for the zone, however it is not expected that the development of these facilities will impact on the Desired Character.

Table 2 – Response to the Mount Remarkable Council Development Plan – Rural Landscape Protection Zone (Agriculture and Conservation)

No	Objective / Principle	Not at variance	DA Ref.	Response
P14.	Borrow pits should not be developed.	N/A		The Project will not involve the construction of borrow pits.

Table 2 – Response to the Mount Remarkable Council Development Plan – Primary Production Zone

No	Objective / Principle	Not at variance	DA Ref.	Response
Primary Production Zone				
Objectives				
O1.	Economically productive, efficient and environmentally sustainable primary production.	N/A		The Project does not include primary production. Only part of the allotments to be used for the solar project is currently used for primary production. The use of this land for a use other than primary production will not adversely affect the region or local landowners.
O2.	Allotments of a size and configuration that promote the efficient use of land for primary production.	N/A		The Project does not involve primary production.
O3.	Protection of primary production from encroachment by incompatible land uses and protection of scenic qualities of rural landscapes.	✓	8.1	The solar farm will be constructed on land which is currently used for cropping and grazing. It is not expected to impact on the natural, rural character and scenic features of the zone.
O4.	Accommodation of wind farms and ancillary development	✓	8.1	The Project does not involve wind farms and ancillary development. The project involves development of a renewable energy facility and is located in an area that maximises the generation and supply of electricity. It will have access to existing power transmission infrastructure, and SA water reservoir allowing for efficient generation of electricity.
O5	Development that contributes to the desired character of the zone.	✓	8.1	The Project will take advantage of existing infrastructure in the area and further develop this to establish a renewable energy source for South Australia. Solar farms and hydro plants are not described in the desired character for the zone, however it is not expected that the development of these facilities will impact on the Desired Character
Desired Character				
DC	The zone covers most of the council area and contains a diversity of physical features and agricultural, pastoral and rural related activities. The range of soil types, rainfall and terrain provide the basis for broadacre pastoral activities in the northern part of the zone, cereal growing and grazing primarily on the plains, and dairying, horticulture, agriculture and other forms of farming adjacent to the Southern Flinders Ranges. It is desirable that the zone continues to maintain a diversity of activities suited to the terrain, rainfall and capability of the land. Retention of agricultural productivity by preserving or increasing rural property holdings will be an important consideration in ensuring that the established rural character is maintained. There is however some opportunity for small scale low impact commercial and industrial development.	✓	2.3	The Project is not expected to impact on the current zone activities and features. The Solar Project is low-impact with the majority of the project on freehold land which is not currently used for primary production.
DC	A considerable portion of the zone is situated between National Highway 1 (to the west) and Main North Road (to the east). A dominant feature and setting are the Southern Flinders Ranges, and this area is crucial in allowing for a natural view of the Ranges. It is important that	✓	8.4	The Solar Project will not impact on views to the Ranges. The visual impact assessment indicates that due to the undulating topography of the coastal plains, the localised relief will be effective in reducing visual impact for sensitive receptors of the solar project.

Table 2 – Response to the Mount Remarkable Council Development Plan – Primary Production Zone

No	Objective / Principle	Not at variance	DA Ref.	Response
	new development does not impair this view.			
DC	Numerous creeks lined with mature vegetation, together with roadside vegetation enhance the district's rural character. These features should be preserved.	✓		The Project is not expected to impact on roadside vegetation. It is expected that any significant tree located within the Project area will be retained.
DC	A mixture of allotment sizes prevail, including a large number of smaller rural sections in proximity to settlements. Many of these allotments have not developed to any significant extent and could desirably be amalgamated and returned to pastoral or agricultural use. Small settlements include Hammond, Bruce, Mambray Creek, Wongyarra and Willowie. There are also unoccupied government towns, some of which were established as roads or railways extended throughout the rural area. The Moockra tower is a key landmark and any buildings or structures in its vicinity need careful design and placement so as not to impair the landmark qualities of the tower.	N/A		The Project is not expected to impact on the land settlement pattern or key landmarks for this zone.
DC	Several important roads and railways, including the National Highway, traverse the zone. It is desirable that development adjacent to primary and secondary arterial roads is established and developed in a manner which preserves the rural character and, if buildings and structures are visible, it is important that they are unobtrusive.	✓	8.2	The Project is expected to have a moderate-low visual impact on the landscape. The project will not be visible to a significant portion of the public in the region and the topography and surrounding vegetation will limit the direct line of sight to residents and road users.
DC	Underground water resources, particularly the Willochra basin and the Baroota Prescribed Wells Area should be protected. It is desirable that activities liable to cause deterioration in water quality not be established in these areas.	✓	6.2	The Solar Project will not impact on underground water resources.
DC	Wind farms and ancillary development such as substations, maintenance sheds, access roads and connecting power-lines (including to the National Electricity Grid) are envisaged within the zone and constitute a component of the zone's desired character. These facilities will need to be located in areas where they can take advantage of the natural resource upon which they rely and, as a consequence, components (particularly turbines) may need to be: • located in visually prominent locations such as ridgelines • visible from scenic routes and valuable scenic and environmental areas • located closer to roads than envisaged by generic setback policy. This, coupled with the large scale of these facilities (in terms of both height and spread of components), renders it difficult to mitigate the visual impacts of wind farms to the degree expected of other types of development. Subject to implementation of management techniques set out by general / council wide policy regarding renewable energy facilities, these visual impacts are to be accepted in pursuit of benefits	✓	8.2	The project involves development of a renewable energy facility and will benefit the environment, the community and the state. The Project is located in an area that maximises the generation and supply of electricity. It will have access to existing power transmission infrastructure, and SA water reservoir allowing for efficient generation of electricity. All infrastructure for the solar project will be located on the plains and not in visually prominent locations such as ridgelines and scenic routes.

Table 2 – Response to the Mount Remarkable Council Development Plan – Primary Production Zone

No	Objective / Principle	Not at variance	DA Ref.	Response
	derived from increased generation of renewable energy			
Principles of Development Control				
Land Use				
P1	The following forms of development are envisaged in the zone: • bulk handling and storage facility • commercial forestry • farming • horticulture • intensive animal keeping • tourist accommodation (including through the diversification of existing farming activities and conversion of farm buildings). • wind farm and ancillary development • wind monitoring and ancillary development.	N/A		The Project is not included in the list of envisaged activities for the Zone, however it is not expected to impact on any of the listed activities.
P2	Development listed as non-complying is generally inappropriate.	N/A		Solar farms and hydro plants are not included in the list of non-complying Development.
P3	Wind farms and ancillary development should be located in areas which provide opportunity for harvesting of wind and efficient generation of electricity and may therefore be sited: (a) in visually prominent locations (b) closer to roads than envisaged by generic setback policy.	✓	8.2	The Project does not involve wind farms but involves development of a renewable energy facility. All infrastructure for the solar project will be located on the plains and the topography and surrounding vegetation will limit the direct line of sight to residents and road users.
P4	Industry and warehousing should only be developed if it supports primary production, processing, storage and distribution of local primary produce or products produced on the same site, and should be developed where: (a) it has a direct relationship with primary production (b) it is unlikely to limit or inhibit the use of adjoining land for primary production (c) the particular use requires a site in proximity to a particular natural resource or other product or materials sourced from the locality (d) it will not result in the alienation of land or water resources identified as significant for primary production or ecological reasons (e) the use would be inappropriate within a township.	✓		The Solar Project is not expected to impact or limit access to surrounding land users.
P5	A shop should be: (a) ancillary to primary production or processing uses, or tourist accommodation or other tourist development (b) located on the same site as the primary use.	N/A		The Project does not include a shop.
P6	Buildings should primarily be limited to farm buildings, a detached dwelling associated with primary production on the allotment and residential outbuildings that are: (a) grouped together on the allotment and set back from allotment	✓	8.2	Buildings associated with the solar project will include a substation and offices. These buildings will be located away from public roads. All infrastructure for the solar project will be located on the plains and the topography and surrounding vegetation will limit the direct line of sight to residents and road users.

Table 2 – Response to the Mount Remarkable Council Development Plan – Primary Production Zone

No	Objective / Principle	Not at variance	DA Ref.	Response
	boundaries to minimise the visual impact of buildings on the landscape as viewed from public roads (b) screened from public roads and adjacent land by existing vegetation or landscaped buffers.			
P7	Tourist accommodation should not be converted to dwellings and should be designed to preclude the conversion of buildings into dwellings such as through shared facilities, common utility services, grouped accommodation and/or shared parking.	N/A		The Project does not include tourist accommodation.
P8	A dwelling should only be developed if: (a) there is a demonstrated connection with farming or other primary production (b) the location of the dwelling will not inhibit the continuation of farming, other primary production or other development that is in keeping with the provisions of the zone (c) it is located more than 500 metres from an existing intensive animal keeping operation unless used in association with that activity (d) it does not result in more than one dwelling per allotment.	N/A		The Project does not include the construction of a dwelling.
Form and Character				
P9	Development should not be undertaken unless it is consistent with the desired character for the zone.	✓		Solar farms are not described in the desired character for the zone, however it is not expected that the development of this facility will impact on the Desired Character.
P10	Development should not occur within 500 metres of a National Park, Conservation Park, Wilderness Protection Area or significant stands of native vegetation if it will increase the potential for, or result in, the spread of pest plants.	✓		The Solar Project is located approximately 12km south-west of the Mt Remarkable National Park. No other conservation or protection areas are within close proximity to the Project.
Land Division				
P11	For land not within a policy area, land division, including boundary realignments, should only occur where it will promote economically productive, efficient and sustainable primary production and achieve one of the following: (a) the allotment is not less than 40 hectares in area (b) the creation of a new allotment not greater than 5 hectares in area to contain a habitable dwelling which existed prior to 2 April 1987 and the balance of the allotment is associated with primary production.	N/A		The Project does not include the division of land.
P12	Land division involving boundary realignments should only occur where the number of resulting allotments of less than 40 hectares is not greater than the number that existed prior to the realignment.	N/A		The Project does not include the division of land.

Table 3 – Response to the Mount Remarkable Council Development Plan – Water Protection Zone

No	Objective / Principle	Not at variance	DA Ref.	Response
Water Protection Zone				
Objectives				
O1.	Protection of surface and underground water resources from pollution, contamination or unsustainable use.	✓	6.2	The Project will involve controlling water through an additional reservoir, however this is not expected to cause pollution, contamination or result in unsustainable use.
O2.	Development excluded from the zone where it is liable to contribute to the contamination or pollution of surface and underground water resources or the reduction of aquifer recharge.	✓	6.2	Solar farms and hydro plants are not included in the list of non-complying Development for this zone.
O3.	Extensive areas of locally indigenous plant species established and retained in order to safeguard the catchment and recharge characteristics of the water resource.	✓	7.1	Vegetation clearance is expected for the Project; however, clearance minimization and re-vegetation will be considered as soon as practicable.
O4.	Development that contributes to the desired character of the zone.	✓		Solar farms and hydro plants are not described in the desired character for the zone, however it is not expected that the development of these facilities will impact on the Desired Character. No change in water quality is expected from the construction of the Pumped Hydro Project.
Desired Character				
DC	This zone covers the Baroota Reservoir catchment, an important resource that warrants particular protection. The recharge area for water from the Spring Creek mine shaft and weir, which is the source of Wilmington's water supply and the catchment area for Baroota Reservoir will be protected from activities liable to cause deterioration in water quality.	✓	6.2	Components of the Pumped Hydro Project will be situated in the Baroota Reservoir catchment. The construction of an additional reservoir is consistent with the existing reservoir. No impact on water quality is expected.
DC	Development that could contribute to the pollution of surface water resources or prejudice the water catchment function of the area will be avoided and not established within the precinct. Protection of water quality is paramount.	✓	6.2	No impact on water quality is expected.
Principles of Development Control				
Land Use				
P1.	The following forms of development are envisaged in the zone: ▪ broadacre cropping ▪ grazing.	N/A		Solar farms and hydro plants are not included in the list of development envisaged for the zone.
P2.	Development listed as non-complying is generally inappropriate.	N/A		Solar farms and hydro plants are not included in the list of non-complying Development for this zone.
P3.	Development should not: (a) prejudice the protection of the water catchment (b) affect the quality and quantity of the catchment's water resources (c) inhibit the potential of the aquifer to recharge (d) involve the storage or disposal of hazardous substances (e) involve the storage of chemicals in quantities that require a licence under the *Environment Protection Act 1993* (f) generate waste of a quantity that affects surface or underground	✓	6.2	The Project will not: a) Alter the protection of the water catchment b) Affect the quality of the catchment's water, with the quantity… c) Will not impact on recharge of the aquifer d) Some hazardous substances will be used as part of the Project; however, these will be stored in accordance with the Australian Standard. e) Any licences will be obtained as required by the Act. f) Generate waste that affectes surface water or groundwater.

Table 3 – Response to the Mount Remarkable Council Development Plan – Water Protection Zone

No	Objective / Principle	Not at variance	DA Ref.	Response
	water resources.			
P4.	Land should not be used for farming or horticulture unless the depth to the watertable is greater than 2 metres from the ground surface.	N/A		The Project does not involve farming or horticulture.
P5.	Land should not be used for farming or horticulture unless the following issues are considered and addressed: (a) the risk of pollution or adverse impacts on dependent ecosystems (b) the risk of any increase in salinity levels of either surface or groundwater supplies (c) the avoidance of adverse impacts on downstream properties in terms of water flow and discharge of pollutants (d) the availability of surface and/or sub-surface water required to sustain the proposed activity (e) the capability of the soil structure and the land to support the proposed activity (f) avoiding any land prone to water logging or subject to flooding through irrigation (g) compatibility with land uses on adjacent land (h) the risk of the watertable falling or rising significantly as a result of excessive irrigation.	N/A		The Project does not involve farming or horticulture.
P6.	Development should maintain the diversity of agricultural, horticultural, pastoral and rural related activities complementary to land capability and to the conservation of biodiversity.	✓		The Project is not expected to impact on the diversity of agricultural, horticultural, pastoral and rural related activities.
P7.	Development involving buildings of heritage or historic significance within settlements, redundant townships, or rural areas should lead to the restoration of the heritage character and features in those settlements or areas.	N/A		The Project does not include development involving buildings of heritage or historical significance.
P8.	Diversion or storage dams used for irrigation should be sited and designed in accordance with the relevant Water Allocation Plan prepared under the *Natural Resources Management Act 200*4.	N/A		The Project does not involve diversion or storage dams for irrigation.
Form and Character				
P9.	Development should not be undertaken unless it is consistent with the desired character for the zone.	✓		The Project is not expected to impact on the desired character of the zone. Water quality will be maintained.
P10.	Irrigated areas should not be sited where they may impact upon a watercourse, lake or well.	N/A		The Project does not include the irrigation of land.
Land Division				
P11.	Land should not be divided unless to alter the boundaries of an allotment for the purpose of increased primary production efficiency or productivity.	N/A		The Project does not include the division of land.

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Department for Energy and Mining

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6 July 2018

Mr Brer Adams
Director
Rise Renewables Pty Ltd
PO Box 2480
BONDI JUNCTION NSW 1355

Email: brer@riserenewables.com

Dear Mr Adams

CROWN SPONSORSHIP BAROOTA PUMPED HYDRO AND SOLAR PROJECT

Thank you for your letter of 24 May 2018 requesting Crown Sponsorship under section 49 of the *Development Act 1993* to assist with Rise Renewables Pty Ltd's (Rise) proposed Baroota Pumped Hydro and Solar Project (Project).

This Project has been considered within the South Australian Department for Energy and Mining (DEM) with input from the Department of Planning, Transport and Infrastructure, the Department of Environment and Water, the Environmental Protection Agency and the Technical Regulator. In principle, the Project is supported, recognising the possible environmental and community issues that will need to be addressed through the development assessment process.

On balance, the development of Rise's Project has the potential to benefit South Australia and can be considered public infrastructure. Accordingly I, as Chief Executive of the DEM, will support the development and specifically endorse the Development Application to construct the Project comprising up to 270 MW of pumped hydro energy storage (PHES) capacity and up to 300MW of solar PV capacity as a development of public infrastructure as required by section 49 of the *Development Act 1993* (the Act). My support under this Crown Sponsorship also extends separately to the individual PHES and solar components and remains valid in the event that Rise decide to proceed with one of these Project components without the other.

It is the responsibility of Rise to prepare all documentation as required by section 49 of the Act. All costs in the preparation of the development application, lodgement and any other subsequent action in relation to this application are the responsibility of Rise.

The DEM makes no representations or gives no warranties in relation to the outcome of the Development Application or time that it takes to secure a planning outcome. It is Rise's responsibility to obtain all other statutory approvals, licences, connection agreements and permits from relevant authorities, manage community expectations and to fund the project. The State Government makes no commitment to purchase any product or service related to the project.

A Development Application under this Crown sponsorship must be lodged with the State Planning Commission and is valid for 12 months from the date of this letter. If this is not achieved by that time, my support under Section 49(2)(c) of the *Development Act 1993* for Rise's Project will lapse.

If you have any questions regarding the preparation of the material to support this section 49 application, please contact Mr Mark Jackson on (08) 8429 2722 or via email: mark.jackson@sa.gov.au.

Yours sincerely

Dr Paul Heithersay
CHIEF EXECUTIVE

Appendix I Certificate from the Technical Regulator

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Government of South Australia
Department of the Premier and Cabinet

Energy and Technical Regulation

Office of the Technical Regulator

Level 8, 11 Waymouth Street
Adelaide SA 5000

GPO Box 320
Adelaide SA 5001

Telephone: 08 8226 5500
Facsimile: 08 8226 5866

www.sa.gov.au/otr

Ref: 2017/01873.01 D18087398

21 June 2018

Brer Adams
Rise Renewables
PO Box 2480
Bondi Junction NSW 1355
By email: brer@riserenewables.com

Dear Brer,

RE: CERTIFICATE FOR DEVELOPMENT OF THE BAROOTA PUMPED HYDRO AND SOLAR PROJECT

The development of the Baroota Pumped Hydro and Solar Project has been assessed by the Office of the Technical Regulator (OTR) under Section 37 of the Development Act 1993.

Regulation 70 of the *Development Regulations 2008* prescribes if the proposed development is for the purposes of the provision of electricity generating plant with a generating capacity of more than 5 MW that is to be connected to the State's power system – a certificate from the Technical Regulator is required, certifying that the proposed development complies with the requirements of the Technical Regulator in relation to the security and stability of the State's power system.

In making a decision on your application, our office has taken the following information into account:

- An email from Agnes Cantin of JBS&G on 4 June 2018, which included the project application attached 'Rise Renewables_OTR Compliance 30052018.pdf';
- A revised application emailed by Agnes Cantin on 5 June 2018;
- A follow up meeting between the OTR, Rise Renewables and SNC-Lavalin representatives on 13 June 2018 to discuss further clarifications regarding the application;
- Additional information regarding the proposal emailed to the OTR by Brer Adams of Rise Renewables on 14 June 2018 and 21 June 2018.

Government of South Australia
Department of the Premier and Cabinet

After assessing the information provided, I advise that approval is granted for the proposed project.

Should you have any questions regarding this matter, please do not hesitate to call David Bosnakis on (08) 8226 5521.

Yours sincerely

Rob Faunt
TECHNICAL REGULATOR

cc: Agnes Cantin – JBS&G
Danny Alarie – SNC-Lavalin

Energy and Technical Regulations

Level 8, 11 Waymouth Street Adelaide SA 5000 | GPO Box 320 Adelaide SA 5001 | DX541
Tel (+61) 8 8226 5500 | Fax (+61) 8 8226 5866 | www.dpc.sa.gov.au | ABN 83 524 915 929

Government of South Australia
Department of the Premier and Cabinet

Ref: 2017/01873.01 D18087402

Energy and Technical Regulation

Office of the Technical Regulator

Level 8, 11 Waymouth Street
Adelaide SA 5000

GPO Box 320
Adelaide SA 5001

Telephone: 08 8226 5500
Facsimile: 08 8226 5866

www.sa.gov.au/otr

21 June 2018

Brer Adams
Rise Renewables
PO Box 2480
Bondi Junction NSW 1355
By email: brer@riserenewables.com

Dear Brer,

RE: CERTIFICATE FOR DEVELOPMENT OF THE BAROOTA PUMPED HYDRO ENERGY STORAGE POWER PROJECT

The development of the Baroota Pumped Hydro Energy Storage Power Project has been assessed by the Office of the Technical Regulator (OTR) under Section 37 of the Development Act 1993.

Regulation 70 of the *Development Regulations 2008* prescribes if the proposed development is for the purposes of the provision of electricity generating plant with a generating capacity of more than 5 MW that is to be connected to the State's power system – a certificate from the Technical Regulator is required, certifying that the proposed development complies with the requirements of the Technical Regulator in relation to the security and stability of the State's power system.

In making a decision on your application, our office has taken the following information into account:

- An email from Agnes Cantin of JBS&G on 4 June 2018, which included the project application attached 'Rise Renewables_OTR Compliance 30052018.pdf';
- A revised application emailed by Agnes Cantin on 5 June 2018;
- A follow up meeting between the OTR, Rise Renewables and SNC-Lavalin representatives on 13 June 2018 to discuss further clarifications regarding the application;
- Additional information regarding the proposal emailed to the OTR by Brer Adams of Rise Renewables on 14 June 2018 and 21 June 2018.

Government of South Australia
Department of the Premier and Cabinet

After assessing the information provided, I advise that approval is granted for the proposed project.

Should you have any questions regarding this matter, please do not hesitate to call David Bosnakis on (08) 8226 5521.

Yours sincerely

Rob Faunt
TECHNICAL REGULATOR

cc: Agnes Cantin – JBS&G
Danny Alarie – SNC-Lavalin

Energy and Technical Regulations

Level 8, 11 Waymouth Street Adelaide SA 5000 | GPO Box 320 Adelaide SA 5001 | DX541
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Government of South Australia
Department of the Premier and Cabinet

Ref: 2017/01873.01 D18087400

Energy and Technical Regulation

Office of the Technical Regulator

Level 8, 11 Waymouth Street
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GPO Box 320
Adelaide SA 5001

Telephone: 08 8226 5500
Facsimile: 08 8226 5866

www.sa.gov.au/otr

21 June 2018

Brer Adams
Rise Renewables
PO Box 2480
Bondi Junction NSW 1355
By email: brer@riserenewables.com

Dear Brer,

RE: CERTIFICATE FOR DEVELOPMENT OF THE BAROOTA BRIDAL TRACK SOLAR PROJECT (SOLAR PROJECT)

The development of the Baroota Bridal Track Solar Project (Solar Project) has been assessed by the Office of the Technical Regulator (OTR) under Section 37 of the Development Act 1993.

Regulation 70 of the *Development Regulations 2008* prescribes if the proposed development is for the purposes of the provision of electricity generating plant with a generating capacity of more than 5 MW that is to be connected to the State's power system – a certificate from the Technical Regulator is required, certifying that the proposed development complies with the requirements of the Technical Regulator in relation to the security and stability of the State's power system.

In making a decision on your application, our office has taken the following information into account:

- An email from Agnes Cantin of JBS&G on 4 June 2018, which included the project application attached 'Rise Renewables_OTR Compliance 30052018.pdf';
- A revised application emailed by Agnes Cantin on 5 June 2018;
- A follow up meeting between the OTR, Rise Renewables and SNC-Lavalin representatives on 13 June 2018 to discuss further clarifications regarding the application;
- Additional information regarding the proposal emailed to the OTR by Brer Adams of Rise Renewables on 14 June 2018 and 21 June 2018.

After assessing the information provided, I advise that approval is granted for the proposed project, provided the required Inertia required for the project, as prescribed by the OTR's Generator Development Approval Procedure Version 1.1, is provided by Rise Renewables'/SNC-Lavalin's Baroota Pumped Hydro Storage Power Project.

Should you have any questions regarding this matter, please do not hesitate to call David Bosnakis on (08) 8226 5521.

Yours sincerely

Rob Faunt
TECHNICAL REGULATOR

cc: Agnes Cantin – JBS&G
Danny Alarie – SNC-Lavalin

Appendix J Letters of Support

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District Council of
Mount Remarkable

P PO Box 94, Melrose SA 5483
T 08 8666 2014
1300 726 252
F 08 8666 2169
E postmaster@mtr.sa.gov.au
W www.mtr.sa.gov.au

Ref: EM2018-9810
File: DCMR0392

24 May 2018

Brer Adams
Director
Rise Renewables Pty Ltd
Email: brer@riserenewables.com

Dear Brer

RE: BAROOTA PUMPED HYDRO AND SOLAR PROJECT

As Chief Executive Officer of the District Council of Mount Remarkable it is with pleasure that I commend Rise Renewables for their enterprise and proposed investment in energy infrastructure in the Council District.

The recent meeting with yourself and team in Adelaide was very positive and Council is excited with the possibilities and benefits the project will bring to the Council District. Council appreciates Rise Renewables has undertaken to continue to work with Council during the design phase to ensure the Project is aligned with regional economic development and other goals and will take steps to engage with local business communities to encourage local procurement to the Project.

A key focus for the District Council of Mount Remarkable is to support development, encourage entrepreneurs to the district, promote tourism in the region through the '*Remarkable Experience'*, attract new business and support new employment and economic benefits within its communities as per its Strategic Management Plan 2008 – 2020.

Council is positive about the opportunities the Baroota Pumped Hydro and Solar Project development will bring to the Council district in particular the Port Germein area. It is understood that the project will create some 300 jobs during construction and a number of permanent positions upon completion.

Council is very supportive of the proposed development of the Baroota Pumped Hydro and Solar Project and looks forward to working with Rise Renewables to see this project to realisation.

Yours sincerely

WAYNE HART
CHIEF EXECUTIVE OFFICER

2018-093
wh-cb

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Regional Development Australia
YORKE AND MID NORTH

85 Ellen Street
Port Pirie SA 5540
P 1300 742 414
F (08) 8632 5724
E info@yorkeandmidnorth.com.au
www.yorkeandmidnorth.com.au
ABN: 68 705 101 048

Mr Brer Adams
Director
Rise Renewables

20th July 2018

Dear Brer,

Re: Support for the Rise Renewables Baroota Pumped Hydro & Solar Project

I write in support of the Rise Renewables Pumped Hydro & Solar Project Baroota, on behalf of Regional Development Australia Yorke and Mid North.

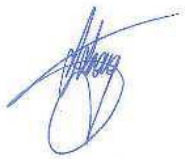
RDAYMN is an incorporated organisation funded by federal, state and local government. The RDAYMN Board promotes and facilitates sustainable community and economic development across Yorke Peninsula, Mid North and the Southern Flinders Ranges.

Located 35kms North of Port Pirie, 12kms North-East of Port Germein the Baroota Pumped Hydro & Solar project stands to offer extensive economic development to the both the District Council of Mount Remarkable and the Upper Spencer Gulf Region. The project aligns with the strategic direction of the 2018-28 Yorke & Mid North Regional Road Map, particularly *Regional Focus 1 - Great Infrastructure and Technology*, and *Regional Focus 2 - An Economy built on value-adding and innovation*. It will advance the expanding renewable energy sector which is now well established in the area.

Rise Renewables have undertaken significant stakeholder engagement throughout the region and it is the understanding of Regional Development Australia Yorke and Mid North that they have resounding support from the community for the project.

To this end, Regional Development Australia Yorke and Mid North provide full support for this application particularly as the results of this project will have direct flow on effects both economically and socially for local community and broader area.

Yours sincerely



Dylan Strong
Chief Executive

An Australian Government Initiative

An Initiative of Government of South Australia

Local Government Partners
Clare & Gilbert Valleys Council | District Council of Barunga West
District Council of Mount Remarkable | Northern Areas Council
District Council of Peterborough | Wakefield Regional Council
District Council of Yorke Peninsula | Regional Council of Goyder
District Council of the Copper Coast | Port Pirie Regional Council
District Council of Orroroo Carrieton

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SA Water

SOUTH AUSTRALIAN
WATER CORPORATION
A.B.N. 69 336 525 019

Brer Adams
Director
Rise Renewables Pty Ltd
PO Box 2480
Bondi Junction NSW 1355

25 July 2018

Dear Brer

RE: Pumped hydro energy storage project on SA Water land holdings.

I write in respect of Rise Renewables access to SA Water's Baroota reservoir to develop a pumped hydro energy storage (PHES) project.

SA Water are aware the reservoir may be suitable for PHES, and regards the project as offering a potentially complementary use for the existing water and associated infrastructure at Baroota.

SA Water is pleased to offer our support to the development application for the project. Subject to appropriate development and planning approvals, we will be pleased to provide long-term access in respect of the reservoir in accordance with mutually agreeable contractual arrangements.

SA Water provides this support on an exclusive basis to support the development application and ongoing assessment of the requirements of both parties for the PHES project at Baroota.

Yours sincerely

Mark Wilson
Senior Manager, Business Development
M 0411 486 499

Government of South Australia

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