STATE COMMISSION ASSESSMENT PANEL
A COMMITTEE OF THE STATE PLANNING COMMISSION

APPLICATION ON NOTIFICATION – CATEGORY 2

Applicant:	RES Australia Pty Ltd
Development Number:	422/E003/17
Nature of Development:	Twin Creek Wind Farm and Energy Storage Facility
Type of development:	Merit
Zone / Policy Area:	Primary Production / Rural Zones
Subject Land:	Numerous land parcels located north-east of Kapunda. Site entrance located on Mosey Road, St Kitts
Contact Officer:	Lee Webb
Phone Number:	(08) 7109 7066
Start Date:	29 March 2018
Close Date:	13 April 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 or emailed to the State Commission Assessment Panel.

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 St
ADELAIDE SA 5000

Email Address: scapadmin@sa.gov.au

SOUTH AUSTRALIAN DEVELOPMENT ACT, 1993
REPRESENTATION ON APPLICATION – CATEGORY 2

Applicant:	RES Australia Pty Ltd
Development Number:	422/E003/17
Nature of Development:	Twin Creek Wind Farm and Energy Storage Facility
Type of development:	Merit
Zone / Policy Area:	Primary Production / Rural Zones
Subject Land:	Numerous land parcels located north-east of Kapunda. Site entrance located on Mosey Road, St Kitts
Contact Officer:	Lee Webb
Phone Number:	(08) 7109 7066
Close Date:	13 April 2018

My name:____

My phone number: _______________________________________

PRIMARY METHOD(s) OF CONTACT: Email address: ___________________________

Postal address:___________________________

_______________________Postcode________

<u>You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard in support of your submission.</u>

My interests are:

☐ 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 _________

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

____
____
____
____
____
____
____

Should the State Commission Assessment Panel conduct a public hearing for this Development Application:

I

☐ **wish to be heard in support of my submission**
☐ **do not wish to be heard in support of my submission**

(Please tick one)

By

☐ **appearing personally**
☐ **being represented by the following person:**

(Please tick one)

Date ____________________ Signature ______________________________

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

DEVELOPMENT APPLICATION FORM

COUNCIL: LIGHT REGIONAL COUNCIL, REGIONAL COUNCIL OF GOYDER AND MID MURRAY COUNCIL

APPLICANT: RES AUSTRALIA PTY LTD

Postal Address: SUITE 4, LEVEL 1, 760 PACIFIC HIGHWAY CHATSWOOD NSW 2067

OWNER: VARIOUS – SEE ATTACHED

Postal Address:

BUILDER: TBA

Postal Address:

Licence No:

CONTACT PERSON FOR FURTHER INFORMATION:

Name: JULIE JANSEN - MASTERPLAN SA PTY LTD

Telephone: 8193 5600

Email: JULIEJ@MASTERPLAN.COM.AU

Mobile: 0413 832 616

EXISTING USE:

AGRICULTURE AND ASSOCIATED DWELLINGS AND OUTBUILDINGS

FOR OFFICE USE

Development No:

Previous Development No:

Assessment No:

❑ Complying	Application forwarded to DA
❑ Non-complying	Commission/Council on:
❑ Notification Cat 2	/ /
❑ Notification Cat 3	Decision:
❑ Referrals/Concurrence	Type:
❑ DA Commission	Date: / /

	Decision	Fees	Receipt No	Date
Planning:				
Building:				
Land Division:				
Additional:				
Dev Approval:				

DESCRIPTION OF PROPOSED DEVELOPMENT: TWIN CREEK WIND FARM AND ENERGY STORAGE FACILITY – INFRASTRUCTURE INCLUDING WIND TURBINE GENERATORS, ON-SITE SUBSTATION, OPERATIONS AND MAINTENANCE COMPOUND, TEMPORARY CONSTRUCTION COMPOUNDS (INCLUDING CONCRETE BATCHING PLANT), TRANSMISSION LINE AND TERMINAL SUBSTATION. A PERIOD OF FIVE YEARS IN WHICH TO SUBSTANTIALLY COMMENCE THE DEVELOPMENT FROM THE OPERATIVE DATE AND SUBSTANTIAL COMPLETION TO BE EXTENDED TO SEVEN YEARS FROM THE OPERATIVE DATE OF THE CONSENT.

LOCATION OF PROPOSED DEVELOPMENT:

House No: VARIOUS Lot No: VARIOUS Street: Town/Suburb:

Section No (full/part): INCLUDING: S278 Hundred: BELVIDERE Volume: 5618 Folio: 693

Section No (full/part): Hundred: Volume: Folio:

DOES EITHER SCHEDULE 21 OR 22 OF THE DEVELOPMENT REGULATIONS 2008 APPLY? YES: ☑ NO: ☐

HAS THE CONSTRUCTION INDUSTRY TRAINING FUND ACT 1993 LEVY BEEN PAID? YES: ☐ NO: ☑

DEVELOPMENT COST (Do not include any fit-out costs): $330 MILLION

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the Development Regulations 2008.

SIGNATURE: [signature] **Dated:** 14 AUSGUST 2017

MR DANIEL LEAHY FOR AND ON BEHALF OF RES AUSTRALIA PTY LTD

TWIN CREEK WIND FARM

Development Application for Development Plan Consent

August 2017

WIND SOLAR STORAGE TRANSMISSION

VOLUME 1
PROJECT SUMMARY

TWIN CREEK WIND FARM

AND ENERGY STORAGE PROJECT

VOLUME 1

PROJECT SUMMARY

RES AUSTRALIA PTY LTD

August 2017

Version	Author	Reviewer
Draft for Review	Julie Jansen 24 March 2017	Daniel Leahy
Draft for Review – Rev A	Julie Jansen, 16 April 2017	
Draft for Review – Rev C	Julie Jansen, 6 June 2017	Simon Tonkin, MP
Final Draft	Julie Jansen, 25 June 2017	Daniel Leahy, RES
Final	Julie Jansen, 30 June 2017	Daniel Leahy, RES
Final – Corrections	Julie Jansen, 01 August 2017	Annette Devenson, RES

Prepared by

MasterPlan SA Pty Ltd

ABN 30 007 755 277, ISO 9001:2015 Certified

33 Carrington Street, Adelaide SA 5000

Telephone: 8193 5600, masterplan.com.au

DEVELOPMENT APPLICATION DOCUMENT STRUCTURE

This is volume one of four volumes comprising the development application for the Twin Creek wind farm development. The application comprises:

Volume 1 – Project Summary

Volume 2 – Technical Reports

Volume 3 – Drawings, Maps and Figures

Volume 4 – Draft Construction Environmental Management Plan

Contents

EXECUTIVE SUMMARY

INTRODUCTION

RES Australia Pty Ltd (RES Australia) proposes to develop the Twin Creek Wind Farm and Energy Storage project within the Mid North area of South Australia. The site of the proposed wind farm and battery energy storage is approximately 90km north east of Adelaide and north east of Kapunda. The site comprises approximately 5,600 hectares of farm land which is used predominately for sheep grazing and cereal cropping.

RES is the world's largest independent renewable energy company, with the expertise to develop, engineer, construct, finance, and operate projects around the globe. RES Australia has been developing renewable energy projects in Australia since 2004 and its recent wind projects include Ararat Wind Farm (75 turbines, 235 MW) and Murra Warra Wind Farm (116 turbines, 418 MW) in Victoria and Taralga Wind Farm (51 turbines, 107 MW) in New South Wales. The combination of the excellent exposure to South Australia's abundant wind resource and a 2.0 kilometre distance buffer from wind turbines to non-involved dwellings makes Twin Creek, an ideal location for a renewable energy project.

The Twin Creek site has excellent exposure to South Australia's abundant wind resources, making it an ideal location for a renewable energy project.

PROJECT OVERVIEW

The proposed wind farm will consist of the following components:

- up to 51 Wind Turbines Generators (WTG);
- a total installed wind capacity in the order of 185 MW;
- overall height of turbines would be up to 180 metres at the blade tip;
- associated hard standing areas and access roads;
- operations and maintenance building and compound with associated car parking;
- two electrical substations;
- battery energy storage facility with an indicative capacity of 215 MW;;
- overhead and underground electrical cable reticulation;
- overhead transmission line for approximately 15 kilometres from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro;
- meteorological masts for measuring wind speed and other climatic conditions; and

- temporary construction facilities including a borrow pit and concrete batching plant facilities.

It is estimated that the Twin Creek Wind Farm was the capacity to generate 613,000 MWh per year. This generation is equivalent to the electricity needs of approximately 118,000 South Australia homes each year, (assuming the average annual household electricity use is 5,200 kWh per annum).

Development of the Twin Creek Wind Farm is forecast to generate $209 million of value added in the State of South Australia over the period of construction over a three-year period. 1,447 person years of employment in South Australia would be supported, or an average of over 480 jobs sustained per year over three years. Once operational the project is estimated to support annually $15.5 million of value added in South Australia, and support directly and indirectly in the order of 105 jobs per year.

Renewable wind energy generation has significant environmental benefits through carbon emissions reduction where it replaces coal or gas generated electricity. The value of carbon emission savings associated with the Twin Creek Wind Farm is estimated to be $9.8 million per annum or a net present value of $104 million over a 20 year period.

This project will contribute to the State Government and Federal Government renewable energy targets. Currently the State Government objective is to produce at least 50 percent of the State's electricity from renewable sources by 2025. The Federal Government objective to achieve an additional 33,000 GWh of electricity from renewable sources by 2020 under the Renewable Energy Target (RET).

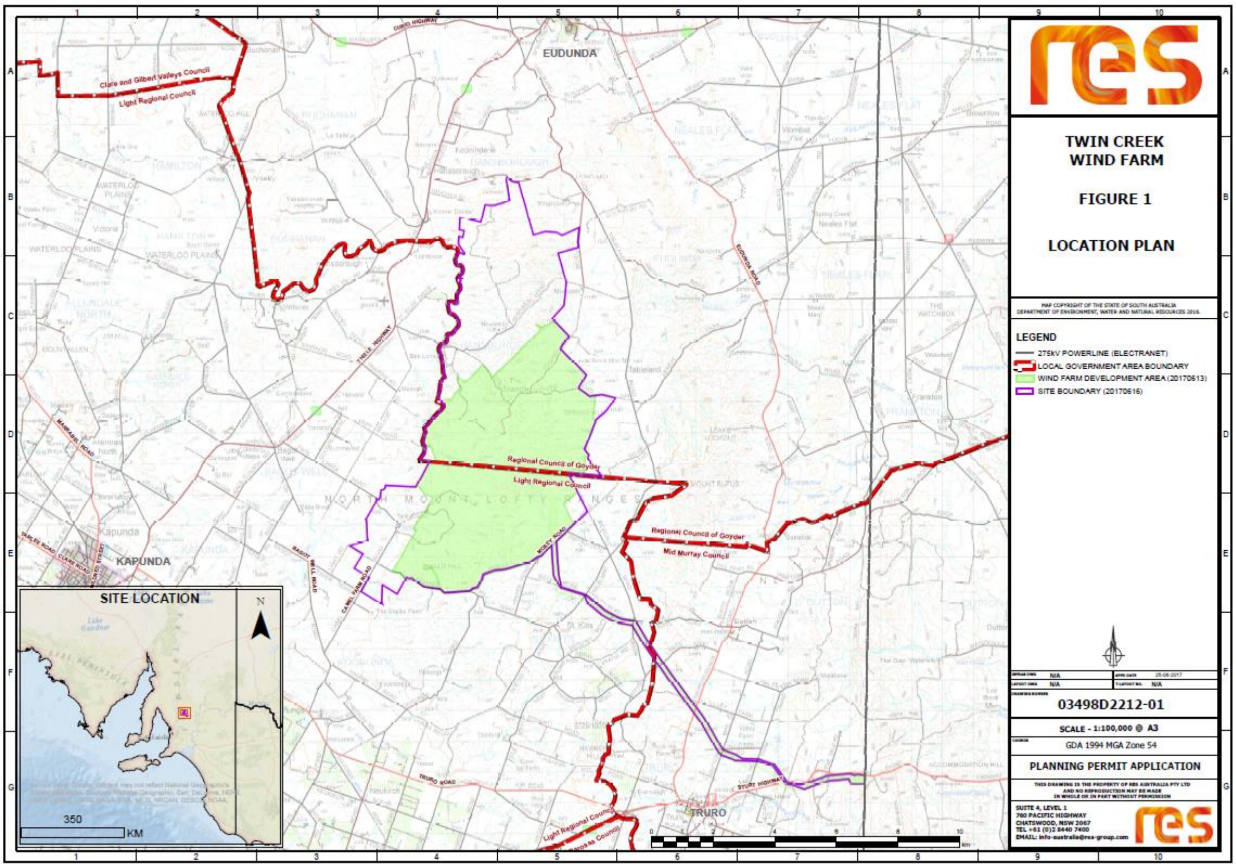
DEVELOPMENT APPLICATION PROCESS

The site of the proposed development transverses three Local Government areas. Infrastructure for the project will be developed within the Light Regional Council, Regional Council of Goyder and Mid Murray Council areas.

In accordance with Schedule 10(14) of the *Development Regulations 2008*, the Development Assessment Commission will be the relevant planning authority to assess the development application, as 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".* Assessment of the application will be undertaken against the relevant provisions of the Light Regional Council Development Plan, the Goyder Council Development Plan and the Mid Murray Development Plan.

PROJECT SITING AND LANDSCAPE

The proposed development is located between the townships of Kapunda, Eudunda and Truro as shown on Figure 1 – Location Plan below in **Volume 3**.


TWIN CREEK WIND FARM
FIGURE 1
LOCATION PLAN
MAP COPYRIGHT OF THE STATE OF SOUTH AUSTRALIA DEPARTMENT OF ENVIRONMENT, WATER AND NATURAL RESOURCES 2016.
LEGEND
275kV POWERLINE (ELECTRANET)
LOCAL GOVERNMENT AREA BOUNDARY
WIND FARM DEVELOPMENT AREA (20170613)
SITE BOUNDARY (20170616)
N/A
N/A
25-06-2017
N/A
03498D2212-01
SCALE - 1:100,000 @ A3
GDA 1994 MGA Zone 54
PLANNING PERMIT APPLICATION
THIS DRAWING IS THE PROPERTY OF RES AUSTRALIA PTY LTD AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION
SUITE 4, LEVEL 1
760 PACIFIC HIGHWAY
CHATSWOOD, NSW 2067
TEL +61 (0)2 8440 7400
EMAIL: info-australia@res-group.com
SITE LOCATION
350
KM
EUDUNDA
KAPUNDA
TRURO
Clare and Gilbert Valleys Council
Light Regional Council
Regional Council of Goyder
Mid Murray Council
NORTH MOUNT LOFTY RANGES

The site is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges.

Landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features. The progressive geological faulting and folding processes that have formed the Southern Flinders Ranges and Northern Mount Lofty Ranges dominate the area creating a series of undulating ridges and escarpments.

Surrounding the site of the proposed development, the landscape is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs in the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse with areas of arable cropping and grazing. This creates a patchwork character to the landscape with changes in colour and texture because of the different agricultural practices.

PROJECT EVOLUTION

RES Australia purchased a wind monitoring mast on the subject land from DP Energy and full development control of the site in January 2015. In 2015/2016 RES engaged and commenced detailed technical feasibility of the project.

Wind Farm development is an evolutionary process. Over the past 18 months – 2 years, RES has prepared numerous design layout iterations for the wind turbine generators, transmission line and ancillary infrastructure.

The project layout proposed is the result of comprehensive wind modelling, extensive environmental surveys and expert technical advice. Variations in the layout have resulted from technical advice regarding constraints, including ecological, civil, acoustic, geological, hydrological, electromagnetic, transportation, cultural heritage or other locational characteristics. In addition to advice from its technical experts, advice and input has been sought from the community, universities, Government Agencies and Light Regional Council, Regional Council of Goyder and Mid Murray Council.

Consultation with the community was undertaken in Kapunda, Eudunda and Truro during October 2016. The feedback received from this consultation was provided to technical experts of the project team and was considered in the final project design, as applicable. A further project open day was held on Friday 7th April 2017 illustrating the revised design ahead submitting this development application.

In preparing the development application, RES Australia has utilised the Clean Energy Council's Best Practice Guidelines for the Australian Wind Industry, 2013. These guidelines provide wind farm proponents, such as RES Australia, with details on best practice for a "typical" project, addressing a wide range of environmental, amenity and stakeholder consultation aspects of a wind farm during its investigation phase, approvals process and construction.

The Guidelines do not replace existing energy or environmental planning legislation, policy or regulations at local or state level. The Twin Creek Wind Farm and Energy Storage project is assessed in accord with the South Australian legislation, namely the *Development Act, 1993* and *Development Regulations 2008.*

Taking account of all the technical advice from independent experts, RES has prepared the development application as now submitted for determination.

TECHNICAL INVESTIGATIONS

The design of the wind farm has evolved and developed following detailed technical, engineering and environmental investigations.

A variety of investigations have been undertaken and assessment reports prepared to examine the existing situation, the likely impacts of the proposal, and mitigation and management mitigation measures proposed. These technical assessments have included noise impact, visual impact (including shadow flicker and blade glint), flora and fauna (including avifauna), Aboriginal and European heritage, traffic and transport, land use, hazards (including bushfire, aviation and physical safety), water resources and site drainage, soils and geology, and the social and economic impact of the project.

The studies and assessments which have been undertaken include:

- Twin Creek Wind Farm Consultation Outcomes Report by GHD dated June 2017;
- Twin Creek Wind Farm Flora and Fauna Assessment" report by EBS Ecology (EBS) dated 28 June 2017;
- Landscape Character and Probable Visual Effect Assessment by Wax Design and Dr Brett Grimm dated 28 June 2017;
- Twin Creek Wind Farm Environmental Noise Assessment by Sonus dated June 2017;
- Desktop Cultural Heritage Assessment Twin Creek Windfarm Report by EBS Heritage dated 14 March 2017;
- Twin Creek Wind Farm Bushfire Management Plan by SA Bushfire Solutions dated June 2017;
- Twin Creek Wind Farm Shadow Flicker and Blade Glint Assessment by DNV-GL dated 26 June 2017;
- Twin Creek Wind Farm EMI Assessment by DNV-GL dated 26 June 2017;
- Aviation Impact Statement, Qualitative Risk Assessment (QRA) and Obstacle Lighting Review by Ambidji Group Pty Ltd (Ambidji a division of Landrum and Brown Worldwide) dated 17 March 2017;
- Traffic Impact Assessment by AECOM Australia Pty Ltd (AECOM) dated 26 June 2017;

- Twin Creek Wind Farm Civil, Geology and Hydrology by AECOM Australia Pty Ltd (AECOM) dated 28 June 2017;
- Socio-Economic Impact Assessment for the Twin Creek Wind Farm by Hudson Howells Strategic Management Consultants dated March 2017; and
- Twin Creek Wind Farm and Energy Storage Facility Development Plan Assessment Report by MasterPlan dated August 2017;

Copies of these technical reports are contained in **Volume 2** of the development application.

The methodology employed and the findings of each of these technical assessments is summarised in this volume of the application documents.

Any issues identified via the technical reports have been incorporated in the final layout of the wind farm, as submitted, or are expected to be appropriately mitigated. No issues have been identified which are likely to preclude the proposed development from proceeding. The findings of the expert reports conclude:

- the development will assist in adding stability to local energy sector in South Australia via the inclusion of battery storage in combination with the wind farm, providing further renewable energy for the State;
- wind farms and ancillary infrastructure is an envisaged land use within the Primary Production Zone of the Light Regional Council Development Plan and Goyder Council Development Plan and the Rural Zone of the Mid Murray Council Development Plan;
- the project is compatible with the primary agricultural land uses of the region;
- the development will comprise approximately 2.0 percent of the project area and accordingly the predominant grazing and cropping land uses can continue;
- wind turbine generators are suitably separated from non-stakeholder dwellings by more than 2,000 metres;
- non-stakeholder dwellings are not adversely impacted by shadow flicker or blade glint;
- overall the Twin Creek Wind Farm would be viewed as a single cluster of infrastructure and the visual impact ranges from slight to substantial depending on the viewpoint of the site from the surrounding region;
- visual impact of the wind turbine generators is greatest to the east and west of the development site and deemed to be a substantial change to the rural landscape. Differing landscape character to the north and south of the development site provide greater landscape absorption;
- views of the wind farm from the towns of Kapunda, Eudunda and Nuriootpa are restricted by local topography and stands of vegetation resulting in limited or no visual effect;

- noise from the wind turbine generators has been assessed to comply with the Wind Farms Environmental Noise Guidelines 2009 at all residences;

- suitable access is available to the development site and the impacts from traffic and traffic related activities are considered acceptable (allowing for the implementation of mitigation measures and compliance with permit conditions);

- during construction of the proposed development, the townships of Kapunda, Truro, Eudunda and also the Koonunga area are likely to be most affected by additional traffic movements;

- the project will provide an improvement to the local road network within the immediate vicinity of the site of the development;

- the project will improve emergency access tracks within the development site and the immediate locality;

- the project should not adversely affect the operation of aerial response to bushfires interference to fixed point-to-point links passing over the project boundaries is unlikely;

- base to mobile station style communications such as television and radio broadcasting and commercial and private mobile telephony services are unlikely to be affected;

- interference to mobile station style communications may be experienced in areas of poor or marginal reception and if interference to television and radio reception is increased as a result of the project, a range of options are available to rectify difficulties;

- investigations, findings and recommendations of the flora and fauna assessment have informed the design, siting and layout of infrastructure of the development to minimise impact threatened species and ecological communities;

- the value of carbon emission savings associated with the Twin Creek Wind Farm is estimated to be $9.8 million per annum or a net present value of $104 million over a 20 year period; and

- the project will generate $209 million of value added (which is a net contribution to Gross State Product1) in the State of South Australia over the period of construction 1,447 person years of employment in South Australia would be supported – or an average of over 4,803 jobs sustained per year over three years of construction.

In summary, the Twin Creek Wind Farm and Energy Storage project will be a significant development and represents an important contribution to future renewable energy generation capability in South Australia. Overall, it is considered that the wind farm is an appropriate land use that warrants approval.

CHAPTER 1 –

INTRODUCTION

CHAPTER 1 - INTRODUCTION

1.0 INTRODUCTION

This development application has been prepared by MasterPlan SA Pty Ltd on behalf of the proponent, RES Australia Pty Ltd, for the proposed development of a wind farm and energy storage project and ancillary infrastructure at Twin Creek, north-east of Kapunda.

The site of the proposed development transverses three Local Government areas. Infrastructure for the project will be developed within the Light Regional Council, Regional Council of Goyder and Mid Murray Council.

In accordance with Schedule 10(14) of the *Development Regulations 2008*, the Development Assessment Commission will be the relevant planning authority to assess the development application, as 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".* Assessment of the application will be undertaken against the relevant provisions of the Light Regional Council Development Plan, the Goyder Council Development Plan and the Mid Murray Development Plan.

1.1 APPLICANT DETAILS

RES Australia Pty Ltd (RES Australia) (ABN 55 106 637 754)
Suite 4, Level 1, 760 Pacific Highway
Chatswood NSW 2067
Website: www.res-group.com

Project Contact Details
Mr Daniel Leahy
Development Project Manger
RES Australia Pty Ltd
Phone: +61 2 8440 7422
Email: daniel.leahy@res-group.com

1.2 APPLICATION STRUCTURE

The development application for the Twin Creek wind farm is contained within four volumes and comprises:

Volume 1 – Project Summary
Volume 2 – Technical Reports
Volume 3 – Drawings, Maps and Figures
Volume 4 – Draft Construction Environmental Management Plan

1.3 PROPOSED LOCATION OF THE TWIN CREEK WIND FARM AND ENERGY STORAGE PROJECT

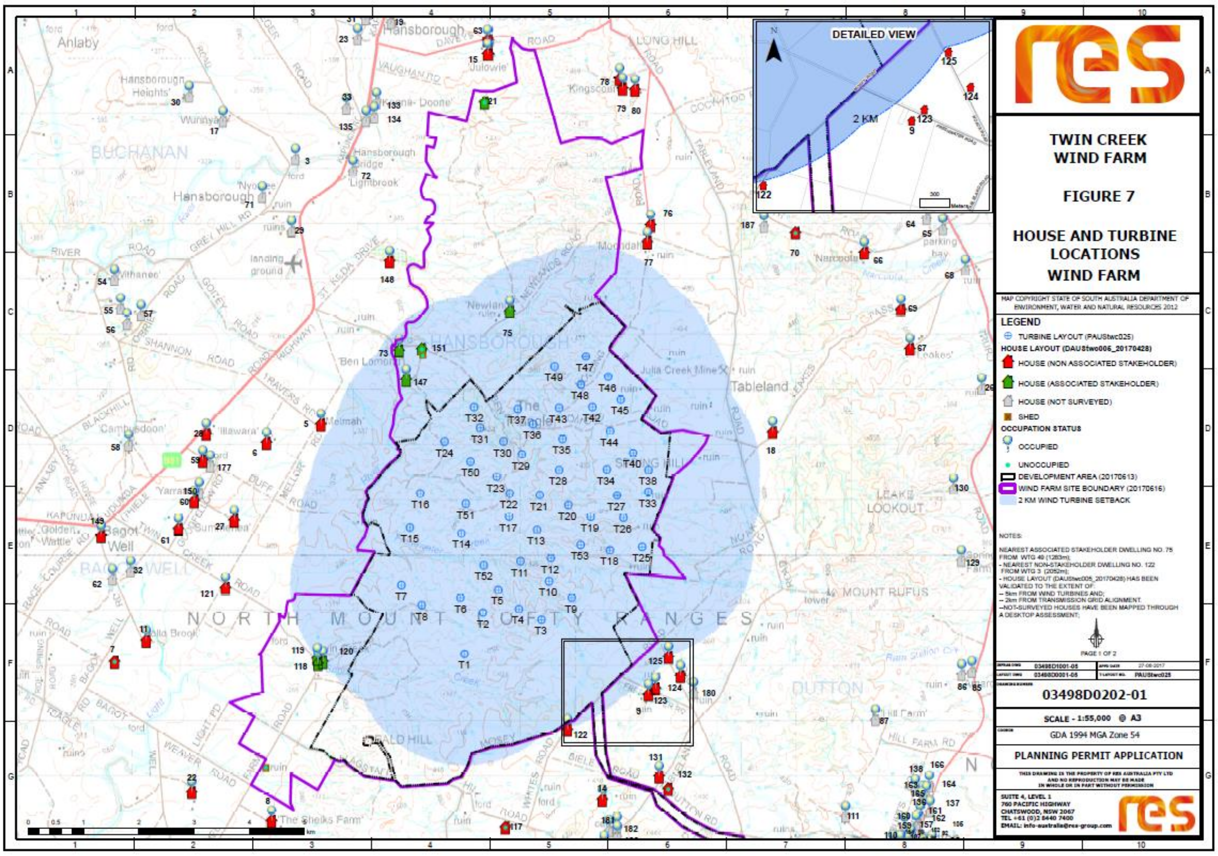
RES Australia proposes to develop the Twin Creek Wind Farm and Energy Storage Project within the Mid North area of South Australia. The site of the proposed wind farm is approximately 90 kilometres north-east of Adelaide and north-east of Kapunda. The proposed development is located between the townships of Kapunda, Eudunda and Truro as identified in Figures 1 – Location Plan.

The site of the development includes the area comprising the project infrastructure, as well as the 275kV transmission line. The transmission line extends approximately 15 kilometres south-east of the site and connects to the Robertstown -Tungkillo 275Kv transmission line adjacent the Sturt Highway near Truro.

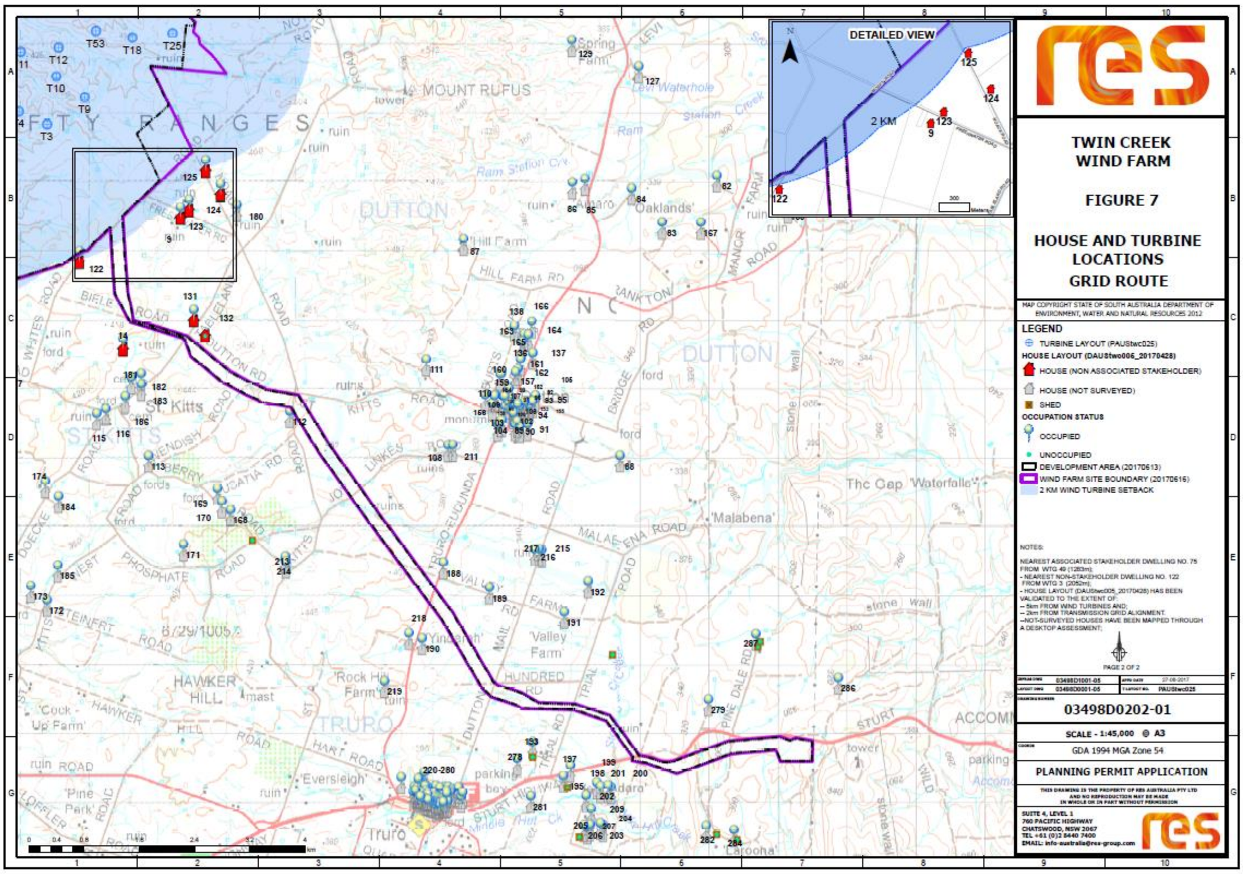
Infrastructure including wind turbine generators, battery energy storage and site substation is located within the Light Regional Council and Regional Council of Goyder area. The transmission line transverses from within the Light Regional Council area to the Mid Murray Council area. The terminal substation at the junction with the Robertstown to Tungkillo 275Kv transmission line is also located within the Mid Murray Council area. Location of these development site relative to the Local Government boundaries and relevant zones is shown on Figure 4 – Planning Overlays.

The site of the development spans approximately 6.0 to 7.0 kilometres in a north- south direction and approximately 5.0 kilometres in an east-west direction (excluding the transmission line). Land within the development site which comprises the wind turbine generators and associated infrastructure is in the ownership of different families (within various entities). The transmission line comprises land owned by 18 land owners in 26 different Certificates of Title. The combined area of these properties is approximately 5,600 hectares.

Land within the site of the development is predominately used for sheep grazing and cereal cropping. A total of 8 dwellings are located within the site of the development and are referred to as "stakeholder" dwellings within the development application, as shown on Figure 7 – House and Turbine Location below.



DETAILED VIEW
TWIN CREEK WIND FARM
FIGURE 7
HOUSE AND TURBINE LOCATIONS WIND FARM
LEGEND
TURBINE LAYOUT (PAUStwc025)
HOUSE LAYOUT (DAUStwc006_20170428)
HOUSE (NON ASSOCIATED STAKEHOLDER)
HOUSE (ASSOCIATED STAKEHOLDER)
HOUSE (NOT SURVEYED)
SHED
OCCUPATION STATUS
OCCUPIED
UNOCCUPIED
DEVELOPMENT AREA (20170613)
WIND FARM SITE BOUNDARY (20170616)
2 KM WIND TURBINE SETBACK
NOTES:
03498D0202-01
SCALE - 1:55,000 @ A3
GDA 1994 MGA Zone 54
PLANNING PERMIT APPLICATION
NORTH MOUNT LOFTY RANGES


TWIN CREEK WIND FARM
FIGURE 7
HOUSE AND TURBINE LOCATIONS
GRID ROUTE
MAP COPYRIGHT STATE OF SOUTH AUSTRALIA DEPARTMENT OF ENVIRONMENT, WATER AND NATURAL RESOURCES 2012
LEGEND
TURBINE LAYOUT (PAUStwc025)
HOUSE LAYOUT (DAUStwc006_20170428)
HOUSE (NON ASSOCIATED STAKEHOLDER)
HOUSE (NOT SURVEYED)
SHED
OCCUPATION STATUS
OCCUPIED
UNOCCUPIED
DEVELOPMENT AREA (20170613)
WIND FARM SITE BOUNDARY (20170616)
2 KM WIND TURBINE SETBACK
NOTES:
NEAREST ASSOCIATED STAKEHOLDER DWELLING NO. 75 FROM WTG 49 (1283m);
- NEAREST NON-STAKEHOLDER DWELLING NO. 122 FROM WTG 3 (2052m);
- HOUSE LAYOUT (DAUStwc005_20170428) HAS BEEN VALIDATED TO THE EXTENT OF:
-- 5km FROM WIND TURBINES AND;
-- 2km FROM TRANSMISSION GRID ALIGNMENT.
--NOT-SURVEYED HOUSES HAVE BEEN MAPPED THROUGH A DESKTOP ASSESSMENT;
PAGE 2 OF 2
03498D1001-05
27-06-2017
03498D0001-05
PAUStwc025
03498D0202-01
SCALE - 1:45,000 @ A3
GDA 1994 MGA Zone 54
PLANNING PERMIT APPLICATION
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SUITE 4, LEVEL 1
760 PACIFIC HIGHWAY
CHATSWOOD, NSW 2067
TEL +61 (0)2 8440 7400
EMAIL: info-australia@res-group.com
DETAILED VIEW
2 KM

1.4 LEGAL DESCRIPTION OF THE SITE OF THE DEVELOPMENT

The site of the development is described below, with reference to land included in the development.

The technical reports may utilise varying terminology to describe the development and the site of the development. References in the various technical reports include "the project", "the proposed development", "the wind farm", the "wind farm infrastructure area", "Twin Creek Wind Farm" and the "Twin Creek Wind Farm and Energy Storage Project". Whilst the terminology may vary, the following should be noted:

- the "site of the development" incorporates all land within the project, including land in private ownership along the transmission route as detailed in Table 1 and 2 below. The "site of development" is shown on the plans prepared by RES as a purple line (site boundary 20170404)

- references to the "development area", which is shown as green on the plans prepared by RES contains all infrastructure of the project, but may not include entire allotments as contained within the "site of the development"

- References to the "wind farm infrastructure area", which is shown as grey on the plans prepared by RES are the corridors for the location of the infrastructure and micro-siting of that infrastructure.

The following tables (Table 1 and 2) comprises the legal description of the site of the development, along with development components located on each site. These properties are depicted in Figure 5 – Wind Farm and Grid Landowners.

Table 1 - WIND FARM – LAND PARCEL AND INFRASTRUCTURE INFORMATION

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5293 FOL 933	ALLOTMENT 3 FILED PLAN 158974 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	INFRASTRUCTURE ZONE	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 934	ALLOTMENT 10 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 50, HARDSTAND ACCESS TRACK, INFRASTRUCTURE ZONE CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 934	ALLOTMENT 11 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 29, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 934	ALLOTMENT 6 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 24, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5293 FOL 934	ALLOTMENT 8 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 31, TURBINE 32, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 934	ALLOTMENT 9 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 30, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 12 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 47, HARDSTAND, PERMANENT MET MAST, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 13 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 48, TURBINE 49, HARDSTANDS, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 14 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 43, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 15 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	TURBINE 36, TURBINE 37, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 122 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 16, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 123 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 23, TURBINE 51, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 124 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 21, TURBINE 22, TURBINE 17, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 125 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 11, TURBINE 13, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5293 FOL 930	SECTION 126 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	ACCESS TRACK, CONSTRUCTION COMPOUND, MATERIAL LAYDOWN AREA, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 127 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 14, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 128 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 15, HARDSTAND, ACCESS TRACK INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 930	SECTION 129 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	INFRASTRUCTURE ZONE, ACCESS TRACKS, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 927	SECTION 218 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 927	SECTION 219 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 42, HARDSTAND, ACCESS TRACK, CONSTRUCTION COMPOUND, MATERIAL LAYDOWN AREA, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 927	SECTION 220 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 45, TURBINE 46, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 931	SECTION 232 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 28, TURBINE 35, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 931	SECTION 233 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 12, TURBINE 20, HARDSTAND, ACCESS TRACK, CONSTRUCTION COMPOUND, MATERIAL LAYDOWN AREA, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 931	SECTION 234 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 19, TURBINE 53, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5293 FOL 931	SECTION 235 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	INFRASTRUCTURE ZONE, ACCESS TRACK, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 928	SECTION 236 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 34, TURBINE 40, TURBINE 44, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 928	SECTION 237 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 38, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 928	SECTION 238 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 928	SECTION 239 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 27, TURBINE 33, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 928	SECTION 240 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 18, TURBINE 26, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5964 FOL 335	SECTION 241 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5964 FOL 335	SECTION 242 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	TURBINE 25, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	REGIONAL COUNCIL OF GOYDER
VOL 5964 FOL 335	SECTION 243 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 689	SECTION 272 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 9, TURBINE 10, HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 706	ALLOTMENT 91 FILED PLAN 199399 IN THE AREAS NAMED BAGOT WELL AND ST KITTS HUNDRED OF BELVIDERE	ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5618 FOL 693	SECTION 278 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	ACCESS TRACK, BATTERY ENERGY STORAGE FACILITY, CONCRETE BATCHING PLANT AREA, CONSTRUCTION COMPOUND MATERIAL LAYDOWN AREA, OPERATIONS AND MAINTENANCE FACILITY, SUBSTATION, INFRASTRUCTURE ZONE, OVERHEAD LINE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 688	SECTION 283 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 688	SECTION 284 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	ACCESS TRACK, INFRASTRUCTURE ZONE, OVERHEAD LINE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 91 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 92 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 93 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 94 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 95 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 96 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5390 FOL 991	ALLOTMENT 97 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 98 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 104 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 105 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 699	SECTION 258 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	INFRASTRUCTURE ZONE, ACCESS TRACK, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 695	SECTION 263 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	INFRASTRUCTURE ZONE, ACCESS TRACK, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 696	SECTION 265 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 7, TURBINE 8, HARDSTANDS, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 701	SECTION 267 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 6, TURBINE 52, HARDSTANDS, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 703	SECTION 268 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 1 HARDSTAND, PERMANENT MAST, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 697	SECTION 269 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 2, TURBINE 5 HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5618 FOL 700	SECTION 270 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	INFRASTRUCTURE ZONE, ACCESS TRACK, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 687	SECTION 271 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 4 HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 692	SECTION 273 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	TURBINE 3 HARDSTAND, ACCESS TRACK, INFRASTRUCTURE ZONE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 691	SECTION 285 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	ACCESS TRACK, PRINCIPAL SITE ENTRANCE, INFRASTRUCTURE ZONE, OVERHEAD LINE, CABLES.	LIGHT REGIONAL COUNCIL
VOL 5865 FOL 275	ALLOTMENT 25 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5488 FOL 108	SECTION 159 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5625 FOL 166	ALLOTMENT 24 FILED PLAN 217158 IN THE AREA NAMED BAGOT WELL HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5293 FOL 930	SECTION 121 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 18 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5865 FOL 275	ALLOTMENT 19 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 17 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 694	SECTION 251 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 704	ALLOTMENT 91 FILED PLAN 217083 IN THE AREAS NAMED KOONUNGA AND ST KITTS HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5488 FOL 108	SECTION 288 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5488 FOL 108	SECTION 157 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5764 FOL 914	SECTION 327 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5293 FOL 934	ALLOTMENT 4 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5390 FOL 991	ALLOTMENT 103 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5290 FOL 269	SECTION 160 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 694	SECTION 255 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5865 FOL 276	SECTION 206 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5290 FOL 267	SECTION 208 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5865 FOL 275	ALLOTMENT 23 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5290 FOL 269	SECTION 164 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 690	SECTION 249 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5290 FOL 269	SECTION 162 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 702	SECTION 257 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 708	ALLOTMENT 571 FILED PLAN 176643 IN THE AREA NAMED BAGOT WELL HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5625 FOL 166	ALLOTMENT 20 FILED PLAN 217158 IN THE AREA NAMED BAGOT WELL HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5290 FOL 269	SECTION 167 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 694	SECTION 254 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5865 FOL 275	ALLOTMENT 20 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 705	ALLOTMENT 569 FILED PLAN 176641 IN THE AREA NAMED ST KITTS HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5531 FOL 406	SECTION 103 HUNDRED OF BELVIDERE IN THE AREA NAMED KOONUNGA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5625 FOL 166	ALLOTMENT 23 FILED PLAN 217158 IN THE AREA NAMED BAGOT WELL HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT 99 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5804 FOL 478	SECTION 252 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5488 FOL 108	ALLOTMENT 2 FILED PLAN 10717 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5878 FOL 290	ALLOTMENT 1 FILED PLAN 160535 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5625 FOL 166	ALLOTMENT 22 FILED PLAN 217158 IN THE AREAS NAMED BAGOT WELL AND ST KITTS HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5390 FOL 991	ALLOTMENT COMPRISING PIECES 102 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5390 FOL 991	ALLOTMENT COMPRISING PIECES 101 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5760 FOL 565	SECTION 206 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5293 FOL 934	ALLOTMENT 5 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5826 FOL 797	ALLOTMENT 572 FILED PLAN 176644 IN THE AREA NAMED BAGOT WELL HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5865 FOL 275	ALLOTMENT 21 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5760 FOL 535	SECTION 509 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5488 FOL 108	SECTION 156 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5865 FOL 275	ALLOTMENT 26 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5625 FOL 166	ALLOTMENT 25 FILED PLAN 217158 IN THE AREA NAMED ST KITTS HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5488 FOL 108	SECTION 291 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 932	SECTION 209 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 16 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5293 FOL 926	ALLOTMENT 17 FILED PLAN 158976 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5865 FOL 275	ALLOTMENT 22 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5625 FOL 166	ALLOTMENT 21 FILED PLAN 217158 IN THE AREA NAMED BAGOT WELL HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 707	ALLOTMENT 102 FILED PLAN 214685 IN THE AREA NAMED KOONUNGA HUNDRED OF BELVIDERE	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5290 FOL 269	SECTION 163 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5390 FOL 991	ALLOTMENT 100 FILED PLAN 199397 IN THE AREA NAMED BAGOT WELL HUNDREDS OF BELVIDERE AND KAPUNDA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5488 FOL 108	SECTION 290 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5488 FOL 108	SECTION 289 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5290 FOL 269	SECTION 169 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 698	SECTION 279 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5672 FOL 368	SECTION 179 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5290 FOL 269	SECTION 166 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5531 FOL 407	SECTION 100 HUNDRED OF BELVIDERE IN THE AREA NAMED KOONUNGA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5293 FOL 934	ALLOTMENT 7 FILED PLAN 158975 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5531 FOL 405	SECTION 105 HUNDRED OF BELVIDERE IN THE AREA NAMED KOONUNGA	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5488 FOL 108	SECTION 155 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5865 FOL 275	ALLOTMENT 24 FILED PLAN 158977 IN THE AREA NAMED HANSBOROUGH HUNDRED OF JULIA CREEK	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5290 FOL 267	SECTION 207 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER

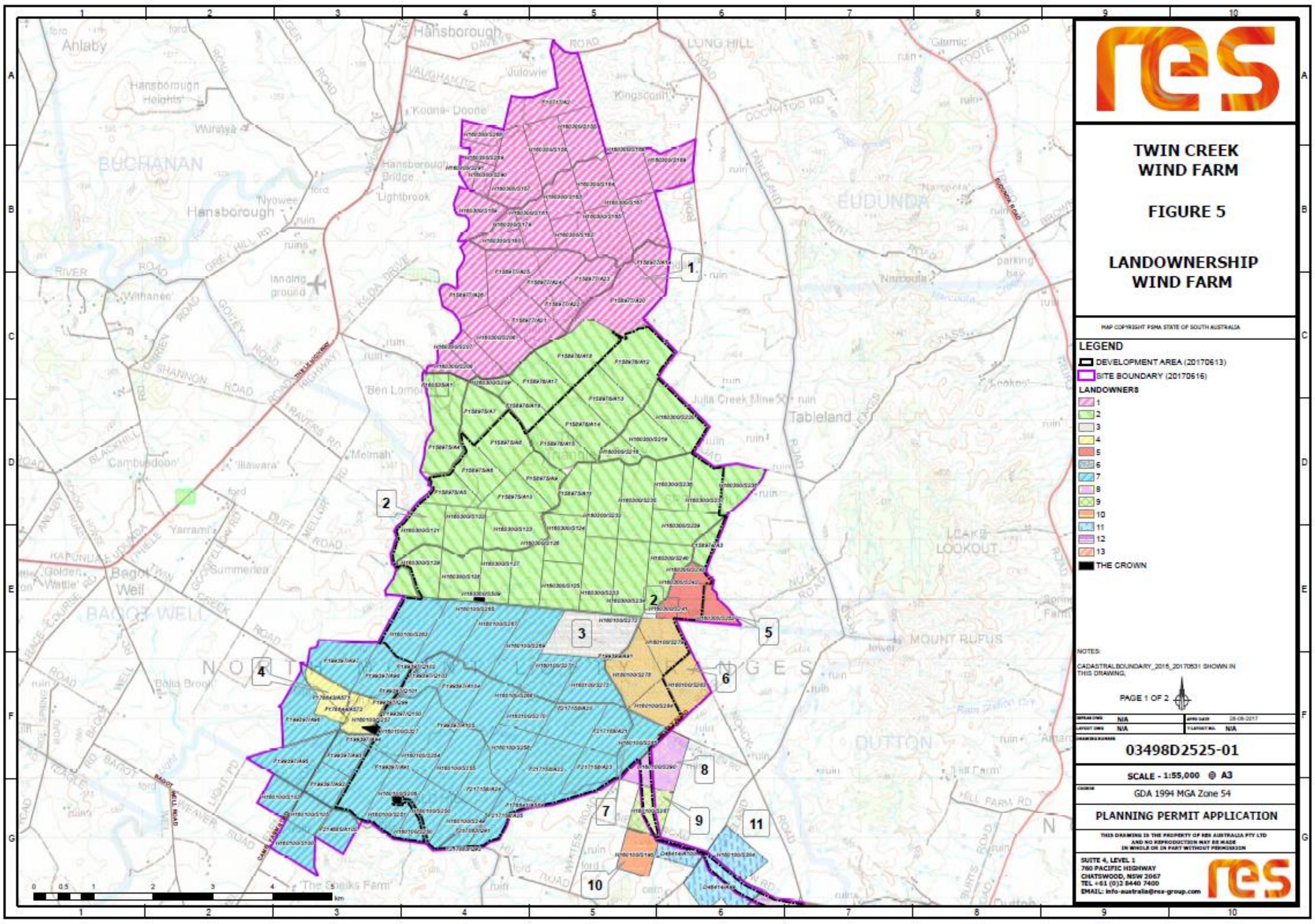
VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5290 FOL 269	SECTION 165 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 694	SECTION 250 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5290 FOL 269	SECTION 161 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER
VOL 5618 FOL 694	SECTION 250 HUNDRED OF BELVIDERE IN THE AREA NAMED BAGOT WELL	NO INFRASTRUCTURE PLANNED	LIGHT REGIONAL COUNCIL
VOL 5293 FOL 930	SECTION 129 HUNDRED OF JULIA CREEK IN THE AREA NAMED HANSBOROUGH	NO INFRASTRUCTURE PLANNED	REGIONAL COUNCIL OF GOYDER

Table 2 - GRID CONNECTION – LAND PARCEL AND INFRASTRUCTURE INFORMATION

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5618 FOL 693	SECTION 278 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5618 FOL 688	SECTION 284 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5264 FOL 963	SECTION 290 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5663 FOL 19	SECTION 287 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5476 FOL 305	SECTION 190 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5486 FOL 562	ALLOTMENT 100 DEPOSITED PLAN 48414 IN THE AREA NAMED ST KITTS HUNDRED OF BELVIDERE	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5486 FOL 561	ALLOTMENT 99 DEPOSITED PLAN 48414 IN THE AREA NAMED ST KITTS HUNDRED OF BELVIDERE	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5274 FOL 160	SECTION 314 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5146 FOL 519	SECTION 581 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 6124 FOL 753	ALLOTMENT 1 DEPOSITED PLAN 36071 IN THE AREA NAMED ST KITTS HUNDRED OF BELVIDERE	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5616 FOL 778	SECTION 319 HUNDRED OF BELVIDERE IN THE AREA NAMED ST KITTS	OVERHEAD LINE	LIGHT REGIONAL COUNCIL
VOL 5616 FOL 778	SECTION 83 HUNDRED OF DUTTON IN THE AREA NAMED DUTTON	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5616 FOL 778	SECTION 85 HUNDRED OF DUTTON IN THE AREA NAMED DUTTON	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5640 FOL 955	SECTION 87 HUNDRED OF DUTTON IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5517 FOL 458	SECTION 37 HUNDRED OF DUTTON IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5485 FOL 579	SECTION 38 HUNDRED OF DUTTON IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5485 FOL 733	SECTION 36 HUNDRED OF DUTTON IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5503 FOL 860	SECTION 34 HUNDRED OF DUTTON IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5322 FOL 638	ALLOTMENT 1 DEPOSITED PLAN 44123 IN THE AREA NAMED TRURO HUNDRED OF DUTTON	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5812 FOL 749	SECTION 51 HUNDRED OF DUTTON IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5810 FOL 208	ALLOTMENT 682 FILED PLAN 209058 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5315 FOL 264	SECTION 221 HUNDRED OF JELLICOE IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5652 FOL 492	ALLOTMENT 1 DEPOSITED PLAN 48415 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5950 FOL 567	SECTION 218 HUNDRED OF JELLICOE IN THE AREA NAMED TRURO	OVERHEAD LINE	MID MURRAY COUNCIL

VOLUME AND FOLIO	ALLOTMENT/SECTION AND FILED/HUNDRED PLAN	INFRASTRUCTURE	LOCAL GOVERNMENT AREA
VOL 5950 FOL 564	ALLOTMENT 106 DEPOSITED PLAN 65817 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5947 FOL 941	ALLOTMENT 110 DEPOSITED PLAN 65818 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5304 FOL 717	ALLOTMENT 94 FILED PLAN 163638 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5360 FOL 970	ALLOTMENT 101 FILED PLAN 174415 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 6157 FOL 823	ALLOTMENT 118 FILED PLAN 174416 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE	MID MURRAY COUNCIL
VOL 5506 FOL 92	ALLOTMENT 91 FILED PLAN 163637 IN THE AREA NAMED TRURO HUNDRED OF JELLICOE	OVERHEAD LINE, TERMINAL SUBSTATION, ACCESS TRACK, VEGETATIVE SCREENING, ELECTRICAL INFRASTRUCTURE.	MID MURRAY COUNCIL


TWIN CREEK WIND FARM
FIGURE 5
LANDOWNERSHIP WIND FARM
MAP COPYRIGHT PSMA STATE OF SOUTH AUSTRALIA
LEGEND
DEVELOPMENT AREA (20170613)
SITE BOUNDARY (20170616)
LANDOWNERS
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THE CROWN
NOTES:
CADASTRALBOUNDARY_2015_20170831 SHOWN IN THIS DRAWING.
PAGE 1 OF 2
N/A
28-06-2017
N/A
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03498D2525-01
SCALE - 1:55,000 @ A3
GDA 1994 MGA Zone 54
PLANNING PERMIT APPLICATION
THIS DRAWING IS THE PROPERTY OF RES AUSTRALIA PTY LTD AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION
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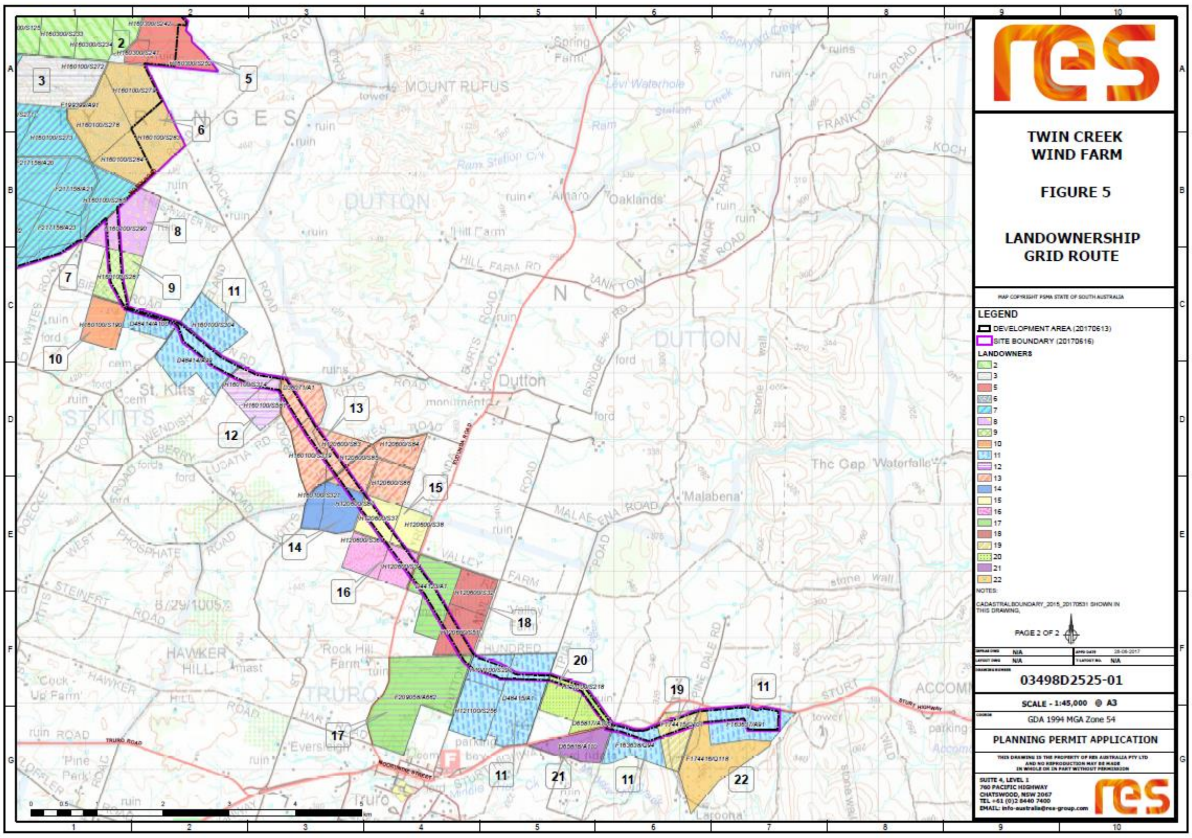
Anlaby
BUCHANAN
EUDUNDA
Tableland
DUTTON
MOUNT RUFUS
Julia Creek Mine
Koonadoone
Kingscote
Lightbrook
Ben Lomond
Bagot Well
BAGOT WELL


TWIN CREEK
WIND FARM
FIGURE 5
LANDOWNERSHIP
GRID ROUTE
MAP COPYRIGHT PSMA STATE OF SOUTH AUSTRALIA
LEGEND
DEVELOPMENT AREA (20170613)
SITE BOUNDARY (20170616)
LANDOWNERS
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CADASTRALBOUNDARY_2015_20170531 SHOWN IN THIS DRAWING.
PAGE 2 OF 2
N/A
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03498D2525-01
SCALE - 1:45,000 @ A3
GDA 1994 MGA Zone 54
PLANNING PERMIT APPLICATION
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MOUNT RUFUS
DUTTON
Dutton
St. Kitts
TRURO
Truro
HAWKER HILL
Rock Hill Farm
'Oaklands'
'Malabena'
The Gap
Waterfalls
Levi Waterhole
STURT HIGHWAY
TRURO ROAD
MALAE-ENA ROAD

1.5 PROJECT OVERVIEW

The proposed Twin Creek Wind Farm and Energy Storage project is to be located approximately 90 kilometres north-east of Adelaide and between the townships of Kapunda, Eudunda and Truro.

The project will involve the construction and operation of up to a maximum of 51 wind turbine generators. Each wind turbine generator has a generation capacity of around 3.6 MW and a total installed capacity of up to 183 MW. The project includes a 50 MW battery energy storage facility.

1.5.1 Summary of Development Components

The proposed development incorporates the following elements:

- up to 51 Wind Turbines Generators (WTG);
- the development application is based on Vestas V136 turbine as a candidate turbine, however the final turbine model will be subject to a competitive tender process post Development Plan Consent;
- each WTG has an indicative capacity of 3.6 MW, however the exact capacity may vary with selection of the final turbine model;
- overall height of turbines would be up to 180 metres at the blade tip. Development Plan Consent is sought for a wind turbine generator with a maximum overall height of 180 metres;
- based on the candidate turbine the indicative dimensions are approximately 112 metres to the hub and blades approximately 68 metres in length. The exact dimensions may alter with the selection of the final turbine model;
- turbines are three-bladed, semi-variable speed, pitch regulated machines with a rotor and nacelle mounted on a reducing cylindrical steel tower;
- wind turbine generator blades constructed in a white or off white colour with non-reflective coatings;
- the WTG's extend approximately 6 to 7 kilometres in a north- south direction and approximately 5 kilometres in an east-west direction;
- micro-siting for the wind turbine generators is sought, for WTG so that, should environmental constraints or unacceptable ground conditions be identified during construction, these can be avoided;
- all infrastructure will be micro-sited within the "infrastructure zone" and within the following parameters:
  - WTG to be located within 100 metres of their proposed locations and in accordance with the micro-siting drawing provided in Volume 3;
  - tracks, hardstands and associated infrastructure to suit any micro-sited WTG locations;

- substations, battery energy storage facility or operation and maintenance compound within 100 metres of their proposed location; and
- overhead transmission line within infrastructure zone.

- two meteorological masts with a height equivalent to the hub height of the final selected turbine. Based on the candidate turbine, this height would be approximately 112 metres;
- a network of internal tracks (5.0 to 7.0 metres in running width) linking turbines and to provide access to and from public roads. The total length of track is approximately 40 kilometres. Where possible existing tracks are utilised and upgraded for access;
- approximately 49 kilometres of 33kV electrical cables (underground) linking turbines to the on-site substation;
- 275kV overhead transmission line for approximately 15 kilometres from the on-site substation to the terminal substation and tee in to the Robertstown to Tungkillo 275 kW transmission line. Poles will be constructed with steel or concrete monopoles up to 35 metres high and spaced approximately 200-400 metres apart (or wider should terrain enable) depending on ground conditions;
- two substations, the first is within the wind farm infrastructure zone, on the south-eastern side of the development site near the wind farm access point. The second substation is the terminal substation, which is located adjacent south of the Sturt Highway east of the township of Truro at the 275kV tee in point;
- at the terminal substation the 275kV transmission towers may comprise lattice towers up to 45 metres high to tee into the existing transmission line;
- operations and maintenance facilities including; office, control room, staff facilities, car park area for staff and visitors and workshop;
- up to four temporary laydown and construction facilities;
- a mobile concrete batching plant within one of the temporary laydown and construction facilities; and
- a battery energy storage facility with an indicative capacity of 215 MW;. The facility includes up to 24 containerised energy storage enclosures (which house batteries, inverters, transformers, racking and associated electrical equipment), a control building and switchroom. The capacity of the energy storage may alter with the selection of the final infrastructure and is subject to the conditions of the Office of Technical Regulator (Schedule 5 of the *Development Regulations 2008* in relation to the security and stability of the State's power system).

1.5.2 Construction Compound, Substation and Battery Energy Storage Facility

The construction operations and maintenance, battery storage and substation compound, includes:

- operations and maintenance area identified on the plan as a "utility zone" of approximately 0.8 hectares. This area comprises:

- the office and staff facilities 20 metres (L) x 10 metres (W) x 4.5 metres (H);
- operations and maintenance building 25 metres (L) x 15 metres (W) x 8 metres (H);
- bunded hazardous chemical storage area; and
- car parking and communications tower (approximately 25 metres in height).

- battery storage compound of approximately 1.1 hectares. This area comprises:
  - 24 energy storage containers containing UL-listed batteries, inverters, transformers, racking and associated equipment, typically 12 to 15 metres in length, 2.5 metres in height and typically 0.5 metres FFL above natural ground;
  - associated transformers;
  - switchroom;
  - control building; and
  - car parking.

- construction laydown area of approximately 2.9 hectares;

- substation including switch room and control buildings of approximately 2.2 hectares. This area comprises:
  - 33kv switch room;
  - control building;
  - one permanent 275kV -33kV substation with approximate dimensions of 75 metres x 85 metres; and
  - bunds for fuel, oil and chemical storage.

Overall the site of the construction operations and maintenance, battery storage and substation compound is approximately 7 hectares. The compound is accessed from Mosey Road via an internal access road. The compound is setback approximately 1.4 kilometres from the nearest public road (at its closest point). All areas of the compound may be fenced with 2m high security fencing. Screen vegetation planting would be undertaken around the perimeter of the compound in accordance with WAX Design recommendations contained within the Landscape Character and Probable Visual Effect Assessment report.

The permanent construction operations and maintenance, battery storage and substation compound is located on Section 278 in Certificate of Title Volume 5618 Folio 693. Plans of the indicative layout of the compound and its associated facilities are incorporated in the development application documents (**Volume 3).**

1.5.3 Concrete Batching Plant

A mobile temporary concrete batching plant is to be located within a compound of approximately 1.3 hectares (115 metres x 115 metres. This compound is to be located immediately to the south-west of the permanent construction operations and maintenance, battery storage and substation compound (if this material is not sourced off-site). This temporary concrete batching plant is located on the same property as the permanent construction operations and maintenance, battery storage and substation compound.

The need for on-site concrete batching plants will depend on the final selected civil contractor requirements.

1.5.4 Temporary Construction Compounds

A total of five temporary laydown and construction facilities are proposed throughout the development site, including the temporary concrete batching plant described above and the three satellite temporary construction compounds.

The temporary construction and laydown facilities are anticipated to be utilised during the 18 month to two year construction timeframe of the development and may include the following sites:

- Section 278 in Certificate of Title Volume 5618 Folio 693 south east of WTG 9;
- Section 2193 in Certificate of Title Volume 5293 Folio 927 between WTG 42 and 48;
- Section 126 in Certificate of Title Volume 5293 Folio 930 between WTG 51 and 17;
- Section 233 in Certificate of Title Volume 5293 Folio 931 between WTG 13 and 19; and
- Allotment 91 in Certificate of Title Volume 5506 Folio 92 adjacent the terminal substation.

The final number and location of these facilities would be determined as part of the final design of the wind farm, following selection of the construction contractor and establishing their requirements.

1.5.5 275kV Terminal Substation

In addition to the substation within the wind farm infrastructure zone, as described in Section 1.5.2, a second substation is the terminal substation at the 275kV tee in point. This substation is located adjacent the Sturt Highway east of the township of Truro on Allotment 91 in Certificate of Title Volume 5506 Folio 92.

The substation including switch room and control buildings is approximately 2.0 hectares and comprises:

- switch room;
- control building;
- two permanent substations;
- 2.0 metre high perimeter security fence;
- site entrance from the Sturt Highway; and
- screen vegetation planting would be undertaken adjacent the road reserve in accordance with WAX Design recommendations contained within the Landscape Character and Probable Visual Effect Assessment.

A temporary construction compound of approximately 1.5 hectares would also be located on the site.

1.5.6 Battery Storage

As described in Section 1.5.2 above, the battery energy storage comprises 24 containerised energy storage units with an indicative capacity of 215 MW. . The components of the facility will include UL-listed batteries, inverters and transformers, switchroom, control building, car parking and associated equipment.

The batteries will have grid support capabilities and can be configured to respond to a variety of network requests to stabilise network services. The services provided will be subject to detailed negotiation as part of the grid connection agreement process. It is likely however that the batteries on Twin Creek will be principally utilised for energy production shifting and performance of regulatory standards.

1.6 PROJECT TIMING

RES Australia is seeking a period of 5 years in which to substantially commence the development from the operative date and substantial completion to be extended to 7 years from the operative date of the consent.

Table 1.1 outlines the likely timetable for construction and operation of the Twin Creek Wind Farm project.

Table 1.1 – Project Timing

PHASE	DURATION
Pre-construction, project planning and development approval	12 months
Construction and commissioning	18-24 months
Operation	25 -30 years
Maintenance	Periodic and as required
Decommissioning or replacement	At completion of project life - up to 24 months

Following determination of the development application for Development Plan Consent, RES Australia will undertake a tender process to confirm the equipment supplier and involved contractors, pre-construction arrangements and finalisation of the Construction Environmental Management Plan (CEMP) and Operational Management Plan, and the construction phase of the project.

CHAPTER 2 –

PROJECT CONTEXT

CHAPTER 2 – PROJECT CONTEXT

2.1 INTRODUCTION

Twin Creek Wind Farm and Energy Storage Project is a development of economic and environmental significance and represents an important contribution to renewable energy generation in South Australia.

The project provides additional generating capacity of approximately 613,000 Megawatt hours (MWh) every year over the operating life of the wind farm. This generation is equivalent to the electricity needs of approximately 118,000 South Australia homes each year, (assuming the average annual household electricity use is 5,200 kWh per annum). In addition to the wind generation, the energy storage facility has a storage capacity of 50 MW.

The wind farm and energy storage will generate electricity for use by electricity customers within the National Electricity Market.

2.2 RES AUSTRALIA AND PROJECTS

RES is the world's leading independent renewable energy companies, with the expertise to develop, engineer, construct, finance, and operate projects around the globe. It has deployed over 12GW of utility renewable energy projects involving wind, solar and energy storage technologies. RES Australia has been developing renewable energy projects in Australia since 2004. RES 's recent Australian projects include Ararat Wind Farm (75 turbines, 235 MW) and Murra Warra Wind Farm (116 turbines, 418 MW) in Victoria and Taralga Wind Farm (51 turbines, 107 MW) in New South Wales.

RES contracted energy storage portfolio exceeds 144 MW (92 MWh), with over 200 MW in development. It has partnered with over 9 utilities across these projects and is recognised by Navigant Research as one of the top two global integrators of energy storage.

2.3 CONTEXT FOR WIND ENERGY DEVELOPMENT

2.3.1 Global Context

There is overwhelming evidence that carbon emissions are having a detrimental effect on the environment and that if such emissions continue to increase there will be serious consequences for biological and social systems worldwide. It is recognised that the use of renewable energy sources will displace greenhouse gas emissions arising from fossil fuel electricity generation. Policies have been put in place at the international, national and state level to proactively support the establishment and use of renewable energy.

The Intergovernmental Panel on Climate Change (IPCC[1]) assesses the scientific, technical and socio economic information relevant for the understanding of risk of human-induced climate change. The Fifth Assessment Report (AR5) produced by the IPCC in 2015 reports comprehensive evidence of climate change, impacts and associated directions for mitigation of the social, environmental and economic costs.

The AR5 concluded that annual global greenhouse gas emissions have risen by 12.5 percent since 1990, and that the concentration of atmospheric carbon dioxide has reached the order of 390 parts per million in 2010, which has increased from the pre-industrial level of about 180 parts per million (an increase of 39 percent). The increase in atmospheric carbon is primarily due to the combustion of fossil fuels, coal, oil and gas.

Research by the World Resources Institute (WRI) has estimated two of the largest global sources of carbon dioxide are electricity and heat (32 percent) and transportation (17 percent) (Climate Analysis Indicators Tool, 2006).

At the United Nations Climate Change Conference held in Paris in 2015, all 196 delegate countries including Australia agreed to reduce greenhouse gas emissions as soon as possible and to keep global warming to below two degrees as measured against preindustrial levels.

Wind power is recognised globally due to its proven technology and because it is less expensive compared to other forms of renewable energy, and accordingly has experienced strong growth globally. The Global Wind Energy Council (GWEC) have reviewed the growth in the wind power market, and despite a 38.3 GW increase in the world's wind power capacity during 2009 (a 31 percent increase from the previous year), during 2010, the overall growth decreased by 0.5 percent to a 38.3 GW growth. This decrease is generally attributed to the global financial crisis; however the outlook for 2011 is more optimistic. The largest contributors to the global wind capacity are China, the United States of America, Germany and Spain.

2.3.2 National Context

Domestically, Australia's current commitment is to reduce emissions of greenhouse gases to five percent below 2000 levels by 2020.

Electricity generation accounts for over 30 percent of Australia's greenhouse gas emissions. On the 23rd June 2015 the Federal Parliament passed the Renewable Energy (Electricity) Amendment Bill 2015 which mandates that 33,000GWh (23.5 percent) of the country's electricity will be generated from renewable sources by 2020.

Australia has a relatively small component of the global wind electricity, however is expected to play a major role in the transition to a low carbon economy. As identified by the GWEC, Australia has some of the best wind resources in the world.

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[1] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

At the end of 2010, the GWEC have identified that 1,880 MW of wind capacity was installed in Australia, consisting of 1,052 operating wind turbines in 52 wind farms. On average, the capacity has increased by 30 percent per year over the past decade.

As electricity generation contributes to a significant proportion of Australia's greenhouse gas emissions, there is considerable pressure for the electricity industry to reduce its contribution. A range of measures, including increased efficiency of generation, fuel switching, and increased renewable energy generation will need to be adopted to achieve a significant mitigation in the growth of greenhouse gas emissions from the electricity industry.

2.3.3 State Context

The South Australian Government has an active programme to deliver reductions in greenhouse gas emissions.

A clean energy future is identified as a key strategy in the actions in reducing greenhouse emissions. The proposed development is directly aligned with the South Australian Strategic Plan target for renewable energy is: "*support the development of renewable energy so that it comprises 33% of the state's electricity production by 2020".* In addition to establishing a target for renewable energy, the SASP has a goal to reduce greenhouse gas emissions. The SASP Target in relation to greenhouse gas emissions reduction is to "*achieve the Kyoto target by limiting the state's greenhouse gas emissions to 108% of 1990 levels during 2008-2012, as a first step towards reducing emissions by 60% (to 40% of 1990 levels) by 2050".* South Australia has achieved its Kyoto target of restricting emissions levels to less than 36.4 Mt CO2-e through to 2012 and is now working towards the 2050 target. Continuing to provide alternative sustainable energy sources is viewed as a technique to a reduction in greenhouse gas emissions.

In March 2017, the South Australia Government released an "Energy Plan" with a vision "*to source, generate and control more of South Australia's power supply in South Australia so we can increase self-reliance and provide reliable, competitive and clean power for all into the future."* The Energy Plan contains the following goals:

- provide South Australia with large-scale storage for renewable energy so power is available when it is needed, beginning the transformation to next-generation renewable technology;
- provide South Australia with a government-owned source of emergency electricity generation;
- give South Australia greater local powers over national market operators and privately owned generators;
- create new investment in cleaner energy to increase competition, put downward pressure on prices and provide more energy system stability;
- South Australia to source and use more South Australian gas to generate its own electricity, increasing the state's self-reliance; and
- create more electricity generation to increase competition and put downward pressure on prices.

It is noted that the SA Energy Plan is seeking to ensure that energy can be dispatched as it is needed to provide energy security. The plan notes that large-scale storage transforms renewable energy into dispatchable energy.

2.3.4 Local Energy-System Security

RES Australia recognise the licensing and registration requirements of a generator on the National Electricity Market and as a generator within the State of South Australia. These require satisfaction of requirements from entities such as ElectraNet, Australian Electricity Market Operator (AEMO) and Essential Services Commission of South Australia (ESCOSA). There are further registration requirements as a renewable energy generator over and above registration as a generator.

RES Australia also recognises ESCOSA's directive around integration of new generation sources into networks in seeking to provide network support. These requirements, as well as potential future requirements, are accommodated in the project design through the WTG technology and battery energy storage facility.

In terms of technology, the Twin Creek project considers the suite of new generation Type 4 full inverter based wind turbine generators as being capable of providing services such as enhanced reactive capability, high levels of active power injection post fault recovery, and enhanced flexibility between wind speed and turbine output, underpinning the Fast Frequency Response (FFR) relative to traditional Type 3 doubly fed induction generators dominating the current wind fleet.

Further, the proposed energy storage capability of the facility increases the capability of the proposal providing flexibility to numerous use scenarios including frequency regulation and contingency FFR decoupled from wind resource, the ability to provide current into faults, and flexible yet highly controllable reactive capability.

RES Australia will work with the statutory bodies in relation to an agreed set of performance standards applicable for the facility, to the satisfaction of all appropriate parties through the standard connection process.

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Further, the proposed energy storage capability of the facility increases the capability of the proposal by providing flexibility to numerous use scenarios including the ability to provide dynamic reactive power, voltage control, configurable performance through contingency events, active power control for frequency response and assistance with system restart.

RES Australia will work with the statutory bodies in relation to an agreed set of performance standards applicable for the facility, to the satisfaction of all appropriate parties through the standard connection, registration and commissioning process.

2.3.6 Integration of Wind Farm and Battery Energy Storage into the National Electricity Network

RES Australia is experienced in the process in connecting generation plant to the National Electricity Market (NEM), having developed the now operating 107 MW Taralga Wind Farm in NSW and the 242 MW Ararat Wind Farm in Victoria which has received AEMO registration and is generating to the NEM.

The Twin Creek energy facility will be registered as a Semi-Scheduled Generator under the National Electricity Rules (the Rules), due to its capacity exceeding the threshold of 30MW. A connection enquiry has been lodged with ElectraNet as the responsible Transmission Network Services Provider for the Twin Creek energy facility and RES has received the following feedback from their investigations:

> *…no constraints are expected under reasonably foreseeable operating conditions. The network connection is in a very strong part of the backbone 275 kV network and hence the reason for low exposure to constraints. Even if further generation is added in the same corridor, the exposure to constraints may be limited, though this has not been fully assessed. With more wind farms added in the Mid North and Eyre, the 132 kV parallel network may come under some scrutiny. These are issues which are likely to have low cost fixes, to further strengthen the network capacity however.*

The process for proceeding with the facility is to progress to the connection application phase of the interconnection studies. This will include detailed static and dynamic modelling to confirm the technology capability with respect to the access standards, ultimately arriving at a set of negotiated generator performance standards. Simultaneously, ESCOSA requirements will also be assessed for the selected technology.

Although the technical performance standards of the battery energy facility will be negotiated as part of the suite of grid connection agreements, RES have extensive experience in implementing utility scale grid connected battery energy storage facilities in a range of functions which include:

1. Generation - Frequency Regulation, Renewable Integration, Spinning Reserve, Ramp Rate Management, Renewable Firming.

2. Transmission - Voltage Support, Substation & Line Upgrade Deferral, Renewable Integration, Loss Reduction, Constraint Relief, Reliability & Grid Stability.

3. Distribution - Disaster Recovery / Relief, Microgrid & Island Grid Support, Distribution Upgrade Support, Peak Load Reduction, Power Quality, Reactive power and voltage Support.

The battery functions are dispatchable in automatic and manual modes using RES's proprietary RES control software 'RESolve'.

The facility design will incorporate the communications requirements of both ElectraNet and the Australian Energy Market Operator (AEMO) to ensure network and Supervisory Control and Data Acquisition (SCADA) signals are received in the required timeframes ensuring integration of the facility with the broader network operation controls.

2.4 GREENHOUSE GAS EMISSIONS

The electricity produced by the proposed Twin Creek Wind Farm and Energy Storage project will be fed into the NEM. Increased generation of electricity using wind energy will inevitably result in greenhouse gas emissions savings from electricity generation.

There is significant literature available that shows that wind farms:

- are one of the most benign forms of generation technologies with one of the lowest possible greenhouse impacts;

- cause no greenhouse gas emissions as a result of operation which results in significant greenhouse gas emission reductions compared to existing electricity generating plants; and

- have little opportunity to make other than very marginal gains in the greenhouse efficiency through changes in construction methods or transportation.

An estimation of greenhouse gas emission savings as a result of the Twin Creek Wind Farm has been undertaken by Hudson Howells (Twin Creek Socio-Economic Impact Assessment in Volume 2 of the application). As discussed in the Hudson Howells assessment report, *"renewable wind energy generation has significant environmental benefits through carbon emission reduction where it replaces coal or gas generated electricity".*

To estimate the value of this reduction it is assumed that the Twin Creek Wind Farm will have the following operating characteristics:

- total wind farm capacity of up to 183 MW;
- annual average utilisation rate of 40 percent;
- total generation of 613 Gigawatt hours (Gwh) per annum.

"It is conservatively assumed that when electricity is generated through coal fired stations, it produces 0.8 tonnes of carbon per megawatt hour of electricity generated. So the generation of 613 Gwh per annum through coal generation would produce in the order of 0.491 million tonnes of carbon emissions. At a carbon price of $20 per tonne (historically conservative relative to international trading schemes, and much lower than what is expected in the longer term – but matching current prices), the value of carbon emission savings therefore associated with the Twin Creek Wind Farm is estimated to be $9.8 million per annum or a net present value of $104million over a 20 year period (real discount rate of 7%)" (page 65).

2.5 COMMUNITY ENHANCEMENT PROGRAMMES

RES Australia will commit to a voluntary community enhancement programme as a benefit to the community, to offset residual impacts in the local area in which the wind farm is proposed. The programme would be established to benefit the community across the three Council areas.

RES Australia has established various community enhancement programmes at their operating wind farms elsewhere in Australia and internationally.

Key stakeholders will be consulted in establishing the community enhancement program, including each of the three Councils and local community and sporting groups. RES Australia would seek nominations from the community to establish a 'board or committee' to operate and manage the program. RES would have a member on the board/committee established as one participant only, without any specific decision making role. Applications for grants would be sought from the community on an annual basis. Funding may be sought for sponsorship of sporting clubs, community events or physical enhancement projects in the community.

The final structure and amount of community engagement programmes will be finalised prior to construction and will seek to have input from a diverse range of community members.

RES Australia is committed to supporting the community and has already provided sponsorship to the Kapunda Football Club, the Rotary Kidman Art Show and the Kapunda High School Centenary Foundation Inc. It has also pledged a donation to Eudunda Hardcourt project (used by local tennis and netball sport clubs).

In addition to an agreed community enhancement programme, Twin Creek Wind Farm will provide local economic benefit, the employment of local contractors through the establishment of a contractors' register list, and increased business opportunities as flow-on effects in nearby townships. Further information relating to the social and economic aspects of the project is provided in the Hudson Howells Twin Creek Socio-Economic Impact Assessment report in **Volume 2** of the application.

2.6 SUMMARY OF PROJECT BENEFITS

The key benefits of the construction and operation of the Twin Creek Wind Farm are summarised below:

- contribute to the achievement of the National and State objectives for the sustainable production of energy and the abatement of greenhouse gas emissions;
- the provision of an additional energy source for retailers to meet the obligations of the Federal Government's RET Scheme;
- additional electricity generation in the order of 613 GWh/year to assist the National Electricity Market to be able to satisfy forecast increased electricity demands, being enough clean energy to provide for approximately 118,000 South Australia homes each year;
- the development will assist in adding stability to local energy sector in South Australia via the inclusion of battery storage in combination with the wind farm, providing further renewable energy for the State;
- the provision of an additional, sustainable energy source to provide for an alternate energy source to fossil fuels;
- the displacement of energy from fossil fuels, with the value of carbon emission savings conservatively estimated to be $9.8 million per annum;
- the provision of management and mitigation measures to ensure the project does not compromise environmental values either during construction or operation, and does not place stress on the existing environmental values at the locality including ecological, heritage, soils or water quality;
- local economic benefit, particularly to the land owners within the project area and also to the wider community. The construction phases of the project in particular will involve the employment of local contractors and increased business opportunities as flow-on effects in nearby townships;
- during construction the wind farm would generate an estimated 1,447 person years of employment in South Australia, or an average of over 480 jobs sustained per year over three years;
- once operational the wind farm is estimated to support annually $15.5 million of value added in South Australia, and support directly and indirectly in the order of 105 jobs per year; and

- the proposal can co-exist with the grazing and cropping land use activities on the subject land which can continue during the operation of the project.

The benefits of the project as outlined above should be considered in the context of the potential impacts of the project. The potential impacts of the project are outlined within this volume of the application (Chapter 6) and in detail in the technical reports contained in **Volume 2.**

An assessment of the proposed development in relation to social, environmental and economic impacts, particularly as established in the relevant Development Plan provisions of the Light Development Plan, Goyder Development Plan and Mid Murray Development Plan is contained in **Volume 2**. The conclusion of this assessment is that on balance, the Twin Creek Wind Farm and energy storage facility is a suitable land use.

CHAPTER 3 –
STRATEGIC AND LEGISLATIVE CONTEXT

CHAPTER 3 – STRATEGIC AND LEGISLATIVE CONTEXT

3.1 SOUTH AUSTRALIAN STRATEGIC CONTEXT

The State Governments policies supporting renewable energy have a strategic context.

3.1.1 South Australia's Strategic Plan

South Australia's Strategic Plan (SASP) establishes targets and priorities as a blueprint for the future of South Australia. First prepared in 2004, the SASP has been updated twice since that time and currently comprises seven strategic priorities, 10 economic priorities and 100 measurable targets.

In 2004, the Plan set a target for South Australia to lead Australia in wind and solar power generation within 10 years and to increase the use of renewable energy to comprise 15 percent of total consumption. By 2009, South Australia had 56 percent of the nation's wind power, 30 percent of the solar photovoltaic capacity feeding into the national grid and consumption of renewable energy reached 16.4 percent. In 2007, the target was increased to aim for 20 percent of the state's production from renewables by 2014. The 2010 Plan Progress Report stated that whilst the target had been considered ambitious, it was now likely to be reached well ahead of schedule.

The 2011 SASP has a primary goal that "*South Australia has reliable and sustainable energy sources, where renewable energy powers our homes, transport and workplaces*". The SASP target for renewable energy is: "*support the development of renewable energy so that it comprises 33% of the state's electricity production by 2020".* The 2014-2015 progress update of the SASP states that: "*the proportion of electricity produced from renewable energy sources in South Australia has grown considerably from 4.9% in 2004-05 (baseline year) to 42.2% in 2014-15. Wind energy is the major renewable energy technology that has contributed to the result. The result for 2013-14 is well in excess of both the 20% milestone to be achieved by 2014 and the target of 33% to be achieved by 2020".*

In addition to establishing a target for renewable energy, the SASP has a goal to reduce greenhouse gas emissions. The SASP Target in relation to greenhouse gas emissions reduction is to "*achieve the Kyoto target by limiting the state's greenhouse gas emissions to 108% of 1990 levels during 2008-2012, as a first step towards reducing emissions by 60% (to 40% of 1990 levels) by 2050".* South Australia has achieved its Kyoto target of restricting emissions levels to less than 36.4 Mt CO_2-e through to 2012 and is now working towards the 2050 target. Continuing to provide alternative sustainable energy sources is viewed as a technique to a reduction in greenhouse gas emissions.

3.1.2 Strategic Infrastructure Plans

The Strategic Infrastructure Plan for SA has guided and coordinated the states approach to infrastructure provision since 2005. It provides an overarching state framework for the planning and delivery of infrastructure by all government and private sector infrastructure providers.

A strategic prior of the Infrastructure Plan is to *"support research and development in renewable technologies, particularly wind, solar PV and geothermal energy, to enhance their technical and economic viability".* The plans identifies that "*the most promising renewables of interest to South Australia, based on regional comparative advantages, are wind, solar and geothermal energy....Successful use of additional wind energy will depend on connection and performance standards for wind farms; the ability to export wind energy to and balance imports from the eastern states via interconnectors; the use of demand side measures or additional flexible generation, as well as the development of improved forecasting and data systems".*

3.1.3 Energy Plan

The newly released South Australian Government Energy Plan (March 2017) establishes clear goals to support a new generation of renewable energy that is can be dispatched as it is needed to provide energy security. The plan notes that large-scale storage transforms renewable energy into dispatchable energy. The vision and goals of the SA Energy Plan are outlined in Section 2.3).

3.1.4 Wind Farm Planning Policy

In 2011 the State Government introduced (on an interim basis) planning policies via the Statewide Wind Farms Development Plan Amendment (DPA) as a commitment to certainty for communities and wind farm investors. The policies of the Statewide Wind Farm DPA were finalised in October 2012. The planning policies found within relevant Development Plans throughout South Australia explicitly envisage wind farms in all primary production (rural) zones in South Australia.

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, excluding the area within the Barossa Valley Region Policy Area 2 and Precinct 19 Marananga Seppeltsfield Fringe, and constitute a component of this part 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; and
- 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 derived from increased generation of renewable energy.
The policies also establish criteria for Category 2 public notification, as noted below:

Wind farms and ancillary development such as substations, maintenance sheds, access roads and connecting power-lines (including to the National Electricity Grid) where the base of all wind turbines is located at least 2000 metres from:

(a) an existing dwelling or tourist accommodation that is not associated with the wind farm;

(b) a proposed dwelling or tourist accommodation for which an operable development plan consent exists; and

(c) the boundaries of any Airfield, Airport, Centre, Community, Fringe, Historic Conservation, Home Industry, Living, Mixed Use, Residential, Settlement, Tourist, Township or Urban Zone, Policy Area or Precinct or any Heritage Area (including within the area of an adjoining Development Plan).

The policies introduced by the Statewide Wind Farm DPA are contained within the current Development Plans of Light Regional Council, Regional Council of Goyder and Mid Murray Council and are relevant to the assessment of the Twin Creek wind farm development application.

3.2 DEVELOPMENT ACT 1993

In accordance with Part 4 of the Development Act 1993, no development may be undertaken unless it is an approved development. A development is approved, only if a relevant authority has assessed the development against, and granted consent in respect a range of consents that may be relevant. The development application by RES Australia for the Twin Creek Wind Farm and Energy Storage facility seeks Development Plan Consent.

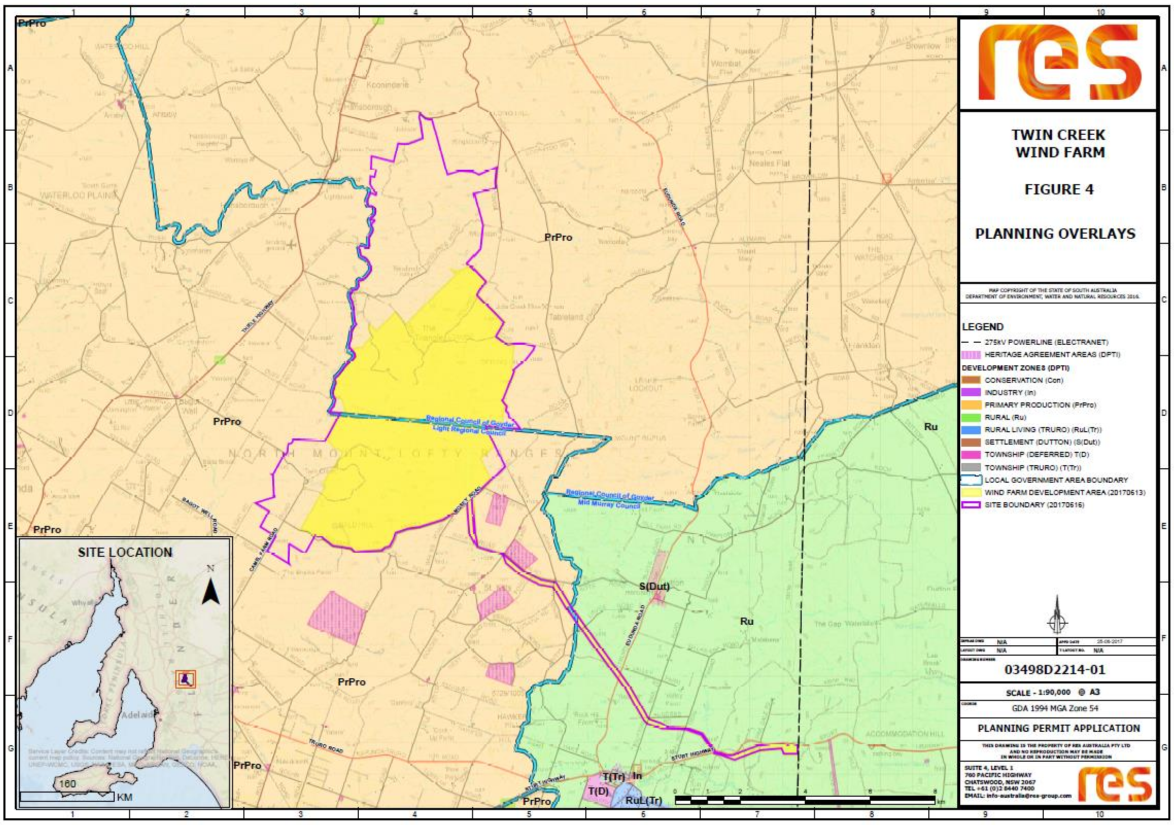
In accordance with Schedule 10(14) of the *Development Regulations 2008*, the Development Assessment Commission will be the relevant planning authority to assess the development application, as the proposed development is *"for the purposes of the provision of electricity generating plant with a generating capacity of more than 5 MW that is to be connected to the State's power system".* Assessment of the application will be undertaken against the relevant provisions of the Light Regional Council Development Plan, the Goyder Council Development Plan and the Mid Murray Development Plan.

Schedule 5 of the *Development Regulations 2008*, requires a certificate be issued by the Technical Regulator certifying that development described in Schedule 10(14) complies with the requirements of the Technical Regulator in relation to the security and stability of the State's power system. A certificate from the Technical Regulator has been issued that certifies that the proposed development complies with the requirements of the Technical Regulator.

The development site of the proposed Twin Creek Wind Farm is located within the following zones:

- Primary Production Zone, General Farming Policy Area 3, Light Regional Council Development Plan (consolidated 8 December 2016);
- Primary Production Zone, Goyder Council Development Plan (consolidated 24 November 2016); and
- Rural Zone, Hills Policy Area 14, Mid Murray Council Development Plan (consolidated 14 June 2017).

Figure 4 – Planning Overlays, illustrates the development site and Council boundaries and land use zones.



A "*wind farm and ancillary development such as substations, maintenance sheds, access roads and connecting power lines (including to the National Electricity Grid)"* is a consent land use within the Primary Production Zone within the Light Regional Council Development Plan and the Rural Zone of the Mid Murray Development Plan, if it is located outside of the Barossa Valley Character Preservation District as defined by Character Preservation legislation. All infrastructure associated with the Twin Creek Wind Farm is outside of the Barossa Valley Character Preservation District.

A wind farm (and ancillary development) is not listed as a complying or non-complying form of development within the Primary Production Zone of the Goyder Council Development Plan and therefore a consent land use to be assessed on merit.

3.3 OTHER APPROVALS

The nature and scale of a wind farm project requires a range of approvals, licences and permits under various State and Commonwealth legislation.

It is common place for wind farm developments to concurrently seek approval in relation to the following three pieces of legislation during the development approval process.

3.3.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is Commonwealth Legislation that focuses on the protection of the environment, especially matters of national environmental significance. The submission and/or determination of an EPBC referral is independent of the development approval process.

RES Australia have identified the need to submit a referral to the Commonwealth Department of the Environment, Water, Heritage and the Arts for consideration under the EPBC Act. This referral is to occur concurrently with the processing of the development application.

3.3.2 Aboriginal Heritage Act 1998

The *Aboriginal Heritage Act 1998* places a duty of care on RES Australia as proponents of the development to address the likelihood of any impact on heritage.

RES Australia along with its consultants, have already undertaken extensive survey work of the site of the development in association with the Ngadjuri local aboriginal community. This process is ongoing and RES Australia are aware of their responsibility pursuant to the *Aboriginal Heritage Act 1998*.

Approvals required pursuant to the *Aboriginal Heritage Act 1998* are independent of the development approval process.

3.3.3 Native Vegetation Act 1991

Any clearance of native vegetation will require approval under the *Native Vegetation Act 1991*. Approval for clearance of native vegetation is independent of the development approval process.

CHAPTER 4 –

PROJECT DESCRIPTION

CHAPTER 4 – PROJECT DESCRIPTION

4.1 SITE SELECTION

RES Australia undertake a systematic process to identify suitable wind farm sites and to assess their relative merits. This process includes identification of potential sites with suitable wind energy resources and transmission infrastructure.

DP Energy established a meteorological monitoring mast on the subject land in around 2012. RES Australia purchased the existing meteorological mast from DP Energy and full development control of the site in January 2015.

RES Australia undertook an initial feasibility study which identified the following advantages of the Twin Creek site:

- high probability of a strong wind resource;
- availability of an appropriate voltage transmission line within a suitably proximity of the site with generation capacity;
- sparse distribution of dwellings within proximity of the site;
- sparse vegetation cover within the development site;
- supportive host landholders; and
- uncomplicated transport access route.

Sophisticated and detailed wind resource modelling was commissioned for the Twin Creek development site. This wind modelling utilised the recorded data from 2012 to present. Figure 2 in Volume 3 illustrates predicted wind speeds.

Concurrent with modelling of the wind resource around Twin Creek, RES Australia have undertaken economic feasibility. Economic and business considerations have a major impact on whether a wind farm project warrants investment. Wind farms need to be of a sufficient size (i.e. number of turbines) relative to the nature of the wind resource and the cost of establishing the project and connection to the national electricity grid.

Proximity to a suitable electricity transmission network is critical. It is also important to minimize the distance of transmission to maximise the efficiency of the project. As energy is transmitted, a small proportion is lost to the atmosphere as heat. Thus, the shorter the distance to grid, the lower the losses and thus the higher the wind farm efficiency.

4.2 PROJECT EVOLUTION

Once Twin Creek Wind Farm site was determined as being an appropriate and suitable wind farm site, detailed technical investigations commenced and the design of the wind farm commenced.

A variety of design options have been considered during the conceptual design of the wind farm. The overall objective of the conceptual design stage was, following identification of potential site constraints to identify the layout of the project to deliver significant savings in greenhouse gas emissions whilst being commercially viable and socially and environmentally acceptable. Constraint analysis included visual analysis, heritage assessment, flora and fauna assessment, community consultation, aviation, acoustic, civil and infrastructure, transportation, bushfire and telecommunications.

The selected design is described in Chapter 5 of this Volume 1 report. Further refinement and micro-siting of the project elements will be undertaken as part of the final design stage, however the proposed design in described in Chapter 5 is sufficiently detailed for the purposes of obtaining Development Plan Consent.

The following variables have been considered in the project design:

- **Turbines:** the spacing of turbines relates to the size of turbines, the orientation of the layout to the prevailing winds and environmental considerations. The following are the specific changes which have occurred to the layout design as a result of the investigations and project consultation:

    - The deletion of 12 turbines with associated tracks and a site entrance road proposed in the south-east of the project area to minimise/avoid the habitat of Pygmy Blue Tongue Lizard.

    - Relocation of T8, T2, T44, T41 and T40 to address concerns from an adjoining neighbour regarding turbine distance to property boundary.

    A review of the wind characteristics of the project area and the commercial available wind turbine equipment indicate that the proposed turbine model and height is most suitable and commercially viable. Lower structures would reduce the electrical generation of the wind farm.

    Consistent with the trend in recent years, larger megawatt class wind turbines are being used increasingly in Australian and overseas. The use of larger turbines has also resulted in reduced costs of wind energy compared to other renewable technologies, as well as reducing the number of turbines required to be constructed to achieve an equivalent generation capacity.

    The candidate turbine model selected for the development application is the Vestas V136 turbines with maximum height to blade tip of 180 metres;

- **Site Access:** Existing tracks have been utilised through the project area wherever possible, and new tracks located to minimise the total length of new tracks, to ensure suitable grades, adequate curvature on bends and to avoid areas of vegetation, fauna or archaeological sensitivity;

- **Electrical Transmission:** a combination of underground and overhead transmission cables will be used in the development. Underground cables are utilised for the connection of the wind turbines to the on-site substation, whilst overhead cables are utilised for the transmission to the terminal substation and existing 275kV transmission line;

- **Energy Storage:** Energy storage was not part of the initial project design and has been incorporated post the original community consultation; and

- **Construction Alternatives:** the Traffic Impact Assessment in Volume 2 (and summarised in Chapter 6 of this report) provides an indication of the viable site access routes for restricted access vehicles. Issues of grade, road surface, curvature, local traffic conditions and minimal disturbance to neighbours have influenced the selection of the preferred route.

  The concrete for construction purposes will be provided on site via installation of a temporary mobile on-site concrete batching plant. The temporary concrete batching plant is located within one of the temporary construction compounds and adjacent to the operations and maintenance compound.

  Subject to material suitability, material may be sourced from a borrow pit within the development site for the construction of access tracks. The construction phase will involve the transport of gravel to locations where it can be spread along the access tracks.

As far as possible the construction period will be limited to minimise any impact on the local community and to enable completion of the wind farm and commencement of the electricity generation as soon as practicable.

4.3 LAYOUT DESIGN

The project site for the wind farm turbines spans an area of approximately 6 to 7 kilometres in a north- south direction and approximately 5 kilometres in an east-west direction (excluding the transmission line). The transmission line travels in a south easterly direction from the onsite substation to the terminal substation for a length of approximately 15 kilometres.

The wind farm is illustrated on the plans prepared by RES and contained in **Volume 3,** as detailed below.

Figure 1 Location Plan – 03498D2212-01

Figure 2 Wind Map – 03498D2213-01

Figure 3 Site and Context Analysis (2 Pages) - 03498D2103-01

Page 1 - Wind Farm

Page 2 - Grid Route

Figure 4 Planning Overlays – 03498D2214-01

Figure 18	Onsite Cable Trench Typical Sections – 03498D4302-01
Figure 19	Typical Overhead Line Poles – 03498D4105-01
Figure 20	Typical Overhead Line Easement and Vegetation Clearance – 03498D4104-01
Figure 21	Preliminary Track Design – 03498D3802-01
Figure 22	Typical Turbine Foundation – 03498D3001-01
Figure 23	Typical Front and Side Elevations of A Wind Turbine – 03498D2301-01
Figure 24	Typical Crane Hardstand – 03498D3801-01
Figure 25	Typical Wind Monitoring Mast – 03498D5001-01

The properties on which it is proposed to construct the wind farm and energy storage project are privately owned and are used predominantly for sheep and cattle grazing and cropping. The development, although covering a wide area, will occupy only a small part of each property and the existing land use will be preserved. Further details on the land within the project area is provided below.

The turbine layout has been designed to provide for the optimum arrangement with the following objectives:

- maximisation of the wind farm electrical output;
- maintain spacing of turbines to minimise turbulence and airflow interactions between turbines;
- avoidance of locations which would affect the existing flora and fauna, and heritage values of the site;
- maintenance of acceptable noise levels and construction of large turbine components;
- enable accessibility in relation to delivery and construction of large turbine components; and
- achieving a wind farm scale required for project economic viability.

The wind farm layout has been informed through:

- extensive wind monitoring data and feasibility studies;
- environmental investigations;
- land suitability assessment;
- land owner requests; and
- community and stakeholder engagement processes.

As described in Section 4.2 above, there have been numerous iterations of the layout design because of these investigations and consultation.

Variations to this layout may result from:

- further public and agency consultations and submissions;
- refinements and minor variations following additional investigations during the detailed design phase, including geotechnical investigations;
- micro siting turbines up to 100 metres from the present location. or
- to address the conditions of any approval granted.

Any such variations will be addressed at the appropriate time, with the layout being finalised prior to development approval being issued.

4.4 WIND TURBINE GENERATORS

A maximum of 51 wind turbine generators (turbines) will be constructed as part of the proposal. The location of the wind turbine generators is shown on Figure 6 - Proposed Turbine Locations (Volume 3) and the locations of which detailed in Table 3.

Table 3 Location of Wind Turbine Generators

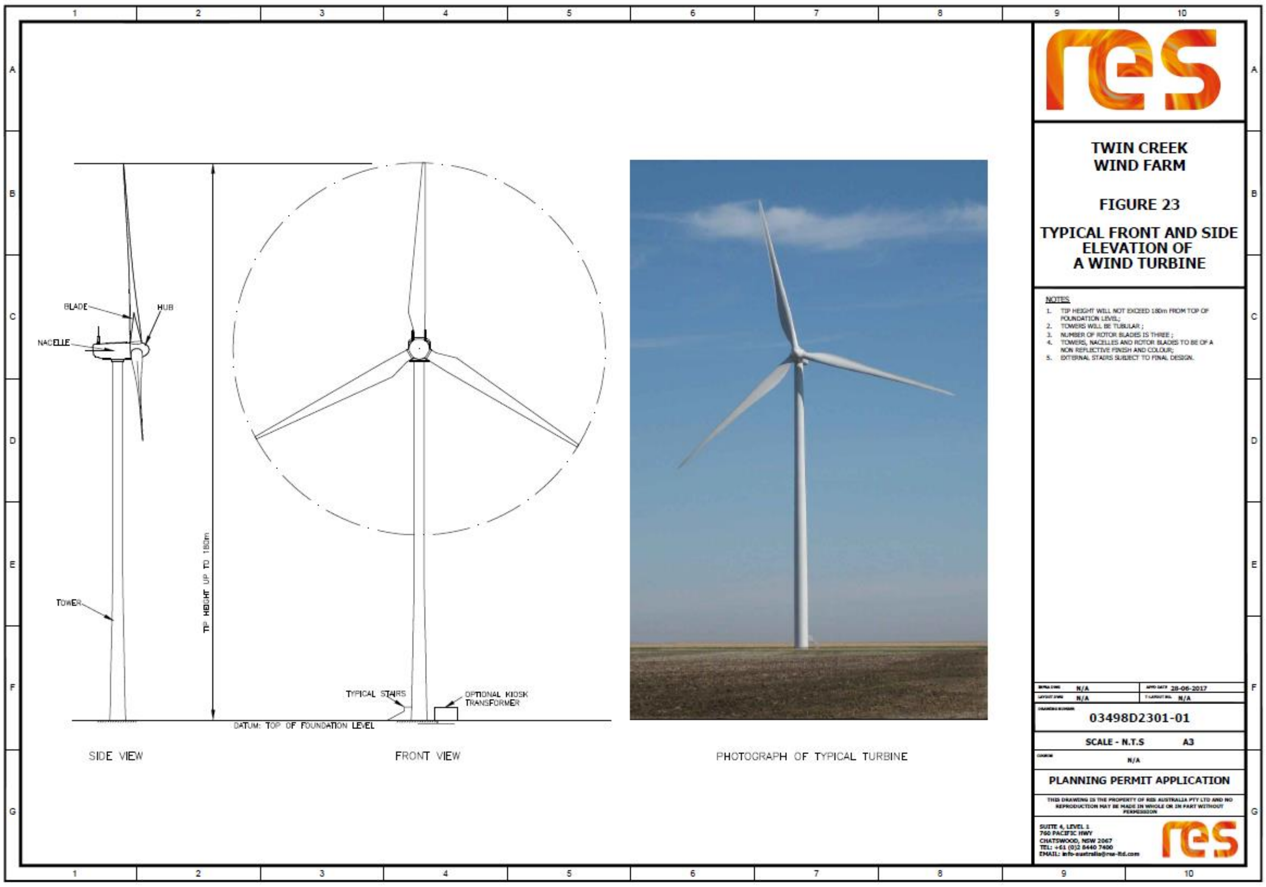
WTG Ref Number	Easting (MGA Z54)	Northing (MGA Z54)
T1	321026	6200205
T2	321360	6200955
T3	322403	6200826
T4	321993	6201019
T5	321620	6201367
T6	320952	6201223
T7	319882	6201452
T8	320250	6201090
T9	322950	6201222
T10	322538	6201521
T11	322022	6201882
T12	322572	6201943
T13	322322	6202456
T14	320971	6202391
T15	320036	6202498
T16	320224	6203111
T17	321816	6202690
T18	323643	6202084
T19	323292	6202686
T20	322886	6202903
T21	322371	6203086
T22	321826	6203111
T23	321590	6203414

WTG Ref Number	Easting (MGA Z54)	Northing (MGA Z54)
T24	320666	6204049
T25	324225	6202148
T26	323887	6202670
T27	323772	6203076
T28	322719	6203537
T29	322046	6203820
T30	321713	6204052
T31	321308	6204303
T32	321201	6204679
T33	324338	6203141
T34	323586	6203550
T35	322782	6204095
T36	322249	6204368
T37	321973	6204642
T38	324342	6203539
T40*	324060	6203843
T42	323325	6204676
T43	322719	6204664
T44	323646	6204246
T45	323837	6204811
T46	323611	6205227
T47	323205	6205593
T48	323115	6205082
T49	322641	6205411
T50	321133	6203686
T51	321050	6202928
T52	321374	6201812
T53	323112	6202183

* The missing turbine numbers 39 and 41 reflect a previously considered turbine location which has not been included in this layout.

The candidate turbine model selected for this development application is the Vestas V136 turbines with tip height of 180 metres.

A schematic illustration of the proposed wind turbine is shown below and in more detail in Figure 23 (Volume 3). The total height of each turbine to blade tip is a maximum of 180 metres. Each turbine will have a control system to each rotation to face the rotor into oncoming wind, and to adjust the pitch of the turbine blades. The turbines and supporting structures will be finished in a matte off-white colour.



TWIN CREEK
WIND FARM
FIGURE 23
TYPICAL FRONT AND SIDE
ELEVATION OF
A WIND TURBINE
NOTES
1. TIP HEIGHT WILL NOT EXCEED 180m FROM TOP OF FOUNDATION LEVEL;
2. TOWERS WILL BE TUBULAR ;
3. NUMBER OF ROTOR BLADES IS THREE ;
4. TOWERS, NACELLES AND ROTOR BLADES TO BE OF A NON REFLECTIVE FINISH AND COLOUR;
5. EXTERNAL STAIRS SUBJECT TO FINAL DESIGN.
BLADE
HUB
NACELLE
TOWER
TIP HEIGHT UP TO 180m
TYPICAL STAIRS
OPTIONAL KIOSK
TRANSFORMER
DATUM: TOP OF FOUNDATION LEVEL
SIDE VIEW
FRONT VIEW
PHOTOGRAPH OF TYPICAL TURBINE
N/A
28-06-2017
N/A
N/A
03498D2301-01
SCALE - N.T.S
A3
N/A
PLANNING PERMIT APPLICATION
THIS DRAWING IS THE PROPERTY OF RES AUSTRALIA PTY LTD AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION
SUITE 4, LEVEL 1
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CHATSWOOD, NSW 2067
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Each of the 51 turbines will comprise several main component parts:

- Towers: each supporting structure will be a tapered steel structure with an approximate diameter of 5.0 metres at the base and 2.5 metres at the top;

- Footings: each tower will be located on a reinforced concrete footing with a diameter of up to 5.0 metres at the surface and 20 metres subsurface to a depth of up to 3.5 metres;

- Rotor and blades: each turbine will have three blades constructed of fibreglass, and attached to a steel rotor and shaft. The rotor will incorporate metallic conductors to conduct lightning strikes to earth; and

- Nacelle: each turbine will incorporate the 'nacelle', housing mounted at the top of each tower which encloses a gear box, generator, motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. The nacelle will be constructed of steel and fibreglass and will be approximately 13 metres long, 4.5 metres wide and 4.0 metres in height. The nacelle will also incorporate weather monitoring equipment.

4.5 Electrical Infrastructure

A series of underground and overground cables, switchgear and a substation are proposed to connect the Twin Creek Wind Farm and Energy Storage project with the national electricity grid. Connection to the existing 275kV Robertstown to Tungkillo transmission line will occur as a "t-connection" approximately 15 km south east of the onsite substation.

Considerable consultation with ElectraNet has been undertaken and the connection point is well suited to the network. Electranet have advised that do not see any constraints to connecting the wind farm to the network under reasonably foreseeable operating conditions. Alternatives were considered including connection to the Templars substation and surrounding 132kV network however these options were not suitable on account of existing grid capacity. A schematic drawing of the electrical substations for the project is shown in Figures 15 and 23 in Volume 3. Figure 18 (Volume 3) illustrates the proposed cable reticulation layout.

The following outlines the main components of the electrical infrastructure:

- the output from each turbine will be directed to 33kV underground cables, which link each turbine to a new proposed substation located in the south-eastern portion of the wind farm development area;

- the 33kV cables will generally follow upgraded and proposed access tracks within the site and have an approximate total length of 49km;

- a new onsite substation will provide a connection for the generated power to a 275kv transmission line;

- a new transmission line will be constructed to terminal substation which will tee-in to the existing 275kV transmission line approximately 15 kilometres to the south east of the onsite substation, adjacent the Sturt Highway east of Truro;

- a new terminal (tee-in) substation will provide connection of the 275kV transmission line into the Robertstown- Tungkillo 275kV transmission line and connected to the national electricity network; and

- 24 energy storage containers containing UL-listed batteries (or similar, depending on technology available at the time of final design).

The following is proposed:

- Local generator transformers, providing the connection between turbine and underground or 33 kV cables:

  - each turbine may incorporate a generator transformer within a 'padmount kiosk' adjacent to the hardstand area, painted in a low visibility green. Depending on the turbine selected, the generator transformer may be located internal to the nacelle and painted in a matte off-white;
  - depending on the supplier, each generator transformer is likely to be approximately 3.5 metres long, by 2.5 metres wide and 2.5 metres high; and
  - the transformers may be either oil-filled or dry, depending on the turbine equipment supplier. If oil-filled transformers are used, the volume of oil used for generator transformers is likely to be in the order of 2,000 litres, with appropriate metres for containment and spill protection utilised.

- Approximately 49 kilometres of underground 33kV cables, providing connections between each turbine and the substation:

  - the turbines are grouped according to location to generally provide the most direct and economical route between the turbines and the substation, and have been developed to minimise route length, according to slope and vegetation features;
  - generally cabling will be located alongside access tracks to minimise site disturbance; and
  - the underground trenches will also incorporate control cables for the monitoring and management of the turbines.

- Substation including switch room and control buildings of approximately 2.2 hectares. This area comprises:

  - 33kv switch room;
  - control building;
  - one permanent 275kV -33kV substation with approximate dimensions of 75 metres x 85 metres;
  - bunded area for storage of hazardous materials. Oil will be stored at the site for use in the transformers and associated components. Oil will be stored in concrete bunds, with an oil spill retention basin and an oil/water separator external to the concrete transformer bunds;
  - an earthen bund embankment will surround the substation area as a secondary containment measure;
  - 2.0 metre high chain mesh will be provided surrounding the perimeter of the substation site; and

- low level security lighting will be installed, with additional flood lighting triggered by security sensors.

- Buildings within the construction, operations and maintenance and energy storage compound have the following general features:

  - buildings will either be slab on ground constructions with steel frames, metal or brick walls and a sheet steel roof, or demountable buildings;
  - roof water will be captured in rainwater tanks for domestic purposes;
  - a septic system will be installed to treat wastewater produced from the office building, subject to Council environmental health standards;
  - the office building will house wind farm control instrumentation, electrical and communications equipment and staff amenities;
  - the operations and maintenance building would accommodate equipment and stores, a small work area;
  - a control building will contain 275kV switchyard control equipment and batteries; and
  - a car park for all site staff, site vehicles and visitors.

4.4.1 Construction of Electrical Infrastructure

The trenching for the installation of approximately 49 kilometres of underground cables will involve the following:

- underground cables, comprising power and control cables will be buried in trenches of approximately 1.2- to 1.5 metres in depth and 0.28 to 0.55 metres in width
- excavation will be depending upon ground conditions, most likely undertaken by either a mobile trenching machine, a hydraulic rock breaker, and an excavator;
- wherever practical, trenches will be backfilled immediately upon cable installation in accordance with the Construction and Environmental Management Plan, with measures adopted to slow stormwater flows and to prevent the scouring of open trench or disturbed ground prior to revegetation;
- a temporary access track will be located alongside the trenches for access during construction for trenching and cable installation vehicles;
- marker tape and posts will be placed above buried cables in accordance with the relevant standards to indicate the presence of underground cables; and
- surplus excavated material will be distributed over the surrounding area and will be revegetated. Alternatively, it may be used in track construction.

4.5 TRANSPORTATION

The following provides an outline of the proposed works to enable access during construction and operational phases of the project. Access works comprise local road upgrades to enable transport of wind farm components, and new and upgraded on-site access tracks for both construction and operation.

A diagram of the proposed regional/local roads is provided in Figure 1 of AECOM Transport Impact Assessment report contained in **Volume 2.**

Figure 1 Recommended route for access to the proposed Twin Creek Wind Farm site

4.5.1 Regional Road Access for Construction Purposes

The following provides a brief description of the various components of the project and anticipated source:

- wind turbine generator components including the nacelle, blades and hubs are anticipated to be imported from overseas via the Port of Adelaide;

- depending on available suppliers, the wind turbine generator towers may be sources from various locations around Australia;

- depending on the selection of the suitable suppliers, electrical equipment may be sourced from various locations around Australia, however it is expected that the main transformers and energy battery containers will arrive via the Port of Adelaide; and

- local quarries will be utilised for stone and concrete aggregate.

Tables 6, 7 and 8 of the Transport Impact Assessment report provides an overview of the dimensions of the various components and to demonstrate the smallest vehicle (in PBS class) that may be used to transport the component and therefore the route along which that vehicle may travel. This analysis has informed the appropriate transport routes to the proposed site.

The Transport Impact Assessment indicates that all wind turbine and tower components fall into the over dimensional category and will therefore require individual permits and police escorts for transportation to the site. The limitations on over dimensional and over mass vehicles requires that 100% of all vehicles transporting the wind turbine components to the site use the Sturt Highway-Truro Road-Bagot Well Road route.

Table 1 Approximate weight and height dimensions of the wind turbine components (Vestas Wind System A/S 2016)

Component	Height (m)	Length (m)	Width (m)	Weight (Tonnes)	Over Dimensional	Over Mass	Suitable PBS Level Access
Nacelle	3.4	12.8	4.2	70	Y (due to height and width)	Y	1A: single articulated vehicle of truck trailer combination
Hub	3.8	3.8	5.5	70	Y (due to height and width)	Y	1A: single articulated vehicle of truck trailer combination
Blades	4.1	66.7	-	5.5 – 6.5	Y	N	Exceeds PBS level 4 due to length

Table 2 Approximate weight and dimensions of the tower components (Vestas Wind System A/S 2016)

Component	Min Diameter (m)	Max Diameter (m)	Length (m)	Weight (Tonnes)	Over Dimensional	Over Mass	Suitable PBS Level vehicle
1 (Top)	2.0 – 2.5	3.0 – 3.5	20.0 – 25.0	25.0	Y	N	2A: B-double
2 (Middle)	3.0 – 3.5	3.5 – 4.0	20.0 – 25.0	40.0	Y	N	2A: B-double
3 (Middle)	3.0 – 3.5	3.5 – 4.0	20.0 – 25.0	40.0	Y	N	2A: B-double
4 (Middle)	3.0 – 3.5	3.5 – 4.0	20.0 – 25.0	40.0	Y	N	2A: B-double
5 (Bottom)	3.5 – 4.0	4.5 – 5.0	20.0 – 25.0	35.0	Y	N	2A: B-double

Table 3 Approximate weight and dimensions of substation transformer component

Component	Height (m)	Length (m)	Width (m)	Weight (Tonnes)	Over Dimensional	Over Mass
Transformer 132/33kV	7.0	8.0	8.0	145.7	Y	Y
Transformer 275/132 kV	7.5	9.0	5.5	TBC Slightly greater than 145.7t	Y	Y

AECOM estimate that there will be approximately 175,000 trips generated over the 18 month construction period, comprised of:

- 1,500 over dimensional and over mass trips;
- 34,000 truck trips; and
- 53,000 car trips.

Table 4 Estimated total trips generated by the proposed wind farm site

Material	Estimated Quantity	Unit		Vehicle Type	Estimated One-Way Vehicle Trips		
					Total trips	Average Trips/Month	Average Trip/Day
Concrete Materials	36000	cubic metres		Semi- trailers	3600	200	9
Reinforcing Steel	1800	Tonnes		Semi- trailers	180	10	0
Road base	252750	Tonnes		Semi- trailers	25275	1404	64
Miscellaneous Equipment and Materials	Nominal	-		Semi- trailers	200	11	1
	Wind Turbine Components						
Tower Sections	300	5 section/tower		Over size	600	33	2
Nacelles	120	2 section/nacelle		Over size	240	13	1
Hub	60	1 hub/turbine		Over size	120	7	0
Blades	180	3 blades/turbine		Over size	360	20	1
	Substation						
Substation Transformer	2	-		Over size	4	0	0
Switchgear and other substation equipment	Nominal	-		Semi- trailers	240	13	1
	Site Work Activities						
Cranes	0	-		Semi- trailers and mobile wheel based cranes	0	0	0
Employees	200	-		Cars/ 4WD	52800	2933	133
Construction Equipment, Plant and Components	1200	-		Various	2400	133	6
	Total trips- Traffic Movements						
	Over size/ oversize vehicles				1,324	74	3
	Trucks				31,895	1,772	81
	Cars				52,800	2,933	133
	Total				172,000	9,558	434

The preferred route for movement of components to the development site is from the Port of Adelaide, via the Port River Expressway, Port Wakefield Road, the Northern Expressway to Sturt Highway, Truro Road, Bagot Well Road, Camel Hill Road, Flagstaff Hill Road and Mosey Road to the site access.

4.5.2 Local Road Upgrades

Preliminary discussions have been held with the Light Regional Council, Regional Council of Goyder and Mid Murray Council regarding proposed access and utilisation and upgrading of local roads. RES Australia propose to enter into a Deed of Agreement with Light Regional Council and the Regional Council of Goyder in relation to local road upgrades (as required), concurrently with the assessment of the development application.

The Traffic Impact Assessment report by AECOM has identified intersections that present possible geometric and load constraints (Table 9 quoted below) for the largest of the wind farm components, that is, the turbine blade. The routes shown as Option 1 and 2 were investigated by AECOM. The findings were that the roads in Option 2 would require the greatest extent of modifications to private property at several locations the greatest of which is the intersection of Truro Road and Teagle Road. Subsequently option 1 is the preferred route, at this time. The final route would be subject to review following the selection of wind turbine components, as the dimensions of these components may allow some variation of the route.

Table 5 Local road intersections presenting possible geometric and load constraints

Option	Constraint location
Option 1 - Truro Road / Bagot Well Road / Camel Farm Road	Sturt Hwy / Truro Rd
	Truro Rd / Bagot Well Rd
	Bagot Well Rd / Camel Flat Rd
	Camel Farm Road / Flagstaff Hill Rd
Option 2 - Truro Road / Teagle Road / Bagot Well Road / Weaver Road / Camel Farm Road	Sturt Hwy / Truro Rd
	Truro Rd / Teagle Road
	Teagle Road (various locations)
	Teagle Road / Bagot Road
	Weaver Road / Camel Farm Road
	Camel Farm Road / Flagstaff Hill Rd

AECOM identify that in general, the road network is considered adequate for the transportation of over dimensional loads. Structural assessments will need to be carried out for over mass vehicles, particularly on local roads and over the bridge located on Truro Road. Preparation of a Traffic Management Plan would occur prior to construction.

4.5.3 On-site Access Tracks

Access tracks will be constructed to enable access to the wind turbine generators for the purposes of turbine construction and maintenance.

The width of access tracks will be approximately 9.0 metres to allow for the delivery of parts and materials to each of the turbine locations. Access tracks will be reduced to a width of 5.0 to 6.0 metres following construction. Those areas of land no longer required for access will be appropriately remediated to the state they existed prior to construction commencing.

The location of on-site access tracks are within the Infrastructure Zone shown on Figure 8 (Volume 3). The layout and design of the access tracks have considered the following:

- upgrades to existing tracks are proposed wherever possible;
- minimising total track length;
- landowner preferences;
- to enable the movement of oversize and heavy vehicles of up to 60 meters in length;
- low to moderate grades and curvatures suitable for the required vehicles (the maximum slope for roadways is typically 14 percent);
- general location along the ridge lines within the project area to enable access to groups of turbines; and
- reducing the need for vegetation clearance.

Construction will involve clearing and the construction of paths in accordance with the proposed traffic and site conditions. The final location of tracks will be subject to the Construction and Environmental Management Plan, and developed in conjunction with members of the project team, such as EBS Ecology and EBS Heritage, along with project contractors to ensure minimal impact on flora and fauna and sites of archaeological sensitivity.

4.5.4 Construction of On-Site Access Tracks

The forming of approximately 49 kilometres of upgrade and new access tracks with a width up to 9.0 metres during construction:

- this will include clearing, grading and removal of topsoil as required, and the compaction of gravel road base;
- the provision of drainage works in accordance with the Construction Environmental Management Plan;
- excavated topsoil will be stockpiled during construction, and later used in the rehabilitation of the site. Stockpiles to be managed in accordance with the Construction Environmental Management Plan;

- access tracks to be reduced to 5.5 to 7.0 metres in width and surrounding land restored, revegetated and/or returned to former grazing uses.

The sourcing of gravel and sand for access road construction:

- a borrow pit within the site of the development to source appropriate materials for internal tracks;
- concrete for the construction of roadways and turbine footings is likely to be sources from local quarries;
- the use of local materials via a borrow pit and local quarries will assist in minimising the transport distance;
- road base material may also be extracted from the removal of material from turbine footing locations;
- the contractor will review options for sourcing gravel for track construction and if any extraction of gravel is proposed then appropriate approvals will be sought, both from legislative approvals and approval from the landowner; and
- any material brought to the site will be assessed against the provisions of the Construction Environmental Management Plan to reduce the risk of weed introduction.

4.5 WATER PROVISION

Water will be required for construction, including for wetting exposed soils during stockpiling to reduce the risk of erosion and dust movement. Water will be sourced by the construction contractor, which may incorporate on site bores or carting and storing water on site. Any bores required would be licensed in accordance with legislative requirements.

Water associated with the staff facilities during construction and once operational would be via rainwater storage tanks and utilise roof drainage.

An approved septic system will be installed to treat small quantities of wastewater produced from staff amenities.

4.6 WIND MONITORING MASTS

Currently the site contains one 60m wind monitoring mast installed within the project for investigations purposes. This mast will be removed prior to construction of the wind turbine generators. Two new meteorological masts will be erected to provide ongoing meteorological investigations and power curve verification. The locations of the existing wind monitoring mast and proposed masts are identified on the, Figure 3, Site and Context Analysis Plan (Volume 3).

The construction of the wind monitoring masts will involve the construction of concrete footings, erection of the mast with supporting guy wires, and the installation of monitoring equipment. Figure 28 (Volume 3) illustrates a typical mast.

4.7 TEMPORARY CONSTRUCTION FACILITIES

Construction of the wind farm will take approximately 18 months to two years, with in the vicinity of 350 people being on site at the peak of the construction period.

Specific elements of the project which will be evident during the construction phase of the project include the following:

- temporary construction compounds, which comprise:
  - several demountable buildings used for office, workshop and storage purposes, an amenities block, and portable toilet facilities will be located at the project area during construction;
  - arrangements will be made for power and communications at the site office during the construction period;
  - on site car parking and
  - a cleared flat area to provide for the storage of various items during construction.

The location of the temporary construction compounds is indicated on the Figure 8 – Infrastructure (Volume 3). A schematic diagram of the temporary or satellite construction compounds is provided in Figure 13 (Volume 3).

One of the four temporary construction compounds is proposed to accommodate a temporary mobile concrete batching plant and will be utilised to produce the concrete required for the project. This would be accommodated within a site of approximately 1.3 hectares and comprise the mobile concrete batching plant would operate during the 18 months to 2 years' construction period. All temporary construction facilities will be removed and the land restored and rehabilitated once construction has been completed. This will include the following:

- the removal of temporary facilities, wastes and surplus materials from the site;
- removal and restoration of any temporary construction tracks and ongoing maintenance of any land stabilisation required;
- revegetation of disturbed areas in consultation with the land owners to return the land to the condition prior to construction (in most cases this will include re-seeding and restoration for agricultural production) to prevent site erosion and sedimentation;
- the rehabilitation of areas where underground cables have been installed; and
- management of weeds in the disturbed areas.

4.8 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLANS

A Construction Environmental Management Plan (CEMP) incorporate the necessary environmental controls during both construction and operation to address any potential identified risks in the assessment of the development. A draft CEMP has been prepared and is contained in **Volume 4** of this application.

The CEMP covers the following aspects, in accordance with the findings of the investigative studies undertaken in the preparation of this application:

- construction traffic management;
- location and extent of site earthworks;
- soil and water management;
- emissions including dust and noise control;
- fuel storage and handling;
- waste storage, handling and disposal;
- bush fire prevention;
- coordination with property owners and effects on stock;
- weed control and site restoration;
- management of any quarrying activities (if relevant); and
- management of any mobile concrete batching plant.

A final version of the CEMP and additional management plans will be prepared during the detailed construction phase of the project and provided to the planning authority prior to Development Approval being issued.

4.9 OPERATIONAL WIND FARM

The wind turbines convert wind energy into electrical energy on an automatic basis. The rotation of the blades by wind, causes the rotation of the turbine rotor which is connected via a gearbox to a generator.

Wind turbine operation will commence at a wind speed of approximately 3.0 metres per second (~11km kilometres per hour) and de-rate or stop at ~23 metres per second (82 kilometres per hour). The turbines will have a maximum rotation speed to 14 to 18 revolutions per minute, causing a rotation of 360 degrees approximately every 4.2 seconds.

Once commissioned, the wind farm will operate with a moderate on-site work force at the operations and maintenance compound of approximately six to ten staff, employed for inspection and maintenance purposes. Additional visits by other technical staff will be made where assistance is required. Once commissioned, the wind farm will be able to operate whenever wind speeds allow for generation.

4.10 DECOMMISSIONING OR REPLACEMENT

At the end of its economic life, all equipment will either be replaced with comparable new equipment, or the wind farm will be decommissioned.

New approvals would be sought, if or as required, at the time of replacement of components.

Decommissioning would generally involve dismantling or removal of all above ground equipment and any cables or other infrastructure buried to a depth of up to 1m below ground surface, and land will be rehabilitated. Access tracks may be retained depending on the landowners' wishes. Any overhead wires no longer required will be removed.

A decommissioning plan would be prepared and submitted to the relevant planning authority for approval, if/as required, prior to decommissioning commencing. The proponent is responsible for the decommissioning of the wind farm and energy storage facility. Every associated land owner of the Twin Creek Wind Farm has this clause in their lease. This is a legally binding obligation that will be tied to the land regardless if the parties of the lease alter over time.

CHAPTER 5 –

CONSULTATION

CHAPTER 5 – CONSULTATION

RES Australia is aware of the necessity for an effective and genuine consultation process, in which the community and stakeholders are actively engaged. It is important for sufficient information to be provided to ensure community members are aware of all factors of the development, and where opportunity is provided to make representations enabling community members to make fully informed comment.

RES engaged GHD Consultants to prepare a Stakeholder and Community Engagement Strategy (SCES) to provide structure and rigour to communications throughout the planning phase of the Twin Creek Wind Farm Project to the lodgement of the development application. A summary report of the consultation undertaken is contained in the GHD Twin Creek Wind Farm Consultation Outcomes Report, which is contained within **Volume 2** of the application.

RES have undertaken an engagement approach that is personal and has focused on consultation and engagement with the landowners, the neighbours and the local communities potentially impacted. Such an approach over a period of time will enable a deeper level of stakeholder and community knowledge regarding the wind farm and greater awareness of the processes to which RES is committed in order to mitigate or manage potential impacts. Through this process greater trust between the community and the project team has been developed and RES are seeking to develop a level of tolerance and potentially acceptance for the project.

The focus of communications during the planning phase of the project has been to seek input from the community about the proposed development in particular what they value about their community, and adequately respond to and address the community's concerns in a timely manner. The methods of community engagement have included:

- mail outs: to host landowners, adjacent and broader and participating land owners informed of investigations and the application process;
- Community Open Days: two separate community open days were held, one in October 2016 and the second in April 2017. On each occasion the sessions were held at Kapunda, Eudunda and Truro;
- meeting and briefings held with Light Regional Council, Regional Council of Goyder and Mid Murray Councils on various occasions by members of the project team;
- personal communication: meetings, emails and phone discussions with landowners, community members, broader residents and anyone who had a general interest in the project;
- meetings and briefings with various Government Agencies by members of the project team; and
- Website: RES have a website which specifically relates to the project. The website http://www.twincreek-windfarm.com/ contains information relating to the project and an enquiry system for members of the public to communicate with the project team.

As a result of the consultation and engagement with the community, there have been variations to the layout of the wind farm and relocation of turbines in direct response to concerns raised from adjoining neighbours (as outlined in Section 4.2).

CHAPTER 6 –

PROJECT ASSESSMENT

CHAPTER 6 – PROJECT ASSESSMENT

6.0 INTRODUCTION

This chapter provides a summary of the investigations and assessment of the Twin Creek Wind Farm undertaken by members of the project team.

A variety of investigations have been undertaken and assessment reports prepared to examine the existing conditions, the likely impacts of the proposal, and mitigation and management mitigation measures proposed. These technical assessments have included noise impact, visual impact (including shadow flicker and blade glint), flora and fauna (including avifauna), Aboriginal and European heritage, traffic and transport, land use, hazards (including bushfire, aviation and physical safety), water resources and site drainage, soils and geology, and the social and economic impact of the project.

Copies of the full technical reports are contained in **Volume 2** of this application.

6.1 FLORA AND FAUNA ASSESSMENT

EBS Ecology (EBS) was engaged by RES Australia to assess the potential flora and fauna constraints for the proposed Twin Creek Wind Farm and Energy Storage facility. The following is a summary and extracts of the investigations, findings and recommendations made by EBS. The complete "Twin Creek Wind Farm Flora and Fauna Assessment" report dated 28 June 2017" is contained within Volume 2 of the application documents.

6.1.1 Investigations Undertaken

Investigations, findings and recommendations of EBS have informed the design, siting and layout of infrastructure for both the principal wind farm infrastructure area (wind turbine generators and associated infrastructure) as well as the transmission line.

EBS Ecology have undertaken the following surveys:

Survey type	Date	Season	Description
Flora and fauna assessment	8-11 September 2015	Spring	General assessment and condition rating of vegetation, bird, bat and PBTL assessment
Targeted Lomandra assessment	8 October 2015	Spring	Assess whether Lomandra Grasslands qualified as a TEC
Avifauna survey	3-5 February 2016	Summer	Revisit bird count surveys established in spring 2015
Avifauna survey	18-20 April 2016	Autumn	Revisit bird count surveys established in spring 2015
Avifauna survey	26-28 August 2016	Winter	Revisit bird count surveys established in spring 2015 and undertake nest checks
Targeted PBTL survey and Bat survey	22 Feb – 4 March 2016	Summer/Autumn	Detailed assessment of PBTL habitat and occupation across the site. Anabat survey repeated from September 2015 survey due to poor weather conditions
Additional PBTL survey	5, 8 and 14 April 2016	Autumn	Investigate additional routes within areas of likely habitat
Additional PBTL survey	31 Oct – 11 Nov 2016	Spring	Targeted areas and additional infrastructure
Additional PBTL survey	22 Nov – 25 Nov 2016	Spring	Targeted areas and additional infrastructure
Vegetation Assessment	23, 24, 29, 30 Nov and 1 Dec 2016	Summer	Vegetation assessment of additional turbine, solar farm, substation and transmission line
Additional PBTL survey	6-9 December 2016	Summer	Targeted areas and additional infrastructure
Additional PBTL survey	9 Jan – 13 Jan 2017	Summer	Targeted areas and additional infrastructure
Vegetation Assessment	5 April 2017	Autumn	Vegetation assessment of 2nd substation and potential shift of transmission line easement

The surveys were in addition to extensive desktop assessment of a variety of sources.

All data from these assessments have informed the final design as now submitted for Development Plan Consent, to mitigate against potential impact on flora and fauna including threatened species, particularly the Pygmy Blue-Tongue Lizard (PBTL).

6.1.2 Vegetation Associations and Identified Flora and Fauna

EBS recorded eight vegetation associations with the site of the development (with a Significant Environmental Benefit (SEB) condition range of 0:1 to 6:1). These vegetation associations are described in Table 18 of the EBS report as follows:

Overall summary of vegetation associations

	Vegetation association	*Area*	*Condition*
1	*Lomandra effusa* + *Austrostipa sp*. grasslands	196.2ha	1:1-6.1
2	*Austrostipa sp*. grassland	1751.7ha	1:1-5:1
3	Planted species	21.8ha	0:1
4	*Eucalyptus leucoxylon +/- Eucalyptus porosa +/- Callitris gracilis* open woodland	64.7ha	2:1-6:1
5	*Juncus spp.* (Rush) and *Juncus pallidus* (Pale rush) Sedgeland +/- *Phragmites australis*(Common Reed)	52.1ha	3:1
6	Cropping	1388.8ha	0:1
7	*Eucalyptus porosa+/- Eucalyptus odorata+/- Eucalyptus gracilis* open woodland	2.4ha	4:1
8	Pasture grassland / exotic grassland	868.2781ha	0:1-1:1
9	Eucalyptus odorata +/- Eucalyptus porosa closed woodland over grassy understorey	6.8ha	4:1
10	Eucalyptus camaldulensis ssp. camaldulensis +/- Eucalyptus leucoxylon Closed Tall Shrubland over Austrostipa sp. (Spear-grass) near creeklines	2.3ha	6:1
11	Eucalyptus leucoxylon Tall Open Woodland over shrubby understorey	3.6ha	5:1-6:1

During the 2015 field survey 59 native fauna species were recorded, including two amphibians, five reptile species, 3 mammals, 42 birds (6 exotic) and 7 bats (all native). One amphibian and two bird species of national or state conservation significance were identified:

- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*) nationally endangered;
- Rainbow Bee-eater (*Merops ornatus*) nationally migratory, and
- Blue-winged Parrot (*Neophema chrysostoma)* State vulnerable.

Three Wedge-tailed Eagle nests we rerecorded within a *Eucalyptus leucoxylon* ssp. woodland area situated just outside of the "development area" but within the site of the development. Other native fauna species recorded during the spring 2015 included seven bat species.

Remnant vegetation has been mapped for South Australia (SA) by the Department of Environment, Water and Natural Resources (DEWNR) based on interpretation of aerial photography or Landsat imagery and floristic data. The following native vegetation communities are mapped for SA within the proposed Twin Creek Wind Farm and Energy Storage development site:

- *Acacia paradoxa* shrubland;
- *Allocasuarina verticillata* woodland;
- *Austrostipa* sp. grassland;
- *Eucalyptus gracilis* mallee woodland;
- *Eucalyptus leucoxylon* ssp. woodland;
- *Eucalyptus odorata* woodland;
- *Lomandra effusa* (mixed) grassland;
- *Lomandra* sp. sedgeland and
- *Phragmites australis, Typha domingensis* grassland.

6.1.3 Threatened Ecological Communities

The EBS report describes that the conservation status of flora and fauna species at three geographic scales:

- national (*Environment Protection and Biodiversity Conservation Act 1999* - EPBC Act),
- state (*National Parks and Wildlife Act 1972* - NPW Act); and
- regional (Gillam 2009) [2].

Threatened ecological communities are recognised under the Environment Protection and Biodiversity Conservation (EPBC Act). There are no formal ratings for threatened ecological communities under the NPW Act. The EBS report acknowledges informal state and regional ratings, but concentrates on ratings recognised under legislation.

Two nationally threatened ecological communities, listed under the EPBC Act 1999 were investigated and assessed for qualification within the project boundary. The listed ecological communities being:

- Iron-grass *(Lomandra spp).* Natural Temperate Grassland of South Australia; and
- Peppermint Box *(Eucalyptus odorata)* Grassy Woodland of South Australia.

Iron-grass Natural Temperate Grassland of South Australia are unique to South Australia, with their main distribution on the slopes and hills of the Mount Lofty Ranges, west of the River Murray and throughout the Mid North. The community generally occurs on gentle slopes of low hills above 380 metres above sea level. Major threats to this community include clearance and fragmentation, inappropriate grazing regimes, and weed invasion (DEWR 2007).

The Iron-grass Grasslands is a grassland dominated by Iron-grasses (*Lomandra multiflora* ssp. *dura* and/or *Lomandra effusa*), with tussock-forming (clumping) grasses, low shrubs and a range of other native plants in the ground layer. Trees and tall shrubs are generally absent or very sparse (less than 10 % cover). To qualify as the EPBC listed community, patches must be at least 0.1 ha in size and meet native species diversity and density criteria (see DEWR 2007).

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[2] Regional conservation ratings are informal and whilst they are not recognised under legislation, they give a better understanding of the status and trend of a species within the local area, and hence the potential impact of proposed developments.

21 sites were assessed within the Lomandra Grasslands across the development site, to confirm whether they qualified as the nationally listed threatened ecological community. One of the 21 sites assessed for the terminal substation qualified as EPBC listed. The terminal substation has been designed to avoid high value Lomandra Grassland. None of the other sites qualified as a threatened ecological community. Thirteen of the Lomandra sites come under Condition class C, which are considered degraded patches amenable to rehabilitation.

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia community was listed as critically endangered under the EPBC Act in 2007, due to a severe decline in distribution and an ongoing loss of integrity. The ecological community is dominated by *Eucalyptus odorata*, however other species of Eucalypt commonly co-occur. A grassy understorey is most often present, although some shrubs may exist such as *Bursaria spinosa* (Sweet Bursaria) and *Acacia pycnantha* (Golden Wattle). The majority of remnants occur between Victor Harbour and Port Augusta, encompassing the mid-north region, as well as the Adelaide region, Mount Lofty Ranges and part of Yorke Peninsula. The key threats to this community are clearing, grazing and invasion by weeds (DEWR 2007).

The site of the development was assessed for any Peppermint Box that may qualify against the criteria outlined in *EPBC Act Policy Statement 3.7, Nationally Threatened Species and Ecological Communities, Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia.* A patch of Peppermint Box was identified within the principle wind farm infrastructure area, during the 2015 survey. It wasn't dominated by *Eucalyptus odorata*; it was a large mix of *E. odorata, E. porosa and E. gracilis*, and therefore did not qualify. Patches of woodland dominated by Peppermint Box were observed during late spring/early summer 2016 survey, whilst surveying additional areas including the proposed transmission line. An assessment against the criteria found them to be Class C which is not listed under the EPBC Act but is 'amenable to rehabilitation'). Based on the current proposal the final clearance impact in Peppermint Box Woodland is expected to be small (insignificant), fitting with minimum requirements under powerlines and should not require an EPBC referral (subject to spring survey and final design).

6.1.4 Threatened Flora Species

A total of 86 native flora species and 74 exotic flora species were recorded within the project boundary. There was no conservation rated flora species identified within vegetation assessments completed during the September 2015 and November 2016 surveys within the proposed Twin Creek Wind Farm project area.

6.1.5 Threatened Fauna Species

The habitats present within the project area were assessed for the nationally endangered Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) and nationally vulnerable Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*). Other than these two species, none of the reptile species recorded within the project area have a conservation rating and can be classed as common in suitable habitats.

The Flinders Worm-lizard is endemic to South Australia but were not detected during the September spring 2015 survey.

6.1.5.1 Pygmy Blue-tongue Lizard

The Pygmy Blue-tongue Lizard is the smallest member of the genus Tiliqua, which consists of seven terrestrial lizard species commonly known as Blue-tongues. The Pygmy Blue-tongue Lizard is a moderate sized skink which has a total length of less than 20 cm. Pygmy Blue-tongue Lizards use un-occupied spider burrows as refuges and the entrance holes are circular in cross section, up to 20 mm in diameter, and lack any sign of excavated soil at the entrances. The Pygmy Blue-tongue Lizard is a largely sedentary species, with most adults moving no greater than 20 m from their burrows (Milne et al. 2003).

The Pygmy Blue-tongue Lizard is endemic to South Australia. Very little information exists on the past distribution of the species, with the few known localities extending from the Adelaide Plains to the North Mount Lofty Ranges (Duffy *et al.* 2009).

EBS undertook targeted Pygmy Blue-tongue Lizard (PBTL) surveys during the 22 February – 4 March 2016 survey and again in April 2016 (5th, 8th and 14th April). Surveys in summer 2016/2017 were undertaken in relation to the proposed transmission line corridor. These surveys followed the spring 2015 survey which categorised habitat for the entire wind farm development area. The habitat and potential presence of PBTL was assessed during the spring 2015 survey and categorised as: likely, possible or not likely.

A large proportion of the project area is considered possible or likely habitat for the PBTL due to the open grasslands, slopes and spider holes observed across the site. Areas considered unlikely to contain PBTLs are cropping, very steep, very rocky or areas with no evidence of spider holes. Table 10 of the EBS report shown below summarises the known suitable habitat for the PBTL.[3]

---

[3] References

Duffy, A., Pound, L. and How, T. (2009) Draft Recovery Plan for the Pygmy Blue-tongue Lizard Tiliqua adelaidensis. Department for Environment and Heritage, South Australia.

Milne, T., Bull, C., and Hutchinson, M. N. (2003) Use of burrows by the endangered Pygmy Blue-tongue Lizard, Tiliqua adelaidensis (Scincidae). Wildlife Research, 30 523-528

Table 10. Categorisation of habitat suitability	
Attributes considered suitable habitat	Spider burrows within native or exotic grasslands; PBTs have also been detected in highly modified treeless grasslands. • Soil of heavy sandy loam (red-brown earth). • Foot slopes of hills. • Sheltered areas of foot slopes.
Attributes considered unsuitable habitat	Areas that have been previously cropped. Areas lacking spider burrows. Areas containing dense ground cover vegetation. Steep terrain and exposed rocky ridgelines. Overly rocky areas.

The southern property has optimal habitat for the species, gentle sloping rolling hills with plenty of spider holes. The northern section of the infrastructure area still has PBTLs present; however, they are typically in lower densities of numbers where infrastructure is proposed.

The potential impacts of a wind farm development within the project area on PBTL individuals or populations may include the following:

Short-term

- Potential direct loss of individuals through habitat clearance during construction.
- Sedimentation of burrows from construction run-off (soil).
- Noise and vibration disturbance during construction.

Long-term

- Potential loss of habitat.
- Division and isolation of populations by vehicular access tracks.
- Sedimentation of burrows from run-off from access tracks.
- Potential disturbance to populations in close proximity to turbines from blade shadow flicker.

6.1.5.2 Mitigation of Impacts on Pygmy Blue-tongue Lizard

Measures which EBS Ecology recommend to mitigate the impact of the proposed development on the PBTL include:

- areas which are suitable to PBTL, should be avoided. All known locations within possible habitat will need to micro-sited prior to construction to mitigate impact;
- utilising cropping areas as much as possible for wind turbine generators, infrastructure areas and access tracks;
- micro-site where possible around proposed infrastructure including the transmission line;
- an EPBC referral will be submitted as part of this proposed development. A translocation of PBTL from areas of less suitability is being recommended to increase the number of turbines being installed and reduce potential impacts on PBTL; and
- ongoing monitoring of PBTL populations within the project boundary is recommended to detect future impacts on the species.

6.1.6 Birds

EBS observed the following bird species during the three surveys within the project area:

- spring 2015 survey - 1,448 individuals from 48 bird species;
- summer 2016 survey - 1,255 individuals from 24 bird species;
- autumn 2016 survey - 751 individuals from 30 bird species; and
- winter 2016 survey – 743 individuals from 30 bird species.

One species with an EPBC migratory rating, the Rainbow Bee-eater (*Merops ornatus)* and a single species with a state conservation rating of rare, the Blue-winged Parrot *(Neophema chrysostoma),* were observed during the spring 2015 survey. No species of conservation significance were observed during the summer, autumn or winter 2016 surveys.

The Rainbow Bee-eater is listed as migratory under the EPBC Act and a highly mobile species with the ability to undertake long distance movements. It is distributed across much of mainland Australia and will migrate into southern Australia during spring into summer. The Rainbow Bee-eater is predictably a seasonal visitor to the project area, it is considered unlikely regional populations would be impacted upon by the proposed wind farm. Flight height and behaviour is generally unknown for this species to be able to make further conclusions.

The State rated Blue-winged Parrot is partly nomadic and may be encountered in the company of the Elegant Parrot. They are locally nomadic, preferring heathland and open country, open woodland, cropland and semiarid scrub. They feed on the seeds of native and introduced grasses as well as shrubs and herbaceous plants. Blue-winged Parrots nest in the cavities of small trees. EBS recommend that woodland areas with tree hollows be avoided during the construction of the wind farm and existing tracks be used where possible, rather than creating new tracks through pasture grass sites and cropland.

Two records of the Peregrine Falcon are situated outside of the Twin Creek Wind Farm project boundary (to the west), with the latest record from the Biological Database of South Australia dated 2002. No nest locations or individual Peregrine Falcon observations were recorded during any of the seasonal surveys.

A total of three potential Wedge-tailed Eagle nests were located across the proposed Twin Creek Wind Farm site during the spring 2015 survey. These nests are typically found within wooded areas; wooded areas were scarcely scattered across the site. The three nests were situated within *Eucalyptus leucoxylon* open woodland (Association 4).

One out of the three nests recorded was active during the September 2015 and winter 2016 survey; the August 2016 survey recorded a Wedge-tailed Eagle sitting on Nest 3 however, neither eggs nor young were discernable at the time. All three nest locations area situated outside of the area containing wind turbine generators and ancillary infrastructure, however they are within the site of the development. The nests are shown on Figure 3 – Site and Design Analysis Plan, which is contained within Volume 3.

Nests 1 and 2 were situated within 100m of each other. A single adult was observed flying from Nest 3 and an additional pair of Wedge-tailed Eagles were flushed when entering the area whilst undertaking the bird survey in September 2015. The pair was observed flying on thermal's approximately 600m from the point count area (where the nests were recorded), 300m above ground. Breeding pairs often switch between multiple nest sites within their territory from one year to the next.

A range of direct and indirect impacts of wind farms on birds are recognised with mortality via direct collision with turbines being an obvious impact. Other impacts include displacement due to habitat loss and various types of disturbance effects, although there is little available data on the disturbance effects of wind farm developments on birds in Australia.

EBS discuss the potential impacts of the wind farm development on birds and raptors in Sections 6.3 and 6.4, which states:

> *Suitable buffers need to be considered in the planning process in order to reduce the likelihood of impacts on birds in the area. Buffers are primarily aimed at reducing the disturbance to the birds during breeding and when juveniles are near fledging. Raptor species such as the Wedge-tailed Eagle and the Peregrine Falcon are considered significant when assessing bird interactions with wind farms as they conduct regular flights at heights coinciding with turbine rotor swept areas (where turbine blades operate).*

The benefit of a buffer around nests is as follows:

- *buffers are generally focussed around areas of high activity; these are where either species may potentially nest;*
- *during the construction of the proposed wind farm, raptor species are more likely to be at risk of disturbance from activities conducted within close proximity to nest locations. By implementing a buffer, this would contribute to decreasing disturbance levels to these species;*
- *wedge-tail Eagle and Peregrine Falcons are territorial and typically return to the same area to nest each year. By placing a buffer distance around the nest location, this would assist with lessoning disturbance levels to this species; and*
- *juveniles are particularly susceptible to collision, as newly fledged chicks have not learnt how to forage on their own nor avoid structures such as turbines. Buffers around nest sites will assist in decreasing the chance of a juvenile eagle or falcon colliding with a turbine.*

EBS Ecology have recommended that any wind turbine generator should be at least 500 m from a known Wedge-tailed Eagle nest, to reduce likelihood of impact. A general buffer of 200 m between turbines and woodland habitat is also recommended. The design response and inclusion of buffers is illustrated on Figure 9 – Design Response located with Volume 3.

6.1.7 Bats

The AnaBat surveys confirmed the presence of seven bat species within the project area:

- White-striped Free tail-bat (*Austronomus australis*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)
- Chocolate Wattled Bat (*Chalinolobus morio*)
- Southern Free tail-bat (*Mormopterus species 4 "big dick")*
- Lesser Long-eared Bat (*Nyctophilus geoffroyi*)
- Large Forest Bat (*Vespadelus darlingtoni*) and
- Southern Forest Bat (*Vespadelus regulus*).

The bat species detected onsite are thought to be common throughout the region with the majority of bats recorded, being within the vicinity of habitat features such as woodlands and open water. None of the recorded bat species have a conservation rating.

EBS notes that the site is subject to a relatively low level of bat activity and this may also be due to the fact the majority of the project area is void of suitable habitat for bats. The EBS report discusses the potential impact of the wind farm on bat species in Section 5.3.9 and notes that adopting buffers between turbines and avoiding identified bat habitat features minimises potential impacts on bat species on the development site.

6.2 VISUAL IMPACT ASSESSMENT

Wax Design and Dr Brett Grimm, referred to in this summary as Wax were engaged by RES Australia to assess the potential visual impact of the proposed Twin Creek Wind Farm project. A copy of the "Landscape Character and Probable Visual Effect Assessment" dated 29 June 2017 is contained within Volume 2 of the application documents. The following summary describes the landscape character, the visual impact of the proposed development from various viewpoints and the likely effect on the physical landscape.

6.2.1 Methodology

The Landscape and Visual Impact Assessment (LVIA) undertaken by Wax comprises of two separate assessments, firstly a landscape character assessment and secondly a visual impact assessment. The landscape character assessment described in the report considers the existing character of the landscape and the site locality. The potential visual impact was assessed using the Grimke matrix methodology (described in detail in the report) and involves onsite assessments, GIS modelling, consultation with relevant stakeholders and interested parties, the preparation of photomontages and a detailed visual impact assessment to illustrate the predicted visual effect of the project within the defined locality.

Wax discuss the "site locality" as the areas around the project from which the wind turbines and associated infrastructure are likely to be visible in the landscape. The report notes that a 20 kilometre site location around the project was defined for assessment purposes. The landscape character assessment and mapping within the report discusses existing character in relation to the local (0-3km), sub-regional (3-10km) and regional (>10km).

Wax also reviewed the extent of the site locality with the Zone of Theoretical Visual Influence (ZTVI) mapping, which provides a reference of the extent or the likely degree of visibility of the project in accordance to topography (excluding vegetation and built form screening). Utilising the ZTVI and following ground truthing and consultation with stakeholders and the public, a total of 7 viewpoints were selected around the locality of the site (wind farm development area, from which a detailed visual assessment of the potential visual effect was made. Each viewpoint represents a typical location where the greatest probable degree of visual change that will be experienced as a result of the proposed development within the existing landscape.

Figure 15 illustrates the selected viewpoints and the local, sub-regional and regional areas around the proposed wind turbine generators.

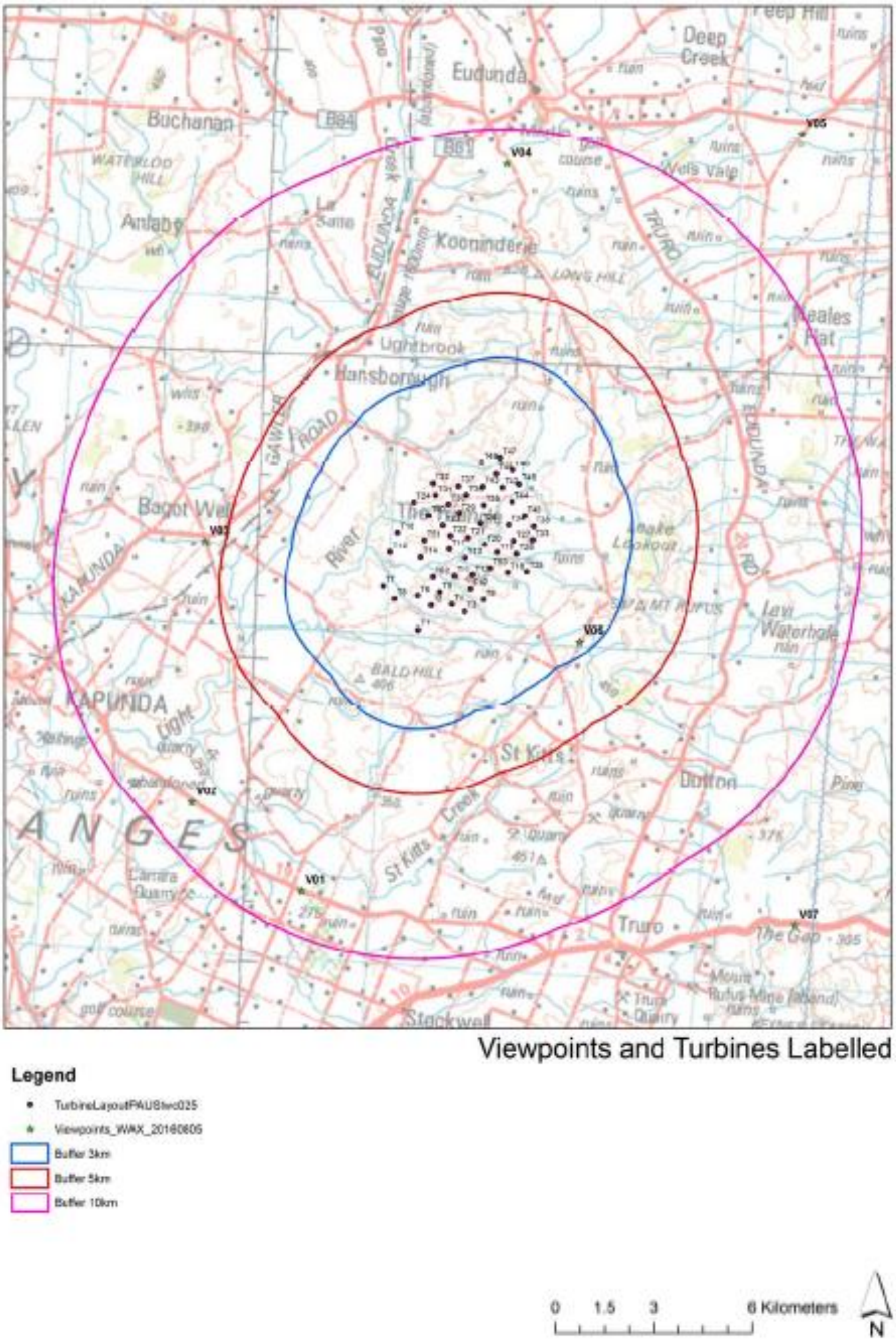

Figure 15: Viewpoint locations and Wind Turbine numbers

6.2.2 Landscape Character

Section 3.1 of the LVIA report (contained in Volume 2) describes the locality as having five distinct landscape character areas which largely follow the four cardinal directions (north, east, south and west).

> *To the south of the subject land is the Northern Barossa Valley, which has a denser level of development and high quality agricultural landscape with a variety of visual interest created by the smaller lot sizes and variety of land uses (grazing, vineyards, animal husbandry). The Western Pastoral Lands and Ridgelines stretch along the western edge of the subject land and is defined by a more open agricultural landscape with rolling ridgelines. The site of the proposed wind turbine generators and to the north are the Central Tablelands, these are characterised by rolling land forms and valleys associated with the Northern Mount Lofty Ranges and have a typically open grass grazing land use with minimal vegetation. To the east of the subject land is Mount Rufus and associated north/south ridgelines which transition further west into the Western Murray River Plains, the ridgeline associated with Mount Rufus forms a distinct division between the subject land and the Murray River Plains.*

Wax notes that "within this visually contained existing landscape character, the layout of the Twin Creek Wind Farm forms a single compact group of 51 wind turbines" (page 53). Further detailed assessment of five identified landscape character units within the regional landscape are further described in Section 3.4 of the report and shown in Figure 7 (as below).

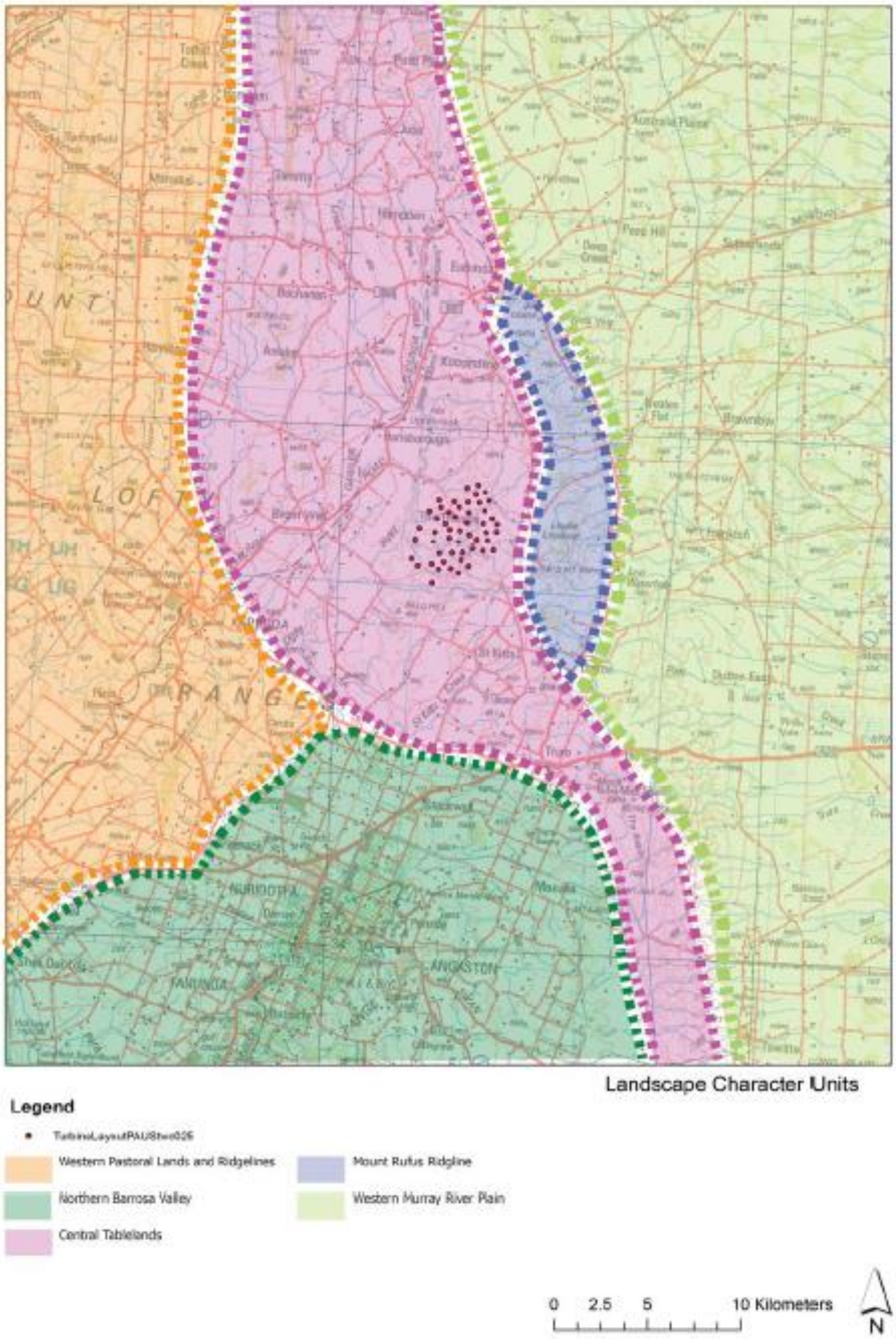

Figure 7: Landscape character units

6.2.3 Visual Impact Assessment

Section 5.9 of the LVIA report, provides the following discussion and summary of the potential visual impact of the wind farm and associated infrastructure.

> *The layout of the proposed wind turbines will result in a single cluster of large infrastructure elements that form a concentrated visual effect in the rural landscape. Travelling through the landscape, the underlying topography of the surrounding ranges modifies views towards the proposed wind farm. The visibility of the proposed development changes due to the screening effects provided by the adjacent hills and ridgelines or areas of existing vegetation.*
>
> *The visual assessment undertaken from the seven selected viewpoints demonstrates that a variety of visual impacts will be experienced within the local (0-3km), sub-regional (3-10km) and regional (>10km) landscapes that surround the proposed wind farm site. To the north and south and from distance of greater than five kilometres the visual effect associated with the proposed development will result in wind turbines being seen behind local ridgelines and landforms. In these locations, the potential visual effect will result from visible sections of the hub and blades above the local topography and vegetation.*
>
> *The potential visual effect reduces over distance with the visual assessment recording the visual effect as slight at a distance more than ten kilometres, particularly to the northeast. This reflects the different landscape characters around the proposed development site and the significant landscape absorption and screening of the ridgelines and vegetation created by the local topography of the areas.*
>
> *To the south, the distance between the proposed wind farm and the Barossa Valley provides significant management of the visual effect limiting the potential impact that the proposed wind farm may have on the Barossa Valley Character Preservation Zone and the associated areas of higher landscape amenity and cultural value.*
>
> *Viewed from the east and west the proposed wind turbines will be seen situated on the elevated topography of the Central Tablelands. The scale of the proposed development in relation to the vertical scale of the underlined landscape is prominent due to number of visible wind turbines and the prominence of the tower, nacelle and blades in the landscape. Within five kilometres of the proposed wind farm, the screening provided by local ridgelines and vegetation belts is limited, and the majority of the wind farm is experienced as a visually prominent element in the rural landscape producing a degree of visual change in the order of 43% to 48% which is described as substantial. This substantial visual effect alters the underlying visual character and composition of the landscape through the introduction of new elements. Views will be altered but the sensitivity of the underlying landscape character to change is considered low.*

Figure 37 of the LVIA, shown below illustrates the extent of visual effect and its variation throughout the locality of the proposed development.

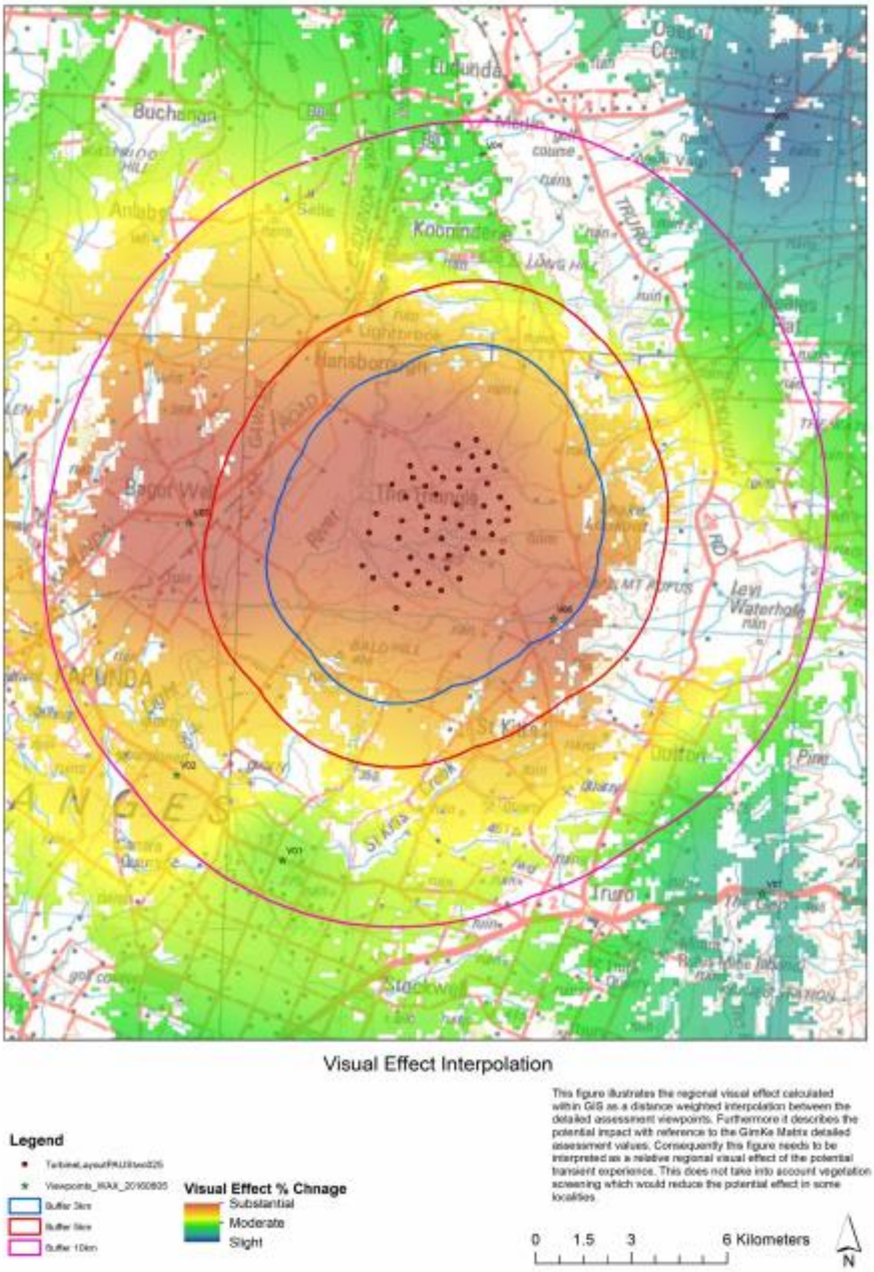

Figure 37: Summary of viewpoint visual effect

In addition to the visual effect of the wind turbine generators, the LVIA assessed the visual effect of the substations and transmission line (Section 5.11). The assessment notes that the "site compound and substation will be partially visible from viewpoint 6… and the scale of the on-site substation will be considerably less conspicuous than the turbines….with local landforms screening the majority of the development". The terminal (or transmission) substation is discussed in Section 5.13 and it is noted that "the visual effect of the substation is increased due to its close proximity to the Sturt Highway. However due to the road alignment which curves both before and after this location, local rigdes and stands of vegetation along the road corridor the substation will only be visible when travelling along a limited section of the Highway".

The conclusion of the LVIA states:

> *…Further away from the proposed development local ridgelines and tree belts create visual screens that fragment or remove the visual effects of the proposed wind turbines. The combination of topography and vegetation increases the screening reducing the degree of visual change that ranges from 23% to 33% and is describe as moderate.*
>
> *At distances of over ten kilometres, the degree of visual changes reduces significantly, and the degree of change is reduced to a range of 12% to 17%, particularly to the north east and south west and is describe as slight.*
>
> *The associated infrastructure; substations and transmission line, will provide localised impacts to their immediate site localities. These visual effects will be limited to shorter distances (contained viewsheds) to the east and south east or Truro. There will be no visual effect from the township of Truro. Transient experiences will be witnessed along local roads within the south east of the regional site with a small section of the Sturt Highway being impacted by the substation terminal connection to the existing 275kv line. Depending on the viewpoint, local landforms will provide visual screening.*
>
> *Furthermore the reduced vertical scale of the gantries and transmission pylons in contrast to the turbines, meaning the associated infrastructure will only slightly contribute to the overall level of visual change in the regional landscape.*
>
> *The visual assessment and visual effect interpolation mapping illustrated the relationship between distance and visual effect and the significance of local of ridgelines in reducing the visibility of the proposed wind farm in the wider locality. The visual effect is represented as bands of visual change radiating from the proposed wind farm. The consistency of the existing landscape character means that distance and visual absorption are the dominant variables in mitigating the visual effect. Although, the visual effect is likely to be moderate to substantial within the local to subregional area, the containment of the effect can be attributed to the visual character of the landscape coupled with uniformity of the agricultural character, meaning that the proposed Twin Creek Wind Farm can be accommodated without significantly altering the underlying landscape character.*

6.3 ACOUSTIC ASSESSMENT

An environmental noise assessment of the wind farm has been prepared by Sonus and this report entitled "Twin Creek Wind Farm Environmental Noise Assessment and dated June 2017 is contained in Volume 2. The assessment was undertaken against the requirements of the South Australian EPA *Wind farms environmental noise guidelines July 2009* (Guidelines). Sonus notes that the assessment has been based on the following data:

- the proposed co-ordinates of each WTG;
- the location and status of residences in the vicinity of the proposed wind farm;
- the locations of the WTGs relative to the residences;
- *Vestas V136 3.6MW* platform representative WTGs without serrated blades and a hub-height of 112m; and
- background noise monitoring conducted at 7 representative locations, between 31 August to 14 October 2016 and 22 December 2016 to 2 February 2017.

Sonus prepared "*A predictive noise model has been prepared for the proposed wind farm layout, which enables noise predictions to be made at local residences from each noise source including the WTG's, transformers and battery storage air conditioning units".*

6.3.1 Legislation, Guidance and Standards

In Section 4 of the environmental noise assessment report, Sonus discuss the application of the *Environment Protection (Noise) Policy 2007* (EPP) and the *Wind Farms Environmental Noise Guidelines 2009 (the Guidelines).* The applicability of the Guidelines is particularly relevant given the policies of the relevant Development Plans refer to the EPP.

Sonus succinctly summarise the application of the EPP and the Guidelines as follows:

> *Although the Development plan references the Environment Protection (Noise) Policy 2007 (EPP), the Environment Protection Authority (EPA) has produced 'Guidelines' to specifically assess the environmental noise from wind farms. The EPP refers to these Guidelines. Clause 34.(1) of the EPP applies the Guidelines to wind farms, and clauses 10 and 17 exclude wind farm noise from assessment under the general provisions of the EPP.*

6.3.2 Methodology

Section 5 of the Environmental Noise Assessment report describes the methodology of the noise assessment in detail. This methodology is not repeated in this summary, but the following is noted:

- the has been made based the Vestas V136 – 3.6MW WTG (hub height of 112 m). The WTGs have a cut-in wind speed of 3 m/s. The rated power wind speed has been taken to be 13 m/s;

- the two transformers at the site substation have been based on units having a maximum rating of 150 MVA each;

- the transformer at the terminal substation have been based on a unit capacity of 300MVA;

- the subject to final design prediction has been conservatively made based on 50 air conditioning units serving each battery container with a nominal cooling capacity of 5 kW;

- noise predictions for the wind farm use a recognised noise propagation model under worst-case meteorological conditions;

- the predictions have been made using the CONCAWE[4] noise propagation model and SoundPLAN noise modelling software;

- the sound propagation model considers the following influences:

  - sound power levels and locations of noise sources;
  - separation distances between noise sources and receivers;
  - topography of the area;
  - influence of the ground;
  - air absorption; and,
  - meteorological conditions.

- the noise assessment criteria applied to non-stakeholder dwellings in the *Wind Farms Environmental Noise Guidelines 2009 (the Guidelines) is:*

  The predicted equivalent noise level ($L_{Aeq,10}$), adjusted for tonality in accordance with these guidelines, should not exceed:

  - 35 dB(A) at relevant receivers in localities which are primarily intended for rural living, or
  - 40 dB(A) at relevant receivers in localities in other zones, or
  - the background noise ($L_{A90,10}$) by more than 5 dB(A)

  whichever is greater, at all relevant receivers for wind speed[5] from cut-in to rated power of the WTG and each integer wind speed in between.

[4] CONCAWE - The oil companies' international study group for conservation of clean air and water – Europe, 'The propagation of noise from petrochemical complexes to neighbouring communities', May 1981.

- where the wind farm noise exhibits a tonal characteristic, a 5 dB(A) penalty is to be applied to the criteria; and

- where background noise monitoring has not been conducted at a residence, the lowest measured background noise levels at any monitoring location have been used to derive the criteria. This is noted to be a conservative approach.

6.3.3 Assessment

Section 5.10 of the Environmental Noise Assessment contains the analysis of the predicted noise levels at residences within the vicinity of the wind farm. Following the analysis of the predicted noise levels at various wind speeds against the relevant criteria, Sonus states that: "*based on the predicted noise levels, the wind farm noise, including the WTGs, transformers and air conditioning units associated with battery storage will comply with the criteria at all residences, for all wind speeds*".

A separate analysis has been undertaken in relation to the terminal substation and the nearest residence (house H286). The noise levels of the terminal substation, if considered in isolation, are readily satisfied. Sonus states that "*the predicted noise level from the combined operation of the wind farm, the site substation, the terminal substation and the battery storage is less than 30 dB(A) at H286".*

6.3.4 Infrasound and Low Frequency Noise

Sonus provide discussion in their report (Section 6) relating to Infrasound and Low Frequency noise, which are often concerns raised by the community in terms of potential adverse impacts on health and amenity. The following points are noted from this discussion:

- the criteria of the SA Guidelines are established to ensure that any audible wind farm noise is low enough in level such that it does not adversely impact on the health or amenity of the community;

- the SA Guidelines have been tested and accepted in the South Australian Environment, Resources and Development Court as the appropriate tool for the assessment of wind farm noise, in order to protect the acoustic amenity of the community;

- modern WTGs are constructed with blades upwind of the tower resulting in noise levels well below the level of audibility at residential setback distances. International studies have confirmed that the level and character of noise from modern WTGs are not different to the noise encountered from other natural and non-natural noise sources;

- a recent South Australian Government study by the Environment Protection Authority into infrasound (Infrasound levels near wind farms and in other environments, January 2013) found:

    - the measured levels of infrasound from wind farms are well below the threshold of perception (that is, the level of infrasound at a residence is inaudible);

- the measured infrasound levels around wind farms are no higher than levels measured at other locations where people live, work and sleep; and
- the characteristics of noise produced by wind farms are not unique and are common in everyday life.

• noise sources that produce low frequency content (such as a freight train locomotive or diesel engine) have dominant noise content in the frequency range between 20 and 200 Hz. Low frequency noise is often described as a "rumble";

• aerodynamic noise from a WTG is not dominant in the low frequency range. The main content of aerodynamic noise generated by a WTG is often in the area known generically as the mid-frequencies, being between 200 and 1000Hz; and

• compliance with the SA Guidelines will inherently provide an adequate level of protection of amenity in the surrounding area from low frequency noise impacts.

6.3.5 Construction Noise

The Environmental Noise Assessment report provides the following commentary in relation to construction noise:

> *The EPP provides an emphasis on implementing reasonable and practicable noise reduction measures and does not set mandatory standards or objective criteria for activity which is conducted during typical day time construction hours. However, the EPP establishes a quantitative approach for night time activity, whereby an average goal noise level of 45 dB(A) and a maximum goal noise level of 60 dB(A) are to be met for activity outside of typical day time hours. The adoption of "all reasonable and practicable" noise mitigation measures during daytime hours....are common(ly) ... incorporated into the project's Construction Environmental Management Plan.*

The draft Construction Environmental Management Plan (Volume 4) incorporates a range of practical noise reduction measures.

6.3.6 Conclusions

In conclusion, Sonus states that:

> *"the predicted noise levels achieve the requirements of the Guidelines at all residences".*

Furthermore, Sonus notes that:

> *"A final noise assessment will be conducted to confirm compliance with the Guidelines when the final WTG, transformer and air conditioning selections are available at the procurement stage of the project, with guaranteed sound power levels provided by the respective manufacturers. The final noise assessment report will be submitted to the relevant authorities prior to the commencement of construction. In addition, noise level monitoring during operation of the wind farm is also typically required by the Environment Protection Authority to confirm ultimate compliance with the Guidelines.*
>
> *In conclusion, the assessment indicates that the Twin Creek Wind Farm can be readily designed to achieve the requirements of the South Australian EPA's Wind farms environmental noise guidelines July 2009 (the Guidelines). Should the wind farm be granted approval, there will be a review of the final design of the wind farm prior to construction and it is most likely that a condition of approval will require monitoring during operation to confirm ultimate compliance with the Guidelines".*

6.4 CULTURAL HERITAGE ASSESSMENT

EBS Heritage was engaged by RES Australia to undertake a desktop cultural heritage assessment for the proposed Twin Creek Wind Farm.

The EBS Heritage "Desktop Cultural Heritage Assessment Twin Creek Windfarm Report" is contained in **Volume 2** of the development application documents. The purpose of the report was to investigate cultural heritage within the project area, particularly investigations of previous archaeological research relevant to the study area; the identification of the relevant Traditional Owner representative body; the relationship between the study area landforms and Aboriginal sites and incorporates recommendations relating to cultural heritage management within the study area.

The EBS Heritage report contains the results of a detailed cultural heritage desktop assessment for the project area, and includes, the results of searches of the relevant heritage databases, an outline of relevant heritage legislation and a review of background information relating to the occupation and use of the study area.

6.4.1 Traditional Owners and Association with Landform

The traditional owners of the land on which the development is proposed, are the Ngadjuri Nation Aboriginal Corporation.

EBS Heritage identify in Section 7.1 that:

> *Any parcel of land, whether developed or not, has the potential to contain cultural heritage sites. Aboriginal heritage sites are the physical remains of past cultural activity and use of environmental resources. They also relate to spiritual beliefs and ceremonial activities.*

There are some generally accepted principles of association between environmental landforms and Aboriginal sites. The most recognised of these is the correlation between Aboriginal archaeological sites and water courses.

Based on this, the Aboriginal site types known as common to the region (rockshelters, painting & engraving sites, camp sites, hunting hides, culturally modified trees etc.) could be expected to be more prevalent with a greater density of intra-site components in the vicinity of more permanent water sources.

6.4.2 Identified Heritage Places

EBS Heritage undertook a detailed desktop assessment of a variety of heritage registers. The searches and the findings are summarised below.

Source	Description of Database	Findings
Register of Aboriginal Sites and Objects	The Central Archive is maintained by DSD-AAR and is a record of previously recorded heritage sites in South Australia.	No entries found for known Aboriginal sited located within the project area or a 1km radius
The South Australian Museum (SAM)	This database is an inventory of Aboriginal cultural material and skeletal remains	One record for skeletal material that has been found in the general region of the project area (Freeling)
The Australian Heritage Database	Contains information about more than 20,000 natural, historic and Indigenous places.	No listed heritage places within the project area
South Australian Heritage Register	Contains information about places of heritage significance in South Australia. It includes places and related objects of State significance and records other categories of heritage places in South Australia (including local, national and world heritage places) which are protected under legislation	There are no listed places of State significance within the project area.

EBS Heritage (Section 5.2) "*considers there is a low potential for earthworks to uncover Aboriginal cultural remains within the project area. Although the potential remains low, it increases in the vicinity of water bodies due to a direct correlation between the density of archaeological sites and the presence of fresh water sources."*

6.4.3 Findings

EBS Heritage conclude from the investigations undertaken that "*that there is potential for archaeological surface and subsurface features to be present throughout the project area in undisturbed areas. Intact subsurface deposits may also be present below the plough zone in heavily farmed areas, with this potential increasing closer to water sources*".

The report then contains three recommendations. One of these recommendations is to engage with the Ngadjuri Nation Aboriginal Corporation in a field survey/site discovery procedure. This engagement has occurred and field survey work is currently underway. The field survey/site discovery process with the traditional owners is separate and independent of the development application assessment process. However, this process has, to date, and will continue to inform the design of the wind farm and the construction methodology and activity. RES Australia is aware of their obligations pursuant to The South Australian Aboriginal Heritage Act (1988), that states that works must not "damage, disturb or interfere" with an item, object of site of Aboriginal Heritage.

6.5 BUSHFIRE RISK

SA Bushfire Solutions have prepared a Bushfire Management Plan, which is contained within **Volume 2** of the development application. The plan focuses specifically to the construction and operation of the proposed development, and defines objectives and recommendations to mitigate the threat that bushfires pose to life, property, the environment and the potential hindrance to suppression operations. The plan makes recommendations that may support and guide management decisions to mitigate potential bushfire risks.

It is noted in the report that evaluation of bushfire risk is extremely complex due to the variety of factors that influence the potential outcome. The site of the development is located within both a general bushfire risk area (within Light Regional Council and Mid Murray Council areas) and within an excluded bushfire risk area within the Goyder Regional Council area. The area of the wind farm has undulating and rocky terrain, minimal vegetation and low overall fuel hazard levels.

There is no recorded fire history for the proposed site of the proposed development. Within the Mid North and Barossa Valley regions there have been significant bushfires in recent years, including Pinery in November 2015, Eden Valley January 2014 and Angaston December 2014. With this knowledge, the Bushfire Management Plan discusses the potential risk of bushfire and considers the:

- the current context of existing risk factors;
- the elements of the proposal that may increase bushfire risk;
- the elements of the proposal that may aid or hinder suppression operations;
- the role of key stakeholders and their legislative responsibilities; and
- current best practice and existing policies.

6.5.1 Context

The Flinders Mid North Yorke Bushfire Management Area Plans (BMAP) covers the Light Regional and Goyder Local Government areas, while the Murray Mallee BMAP covers the Mid Murray Local Government area.

The Bushfire Management Plan outlines the bushfire environment of the wind farm site and locality, and the following is noted:

- the Flinders Mid North Yorke BMAP covers the Light Regional and Goyder Local Government areas, while the Murray Mallee BMAP covers the Mid Murray Local Government area;
- Mt Lofty Ranges is predominantly characterised by Casuarina and Allocasuarina forests and woodlands. Eucalyptus low open woodlands commonly dominate the higher rainfall areas and give way to Allocasuarina species in the more arid parts. The overall fuel hazards with these vegetation types can vary considerably and are expected to have higher fuel loads in the areas of remnant vegetation;
- the neighbouring lower plains (off site further to the west) are predominantly cereal cropping lands and depending on the season can have extreme near surface / elevated fuel loads and have significant bushfire potential, especially during harvesting operations;
- access and egress throughout many parts of the proposed development area is restricted because much of it is privately owned property with complex terrain. Public roads are limited and existing farm tracks are of varying standards that may not meet the Government Agencies Fire Management Working Group (GAFMWG) standards for emergency response vehicles;
- construction of the wind farm will include engineered access roads (greater than the identified GAFMWG standards) to each turbine location which will greatly improve fire crew access through the site and difficult terrain areas; and
- there is limited water infrastructure close to the proposed project area. Standpipes in nearby Eudunda and Kapunda are the principal sources of water for firefighting purposes.

6.5.2 Bushfire Risk from the Proposal

The Bushfire Management Plan discusses the bushfire risk of the wind farm from two perspectives, which are:

- firstly, is the wind farm likely to cause or increase risks of a bushfire (either during its construction or operational phases); and
- secondly, is the wind farm likely to limit any bushfire suppression operations.

6.5.2.1 Bushfire Risks During Construction

Existing land uses and human activity already pose some level of risk of generating a bushfire event during the fire danger season, however the construction phase of the project has the potential to increase bushfire risks primarily by increasing the level of activity in the region, specifically in relation to:

- the use of heavy earthmoving machinery operating in rocky environment;
- increasing the potential for vehicles to drive through dry grass;
- increasing the volume of human activity and vehicle accessing the area;
- storage and use of flammable fuels and materials; and
- the use of grinders and welding equipment.

Increased activity on grassland vegetation during construction, could potentially result in accidental ignition. Depending on the conditions and the location of such an event, a bushfire may become challenging to contain in the steep slopes and within areas of limited access, however, this will be offset by the construction of new roads that will improve emergency vehicle access and increase response times to reported incidents as well as serve as firebreaks.

The increased bushfire risk on the surrounding areas during construction and operation of the wind farm, is not considered to be more prevalent than any other development application or existing general activity (for example farming, contracting or other construction).

In each case the potential of increased risk can be managed and mitigated provided appropriate training, communication and management practices are put into place in accordance with the recommendations identified in this bushfire management plan.

6.5.2.2 Bushfire Risks During Operation

The proposed wind farm development will introduce additional elements to the region that have, in theory, the potential to increase bushfire risk. Many of these elements already exist or occur in the region from other industries or operations including:

- introducing infrastructure that can pose difficulties for suppression (e.g. Nacelle fires due to height and OH&S considerations of falling debris and tower infrastructure affecting aerial suppression);
- increase to management and maintenance vehicles and crew working in area;

- increase in the number of turbines, substations and power lines in area (potential for mechanical and electrical failures);
- increasing the potential for lightning conductors; and
- electronics stored with combustible oils and lubricants.

The functioning wind turbines may experience electrical or mechanical failure causing ignition in the nacelle and may lead to subsequent bushfires if not controlled. Whilst there is evidence to prove that wind farms have caught fire from various factors the subsequent risk of these nacelle fires causing uncontrollable bushfires is considered "less than that of many other activities expected in these rural environments" (Australasian Fire and Emergency Service Authorities Council, 2014). It should be noted that in comparison to other power generation e.g. coal or gas, wind energy has a much lower ignition risk (see Hazelwood Mine Fire Inquiry).

The types of fire risks related to wind energy facilities may include:

- nacelle (including turbine oil) fires;
- electrical faults during construction or from connection lines;
- firefighting limitations within and adjoining the wind farm footprint, such as possible limitations on aerial support, and access and egress conditions;
- access to water sources within or adjoining the facility;
- operation of winches and machinery during monitoring and maintenance tasks;
- possible impacts from downwind air turbulence on fire behaviour (see 3.31 below); and
- impacts of lightning.

Suppression of fire in the nacelle by ground crew is impossible; the initial detection of problems that may lead to fire in the nacelle and subsequent fires on the ground is the key to minimising asset and infrastructure loss and ignition of bushfires. Detection and automatic fire protection systems would reduce the risks, increase the ability to contain potential problems and decrease response times to reported incidents.

With the site proposed to be developed on lands with naturally low fuels and construction of roads to turbines increasing access for emergency vehicles through the area the overall potential for operational activities to increase the bushfire risk and impact on the surrounding areas is low, if the recommendations within this plan are implemented.

6.5.3 Operational Constraints and Opportunities

6.5.3.1 Potential Constraints

The report discusses in Section 3.3, a number of possible constraints of an operating wind farm on bushfire suppression, including:

- the operating wind farm could potentially impact bushfire suppression operations by:
  - possible interference with radio transmissions (radio frequency);
  - increasing the total number of assets to be protected in the area;
  - increasing safety risks with nacelle fires and falling debris;
  - affecting aircraft operations (access, efficiency and turbulence); and
  - increasing elevated structures as risk factors (vertical and horizontal).

Matters of potential interference with radio transmission are discussed in the DNV-GL EMI Assessment report, contained in **Volume 2** of the application documents. This report concludes that interference to fixed point to point links passing over the project boundaries is unlikely and excluding one operator (SA Water) all responses by service operators indicate that the project is unlikely to have any impact on services. As part of the consultation of stakeholders, the SA CFS were consulted and did not express any concerns.

Similarly, the potential impact on aerial firefighting activities is discussed in the Aviation Impact Assessment report prepared by The Ambidji Group Pty Ltd (contained in Volume 2 of the application documents).

In relation to potential impacts on aerial firefighting, the conclusions of the Aviation Impact Assessment report and the Bushfire Management Plan report are comparable. The Bushfire Management Plan report (Section 3.3) notes that:

- Twin Creek Wind Farm is in the CFS Secondary Response Zone (refer CFS Operations Tri Manual SOP 11.1 Aerial Fire Fighting). This means that bushfire suppression activities may be able to be supported by aerial suppression (rotary and fixed wing) based on a specific request by an Incident Controller and approved at a state level;

- there is no guarantee that aircraft for either suppression or an observation platform will be available for immediate dispatch, particularly in the Secondary Response Zone. This will be determined at the time by the CFS State Air Resource Coordinator (SARC) in consultation with the CFS Regional Office and Incident Management;

- pilots, air attack supervisors and air operation managers constantly undertake dynamic risk assessments to review and consider options and determine appropriate strategies to safely undertake suppression operations. In this context, aerial firefighting will treat turbine towers the same as any other obstacle; and

- the CFS fact sheet understanding Aerial Firefighting highlights that "...community perception is that aircraft alone put out bushfires, this is not true" and the CFS website Aerial firefighting defines aerial firefighting as "the use of aircraft and other aerial resources to assist firefighters on the ground in achieving bushfire suppression objectives". It is important to note, that firefighting aircraft (regardless of their size or type) do not extinguish a bushfire alone, but are deployed to provide an important support function to ground firefighting resources.

6.5.3.2 Potential Opportunities

Topography and terrain currently restrict access and egress to the large portions of the wind farm development site. As noted in the Bushfire Management Plan report (Section 3.3) "*post construction the increased number of service tracks to the turbines and substations will improve bushfire suppression operations by increasing vehicle access, emergency assembly points, strategic observation points and safe zones to emergency crews".* The report (Section 4.4) also notes that all tracks onsite will exceed the Government Agencies Fire Management Working Group (GAFMWG) requirements for a major fire access track and will be suitable as firebreaks.

6.5.6 Conclusion and Recommendations

The Bushfire Management Plan concludes (Section 7) that like any other construction project there is a potential increase risk of bushfire. "*The potential risks and impacts on surrounding areas are significantly reduced if the plan's recommendations are implemented*". Recommendations of the Bushfire Management Plan are noted for inclusion in the Statement *of* Commitments and/or the Construction Environmental Management Plan.

6.6 SHADOW FLICKER AND BLADE GLINT ASSESSMENT

Garrad Hassan Pacific Pty Ltd ("DNV GL") were commissioned to independently assess the expected annual shadow flicker duration in the vicinity of the proposed Twin Creek Wind Farm. This assessment is contained in the "Shadow Flicker and Blade Glint Assessment" report, which is contained in **Volume 2** of the application documents. The Executive Summary of the DNV GL report, quoted below provides a summary of the methodology and findings in relation to shadow flicker and blade glint.

> *Shadow flicker involves the modulation of light levels resulting from the periodic passage of a rotating wind turbine blade between the sun and an observer. The maximum potential duration of shadow flicker experienced at a specific location can be determined using a purely geometric analysis which takes into account the relative position of the sun throughout the year, the wind turbines at the site, local topography, and the viewer. This method has been used to determine the shadow flicker duration at sensitive locations neighbouring the Twin Creek Wind Farm.*

However, this analysis method tends to be conservative and typically results in over-estimation of the number of hours of shadow flicker experienced at a dwelling. Therefore, an attempt has been made to quantify the likely reduction in shadow flicker duration due to turbine orientation and cloud cover and hence predict the actual shadow flicker duration likely to be experienced at a dwelling.

.... the Environment Protection and Heritage Council (EPHC) Draft National Wind Farm Development Guidelines (Draft National Guidelines) released in July 2010, (which) include recommendations for shadow flicker limits relevant to wind farms in Australia.

The Draft National Guidelines recommend that the modelled theoretical shadow flicker duration should not exceed 30 hours per year, and that the actual or measured shadow flicker duration should not exceed 10 hours per year. The Draft National Guidelines also recommend that the shadow flicker duration at a dwelling be assessed by calculating the maximum shadow flicker occurring within 50 m of the centre of a dwelling.

The results indicate that, of the dwellings identified by Twin Creek Energy Pty Ltd (TCE), there are locations within 50 m of a single dwelling, identified as dwelling 147, that are predicted to experience shadow flicker, with a maximum theoretical duration of 29.3 hours per year. Based on information provided by TCE, this dwelling is owned by a project stakeholder, and it is not predicted to experience theoretical shadow flicker durations in excess of the recommended limit of 30 hours per year within 50 m of the dwelling.

When considering the predicted actual shadow flicker duration, which takes into account the reduction in shadow flicker due to turbine orientation and cloud cover, the maximum shadow flicker duration in the vicinity of dwelling 147 is predicted to reduce to 11.7 hours per year, which is above the recommended limit for actual shadow flicker of 10 hours per year within 50 m of the house location. It should however be noted that the Draft National Guidelines considers compliance in cases where the maximum theoretical duration limit is satisfied.

The prediction of the actual shadow flicker duration does not take into account any reduction due to low wind speed, vegetation, or other shielding effects around each house in calculating the number of shadow flicker hours. Therefore, the values presented may still be regarded as conservative. The effects of shadow flicker can also be reduced through a number of mitigation measures such as the installation of screening structures or planting of trees (if not already in place) to block shadows cast by the turbines, or the use of turbine control strategies which shut down turbines when shadow flicker is likely to occur.

It should also be noted that, with regards to shadow flicker impact on passing vehicles, the Draft National Guidelines state that "there is a negligible risk associated with distraction of vehicle drivers show experience shadow flicker". Therefore, shadow flicker impact on passing vehicles is not expected to be a problem for the proposed wind farm.

Blade glint involves the reflection of light from a turbine blade, and can be seen by an observer as a periodic flash of light coming from the wind turbine. Blade glint is not generally a problem for modern turbines provided non-reflective coatings are used for the surface of the blades.

6.7 EMI ASSESSMENT

DNV GL Australia Pty Ltd ("DNV GL") has assessed the potential electromagnetic interference (EMI) impacts associated with the development and operation of the proposed Twin Creek Wind Farm.

As stated in EMI Assessment Report (Section 5), "*if not properly designed, wind farms have the potential to interfere with radiocommunications services. Two services that are most likely to be affected include television broadcast signals and fixed point-to-point microwave signals. Terrestrial broadcast signals are commonly used to transmit domestic television, while microwave links are used for line-of-sight connections for data, voice and video. The interference mechanisms are different for each of these and, hence, there are different ways to avoid interference".*

6.7.1 Investigations and Methodology

The EMI Assessment report investigates the potential EMI impact of the Project on:

- fixed point-to-point links;
- fixed point-to-multipoint links;
- radiocommunications assets belonging to emergency services;
- meteorological radars;
- trigonometrical stations;
- Citizen's band (CB) radio and mobile phones;
- wireless internet;
- satellite television and internet; and
- broadcast radio and television.

The investigations were undertaken with reference to:

- Planning SA, "Planning Bulletin: Wind Farms - Draft for Consultation," Government of South Australia, August 2002
- Central Local Government Region of South Australia, "Wind Farm Development Guidelines for Developers and Local Government Planners," June 2014.

- Environment Protection and Heritage Council (EPHC), "National Wind Farm Development Guidelines - Draft," July 2010.

In relation to EMI, these guidelines provide advice and methodologies to identify likely affected parties, assess EMI impacts, consult with affected parties, and develop mitigation steps to address the likely EMI impacts. DNV GL considers that the recommendations of the Draft National Guidelines meet, if not exceed, the recommendations of the Draft SA Planning Bulletin and Central SA Guidelines, and therefore the Draft National Guidelines were used to inform the methodology adopted in the assessment.

The EMI Assessment report provides extensive details about the methodology engaged, which included direct consultation with identified "likely affected parties". The consultation and response from parties is contained in Table 4 of the report and quoted below.

Summary of EMI assessment results for the proposed Project

Licence/Service Type	Assessment Findings	Stakeholder Feedback (to date)
Fixed point-to-point microwave links	Three links crossing Project boundary: SA Water *No turbines in exclusion zone* W & L Phillips Pty Limited (Flow FM) *No turbines in exclusion zone* NBN Co *No turbines in exclusion zone*	Potential for interference No concerns raised No concerns raised
Fixed point-to-multipoint microwave links	222 assignments within 75km of Project boundary Seven base stations within 20km of Project boundary: Aussie Broadband (Side ID 9012660) Barossa Valley Golf Club (Site ID 501154) SA Water (Site ID 24263 and 9007183) SA Power Networks / Telstra (Site ID 24227) The Barossa Council (Site ID 9011554) Treasury Wine Estates Vintners (Site ID 138906)	Potential for interference to SA Power Networks point-to-multipoint link; resolved with proposed exclusion zone
Other licence types	Base to mobile station style communications: unlikely to be affected (see "Emergency services", "Mobile phones", "Radio broadcasting", "Television broadcasting") Aeronautical and radiodetermination: to be considered as part of an aviation impact assessment	-
Emergency services	Point-to-point microwave links: No links crossing boundary Base to mobile station style communications: unlikely to be affected	No concerns raised
Aircraft navigation systems and radar	To be considered as part of an aviation impact assessment	-

Licence/Service Type	Assessment Findings	Stakeholder Feedback (to date)
Meteorological radar	Nearest station: 'Buckland Park' (Adelaide), 63km from nearest turbine Unlikely to be affected	Potential for interference to Buckland Park radar; satisfied with proposed turbine locations
Trigonometrical stations	56 stations within 20km of Project boundary Electronic equipment: unlikely to be affected Sight lines to other stations: may be blocked by turbines	No concerns raised
Citizen's band radio	Unlikely to be affected	-
Mobile phones	Fair to good coverage across site Unlikely to be affected, may experience interference in areas with marginal coverage	No concerns raised
Wireless internet	Likely service providers: Agile Communications, Aussie Broadband NBN: currently available in areas surrounding Project May experience interference in areas with marginal coverage	No concerns raised
Satellite television and internet	Services intended for Australia: unlikely to be affected Other services: no signals intercepted	-
Radio broadcasting	AM signals: unlikely to be affected FM signals: may experience interference (low level hiss or distortion) in close proximity to turbines FM signals from nearby Flow FM transmission tower: may experience interference in areas with poor or marginal reception to the north and northeast of the Project Digital radio signals: unlikely to be affected	AM and digital radio signals: no consultation required FM signals: potential for interference to Flow FM signal
Television broadcasting	Digital signals: may experience interference in areas with poor or marginal reception Adelaide Tower: 'variable' to 'good' coverage across site Eight dwellings (three belonging to associated landholders) in potential interference zone Eudunda, Renmark/Loxton, and Waikerie towers: 'variable' coverage to north and east of site No dwellings with coverage in potential interference zone	-

6.7.2 Findings and Potential Mitigation

The EMI assessment has found that the project has the potential to cause interference to digital television signals received at dwellings in the vicinity, and FM radio broadcasts to the west and northwest of the Project. Potential EMI impacts on other services considered in the assessment, including meteorological radar, trigonometrical stations, CB radio, and mobile phones, are either considered to be minor or have been assessed through consultation with the service operators.

DNV-GL discuss state in their report that "*although DTV signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate coverage, interference could be encountered in areas where coverage is marginal and antennas at dwellings may receive a reflected signal from a turbine that is of sufficient power to interfere with the signal received directly from the transmitter. Based on the coverage maps for the area around the Project, it is possible that some areas could be deemed to have marginal reception, and interference could be encountered*" (Section 5.14.4).

The EMI report provides several mitigation options in the event of television interference (Section 5.14.5), including:

- *Realigning the householder's television antenna more directly towards their existing transmitter;*
- *Tuning the householder's antenna into alternative sources of the same television signal or a substitute signal;*
- *Installing a more directional and/or higher gain antenna at the affected house;*
- *Relocating the antenna to a less affected position;*
- *Installing cable or satellite television at the affected house; and*
- *Installing a television relay station.*

DNV-GL further state that "*in the event that terrestrial DTV reception cannot be improved, satellite television represents another potential amelioration option. Satellite based television comprises of both free to air and subscription based broadcasts. Residents in areas which are unable to receive DTV through their normal television antenna due to local interference, terrain or distance from the transmitter in their area may be eligible to access the Australian Government funded Viewer Access Satellite Television (VAST) service".*

Section 6 of the EMI Assessment report states that "*the turbines at the project may interfere with digital television broadcast signals received from the Adelaide broadcast towers at houses surrounding the Project, particularly in areas where the residents currently experience poor or marginal reception. Interference to the FM radio signal broadcast by the nearby Flow FM transmission tower may also be experienced near the edges of the signal coverage area to the west and northwest of the Project".*

The EMI Assessment report (Section 5.13.2) proposes that *"if interference to FM radio signals is experienced, mitigation options include installing high-quality antennas and/or amplifiers at affected residences, increasing the broadcast signal strength from the Kapunda transmitting tower or the nearby Maitland or Hallett towers, moving the Kapunda tower to a new location more than 4 km from any turbine, or installing a signal repeater on the opposite side of the Project".*

Furthermore, the report summary and conclusions note:

> *Although base to mobile station style communications such as television and radio broadcasting and commercial and private mobile telephony services are generally unlikely to be affected by wind farms, interference may be experienced in areas of poor or marginal reception. If interference to television and radio reception is increased as a result of the project, a range of options are available to rectify difficulties.*
>
> *This EMI assessment has found that the project has the potential to impact on a number of radiocommunications services in the vicinity of the project. Specifically, the turbines at the project may interfere with digital television broadcast signals received from the Adelaide broadcast towers at houses surrounding the project, particularly in areas where the residents currently experience poor or marginal reception. Interference to the FM radio signal broadcast by the nearby Flow FM transmission tower may also be experienced near the edges of the signal coverage area to the west and northwest of the project.*
>
> *DNV GL has assessed the potential EMI impacts on point-to-multipoint links, emergency services, and wireless internet services through consultation with service operators. DNV GL has also consulted with other organisations operating services that may be affected by the development and operation of the project to seek feedback regarding any potential EMI-related impact the project could have on their operations and services. While DNV GL considers that interference to fixed point-to-point links passing over the project boundaries is unlikely, it is noted that one operator, SA Water, has expressed concerns regarding potential impacts on their links. All other responses received to date indicate that the project is unlikely to have any impact on the relevant services.*

6.8 AVIATION IMPACT ASSESSMENT

The Ambidji Group Pty Ltd (Ambidji a division of Landrum and Brown Worldwide) were engaged to prepare an Aviation Impact Assessment (AIA), Aviation Impact Statement (AIS), Qualitative Risk Assessment (QRA) and an Obstacle Lighting Review (OLR) for the proposed Twin Creek Wind Farm (TCWF).

In relation to the proposed development, the aviation assessment notes the following:

- the highest ground in the project area is at wind turbine generator T38 and in combination with a tip height of 180 metres the overall highest point is 660.22 m (2166ft) above the Australian Height Datum (AHD);

- there are no military, certified or registered aerodromes within 30nm (56km) of the TCWF;
- the nearest aerodrome is the Edinburgh Military base (YPED) 31nm (57.4km) south west of the TCWF;
- there are three Aeroplane Landing Areas (ALA) identified within 30km of the TCWF including:
  - Truro Flat Sport Aviation
  - Stonefield - Gliding
  - Kapunda - Private [rarely used]
- the Gawler Aeroplane Landing Area (ALA) is 42km south west of the TCWF and is used extensively for gliding and sport aviation activity. Whilst it is beyond the 30km distance it was considered in the investigations due to its volume of aviation activity;
- the TCWF does not impact any Obstacle Limitation Surfaces (OLS);
- the TCWF does not impact any PANS-OPS surfaces (Procedures for Air Navigation Services - Aircraft Operations);
- there are no Airservices Australia (AsA) communications facilities located at or within 30nm of the TCWF;
- the TCWF will not impact on the performance of any communication facilities;
- there are no Radio Navigation Aids (NAVAIDs) in the vicinity of the TCWF. Airservices Australia have advised that the wind farm will not adversely impact the performance of any Airservices Precision/Non-Precision Nav Aids, Anemometers, HF/VHF/UHF Comms, ASMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links;
- the nearest Airservices Australia (AsA) Radar installations are at Adelaide Airport, 84km to the south west, and Summerton, 75.5km to the south south west of the TCWF. Both radars are too far from the TCWF for the wind turbines to have any impact on radar performance;
- Airservices Australia (AsA) have advised that the wind farm will not affect any air route, sector or circling altitude, nor any instrument approach or departure procedure at any airport;
- the Department of Defence have advised they have no objection to the proposed TCWF.
- a Military Restricted Area (R265B) is sited above the TCWF. This Restricted Area is designated for military flying operations and flights would not operate below 4500ft. A civil aircraft is permitted to transit at the lower limit of 3500ft for R265B when it is active;
- an aerial agricultural operator advised and noted that there is very little aerial applications undertaken in the area of the wind farm;

- the Australian Fire and Emergency Service Authorities Council (AFAC) Wind Farms and Bushfire Operations Position Paper 30 October 2014 states: "Aerial firefighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.";

- the turbines and meteorological monitoring towers used in the TCWF must be reported to Civil Aviation Safety Authority (CASA) and the RAAF in accordance with AC 139-08(1) Reporting of Tall Structures and marked on the appropriate aeronautical charts; and

- the risk assessment for the TCWF indicates that the overall risk to aviation is Low. A risk assessment of Low indicates that the wind farm is 'not a hazard to aircraft safety'. The TCWF is not a hazard to aircraft safety; therefore there is no need to install additional obstacle marking or obstacle lighting.

The conclusion of the aviation assessment undertaken is that with the tallest wind turbine generator at a tip height of 660.22m (2166ft) above the Australian Height Datum (AHD), the proposed Twin Creek Wind Farm does not interfere with any airspace procedures or aviation related communications, navigation or surveillance facilities for both civil or military aerodromes and airspace.

The aviation assessment does include a recommendation in relation to ensuring any new or additional wind monitoring masts are appropriately marked to increase visibility.

6.9 TRAFFIC IMPACT ASSESSMENT

A Traffic Impact Assessment (TIA) has been prepared by AECOM Australia Pty Ltd (AECOM), which details the impacts of the transport related activities associated with the life cycle of the wind farm development through construction, operation and decommissioning phases. A copy of the Traffic Impact Assessment is contained with **Volume 2** of the development application documents.

The Traffic Impact Assessment Report examines existing conditions in the locality of the site, an assessment of the likely access routes during the construction phase (from the port to the wind farm), an assessment of access points; and recommendations regarding mitigation measures required to enable proper access to the development site.

The greatest volume of heavy vehicle access will occur during the construction phase. Components that are transported during this construction phase include: wind turbine components; substation components; battery storage containers; and miscellaneous construction equipment and materials.

Overall, it is estimated that approximately 175,000 trips will be generated in total for the construction phase of the development, with approximately 1,500 over dimensional or over mass vehicle trips, 32,000 truck trips, and 53,000 car trips.

6.9.1 Existing Conditions

The TIA identifies that the "*main townships that will be most impacted by the wind farm development are Kapunda, Truro, Eudunda and also the Koonunga area. The surrounding arterial road network is primarily state-managed, high speed rural roads, with Thiele and Sturt Highways experiencing the highest daily traffic volumes. All minor roads in the area are primarily unsealed and unmarked.".*

The Thiele Highway, Sturt Highway and Truro Road are state controlled arterial road. Belvidere Road and Eudunda Roads, which are managed by Light Regional Council and the Regional Council of Goyder respectively are classified as regional collector roads. Heavy vehicles (Performance Based Standards (PBS) Level 2B vehicles, such as 26 m B-double trucks) may travel along Sturt and Thiele Highways, Belvidere and Truro Roads to gain access to the site. Eudunda Road is not classified as PBS approved route.

The site is bounded and intersected by multiple minor roads, which are unsealed and unmarked. The TIA reviewed the conditions of the following roads in its examination of potential access routes to the development site.

- Flagstaff Hill Road
- Mosey Road
- Camel Farm Road
- Weaver Road
- Bagot Well Road
- Teagle Road
- Noack Road
- Leakes Pass
- Holding Road
- Travers Road
- Ben Lomond Road

6.9.2 Preferred Access Route

The TIA considered several access routes, particularly for transport of components during construction. The TIA considers options for delivery of components during construction from both the Port of Adelaide and Port Pirie. The access routes considered through metropolitan Adelaide include:

- route out of the Adelaide metropolitan region via: Main North Road, Port Wakefield Road and the Fatchen Northern Expressway (Northern Expressway); or
- route to site via Thiele Highway or Sturt Highway.

The preferred route is from the Port of Adelaide, via the Port River Expressway, Port Wakefield Road, the Northern Expressway to Sturt Highway as it:

- reduces the number of traffic signals encountered on the trip;
- minimises the impact of other road users; and
- avoids the transportation of oversize and over mass loads through Kapunda.

The TIA considered several access routes from the surrounding highways to the development site for the construction phase of the project. Consideration of the appropriate route has taken account of the various road layouts and capacities and potential impacts. AECOM has considered the following in this assessment:

- road layout such as intersection turn constraints, capacity of pavements, water crossings and culverts, and vertical road alignment;
- vegetation and low level powerline clearance; and
- generation of noise and dust.

The preferred access route from Sturt Highway is via Truro Road, Bagot Well Road, Camel Hill Road, Flagstaff Hill Road and Mosey Road to the site access. This route minimises the impact of heavy vehicles on local roads and the surrounding landowners, by limiting the number of journeys past existing dwellings.

Delivery of substation components has also been assessed in the TIA. The wind farm comprises two substations, the first is within the wind farm infrastructure area, on the south-eastern side of the wind farm site near the wind farm access point. The second substation is the terminal substation, which is located adjacent the Sturt Highway near the township of Truro at the 275 kV tee in point. Substation components are both over dimensional and over mass, requiring permits to be transported to the site. The wind farm substation can be accessed via the selected route from the Sturt Highway. The terminal substation can be readily accessed from the Sturt Highway. The current junction at the Sturt Highway has recently been upgraded to provide a sheltered right turn lane and therefore will be adequate to support the delivery of material for construction of the substation.

The preferred route has also been the subject of discussions with the Department of Planning, Transport and Infrastructure, Light Regional Council and the Regional Council of Goyder.

This summary report discusses the preferred route as outlined above. The AECOM TIA also discusses the alternate routes considered.

6.9.3 Traffic Impact Assessment

A detailed assessment of the traffic impact assessment is contained within Section 6 of the AECOM report. In summary, the Executive Summary of the TIA states that *"the traffic generated during the construction phase represents the greatest demand for the site, occurring over the assumed 18 month period. Overall, it is estimated that there will be 175,000 one-way vehicle trips, comprised of:*

- 1,500 over dimensional and over mass trips;
- 32,000 truck trips; and
- 53,000 car trips.

This relates to an approximate daily volume of 7 over dimensional or over mass vehicles, 60 heavy vehicles and 140 car trips.

The expected impacts on road users and the community are discussed in the TIA report and the following discussion is noted:

- *"It is expected that, because of the large numbers of heavy vehicles required during the construction and decommissioning phases, there is the potential for the development to have a large impact on road users and the local community. In general, the construction phase will increase daily traffic volumes, which may result in more congested routes for local road users. The most significant impact would be for the sections of the access route that is contained within the metropolitan region, since the vehicles will be required to share main arterial routes with general traffic. By selecting the access route via the Northern Expressway, the impact on road users will be reduced, as this route allows for significant overtaking capacity and reduces the likelihood of frequent stops (Section 5.5).*
- *The transportation of components and construction materials may also cause noise and dust impacts during the construction and decommissioning phases that will impact the local residents closer to the wind farm site (Section 5.5).*
- *As local school bus routes also exist in this area, there may be impacts on these transportation routes. These impacts can be minimised by scheduling over dimensional/mass and heavy vehicle transport during off-peak times to avoid commuter traffic and school bus movements (Section 5.5).*
- *The increase in daily traffic along most routes is less than 10%. The largest percentage increase occurs along Truro Road, as this is the only access route from the Sturt Highway and is not currently heavily used. The increase in daily traffic on Truro Road is;*
    - *from the west, 6% increase in total traffic (15% increase in heavy vehicles), and*
    - *from the east, 11.25% increase in total traffic (40.8% increase in heavy vehicles) (Section 6.2.3)*

- *As no traffic data was available for Teagle Road or Bagot Well Road, the percentage increase has not been calculated; however it is likely that the current traffic volumes are low. As a result there is likely be a noticeable impact from the development construction phase (Section 6.2.3)*

- *Truro Road,... will experience a significant increase in heavy vehicle use, as it is not currently a high use heavy vehicle route. In this situation, the increase in heavy vehicles may cause some damage to the road, particularly if high volume movements are undertaken in wetter conditions. Pre and post construction assessments should be undertaken to assess the required rehabilitation of road pavements. All unsealed roads are expected to require upgrades as they will experience a significant increase in daily traffic. Over-mass loads should ideally be transported in dry weather only to avoid excessive damage to unsealed roads (Section 7.1.3).*

- *Bagot Well Road crosses St Kitt's Creek ...this crossing... is bridge structure. Given the current low traffic volumes of this local area road and Council do not have a load rating for the bridge, a structural assessment will need to be undertaken to ensure that it can sustain the over mass vehicle loads., If the Bagot Well Road access option is chosen as the access route, any upgrades recommended by the structural assessment would need to be designed to support these loads (Section 7.1.3).*

- *The majority of arterial roads on the proposed access route have adequate vegetation and power line clearances as these routes are designed for high speed and high volume traffic. However, some vertical envelope restrictions currently exist along Truro Road and the start of Bagot Well Road. ... In most instances, the clearance restrictions are a result of overhanging trees on both sides of the road, which will require pruning to achieve adequate clearance (Section 7.1.4).*

- *The use of heavy vehicles on these routes will generate an increase in noise and dust from the current level, particularly on rural roads off Truro Road, where the majority of the network is unsealed. There are a number of measures that can be taken to reduce noise and dust including:*

  - *restrict vehicle movements to and from the site to off peak times to reduce the impact of noise on surrounding residents;*
  - *provide for clear turning circles to reduce engine noise associated with revving and reversing beeping and generation of excess dust;*
  - *no vehicles shall be left idling on any roads in the vicinity of residential properties;*
  - *enforce vehicle speed limits on the construction site and rural roads off Truro Road to minimise the generation of dust; and*
  - *minimise soil deposit on surrounding roads, using rumble grids if needed (Section 7.3).*

The TIA notes that *"the decommission phase is likely to generate a similar amount of traffic, but it is recommended that another traffic impact assessment be carried out closer to the decommissioning date to better captures the changes of traffic usage and road conditions over time. The operations and maintenance phases is likely to generate the lowest traffic impact, as it is expected that only a small number of vehicles will be required on a daily basis to carry out monitoring and basic repairs (Section 6.1)".*

6.9.4 Conclusions

Section 10 of the TIA comprises the following conclusion of the traffic assessment:

The traffic generated by the Twin Creek wind farm development is likely to have a noticeable impact on the road network both in the local area and the broader transport network. The largest impact is generated by the construction phase of the development while other phases (operations and maintenance work) will have little impact. During the construction phase the impact will extend over approximately an 18 month period, requiring an estimated 175,000 trips, made up of approximately:

- *1,500 over dimensional and over size trips;*
- *32,000 truck trips; and*
- *53,000 car trips.*

The decommission phase is likely to generate a similar amount of traffic, however it is recommended that another traffic impact assessment be carried out closer to the decommissioning date.

In considering the route options, from either Port of Adelaide or Port Pirie to the Sturt Highway and from the Sturt Highway to the Wind Farm site the preferred access route for the transportation of wind turbine components and substation components is from the Port of Adelaide, via Port River Expressway, Port Wakefield Road, the Northern Expressway, Sturt Highway, Truro Road, Bagot Well Road, Flagstaff Hill Road and Mosey Road to the site access point (ie. Option A to Sturt Highway and Option 1 from Sturt Highway to the site)

The majority of vehicles accessing the site will be either staff vehicles or semi-trailers, however, for the over dimensional and over mass vehicles, the appropriate permits and assessments must be sought and carried out. Permits are required for each vehicle and each trip, and assessments into the structural capacity of the roads and bridges along the route will be needed for the over mass trips. The permits outline the necessary safety considerations for the movement of these vehicles, such as use of a police escort, pilot vehicles, appropriate signage and hours of transport operations.

Access for these over dimensional trips is generally adequate along the recommended route. The majority of the route is on restricted vehicle access approved routes, however, some tree trimming, movement of street furniture and access into private land is likely to be required in isolated locations. The St Kitts Creek crossing on Bagot Well Road will require a detailed structural assessment and potential upgrade for over dimensional and over size vehicles. In general, the sight distances along the route are considered adequate for all vehicles, given the appropriate escorts are used for over dimensional vehicles. All movement of over-dimensional and over-mass components should be undertaken with regard to weather conditions to avoid excessive damage to unsealed road pavements.

In conclusion, allowing for the implementation of mitigation measures and compliance with permit conditions, the impacts from traffic and traffic related activities are considered acceptable for the area in which the Twin Creek Wind Farm is proposed.

6.10 CIVIL, GEOLOGY AND HYDROLOGY ASSESSMENT

AECOM Australia Pty Ltd (AECOM) have prepared a Civil, Geology and Hydrology assessment of the proposed development site. A copy of this assessment is contained in Volume 2 of the application documents.

6.11.1 Natural Features

The AECOM report describes (in Section 5 of the report) the natural features of the site as follows:

- *the topography of the site is hilly, with numerous incised creek valleys typically draining towards the west into the Light River. The elevation of the Light River near the site varies from about RL 270 m to 290 m AHD, whereas the ridge lines and hills within the project site typically have elevations in the range of about RL 400 m to 450 m AHD;*
- *the hills and ridge tops are generally rounded, but become steeper towards the valleys where creeks are incised in relatively steep sided channels. In general the terrain undulates somewhat more steeply in the southern part of the site;*
- *rock outcrops are visible throughout the site, ranging from rocky hill tops and ridges, to rocky creek beds. Orange clay typically overlay the rock, with the soil thickness varying up to about 3 m in some creek beds, but reducing to close to zero on the hill tops;*
- *at the time of the site visit, vegetation typically comprised low grass with occasional, scattered mature trees;*
- *numerous small farm dams, some windmills and old stone ruins were also present across the site;*
- *access tracks across the site appeared to have been constructed from local materials, and typically comprised a mixture of gravel and exposed clay. The main tracks/roads had been sheeted with gravel that resembled local site won crushed/sorted rock. Trafficability was general acceptable for a light 4WD vehicles in dry conditions, but the more clayey tracks were slippery when wet;*

- *no evidence of significant landslides was observed from either the stereo pairs of aerial photographs, or from the areas of the site observed during the walk-over, although considerable erosion and 'wombat holes' were observed in the orange clay, particularly near the creeks;*

- *watercourses within the site area are predominantly fed by rainfall and are ephemeral, ceasing to flow in dry weather. The Light River flows along the western boundary of the site, entering from the north-western corner and leaving at the south-western corner. The Light River has a catchment of approximately 1820 km2. The majority of the catchment is used for dryland agriculture, with cereal and canola crops as well as livestock grazing;*

- *Freshwater Creek enters the site in the north-eastern area, flows in a south westerly direction through the site and contributes the Light River approximately halfway along the western boundary of the site. The catchment for Freshwater Creek is approximately 34.66 km2 in size with approximately 20 km2 of the catchment within the site boundary. Spring Creek originates in the south-east area of the site, flows west and contributes to the Light River just outside the south west corner of the site. The catchment for Spring Creek is approximately 9.26 km2;*

- *Other watercourses within the site originate from the ridge on the eastern side of the site and flow through naturally occurring valleys before contributing to the Light River, or Freshwater Creek or Spring Creek. The watercourses throughout the site have catchment sizes ranging from 1 km2 to over 30 km2 for Freshwater Creek;*

- *it is noted that the site is located north and outside the Barossa Prescribed Water Resources Area, which covers groundwater, water courses and surface water;*

- *The site is located within the Adelaide Geosyncline, comprising thick sedimentary and minor igneous rocks that were formed during the late Precambrian (between about 1,100 Ma and 600 Ma). These rocks later became folded, metamorphosed, intruded and uplifted...; and*

- *two former mines are located within the project boundaries, namely Benita Copper and Newlands Barite and a further mine, Julia Creek Barite is located close to the eastern boundary of the site.*

6.11.2 Geotechnical Constraints and Opportunities

The AECOM report utilise the data collected and described above in providing advice for the design of the wind farm, the siting of access tracks, siting of the substation, operations and maintenance compound, temporary compounds and associated infrastructure.

The findings of the investigations are discussed in Section 7.0 of the report in terms of geotechnical constraints and opportunities, as summarised below.

- *rock is expected to be present either at the surface or at very shallow depth at all turbine locations, which should make anchored footings a viable option for many turbines;*

- *if the rock is highly fractured or deeply weathered, the anchors may need to be excessively deep and/or the associated overall rock mass may have a low stiffness which would result in excessive deflections of the base of turbine. In such areas gravity footings may be required;*

- *the majority of footing excavations for the turbines are expected to be in rock, which will require the use of rock excavation techniques, such as hydraulic rock breakers mounted on large excavators. The use of blasting should be avoided however, as it may loosen the rock mass and lower the stiffness of the rock below the footing level;*

- *future geotechnical investigations will be required to assess the condition of the rock at each turbine location. Similar investigations at key points along proposed access road tracks and at the proposed substation site should also be performed;*

- *potential borrow pit sites that are suitable for producing aggregate for unsealed road construction are expected to be readily available throughout the project area;*

- *due to the higher quality demands on concrete aggregate, it is expected that off-site sources of concrete will be used;*

- *the ability to utilise surface water for construction is expected to be limited to the wetter months of the year;*

- *a number of existing bores are present throughout the project area that are currently used for stock watering or other agricultural purposes. Should the installation and development of new bores be required during construction, a South Australian Government permit (from the Department of Water and Natural Resources) will be required for each new bore;*

- *the stability of turbine footings in close proximity to steep slopes must also be assessed, particularly where the rock mass is highly fractured or has unfavourably orientated defects; and*

- *any new excavations that expose the soil profile must be provided with protection from erosion, and mitigation measures such as silt fences may be required down gradient of active earthworks areas to avoid fouling the natural creeks.*

A number of the findings of these investigations will be incorporated into the Construction, Environmental Management Plan for the site.

6.11 SOCIO-ECONOMIC IMPACT ASSESSMENT

Hudson Howells Strategic Management Consultants have prepared a Socio-Economic Impact Assessment for the Twin Creek Wind Farm project and this report is included in its entirety in **Volume 2** of the application documents. The Executive Summary of the Socio-Economic Impact Assessment report, as quoted below, provides a succinct summary of the socio-economic impacts of the project.

This socio-economic impact assessment focuses on the effect of the Twin Creek Wind Farm Project on regional incomes and employment associated with the construction and operating phases of the project. This effect arises through the primary expenditure directly associated with the project, and then from further 'rounds' of indirect expenditure that this direct expenditure stimulates as it flows to supplying industries and into incomes and consumption.

The economic modelling for the project has been undertaken using indicative assumptions with respect to labour supply. The commitment of the project developers is that there will be prioritisation of local contractors wherever possible, but the modelling assumes that the wind turbine generators are imported from interstate or overseas, and the major local impact is based on transport and assembly.

From a State perspective, economic modelling indicates that the project will generate $209 million of value added (which is a net contribution to Gross State Product[1]) in the State of South Australia over the period of construction and that this would happen over three years (allowing for lagged flow through effects). 1,447 person years[2] of employment in South Australia would be supported – or an average of over 4803 jobs sustained per year over three years. Once operational the project is estimated to support annually $15.5 million of value added in South Australia, and support directly and indirectly in the order of 105 jobs per year.

The impact at the national level would be similar to the state level, unless there are constraints in national labour and capital markets with such constraints likely to be limited in the current macroeconomic environment.

From a regional perspective[4], the modelling indicates that the project will generate $64 million of value added (contribution to Gross Regional Product) in the region (Barossa and Lower North) over the period of construction and, again allowing for lagged flow through effects, this would happen over three years. 477 person years of employment would be supported, or an average of 159 jobs sustained per year over three years. Once operational the project is estimated to support annually $6.2 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 44 jobs per year.

From a local perspective[5], based on the assumptions used (which involve the project drawing labour from both the Goyder and Light areas) the modelling indicates that the project will generate:

- *$18 million of value added (contribution to Gross Regional Product) in the LGA of Goyder over the period of construction and, again allowing for lagged flow through effects, this would happen over three years. 130 person years of employment for local residents would be supported, or an average of 43 jobs sustained per year over three years. Once operational the project is estimated to support annually $1.8 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 12 jobs per year.*

- *$20 million of value added (contribution to Gross Regional Product) in the LGA of Light over the period of construction over three years. 146 person years of employment for local residents would be supported, or an average of 49 jobs sustained per year over three years. Once operational the project is estimated to support annually $2.3 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 16 jobs per year.*

The above economic modelling results are summarised in the following tables:

3 Year Construction Impacts

Contribution to GRP – South Australia	Employment Impact – South Australia	Contribution to GRP – Lower North & Barossa	Employment Impact – Lower North & Barossa	Contribution to GRP – Goyder LGA	Employment Impact – Goyder LGA	Contribution to GRP – Light LGA	Employment Impact – Light LGA
$209.1 million	1447; or 482 per annum	$64.3 million	477; or 159 per annum	$18.3 million	130; or 43 per annum	$20.1 million	146; or 49 per annum

Annual Operational Impacts

Contribution to GRP – South Australia	Employment Impact – South Australia	Contribution to GRP – Lower North & Barossa	Employment Impact – Lower North & Barossa	Contribution to GRP – Goyder LGA	Employment Impact – Goyder LGA	Contribution to GRP – Light LGA	Employment Impact – Light LGA
$15.5 million	105 per annum	$6.2 million	44 per annum	$1.8 million	12 per annum	$2.3 million	16 per annum

These outcomes are based on assumed levels of local supply, and where more of the activity can be retained in the region (while acknowledging the specialist nature of the construction itself), the more extensive the degree of regional economic activity.

Wind farms can have other positive and negative socio-economic impacts depending on a variety of factors and the specific communities being impacted by the developments. For example, farmers hosting turbines may receive positive financial benefits while other communities might be subject to visual impacts from windfarm infrastructure with no financial benefits. In addition to employment and income generation, property values and carbon emissions are socio-economic externalities of wind farms.

In relation to property values, many studies[6] by independent organisations around the world have failed to find any correlation between wind turbines and declining property values. Some studies have found positive property value impacts associated with:

- *improved regional amenities and infrastructure including local roads, firefighting access roads, etc;*
- *increased regional incomes, jobs and property demand (as assessed above);*
- *additional rental income from hosting wind turbine generators;*
- *provision of a drought-proofing income streams;*
- *provision of post-retirement income for farmers;*
- *improved biodiversity via less intensive farm activity;*
- *prevention of land subdivision and slowing down the process of productive agricultural land changing to rural residential uses in the short to medium term with the shift caused by the additional income generated from the wind farm providing additional cash streams to underpin agricultural use; and*
- *erosion control and passive wind protection for stock from sub stations and turbine wind turbine generators structures.*

There will be localised positive and negative impacts associated with wind farms depending on individual property locations. Some may appreciate faster than market trends due to improved farm incomes from hosting wind turbine generators and improved access to infrastructure. Some may fail to keep pace with market trends due to visual and noise impacts.

Potential disruption during wind turbine generator assembly and infrastructure establishment is also noted. However, the evidence supports no overall long term negative impact on property values associated with wind farm developments.

Finally, renewable wind energy generation has significant environmental benefits through carbon emissions reduction where it replaces coal or gas generated electricity.

It is assumed that the Twin Creek Wind Farm will have the following operating characteristics:

- *total wind farm capacity of up to 183 megawatts;*
- *annual average utilisation rate of 40%[7]; and*
- *total generation of 613 Gigawatt hours (Gwh) per annum.*

It is conservatively assumed that when electricity is generated through coal fired stations, it produces 0.8 tonnes of carbon per megawatt hour[8] of electricity generated. So the generation of 613 Gwh per annum through coal generation would produce in the order of 0.491 million tonnes of carbon emissions. At a carbon price of $20 per tonne (historically conservative relative to international trading schemes, and much lower than what is expected in the longer term – but matching current prices[9]), the value of carbon emission savings associated with the Twin Creek Wind Farm is estimated to be $9.8 million per annum or a net present value of $104 million over a 20 year period (discount rate of 7% real).

6.12 DEVELOPMENT PLAN ASSESSMENT

The site of the Twin Creek Wind Farm and Energy Storage Project is located across three Local Government Areas, including the Light Regional Council, the Regional Council of Goyder and the Mid Murray Council. Infrastructure including wind turbine generators, on site substation, operations and maintenance compound, temporary construction compounds (including concrete batching plant) are located within the Light Regional Council and Regional Council of Goyder area. The transmission line transverses from within the Light Regional Council area to the Mid Murray Council area and terminates with a terminal substation east of Truro.

In each of the three Council areas, the site of the proposed development is within a Rural or Primary Production Zone. Within these zones, a "*wind farm and ancillary development such as substations, maintenance sheds, access roads and connecting power lines (including to the National Electricity Grid)"* is a consent land use.

More specifically, the site of the proposed Twin Creek Wind Farm is located within the following zones:

- Primary Production Zone, General Farming Policy Area 3, Light Regional Council Development Plan (consolidated 8 December 2016);
- Primary Production Zone, Goyder Council Development Plan (consolidated 24 November 2016); and
- Rural Zone, Hills Policy Area 14, Mid Murray Council Development Plan (consolidated 14 June 2017).

Each of the three Development Plans contains the same procedural provision in relation to a wind farm. A wind farm in the Rural Zone of the Mid Murray Council Development Plan and the Primary Production Zones of the Light Regional Council Development Plan and the Goyder Council Development Plans is Category 2 for notification purposes.

An assessment of the merits of the wind farm must be undertaken against the relevant provisions of each of the three Development Plans.

Following an assessment of the proposed development against the provisions of the Light Regional Council Development Plan, the Goyder Council Development Plan and the Mid Murray Council Development Plan, it is considered that the proposed development is <u>not</u> significantly at variance with the Development Plan.

In summary, MasterPlan conclude that the proposed development has substantial planning merit when assessed against the relevant provisions of the three Development Plans, including:

- a wind farm and ancillary development is an envisaged land use within the Primary Production and Rural Zones;
- the site of the development is outside of the Barossa Valley Character Preservation District;
- retention of the principal and underlying land use of the locality, that is primary production;
- the proposal is unlikely to adversely impact on aerial agriculture within the locality;
- the development is a renewable energy facility that provides a benefit to the community and the state;
- the siting and design of the wind farm and energy storage facilities adequately minimise the impact on the natural environment;
- the proposal contains suitable methodology for minimising and managing impacts on Pygmy Blue Tongue Lizards;
- the development does not adversely affect safety of water or air transport;
- the minimum setback of 1,000 metres to all non-associated (non-stakeholder) dwellings for a wind turbine generator is exceeded by the development which incorporates a minimum 2,000 metre setback;
- there are no known tourist accommodation facilities within the locality (that is, within 1,000 metres of the nearest wind turbine generator);
- there are no townships, settlements or urban zones within 2,000 metres of any wind turbine generators;
- predicated noise levels are compliant with relevant noise criteria for sensitive receivers;
- the turbines are designed to minimise glare/blade glint;
- the wind farm is compliant with guidelines for theoretical and actual shadow flicker to owners and occupiers of non-stakeholder dwellings;
- the proposal contains suitable methodology that minimises impacts such as dust, noise and vibration through the construction phase;
- the proposal contains suitable methodology for managing traffic movements, particularly during construction;

- the proposal contains suitable methodology for minimising the visual impact of the infrastructure (other than wind turbine generators) via new vegetation planting in appropriate locations;
- the proposal contains suitable methodology for minimising and managing impacts of EMI; and
- the proposal contains suitable methodology for managing bushfire risks.

On balance, the proposed Twin Creek Wind Farm and Energy Storage project is a suitable form of development within the Primary Production and Rural Zone, that appropriately addresses potential impacts and thereby warrants the granting of Development Plan Consent.

CHAPTER 7 –

CONCLUSIONS

CHAPTER 7 – CONCLUSIONS

The following provides an overview for the acceptability of the environmental and other impacts of the proposal, as detailed throughout this **Volume 1** summary of the development application.

The Twin Creek Wind Farm and Energy Storage project is being developed as a commercially viable project. At a national level, the project will contribute to Australia's economic health through reduced reliance on non-renewable resources. The Twin Creek Wind Farm will provide close to an additional 613 Gigawatt hours (Gwh) per annum, over the operating life of the wind farm. This generation is equivalent to the electricity needs of approximately 118,000 South Australia homes each year, (assuming the average annual household electricity use is 5,200 kWh per annum).

In addition to the electricity generation, the battery storage with an indicative capacity of 215 MW aligns with the South Australia Government Energy Plan to ensure that energy can be dispatched as it is needed to provide energy security.

The project will have a direct and tangible contribution to both the Australian Government's South Australia Governments Renewable Energy Target. In accord with the goals of the South Australian Energy Plan of March 2017 the project will assist South Australia to provide reliable, competitive and clean power into the future.

The value of carbon emission savings therefore associated with the proposed development is estimated to be $9.8 million per annum or a net present value of $104million over a 20 year period (real discount rate of 7%)". Emission savings will directly assist the achievement of state, national and global targets for reduced greenhouse gas emissions.

The project area comprises approximately 5,600 hectares; the majority of which is used for grazing or cropping. Of the total project area, approximately 2.0 percent of the land will be utilised for the wind farm development. Accordingly, existing land uses can largely continue without effect. Wind farm and ancillary infrastructure are envisaged land uses within the Primary Production and Rural Zones of the Light Regional Council, Regional Council of Goyder and Mid Murray Council Development Plans.

The project has been designed to avoid vegetated areas which provide important habitat as far as possible, and micro-siting of project elements will further assist in avoiding vegetated areas. Impacts on avifauna have been assessed and the project is not expected to cause effect to any threatened species which occur, or may occur within the project area. The proposal is unlikely to diminish biodiversity values of the region, and has been assessed as unlikely to impact threatened species/communities identified within the project area including the Pygmy Blue-Tongue Lizard.

Although visual effect of the wind turbine generators and associated infrastructure is likely to be moderate to substantial within the local and subregional area, as distances increase, the degree of visual change reduces significantly and in most areas, is described as slight. The wind farm is not expected to be detrimental to the landscape and wider amenity of the region. There are no visually sensitive or scenic areas in the region.

Vegetation screen planting along roadsides and adjacent infrastructure elements such as compounds and substations will further assist minimising visual impacts.

There are no wind turbine generators proposed within 2.0 kilometres of any non-stakeholder dwelling. There is no adverse impact on any non-stakeholder dwelling from blade glint, shadow flicker or noise.

An assessment of the noise levels of the wind farm has been undertaken and the *predicted noise levels achieve the requirements of the Wind Farms Environmental Noise Guidelines 2009 at all residences.* Compliance with the SA Guidelines will inherently provide an adequate level of protection of amenity in the surrounding area from low frequency noise impacts.

Potential impacts have been identified on television transmission for some dwellings with areas of poor or marginal reception, and those in the down range diffraction zone of the wind farm. Mitigation measures are available for those dwellings affected. Similarly, mitigation options are available to address the potential impacts identified on Flow FM radio signal broadcast.

There are unlikely to be any unreasonable impacts to soil, water and air quality as a result of the proposed development, as the project has been designed according to the physical features of the project area. A range of mitigation and management measures will be incorporated into the Construction Environmental Management Plan to minimise airborne dust events, erosion, and soil discharge into watercourses.

A desktop heritage assessment of Aboriginal and non-Aboriginal heritage was undertaken for the development area. There are no items of European heritage within the boundaries of the project area. The assessment did not identify any specific locations of Aboriginal heritage within the project area, but recognised that earthworks may uncover Aborginal Cultural remains. Although the potential for this to occur is low, the assessment recommended engagement with the Ngadjuri Nation Aboriginal Corporation. A field survey/site discovery procedure is currently underway with the traditional owners, however this is separate and independent of the development application assessment process.

The construction phase of the project will result in increased traffic to and from the site including the movement of restricted access vehicles. A Traffic Management Plan will be prepared as part of the Construction Management Plan to ensure the works can be undertaken safely and with minimal disruption to local traffic. Once operational, the traffic entering the wind farm site will be negligible.

The potential for bushfire risks, physical safety issues and aircraft safety have also been reviewed, and management measures proposed as necessary. Following the implementation of management measures, these risks are expected to be 'low'. Recommendations of the Bushfire Management Plan will be incorporated as part of the Operational Environmental Management Plan.

A mix of positive and negative opinion has been expressed in relation to the project to date from the public consultation processes undertaken. Some amendment to the design of the project has occurred as a direct result of the consultation process. The proponent is aware of the necessity for an effective and genuine ongoing public consultation programme, and has outlined a methodology for continued meetings with neighbours and community stakeholders, updates to local media providers, notices to community, and liaison with local government regarding the future stages of the project.

The project will provide for a range of flow-on economic effects, particularly during the construction phase of the project, including income to local service providers, employment to a large temporary workforce, improvements to local infrastructure, and benefits related to the financial agreements of the land owners within the project area.

In a broader sustainability sense and with consideration of the broader 'public interest', the project can be implemented with minimal environmental impacts to the project area and its location, and is a sustainable energy development. The wind farm will assist in addressing global concerns about climate change, and assists in inter-generational and social equity through reducing society's consumption of finite resources.

Whilst there will be some effects to the region as a result of the wind farm and energy storage project, these are generally limited to short term transport and construction effects, which will be managed through Construction and Operational Environmental Plans. Overall, it is considered that any adverse impacts will be relatively minor and will be outweighed by the positive longer term environmental, social and economic benefits of the project.

CHAPTER 8 –

STATEMENT OF COMMITMENTS

CHAPTER 8 - STATEMENT OF COMMITMENTS

The Statement of Commitments (Commitments) relate to overall project management and specific measures, during final design and pre-construction planning, construction, operation, and decommissioning. RES Australia will work with all stakeholders during compliance reviews and if by chance there is non-compliance, measures will be taken to rectify the problem.

The Statement of Commitments will be finalised to address the planning authorities conditions of Development Plan Consent (if granted). Implementation of the Commitments and the performance of the project's environmental management system will be subject to periodic reviews and corrective action if/as required.

8.1 General and Administrative Commitments

Issue	Commitment	Timing
Scope of development	RES will carry out the development in accordance with the information contained within development application and in compliance with the conditions of Development Plan Consent.	Ongoing
Minimising harm to the environment	RES will implement all practicable measures to prevent and minimise any harm to the environment that may result from the construction, commissioning, operation, maintenance and decommissioning of the development.	Ongoing
Statutory requirements	RES will ensure compliance with all relevant environmental requirements and ensure that all necessary approvals, licences and permits are obtained and are kept up to date as required throughout the life of the development. Copies of these documents will be maintained at the Site Office and Environmental Management Plans (EMP's) will include measures to ensure compliance.	Ongoing
Decommissioning	At the end of its economic life, all equipment will either be replaced with comparable new equipment, or the wind farm will be decommissioned. Replacement may be subject to new approvals.	Upon decommissioning.
	A decommissioning and rehabilitation plan would be prepared and submitted to the relevant planning authority for approval (if/as required) prior to decommissioning commencing. This plan would include relevant technical reports that are required to inform the decommissioning process and minimise environmental harm and impact on the amenity of the community within the locality or as maybe affected.	Prior to decommissioning
	Decommissioning would involve dismantling or removal of all equipment, and site rehabilitation. Turbine footings would be retained at a level below the ground surface, as acceptable to the land owner. Access tracks may be retained depending on the land owners' wishes. Any overhead wires no longer required will be removed.	During decommission

8.2 Community Consultation

Issue	Commitment	Timing
Notice of construction activities	RES will ensure that the local community and businesses are advised of construction activities that could cause disruption prior to those activities occurring. Communication methods will be detailed within the final CEMP. Information will include: - details of traffic disruptions and controls; - construction of temporary detours; and - work approved to be undertaken outside standard construction hours, particularly noisy works.	Prior to disruptive works.
Periodic project updates	The following will be updated to local media providers, as update newsletters circulated to local papers: - periodic updates of work progress, consultation activities, and planned work schedules when significant changes in noise or traffic impacts are expected.	As required
Periodic project updates on project website	RES will maintain a project website until construction ends. The website will contain: - periodic updates of work progress, consultation activities, and planned work schedules when significant changes in noise or traffic impacts are expected. The website will indicate the date of the latest update and expected frequency of updates; - a description of the relevant approval authorities and their areas of responsibility; - project reports and plans that are publicly available for download; - contact names and phone numbers of relevant communications staff; and - a 24 hour toll-free complaints contact telephone number.	Ongoing until construction is complete
Construction noise communication requirements	Prior to the commencement of construction, neighbours to the wind farm site will be informed of the construction works, the nature and duration of components of the construction phase, the potential impacts and contact details for registering components or enquires. The developer will provide noise and vibration elements into the community consultation process. The aim of consultation will be to ensure adequate community awareness and notice of expected	Prior to construction commencing and as required

Issue	Commitment	Timing
	construction noise. Consultation will include: - regular community information newsletters providing details of the construction plan and duration; - - a site notice board in a community location(s) providing copies of the newsletters, updated construction programme details, contact details of the project team members, and an ability to register for email updates of the newsletter; - a feedback mechanism for the community to submit questions to the construction team and for the construction team to respond; - regular updates on the construction activities to local authorities to assist in complaint management if necessary; and - contact details of the project manager and/or site 'environmental representative'.	
Complaints management	Prior to construction commencing, RES will ensure the following is available: - a postal and email address to which written complaints can be sent; and - a 24 hour telephone contact line. BWFPL will keep record of a Complaints Register for a period of at least four years after the complaint was made. This will include: - the date and time of the complaint; - whether the complaint was via mail, email or telephone; - any personal details provided (if any) or a note if no details were provided; - the nature of the complaint; - any action(s) taken by BWFPL in relation to the complaint, including follow-up; and - if no action was taken in relation to the complaint, the reason(s) why. The Complaints Register will be made available for inspection upon request of the planning authority or other relevant government agency.	Prior to construction commencing
Additional consultation requirements communications	Additional consultation for the communication aspects of the project, as recommended by DNV GL in its EMI Assessment Report and the Ambidji Aviation Assessment report.	Prior to construction commencing

8.3 Design and Miscellaneous Measures

Issue	Commitment	Timing
Project layout	The Twin Creek Wind Farm project is based upon the layout shown in the application documents and incorporates up to 51 wind turbine generators. The candidate turbine selected for all investigations is the Vestas 136. The actual turbine model and number to be installed may vary slightly dependant on the final design conditions. Micro-siting of individual turbine locations up to 100 metres is proposed, however any micro-siting changes will be consistent with consent, otherwise a modification will be sought. Adjustment will consider relevant sensitivities of the location. The final design will be subject to Building Rules Consent and Development Approval.	Prior to construction commencing
	Cable routes will be located alongside access tracks to minimise site disturbance.	During construction
	RES will require the design of facilities and services buildings to incorporate the collection of roof drainage.	Prior to construction commencing
	Wastewater systems would be designed in accordance with Council requirements. Approvals will be obtained prior to installation.	Prior to construction commencing
	RES will confirm design and siting of temporary construction site offices prior to obtaining Development Approval.	Prior to construction commencing
	If the project contractor seeks to utilise the approval for the temporary concrete batching plant on site, the contractor will be required to obtain any further licenses required.	Prior to construction commencing
	Permanent tracks will be located to achieve suitable grades on stable slopes and design to that they will not exacerbate erosion. Location will be chosen to minimise visual impact from the surrounding countryside as far as possible. Earth batters on any tracks that are benched into slopes will be revegetated to prevent erosion and to reduce visibility of the constructed tracks.	Prior to construction commencing
Aboriginal Heritage	Complete a site discovery procedure with the Ngadjuri Nation Aboriginal Corporation	Prior to construction commencing
	Undertake construction in accordance with the South Australian Aboriginal Heritage Act (1988), which establishes site reporting requirements during construction so that the works does not "damage, disturb or interfere" with an item, object of site of Aboriginal Heritage	During construction
	Ensure staff undertaking construction are appropriately inducted to be aware of the risks and have idea of how to identify Aboriginal cultural	Prior to construction commencing

Issue	Commitment	Timing
	materials.	and during construction
Visual impact measures	Measures to mitigate the visual impact of the project will include: - turbines to be a matt white (non-reflective) finish and a three-bladed design; - underground cabling will be used throughout the wind farm wherever practical; - areas of existing native vegetation will be preserved as far as possible; - earthworks will be restored as soon as practical following the completion of construction; - cable trenches will be backfilled as soon as practical; and - access roads will be selected according to the pattern of existing tracks within the project area and to reduce visual impact.	During construction
	Visual screen planting will be located in the following locations including: - between the terminal substation and Sturt Highway - to the south of the on-site substation Additional screen planting will be undertaken subject to land owner and neighbour's requests. A landscape management plan will be prepared to manage the establishment and maintenance of newly established landscape areas.	During construction
Shadow Flicker	If shadow flicker presents a problem for stakeholder Dwelling 147, mitigation strategies to reduce the duration of shadow flicker experienced will be undertaken. The mitigation measures may include: - installation of screening structures or planting of trees to block shadows cast by the turbines, - use of turbine control strategies which shut down turbines when shadow flicker is likely to occur	Post construction and during operation
Aviation safety	Final details of the height and location of each wind turbine generator and wind monitoring towers be provided to CASA, Department of Defence, AirServices Australia, the Aerial Agricultural Association of Australia and operators of Gawler, Stonefield and Truro Flat ALA's.	Before erection of the wind turbine generators
	The wind monitoring towers be constructed with appropriately marked, preferably using high visibility balls on the guy wires	Construction of wind monitoring towers

Issue	Commitment	Timing
Acoustics	A final noise assessment will be conducted to confirm compliance with the Wind Farms Environmental Noise Guidelines 2009 when the WTG, transformer and air conditioning selections are available at the procurement stage of the project, with guaranteed sound power levels provided by the manufacturers. The final noise assessment report will be submitted to the relevant authorities prior to the commencement of construction.	Prior to construction

8.4 Flora and Fauna Mitigation Measures

Issue	Commitment	Timing
Project layout	Submit a EPBC referral for the project in relation to PBTL	Prior to construction commencing
	Submit and obtain approval for the clearance of native vegetation as required by the Native Vegetation Act 1991. Identify SEB offset areas.	Prior to construction commencing
	Micro -site wind turbine generators and other infrastructure and access tracks to avoid PBTL	Prior to construction commencing
	During final design, construction and operation of the project, provide a 500 metre buffer from any wind turbine generator to the three known Wedge Tailed Eagle nests within the development site	Ongoing
	During final design, construction and operation of the project, provide a 200 metre buffer between wind turbine generators and woodland habitat	Ongoing
	Avoid removal of woodland areas that contain tree hollows that may provide nesting cavities.	Construction and ongoing
Management Plans	Development a Weed Management Plan/Rehabilitation Plan. Management of declared and environmental weeds maybe part of the SEB options.	Prior to construction
	Development a Construction Environmental Management Plan (CEMP) which incorporates best practice environmental management measures including: - vehicles and equipment should be cleaned to ensure they are free of plant material and soil, to reduce the dispersal of exotic flora species into, out of, and within the project area - Control of declared and environmental weeds found within the site - Minimise the construction footprint e.g. along access roads, in turn-around areas and around turbine pads - Staff training to ensure they are aware of the threatened flora and fauna species and ecological communities present and potentially present; and the potential and actual impacts of	Prior to construction

Issue	Commitment	Timing
	construction, operation and maintenance of the proposed wind farm on flora and fauna species and habitats.	

8.5 Bushfire Mitigation Measures

Issue	Commitment	Timing
Bushfire Risk Management: Design Components	The potential fire risk associated with electrical failure will be managed by the following measures: - use of fully enclosed electrical equipment on turbine structures and pad-mount transformers; - extensive use of underground cabling between turbines; - design of any overhead lines in accordance with industry standards; - exclusion of vegetation from within the substation enclosure; and - use of circuit breakers and fuses to interrupt any electrical fault.	During project design
Project Design	In consultation with the CFS, identify the appropriate size and location of static water points onsite	During final design
	Install agreed static water storage tanks (as appropriate) in the form of above ground water tank constructed of concrete or steel.	During construction
Bushfire Management Plan	In consultation with the CFS, prepare a Bushfire Management Plan that addresses the following during construction: • Activities to be undertaken during the Fire Danger Season are appropriate under the Fire and Emergency Services Act and Regulations 2005 Division 4 - Fire Prevention of the regulations. • Staff, contractors and site visitors to be informed of fire response procedures that follow identified legislative requirements, policies and procedures • Works during the fire danger season to have appropriate permits from Local Government, (Goyder, Light Regional and Mid Murray Councils). • Construction and operational works follow appropriate Work Health and Safety requirements. • Principal Contractor to ensure there is a bushfire survival plan for personnel at the site. • Facilitate a high standard of communication with landowners, relevant stakeholders and the	Prior to construction

Issue	Commitment	Timing
	community regarding daily activities through community liaison groups or similar. • Primary contact person for the community to contact with concerns, questions or issues to be established. • Ensure all contractors: - Are appropriately briefed and understand their legal obligations in relation to managing bushfire risks. - Have appropriate procedures, safe work practices, contingency plans, MSDS for operation of all equipment, chemicals, flammable materials that may contribute to bushfires. • Have appropriate "initial" suppression equipment available on site i.e. fire extinguishers or firefighting equipment in vehicles. • Carry emergency communications equipment. • Vehicles should keep to the tracks whenever possible. • Restrict low clearance vehicles with catalytic converters from entering the site on high fire danger days. • Restrict smoking to prescribed areas. • Consider a policy of "no work" or "essential work only" on declared Catastrophic Fire Danger Days. • Provide appropriate bushfire training for contractors and staff. • Establish an "APZ" of at least 40 m around each turbine (Clear vegetation, such as scrub, trees, etc. within 40 m of a turbine) and consider other zoning strategies to assist bushfire mitigation (e.g. BBZ as per DEWNR zoning policy). • Ensure all building construction is in line with CFS regulations and Minister Specifications of building in Bushfire risk areas. • Ensure appropriate bunding in areas where there is potential for flammable fuels and oils to leak and create bushfires or other environmental risks. • Ensure all access roads and tracks are identified and meet GAFMWG standards for emergency vehicle access. (Govt SAd, 2008). • Consider appropriate signs (as per GAFMWG standards) to assist emergency response crews determine track names, location and turbines etc. • Establish emergency assembly areas. • Consider the option to have all power lines underground. • Ensure all environmental risks of construction have been considered and approved by relevant authority. • Consider security fencing as necessary around	

Issue	Commitment	Timing
	turbines and substations to prevent public access. • Provide adequate access tracks to assist CFS in responding to and managing fires on site. • Ensure adequate access to water for CFS, and/or for sprinklers, and the provision of onsite static water supplies. • Consider early fire/smoke detection systems, in built fire protection systems, remote alarming and notification systems in turbines to report potential bushfire risks from any mechanical or electrical failures.	
	Ensure that the Bushfire Management Plan incorporates the following for the operation phase of the project: • Invite local brigades on regular site familiarisation tours. • Communicate to community the bushfire risk mitigation works undertaken. • Provide site plans to CFS marking assets, access points, tracks, firebreaks, hazards and water points once facility is constructed. • Undertake regular inspections and maintain records of all turbines, the substation, and power lines (including easements). • Ensure suitable firefighting equipment is available onsite or readily accessible • Ensure staff and contractors are trained in firefighting equipment and have appropriate personal protective clothing. • Ensure the maintenance of fuel load management zones (A and B zones). • Consider remote shut down possibilities of turbine operations during high bushfire risk days, actual bushfires or reported faults. • Consider lightning conductors to dissipate electricity to ground and reduce turbine damage and bushfire risk. • Ensure all access roads and tracks are maintained to meet GAFMWG standards for emergency vehicle access.	Prior to commission and ongoing

8.6 Traffic Management

Issue	Commitment	Timing
Infrastructure Deed	Enter into an Infrastructure Deed with the Light Regional Council and Regional Council of Goyder in relation to upgrades of local roads proposed to be utilised during construction of the project	Prior to Developmen t Approval

Issue	Commitment	Timing
Traffic Management Plan	Prepare a more detailed Traffic Management Plan will be developed once Development Approval is obtained. This Traffic Management Plan would incorporate: - Pre construction assessments of road pavements and infrastructure (such as structural assessment of the bridge on Bagot Well Road where it crosses St Kitt's Creek) along access route to assess the required upgrading or likely rehabilitation. - Undertake further consultation with stakeholders and community - Details of noise and dust mitigation.	Prior to construction
Decommissioning	Prepare a Traffic Management Plan for the decommissioning of the development	Post economic life of the development

8.7 Communications and Television

Issue	Commitment	Timing
Telecommunication mitigation measures	Prior to construction, RES will ensure that the final turbine layout is assessed in terms of their potential impact on fixed path radio links in the locality to ensure services are not disrupted or degraded. Where necessary, the relevant communication service operator will be contacted to confirm operational details.	Before construction commences
Television Reception	RES to rectify television reception of dwellings affected by the project via one of the following options: - Realigning the householder's television antenna more directly towards their existing transmitter. - Tuning the householder's antenna into alternative sources of the same television signal or a substitute signal. - Installing a more directional and/or higher gain antenna at the affected house. - Relocating the antenna to a less affected position. - Installing cable or satellite television at the affected house.	Post construction

RES Australia Pty Ltd

Twin Creek Wind Farm

Consultation Outcomes Report

June 2017

Executive summary

RES engaged consultant GHD to prepare a Stakeholder and Community Engagement Strategy (SCES) to provide structure and rigour to communications throughout the planning phase of the Twin Creek Wind Farm Project to the lodgement of the development application.

This overarching strategy provided a framework to facilitate a more consistent approach, allowing for more proactive stakeholder and community engagement during the project development application process. The stakeholder and community engagement approach developed was designed to be dynamic and flexible so that adjustments can be made to meet the expectations of the community.

The strategy identified stakeholders, issues and risks, the approach and methodology for engaging the stakeholders and community, and then an implementation and delivery plan was completed.

The approach taken by RES for the development if Twin Creek is consistent with best practice guidelines.

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1. Project Description

1.1 Introduction

RES Australia Pty Ltd (RES Australia) proposes to develop the Twin Creek Wind Farm within the Mid North area of South Australia. The site of the proposed wind farm is approximately 90km north east of Adelaide and north east of Kapunda.

RES is one of the world's leading independent renewable energy companies, with the expertise to develop, engineer, construct, finance, and operate projects around the globe. RES Australia has been developing renewable energy projects in Australia since 2004.

1.2 Project Overview

The proposed wind farm will consist of the following components:

- Up to 51 Wind Turbines Generators (WTG)
- Each WTG has a capacity up to 3.6 Megawatts (MW), with a total installed wind capacity approximately 185MW
- Overall height of turbines would be up to 180 metres at the blade tip
- Associated hard standing areas and access roads
- Operations and maintenance building and compound with associated car parking
- Two electrical substations
- 50MW battery energy storage facility
- Overhead and underground electrical cable reticulation
- Overhead transmission line for approximately 15 kilometres from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro
- Meteorological masts for measuring wind speed and other climatic conditions
- Temporary construction facilities including a borrow pit and concrete batching plant facilities.

2. Project Siting / Locality Description

RES Australia proposes to develop the Twin Creek Wind Farm within the Mid North area of South Australia. The site of the proposed wind farm is approximately 90km north east of Adelaide and 11km north east of Kapunda. The proposed development is located between the townships of Kapunda, Eudunda and Truro.

The site is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges.

Landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features.

Surrounding the site of the proposed development, the landscape is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs in the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse with areas of arable cropping and grazing.

3. Introduction

RES has engaged consultant GHD to prepare a Stakeholder and Community Engagement Strategy (SCES) to provide structure and rigour to communications throughout the planning phase of the Twin Creek Wind Farm Project to the lodgement of the development application.

This overarching strategy provides a framework to facilitate a more consistent approach, allowing for more proactive stakeholder and community engagement during the project development application process. The stakeholder and community engagement approach developed was designed to be dynamic and flexible so that adjustments can be made to meet the expectations of the community.

The strategy identified stakeholders, issues and risks, the approach and methodology for engaging the stakeholders and community, and then an implementation and delivery plan was completed.

3.1 Guidelines for best practice

To ensure best practice, the project was guided by the industry standard for stakeholder engagement – the International Association for Public Participation (IAP2) core values. This framework is presented in Figure 1. Generally, the engagement activities delivered during the approvals phase of the project are seeking to achieve a 'Consult' level of engagement.

However, different activities and scenarios as the project progresses may provide the opportunity for the 'Involve' level of engagement and others will be undertaken at the 'Inform' level of engagement to ensure community members are made aware of project updates and any activities in a timely manner.

IAP2'S PUBLIC PARTICIPATION SPECTRUM

iap2 international association for public participation

The IAP2 Federation has developed the Spectrum to help groups define the public's role in any public participation process. The IAP2 Spectrum is quickly becoming an international standard.

INCREASING IMPACT ON THE DECISION

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision. We will seek your feedback on drafts and proposals.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will work together with you to formulate solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Figure 1 IAP2's Public Participation Spectrum

4. Overview of Communication Tools

RES is committed to developing and maintaining positive long-term relationships with its local community and other key stakeholders.

Given that there is a heightened level of community interest about wind farms, RES have undertaken an engagement approach that is personal and has focused on consultation and engagement with the landowners, the neighbours and the local communities potentially impacted. Such an approach over a period of time will enable a deeper level of stakeholder and community knowledge regarding the wind farm and greater awareness of the processes to which RES is committed in order to mitigate or manage potential impacts. Through this process greater trust between the community and the project team has been developed and RES are seeking to develop a level of tolerance and potentially acceptance for the project.

The focus of communications during the planning phase of the project has been to seek input from the community about the proposed development in particular what they value about their community, and adequately respond to and address the community's concerns in a timely manner.

Table 1 Communication Tools

Task no.	Communication Tool	Objective	Target stakeholders	Actions	Completed
1	Develop a complaint and enquiry database management system.	Assist in tracking issues, identifying trends and providing early identification of concerns. Provides a framework for monitoring enquiries	All	Develop a complaint and enquiry management system.	Yes
2	Develop a freephone community information line, project email and postal address	The 1800 number is a critical support tool for issues management	All	Widely promote on all project communication materials including advertising, website, display and stakeholder and community letters.	Yes
4	Website Feedback	Provides a direct line of communication to RES.	All	Develop a dedicated 'Have Your Say' mechanism on website.	Yes

Task no.	Communication Tool	Objective	Target stakeholders	Actions	Completed
8	Regular updates to Twin Creek website	To provide a 'one stop shop' for all project information	All	Project status Contact details via email All newly published material as it is finalised and distributed	Yes and ongoing
9	Telephone calls	To seek a face-to-face meeting and to offer a site tour to allay project concerns and build acceptance of the project.	Directly affected landowners within 2km of turbines but focus on adjoining landowners	Identify list of key neighbouring landowners.	Yes
10	Face to face meetings	To build confidence in RES project team and the approval process. To start to build partnerships with the community.	Landowners immediately adjacent to the host turbine properties. Local MPs Ministers – Planning and Infrastructure Key Stakeholder	Schedule meetings with landowners and key stakeholder and develop Q and As so that responses are prepared for each key issue. Record discussions in the contact database and follow up with responses to concerns raised that were not able to be immediately addressed.	Yes
12	Presentation / Briefing Sessions	Provide influential stakeholders with opportunity to buy-in to project content so that submission responses can be minimised.	As identified in stakeholder analysis	Design, coordinate and present presentation: Identify stakeholders and set up briefings Contact stakeholders. Tailor specific presentations.	Yes

Task no.	Communication Tool	Objective	Target stakeholders	Actions	Completed
15	Community Information Sessions	To provide information on the project, address community concerns and get community buy-in to the project	Broader community and adjoining landowners	Schedule dates, locations and times for 3 x 5 hr community information days Identify landowners and community information to invite Draft personalised letter to landowners and key stakeholders Identify most appropriate newspaper to run advertisement Draft & place advertisement in local papers Agree & approve information, maps and posters required for session. Identify & coordinate equipment and IT requirements Coordinate catering requirements.	Planning for round 2 early April 2017. Community Info Days in November 2016

5. Overview of Community Engagement Activities

5.1 Mail outs

RES made use of mail outs to inform about the investigation of a Wind Farm and also to inform and keep host, adjacent, broader and participating landowners in the loop.

5.2 Community Information Days

The following Community Information Days were scheduled and held as follows:

- Kapunda Soldiers Memorial Hall Hill Street Kapunda 27 October 2016 – 3 pm till 7 pm.
- Eudunda Hall | Bruce Street Eudunda 28 October 2016 – 3 pm till 7 pm.
- Truro Oval Complex | Railway Terrace Truro 29 October 2016 – 10 am till 2 pm.

The sessions were advertised via mail outs and/or emails to all stakeholders and landowners in the Twin Creek Wind Farm database and also advertised in the Barossa Herald and The Leader local papers on the 12th and 19th October 2016.

Consultants that attended the Community information days included;

- RES – Daniel Leahy, Project Manager; Heidi Creighton Land and Property Manager; Astrid Warner Technical Analyst and Tanya Jackson, Communications Manager.
- GHD – Birgit Porter (Community Consultation).
- Sonus – Chris Turnbull and/or Jason Turner (Noise).
- Wax - Warwick Keates and Carina Sidwell (Visual).

A wide variety of information was made available at each session including posters on the following topics:

- Who is RES?
- Project Overview
- Project Benefits
- Development Application Process
- Ecology
- Noise
- Fire Management
- Aviation
- Property Values
- Cultural Heritage
- Health
- Power Supply in SA
- Series of Visual Montages
- Visual Methodology and Impacts
- Zone of Theoretical Visual Influence

- Layout Plan

Each session was attended by between 40-60 landowners, adjoining landowners, councillors and broader community members.

Another round of three community information sessions were also held prior to lodging the Development Application. As outlined below:

- Kapunda Soldiers Memorial Hall Hill Street Kapunda Friday 7 April- 9 am till 11am
- Truro Oval Complex | Railway Terrace Truro Friday 7 April - 1 pm till 3 pm
- Eudunda Hall Friday 7 April - 5 pm to 7 pm

The sessions were advertised via mail outs and/or emails to all stakeholders and landowners in the Twin Creek Wind Farm database and also advertised in the Barossa Herald and The Leader local papers on the 29th March and 5 April 2017.

Consultants that attended the Community information days included;

- RES – Daniel Leahy, Project Manager and Tanya Jackson, Communications Manager.
- GHD – Birgit Porter (Community Consultation).
- Sonus –Jason Turner (Noise).
- Wax – Carina Sidwell (Visual).

A wide variety of information was made available at each session including an updated project layouts, updated visual montages and noise contour maps.

5.3 Local Councils

RES have been consulting with all three local Councils, which are included in the project area: Mid Murray Council, Light Regional Council and Regional Council of Goyder. Below is a summary of the meeting dates, agendas and outcomes.

Table 2 Local Council Consultation

Consultation	Date	Agenda	Follow Up	Post Mitigation Actions
Mid Murray Council				
Meeting with Greg Hill and Russell Peate to discuss preliminary project plan	26/05/2016	DAC approach discussed	None	None
Site Design and Planning approach briefing to councillors and elected members	13/09/2016	None	None	None
Traffic & transport Consultation Meeting	23/01/2017	Road Maintenance Agreement to be drafted by Light Regional and agreed	RES to consider wind farm access via Bagot Well and Camel Farm Road.	Conjoined Road Maintenance Agreement to be signed between RES, Light Regional and Goyder.

Consultation	Date	Agenda	Follow Up	Post Mitigation Actions
Community Project Open Day	29/10/2016	Various		
Light Regional Council				
Meeting with Lisa Sapio, Darby Shultz and Neil Manning to discuss preliminary project plan	27/05/2016	None	None	None
Site Design and Planning approach Briefing to councillors and elected members	27/09/2016	None	None	None
Traffic & transport Consultation Meeting	23/01/2017	Road Maintenance Agreement to be drafted by Light Regional and agreed	RES to consider wind farm access via Bagot Well and Camel Farm Road.	Conjoined Road Maintenance Agreement to be signed between RES, Light Regional and Goyder.
Community Project Open Day	27/10/2016	Various		
Regional Council of Goyder				
Meeting with John Brak to discuss preliminary project plan	27/05/2016	None	None	None
Site Design and Planning approach briefing to councillors and elected members	20/09/2016	None	None	None
Community Project Open Day	28/10/2016	Various		

5.4 Broader Community

As a result of the project letters, community information days and the project website, RES has responded to numerous emails and also had over 80 face-to-face meetings with any landowners, community members, broader residents and also anyone who had a general interest in the project. This had allowed for issues, concerns and more information regarding the project to be discussed with a member of the RES project team.

Below is a summary of individual engagement activities:

Table 3 Individual Engagement Activities

Consultation	Date	Agenda	Follow Up	Post Mitigation Actions
Local resident	19/07/2016	Email offering a project update meeting following Community Info Day	None	None
Local resident	20/07/2017	Email offering a project update meeting and discuss work completed on ecology following Community Info Day	None	None
Local resident	19/10/2016	Email expressing concerns about impact to telecommunication, magnetic fields, wildlife,	Response email	None
Adjoining neighbour	19/10/2016	Letter seeking detailed plans	Plans posted 24th October 2016	None
Local Resident	24/10/2016	Email seeking detailed plans	Provided Mast Wind Data, Project drawings and reviewed Waterloo Wind Farm.	
Meeting with adjoining neighbour		Questions of wind farms in general.	None	None
Meeting with adjoining neighbour	Jan 2017	Questions of wind farms in general.	Send through completed reports when finished.	None
Meeting with adjoining neighbour	Dec 2016	Seeking turbines to be moved further away from land boundaries.	Turbine layout re-design	Relocation of T44, T41 and T40 to address concerns from a neighbour regarding turbine distance to property boundary
Meeting with adjoining neighbour	Jan 2017	No concerns – supportive off development.	None	None

Consultation	Date	Agenda	Follow Up	Post Mitigation Actions
Meeting with landowner (7km landowners)	Dec 2016	Questions about wind farm in general and concern particularly over most southerly turbines.	Turbine layout re-design	Relocation of T2 to address concerns raised from a neighbour regarding view from property
Meeting with adjoining neighbour	Dec 2016	Seeking turbines to be moved further away from land boundaries	Turbine layout re-design	Relocation of T8 to address concerns raised from a neighbour regarding turbine distance to property boundary
Numerous emails, phonecalls, letters	Dec 2016 – June 2017	Questions about viewpoints, background noise surveys, ecology, job opportunities,	Ensure consultant team is aware of requests and include in their assessments where appropriate	Contact businesses and individuals seeking employment prior to construction commencement.

5.5 Agency Consultation

The following table provides an overview of the consultation undertaken with various statutory authorities, regional and state organisations.

Table 4 Agency Consultation

Consultation	Date	Agenda	Follow Up	Post Mitigation Actions
EMI				
Various – led by DNVGL, but includes SA Water, Flow FM.	October 2016- March 20 17			
Ecology				
Ecology – led by EBS, but includes Dept of Environment & Energy, Department of Environment Water & Natural Resources, Flinders University.		Pigmy Blue Tongue Lizard Impact Mitigation	Complete Infrastructure Review	Deletion and or relocation of 11 turbines and access tracks. Re-design of site entrance road.
Cultural Heritage				

Consultation	Date	Agenda	Follow Up	Post Mitigation Actions
Ngadjuri & Native title SA		Walkover survey to be completed	Stage 1 walkover survey is completed, Stage 2 will be undertaken after cultural heritage agreement execution	Sign Agreement with Ngadjuri
Access, Traffic and Transport				
Department of Planning Transport and Infrastructure	Jan-Mar 16			

5.6 Communication Collateral

5.6.1 Website

RES have designed a website where all information regarding the proposed Twin Creek Wind Farm project can be found. Information includes the location and design of the project . There is also an enquiry system to allow for members of the community and or public to get in touch with the project team.

http://www.twincreek-windfarm.com/

6. Amendments to Layout

As a result of the consultation and engagement there has been the relocation of 5 turbines in direct response to concerns raised.

The following turbines have been relocated since the Community Information Day:

- Relocation of T44, T41 and T40 to address concerns from an adjoining neighbour regarding turbine distance to property boundary.
- Relocation of T2 to address concerns raised from an adjoining neighbour regarding view from property.

Relocation of T8 to address concerns raised from an adjoining neighbour regarding turbine distance to property boundary.

Appendices

Appendix A – Advertisements from Local Paper

TWIN CREEK WIND FARM

Proposed Twin Creek Wind Farm

RES is looking into the potential of constructing Twin Creek Wind Farm and is holding a series of Community Information Sessions:

Kapunda Soldiers Memorial Hall
Hill Street Kapunda
7 April 2017 - 9 am till 11 am

Truro Oval Complex | Railway Terrace Truro
7 April 2017 - 1 pm till 3 pm

Eudunda Hall | Bruce Street Eudunda
7 April 2017 - 5 pm till 7 pm

The Project Team and key project consultants will be in attendance to provide an overview on the proposed wind farm and answers to any queries you may have on the project.

For more information, please visit the project website www.twincreek-windfarm.com or contact the Project Team on 1800 841 178 or email info@twincreek-windfarm.com

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Appendix B – Posters from Community Open Day

TWIN CREEK WIND FARM

WHO IS RES?

RES Australia has been at the forefront of renewables for two decades.

RES was established in Australia in 2004. Since then we have developed a pipeline of wind farm projects in Australia and New Zealand.

Our recent Australian projects include Taralga Wind Farm in NSW and Ararat Wind Farm in Victoria.

Our highly experienced energy team is based in Sydney, and includes specialists in developing, engineering, constructing and connecting renewable energy projects. We have all the commercial and financial expertise needed to take utlity scale renewable energy projects from planning to completion.

We also use specialist staff from other areas of RES when we need to - such as turbine procurement, measurement services, technical analysis and asset management.

In-depth knowledge of the grid and regulatory expertise have helped us diversify.

Our projects now cover onshore and offshore wind, solar and transmission - and we're investigating efficient locally generated energy solutions, such as energy storage and demand side management. The latter uses state-of-the-art technology to control electrical equipment in seconds to create a plentiful and flexible energy capacity.

TWIN CREEK WIND FARM

PROJECT OVERVIEW

RES Australia are investigating the possibility of developing the Twin Creek Wind Farm located around 90km north east of Adelaide, north east of Kapunda, in the Mid North area of South Australia.

The site is called 'Twin Creek' and RES is developing the project.

RES Australia has commissioned a comprehensive suite of environmental surveys and is undertaking extensive community consultation to assess the viability of constructing a wind farm.

The project includes:

- Approximately 50 wind turbines (up to 180m in height), with associated hardstanding areas and access roads.
- The turbines will be rated at approximately 3.5MW each, bringing the total installed wind capacity up to around 175MW.
- Operations and maintenance building with associated car parking.
- An electrical substation.
- Overhead and underground electrical cable reticulation.
- Meteorological masts for measuring wind speed and other climatic conditions.
- Temporary construction facilities including a site quarry and concrete batching plant facilities.

TWIN CREEK WIND FARM

PROJECT BENEFITS

Employment

The project will generate:

- Around 160 jobs during construction.
- Around 130 indirect supply chain jobs.
- Around 8 full time jobs during the operation and maintenance phase.
- Around 20 medium term contract jobs during any major maintenance activities.

Community

Twin Creek has committed to establishing a community fund once the project is operational:

- To the value of $50,000 (increased annually with CPI) paid for approximately 25 years.
- Providing ongoing funding to support local projects, community groups and organisations.

Environmental

The project will provide:

- Minimal impact on the productivity of traditional farming activities.
- Ability for land to be rehabilitated to its original condition at the end of the project.
- Smaller environmental footprint than comparative forms of generation.
- Additional fire breaks and improved access roads for firefighting.
- Enough clean renewable energy to power approximately 118,000 South Australia homes.
- Additional energy supplies to help meet the growing demands in South Australia.

Contributing to Climate Change Policy Targets

The Twin Creek project will contribute to the following targets if constructed:

- The South Australian Government objective to produce at least 50% of the State's electricity from renewable sources by 2025.
- The Federal Government objective to achieve an additional 33GW of electricity from renewable sources by 2020 under the Renewable Energy Target or RET.
- The COP21, (2015 Paris Climate Conference), achieved a legally binding and universal agreement on climate, with the aim of keeping global warming below 2°C, chiefly by reducing greenhouse gas emissions.

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TWIN CREEK WIND FARM

DEVELOPMENT APPLICATION PROCESS

STATE COORDINATOR GENERAL - DEVELOPMENT ASSESSMENT COMMISSION

Initiation Meeting
with State Coordinator General (CoG)

↓

Details of proposal lodged with CoG
(September 2016)

↓

Pre-lodgement Panel process
including initial liason with each
Light Regional Council, Regional Council of Goyder
and Mid Murray Council

↓

Is the project
of ***State economic significance?***

→ YES →

Coordinator General
will call in the application and the Development Assessment Commision (DAC) will be the planning authority

→

RES Australia
lodges development application
with DAC
(early 2017)

↓

Development Assessment Commision
(DAC) processes the application

↓

Application referred to:
- Light Regional Council
- Regional Council of Goyder
- Mid Murray Council
for consideration and comment.

Each council has to provide a report to DAC.

Notification of application
to adjoining owners and occupiers (Category 2). Comments to be made to DAC in 10 business days

Application referred to government agencies, which may include:
- EPA
- DEWNR
- Commisioner of Highways
- CFS

Each agency has between 4-6 weeks to provide a report to DAC.

↓

Development Assessment Commission
- hold hearing of representors
- determines the application

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TWIN CREEK WIND FARM

ECOLOGY

Flora and Fauna Surveys

EBS has conducted numerous surveys across the four seasons, to gain a thorough understanding of seasonal variation between species which may potentially utilise the project area.

These covered summer, autumn, winter and spring and are summarised as the following:

- A spring flora and fauna survey was conducted from the 8th – 11th September 2015; this included a general assessment and condition rating of the vegetation within infrastructure zone, as well as a bird, bat and Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) assessment.
- An additional one-day survey was completed on the 8th October to assess whether the Lomandra Grasslands mapped within the project area, qualified as the threatened ecological community.
- A summer (3-5 February 2016), autumn (18-20 April 2016) and winter (26-28 August 2016) bird survey was conducted; these surveys revisited the point count sites that were established during the spring 2015 survey.
- A two week targeted Pygmy Blue-tongue Lizard (PBTL) survey was undertaken between 22nd February and 4th of March 2016.
- AnaBat surveys were repeated during the PBTL survey to collect further data on bats.
- An additional three day PBTL survey was also conducted (5th, 8th and 14th April 2016) to investigate additional routes within areas of likely habitat for the presence of PBTL. This was aimed at further assisting with the refinement of the infrastructure layout and design.

EBS's findings describes the ecological assets and constraints associated with the Twin Creek WF design pre October 2016. As of 9 October 2016 the WF infrastructure design has changed, the design now goes into new areas that have yet to be assessed and would require micro-siting for vegetation attributes, PBTL targeted assessment and other ecological issues. Changes to locations of the infrastructure design now include changes to WTG locations, infrastructure zone and an offsite overhead transmission line to the terminal substation.

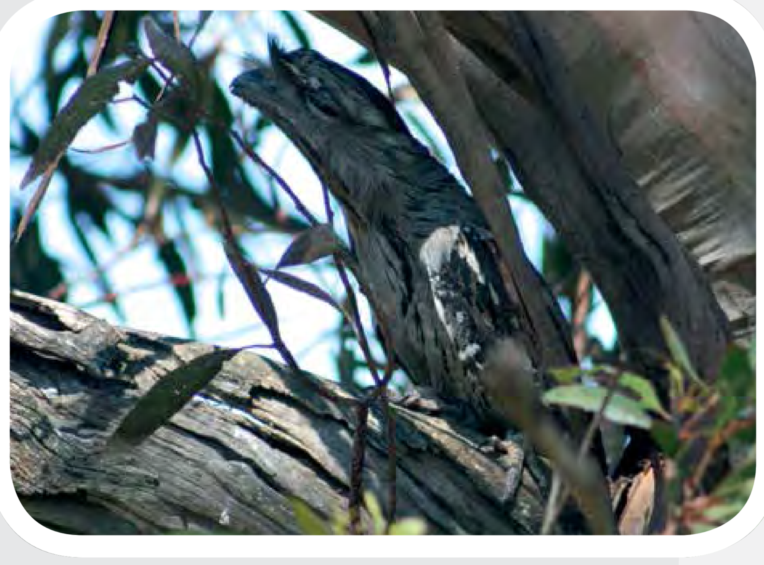
Flora Assessment

Eight vegetation associations were recorded, with a SEB condition range of 0:1 to 6:1. Two nationally threatened ecological communities, listed under the *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999 were investigated:

- Iron-grass (*Lomandra spp*). Natural Temperate Grassland of South Australia.
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

Neither the Lomandra Grasslands, nor the Peppermint Box Grass Woodland qualified as a threatened ecological community.

In total, 79 flora species were recorded during the 2015 field survey, including 28 exotic species. No flora species of national or state conservation significance were recorded. Out of the 28 weed species recorded during the 2015 field survey, six were classified as declared under the *Natural Resources Management Act 2004* (NRM Act), and eight as environmental weed species.



Fauna Assessment

Out of the fauna surveys completed on site, one reptile species and two bird species were of national or state conservation significance:

- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*) nationally endangered.
- Rainbow Bee-eater (*Merops ornatus*) nationally migratory.
- Blue-winged Parrot (*Neophema chrysostoma*) State vulnerable.

Pygmy Blue-tongue Lizards were detected within the Twin Creek Wind Farm project area during the original flora and fauna survey, which triggered the need for follow up targeted PBTL surveys. No nationally vulnerable Flinders Ranges Worm-lizards (*Aprasia pseudopulchella*) or State rare Peregrine Falcons (*Falco peregrinus*) were observed during field studies.

Three Wedge-tailed Eagle nests we rerecorded within a *Eucalyptus leucoxylon ssp.* woodland area situated just outside of the project area, with one recorded as active during the winter/spring field studies. Other native fauna species that have been recorded include:

- Two amphibian sightings from two species.
- 20 reptile sightings from five species.
- 21 mammal sightings from three species (excluding bat species).
- 1364 bat echolocation calls from eight species (during the summer/autumn surveys).

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TWIN CREEK WIND FARM

NOISE

Noise Assessment

An Environmental Noise Assessment has been prepared for the Twin Creek Wind Farm to assess its potential impacts.

The assessment utilises the criteria of the South Australian EPA Wind Farms Environmental Noise Guidelines 2009 (the EPA Guidelines) to assess operational noise. The EPA Guidelines compare the predicted noise levels from the wind farm against criteria developed from measured background noise levels to ensure there are no adverse noise impacts on the amenity of the surrounding community.

Based on the assessment, the noise from the proposed Twin Creek Wind Farm will achieve the environmental noise criteria established in accordance with the EPA Guidelines at all dwellings.

The assessment of operational noise from the proposed Twin Creek Wind Farm will be repeated during the procurement stage to demonstrate that the final turbine selection and final layout following "micro-siting" will achieve compliance with the EPA Guidelines.

The steps in the assessment comprise:

1. Collation of measurement data for the background noise levels at 6 representative dwelling locations in the surrounding community.
2. Establishment of the project noise criteria based on the background noise levels and the EPA Guidelines.
3. Prediction of the noise levels using the CONCAWE noise propagation model under worst-case (highest noise level) meteorological conditions.
4. Comparison of the predicted noise levels at each residence against the relevant noise criteria to ensure compliance with the EPA Guidelines.

A noise contour showing the highest predicted noise level from the wind farm has been prepared (refer below). The contour shows the predicted noise levels at any location, the turbine locations and the nearest dwellings in the surrounding community.

Construction Noise & Vibration

The construction of a wind farm comprises activities such as road construction, civil works, excavation and hardstand construction, electrical infrastructure works and turbine erection.

These activities are similar to other construction projects in that they generally generate short term and transient noise; however, in the case of a wind farm, the construction occurs at significant separation distances. The separation distances will result in appreciable attenuation of the noise and vibration generated by the activity.

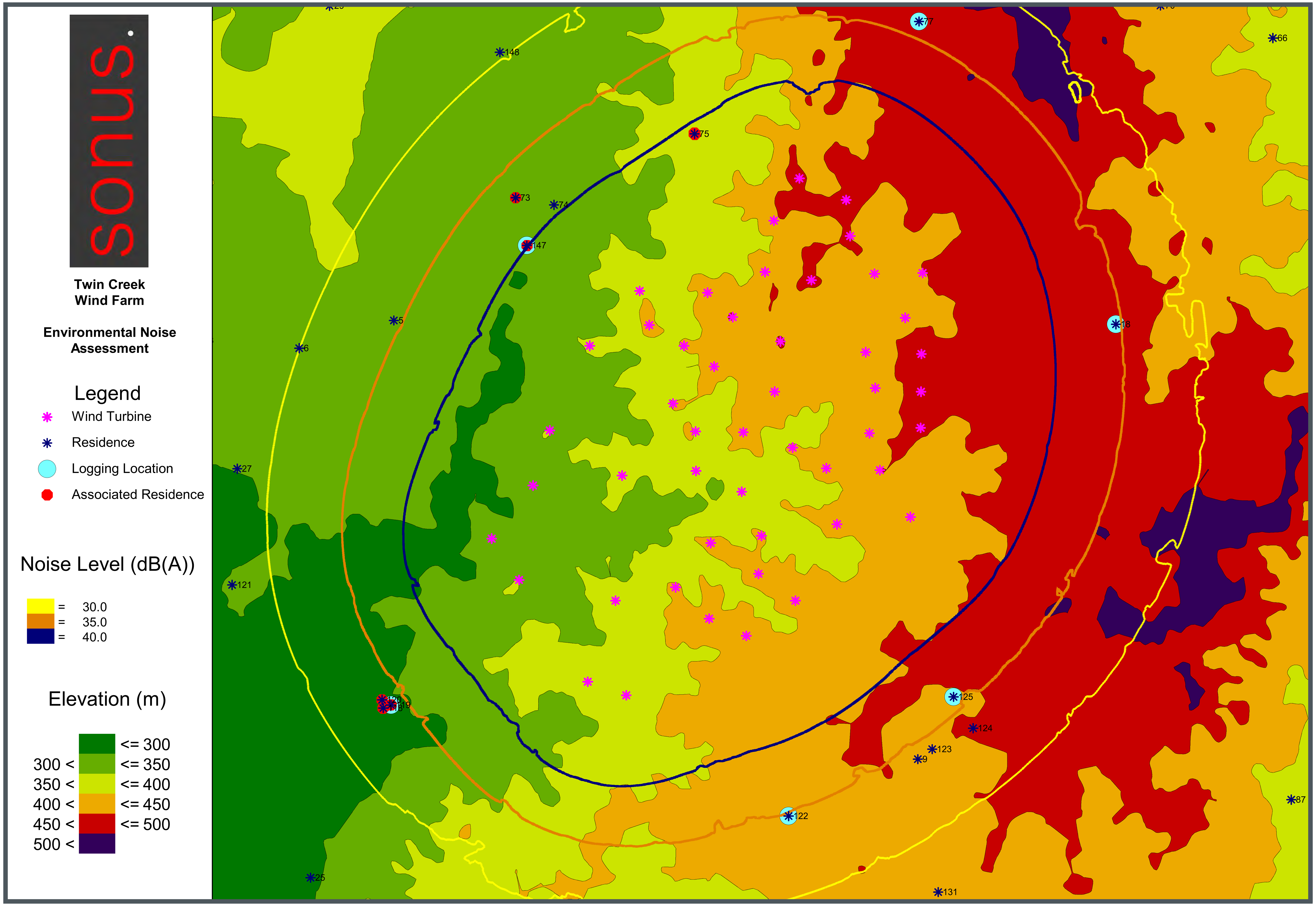
Notwithstanding, the management of construction noise requires appropriate programming, community consultation and the use of the best available and practical work practices and mitigation measures balanced against the requirement to expedite completion of the project.

Frequently Asked Questions

The most frequently asked questions regarding wind farm noise relate to low frequency noise and infrasound:

1. Early wind turbines were constructed with blades located downwind of the tower. These turbines produced significant levels of infrasound (sound below 20Hz) as a result of the wake caused by the tower. Modern wind turbines are constructed with blades upwind of the tower, resulting in infrasound levels well below the level of perception at residential setback distances.
2. Sonus has conducted studies into the level of infrasound produced by wind turbines. These studies confirm that the level of infrasound from wind turbines is no greater than the noise encountered from other natural and non-natural noise sources on a daily basis.
3. A study by the South Australian Environment Protection Authority into infrasound (Infrasound levels near wind farms and in other environments, January 2013) provided findings which were consistent with the Sonus studies, including:
   - The measured levels of infrasound from wind farms are well below the threshold of perception.
   - The measured infrasound levels around wind farms are no higher than levels measured at other locations where people live, work and sleep.
   - The characteristics of noise produced by wind farms are not unique and are common in everyday life.
4. Noise sources that produce low frequency content (such as a freight train locomotive) have dominant noise content in the frequency range between 20Hz and 200Hz. Low frequency noise is often described as a "rumble". Aerodynamic noise from a wind turbine is not dominant in the low frequency range. The main content of aerodynamic noise generated by a wind turbine is often in the area known generically as the mid-frequencies, being between 200Hz and 1000Hz.
5. Low frequency sound produced by wind farms is not unique in overall level or content. Low frequency sound can be easily measured and heard at a range of locations at levels well in excess of the level in the vicinity of a wind farm.

TWIN CREEK WIND FARM



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TWIN CREEK WIND FARM

FIRE MANAGEMENT

No bushfire has ever started as a result of a wind turbine.

(Source: CEC)

Risk of Fire

The risk of fire at wind farms is very low due to:

- Flammable elements are located high above the ground.
- Each turbine is situated next to a cleared construction pad reducing the available fuel load.
- Lightning protection devices are installed on every turbine also reducing ground strike.
- Monitoring systems installed in the WTGs detect temperature increases and will automatically slow or shut down if WTG if the temperature or wind speed exceeds an assigned threshold.

No Special Hazards

Wind farms are not considered to pose any special hazards when it comes to fighting fires from the air.

The most effective way to manage a fire is the use of ground-based resources closely integrated with aircraft when required.

Pilots view WTGs no different to other tall structures and hazards such as power lines, transmission towers, radio masts, mountains and valleys. Wind farms are just another piece of infrastructure in the environment that needs to be managed on a risk basis when fighting fires.

Wind turbines are not expected to pose increase risks due to wind turbulence or moving blades.
Local wind speeds and direction are already variable across landscapes affected by turbulence from ridge lines, tall trees and buildings. Pilots fly by sight and will not fly into smoke. Wind turbines if not covered by smoke are easily visible in the environment.

The Australasian Fire and Emergency Services Council (AFAC) position paper on Wind Farms and Bushfire Operations concluded that "wind turbines are not expected to pose increased risks due to wind turbulence or the moving blades. Local wind speeds and direction are already highly variable across landscapes affected by turbulence from ridge lines, tall trees and buildings."

Twin Creek Bushfire Risk Management

SA Bushfire Solutions has undertaken a detailed review of the Twin Creek Wind farm project and provided recommendations for the development, construction and operational project phases. In addition the CFS have been consulted to ensure that a robust bushfire risk management plan can be developed.

The Twin Creek wind farm is situated on ridgelines which are presently largely inaccessible to ground fire crews. The project includes roads between turbines built to a very high standard, which will dramatically increase the ability of ground fire crews to access the ridgeline if required. The roads also act as a fire break. Here is a recent examples of wind farm roads stopping the advance of bushfires.

TWIN CREEK WIND FARM

AVIATION

The Project will not impact any existing Obstacle Limitations Surfaces (OLS), Procedures for Air Navigation Services – Operations (PANS-OPS) surfaces, LSALTS for Air routes and grid in the area, any civil or military air space or the operation of any CNS facilities. Obstacle lighting is not required for the Project.

The proposed Twin Creek Wind Farm is not a hazard to aircraft safety and does not:

- Interfere with any military or civil airspace procedures.
- Impact on the operation of any military or civil communications, navigation or surveillance facilities.
- Require aviation obstructing lighting.

There are no military, certified or registered aerodromes within 56 km) of the proposed wind farm and the nearest aerodrome is the Edinburgh Military base which is 57km south west of the site.

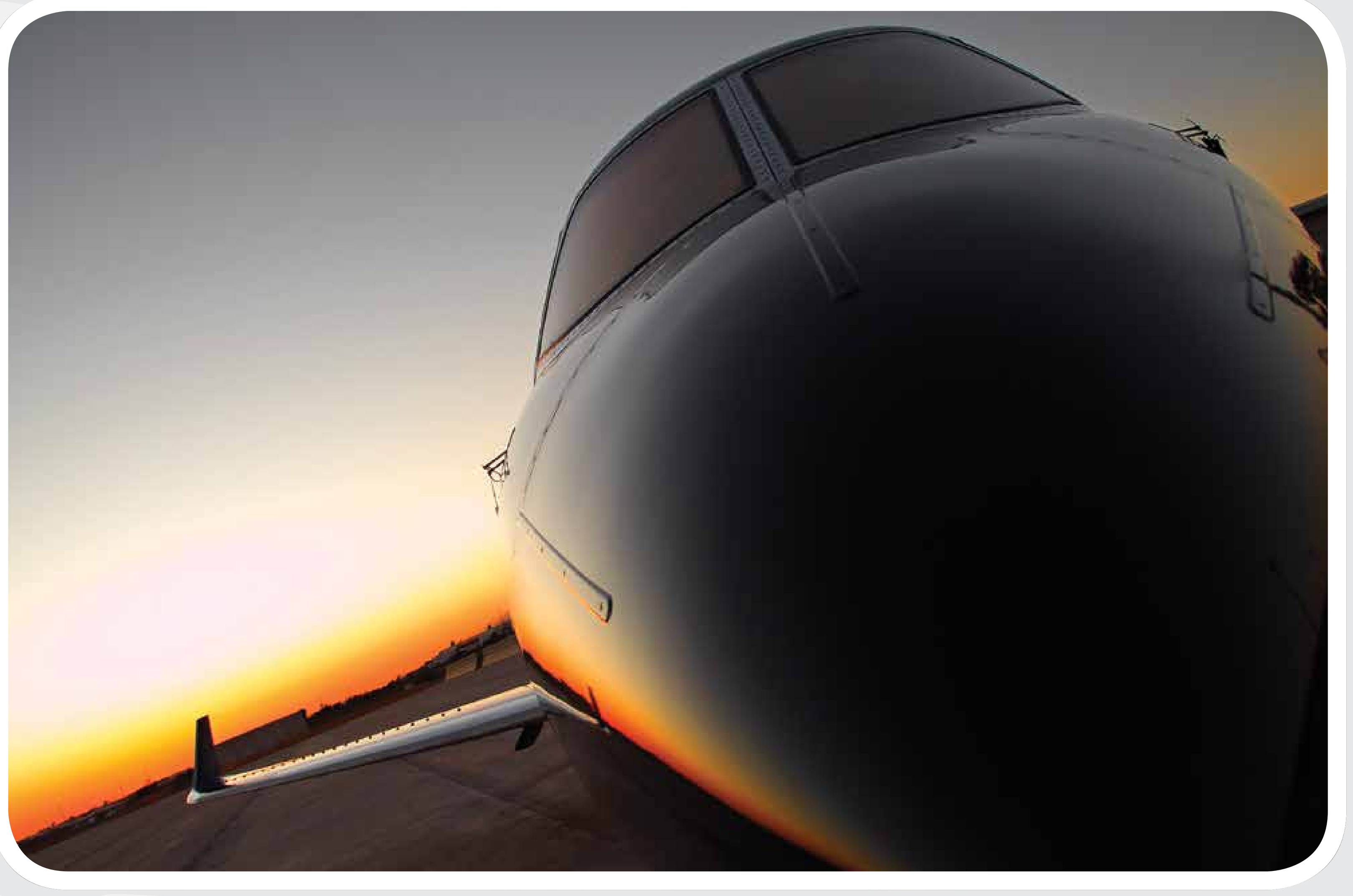
WTG locations and heights will be provided to emergency services and local and regional aircraft operators for inclusion in databases and navigational charts of the area.

Meteorological Monitoring Masts

Meteorological Monitoring Masts are installed to measure wind speed and direction and performance before and after construction.

There will be 2 permanent wind monitoring masts installed as part of the project. These masts will have aviation markings.

The location and height of the Meteorological Monitoring Masts at the Twin Creek Wind Farm site will be communicated through the RAAF 'tall structures reporting" system.

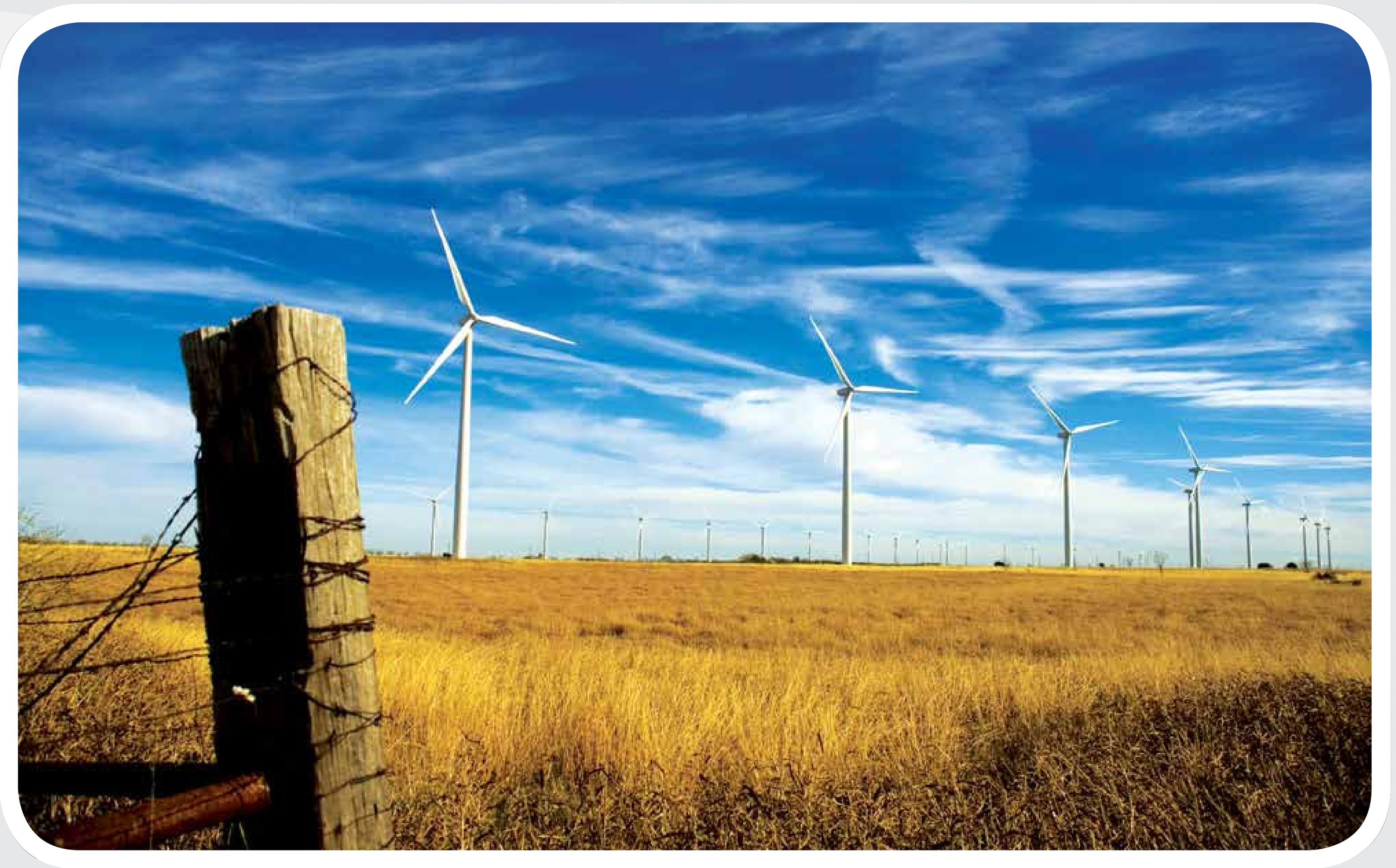


TWIN CREEK WIND FARM

PROPERTY VALUES

Wind farms Do Not Negatively Impact Property Prices

There have been multiple major studies by respected and independent organisations over the last few decades that have failed to demonstrate any correlation between wind turbines and declining property values. In fact, some of these studies found positive impacts.



No Link with Reduced Property Values

Many robust studies by independent organisations around the world have failed to find any link between wind turbines and declining property values.

A report on community acceptance of rural wind farms by the CSIRO's Science into Society found that rural landowners with wind farms on their properties stood to gain from such benefits[1].

One landowner said having a wind farm on their property could provide "a drought-proofing income stream for my property ... Few farmers in this region could survive without off-farm income".

Another said wind farms helped fund land protection: "[With] a bit of money to put turbines on my property – that won't devalue my property – we'll be able to run less animals and put less pressure on the land and look after it a whole lot better, get the biodiversity happening as it should – that's a good outcome for me."[1]

For properties without wind turbines, but in the line of sight of turbines, statistical evidence supports that property values do not perform worse than properties in comparable regions without wind turbines. In many cases, property values have actually gone up faster than values in the comparable regions.

A study conducted by the NSW Department of Lands looked at properties located near eight wind farms and found no evidence that wind turbines caused property values to drop. The report found that wind farms "Do not appear to have negatively affected property values in most cases". The report also found that "No reductions in sale price were evident for rural properties or residential properties located in nearby townships with views of the wind farm."[2]

1. CSIRO report http://www.csiro.au/Organisation-Structure/Flagships/Energy-Transformed-Flagship/Exploring-community-acceptance-of-rural-wind-farms-in-Australia.aspx, reported in Wind Energy the Facts, Clean Energy Council, March 2013.
2. NSW Department of Lands report http://www.lpi.nsw.gov.au/__data/assets/pdf_file/0018/117621/t0L51WT8.pdf reported in Wind Energy the Facts, Clean Energy Council, March 2013.
3. Lawrence Berkeley study, United States http://eetd.lbl.gov/ea/ems/reports/lbnl-2829e.pdf, reported in Wind Energy the Facts, Clean Energy Council, March 2013.
4. Impact of the Lempster Wind Power Project on Local Residential Property Values, January 2012 http://antrim-wind.com/files/2012/05/14B_lempster_property_value_impacts_final-copy-copy.pdf reported in Wind Energy the Facts, Clean Energy Council, March 2013.
5. A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States, August 2013).

International Studies

Internationally, a decade-long study across nine different states in the US by the Lawrence Berkeley National Research Laboratory found no negative relationship between wind turbines and property values.

Internationally, a decade-long study across nine different states in the US by the Lawrence Berkeley National Research Laboratory found no negative relationship between wind turbines and property values.

The study found "Neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices."[3]

The University of New Hampshire's research on the Impact of the Lempster Wind Power Project on Local Residential Property Values from January 2012 found no evidence that the project had an impact on property values in the region. The study also said "This is consistent with the near unanimous findings of other studies – based their analysis on arms-length property sales transactions – that have found no conclusive evidence of widespread, statistically significant changes in property values resulting from wind power projects."[4]

A recent comprehensive study commissioned by the U.S. Department of Energy looked at over 50,000 home sales across 27 counties (including around 1,200 homes within 1 mile of a turbine) and included accounted for other contributing factors like confounding home-value and spatial dependence in the data. The study found no statistical evidence that home values near turbines were affected in the post-construction or postannouncement/ pre-construction periods[5].

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TWIN CREEK WIND FARM

CULTURAL HERITAGE

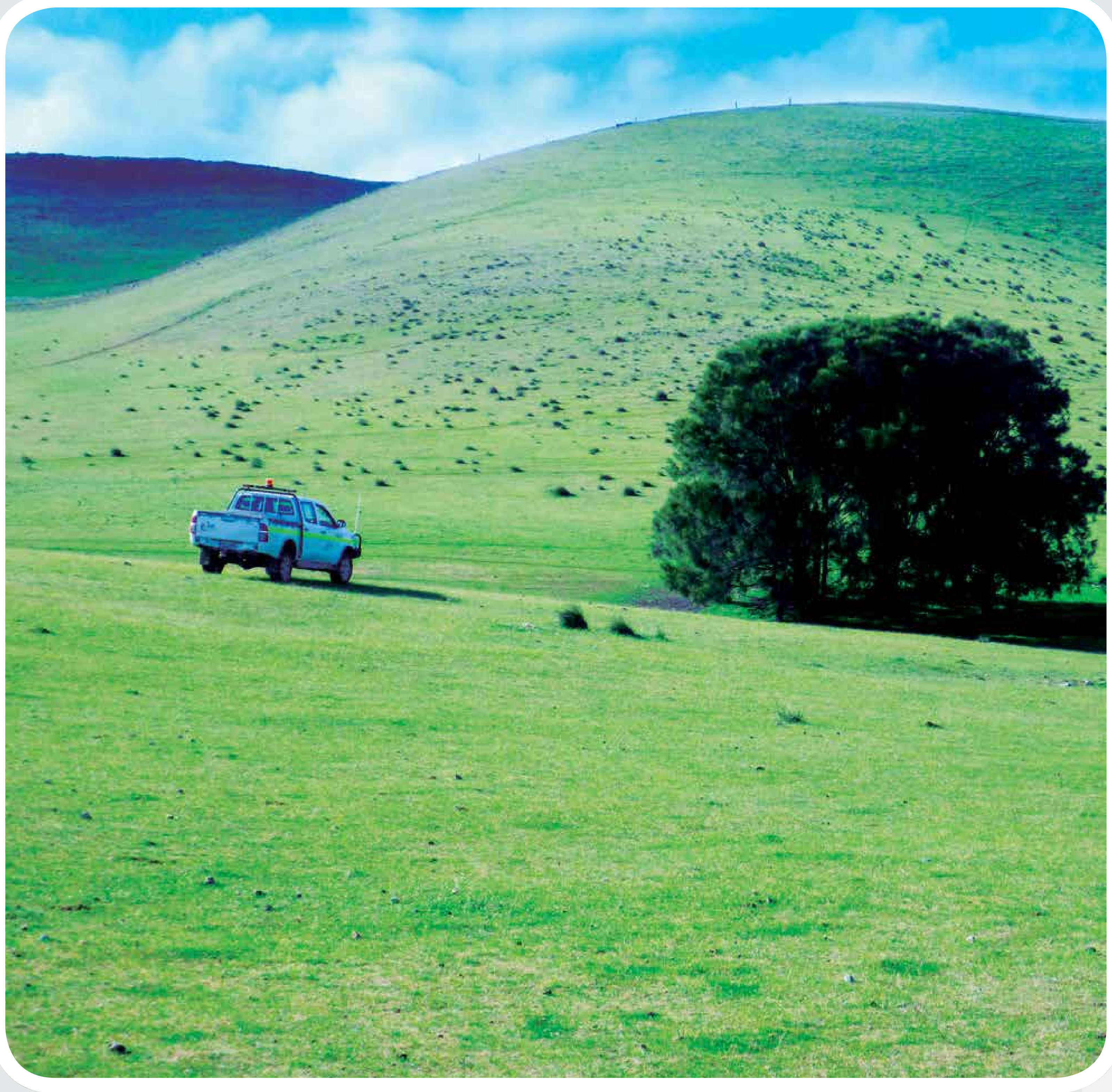
Heritage Assessment

EBS Heritage has been engaged by RES to undertake Aboriginal and European cultural heritage assessments for the Twin Creek Wind Farm.

Cultural heritage assessments are used as a risk management tool to ensure that the Twin Creek Wind Farm project meets all obligations under key South Australian heritage protection legislation in South Australia, namely the Aboriginal Heritage Act 1988 (Aboriginal Heritage), the Heritage Places Act 1999 and the Development Act 1993 (European Heritage).

Methodology

Heritage consultants work closely with the relevant Aboriginal stakeholders to conduct surveys inside the project footprint. These surveys aim to identify the presence of Aboriginal heritage sites (archaeological and ethnographic) as well as European heritage sites.



Managing the Impacts

Aboriginal Heritage

Details of recorded Aboriginal heritage sites have been provided to RES as part of a confidential report and surveys are currently being conducted with representatives from the Ngadjuri Nation to identify any new sites or areas of cultural significance that may be affected by the proposed development. As an outcome of the consultation and cultural heritage surveys, the consultants and Ngadjuri will provide RES with recommendations on how to best manage, mitigate and avoid cultural heritage sites in line with the current legislation.

European Heritage

There are no registered European heritage sites inside the current project footprint, although there are a number of unlisted heritage footings and remnant buildings dating to the early 19th into the 20th century. Where possible RES will seek to minimise their impact on European heritage in the project area.

Statement of Findings

Consultation and surveys are on-going.

TWIN CREEK WIND FARM

HEALTH

There is overwhelming scientific evidence and findings that indicate wind farms do not cause health issues.

Reviews conducted by leading health and research organisations from all over the world have found no direct link between wind farms and health effects.

National Health and Medical Research Council

The top Australian authority on health issues, the National Health and Medical Research Council (NHMRC), conducted a review into wind farms and potential health issues in 2010. The NHMRC report concluded:

"This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."

Australian Medical Association, 2014, Wind farms and health. Available https://ama.com.au/position-statement/wind-farms-and-health-2014

National Health and Medical Research Council, 2014, NHMRC Draft Information Paper: Evidence on Wind Farms and Human Health Available https://consultations.nhmrc.gov.au/public_consultations/wind_farms

Waterloo Wind Farm

The SA EPA has also recently released the results of its noise study on Energy Australia's Waterloo Wind Farm, looking at claims of non-compliance and health impacts. The study found that the wind farm was operating within its guidelines and that noise nuisance claims were not attributable to the wind farm (as they coincided with periods when the wind farm was not operating). The study concluded "there is no evidence linking the noise from the wind farm to adverse impacts on residents" and that the EPA criteria for wind farm noise are adequate to ensure wind farms will not cause health issues.

EPA South Australia, 2013, Wind farms. Available http://www.epa.sa.gov.au/environmental_info/noise/wind_farms

NSW Health Department

In 2012, the NSW Health Department provided written advice to the NSW Government that stated existing studies on wind farms and health issues had been examined and no known causal link could be established. NSW Health officials stated that fears that wind turbines make people sick are "not scientifically valid" and that the arguments mounted by anti-wind farm campaigners are unconvincing. The officials wrote that there was no evidence for "wind turbine syndrome", a collection of ailments including sleeplessness, headaches and high blood pressure that some people believe are caused by the noise of spinning blades.

Victorian Department of Health

The Victorian Department of Health released two booklets on wind farms, sound and health in May 2013, one focusing on technical information about the nature of sound and the other containing community information. The community information booklet concluded that: "The evidence indicates that sound can only affect health at sound levels that are loud enough to be easily audible. This means that if you cannot hear a sound, there is no known way that it can affect health. This is true regardless of the frequency of the sound."

A recent final approval by the Victorian Civil and Administrative Tribunal (VCAT) for Infigen Energy's Cherry Tree wind farm, has reinforced this, after an initial decision was put on hold pending the outcome of several studies, including health impact. The decision explicitly restated advice from the NSW and Victorian Health Departments that there is no evidence that inaudible sounds can have direct physiological effects.

Department of Health, Victoria, 2013, Windfarms. Available http://www.health.vic.gov.au/environment/windfarms.htm

University of Sydney Study on Wind Farm Noise Complaints

A study from a University of Sydney Professor of Public Health, Simon Chapman in 2013, examined all complaints made about wind farm noise or health problems at Australia's 49 wind farms. The study found that despite there being 32,677 people who live within 5 kilometres of a wind farm, just 120 people – or one in 272 – have ever made a formal complaint, appeared in a news report or sent a complaining submission to government. The study also found that some complainants took many years to voice their first complaint, when wind farm opponents regularly warn that the ill effects can be almost instant.

This work supported the findings from the University of Auckland study that anxiety and fear about wind turbines spread by anti-wind farm groups can cause people who hear the frightening information to develop symptoms. Discussion within communities about the alleged health effects of wind farms may trigger the very symptoms about which residents are concerned. If this is the case, media coverage of the wind farm debate must be balanced, so that undue emphasis is not placed on purported health risk.

University of Sydney, 2013, Spatio-temporal differences in the history of health and noise complaints about Australian wind farms:evidence for the psychogenic "communicated disease" hypothesis. Available http://ses.library.usyd.edu.au/handle/2123/8977

TWIN CREEK WIND FARM

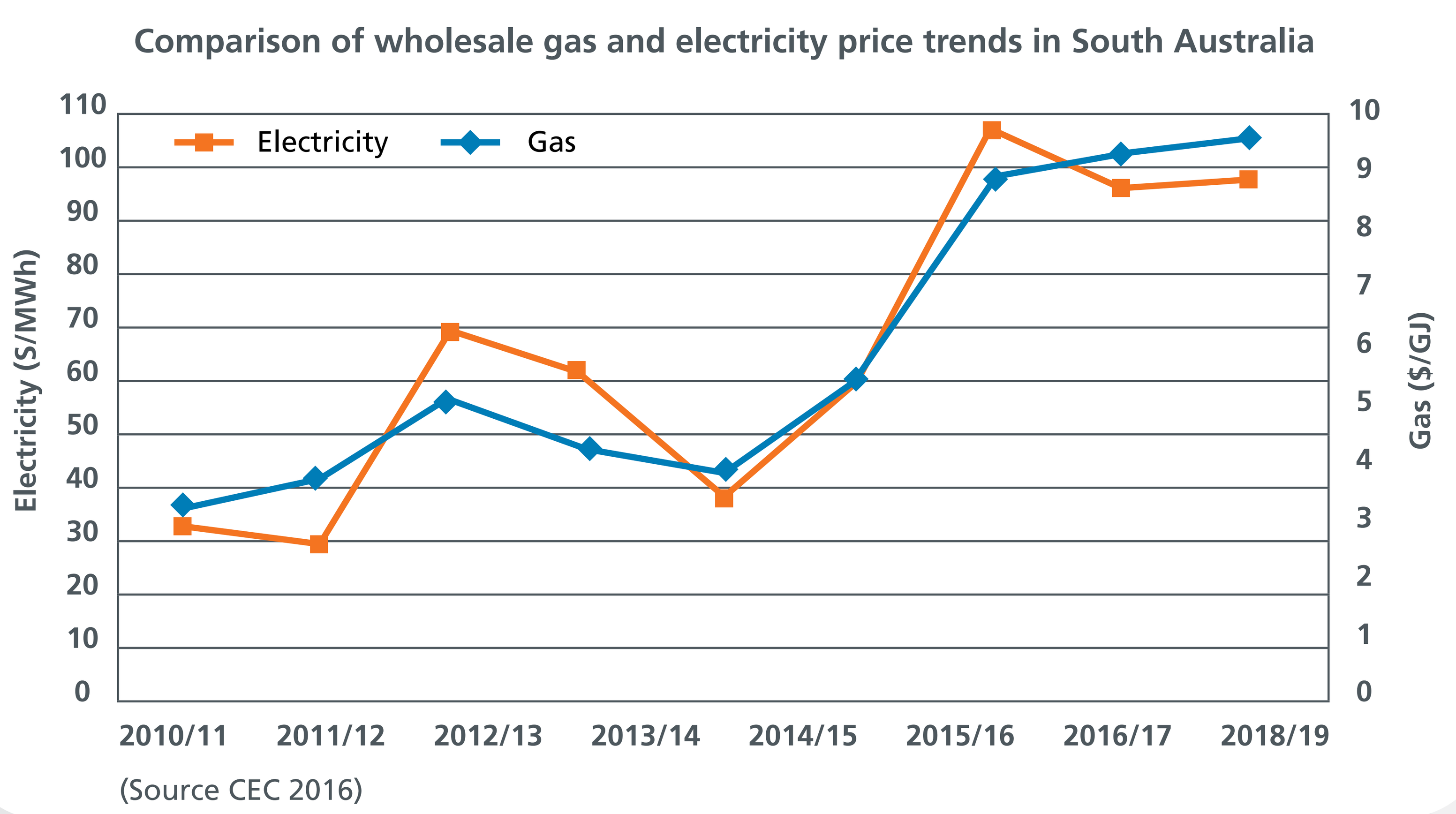
POWER SUPPLY IN SOUTH AUSTRALIA

A State without Power – so what caused the recent blackouts?

- A one in fifty year storm brought high winds and lighting to the State on Wednesday 28th September. The storm took out 23 high voltage power poles in five different locations, taking three of the big four transmission lines offline that carry electricity to and from the north of the state, sparking a state-wide outage and its isolation from Victoria. Due to a number of system faults - no generators were able to 'ride through' the faults – and as such automatic safety systems shut down the power and SA went into blackout (Source: AEMO).
- South Australia has more than enough gas capacity to meet any demand situation, but on September 28 most of it was either not running, not available, or it failed – particularly when highly paid services were called in to action to restart the grid (Source: Reneweconomy).

  (Photo: courtesy of Reneweconomy)

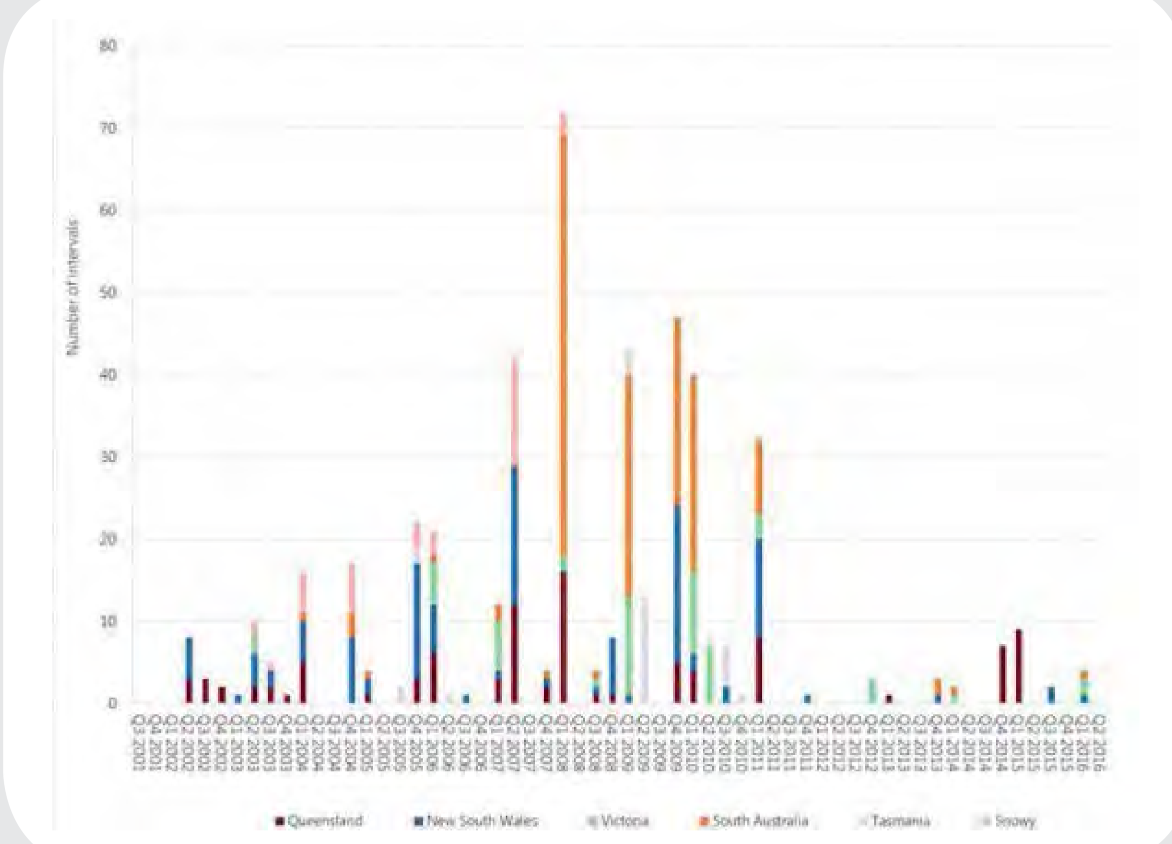
Historic and Future Wholesale Gas and Power Prices in South Australia



(Source CEC 2016)

The Facts - Why are power prices high in SA?

- SA is heavily dependent on gas generators to generate the State's electricity. The wholesale power price in SA closely linked to gas price and increasing LNG exports are tightening gas supplies, which in turn are driving South Australian wholesale electricity prices upwards (see CEC graph below).
- The wholesale energy market has a 30 minute financial settlement period – calculated by the average of the previous six 5 minute periods. Gas generators are able to manipulate the market by withholding generation, causing the price to spike. For example according to the Australian Energy Regulator, a price spike to $14,000/MWh occurred just after 11.35pm on Monday, September 5, when demand jumped 212MW as the grid operator switched on all the electric hot water systems under its controlled load operations. Apparently, gas generation was "not available" and the price jumped to $14,000/MWh. Within five minutes all the "unavailable" gas generation suddenly became "available" – this created a stampede of offers from generators that had been "unavailable" just 5 minutes earlier (as the generators were guaranteed a minimum payment of $2,600/MWh during the 30 minute period) and the price fell immediately to $44/MWh. The manipulation of gas generators in this way is not against the rules and the distributed energy industry (i.e. energy storage providers) are calling for 5 minute settlement periods to prevent this market manipulation.
- The Murdoch media continues to blame SA's electricity prices on renewable energy, however large price spikes in electricity prices were common-place before the wind and solar industry came into the Australian electricity market. Large price spikes occurred nearly once every second day in summer months, when market operators had to turn to expensive gas generation to meet surges in demand. Most of those daytime peaks have disappeared now. The graph below shows the number of high price events above $5,000/MWh.



(Source: Reneweconomy)

- Wind farms often bid negative wholesale pricing - forcing out coal and gas that has a minimum fuel cost and cannot compete. Renewable energy therefore increases competition in the SA wholesale power market, and in any market, greater completion means lower prices.

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WIND | SOLAR | STORAGE | TRANSMISSION | DSM

TWIN CREEK WIND FARM

METHODOLOGY

Landscape and Visual Impact Assessment (LVIA)

The aim of the LVIA methodology is to provide an objective and measurable analysis of the potential visual impact when considered against the existing landscape character.

The approach used for the LVIA is based on two assessment stages.

Stage 1

Landscape character assessment is concerned with identifying and assessing the importance of landscape characteristics and the existing landscape quality.

Stage 2

The visual assessment aims to quantify the extent to which the development is visible as well as defining the degree of visual change and the associated visual impacts.

The completed landscape character assessment and visual impact assessment are used to draw a number of conclusions about the significance of the visual impacts of the Project in the landscape.

Landscape and Visual Impact Assessment (LVIA)

- Desktop Studies
- Site Visits
- **Stage 1:** Landscape Character Assessment
- Preliminary Photomontage Production
- Community Open Days
- Final Viewpoint Assessment
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  Cumulative Visual Assessment
  Design Review and Visual Management
  Planning Review

TWIN CREEK WIND FARM

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TWIN CREEK WIND FARM

VISUAL IMPACT

Visual Impact

A landscape character and visual impact assessment is currently being undertaken to identify the potential impact of the Twin Creek Wind Farm. The assessment will aim to evaluate the existing landscape character and the degree of visual change that will be produced by the wind farm and associated infrastructure.

The potential visual impact will be assessed through a detailed methodology which includes on-site assessments, consultation with the community regarding landscape values, and the preparation of photo montages anticipating the visual effect of the Twin Creek Wind Farm.

What will the wind farm look like?

The nature and size of wind turbines mean that some visual impacts will be unavoidable. However every effort will be made through location and orientation of the turbines to minimise the adverse visual effect of them on major public vantage points.

The typical off white / grey turbine colours will assist in minimising visual impacts against the sky backdrop.

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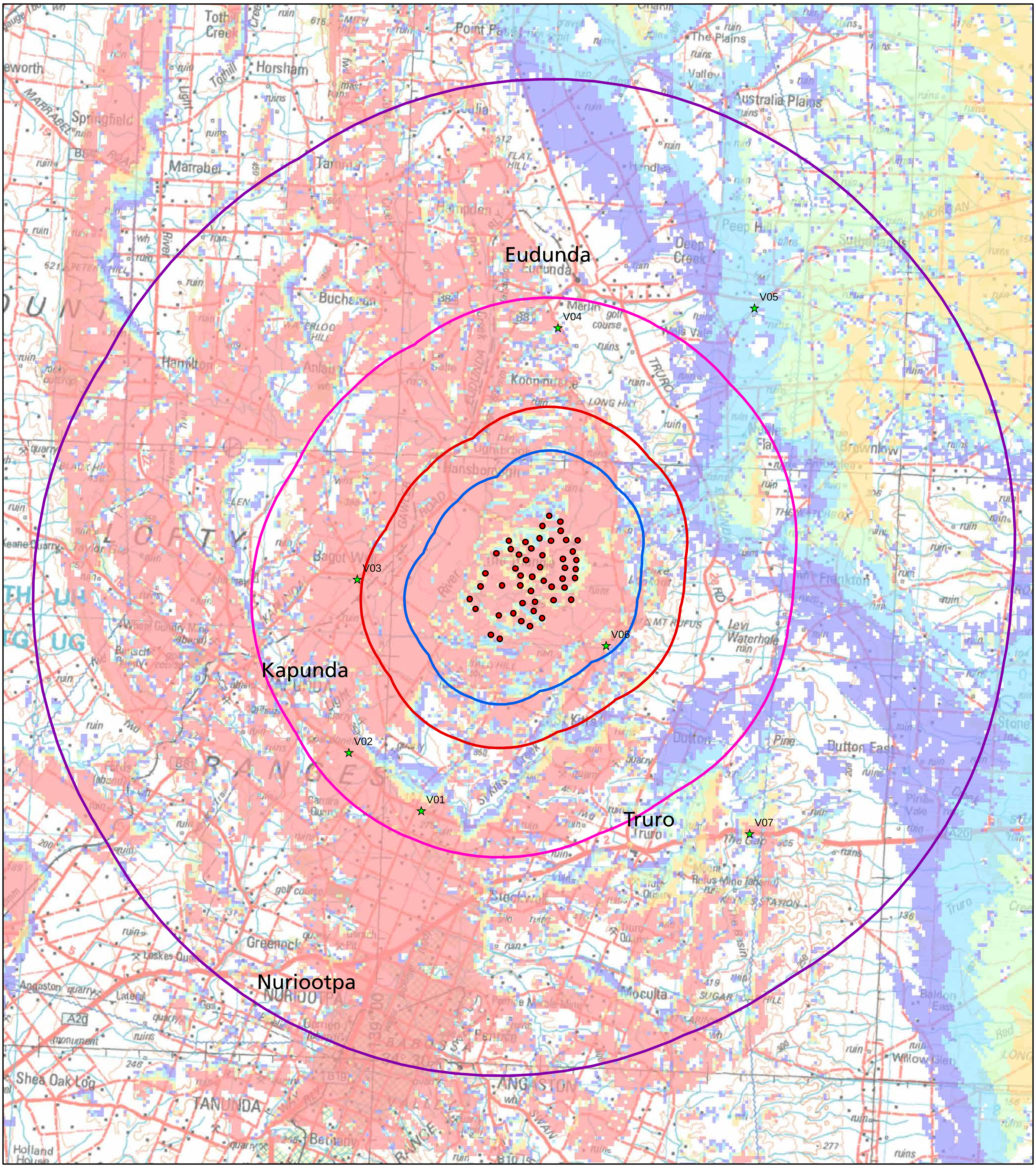
WIND SOLAR STORAGE TRANSMISSION DSM

TWIN CREEK WIND FARM

ZONE OF THEORETICAL VISUAL INFLUENCE



Legend

- Turbine layout_PAUStwc017
- Viewpoints_WAX_20160805
- Buffer 3km
- Buffer 5km
- Buffer 10km
- Buffer 20km

No. Turbines Visible

- 1 - 11
- 12 - 20
- 21 - 30
- 31 - 39
- 40 - 49

Zone of Theoretical Visual Influence_Tip of Blade (180m)

ZTVI represents 'worst case scenario' it is based on 10m contour data and does not take into account vegetation or built form screening or localised ridgelines

5km

October 2016

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TWIN CREEK WIND FARM

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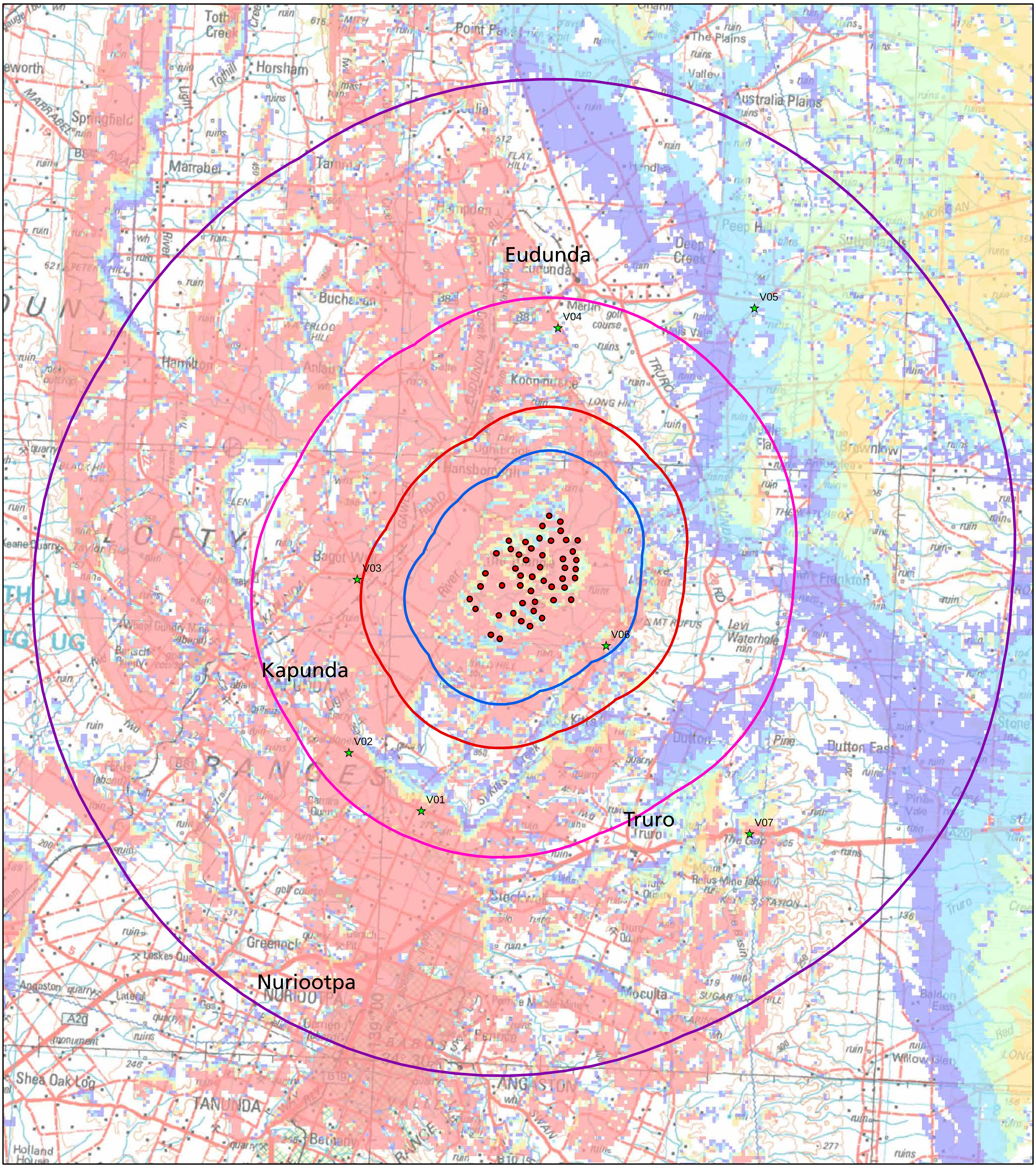

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft 0	B Porter					

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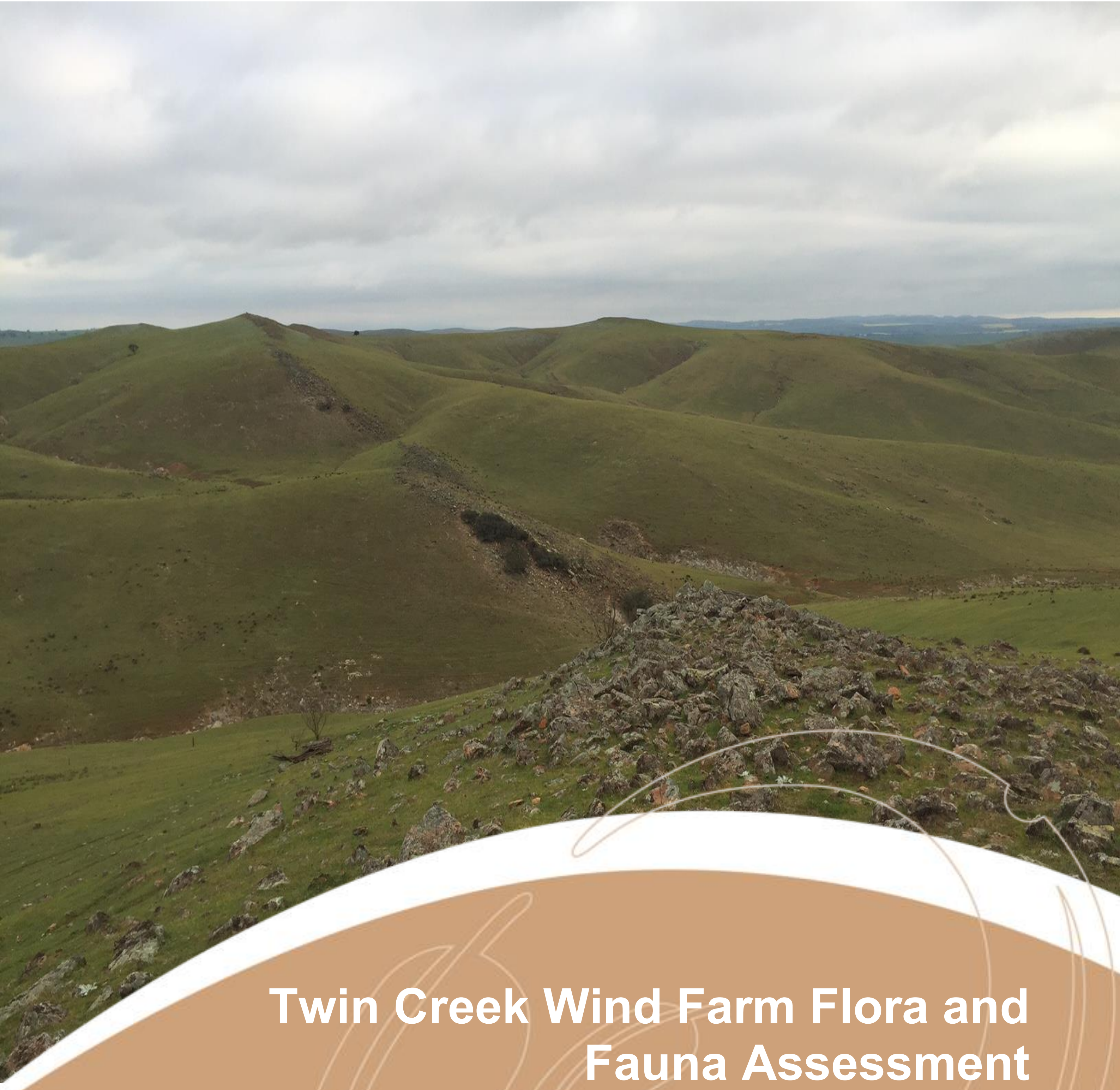

Twin Creek Wind Farm Flora and Fauna Assessment

Twin Creek Wind Farm Flora and Fauna Assessment

28 June 2017

Version 6

Prepared by EBS Ecology for RES

Document Control					
Revision No.	Date issued	Authors	Reviewed by	Date Reviewed	Revision type
1	06/11/2015	EBS	EBS	05/11/2015	Draft
2	03/05/2016	EBS	EBS	02/05/2016	Draft
3	18/04/2017	EBS	EBS	12/04/2017	Final
4	24/04/2017	EBS	EBS	24/04/2017	Final
5	22/06/2017	EBS	EBS	21/06/2017	Final
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EBS Ecology Project Number: G40902

CITATION: EBS Ecology (2017) Twin Creek Wind Farm Flora and Fauna Assessment . Report to RES. EBS Ecology, Adelaide.

Cover photograph: Northern extent of the proposed wind farm looking south along one of the ridgelines.

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GLOSSARY AND ABBREVIATION OF TERMS

AML NRM	Adelaide and Mount Lofty Ranges Natural Resources Management Board
BDBSA	Biological Database of South Australia (managed by DEWNR)
DEH	Department of Environment and Heritage (now known as DEWNR)
DENR	Department of Environment and Natural Resources (now known as DEWNR)
DEWNR	Department of Environment, Water and Natural Resources
DotEE	Department of the Environment and Energy
EBS	Environmental and Biodiversity Services / EBS Ecology
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
NPW Act	*National Parks and Wildlife Act 1972*
NRM Act	*Natural Resources Management Act 2004*
PBTL	Pygmy Blue-tongue Lizard
Project boundary	Development area, Infrastructure zone and proposed grid route; also referred to as the project site
RES	RES Australia Pty Ltd
SEB	Significant Environmental Benefit
ssp.	sub-species
spp.	species (plural)
TEC	Threatened Ecological Community
TSA	Transport SA (now the Department of Transport, Energy and Infrastructure)
WTGs	Wind turbine generators

EXECUTIVE SUMMARY

EBS Ecology (EBS) was engaged by RES Australia to assess the potential flora and fauna constraints for the proposed Twin Creek Wind Farm. Investigations, findings and recommendations of EBS have informed the design, siting and layout of infrastructure for both the principal wind farm infrastructure area (wind turbine generators and associated infrastructure) as well as the transmission line (hereby referred to as the project boundary). EBS Ecology have undertaken the following surveys:

Survey type	Date	Season	Description
Flora and fauna assessment	8-11 September 2015	Spring	General assessment and condition rating of vegetation, bird, bat and PBTL assessment
Targeted Lomandra assessment	8 October 2015	Spring	Assess whether Lomandra Grasslands qualified as a TEC
Bird survey	3-5 February 2016	Summer	Revisit bird count surveys established in spring 2015
Bird survey	18-20 April 2016	Autumn	Revisit bird count surveys established in spring 2015
Bird survey	26-28 August 2016	Winter	Revisit bird count surveys established in spring 2015 and undertake nest checks
Targeted PBTL survey and Bat survey	22 Feb – 4 March 2016	Summer/Autumn	Detailed assessment of PBTL habitat and occupation across the site. Anabat survey repeated from September 2015 survey due to poor weather conditions
Additional PBTL survey	5, 8 and 14 April 2016	Autumn	Investigate additional routes within areas of likely habitat
Additional PBTL survey	31 Oct – 11 Nov 2016	Spring	Targeted areas and additional infrastructure
Additional PBTL survey	22 Nov – 25 Nov 2016	Spring	Targeted areas and additional infrastructure
Vegetation Assessment	23, 24, 29, 30 Nov and 1 Dec 2016	Summer	Vegetation assessment of additional turbine, substation and transmission line
Additional PBTL survey	6-9 December 2016	Summer	Targeted areas and additional infrastructure
Additional PBTL survey	9 Jan – 13 Jan 2017	Summer	Targeted areas and additional infrastructure
Vegetation Assessment	5 April 2017	Autumn	Vegetation assessment of 2nd substation and potential shift of transmission line easement

The online Protected Matters Search Tool was used to identify any species or ecological communities of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that may occur or may have suitable habitat within the project area. A 20 km buffer was applied to the search to incorporate the current infrastructure zone (which includes wind turbines, \substation, transmission line, access tracks and associated infrastructure, as of June 2017).

EBS recorded 11 vegetation associations within the project boundary (with a Significant Environmental Benefit (SEB) condition range of 0:1 to 6:1). The best quality vegetation was generally observed along the transmission line. These vegetation associations are described as follows:

	Vegetation association	Area	Condition
1	*Lomandra effusa* + *Austrostipa sp*. grasslands	196.2 ha	1:1-6:1
2	*Austrostipa sp*. grassland	1751.7 ha	1:1-5:1
3	Planted species	21.8 ha	0:1
4	*Eucalyptus leucoxylon +/- Eucalyptus porosa +/- Callitris gracilis* open woodland	64.7 ha	2:1-6:1
5	*Juncus spp.* (Rush) and *Juncus pallidus* (Pale rush) Sedgeland *+/- Phragmites australis* (Common Reed)	52.1 ha	3:1
6	Cropping	1388.8 ha	0:1
7	*Eucalyptus porosa+/- Eucalyptus odorata+/- Eucalyptus gracilis* open woodland	2.4 ha	4:1
8	Pasture grassland / exotic grassland	868.2 ha	0:1-1:1
9	*Eucalyptus odorata +/- Eucalyptus porosa* closed woodland over grassy understorey	6.8 ha	4:1
10	*Eucalyptus camaldulensis* ssp. *camaldulensis +/- Eucalyptus leucoxylon* Closed Tall Shrubland over *Austrostipa* sp. (Spear-grass) near creeklines	2.3 ha	6:1
11	*Eucalyptus leucoxylon* Tall Open Woodland over shrubby understorey	3.6 ha	5:1-6:1

During the spring 2015 field survey 59 native fauna species were recorded, including one reptile species and two bird species of national or state conservation significance:

- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*) nationally endangered;
- Rainbow Bee-eater (*Merops ornatus*) nationally migratory, and
- Blue-winged Parrot (*Neophema chrysostoma)* state vulnerable.

EBS recorded 1448 bird sightings of 48 species recorded via point count surveys and opportunistic observations during the spring 2015 survey. Three Wedge-tailed Eagle nests we recorded within a *Eucalyptus leucoxylon* ssp. woodland area situated just outside of the project boundary. One out of the three nests recorded was active during the September 2015 and winter 2016 survey; the August 2016 survey recorded a Wedge-tailed Eagle sitting on Nest 3 however, neither eggs nor young were discernable at the time

Other native fauna species recorded during the spring 2015 survey were:

- Two amphibian sightings from two species;
- 20 reptile sightings from five species;
- 21 mammal sightings from three species (excluding bat species); and
- 484 bat echolocation calls from seven species (September 2015). The summer/autumn bat survey (February/March 2016) resulted in 1249 bat echolocation calls from at least seven species.

EBS observed the following bird species across the four seasonal surveys within the project boundary:

- Spring 2015 survey - 1,448 individuals from 48 bird species;

- Summer 2016 survey - 1,255 individuals from 24 bird species;

- Autumn 2016 survey - 751 individuals from 30 bird species; and
- Winter 2016 survey – 743 individuals from 30 bird species.

No species of conservation significance were observed during the summer, autumn or winter 2016 surveys.

The AnaBat surveys confirmed the presence of seven bat species within the project boundary:

- White-striped Free tail-bat (*Austronomus australis*);
- Gould's Wattled Bat (*Chalinolobus gouldii*);
- Chocolate Wattled Bat (*Chalinolobus morio*);
- Southern Free tail-bat (*Mormopterus species 4 "big dick")*;
- Lesser Long-eared Bat (*Nyctophilus geoffroyi*);
- Large Forest Bat (*Vespadelus darlingtoni*); and
- Southern Forest Bat (*Vespadelus regulus*).

The bat species detected onsite are thought to be common throughout the region with the majority of bats recorded, being within the vicinity of habitat features such as woodlands and open water. None of the recorded bat species have a conservation rating.

Two nationally threatened ecological communities, listed under the EPBC Act 1999 were investigated and assessed for qualification within the project boundary. The listed ecological communities being:

- Iron-grass (*Lomandra* spp). Natural Temperate Grassland of South Australia and
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

There were 21 sites assessed within the *Lomandra* Grasslands across the project site in 2015; these were assessed to confirm whether they qualified as a nationally listed threatened ecological community. One of the sites assessed for the terminal substation (18), qualified as EPBC listed and another two sites (19 and 21) are considered likely to qualify if surveyed when more plants are in their visible life phase (early/mid spring), as they were only a few species short of qualifying. Site 20 may also possibly qualify. None of the other sites met criteria qualified as either condition A or B, and therefore, do not qualify as a threatened ecological community. Of the 21 *Lomandra* sites, 13 come under Condition class C, which are considered degraded patches amenable to rehabilitation. Five of the sites (*Lomandra* Site 2, 14, 15, 19 and 21) were within 1-3 native species of meeting the condition class B threshold. Based on survey findings, the design for the Terminal Substation was refined to avoid high value *Lomandra* Grassland and an EPBC referral should not be required for the Terminal Substation based on this design. A spring survey of the transmission line is recommended as part of the final design, in particular if any Lomandra areas (mapped by EBS) will be impacted upon by the final design.

The project boundary was assessed for any Peppermint Box that may qualify against the criteria outlined in *EPBC Act Policy Statement 3.7, Nationally Threatened Species and Ecological Communities, Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia.* A patch of Peppermint Box was identified within the principle wind farm infrastructure area, during the 2015 survey. It wasn't dominated by *Eucalyptus odorata*; it was a large mix of *E. odorata*, *E. porosa* and *E. gracilis*, and therefore did not qualify. Patches of woodland dominated by Peppermint Box were observed during late spring/early summer 2016 survey, whilst surveying additional areas including the proposed transmission line. An assessment against the criteria found them to be Class C which is not listed under the EPBC Act but is ‘amenable to rehabilitation’. However, one of the sites north of Dutton Road was only two species short of qualifying as listed under the EPBC Act. This patch may qualify if surveyed earlier in spring when more plants are in their visible life phase.

An additional survey was undertaken on 5 April 2017 to assess Peppermint Box as part of the finalisation of the transmission line, including the route ong Biele Road. From observations made, it appeared degraded and may not qualify for the EPBC listed TEC. This statement cannot be certain without adequate access and additional surveying in spring. It did not appear planted. EBS’s recommends positioning the transmission line through the cropping land where possible, rather than Peppermint Box Woodland areas. Amendments have been made to infrastructure design to avoid Site 1 (likely to qualify) and minimise impact on Site 2 (possibly qualifying). Based on the current proposal the final clearance impact in Peppermint Box Woodland is expected to be small (insignificant), fitting with minimum requirements under powerlines and should not require an EPBC referral (subject to spring survey and final design).

A total of 86 native flora species and 74 exotic flora species were recorded within the project boundary. There was no conservation rated flora species identified within vegetation assessments completed during the September 2015 and November 2016 surveys within the proposed Twin Creek Wind Farm project boundary.

The habitats present within the project boundary were assessed for the nationally endangered Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) and nationally vulnerable Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*). Other than these two species, none of the reptile species recorded within the project boundary have a conservation rating and can be classed as common in suitable habitats.

The Flinders Worm-lizard is endemic to South Australia but were not detected during the September spring 2015 survey.

EBS undertook targeted Pygmy Blue-tongue Lizard (PBTL) surveys during the 22 February – 4 March 2016 survey and again in April 2016 (5th, 8th and 14th April). Surveys in summer 2016/2017 were undertaken in relation to the proposed transmission line corridor. These surveys followed the spring 2015 survey which categorised habitat for the entire project boundary. The habitat and potential presence of PBTL was assessed during the initial flora and fauna assessment 8-11 September 2015, and categorised as: likely, possible or not likely. A large proportion of the project boundary is considered possible or likely habitat for the PBTL due to the open grasslands, slopes and spider holes observed across the site. Areas considered unlikely to contain PBTLs are cropping, very steep, very rocky or areas with no evidence of spider holes. The southern area of the wind farm development area has optimal habitat for the species, gentle sloping rolling hills with plenty of spider holes. The northern section of the infrastructure area still has PBTLs present; however, they are typically in lower densities of numbers where infrastructure is proposed.

Measures which EBS Ecology recommend to mitigate the impact of the proposed development on the PBTL include:

- Areas which are suitable to PBTL, should be avoided. All known locations within possible habitat will need to micro-sited prior to construction to mitigate impact;
- Utilising cropping areas as much as possible for wind turbine generators, infrastructure areas and access tracks;
- Micro-site where possible around proposed infrastructure including the transmission line;
- An EPBC referral will be submitted as part of this proposed development. A translocation of PBTL from areas of less suitability is being recommended to increase the number of turbines being installed and reduce potential impacts on PBTL; and
- Ongoing monitoring of PBTL populations within the project boundary is recommended to detect future impacts on the species.

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1 INTRODUCTION

RES Australia Pty Ltd (RES) is undertaking feasibility studies for a wind farm development proposed to be located near Kapunda, approximately 80 km north east of Adelaide. The proposal is for up to 51 wind turbine generators (herein referred to as WTGs or turbines) along with associated infrastructure including access tracks, transmission lines, overhead and underground electrical cabling and an overhead transmission line.

During 2015-2017, EBS Ecology was engaged by RES to undertake a series of detailed assessments of the potential ecological impacts of the proposed Twin Creek Wind Farm, and where potential impacts were identified, to propose options and recommendations for mitigation. The ecological assessments are intended to support State and Federal project approval documents such as the Development Application, EPBC Referral, Native Vegetation Clearance Application and comply with Auswind Best Practise Guidelines.

Whilst the SEB calculation is not summarised as part of this report, the breakdown of SEB calculations for the infrastructure components of the Twin Creek Wind Farm, will be provided in a separate report to the Native Vegetation Council. This will be required by RES to make an appropriate SEB either through on-ground works (an Offset Management Plan will be developed) or payment into the Native Vegetation Fund.

1.1 Objectives

The specific objectives of the assessment were to:

- Identify and map vegetation communities;
- Identify and map the extent and significance of fauna habitat, including targeted specific surveys for bird and bat species;
- Identify species of national, state or local conservation significance known or likely to occur in the area and details on possible impacts;
- Identify areas of conservation value, including areas of high biodiversity value;
- Identify pest plants and animals;
- Assess the likely level of impact from an ecological perspective;
- Identify sensitive/exclusion areas;
- Recommend measures to mitigate potential ecological impacts, including avoidance and management of sensitive areas; and
- Calculate SEB offset requirements (for the Native Vegetation Clearance application).

There were some specific objectives of the assessment relating to Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*):

- Inspect proposed turbine locations for PBTL:

- Identify and categorise all potential PBTL habitat within the turbine locations and within likely locations of access tracks and infrastructure routes, including an assessment of likely PBTL density;
- Provide recommendations to minimise potential project impacts on PBTL's and their habitat; and
- Recommend measures to mitigate potential ecological impacts, including avoidance and management of sensitive areas.

1.2 Project area

The proposed Twin Creek Wind Farm is located approximately 80 km north east of Adelaide and is situated within the northern hills of the Mount Lofty Ranges (Figure 1). The project site is dominated by ridgelines in the north and plains or undulating hills in the south. The area of the development site surveyed included the wind farm development area and transmission route. This extended 6-7km north south and 5km east west.

Land use within the area is predominantly agricultural (e.g. grazing for sheep and cattle). Native vegetation has been extensively cleared, with most of the footprint containing grasslands. Woodland vegetation is generally restricted to creek lines and within small patches. The general region is open, low hills with occasional rocky outcrops that fall away to low foot slopes and drainage channels at regular intervals. Vegetation cover is dominated by grasses and perennial herbaceous forbs, with sparse incidents of remnant woodland primarily comprised of *Eucalyptus leucoxylon* subsp. *pruinosa* (South Australian Blue-gum) and *Eucalyptus porosa* (Mallee Box). Patches of *Eucalyptus odorata* (Peppermint Box) also occur in the transmission line and the species was also found scattered across the site.

1.3 Proposed wind farm specifications

The candidate turbine considered in our assessment has a maximum tip of blade height of 180 m, 112 m for the tower height and 67 m for the blade lengths. The risk assessment in this report has been based on the lowest extent of a rotating blade tip being 45 m from the ground. If the tower height and/or blade length (and ultimately the lowest extent of the rotating tip and the rotor swept area) substantially alter through the detail design of the project, the risk assessment may need to be reassessed.

The turbine foundations will be approximately 5 m in diameter at the surface, 20 m at the sub-surface and 3.5 m deep. Turbines will be connected to the on-site substation by underground cabling and to the terminal substation by overhead transmission lines. New access tracks will be required however existing roads and tracks will be utilized and upgraded where possible to minimise the overall impact. Project specifications are provided in Table 1. Overhead Transmission Line pole foundations will have a foundation of 1.5m in diameter and footprint of approximately 3m.

The design considered alternate access routes. An assessment has been made of the entire access route, although this is outside of the site of the development. Upon selection of the final access route, road reserves within the locality will be ground-truthed prior to clearance. Possible clearance is restricted to small degraded roadsides, which are expected to have minimal impact.

Table 1. Project specifications.

Component	Description
Project Layout	Up to 51 turbines and associated infrastructure. Approximate generation capacity of up to 1854MW with each WTG up to 3.6MW.
Wind Turbines	Maximum height (to blade tip) – 180 m. Blade Length – 67 m Tower Height – 112 m Foundations - approximately 5 m diameter at surface and 20 m sub-surface and up to 3.5 m deep.
WTG laydown and Hardstand area	An average area of approximately 90m x 45m for foundation, laydown and crane hardstand areas - plus two smaller 15m x 15m cranes hardstand areas (to erect the main crane jib) Hardstand areas will be required adjacent to the base of each turbine to enable the assembly and erection of the WTG components. The shape and area will vary depending on the construction approach and the site conditions at each WTG location.
External Electrical Transformers	A pad mounted enclosed transformer (kiosk) located at the base of each turbine. Approximate dimensions (2m long x 2m wide x 1.5m high).
Site Access	On-site access tracks up to 5.5 – 7 m wide to accommodate construction activities and cranes. The main access tracks will provide access the WTG sites and will be designed to take the weight of WTG transport and construction vehicles and the crane used to erect the turbines. These will be located to align with existing property access tracks where possible. Some sections of the access tracks may be wider to accommodate overtaking areas and turning circles.
Overhead electrical cabling	Approximate total length 15.5 km.
Underground electrical cabling	Approximate total length 49km. Trench width approximately 0.3m per circuit and depth of approximately 1m (minimum of 1m coverage over top of cable). Trench impact area of 5 m width for a single cable alignment + 0.5m for each additional cable. To be located adjacent the access tracks where possible (within approximately 5m of the shoulder of the track). The exact dimensions will depend on the installation method used by the contractor.
Overhead 275kV transmission line	Approximate length 15.5 km. The transmission would be constructed with steel or spun concrete poles of 35m high and spaced approximately 275 – 375 metres apart (or wider should terrain enable). At the terminal substation the 275kV transmission towers will comprise lattice towers up to 45 metres high to tee into the existing transmission line The impact areas will be approx. 3m x 3m for the monopole tower locations.
Substation and Operations and Maintenance Facilities	One 33kV/275kV substation, one Operations/Maintenance Facility and one Battery Energy Storage Facility all within a permanent hardstand measuring approximately 200m X 300m.
Meteorological masts	1 existing mast. An additional 2 to be installed. Approximate area of 14m2 (allowing for guyed wires).
Temporary Construction Compounds	One main temporary construction compound of up to 115m x 115m in area. The size will depend on the facilities required which may include:

Component	Description
	• site office and staff facilities • amenities • workshops • car park • skip bins • material storage areas • laydown area.
Concrete Batching Plants	One temporary concrete batching plant (if not sourced offsite). This will be located within a compound of approximately 115m X 115m.
Public Road Improvements	Access routes for all over-dimensional vehicles will be limited to those specified in the Traffic Management Plan. Roads and intersections will be up-graded to meet load and safety standards as agreed in the management plan. Public road access will require road upgrades to a width of 5.5m and a 1m shoulder either side. Localised widening in excess of up to 12m may be required to support transport and construction activity such as passing bays. All public roads will be left in good repair following construction as agreed in the management plan. All access routes will be subject to DPTI and Council agreement.

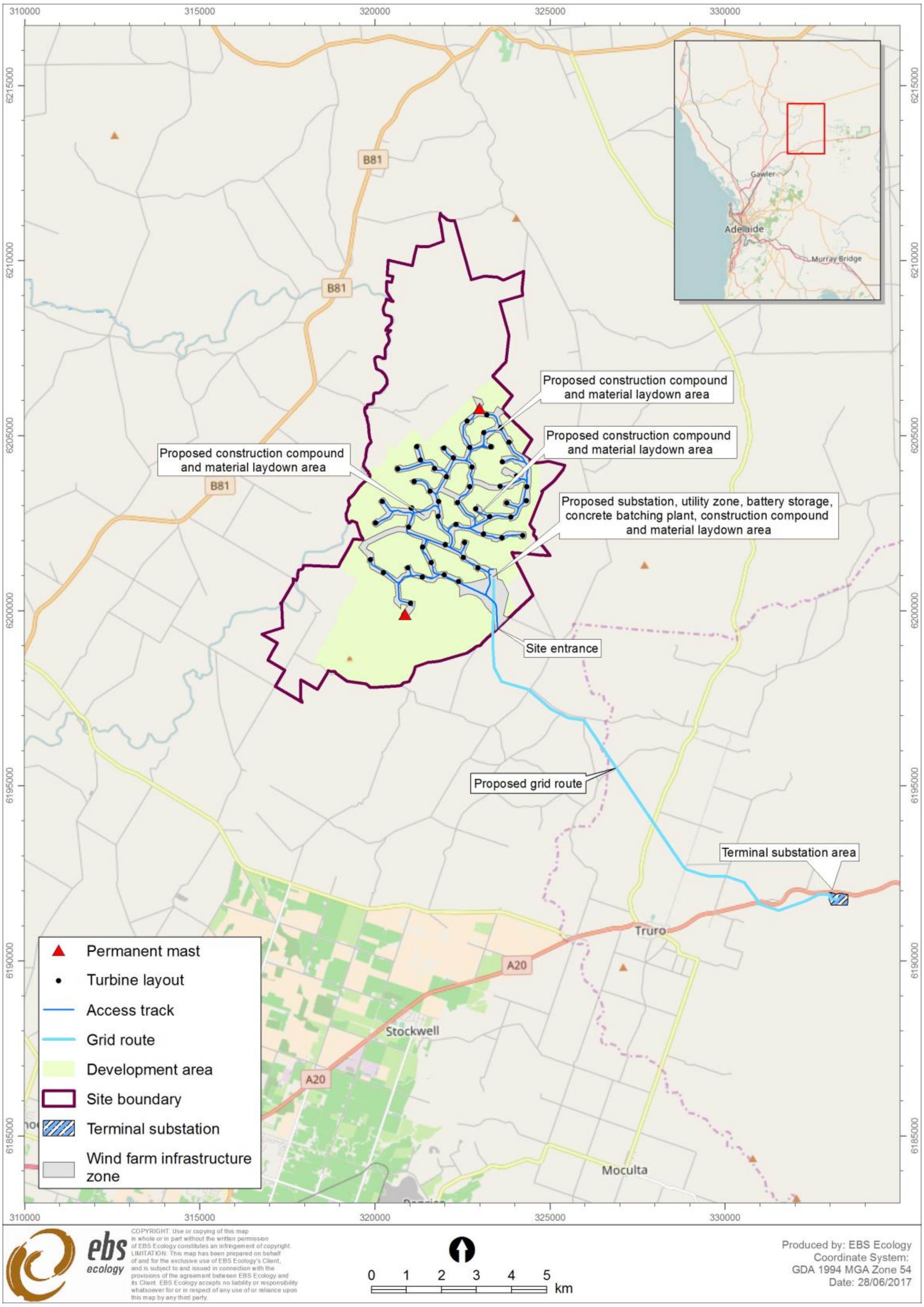


Figure 1. Twin Creek Wind Farm project area.

2 COMPLIANCE AND LEGISLATIVE SUMMARY

A summary of relevant Commonwealth and State environment legislation is provided below, with further detail in Table 2.

2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the Act as 'matters of national environmental significance'.

There are nine matters of national environmental significance protected under the EPBC Act, one of which is of relevance to the Twin Creek Wind Farm project:

- listed threatened species and ecological communities.

Any action that has, will have, or is likely to have a significant impact on matters of national environmental significance requires referral under the EPBC Act. Substantial penalties apply for undertaking an action that has, will have, or is likely to have significant impact on a matter of national environmental significance without approval.

2.2 Native Vegetation Act 1991

Native vegetation within the project area is protected under the *Native Vegetation Act 1991* and *Regulations 2003*. Any proposed clearance of native vegetation in South Australia (unless exempt under the regulations) is to be assessed against the Principles of Clearance under the Act, and requires approval from the Native Vegetation Council (NVC). A net environmental benefit is generally conditional on an approval being granted.

An assessment against the Native Vegetation Clearance Principles may not be required if the clearance is considered to comply with **Exemption 5(1)(d) Building or provision of infrastructure including infrastructure in the public interest** (see below). Even if this is the case, an application is still required to the NVC.

Regulation 5(1) (d) Building or provision of infrastructure, including infrastructure in the Public Interest

Pursuant to Section 27(1) (b) of the Act, native vegetation may, subject to any other Act or law to the contrary, be cleared if-

(i)

(A) the clearance is incidental to the construction or expansion of a building or infrastructure, and the Minister has, by instrument in writing, declared that he or she is satisfied that the clearance is in the public interest; or

(B) the clearance is required in connection with the provision of infrastructure or services to a building or proposed building, or to any place; and

(ii) any development authorisation required by or under the *Development Act 1993* has been obtained; and

(iii) the Council is satisfied (on the basis of information provided to the Council by the person seeking the benefit of this paragraph and such other information as the Council thinks fit) that, after taking into account the need to preserve biological diversity and the nature and purposes of any proposed building or infrastructure that is yet to be constructed, the proposed site of the building or infrastructure is the most suitable that is available; and

(iv) the Council is satisfied (on the basis of information provided to the Council by the person seeking the benefit of this paragraph and such other information as the Council thinks fit) that there is no other practicable alternative that would involve no clearance or the clearance of less vegetation or the clearance of vegetation that is less significant or (if relevant) the clearance of vegetation that has been degraded to a greater extent than the vegetation proposed to be cleared; and

(v) the clearance is undertaken in accordance with a standard operating procedure determined or approved by the Council for the purposes of this provision or a management plan that has been approved by the Council, and either -

(A) there will be a significant environmental benefit on the property where the clearance is being undertaken or within the same region of the State; or

(B) either -the owner of the land (or a person acting on his or her behalf); or person connected with the construction or expansion of the building or infrastructure, or the provision of the infrastructure or services (as the case requires), has, an application to the Council to proceed with clearing the vegetation in accordance with this provision, made a payment into the Fund of an amount considered by the Council to be sufficient to achieve a significant environmental benefit in the manner contemplated by section 21(6) of the Act.

2.3 National Parks and Wildlife Act 1972

Native plants and animals in South Australia are protected under the *National Parks and Wildlife Act 1972* (NPW Act). It is an offence to take a native plant or protected animal without approval. Conservation rated flora and fauna species listed on Schedules 7, 8, or 9 of the NPW Act are known to or may occur within the project area.

2.4 Natural Resources Management Act 2004

Under the *Natural Resources Management Act 2004* (NRM Act) landholders have a legal responsibility to manage declared pest plants and animals and prevent land and water degradation.

Key components under the Act include the establishment of regional Natural Resource Management (NRM) Boards and development of regional NRM Plans; the ability to control water use through prescription, allocations and restrictions; requirement to control pest plants and animals and activities that might result in land degradation.

A ‘duty of care’ is a fundamental component of this Act i.e. ensuring one’s environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations.

Table 2. Summary of relevant Commonwealth and State legislation.

Legislation	Summary	Relevance
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999	To protect 'matters of national environmental significance': Any action that has, will have or is likely to have a significant impact on a matter of national environmental significance requires referral and approval under the EPBC Act. To determine whether an action is likely to have a significant impact on a matter of national environmental significance, refer to the Significant Impact Guidelines (Commonwealth of Australia 2013).	Where an activity may trigger requirements of the EPBC Act, this legislation must be taken into account. Significant penalties apply. The EPBC Act Significant Impact Guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance. In terms of nationally threatened species, the guidelines define an action as likely to have a significant impact if there is a real chance or possibility that it will: • lead to a long term decrease in the population • reduce the area of occupancy of the species • fragment an existing population • adversely affect critical habitat • disrupt breeding cycles • modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • result in the establishment of invasive species that are harmful to the species • introduce disease that may cause the species to decline interfere with the recovery of the species.
State		
National Parks and Wildlife Act 1972	Allows for the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters); provides for the protection of native flora and fauna; identifies flora and fauna species considered to be of conservation significance (under Schedules 7, 8, and 9 of the Act); and provides for the use of approved wildlife through a system of permits allowing certain actions, i.e. keeping and selling (s.58), harvesting (s.60G), farming (s.60C), hunting (s.68A), releasing (s.55) and undertaking scientific research (s.53) on/of native fauna species, and for the taking of plants (s.49).	A person must not "take" a native plant, protected animal or the eggs of a protected animal without approval (s.48A). To take a protected animal means to remove, hunt, catch, restrain, kill or injure an animal, or attempt to do so. Taking a native plant or protected animal, or the eggs of an animal carries a maximum penalty of $10 000. Potential impacts on native plants and animals should be avoided where possible, particularly conservation significant flora and fauna species listed in Schedules 7. 8 or 9 of the Act.
Native Vegetation Act 1991	An Act to preserve, enhance and manage the State's native vegetation; provide a regulatory framework to control clearance of vegetation; and provide incentives and assistance to landowners to encourage them to preserve and enhance native vegetation. The Act protects all native vegetation that naturally occurs, i.e. vegetation which has not been planted. This includes all naturally occurring local native plants, from small ground covers and native grasses to mallee scrub and tall trees. It does not cover planted trees.	Any clearance of native vegetation in South Australia (unless under exemption) needs approval from the Native Vegetation Council (NVC). The NVC considers applications to clear native vegetation under ten principles. Native vegetation should not be cleared if it is significantly at odds with these principles: • it contains a high level of diversity of plant species • it is an important wildlife habitat • it includes rare, vulnerable or endangered plant species • the vegetation comprises a plant community that is rare, vulnerable or endangered • it is a remnant of vegetation in an area which has been extensively cleared

Legislation	Summary	Relevance
	Under the Act, clearance is defined as: • the killing or destruction of native vegetation • the removal of native vegetation • the severing of branches, limbs, stems or trunks of native vegetation • the burning, poisoning and slashing of native vegetation • any other substantial damage to native vegetation including activities such as the draining for the reclamation of wetlands or flooding of land • grazing land where stock has been excluded for more than ten years. The Act also provides the opportunity for landholders to enter into voluntary "Heritage Agreement(s)" to ensure vegetation on private land is protected for perpetuity (s.23).	• it is growing in, or association with, a wetland environment • it contributes to the amenity of the area • the clearance of vegetation is likely to contribute to soil erosion, salinity, or flooding • the clearance of vegetation is likely to cause deterioration in the quality of surface or underground water • after clearance, the land is to be used for a purpose which is unsustainable. The NVC will take into account the impacts of the proposed clearance and may grant consent, refuse consent or grant consent subject to certain conditions (s.29). A net environment benefit is generally conditional on an approval being granted. Significant penalties apply if a person clears native vegetation without the permission of the NVC (s.26). The NVC can also take civil enforcement proceedings in the District Court for an order that the native vegetation be re-instated (s.31).
Natural Resources Management Act 2004	To promote and facilitate integrated and sustainable management of all natural resources (water, soil, biodiversity etc.); and to provide for arrangements to involve the community in the development and implementation of regional initiatives to improve the management of the natural resources. Key components include the establishment of regional Natural Resource Management (NRM) Boards and development of regional NRM Plans; the ability to control water use through prescription, allocations and restrictions; requirement to control pest plants and animals, and activities that might result in land degradation. A 'duty of care' is a fundamental element of this Act, i.e. ensuring one's environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations. The project area falls within the South Australian Murray-Darling Basin Natural Resources Management Board. Section 188(5) of the Act requires that the NRM Board must take into account any relevant provision of the regional NRM plan.	The NRM Board may appoint authorised officers to administer and enforce the Act. Authorised officers possess powers of entry, powers to give directions, powers to collect evidence and seize and remove animals and plants. An authorised officer may issue a protection order for the purpose of securing compliance with specified provisions of the Act: • breach of the general statutory duty; • breach of the duty not to damage watercourses or lakes; • failure to take action to destroy or control certain animals or plants; • failure to comply with the terms of a management agreement entered into under the Act; and • any other requirement imposed by the NRM Act or a repealed Act and which has been specified in the NRM Regulations. An owner of land who is, or is likely to be, in breach of the general statutory duty under the Act resulting or likely to result in land degradation may be required to prepare an action plan. Failure to comply with a notice requiring preparation of an action plan is an offence. An NRM authority or a State authorised officer may issue a reparation order in certain circumstances where a person has caused harm to a natural resource and repair is necessary. Enforcement action in the ERD Court can be taken if necessary.

Note: this summary is not intended to be a substitute for particular legal advice.

3 BACKGROUND INFORMATION

3.1 Administrative boundaries

The site is within three local government areas: the Regional Council of Goyder, the Light Regional Council and the Mid Murray Council. The site also falls within two Natural Resources Management Board regions: the Adelaide and Mount Lofty Ranges and the Northern and Yorke.

3.2 Environmental setting

The project is located in northern Mount Lofty Ranges Botanical Region. Interim Biogeographical Regionalisation of Australia (IBRA) is a landscape-based approach to classifying the land surface across a range of environmental attributes, which is used to assess and plan for the protection of biodiversity (DoE 2013a). The majority of the project area falls within the Flinders Lofty Block IBRA bioregion, Broughton subregion and Mopami and Rufus environmental associations. Less than 10% of the remnant native vegetation within the Mopami and Rufus environmental associations is remaining, which highlights its importance. Most of the native vegetation is located on private land and is subject to grazing. A small area of the proposed terminal substation falls within the Kanmantoo IBRA Bioregion, Fleurieu Sub-region and Scotts Hill environmental association. The Fleurieu IBRA subregion has only 12% native vegetation mapped and high quality native grasslands were observed in this area during EBS surveys. Landscape and remnancy descriptions are summarised in Table 3.

Table 3. IBRA bioregion, subregion, and environmental association environmental landscape summary.

Environmental setting (excluding portion of terminal substation)	
Flinders Lofty Block IBRA bioregion	
Temperate to arid Proterozoic ranges, alluvial fans and plains, and some outcropping volcanics. The semi-arid to arid north supports native cypress, black oak (belah) and mallee open woodlands, *Eremophila* and *Acacia* shrublands and bluebush/saltbush chenopod shrublands on shallow, well-drained loams and moderately-deep, well-drained red duplex soils. The increase in rainfall to the south corresponds with an increase in low open woodlands of *Eucalyptus obliqua* and *E. baxteri* on deep lateritic soils, and *E. fasciculosa* and *E. cosmophylla* on shallower or sandy soils.	
Broughton IBRA subregion	
This subregion is characterised by a series of wide undulating intramontane basins with red duplex soils, separated by low but distinct northerly trending strike ridges. In the north the region leads into the Southern Flinders Ranges with no sharply defined landform boundary, but a land use boundary marking the northern extremity of wheat cultivation. Due to widespread clearing for farming the only significant remnant of native vegetation is found in the Mt Remarkable area, where an open forest dominated by *Eucalyptus cladocalyx* or by *E. goniocalyx* and *E. leucoxylon* on reddish dense loams remains. Degraded remnants of *E. leucoxylon* and *E. odorata* woodlands can still be found on stony crests and steep slopes.	
Remnant vegetation	Approximately 10 % (106330 ha) of the subregion is mapped as remnant native vegetation, of which 3 % (3064 ha) is formally conserved
Landform	Hills and valleys; alternating subparallel hilly ridges and valleys with a general N-S trend in north. In south, there is hilly dissected tableland
Geology	Dissected lateralized surface in south

Soil	Hard setting loams with red clayey subsoils, highly calcareous loamy earths, hard setting loams with mottled yellow clayey subsoil, coherent sandy soils, cracking clays
Vegetation	Assumed native vegetation cover
Conservation significance	55 species of threatened fauna, 113 species of threatened flora. 0 wetlands of national significance.
Mopami IBRA environmental association	
Remnant vegetation	Approximately 6 % (4257 ha) of the association is mapped as remnant native vegetation, of which 2 % (85 ha) is formally conserved
Landform	Undulating plain on metasediments with low ridges and hills rising above it.
Geology	Metasediments and alluvium.
Soil	Hard pedal red duplex soils, reddish powdery calcareous loams and brown self-mulching cracking clays.
Vegetation	Grasslands and open parkland.
Conservation significance	25 species of threatened fauna, 39 species of threatened flora. 0 wetlands of national significance.
Rufus IBRA environmental association	
Remnant vegetation	Approximately 9 % (1639 ha) of the association is mapped as remnant native vegetation, of which 0 % (3 ha) is formally conserved
Landform	Northerly trending strike ridges with dissected footslopes on metasediments.
Geology	Quartzite and metasediments.
Soil	Reddish dense loams and hard pedal red duplex soils.
Vegetation	Grasslands and open parkland.
Conservation significance	18 species of threatened fauna, 14 species of threatened flora. 0 wetlands of national significance.
Environmental setting (portion of terminal substation)	
Kanmantoo IBRA bioregion	
Temperate, well defined uplands of Cambrian and Late Proterozoic marine sediments, and a lateritized surface becoming increasingly dissected northwards, with eucalypt open forests and woodlands and heaths on mottled yellow and ironstone gravelly duplex soils in the wetter areas, and Eucalyptus odorata and drooping sheoak on shallow rocky soils in drier areas. Extensively cleared for agriculture.	
Fleurieu IBRA subregion	
This subregion is predominantly an undulating to low hilly upland with steeper marginal ranges and hills. A lateritized surface occurs on the Fleurieu Peninsula and becomes increasingly dissected northward to where only a few remnants survive as rounded crests and summits with mottled -yellow duplex soils. The lowest lying areas are within the Inman Valley where soft glacial and fluvio-glacial deposits have been lowered more quickly than the surrounding sedimentary rocks. Much of the native vegetation has been cleared, however some remains in reserves and small isolated inaccessible areas. Low open woodland commonly dominated by Eucalyptus obliqua and E. baxteri are found in higher rainfall areas on deep, lateritic soils. Shallower or sandy soils support E. fasciculosa, E cosmophylla and in the northern part of the region E. goniocalyx. E leucoxylon dominates the woodlands on podzolised soils in the lower rainfall areas, E. viminalis ssp. cygnetensis dominates the wetter and cooler woodlands and E. odorata characterises drier sites. Eucalypts give way to drooping sheoak (Allocasuarina verticillata) in the most arid woodlands and in coastal situations on shallow rocky soils.	
Remnant vegetation	Approximately 12% (45372 ha) of the subregion is mapped as remnant native vegetation, of which 24% (10865ha) is formally conserved

Landform	Hills and valleys; alternating subparallel hilly ridges and valleys with a general N-S trend in north. In south, hilly dissected tableland
Geology	Dissected lateritized surface in south
Soil	Hard setting loams with red clayey subsoils, Highly calcareous loamy earths, Hard setting loams with mottled yellow clayey subsoil, Coherent sandy soils, Cracking clays
Vegetation	Eucalyptus woodlands with a shrubby understorey
Conservation significance	117 species of threatened fauna, 268 species of threatened flora. 9 wetlands of national significance.
Scotts Hill IBRA environmental association	
Remnant vegetation	Approximately 10% (9673 ha) of the association is mapped as remnant native vegetation, of which 5% (464ha) is formally conserved
Landform	Structurally controlled ridges with steep slopes.
Geology	Metasediments.
Soil	Grey-brown weakly structured sandy soils, hard pedal mottled-yellow duplex soils and reddish siliceous loams.
Vegetation	Low woodland of drooping sheoak and peppermint box and low open scrub of scarlet mintbush and mallee correa.
Conservation significance	41 species of threatened fauna, 59 species of threatened flora. 0 wetlands of national significance.

3.2.1 Climate

Nearest long term climate data comes from Kapunda weather station (BOM 2015), which shows trends of a typical Mediterranean climate (Figure 2). Most rainfall occurs in the mild winter months with low rainfall and average maximum temperatures nearing 30°C in the summer months. This area has an average annual rainfall of 494 mm, which supports cropping and improved pasture activities.

3.2.2 Vegetation

Remnant vegetation has been mapped by the Department of Environment, Water and Natural Resources (DEWNR) as part of the Native Vegetation Information System (NVIS) floristic analysis and mapping project. The NVIS mapping is based on interpretation of aerial photography or Landsat imagery and floristic data derived from Biological Survey of SA vegetation sites or field trips. Given the NVIS mapping is largely derived from remote assessment, it can be inaccurate and hence was ground-truthed by EBS. The following native vegetation communities have been previously mapped by DEWNR (within the proposed Twin Creek Wind Farm project area) and are shown in Figure 3.

- *Acacia paradoxa* shrubland;
- *Allocasuarina verticillata* woodland;
- *Austrostipa* sp. grassland;
- *Eucalyptus gracilis* mallee woodland;
- *Eucalyptus leucoxylon* ssp. woodland;

- *Eucalyptus odorata* woodland;
- *Lomandra effusa* (mixed) grassland;
- *Lomandra* sp. sedgeland; and
- *Phragmites australis*, *Typha domingensis* grassland.

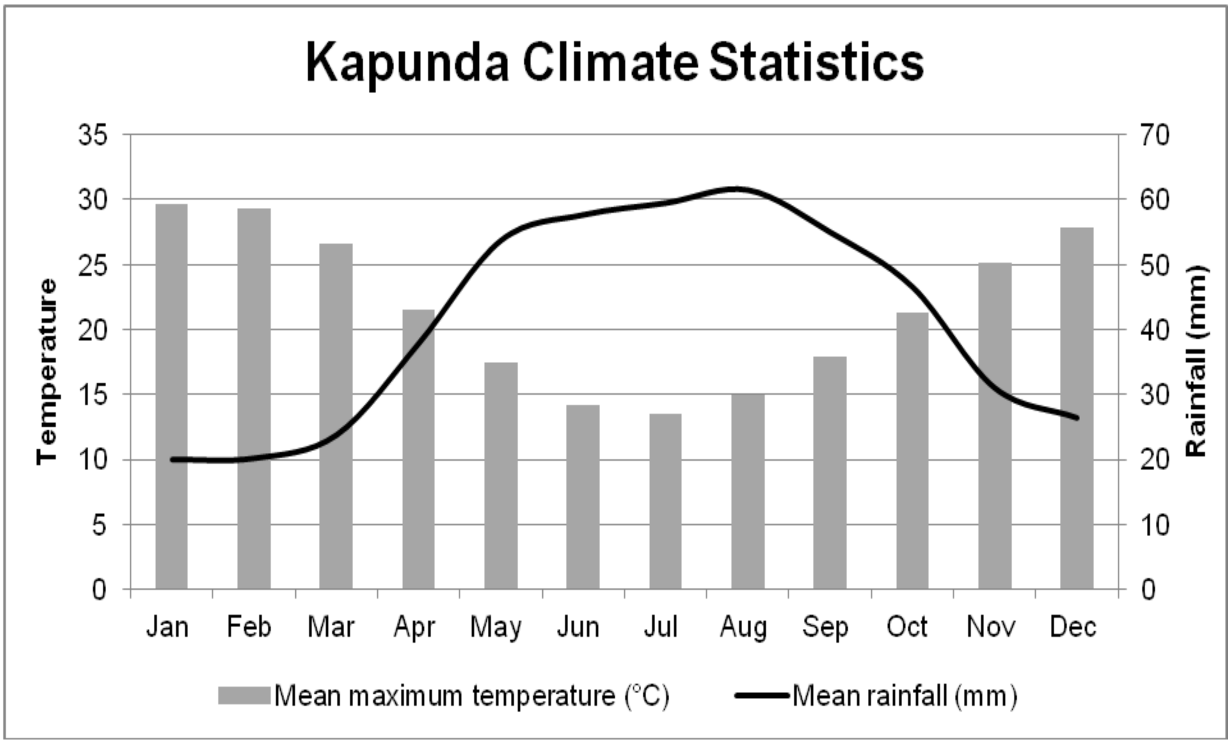


Figure 2. Average monthly rainfall and temperature data for Kapunda weather station.

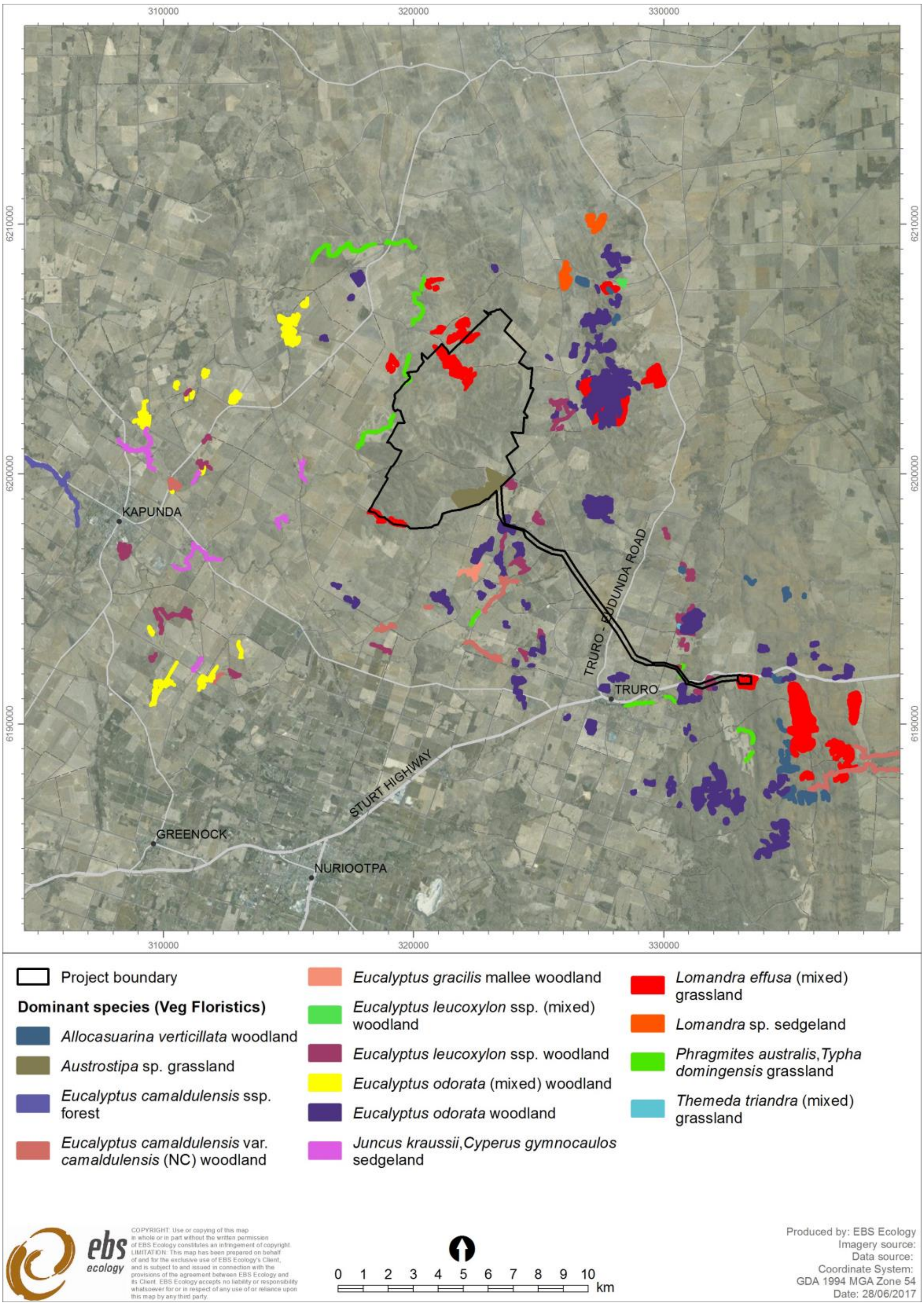


Figure 3. DEWNR native vegetation floristic mapping within the current infrastructure zone.

3.2.3 Protected areas

The closest DEWNR reserves to the proposed Twin Creek Wind Farm footprint are Kaiserstuhl Conservation Park (approximately 25 km south) and Brookfield Conservation Park (approximately 32 km east). Three existing Heritage Agreements under the *Native Vegetation Act 1991* are situated 4 km south (Heritage Agreement No.287) and 6 km east of the project area (Heritage Agreement numbers 677 and 1314) (Figure 4).

3.2.4 Previous surveys conducted

EBS undertook a vegetation assessment (on behalf of DP Energy in 2012) for the placement of the meteorological mast where it currently resides. EBS is aware of a series of targeted Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) surveys that have been conducted, by others on the southern landholder's property (K. Mosey, pers.comm. 2015). Several surveys for PBTLs have been conducted by others within the Twin Creek project area (BDBSA 2010, 2011, 2012). The PBTL location data from these surveys has been included in Section 5.3.3 of this report.

The Government of South Australia (Naturemaps) detected six DEWNR flora survey sites located in and around the project area; two out of the six sites were situated within the wind farm footprint (Patch ID 15595 and 292471, which were described as vegetation and vegetation/vertebrates surveys respectively) (Table 4).

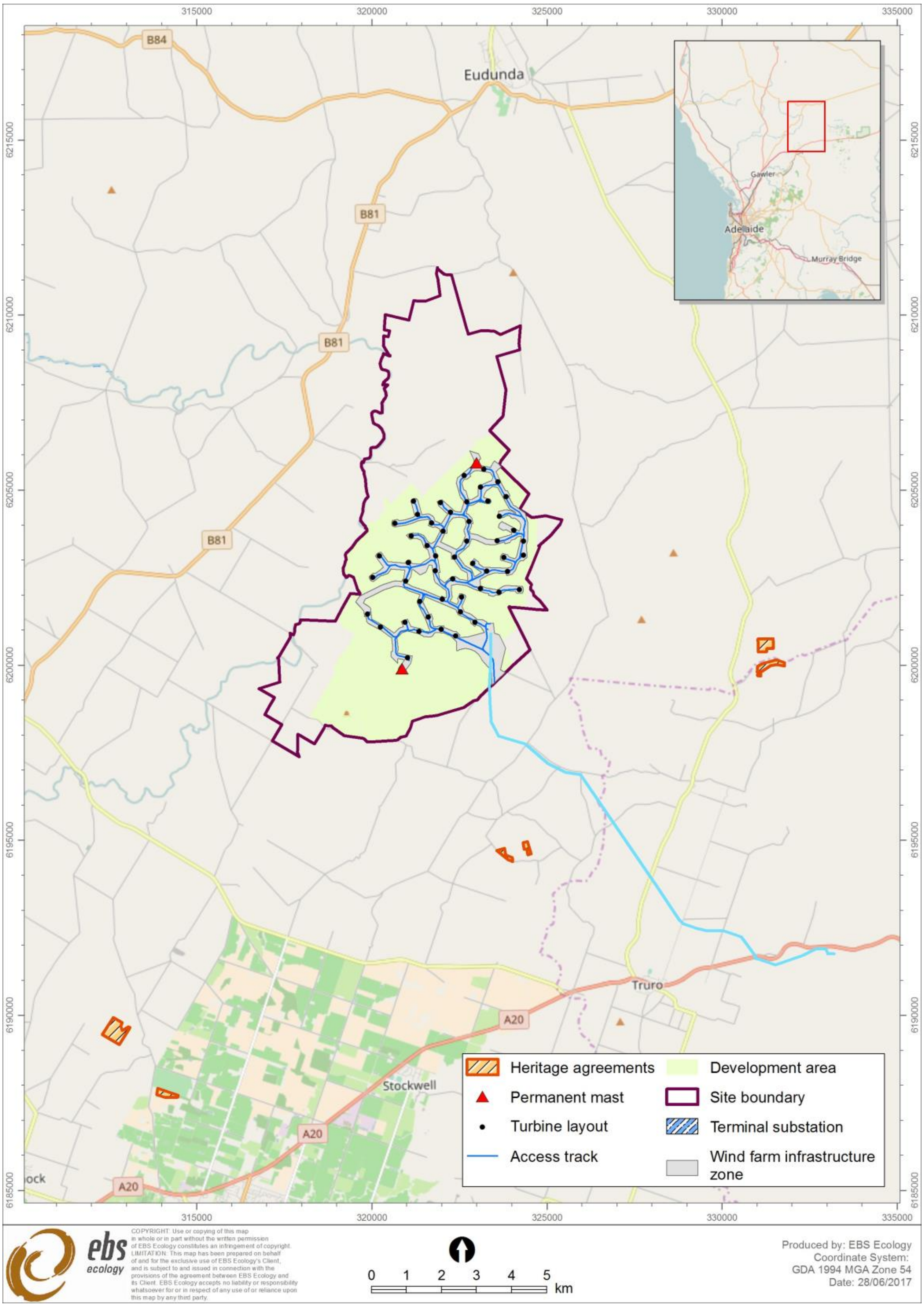


Figure 4. Heritage Agreements relevant to the proposed Twin Creek Wind Farm project area.

Table 4. Summary of previous DEWNR surveys.

Patch ID	Survey No.	Site ID	Survey name	Visit date	Survey type	Abstract	Data Custodian
15594	83	LBGTRU03	Lofty Block Grasslands	4/12/1996	vegetation only	A 1995 to 1996 vegetation survey to document grassland and grassy woodland remnants in the Lofty Block Bioregion	DEH - Biological Survey and Monitoring
15595	83	LBGTRU04	Lofty Block Grasslands	5/12/1996	vegetation only	A 1995 to 1996 vegetation survey to document grassland and grassy woodland remnants in the Lofty Block Bioregion	DEH - Biological Survey and Monitoring
9925	45	TRU0101	Western Murray Flats	29/04/1992	vegetation only	Survey aimed to classify and map the floristic composition and structure of vegetation within the Western Murray Flats	DEH - Biological Survey and Monitoring
9931	45	TRU0401	Western Murray Flats	27/04/1992	vegetation only	Survey aimed to classify and map the floristic composition and structure of vegetation within the Western Murray Flats	DEH - Biological Survey and Monitoring
292473	836	KAPDUF01	Grasslands - Lower North	19/10/2012	vegetation and vertebrates	Produce flora, reptile and bird data from grassland and grassy woodland sites on the Adelaide Plains and foothill areas of the AML NRM Board Region	AML NRM Board
292471	836	KAPFLA01	Grasslands - Lower North	21/10/2012	vegetation and vertebrates	Produce flora, reptile and bird data from grassland and grassy woodland sites on the Adelaide Plains and foothill areas of the AML NRM Board Region	AML NRM Board

4 METHODS

4.1 Desktop assessment

4.1.1 Database searches

The online Protected Matters Search Tool was used to identify any species or ecological communities of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that may occur or may have suitable habitat within the project area. A 20 km buffer was applied to the search to incorporate the current infrastructure zone (which includes wind turbines, battery storage, substation, transmission line, access tracks and associated infrastructure, as of March 2017).

A search of the Biological Database of South Australia (BDBSA) maintained by the Department of Environment, Water and Natural Resources (DEWNR), was obtained to identify flora and fauna species previously recorded within 20 km of the project area (DEWNR 2015).

The BDBSA is comprised of an integrated collection of corporate databases which meet DEWNR standards for data quality, integrity and maintenance. In addition to DEWNR biological data, the BDBSA also includes data from partner organisations (Birds Australia, Birds SA, Australasian Wader Study Group, SA Museum, and other State Government Agencies). This data is included under agreement with the partner organisation for ease of distribution but they retain ownership of the data and should be contacted directly for further information.

4.1.2 Background research

Existing information relevant to the project site was referred to:

- Aerial imagery.
- GIS spatial datasets including DEWNR biological survey sites, vegetation cover, protected areas, IBRA, NVIS floristic mapping and TSA roadside vegetation survey.
- DotEE website for Species Profiles and Threats (SPRATs), conservation advices and policy statements for nationally listed species and ecological communities.
- Reports and plans, key references being:
    - Biodiversity Plan for the Northern Agricultural Districts (Graham *et al.* 2001);
    - A Regional Species Conservation Assessment Process for South Australia - Phase 2: Species Prioritisation, Northern & Yorke (Gillam 2009);
    - Northern and Yorke Regional Natural Resources Management Plan (NYNRMB 2008);
    - Native Vegetation of the Northern and Yorke Region (Berkinshaw 2006);
    - Adelaide and Mount Lofty Ranges Natural Resources Management Plan (AMLR NRMB 2013).
- Documents relating to threatened species and communities within the region, such as the Recovery Plan for the Pygmy Blue-tongue (*Tiliqua adelaidensis*).

This information was used to build a picture of:

- native vegetation cover within the project area and immediate surrounds;
- previous survey effort in the area;
- vegetation associations present (including associations of significance);
- flora and fauna species (including species of national, state or local conservation significance) known or likely to occur in the area;
- potential ecological constraints for the project; and
- key threatening processes (e.g. weeds, pest animals) that may require specific management.

4.2 Assessment of the likelihood of threatened species occurring

A likelihood of occurrence rating (i.e. likelihood of that species occurring on or near the project area) was assigned to each threatened species identified in the Protected Matters Search and BDBSA database search. This likelihood of occurrence rating, 'Highly Likely', 'Likely', 'Possible' and 'Unlikely' take the following criteria into consideration:

- proximity of the records (distance to the project area);
- date of the records;
- landscape features, vegetation remnancy and vegetation type at the location of the record (taking into consideration similarities within the project area); and
- knowledge of species' habitat preferences, causes of decline and local population trends.

4.3 Field survey

4.3.1 Survey area and dates

EBS Ecology have undertaken a series of assessment's at the Twin Creek Wind Farm site, as new infrastructure areas were added over the course of the wind farm design and to determine if there were any seasonal variations in fauna (largely in bird assemblages) across the site. Targeted surveys for the Pygmy Blue-tongue Lizard were also conducted across the site, again as new infrastructure areas were proposed as well as micro sighting around wind turbines and access tracks within the main wind farm boundary. Table 5 is a summary of all surveys completed within the Twin Creek Wind Farm project area (as of March 2017).

Table 5. Consolidated list of surveys completed for Twin Creek Wind Farm.

Survey type	Date	Season	Description
Flora and fauna assessment	8-11 September 2015	Spring	General assessment and condition rating of vegetation, bird, bat and PBTL assessment
Targeted Lomandra assessment	8 October 2015	Spring	Assess whether Lomandra Grasslands qualified as a TEC

Survey type	Date	Season	Description
Bird survey	3-5 February 2016	Summer	Revisit bird count surveys established in spring 2015
Bird survey	18-20 April 2016	Autumn	Revisit bird count surveys established in spring 2015
Bird survey	26-28 August 2016	Winter	Revisit bird count surveys established in spring 2015 and undertake nest checks
Targeted PBTL survey and Bat survey	22 Feb – 4 March 2016	Summer/Autumn	Detailed assessment of PBTL habitat and occupation across the site. Anabat survey repeated from September 2015 survey due to poor weather conditions
Additional PBTL survey	5, 8 and 14 April 2016	Autumn	Investigate additional routes within areas of likely habitat
Additional PBTL survey	31 Oct – 11 Nov 2016	Spring	Targeted areas and additional infrastructure
Additional PBTL survey	22 Nov – 25 Nov 2016	Spring	Targeted areas and additional infrastructure
Vegetation Assessment	23, 24, 29, 30 Nov and 1 Dec 2016	Summer	Vegetation assessment of additional turbine, substation and transmission line
Additional PBTL survey	6-9 December 2016	Summer	Targeted areas and additional infrastructure
Additional PBTL survey	9 Jan – 13 Jan 2017	Summer	Targeted areas and additional infrastructure
Vegetation Assessment	5 April 2017	Autumn	Vegetation assessment of 2nd substation and potential shift of transmission line easement

4.3.2 Vegetation survey

Vegetation across the site was mapped into vegetation communities and described. All native and exotic flora species observed within the 11 vegetation associations, were recorded (Appendix 1). Species nomenclature used in this report follows that used in the Biological Database of South Australia (BDBSA).

Pre-prepared aerial maps were used to guide the field assessment. The survey was undertaken on foot and by vehicle, using the network of existing vehicle tracks and traversing across cleared paddocks where required. The entire development footprint is referred to hereon in as the project boundary. Field surveys initially covered a broad area; the development footprint was refined during the course of the assessment process, in response to findings by EBS Ecology and other consultants. An assessment has been made of the access route, however impact areas will be ground-truthed prior to clearance. Impact footprints restricted to roadsides and are minimal in size. Ground survey will be conducted prior clearance. There is another area of the Transmission Line (just north of the Sturt Highway) (Figure 32 and Figure 33) classified using aerial photography and based on surveyed vegetation in the adjacent paddock. This area will require follow up ground survey.

The general vegetation survey focused on validating and building on from the broad DEWNR floristic mapping, to obtain a greater understanding of the vegetation communities and vegetation condition within the area. This involved surveying all areas of native vegetation and recording the following:

- Location of vegetation associations;
- Species list for each vegetation association;

- Vegetation condition, determined using criteria adopted by the Native Vegetation Council (NVC) to calculate significant environmental benefit (SEB) offset requirements for native vegetation clearance (Table 6). Using these criteria, vegetation was assigned an SEB condition ratio based on the percentage of native and exotic species in the understorey, disturbance, and intactness of vegetation stratum;
- Isolated trees or small clumps of trees with a very low percentage of native understorey are considered scattered trees by definition of the NVC. These include trees in crops and exotic grasslands, or on degraded roadsides and was particularly relevant when assessing the transmission line and access roads. Such trees were assessed using the appropriate methodology which includes recording tree attributes such as species, height, girth, health and habitat value and using them to calculate a tree score using the NVC point scoring system. These trees have not been described or presented on maps in this report. However, SEB calculations will be undertaken for trees affected once the final works footprint and clearance required is known. This was particularly relevant when assessing the proposed transmission line for native vegetation;
- Location and extent of declared and serious environmental weed species;
- Flora species and ecological communities of conservation significance; and
- Habitat value.

The SEB Condition Ratios (Table 6) and Tree Scores in addition to other policies are used to calculate appropriate offset area or offset cost requirements. High quality vegetation or vegetation that provides important habitat such as for state or nationally threatened species is subject to additional policies that increase the required offset area or value.

In addition, the Native Vegetation Council (NVC) has advised that in the event of native vegetation clearance applications, woodland associations may warrant a higher SEB rating depending on the condition of the overstorey.

A Native Vegetation Clearance Report will be prepared and submitted to the NVC, which will discuss and determine the required Significant Environmental Benefit (SEB) as part of the proposed native vegetation clearance for this proposed development.

Table 6. Assessment criteria for the condition of vegetation communities.

Condition	SEB ratio	% indigenous cover	Overstorey condition description	Understorey condition description	Indicators	NVC Interim Policy (1.2.11)
Very Poor	**0:1**	<10%	No overstorey stratum remaining.	Complete destruction of indigenous understorey* (by grazing &/or introduced plants).	Vegetation structure no longer intact (e.g. 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, complete depletion of soil surface crust).	Where proposed clearance is considered to be minor and of limited biodiversity impact, e.g. lopping of overhanging limbs only or minor clearance of shrubs in areas otherwise considered as highly disturbed.
	1:1	10-19%	Scattered trees in poor health and/or representing an immature stand.	Almost complete destruction of indigenous understorey* (by grazing &/or introduced plants) - reduced to scattered clumps and individual plants.		Where proposed clearance is in areas dominated by introduced species, the area of native vegetation is largely reduced to scattered trees, indigenous understorey reduced to scattered clumps and individual plants.
	2:1	20-29%	Scattered trees either immature in good health or mature in poor/moderate health. Alternatively, the dominant overstorey stratum is largely intact and is an immature stand (or regrowth), and is generally in poor health.			
Poor	**3:1**	30-39%	Dominant overstorey stratum is largely intact and is a moderately healthy mature stand.	Heavy loss of native plant species (by grazing &/or introduced plants). The understorey* consists predominately of alien species, although a small number of natives persist.	Vegetation structure substantially altered (e.g. 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).	Where the proposed clearance is of mostly intact overstorey vegetation but there is still considerable weed infestation amongst the understorey flora.
	4:1	40-49%	Dominant overstorey stratum is largely intact and is a healthy mature stand with high wildlife habitat value (e.g. hollows).			

Condition	SEB ratio	% indigenous cover	Overstorey condition description	Understorey condition description	Indicators	NVC Interim Policy (1.2.11)
Moderate	**5:1**	50-59%	Dominant overstorey stratum is largely intact – any condition+	Moderate loss of native understorey diversity. Weed-free areas small. Substantial invasion of aliens resulting in significant competition, but native understorey* persists; for example, may be a low proportion of native species and a high native cover, or a high proportion of native species and low native cover.	Vegetation structure altered (e.g. one or more vegetation strata depleted). Most seed sources available to regenerate original structure. Obvious signs of disturbance (e.g. tracks, bare ground). Minor clearing (<10% of area). Considerable weed infestation with some aggressive weeds. Evidence of some grazing (tracks, soil surface crust patchy).	Where the proposed clearance is of mostly intact overstorey vegetation with moderate but not severe weed infestation amongst the understorey flora. Clearance is not seriously at variance with the Principles.
	6:1	60-69%	Dominant overstorey stratum is largely intact – any condition+	Moderate but not severe weed infestation amongst the understorey flora.		
Good	**7:1**	70-79%	Original overstorey stratum is still dominant and intact – any condition+	Understorey only slightly modified. High proportion of native species and native cover in the understorey*; reasonable representation of probable pre-European vegetation.	Vegetation structure intact (e.g. all strata intact). Disturbance minor, only affecting individual species. Only non-aggressive weeds present. Some litter build-up.	Where the proposed clearance is of mostly intact overstorey and understorey vegetation, weed infestation is moderate to low, but the original vegetation is still dominant. Clearance is assessed by the NVC to be at variance with the Principles.
	8:1	80-89%	Original overstorey stratum is still dominant and intact – any condition+	Understorey only slightly modified. High proportion of native species and native cover in the understorey*; reasonable representation of probable pre-European vegetation.		
Excellent	**9:1**	> 89%	Original vegetation is still dominant and intact. Overstorey individuals in good condition and represent a mature stand.	Diverse vegetation with very little weed infestation.Understorey largely undisturbed, minimal loss of plant species diversity. Very little or no sign of alien vegetation in the understorey*; resembles probable pre-European condition.	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.	Where the proposed clearance is of diverse vegetation with very little weed infestation. Clearance is assessed by the NVC to be seriously at variance with the Principles.
	10:1		Original vegetation is still dominant and intact. Overstorey individuals in good condition and represent a mature stand, with high habitat value (e.g. hollows).			

* Or all strata if the upper and lower strata are difficult to distinguish. + Ratio assessment will largely depend upon condition of understorey associated with an intact overstorey stratum.
Adapted from *Guide to Roadside Vegetation Survey Methodology for South Australia* (Stokes et al. 1998) and *Guidelines for a Native Vegetation Significant Environmental Benefit Policy* (DWLBC 2005).

4.3.3 Threatened ecological communities

Targeted surveys were undertaken in areas of *Eucalyptus odorata* (Peppermint Box) woodlands and *Lomandra* spp. (Iron-grass) grasslands to determine if the areas qualified as threatened ecological communities under the EPBC Act.

Baseline surveys for *Lomandra* Grasslands in the turbine area were undertaken in September 2015. An additional one day survey was undertaken on 8 October 2015 to assess whether the *Lomandra* Grasslands in the turbine area qualified as the threatened ecological community. Additional areas of *Lomandra* grassland were located during vegetation surveying for the transmission line in late 2016 and assessed at the time (early summer) or during a follow up survey on 5th April 2017.

Areas of *Eucalyptus odorata* woodland mapped in the proposed transmission line (Biele Road) during the late 2016 survey were assessed at the time. An additional area was visited during the 5th April 2017 survey (Biele Road), due to a proposed shift in the transmission line. A further detailed survey is required to determine whether this patch of *Eucalyptus odorata* woodland qualifies as a TEC.

Surveys with appropriate access followed the criteria outlined in the *EPBC Act Policy Statement 3.7: Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia* (DEWR 2007).

The extent of *Lomandra* grassland patches and Peppermint Box woodland were recorded using hand held Garmin GPS (accuracy +/- 10 m). Species diversity totals were obtained from a 50 x 50 m quadrat for each representative area. All species observed within the quadrats were recorded with totals compared against the benchmark criteria outlined in DEWNR (2007). Table 7 details the minimum criteria used for listing the Iron-grass Natural Temperate Grassland of South Australia. The flowchart in Figure 5 highlights the steps necessary to assess an area against the EPBC criteria for *Iron-grass Natural Temperate Grasslands of South Australia*.

Note: To meet the criteria an area must have either one, or both, of the Iron-grass species present out of *Lomandra multiflora* ssp. *dura* (Hard Mat-rush) or *Lomandra effusa* (Scented Mat-rush).

Table 8 details the minimum criteria used for listing the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

Areas of Condition Class A are considered the highest quality representation of the community. Condition Class B areas are also of high quality, but do not have the native species diversity of Condition Class A. Classes A and B are indicative of the listed ecological community. Condition Class C areas, which are typically significantly degraded (low condition), are not included as the listed ecological community, and therefore, do not trigger the 'significant test' of the EPBC Act. Condition Class C areas are still considered to be amenable to rehabilitation through measures such as weed control, natural regeneration and protection from grazing.

Table 7. Condition classes for Iron-grass Natural Temperate Grassland of South Australia.

Condition Class	Minimum Size	Diversity of Native Species[1]	No. of Broad-leaved Herbaceous Species[1] in addition to identified disturbance resistant species[2]	No. of Perennial Grass Species[1]	Tussock Count[3]
Listed ecological community					
A	0.1 ha	> 30	+10	≥5	1/m
B	0.25 ha	> 15	+3	>4	1/m
Degraded patches amenable to rehabilitation					
C		> 5	No minimum	≥1	No minimum

[1] As measured in a 50 m X 50 m quadrat;

[2] The following species are identified as disturbance resistant species: *Ptilotus spathulatus* forma *spathulatus; Sida corrugata; Oxalis perennans; Convolvulus erubescens; Euphorbia drummondii;* and, *Maireana enchylaenoides;* and,

[3] As measured along a 50 m transect.

Table 8. Condition classes for Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

Condition Class	Minimum Size	Diversity of Native Species[1]	No. of Broad-leaved Herbaceous Species[1] in addition to identified disturbance resistant species[2]	No. of Perennial Grass Species[1]
Listed ecological community				
A	0.1 ha	> 30	+10	≥5
B	1 ha	> 15	+3	≥2
Degraded patches amenable to rehabilitation				
C		> 5	No minimum	≥1

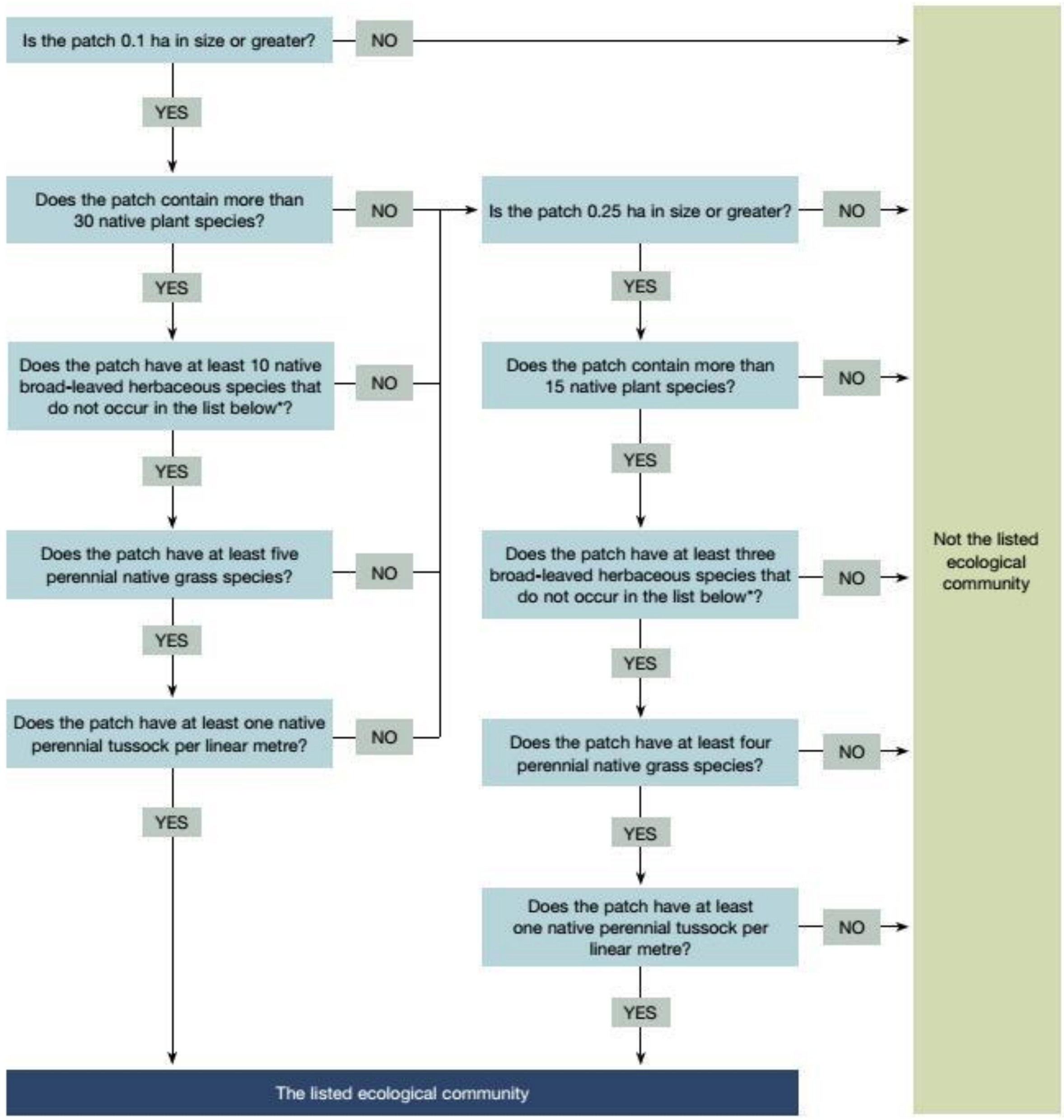
[1] As measured in a 50 m X 50 m quadrat;

[2] The following species are identified as disturbance resistant species: *Ptilotus spathulatus* forma *spathulatus; Sida corrugata; Oxalis perennans; Convolvulus erubescens; Euphorbia drummondii;* and, *Maireana enchylaenoides.*

4.3.4 Fauna

Fauna surveys were undertaken across all seasons in an attempt to detect seasonal variations, including possible migratory birds moving into the area and assessing the breeding success of raptors at identified nesting locations.

Flowchart 2. Iron-grass Natural Temperate Grassland of South Australia



* *Ptilotus spathulatus* forma *spathulatus*; *Sida corrugata*; *Oxalis perennans*; *Convolvulus augustissimus*; *Euphorbia drummondii*; and *Maireana enchylaenoides*.

Figure 5. Flowchart to assess an area against EPBC criteria for *Lomandra* Grassland.

Targeted fauna surveys were undertaken for birds and bats as these fauna groups are considered particularly at risk in regard to wind farm developments. Bird and bat surveys were performed in line with the following guidelines:

- Best Practice Guidelines for implementation of wind energy projects in Australia (Clean Energy Council 2013, with reference to additional detail on birds and bats in AusWind 2006) and
- National guidelines for detecting bats listed as threatened under the EPBC Act (AGDEWHA 2010).

The Best Practice Guidelines for implementation of wind energy projects in Australia outline three tiers of surveys for birds and bats (Table 9). The guidelines for Australia's threatened bats (AGDEWHA 2010) outline field survey expectations and survey techniques to detect nationally listed bat species. The guidelines are not mandatory and should be read in conjunction with the EPBC Act Significant Impact Guidelines (Commonwealth of Australia 2013).

The assessment of fauna habitat on site occurred to determine its suitability for threatened species that are known to occur in the broader area. The determination of species that were to be targeted during the field survey was made based on the desktop assessment, existing records and habitat suitability. All fauna species observed (e.g. via sightings, scats, diggings, tracks, burrows) during the spring 2015 survey were recorded. Any opportunistic sightings during the summer, autumn and winter bird surveys, as well as during the PBTL and bats surveys, were also recorded.

Survey methodology for these fauna groups is further described below.

Table 9. Auswind (2006) survey level requirements.

Survey Level	Bat	Bird
Level One – Initial surveys	Minimum requirement for assessing potential bat impacts at wind farms • Determine the bat species present on or near the site; • Identify if there are any priority species on or near the site; • Identify bat habitat (which may include habitat used for foraging, breeding, roosting, etc) of priority species on or near the wind farm; Level One investigation can act as pilot studies for higher level investigations, should these be required.	Minimum requirement for assessing potential bird impacts at wind farms • Determine the avian species present on or near the site; • Identify any priority species on or near the site; • Identify avian habitat (which may include habitat used for foraging, breeding, roosting, etc) of priority species on or near the site; Level One investigations may involve desk top surveys, but a site visit is usually required to verify desktop data (which are sometimes coarse in their resolution or incomplete). These surveys can also act as pilot studies for higher level investigations. For example, roaming surveys are a good way of identifying avian habitats and areas of avian use within a site, which will assist with the design of higher level investigations
Level Two – detailed surveys	Allow more detailed quantification for assessing potential impacts than is possible through Level One investigations. Investigations may involve (but not be limited to): • More detailed bat surveys, which quantify which species are present and relative activity levels, the numbers and how they use the site • Gradient studies may be a suitable method in some circumstances	Designed to obtain more detailed data on birds necessary for a risk assessment than was achieved from through Level One investigations. Studies may involve (but are not limited to): • Bird utilisation surveys, which quantify which species are present, their numbers and how they use the site. Data from these surveys can be input to collision risk models to estimate the potential collision risk of species; • Collision risk modelling. The advantage of using a model is that it is a more objective quantification of the risk than can be derived from a subjective assessment. Further, inputs can be modified based on advice from experts and Regulators. In the absence of empirical bird utilisation data, scenario modelling can be conducted, where a series of assumptions are input into the model to

Survey Level	Bat	Bird
		examine collision risk. Inputs can be varied to test an array of scenarios • Gradient studies may be a suitable method in some circumstances.
Level Three – targeted surveys	Investigate specific issues that level two investigations have been unable to adequately address. Studies may be (but are not limited to): • Population viability analysis for priority species (if one is available, or if there are sufficient data to undertake one); • Other modelling exercises; • Detailed studies examining a specific issue.	Investigate specific issues that Level Two investigations have been unable to adequately address. Studies may be (but are not limited to): • Population viability analysis for priority species (if a PVA is available, or if there are sufficient data to undertake one); • Other modelling exercises; • Detailed studies examining a specific issue.

4.3.5 Birds

An Auswind Level 2 bird survey was undertaken in September 2015 (spring), February 2016 (summer), April 2016 (autumn) and August 2016 (winter). Sixteen (16) monitoring point count sites were originally established in 2015 (Figure 6), with the aim being to sample a range of habitats and achieve a spread of sites within the project boundary. This was to ensure that site visits were timed to coincide with a range of seasons which would provide a better representation of both the resident and transient bird species, so that the entire bird community was identified.

Each point count was of a thirty minute duration, commencing after a five minute acclimatisation period. Point counts were conducted twice at each site, once in the morning and once in the afternoon. These were undertaken on two separate days to avoid temporal biasing of species present. Data collected for each point count observation were as follows:

- Species observed
- Number of individuals
- Height above ground (m) (minimum and maximum)
- Distance from observed (m)
- Behaviour:
  - Flying in a single direction – FLM
  - Flying (hovering or circling) over or around a single point – FLH
  - Foraging (feeding) on ground – FOG
  - Perching/resting/walking on ground – ROG
  - Perching/resting/climbing on trees or shrubs – ROT
- Direction of flight where possible.

Roaming surveys were undertaken through cleared cropping land to maximise the time spent conducting point count surveys within more suitable habitat areas, where bird abundance and diversity were expected to be greater. All opportunistic records of birds observed during the course of moving around the site were recorded. The gathered bird data was used to identify potential impacts of the proposed wind farm on bird species. A call play-back survey technique was used where it was deemed appropriate. In addition, the bird survey focused on key habitats for any threatened bird species identified as potentially occurring in the area.

Flight height and movement details were specifically recorded for ‘at-risk’ bird species; meaning those species with the potential to fly at heights within the rotor-swept area, making them at risk of turbine strike. Flight height and movement details were used to help assess the potential collision risk of bird’s species (refer to Section 4.4 for risk assessment methodology).

The maximum turbine height proposed for the Twin Creek Wind Farm is 180 m (at the blade tip). At these dimensions, the lowest extent of a rotating blade tip is approximately 45 m. For the purposes of this report, flights that are performed above 45 m over the top of the ridge are considered at-risk movements, as this air-space corresponds with the rotor-swept area of turbines. Refer to the Discussion (Section 5.3.8) for further details on the concept of at-risk and rotor swept area.

4.3.6 Targeted Wedge-tailed Eagle nest searches

The Wedge-tailed Eagle (*Aquila audax*) is often referred to as a flagship raptor species; although not a species of state or national conservation significance, it is iconic and readily identifiable to many people. The Wedge-tailed Eagle is an at-risk bird species in relation to wind farm developments due to its flight heights and flight behaviours.

All Wedge-tailed Eagle sightings and behaviours were recorded across the four seasonal surveys (spring 2015, summer 2016, autumn 2016 and winter 2016). Any eagles flying to and from the recorded nests, were recorded during the spring 2015 and winter 2016 surveys, when the nest checks were undertaken.

Spring 2015

Searches were conducted on foot through all woodland habitat across the site to locate Wedge-tailed Eagle nests and determine the breeding success (if any) of birds present. For each nest, the location, dimensions and signs of activity were recorded. Photographs of each of the nesting sites were taken and the occupancy of a nest site was assessed as well as its status. The presence of chick, fledgling or adult Wedge-tailed Eagles, in or near the nest, was recorded. Any Wedge-tailed Eagles flying from the area upon arrival were also recorded. Other parameters were also used as an indication of nest occupancy, such as fresh whitewash (bird excrement), prey remains on the ground beneath or within the nest and the presence of green leaves in the nest bowl (when views were available).

Winter 2016

Nests that were originally found during the spring 2015 survey, were again rechecked for breeding status during the winter (August) 2016 survey. This was undertaken at an optimal time of the year, when potential breeding pairs of eagles would have mated and should be sitting on nest (incubating an egg).

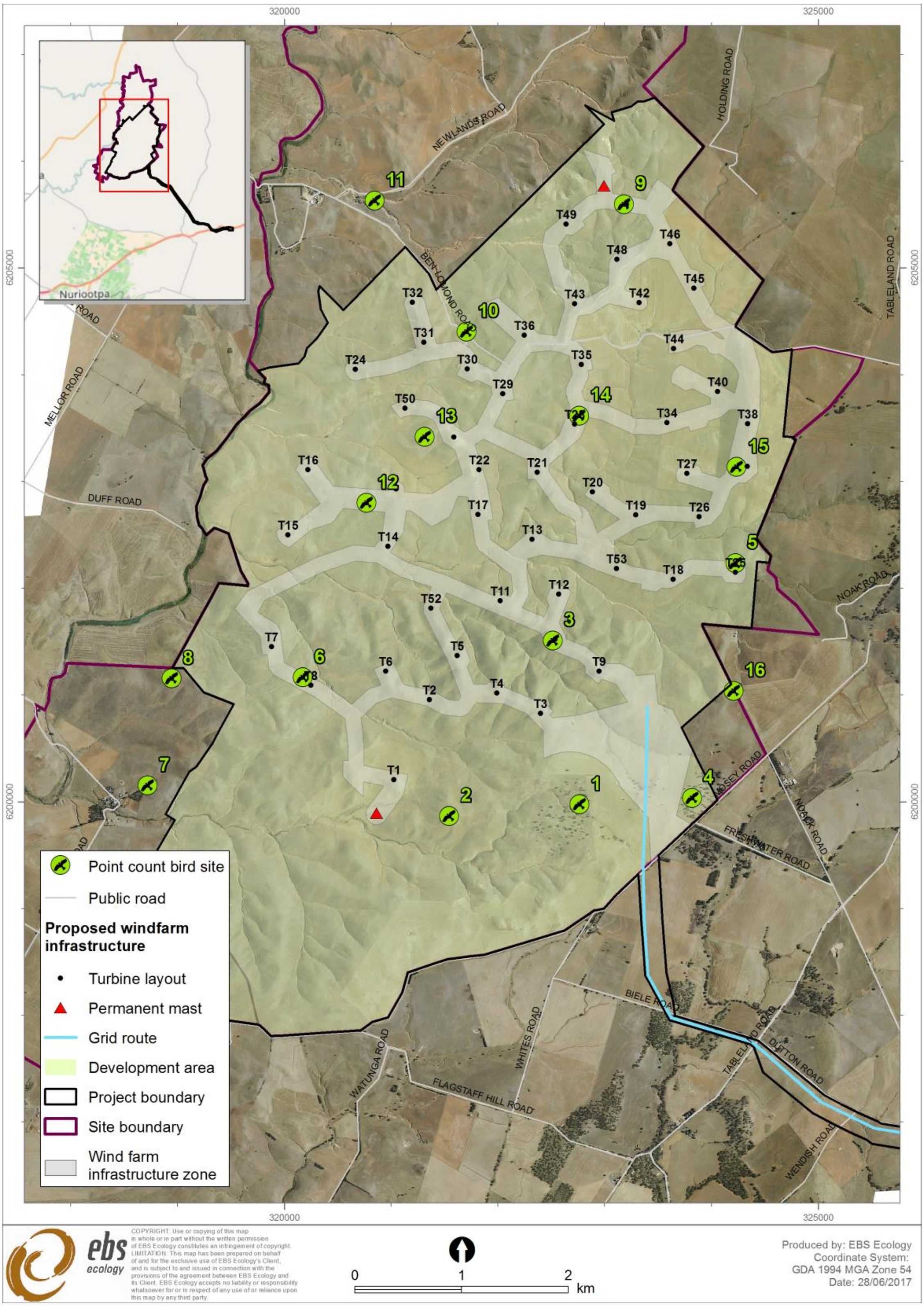


Figure 6. Bird survey locations across the Twin Creek Wind Farm site.

4.3.7 Targeted Peregrine Falcon nest searches

Along with the Wedge-tailed Eagle, the Peregrine Falcon (*Falco peregrinus*) was also targeted during the spring 2015 surveys, with potential nest locations and breeding status investigated. Suitable breeding habitat for Peregrines Falcons include rocky crevices and ledges, however, the species has also been known to utilise abandoned nests of other species e.g. Wedge-tailed Eagles. Rocky crevices and ledges were not typically present within the project boundary.

4.3.8 Bats

An Auswind Level 1 (Table 9) bat survey was performed in spring 2015. The spring survey encountered poor weather and a malfunction of one of the Anabat detectors, and therefore a subsequent survey was conducted in summer/early autumn 2016 (22 February - 4 March 2016). AnaBat detectors were set up at three locations across the site (Figure 7), and recorded bat calls from late afternoon until early the following morning. Anabat detectors were strategically placed within areas thought to be suitable habitat for bats to roost or forage within, and therefore, woodland areas which contained hollows for roosting and ‘fly-ways’ through the canopy were targeted for bat call activity (Figure 8).

Bat calls recorded on the AnaBat detectors were analysed and interpreted by Dennis Matthews in line with the reporting standards for echolocation call analysis developed by the Australasian Bat Society. The bat identifications made were based on a combination of manual and automated methods using either reference calls from the region or from species calls recorded outside the region, that are likely to represent the calls from species in the survey region. A species inventory was tabulated for each detector night and the number of calls for each species was recorded. Species identifications were only made if call identification was certain.

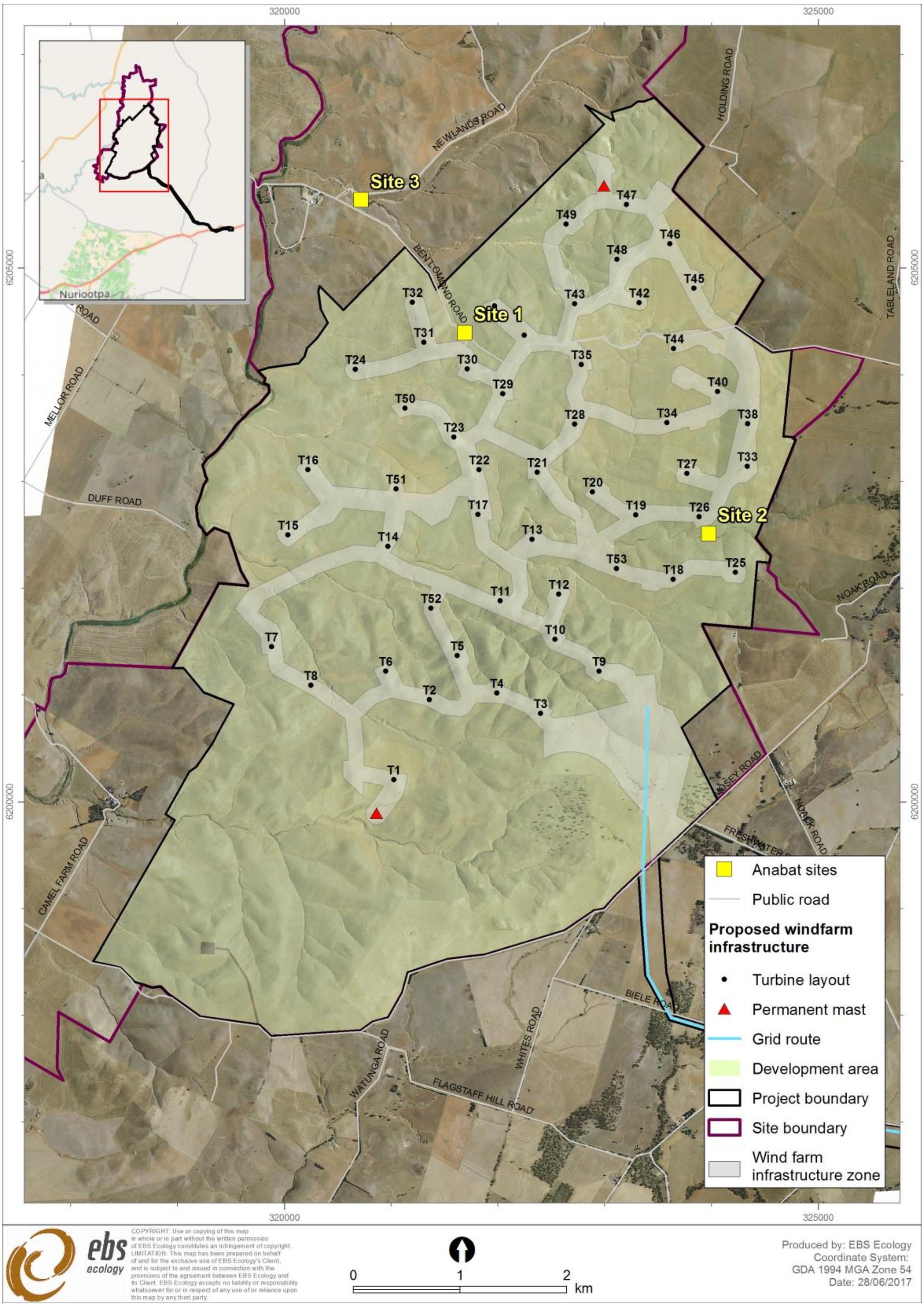


Figure 7. Bat survey locations across the proposed Twin Creek site.

Figure 8. Bird survey location typically set up within wooded areas across the proposed Twin Creek site.

4.3.9 Pygmy Blue-tongue Lizards

The habitats present within the project boundary were assessed for their suitability for the nationally endangered Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) during the initial flora and fauna assessment of the project site (8-11 September 2015).

A search for spider holes was undertaken within potential PBTL habitat, as well as opportune searches in other areas of potential habitat throughout the project boundary. The habitat was categorised for the PBTL as likely, possible and unlikely habitat. The habitat assessment was based on the habitat attributes provided in Table 10. A further categorisation was made based on the likely density of PBTL in an area (no lizards, low density, high density), using information gathered from each area within the project boundary. Known suitable Pygmy Blue-tongue Lizard habitat attributes versus unsuitable habitat attributes are summarised in Table 10.

Table 10. Categorisation of habitat suitability.

Attributes considered suitable habitat	Spider burrows within native or exotic grasslands; PBTLs have also been detected in highly modified treeless grasslands
	• Soil of heavy sandy loam (red-brown earth)
	• Foot slopes of hills
	• Sheltered areas of foot slopes
Attributes considered unsuitable habitat	Areas that have been previously cropped
	Areas lacking spider burrows
	Areas containing dense ground cover vegetation
	Steep terrain and exposed rocky ridgelines
	Overly rocky areas

Targeted Survey

Targeted searches for PBTL were undertaken by EBS. The survey effort for target areas was based on the experience of the EBS team and experience of researchers who have undertaken PBTL surveys for many years (J. Clayton pers. comm 2017 and M. Hutchinson pers comm 2016). The targeted PBTL survey was conducted over a two-week period (22 February – 4 March 2016) to cover as much of the survey area as possible focusing on the proposed infrastructure areas and at proposed turbine locations. An additional three-day survey was also conducted (5, 8 and 14 April 2016) to investigate areas of likely habitat for the presence of PBTL, which was to assist with turbine placement and associated infrastructure design. Extensive surveys were then undertaken in potential PBTL habitat across the entire project site over a five week period, between November 2016 and January 2017 (31/11/16 – 11/11/16; 22/11/16 – 25/11/16; 09/01/17 – 13/01/17) (Table 5). These surveys included any additional project areas, including the transmission corridors and varied turbine layout.

Suitable spider holes within infrastructure and turbine locations were inspected using a burrowscope during all targeted PBTL surveys. The presence or absence of a spider or PBTL within each hole was recorded. A GPS location was obtained for each general area within which spider holes were inspected. A typical PBTL burrow is shown in Figure 9.

Turbine locations

Each of the 51 turbine locations and transmission corridors were surveyed by one or two ecologists. The summer/autumn 2016 turbine surveys included the following steps:

1. The proposed turbine locations were predetermined by RES and coordinates provided. The location of proposed turbines was then marked using either the survey vehicle or a temporary survey peg.

2. A 100 x 100 m survey area was marked out using the turbine location as the centre point. Each of the four corners (north, east, south, west) of the survey area were temporarily marked using survey pegs. The use of the temporary survey markers provided a visual boundary of the survey area for the surveyors. A site photo was taken from the western corner looking towards the proposed turbine location. The surveyors started on opposite sides of the survey area and moved towards each other at 5 m intervals. All spider holes and/or PBTL burrows located were temporarily marked using a survey peg (a different colour to the boundary and turbine location survey pegs). Each surveyor carried a GPS and used the track log function which provided the ‘real time’ location of the surveyor which helped in aligning the 5 m transects.

3. Each of the temporarily marked holes and/or burrows were then checked with a fibre optic scope (‘Burrowscope’) to determine the presence of lizards. All locations of holes and/or burrows were recorded using a GPS. Data collected at each hole or burrow recorded hole/burrow occupancy (i.e. spider, debris, beetle, empty, PBTL). All holes not containing a PBTL have been described as being empty for the purpose in this report. Survey pegs were removed after inspecting each hole/burrow.

Figure 9. A Pygmy Blue-tongue Lizard burrow.

Subsequent surveys in the summer of 2016/2017 followed similar methods with the following amendments:

1. Turbine locations and transmission corridors were surveyed using marker pegs spaced out at 10m intervals to ensure surveyors covered all of the area. An interactive map on an iPad was used to ensure that areas within the boundaries of the project site were included in the search.

2. Burrows were inspected as the surveyors moved, removing the need to double-up on covering the same areas.

Track alignments

An extensive track network is required for the wind farm. Due to the large area requiring inspection for the proposed track alignments, a 40 m wide corridor was assessed (20 m either side of the midpoint of the access track). The surveys along the proposed track alignments were not as detailed as the 100 m x 100 m turbine surveys (undertaken during the initial flora and fauna assessment, 8-11 September 2015), due to the scale of the assessment.

PBTL surveys have not been conducted along the access routes outside of the development site. The access road clearance footprint is small (restricted to turn points); the final impact footprint will be subject to on ground survey prior clearance.

Transmission corridor

In the summer 2016/2017 surveys, corridors to proposed WTG were also inspected for PBTL. A 200m wide corridor was assessed. Surveys within corridors were not as extensive as within WTG infrastructure zones due to the large area that needed to be covered and the lower impact of the overhead line compared to WTG infrastructure zone. Targeted surveys were carried out in likely PBTL habitat and less time was spent in areas that consisted of possible PBTL habitat. All areas within the transmission corridors were, at a minimum, assessed for their likelihood of having PBTL occupants and potential density of lizards.

4.3.10 Flinders Ranges Worm-Lizard (Aprasia pseudopulchella)

As well as the nationally endangered PBTL, the habitats present within the project boundary were also assessed for their suitability for the nationally vulnerable Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*). This was also undertaken during the initial flora and fauna assessment of the project site (8-11 September 2015).

4.4 Risk assessment

A risk assessment matrix was used to qualitatively define the risk of the proposed Twin Creek Wind Farm on birds that performed at-risk movements within the project boundary. The assessment is an adaptation of the qualitative measures of likelihood and consequence used in the Australian Defence Risk Management Framework (DRMF) (Gaidow and Boey 2005).

The DRMF provided generic guidance on the introduction and ongoing implementation of a risk management process; it may be applied to different activities or operations of any corporate, community or public sector organisation (Gaidow and Boey 2005). This risk assessment matrix considered the risk consequences (impact or magnitude of effect) and likelihood (measured by frequency or probability) of risk occurrence to combine them into the level of risk.

The risk assessment methodology used within the DRMF was adapted to a science based situation to include likelihood and consequence of an event on a species or local population. EBS Ecology used the risk assessment matrix to qualitatively define the risk of a proposed wind monitoring mast on birds within numerous proposed wind farms located in the mid-north of South Australia. The risk matrix was accepted (when previously used by EBS Ecology) by the Environment, Resources and Development (ERD) Court. State threatened species, raptors and migratory species were targeted in the assessment. This was based on bird species that had been identified as potentially occurring on site (through database searches) and those species that had been previously recorded on site.

Likelihood was defined as how likely is mortality from collision to occur, and consequence was defined by significance of associated impact on species viability (Table 11). A category of A to E was used to define likelihood, ranging from chronic (the event is expected to occur in most circumstances) to rarely (where the event may occur only in exceptional circumstances). A category of one to five was used to define consequence, where one equated to nil/insignificant (individuals may be affected, but viability of local population was not impacted) and five equated to catastrophic disaster (potential to lead to collapse of a species) (Table 11). Table 12 outlines the qualitative risk analysis matrix, which summarises four levels of impact: low, medium, high and extreme.

If the level of risk was determined as high to extreme, then resulting impact on an individual species and local population would be unacceptable. If the level of risk was categorised as medium, then all efforts should be made to mitigate against potential impact on the species. If the level of risk was low, then impact would be restricted to an individual level and impact on a species would be unlikely to affect the viability of a local population.

Table 11. Qualitative measures of likelihood and consequence (adopted from AS/NZS 4360:1999).

Likelihood (How likely is mortality from collision to occur)	**Consequence (Significance of associated impact on species viability)**
Rating Definition	**Rating Definition**
A Chronic: The event is expected to occur in most circumstances	**5 Catastrophic Disaster:** potential to lead to collapse of species
B Frequent: The event probably will occur in most circumstances (e.g. weekly to monthly).	**4 Major**: Critical event, very likely to have significant impact on species
C Likely: The event should occur at some time i.e. once in a while	**3 Moderate**: likely to have impact on population, potential to impact on long term viability under some scenarios
D Unlikely: The event could occur at some time	**2 Minor**: may have impact on local population, no impact on species
E Rarely: The event may occur only in exceptional circumstances	**1 Insignificant**: individuals may be affected, but viability of local population not impacted

Table 12. Qualitative Risk Analysis Matrix – Level of Risk (adopted from AS/NZS 4360:1999 and HB 143:1999).

Likelihood	**Consequences**				
	Insignificant 1	**Minor 2**	**Moderate 3**	**Major 4**	**Catastrophic 5**
A (chronic)	High	High	Extreme	Extreme	Extreme
B (frequent)	Medium	High	High	Extreme	Extreme
C (likely)	Low	Medium	High	Extreme	Extreme
D (unlikely)	Low	Low	Medium	High	Extreme
E (rarely)	Low	Low	Medium	High	High

4.5 Limitations

The findings and conclusions expressed by EBS Ecology are based solely upon information in existence at the time of the assessments. Field data collected during the spring, summer, autumn and winter surveys, combined with database records and background research, is part the way to providing an adequately detailed assessment of the flora and fauna that occurs, and is likely to occur, within the project boundary.

The 2015 surveys for the turbine area were undertaken in spring when plants are generally in their visible life phase and easy to identify. However, follow up surveys in 2016 and 2017 (covering additional infrastructure components such as the substation and proposed transmission line); were undertaken in early summer and early autumn when the site had dried off significantly when the site had largely dried off and some understorey species were more difficult to identify or in their dormant phase. This is particularly important for Peppermint Box woodlands and *Lomandra* grasslands located in the Transmission Line and Terminal substation, requiring assessment to determine if they qualified as listed communities under the EPBC Act. It could not be determined with certainty whether sites qualified, except in some cases. However, a likelihood of qualifying is provided.

Existing flora and fauna records were sourced from the Biological Database of South Australia (BDBSA). The BDBSA only includes verified flora and fauna records submitted to the Department of Environment, Water and Natural Resources (DEWNR) or partner organisations. Although much of the BDBSA data has been through a variety of validation processes, the lists may contain errors. It should be noted that the spatial precision of the BDBSA data ranges from 5 m to over 25 km. Hence the location of mapped BDBSA records may not reflect their exact location.

Unforeseen rainy conditions were experienced on the first two days of the spring 2015 survey (8-9 September 2015). Prevailing weather conditions can impact on survey results, with rainy weather possibly leading to fewer observations of birds and bats. This unforeseen bad weather resulted in an additional bat survey being undertaken and also provided weight to the decision to undertake bird surveys across all four seasons (to account for variability).

AnaBat detectors aid in the identification of bat species and levels of bat activity, however, the technology does have limitations. Certain bat species are readily identified via AnaBat recordings however, others cannot be distinguished to species level by a call recording alone. For example, multiple calls from a single bat can be indistinguishable from single calls from multiple bats (Law *et al.* 1998). AnaBats are not able to determine flight heights performed by bats. The AnaBat recording range varies with temperature and humidity, therefore, the range being sampled is not equal across the nights. Different species are active at different times during the night; this means that depending on weather conditions, not all species will be recorded equally (D. Matthews, pers. comm. 2013).

A range of bird survey locations were positioned within different habitat types within the project boundary. Naturally some of these bird sites were situated along ridgelines in order to observe birds utilising this part of the landscape. A bias toward the number of observations recorded along the ridgeline may have been a result of this site placement.

In the summer/autumn 2016 survey, the ground cover vegetation was at an optimal stage (reasonably dry and lacked growth) for conducting spider holes/PBTL burrow searches. The lack of vegetative growth assisted the surveyor(s) to detect spider holes/PBTL burrows. For the duration of the summer 2016/2017 survey, vegetation cover was high and dense, due to higher than average rainfall throughout the season. This meant that the probability of detecting spider holes/PBTL burrows was lower than usual.

The PBTL survey aimed at examining all spider holes within 100 x 100 m turbine survey areas, however, it is possible some spider holes were missed as they are difficult to detect. Broader PBTL population surveys were not conducted during the both the summer/autumn 2016 and summer 2016/2017 assessments. The location of each spider hole was recorded using a handheld global positioning system (GPS), accurate to +/- 10 m. Pygmy Blue-tongue Lizard habitat across the infrastructure boundaries was assessed, however, due to the large area to be assessed, detailed surveys were not undertaken to the full 200 m. Information gathered in extensively searched areas was used to inform decisions made on the likelihood of PBTL occupation in areas that were not able to be extensively searched.

5 RESULTS

5.1 Desktop assessment

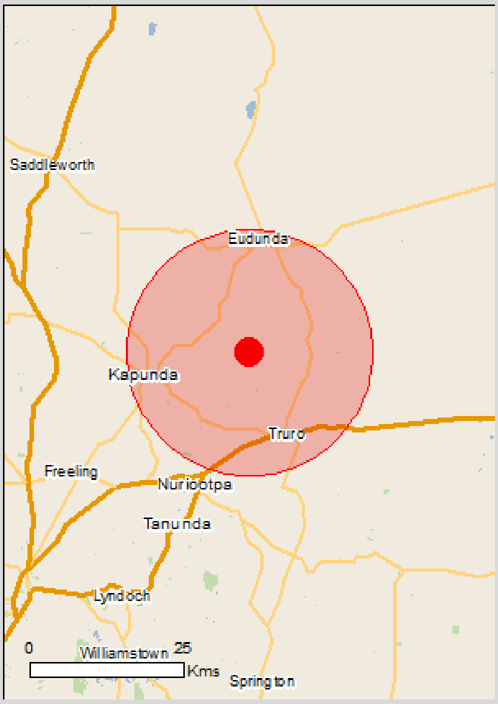
A Protected Matters database search was performed for the project boundary within a 20km buffer from a central point at the project site (Latitude 34.31, Longitude 139.07). The database search was used to identify flora and fauna species as well as threatened ecological communities of national environmental significance listed under the EPBC Act that may occur within the project boundary (DoE 2015).

A search of the Biological Database of South Australia (BDBSA) was undertaken to identify flora and fauna species previously recorded within the project boundary, also with a 20 km buffer (DEWNR 2015).

5.1.1 Matters of national environmental significance

The results from the EPBC Protected Matters Search is summarised below. The 20km search buffer identified 34 threatened species, ten migratory species and three ecological communities (Table 13).

Table 13. Summary of results from EPBC Protected Matters Search.

Search area	Matters of National Environmental Significance	20km
	World Heritage Properties	None
	National Heritage Places	None
	Wetlands of International Importance	None
	Great Barrier Reef Marine Park	None
	Commonwealth Marine Areas	None
	Listed Threatened Ecological Communities	3
	Listed Threatened Species	34
	Listed Migratory Species	10
	Listed Marine Species	15
	Whales and Other Cetaceans	None
	Other Matters Protected by the EPBC Act	
	Commonwealth Heritage Places	None
	Critical Habitats	None
	Commonwealth Land	None
	Commonwealth Reserves Terrestrial	None
	Commonwealth Reserves Marine	None
	Extra Information	
	State and Territory Reserves	6
	Regional Forest Agreements	None
	Invasive Species	33
	Nationally Important Wetlands	None
	Key Ecological Features (Marine)	None

5.1.2 Threatened ecological communities

Three threatened ecological communities were assessed as potentially occurring within the project boundary:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions;
- Iron-grass Natural Temperate Grassland of South Australia; and
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

Buloke woodlands do not occur in the project area.

The Iron-grass Natural Temperate Grassland of South Australia is listed as Critically Endangered under the EPBC Act. It comprises a grassland dominated by Iron-grasses (*Lomandra multiflora* ssp. *dura* and/or *Lomandra effusa*), with tussock-forming (clumping) grasses, low shrubs and a range of other native plants in the ground layer. Trees and tall shrubs are generally absent or very sparse (less than 10 % cover). To qualify as the EPBC listed community, patches have to be at least 0.1 ha in size and meet native species diversity and density criteria (DEWR 2007).

Iron-grass Grasslands are unique to South Australia, and are predominantly distributed on the slopes and hills of the Mount Lofty Ranges, west of the River Murray and throughout the Mid North. Iron-grass Grasslands typically grow within loam to clay loam soil, with an estimated clay content of 30-35%. Geologically, Iron-grass Grasslands are often associated with surface pebbles and shale or sandstone rocky outcrops. Major threats to Iron-grass Grasslands include clearance and fragmentation, inappropriate grazing regimes, and weed invasion (DEWR 2007).

Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia was listed as critically endangered under the EPBC Act in 2007, due to a severe decline in distribution and an ongoing loss of integrity. The dominant tree species is *Eucalyptus odorata*, however, other species of Eucalypt commonly co-occur. A grassy understorey is most often present, although some shrubs may exist such as *Bursaria spinosa* (Sweet Bursaria) and *Acacia pycnantha* (Golden Wattle). The majority of remnants occur between Victor Harbor and Port Augusta, encompassing the mid-north region, as well as the Adelaide region, Mount Lofty Ranges and part of Yorke Peninsula. The key threats to this community are clearing, grazing and invasion by weeds (DEWR 2007).

5.1.3 Threatened flora

The 20km EPBC and BDBSA database searches identified 20 nationally listed flora species under the EPBC Act as potentially occurring or having suitable habitat potentially occurring within the project boundary. The 20 species consisted of:

- 1 species listed as Critically Endangered;
- 11 species listed as nationally endangered; and
- 8 species listed as nationally vulnerable.

Their likelihood of occurrence within the project boundary is provided in Table 14. Seven out of the 20 species, identified by the EPBC database search, have been determined as possibly occurring within the project boundary. Peep Hill Hop-bush (*Dodonaea subglandulifera*), which is listed as nationally and State endangered, has a record north of the project site, just south of Eudunda (Figure 10).

Table 14. Nationally threatened flora species potentially occurring within the project boundary.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Acacia glandulicarpa	Hairy-pod Wattle	VU	E	1		Possible
Acacia menzelii	Menzel's Wattle	VU	V	1		Unlikely
Acacia spilleriana	Spiller's Wattle	EN	E	2	11/5/1982	Possible
Caladenia argocalla	White-beauty Spider-orchid	EN	E	1	1/5/1995	Unlikely
Caladenia behrii	Pink-lipped Spider Orchid	EN	E	1		Unlikely
Caladenia colorata	Coloured Spider-orchid	EN	E	2	1/09/1979	Unlikely
Caladenia gladiolata	Bayonet Spider-orchid	EN	E	1		Unlikely
Caladenia macroclavia	Large-club Spider-orchid	EN	E	1		Unlikely
Caladenia tensa	Greencomb Spider-orchid	EN		1		Possible (southern extent))
Caladenia woolcockiorum	Woolcock's Spider-orchid	VU	E	1		Unlikely
Caladenia xantholeuca	Flinders Ranges White Caladenia	EN	E	1		Unlikely
Dodonaea procumbens	Trailing Hop-bush	VU	V	1		Possible
Dodonaea subglandulifera	Peep Hill Hop-bush	EN	E	1	13/9/1987	Possible
Euphrasia collina ssp. osbornii	Osborn's Eyebright	EN	E	1		Possible (southern extent
Hibbertia tenuis		CE	E	1		Unlikely
Olearia pannosa subsp. pannosa	Silver Daisy-bush	VU	V	1	26/11/1986	Possible (record near Truro)
Prasophyllum pallidum	Pale Leek-orchid	VU	R	1	11/11/1976	Unlikely
Prasophyllum pruinosum	Plum Leek-orchid	EN	V	1		Unlikely
Swainsona pyrophila	Yellow Swainson-pea	VU	R	1		Unlikely
Thelymitra matthewsii	Spiral Sun-orchid	VU	E	1		Unlikely

Conservation status

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level.

Source of Information

1. **EPBC Act Protected Matters Report (data extraction 13/8/2015) – 20 km buffer applied to project site.**
2. **Biological Database of South Australia data extract (data extraction 5/8/2015) - 20 km buffer applied to project site.**

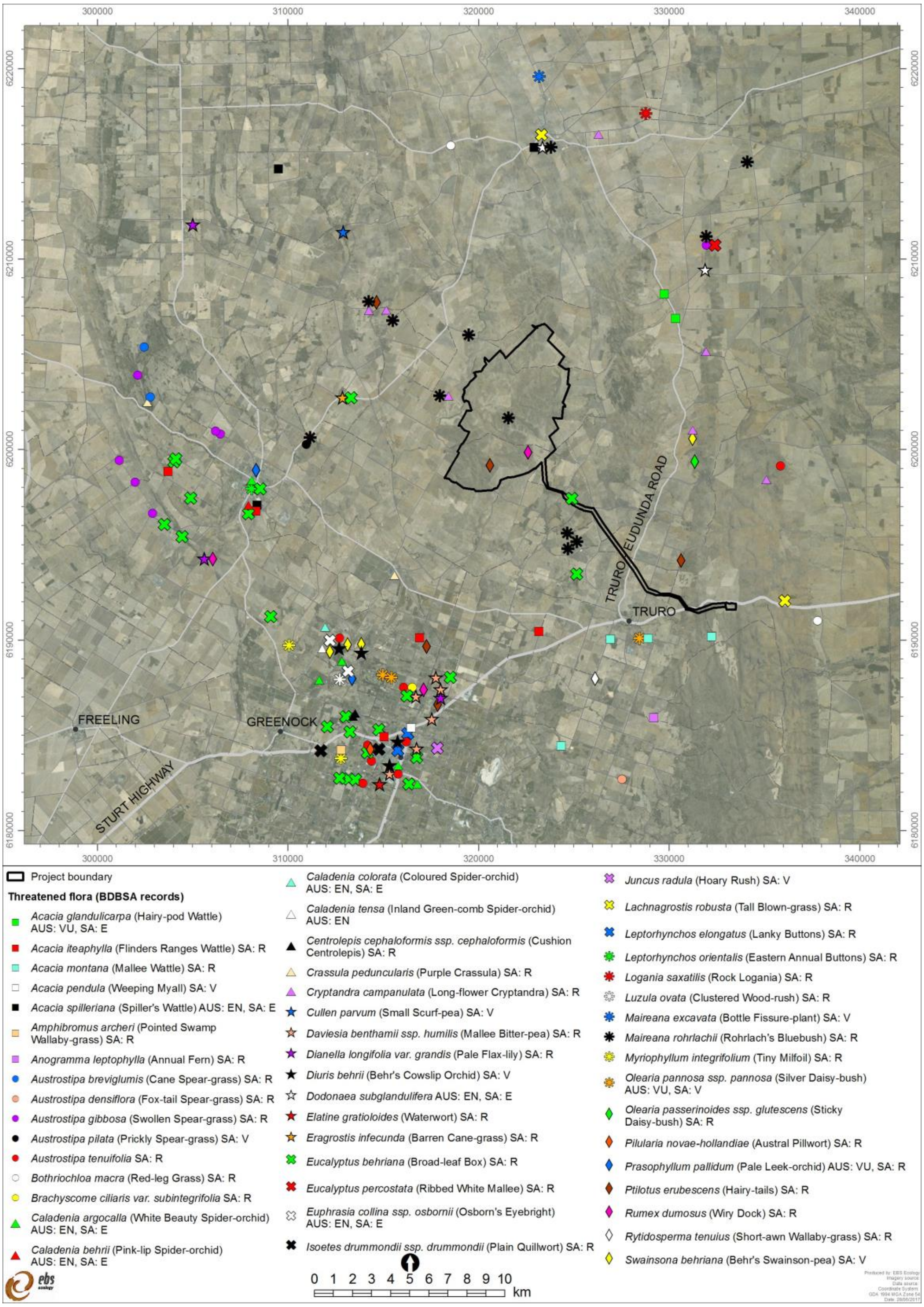


Figure 10. Threatened flora (BDBSA) clipped to a 20km search.

The BDBSA search identified 39 state listed flora species listed under the NPW Act, as having previous records within 20 km of the centre of the project site, (in addition to the 19 nationally threatened plants). Of these 39 species, seven were State vulnerable and 32 were State rare. Their likelihood of occurrence within the project boundary is provided in Table 15. Four species are known to the project site and one has been determined as likely to occur within the project boundary (Table 15). Those species known to occur and determined as likely to occur are discussed in further detail in Section 6.1. See Appendix 5 for all BDBSDA flora records within 20km of the site.

Table 15. Threatened flora species potentially occurring within the project boundary (BDBSA search – 20km buffer).

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Acacia iteaphylla	Flinders Ranges Wattle		R	2	11/07/2002	Possible (records close to site at Truro)
Acacia montana	Mallee Wattle		R	2	24/11/1975	Possible (records close to site at Truro)
Acacia pendula	Weeping Myall		V	2	21/03/2001	Unlikely
Amphibromus archeri	Pointed Swamp Wallaby-grass		R	2	24/11/1992	Unlikely
Anogramma leptophylla	Annual Fern		R	2	18961101	Unlikely
Austrostipa breviglumis	Cane Spear-grass		R	2	12/04/2002	Possible
Austrostipa densiflora	Fox-tail Spear-grass		R	2	20/10/1993	Possible
Austrostipa gibbosa	Swollen Spear-grass		R	2	10/12/2013	Possible
Austrostipa pilata	Prickly Spear-grass		V	2	19/10/2012	Possible
Austrostipa tenuifolia			R	2	30/11/2005	Possible
Bothriochloa macra	Red-leg Grass		R	2	4/04/2000	Possible (records close to term substation)
Brachyscome ciliaris var. *subintegrifolia*			R	2	1/08/2004	Possible
Centrolepis cephaloformis ssp. *cephaloformis*	Cushion Centrolepis		R	2	14/11/1996	Unlikely
Crassula peduncularis	Purple Crassula		R	2	30/09/1993	Possible
Cryptandra campanulata	Long-flower Cryptandra		R	2	13/05/2015	Likely
Cullen parvum	Small Scurf-pea		V	2	1/10/1912	Possible
Daviesia benthamii ssp. *humilis*	Mallee Bitter-pea		R	2		Unlikely
Dianella longifolia var. grandis	Pale Flax-lily		R	2	21/10/2012	Possible
Diuris behrii	Behr's Cowslip Orchid		V	2	28/09/2010	Possible

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Elatine gratioloides	Waterwort		R	2	25/10/1992	Unlikely
Eragrostis infecunda	Barren Cane-grass		R	2	12/02/2000	Possible
Eucalyptus behriana	Broad-leaf Box		R	2	8/05/2015	Known
Eucalyptus percostata	Ribbed White Mallee		R	2	10/12/2013	Unlikely
Isoetes drummondii ssp. *drummondii*	Plain Quillwort		R	2	9/10/1996	Possible
Juncus radula	Hoary Rush		V	2	25/10/1992	Possible
Lachnagrostis robusta	Tall Blown-grass		R	2	12/02/2000	Possible
Leptorhynchos elongatus	Lanky Buttons		R	2	18/09/1965	Unlikely
Leptorhynchos orientalis	Eastern Annual Buttons		R	2	24/09/1938	Unlikely
Logania saxatilis	Rock Logania		R	2	24/08/1946	Unlikely
Luzula ovata	Clustered Wood-rush		R	2	24/11/1992	Unlikely
Maireana excavata	Bottle Fissure-plant		V	2	2/10/1992	Possible
Maireana rohrlachii	Rohrlach's Bluebush		R	2	11/05/2015	Known
Myriophyllum integrifolium	Tiny Milfoil		R	2	27/01/1993	Unlikely
Olearia passerinoides ssp. *glutescens*	Sticky Daisy-bush		R	2	5/04/1987	Possible
Pilularia novae-hollandiae	Austral Pillwort		R	2	25/10/1992	Unlikely
Ptilotus erubescens	Hairy-tails		R	2	19/10/2012	Known
Rumex dumosus	Wiry Dock		R	2	21/10/2012	Known
Rytidosperma tenuius	Short-awn Wallaby-grass		R	2	11/11/1993	Possible

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Swainsona behriana	Behr's Swainson-pea		V	2	28/09/2010	Possible

<u>Conservation status</u>

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level.

<u>Source of Information</u>

2. **Biological Database of South Australia data extract (data extraction 5/8/2015) - 20 km buffer applied to project site.**

5.1.4 Threatened and migratory fauna species

The 20km search identified 26 nationally listed fauna species under the EPBC Act as potentially occurring or having suitable habitat potentially occurring within the project boundary (Table 16). These consisted of:

- Two fish species, one critically endangered and one vulnerable;
- 21 bird species: three listed as critically endangered, three endangered, two vulnerable, ten as migratory and three as marine;
- One mammal species listed as vulnerable and
- Two reptile species; one listed as nationally endangered and one as vulnerable.

A summary of these species and comment regarding their likelihood of occurrence within the project boundary provided in Table 16. Three out of the 26 identified fauna species, were determined as possibly occurring within the project boundary. The Rainbow Bee-eater (*Merops ornatus*) and Pygmy Blue-tongue Lizard (PBTL) are known to the site and were observed during the spring 2015 survey. The PBTL was also observed during the summer/autumn 2016 and summer 2017 targeted surveys.

The two species that are known to occur within the project boundary are discussed in further detail in Section 6.2.

The BDBSA search identified 30 state listed fauna species under the NPW Act as having previous records within 20 km of the centre of the project boundary (Table 17), consisting of:

- Two mammal species listed as State endangered, which were both determined as unlikely to occur and one mammal species listed as State rare which was determined as possibly occurring within the project boundary;
- 26 avian species were listed. One species is known to the project site and was observed during the spring 2015 survey, the Blue-winged Parrot (*Neophema chrysostoma*). Nine species were determined as possibly occurring within the project boundary and 16 were determined as unlikely; and
- One reptile species listed as State rare.

A summary of these species and comment regarding their likelihood of occurrence within the project boundary is provided in Table 17. BDBSA records of threatened fauna within 20 km of the project site are shown in Figure 11. See Appendix 4 for all BDBSDA fauna records within 20km of the site

Threatened fauna species known to the project site are discussed further in Section 6.2.

Table 16. Nationally threatened fauna species potentially occurring within the project boundary.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Fish						
Galaxias rostratus	Flathead Galaxias	CE		1		Unlikely
Maccullochella peelii	Murray Cod	VU		1		Unlikely
Aves						
Apus pacificus	Fork-tailed Swift	Mi, Ma		1		Possible
Ardea alba	Great Egret	Ma, Mi, W		2	24/11/01	Possible – fly over
Ardea ibis	Cattle Egret	Ma, Mi, W		1		Possible – fly over
Botaurus poiciloptilus	Australasian Bittern	EN	V	1		Unlikely
Calidris ferruginea	Curlew Sandpiper	CE, Ma		1		Unlikely
Cinclosomosa punctatum anachoreta	Spotted Quail-thrush	CE		1		Unlikely
Gallinago hardwickii	Latham's Snipe	Ma, Mi, W	R	1		Unlikely
Haliaeetus leucogaster	White-bellied Sea-Eagle	Ma	E	1		Unlikely
Hirundapus caudacutus	White-throated Needle-tail	Mi, T		1		Unlikely
Leipoa ocellata	Malleefowl	VU	V	1		Unlikely
Merops ornatus	Rainbow Bee-eater	Mi, T		2	EBS Surveys	Known
Motacilla cinerea	Grey Wagtail	Ma		1		Unlikely
Motacilla flava	Yellow Wagtail	Ma, Mi, T		1		Unlikely
Myiagra cyanoleuca	Satin Flycatcher	Ma, Mi, T	E	1		Unlikely
Numenius madagascariensis	Eastern Curlew	Ma		1		Unlikely
Pandion haliaetus	Eastern Osprey	Ma, Mi, W	E	1		Unlikely
Pedionomus torquatus	Plains-wanderer	CE	E	1		Unlikely
Pezoporus occidentalis	Night Parrot	EN		1		Unlikely
Rostratula australis	Australian Painted Snipe	EN, Ma	V	1		Unlikely

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Tringa nebularia	Common Greenshank	Ma, Mi, W		1		Unlikely
Zoothera lunulata halmaturina	Bassian Thrush	VU		1		Unlikely
Mammals						
Pteropus poliocephalus	Grey-headed Flying-fox	VU		1		Unlikely
Reptiles						
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		1		Possible
Tiliqua adelaidensis	Pygmy Blue-tongue Lizard	EN	E	2	EBS Surveys	Known

Conservation status

Aus: Australia (Environment Protection and Biodiversity Conservation Act 1999). SA: South Australia (National Parks and Wildlife Act 1972). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level. Mi: listed as migratory under the EPBC Act. Ma: listed as marine under the EPBC Act. MI, T: listed as migratory terrestrial under the EPBC Act. Mi, W: listed as migratory wetland under the EPBC Act.

Source of Information

1. **EPBC Act Protected Matters Report (data extraction 13/8/2015) – 20 km buffer applied to project boundary.**
2. **Biological Database of South Australia data extract (data extraction 5/8/2015) - 20 km buffer applied to project boundary.**

Table 17. State threatened fauna species potentially occurring within the project boundary (20km buffer).

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Mammals						
Dasyurus viverrinus	Eastern Quoll		E	2	1/1/1880	Unlikely
Bettongia lesueur	Burrowing Bettong	EX	E	2	1/1/1922	Unlikely
Trichosurus vulpecula	Common Brushtail Possum		R	2	1/01/1988	Possible
Aves						
Anas rhynchotis	Australasian Shoveler		R	2	27/01/2006	Unlikely
Anhinga novaehollandiae	Australasian Darter		R	2	27/1/2003	Unlikely
Ardeotis australis	Australian Bustard		V	2	13/7/1985	Unlikely
Biziura lobata	Musk Duck		R	2	27/1/2003	Unlikely
Corcorax melanorhamphos	White-winged Chough		R	2	8/8/2013	Possible
Cladorhynchus leucocephalus	Banded Stilt		V	2	1/09/2000	Unlikely
Falco peregrinus	Peregrine Falcon		R	2	1/8/2002	Possible
Falcunculus frontatus	Crested Shrike-tit		R	2	9/02/2012	Possible
Gerygone fusca	Western Gerygone		R	2	2/12/1985	Unlikely
Lichenostomus cratitius	Purple-gaped Honeyeater		R	2	1/1/1985	Unlikely
Melanodryas cucullata cucullata	Hooded Robin		R	2	1/9/2002	Possible
Melithreptus gularis	Black-chinned Honeyeater		V	2	28/11/2003	Unlikely
Microeca fascinans fascinans	Jacky Winter		R	2	1/4/1999	Possible
Myiagra inquieta	Restless Flycatcher		R	2	1/6/2002	Unlikely
Neophema chrysostoma	Blue-winged Parrot		V	2	26/10/2011	Known
Neophema elegans	Elegant Parrot		R	2	1/01/2006	Possible
Oxyura australis	Blue-billed Duck		R	2	27/1/2002	Unlikely
Pachycephala inornata	Gilbert's Whistler		R	2	1/9/2001	Unlikely

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)	Likelihood of occurrence within project area
		Aus	SA			
Petroica boodang	Scarlet Robin		R	2	1/11/1985	Unlikely
Plectorhyncha lanceolata	Striped Honeyeater		R	2	11/06/1985	Unlikely
Polytelis anthopeplus	Regent Parrot	V	V	2	21/11/1997	Unlikely
Stagonopleura guttata	Diamond Firetail		V	2	1/9/2002	Possible
Turnix varius	Painted Button-quail		R	2	9/02/2012	Possible
Zoothera lunulata	Bassian Thrush		R	2	1/11/1985	Unlikely
Reptiles						
Morelia spilota	Carpet python		R	2	8/07/1963	Unlikely

Conservation status

Aus: Australia (Environment Protection and Biodiversity Conservation Act 1999). SA: South Australia (National Parks and Wildlife Act 1972). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level. Mi: listed as migratory under the EPBC Act. Ma: listed as marine under the EPBC Act.

Source of Information

2. **Biological Database of South Australia data extract (data extraction 5/8/2015) - 20 km buffer applied to project boundary.**

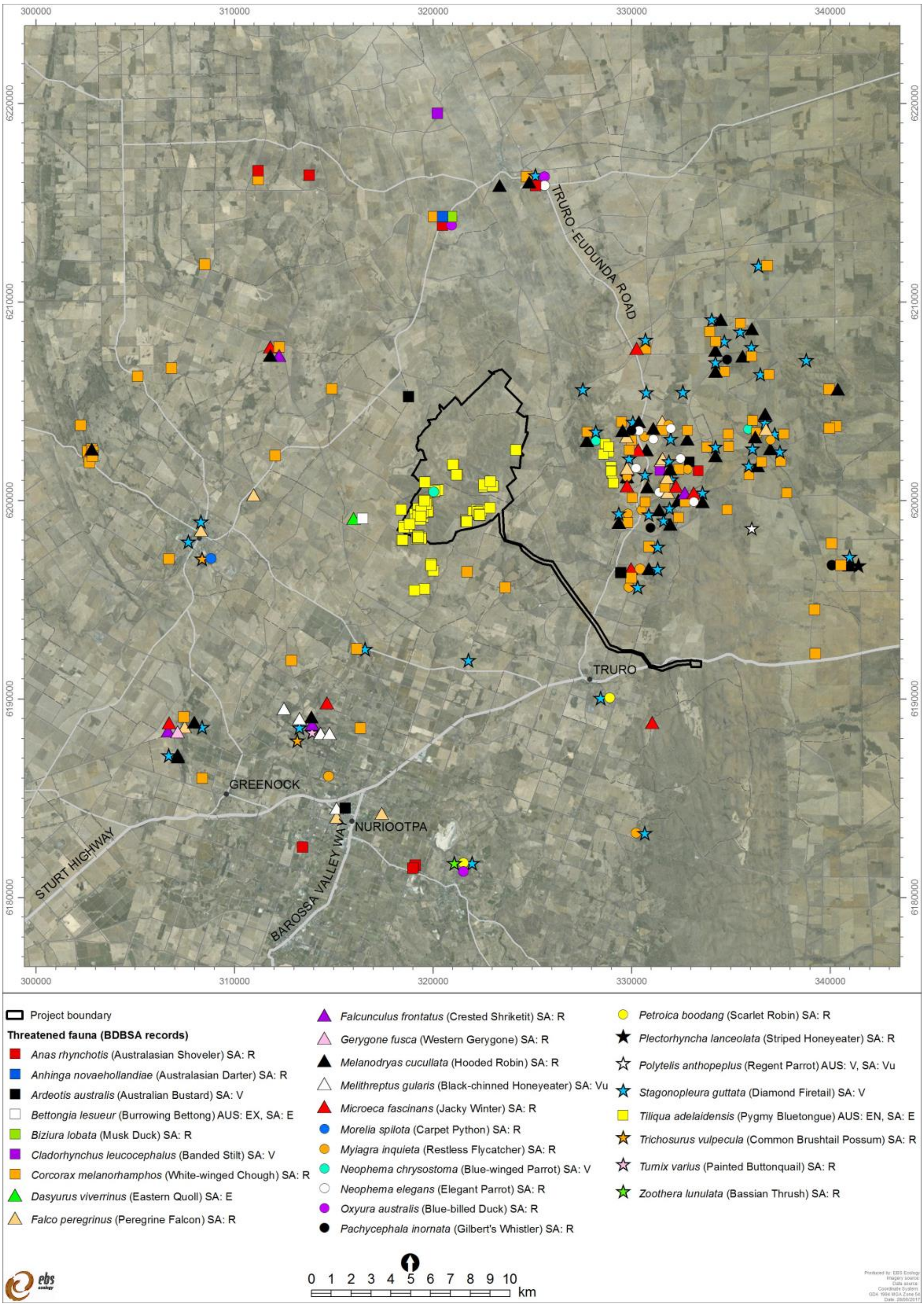


Figure 11. Threatened fauna (BDBSA) clipped to a 20km search.

5.2 Field survey

The spring 2015 flora and fauna assessment was conducted from 8 to 11 September 2015. The flora and fauna survey included a general vegetation / habitat assessment and condition rating of the vegetation within the main turbine area of the project boundary (infrastructure area), and a bird and bat survey. A vegetation assessment of additional infrastructure areas such as the main substation, terminal substation, access tracks, construction compound and transmission line, were completed 23, 24, 29 and 30 November 2016, 1 December 2016 and mostly recently on 5 April 2017 (Table 5).

5.2.1 Vegetation associations

Eleven vegetation associations were mapped within the project boundary, with a Significant Environmental Benefit (SEB) condition range of 0:1 to 6:1 based on vegetation condition alone. In line with NVC policy, the ratings for some areas may increase if they provide important habitat for threatened species. This will be described further in the Native Vegetation Clearance Report.

Table 18 provides an overall summary of the vegetation associations. Table 19 to Table 29 describes each association in more detail with photographic representation in Figure 12 to Figure 29. Figure 30 to Figure 35 shows vegetation associations and SEB condition ratios within the project boundary (proposed infrastructure area, transmission line and terminal substation).

Table 18. Overall summary of vegetation associations.

	Vegetation association	Area	Condition
1	*Lomandra effusa* + *Austrostipa sp*. grasslands	196.2 ha	1:1-6:1
2	*Austrostipa sp*. grassland	1751.7 ha	1:1-5:1
3	Planted species	21.8 ha	0:1
4	*Eucalyptus leucoxylon +/- Eucalyptus porosa +/- Callitris gracilis* open woodland	64.7 ha	2:1-6:1
5	*Juncus spp.* (Rush) and *Juncus pallidus* (Pale rush) Sedgeland *+/- Phragmites australis* (Common Reed)	52.1 ha	3:1
6	Cropping	1388.8 ha	0:1
7	*Eucalyptus porosa+/- Eucalyptus odorata+/- Eucalyptus gracilis* open woodland	2.4 ha	4:1
8	Pasture grassland / exotic grassland	868.2 ha	0:1-1:1
9	*Eucalyptus odorata +/- Eucalyptus porosa* closed woodland over grassy understorey	6.8 ha	4:1
10	*Eucalyptus camaldulensis* ssp. *camaldulensis +/- Eucalyptus leucoxylon* Closed Tall Shrubland over *Austrostipa* sp. (Spear-grass) near creeklines	2.3 ha	6:1
11	*Eucalyptus leucoxylon* Tall Open Woodland over shrubby understorey	3.6 ha	5:1-6:1

Association 1 *Lomandra effusa* + *Austrostipa sp*. Grasslands.

Table 19. Summary of vegetation Association 1.

Description	Open Grasslands with occasional emergent trees. Grasslands generally had weed cover between *Lomandra tussocks* with occasional native grasses and other species. However grassland in the proposed terminal substation area was dominated by native species. This association is protected under the EPBC Act if it meets minimum criteria (see section 5.1.2).
Common native understorey species	*Lomandra effusa* (Scented Mat-rush), *Lomandra multiflora* (Many flower Mat Rush), *Austrostipa sp.* (Spear Grass), *Enneapogon nigricans* (Black-head Grass), *Aristida behriana* (Brushwire Grass), *Ptilotus spathulatus* (Pussy-tails), *Vittadinia gracilis* (Woolly New Holland Daisy), *Maireana enchylaenoides* (Wingless fissure Plant). Occasional emergent *Eucalyptus leucoxylon* ssp. (South Australian Blue Gum).
Common weed species	*Avena barbata (Wild oats), Hordeum vulgare (Barley), Taraxacum officinale (Dandelion), Vulpia myuros (Fescue), Artemisa tridentate (Sagebrush). Juncus acutus* (Spiny Rush) *was noted in creeklines*
Conservation flora significant species	None
Vegetation condition	Poor (3:1) to Moderate (6:1)

Figure 12. Representation of Association 1 (Turbine Area).

Figure 13. Representation of Association 1 (Transmission Line 4:1).

Figure 14. Representation of Association 1 (Terminal Sub-station 6:1) (EPBC listed site 18).

Association 2 *Austrostipa* sp. Grassland.

Table 20. Summary of vegetation Association 2.

Description	Open Grasslands with occasional emergent trees and varying from expanses of native grass to highly degraded weed dominated grasslands, particularly along roadsides or near infrastructure. Soils vary from rocky hills with no emergent trees to heavier soils in lower lying areas with more scattered trees.
Common native understorey species	*Austrostipa* (Spear-grass) species dominate with native species including *Austrostipa scabra (Spear grass), Austrostipa eremophila (*Rusty Spear Grass*), Austrostipa* sp. *(*Spear Grass*, Austrodanthonia* sp. (Wallaby Grass)*, Enneapogon nigricans* (Black-head Grass), *Aristida behriana* (Brush Wire-grass), *Ptilotus spathulatus* (Pussy-tails), *Vittadinia gracilis* (Woolly New Holland Daisy), *Maireana enchylaenoides* (Wingless fissure Plant). *Vittadinia blackii* (Western New Holland Daisy) was common along roadsides. Scattered *Lomandra effusa* (Scented Mat Rush) and occasional emergent trees including *Eucalyptus leucoxylon* (South Australian Blue Gum)*, Eucalyptus porosa* (Mallee Box) and *Eucalyptus odorata* (Peppermint Box).
Common weed species	*Avena* barbata. (Wild oats), *Hordeum vulgare* (Barley), *Taraxacum officinale* (Dandelion), *Vulpia myuros* (Fescue) *Bromus* sp. (Bromus), *Cynara cardunculus* (Artichoke thistle), *Echium plantagineum* (Salvation Jane), Thick patches of *Carthamus lanatus* (Saffron Thistle) in the far north of the turbine area.
Conservation significant species	None
Vegetation condition	Very Poor (1:1) – Poor (4:1)

Figure 15. *Austrostipa* sp. grasslands on rocky hills.

Figure 16. *Austrostipa* sp. grasslands on flats of heavier soils with scattered trees.

Figure 17. *Austrostipa* sp. grasslands on roadsides – degraded, but often with many native grasses.

Association 3 Planted species.

Table 21. Summary of vegetation Association 3.

Description	Patches of planted vegetation.
Common overstorey and midstorey species	Common species in planted areas: *Pinus sp, Eucalyptus sp.* (interstate species*), Eucalyptus cladoclayx (*Sugar Gum*).* Other common species in revegetation areas: *Acacia paradoxa* (Kangaroo Thorn), *Acacia pycnantha* (Golden Wattle), *Allocasuarina verticillata* (Drooping Sheoak), *Rhagodia parabolica* (Mealy Saltbush)
Common weed species	*Avena* sp. (Wild oats), *Hordeum vulgare* (Barley), *Taraxacum officinale* (Dandelion), *Vulpia myuros* (Fescue),
Conservation significant species	None
Vegetation condition	Very Poor (0:1)

Figure 18. Representation of Association 3.

Association 4 *Eucalyptus leucoxylon* +/- *Eucalyptus porosa* open woodland.

Table 22. Summary of vegetation Association 4.

Description	Open woodland over mixed native and exotic grassland with occasional shrubs. Tree density varies across the project area.
Common native	*Eucalyptus leucoxylon* (Bluegum), *Eucalyptus porosa* (Mallee Box), *Bursaria spinosa* ssp. *spinosa* (Sweet Bursaria), *Allocasuarina verticillata* (Drooping Sheoak), *Austrostipa sp*, (Spear-grass), *Lomandra multiflora* (Many Flower Mat-rush), *Aristida behriana* (Brush Wire-grass), *Rytidosperma* sp. (Wallaby Grass). Occasional *Euphorbia drummondi* (Caustic weed)
Common weed species	*Avena barbata* (Wild oats), *Hordeum vulgare* (Barley), *Taraxacum officinale* (Dandelion), *Vulpia myuros* (Fescue), *Cynara cardunculus* (Artichoke thistle)
Conservation significant species	None
Vegetation condition	Very Poor (2:1) - Moderate (6:1)

Figure 19. Open Woodland in wind turbine area.

Figure 20. Open woodland along transmission line.

Association 5 *Juncus* spp. (Rush) and *Juncus pallidus* (Pale rush) Sedgeland +/- *Phragmites australis* (Common Reed).

Table 23. Summary of vegetation Association 5.

Description	Inundated creeklines with patches of native sedges and reeds but dominated in large areas by the invasive weed **Juncus acutus* (Spiny Rush). *Muehlenbaeckia florentula* (Lignum), native grasses and grassy weeds along fringes.
Common native understory species	*Cyperus gymnocaulous* (Spiny Flat-sedge), *Juncus pallidus* (Pale Rush), *Juncus sp.* (Rush), *Carex* sp. (Sedge), *Eleocharis acuta* (Common Spike-rush). Scattered patches of *Phragmites australis* (Common Reed) and *Cymbopogon ambiguus* (Lemon Grass), *Austrostipa* sp. (Spear-grass) and *M. florentula* along creekline fringes.
Common weed species	Dense patches of **Juncus acutus* (Spiny rush). **Rosa canina* (Dog Rose), **Cotula coronopifolia* (Water Buttons), **Cynara cardunculus* (Artichoke thistle), **Silybum marianum* (Variegated Thistle). Occasional **Lycium ferocissimum* (African Boxthorn).
Conservation significant species	None
Vegetation condition	Poor (2:1 - 3:1)

Figure 21. Representation of Association 5.

Figure 22. Representation of Association 5 showing Spiny Rush weed invasion.

Association 6 Cropping.

Table 24. Summary of vegetation Association 6.

Common weed species	*Triticum aestivum* (Common Wheat), *Bromus* sp. (Brome), *Avena barbata* (Wild oats), *Hordeum vulgare* (Barley), *Taraxacum officinale* (Dandelion), *Vulpia myuros* (Fescue), *Artemisia tridentate* (Wild Sage).
Conservation significant species	None
Vegetation condition	Poor (0:1)

Figure 23. Representation of Association 6.

Association 7 *Eucalyptus porosa* +/- *Eucalyptus odorata* +/- *Eucalyptus gracilis* open woodland.

Table 25. Summary of vegetation Association 7.

Description	Degraded open woodland with low diversity
Common native overstorey and midstorey species	*Eucalyptus porosa* +/- *Eucalyptus gracilis* +/- *Eucalyptus odorata* (Peppermint Box). Scattered *Bursaria spinosa* ssp. *spinosa* (Sweet Bursaria)
Common native understorey species	*Austrostipa sp.* (Spear-grass), *Maireana enchylaenoides* (Wingless Fissure-plant), *Vittadinia gracilis* (Woolly New Holland Daisy)
Common weed species	*Avena* sp. (Wild Oats), *Bromus sp.* (Brome), *Erodium sp.* (Long Heron's-bill), *Hordeum vulgare* (Barley), *Trifolium angustifolium* (Narrow-leaf Clover)
Conservation significant species	None
Vegetation condition	Poor (4:1)

Figure 24. Representation of Association 7.

Association 8 Pasture Grassland / exotic grassland.

Table 26. Summary of vegetation Association 8.

Description	Degraded grasslands dominated by weeds with very few native species
Common native understorey species	Scattered or over *Austrostipa sp. (Spear Grass) grazed grazing areas. Vittadinia blackii* (Western New Holland Daisy) was common along roadsides
Common weed species	*Avena* sp. (Wild Oats), *Bromus sp.* (Brome), *Erodium sp.* (Long Heron's-bill), *Hordeum vulgare* (Barley), *Trifolium angustifolium* (Narrow-leaf Clover)
Conservation significant species	None
Vegetation condition	Very Poor (1:1)

Figure 25. Exotic grassland with planted trees.

Association 9 *Eucalyptus odorata / Eucalyptus porosa* Woodland.

Table 27. Summary of vegetation Association 9.

Description	Woodland to open woodland with *E. odorata* being the dominant tree present. Understorey was weed dominated and degraded sparse native understorey. This association was observed during surveying for the proposed Transmission Line during early summer 2016 when not all plants are in their visible life phase. This association is protected under the EPBC Act if it meets minimum criteria (see section 5.1.2).
Common native understorey species	*Eucalyptus odorata* (Peppermint Box, *Eucalyptus porosa* (Mallee Box), *Austrostipa* sp. (Spear-grass), *Rytidosperma* sp. (Wallaby Grass), *Atriplex semibaccata* (Creeping Saltbush), *Aristida behriana* (Brush Wire-grass), *Maireana enchylaenoides* (Wingless Fissure-plant) and *Arthropodium strictum* (Common Vanilla-lily).
Common weed species	*Avena* sp. (Wild Oats), *Bromus sp.* (Brome).
Conservation significant species	None
Condition	Poor (4:1)

Figure 26. Peppermint Box Woodland with weedy understorey – transmission line.

Figure 27. Peppermint Box Woodland with weedy understorey – transmission line.

Association 10 *Eucalyptus camaldulensis* ssp. *camaldulensis / Eucalyptus leucoxylon* Tall Woodland near creeklines.

Table 28. Summary of vegetation Association 10.

Description	Tall woodland along creeklines dominated by *E. camaldulensis* ssp. *camaldulensis* (River Red Gum). Understorey patchy dominated by dense native grass or sometimes degraded and weed dominated.
Common native understorey species	*E. camaldulensis* ssp. *camaldulensis* (River Red Gum)/*Eucalyptus leucoxylon* (South Australian Blue Gum), *Eleocharis acuta* (Spike-rush), *Juncus pallidus* (Pale Rush), *Austrostipa* sp. (Spear-grass), *Rytidosperma* sp. (Wallaby Grass), *Atriplex semibaccata* (Creeping Saltbush), *Aristida behriana* (Brush Wire-grass), *Maireana enchylaenoides* (Wingless Fissure-plant), *Arthropodium strictum* (Common Vanilla-lily).
Common weed species	*Avena* sp. (Wild Oats), *Bromus sp.* (Brome), *Trifolium* sp. (Narrow-leaf Clover).
Conservation significant species	None
Condition	Moderate (6:1)

Figure 28. River Red Gum Creekline – Transmission line area.

Association 11 *Eucalyptus leucoxylon* Woodland over grass and shrubby understorey.

Table 29. Summary of vegetation Association 11.

Description	Woodland in the south of the site in good condition with grass understorey but increased cover of shrubs and more diverse than other associations.
Common native understorey species	*Eucalyptus leucoxylon* (South Australian Blue Gum), *Rhagodia parabolica* (Mealy Saltbush), *Dianella revoluta* (Black-anther Flax-lily), *Vittadinia blackii* (Western New Holland Daisy), *Austrostipa sp.* (Spear-grass), *Rytidosperma* sp. (Wallaby Grass), *Atriplex stipitata* (Bitter Saltbush), *Aristida behriana* (Brush Wire-grass).
Common weed species	*Avena* barbata (Wild Oats), *Bromus hordeaceus ssp. hordeaceus* (Soft Brome), *Trifolium angustifolium* (Narrow-leaf Clover), *Sonchus* sp. (Sow-thistle)
Conservation significant species	*Olea europaea* (Olive)
Condition	Moderate (6:1)


Figure 29. Vegetation Association 8 with *Vittadinia blackii* and native grasses.

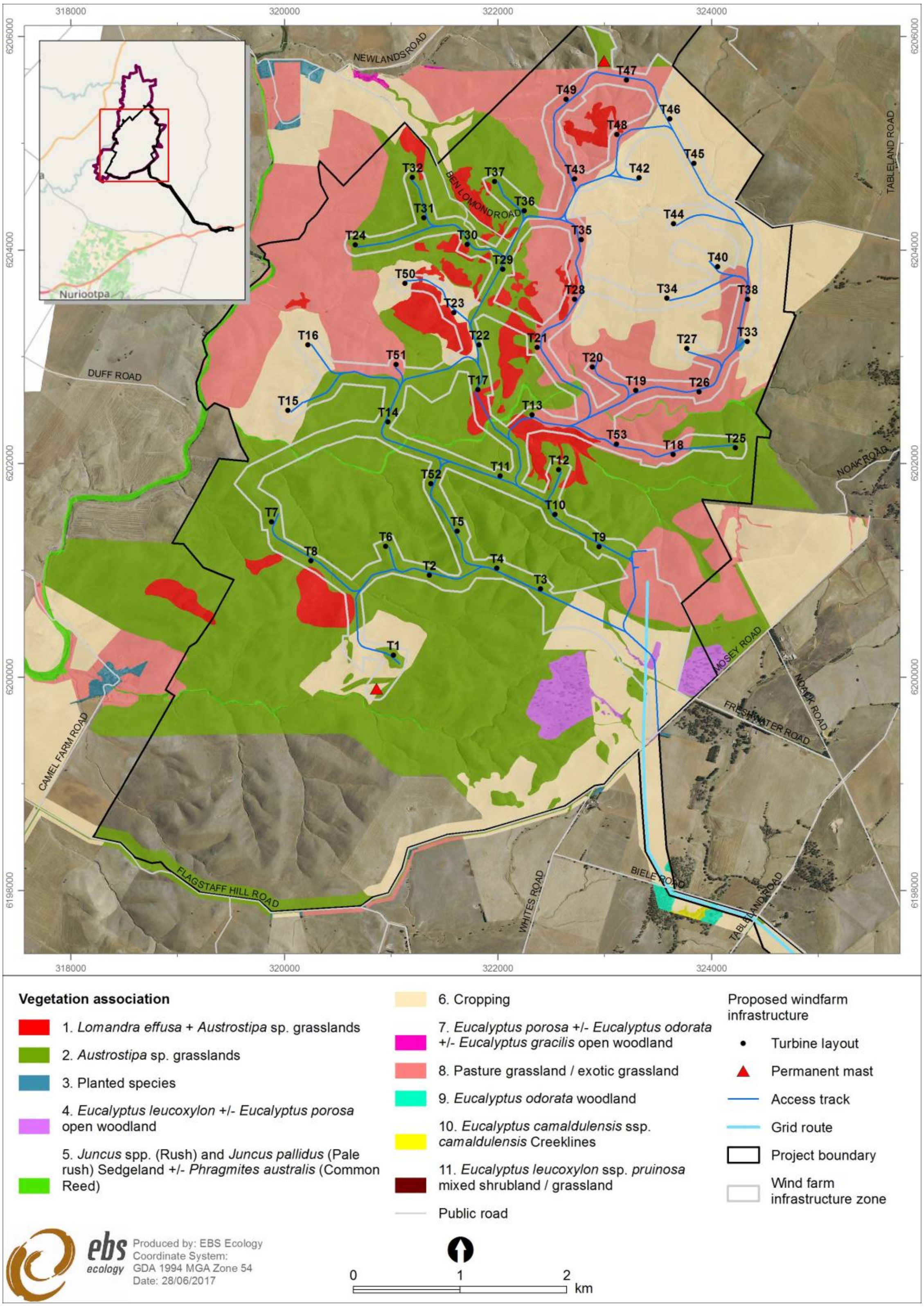


Figure 30. Vegetation associations in site boundary and proposed substation (including utility zone, battery storage, concrete batching plant, construction compound and material laydown area).

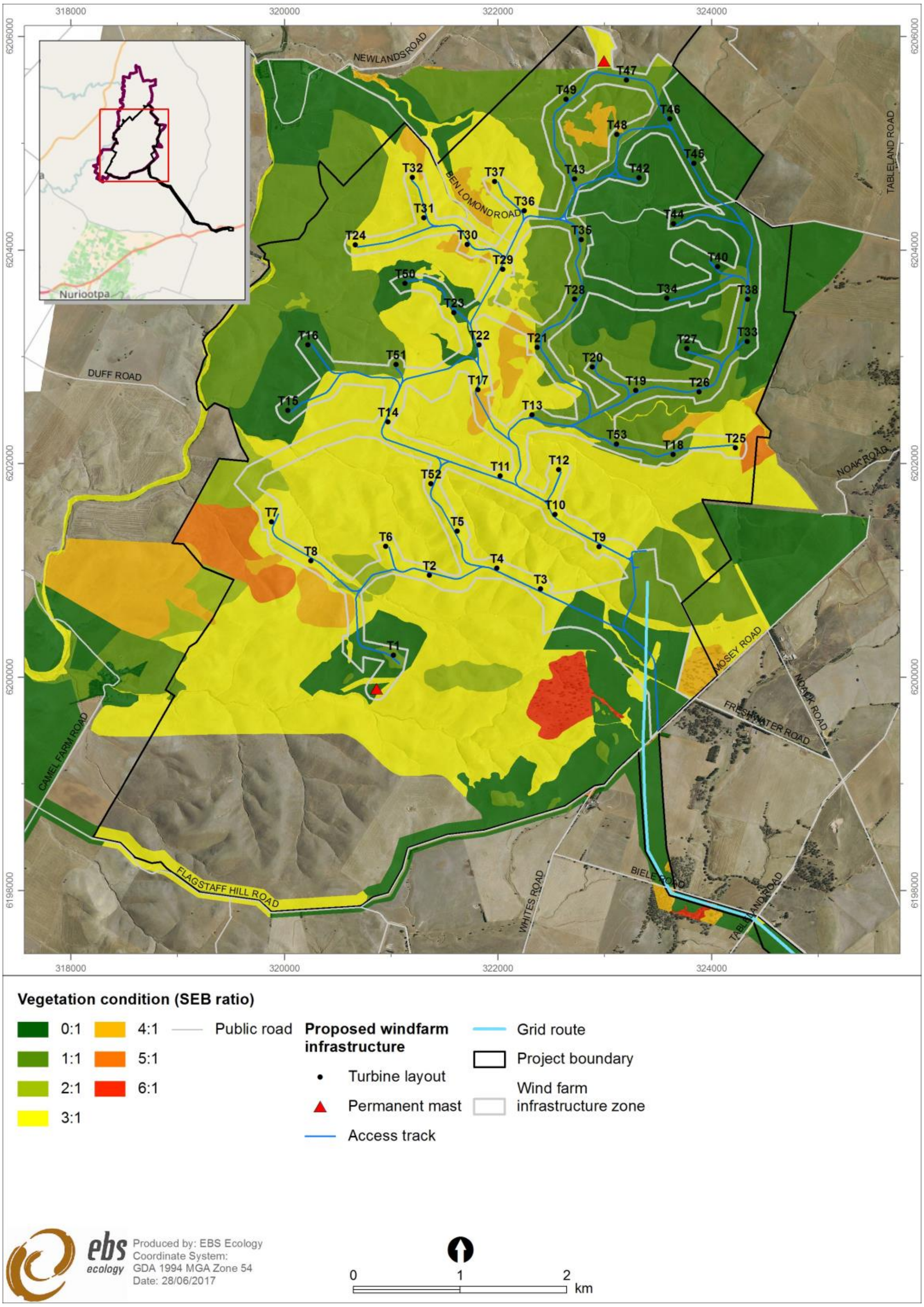


Figure 31. SEB conditions of vegetation associations in site boundary and proposed substation (including utility zone, battery storage, concrete batching plant, construction compound and material laydown area).

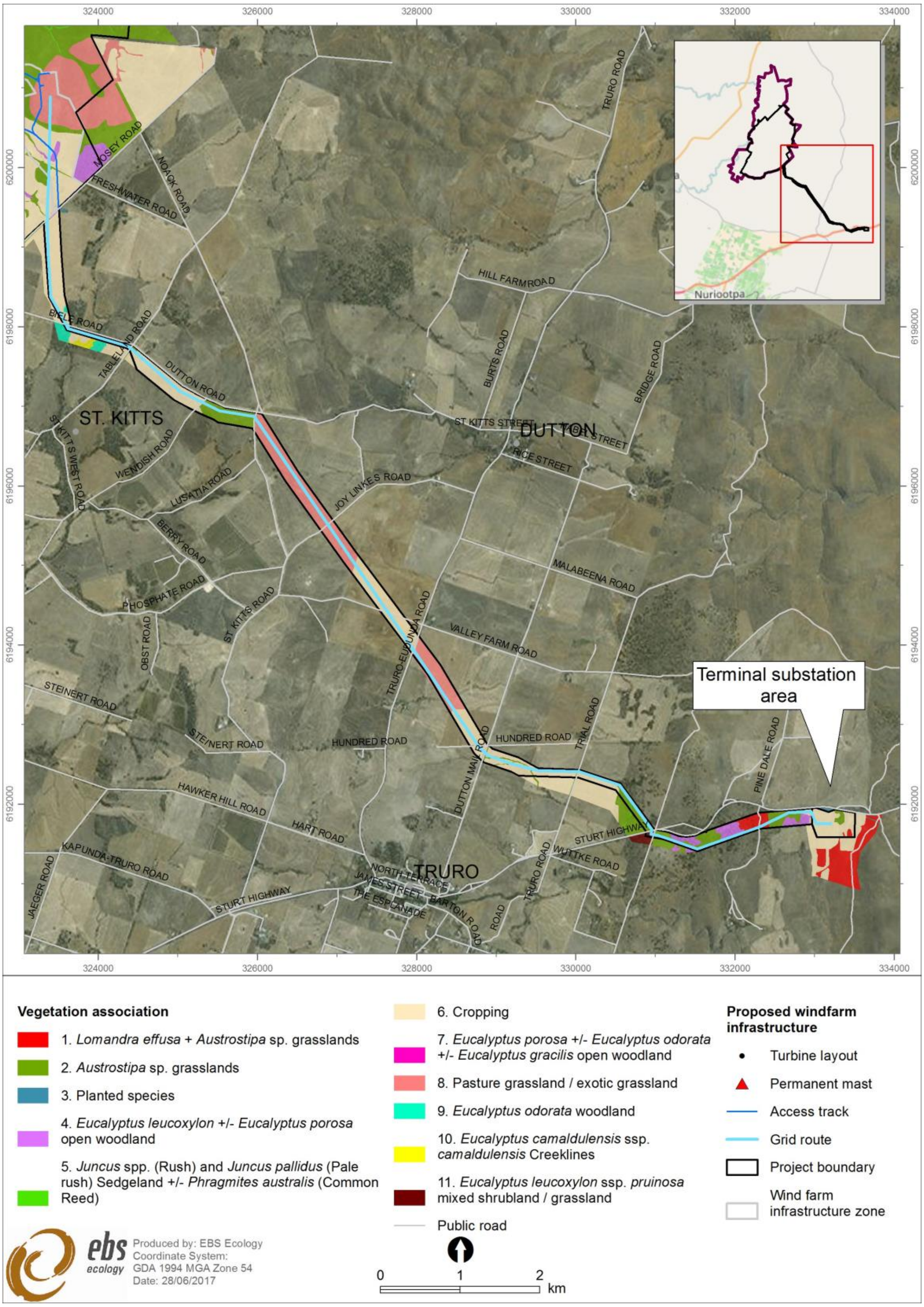


Figure 32. Vegetation association in proposed transmission route and terminal substation.

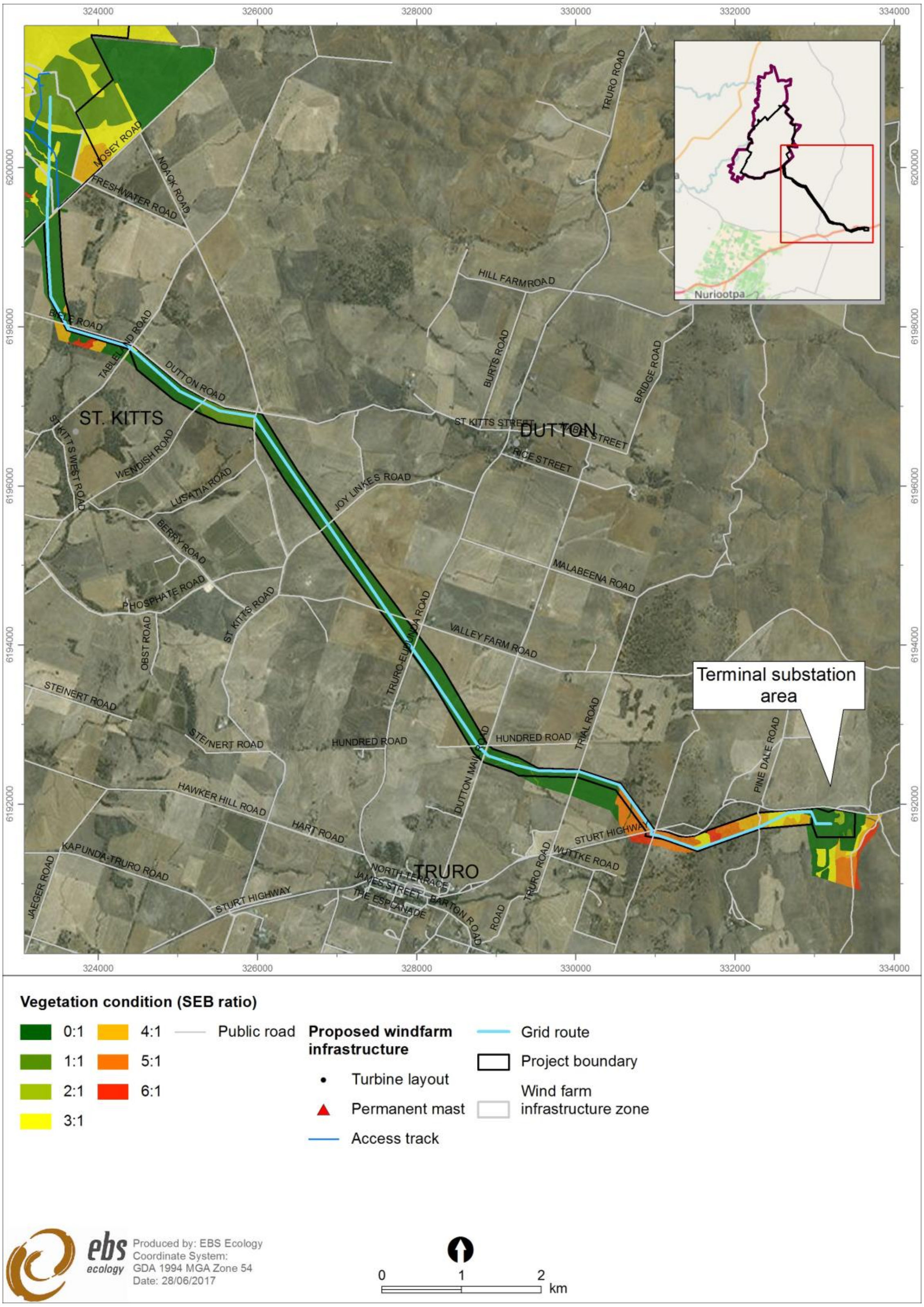


Figure 33. Vegetation condition in proposed transmission route and terminal substation.

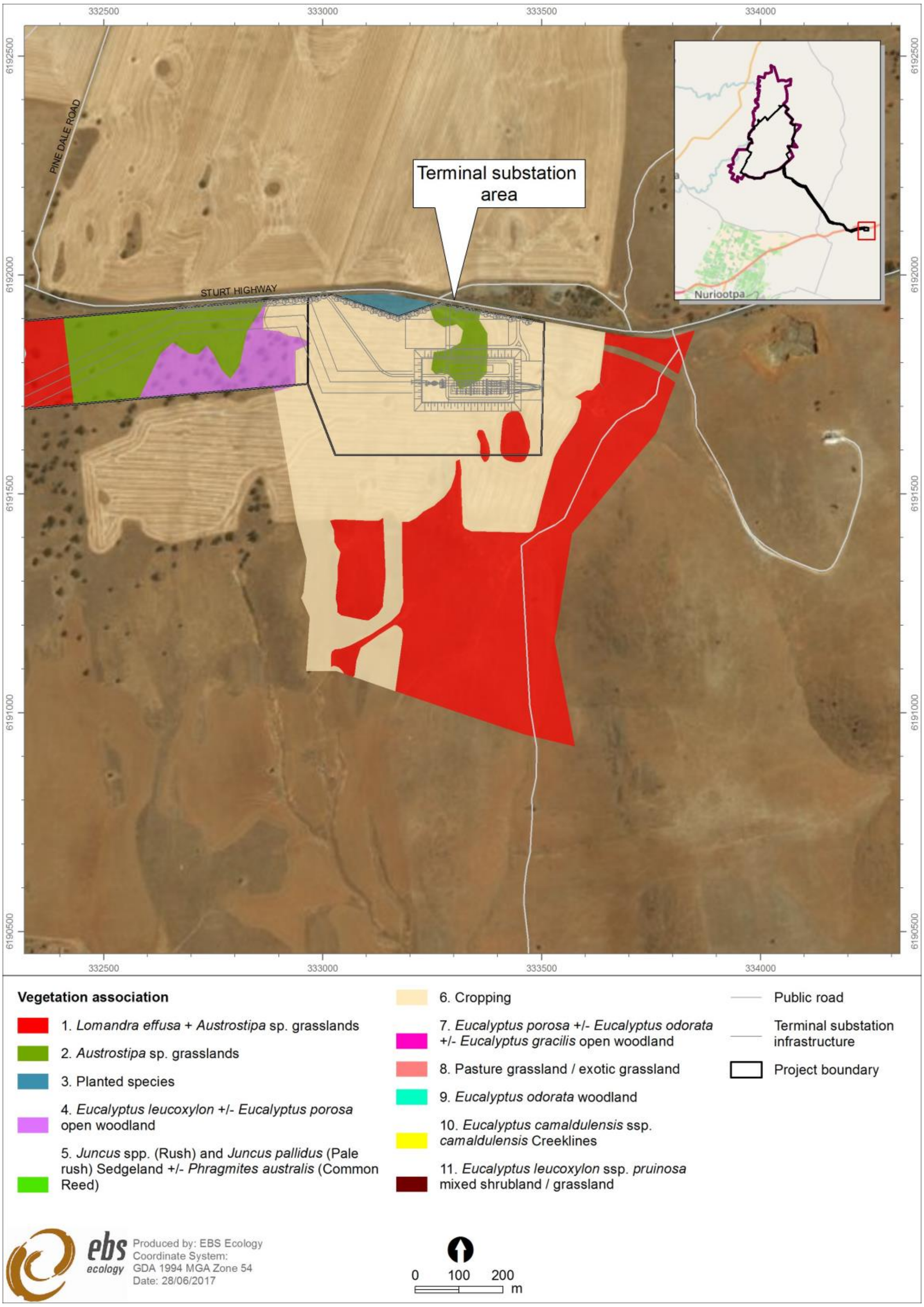


Figure 34. Vegetation associations (close-up) of the terminal substation area.

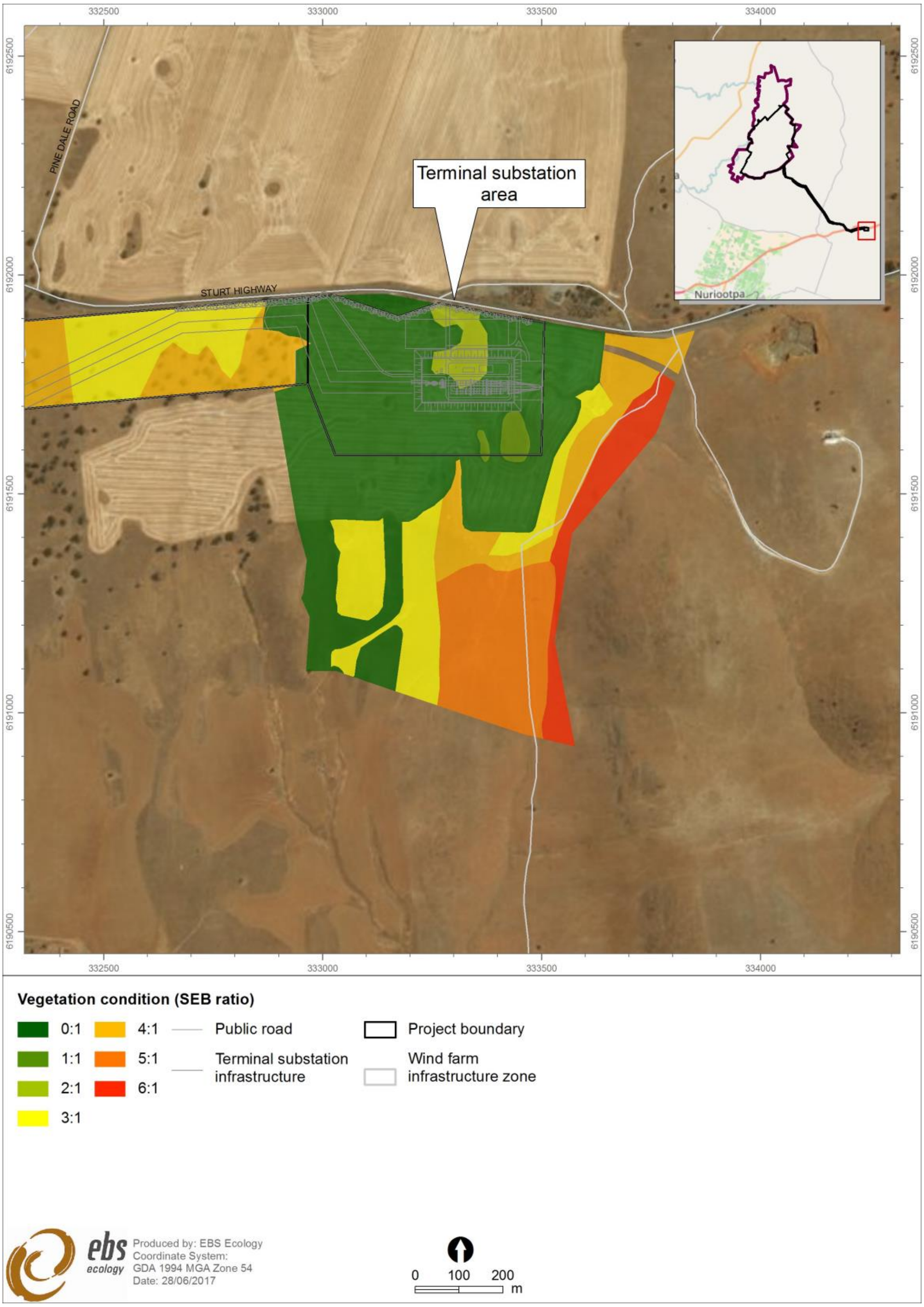


Figure 35. Vegetation condition (close-up) of the terminal substation area.

5.2.2 Threatened ecological communities

Two EPBC listed ecological communities were assessed for qualification within the project boundary:

- Iron-grass Natural Temperate Grassland of South Australia; and
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

5.2.3 Iron-grass Natural Temperate Grassland of South Australia

There were 21 sites assessed within the *Lomandra* Grasslands across the project site in 2015 (Figure 36, Figure 37), to confirm whether they qualified as the nationally listed threatened ecological community (Table 30). Additional *Lomandra* grasslands were observed whilst surveying the proposed transmission line and terminal substation (Figure 37). Site 17 (transmission line) was assessed during summer 2016 surveying, whilst sites 18-21 (terminal substation) were assessed in autumn 2017.

One of the sites assessed for the terminal substation (18, Figure 14), qualified as EPBC listed and another two sites (19 and 21) are considered likely to qualify if surveyed when more plants are in their visible life phase (early/mid spring), as they were only a few species short of qualifying. Site 20 may also possibly qualify. None of the other sites met criteria qualified as either condition A or B, and therefore, do not qualify as a threatened ecological community. Of the 21 *Lomandra* sites, 13 come under Condition class C, which are considered degraded patches amenable to rehabilitation. Five of the sites (*Lomandra* Site 2, 14, 15, 19 and 21) were within 1-3 native species of meeting the condition class B threshold (Table 30).

Based on vegetation identifying high value Lomandra Grassland in the general Terminal Substation area, the final design was located in cropping and *Austrostipa* sp. grassland to avoid *Lomandra* Grassland except for a small degraded patch (Figure 34). However, there is *Lomandra* grassland further west along the Transmission Line that may be impacted. The site (17) was considered unlikely to qualify due to the lack of grasses, but was only briefly assessed and it is recommend that specific areas impacted are assessed in spring once the impact footprint is finalised.

Any new or intensified activities that may or are likely to have a significant impact upon this community should be referred to the Australian Minister for the Environment and Water Resources for assessment and approval (unless they are subject to an exception under the EPBC Act). Activities that may have a significant impact include, but are not restricted to, clearing of remnants or supporting vegetation, grazing, introducing excessive nutrients to remnants and introducing potentially invasive pasture species into the proximity of remnants (DEWR 2007).

Table 30. Results for *Lomandra* Grassland within the project boundary.

Lomandra site	Diversity of native plant species	Broad-leaved herbaceous species^	Native perennial grass species	Tussock count (per m)	Condition class rating	Time of survey	Likelihood of qualifying
1	3	0	1	>1/m	No rating	Spring	NA
2	13	4	4	>1/m	Class C	Spring	NA
3	9	3	2	>1/m	Class C	Spring	NA

Lomandra site	Diversity of native plant species	Broad-leaved herbaceous species^	Native perennial grass species	Tussock count (per m)	Condition class rating	Time of survey	Likelihood of qualifying
4	2	1	0	>1/m	No rating	Spring	NA
5	3	1	1	>1/m	No rating	Spring	NA
6	9	3	2	>1/m	Class C	Spring	NA
7	9	4	3	>1/m	Class C	Spring	NA
8	9	4	3	>1/m	Class C	Spring	NA
9	9	4	3	>1/m	Class C	Spring	NA
10	2	0	1	>1/m	No rating	Spring	NA
11	4	2	2	>1/m	No rating	Spring	NA
12	4	2	2	>1/m	No rating	Spring	NA
13	3	2	1	>1/m	No rating	Spring	NA
14	14	7	4	>1/m	Class C	Spring	NA
15	15	5	6	>1/m	Class C	Spring	NA
16	10	2	5	>1/m	Class C	Spring	NA
17	7	2	1	>1/m	Class C	Summer	Unlikely
18	17	3	9	>1/m	Class B	Autumn	Qualifies
19	15	3	5	>1/m	Class C	Autumn	Likely
20	11	2	4	>1/m	Class C	Autumn	Possible
21	13	2	4	>1/m	Class C	Autumn	Likely
Minimum Criteria							
0.1 ha	> 30	+10	≥5	1/m	Class A	0.1 ha	
0.25 ha	> 15	+3	>4	1/m	Class B	0.25 ha	
No minimum	> 5	No minimum	≥1	> 5			

5.2.4 Peppermint Box (odorata) Grassy Woodland of South Australia

The project site was assessed for any Peppermint Box that may qualify against the criteria outlined in *EPBC Act Policy Statement 3.7, Nationally Threatened Species and Ecological Communities, Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia.*

During spring 2015 flora assessment, the only patch of Peppermint Box that was identified within the project boundary, wasn't dominated by *Eucalyptus odorata*; it was a large mix of *E. odorata*, *E. porosa* and *E. gracilis*, and therefore did not qualify.

Patches of woodland dominated by Peppermint Box were observed during the summer 2016 flora survey (Figure 38). An assessment of these against EPBC Act Policy Statement 3.7 found them to be Class C (Table 31) which is not listed under the EPBC Act but is 'Amenable to rehabilitation'. However, site 1 was only one species short of qualifying as Class B in the overall diversity category and had a high enough diversity of herbs and grasses to qualify. This survey was undertaken in early summer which is not an optimum time for observing all possible species present due to dry conditions. Therefore it is difficult to say with certainty that these areas do not qualify as threatened ecological communities, particularly site 1. It would be preferable if the proposed transmission line avoided these areas completely.

An additional survey was undertaken on 5 April 2017 to assess Peppermint Box as part of the finalisation of the transmission line, including the route along Biele Road. From observations made, it appeared degraded and may not qualify for the EPBC listed TEC. This statement cannot be certain without adequate access and additional surveying in spring. It did not appear planted. It would be EBS's recommendation to position the transmission line through cropping land where possible rather than where Peppermint Box is present.

Based on the survey results the final infrastructure design was amended to avoid the Peppermint Box likely to qualify (north of Biele Road), but a more degraded occurrence south of the road may be subject to a small impact footprint (Figure 38). If this cannot be avoided it is recommended that clearance is kept to the minimum required for safety around powerlines and poles are located away from this area.

The Peppermint Box assessment sites (within the proposed transmission line) are shown in Figure 38.

Table 31. Results for *Peppermint Box* within the project boundary (summer 2016).

Peppermint Box site	Diversity of native plant species	Broad--leaved herbaceous species^	Native perennial grass species	Condition Class	Time of Survey	Likelihood of qualifying
1	14	5	4	Class C	Summer	Likely
2	11	2	4	Class C	Summer	Possible
3	10	0	4	Class C	Summer	Unlikely
Minimum criteria						
0.1 ha	> 30	+10	≥5	A		
0.25 ha	> 15	+3	≥2	B		
No minimum	> 5	No minimum	≥1	C		

5.2.5 Flora

A total of 168 species were recorded during flora surveys in 2015, 2016 and 2017 across the 11 associations, including 92 native and 76 exotic species (Appendix 1). These figures likely represent some species twice as it is unclear if some species, identified to genus level in 2015, were subsequently identified to species level during the surveys in 2016 and 2017.

There were no conservation rated flora species identified during the vegetation surveys in 2015, 2016 and 2017 within the proposed Twin Creek Wind Farm project boundary. However, there was a *Maireana* species scattered in the eastern half of the proposed terminal substation footprint that requires further investigation to determine the exact species, which could be potentially threatened. This area contains EPBC listed *Lomandra* grasslands and would be best avoided all together. Additionally, four species with state ratings are known to occur within the project boundary based on BDBSA records.

5.2.6 Weeds

A total of 76 weeds were observed across the site during the flora surveys. One of these (African Boxthorn) is classed as a Weed of National Significance (WoNS). Eight were classed as Declared Plants for South Australia (DP) under the *Natural Resources Management Act 2004*, and a further 13 were considered environmental weeds (Table 32).

Landholders are obliged to control declared weeds on their property, as they are known to cause significant economic, social and environmental impacts. Environmental weeds have the potential to cause significant environmental impacts, but their control is not legislated.

Table 32. Declared and environmental weeds located within the project boundary.

Scientific name	Common name	WONS	Declared	Environmental
Avena barbata	Wild Oats			✓
Carthamus lanatus	Saffron Thistle			✓
Cirsium vulgare	*Spear Thistle*			✓
Cynara cardunculus ssp. *flavescens*	Artichoke Thistle		✓	
Echium plantagineum	Salvation Jane		✓	
Ehrharta longiflora	Annual Veldt Grass			✓
Hordeum vulgare	Barley			✓
Hypochaeris radicata	Rough Cat's Ear			✓
Juncus acutus	Spiny Rush			✓
Lycium ferocissimum	African Boxthorn	✓	✓	
Marrubium vulgare	Horehound		✓	
Olea europaea	Olive		✓	
Pinus sp.	Pine			✓
Rosa canina	Dog Rose		✓	✓
Salvia verbenaca var.	Wild Sage			✓
Scabiosa atropurpurea	Pincushion			✓
Schinus molle	Pepper-tree			✓
Silybum marianum	Variegated Thistle		✓	
Solanum elaeagnifolium	Silver-leaf Nightshade		✓	
Solanum nigrum	Black Nightshade			✓
Sonchus oleraceus	Common Sow-thistle			✓
Taraxacum officinale	Dandelion			✓

Status: Declared - Declared plant under the *Natural Resources Management Act 2004*
Environmental - Environmental weed (DPTI Environmental Weeds List)

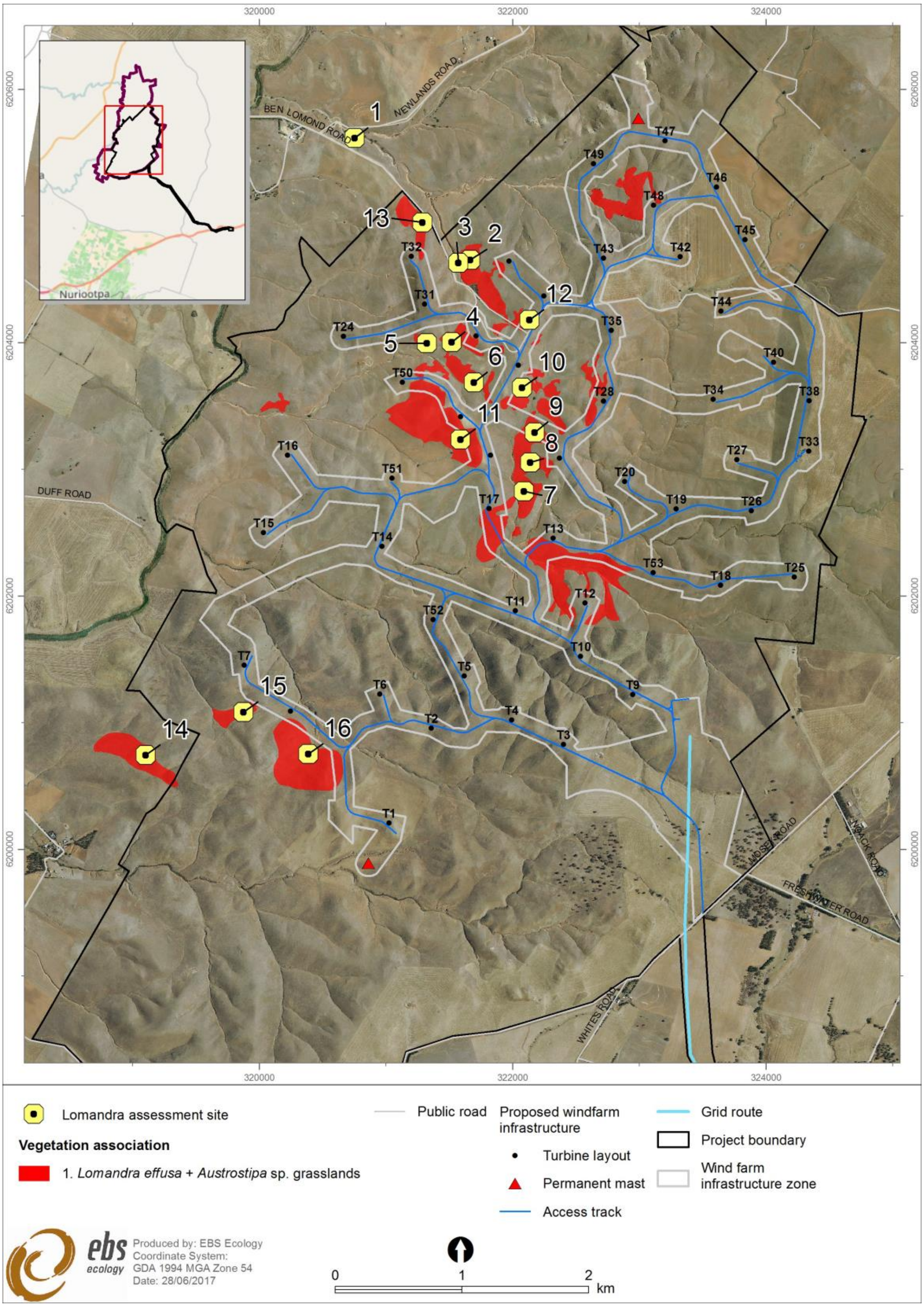


Figure 36. *Lomandra* Grassland assessment sites within the wind turbine and infrastructure zones.

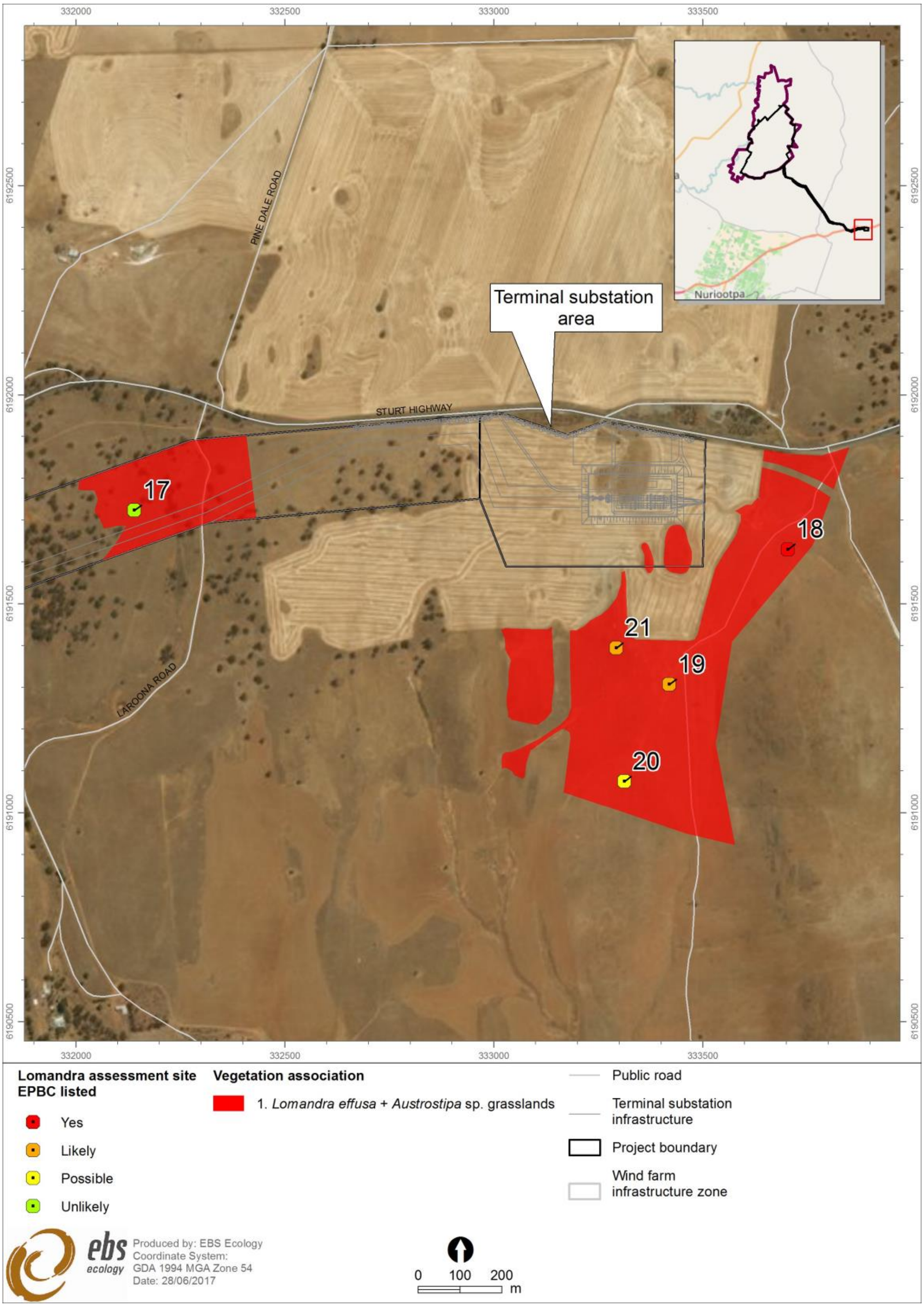


Figure 37. *Lomandra* Grassland assessment sites within the proposed terminal substation area.

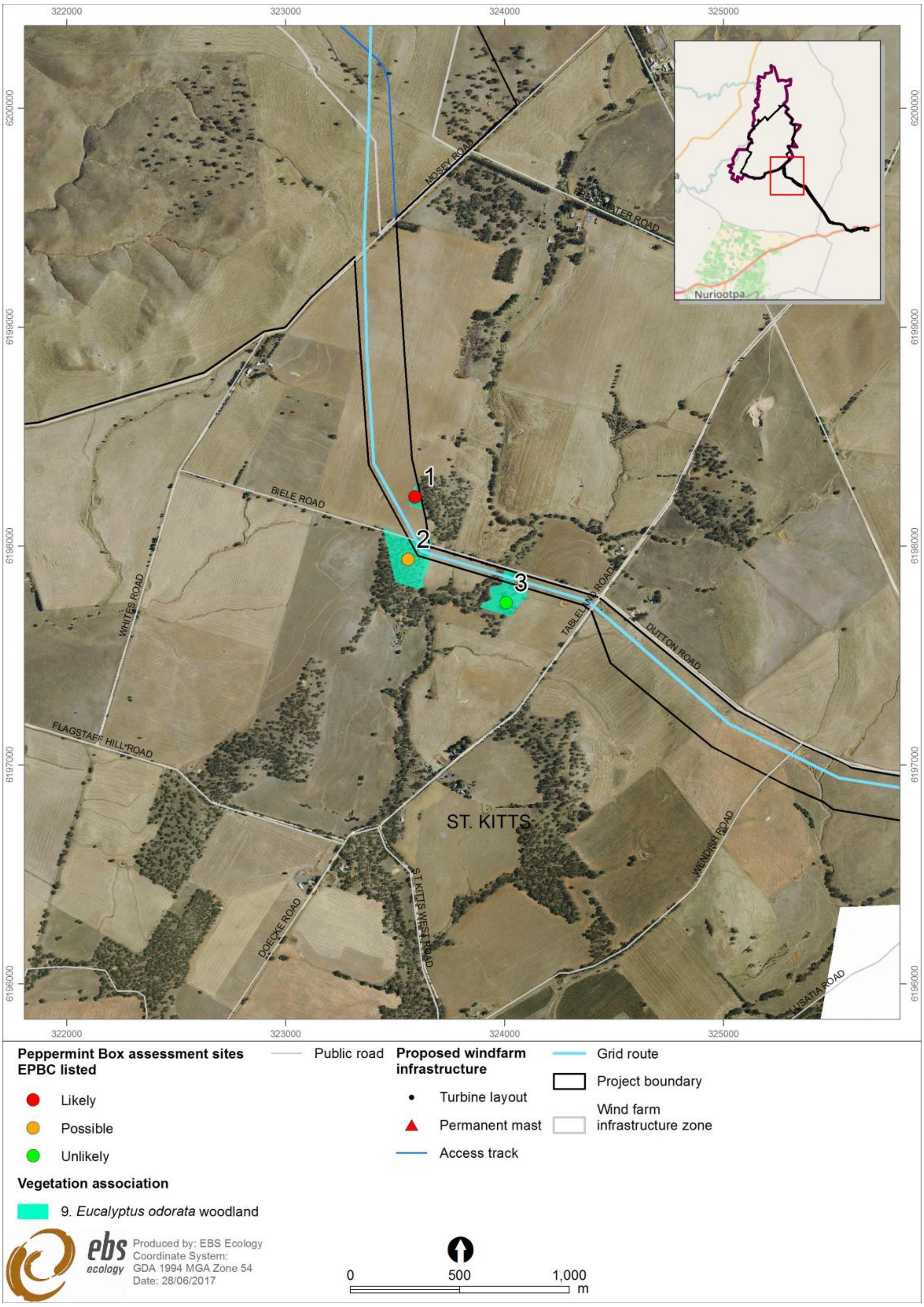


Figure 38. Peppermint Box assessment sites within the proposed transmission line.

5.3 Fauna

5.3.1 Terrestrial native fauna species

Non-avian terrestrial fauna were opportunistically recorded; a record of the number of individuals observed and a GPS location of each observation was undertaken. A single reptile species was recorded that was not identified during the BDBSA search, the Mallee Black-headed Snake (*Parasuta spectabilis*) (Table 33). With the exception of the PBTL, none of the reptile species recorded have a conservation rating and can be classed as common in suitable habitats.

Two amphibian species, the Common Froglet (*Crinia signifera*) and Spotted Marsh Frog (*Limnodynastes tasmaniensis*) were recorded during the September 2015 survey, neither of which has a conservation rating (Table 33). The Common Froglet was observed at a single creekline, and is expected to be widespread across much of the site, as it is one of the most common species of frog in South Australia. A single Spotted Marsh Frog was heard during the September 2015 survey. This species is very adaptable and is often one of the first frogs to take advantage of new dams, ditches and water-covered areas on disturbed ground. It can be found in woodland, shrubland and grassland; it is usually found under cover near water by day.

Table 33. Terrestrial non-avian fauna.

Scientific name	Common name	Conservation status			Number observed
		Aus	SA	Intro	
Amphibian					
Crinia signifera	Common Eastern Froglet	-	-		1
Limnodynastes tasmaniensis	Spotted Marsh Frog	-	-		1
Reptiles					
Parasuta spectabilis	Mallee Black-headed Snake	-	-		1
Pogona barbata	Eastern Bearded Dragon	-	-		5
Tiliqua adelaidensis	Pygmy Blue-tongue Lizard	EN	E		115
Tiliqua rugosa	Sleepy Lizard	-	-		16
Tiliqua scincoides	Eastern Bluetongue Lizard	-	-		1
Mammals					
Lasiorhinus latifrons	Southern Hairy-nosed Wombat	-	-		6
Macropus fuliginosus	Western Grey Kangaroo	-	-		14
Macropus robustus	Euro	-	-		2
*Oryctolagus cuniculus**	Rabbit (European Rabbit)	-	-		8
*Vulpes vulpes**	Fox (Red Fox)	-	-		1

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare *delineates introduced species.

Three native terrestrial mammal species were observed, none of which have a conservation rating (Table 33). Six Southern Hairy-nosed Wombats (*Lasiorhinus latifrons*) were observed by field staff with many other wombat warrens observed along the edges of drainage areas. Two introduced mammal species were detected during the September 2015 survey: a single Red Fox (*Vulpes vulpes*) and the European Rabbit (*Oryctolagus cuniculus*). Rabbit scratching's and scars were also detected opportunistically.

5.3.2 Flinders Worm Lizard

No Flinders Worm Lizards were detected during the September spring 2015 survey.

5.3.3 Pygmy Blue-tongue Lizard

The PBTL was also observed during the summer and autumn 2016 targeted surveys and the summer 2016/2017 targeted survey, with a total number of 115 individuals observed (Table 33).

Habitat categorisation was completed within the entire project boundary. The habitat and potential presence of PBTLs were assessed during the spring 2015 survey and categorised as likely, possible or not likely. This initial habitat mapping aided subsequent targeted surveys within 'likely' and 'possible' areas which were investigated further to determine the spread and potential numbers of PBTL.

Six individual PBTLs were identified during the broad sweep of assessing potential habitat across the project site during the spring 2015 survey; suitable habitat was identified across the entire project site with the exception of cropping and drainage areas (Figure 39).

Habitat categorization was updated in the summer 2016/2017 surveys as the project boundary was more extensively searched. Generally, a large proportion of the project site is considered possible or likely habitat for the PBTL due to the open grasslands, slopes and spider holes observed across the site. Areas considered unlikely to contain PBTLs are cropping, very steep, very rocky or areas with no evidence of spider holes. Due to the widespread nature of the PBTL population in the project area, habitat was further categorized into areas that are either likely to have a high abundance of lizards or likely to have a low abundance of lizards. This information will be valuable for identifying areas that may be appropriate for the translocation of PBTL, as part of this project.

Turbine locations

Each of the proposed WTG was assessed for the presence of PBTLs across an area of approximately 100 m x 100 m. A total of 115 PBTLs were recorded at WTG locations and within transmission corridors (Table 33). Six of out 49 potential turbine locations inspected, contained lizards while lizards were observed in close proximity to a further seven, and within much of the uncropped transmission corridor.

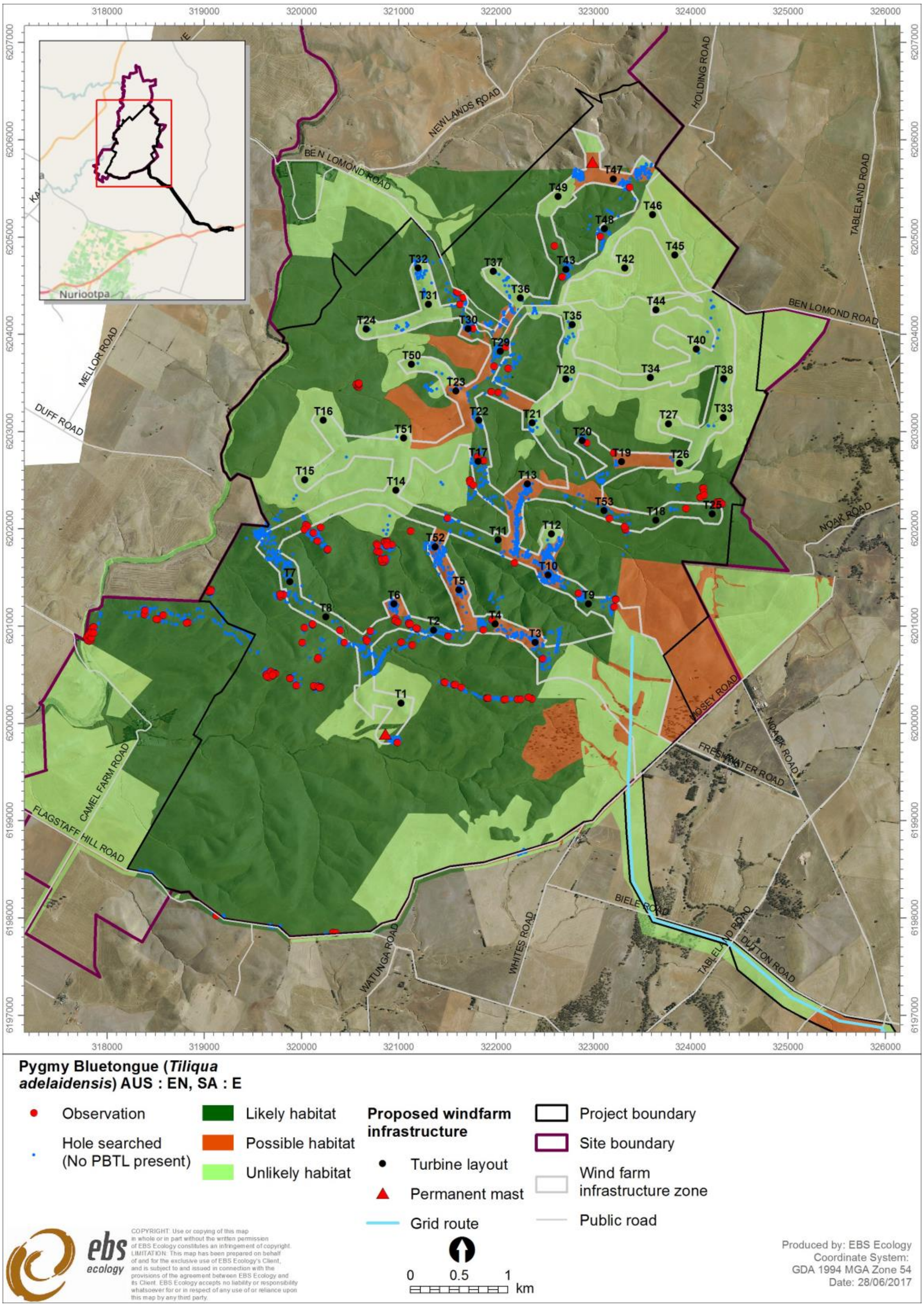


Figure 39. Categorisation of habitat suitability for PBTL.

Across the southern area of the wind farm development area, PBTL were found at one of the 12 proposed WTG locations, and in very close proximity to a further five. PBTL were found within many sections of the transmission corridor. Across the northern property of the project site, five of the 37 proposed turbine locations contained PBTLs, and a further two PBTL were found in very close proximity to WTG. The northern property contains large areas of less suitable habitat for PBTLs with steeper and rockier terrain as well as a larger area that is used for cropping.

The number of individual PBTLs and the number of spider holes surveyed at each turbine location is provided in Table 34. PBTL were recorded in six of the turbine locations specifically. Recommendations have been provided for each turbine site, with reference to potential translocation sites (sites which would be most appropriate to move lizards from).

Table 34. Summary results from each turbine assessment – summer 2016/2017.

Turbine	No. of holes recorded	PBTL records	Comments	Recommendation
1	0	0	Small patch of rocky area within crop	Suitable for development
2	0	0	Patch of rocky habitat within crop	Suitable for development
3	25	0	Possible PBTL. Spider holes present, no PBTL observed	PBTL in corridor – needs micro siting (may be suitable translocation)
4	30	1	Good holes, low density of PBTL near to turbine	Low number of PBTL Present, may be able to micro-site. (may be suitable translocation)
5	21	0	Lots of holes, no PBTL recorded	Micro-siting required but may be suitable for development.
6	29	0	Good PBTL holes, no PBTL recorded; surrounding corridor has high density of PBTL	PBTL in corridor – final turbine position to be micro-sited to avoid impact
7	18	0	Good holes, low density of PBTL near to turbine	Low number of PBTL Present, may be able to micro-site, dependant on surrounding area.
8	20	0	Good holes, no PBTL recorded	Micro-siting required but may be suitable for development
9	0	0	PBTL found in corridor but not in turbine location. 0	PBT in corridor – low abundance (suitable for translocation or micro-siting). (may be suitable translocation)
10	28	0	PBTL found in corridor but not in turbine location. Suitable holes present	PBT in corridor – low abundance (suitable for translocation or micro-siting)
11	0	0	PBTL found in corridor but not in turbine location.	PBT in corridor – low abundance (suitable for translocation or micro-siting)
12	1	0	Dense, weedy vegetation, no PBTL recorded	Suitable for development
14	0	0	cropped	Suitable for development
15	0	0	cropped	Suitable for development
16	0	0	cropped	Suitable for development
17	12	2	PBTL present; suitable burrows	PBTL present - final turbine position to be micro-sited to avoid impact

Turbine	No. of holes recorded	PBTL records	Comments	Recommendation
18	2	0	PBTL present in close proximity to turbine location	PBTL abundance high in corridor. Micro-siting may be possible here
19	5	0	PBTL present in close proximity to turbine	PBTL in corridor - final turbine position to be micro-sited to avoid impact
20	7	1	PBTL found	PBTL found - final turbine position to be micro-sited to avoid impact
21	1	0	Rocky, steep, no PBTL recorded	Suitable for development
22	3	0	PBTL in surrounding corridor. PBTL likely here	PBTL likely - final turbine position to be micro-sited to avoid impact
23	3	0	Heavily grazed. Suitable holes observed	Micro-siting required but may be suitable for development
24	0	0	Heavily grazed	Suitable for development
25	2		PBTL found in close proximity	Micro-siting required but may be suitable for development
26	1	0	Rocky, shallow soil.	Suitable for development
27	0	0	Rocky, shallow soil.	Suitable for development
28	4	0	Rocky, shallow soil.	Suitable for development
29	23	1	Good holes, PBTL found	PBTL found - final turbine position to be micro-sited to avoid impact
30	16	1	Good holes, PBTL found	PBTL found - final turbine position to be micro-sited to avoid impact
31	0	0	Rocky, steep, shallow soil	Suitable for development
32	31	0	Rocky, steep, shallow soil	Suitable for development
33	0	0	Crop	Suitable for development
34	0	0	Crop	Suitable for development
35	4	0	Crop	Suitable for development
36	1	0	Good holes, possible PBTL. No PBTL recorded	Micro-siting required but may be suitable for development
37	2	0	Possible PBTL in corridor. Turbine site rocky	Micro-siting required but may be suitable for development
38	0	0	Crop	Suitable for development
39	0	0	Crop	Suitable for development
40	2	0	Crop	Suitable for development
41	3	0	Crop	Suitable for development
42	0	0	Crop	Suitable for development
43	2	1	PBTL recorded	PBTL recorded - final turbine position to be micro-sited to avoid impact
44	0	0	Crop	Suitable for development
45	0	0	Crop	Suitable for development
46	0	0	Crop	Suitable for development
47	42	0	Good holes, no PBTL recorded	Micro-siting required but may be suitable for development

Turbine	No. of holes recorded	PBTL records	Comments	Recommendation
48	0	0	Rocky, steep, no PBTL recorded	Suitable for development
49	0	0	Rocky, steep, no PBTL recorded	Suitable for development

Access and infrastructure layouts

A greater PBTL survey focus was given to turbine locations than was given track locations, due to the larger infrastructure footprint of the turbine foundation, crane hard standing and laydown areas.

As per the survey of the proposed turbine locations, the survey of the southern area of the wind farm development area, found higher numbers of PBTLs and more habitat classed as likely when compared to the northern property (Figure 39). Figure 40 shows the likely PBTL habitat as either likely to have a low abundance or high abundance of PBTL; this mapping has been based on the number of PBTL observed and the categorisation of habitat suitability throughout the site. Figure 41 and Figure 42 show PBTL habitat mapped along the proposed delivery route, transmission line and terminal substation. There were also several sections where habitat was determined as possible. Figure 42 shows the section mapped as likely habitat in higher resolution.

Substation (near Mosey Road)

Habitat mapping and a targeted survey was carried out within the proposed substation area; the majority of the area was determined as unlikely habitat for PBTL, however the northern extent was mapped as likely with one PBTL observation and a number of spider holes present.

Transmission Corridor

The transmission corridor is either all cropped or unsuitable for PBTL, with the exception of the uncropped habitat along Flagstaff Hill Road. This habitat has PBTL on both sides of the road. It is recommended that micro-siting occurs along this area of the transmission line and/or the road corridor can be utilised.

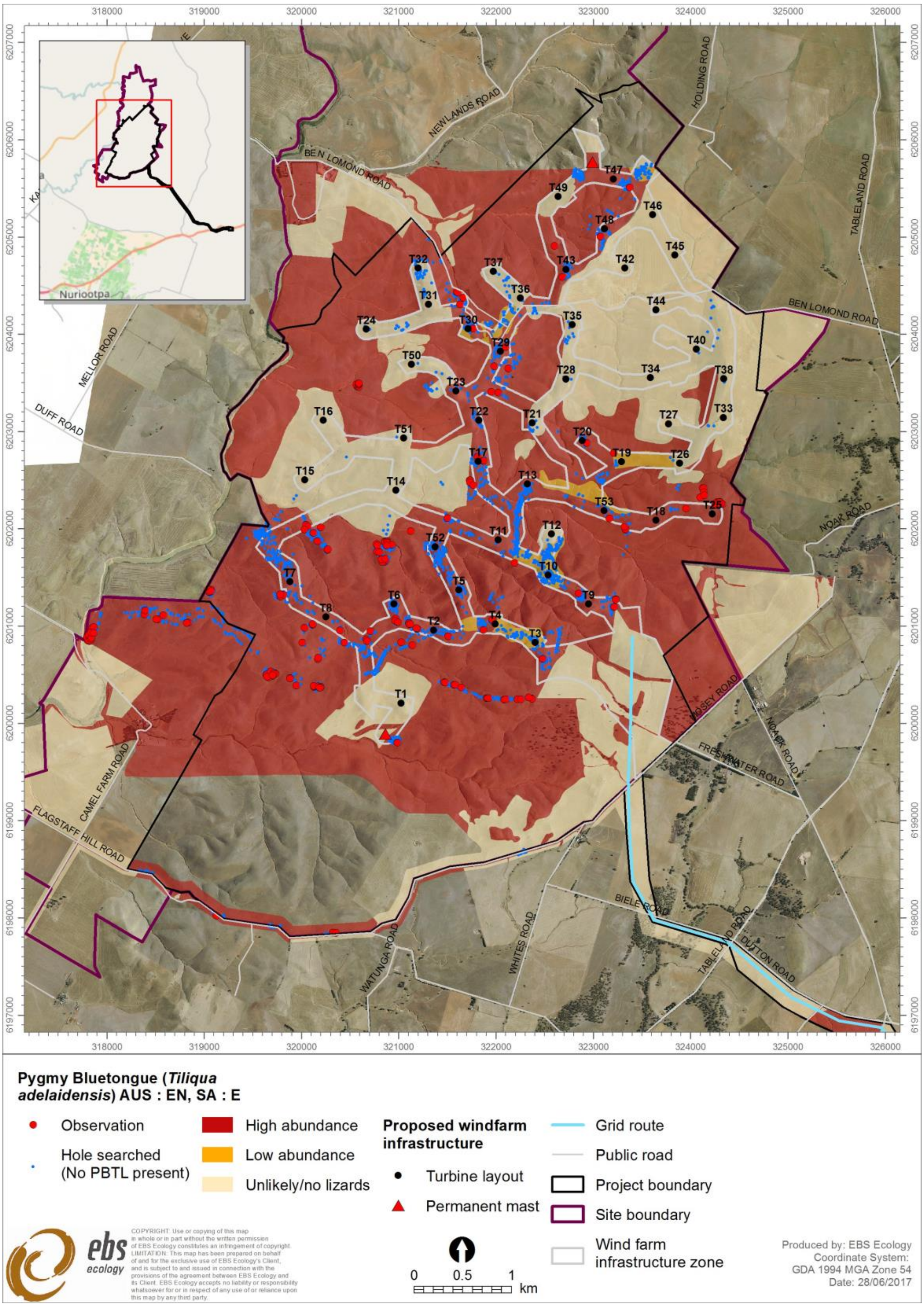


Figure 40. Likely PBTL habitat as either likely to have a low abundance or high abundance of PBTL.

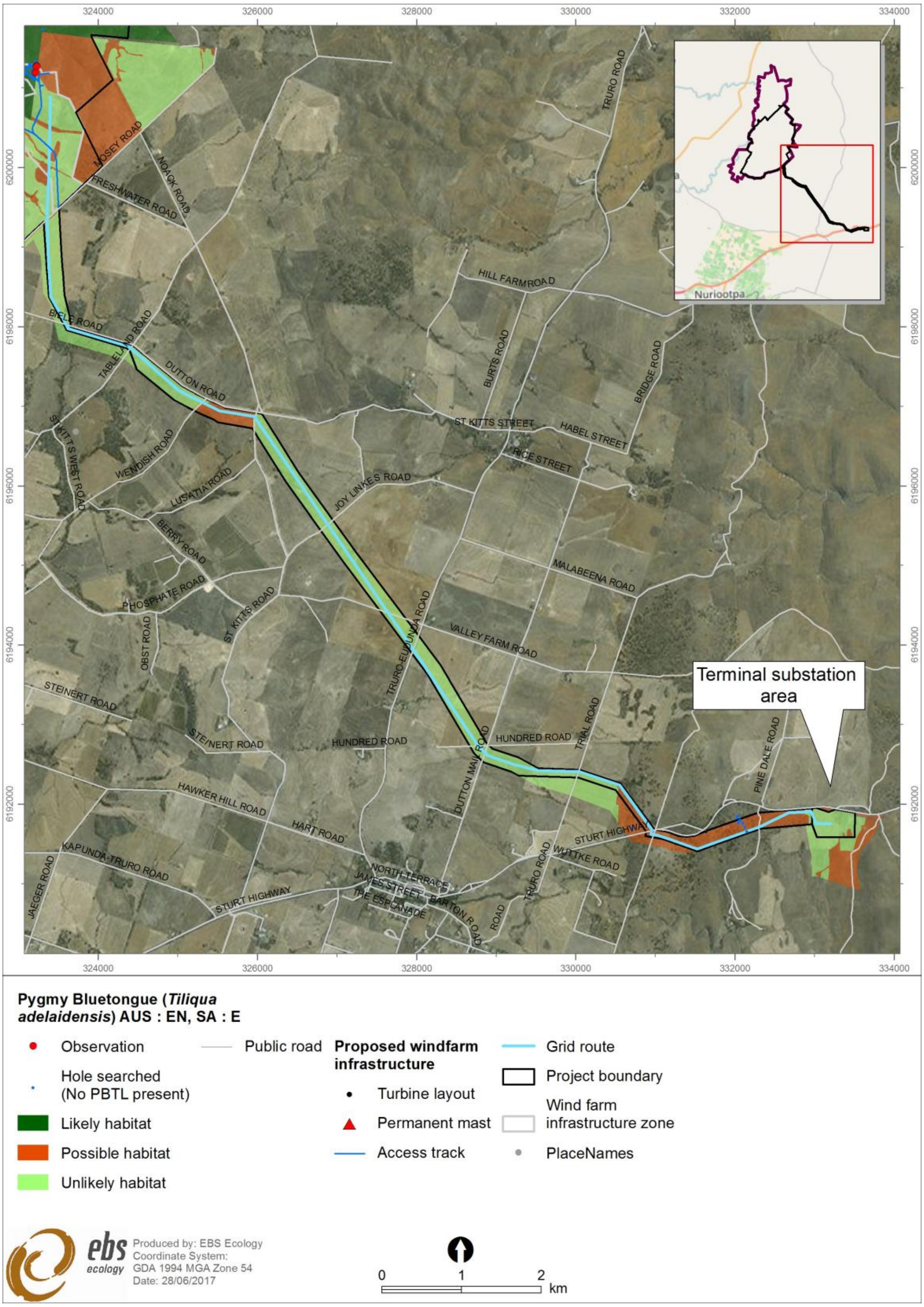


Figure 41. PBTL habitat assessed within proposed transmission line and terminal substation area.

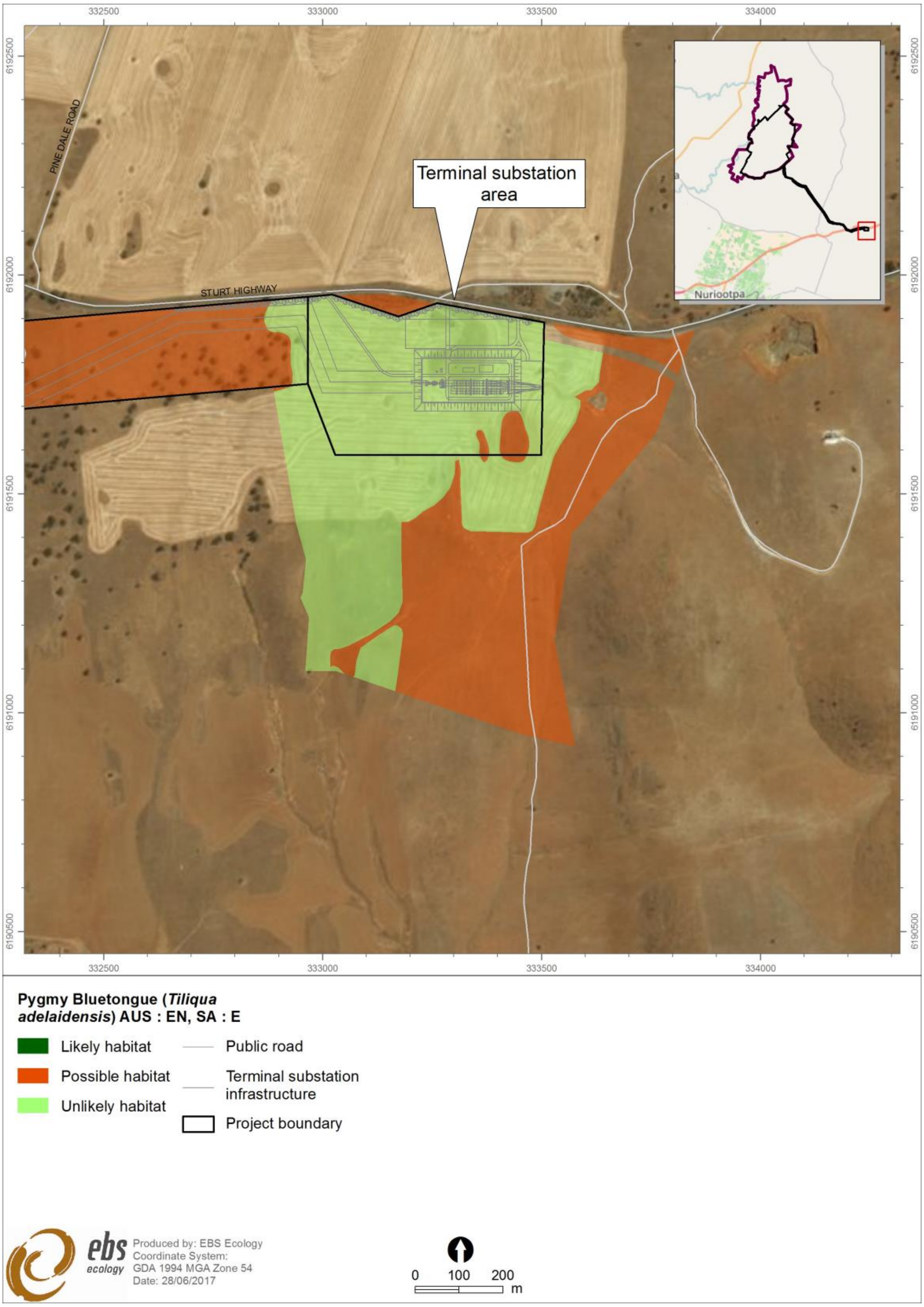


Figure 42. PBTL habitat area (close-up) assessed for the proposed terminal substation area.

5.3.4 Threatened and migratory bird species

One species with an EPBC migratory rating, the Rainbow Bee-eater (*Merops ornatus)* and a single species with a state conservation rating of rare, the Blue-winged Parrot (*Neophema chrysostoma*), were observed during the spring 2015 survey (Figure 43). No species of conservation significance were observed during the summer, autumn and winter 2016 surveys.

The Rainbow Bee-eater was observed opportunistically in Association 7: *Eucalyptus porosa* +/- *Eucalyptus odorata* +/- *Eucalyptus gracilis* open woodland (Figure 43). Seven Rainbow Bee-eaters were observed flying over open woodland during the Lomandra Grassland field trip (8 October 2015). Three individual Blue-winged Parrots were observed flying over Associations 1 and 2: *Lomandra effusa* + *Austrostipa sp*. grasslands and *Austrostipa sp.* grassland (respectively). It is believed that Blue-winged Parrots utilise these vegetation associations for foraging. The Blue-winged Parrot has previously been recorded within the project boundary, with the most recent BDBSA record being 26/10/2011 (Table 17). Whilst nesting sites for both these species were not recorded on site, both species have the potential to breed on site. Both the Rainbow Bee-eater and the Blue-winged Parrot are discussed in more detail in Section 6.2.

5.3.5 Birds

Spring 2015

A total of 1,448 individuals from 48 bird species were observed during 16 point counts and opportunistic surveys across the Twin Creek Wind Farm project site during the spring 2015 survey.

Six species of bird observed were non-native; Eurasian Skylark (*Alauda arvensis*), European Goldfinch (*Carduelis carduelis*), Feral Pigeon [Rock Dove] (*Columba livia),* House Sparrow (*Passer domesticus*), European Starling (*Sturnus vulgaris*) and European Blackbird (*Turdus merula*).

Point Count

Sixteen (16) point count surveys were performed within the project boundary (Figure 43). The location of these 16 point count sites are summarised in Appendix 2.

The most abundant species observed during dedicated point count surveys (Table 35) were the Common Starling (*Sturnus vulgaris*) (343 individuals), Galah (*Eolophus roseicapilla*) (274 individuals) and Australian Magpie (*Gymnorhina tibicen*) (170 individuals).

Opportunistic birds

Of the 1,448 individual birds recorded, 300 individuals from 30 species were observed opportunistically across the site (Table 35). Many of these were observed during active searching, as well as while moving between bird point count sites. The species with the highest representation in opportunistic observations were the Australian Magpie (*Gymnorhina tibicen*) (72 individuals), Galah (*Eolophus roseicapilla*) (56 individuals) and the Little Corella (*Cacatua sanguinea*) (30 individuals).

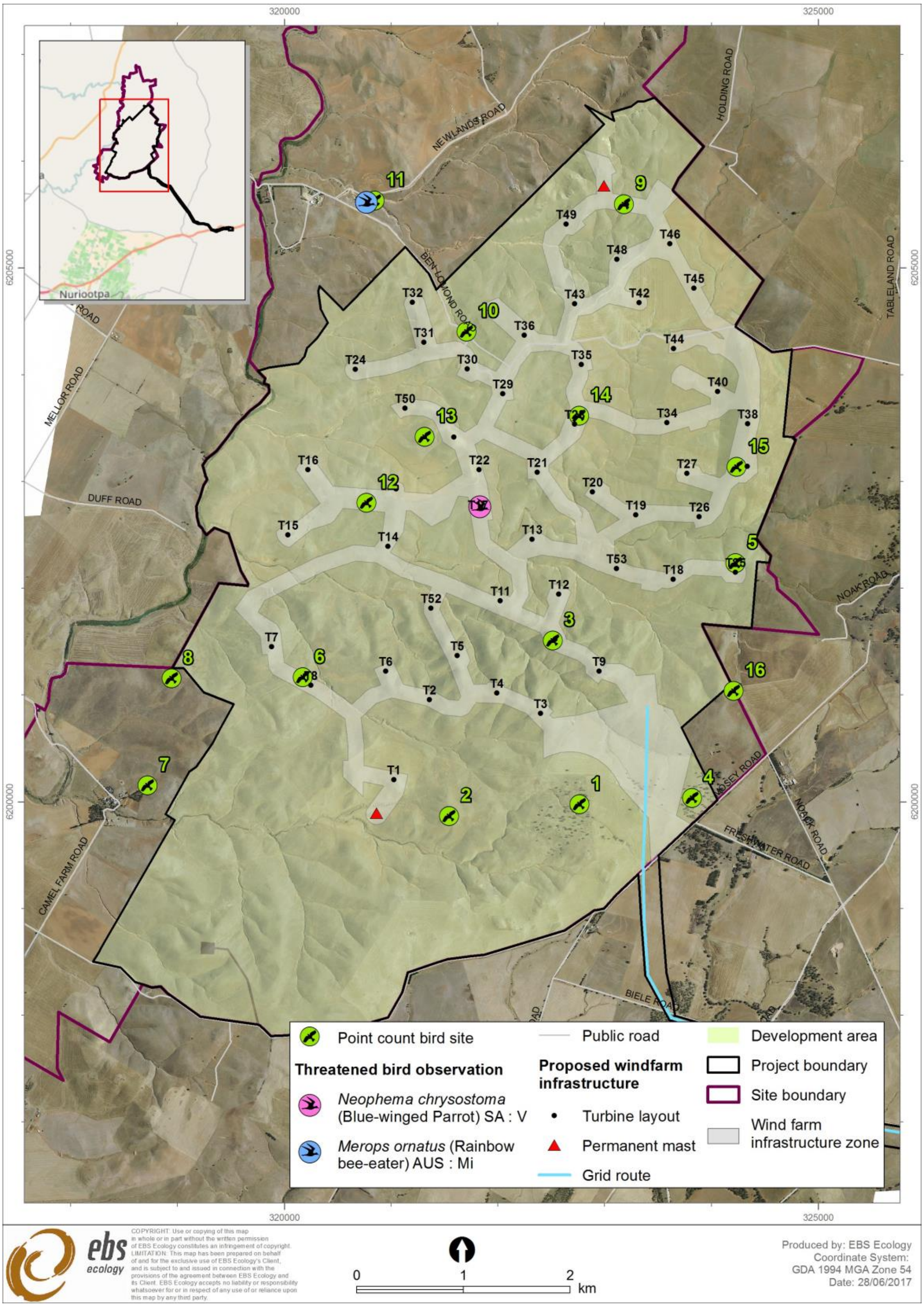


Figure 43. Bird point count sites and threatened bird observations (EBS spring 2015).

Table 35. Bird survey results spring 2015.

Scientific name	Common name	Conservation status^			Number observed^		
		Aus	SA	Intro	PC	OPP	Total
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-	-	13	14	27
Acrocephalus australis	Australian Reed Warbler	-	-	-		1	1
Alauda arvensis	Eurasian Skylark	-	-	*	9	5	14
Anas superciliosa	Pacific Black Duck	-	-	-	2	11	13
Anthochaera carunculata	Red Wattlebird	-	-	-		1	1
Anthus australis	Australian Pipit	-	-	-	18	6	24
Aquila audax	Wedge-tailed Eagle	-	-	-	4		4
Ardea pacifica	White-necked Heron	-	-	-		1	1
Cacatua sanguinea	Little Corella	-	-	-		30	30
Carduelis carduelis	European Goldfinch	-	-	*	2		2
Chenonetta jubata	Maned (Australian Wood Duck)	-	-	-	2	4	6
Cincloramphus cruralis	Brown Songlark	-	-	-	7	5	12
Cincloramphus mathewsi	Rufous Songlark	-	-	-	1		1
Circus assimilis	Spotted Harrier	-	-	-		1	1
Columba livia	Feral Pigeon [Rock Dove]	-	-	*		8	8
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	-	-		1	1
Corvus coronoides	Australian Raven	-	-	-	19	13	32
Corvus mellori	Little Raven	-	-	-	38	17	55
Daphoenositta chrysoptera	Varied Sittella	-	-	-	5		5
Egretta novaehollandiae	White-faced Heron	-	-	-	5	1	6
Elanus axillaris	Black-shouldered Kite	-	-	-		3	3
Eolophus roseicapilla	Galah	-	-	-	274	56	330
Falco berigora	Brown Falcon	-	-	-		1	1
Falco cenchroides	Nankeen Kestrel	-	-	-	11	3	14
Falco longipennis	Australian Hobby	-	-	-	1		1
Fulica atra	Eurasian Coot	-	-	-		1	1
Gavicalis virescens	Singing Honeyeater	-	-	-	1		1
Grallina cyanoleuca	Magpie-lark	-	-	-	2		2
Gymnorhina tibicen	Australian Magpie	-	-	-	170	72	242
Hirundo neoxena	Welcome Swallow	-	-	-	4	10	14
Merops ornatus	Rainbow Bee-eater	Mi	-	-		7	1

Scientific name	Common name	Conservation status^			Number observed^		
		Aus	SA	Intro	PC	OPP	Total
Manorina melanocephala	Noisy Miner	-	-	-	32		32
Microcarbo melanoleucos	Little Pied Cormorant	-	-	-		1	1
Neophema chrysostoma	Blue-winged Parrot	-	V	-		3	3
Ocyphaps lophotes	Crested Pigeon	-	-	-	4		4
Pachycephala rufiventris	Rufous Whistler	-	-	-	1		1
Pardalotus striatus	Striated Pardalote	-	-	-	10		10
Passer domesticus	House Sparrow	-	-	*	30		30
Petrochelidon nigricans	Tree Martin	-	-	-	4		4
Platycercus elegans	Crimson Rosella	-	-	-	60	5	65
Podargus strigoides	Tawny Frogmouth	-	-	-	1		1
Psephotus haematonotus	Red-rumped Parrot	-	-	-	47		47
Ptilotula penicillata	White-plumed Honeyeater	-	-	-	1	3	4
Rhipidura albiscapa	Grey Fantail	-	-	-	3		3
Rhipidura leucophrys	Willie Wagtail	-	-	-	8	6	14
Sturnus vulgaris	Common Starling	-	-	*	343	10	353
Turdus merula	Common Blackbird	-	-	*	14		14
Vanellus tricolor	Banded Lapwing	-	-	-	2		2
	Total:				**1148**	**300**	**1448**

^ Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi**: Migratory. **Intro**: Introduced (* denotes introduced species). **OPP**: Opportune. **PC**: Point Count.

Thirteen (13) out of the total 48 species were only recorded opportunistically:

- Australian Reed Warbler (*Acrocephalus australis*);
- Red Wattlebird (*Anthochaera carunculata*);
- White-necked Heron (*Ardea pacifica*);
- Little Corella (*Cacatua sanguinea);*
- Spotted Harrier (*Circus assimilis*);
- Feral Pigeon (*Columba livia*);
- Black-faced Cuckoo-shrike (*Coracina novaehollandiae*);
- Black-shouldered Kite (*Elanus axillaris*);
- Brown Falcon (*Falco berigora*);
- Eurasian Coot (*Fulica atra*);
- Rainbow Bee-eater (*Merops ornatus*);
- Little Pied Cormorant (*Microcarbo melanoleucos*); and
- Blue-winged Parrot (*Neophema chrysostoma*).

Summer 2016

A total of 1,255 individuals from 24 bird species were observed during dedicated point count and opportunistic surveys across the Twin Creek Wind Farm project site.

The species with the greatest number of recorded individuals was the Common Starling (240 individuals) followed closely by the Australian Magpie (221 individuals). There were five species for which only a single individual was recorded during the summer 2016 survey: the Australian Owlet-nightjar (*Aegotheles cristatus*), which was heard at point count site number one (Table 36), Red Wattlebird (*Anthochaera carunculata*), Brown Songlark (*Cincloramphus cruralis*), Brown Falcon (*Falco berigora*) and Singing Honeyeater (*Gavicalis virescens*).

Point Count

Sixteen (16) point count surveys were re-surveyed across the project area (Figure 43). Of the 1,255 birds that were observed during the summer 2016 survey, 924 of these were recorded during point count surveys. The introduced House Sparrow recorded the highest number of individuals with 203 birds. The Australian Owlet-nightjar was the only new bird species recorded from the previous spring 2015 survey.

Opportunistic birds

Of the 1,255 individual birds recorded, 331 individuals from 13 species were observed opportunistically across the site (Table 36). The species with the highest representation in opportunistic observations was the Australian Raven with 104 individuals.

Table 36. Bird survey results summer 2016.

Scientific name	Common name	Conservation status^			Number observed^		
		Aus	SA	Intro	PC	OPP	Total
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-	-	11	4	15
Aegotheles cristatus	Australian Owlet-nightjar				1		1
Anthochaera carunculata	Red Wattlebird	-	-	-	1		1
Anthus australis	Australian Pipit	-	-	-	19	7	26
Aquila audax	Wedge-tailed Eagle	-	-	-	4	2	6
Chenonetta jubata	Maned (Australian Wood Duck)	-	-	-	5		5
Cincloramphus cruralis	Brown Songlark	-	-	-	1		1
Columba livia	Feral Pigeon [Rock Dove]	-	-	*	6		6
Corvus coronoides	Australian Raven	-	-	-	53	104	157
Eolophus roseicapilla	Galah	-	-	-	167	48	215
Falco berigora	Brown Falcon	-	-	-		1	1
Falco cenchroides	Nankeen Kestrel	-	-	-	11	6	17
Gavicalis virescens	Singing Honeyeater	-	-	-	1		1
Grallina cyanoleuca	Magpie-lark	-	-	-	8		8
Gymnorhina tibicen	Australian Magpie	-	-	-	132	89	221
Manorina melanocephala	Noisy Miner	-	-	-	23		23
Ocyphaps lophotes	Crested Pigeon	-	-	-	12	4	16
Pardalotus striatus	Striated Pardalote	-	-	-	2		2
Passer domesticus	House Sparrow	-	-	*	203		203
Platycercus elegans	Crimson Rosella	-	-	-	25	2	27
Psephotus haematonotus	Red-rumped Parrot	-	-	-	44	2	46
Ptilotula penicillata	White-plumed Honeyeater	-	-	-	3		3
Rhipidura leucophrys	Willie Wagtail	-	-	-	12	2	14
Sturnus vulgaris	Common Starling	-	-	*	180	60	240
	Total:				**924**	**331**	**1255**

^ **Aus:** Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi**: Migratory. **Intro**: Introduced (* denotes introduced species). **OPP**: Opportune. **PC**: Point Count.

Autumn 2016

A total of 751 individuals from 30 bird species were observed during dedicated point count and opportunistic surveys across the Twin Creek Wind Farm project site (Table 37).

Three species of bird observed were non-native; Eurasian Skylark (*Alauda arvensis*), House Sparrow (*Passer domesticus*) and the European Starling (*Sturnus vulgaris*). In addition, four new species were observed. These were the Musk Lorikeet (*Glossopsitta concinna*), Zebra Finch (*Taeniopygia guttata*), White-backed Swallow (*Cheramoeca leucosterna*), and the Little Buttonquail (*Turnix velox*). This has resulted in a total of 54 species being observed across the project site (across spring, summer and autumn surveys).

Point Count

Sixteen (16) point count surveys were undertaken across the project area (Figure 43). The most abundant species detected during dedicated point count surveys (Table 37) were the Australian Magpie (97 individuals), the introduced Common Starling (74 individuals), and Galah (55 individuals).

Opportunistic birds

A total of 178 individuals from 7 species were observed opportunistically across the site (Table 37). The species with the highest representation in opportunistic observations were the Common Starling (150 individuals).

During a separate field survey, performed on 5 April 2016 whilst surveying additional areas for PBTL, EBS field staff observed a White-fronted Chat (*Epthianura albifrons*) nest (Figure 44). This species had not been recorded on site previously by EBS.

Table 37. Bird survey results autumn 2016.

Scientific name	Common name	Conservation status^			Number observed^		
		Aus	SA	Intro	PC	OPP	Total
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-	-	6	0	6
Alauda arvensis	Eurasian Skylark			*	14	0	14
Anthus australis	Australian Pipit	-	-	-	24	0	24
Aquila audax	Wedge-tailed Eagle	-	-	-	1	3	4
Coracina novaehollandiae	Black-faced Cuckoo shrike	-	-	-	2	0	2
Corvus coronoides	Australian Raven	-	-	-	18	7	25
Corvus mellori	Little Raven	-	-	-	49	0	49
Eolophus roseicapilla	Galah	-	-	-	55	0	55
Falco cenchroides	Nankeen Kestrel	-	-	-	2	7	9
Gavicalis virescens	Singing Honeyeater	-	-	-	11	0	11
Grallina cyanoleuca	Magpielark	-	-	-	4	0	4
Gymnorhina tibicen	Australian Magpie	-	-	-	97	4	101

Scientific name	Common name	Conservation status^			Number observed^		
		Aus	SA	Intro	PC	OPP	Total
Hirundo neoxena	Welcome Swallow	-	-	-	3	0	3
Manorina melanocephala	Noisy Miner	-	-	-	32	0	32
Ocyphaps lophotes	Crested Pigeon	-	-	-	7	0	7
Pardalotus striatus	Striated Pardalote	-	-	-	17	0	17
Passer domesticus	House Sparrow	-	-	*	15	0	15
Petrochelidon nigricans	Tree Martin	-	-	-	25	0	25
Platycercus elegans	Crimson Rosella	-	-	-	34	0	34
Psephotus haematonotus	Red-rumped Parrot	-	-	-	29	0	29
Ptilotula penicillata	White-plumed Honeyeater	-	-	-	12	0	12
Rhipidura leucophrys	Willie Wagtail	-	-	-	18	0	18
Sturnus vulgaris	Common Starling	-	-	*	74	150	224
Vanellus tricolor	Banded Lapwing	-	-	-	7	0	7
Cheramoeca leucosterna	White-backed Swallow	-	-	-	2	0	2
Epthianura albifrons	White-fronted Chat	-	-	-	3	5	8
Anas gracilis	Grey Teal	-	-	-	3	0	3
Glossopsitta concinna	Musk Lorikeet	-	-	-	8	0	8
Turnix velox	Little Buttonquail	-	-	-	1	0	1
Taeniopygia guttata	Zebra Finch	-	-	-	0	2	2
	Total:				**178**	**573**	**751**

^ **Aus:** Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi**: Migratory. **Intro**: Introduced (* denotes introduced species). **OPP**: Opportune. **PC**: Point Count.

Figure 44. White-fronted Chat nest recorded during the additional one-day survey 5 April 2016.

Winter 2016

A total of 743 individuals from 30 bird species were observed during dedicated point count and opportunistic surveys across the Twin Creek Wind Farm project site (Table 38). The species observed were typical of those inhabiting open country and woodlands in South Australia.

The most numerous species observed were the Galah (163 individuals), Australian Magpie (148 individuals) and Little Raven (116 individuals). Two new species were recorded in winter 2016: the Pacific Black Duck (*Anas superciliosa*) and the White-faced Heron (*Egretta novaehollandiae)*.

Point Count

Sixteen (16) point count surveys were re-surveyed across the project area (Figure 43). A total of 743 birds were observed during the winter 2016 surveys. The most abundant species recorded was the Galah, with 128 recorded. The Musk Lorikeet and Little Button-quail, which were first recorded in autumn 2016, were again observed in the winter 2016 survey during point counts.

Opportunistic birds

A total of 132 birds from nine species were opportunistically sighted during the winter 2016 surveys. Of the nine species, three were raptors: Nankeen Kestrel (27 individuals), Brown Falcon (3 individuals) and Wedge-tailed Eagle (2 individuals).

Table 38. Bird survey results autumn 2016.

Scientific name	Common name	Conservation status^			Number observed^		
		Aus	SA	Intro	PC	OPP	Total
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-	-	4		4
Alauda arvensis	Eurasian Skylark	-	-	*	13		13
Anas gracilis	Grey Teal	-	-	-	2		2
Anas superciliosa	Pacific Black Duck	-	-	-	1		1
Anthochaera carunculata	Red Wattlebird	-	-	-	1		1
Anthus australis	Australian Pipit	-	-	-	32		32
Aquila audax	Wedge-tailed Eagle	-	-	-		2	2
Chenonetta jubata	Maned (Australian Wood Duck)	-	-	-	2	8	10
Cincloramphus cruralis	Brown Songlark	-	-	-	2		2
Columba livia	Feral Pigeon [Rock Dove]	-	-	*	3		3
Corvus mellori	Little Raven	-	-	-	116		116
Egretta novaehollandiae	White-faced Heron	-	-	-	3	2	5
Eolophus roseicapilla	Galah	-	-	-	128	35	163
Falco berigora	Brown Falcon	-	-	-	2	3	5
Falco cenchroides	Nankeen Kestrel	-	-	-	13	27	40
Gavicalis virescens	Singing Honeyeater	-	-	-	5		5
Glossopsitta concinna	Musk Lorikeet	-	-	-	11		11
Gymnorhina tibicen	Australian Magpie	-	-	-	106	42	148
Hirundo neoxena	Welcome Swallow	-	-	-	11		11
Manorina melanocephala	Noisy Miner	-	-	-	34		34
Ocyphaps lophotes	Crested Pigeon	-	-	-	2		2
Pardalotus striatus	Striated Pardalote	-	-	-	33		33
Passer domesticus	House Sparrow	-	-	-	13		13
Petrochelidon nigricans	Tree Martin	-	-	-	29	12	41
Platycercus elegans	Crimson Rosella	-	-	-	33		33
Psephotus haematonotus	Red-rumped Parrot	-	-	-	22	1	23
Ptilotula penicillata	White-plumed Honeyeater	-	-	-	4		4
Rhipidura leucophrys	Willie Wagtail	-	-	-	17		17
Sturnus vulgaris	Common Starling	-	-	-	97		97
Turnix velox	Little Buttonquail	-	-	-	1		1
	Total:				**740**	**132**	**872**

^ Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare. **Mi**: Migratory. **Intro**: Introduced (* denotes introduced species). **OPP**: Opportune. **PC**: Point Count.

5.3.6 Peregrine Falcon

Eleven records of the Peregrine Falcon are situated outside of the Twin Creek Wind Farm project site (including to the west, east and south) (Figure 11). No nest locations or individual Peregrine Falcon observations were recorded during the spring 2015, summer 2016, autumn 2016 or winter 2016 surveys.

5.3.7 Wedge-tailed Eagle

Targeted Wedge-tailed Eagle nest surveys have been conducted during their breeding season in spring (September) 2015 and winter (August) 2016. A total of three potential Wedge-tailed Eagle nests were located within the proposed Twin Creek Wind Farm site (Figure 45). These nests were typically found in wooded areas within the project boundary, which were scarcely scattered across the site. The three nests were situated within *Eucalyptus leucoxylon* ssp. Woodland (Association 4). Photographic representation of all Wedge-tailed Eagle nests was recorded (Figure 46 to Figure 48). One out of the three nests (Nest 3) was active during the spring 2015 (Table 39) and winter 2016 survey (Table 40), however given that this was likely to belong to a single breeding pair, all three nests could be potentially utilised for breeding in the future.

Breeding behaviour was recorded during the spring 2015 and winter 2016 surveys. During the spring 2015 survey, a single adult was observed flying from Nest 3, and an additional pair of Wedge-tailed Eagles were flushed when entering the area. The pair were observed flying on thermals approximately 600 m from the point count area (where the nests were recorded), 300 m above ground. The August 2016 survey recorded a Wedge-tailed Eagle sitting in Nest 3, however neither eggs nor young were discernable. Wedge-tailed Eagles were observed on two of the three days of surveys in August 2016.

Wedge-tailed Eagles were also observed during the autumn (April 2016) and summer (February 2016) surveys. In autumn, there were four observations of the Wedge-tailed Eagle, three of which were opportunistic sightings. These sightings were spread across the site, with observations occurring close to WTG21, WTG14 and WTG31. Only one Wedge-tailed Eagle was observed during point counts in autumn, at point count 008 (Figure 6). During the summer (February 2016) survey, six Wedge-tailed Eagles were observed on site (four during point count surveys and two during opportunistic observations). Two opportune sightings were recorded south of WTG46. During point count observations, two were sighted and another two individuals were observed being chased by ravens which dropped down into the valley rather than flying high above the ridgeline.

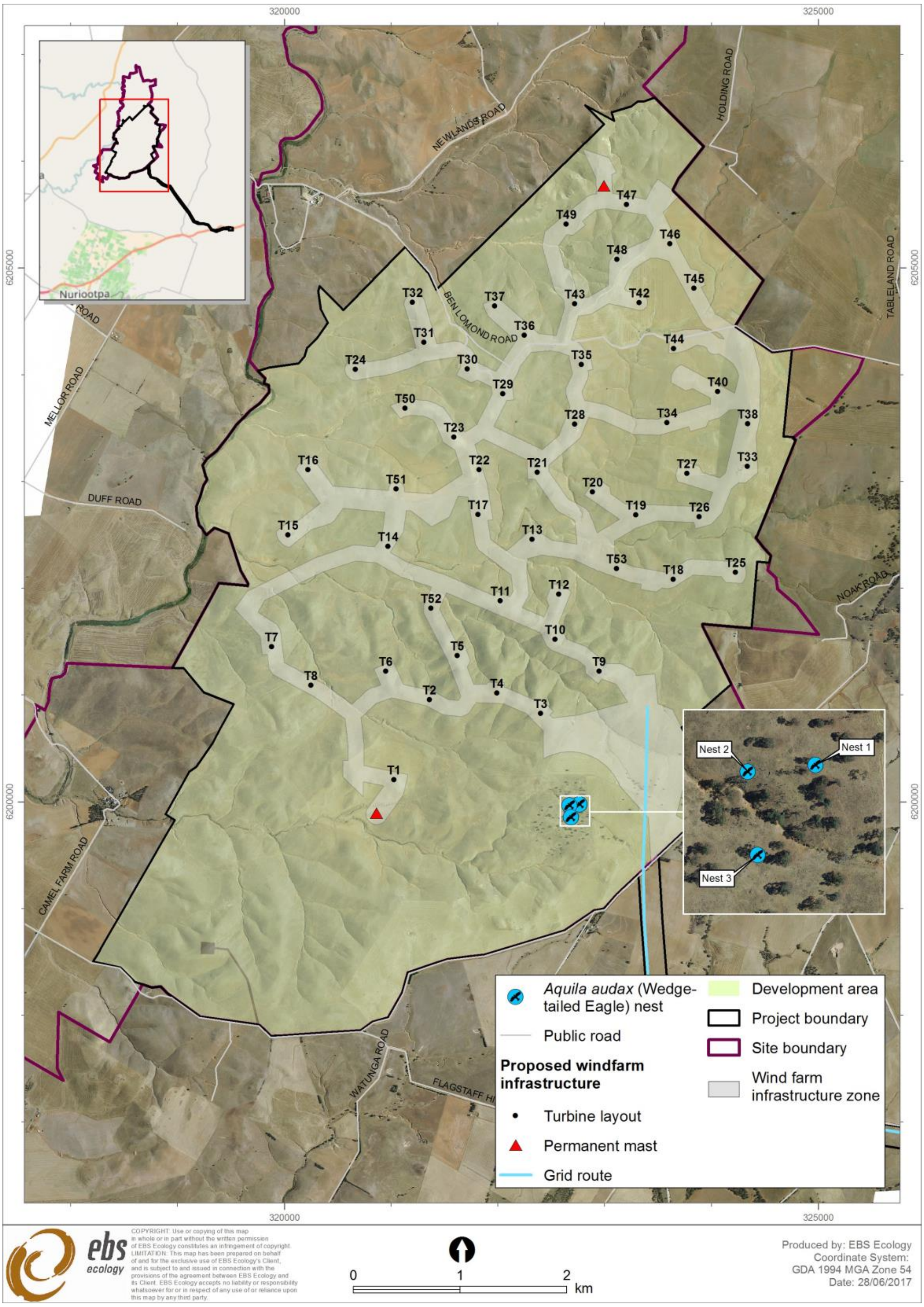


Figure 45. Wedge-tailed Eagle nest locations.

Figure 46. Nest 1.

Figure 47. Nest 2.

Figure 48. Nest 3.

Table 39. Location of Wedge-tailed Eagle nests within the project boundary in spring 2015.

Nest no.	Easting	Northing	Nest height in tree (m)	Size of nest	Nest material	White wash	Intact/ dilapidated	Condition	Fledge / no fledge	Active / not active
1	322766	6199977	15	M	A	A	I	M	N	NA
2	322673	6199968	15	S	A	A	D	P	N	NA
3	322687	6199854	10	L	P	P	I	G	N	A

Size of nest: S (small), M (medium) or L (large), Nest material: A (absent) or P (present), White wash: A (absent) or P (present), I (intact) or D (dilapidated), Condition: P (poor), M (medium) or G (Good), Fledge/no fledgling: N (no fledgling), Active / not active: NA (not active) or A (active).

Table 40. Location of Wedge-tailed Eagle nests within project boundary in winter 2016.

Nest no.	Easting	Northing	Nest height in tree (m)	Size of nest	Nest material	White wash	Intact/ dilapidated	Condition	Fledge / no fledge	Active / not active
1	322766	6199977	15	L	A	A	I	G	N	NA
2	322673	6199968	15	M	A	A	I	G	N	NA
3	322687	6199854	10	L	P	A	I	G	N	A

Size of nest: S (small), M (medium) or L (large), **Nest material**: A (absent) or P (present), **White wash**: A (absent) or P (present), I (intact) or D (dilapidated), **Condition**: P (poor), M (medium) or G (Good), **Fledge/no fledgling:** N (no fledgling), **Active / not active**: NA (not active) or A (active).

5.3.8 At-risk flight height / movements of birds

Minimum and maximum flight heights were recorded for raptor species and threatened avian species. The report has been based on indicative dimensions of 112 m for the tower height and 67 m for the blade lengths. The risk assessment in this report has been based on the lowest extent of a rotating blade tip being 45 m from the ground (based on the indicative dimensions provided by RES). If the tower height and/or blade length (and ultimately the lowest extent of the rotating tip and the rotor swept area) change through the detail design of the project, the risk assessment may need to be redone.

Flight heights of seven bird species were recorded during the spring 2015 survey (Table 41); these included six raptor species and one with a state conservation rating. A Wedge-tailed Eagle performed two flight movements with the highest being 300m above the ground; the Australian Hobby (*Falco longipennis*) and Spotted Harrier (*Circus assimilis*) were observed flying low to the ground in search of food (Table 41).

Flight heights of three species of bird were recorded during the summer 2016 survey (Table 42). Wedge-tailed Eagles recorded two movements at low minimum and maximum heights, one of which was due to the fact a number of ravens chased a pair of eagles low into the valley. The Nankeen Kestrel was the raptor with the most number of observations recorded flying across the site during the summer 2016 survey; minimum height ranges were as low as 1m and maximum height ranges as high as 80 m (Table 42).

Flight heights of two species of raptor were recorded during the autumn 2016 survey, being the Nankeen Kestrel and the Wedge-tailed Eagle (Table 43). Of the four recorded Wedge-tailed Eagle observations, all but one are at low altitudes, between 10 and 45 m, however one flight recorded was at very high altitudes, with the lowest flights recorded at 300-350 m. A total of nine flight observations were recorded for the Nankeen Kestrel. The majority of these flights were at relatively low altitudes, with only two maximum flights heights recorded above 50m in altitude.

Flight heights of three species of raptor were recorded during the winter 2016 survey; Nankeen Kestrel, Brown Falcon and Wedge-tailed Eagle (Table 44). A total of 36 Nankeen Kestrel flights were recorded, with the altitudes ranging between ground level and 85 m. Of the 36 flights recorded, five were at altitudes greater than 40 m. Four Brown Falcon flights were recorded, with maximum flight heights reaching 40 m. Two Wedge-tailed Eagles flights were recorded, with altitudes ranging between 15 and 120 m.

Table 41. Flight details of raptor and threatened birds species determined as possibly at-risk of colliding with turbines (spring 2015).

Common name	Scientific name	Total movements	Min height (m)	Max height (m)	At-risk flights recorded Y/N
Wedge-tailed Eagle	*Aquila audax*	2	10	300	Y
Spotted Harrier	*Circus assimilis*	1	0	5	N
Black-shouldered Kite	*Elanus axillaris*	1	0	0	N
Black-shouldered Kite	*Elanus axillaris*	1	30	60	Y

Black-shouldered Kite	*Elanus axillaris*	1	10	40	N
Brown Falcon	*Falco berigora*	1	10	100	Y
Nankeen Kestrel	*Falco cenchroides*	1	30	200	Y
Nankeen Kestrel	*Falco cenchroides*	1	50	200	Y
Nankeen Kestrel	*Falco cenchroides*	1	0	30	N
Nankeen Kestrel	*Falco cenchroides*	1	5	40	N
Nankeen Kestrel	*Falco cenchroides*	1	10	25	N
Nankeen Kestrel	*Falco cenchroides*	1	15	150	Y
Australian Hobby	*Falco longipennis*	1	0	15	N
Blue-winged Parrot	*Neophema chrysostoma*	1	10	40	N

Table 42. Flight details of raptor and threatened birds species determined as possibly at-risk of colliding with turbines (summer 2016).

Common name	Scientific name	Total movements	Min height (m)	Max height (m)	At-risk flights recorded Y/N
Wedge-tailed Eagle	*Aquila audax*	1	15	70	Y
Wedge-tailed Eagle	*Aquila audax*	1	5	20	N
Brown Falcon	*Falco berigora*	1	20	50	Y
Nankeen Kestrel	*Falco cenchroides*	2	10	32	N
Nankeen Kestrel	*Falco cenchroides*	1	2	25	N
Nankeen Kestrel	*Falco cenchroides*	1	1	5	N
Nankeen Kestrel	*Falco cenchroides*	1	5	20	N
Nankeen Kestrel	*Falco cenchroides*	1	10	80	Y
Nankeen Kestrel	*Falco cenchroides*	1	15	60	Y
Nankeen Kestrel	*Falco cenchroides*	1	5	50	Y
Nankeen Kestrel	*Falco cenchroides*	1	15	40	N
Nankeen Kestrel	*Falco cenchroides*	1	10	60	Y
Nankeen Kestrel	*Falco cenchroides*	1	10	80	Y

Table 43. Flight details of raptor and threatened birds species determined as possibly at-risk of colliding with turbines (autumn 2016).

Common name	Scientific name	Total movements	Min height (m)	Max height (m)	At-risk flights recorded Y/N
Wedge-tailed Eagle	*Aquila audax*	1	10	45	Y
Wedge-tailed Eagle	*Aquila audax*	1	10	15	N

Wedge-tailed Eagle	*Aquila audax*	1	10	40	N
Wedge-tailed Eagle	*Aquila audax*	1	300	350	Y
Nankeen Kestrel	*Falco cenchroides*	1	10	25	N
Nankeen Kestrel	*Falco cenchroides*	1	10	30	N
Nankeen Kestrel	*Falco cenchroides*	1	10	25	N
Nankeen Kestrel	*Falco cenchroides*	1	10	40	N
Nankeen Kestrel	*Falco cenchroides*	1	10	50	Y
Nankeen Kestrel	*Falco cenchroides*	1	20	30	N
Nankeen Kestrel	*Falco cenchroides*	1	40	50	Y
Nankeen Kestrel	*Falco cenchroides*	1	60	80	Y
Nankeen Kestrel	*Falco cenchroides*	1	10	25	N

Table 44. Flight details of raptor and threatened birds species determined as possibly at-risk of colliding with turbines (winter 2016).

Common name	Scientific name	Total movements	Min height (m)	Max height (m)	At-risk flights recorded Y/N
Wedge-tailed Eagle	*Aquila audax*	1	35	120	Y
Wedge-tailed Eagle	*Aquila audax*	1	15	60	Y
Brown Falcon	*Falco berigora*	1	25	35	N
Brown Falcon	*Falco berigora*	1	0	5	N
Brown Falcon	*Falco berigora*	1	15	40	Y
Brown Falcon	*Falco berigora*	1	0.5	2.5	N
Nankeen Kestrel	*Falco cenchroides*	1	20	35	N
Nankeen Kestrel	*Falco cenchroides*	1	20	35	N
Nankeen Kestrel	*Falco cenchroides*	1	25	50	Y
Nankeen Kestrel	*Falco cenchroides*	1	10	20	N
Nankeen Kestrel	*Falco cenchroides*	1	2	10	N
Nankeen Kestrel	*Falco cenchroides*	1	10	25	N
Nankeen Kestrel	*Falco cenchroides*	1	5	10	N
Nankeen Kestrel	*Falco cenchroides*	1	40	85	Y
Nankeen Kestrel	*Falco cenchroides*	1	2	10	N
Nankeen Kestrel	*Falco cenchroides*	1	5	40	N
Nankeen Kestrel	*Falco cenchroides*	1	5	15	N
Nankeen Kestrel	*Falco cenchroides*	1	40	85	Y

Nankeen Kestrel	*Falco cenchroides*	1	5	60	Y
Nankeen Kestrel	*Falco cenchroides*	1	0.5	4	N
Nankeen Kestrel	*Falco cenchroides*	1	25	35	N
Nankeen Kestrel	*Falco cenchroides*	1	2	10	N
Nankeen Kestrel	*Falco cenchroides*	1	20	80	Y
Nankeen Kestrel	*Falco cenchroides*	1	25	35	N
Nankeen Kestrel	*Falco cenchroides*	1	5	15	N
Nankeen Kestrel	*Falco cenchroides*	1	20	30	N
Nankeen Kestrel	*Falco cenchroides*	1	1	30	N
Nankeen Kestrel	*Falco cenchroides*	1	2	20	N
Nankeen Kestrel	*Falco cenchroides*	1	5	15	N
Nankeen Kestrel	*Falco cenchroides*	1	10	15	N
Nankeen Kestrel	*Falco cenchroides*	1	1	5	N
Nankeen Kestrel	*Falco cenchroides*	1	6	15	N
Nankeen Kestrel	*Falco cenchroides*	1	8	15	N
Nankeen Kestrel	*Falco cenchroides*	1	5	15	N
Nankeen Kestrel	*Falco cenchroides*	1	10	20	N
Nankeen Kestrel	*Falco cenchroides*	1	5	0.5	N
Nankeen Kestrel	*Falco cenchroides*	1	10	15	N
Nankeen Kestrel	*Falco cenchroides*	1	10	20	N
Nankeen Kestrel	*Falco cenchroides*	1	5	15	N
Nankeen Kestrel	*Falco cenchroides*	1	10	25	N
Nankeen Kestrel	*Falco cenchroides*	1	8	15	N

5.3.9 Bats

Bat surveys were performed on the nights of 9 and 10 September 2015. Two AnaBat devices were used over both nights however one AnaBat failed to work on the second night. Survey sites were located within wooded areas or near surface water located within the project area (Figure 7).

A second bat survey was performed over four nights in February and March 2016. This survey utilised three AnaBat devices. The sites chosen for the survey repeated within wooded areas or near surface water located within the project boundary, that were selected in September 2015.

The AnaBat survey in September 2015 confirmed the presence of seven bat species (Table 45):

- White-striped Free tail-bat (*Austronomus australis*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)

- Chocolate Wattled Bat (*Chalinolobus morio*)
- Southern Free tail-bat (*Mormopterus species 4)*
- Lesser Long-eared Bat (*Nyctophilus geoffroyi*)
- Large Forest Bat (*Vespadelus darlingtoni*) and
- Southern Forest Bat (*Vespadelus regulus*).

Sample AnaBat files taken from six of the bat species, is shown in Appendix 3.

Three bat species that were identified as potentially occur within the project boundary (based on potential habitat and distribution of the species), but were undetected during the surveys, were:

- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) (State rare);
- Inland Broad-nosed Bat (*Scotorepens balstoni*); and
- Little Forest Bat (*Vespadelus vulturnus*).

It is possible that these species would occur, although only infrequently and in low numbers. Hence, the potential risk of impact to these species is considered to be very low.

None of the recorded bat species have a conservation rating. The number of AnaBat calls recorded for each species are summarised in Table 45. Refer to Figure 7 for the location of the bat survey sites. Due to overlapping call frequencies and/or insufficient call quality, some of the bat calls could not be ascribed to a particular species.

Based on the total number of AnaBat calls and captures, the Gould's Wattled Bat was the most common species. The number of calls may not reflect abundance, but would suggest the project site is subject to a relatively low level of bat activity; this may also be due to the fact the majority of the project site is void of suitable habitat for bats.

The AnaBat survey in February/March 2016 confirmed the presence of at least seven bat species (Table 46). Again, based simply on amount of calls recorded, the Gould's Wattled Bat was the most common species.

The bat species detected onsite are thought to be common throughout the region with the majority of bats recorded, being within the vicinity of habitat features such as woodlands and open water. Adopting buffers between turbines and avoiding identified bat habitat features can minimise significant impacts on bat species using the site.

Table 45. Bat survey results September 2015.

Species	Common name	Conservation status		AnaBat	No. calls recorded Sept 2015^
		Aus	SA		
Austronomus australis	White-striped Free tail-bat			✓	155
Chalinolobus gouldii	Gould's Wattled Bat			✓	171

Species	Common name	Conservation status		AnaBat	No. calls recorded Sept 2015^
		Aus	SA		
Chalinolobus gouldii or Mormopterus species 4 "big dick"				✓	65
Chalinolobus morio	Chocolate Wattled Bat			✓	42
Mormopterus species 4 "big dick"	Southern Free tail-bat			✓	18
Nyctophilus geoffroyi	Lesser Long-eared Bat			✓	25
Vespadelus darlingtoni	Large Forest Bat			✓	
Vespadelus regulus	Southern Forest Bat			✓	8

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare.

^Note: The number of AnaBat calls recorded is not necessarily indicative of abundance. Multiple calls could constitute a single bat flying past the AnaBat detector numerous times, or multiple individuals. Bat activity levels also vary depending on the weather conditions. Generally high activity is recorded on warm nights. Results should not be compared within and between survey periods due to different survey effort and weather conditions.

Table 46. Bat survey results February/March 2016.

Species	Common name	Conservation status		AnaBat	No. calls recorded Sept 2016^
		Aus	SA		
Austronomus australis	White-striped Free tail-bat			✓	9
Chalinolobus gouldii	Gould's Wattled Bat			✓	713
Chalinolobus gouldii or Mormopterus species 4 "big dick"				✓	75
Chalinolobus morio	Chocolate Wattled Bat			✓	62
Mormopterus species 3 or4	Southern Free tail-bat			✓	45
Nyctophilus geoffroyi	Lesser Long-eared Bat			✓	310
Vespadelus darlingtoni	Large Forest Bat			✓	3
Vespadelus regulus	Southern Forest Bat			✓	32

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: CE:** Critically Endangered. **EN/E:** Endangered. **VU/V:** Vulnerable. **R:** Rare.

^Note: The number of AnaBat calls recorded is not necessarily indicative of abundance. Multiple calls could constitute a single bat flying past the AnaBat detector numerous times, or multiple individuals. Bat activity levels also vary depending on the weather conditions. Generally high activity is recorded on warm nights. Results should not be compared within and between survey periods due to different survey effort and weather conditions.

6 DISCUSSION

6.1 Flora

In total, 168 flora species were recorded during the 2015 and 2016 field surveys, including 76 exotic species (which equates to 45% of the total number of flora species). All vegetation associations exhibited a degree of weed invasion and damage from stock. Out of the 76 weed species recorded, one was a Weed of National Significance (African Boxthorn), eight were classified as declared under the *Natural Resources Management Act 2004 (*NRM Act), and 13 as environmental weed species.

Appendix 1 summaries the flora species recorded in each of the 11 vegetation associations (including exotic species). The most widespread native species included *Austrostipa species, (Spear grasses), Aristida behriana (Brush-wire Grass), Lomandra effusa* (Scented Mat-rush), *Eucalyptus odorata* (Peppermint Box), *Eucalyptus leucoxylon* (South Australian Blue-Gum) and *Ptilotus spathulatus* (Pussy-tails). The most common weeds included *Avena barbata* (Wild Oats), *Ehrharta longiflora* (Annual Veldt Grass), *Erodium cicutarium* (Cut-leaf Heron's-bill), *Bromus species* (Brome), *Hordeum* spp. (Barley grass), *Marrubium vulgare* (Horehound) and *Medicago polymorph*a ssp. *polymorpha* (Burr-medic). *Scabiosa atropurpurea* (Pincushion) and *Brassica* sp. were common along roadsides. Many exotic species were present across all vegetation associations.

No flora species of National or State conservation significance were recorded during the spring 2015 survey. However, four species with a state conservation rated flora species are known to occur within the project boundary through the BDBSA database results: *Maireana rohrlachii* (Rohrlach's Bluebush), *Ptilotus erubescens* (Hairy-tails), *Rumex dumosus* (Wiry Dock) and *Eucalyptus behriana* (Broad-leaf Box). The former three species have records scattered throughout the turbine area (Figure 10). *E. behriana* occurred on the northern side of Dutton Road directly adjacent (but outside) the proposed transmission line corridor. *Cryptandra campanulata* (Long-flower Cryptandra) was also determined as likely to occur within the project boundary based on last records and their proximity to the project site.

Maireana rohrlachii is found in sandy clay loam, limestone plain and open mallee. *Ptilotus erubescens* typically occurs within better quality habitat, such as relatively fertile soils of grasslands and woodlands. *R. dumosus* occurs on loamy or sandy soils, but also on clays. Impact on these species would be low, if vegetation determined as preferred habitat was not removed. *Eucalyptus behriana* grows on sites that retain soil moisture better than surrounding sites, usually on heavy soils in slight depressions or in gently undulating terrain (Nicolle, 2013).

Two ecosystems on the ‘Provisional List of Threatened Ecosystems of South Australia’ were observed during the field surveys: *Lomandra effusa* Grassland (Endangered) and *Eucalyptus odorata* (Peppermint Box) +/- *Eucalyptus leucoxylon* (South Australian Blue Gum) Grassy Low Woodlands (Endangered). Ecosystems are not currently officially protected under South Australian legislation. However, both vegetation communities are protected under the EPBC Act if their condition is sufficient and qualifies as condition Class A or B as outlined under EPBC Act requirement.

Lomandra Grasslands and Peppermint Box Woodlands across the project site were assessed against EPBC Act criteria.

Peppermint Box woodland occurred along the proposed transmission line near Biele Road. These areas could largely be avoided when considering the location of transmission line infrastructure. Out of the three Peppermint Box sites assessed in summer, none of them qualified for listing at the time of the survey (summer). The sites were categorised as Class C and are not protected under the EPBC Act, but are considered amenable to rehabilitation. However, if surveyed during spring when more plants are in their visible life phase, site 1 is considered likely to qualify, whilst site 2 is considered to possibly qualify. Another area of Peppermint Box just north of Biele Road was visited in April 2017, as part of the finalistaion of the transmission line. From observations made, it appeared degraded and may not qualify for the EPBC listed TEC. The proposed transmission line was amended to avoid the area likely to qualify (Site 1), but a small area of Site 2 may be subject to some clearance (Figure 38). Clearance in this area should be the minimum required for safety under powerlines and no poles should be located within the woodland. However, the impact site should be assessed in spring to determine if it qualifies as an EPBC listed community, and the final design reviewed to ensure the impact is not considered significant. Should the impact be considered significant an EPBC referral is required (if the site qualifies).

Lomandra grasslands (Association 1) occurred in patches across the project site (Figure 36). Of the 21 Lomandra sites assessed, site 18 (substation) qualified as an EPBC listed community, rated as Class B. Of the other sites, 1-16 did not qualify and were surveyed in spring which is the optimal time. These included seven sites rated as condition class C and nine sites with no rating. Site 17 was surveyed in summer, but had low diversity and was unlikely to qualify (Class C). Sites 19-21 were surveyed in early autumn when dry and all rated as Class C, but are considered likely to or possibly qualifying if surveyed during the optimal time in spring.

Condition Class C areas are typically significantly degraded (low condition), are not included as a listed ecological community and therefore do not trigger the 'significant test' of the EPBC Act. Class C is indicative of patches that are degraded but could be rehabilitated to the listed ecological community through measures such as weed control, natural regeneration and protection from grazing. Areas that did not qualify in any class were highly degraded, but should still be avoided where possible.

Lomandra sites that qualify or are likely to qualify for EPBC listing were located in the eastern half of the area proposed for the terminal substation. The western half of this area comprised degraded Lomandra grasslands or cropping and any infrastructure should be targeted for this area to minimise impact and avoid a possible EPBC referral. Based on these findings, the terminal substation was positioned in cropping land, Austrostipa grassland and only a small degraded patch of Lomandra grassland (Figure 37). An EPBC referral is unlikely to be required for *Lomandra* grassland based on the current design. However, there is *Lomandra* grassland further west along the Transmission Line that may be impacted (site 17) and a spring survey is recommended to confirm that area is not EPBC listed.

6.2 Fauna

6.2.1 Habitat

The project site is generally void of good quality vegetation to sustain significant fauna diversity, although some pockets do exist. Diversity across the different fauna classes was average; 48 bird species were recorded, five species of reptile, two species of amphibian, three species of native mammal (excluding bats) and seven species of bat (during the spring 2015 survey). There were a high number of exotic birds and weed species recorded during the spring 2015 survey. The main focus of the proposed Twin Creek Wind Farm will be minimising vegetation clearance of any remaining/scattered woodland areas within the infrastructure zone as well as micro-sighting to avoid known PBTL habitat.

The vegetation communities in best condition, scoring up to 6:1, were Association 4 (*E. leucoxylon* +/- *E. porosa* open woodland), Association 10 (*Eucalyptus camaldulensis* ssp. *camaldulensis* +/- *Eucalyptus leucoxylon*) and Association 11 (*Eucalyptus leucoxylon* Tall Open Woodland over shrubby understorey).

Association 4 lies mainly within the project boundary but outside of the infrastructure zone, with areas scoring 6:1 outside of the current impact footprint. The woodland areas mapped within the project site typically contained medium/large hollows, in particular *E. odorata* open woodland (Association 7) and *E. leucoxylon* open woodland (Association 4) (Figure 49). Scats and feathers were observed at the entrance of some of the hollows. This indicates that bird species are likely to utilise hollows for protection and breeding. A single Tawny Frogmouth (*Podargus strigoides*) was observed in Association 7, which demonstrates this species ability to utilise favourable habitat in an otherwise fragmented landscape (Figure 50).

6.2.2 Bird guilds

The project site is within a fragmented landscape so it makes sense that species in a community such as this, will exploit the same set of resources in a similar manner. For instance waterfowl, parrots and woodland birds were present within the project site. Waterfowl included White-necked Heron, Eurasian Coot, Australian Reed Warbler, White-faced Heron, Pacific Black Duck and Australian Wood Duck. The parrot family included the Red-rumped Parrot, Adelaide Rosella and Blue-winged Parrot, and there was a good spread of woodland birds including: the Striated Pardalote, Varied Sittella, Rufous Whistler, Grey Fantail, Yellow-rumped Thornbill, White-plumed Honeyeater, Red Wattlebird and Black-faced Cuckoo-shrike. The Red-rumped Parrot also took advantage of a human modified resource, such as a feeding lot, to supplement their diet (Figure 51).

There were raptor species that were recorded within the 20km BDBSA data that were not recorded onsite (see Appendix 4). These include species such as the Black Falcon (*Falco subniger*) and Little Eagle (*Hieraaetus morphnoides*), which may be transient through the proposed wind farm area. The Little Eagle is considered widespread, but uncommon. It is widespread over diverse habitats, including woodland, open scrub, and open country intermixed with wooded hills across farmland, irrigated land. The Black Falcon uses tree-lined water-courses, isolated stands of trees. This species typically hunts over wetlands, temporary waters where prey is abundant. It is considered uncommon; migratory with main stronghold and breeding region in the interior of Queensland and North West Victoria. Like many other raptor species, there is some risk of bird strike from wind turbines, however it is difficult to predict based on no observations and there no flight heights recorded for both these bird species (and others that were not recorded onsite).

Figure 49. Medium to large hollows was observed within *E. leucoxylon* +/- *E. porosa* open woodland).

Figure 50. A single Tawny Frogmouth was observed in the small patch of Association 7 (intersection of Newlands Road and Ben Lomond Road.

Figure 51. Red-rumped Parrots utilising feeding lots placed within open woodland areas.

6.2.3 Threatened bird species

Two birds of conservation significance were recorded during the spring 2015 survey.

Rainbow Bee-eater

The Rainbow Bee-eater is listed as migratory under the EPBC Act. It is distributed across much of mainland Australia. The number of locations that the Rainbow Bee-eater occurs in is unknown, and has not been estimated. It is assumed that the species is widespread given its ability to undertake long-distance movements (Barrett *et al*. 2003), and will migrate to southern Australia, and remain from spring to summer. The Rainbow Bee-eater occurs in open woodlands and shrubland, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands (Gibson 1986) as well as riparian, floodplain or wetland areas in semi-arid and arid areas (Badman 1989). As the Rainbow Bee-eater is a predictable seasonal visitor to the project area, it is unlikely regional populations would be impacted upon by the proposed wind farm. Flight height and behaviour are generally unknown for this species to be able to make further conclusions.

Blue-winged Parrot

The State rated Blue-winged Parrot has a preference for open woodland, cropland and open country, where it feeds on the seeds of native and introduced grasses. They are locally nomadic, and can be often encountered in flocks of 20-100 or more during the non-breeding season. Come the breeding season, Blue-winged parrots tend to be found in pairs or small parties. Like other *Neophema species,* they are quiet, unobtrusive and predominantly forage on the ground. The flight pattern of the Blue-winged Parrot is high, swift and direct. Blue-winged Parrots are partly nomadic and may be encountered in the company of the Elegant Parrot. The habitats within which they occur include: heathland, open country, open woodland, cropland, and semi-arid scrub. They feed on the seeds of native and introduced grasses as well as shrubs and herbaceous plants. Blue-winged Parrots nest in the cavities of small trees.

Woodland areas with tree hollows should be avoided during the construction of the wind farm and existing tracks will be used where possible, rather than creating new tracks through pasture grass sites and cropland.

6.2.4 Mammals

With the exception of bat species, three mammal species were recorded during the spring 2015 survey.

Euro and Western Grey Kangaroo

There were only two Euro's observed during the spring 2015 survey; a higher number of Western Grey Kangaroos (*Macropus fuliginosus*) utilised the project area for grazing. There is unlikely to be any impact on these species as part of the proposed wind farm development.

Southern Hairy-nosed Wombat (Lasiorhinus latifrons)

A total of six Southern Hairy-nosed Wombats were observed in spring 2015 and winter 2016. Most of their warrens are situated on the edges of drainage areas throughout the project area (Figure 52). The Southern Hairy-nosed Wombat does not have a national or state conservation status. Populations are known from the project area and their presence is often indicated by their extensive burrow networks. Southern Hairy-nosed Wombats are primarily grazers, mainly feeding on native grasses. Population levels fluctuate with climatic conditions, with declines observed during drought conditions. Potential impacts associated with the development may include mortality via collision and damage to burrow systems associated with vehicle access. Such impacts are considered localised; enforcement of speed limits as part of on-site management would reduce this risk.

Bats

There are significant knowledge gaps regarding the diversity, distribution and abundance of bat species in the region. Species thought to be once common may now be regionally threatened. Based on AnaBat recordings and trapping, at least seven bat species are known to inhabit the project area.

AnaBat data enables the identification of most bats to species level, but is not a suitable measure of abundance, given the number of calls recorded may be related to the activity of one individual or many, and detection depends on a number of other factors such as microphone sensitivity and climatic conditions.

Some calls fall in to the overlap of parameters between two species and species identification cannot be confirmed without trapping.

AnaBat calls were captured within a range of the habitats present. Bats forage around woodland vegetation, in open space and over open water, dependent on the species foraging strategies. Many bat species found in South Australia use an 'edge-space' aerial foraging strategy focused on treed habitat and water bodies, and are expected to stay within close proximity to these features (Churchill 2008). This is generally the case for the bat species recorded during the field survey.

Figure 52.Southern Hairy-nosed Wombat and its offspring sitting on a burrow.

Linear features such as roads, drains and ridges have been recorded to have high bat activity (often associated with vegetation or water) and bats have been observed to navigate and forage along the length of these features (Churchill 2008). Higher bat activity levels are generally observed in wooded areas, where bat foraging and roosting habitat is abundant.

Although not recorded, the Yellow-bellied Sheath tail Bat (*Saccolaimus flaviventris*) listed as rare under the NPW Act may potentially exist in the project area. Although this species occurs across much of Australia, it is never found in large numbers. The species migrates from northern Australia into south-eastern Australia during the summer months (Churchill 2008). All records of this species from the region are from late March to early June, suggesting that it is an autumn migrant (Kahrimanis *et al.* 2001). This species is considered an occasional seasonal visitor that may roost temporarily in tree hollows within the project area.

The Yellow-bellied Sheath tail Bat flies predominately above the tree canopy, thus it is rarely trapped or detected via AnaBat. The flight height of this species makes it potentially vulnerable to turbine strike, however, given it is an infrequent visitor, the overall risk to the species is considered low. The species prefers large hollow trees and is therefore also threatened by the clearance of such trees.

Some suitable bat roosting habitat was present in woodland associations within the project area. Any clearance of such habitats would result in direct removal of potential roosting habitat for bats, and possibly the destruction of roosting bats. Clearance of any roosting habitat should be avoided, especially given low levels of remnant vegetation within the region (Graham *et al.* 2001).

Bat-strike interactions are possible during the operation of proposed wind turbines in the project site; this is based on the fact the site is generally devoid of trees and vegetative cover. Although it is not known which species may fly within the rotor-swept area, it is expected that several species may have interactions with turbines within the project area. Little is known about the effect of operating turbines on bat behaviour, whether bats avoid turbines or not, and the actual number of bat-strikes that have been caused by operational wind farms in Australia (T. Reardon pers. comm. 2011).

Most of the bat species likely to occur at the site forage within and around woodland vegetation, which is limited onsite. The interaction between such bat species and turbines can be reduced by implementing a buffer between turbines and wooded habitats. Bat species with open space foraging strategies are difficult to avoid since they may forage throughout the project area, up to 100 m in height.

Without more detailed knowledge of the bat species present, their distribution and their behaviours in the project area (pre/post construction and during operation), it is difficult to accurately assess the impacts of the proposed wind farm on bats. Ideally, on-going monitoring of bat populations would be undertaken to gain a better understanding of their regional status and utilisation of the site. A methodology should be developed for detecting bat-strikes that may occur during the operational stages of the wind farm, as well as a procedure for reporting bat-strikes that may occur.

6.2.5 Flinders Ranges Worm-Lizard

Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*) was not targeted during this survey; however potential habitat for this species exists within the project area. Suitable habitat for this species includes unploughed grasslands, particularly where flat surface rocks occur in the landscape, and woodland areas containing loose woody debris and leaf litter.

The Flinders Ranges Worm-lizard is a very small, worm-like, burrowing lizard with poorly developed hind limb flaps (Figure 53). It burrows freely in loose sand and soil, under rocks and litter 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 beneath stones and rotting stumps or occasionally in ant and termite nests. Their diet consists almost entirely of the larvae and pupae of ants.

The Flinders Worm-lizard is endemic to South Australia and although it has a national conservation rating, it does not have a state conservation rating. At the time (approximately 1993) when the national conservation rating was assigned to this species, little was known about its habits and abundance (M Hutchinson. pers. comm.). Since the early 1990s, this species has been found at numerous sites. The state conservation ratings have been updated more recently than the national ratings, which have caused the difference between the two.

Figure 53. Image of a nationally vulnerable Flinders Ranges Worm-lizard (EBS 2004).

6.2.6 Pygmy Blue-tongue Lizard

The PBTL is the smallest member of the genus *Tiliqua*, which consists of seven terrestrial lizard species commonly known as Blue-tongues. The PBTL is a moderate sized skink which has a total length of less than 20 cm. It has a relatively heavy body, large head and short limbs. Its body colour varies from grey brown to orange brown, and may include a series of black flecks along the back and flanks. The distinct orange coloured eye and black pupil are other distinguishable features of the species (Figure 54).

Figure 54. Pygmy Blue-tongue Lizard.

Refuge, movement, breeding and diet

Pygmy Blue-tongue Lizards use un-occupied spider burrows as refuges, basking sites and ambush points. The entrance holes are circular in cross section, up to 20 mm in diameter, and lack any sign of excavated soil at the entrances. The average depth of holes is approximately 25 cm, ranging from 10 to 75 cm. These holes appear indistinguishable from holes inhabited by mygalomorph and lycosid spiders (Figure 55). The lizards make no obvious external modifications to the holes, except for a slight bevelling of the edges caused by their movement. Pygmy Blue-tongue Lizards may deposit scats near the perimeter of the burrow entrance (A. Fenner, pers. comm., 2010). Burrow entrances are used as vantage points from which lizards are able to make short forays after any prey detected nearby. The lizards are extremely sensitive to both movement and noise. Only one adult lizard is found in each active burrow.

The PBTL is a largely sedentary species, with most adults in a three-year study by Milne (1999, cited in Milne and Bull 2000) moving no greater than 20 m from their burrows. The males are more active than females during spring, most likely searching for mating partners. The PBTL has a spring mating season (October and November) (Milne and Bull 2000) and bears live young, like the other *Tiliqua* species. Males can reproduce from one year of age and females are sexually mature from approximately three years of age, and can have up to four young each season. Young are born between January and March, and disperse from the mother's burrow within weeks of their birth to find burrows of their own (Clarke 2000; Duffy *et al.* 2009; Milne and Bull 2000).

Figure 55. A Wolf Spider (*Lycosa* sp.) next to its hole (note: the tip of the Burrowscope is 6 mm).

Conservation status

The PBTL is currently listed as nationally endangered under the *Environment Protection and Biodiversity Conservation Act 1999* and endangered in South Australia under the *National Parks and Wildlife Act 1972*. These classifications are consistent with the International Union for Conservation of Nature (IUCN) (2001) criteria for listing species on the IUCN Red List System (Duffy *et al.* 2009).

Distribution and populations

The PBTL is endemic to South Australia, where their population is severely fragmented (Duffy *et al.* 2009). Very little information exists on the past distribution of the species, with the few known localities extending from the Adelaide Plains to the North Mount Lofty Ranges (Duffy *et al.* 2009). The relative abundance of PBTL in European collections of specimens in the 19th century suggests that the species was formerly more common, and has undergone a marked decrease in distribution (Shea 1992, in Duffy *et al.* 2009).

The PBTL is now known from 27 sites, ranging from north of Port Wakefield in the Hummocks to south of Peterborough and west of Clare (Duffy *et al.* 2009) (Figure 56). All known populations are located on private land, most of which are used for sheep grazing. They are generally surrounded by unsuitable habitat, usually cropped agricultural land. However, the full extent of most populations has not yet been determined, and it is possible that some apparently isolated localities belong to single contiguous populations (J. Schofield pers. comm.). From previous studies completed in the southern area of the wind farm development area, EBS has mapped where these previous records were found (DEWNR 2016) (Figure 57).

The total population size of the PBTL is uncertain (Duffy *et al.* 2009). Prior to 2000, the population was estimated to be around 5000 lizards, based on 10 known populations. Since this time, another 17 populations have been discovered. Suitable habitats are largely on private land, therefore historically surveys were not as accessible. However, due to the PBTL Recovery Plan efforts, university studies and also by wind farm surveys, surveys of PBTLs have increased in the last few years. Since 2000, another 17 populations have been discovered. Overall population numbers are hard to estimate due to the fluctuations in the population numbers (M. Hutchinson pers. comm.).

Habitat requirements

Pygmy Blue-tongue Lizards are known to occupy native grassland habitats (Milne 1999). Even highly degraded grasslands (dominated by exotic species) are potential habitat, providing that the area is unploughed and the soil structure remains intact (J Schofield pers. comm. 2008). The species has been recorded at sites dominated by species including *Austrostipa* spp. (Spear-grasses), *Austrodanthonia* spp. (Wallaby Grasses), *Maireana* spp. (Bluebush), *Aristida behriana* (Brush Wire-grass) and *Lomandra* spp. (Iron-grasses) (Hutchinson *et al.* 1994, Souter *et al.* 2007, in Duffy *et al.* 2009).

Refuge requirements

A study into the habitat requirements of the species (Souter 2003, in Duffy *et al.* 2009) indicated that the abundance of the species within grasslands was dependent on the availability of deep spider burrows in well-draining soils. Suitable lizard burrows were absent or scarce in areas that lacked native grassland or had a dense cover of introduced species.

Soil which is either not deep enough or free-draining enough inhibits spiders from constructing suitable burrows, and therefore these areas lack habitat suitable for PBTLs. The lizards tend to be present in greatest densities on the lower slopes of hillsides, where the soil and consequently the spider burrows are deepest (Schofield 2006, in Duffy *et al.* 2009).

The habitat and targeted PBTL surveys determined that suitable habitat was identified across the entire project site, with the exception of cropping, steep/rocky areas and drainage areas. A total of six PBTLs were observed during the habitat survey (spring 2015), while 115 individuals were observed during the targeted surveys.

The southern area of the wind farm development area has optimal habitat for the species, which consist of gentle sloping rolling hills with plenty of spider holes. The northern section still has PBTLs present however, they are typically in lower densities where infrastructure is proposed. Utilising cropping areas as much as possible for major infrastructure layouts will reduce the impact to PBTL habitat. The potential impacts of a wind farm development within the project area on PBTL Lizard individuals or populations may include the following:

Short-term

- Potential direct loss of individuals through habitat clearance during construction;
- Sedimentation of burrows from construction run-off (soil); and
- Noise and vibration disturbance during construction.

Long-term

- Potential loss of habitat;
- Division and isolation of sub-populations by vehicular access tracks;
- Sedimentation of burrows from run-off from access tracks; and
- Potential disturbance to populations in close proximity to turbines from blade shadow flicker.

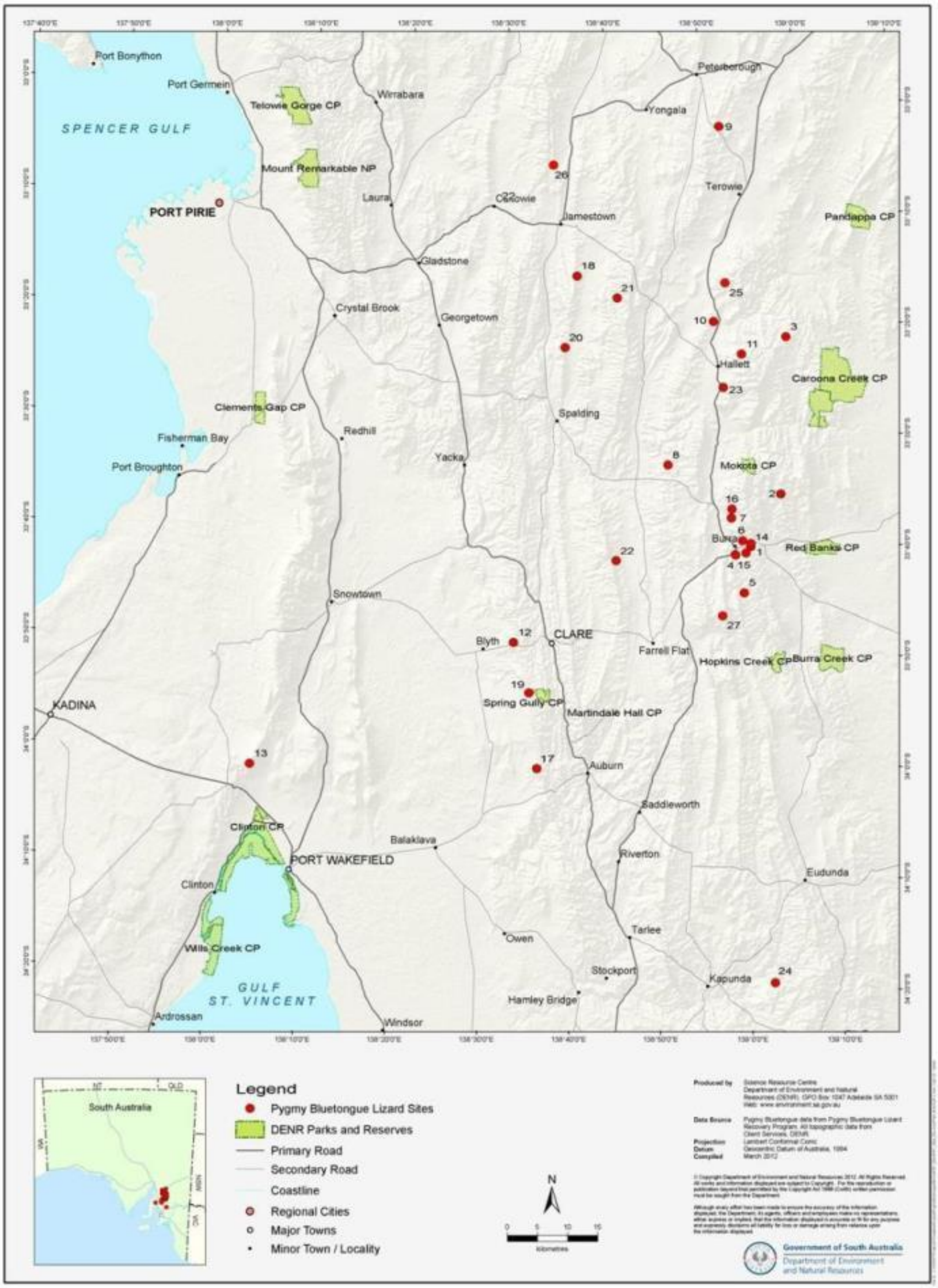


Figure 56. Known Pygmy Blue-tongue Lizard sites (2012).

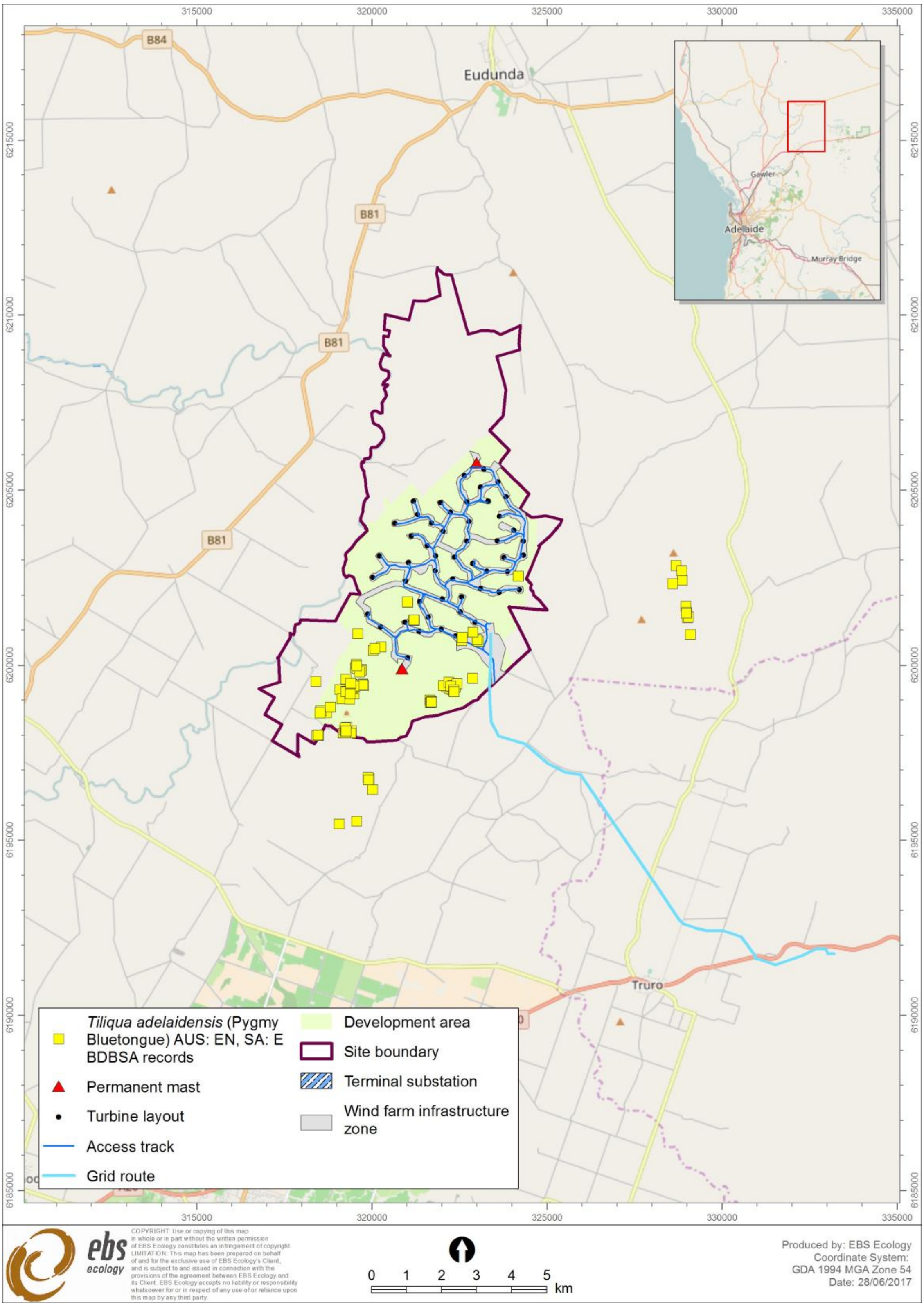


Figure 57. Known PBTL records within the project boundary.

Translocation Plan and PBTL Offset

An impact assessment on the PBTL will be conducted as part of the EPBC referral process for this project, and which is a deliverable that RES has committed to. A suitable offset will also be calculated and developed as part of the impact assessment process. This will be based on the calculated impacts on the species and offsetting the residual impact of the project on the PBTL.

A translocation plan for the species will also be developed as part of the impact assessment process. Possible translocation suitability is shown in Figure 58; though PBTL were located in many of the transmission corridors, the potential for a translocation from those which are likely to have a low abundance of PBTL is most plausible.

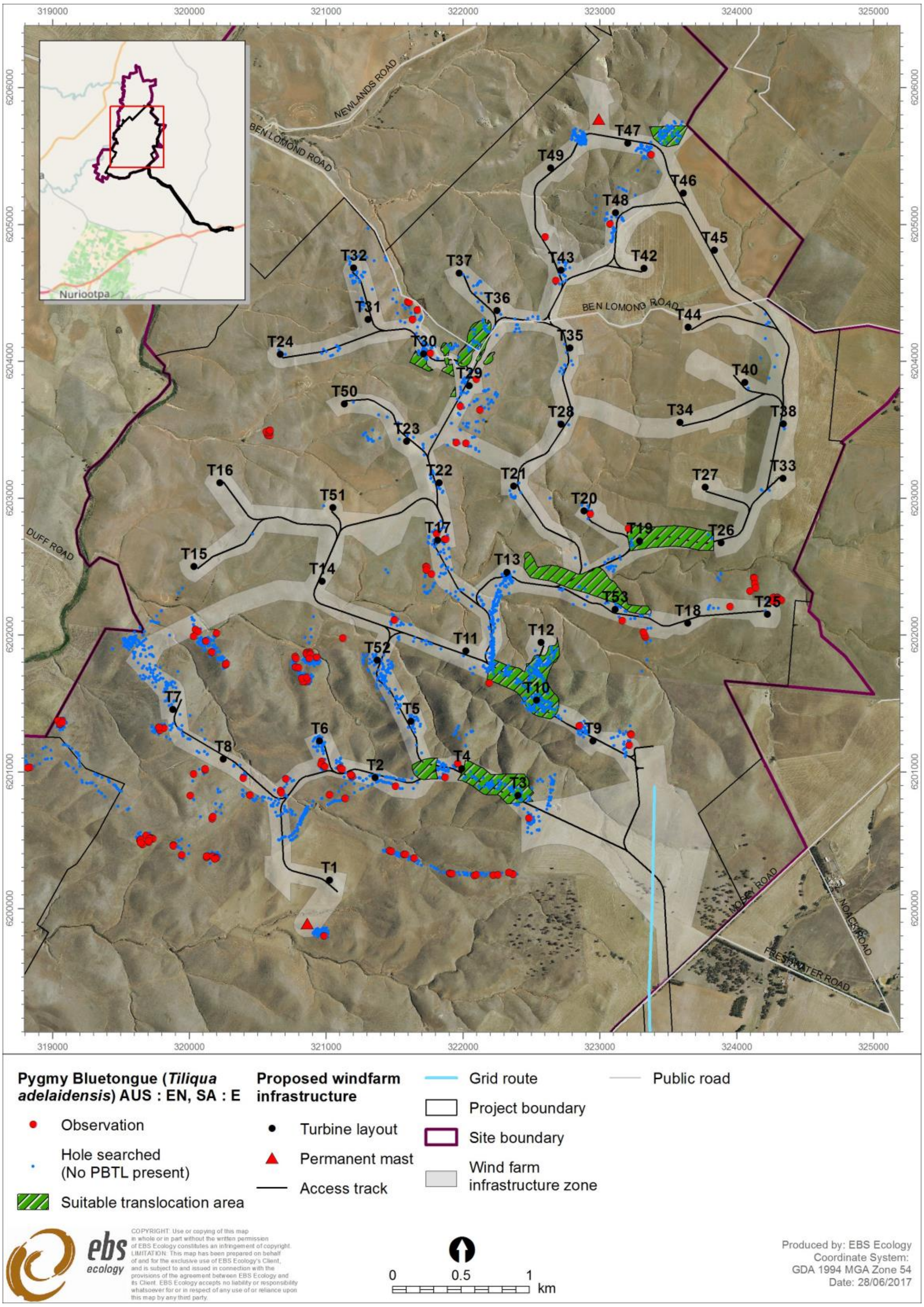


Figure 58. Possible translocation PBTL suitability.

6.3 Reducing impacts to raptors via nest buffers

A range of direct and indirect impacts of wind farms on birds are recognised with mortality via direct collision with turbines being an obvious impact. Other impacts include displacement due to habitat loss and various types of disturbance effects (Drewitt and Langston 2006). There is little available data on the disturbance effects of wind farm developments on birds in Australia.

Suitable buffers need to be considered in the planning process in order to reduce the likelihood of impacts on birds in the area. Buffers are primarily aimed at reducing the disturbance to the birds during breeding season and when juveniles are near fledging. Raptor species such as the Wedge-tailed Eagle and Peregrine Falcon are considered significant when assessing bird interactions with wind farms, as they conduct regular flights at heights coinciding with turbine rotor swept areas (where turbine blades operate).

The benefit of a buffer around nests is as follows:

- Buffers are generally focussed around areas of high activity; these are where either species may potentially nest
- During the construction of the proposed wind farm, raptor species are more likely to be at risk of disturbance from activities conducted within close proximity to nest locations. By implementing a buffer, this would contribute to decreasing disturbance levels to these species
- Wedge-tail Eagles are territorial and typically return to the same area to nest each year. By placing a buffer distance around the nest location, this would assist with lessoning disturbance levels to this species.
- Juveniles are particularly susceptible to collision, as newly fledged chicks have not learnt how to forage on their own nor avoid structures such as turbines. Buffers around nest sites will assist in decreasing the chance of a juvenile eagle or falcon colliding with a turbine.

6.4 Collision risks

6.4.1 Bird species

One of the principal risks to birds and bats posed by turbines is the potential for individuals to be killed as a result of collision with moving rotor blades (Smales 2006). However, a recently published study from Tasmania by Hull *et al* (2013) suggests that the likelihood of collision for different species is not related to their abundance on site. Findings showed that approximately 18% (of 85 species) and 21% (of 77 species) of all bird species recorded at two sites were reported to have collided with a turbine. The number of species found during carcass searches is likely to be higher, with 82 and 14 records (at the two sites) not being able to be identified to species level (feather spots were recorded).

There are also complexities in the assessment of collision risk for bird species, with species clearly displaying avoidance behaviour within wind farms. Hull and Muir (2013) found that whilst avoidance behaviours varied dependent on species and site, raptors generally displayed a high avoidance rate. This means that they have actively changed their behaviour to avoid turbines. The study by Hull and Muir (2013) concentrated on White-bellied Sea-eagles (*Haliaeetus leucogaster*) and Wedge-tailed Eagles (*Aquila audax fleayi* (Tasmanian subspecies)) and found that both species actively change their flight paths to avoid turbines. It was also found that Wedge-tail Eagles have a higher avoidance rate in bad weather (rainy and windy weather) (Hull and Muir 2013).

6.4.2 Bat species

The potential impacts of wind turbines on bats are another complex area. Bat collisions have been reported at wind farms in Australia, but few published studies are available. Barotrauma, an impact that is thought to be caused by a sudden drop in pressure around turbine blades, has been suggested as a potential cause of bat deaths at wind farms overseas, but the incidence of barotrauma has been recently queried (Grodskey et al. 2011; Rollins et al. 2012). Collisions with blades are considered to be the primary cause of fatality. In the most extensive Australian study undertaken on the impact of wind farms on bats, Hull and Cawthen (2013) found 54 bat carcasses across two wind farm sites within an eight year period. This is likely to be an underestimation based on survey design, detectability of carcasses and scavenging of carcasses. However, the focus of the Hull and Cawthen (2013) study was to determine the bat species colliding with turbines. It was found that of the 54 carcasses, 38 were of Gould's Wattled Bat (*Chalinolobus gouldii*), 14 were likely to be Gould's Wattled Bat and two were likely to be Forest Bats (*Vespadelus sp.*). Both of these species are open air foragers, and make flights at a moderate to high height, placing them within the at-risk zone of a turbine. Several other species, known to occur at the two study sites, were not represented by the carcasses, presumably as they are low-flying / foraging species (Hull and Cawthen 2013). Both Gould's Wattled Bat and species of *Vespadelus* have been recorded via AnaBat, and as such could be impacted by the proposed wind farm.

7 RECOMMENDATIONS

The following recommendations have been made to mitigate the significant impacts of the development of the proposed Twin Creek Wind Farm on native vegetation, threatened species and ecological communities, as well as Pygmy Blue-tongue Lizards and suitable Pygmy Blue-tongue Lizard habitat:

7.1 Pygmy Blue-tongue Lizard

- Submit an EPBC referral for the project. The presence of PBTL is known to the project site. Extensive surveys have shown that PBTL are located across the entire wind farm area, excluding cropped and small areas of unsuitable habitat. Areas which are suitable to PBTL should be avoided. Utilising cropping areas as much as possible for major infrastructure layouts will reduce the impact to PBTL habitat; the project design has taken into account this recommendation;
- Micro-site around proposed turbines and all associated infrastructure including access tracks, substations and transmission line (should pre-construction surveys identify PBTL as present). Surveys are recommended prior to construction, to determine which spider holes are occupied so as to determine the best options possible with regard to turbine and infrastructure placement;
- Micro-site the transmission line; the uncropped habitat along Flagstaff Hill Road supports PBTL on both sides of the road. It is recommended that micro-siting occurs here (should pre-construction surveys identify PBTL as present) and that the transmission is aboveground in this area (unless the road corridor can be used in some way);
- Micro-site proposed terminal substation for potential habitat and presence of PBTL;
- A translocation of PBTL from areas of less suitability is recommended which will assist with reducing potential impacts on PBTL; and
- Develop and implement a suitable offset area for PBTL with an appropriate management plan to guide future management of the offset area.

7.2 Other

- **Minimise clearance of scattered woodland / patches identified in vegetation associations across the project area;**
  A 200 m buffer between woodland areas and proposed turbine locations is recommended. This is aimed at minimising disturbance to wooded areas where woodland birds and bats are likely to roost.
- **Avoid or minimise clearance of Peppermint Box Woodland (endangered for South Australia) –** some patches containing Peppermint Box came close to qualifying. When micro-siting occurs pre- construction, it would be beneficial to assess the patches (during an optimal time of the year) that almost qualified. If Peppermint Box is affected, undertake further surveying in spring to determine with certainty if they qualify as listed communities.

- **Avoid clearance of Lomandra Grasslands that are EPBC listed, or likely to qualify.**
  Completely avoid clearance of Lomandra grasslands near sites 18-21 (eastern half of proposed substation area. If these grasslands are affected, undertake further surveying in spring to determine with certainty if they qualify as listed communities.
- **Avoid or minimise clearance of all Lomandra Grasslands where possible (endangered for South Australia) –** several patches of Lomandra almost qualified within the proposed terminal substation area. Micro site substation away from these areas, or undertake an additional survey prior to construction to determine if these areas qualify as a Class B.
- **Avoid clearance of vegetation with higher offset ratings.** This will minimise clearance of high quality vegetation as well as lowering the offset cost. General offset ratios have been provided in Section 5.2.1, whilst detailed offset values for individual areas have been supplied as mapping layers. These will be presented in the clearance report when the impact footprint is finalised.
- **Buffer known Wedge-tailed Eagle nests by 500 m;**
  Although the three nest locations are situated outside of the current project area, the infrastructure zone and boundary may change over time. Any turbine location should be at least 500 m from a known Wedge-tailed Eagle nest, to reduce likelihood of impact; the project design has taken into account this recommendation;
- **Avoid clearance near known threatened flora species records.**
  Ensure staff are made aware of the species features to assist avoiding impact. Flag or signage to protect the rare *Eucalyptus behriana* along Dutton Road.
- **Seek approval from the NVC regarding any vegetation clearance that is required and provide an appropriate SEB offset.**
  All native vegetation within the project area is protected by the *Native Vegetation Act 1991* and any proposed clearance will need to be assessed against native vegetation principles (unless under exemption). A clearance application to the Native Vegetation Council is required if the proposed infrastructure involves the clearance of native vegetation not covered by exemptions. An appropriate SEB offset area needs to be identified.

General recommendations with respect to the future development of the site:

- **Development a Weed Management Plan/Rehabilitation Plan**
  When an SEB offset is determined (when a Native Clearance Report is prepared for the Native Vegetation Council), a Weed Management Plan or Rehabilitation Plan will assist with this.

- **Construction Environmental Management Plan (CEMP)**

- **Best practice environmental management measures**
  Best practice environmental management measures should be adopted during and following the construction phase. For example, vehicles and equipment should be cleaned to ensure they are free of plant material and soil, to reduce the dispersal of exotic flora species into, out of, and within the project area. Control of declared and environmental weeds found within the site may be

required. The construction footprint should be minimised, e.g. along access tracks, in turn-around areas and around turbine pads.

- **Staff training and awareness**
  Staff working in the project area should be aware of the threatened flora and fauna species and ecological communities present and potentially present; and the potential and actual impacts of construction, operation and maintenance of the proposed wind farm on flora and fauna species and habitats. Training should reinforce staff expectations to minimise potential impacts related to on-site works, and encourage staff to report significant flora and fauna sightings.

8 REFERENCES

Adelaide Mount Lofty Ranges Natural Resource Management Board (AMLR NRMB) (2013) *Adelaide and Mount Lofty Ranges Natural Resources Management Plan*. AMLR NRMB.

Auswind (now the Clean Energy Council) 2006. *Best Practice Guidelines for the Australian Wind Industry*. Clean Energy Council.

Badman, F.J. (1989). *The Birds of Middle and Lower Cooper Creek in South Australia*. Nature Conservation Society of South Australia, Adelaide.

Barrett, G., Silcocks, A. Barry, S. Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Melbourne, Victoria: Birds Australia. Berkinshaw 2006 *Native Vegetation of the Northern and Yorke Region* Greening Australia SA

Clarke, S. (2000). *Management of the Pygmy Bluetongue lizard (Tiliqua adelaidensis) on private grazing properties, Mid-North SA*. Environment Australia, Canberra.

Clean Energy Council (CEC) *Best Practice Guidelines for Implementation of Wind Farm Energy Projects in Australia* (CEC)

Churchill, S. (2008) *Australian Bats*. Crow's Nest, N.S.W: Allen &Unwin, 2008.

Department of Sustainability, Environment, Water, Population and Communities, 2011, *Australia's IBRA Regions*, DSEWPaC, Canberra, online resource accessed 11 January 2012 <http://environment.gov.au/parks/nrs/science/ibra.html>.

Department for Water Land and Biodiversity Conservation, 2007, *Guidelines for a Native Vegetation Significant Environmental Benefit Policy,* DWLBC, Government of South Australia.

Department of the Environment and Water Resources, (June 2007) *Environment Protection and Biodiversity Conservation Act Policy Statement 3.7 Nationally Threatened Species and Ecological Communities: Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*. DEWR

Department of the Environment, Water, Heritage and the Arts (2010) Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DEWHA)

Department of the Environment, Water, Heritage and the Arts (DoEE) (2013) *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DEWHA)

Department of Planning, Transport and Infrastructure (2015). *Declared Plants.* Prepared for use by the Department of Planning, Transport and Infrastructure, Safety and Service Division Environmental Group, Adelaide.

Department of the Environment and Water Resources, Canberra (DEWHA) (2007) *EPBC Policy Statement 3.7.Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*. DEWHA.

DEWNR (2015) *Biological Database of South Australia.* Data extracted for the project area, 5 August 2015. Department of Water and Natural Resources, South Australia.

DEWNR (2009) *A guide to the exemptions under the Native Vegetation Regulations, 2003* Department of Environment, Water and Natural Resources, Government of South Australia

DOE (2015) *EPBC Protected Matters Search*, http://www.environment.gov.au/erin/ert/epbc/index.html, accessed 13 August 2015. Australian Government Department of the Environment.

Drewitt, A. and Langston, R. (2006) Assessing the impacts of wind farms on birds, *Ibis*, Vol 148, pp29–42.

Duffy, A., Pound, L. and How, T. (2009) Draft Recovery Plan for the Pygmy Blue-tongue Lizard *Tiliqua adelaidensis*. Department for Environment and Heritage, South Australia.

Gaidow S and Boey S (2005) *Australian Defence Risk Management Framework: A comparative study*. Commonwealth of Australia - DSTO Systems Sciences Laboratory.

Gibson, D.F. (1986). A Biological Survey of the Tanami Desert in the Northern Territory. *Technical Report*. 30. Alice Springs, Northern Territory, Conservation Commission of the Northern Territory.

Gillam, S. (2009) *A Regional Species Conservation Assessment Process for South Australia - Phase 2: Species Prioritisation, Northern & Yorke, Northern and Yorke Natural Resource Management Board, Department for Environment and Heritage.*

Graham, A., Oppermann, A. and Inns, R. W. (2001) *Biodiversity Plan for the Northern Agricultural Districts*. Department of Environment and Heritage, South Australia.

Grodsky, S.M. et al (2011). *Investigating the causes of death for wind turbine-associated bat fatalities*. Journal of Mammalogy, 92(5):917-925. 2011. American Society of Mammologists.

Hull, C. and Muir, S. C. (2013) *Behaviour and turbine avoidance rates of eagles at two wind farms in Tasmania, Australia*. Wildlife Society Bulletin 37(1):49–58; 2013.

Hull, C.L. and Cawthen, L. (2013). *Bat fatalities at two wind farms in Tasmania, Australia: bat characteristics, and spatial and temporal patterns*. New Zealand Journal of Zoology 40:1, 5-15.

Hull, C.L., Stark, E. M., Peruzzo, S. and Sims, C. C. (2013) *Avian collisions at two wind farms in Tasmania, Australia: taxonomic and ecological characteristics of colliders versus noncolliders*. New Zealand Journal of Zoology, 40:1, 47-62.

Hutchinson, M., Milne, T. & Croft, T. (1994). *Redescription and ecological notes on the Pygmy Bluetongue, Tiliqua adelaidensis (Squamata: Scincidae).* Transactions of the Royal Society of South Australia 118, 217-226.

Jessop, J.P. and Toelken, H. R. (1986) *Flora of South Australia*, Adelaide, South Australia: SA Government Printing Division

Kahrimanis, M. J., Carruthers, S., Oppermann, A. and Inns, R. (2001) *Biodiversity Plan for the South Australian Murray-Darling Basin*, Department for Environment and Heritage, South Australia.

Law, B.S., Anderson, J., and Chidel, M. (1998) A survey of bats of the south-west slopes region of NSW and suggestions for the improvements of survey techniques. *Australian Zoologist* **30**: 467-79.

Milne, T. (1999) *Conservation and Ecology of the Endangered Pygmy Bluetongue Lizard (*Tiliqua adelaidensis*)*. PhD Thesis, Flinders University of South Australia.

Milne, T., Bull, C., and Hutchinson, M. N. (2003) *Use of burrows by the endangered Pygmy Blue-tongue Lizard, Tiliqua adelaidensis (Scincidae).* Wildlife Research, 30 523-528.

Milne, T. & Bull, M. (2000). *Burrow choice by individuals of different sizes in the endangered pygmy blue tongue lizard Tiliqua adelaidensis*. Biological Conservation 95, 295-301.

Milne, T., Hutchinson, M., and Clarke. S. (2000) *National recovery plan for the Pygmy Blue-tongue Lizard (Tiliqua adelaidensis).*Department of Sustainability, Water, Population and Communities. Canberra.

Northern and Yorke Natural Resources Management Board (NYNRMB) (2008) *Northern and Yorke Regional Natural Resources Management Plan Board* NYNRMB

Nicolle, D. (2013) *Native Eucalypts of South Australia.* Lane Print & Post, Adelaide

Rollins et al (2012). *A Forensic Investigation Into the Etiology of Bat Mortality at a Wind Farm: Barotrauma or Traumatic Injury?* Veterinary Pathology, Vol 49, Issue 2, 2012.Schofield, J. (2006) *Pygmy Blue-tongue Lizards: Best Practice Management Guidelines for Landholders*. Report for the Department for Environment and Heritage, Adelaide

Shea, G. M. (1992). *The systematics and reproduction of bluetongue lizards of the genus Tiliqua (Squamata: Scincidae)*. Unpublished doctoral dissertation. Department of Veterinary Anatomy, University of Sydney.

Smales, I. (2006) *Impacts of avian collision with wind power turbines: an overview of the modelling of cumulative risks posed by multiple wind farms*. Biosis Research Pty Ltd – a report for the Department of Environment and Heritage.

Souter, N.J., Bull, C.M., Lethbridge, M.R., Hutchinson, M.N. (2007) *Habitat requirements of the endangered pygmy bluetongue lizard, Tiliqua adelaidensis*. Biological Conservation, 135 33 - 45.

Souter, N. J. (2003). Habitat requirements and conservation of the endangered Pygmy Bluetongue lizard Tiliqua adelaidensis. PhD thesis. Flinders University, South Australia.

Stokes, A., Heard, L.M.B., Carruthers, S., and Reynolds, T. (1998) *Guide to the Roadside Vegetation Survey Methodology for South Australia (Draft).* Geographic Analysis and Research Unit, Planning SA and Environment Unit, Transport SA, Department for Transport Urban Planning and the Arts.

Whibley, D.J.E. (1980). *Acacias of South Australia*. State Herbarium of South Australia.

9 APPENDICES

Appendix 1.Flora species recorded in each of the eleven vegetation associations (including exotic species).

Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Acacia acinacea	*Wreath Wattle*	*2*			√									√
Acacia argyrophylla	*Silver Mulga-bush*	*2*												√
Acacia paradoxa	Kangaroo Thorn	1			√					√				
Acacia pycnantha	*Golden Wattle*	*1,2*			√	√								√
Acacia sp.	*Wattle*	*2*				√								
Alectryon oleifolius ssp. canescens	Bullock Bush	*1,2*						√						
Allocasuarina verticillata	*Drooping Sheoak*	*2*			√	√	√					√	√	
Aristida behriana	*Brush Wire-grass*	*2*		√	√							√	√	√
Arthropodium sp.	*Vanilla-lily*	*2*		√			√	√						√
Asperula conferta	*Common Woodruff*	*2*			√									
Atriplex semibaccata	*Berry Saltbush*	*2*		√								√		
Atriplex stipitata	*Bitter Saltbush*	*2,3*		√										√
Austrostipa blackii	*Crested Spear-grass*	1		√	√		√					√		
Austrostipa eremophila	*Rusty Spear-grass*	1						√						√
Austrostipa mollis group	*Soft Spear-grass*	*1,2*					√							
Austrostipa scabra	Spear-grass	1		√	√		√							
Austrostipa scabra ssp. *falcata*	*Slender Spear-grass*	*2*			√							√		√
Austrostipa sp.	*Spear-grass*	*2*					√	√					√	
Austrostipa sp.		1		√			√	√		√	√			
Brachyscome lineariloba	Hard-head Daisy	*2*					√							
Bursaria spinosa ssp.	Bursaria	2						√		√				√
Calandrinia sp.	Purslane/Parakeelya	1,2						√						

Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Callitris gracilis	Southern Cypress Pine	1			√									
Calocephalus citreus	Lemon Beauty-heads	2												√
Carex sp.	Sedge	2						√						
Cheilanthes austrotenuifolia	Annual Rock-fern	1						√						
Cheilanthes lasiophylla	Woolly Cloak-fern	2						√						
Chenopodium desertorum ssp.	Desert Goosefoot	2												√
Chenopodium pumilio	Small Crumbweed	3		√										
Chloris sp.	Windmill Grass	3		√										
Convolvulus erubescens complex		1,2		√	√		√							
Convolvulus remotus	Grassy bindweed	1,2			√							√		√
Crassula colorata	*Dense Crassula*	3		√										
Cymbopogon ambiguus	Lemon-grass	1,2						√						
Cyperus gymnocaulos	Spiny Flat-sedge	2						√						
Cyperus sp.	Flat-sedge	2						√		√				
Dianella revoluta var. revoluta	Black-anther Flax-lily	1		√										√
Distichlis distichophylla	Emu-grass	1			√			√						
Drosera sp.	Sundew	1					√							
Dysphania pumilio	Small Crumbweed	1,2		√	√									
Einadia nutans ssp.	Climbing Saltbush	1,2												√
Eleocharis acuta	Common Spike-rush	2											√	
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	2		√										√
Enneapogon nigricans	Black-head Grass	1,2		√	√		√							√
Eremophila longifolia	Weeping Emubush	1,2						√						
Eucalyptus camaldulensis ssp. *camaldulensis*	River Red Gum	2												√
Eucalyptus cladocalyx ssp.	Sugar Gum	1,2					√							

Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Eucalyptus gracilis	Yorrell									√				
Eucalyptus leucoxylon ssp. *pruinosa*	Inland South Australian Blue Gum	1		√	√		√				√	√	√	√
Eucalyptus odorata	Peppermint Box	2				√	√	√	√	√		√	√	
Eucalyptus porosa	Mallee Box	1					√			√		√	√	
Euphorbia drummondii group	Spurge	1,2		√	√		√	√						√
Galium sp.	Bedstraw				√		√							
Glycine canescens	Silky Glycine	2		√										
Glycine clandestina	Twining Glycine	2		√	√									
Goodenia pinnatifida	Cut-leaf Goodenia	1												√
Goodenia sp.	Goodenia	2		√			√							
Haloragis sp.	Raspwort	1,2						√						
Hyalosperma semisterile	Orange Sunray	2		√				√						
Juncus pallidus	Pale Rush	1,2						√						
Juncus sp.	Rush						√	√						
Lomandra effusa	Scented Mat-rush	1,2		√	√		√	√		√				
Lomandra multiflora ssp.	Many-flower Mat-rush			√	√		√							
Lomandra multiflora ssp. dura	Hard Mat-rush	1,2												√
Lomandra sp.	Mat-rush													√
Maireana brevifolia	Short-leaf Bluebush	1,2		√							√			√
Maireana enchylaenoides	Wingless Fissure-plant	1,2		√	√		√					√		
Maireana sp.	Bluebush													
Muehlenbeckia florulenta	Tangled Lignum	1,2						√						
Oxalis perennans	Native Sorrel	1,2		√	√		√					√	√	√
Phragmites australis	Common Reed	1,2						√						
Pimelea curviflora var.	Curved Riceflower	2		√	√									
Plantago varia	Dark Plantain	2, 3		√										√

Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Podolepis capillaris	Wiry Podolepis	2		√	√									
Ptilotus spathulatus	Pussy-tails	1,2		√	√		√	√				√	√	√
Rhagodia parabolica	Mealy Saltbush	2						√						√
Rytidosperma caespitosum	Common Wallaby-grass	2										√		
Rytidosperma carphoides	Short Wallaby-grass	2										√		
Rytidosperma erianthum	Hill Wallaby-grass	2										√		
Rytidosperma fulvum	Leafy Wallaby-grass	2			√									
Rytidosperma sp.		1		√	√		√							
Salsola kali	Buckbush	3			√									
Setaria sp. (to be ID)	Wartego Summer Grass	3			√									
Sida corrugata var.	Corrugated Sida	1,2		√									√	√
Stackhousia monogyna	Creamy Candles	1,2			√							√		
Themeda triandra	Kangaroo Grass	3		√										
Vittadinia blackii	Narrow-leaf New Holland Daisy	2					√							
Vittadinia gracilis	Woolly New Holland Daisy	1,2		√	√		√					√		√
Vittadinia megacephala	Giant new Holland Daisy	1		√										
Vittadinia sp.	New Holland Daisy	2			√							√		
Wahlenbergia luteola	Yellow-wash Bluebell	1,2		√	√									
Wurmbea dioica ssp.		1		√			√							
Weeds														
Aira sp.	Hair-grass	2	*	√	√							√		√
Aloe maculata	Broad-leaf Aloe	1,2	*					√						√
Arctotheca calendula	Cape Weed	2	*					√				√	√	√
Artemisa tridentata	Wild Sage	2	*				√	√	√					
Asparagus asparagoides f. *asparagoides*	Bridal Creeper	1,2	*				√							

Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Asteriscus spinosus	Golden Pallensis	1	*					√						
Avena barbata	Bearded Oat	1	*	√	√	√	√	√	√	√	√	√	√	√
Brachypodium distachyon	False Brome	1	*									√	√	√
Brassica sp.	Mustard species	1	*											√
Bromus diandrus	Great Brome	2	*		√			√			√	√	√	
Bromus hordeaceus ssp. *hordeaceus*	Soft Brome	1	*	√	√		√				√	√	√	
Bromus rubens	Red Brome	2	*		√			√				√		
Bromus sp.	Brome	1	*	√	√		√		√		√			
Calostemma purpureum	Pink Garland-lily	2	*											√
Carthamus lanatus	Saffron Thistle	2	*	√	√									
Centaurea sp.	Centaury	2	*		√									
Cirsium vulgare	Spear Thistle	1	*											√
Cotula coronopifolia	Water Buttons	1,2	*					√						
Crassula alata var. *alata*	Three-part Crassula	1,2	*	√	√		√							
Cynara cardunculus ssp. *flavescens*	Artichoke Thistle	1	*	√	√	√	√	√						
Echium plantagineum	Salvation Jane	1	*		√						√	√		√
Ehrharta longiflora	Annual Veldt Grass	1,2	*					√	√	√	√	√	√	√
Ehrharta longiflora	Annual Veldt Grass	1	*											
Erodium cicutarium	Cut-leaf Heron's-bill	1,2	*	√	√	√	√	√	√	√				
Euphorbia terracina	*False caper*	2	*											
Fumaria sp.	*Fumitory*	1,2	*							√				
Gazania sp.	*Gazania*	2	*											√
Geranium sp.	Geranium	2	*				√							
Heliotropium europaeum	*Common Heliotrope*	2	*	√							√			
Holcus lanatus	Yorkshire Fog	2	*					√						

Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Hordeum sp.	*Barley-grass*	1,2	*		✓		✓	✓			✓	✓	✓	
Hordeum vulgare	Barley	1	*	✓	✓	✓	✓	✓	✓	✓	✓			
Hypochaeris glabra	*Smooth Cat's Ear*	1,2	*	✓	✓									
Hypochaeris radicata	*Rough Cat's Ear*	1,2	*	✓	✓	✓	✓	✓			✓			✓
Juncus acutus	*Sharp Rush*	1	*		✓			✓						
Lepidium africanum	*Common Peppercress*	2	*										✓	
Lolium sp.	*Ryegrass*	2	*				✓	✓			✓	✓	✓	
Lycium ferocissimum	*African Boxthorn*	1,2	*				✓	✓						
Malva sp.	*Mallow*	2	*								✓	✓		
Marrubium vulgare	Horehound	1,2	*	✓	✓	✓	✓	✓	✓	✓	✓			
Medicago polymorpha var. *polymorpha*	*Burr-medic*	2	*	✓				✓				✓		
Medicago sp.	Medic	1	*	✓	✓	✓	✓	✓	✓	✓	✓			
Moraea setifolia	Thread Iris	1,2	*	✓	✓		✓	✓	✓	✓	✓		✓	✓
Nicotiana glauca	Tree Tobacco	1,2	*	✓	✓		✓	✓						
Olea europaea ssp.	*Olive*	2	*	✓				✓						✓
Opuntia sp.	*Prickly Pear*	1	*											
Petrorhagia dubia	*Velvet Pink*	1	*		✓									
Phalaris aquatica	Phalaris	*1*	*					✓						
Pinus radiata	Radiata Pine	*1,2*	*											
Pinus sp.	Pine	*1*	*			✓	✓							
Plantago lanceolata var.	Ribwort	*1,2*	*											✓
Reichardia tingitana	False Sowthistle	*1,2*	*	✓	✓									✓
Reseda lutea	Cut-leaf Mignonette	*1*	*		✓									
Rosa canina	Dog Rose	*1,2*	*				✓	✓						
Rostraria cristata	Annual Cat's-tail	***1,2***	*		✓									
Rumex crispus	Curled Dock	*2*	*								✓			

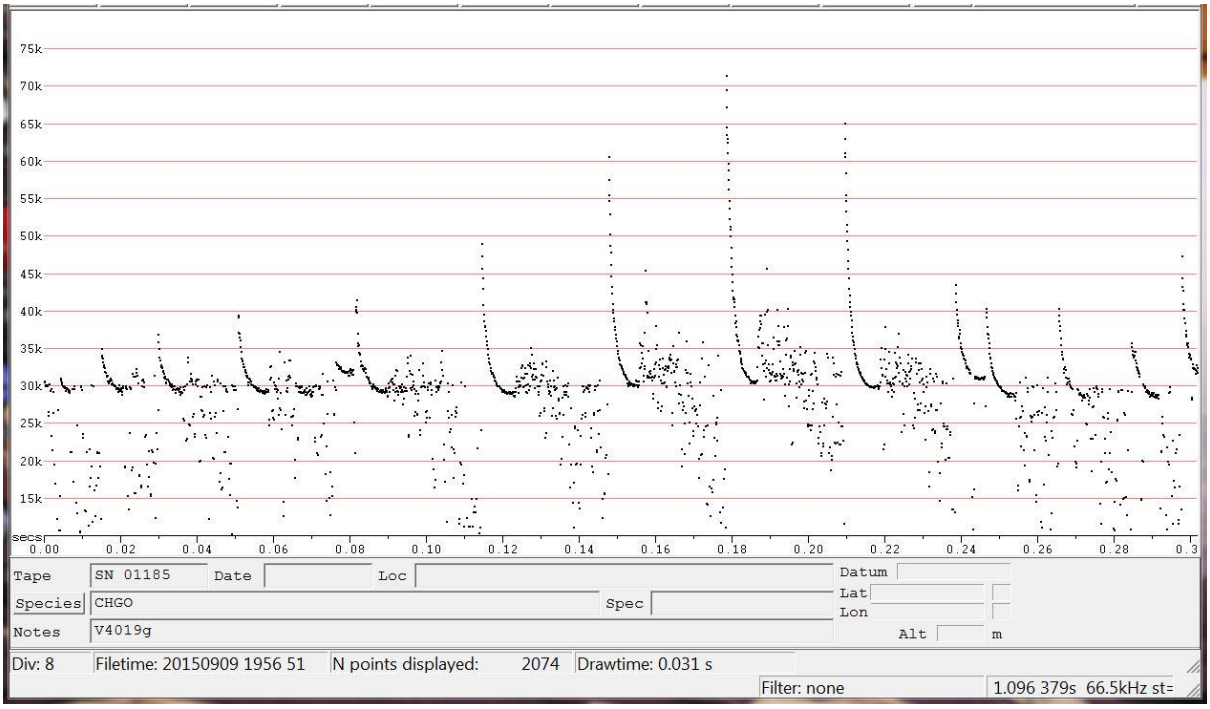
Scientific name	Common Name	Trip	Exotic	1	2	3	4	5	6	7	8	9	10	11
Rumex sp.	Dock	*2*	*				√	√						
Salvia verbenaca var.	Wild Sage	*2*	*	√	√									√
Scabiosa atropurpurea	Pincushion	*2*	*											
Schinus molle	Pepper-tree	1,2	*					√						
Silybum marianum	Variegated Thistle	*1*	*					√						
Solanum elaeagnifolium	Silver-leaf Nightshade	1	*	√	√				√					
Solanum nigrum	Black Nightshade	1	*	√				√	√					
Sonchus oleraceus	Common Sow-thistle	2	*	√				√						
Sonchus sp.	Sow-thistle	*1*	*		√							√		√
Taraxacum officinale	Dandelion	1	*	√	√	√	√	√	√	√	√			
Themeda triandra	Kangaroo Grass	*3*		√										
Trifolium angustifolium	Narrow-leaf Clover	*1,2*	*	√	√	√	√	√	√	√	√	√		√
Trifolium arvense var. *arvense*	Hare's-foot Clover	*2*	*	√	√		√					√		√
Trifolium campestre	Hop Clover	*1*	*									√		
Triticum aestivum	Wheat	*1,2*	*						√					
Urtica dioica	Stinging Nettle	2	*				√							
Urtica urens	Small Nettle	*1*	*								√			
Vicia sp.	Vetch	*2*	*											
Vulpia myuros	Fescue	2	*	√	√	√	√	√	√	√				
Vulpia sp.	Fescue	*1*	*	√	√		√	√				√	√	√

Appendix 2.Location of bird point count sites.

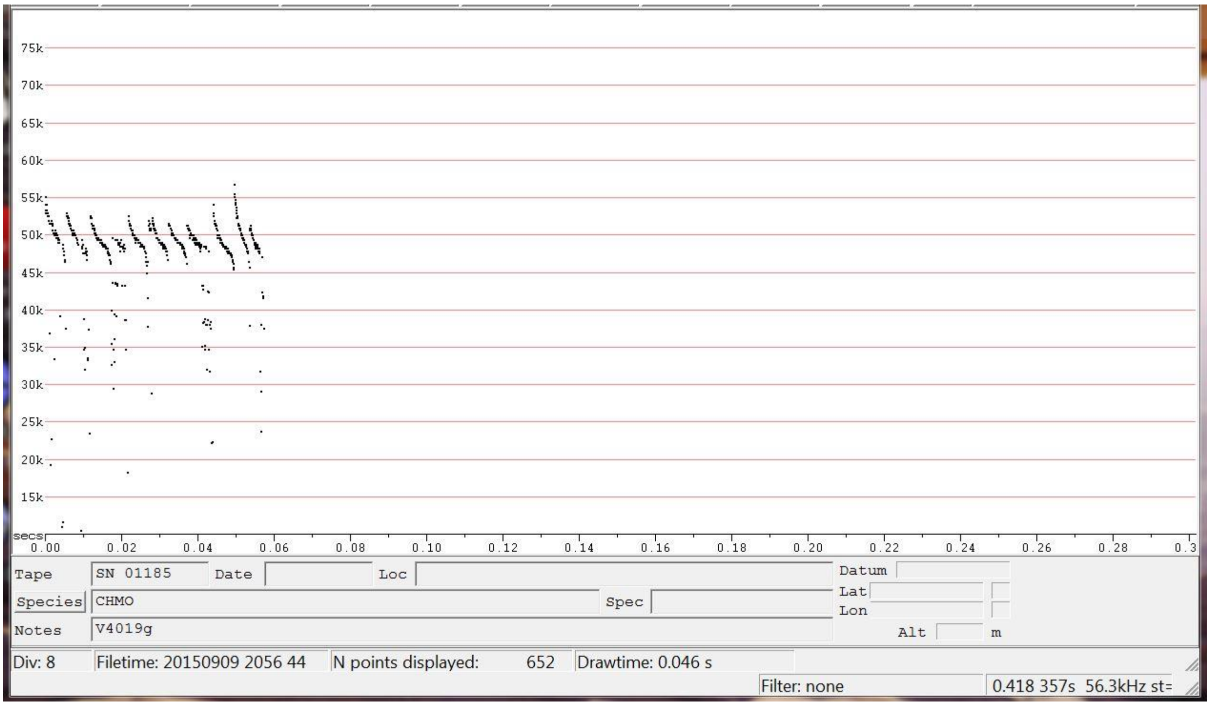
Point Count	Easting	Northing
1	322766	6199977
2	321545	6199867
3	322515	6201511
4	323819	6200037
5	324228	6202237
6	320175	6201167
7	318721	6200153
8	318945	6201156
9	323183	6205598
10	321708	6204405
11	320848	6205633
12	320771	6202801
13	321317	6203420
14	322762	6203617
15	324238	6203136
16	323529	6202719

Appendix 3.Sample AnaBat Files.

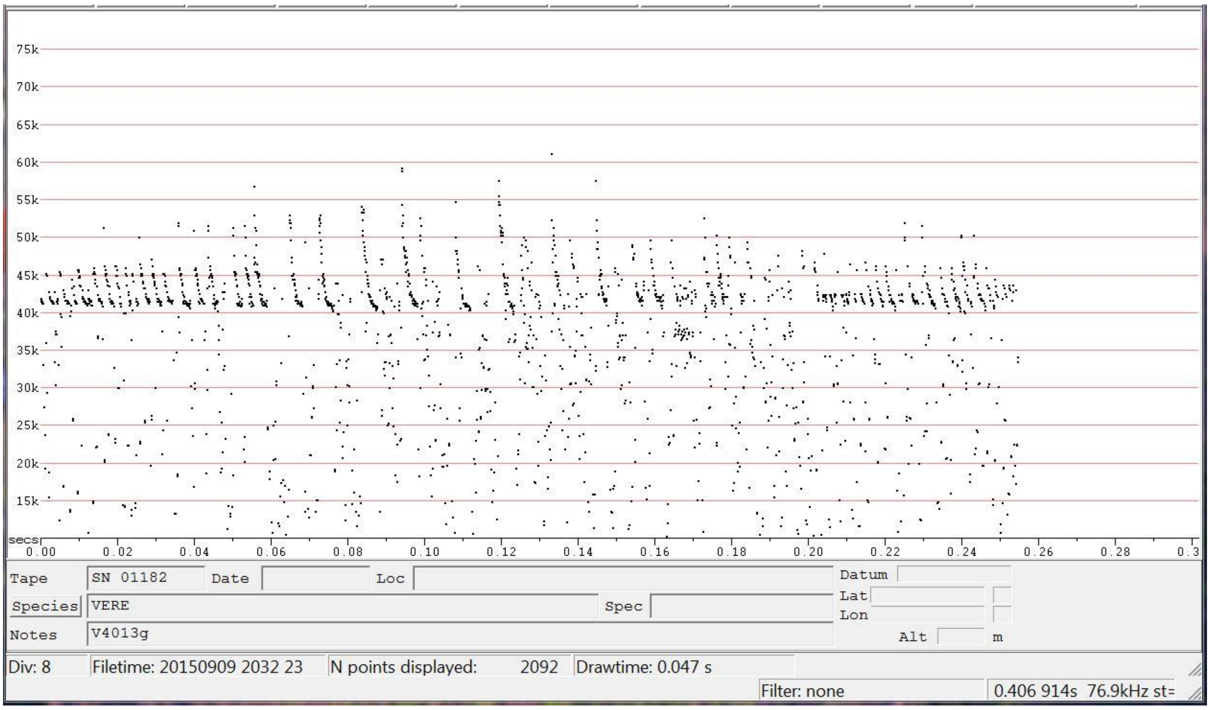
Chalinolobus gouldii



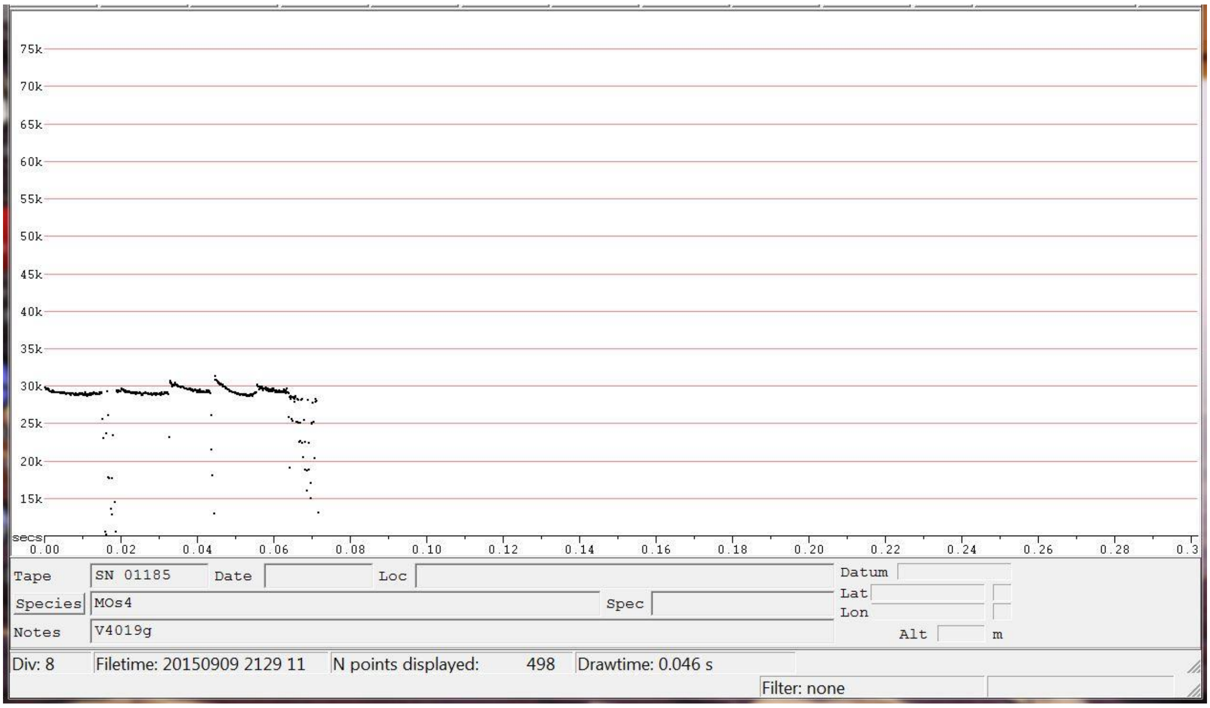
Chalinolobus morio



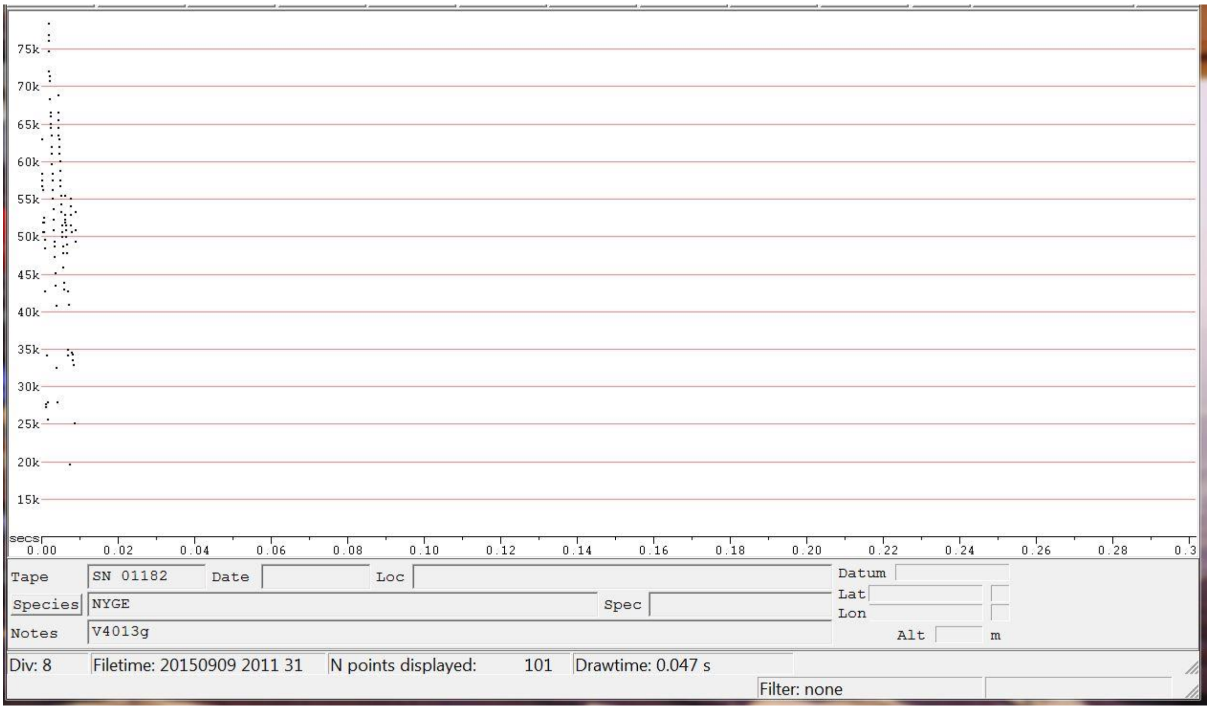
Vespadelus regulus



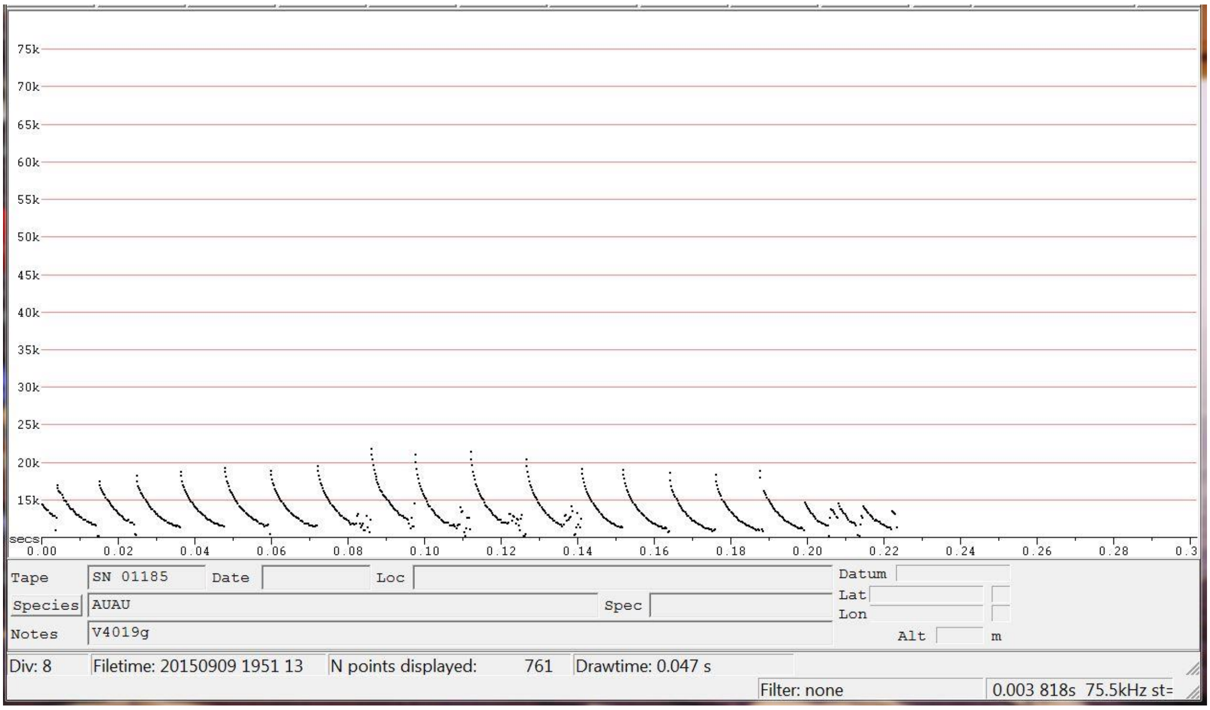
Mormopterus sp4



Nyctophilus geoffroyi



Austronomus australis



Appendix 4.BDBSA flora and fauna records from the 20km buffer.

Table 47. BDBSA Fauna records within 20km of the site.

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
AMPHIBIANS					
Crinia signifera	Common Froglet	Y			22/09/2002
Limnodynastes dumerilii	Banjo Frog	Y			20/09/2001
Limnodynastes	Spotted Marsh Frog	Y			16/09/1996
Litoria ewingii	Brown Tree Frog	Y			10/10/2002
Litoria peronii	Peron's Tree Frog	Y			19/04/2002
Neobatrachus pictus	Burrowing frog	Y			20/06/1971
AVES					
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Y			17/09/2002
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Y			28/07/2000
Acanthiza lineata	Striated Thornbill	Y			1/03/1985
Acanthiza nana	Yellow Thornbill	Y			2/02/2012
Acanthiza reguloides	Buff-rumped Thornbill	Y			14/03/2004
Acanthiza uropygialis	Chestnut-rumped Thornbill	Y			1/11/2002
Acanthorhynchus	Eastern Spinebill	Y			23/12/1999
Accipiter cirrocephalus	Collared Sparrowhawk	Y			2/12/1985
Accipiter fasciatus	Brown Goshawk	Y			16/11/2012
Acrocephalus australis	Australian Reed Warbler	Y			1/12/1999
Aegotheles cristatus	Australian Owlet-nightjar	Y			17/11/1985
Anas castanea	Chestnut Teal	Y			8/04/1987
Anas gracilis	Grey Teal	Y			1/07/1985
Anas rhynchotis	Australasian Shoveler	Y		R	27/01/2006
Anas superciliosa	Pacific Black Duck	Y			27/06/2005
Anas superciliosa x anas	Pacific Black Duck/Mallard Hybrid	Y			18/05/1987
Anhinga novaehollandiae	Australasian Darter	Y		R	27/01/2003
Anthochaera carunculata	Red Wattlebird	Y			19/04/2000
Anthochaera chrysoptera	Little Wattlebird	Y			10/01/2004
Anthus australis	Australian Pipit	Y			14/10/1985
Aphelocephala leucopsis	Southern Whiteface	Y			1/06/1985
Aquila audax	Wedge-tailed Eagle	Y			26/12/2001
Ardea alba	Great Egret	Y			24/11/2001
Ardea pacifica	White-necked Heron	Y			9/12/2001
Ardeotis australis	Australian Bustard	Y		V	1/06/2005
Artamus cinereus	Black-faced Woodswallow	Y			1/10/1999
Artamus cyanopterus	Dusky Woodswallow	Y			1/02/2001
Artamus leucorynchus	White-breasted Woodswallow	Y			2/12/1985
Artamus personatus	Masked Woodswallow	Y			11/11/1999

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Artamus superciliosus	White-browed Woodswallow	Y			9/10/2001
Aythya australis	Hardhead	Y			1/11/1985
Barnardius zonarius	Australian Ringneck	Y			13/04/1999
Biziura lobata	Musk Duck	Y		R	27/01/2003
Cacatua galerita	Sulphur-crested Cockatoo	Y			18/08/2001
Cacatua sanguinea	Little Corella	Y			1/10/2001
Cacatua sp.		Y			3/08/2005
Cacatua tenuirostris	Long-billed Corella	Y			31/12/2004
Cacomantis flabelliformis	Fan-tailed Cuckoo	Y			6/04/2000
Cacomantis pallidus	Pallid Cuckoo	Y			1/11/1985
Calidris ruficollis	Red-necked Stint	Y			1/10/2000
Caligavis chrysops	Yellow-faced Honeyeater	Y			22/09/1985
Certhionyx variegatus	Pied Honeyeater	Y			1/10/1999
Chalcites basalis	Horsfield's Bronze Cuckoo	Y			1/08/1999
Chenonetta jubata	Maned (Australian Wood Duck)	Y			21/03/2005
Chlidonias hybrida	Whiskered Tern	Y			12/10/2004
Chroicocephalus	Silver Gull	Y			1/06/2002
Cincloramphus cruralis	Brown Songlark	Y			26/12/2001
Cincloramphus mathewsi	Rufous Songlark	Y			18/11/2001
Circus approximans	Swamp Harrier	Y			27/01/2003
Circus assimilis	Spotted Harrier	Y			23/07/2002
Cladorhynchus	Banded Stilt	Y		V	1/09/2000
Climacteris picumnus	Brown Treecreeper	Y			23/06/2011
Colluricincla harmonica	Grey Shrike-thrush	Y			18/07/2002
Coracina maxima	Ground Cuckoo-shrike	Y			1/02/2005
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Y			18/11/2001
Corcorax	White-winged Chough	Y		R	8/08/2013
Corvus coronoides	Australian Raven	Y			19/04/2001
Corvus mellori	Little Raven	Y			1/11/1985
Corvus sp.		Y			2/11/1999
Coturnix pectoralis	Stubble Quail	Y			16/06/2002
Cracticus torquatus	Grey Butcherbird	Y			1/07/1985
Cygnus atratus	Black Swan	Y			20/02/2002
Dacelo novaeguineae	Laughing Kookaburra	Y			1/07/1985
Daphoenositta	Varied Sittella	Y			9/08/2001
Dicaeum hirundinaceum	Mistletoebird	Y			1/11/1985
Dromaius novaehollandiae	Emu	Y			1/01/2003
Egretta novaehollandiae	White-faced Heron	Y			24/03/1985
Elanus axillaris	Black-shouldered Kite	Y			1/07/1985
Elseyornis melanops	Black-fronted Dotterel	Y			5/09/2005

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Eolophus roseicapilla	Galah	Y			10/01/2003
Epthianura albifrons	White-fronted Chat	Y			12/05/1985
Epthianura aurifrons	Orange Chat	Y			27/01/2003
Epthianura tricolor	Crimson Chat	Y			1/10/1999
Erythrogonys cinctus	Red-kneed Dotterel	Y			27/01/2006
Eurostopodus argus	Spotted Nightjar	Y			1/01/2000
Eurystomus orientalis	Oriental Dollarbird	Y			1/03/1999
Falco berigora	Brown Falcon	Y			23/06/2011
Falco cenchroides	Nankeen Kestrel	Y			25/10/2001
Falco longipennis	Australian Hobby	Y			12/09/2003
Falco peregrinus	Peregrine Falcon	Y		R	19/10/2012
Falco subniger	Black Falcon	Y			1/09/2000
Falcunculus frontatus	Crested Shrike-tit	Y		R	9/02/2012
Fulica atra	Eurasian Coot	Y			16/04/2005
Gallinula tenebrosa	Dusky Moorhen	Y			18/07/2003
Gallirallus philippensis	Buff-banded Rail	Y			1/10/2001
Gavicalis virescens	Singing Honeyeater	Y			24/03/1985
Geopelia cuneata	Diamond Dove	Y			9/02/2012
Geopelia placida	Peaceful Dove	Y			9/02/2012
Gerygone fusca	Western Gerygone	Y		R	2/12/1985
Glossopsitta concinna	Musk Lorikeet	Y			29/11/1999
Glossopsitta	Purple-crowned Lorikeet	Y			20/06/2003
Grallina cyanoleuca	Magpielark	Y			29/11/1999
Gymnorhina tibicen	Australian Magpie	Y			19/04/2000
Haliastur sphenurus	Whistling Kite	Y			27/01/2003
Hieraaetus morphnoides	Little Eagle	Y			30/12/1985
Himantopus	White-headed Stilt	Y			11/06/2005
Hirundo neoxena	Welcome Swallow	Y			1/07/1985
Hydroprogne caspia	Caspian Tern	Y			12/10/2004
Lalage tricolor	White-winged Triller	Y			9/02/2012
Lichenostomus cratitius	Purple-gaped Honeyeater	Y		ssp	1/05/1985
Malacorhynchus	Pink-eared Duck	Y			1/11/1985
Malurus cyaneus	Superb Fairy-wren	Y			1/05/1985
Malurus lamberti	Variegated Fairy-wren	Y			1/02/2001
Malurus leucopterus	White-winged Fairy-wren	Y			11/06/1985
Manorina flavigula	Yellow-throated Miner	Y			22/06/1985
Manorina melanocephala	Noisy Miner	Y			1/03/1985
Megalurus gramineus	Little Grassbird	Y			11/06/2003
Melanodryas cucullata	Hooded Robin	Y		ssp	2/03/2012
Melithreptus brevirostris	Brown-headed Honeyeater	Y			2/02/2012

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Melithreptus gularis	Black-chinned Honeyeater	Y		ssp	28/11/2003
Melithreptus lunatus	White-naped Honeyeater	Y			1/11/2000
Melopsittacus undulatus	Budgerigar	Y			24/12/1999
Merops ornatus	Rainbow Bee-eater	Y			13/10/1985
Microcarbo melanoleucos	Little Pied Cormorant	Y			1/07/1985
Microeca fascinans	Jacky Winter	Y		ssp	17/10/2004
Milvus migrans	Black Kite	Y			1/07/1999
Mirafra javanica	Horsfield's Bush Lark	Y			27/01/1985
Myiagra inquieta	Restless Flycatcher	Y		R	1/07/2005
Neochmia temporalis	Red-browed Finch	Y			1/11/1985
Neophema chrysostoma	Blue-winged Parrot	Y		V	26/10/2011
Neophema elegans	Elegant Parrot	Y		R	1/01/2006
Nesoptilotis leucotis	White-eared Honeyeater	Y			1/06/2004
Ninox boobook	Southern Boobook	Y			1/03/2000
Northiella haematogaster	Bluebonnet	Y		ssp	5/05/2005
Nycticorax caledonicus	Nankeen Night Heron	Y			5/09/2005
Nymphicus hollandicus	Cockatiel	Y			1/07/1985
Ocyphaps lophotes	Crested Pigeon	Y			23/05/2005
Oreoica gutturalis	Crested Bellbird	Y			12/07/1999
Oxyura australis	Blue-billed Duck	Y		R	23/09/2004
Pachycephala inornata	Gilbert's Whistler	Y		R	9/02/2003
Pachycephala pectoralis	Australian Golden Whistler	Y			1/07/1985
Pachycephala rufiventris	Rufous Whistler	Y			1/07/1985
Pardalotus punctatus	Spotted Pardalote	Y			1/01/1985
Pardalotus sp.		Y			8/12/2011
Pardalotus striatus	Striated Pardalote	Y			15/08/2005
Pelecanus conspicillatus	Australian Pelican	Y			27/01/2003
Petrochelidon ariel	Fairy Martin	Y			1/05/1985
Petrochelidon nigricans	Tree Martin	Y			1/07/1985
Petroica boodang	Scarlet Robin	Y		ssp	1/11/1985
Petroica goodenovii	Red-capped Robin	Y			1/07/1985
Phalacrocorax carbo	Great Cormorant	Y			19/08/1984
Phalacrocorax sulcirostris	Little Black Cormorant	Y			1/01/1985
Phalacrocorax varius	[Australian] Pied Cormorant	Y			14/02/2005
Phaps chalcoptera	Common Bronzewing	Y			13/10/2003
Phylidonyris	New Holland Honeyeater	Y			27/06/2005
Platalea flavipes	Yellow-billed Spoonbill	Y			1/10/2001
Platycercus elegans	Crimson Rosella	Y			27/02/2001
Plectorhyncha lanceolata	Striped Honeyeater	Y		R	11/06/1985
Podargus strigoides	Tawny Frogmouth	Y			1/07/2002

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Poliocephalus	Hoary-headed Grebe	Y			22/06/2005
Polytelis anthopeplus	Regent Parrot	Y	ssp	V	21/11/1997
Pomatostomus ruficeps	Chestnut-crowned Babbler	Y			23/07/2002
Pomatostomus	White-browed Babbler	Y			13/01/2001
Porphyrio porphyrio	Purple Swamphen	Y			8/01/2005
Porzana fluminea	Australian Crake (Australian	Y			4/01/2006
Psephotus haematonotus	Red-rumped Parrot	Y			15/08/2003
Psephotus varius	Mulga Parrot	Y			13/01/2000
Ptilotula ornata	Yellow-plumed Honeyeater	Y			11/06/1985
Ptilotula penicillata	White-plumed Honeyeater	Y			24/01/2002
Purnella albifrons	White-fronted Honeyeater	Y			9/07/2002
Recurvirostra	Red-necked Avocet	Y			5/08/2005
Rhipidura albiscapa	Grey Fantail	Y			1/11/2002
Rhipidura leucophrys	Willie Wagtail	Y			27/02/2001
Smicrornis brevirostris	Weebill	Y			20/05/2001
Stagonopleura guttata	Diamond Firetail	Y		V	2/03/2012
Strepera versicolor	Grey Currawong	Y		ssp	25/06/2006
Struthidea cinerea	Apostlebird	Y			1/05/2005
Sugomel niger	Black Honeyeater	Y			10/12/1999
Tachybaptus	Australasian Grebe	Y			1/08/2000
Tadorna tadornoides	Australian Shelduck	Y			27/01/2003
Taeniopygia guttata	Zebra Finch	Y			26/12/2001
Threskiornis moluccus	Australian White Ibis	Y			5/01/2005
Todiramphus pyrrhopygius	Red-backed Kingfisher	Y			6/11/1999
Todiramphus sanctus	Sacred Kingfisher	Y			4/01/2001
Tribonyx ventralis	Black-tailed Native-hen	Y			28/03/2005
Trichoglossus	Rainbow Lorikeet	Y			28/07/2000
Tringa stagnatilis	Marsh Sandpiper	Y			27/01/2003
Turnix varius	Painted Buttonquail	Y		R	9/02/2012
Turnix velox	Little Buttonquail	Y			1/11/2003
Tyto delicatula	Eastern Barn Owl	Y			1/06/2001
Vanellus miles	Masked Lapwing	Y			1/11/1985
Vanellus tricolor	Banded Lapwing	Y			1/08/2005
Zoothera lunulata	Bassian Thrush	Y		R	1/11/1985
Zosterops lateralis	Silvereye	Y			1/07/1985
Alauda arvensis	Eurasian Skylark	N			17/08/1985
Anas platyrhynchos	Mallard (Northern Mallard)	N			23/08/2002
Carduelis carduelis	European Goldfinch	N			8/11/2002
Columba livia	Feral Pigeon [Rock Dove]	N			19/08/2001
Passer domesticus	House Sparrow	N			23/12/1999

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Spilopelia chinensis	Spotted Dove	N			1/11/1985
Sturnus vulgaris	Common Starling	N			6/11/2000
Turdus merula	Common Blackbird	N			23/12/1999
Mammals					
Bettongia lesueur	Burrowing Bettong	Y	EX	E	1/01/1922
Cercartetus concinnus	Western Pygmy-possum	Y			1/10/1933
Dasyurus viverrinus	Eastern Quoll	Y		E	18800101
Hydromys chrysogaster	Water Rat	Y			7/11/2011
Lasiorhinus latifrons	Southern Hairy-nosed Wombat	Y			16/03/2011
Macropus fuliginosus	Western Grey Kangaroo	Y			5/05/2011
Macropus robustus	Euro	Y			7/04/2004
Macropus rufus	Red Kangaroo	Y			21/10/2010
Macropus sp.		Y			19/10/2012
Tachyglossus aculeatus	Short-beaked Echidna	Y			2/10/1979
Trichosurus vulpecula	Common Brushtail Possum	Y		R	1/01/1988
Bos taurus	Cattle (European Cattle)	N			16/11/2012
Lepus sp.		N			19/10/2012
Oryctolagus cuniculus	Rabbit (European Rabbit)	N			1/01/2010
Ovis aries	Sheep (Feral Sheep)	N			5/01/2013
Vulpes vulpes	Fox (Red Fox)	N			2/03/2013
REPTILES					
Anilios bicolor	Southern Blind Snake	Y			1/01/1950
Anilios bituberculatus	Rough-nosed Blind Snake	Y			18/08/1908
Christinus marmoratus	Marbled Gecko	Y			1/01/1950
Ctenophorus decresii	Tawny Dragon	Y			1/12/1995
Ctenotus sp.		Y			2/03/2013
Ctenotus spaldingi	Eastern Striped Skink	Y			1/01/1950
Delma molleri	Adelaide Snake-lizard	Y			10/09/1996
Gehyra lazelli	Southern Rock Dtella	Y			1/01/1950
Hemiergis decresiensis	Three-toed Earless Skink	Y			5/06/1983
Lampropholis guichenoti	Garden Skink	Y			15/01/1981
Lerista bougainvillii	Bougainville's Skink	Y			19/10/2012
Menetia greyii	Dwarf Skink	Y			22/09/2000
Morelia spilota	Carpet Python	Y		R	8/07/1963
Morethia adelaidensis	Adelaide Snake-eye	Y			19/10/2012
Morethia obscura	Mallee Snake-eye	Y			29/11/1991
Parasuta nigriceps	Mitchell's Short-tailed Snake	Y			1/01/1950
Pogona barbata	Eastern Bearded Dragon	Y			19/10/2012
Pogona vitticeps	Central Bearded Dragon	Y			10/03/2011
Pseudonaja textilis	Eastern Brown Snake	Y			1/01/1950

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Pygopus lepidopodus	Common Scaly-foot	Y			1/01/1950
Tiliqua adelaidensis	Pygmy Bluetongue	Y	EN	E	27/03/2014
Tiliqua rugosa	Sleepy Lizard	Y			5/08/1987
Tiliqua scincoides	Eastern Bluetongue	Y			1/01/1950

Conservation status

Aus: Australia (Environment Protection and Biodiversity Conservation Act 1999). SA: South Australia (National Parks and Wildlife Act 1972). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level. Mi: listed as migratory under the EPBC Act. Ma: listed as marine under the EPBC Act.

Appendix 5

Table 48. Threatened flora species potentially occurring within the project area (20 km buffer).

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Acacia acinacea	Wreath Wattle	Y			13/05/2015
Acacia argyrophylla	Silver Mulga-bush	Y			14/06/2005
Acacia brachybotrya	Grey Mulga-bush	Y			8/05/2008
Acacia calamifolia	Wallowa	Y			15/11/2002
Acacia calamifolia (NC)	Wallowa	Y			15/11/2002
Acacia euthycarpa	Wallowa	Y			1/11/2006
Acacia glandulicarpa	Hairy-pod Wattle	Y	VU	E	8/05/2008
Acacia hakeoides	Hakea Wattle	Y			14/06/2005
Acacia iteaphylla	Flinders Ranges Wattle	Y		R	11/07/2002
Acacia ligulata	Umbrella Bush	Y			8/05/2008
Acacia montana	Mallee Wattle	Y		R	24/11/1975
Acacia notabilis	Notable Wattle	Y			13/04/2015
Acacia nyssophylla	Spine Bush	Y			27/03/1986
Acacia oswaldii	Umbrella Wattle	Y			25/05/1923
Acacia paradoxa	Kangaroo Thorn	Y			13/05/2015
Acacia pendula	Weeping Myall	Y		V	21/03/2001
Acacia pycnantha	Golden Wattle	Y			13/05/2015
Acacia retinodes	Wirilda	Y			8/05/2015
Acacia retinodes var. *(NC)*	Silver Wattle	Y			4/06/2002
Acacia salicina	Willow Wattle	Y			12/08/1999
Acacia sp.	Wattle	Y			8/05/2008
Acacia spilleriana	Spiller's Wattle	Y	EN	E	11/05/1982
Acacia spinescens	Spiny Wattle	Y			4/04/2011
Acacia wattsiana	Dog Wattle	Y			8/04/2011
Acaena echinata	Sheep's Burr	Y			5/10/2012
Acrotriche affinis	Ridged Ground-berry	Y			30/06/2000
Actinobole uliginosum	Flannel Cudweed	Y			19/10/2012
Agrostis sp.	Blown-grass/Bent Grass	Y			15/12/2001
Alectryon oleifolius ssp. *canescens*	Bullock Bush	Y			10/12/2013
Allocasuarina pusilla	Dwarf Oak-bush	Y			26/11/1887
Allocasuarina sp.	Sheoak/Oak-bush	Y			14/06/2005
Allocasuarina verticillata	Drooping Sheoak	Y			13/05/2015
Alternanthera denticulata	Lesser Joyweed	Y			30/04/1993
Alyxia buxifolia	Sea Box	Y			23/09/1961
Amphibromus archeri	Pointed Swamp Wallaby-grass	Y		R	24/11/1992
Amphibromus nervosus	Veined Swamp Wallaby-grass	Y			1/01/2005
Amphipogon caricinus var. *caricinus*	Long Grey-beard Grass	Y			19/10/2012
Amphipogon strictus	Spreading Grey-beard Grass	Y			25/01/1991
Amyema miquelii	Box Mistletoe	Y			11/05/2015
Amyema miraculosa ssp. *boormanii*	Fleshy Mistletoe	Y			25/05/1923
Amyema preissii	Wire-leaf Mistletoe	Y			1/01/2005

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Amyema sp.	Mistletoe	Y			10/12/2013
Anogramma leptophylla	Annual Fern	Y		R	1/11/1896
Anthosachne scabra	Native Wheat-grass	Y			11/05/2015
Apium prostratum var. *filiforme*	Native Celery	Y			8/01/1912
Apium prostratum var. *prostratum*	Native Celery	Y			8/01/1912
Arabidella trisecta	Shrubby Cress	Y			25/09/1971
Argentipallium blandowskianum	Woolly Everlasting	Y			1/11/1927
Aristida behriana	Brush Wire-grass	Y			13/05/2015
Aristida contorta	Curly Wire-grass	Y			16/11/2012
Aristida holathera var. *holathera*	Tall Kerosene Grass	Y			21/10/2011
Aristida sp.	Three-awn/Wire-grass	Y			12/04/2002
Arthropodium fimbriatum	Nodding Vanilla-lily	Y			10/12/2013
Arthropodium sp.	Vanilla-lily	Y			21/10/2011
Arthropodium strictum	Common Vanilla-lily	Y			13/05/2015
Asperula conferta	Common Woodruff	Y			5/10/2012
Asplenium flabellifolium	Necklace Fern	Y			01/10/1897
Astroloma conostephioides	Flame Heath	Y			1/11/2006
Astroloma humifusum	Cranberry Heath	Y			1/11/2006
Atriplex semibaccata	Berry Saltbush	Y			11/05/2015
Atriplex stipitata	Bitter Saltbush	Y			10/12/2013
Atriplex vesicaria	Bladder Saltbush	Y			19/10/1962
Austrodanthonia sp. *(NC)*		Y			8/05/2008
Austrostipa acrociliata	Graceful Spear-grass	Y			10/12/2013
Austrostipa blackii	Crested Spear-grass	Y			18/11/2012
Austrostipa breviglumis	Cane Spear-grass	Y		R	12/04/2002
Austrostipa curticoma	Short-crest Spear-grass	Y			7/12/2012
Austrostipa densiflora	Fox-tail Spear-grass	Y		R	20/10/1993
Austrostipa drummondii	Cottony Spear-grass	Y			10/12/2013
Austrostipa elegantissima	Feather Spear-grass	Y			8/05/2015
Austrostipa eremophila	Rusty Spear-grass	Y			18/11/2012
Austrostipa exilis	Heath Spear-grass	Y			25/10/1992
Austrostipa flavescens	Coast Spear-grass	Y			7/12/2012
Austrostipa gibbosa	Swollen Spear-grass	Y		R	10/12/2013
Austrostipa hemipogon	Half-beard Spear-grass	Y			1/11/2007
Austrostipa mollis	Soft Spear-grass	Y			1/12/2006
Austrostipa mollis group	Soft Spear-grass	Y			24/04/2015
Austrostipa nitida	Balcarra Spear-grass	Y			7/12/2012
Austrostipa nodosa	Tall Spear-grass	Y			11/05/2015
Austrostipa pilata	Prickly Spear-grass	Y		V	19/10/2012
Austrostipa platychaeta	Flat-awn Spear-grass	Y			8/04/2011
Austrostipa puberula	Fine-hairy Spear-grass	Y			10/12/2013
Austrostipa scabra ssp.	Rough Spear-grass	Y			15/04/2015

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Austrostipa scabra ssp. *falcata*	Slender Spear-grass	Y			16/11/2012
Austrostipa scabra ssp. *scabra*	Rough Spear-grass	Y			8/12/2011
Austrostipa semibarbata	Fibrous Spear-grass	Y			4/12/1993
Austrostipa setacea	Corkscrew Spear-grass	Y			21/10/2012
Austrostipa sp.	Spear-grass	Y			13/05/2015
Austrostipa tenuifolia		Y		R	30/11/2005
Banksia marginata	Silver Banksia	Y			15/11/2002
Baumea juncea	Bare Twig-rush	Y			12/06/1995
Beyeria lechenaultii	Pale Turpentine Bush	Y			24/10/1994
Blennospora drummondii	Dwarf Button-flower	Y			14/11/1996
Boerhavia dominii	Tar-vine	Y			18/04/1998
Boerhavia dominii (NC)	Tar-vine	Y			16/11/2012
Bolboschoenus caldwellii	Salt Club-rush	Y			14/02/1991
Bolboschoenus medianus	Marsh Club-rush	Y			8/01/1912
Bossiaea prostrata	Creeping Bossiaea	Y			23/09/1961
Bothriochloa macra	Red-leg Grass	Y		R	4/04/2000
Brachychiton gregorii	Desert Kurrajong	Y			9/12/2009
Brachyloma ericoides ssp.	Brush Heath	Y			14/11/1996
Brachyloma ericoides ssp. *ericoides*	Brush Heath	Y			21/05/2002
Brachyscome ciliaris var. *ciliaris*	Variable Daisy	Y			4/12/1996
Brachyscome ciliaris var. *subintegrifolia*		Y		R	1/08/2004
Brachyscome exilis	Slender Daisy	Y			25/10/1992
Brachyscome goniocarpa	Dwarf Daisy	Y			9/10/1996
Brachyscome lineariloba	Hard-head Daisy	Y			11/12/1996
Brachyscome perpusilla	Tiny Daisy	Y			18/09/1965
Brachyscome sp.	Native Daisy	Y			26/10/2011
Bromus sp.	Brome	Y			1/05/2015
Brunonia australis	Blue Pincushion	Y			27/04/1992
Bulbine bulbosa	Bulbine-lily	Y			21/10/2012
Burchardia umbellata	Milkmaids	Y			4/12/1993
Bursaria spinosa ssp.	Bursaria	Y			8/05/2015
Bursaria spinosa ssp. *spinosa*	Sweet Bursaria	Y			1/05/2015
Bursaria spinosa var. (NC)		Y			27/04/1992
Caesia calliantha	Blue Grass-lily	Y			8/05/2015
Caladenia argocalla	White Beauty Spider-orchid	Y	EN	E	1/09/1999
Caladenia behrii	Pink-lip Spider-orchid	Y	EN	E	20/09/1978
Caladenia cardiochila	Heart-lip Spider-orchid	Y			6/10/1918
Caladenia colorata	Coloured Spider-orchid	Y	EN	E	1/09/1979
Caladenia sp.	Spider-orchid	Y			23/09/2005
Caladenia tensa	Inland Green-comb Spider-orchid	Y	EN		31/08/1992
Caladenia tentaculata	King Spider-orchid	Y			14/11/1996
Calandrinia calyptrata	Pink Purslane	Y			11/11/1996

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Calandrinia eremaea	Dryland Purslane	Y			16/11/2012
Calandrinia sp.	Purslane/Parakeelya	Y			30/06/2000
Callistemon sp.	Bottlebrush	Y			8/05/2015
Callistemon teretifolius	Needle Bottlebrush	Y			30/11/1999
Callitris canescens	Scrubby Cypress Pine	Y			14/11/1959
Callitris glaucophylla	White Cypress-pine	Y			8/05/2008
Callitris gracilis	Southern Cypress Pine	Y			10/12/2013
Calocephalus citreus	Lemon Beauty-heads	Y			7/12/2012
Calostemma purpureum	Pink Garland-lily	Y			13/05/2015
Calytrix tetragona	Common Fringe-myrtle	Y			15/11/2002
Carex bichenoviana	Notched Sedge	Y			30/04/1993
Carex breviculmis	Short-stem Sedge	Y			30/09/1993
Carex inversa var. *major*	Knob Sedge	Y			8/11/2012
Carex sp.	Sedge	Y			8/11/2012
Carex tereticaulis	Rush Sedge	Y			3/04/1994
Carpobrotus modestus	Inland Pigface	Y			30/06/2000
Carpobrotus sp.	Pigface	Y			21/05/2002
Cassinia arcuata	Drooping Cassinia	Y			3/03/2011
Cassinia laevis	Curry Bush	Y			26/03/2000
Cassytha melantha	Coarse Dodder-laurel	Y			22/12/1987
Cassytha pubescens	Downy Dodder-laurel	Y			12/06/1995
Cassytha sp.	Dodder-laurel	Y			30/06/2000
Casuarina pauper	Black Oak	Y			30/04/1972
Casuarinaceae sp.	Sheaok Family	Y			21/04/2008
Centipeda crateriformis ssp. compacta	Desert Sneezeweed	Y			1/10/1912
Centipeda cunninghamii	Common Sneezeweed	Y			27/11/1965
Centipeda cunninghamii (NC)	Common Sneezeweed	Y			30/09/1993
Centrolepis aristata	Pointed Centrolepis	Y			9/10/1990
Centrolepis cephaloformis ssp. cephaloformis	Cushion Centrolepis	Y		R	14/11/1996
Centrolepis polygyna	Wiry Centrolepis	Y			14/11/1996
Centrolepis strigosa ssp. *strigosa*	Hairy Centrolepis	Y			14/11/1996
Chamaescilla corymbosa var. corymbosa	Blue Squill	Y			9/10/1990
Chamaesyce drummondii (NC)	Caustic Weed	Y			15/12/2001
Cheilanthes austrotenuifolia	Annual Rock-fern	Y			8/05/2015
Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern	Y			5/04/2011
Cheilanthes sp.	Rock-fern	Y			23/09/2005
Cheiranthera alternifolia	Hand-flower	Y			1/11/2006
Chenopodium curvispicatum	Cottony Goosefoot	Y			28/04/1992
Chenopodium desertorum ssp.	Desert Goosefoot	Y			10/12/2013

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Chenopodium desertorum ssp. desertorum	Frosted Goosefoot	Y			1/08/2004
Chenopodium desertorum ssp. microphyllum	Small-leaf Goosefoot	Y			11/05/2015
Chloris truncata	Windmill Grass	Y			24/04/2015
Chorizandra enodis	Black Bristle-rush	Y			1/08/2004
Chrysocephalum apiculatum	Common Everlasting	Y			19/10/2012
Chrysocephalum apiculatum (NC)	Common Everlasting	Y			1/11/2006
Chrysocephalum baxteri	White Everlasting	Y			10/10/1924
Chrysocephalum semipapposum	Clustered Everlasting	Y			8/05/2015
Chthonocephalus pseudevax	Ground-heads	Y			19/10/2012
Cladonia cervicornis ssp. *verticillata*		Y			1/09/1964
Cladonia southlandica		Y			8/03/1966
Clematis microphylla	Old Man's Beard	Y			4/04/2011
Clematis microphylla var. *microphylla (NC)*	Old Man's Beard	Y			1/12/2006
Conospermum patens	Slender Smoke-bush	Y			10/11/1881
Convolvulus angustissimus ssp.		Y			26/10/2011
Convolvulus angustissimus ssp. angustissimus	Australian Bindweed	Y			1/05/2015
Convolvulus angustissimus ssp. peninsularum	Grassland Bindweed	Y			16/11/2012
Convolvulus erubescens (NC)	Australian Bindweed	Y			9/05/2002
Convolvulus remotus	Grassy Bindweed	Y			13/05/2015
Convolvulus sp.	Bindweed	Y			15/04/2015
Cotula australis	Common Cotula	Y			11/11/1996
Craspedia haplorrhiza	Billy-buttons	Y			1/09/2005
Craspedia variabilis	Billy-buttons	Y			5/10/2012
Crassula closiana	Stalked Crassula	Y			20/10/1992
Crassula colligata ssp. *colligata*		Y			10/12/2013
Crassula colorata var.	Dense Crassula	Y			1/08/2004
Crassula colorata var. *acuminata*	Dense Crassula	Y			11/12/1996
Crassula colorata var. *colorata*	Dense Crassula	Y			14/11/1996
Crassula decumbens var. decumbens	Spreading Crassula	Y			1/08/2004
Crassula peduncularis	Purple Crassula	Y		R	30/09/1993
Crassula sieberiana ssp. tetramera (NC)	Australian Stonecrop	Y			1/06/2000
Cryptandra amara var. amara (NC)	Spiny Cryptandra	Y			11/12/1996
Cryptandra campanulata	Long-flower Cryptandra	Y		R	13/05/2015

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Cryptandra sp.	Cryptandra	Y			12/11/1996
Cryptandra tomentosa	Heath Cryptandra	Y			1/08/2005
Cullen australasicum	Tall Scurf-pea	Y			16/11/2012
Cullen parvum	Small Scurf-pea	Y		V	1/10/1912
Cymbonotus preissianus	Austral Bear's-ear	Y			5/10/2012
Cymbopogon ambiguus	Lemon-grass	Y			26/11/2002
Cymbopogon sp.	Lemon Grass	Y			10/12/2013
Cynoglossum suaveolens	Sweet Hound's-tongue	Y			15/11/1996
Cyperus gunnii ssp. gunnii	Flecked Flat-sedge	Y			3/04/1994
Cyperus gymnocaulos	Spiny Flat-sedge	Y			15/04/2015
Cyperus laevigatus	Bore-drain Sedge	Y			27/03/1986
Cyperus sp.	Flat-sedge	Y			15/12/2001
Cyperus vaginatus	Stiff Flat-sedge	Y			10/12/2013
Dampiera dysantha	Shrubby Dampiera	Y			1/01/1980
Dampiera rosmarinifolia	Rosemary Dampiera	Y			14/06/2005
Danthonia sp. *(NC)*	Wallaby-grass	Y			14/06/2005
Daucus glochidiatus	Native Carrot	Y			5/10/2012
Daviesia arenaria	Sand Bitter-pea	Y			30/06/2000
Daviesia benthamii ssp.	Spiny Bitter-pea	Y			1/08/2004
Daviesia benthamii ssp. *humilis*	Mallee Bitter-pea	Y		R	1/08/2004
Daviesia brevifolia	Leafless Bitter-pea	Y			9/04/1969
Daviesia leptophylla	Narrow-leaf Bitter-pea	Y			
Daviesia ulicifolia ssp. incarnata		Y			9/04/1969
Dianella brevicaulis/revoluta var.	Black-anther Flax-lily	Y			11/12/1996
Dianella longifolia var. *(NC)*	Pale Flax-lily	Y			27/04/1992
Dianella longifolia var. *grandis*	Pale Flax-lily	Y		R	21/10/2012
Dianella revoluta (NC)		Y			2/10/1992
Dianella revoluta var.		Y			13/05/2015
Dianella revoluta var. *revoluta*	Black-anther Flax-lily	Y			13/05/2015
Dianella sp.	Flax-lily	Y			8/05/2008
Dichanthium sericeum ssp. *sericeum*	Silky Blue-grass	Y			26/11/2002
Dichelachne crinita	Long-hair Plume-grass	Y			10/11/1995
Dichondra repens	Kidney Weed	Y			1/08/2004
Digitaria ammophila	Spider Grass	Y			10/06/1884
Digitaria brownii	Cotton Panic-grass	Y			16/11/2012
Distichlis distichophylla	Emu-grass	Y			15/04/2015
Diuris behrii	Behr's Cowslip Orchid	Y		V	28/09/2010
Diuris pardina	Spotted Donkey-orchid	Y			1/01/1980
Dodonaea stenozyga	Desert Hop-bush	Y			10/06/1922
Dodonaea subglandulifera		Y	EN	E	13/09/1987
Dodonaea viscosa ssp.	Sticky Hop-bush	Y			23/02/2012

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush	Y			26/11/2002
Dodonaea viscosa ssp. *spatulata*	Sticky Hop-bush	Y			21/10/2012
Drosera auriculata	Tall Sundew	Y			9/10/1990
Drosera glanduligera	Scarlet Sundew	Y			14/11/1996
Drosera macrantha ssp. *planchonii*	Climbing Sundew	Y			4/12/1996
Drosera peltata	Pale Sundew	Y			14/11/1996
Drosera peltata (NC)	Pale Sundew	Y			23/09/2005
Drosera whittakeri		Y			9/10/1990
Drosera whittakeri (NC)	Scented Sundew	Y			20/10/1992
Drosera whittakeri ssp. (NC)		Y			23/09/2005
Duma florulenta	Lignum	Y			15/05/2002
Dysphania pumilio	Small Crumbweed	Y			13/05/2015
Einadia nutans ssp.	Climbing Saltbush	Y			11/05/2015
Einadia nutans ssp. *nutans*	Climbing Saltbush	Y			5/10/2012
Elatine gratioloides	Waterwort	Y		R	25/10/1992
Eleocharis acuta	Common Spike-rush	Y			9/05/2002
Elymus scaber var. *scaber (NC)*	Native Wheat-grass	Y			12/04/2002
Enchylaena tomentosa var.	Ruby Saltbush	Y			11/05/2015
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	Y			18/11/2012
Enneapogon nigricans	Black-head Grass	Y			13/05/2015
Enneapogon sp.	Bottle-washers/Nineawn	Y			8/05/2008
Enteromorpha clathrata		Y			1/08/1981
Enteropogon acicularis	Umbrella Grass	Y			11/12/1996
Enteropogon acicularis (NC)	Umbrella Grass	Y			2/10/1992
Epilobium billardierianum ssp. cinereum	Variable Willow-herb	Y			24/04/1994
Epilobium billardierianum ssp. X intermedium	Variable Willow-herb	Y			30/09/1993
Epilobium hirtigerum	Hairy Willow-herb	Y			1/06/2000
Eragrostis infecunda	Barren Cane-grass	Y		R	12/02/2000
Eremophila alternifolia	Narrow-leaf Emubush	Y			1/11/1984
Eremophila behriana	Rough Emubush	Y			28/12/1981
Eremophila longifolia	Weeping Emubush	Y			10/12/2013
Eriochiton sclerolaenoides	Woolly-fruit Bluebush	Y			28/04/1992
Erodium sp.	Heron's-bill/Crowfoot	Y			13/05/2015
Eucalyptus behriana	Broad-leaf Box	Y		R	8/05/2015
Eucalyptus brachycalyx	Gilja	Y			8/05/2008
Eucalyptus camaldulensis ssp.	River Red Gum	Y			16/11/2012
Eucalyptus camaldulensis ssp. *camaldulensis*	River Red Gum	Y			15/04/2015

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Eucalyptus camaldulensis var. camaldulensis (NC)	River Red Gum	Y			14/06/2005
Eucalyptus cladocalyx (NC)	Sugar Gum	Y			14/06/2005
Eucalyptus dumosa	White Mallee	Y			2/04/2002
Eucalyptus gracilis	Yorrell	Y			10/12/2013
Eucalyptus incrassata	Ridge-fruited Mallee	Y			4/06/2002
Eucalyptus largiflorens	River Box	Y			4/04/2002
Eucalyptus leptophylla	Narrow-leaf Red Mallee	Y			15/11/2002
Eucalyptus leptophylla (NC)	Narrow-leaf Red Mallee	Y			14/06/2005
Eucalyptus leucoxylon (NC)	South Australian Blue Gum	Y			20/10/1992
Eucalyptus leucoxylon ssp.	South Australian Blue Gum	Y			8/11/2012
Eucalyptus leucoxylon ssp. *leucoxylon*	South Australian Blue Gum	Y			1/08/2004
Eucalyptus leucoxylon ssp. *pruinosa*	Inland South Australian Blue Gum	Y			13/05/2015
Eucalyptus leucoxylon ssp. *pruinosa (NC)*		Y			2/10/1992
Eucalyptus leucoxylon ssp. *stephaniae*	Scrubby Blue Gum	Y			8/05/2015
Eucalyptus odorata	Peppermint Box	Y			13/05/2015
Eucalyptus odorata (NC)	Peppermint Box	Y			8/11/2012
Eucalyptus oleosa ssp.		Y			8/05/2008
Eucalyptus oleosa ssp. oleosa	Red Mallee	Y			8/05/2008
Eucalyptus percostata	Ribbed White Mallee	Y		R	10/12/2013
Eucalyptus phenax (NC)	Sessile-fruit White Mallee	Y			28/04/1992
Eucalyptus phenax ssp.		Y			8/05/2008
Eucalyptus porosa	Mallee Box	Y			10/12/2013
Eucalyptus socialis (NC)	Beaked Red Mallee	Y			10/12/2001
Eucalyptus socialis ssp.		Y			8/05/2008
Eucalyptus sp.		Y			8/05/2008
Eucalyptus viminalis ssp. *cygnetensis*	Rough-bark Manna Gum	Y			4/03/2009
Euchiton involucratus	Star Cudweed	Y			15/11/1907
Euphorbia dallachyana	Caustic Weed	Y			13/04/2015
Euphorbia drummondii (NC)		Y			10/12/2013
Euphorbia sp.	Spurge	Y			13/05/2015
Euphrasia collina ssp. *osbornii*	Osborn's Eyebright	Y	EN	E	13/10/2010
Eutaxia diffusa	Large-leaf Eutaxia	Y			15/12/2001
Eutaxia microphylla	Common Eutaxia	Y			8/05/2015
Eutaxia microphylla var. *microphylla (erect) (NC)*	Common Eutaxia	Y			14/11/1996
Eutaxia microphylla var. microphylla (prostrate) (NC)	Common Eutaxia	Y			15/11/1996

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			Aus	SA	
Eutaxia sp.	Eutaxia	Y			29/04/1992
Exocarpos aphyllus	Leafless Cherry	Y			10/12/2013
Exocarpos cupressiformis	Native Cherry	Y			8/04/2011
Exocarpos sp.	Native Cherry/Ballart	Y			8/05/2008
Galium gaudichaudii (NC)	Rough Bedstraw	Y			15/12/2001
Galium gaudichaudii ssp. *gaudichaudii*	Rough Bedstraw	Y			10/11/1995
Galium leptogonium	Reflexed Bedstraw	Y			25/10/1992
Galium migrans (NC)	Loose Bedstraw	Y			1/08/2004
Galium migrans ssp. migrans	Loose Bedstraw	Y			26/10/2011
Galium sp.	Bedstraw	Y			11/11/1993
Geijera linearifolia	Sheep Bush	Y			10/12/2013
Geranium retrorsum	Grassland Geranium	Y			5/10/2012
Geranium solanderi	Austral Geranium	Y			23/09/2005
Geranium sp.	Geranium	Y			1/05/2015
Glischrocaryon behrii	Golden Pennants	Y			18871027
Glossodia major	Purple Cockatoo	Y			9/10/1990
Glycine clandestina var. *(NC)*	Twining Glycine	Y			1/01/1980
Glycine rubiginosa	Twining Glycine	Y			11/12/1996
Gnaphalium indutum ssp. indutum	Tiny Cudweed	Y			14/11/1996
Gonocarpus elatus	Hill Raspwort	Y			8/05/2015
Gonocarpus mezianus	Broad-leaf Raspwort	Y			5/10/2012
Gonocarpus tetragynus	Small-leaf Raspwort	Y			19/10/2012
Goodenia albiflora	White Goodenia	Y			16/11/2012
Goodenia blackiana	Native Primrose	Y			1/11/2006
Goodenia geniculata	Bent Goodenia	Y			15/09/1987
Goodenia pinnatifida	Cut-leaf Goodenia	Y			11/05/2015
Goodenia pusilliflora	Small-flower Goodenia	Y			26/10/2011
Goodenia willisiana	Silver Goodenia	Y			1/01/1980
Gramineae sp.	Grass Family	Y			13/05/2015
Grevillea huegelii	Comb Grevillea	Y			8/05/2008
Grevillea ilicifolia ssp.		Y			1/08/2004
Grevillea ilicifolia ssp. *ilicifolia*	Holly-leaf Grevillea	Y			24/10/1984
Grevillea ilicifolia var. *ilicifolia (NC)*	Holly-leaf Grevillea	Y			4/06/2002
Grevillea lavandulacea ssp. lavandulacea	Spider-flower	Y			18871027
Grevillea lavandulacea var. *(NC)*	Spider-flower	Y			25/01/1991
Grevillea lavandulacea var. *lavandulacea (NC)*	Spider-flower	Y			30/06/2000
Hakea leucoptera ssp. *leucoptera*	Silver Needlewood	Y			4/12/1996
Hakea rostrata	Beaked Hakea	Y			8/05/2008
Hakea rugosa	Dwarf Hakea	Y			22/05/2002

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Halgania cyanea	Rough Blue-flower	Y			4/06/2002
Haloragis aspera	Rough Raspwort	Y			18/11/2012
Haloragis heterophylla	Variable Raspwort	Y			28/12/1992
Hardenbergia violacea	Native Lilac	Y			21/05/2002
Helichrysum bilobum ssp. (NC)		Y			27/04/1992
Helichrysum leucopsideum	Satin Everlasting	Y			1/11/2006
Helichrysum sp. *(NC)*		Y			12/02/1980
Heliotropium sp.	Heliotrope	Y			12/01/2004
Hibbertia australis	Stalked Guinea-flower	Y			15/08/1987
Hibbertia exutiacies	Prickly Guinea-flower	Y			14/11/1996
Hibbertia sericea	Silky Guinea-flower	Y			30/05/1964
Hibbertia virgata	Twiggy Guinea-flower	Y			15/11/2002
Hyalosperma demissum	Dwarf Sunray	Y			10/12/2013
Hyalosperma glutinosum ssp. glutinosum	Golden Sunray	Y			4/12/1996
Hyalosperma semisterile	Orange Sunray	Y			16/11/2012
Hydrocotyle callicarpa	Tiny Pennywort	Y			14/11/1996
Hydrocotyle foveolata	Yellow Pennywort	Y			14/11/1996
Hydrocotyle laxiflora	Stinking Pennywort	Y			5/10/2012
Imperata cylindrica	Blady Grass	Y			25/01/1987
Isoetes drummondii ssp. *drummondii*	Plain Quillwort	Y		R	9/10/1996
Isoetopsis graminifolia	Grass Cushion	Y			26/10/2011
Isolepis cernua	Nodding Club-rush	Y			27/03/1986
Isolepis congrua	Slender Club-rush	Y			20/10/1996
Isolepis fluitans	Floating Club-rush	Y			1/12/1992
Isolepis inundata	Swamp Club-rush	Y			9/09/2004
Ixodia achillaeoides ssp. *alata*	Hills Daisy	Y			1/02/1947
Juncus aridicola	Inland Rush	Y			18820103
Juncus bufonius	Toad Rush	Y			30/09/1993
Juncus caespiticius	Grassy Rush	Y			8/01/1912
Juncus flavidus	Yellow Rush	Y			12/11/1994
Juncus kraussii	Sea Rush	Y			13/04/2015
Juncus pallidus	Pale Rush	Y			9/05/2002
Juncus radula	Hoary Rush	Y		V	25/10/1992
Juncus sarophorus		Y			12/08/1999
Juncus sp.	Rush	Y			12/04/2002
Juncus subsecundus	Finger Rush	Y			5/10/2012
Kennedia prostrata	Scarlet Runner	Y			18930901
Kunzea pomifera	Muntries	Y			31/05/2003
Lachnagrostis aemula	Blown-grass	Y			18971101
Lachnagrostis perennis	Perennial Blown-grass	Y			12/02/2000
Lachnagrostis robusta	Tall Blown-grass	Y		R	12/02/2000
Lagenophora huegelii	Coarse Bottle-daisy	Y			24/04/2015
Leguminosae sp.		Y			19/10/2012

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Leiocarpa tomentosa	Woolly Plover-daisy	Y			13/05/2002
Lepidium sp.	Peppercress	Y			1/12/2006
Lepidosperma canescens	Hoary Rapier-sedge	Y			1/07/2002
Lepidosperma carphoides	Black Rapier-sedge	Y			1/07/2002
Lepidosperma concavum	Spreading Sword-sedge	Y			13/06/1977
Lepidosperma concavum/congestum/laterale	Sword-sedge	Y			1/01/1980
Lepidosperma congestum (NC)	Clustered Sword-sedge	Y			12/02/1980
Lepidosperma curtisiae	Little Sword-sedge	Y			1/11/2006
Lepidosperma laterale (NC)	Sharp Sword-sedge	Y			27/04/1992
Lepidosperma sp.	Sword-sedge/Rapier-sedge	Y			15/05/2002
Lepidosperma viscidum	Sticky Sword-sedge	Y			18/11/2012
Leporella fimbriata	Fringed Hare-orchid	Y			21/04/1981
Leptomeria aphylla	Leafless Currant-bush	Y			1/12/2006
Leptorhynchos elongatus	Lanky Buttons	Y		R	18/09/1965
Leptorhynchos orientalis	Eastern Annual Buttons	Y		R	24/09/1938
Leptorhynchos squamatus ssp. squamatus	Scaly Buttons	Y			19/10/2012
Leptorhynchos tetrachaetus	Little Buttons	Y			16/11/2012
Leptospermum myrsinoides	Heath Tea-tree	Y			30/06/2000
Leucopogon sp.	Beard-heath	Y			14/06/2005
Leucopogon virgatus var. *virgatus*	Common Beard-heath	Y			9/04/1969
Levenhookia dubia	Hairy Stylewort	Y			4/12/1996
Levenhookia pusilla	Tiny Stylewort	Y			19/10/1996
Lichen sp.		Y			15/11/1996
Lilaeopsis polyantha	Australian Lilaeopsis	Y			12/02/2000
Limosella australis	Australian Mudwort	Y			1/06/2000
Linum marginale	Native Flax	Y			19/04/2011
Lobelia anceps	Angled Lobelia	Y			8/01/1912
Logania recurva	Recurved Logania	Y			9/04/1969
Logania saxatilis	Rock Logania	Y		R	24/08/1946
Lomandra collina	Sand Mat-rush	Y			4/12/1996
Lomandra densiflora	Soft Tussock Mat-rush	Y			13/05/2015
Lomandra effusa	Scented Mat-rush	Y			13/05/2015
Lomandra fibrata	Mount Lofty Mat-rush	Y			9/04/1969
Lomandra leucocephala ssp. robusta	Woolly Mat-rush	Y			22/05/2002
Lomandra micrantha ssp.	Small-flower Mat-rush	Y			13/05/2015
Lomandra micrantha ssp. *micrantha*	Small-flower Mat-rush	Y			19/10/2012
Lomandra micrantha ssp. *tuberculata*	Small-flower Mat-rush	Y			1/07/2003
Lomandra multiflora ssp.	Many-flower Mat-rush	Y			16/11/2012

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Lomandra multiflora ssp. *dura*	Hard Mat-rush	Y			13/05/2015
Lomandra nana	Small Mat-rush	Y			16/11/2012
Lomandra sororia	Sword Mat-rush	Y			14/11/1996
Lomandra sp.	Mat-rush	Y			8/11/2012
Lotus australis	Austral Trefoil	Y			21/09/1964
Luzula meridionalis	Common Wood-rush	Y			5/10/2012
Luzula ovata	Clustered Wood-rush	Y		R	24/11/1992
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	Y			15/11/2002
Lythrum hyssopifolia	Lesser Loosestrife	Y			1/06/2000
Maireana aphylla	Cotton-bush	Y			27/04/2015
Maireana brevifolia	Short-leaf Bluebush	Y			13/05/2015
Maireana enchylaenoides	Wingless Fissure-plant	Y			13/05/2015
Maireana erioclada	Rosy Bluebush	Y			28/04/1992
Maireana excavata	Bottle Fissure-plant	Y		V	2/10/1992
Maireana pyramidata	Black Bluebush	Y			8/05/2008
Maireana rohrlachii	Rohrlach's Bluebush	Y		R	11/05/2015
Maireana sedifolia	Bluebush	Y			8/05/2008
Maireana sp.	Bluebush/Fissure-plant	Y			8/05/2008
Maireana trichoptera	Hairy-fruit Bluebush	Y			11/12/1996
Malvaceae sp.		Y			17/09/2002
Melaleuca brevifolia	Short-leaf Honey-myrtle	Y			27/03/1986
Melaleuca decussata	Totem-poles	Y			14/06/2005
Melaleuca lanceolata	Dryland Tea-tree	Y			8/05/2008
Melaleuca sp.	Tea-tree	Y			8/05/2008
Microlaena stipoides var. *stipoides*	Weeping Rice-grass	Y			1/12/2006
Microseris lanceolata	Yam Daisy	Y			14/11/1996
Microtis arenaria	Notched Onion-orchid	Y			22/11/2005
Microtis frutetorum		Y			22/11/2005
Microtis parviflora	Slender Onion-orchid	Y			1/12/2005
Microtis unifolia complex	Onion-orchid	Y			9/10/1990
Millotia myosotidifolia	Broad-leaf Millotia	Y			11/12/1958
Millotia tenuifolia var.	Soft Millotia	Y			10/12/2013
Millotia tenuifolia var. *tenuifolia*	Soft Millotia	Y			11/12/1996
Minuria leptophylla	Minnie Daisy	Y			15/11/1996
Moss sp.		Y			15/11/1996
Myoporum platycarpum ssp.	False Sandalwood	Y			13/04/2015
Myoporum platycarpum ssp. platycarpum	False Sandalwood	Y			1/06/1933
Myoporum viscosum	Sticky Boobialla	Y			15/11/1996
Myoporum viscosum (NC)	Sticky Boobialla	Y			15/11/1996
Myosotis australis	Austral Forget-me-not	Y			23/09/2005
Myriocephalus rhizocephalus	Woolly-heads	Y			18871027

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			Aus	SA	
Myriophyllum integrifolium	Tiny Milfoil	Y		R	27/01/1993
Neurachne alopecuroidea	Fox-tail Mulga-grass	Y			24/04/2015
Nicotiana maritima	Coast Tobacco	Y			1/09/2005
Nitraria billardierei	Nitre-bush	Y			8/05/2008
Olearia decurrens	Winged Daisy-bush	Y			21/03/2001
Olearia floribunda	Heath Daisy-bush	Y			21/05/2002
Olearia pannosa ssp. pannosa	Silver Daisy-bush	Y	VU	V	28/09/2010
Olearia passerinoides ssp. *glutescens*	Sticky Daisy-bush	Y		R	5/04/1987
Olearia pimeleoides	Pimelea Daisy-bush	Y			14/06/2005
Olearia pimeleoides ssp. *(NC)*	Pimelea Daisy-bush	Y			27/04/1992
Olearia ramulosa	Twiggy Daisy-bush	Y			13/05/2015
Opercularia ovata	Broad-leaf Stinkweed	Y			18971101
Opercularia turpis	Twiggy Stinkweed	Y			18/09/1994
Ophioglossum lusitanicum	Austral Adder's-tongue	Y			18871027
Oxalis perennans	Native Sorrel	Y			13/05/2015
Oxalis perennans (NC)	Native Sorrel	Y			15/12/2001
Ozothamnus retusus	Notched Bush-everlasting	Y			1/11/2006
Ozothamnus sp.	Bush-everlasting	Y			21/03/2002
Panicum decompositum var. decompositum	Native Millet	Y			8/05/2015
Panicum effusum var. effusum	Hairy Panic	Y			2/04/2002
Panicum sp.	Panic/Millet	Y			8/05/2008
Pauridia glabella var. *glabella*	Tiny Star	Y			1/08/2004
Persicaria prostrata	Creeping Knotweed	Y			1/06/2000
Pheladenia deformis	Bluebeard Orchid	Y			31/08/1992
Phragmites australis	Common Reed	Y			13/04/2015
Phyllangium divergens	Wiry Mitrewort	Y			18800929
Pilularia novae-hollandiae	Austral Pillwort	Y		R	25/10/1992
Pimelea curviflora var. *gracilis (NC)*	Curved Riceflower	Y			27/03/2002
Pimelea glauca	Smooth Riceflower	Y			24/10/1994
Pimelea humilis	Low Riceflower	Y			18971101
Pimelea micrantha	Silky Riceflower	Y			16/11/2012
Pimelea serpyllifolia ssp. serpyllifolia	Thyme Riceflower	Y			4/06/2002
Pimelea stricta	Erect Riceflower	Y			1/11/2006
Pittosporum angustifolium	Native Apricot	Y			29/04/2015
Plantago gaudichaudii	Narrow-leaf Plantain	Y			5/10/2012
Plantago hispida	Hairy Plantain	Y			16/11/2012
Plantago sp.	Plantain	Y			8/05/2008
Plantago varia	Variable Plantain	Y			8/05/2015
Pleurosorus rutifolius	Blanket Fern	Y			1/06/2000
Poa clelandii	Matted Tussock-grass	Y			23/10/1966

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Poa crassicaudex	Thick-stem Tussock-grass	Y			16/11/2012
Poa labillardieri var. *labillardieri*	Common Tussock-grass	Y			8/11/2012
Poa sp.	Meadow-grass/Tussock-grass	Y			1/05/2015
Podolepis canescens	Grey Copper-wire Daisy	Y			19/10/2012
Podolepis tepperi	Delicate Copper-wire Daisy	Y			9/11/2010
Pogonolepis muelleriana	Stiff Cup-flower	Y			16/11/2012
Polygonum plebeium	Small Knotweed	Y			24/04/1994
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris	Y			13/05/2002
Poranthera microphylla	Small Poranthera	Y			14/11/1959
Potamogeton crispus	Curly Pondweed	Y			18861029
Potamogeton tepperi	Tepper's Pondweed	Y			14/12/1939
Pottia sp.		Y			27/07/1963
Prasophyllum occidentale	Plains Leek-orchid	Y			1/09/1979
Prasophyllum odoratum	Scented Leek-orchid	Y			23/10/1966
Prasophyllum pallidum	Pale Leek-orchid	Y	VU	R	11/11/1981
Prasophyllum sp.	Leek-orchid	Y			23/09/2005
Prostanthera behriana	Downy Mintbush	Y			7/10/1993
Pseudoraphis spinescens	Spiny Mud-grass	Y			18871027
Pterostylis biseta	Two-bristle Greenhood	Y			14/11/1996
Pterostylis biseta (NC)	Two-bristle Greenhood	Y			14/11/1996
Pterostylis nana	Dwarf Greenhood	Y			31/08/1992
Pterostylis robusta	Large Shell-orchid	Y			1/06/2000
Pterostylis sp.	Greenhood	Y			30/06/2000
Ptilotus erubescens	Hairy-tails	Y		R	19/10/2012
Ptilotus nobilis ssp. *nobilis*	Yellow-tails	Y			11/12/1996
Ptilotus sp.	Mulla Mulla	Y			2/10/1992
Ptilotus spathulatus	Pussy-tails	Y			8/05/2015
Pultenaea largiflorens	Twiggy Bush-pea	Y			8/05/2015
Pultenaea pedunculata	Matted Bush-pea	Y			9/04/1969
Pultenaea tenuifolia	Narrow-leaf Bush-pea	Y			18871027
Pyrorchis nigricans	Black Fire-orchid	Y			1/01/1975
Ramaria gracilis		Y			3/07/1955
Ranunculus pachycarpus	Thick-fruit Buttercup	Y			18/09/1965
Ranunculus sessiliflorus var. sessiliflorus	Annual Buttercup	Y			1/08/2004
Rhagodia candolleana ssp. *candolleana*	Sea-berry Saltbush	Y			14/06/2005
Rhagodia parabolica	Mealy Saltbush	Y			11/05/2015
Rhagodia preissii ssp. *preissii*	Mallee Saltbush	Y			14/06/2005
Rhagodia spinescens	Spiny Saltbush	Y			1/05/1992
Rhodanthe corymbiflora	Paper Everlasting	Y			15/11/1996
Rhodanthe moschata	Musk Daisy	Y			3/10/1916
Rhodanthe polygalifolia	Milkwort Everlasting	Y			5/08/1969
Rhodanthe pygmaea	Pigmy Daisy	Y			19/10/2012

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Rhodanthe troedelii	Small Paper-everlasting	Y			19/07/1955
Rumex brownii	Slender Dock	Y			8/12/2011
Rumex brownii (NC)	Slender Dock	Y			4/12/1996
Rumex dumosus	Wiry Dock	Y		R	21/10/2012
Rumex sp.	Dock	Y			8/05/2015
Rytidosperma auriculatum	Lobed Wallaby-grass	Y			7/12/2012
Rytidosperma caespitosum	Common Wallaby-grass	Y			15/04/2015
Rytidosperma carphoides	Short Wallaby-grass	Y			7/12/2012
Rytidosperma duttonianum	Brown-back Wallaby-grass	Y			14/11/1996
Rytidosperma erianthum	Hill Wallaby-grass	Y			10/12/2013
Rytidosperma fulvum	Leafy Wallaby-grass	Y			1/12/2006
Rytidosperma geniculatum	Kneed Wallaby-grass	Y			1/12/2006
Rytidosperma pilosum	Velvet Wallaby-grass	Y			1/06/2000
Rytidosperma racemosum var. racemosum	Slender Wallaby-grass	Y			7/12/2012
Rytidosperma setaceum	Small-flower Wallaby-grass	Y			10/12/2013
Rytidosperma sp.		Y			29/04/2015
Rytidosperma tenuius	Short-awn Wallaby-grass	Y		R	11/11/1993
Salsola australis	Buckbush	Y			11/05/2015
Samolus repens	Creeping Brookweed	Y			8/11/2012
Santalum acuminatum	Quandong	Y			4/06/2002
Scaevola albida	Pale Fanflower	Y			8/05/2015
Scaevola sp.	Fanflower	Y			10/11/1993
Schoenoplectus pungens	Spiky Club-rush	Y			8/11/2012
Schoenoplectus validus	River Club-rush	Y			1/02/2005
Schoenus apogon	Common Bog-rush	Y			1/08/2004
Schoenus breviculmis	Matted Bog-rush	Y			1/08/2004
Schoenus nanus	Little Bog-rush	Y			21/10/1995
Sclerolaena diacantha	Grey Bindyi	Y			10/12/2013
Sclerolaena obliquicuspis	Oblique-spined Bindyi	Y			28/04/1992
Sclerolaena patenticuspis	Spear-fruit Bindyi	Y			28/04/1992
Sebaea ovata	Yellow Sebaea	Y			9/10/1990
Selliera radicans	Shiny Swamp-mat	Y			20/01/2000
Senecio dolichocephalus	Woodland Groundsel	Y			30/09/1993
Senecio glossanthus	Annual Groundsel	Y			1/09/1964
Senecio glossanthus (NC)	Annual Groundsel	Y			30/06/2000
Senecio odoratus	Scented Groundsel	Y			26/11/1986
Senecio phelleus	Woodland Groundsel	Y			5/10/2012
Senecio picridioides	Purple-leaf Groundsel	Y			1/06/2000
Senecio quadridentatus	Cotton Groundsel	Y			18980301
Senecio spanomerus		Y			18/09/1965
Senecio tenuiflorus (NC)	Woodland Groundsel	Y			1/06/2000
Senna artemisioides ssp.	Desert Senna	Y			13/04/2015
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	Y			8/05/2008
Senna artemisioides ssp. *petiolaris*		Y			14/06/2005

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Senna artemisioides ssp. *quadrifolia*	Four-leaf Desert Senna	Y			30/09/1993
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	Y			10/12/2013
Setaria constricta	Knotty-butt Paspalidium	Y			16/11/2012
Setaria jubiflora	Warrego Summer-grass	Y			15/04/2015
Sida corrugata var.	Corrugated Sida	Y			15/04/2015
Sida corrugata var. *angustifolia*	Grassland Sida	Y			16/11/2012
Sida corrugata var. *corrugata*	Corrugated Sida	Y			16/11/2012
Siloxerus multiflorus	Small Wrinklewort	Y			30/09/1993
Solanum simile	Kangaroo Apple	Y			1/07/1973
Solenogyne dominii	Smooth Solenogyne	Y			5/10/2012
Sonchus hydrophilus	Native Sow-thistle	Y			27/03/1986
Sonchus sp.	Sow-thistle	Y			21/04/2008
Sporobolus mitchellii	Rat-tail Couch	Y			26/03/2000
Sporobolus virginicus	Salt Couch	Y			5/04/2011
Spyridium parvifolium	Dusty Miller	Y			9/04/1969
Stackhousia monogyna	Creamy Candles	Y			21/10/2012
Stenopetalum lineare (NC)	Narrow Thread-petal	Y			11/12/1996
Stuartina muelleri	Spoon Cudweed	Y			11/12/1996
Swainsona behriana	Behr's Swainson-pea	Y		V	28/09/2010
Swainsona fissimontana	Broken Hill Pea	Y			19/07/1955
Swainsona tephrotricha	Ashy-haired Swainson-pea	Y			26/11/1986
Tecticornia pergranulata ssp. pergranulata	Black-seed Samphire	Y			21/05/2002
Teucrium racemosum	Grey Germander	Y			15/04/2015
Teucrium sessiliflorum	Mallee Germander	Y			24/10/1994
Thelymitra albiflora		Y			
Thelymitra antennifera	Lemon Sun-orchid	Y			23/10/1966
Thelymitra megcalyptra	Scented Sun-orchid	Y			23/09/1961
Thelymitra nuda		Y			1/10/2001
Thelymitra nuda (NC)	Scented Sun-orchid	Y			14/11/1996
Thelymitra pauciflora (NC)	Slender Sun-orchid	Y			9/10/1990
Themeda triandra	Kangaroo Grass	Y			13/05/2015
Thomasia petalocalyx	Paper-flower	Y			18871017
Thysanotus baueri	Mallee Fringe-lily	Y			11/12/1996
Thysanotus patersonii	Twining Fringe-lily	Y			1/11/2006
Trachymene cyanopetala	Purple Trachymene	Y			9/10/1990
Trachymene pilosa	Dwarf Trachymene	Y			14/11/1996
Tricoryne elatior	Yellow Rush-lily	Y			14/11/1996
Triglochin calcitrapum (NC)	Spurred Arrowgrass	Y			9/10/1990
Triglochin centrocarpum (NC)	Dwarf Arrowgrass	Y			14/11/1996
Triglochin isingiana	Spurred Arrowgrass	Y			31/08/1993
Triodia bunicola	Flinders Ranges Spinifex	Y			18871029
Triptilodiscus pygmaeus	Small Yellow-heads	Y			19/10/2012

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			Aus	SA	
Typha domingensis	Narrow-leaf Bulrush	Y			27/03/1986
Typha sp.	Bulrush	Y			15/12/2001
Unidentified sp.		Y			8/05/2008
Velleia arguta	Toothed Velleia	Y			16/11/2012
Velleia paradoxa	Spur Velleia	Y			19/10/2012
Vittadinia australasica var.	Sticky New Holland Daisy	Y			19/10/2012
Vittadinia australasica var. *australasica*	Sticky New Holland Daisy	Y			1/11/1992
Vittadinia blackii	Narrow-leaf New Holland Daisy	Y			27/04/2015
Vittadinia cervicularis var. *cervicularis*	Waisted New Holland Daisy	Y			10/12/2013
Vittadinia condyloides	Club-hair New Holland Daisy	Y			27/04/1992
Vittadinia cuneata var.	Fuzzy New Holland Daisy	Y			26/10/2011
Vittadinia cuneata var. *cuneata*	Fuzzy New Holland Daisy	Y			18/11/2012
Vittadinia cuneata var. *murrayensis*	Murray New Holland Daisy	Y			24/10/1984
Vittadinia gracilis	Woolly New Holland Daisy	Y			11/05/2015
Vittadinia megacephala	Giant New Holland Daisy	Y			16/11/2012
Vittadinia sp.	New Holland Daisy	Y			8/05/2015
Vulpia bromoides/myuros		Y			20/10/1992
Wahlenbergia communis	Tufted Bluebell	Y			5/04/2011
Wahlenbergia gracilenta	Annual Bluebell	Y			16/11/2012
Wahlenbergia littoricola	Coast Bluebell	Y			29/04/1992
Wahlenbergia luteola	Yellow-wash Bluebell	Y			18/11/2012
Wahlenbergia multicaulis	Tadgell's Bluebell	Y			12/11/1994
Wahlenbergia preissii		Y			18/11/2012
Wahlenbergia sp.	Native Bluebell	Y			11/05/2015
Wahlenbergia stricta ssp. stricta	Tall Bluebell	Y			21/10/2011
Walwhalleya proluta	Rigid Panic	Y			18/11/2012
Walwhalleya proluta (NC)	Rigid Panic	Y			8/12/2011
Wurmbea dioica ssp.		Y			19/10/2012
Wurmbea dioica ssp. *brevifolia*	Early Nancy	Y			27/03/1987
Wurmbea dioica ssp. *dioica*	Early Nancy	Y			19/10/2012
Wurmbea dioica ssp. *dioica (NC)*	Early Star-lily	Y			4/12/1996
Xanthorrhoea quadrangulata	Rock Grass-tree	Y			27/03/2002
Zygophyllum aurantiacum (NC)	Shrubby Twinleaf	Y			28/04/1992
Zygophyllum aurantiacum ssp.		Y			8/05/2008
Zygophyllum aurantiacum ssp. *aurantiacum*	Shrubby Twinleaf	Y			30/08/1984
Zygophyllum crenatum	Notched Twinleaf	Y			22/10/1967
Acacia baileyana	Cootamundra Wattle	N			11/07/2002

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			Aus	SA	
Acacia decurrens	Early Black Wattle	N			9/04/1969
Acacia longifolia ssp. longifolia	Sallow Wattle	N			9/04/1969
Acer sp.	Maple	N			14/06/2005
Acetosella vulgaris	Sorrel	N			1/05/2015
Adonis microcarpa	Pheasant's Eye	N			27/10/1970
Agave americana	Century Plant	N			9/12/2009
Agave americana var. (NC)	Century Plant	N			4/06/2002
Agrostis capillaris	Brown-top Bent	N			18971101
Agrostis gigantea	Red-top Bent	N			8/01/1912
Aira caryophyllea	Silvery Hair-grass	N			6/11/1984
Aira cupaniana	Small Hair-grass	N			5/10/2012
Aira elegantissima	Delicate Hair-grass	N			21/10/2012
Allium sp.		N			8/11/2012
Allium triquetrum	Three-cornered Garlic	N			2/10/2014
Allium vineale	Crow Garlic	N			28/05/2002
Aloe arborescens		N			6/08/1988
Aloe sp.	Aloe	N			15/05/2002
Amaranthus caudatus	Love-lies-bleeding	N			14/05/1993
Amaranthus retroflexus	Red-root Amaranth	N			29/02/1992
Amsinckia calycina	Hairy Fiddle-neck	N			12/11/1916
Anagallis arvensis	Pimpernel	N			5/10/2012
Anagallis minima	Chaffweed	N			14/11/1996
Arctotheca calendula	Cape Weed	N			13/05/2015
Artemisia absinthium	Wormwood	N			4/06/2002
Artemisia arborescens	Silver Wormwood	N			19/11/1999
Arundo donax	Giant Reed	N			22/06/2011
Asparagus asparagoides (NC)	Bridal Creeper	N			17/09/2002
Asparagus asparagoides f.		N			28/06/2011
Asparagus asparagoides f. *asparagoides*	Bridal Creeper	N			8/04/2011
Asparagus declinatus		N			28/06/2011
Asphodelus fistulosus	Onion Weed	N			13/04/2015
Asteriscus spinosus	Golden Pallensis	N			16/11/2012
Atriplex prostrata	Creeping Saltbush	N			20/03/1962
Avellinia michelii	Avellinia	N			14/11/1996
Avena barbata	Bearded Oat	N			10/12/2013
Avena fatua	Wild Oat	N			15/11/1996
Avena sativa	Cultivated Oat	N			17/08/1983
Avena sp.	Oat	N			13/05/2015
Bassia scoparia		N			18/03/1995
Brachypodium distachyon	False Brome	N			13/05/2015
Brassica sp.		N			13/01/2004
Brassica tournefortii	Wild Turnip	N			8/05/2015
Briza maxima	Large Quaking-grass	N			13/05/2015
Briza minor	Lesser Quaking-grass	N			23/09/2005

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Bromus alopecuros	Mediterranean Brome	N			11/11/1996
Bromus catharticus	Prairie Grass	N			19/11/1999
Bromus diandrus	Great Brome	N			1/05/2015
Bromus diandrus (NC)	Great Brome	N			21/04/2008
Bromus hordeaceus ssp. *hordeaceus*	Soft Brome	N			8/11/2012
Bromus madritensis	Compact Brome	N			10/12/2013
Bromus rubens	Red Brome	N			29/04/2015
Buglossoides arvensis	Sheepweed	N			29/07/1983
Bupleurum semicompositum	Hare's Ear	N			5/12/1996
Carduus tenuiflorus	Slender Thistle	N			5/10/2012
Carrichtera annua	Ward's Weed	N			28/04/1992
Carthamus lanatus	Saffron Thistle	N			27/04/2015
Catapodium rigidum	Rigid Fescue	N			11/11/1996
Cenchrus clandestinus	Kikuyu	N			8/11/2012
Cenchrus longisetus	Feather-top	N			14/06/2005
Cenchrus longispinus	Spiny Burr-grass	N			15/04/1940
Cenchrus macrourus	African Feather-grass	N			14/06/2005
Cenchrus setaceus	Fountain Grass	N			17/11/1999
Centaurea calcitrapa	Star Thistle	N			8/05/2008
Centaurea melitensis	Malta Thistle	N			13/01/2004
Centaurea solstitialis	St Barnaby's Thistle	N			4/04/2002
Centaurea sp.	Centaury	N			30/09/1993
Centaurium erythraea	Common Centaury	N			1/08/2004
Centaurium maritimum	Sea Centaury	N			26/10/2011
Centaurium sp.	Centaury	N			14/11/1996
Centaurium tenuiflorum	Branched Centaury	N			9/11/2010
Centaurium tenuiflorum (NC)	Branched Centaury	N			10/11/1993
Cerastium glomeratum	Common Mouse-ear Chickweed	N			14/11/1996
Cerastium sp.	Chickweed	N			30/09/1993
Ceratonia siliqua	Carob Tree	N			4/06/2002
Chamaecytisus palmensis	Tree Lucerne	N			1/01/2005
Chamaerops humilis	European Fan Palm	N			26/03/2000
Chenopodium album	Fat Hen	N			28/05/2002
Chenopodium glaucum	Glaucous Goosefoot	N			
Chenopodium murale	Nettle-leaf Goosefoot	N			5/04/2011
Chloris gayana	Rhodes Grass	N			18/03/2014
Chondrilla juncea	Skeleton Weed	N			1/12/2006
Chrysanthemoides monilifera ssp. monilifera	Boneseed	N			9/04/1969
Cirsium vulgare	Spear Thistle	N			5/04/2011
Conringia orientalis	Treacle Mustard	N			1/01/1936
Convolvulus arvensis	Field Bindweed	N			26/11/2002
Conyza bonariensis	Flax-leaf Fleabane	N			21/05/2002
Cotoneaster simonsii	Cotoneaster	N			4/06/2002

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Cotula bipinnata	Ferny Cotula	N			5/10/1992
Crassula tetragona ssp. *robusta*	Crassula	N			22/05/2002
Critesion murinum ssp. (NC)	Barley-grass	N			15/12/2001
Cucumis sp.	Melon	N			24/04/2015
Cydonia oblonga	Quince	N			22/05/2002
Cynara cardunculus ssp. flavescens	Artichoke Thistle	N			8/05/2015
Cynodon dactylon (NC)	Couch	N			14/06/2005
Cynodon dactylon var. *dactylon*	Couch	N			13/04/2015
Cynodon sp.	Couch	N			14/06/2005
Cynosurus echinatus	Rough Dog's-tail Grass	N			5/10/2012
Cyperus rotundus (NC)	Nut-grass	N			9/05/2002
Cyperus tenellus	Tiny Flat-sedge	N			14/11/1996
Cytisus scoparius	English Broom	N			22/05/2002
Cytisus sp.	Broom	N			19/11/1999
Dactylis glomerata	Cocksfoot	N			1/08/2004
Datura stramonium	Common Thorn-apple	N			25/04/1961
Delairea odorata	Cape Ivy	N			22/06/2011
Diplotaxis tenuifolia	Lincoln Weed	N			14/06/2005
Disa bracteata	South African Weed Orchid	N			21/11/2005
Dittrichia graveolens	Stinkweed	N			5/04/2011
Ecballium elaterium	Squirting Cucumber	N			16/04/2001
Echinochloa crus-galli	Common Barnyard Grass	N			28/02/1925
Echium plantagineum	Salvation Jane	N			13/05/2015
Echium sp.	Bugloss	N			27/04/1992
Ehrharta calycina	Perennial Veldt Grass	N			8/04/2011
Ehrharta longiflora	Annual Veldt Grass	N			5/10/2012
Ehrharta sp.	Veldt Grass	N			4/06/2002
Elytrigia repens	Twitch Grass	N			1/12/2006
Eragrostis barrelieri	Pitted Love-grass	N			1/02/2005
Eragrostis cilianensis	Stink Grass	N			21/04/2008
Eragrostis curvula	African Love-grass	N			17/05/2010
Eragrostis minor	Small Stink-grass	N			1/02/2005
Erodium botrys	Long Heron's-bill	N			26/10/2011
Erodium cicutarium	Cut-leaf Heron's-bill	N			1/05/2015
Erodium moschatum	Musky Herons-bill	N			17/09/2002
Eruca sativa	Purple-vein Rocket	N			8/01/1912
Euphorbia maculata	Eyebane	N			26/03/2000
Euphorbia terracina	False Caper	N			22/06/2011
Ficus carica	Edible Fig	N			4/04/2002
Foeniculum vulgare	Fennel	N			8/11/2012
Frankenia pulverulenta	Mediterranean Sea-heath	N			3/12/1993
Fraxinus angustifolia ssp. *angustifolia*	Desert Ash	N			2/10/2014

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Freesia cultivar	Freesia	N			8/04/2011
Fumaria capreolata	White-flower Fumitory	N			22/06/2011
Fumaria officinalis ssp. *officinalis*	Common Fumitory	N			4/12/1993
Fumaria parviflora var. *parviflora*	Small-flower Fumitory	N			2/10/1992
Fumaria sp.	Fumitory	N			30/09/1993
Galenia sp.	Galenia	N			29/04/2015
Galium aparine	Cleavers	N			9/12/2009
Galium divaricatum	Slender Bedstraw	N			4/12/1996
Galium murale	Small Bedstraw	N			19/10/2012
Gastridium phleoides	Nit-grass	N			28/02/1925
Gazania linearis	Gazania	N			13/05/2015
Gazania sp.	Gazania	N			1/08/2004
Genista monspessulana	Montpellier Broom	N			12/08/1999
Geranium dissectum	Cut-leaf Geranium	N			27/10/1993
Geranium molle var. molle	Soft Geranium	N			20/10/1993
Gladiolus undulatus	Wild Gladiolus	N			8/11/2012
Glycyrrhiza glabra	Liquorice	N			9/12/2009
Gomphocarpus cancellatus	Broad-leaf Cotton-bush	N			13/05/2015
Gomphocarpus fruticosus	Narrow-leaf Cotton-bush	N			30/11/1977
Heliotropium supinum	Creeping Heliotrope	N			6/03/1967
Helminthotheca echioides	Ox-tongue	N			1/08/2004
Holcus lanatus	Yorkshire Fog	N			1/08/2004
Hordeum glaucum	Blue Barley-grass	N			19/10/2012
Hordeum leporinum	Wall Barley-grass	N			8/04/2011
Hordeum marinum	Sea Barley-grass	N			8/11/2012
Hordeum sp.		N			29/04/2015
Hyparrhenia hirta	Tambookie Grass	N			12/06/2000
Hypericum perforatum	St John's Wort	N			8/11/2012
Hypochaeris glabra	Smooth Cat's Ear	N			1/05/2015
Hypochaeris radicata	Rough Cat's Ear	N			8/05/2015
Hypochaeris sp.	Cat's Ear	N			10/12/2013
Iris germanica	Flag Iris	N			8/11/2012
Iris germanica (NC)	Flag Iris	N			11/07/2002
Iris sp.	Iris	N			13/01/2004
Isolepis marginata	Little Club-rush	N			15/11/1996
Ixia maculata	Yellow Ixia	N			1/07/1959
Juncus acutus	Sharp Rush	N			13/04/2015
Juncus articulatus	Jointed Rush	N			1/12/1992
Juncus capitatus	Dwarf Rush	N			14/11/1996
Koelreuteria paniculata		N			4/03/2009
Lactuca serriola (NC)	Prickly Lettuce	N			14/06/2005
Lactuca serriola f.		N			8/12/2011
Lactuca serriola f. *integrifolia*	Prickly Lettuce	N			20/01/2000
Lactuca serriola f. *serriola*	Prickly Lettuce	N			8/05/2008

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Lagurus ovatus	Hare's Tail Grass	N			17/11/1999
Lamarckia aurea	Toothbrush Grass	N			4/12/1993
Lamium amplexicaule var. *amplexicaule*	Deadnettle	N			11/11/1996
Lathyrus latifolius	Perennial Pea	N			30/09/1993
Leontodon rhagadioloides	Cretan Weed	N			5/10/2012
Lepidium africanum	Common Peppercress	N			11/05/2015
Lepidium draba	Hoary Cress	N			1/04/1981
Lepidium latifolium	Perennial Peppercress	N			14/06/2005
Lepidium sativum	Garden Cress	N			1/10/1946
Leptospermum laevigatum	Coast Tea-tree	N			12/06/1995
Ligustrum vulgare	European Privet	N			21/05/2002
Limonium companyonis	Sea-lavender	N			5/04/2011
Logfia gallica	Narrow Cudweed	N			24/10/1992
Lolium loliaceum	Stiff Ryegrass	N			11/11/1996
Lolium perenne	Perennial Ryegrass	N			2/10/1992
Lolium perenne X Lolium rigidum	Hybrid Ryegrass	N			27/10/1993
Lolium rigidum	Wimmera Ryegrass	N			19/10/2012
Lolium sp.	Ryegrass	N			13/04/2015
Lycium barbarum	Chinese Boxthorn	N			1/01/2005
Lycium ferocissimum	African Boxthorn	N			13/05/2015
Malcolmia flexuosa		N			18/03/1995
Malus pumila	Apple	N			12/04/2002
Malva parviflora	Small-flower Marshmallow	N			14/06/2005
Malva sp.	Mallow	N			8/05/2015
Marrubium vulgare	Horehound	N			1/05/2015
Medicago minima var. minima	Little Medic	N			5/12/1996
Medicago polymorpha var. polymorpha	Burr-medic	N			5/10/2012
Medicago sp.	Medic	N			15/12/2001
Medicago truncatula	Barrel Medic	N			13/04/2015
Melia azedarach	White Cedar	N			4/04/2002
Melilotus indicus	King Island Melilot	N			2/08/1992
Minuartia mediterranea	Slender Sandwort	N			5/12/1996
Moenchia erecta	Erect Chickweed	N			1/08/2004
Moraea miniata	Two-leaf Cape Tulip	N			25/09/1988
Moraea setifolia	Thread Iris	N			13/05/2015
Moraea vegeta		N			16/10/1962
Neatostema apulum	Hairy Sheepweed	N			19/10/2012
Nicotiana glauca	Tree Tobacco	N			21/10/2012
Not naturalised in SA sp.		N			13/01/2004
Nothoscordum borbonicum		N			3/12/1978
Oenothera glazioviana		N			18/03/1995
Oenothera stricta ssp. *stricta*	Common Evening Primrose	N			26/11/2002

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Olea europaea ssp.	Olive	N			1/05/2015
Olea europaea ssp. *europaea*	Olive	N			19/10/2012
Onopordum acaulon	Horse Thistle	N			4/06/2002
Onopordum illyricum	Illyrian Thistle	N			15/01/1975
Opuntia puberula		N			30/09/2005
Opuntia sp.		N			1/05/2015
Opuntia sp. (NC)	Prickly Pear	N			4/06/2002
Opuntia spp.	Prickly Pear	N			1/01/2010
Opuntia stricta	Erect Prickly Pear	N			9/12/2009
Ornithogalum arabicum	Star Of Africa	N			13/11/1966
Oxalis flava	Finger-leaf Oxalis	N			22/05/2002
Oxalis hirta	Hairy Wood-sorrel	N			21/05/2002
Oxalis pes-caprae	Soursob	N			13/05/2015
Panicum capillare var. *brevifolium*	Witch-grass	N			8/04/2011
Panicum miliaceum	Broom Millet	N			15/06/2005
Papaver hybridum	Rough Poppy	N			13/11/1966
Parapholis incurva	Curly Ryegrass	N			8/11/2012
Parentucellia latifolia	Red Bartsia	N			10/12/2013
Paronychia argentea	Silver Whitlow	N			7/09/1996
Paspalum dilatatum	Paspalum	N			13/01/2004
Paspalum sp.		N			21/05/2002
Pentameris airoides ssp. *airoides*	False Hair-grass	N			24/04/2015
Pentameris pallida	Pussy Tail	N			1/08/2004
Petrorhagia dubia	Velvet Pink	N			1/08/2004
Petrorhagia nanteuilii		N			22/10/1993
Petrorhagia sp.	Pink	N			10/12/2013
Phalaris aquatica	Phalaris	N			8/05/2008
Phalaris minor	Lesser Canary-grass	N			10/12/2001
Phalaris sp.	Canary Grass	N			8/05/2008
Phoenix canariensis	Canary Island Palm	N			9/12/2009
Phoenix dactylifera	Date Palm	N			12/01/2004
Phyla canescens	Lippia	N			21/05/2002
Phyllopodium cordatum		N			14/11/1996
Picnomon acarna	Soldier Thistle	N			11/07/2002
Pinus halepensis	Aleppo Pine	N			22/06/2011
Pinus pinaster	Maritime Pine	N			1/02/1947
Pinus radiata	Radiata Pine	N			8/05/2008
Pinus sp.	Pine	N			13/01/2004
Piptatherum miliaceum	Rice Millet	N			15/04/2015
Plantago bellardii	Hairy Plantain	N			11/12/1996
Plantago coronopus ssp. coronopus	Bucks-horn Plantain	N			26/10/2011
Plantago lanceolata var.	Ribwort	N			5/10/2012

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Plantago lanceolata var. lanceolata	Ribwort	N			14/11/1996
Plantago major	Greater Plantain	N			23/09/2005
Poa bulbosa	Bulbous Meadow-grass	N			11/05/2015
Polycarpon tetraphyllum	Four-leaf Allseed	N			1/08/1906
Polygonum aviculare	Wireweed	N			15/04/2015
Polygonum aviculare (NC)	Wireweed	N			4/06/2002
Polypogon monspeliensis	Annual Beard-grass	N			1/03/1925
Populus sp.	Poplar	N			4/06/2002
Prunus dulcis	Almond	N			11/07/2002
Prunus persica var.	Peach	N			2/04/2002
Prunus sp.	Plum	N			27/11/2002
Psilocaulon granulicaule	Match-head Plant	N			13/04/2015
Psilurus incurvus	Bristle-tail Grass	N			14/11/1996
Puccinellia fasciculata	Borrer's Saltmarsh-grass	N			6/12/1970
Pyrus communis	Pear	N			21/05/2002
Ranunculus muricatus	Pricklefruit Buttercup	N			30/09/1993
Raphanus raphanistrum	Wild Radish	N			12/04/2002
Rapistrum rugosum ssp. *rugosum*	Turnip Weed	N			21/10/2012
Reichardia tingitana	False Sowthistle	N			16/11/2012
Reseda luteola	Wild Mignonette	N			12/04/2002
Ricinus communis	Castor Oil Plant	N			27/03/2002
Romulea minutiflora	Small-flower Onion-grass	N			2/10/2014
Romulea rosea var. australis	Common Onion-grass	N			21/10/2012
Romulea sp.	Onion-grass	N			13/05/2015
Rosa canina	Dog Rose	N			8/05/2015
Rosa rubiginosa	Sweet Briar	N			1/12/2006
Rosa sp.	Wild Rose/Briar	N			15/04/2015
Rosmarinus officinalis	Rosemary	N			22/05/2002
Rostraria cristata	Annual Cat's-tail	N			11/12/1996
Rostraria pumila	Tiny Bristle-grass	N			10/12/2013
Rubus leucostachys	Blackberry	N			10/12/2009
Rubus sp.	Blackberry	N			1/08/2004
Rubus ulmifolius var. *anoplothyrsus*	Thornless Blackberry	N			4/03/2009
Rubus ulmifolius var. *ulmifolius*	Blackberry	N			10/12/2009
Rumex conglomeratus	Clustered Dock	N			8/11/2012
Rumex crispus	Curled Dock	N			14/06/2005
Rumex obtusifolius	Broad-leaf Dock	N			27/04/1992
Salvia verbenaca var.	Wild Sage	N			13/05/2015
Salvia verbenaca var. *verbenaca*	Wild Sage	N			19/10/2012
Sanguisorba minor ssp. *muricata*	Sheep's Burnet	N			19/11/1999
Scabiosa atropurpurea	Pincushion	N			13/05/2015

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Schinus molle	Pepper-tree	N			13/05/2015
Schismus barbatus	Arabian Grass	N			10/12/2013
Sclerochloa dura	Hard Meadow-grass	N			10/11/1995
Secale cereale	Rye	N			18/08/1954
Senecio pterophorus	African Daisy	N			5/10/2012
Setaria verticillata	Whorled Pigeon-grass	N			14/06/2005
Setaria viridis	Green Pigeon-grass	N			26/03/2000
Sherardia arvensis	Field Madder	N			10/11/1993
Silene apetala	Sand Catchfly	N			7/09/1992
Silene gallica var.	French Catchfly	N			29/04/1992
Silene nocturna	Mediterranean Catchfly	N			26/10/2011
Silene sp.	Catchfly	N			10/12/2013
Silene vulgaris	Bladder Campion	N			13/11/1966
Silybum marianum	Variegated Thistle	N			28/05/2002
Sisymbrium erysimoides	Smooth Mustard	N			11/12/1996
Sisymbrium officinale	Hedge Mustard	N			21/03/2001
Sisymbrium sp.	Wild Mustard	N			28/05/2002
Solanum elaeagnifolium	Silver-leaf Nightshade	N			13/04/2015
Solanum marginatum	White-edged Nightshade	N			26/05/1964
Solanum nigrum	Black Nightshade	N			27/04/2015
Solanum physalifolium var. *nitidibaccatum*		N			15/02/1989
Solanum rostratum	Buffalo Burr	N			26/03/2000
Sonchus oleraceus	Common Sow-thistle	N			8/05/2015
Sonchus oleraceus (NC)	Common Sow-thistle	N			15/06/2005
Sorghum halepense	Johnson Grass	N			13/01/2004
Sparaxis sp.	Sparaxis	N			1/12/2006
Sparaxis tricolor	Tricolor Harlequin Flower	N			4/10/1986
Spergula arvensis	Corn Spurrey	N			9/07/1915
Spergularia bocconei	Red Sand-spurrey	N			25/10/1992
Spergularia diandra	Lesser Sand-spurrey	N			26/10/2011
Spergularia rubra	Red Sand-spurrey	N			29/04/1992
Spergularia rubra (NC)	Red Sand-spurrey	N			11/12/1996
Spergularia sp.	Sand-spurrey	N			10/12/2013
Stachys arvensis	Stagger Weed	N			13/11/1966
Stellaria media	Chickweed	N			14/11/1996
Symphyotrichum subulatum	Aster-weed	N			5/04/2011
Tamarix aphylla	Athel Pine	N			15/06/2005
Tamarix aphylla (NC)	Athel Pine	N			21/05/2002
Tamarix ramosissima		N			9/12/2009
Thinopyrum elongatum	Tall Wheat-grass	N			9/05/2002
Thymelaea passerina	Thymelaea	N			4/04/2000
Tragopogon porrifolius	Salsify	N			9/05/2002
Trifolium angustifolium	Narrow-leaf Clover	N			11/05/2015
Trifolium arvense var. *arvense*	Hare's-foot Clover	N			10/12/2013

Scientific name	Common name	Native	Conservation status		Last sighting (year)
			Aus	SA	
Trifolium campestre	Hop Clover	N			10/12/2013
Trifolium fragiferum var.	Strawberry Clover	N			20/10/1992
Trifolium fragiferum var. *fragiferum*	Strawberry Clover	N			19/10/2012
Trifolium glomeratum	Cluster Clover	N			1/12/2006
Trifolium hirtum	Rose Clover	N			1/01/1977
Trifolium scabrum	Rough Clover	N			10/12/2013
Trifolium sp.	Clover	N			13/05/2015
Trifolium subterraneum	Subterranean Clover	N			1/08/2004
Trifolium tomentosum	Woolly Clover	N			12/11/1996
Triticum aestivum	Wheat	N			26/11/2002
Ulex europaeus	Gorse	N			8/11/2012
Verbascum virgatum	Twiggy Mullein	N			28/05/2002
Veronica persica	Persian Speedwell	N			1/08/2004
Vicia sativa ssp.	Common Vetch	N			5/10/2012
Vicia sativa ssp. sativa	Common Vetch	N			1/09/1964
Vicia sp.	Vetch	N			22/12/1987
Vinca major	Blue Periwinkle	N			22/06/2011
Vitis vinifera	Grape Vine	N			27/11/2002
Vulpia bromoides	Squirrel-tail Fescue	N			19/10/2012
Vulpia fasciculata	Sand Fescue	N			14/11/1996
Vulpia muralis	Wall Fescue	N			4/12/1996
Vulpia myuros f.	Fescue	N			19/11/1999
Vulpia myuros f. *megalura*	Fox-tail Fescue	N			21/10/2012
Vulpia myuros f. *myuros*	Rat's-tail Fescue	N			9/11/2010
Vulpia sp.	Fescue	N			15/04/2015
Yucca gloriosa	Yucca	N			4/06/2002
Zaluzianskya divaricata	Spreading Night-phlox	N			1/08/2004
Heliotropium europaeum	Common Heliotrope	?			24/04/2015
Isolepis trachysperma	Grassy Club-rush	?			25/10/1992
Pseudognaphalium luteoalbum	Jersey Cudweed	?			30/09/1993

Conservation status

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level. An asterisk denotes ratings that need to be qualified for a variety of reasons, such as changes to taxonomy or nomenclature since listing or because a species assessed as 'presumed extinct' had to be listed under the Endangered category. Further details are available from the Vascular Plant Metadata document on the DEWNR website.

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Landscape Character and Probable Visual Effect Assessment

Twin Creek Wind Farm Project

RES Australia Pty Ltd

29 June 2017

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REVISION	DATE	AUTHOR(s)	REVIEWER
G	27/06/17	BG/CS/WK	WK
F	22/06/2017	BG/CS/WK	CS
E	18/04/2017	BG/CS/WK	CS/BG
D	20/03/2017	BG/CS/WK	WK
C	05/12/2016	BG/CS/WK	CS
B	11/08/2016	BG/CS/WK	CS
A	15/07/2016	BG/CS/WK	WK

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01 Scope of Assessment

1.0 Scope of Assessment

1.1 Introduction

This report has been prepared by Warwick Keates of WAX Design in association with Dr Brett Grimm of Brett Grimm Landscape Architect for RES Australia Pty Ltd (RES) to assess the potential visual impact of the proposed Twin Creek Wind Farm project (the Project). The aim of this report is to evaluate the existing landscape character, identify the potential viewpoints for the final visual impact assessment and provide a discussion around the degree of visual change that is likely to result from the introduction of the proposed wind farm and associated infrastructure into the existing landscape character of the locality.

The Landscape and Visual Impact Assessment (LVIA) comprises of two separate assessments, a landscape character assessment and a visual impact assessment; these are interrelated processes as described in the Guidelines for Landscape and Visual Impact Assessment[1]. The landscape character assessment described in this report considers the existing character of the landscape and the site locality. The site locality is considered as the areas around the Project from which the wind turbines and associated infrastructure are likely to be visible in the landscape as described in section 1.3 below. The visual impact assessment considers the likely effect of the proposed development on the physical landscape which may give rise to changes in its character and the resultant effects on visual amenity.

The potential visual impact will be assessed using the Grimke matrix methodology that involves on-site assessments, GIS modelling, consultation with relevant stakeholders and interested parties through RES, the preparation of photomontages and a detailed visual impact assessment to illustrate the predicted visual effect of the Project within the defined locality. The visual impact assessment forms the second stage of the LVIA process.

1.2 Project Description

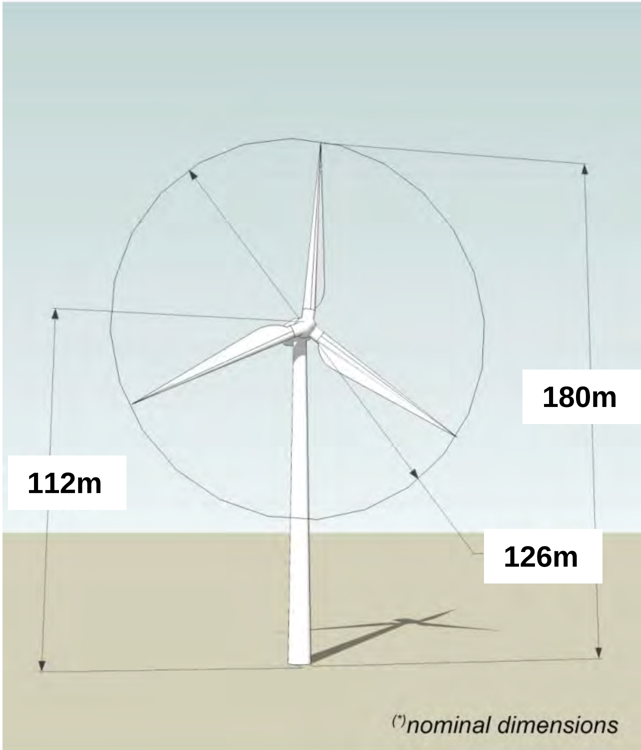
RES Australia Pty Ltd (RES Australia) proposes to develop the Twin Creek Wind Farm within the Mid North area of South Australia. The site of the proposed wind farm is approximately 90km north east of Adelaide and northeast of Kapunda.

RES is one of the world's leading independent renewable energy companies, with the expertise to develop, engineer, construct, finance, and operate projects around the globe. RES Australia has been developing renewable energy projects in Australia since 2004.

The proposed wind farm will consist of the following components:

- Up to 51 Wind Turbines Generators (WTG)
- Each WTG has a capacity up to 3.6 Megawatts (MW), with a total installed wind capacity up to 183MW
- Overall height of turbines would be up to 180 metres at the blade tip
- Associated hard standing areas and access roads
- Operations and maintenance building and compound with associated car parking
- Two electrical substations
- Battery energy storage
- Overhead and underground electrical cable reticulation
- 132kV overhead transmission line
- Meteorological Masts for measuring wind speed and other climatic conditions
- Temporary construction facilities including a borrow pit and concrete batching plant facilities.

1Swanwick, C. (2013). *Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment.*



1.3 Site Locality

A 20km site locality around the project has been defined for assessment purposes and is based on research and previous experience in defining thresholds for scale and identification of visual effect. Most notably the Thomas matrix[2] and Bishop (2002)[3] has provided guidance on this matter. Also, the extent of the site locality has been reviewed against the Zone of Theoretical Visual Influence (ZTVI) mapping. This mapping provides a reference of the extent to which the Project is likely to be visible in the landscape and defines the viewshed resulting from the local topography (excluding vegetation and built form screening).

The landscape character assessment of the proposed wind farm consists of written descriptions and photographic surveys of the surrounding locality to articulate the character of the existing landscape that surrounds the site in relation to the local (0-3km), sub-regional (3-10km) and regional (>10km) landscapes. This is followed by a discussion of the probable visual effect that is anticipated to occur across the regional landscape as well as within the infrastructure corridors associated with the proposed project. The landscape character and visual assessment provide the basis on which to measure the suitability of the development in relation to the visual impact within the regional area (20km) and in regards to the relevant provisions of the development plan.

Recognition of the potential visual impact of a layout design is implicit in the design process. This includes early reference to development plan provisions and relevant guidance reports.

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2Sinclair, G. (2001). *The Potential Visual Impact of Wind Turbines in relation to distance: An approach to the environmental assessment of planning proposals. E.I.Services*

3 Bishop, I. (2003). *Determination of thresholds of visual impact: the case of the wind turbines: Environment and Planning B: Planning and Design: 707-718*

02 Introduction

2.1 Visual Assessment Approach

The aim of the LVIA methodology is to provide an objective, reliable, credible, replicable and measurable analysis of the potential visual impact when considered against the existing landscape character.

The process for the visual assessment is based on the recommendations of John Ginivanand Planning SA (2002)[4] and considers the visual assessment regarding the Primary Landscape Character Assessment and Detailed Visual Effect Assessment (excluding Qualitative Subjective Assessment).

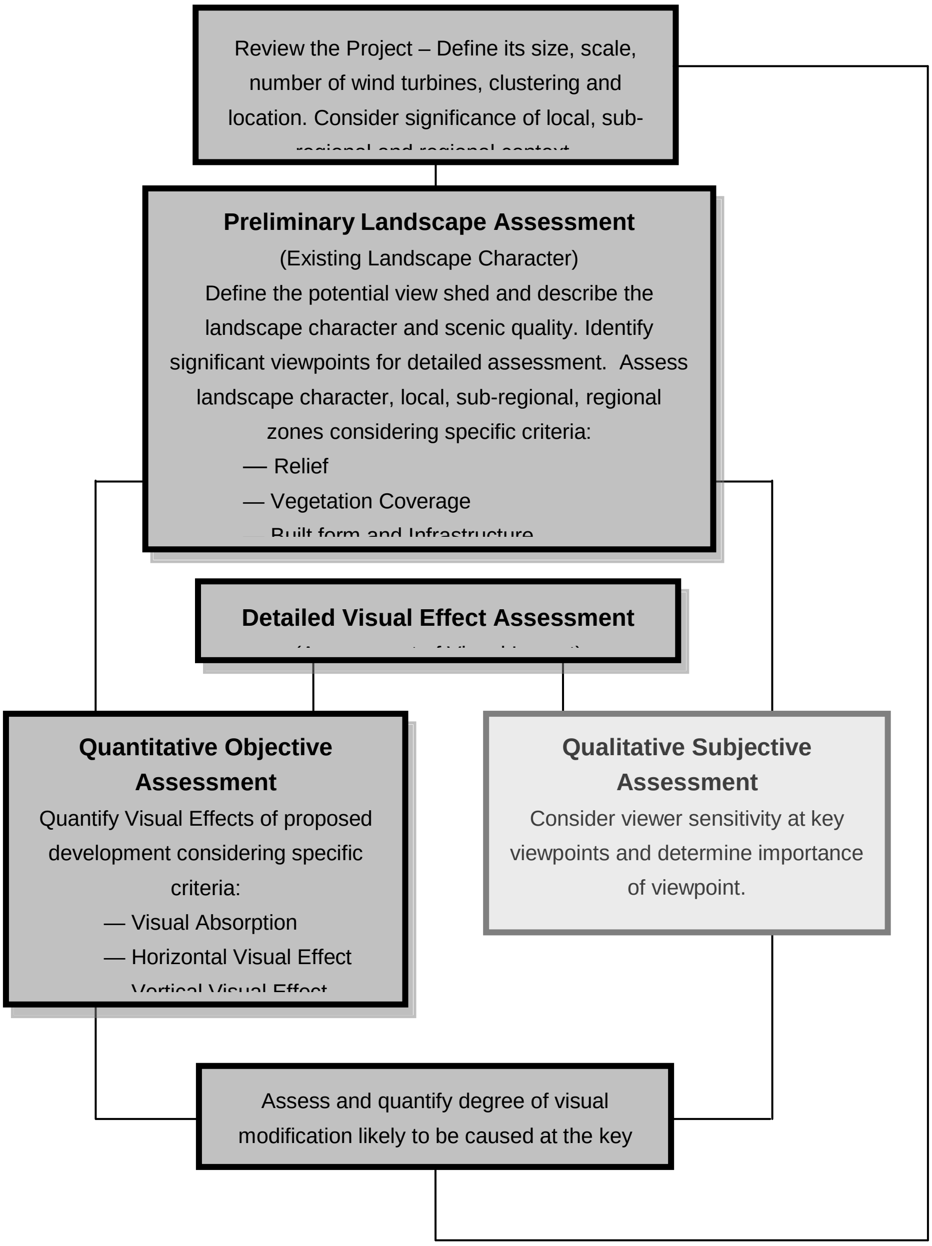

Figure 1: Detailed Visual Assessment Process

[4] *Planning South Australia (2002). Advisory Notice Planning- Draft for Consultation 21 Wind Farms. S.A Adelaide*

2.2 Guidance and Best Practice

Currently, there is no formalised standard visual assessment methodology at local, state or federal government levels. While various guidelines and frameworks have been produced, they do not provide a definitive methodology or technique to be applied. For the visual assessment of the Twin Creek Wind Farm to follow a 'best practice' approach, the assessment methodology has been defined with reference to the following documents:

- Wind Farm Development Guidelines for Developers and Local Government Planners (2014), Central Local Government Region of South Australia5;
- Environment Protection and Heritage Council (2010) National Wind Farm Development Guidelines;
- Siting and Designing Wind Farms in the Landscape (version2)(2014) Scottish Natural Heritage;
- Guidelines for Landscape and Visual Impact Assessment (Third edition) (2013), Landscape Institute;
- Grimm, B (2009). Quantifying the Visual Effects of Wind Farms; A Theoretical Process in an Evolving Australian Visual Landscape. PhD Thesis Adelaide University;
- Australian Wind Energy Association and Australian Council of National Trusts (2007) Wind Farms and Landscape Values: National Assessment Framework;
- Visual Landscape Planning in Western Australia. (2007).A manual for evaluation, assessment, siting and design, Western Australian Planning Commission;
- Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia (2006);
- Lothian, A. (2008). Scenic perceptions of the visual effects of wind farms on South Australian landscapes. Geographical Research, 46:2, 196 – 207;
- Swanwick, C. (2013). Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment;
- Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria (2002);
- South Australian Wind Farms Planning Bulletin (2002); and
- Lothian, A. (2000). Landscape Quality Assessment of South Australia. PhD Thesis Adelaide University.

2.3 Methodology

The approach used for the LVIA is based on two assessment stages with reference to the Guidelines for Landscape and Visual Impact Assessment, and set out in Figure 2.Stage 1; Landscape character assessment is concerned with identifying and assessing the importance of landscape characteristics and the existing landscape quality. Stage 2; The visual assessment aims to quantify the extent to which the development is visible as well as defining the degree of visual change and the associated visual impacts using the Grimke Matrix.

The completed landscape character assessment and visual impact assessment are used to draw a number of conclusions about the magnitude of the visual effects of the proposed development on the site locality.

The LVIA includes two assessment stages and associated tasks as seen in Figure 2. The following table outlines a detailed description of each process conducted within the methodology.

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[5] Source online (2015). http://www.lga.sa.gov.au/webdata/resources/files/2012.32%20-%20Windfarm%20Development%20Guidelines%20-%20Final%20Report.pdf. [Accessed 08 September 2015].

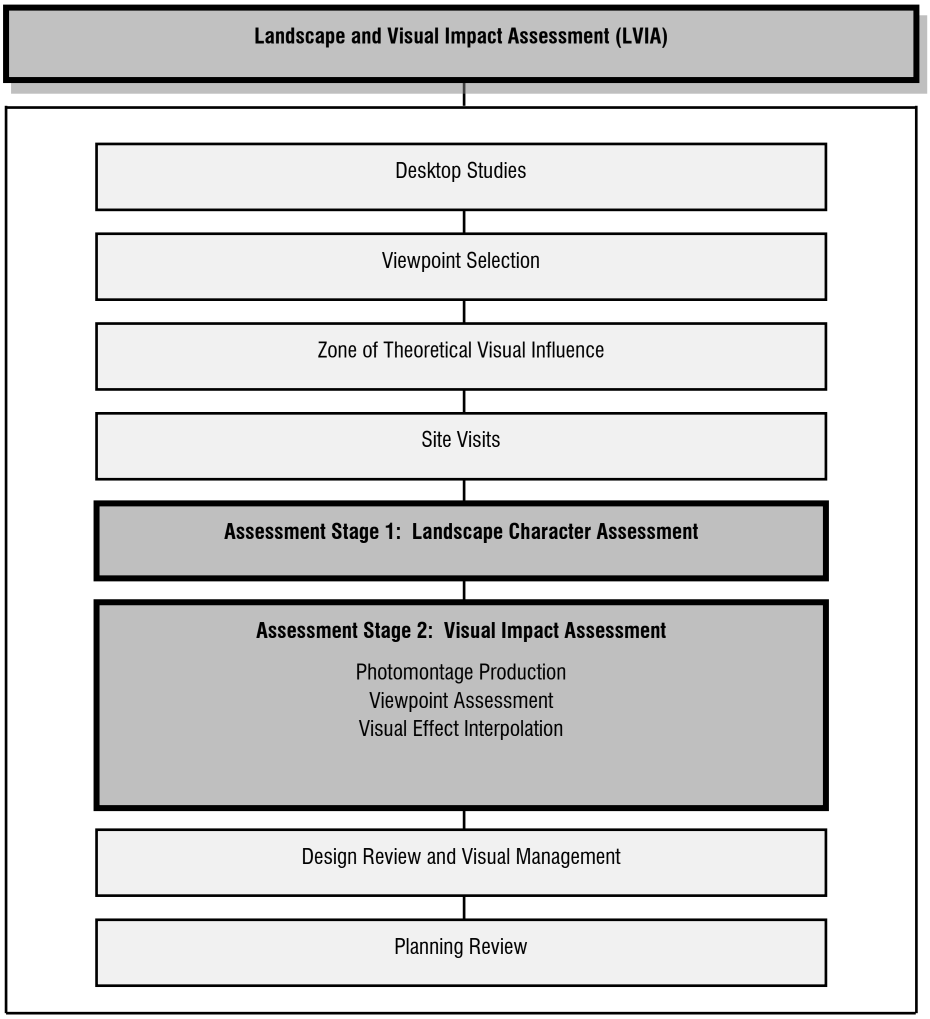

Figure 2: LVIA – Two Assessment Stages and Associated Tasks.

Desktop Studies

The Landscape Character Assessment for the project includes reviews of the project documentation, the proposed development location and infrastructure associated with the proposed development. Analysis of GIS maps, landscape photography, aerial photographs and supporting literature were also reviewed to establish a broad comprehension of the scope of the proposed wind farm and the existing landscape character.

02 Introduction

Viewpoint Selection

Viewpoint selection was conducted by WAX Design and BGLA as part of an initial site visit on the 20th May 2016 and during subsequent desktop analysis. The selection of the viewpoints provides locations from which a detailed visual assessment of the potential visual effect can be made as part of the stage 2 assessment. The locations are also selected on the basis of being representative of the locality, public locations and viewpoints where a large proportion of the wind farm is visible.

A total of seven (7) viewpoints were selected surrounding the project during this site visit to provide an understanding of the likely visual effect.

Viewpoint locations were identified using a preliminary ZTVI map which illustrates the likely degree of visibility in accordance to topography. The site assessment certified the evaluation of the ZTVI with reference to vegetation screening and local landforms not depicted in the ZTVI.

Each viewpoint represents a typical location where the greatest probable degree of visual change that will be experienced as a result of the proposed development within the existing landscape. The seven viewpoints were confirmed by RES, relevant stakeholders and tested during the initial community consultation before the final stage of visual impact assessment.

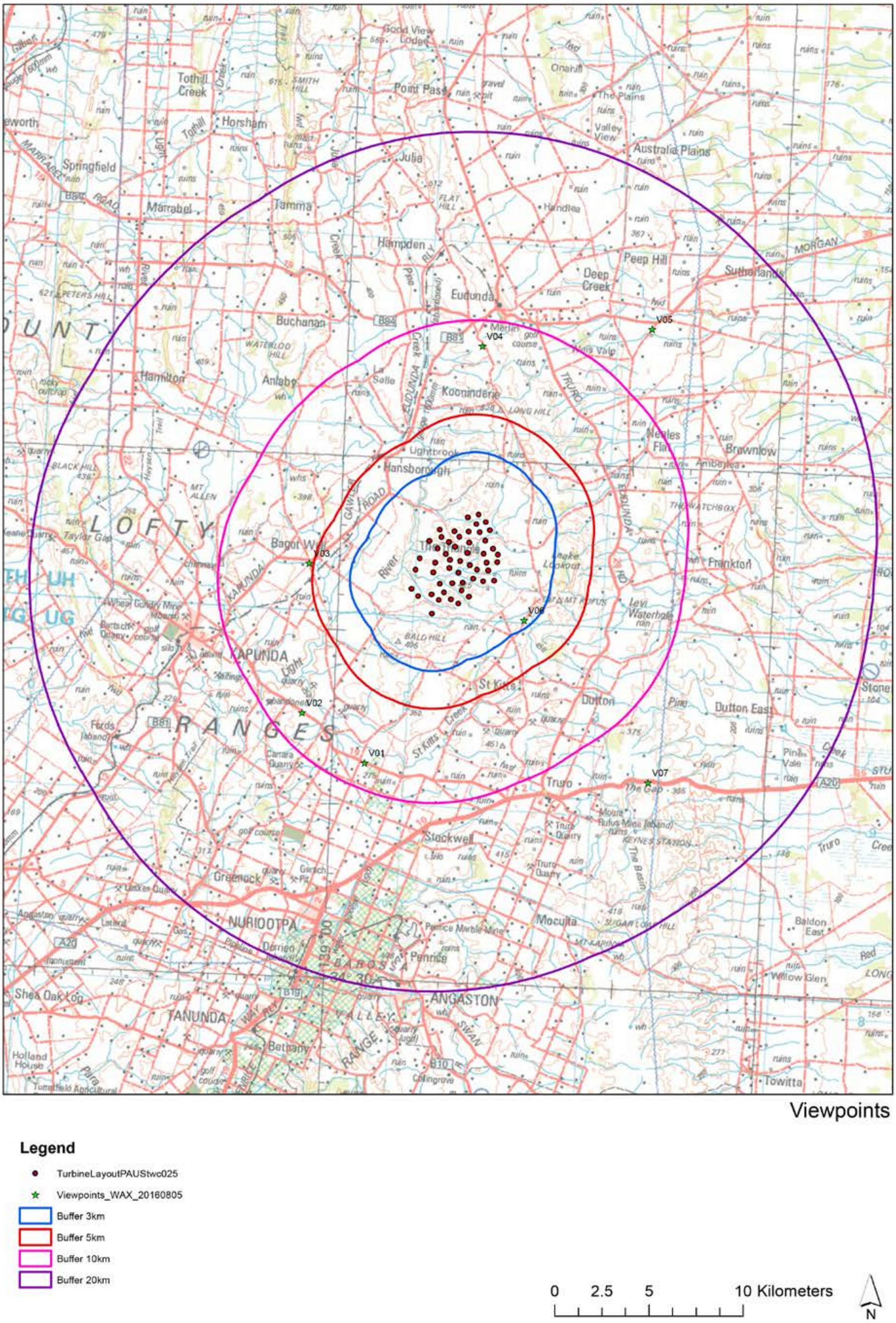

Figure 3: Viewpoint Locations

Zone of Theoretical Visual Influence

In order to gain an appreciation of where the project will be visible from; Zone of Theoretical Visual Influence (ZTVI) maps have been produced. The mapping provides an illustrative depiction of where the development may be seen within the landscape. The maps quantify the extent to which the wind turbines are likely to be seen considering a maximum blade tip height of 180m and hub height of 112m.

The analysis uses a digital terrain model, and computer generated models of the turbines to illustrate how many individual turbines would be visible from any location around the wind farm. It should be noted that the ZTVI does not take into account the impact of local vegetation, buildings or localised landforms as it is based on a 10m contour data set. This means that theoretically, the visual impact of the wind turbines is evaluated within a landscape devoid of any screening vegetation or other features and as such represents a 'worst case' scenario.

Assessment Stage 1: Landscape Character Assessment

The assessment includes identification and description of landscape character units (areas of defined quality determined by topographic form, land use, vegetation association including patterning, colouration and textural relief). In addition, special landscape features are identified. Mapping and photographic surveys are undertaken in addition to written commentary to describe the locality and existing landscape character of the site locality.

As part of the landscape character assessment, the viewpoint selection was confirmed, and the base photography was taken for photomontage production.

The assessment was undertaken on the 20th May 2016to enable the project team to develop a good understanding of the existing landscape character. Weather conditions were predominately overcast and rainy, clearing intermittently.

Assessment Stage 2: Visual Impact Assessment

The assessment of the visual impact includes the production of photomontages to assist in the quantification and qualification of the potential visual effect. The viewpoints identified as part of the preliminary assessment stages were measured using a series of landscape and visual criteria. The assessment results were then mapped to demonstrate the likely visual impact of the project.

The Stage 2 assessment was undertaken on the 8th November 2016 with the site conditions clear with some cloud cover and the visibility was rated as good, extending over several kilometres, throughout the landscape character zone.

Assessment Stage 2: Photomontage Production

Photomontages of the proposed development from each viewpoint were produced by Convergen. The photomontages represent 120 degree horizontal field of view with a 50mm lens digital equivalent photo capture. This has been proven to best represent the human binocular field of view. Details of the methodology used to produce the photomontages are described in Appendix B and represents a best practice approach with reference to 'Photography and photomontage in landscape and visual impact assessment' (2011) Landscape Institute (advice note 01/11). For the purposes of the photomontage production, a neutral off white colour was used to represent the wind turbines. This colour selection was made to reflect the proposed colour of the turbines (RAL 7035, Light Grey) while allowing for variations in local light and environmental conditions.

WAX and BGLA validated the accuracy of the photomontages during a site visit on the 8th November 2016. The combination of a photomontage assessment and an on-site review ensures issues typically associated with photographic simulations such as image compression and distortion are mitigated by assessing and measuring the visual effect in-situ using GPS and a bearing compass.
This enables the photomontages to be ground-truthed for positional correctness and scale. Any minor

distortion to the edge of the 120 degrees provided by the horizontal field extent and 2 dimensional image representations are reflected relatively in the simulated modelling overlay.

The photomontage images were used to inform the detailed viewpoint assessment.

Assessment Stage 2: Viewpoint Impact Assessment

The viewpoint assessment of the project uses a combination of visual assessment measurements and descriptive text. This comprises site observations with reference to prepared photomontages and a detailed assessment of the baseline landscape character and visual impact.

Initially, the baseline landscape character for each viewpoint was assessed regarding:

- Relief (the complexity of the land that exists as part of the underlying landscape character);
- Vegetation Cover (the extent to which vegetation is present and its potential to screen and filter views);
- Infrastructure and Built Form (the impact of development on landscape and visual character); and
- Cultural Sensitivity(existing cultural overlays, planning designations and any identified listing of heritage items and or local sensitivities to landscape such as scenic drives and viewpoints).

A value was generated for the existing landscape relative to each viewpoint. This value formed the baseline assessment value. It is this baseline value that is modified by the impact of the development on the landscape, which in turn informs the degree of visual effect.

Following the landscape character assessment, each viewpoint was then assessed on the following visual effects:

- Percent of landscape absorption (the landscape's ability to absorb and screen the development form);
- Horizontal visual effect (percentage spread of the development in the field of view);
- Vertical visual effect (vertical scale of the development as a percentage of the existing landscape scale within the field of view); and
- Distance of visual effect (distance between viewpoint and development).

The landscape character and visual effect measurements were combined to produce a quantified value for the degree of visual change that resulted from the project at each viewpoint (refer to Appendix E for detailed assessment criteria and matrix methodology).

Assessment Stage 2: Visual Effect Interpolation

The findings of the visual impact assessment for each viewpoint were used to provide a percentage value to the degree of visual change. Each viewpoint was cartographically mapped in GIS, and the values used in a distance weighted interpolation. The ZTVI was overlayed onto the visual effect interpolation map to define the extent of visibility. The combination of Visual Effect Interpolation and ZTVI provided a map of likely visual impact experienced in the site locality as a result of the project. This map provides relativity to the likely experience of visual effect within the regional locality.

Design Review and Visual Management

The evolution of the development proposal has seen iterations to the layout and scope of the project. The original proposal comprised of 60 wind turbines of which 16 have been removed resulting in a wind farm that consists of 51 wind turbines. In addition, several micro-siting changes were made as part of an iterative process due to stakeholder consultation and preliminary site investigations for flora and fauna.

During the Design Review and Visual Management stage an additional visual assessment was undertaken to understand the anticipated visual effect of the proposed infrastructure associated with the wind farm. This included an additional photomontage of viewpoint 6 and 7 to include the proposed infrastructure elements as well as the production of an additional viewpoint that shows the proposed transmission substation. The production of these additional photomontages made a number of assumptions in regards to the final design of the infrastructure elements. It is for this reason that the infrastructure elements of the development and there potential visual effect are assessed in this section and are not incorporated into sections 5.1 to 5.9.

Planning Review

A review of the landscape and visual impacts of the development from a planning context was also undertaken. The planning review included a review of the Light Regional Council Development Plan (Consolidated 8 December 2016), Goyder Council Development Plan (Consolidated 24 November 2016) and the Mid Murray Council Development Plan (24 November 2016 - Integrated Water Management Regional DPA not consolidated into 31 July 2014), the State Wide Landscape Scenic Quality Values report[6] and a research study conducted by Dr Andrew Lothian in addition to research on the visual effects of wind turbines[7].

These documents provided a range of recommendations that influenced the development assessment of the Project proposal. In particular, the potential visual impact of the development has been reviewed and discussed against the relevant desired character statements with specific reference to landscape and visual considerations resulting from the development of the Project.

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6 *Lothian, A. (2000). Landscape Quality Assessment of South Australia. Department of Geographical & Environmental Studies. University of Adelaide. PhD*

7 *Lothian, A. (2008). Scenic Perceptions of the Visual Effects of Wind Farms on South Australian Landscapes. Geographical Research, 46:2, June, 1996-207*

03 Landscape Character Assessment

3.1 The Site Locality

The project (as shown in Figure 5) is located approximately 90 kilometres northeast of Adelaide. The subject land is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges. The site is located between the townships of Kapunda, Eudunda and Truro.

The locality can be defined by four distinct landscape character areas which largely follow the four cardinal directions (north, east, south and west). To the south of the subject land is the Northern Barossa Valley, which has a denser level of development and high quality agricultural landscape with a variety of visual interest created by the smaller lot sizes and a variety of land uses (grazing, vineyards, animal husbandry). The Western Pastoral Lands and Ridgelines stretch along the western edge of the subject locality and is defined by a more open agricultural landscape with rolling ridgelines. The subject locality itself and to the north are the Central Tablelands; these are characterised by rolling landforms and valleys associated with the Northern Mount Lofty Ranges and have a typically open grass grazing land use with minimal vegetation. To the east of the subject locality is Mount Rufus and associated north/south ridgelines which transition further west into the Western Murray River Plains, the ridgeline associated with Mount Rufus forms a distinct division between the subject locality and the Murray River Plains.

Figure 4: View of the land use and land forms typical for the locality

03 Landscape Character Assessment

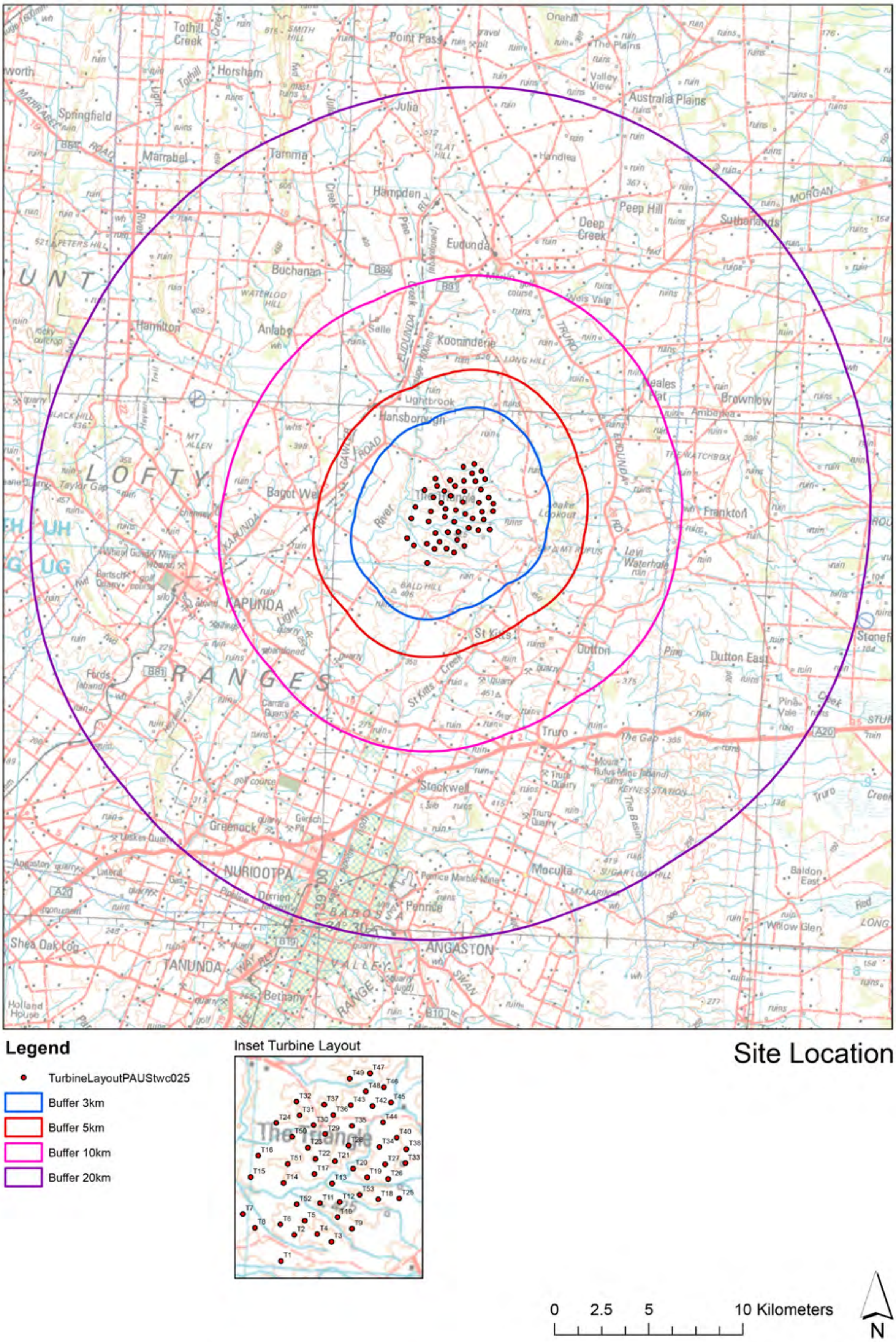

Figure 5: Proposed site location

03 Landscape Character Assessment

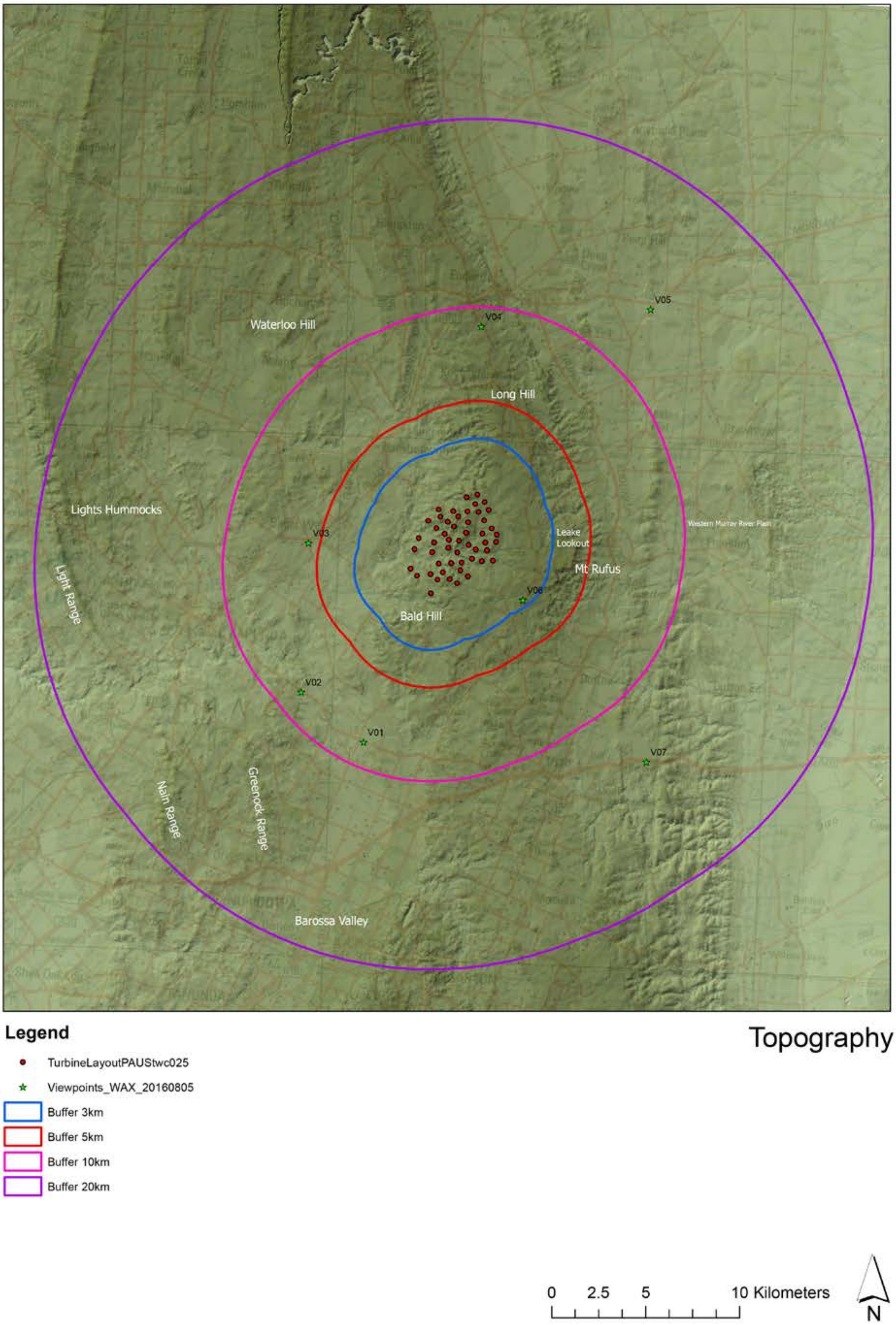

Figure 6: Topographic digital terrain model (10m contours)

3.2 Land Use and Land Cover

The land cover associated with the locality of the development site reflects various agricultural land use including arable and pastoral practices and is consistent across the locality with little variation in scale or function. The landscape surrounding the site is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs on the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse with areas of arable cropping and grazing.

This land cover creates a patchwork character to the landscape with changes in colour and texture as a result of the different agricultural practices. Typically, the land cover and associated vegetation are low lying with limited visual screening to the west, south and north. Areas to the east associated with the Mount Rufus ridgelines and the northern outskirts of Nuriootpa possess more extensive tree cover. Vineyards are a notable visual element creating a defined pattern to the northern outskirts of Nuriootpa emphasising the landscape qualities of the Barossa Valley.

3.3 Landform and Geomorphology

The landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features. The progressive geological faulting and folding processes that have formed the Southern Flinders Ranges and Northern Mount Lofty Ranges dominate the area creating numerous undulating ridges and escarpments.

The site is dominated by the prominent geomorphology of the Light Ranges and northern extent of the Barossa Ranges that create north/south orientated ridgelines. Further south of the project site the ridgelines decrease in height and become more fragmented creating isolated hills and promontories, which produce an elevated undulating landscape.

East is an expansive low lying landscape associated with the Murray Plains. This open landscape character creates distant views east and south east from elevated locations such as Mount Rufus.

To the west are the ridges and valleys formed by the Nain Ranges, Greenock Ranges and Light Ranges which create overlapping north/south landforms of an approximate 100-200m vertical variance to the valleys in between which is typical of the area.

To the north, the geomorphology of the landscape increases in scale and complexity with larger and more widely spaced ridges and valleys, particularly in relation to the Tothill and Scrubby Ranges and the Belalie Plain. These landforms continue in a north/south direction before transitioning into the more dramatic topography of the Southern Flinders Ranges.

3.4 Landscape Character Units

To understand how and to what degree the Project will produce a visual effect in the existing landscape, an assessment to identify landscape character units has been undertaken as is shown in Figure 7. This assessment identified a number of landscape character areas within the site locality that contain similar landscape qualities in relation to land use, topography, vegetation, visual patterning, texture and scale.

The regional landscape context surrounding the project contains five (5) landscape character areas which are;

1. Northern Barossa Valley
2. Western Pastoral Lands and Ridgelines
3. Central Tablelands
4. Mount Rufus Ridgeline
5. Western Murray River Plains

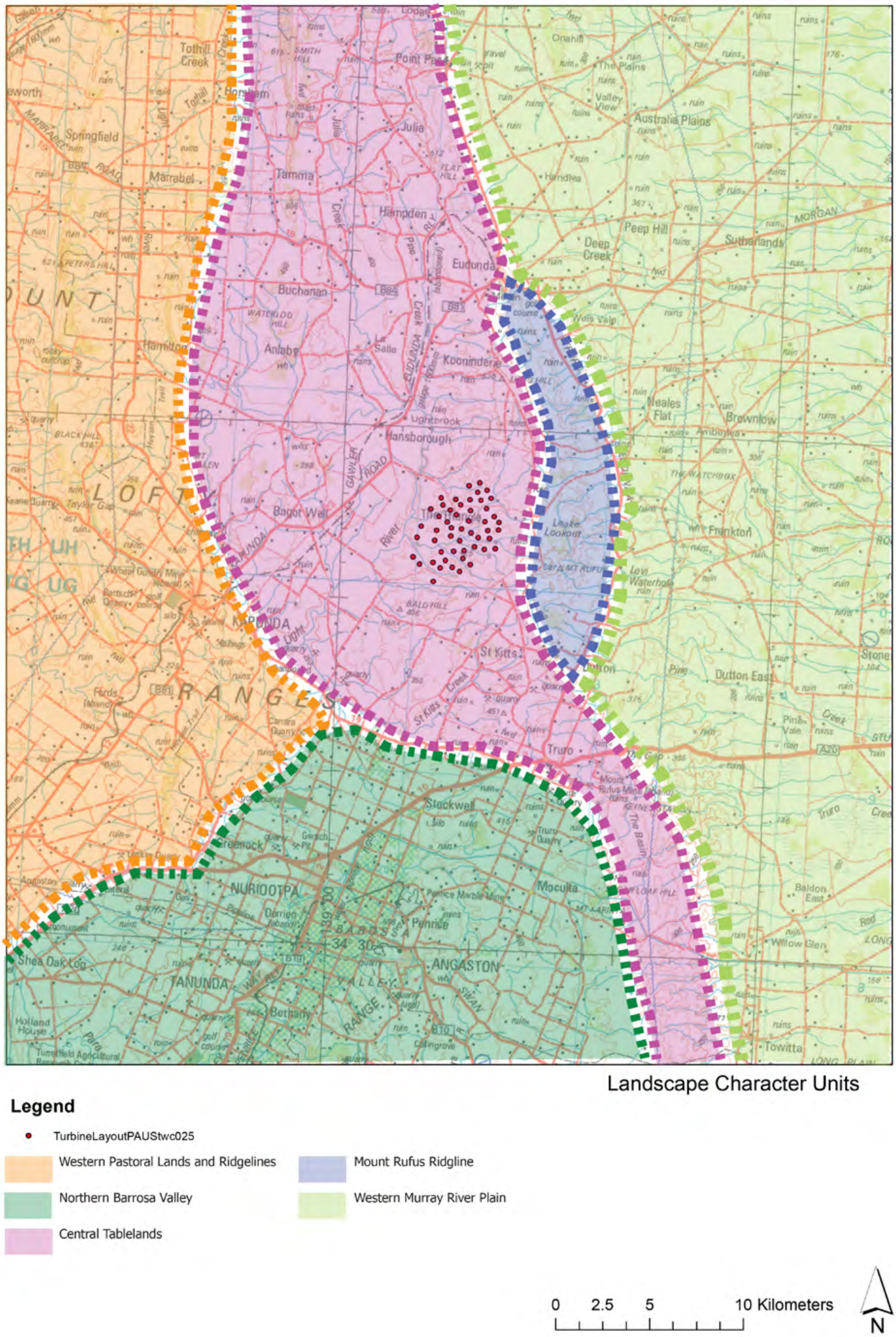

Figure 7: Landscape character units

3.4.1 Northern Barossa Valley

The northern edge of the Barossa Valley forms a defined landscape character south of the proposed wind farm site and is defined by the townships of Nuriootpa, Stockwell and Greenock.

Nuriootpa, with the largest population, demonstrates the more urban nature of these townships which results in a number of commercial and industrial buildings to the outskirts of town and an increased density of residential development in and around the town.

The cadastral overlay of the landscape character reflects the historical 80 acre agricultural pattern creating a defined patchwork of paddocks, vegetated field boundaries and tree groups that cover the gently rolling landscape and topography of the area. The land use is predominantly agricultural including vineyards, grazing, cropping and various areas of animal husbandry interspersed with rural living properties and single story dwellings on large rural land parcels. This combination of topography, large belts of vegetation and land use creates an attractive rural landscape.

The low lying topography of this area creates an open visual character to the north that is framed by vegetation and distant ridgelines to the east and west associated with the Northern Mount Lofty Ranges and Southern Mount Lofty Ranges respectively. Localised embankments and residential development coupled with vegetation along field boundaries restrict the potential for long distance views towards the north.

The northern ridgeline associated with Bald Hill defines the northern edge of the Barossa Valley. The well vegetated landscape character and defined field boundaries of the Barossa is replaced with a rolling grazed landscape with isolated pockets of trees and an absence of fencing or agricultural buildings.

Figure 8: Views north from Wolf Blass winery along Kapunda-Truro Road

Between the township of Nuriootpa and Stockwell, along the Kapunda-Truro Road, is the Wolf Blass winery. This represents a tourist location and illustrates the visual landscape character of this locality. Views from this location are largely screened towards the project site and enclosed by belts of vegetation associated with the existing field patterns. The land cover is predominantly vineyards with rural living and single story development on large land parcels. The existing vegetation consists of large stands of eucalypts across the valley floor and results in a series of dense landscape screens that limit visibility down to 30 metres east and west along the Sturt Highway Road corridor and to a maximum of 100 metres across existing field boundaries. The enclosed visual character means that views to the project site are largely screened or completely removed.

3.4.2 Western Pastoral Lands and Ridgelines

To the west of the proposed project site is a ridgeline associated with the Greenock and Nain Range which creates a defined elevated topographic feature that connects the towns of Greenock and Kapunda. The elevated undulating landscape character around St John's and Koonunga create defined viewpoints with expansive views over significant distances to the north and north-east towards the project site.

The township of Kapunda is located on the south-western edge of the locality. The arrangement of the township in relation to the Greenock Range results in the town being orientated to the western slope of the ranges. The town's orientation results in limited views overlooking the ridgeline to the east towards the proposed wind farm. The alignment of the streets creates an internalised visual character with single story dwellings orientated towards the main street.

Between the townships of Kapunda and Eudunda, and the edge of the Greenock and Nain Ranges is the Waterloo Plain which is defined by low lying rolling hills, grazing and cropping and isolated dwellings or structures associated with agricultural practices. The settlement pattern of the plain is larger than the Northern Barossa Valley with a more uniform land use creating less visual contrast within the landscape.

Along the southern section of the Kapunda-Morgan Road the local topography and tree groups along the roadside screen the subject land allowing only glimpsed views. Further north towards Eudunda the topography provides more panoramic views of the Project Site, particularly between the Kapunda-Morgan Road and Bagot Well Road.

Further to the west, the visual character of the locality is contained by the ridgeline associated with the Greenock, Light and Nain Range. The Heysen Trail traverses this portion of the Northern Mount Lofty Ranges. However the distance from the proposed development which is approximately 15 kilometres away, local landforms, vegetative cover and positioning of the trail restricts views of the project site.

Figure 9: Enclosed views in the township of Kapunda

3.4.3 Central Tablelands

The landscape character associated with the locality immediately surrounding the proposed wind farm development is defined by numerous undulating landforms forming a broad raised tableland that extends between Bald Hill, at the northern edge of the Barossa Valley, north towards Eudunda. The undulating landforms rise approximately twenty to thirty metres in elevation above the underlying valley plain creating a visual complexity of prominent landforms and wide gullies. The land cover is defined by an open grazed field pattern which is almost completely devoid of vegetation except for isolated trees to some tree groups in parts of the landscape.

The elevated landforms have defined rolling escarpments that create topographic screens reducing views to other areas. This is particularly prevalent along Camel Road and from a number of properties located within the area.

Figure 10: The Central Tablelands looking east along Twin Creek Road

To the north, the landscape character is defined by a series of north-south ridgelines with wider valleys. These include the ridgeline that is defined by Long Hill to the east and Waterloo Hill to the west. The interaction of the ridgelines, undulating landscape forms and wide valleys create a visually complex landscape character. The increased topographic complexity results in a degree of visual fragmentation towards the proposed wind farm. Screening occurs as a result of the interaction of local landforms and the alignment of the road corridors and fields that traverse the landscape.

The township of Eudunda is orientated in an east-west direction across the topography of the Southern Mount Lofty escarpment which defines the edge of Murray Plains to the east. The defined orientation of the town and local ridgelines particularly to the west and south limit views from within the town and provide a degree of visual enclosure. The ZTVI mapping indicates that the township is contained within a defined viewshed and that the visual impact associated with the proposed development will not be experienced within the township or from surrounding residential areas.

3.4.4 Mount Rufus Ridgeline

The Truro Road defines the eastern landscape character zone that runs for the full extent of the locality, extending from Eudunda south towards Dutton and Truro. The landscape character to the north/east of the proposed development site is defined by widely separated north/south ridgelines. The separated ridgelines and wide valley form an enclosed visual character with views contained by local topography and features associated with the valley floor. The land cover to the lower lying area of the ridgeline is typical of the locality with grazing and cropping practices occurring across the landscape.

Figure 11: Views east to Mt Rufus ridgeline

The prominent ridgeline formed by Long Hill and Mount Rufus is associated with the edge of the Murray Plains to the east. There are defined areas of vegetation associated with creek lines, field boundaries and remnant vegetation groups clustered around rocky outcrops that occur to the edge of the ridgelines. Dense vegetation occupies land surrounding Leake Lookout and Mt Rufus providing visual amenity and an enclosed landscape character.

The Federation Lavender Trail runs north/south between Truro and Eudunda; the trail is located predominately through farmland and away from the main roadways. The majority of the trail runs along the eastern side of the Mount Rufus ridgelines ensuring that the topography, local landforms and vegetative cover restrict the view of the proposed wind farm for most of the trail within the locality. The Leake lookout (not accessible by public road) is a stopping point along this trail, it has not been considered in this assessment, however the lookout and the Lavender trail is considered to be consistent with the relativity of visual experience depicted in the interpolation mapping.

The township of Truro is located to the south east along the Truro Road. The township is defined by the east-west orientation of the main street that runs through the centre of the town. The settlement pattern and built form creates a series of low rise buildings that face onto the road alignment. The topographic form on which the town is located creates a defined valley form with views to the surrounding areas contained by local ridgelines, belts of vegetation and isolated dwellings as well as rural buildings.

The underlying topography of the town is interrelated to the Mt Rufus Ridgeline and the Central Tablelands landscape providing a transitional landscape with localised rolling ridgelines limiting distant views. The visual containment of the town extends for several hundred metres north and south from the main street road corridor and for similar distances east-west along the corridor itself.

3.4.5 Western Murray River Plains

Further to the east the topography of the landscape diminishes significantly and extends across the Murray Plains east towards the Murray River. The portion of the Murray Plains that is included as part of this landscape character unit is the western edge of the Murray Plains. The low lying landscape character of the Plains allows expansive views to the east over significant distances with limited variation in topography. The landscape is defined by the rural agricultural landscape typical of the area with small clusters of vegetation associated with field boundaries and creek lines within the landscape.

Figure 12: Views east looking over the Murray Plains

04 Zone of Theoretical Visual Influence

04 Zone of Theoretical Visual Influence

4.1 Zone of Theoretical Visual Influence (ZTVI)

The Zone of Theoretical Visual Influence (ZTVI) mapping provides an illustration of where the proposed wind farm may be seen within the landscape. The mapping quantifies the extent and number of wind turbines which are likely to be seen within the wider landscape.

The ZTVI mapping is developed in GIS using 10m contour data that has been provided for a 20km radius of the project site. The ZTVI represents a ‘worst case’ scenario as it does not incorporate vegetation, built form or localised screening effects, which are assessed onsite.

Two ZTVIs were produced. One map is based on the entire wind turbine using a blade tip height of 180 metres. The second was based on wind turbine hub height of 112 metres. Both maps demonstrate the higher potential impact on the western side of the project site and the reduced potential visual impact to the east due to the Bald Hill and Mount Rufus ridgeline.

The on site assessment of the existing landscape indicates that there is substantial tree canopy structure to the south surrounding the northern outskirts of the Barossa Valley (Nuriootpa). This vegetation limits and in some cases removes the extensive views to the north that are indicated in the ZTVI mapping.

04 Zone of Theoretical Visual Influence

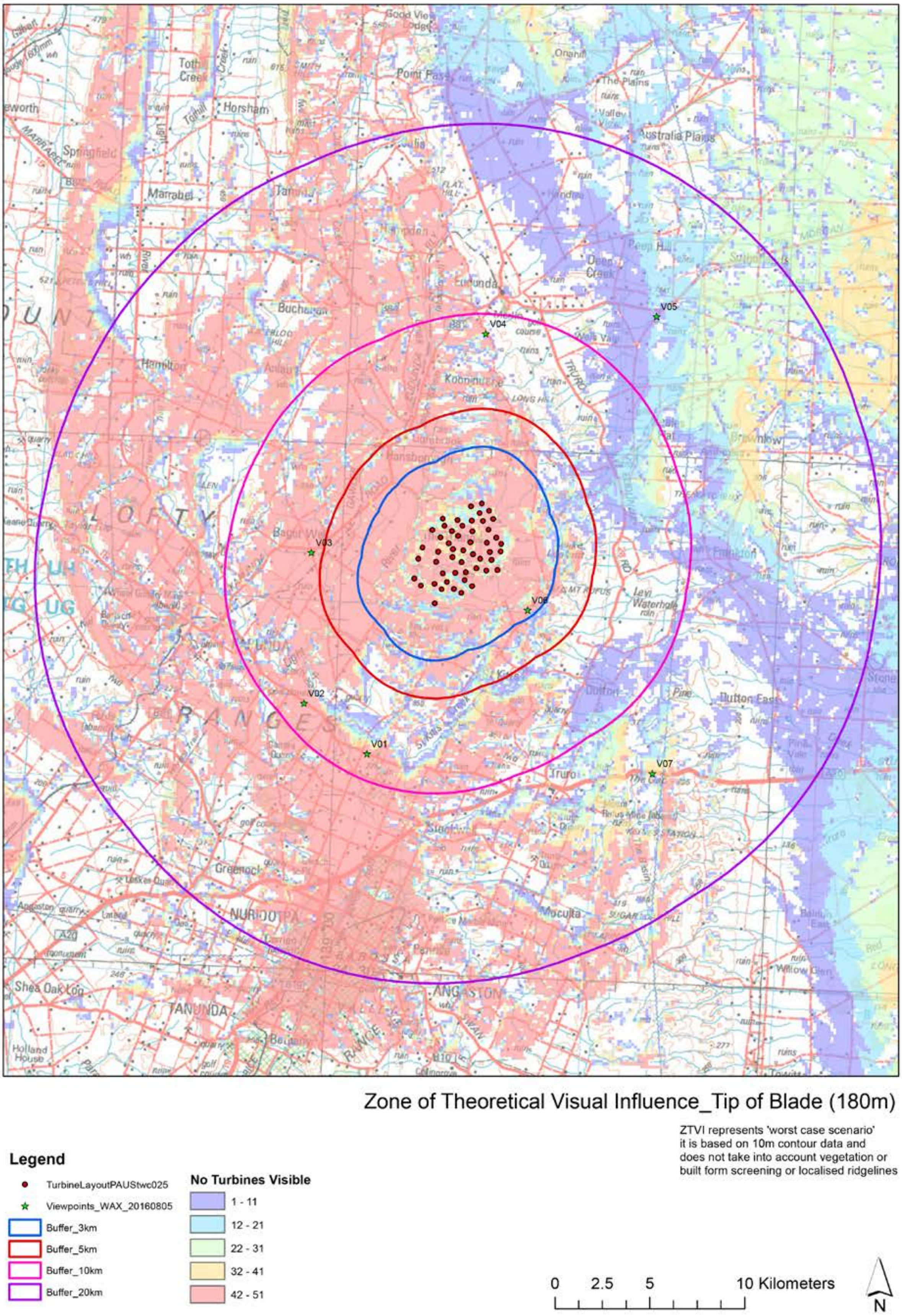

Figure 13: ZTVI map for the Twin Creek Wind Farm based on 180 metre turbine height

04 Zone of Theoretical Visual Influence

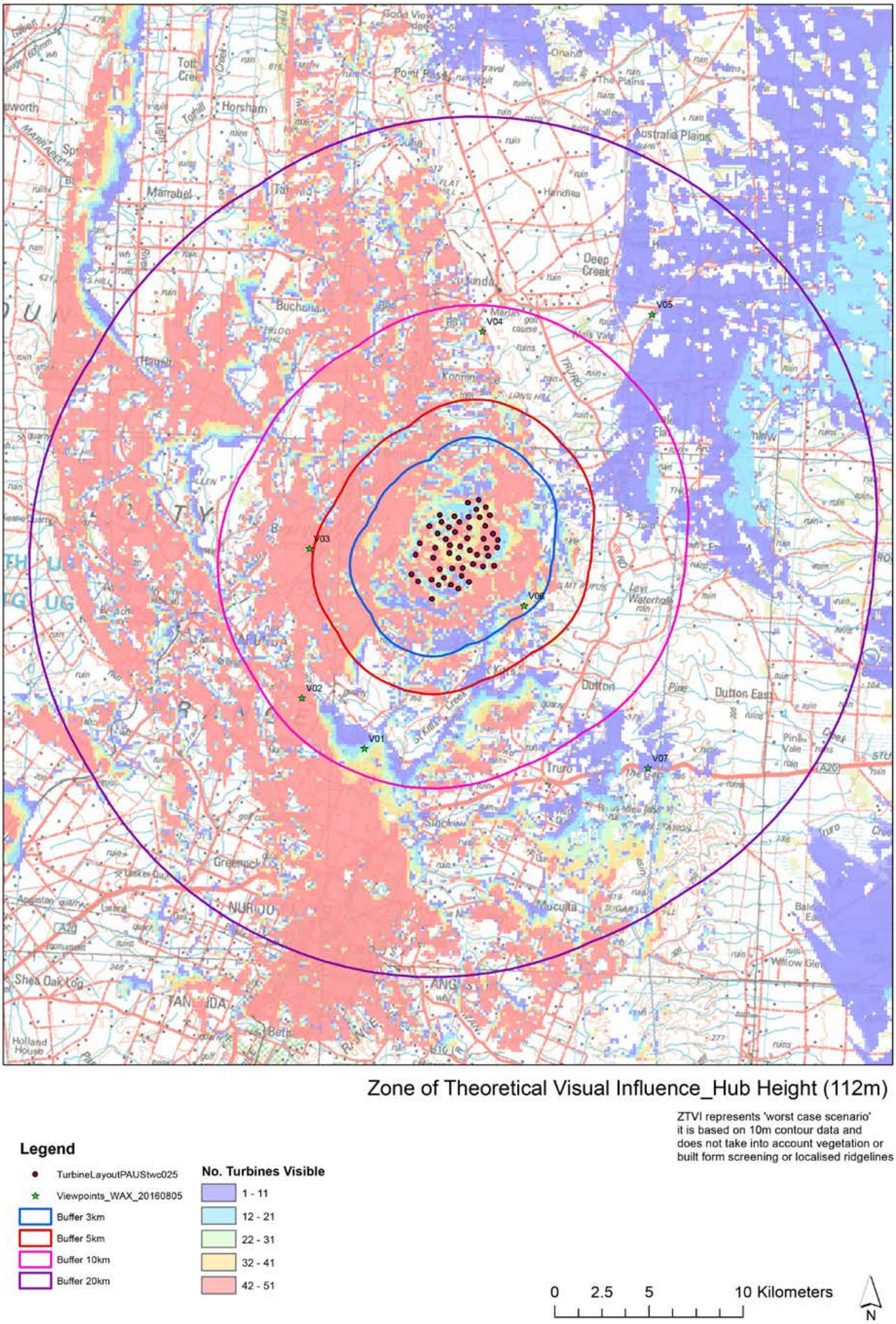

Figure 14: ZTVI map for the Twin Creek Wind Farm based on 112 metre turbine hub height

05 Visual Impact Assessment

5.1 Visual Assessment Scope

The visual impact assessment was based on 51 wind turbines and the site locality as described in the landscape character assessment to a radius of 20km of the proposed development.

The visual impact assessment considered key aspects of the existing landscape such as relief, vegetation, built form and infrastructure; as well as cultural and scenic landscape values from each of the seven selected viewpoints. These key aspects from each viewpoint were scored out of 5 to produce an assessment value out of 20. This enabled a baseline landscape value to be calculated from which the visual impact was measured in relation to the degree of visual change likely to occur as a result of the introduction of the proposed development into the existing landscape character.

The visual effect was assessed using a set of criteria that considered factors such as the degree of landscape absorption, horizontal and vertical effects and distance to the development from each viewpoint.

The visual effect was then expressed as a coefficient and applied to the baseline landscape value to produce a measurement of the likely degree of visual change, that is to say, the extent to which the Project is predicted to alter the existing landscape.

5.2 Visual Impact Assessment

Using the visual assessment matrix as described in Appendix E, the potential degree of visual change and resulting visual impact of each viewpoint was measured and evaluated against the following criteria:

- Baseline Landscape Value is expressed as a value between 4 and 20;
- Visual Assessment Value is expressed as a value between 4 and 20;
- Coefficient of Visual Impact is calculated as decimal fraction of the visual assessment value;
- Relative Value of Visual Impact is calculated as the baseline landscape character multiplied by the coefficient; and
- Degree of Visual Change is expressed as the visual impact divided by the landscape character assessment range represented as a percentage.

The visual assessment also includes a description of the viewpoint context in relation the landscape character that surrounds the viewpoint and the potential visual impact. This assessment is supported by photomontages of the development and wireframe illustrations of the relative wind turbine positions.

For clarity and legibility of the report all reference images, maps and photomontages have been extracted to Appendix A, C and D and reproduced at A3 to enable them to be studied while reviewing the associated text for each viewpoint.

The viewpoints selected for the visual impact assessment as shown in Table 1 are:

VP01	Kapunda-Truro Road, Ebenezer (north - regional)
VP02	Kaunda-Truro Road, Koonunga (northeast - regional)
VP03	Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well (east – sub-regional)
VP04	Tablelands Road, south of Eudunda (south – regional)
VP05	Von Reiben Road, east of Eudunda (southwest – regional)
VP06	Tablelands Road, south of Mount Rufus (west - regional)
VP07	Sturt Highway, east of Truro (northwest - regional)

Ref.	Viewpoint	Longitude	Latitude	Distance to nearest WTG	View Direction
VP01	Kapunda-Truro Road, Ebenezer	317919	6192096	8.41km	25º
VP02	Kaunda-Truro Road, Koonunga	314453	6194570	8.62km	40º
VP03	Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well	314383	6202506	5.22km	85º
VP04	Tablelands Road, south of Eudunda	322870	6214541	8.9km	180º
VP05	Von Reiben Road, east of Eudunda	331788	6215965	13.3km	220º
VP06	Tablelands Road, south of Mount Rufus	325931	6200154	2.64km	300º
VP07	Sturt Highway, east of Truro	332988	6191953	13.6km	310º

Table 1: Summary of Viewpoint location information

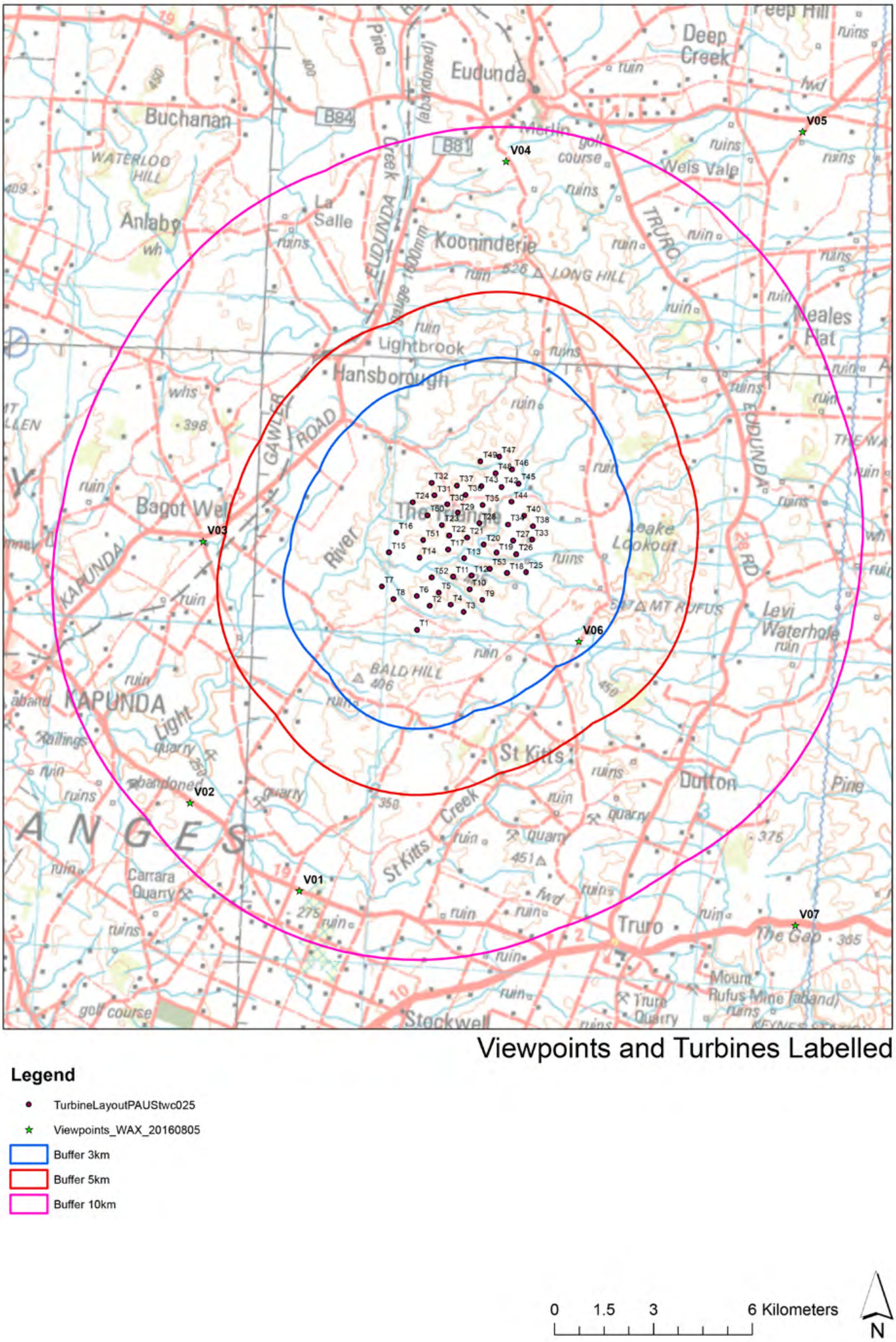

Figure 15: Viewpoint locations and Wind Turbine numbers

5.2 Viewpoint 1: Kapunda-Truro Road, Ebenezer

Viewpoint Context

Viewpoint 1 is located on the southern edge of the proposed wind farm along the east-west orientated Kapunda-Truro Road close to the intersection with Belvedere Road. This road corridor is the closest sealed and frequently travelled road south of the Project Site. Viewpoint 1 is located 1 kilometre away from the Yatara Farm which is State Heritage listed. The viewpoint is typical of the landscape character of the northern Barossa Valley and represents the probable visual effect that will be experienced within this locality.

The low-lying valley floor supports a mixture of arable practices, grazing and vineyards which are typical of this locality. This productive landscape includes a range of farms buildings and ancillary structures scattered through the landscape associated with the predominately agricultural land use. Extensive belts of vegetation provide localised landscape amenity, and the rising landform of the Greenhill Ranges provides a degree of visual enclosure within the locality. The ridgelines associated with Bald Hill and St Kitts form a visual envelope and viewshed to the north of the view point.

Figure 16: Viewpoint 1: Kapunda-Truro Road, Ebenezer

Figure 17: Digital Overlay showing all Turbines: Viewpoint 1

Figure 18: Absorption Capacity Calculations: Viewpoint 1

Viewpoint Assessment

Assessment	Value	Description
Relief	2	Negligible local foreground variation with limited to moderate subregional to regional background topographic form
Vegetation Coverage	3	Sporadic foreground vegetation of mature scale that enhances the landscape qualities
Infrastructure and Built Form	5	Limited development form, primarily a rural agricultural landscape
Cultural and Landscape Value	3	On the fringe of the northern Barossa Valley hence has an increased level of association to the cultural vineyard landscapes.
Baseline Landscape	**13**	
Landscape Absorption	**2**	The ridgeline and mature vegetation coverage to the north provide 65% screening which is a moderate to substantial degree limiting the degree of the development seen from this location
Horizontal	**2**	The extent of horizontal effect is recorded as 24 degrees which equate to 20 % of the field of view
Vertical	**3**	Moderate visual effect of 49% vertical effect. This is created by the maximum tip of blade elevation 610m (Turbine 4) from this viewpoint with landscape scale of 400m.
Distance	**1**	The closest turbine is turbine 1 which is 8.6km to the north
Visual Effect	**8**	
Coefficient	**0.4**	
Degree of Visual Change	**26%**	13x0.4= 5.2 Landscape visual effect 5.2/20= Degree of visual change

Description of potential visual impact

The local ridgelines associated with Bald Hill and St Kitts provide a visual screen behind which the proposed development is located. The majority of the turbines will be completely screened from the viewpoint as well as the wider locality reinforcing the visual separation that will be provided due to the landform and vegetation to the northern edge of the Barossa Valley.

The probable visual effect occurs due to the visibility of the blade rotation behind the ridgeline as well as the visual effect associated with a number of more elevated turbines particularly wind turbines 1, 2, 3, 4, 5 and 9 which result from the nacelle and hub being visible as well as the blades.

The wind turbines are collectively seen as a single visual element due to the densely clustered layout of the wind farm. The visual effect is limited due to the partial screen by the foreground to midground topography.

The combination of wind turbine layout and local topography results in the proposed development producing a single dynamic visual element located along a portion of the ridgeline that marks the northern extent of the Barossa Valley landscape unit.

5.3 Viewpoint 2: Kaunda-Truro Road, Koonunga

Viewpoint Context

Viewpoint 2 is located to the south-west of the proposed development along the Kapunda-Truro Road on the rise of a local ridgeline. The viewpoint location is typical of the transitioning landscape between the edge of the northern Barossa Valley and the western pastoral lands and ridgelines. This viewpoint represents the visual effect that may be experienced by visitors and from dwellings to the south-west of the proposed development, particularly from elevated properties along Brewery Road and to the eastern edge of Kapunda.

The elevation of the viewpoint provides panoramic views with the tablelands on which the wind farm is located forming a distinct viewshed and horizon line to the locality. The progressive agricultural development of the locality has resulted in a cleared landscape with little vegetation to the ridgelines. The open field boundaries and absence of tree coverage is typical to landscape areas to the north-east.

Isolated tree groups exist to the low lying areas around the tablelands and increase in intensity to the south as a result of the landscape character associated with the Barossa Valley. Further to the north are a series of defined ridgelines that mark the Northern Mount Lofty Ranges and the elevated parallel ridgelines that are typical throughout the mid- north. The open landscape character, distant ridgelines and vegetative qualities of the northern edge of the Barossa Valley provide a degree of visual amenity across the landscape.

Figure 19: Viewpoint 2; Kapunda-Truro Road, Koonunga

Figure 20: Digital Overlay showing all Turbines: Viewpoint 2

Figure 21: Absorption Capacity Calculations: Viewpoint 2

Viewpoint Assessment

Assessment	Value	Description
Relief	3	Limited local foreground variation with limited to moderate subregional to regional background topographic form
Vegetation Coverage	2	More scattered vegetation surrounding properties. The view is comprised largely by low lying crops
Infrastructure and Built Form	4	Visual presence of a borrowed pit (disused quarry) and man -made dams within the landscape
Cultural and Landscape Value	2	Tablelands landscape character has local cultural values for its scenic qualities
Baseline Landscape	**11**	
Landscape Absorption	**5**	Limited landscape absorption due to the elevated viewpoint and limited vegetation screening (19% absorption capacity)
Horizontal	**1**	The horizontal visual effect is created by turbines 25 and 24 which equates to 18 degrees or 15% of the horizontal field of view.
Vertical	**5**	The vertical visual effect is considered substantial due to the scale of the turbines being 98% increase in proportion to the existing landscape vertical scale
Distance	**1**	Turbine 1 is the closest turbine at a distance of 8.7km
Visual Effect	**12**	
Coefficient	**0.6**	12/20=
Degree of Visual Change	**33%**	11x0.6= 6.6 Landscape visual effect 6.6/20= Degree of visual change

Description of potential visual impact

The proposed wind farm will form a defined cluster of large infrastructure elements visible on the ridgeline. It is anticipated that the layout of the wind farm will result in a series of prominent vertical elements extending above the ridgeline. The elevated location of the viewpoint results in an increased visibility of the proposed development which is representative of the worst case visual effect experienced within this locality.

The uniformity of the layout and typical 400 - 500m spacing limits the visual impact and prominence of individual turbines. The entire wind farm is seen as a collection of large vertical infrastructure elements resulting in a compact visual effect within the wider panoramic character of the landscape. The location of wind turbines 1 to 15 produce a degree of increased visual prominence due to their relative proximity to the viewpoint. However; the majority of turbines are seen with a similar degree of visual effect within the landscape resulting in a condensed linear cluster of visual change within the landscape.

5.4 Viewpoint 3: Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well

Viewpoint Context

Viewpoint 3 is located to the western side of the proposed development at the intersection of Bagot Well Road and the Kapunda-Eudunda Road (Thiele Highway). The viewpoint is located adjacent to the Old School House which is local heritage listed. The viewpoint represents the landscape character of the central tablelands and the typical landscape associated with the eastern edge of Greenock Ranges and the lower lying undulating landscape between the ranges and tablelands.

This viewpoint represents the anticipated visual effect experienced from the northern outskirts of Kapunda as well as the Kapunda-Eudunda Road and from elevated residential properties to the south-western side of the wind farm.

The land cover transitions from the dense field boundary and vegetated character of the Barossa Valley in the south-east to an open pastoral landscape with larger fields used for grazing and some arable cropping. The belts of vegetation that exist across the low lying areas create a more defined vegetation pattern that follows the field boundaries and creek lines. The elevation of the ridgeline and escarpment formed by the local topography associated with Mount Rufus is largely devoid of vegetation and forms a defined viewshed.

The topography of the tablelands encloses the visual character particularly to the lower lying landscape areas along the road corridor. The layered hills and hummocks associated with the tablelands form a complex terrain with numerous ridges and prominent topographic forms as well as shallow gullies. The diversity of visual character is reinforced by the colouration of the land cover as well as the temporal light qualities of the escarpment which creates an additional degree of visual interest.

Figure 22: Viewpoint 3; Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well

Figure 23: Digital Overlay showing all Turbines: Viewpoint 3

Figure 24: Absorption Capacity Calculations: Viewpoint 3

Viewpoint Assessment

Assessment	Value	Description
Relief	3	Negligible foreground topographic variation with moderate subregional to regional background elevated punctuated forms
Vegetation Coverage	3	Sporadic mature vegetation following creek lines and cadastral boundaries to the foreground which frames views
Infrastructure and Built Form	4	Scattered farm dwellings that are typically isolated from view by vegetation and not of a scale to deter from the underlying agricultural land use.
Cultural and Landscape Value	2	Central Tablelands landscape with transient views along the Kapunda-Truro Road which is a major arterial road between townships
Baseline Landscape	**12**	
Landscape Absorption	**5**	The elevated location of the turbines on the leading edge of the sub-regional ridgeline with limited foreground topography and vegetation means that the landscape has limited capacity to absorb the visual effect from this viewpoint
Horizontal	**3**	The horizontal visual effect is created by turbines 1 and 49 which equates to 40 degrees or 33% of the horizontal field of view.
Vertical	**5**	The low lying nature of the existing landscape with limited to moderate topographic scale to the ridgeline associated to Mt Rufus is

		disproportionate to the visual scale of the turbines. The vertical scale of the turbines increase the vertical scale by more than 100%
Distance	3	Turbine 7 is the closest turbine at a distance of 5.6km
Visual Effect	**16**	
Coefficient	**0.8**	16/20=
Degree of Visual Change	**48%**	12x0.8= Landscape visual effect 9.6/20= Degree of visual change

Description of potential visual impact

The uniform layout will create a defined visual effect resulting in a continuous cluster of vertical infrastructure located within the landscape. The interrelationship of the local topography will create a degree of variation to the base height of the turbines which in turn varies the potential visual prominence of individual wind turbines.

The most prominent visual effects are produced by wind turbines 7, 8, 14, 15, and 16, and are reinforced by the clustering of turbines behind these leading visual elements.

The position of individual turbines in relation to the rising topography of Mount Rufus and the continued elevation of the ridgelines further to the east provide a small degree of back screening to the vertical elements of the turbines. However, the wind turbines will be seen as large vertical elements within the landscape and of a scale more significant to the existing topography.

To the outskirts of Kapunda, local ridgelines provide a visual screen particularly from the local road corridors and lower lying areas associated with the Kapunda-Eudunda and Kapunda-Truro Road intersection. The degree of visibility is likely to increase from elevated locations and particularly residential properties to the northern ridgeline of Kapunda. From these viewpoints the visual effect will be similar to that experienced at Viewpoint 2.

The layered positioning of the wind turbines and the dynamic rotation of the blades will increase the notability of the wind turbines and amplify the complexity of visual change.

5.5 Viewpoint 4: Tablelands Road, south of Eudunda

Viewpoint Context

Viewpoint 4 is located along Tablelands Road and represents the potential visual effect that will be experienced to the north of the wind farm, particularly around the southern outskirts of Eudunda. The viewpoint is typical of the undulating landscape character of the elevated central tablelands.

The landscape character surrounding the viewpoint is defined by an open agricultural landscape of grazing and cropping and a general absence of vegetation apart from a few isolated trees. Numerous hills and localised ridgelines create a defined undulating landscape character typical of the locality. From the viewpoint and other surrounding areas views extend south across local ridgelines with more expansive panoramic views to the east and west.

To the west, views extend as far as the north-south ridgeline of the Greenock Range, some forty kilometres away, and east towards the Southern Mt Lofty Ranges escarpment with the Murray Plains forming a distant landscape in the horizon.

Figure 25: Viewpoint 4; Tablelands Road, south of Eudunda

Figure 26: Digital Overlay showing all Turbines: Viewpoint 4

Figure 27: Absorption Capacity Calculations: Viewpoint 4

Viewpoint Assessment

Assessment	Value	Description
Relief	3	The elevated viewing area associated to the Mt Rufus ridgeline provides a moderate local to sub regional variation in topography with limited regional variation as it flattens into the Western Pastoral lands
Vegetation Coverage	1	Limited to grazing and crops
Infrastructure and Built Form	5	Limited presence of infrastructure within the field of view.
Cultural and Landscape Value	2	Elevated views that are present to the outskirts of Eudunda. Views would be associated with the experience on walking trails within the area.

Baseline Landscape	**11**	
Landscape Absorption	**3**	The undulating forms of the Mt Rufus ridgeline provide moderate to substantial absorption screening of 49%
Horizontal	**2**	The horizontal visual effect is created by turbines 38 and 15 which equates to 28 degrees or 23% of the horizontal field of view.
Vertical	**3**	The underlying localised ridgelines associated to Mt Rufus provide a scale that is proportionate to the vertical scale of the turbines. The vertical scale of the turbines increase the vertical scale by 46%
Distance	**1**	Turbine 47 is the closest turbine at a distance of 8.96km
Visual Effect	**9**	
Coefficient	**0.45**	9/20=
Degree of Visual Change	**23%**	11x0.45= Landscape visual effect 4.95/20= Degree of visual change

Description of potential visual impact

The wind turbines form a distinct cluster of elements set just behind the ridgeline to the south. The uniform layout creates a dispersed visual effect along the horizon line. The wind turbines will appear layered in front and behind each other. Similar to other viewpoints, the layering of and rotation of the wind turbine blades will increase the complexity of the visual effect.

The setback of the wind farm in the landscape relative to other localised landforms provides a degree of visual mitigation in relation to the scale of the turbines from this viewpoint.

While the wind farm and associated turbines will be notable elements within the locality, the compact layout and screening provided by surrounding topography limits the visibility and potential visual effects. In this regard, the visual effect is notable but limited to a marrow field of view.

5.6 Viewpoint 5: Von Reiben Road, east of Eudunda

Viewpoint Context

Viewpoint 5 is located on Von Reiben Road some 16 kilometres north-east of the proposed development. The viewpoint represents the potential visual effect with a degree of visual change that will be experienced to the northeast and east of the proposed development in relation to regional locations across the Murray Plains.

The low lying character of the viewpoint is typical of the Murray Plains with extensive views across the rural landscape of the plains. The underlying land cover is typical of the area consisting of cropping and grazing with scattered belts of vegetation following field boundaries or creeks.

To the south-west is the elevated escarpment associated with Mount Rufus, Long Hill and the township of Eudunda. Prominent topographical features such as Mt Rufus are clearly visible along the horizon line. These landforms produce a defined undulating ridgeline in front of the proposed development.

Figure 28: Viewpoint 5; Von Reiben Road, east of Eudunda

Figure 29: Digital Overlay showing all Turbines: Viewpoint 5

Figure 30: Absorption Capacity Calculations: Viewpoint 5

Viewpoint Assessment

Assessment	Value	Description
Relief	3	There is limited foreground topographic variation with moderate subregional to regional
Vegetation Coverage	2	Scattered copse planting of mature tree within paddocks and along creek lines and cadastral boundaries
Infrastructure and Built Form	4	Unsealed road corridor provides a dominant element to the foreground within the field of view.
Cultural and Landscape Value	2	The Murray River plain landscape is expansive with limited culturally sensitive elements of significance present within the proximity of the viewpoint. However, this particular viewpoint is located close to the

		Eudunda Morgan Road which is an arterial road with greater frequency of occupation and hence visitation and views.
Baseline Landscape	**11**	
Landscape Absorption	**1**	The eastern edge of the Mt Rufus ridgeline provides substantial absorption screening of 86%
Horizontal	**1**	The horizontal visual effect is created by turbines 32 and 25 which equates to 14 degrees or 11% of the horizontal field of view.
Vertical	**1**	The eastern escarpment ridgeline associated to Mt Rufus provides a scale proportionate to the vertical scale of the turbines. The vertical scale of the turbines increase the vertical scale by only 8%
Distance	**1**	Turbine 47 is the closest turbine at a distance of 13.5km
Visual Effect	**4**	
Coefficient	**0.2**	4/20=
Degree of Visual Change	**11%**	11x0.2= Landscape visual effect 2.2/20= Degree of visual change

Description of visual impact

The visual effect results from the partial visibility of the turbine blades as they rotate above the edge of the ridgeline. The majority of the turbines, turbine towers, hubs and nacelles will be screened by the local ridgeline which creates a defined visual enclosure around the proposed wind farm.

The potential for a slight visual effect is likely to be experienced from locations to the east of the proposed development. The visual effect is created by the flicking visibility of the turbine blades as they appear above and disappear behind the ridgeline. It is anticipated that with varying climatic conditions the degree of visibility will be further reduced and from other locations to the east of the development the wind farm maybe completely screened.

5.7 Viewpoint 6: Tablelands Road, south of Mount Rufus

Viewpoint Context

Viewpoint 6 is located on Tablelands Road, south of Mt Rufus, and represents the potential visual effect that will be experienced from locations to the eastern edge of the wind farm development site. The viewpoint is located on one of the many locally elevated hills that form the transitional landscape character between the central tablelands and the Mt. Rufus ridgeline.

The locality of the viewpoint represents the landscape amenity that is provided by the undulating rural landscape and the combination of extensive vegetation belts, isolated trees, open arable land, isolated farm dwellings and panoramic views to distant ridgelines. Further to the south are a number of local heritage properties that provide a degree of cultural significance to the landscape character and locality of the area. While the landscape represents a modified agricultural land use, the combination and arrangement of landscape and built form elements provide a degree of visual amenity and scenic value.

The elevation and isolated tree cover of the agricultural landscape results in panoramic views to the south-west and, to a lesser extent, the north. Views to the east are contained by local ridgelines associated with Mt Rufus and the southern extent of the ridgelines that continue towards the Barossa Valley. The rolling landscape contains belts of vegetation which increase in frequency and prominence towards the edge of the Barossa Valley further to the south. Further to the east are the distant ranges and topographic forms such as Bald Hill which define the horizon line and visual envelope of the locality.

Figure 31: Viewpoint 6; Tablelands Road, south of Mount Rufus

Figure 32: Digital Overlay showing all Turbines: Viewpoint 6

Figure 33: Absorption Capacity Calculations: Viewpoint 6

Viewpoint Assessment

Assessment	Value	Description
Relief	2	From this viewpoint, the landscape is perceived to have limited foreground

		mid ground and background
Vegetation Coverage	2	Limited sporadic trees in linear bands associated with cadastral boundaries and fence lines
Infrastructure and Built Form	4	Scattered farm dwellings are evident to the foreground to mid-ground
Cultural and Landscape Value	2	Views from this locality provide reference to typical intermittent views along the Mt Rufus ridgeline which has the Lavender Trail traversing through the landscape
Baseline Landscape	**10**	
Landscape Absorption	**5**	The western edge of the Mt Rufus ridgeline provides limited/minor absorption screening of 15% due to the tablelands landscape character being relatively devoid of undulations.
Horizontal	**3**	The horizontal visual effect is created by turbines 1 and 45 which equates to 60 degrees or 50% of the horizontal field of view.
Vertical	**5**	The low lying nature of the existing landscape with the limited topographic scale to the foreground is disproportionate to the visual scale imposed by the turbines. The vertical scale of the turbines increases the vertical scale by more than 100% primarily due to the distance of effect with limited foreground to background variation in landscape topography.
Distance	**4**	Turbine 25 is the closest turbine at a distance of 2.63km
Visual Effect	**17**	
Coefficient	**0.85**	17/20=
Degree of Visual Change	**43%**	10x0.85= Landscape visual effect 8.5/20= Degree of visual change

<u>Description of potential visual impact</u>

From the viewpoint, the wind turbines form a distinct cluster of large visual elements within the landscape. The majority of the wind turbines are located on the ridgeline that defines the western edge of the field of view from this viewpoint. The visual effect is formed by the entire wind farm with the relative position of wind turbines 3, 4, 9, 10, 18, and 25 forming prominent visual elements within the cluster of wind turbines. The elevation and height of the wind turbines extend above the ridgelines and local landscape features.

While the visual effect of the wind turbines will be experienced as a distinct cluster, the location of the wind turbines on the ridgeline increase the resulting visual effect; disrupting distant views particularly to the east creating an additional degree of visual enclosure to the locality.

Overall the visual effect experienced at Viewpoint 6 is likely to have a greater magnitude due to the relative position of the viewpoint in relation to the wind turbine layout. The elevation of the wind turbines and limited screening provided by adjacent landscape features reinforces the vertical height of the wind turbines within the landscape.

As previously discussed further to the north and south the interrelationship of vegetation and local landforms provide isolated screens and a degree of visual enclosure which limits the degree of visibility of the wind turbines within the wider landscape.

A detailed discussion on the associated infrastructure for the wind farm and it's probable visual effect for viewpoint 6 is included in section 5.11-5.15 of this report.

5.8 Viewpoint 7:Sturt Highway, east of Truro

Viewpoint Context

Viewpoint 7 is located 5 kilometres outside Truro along the Sturt Highway. The view point represents the anticipated visual effect that will be experienced to the south east of the wind farm. The Sturt Highway provides an entrance gateway into the township of Truro.

Vehicles travelling along this highway are typically travelling at speeds of between 70-80 kilometres per hour. The existing landscape character of the viewpoint is typical of the local area with rolling undulating landforms predominantly grazed defining the land use character.

The landscape is punctuated by isolated trees that produce notable visual landscape markers. There is little screening within the wider landscape.

The topography of Mount Rufus and the extension of the north-south ridgeline form the dominant landscape feature which defines the horizon line and contains the field of view.

Figure 34: Viewpoint 7; Sturt Highway, east of Truro

Figure 35: Digital Overlay showing all Turbines: Viewpoint 7

Figure 36: Absorption Capacity Calculations: Viewpoint 7

Viewpoint Assessment

Assessment	Value	Description
Relief	3	Limited foreground complexity in variation with moderate mid ground to background
Vegetation Coverage	2	Limited sporadic copse or isolated planting of mature trees retained in paddocks
Infrastructure and Built Form	4	Sturt Highway present to the foreground, but has limited impact on the perspective view. Distant transmission line evident
Cultural and Landscape Value	3	Sturt Highway corridor and outskirts or Truro. Hence the frequency of views would be greatest along this corridor as a transient experience of the regional landscape
Baseline Landscape	**12**	
Landscape Absorption	**2**	The south western ridgelines associated to Mt Rufus provide substantial absorption screening of 75%
Horizontal	**1**	The horizontal visual effect is created by turbines 1 and 38 which equates to 16 degrees or 15% of the horizontal field of view.
Vertical	**1**	The vertical visual effect of the turbines are proportionate to the landscape scale hence the tip of blades are not seen to increase the scale. The scale provides minor to negligible vertical effect.
Distance	**1**	Turbine 25 is the closest turbine at a distance of 13.42km
Visual Effect	**5**	
Coefficient	**0.25**	5/20=
Degree of Visual Change	**15%**	12x0.25= Landscape visual effect 3/20= Degree of visual change

Description of potential visual impact

The turbines are seen as a distant cluster of elements located just below a series of ridgelines that define the complex topography of the local area. The undulating ridgelines modify the degree of visibility with the nacelle and blades on a number of wind turbines being visible, particularly the turbines along the eastern edge of the wind farm including wind turbines 3, 5, 9, 10 and 11. The blades of other turbines will be visible creating a minor visual effect along the ridgeline.

The Greenock Ridge is visible as a prominent landscape element and backdrop to the viewpoint. The topographic significance and visual character of this element is retained. The presence of existing remnant vegetation to the ridgeline and scattered trees provides an additional screening that will reduce the visual effect.

Due to the compact nature of the layout, distance from the viewpoint as well as the interrelationship of the undulating ridgelines and local topography result in a reduced visual effect that is characterised by glimpsed views of wind turbine blades and a limited number of nacelles.

Potential visual impacts on the surrounding landscape and Barossa Valley to the east remain limited due to the contained visual character that is formed by the local topography and isolated vegetation groups.

A detailed discussion on the associated infrastructure for the wind farm and it’s probable visual effect for viewpoint 7 is included in section 5.11-5.15 of this report.

5.9 Summary of Visual Impacts

The visual assessment of the seven viewpoints demonstrates that a variety of visual impacts will be experienced within the local, sub-regional and regional landscapes that surround the proposed wind farm development. Typically, the visual effect associated with the wind farm will occur within a modified agricultural landscape that is contained by defined topographic and landscape features to north, south, east and west. The resulting landscape character creates a defined locality in which a variety of visual effects are likely to occur.

The two tables below illustrate the degree of visual change recorded at each of the viewpoints and classification of the potential visual impacts. Of note are the key factors that will affect the visual impact which occurs at each viewpoint and in the wider landscape. They include:

Existing landscape character value and the presence or absence of significant vegetation or scenic value and or existing infrastructure;

- The degree of landscape absorption provided by the existing landscape;
- Degree of visual containment and resulting viewshed;
- Horizontal and vertical visual effects produced by the proposed; and
- Distance to the proposed development.

As shown in Table 2 below, there is a notable degree of variation in the measured visual impacts which ranges from slight to the northeast and southeast, moderate to the north and south and substantial to the east and west. The existing landscape character remains consistent with a measure value range of 10 to 13. This reflects the uniformity of the existing landscape character of the area with subtle variations. More significant is the screening and mitigation provided by the local topography and vegetation in relation to the degree of visual change throughout the site locality.

Viewpoints	Relief	Vegetation Coverage	Infrastructure	Cultural/Landscape Value	Landscape Character	Landscape Absorption	Horizontal	Vertical	Distance	Visual Assessment	Degree of Visual Change
Viewpoint 1	2	3	5	3	**13**	2	2	3	1	**8**	**26%**
Viewpoint 2	3	2	4	2	**11**	5	1	5	1	**12**	**33%**
Viewpoint 3	3	3	4	2	**12**	5	3	5	3	**16**	**48%**
Viewpoint 4	3	1	5	2	**11**	3	2	3	1	**9**	**23%**
Viewpoint 5	3	2	4	2	**11**	1	1	1	1	**4**	**11%**
Viewpoint 6	2	2	4	2	**10**	5	3	5	4	**17**	**43%**
Viewpoint 7	3	2	4	3	**12**	2	1	1	1	**5**	**15%**

Table 2: Summary of Visual Impacts

The following Table 3 is a summary of the classifications described in the GrimKe matrix which provides additional information on the potential visual impact used to describe each viewpoint.

Percentage of Visual Change	Descriptive of Visual Impact	Descriptors – appearance in central vision field	Comments
80-100%	**Extreme**	*Commanding, controlling the view*	*Extreme change in view: change very prominent involving total obstruction of existing view or change in character and composition of the landscape and view through loss of key elements or addition of new or uncharacteristic elements which significantly alter underlying landscape visual character and amenity. The sensitivity of the underlying landscape character to change is unable to accommodate or mitigate the introduction of development, and the visual effect is highly adverse.*
60-80%	**Severe**	*Standing out, striking, sharp, unmistakable, easily seen*	*Severe change in view involving the obstruction of existing views or alteration to underlying landscape visual character through the introduction of new elements. Change may be different in scale and character from the surroundings and the wider setting or a severe change in the context of the existing landscape character. Resulting in a perceived adverse visual effect and an increase in proportional change to the underlying landscape visual character.*
40-60%	**Substantial**	*Noticeable, distinct, catching the eye or attention, clearly visible, well defined*	*Substantial change in view: which may involve partial obstruction of existing view or alteration of underlying landscape visual character and composition through the introduction of new elements. Composition of the view will alter however the sensitivity of the underlying landscape character to change low, and it provides opportunities for mitigation, management and absorptions of the visual effect. View character may be partially changed through the introduction of features.*
20-40%	**Moderate**	*Visible, evident, obvious*	*Moderate change in view: change will be distinguishable from the surroundings while composition, and underlying landscape visual character will be retained. The sensitivity of the existing landscape to change is low.*
0-20%	**Slight**	*Lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred, indefinite*	*Very slight change in view: change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.*

Table 3: Classification of Visual Impacts

The landscape assessment and ZTVI highlight the enclosed visual character of the landscape. Ridgelines associated with Nain Ranges, Greenock Ranges and Light Ranges and northern extent of the Barossa Ranges form a defined visual envelope to the west which extends north and combines with the topography of the Tothill Ranges to limit the visibility around the wind farm. To the east, the ridge associated with Mount Rufus produces a degree of visual enclosure, and to the south, local landforms and extensive belt of vegetation associated with the northern edge of the Barossa Valley provide extensive visual screening. Within this visually contained existing landscape character, the layout of the Twin Creek Wind Farm forms a single cluster of 51 wind turbines.

The landscape and visual impact assessment, with reference to ZTVI mapping, demonstrates that the degree of visibility will be experienced within a contained viewshed. The layout of the proposed wind turbines will result in a single cluster of large infrastructure elements that form a concentrated visual effect in the rural landscape. Travelling through the landscape, the underlying topography of the surrounding ranges modifies views towards the proposed wind farm. The visibility of the proposed development changes due to the screening effects provided by the adjacent hills and ridgelines or areas of existing vegetation.

The visual assessment undertaken from the seven selected viewpoints demonstrates that a variety of visual impacts will be experienced within the local (0-3km), sub-regional (3-10km) and regional (>10km) landscapes that surround the proposed wind farm site. To the north and south and from distance of greater than five kilometres the visual effect associated with the proposed development will result in wind turbines being seen behind local ridgelines and landforms. In these locations, the potential visual effect will result from visible sections of the hub and blades above the local topography and vegetation.

The potential visual effect reduces over distance with the visual assessment recording the visual effect as slight at a distance more than ten kilometres, particularly to the northeast. This reflects the different landscape characters around the proposed development site and the significant landscape absorption and screening of the ridgelines and vegetation created by the local topography of the areas.

To the south, the distance between the proposed wind farm and the Barossa Valley provides significant management of the visual effect limiting the potential impact that the proposed wind farm may have on the Barossa Valley Character Preservation Zone and the associated areas of higher landscape amenity and cultural value.

Viewed from the east and west the proposed wind turbines will be seen situated on the elevated topography of the Central Tablelands. The scale of the proposed development in relation to the vertical scale of the underlined landscape is prominent due to number of visible wind turbines and the prominence of the tower, nacelle and blades in the landscape. Within five kilometres of the proposed wind farm, the screening provided by local ridgelines and vegetation belts is limited, and the majority of the wind farm is experienced as a visually prominent element in the rural landscape producing a degree of visual change in the order of 43% to 48% which is described as substantial. This substantial visual effect alters the underlying visual character and composition of the landscape through the introduction of new elements. Views will be altered but the sensitivity of the underlying landscape character to change is considered low.

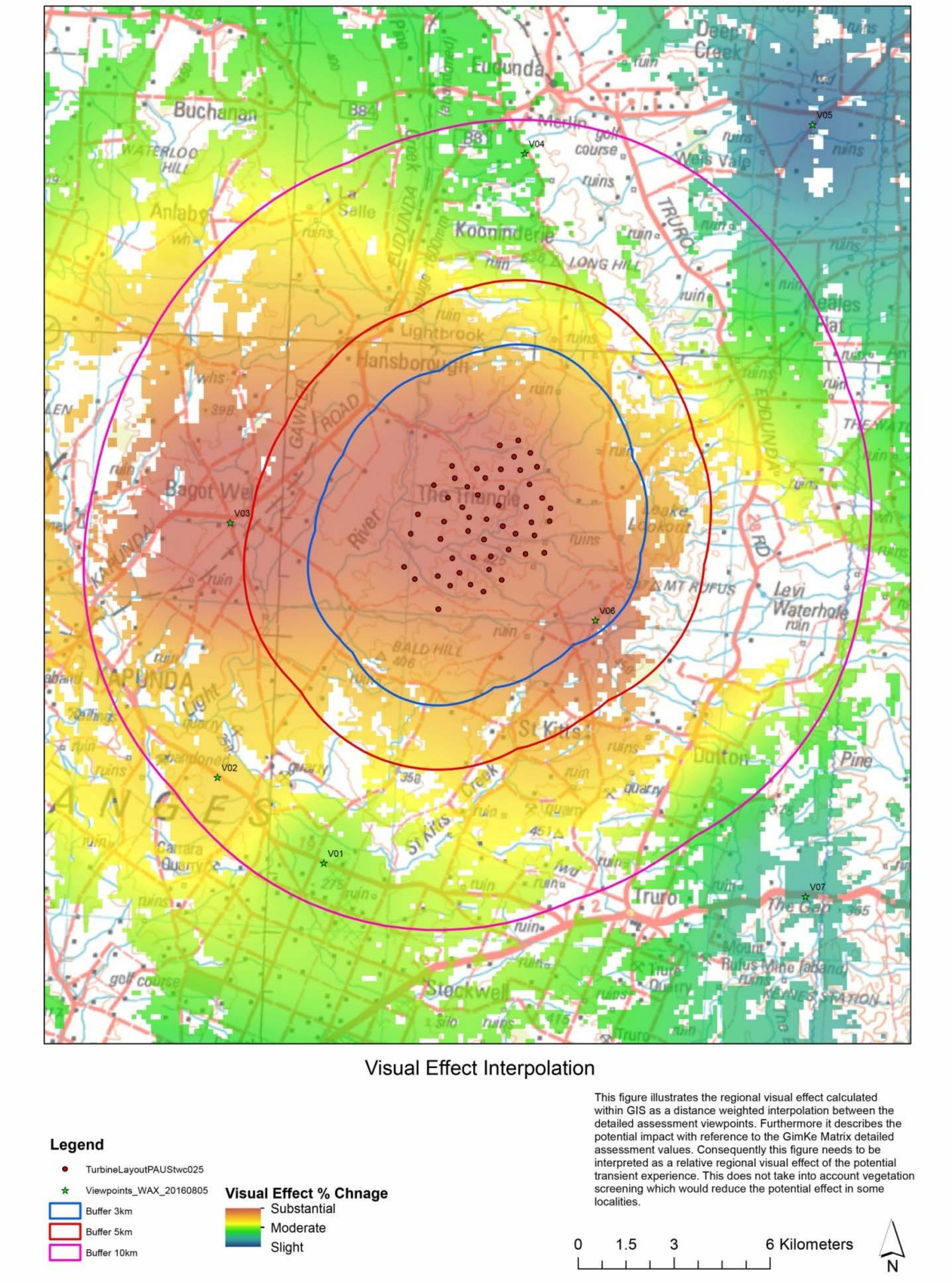

Figure 37: Summary of viewpoint visual effect

From location and viewpoints further away from the proposed development the topography and landscape character of the locality produce numerous visual screens that fragment or remove the visual effects of the proposed wind turbines. The landscape screening; increased visual absorption, and greater distance between the viewpoint and the wind turbines reduce the visual effect resulting in a degree of visual change that ranges from 23% to 33% and is described as moderate.

The resulting visual change will be distinguishable from the surroundings while the composition and underlying visual character of the landscape will remain dominant.

Beyond ten kilometres, the degree of visual change reduces significantly, and the topography and vegetation of the locality provide increased levels of screening. From these locations, the degree of change is reduced to a range of 12% to 17%, particularly to the north east and south west and is described as slight.

Although the Visual Effect Interpolation map shows moderate and substantial visual effect to the edges of the townships of Nuriootpa and Kapunda the local topography and vegetation around the towns provide significant screening. Within the surrounding towns of Nuriootpa, Kapunda, Eudunda and Truro there are restricted views towards the proposed development. This is due to a number of factors including; the location of the towns in valleys or on hillsides facing away from the subject land; the local topography and stands of vegetation which screen the proposed development resulting in limited or no visual effect.

5.10 Design Review and Visual Management

A key consideration of the provisions of the Rural Zone is the management of the visual effect that will result from the development of the Twin Creek Wind Farm. The management of the visual effect was considered at a number of different stages during the development of the application and based on an extensive review process, environmental constraints and consideration of the relevant provisions of the Development Plan.

The original proposal comprised of 60 wind turbines of which 9 were removed as a result of ongoing site investigations. In addition, several micro-siting changes were made as part of design development due to stakeholder consultations and investigations relating to flora and fauna. Consequently, the assessment of the wind farm resulted in several wind turbines located to the south being removed or relocation.

From a visual management perspective, these modifications increased the separation distance between the wind farm and the Barossa Valley, reducing the potential for visual effect on an area of recognised landscape amenity thereby managing, in part, the visual effect of the proposed development.

5.11 Substations and Transmission line Visual Effect Assessment

In addition to the wind turbine visual effect an assessment was undertaken to understand the anticipated visual effect of the proposed substations and transmission line alignment. This included supplementary illustrative imagery of viewpoints 6 and 7 as well as the production of an additional viewpoint 9 that shows the proposed transmission substation. The production of these additional illustrative imagery made a number of assumptions in regards to the final design of the infrastructure elements including:

- The proposed transmission poles constructed from steel or spun concrete monopoles up to 35 metres high and spaced approximately 275 – 375 metres apart (exact locations of poles to be confirmed)
- The transmission substation is based on elevations provided, and
- The finished floor level (FFL) of the substation is based on a midpoint of the surrounding topography (this may be more or less based on final design development).

Furthermore the photomontages for viewpoint 6, 7 and 9 are modelled using 10m contour terrain data. This limitation in data may result in some local landforms or topographical changes less than 10m which could further enhance localised screening. Variances in topographic scale of >10 metres could proportionally provide up to 45% landscape absorption which is considerable for the scale of the proposed substation and transmission.

It is for these reasons that the infrastructure elements of the development and there potential visual effect are assessed in this section and are not incorporated into sections 5.1 to 5.9.

For clarity and legibility of the report all reference images, maps and photomontages have been extracted to Appendix A, C and D and reproduced at A3 to enable them to be studied while reviewing the associated text for each viewpoint.

5.12 Site Substation, Control Buildings and Operational Maintenance Compound

The proposed wind farm will require one on site substation including switching yards, associated electrical infrastructure, control buildings, battery storage, staff facilities and car park.

The sub-station/switching yard will be locatedon the south eastern edge of the site in the vicinity of wind turbine 9. The sub-station has been located to provide a short distance to the grid connection thus reducing the extent of landscape impacted by ancillary infrastructure components. This will however increase the proportional visual effects surrounding viewpoint 6 as the transmission line will extend the visual cluster of infrastructural form to the south to south west. The site compound and substation will be partially visible from viewpoint 6. The scale of the on-site substation will be considerably less conspicuous than the turbines as it is proposed to be positioned in a lower lying area adjacent to turbine 9 at an approximate distance of 2.7km from viewpoint 6, with local landforms screening the majority of the development.

The substation/switching yard compound will comprise of the following;

- One permanent 132kV grid connection
- One control building
- Operations and maintenance building and compound with associated car parking
- Concrete batching plant within compound (during construction)
- Battery energy storage
- Construction compound and material lay down area (during construction)

The substation will be located 2.5 kilometres west of Tablelands Road and will be accessed from Mosey Road. From Tablelands Road and other local track, the substation will create a visual contrast to the rural character of the landscape reinforcing the perceived land use changes that will occur with the introduction of the proposed wind farm.

The vertical scale of the substation gantry (approximately 20m) is likely to produce an increased degree of visibility within the locality of the substation. The change in elevation between viewpoint 6 and the substation location is 60m which in terms of scale of the proposed gantry (20m) will limit the degree of visual effect. In addition the gantry and towers are proposed to be lattice partially reducing the visual mass and form of the structure.

While the visual effect of the substation in relation to the overall effect of the wind farm is limited, from local viewpoints around Tablelands Road, the degree of visual change within the rural landscape will slightly increase, and the substation will be a noticeable development form.

To mitigate the potential visual effect of the substation and operational maintenance compound, it is proposed that landscape treatments are provided to the perimeter of the substation compound. The landscape treatment would be a combination of local provenance screening tree groups and shrubs suitable for the conditions in which the infrastructure associated with the wind development is located. Any screening will need to be undertaken in line with electrical code best practice. Planting should be considered in copse form rather than linear to provide correlation to the natural vegetation patterns in the area of larger stands of copse plantings surrounded by grazed paddocks. Additional tree plantings within the south west of the infrastructure corridor closer to the surrounding edges should be considered to create a layered depth of planting so that the vegetation is not seen as a dominant visual element that juxtaposes the underlying land forms. In essence the planting should create a veil that enables filtered views through the landscape rather than defining the field of view.

Tree species could include Allocasuarina verticillata, Pittosporum angustifolium, Melaleuca lanceolata, and Santalum acuminatum or other to be determined. These trees will provide elevated canopies of 6 to 10m which would be proportionate to the ancillary infrastructure depending on the distance of view and proximity of planting. The shrub species could include Acacia paradoxa, Acacia euthycarpa and Cassiniauncata or other to be determined. Planted in a double row at 0.5 to 1m centres of the shrubs would create a 2 to 3m screen to the boundary of the substation, providing screening to the local area.

From more distant views of the lattice tower, gantry will become recessive, limiting the visual presence and effect of the substation infrastructure. While the lattice construction of the gantry will not remove the visual effect completely, this visually permeable form of construction will mitigate to a certain degree the potential visual impact of the infrastructure associated with the substation.

5.13 Transmission Line and Substation Connection to Existing 275kv

As part of the infrastructure provision of the Twin Creek Wind Farm, an overhead transmission line will be required to link the site substation with the existing ElectraNet transmission corridor. The proposed 132kV transmission line is aligned to traverse the south west tablelands towards the Murray Plains landscape character zone. The alignment is to the south of the Mt Rufus character area and north east of the Barrossa zone. Visual effects are mitigated from key culturally sensitive areas and townships of Nuriootpa and Truro.

The landscape assessment undertaken in section 5 indicates that the existing landscape character is formed by a number of distinct landscape and topographic areas. These differing character landscape areas will produce various visual contexts in which the transmission line is proposed to be located.

The infrastructure corridor will travel south east of the site for approximately 15.5kilometres. The proposed transmission line is anticipated to be supported by spun concrete poles up to 35 metres high and spaced approximately 250 – 300 metres, this will produce a fragmented visual effect across the existing rural landscape.

It is only from locations adjacent to the proposed transmission line and over relatively short distances (less than 300 to 400m) that the visual effect increases. While the poles produce individual visual effects, the uniformity and repetitive pattern of the entire development ensures that the transmission line is seen within the context of the wider agricultural landscape. As a result, the proposed transmission will be seen as ‘another piece’ of infrastructure, no more significant than the existing stobie poles, and transmission infrastructure within the landscape.

The substation connecting the transmission line to the existing 275kv line is proposed to be located adjacent the Sturt Highway approximately15km south east of the proposed wind farm development and approximately 6 km east of Truro. This piece of infrastructure will comprise of a benched level pad, lattice tower gantries and electrical wiring all contained within a site compound surrounded by palisade fencing. Further detailed design will be required to appreciate how this compound will be positioned on the landscape as to the potential cut and fill to create a benched level pad for construction, drainage and maintenance access within the site. The following figure (38) illustrates the substation locations and transmission line alignment.

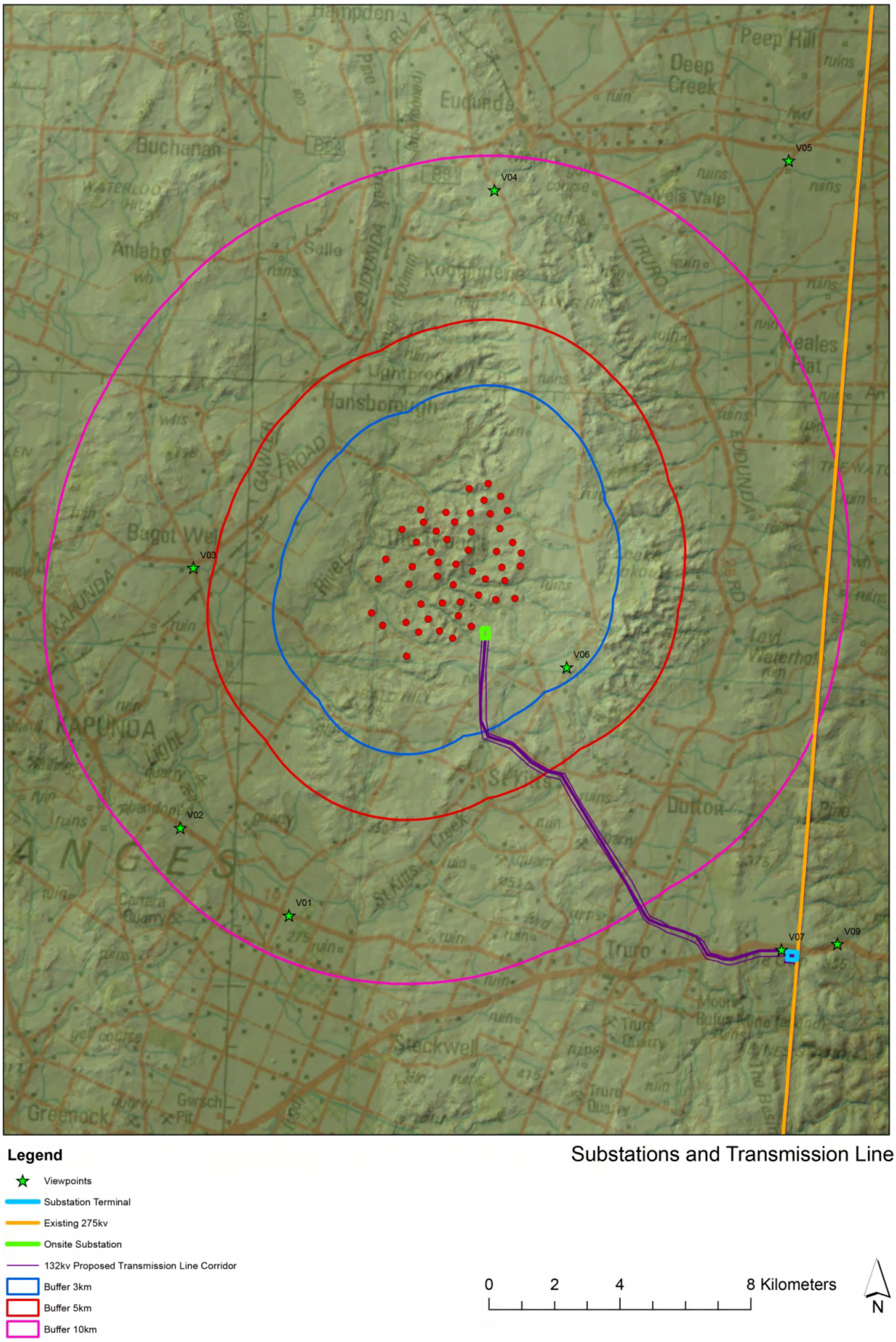

Figure 38: Substations and Transmission Line

5.14 Probable Visual Effect Discussion for Viewpoints 6, 7 and 9

The following discussion provides reference to the likely visual effects created by the substations and transmission line relating to the assessed viewpoints that are likely to experience visual change. In addition viewpoint 9 has been recorded to illustrate the potential visual effect surrounding this particular locality of the proposed development.

Viewpoint 6: Tablelands Road, south of Mount Rufus

Partial views of onsite substation and the transmission line east of the turbine cluster are likely to be experienced from this viewpoint. The location of the substation relative to the local topography provides a degree of screening with only a portion of this piece of infrastructure likely to be visible from this viewpoint. The transmission line due to its monopole design, relative scale and positioning within the landscape and topography creates a fragmented visual effect within the landscape. The visual impact will only slightly increase due to the substation and transmission line presence.

Figure 39: Viewpoint 6; Tablelands Road, south of Mount Rufus

Figure 40: Viewpoint 6 Photomontage

Figure 41: Digital Overlay showing all Infrastructure and Turbines: Viewpoint 6

Viewpoint 7: Sturt Highway, east of Truro

Viewpoint 7 will experience an increased visual effect. The 132kV transmission line will create an infrastructure corridor connecting the wind farm to the existing ElectraNet transmission line. The transmission line will be seen within the Sturt Highway corridor on the southern side of the road within proximity to the viewpoint. The proposed transmission line is anticipated to be supported by spun concrete monopoles up to 35m high which will produce a fragmented visual effect across the existing rural landscape. The scale of the poles will be relatively large in the foreground however they will be dispersed some distance apart which limits the degree of visual mass and effect of turbines and transmission in the same field of view. A local ridge to the north west of the view will screen a proportion of the transmission line as it crosses the road corridor.

There is an increased visual effect experienced of the transmission line from this location due to the close adjacency of this viewpoint to the proposed transmission corridor. It is only from locations adjacent to the proposed transmission line and over relatively short distances (less than 300 to 400m) that the visual effect increases. In other locations along this road corridor and within the locality the visual effect is decreased due to distance and the presence of the existing transmission corridor which is of a similar scale and appearance.

Figure 42: Viewpoint 7; Sturt Highway, east of Truro

Figure 43: Viewpoint 7 Photomontage

Figure 44: Digital Overlay showing all Infrastructure and Turbines: Viewpoint 7

Viewpoint 9: Sturt Highway, east of Transmission Substation

Viewpoint 9 is located east of the transmission substation along the Sturt Highway. Due to its close proximity to viewpoint 7 the viewpoint landscape character can be described in similar terms (refer to section 5.8). From viewpoint 9 the proposed wind farm will not be visible due to the local ridgelines, limiting the connectivity of the development form and extension of visual impact.

The intersection of the 132kV transmission line to the 275kV ElectraNet corridor is located south of the Sturt Highway, to which transmission substation terminal is proposed. When viewed from close proximity the transmission substation will be a dominant visual element in the locality. There will be an increase in the concentration of infrastructure elements experienced within the landscape due to its connection to two transmission lines.

The visual effect of the substation is increased due to its close proximity to the Sturt Highway. However due to the road alignment which curves both before and after this location, local ridges and stands of vegetation along the road corridor the substation will only be visible when travelling along a limited section of the Highway.

Further to the south approximately 900m of the proposed substation terminal is a small existing quarry providing a scale of development to the locality. This is also combined with the existing 275kv transmission line which traverses across the field of view in a north south orientation.

To mitigate the potential visual effect of the substation along the road corridor it is proposed that landscape treatments are provided to the perimeter of the substation in line with the considerations described in section 5.11. Any screening will need to be undertaken in line with electrical code best practice to avoid potential disruption of supply.

Additional landscape treatments along the road corridor, such as an increase of roadside trees would further fragment and partially screen the substation. Further refining the benching level of the development during the detailed design phase could allow the development to sit lower in the landscape and increase the effectiveness of landscape screening treatments.

Figure 45: Viewpoint 9; Sturt Highway, east of Truro

Figure 46: Viewpoint 9 Photomontage

Figure 47: Digital Overlay showing all Infrastructure and Turbines: Viewpoint 9

Figure 488: Digital illustration showing landscape screening after 10 years: Viewpoint 9

5.15 Access tracks

As part of the proposed development, a series compacted gravel tracks will be required to access the turbine locations off public access roads. The tracks developed across private land areas will typically be 10 m during the construction period and reduced 5 m after implementation. Public road access tracks will be limited to 5-6 m width.

Wherever possible the proposal will utilise existing access track and road connections. In addition, the form, materiality and colour of the new tracks will be in keeping with other tracks and roads in the area. While the proposed tracks will appear as new development, post construction they will not appear out of character within the wider rural landscape. The track surface will be crushed rock sourced either on site or from a local supplier. Overtime, the track material is likely to weather and will be subject the revegetation to the track edges which will further reduce the associated visual effect.

Finally, the visibility of the tracks needs to be assessed relative to the other development forms associated with the wind farm proposal. The proportional effect of the tracks will always be a secondary or partial visual element when considered against the degree of visual change produced by wind turbines. In this regard, the visual effect of the track is described as negligible and will progressively diminish over time.

5.16 Underground cable routes

The undergrounding of cable as part of the proposal limits visual impact. Trenching will be typically 0.45 m wide by 1 m deep. All trenches will be backfilled to meet existing surface levels limiting associated visual impacts and should be considered in context with the access tracks and overall visual effect of the entire development. Cable trenches will predominantly be located immediately adjacent to access tracks thereby avoiding additional site and visual impacts associated with separate trenching.

The absence of significant vegetation areas of vegetation within the anticipated cable routes means that the potential vegetation clearance will be limited, and the resulting visual effect will be negligible.

06 Review of Development Plan (Desired Character Statements)

6.1 Introduction

The following section details the various development plan provisions, zones and policy areas that have been considered in relation to the potential visual effect of the Twin Creek Wind Farm and associated infrastructure. The proposed development is situated across three council areas:

- Light Regional Council Development Plan (Consolidated 8 December 2016)
- Goyder Council Development Plan (Consolidated 24 November 2016)
- Mid Murray Council Development Plan (Consolidated 14 June 2017).

The proposed wind farm development has been considered and assessed as a whole so although the transmission line and transmission substation is the only piece of infrastructure located within the Mid Murray Council area it has still been assessed as part of the whole wind farm development.

As the following discussion will make reference to all three relevant development plans the following abbreviations will be used to remain concise:

- Mid Murray Council Development Plan - MMDP
- Goyder Council Development Plan – GDP
- Light Regional Council Development Plan – LDP

The intent of the review is to provide clarity as to the relevance and consistency with particular provisions in relation to the development of wind farms and associated infrastructure, visual impacts, and the effects on the landscape character and amenity.

Having reviewed the Development Plan consideration has been given to the following provisions as they deal directly with wind farms, the specific form of development associated with wind turbines and the associated infrastructure;

- Primary Production and Rural Zone Desired Character Statement, Objectives and Principles of Development Control (PDCs);
- Council Wide Renewable Energy Facilities: Wind Farms and Ancillary Development, Objectives and PDCs.

These desired character statements, objectives and principles of development control specifically refer to wind farms and ancillary development and whether they are an appropriate form of development within the Primary Production and Rural Zones.

The Council Wide objectives and provisions for Renewable Energy (Wind Farms and Ancillary Development) specifically discuss the visual impact of wind farms and ancillary development.

These provisions envisage this form of development and anticipate the implementation of wind farms within the council areas and identify that wind farms are part of the desired character of the Zones.

At the same time, due to the nature and scale of the wind farm, it is acknowledged that there is likely to be a degree of conflict within the Development Plan between provisions which envisage wind farms and other provisions which discuss development, buildings and structures in a broader manner.

It is acknowledged that under the Development Act 1993 a wind farm or wind turbine can be defined as development, building or structure. However, the Development Plan provisions which relate to development, buildings, and structures may or may not apply to the proposed development. To understand whether a provision is applicable to the proposed form of development the following considerations have been applied:

- The context in which the provision applies, or the intent behind the provision, including what form of development the provision refers to and in what situation it would apply.

- Whether the provision is relevant to a wind farm development, and whether said provision appears to have been written with wind farms in mind.
- Whether the provision is a realistic expectation in relation to a wind farm development (e.g. where provisions make reference to walls or windows consideration has not be given to the associated provision.

The visual assessment report contained in Section 5 concludes that the visual effect of the proposed wind farm on the existing rural landscape character will create a range of visual effects from slight to substantial (on a scale of slight, moderate, substantial, severe and extreme). The visual effect associated with the wind farm is described as being distinguishable from the surroundings while the composition and underlying landscape visual character was retained, and the sensitivity of the existing landscape character to change was low. That is to say; the modified rural landscape can accommodate the wind farm and the potential degree of visual change without significantly altering the agricultural character of the landscape.

6.2 Primary Production Zone (GDP and LDP) and Rural Zone (MMDP)

The desired character statements for the Primary Protection and Rural Zones recognise the rural and productive landscape character including large farming properties, horticulture and agriculture. It also aims to preserve the resources of the zone including mineral and fresh water supplies.

All three desired character statements place a value on the protection of scenic qualities of rural landscape within these zones (Primary Production Zone Objective 4 LDP and Objective 3 GDP; Rural Zone PDC 4 MMDP). The desired characters statements of these zones also acknowledges that wind farms are envisaged in the zones and that their presence will result in visual impacts on the landscape, particularly in relation to valuable scenic areas.

Stating that:

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; and*
- *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 derived from increased generation of renewable energy.

Further the objectives for each zone aim to:

Accommodation of wind farms and ancillary development (Primary Production Zone Objective 5 LDP, Objective 4 GDP)

Accommodation of wind farms and ancillary development outside of the Barossa Valley Character Preservation District as defined by Character Preservation legislation (Rural Zone Objective 2 MMDP)

The proposed development does not fall within the Barossa Valley and McLaren Vale – Revised – Protection Districts Development Plan Amendment (2013).

The principles of development control within all three zones also state that:
Development should not be undertaken unless it is consistent with the desired character and acceptable forms of development for the zone and the relevant policy area (Rural Zone PDC 1 MMDP)

Development should not be undertaken unless it is consistent with the desired character for the zone (Primary Production PDC 9 LDP, PDC 10 GDP)

In summary, wind farms and their associated infrastructure are an anticipated form of development in the Primary Production Zone (GDP and LDP) and Rural Zone (MMDP), as is the potential for visual impact that is associated with them acknowledged as a consequence of this form of development.

6.3 Renewable Energy Facilities: Wind Farms and Ancillary Development

In preparing discussions relating to the potential for visual impact associated with the relevant zones, consideration has also been given to the provisions which relate specifically to the visual impact of wind farms and their associated development. In particular, Renewable Engergy PDC 2 (LDP and GDP) and Council wide PDC 396 (MMDP) which seek to manage visual impact of wind farms and ancillary development (such as substations, maintenance sheds, access roads and wind monitoring masts) by applying the following measures:

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.

The separation from dwelling and townships, the spacing of individual turbines and the configuration of the wind farm meets the principles set by PDCs. The layout of the turbines into a single cluster manages the extent to which the entire wind farm is visible in the landscape with the topography and vegetation in the locality providing screening and additional mitigation of the visual effect.

While the overall size of an individual wind turbine is large when compared with other infrastructure in the area, the spacing and clustering of the turbines mean that the underlying rural character of the landscape remains. That is to say when viewing the wind farm from the surrounding regional landscape, the rural and pastoral qualities of the landscape are still seen and experienced in and around the wind turbines.

Also, the wind turbine uses a tubular tower design, will be uniform in size and shape with consistent blade rotation. The selection of a neutral off-white colour (RAL 7035) ensures that the potential for colour contrasts between the wind turbines and any climatic, diurnal and seasonal variations is minimised and the potential visual effect is managed.

The location of the individual turbines within the cluster have also managed to achieve a setback of at least 2000 metre from the nearest non-associated (non stakeholder) dwelling, there is no tourist accommodation within close proximity to the site.

6.4 Council Wide Provisions

A number of Council Wide Objectives and PDC relate to impacts on the existing landscape character, the design and form of development and associated visual effects with Council Wide sections discussing Natural Resources, Siting and Visibility, Landscaping, Fencing and Walls considering the effects of development on the existing landscape. Of the objectives and PDCs contained within these sections this assessment has given consideration to those that are relevant and realistic to wind farm developments.

In addition to the Primary Production and Rural Zone objectives on the preservation of scenic value a number of council wide provision also discuss the protection of scenic value more broadly across the council area including:

LDP - Natural Resources Objective 13, PDC 1; Siting and Visibility Objective 1, PDC 1

GDP - Natural Resources Objective 12, PDC 1; Siting and Visibility Objective 1, PDC 1

MMDP - Council Wide Objectives 54 and 58, PDC 164

In relation to maintaining the rural character of the landscape, the proposed wind farm will produce a single defined development footprint in the rural landscape. In this regard, the physical impact of the wind farm on the rural landscape is limited, and the productive qualities and characteristics of the landscape will remain.

The separation of the wind turbines and turbines clusters ensure that the visual effect of the proposed wind farm is fragmented and views of the rural landscape between wind turbines are maintained. The agricultural landscape is retained while the visual character is changed to a moderate degree.

The Sturt Highway is identified as a scenic route (MAP MiMu1 (overlay 2) MMDP). The localised visual effect of the substation is increased due to its location adjacent to the Sturt Highway. However the visual effect to the whole of the scenic route could be described as limited. This is due to the road alignment; which curves both before and after this location, local ridges and stands of vegetation along the road corridor the substation will only be visible when travelling along a limited section of the Highway.

A number of Council Wide provisions discuss the modification of the natural landform both in relation to access tracks as well as development ground works. These provisions seek the minimisation of impacts or the protection and conservation of natural landscape assets contributing to the retention of scenic value.

LDP - Natural Resources Objective 10; Siting and Visibility PDC 8; Sloping Land Objective 1, PDCs 1 and 2

GDP - Natural Resources Objective 9; Siting and Visibility PDC 7; Sloping Land Objective 1, PDCs 1 and 2

MMDP – Rural Zone Policy Area 14 PDC 4; Council Wide Objective 54, PDCs 171, 194, 380, 381

The wind farm will require a degree of modification to natural landforms, typically requiring a series of 10m wide gravel tracks to provide access to each wind turbine locations during construction and an area approximately 90m x 45m for the footings and crane hardstand area. The location and grading of these access tracks are determined by the functional requirements of the development.

The resulting disturbance is considered minimal and needs to be considered against the context of the wider agricultural landscape. The form, materiality and colour of the tracks and hardstand areas are in keeping with other tracks, lay down areas and roads in the area. Over time, these tracks, through limited use by the wind farm operator, will become overgrown by herbaceous species, particularly to the edges, reducing the visual effect.

In addition, the visibility of the tracks is part of an envisaged form of development. The proportional visual effect of the tracks will be minimal and secondary when considered against the degree of visual change produced by wind turbines.

The modification of the landform for both substations could be refined during the detailed design phase and may allow the development to sit lower in the landscape, retain the natural character of the landforms and increase the effectiveness of landscape screening treatments.

The development plan discuss requirement for screening developments using landscaping to provide visual screening when viewed from adjoining properties and public roads.

LDP - Siting and Visibility PDC 9

GDP - Siting and Visibility PDC 8

MMDP – Rural Zone Policy Area 14 PDC 3; Council Wide PDC 171

While landscape screening is not realistic to achieve in regards to the turbines due to scale and operational requirements there is potential to screen or partially screen some of the associated infrastructure. With regards to other requirements such as access and electricity supply landscaping could contribute to the reduction of visual effect for some pieces of associated infrastructure as discussed in section 5.11 to 5.14 of this report.

Again, there is are tensions between the Primary Production and Rural Zone desired future character and the general requirements of the Council Wide PDCs, particularly relating to Siting and Design, Conservation and Water Resources. The turbine layout for Twin Creek wind farm is a compact cluster which minimises both the duration that the wind farm is viewed along road ways but also reduces the proportion of the view which is changed. The siting for Twin Creek within a defined visual envelope as discussed within section 5.9 of this report aids in minimising the visual impact on the existing landscape character, natural areas, areas of scenic value and tourist routes, accepting that wind farms are an anticipated form of development in the Zone and that wind turbines will be visually prominent in the landscape.

06 Review of Development Plan (Desired Character Statements)

06 State Wide Landscape Scenic Quality Values

6.1 Review of State Wide Landscape Scenic Quality Values

To present a wider understanding of the landscape value associated with the existing landscape and impact of the proposed development, a review has been undertaken of a research study conducted by Dr Andrew Lothian in relation to landscape character, landscape value and the potential visual change created by wind farms.

6.2 State Wide Landscape Scenic Quality Values

Referring to Lothian (2000)[8], the biophysical landscape character of the Southern Flinders Ranges, Mid North Plains and surrounding region has been classified as agricultural plains, low ranges/ hills and main ranges, Figure 49.

The assessment process conducted by Lothian (2000) measured public scenic beauty perception values of South Australian Landscapes. Scenes were rated out of 10.

The mean ratings for scenes within the Southern Agricultural Province were;

- Main High Ranges **6**
- Agricultural Hills and low ranges **5**
- Plain (Coastal) **4**

In addition, scenes were assessed with regards to land use and physical characteristics such as vegetation type and coverage, topographic variance, the presence of water. Crops and pastures occupy the majority of the southern agricultural province. The mean of these scenes was 4.36. To be more specific, scenes of crops and pastures with ridgelines had a mean of 4.53 whereas flat terrain recorded a mean 3.97 and coastal areas had a median range of 6-6.99.

The agricultural landscape of the Northern Mount Lofty Ranges received a moderate ranking in terms of the scenic quality. Figure 50 illustrates the landscape quality variance of South Australia and the proposed location of the Twin Creek Wind Farm and represents landscape quality values of 5 to 6.

A subsequent study was conducted by Lothian (2008)[9], the objective of which was to measure the scenic perceptions and visual effects of wind farms in the landscape. Using the South Australian landscape quality assessment as a baseline reference, the potential sensitivity of wind farms in particular geographic localities was interpolated in the study.

The findings of the 2008 study reported that scenes with a scenic quality of less than 5.1 would be improved by the presence of a wind farm. The trend correlation between existing landscape quality and visual sensitivity to wind farm developments is derived by an existing landscape quality rating of 5.1 at which point a lower valued landscape will not be devalued by the presence of a wind farm. In fact, the development has the potential to add qualities such as scale, form and/or a dynamic visual element within a modified and often denuded landscape.

In the case of the Project, the existing landscape quality is extremely diverse with areas of scenic values and well areas that are impacted significantly by industrial infrastructure. Consequently, the visual effect of the proposed wind farm may potentially be improved by the presence of a wind farm, while other locations may be impacted. As such, the findings of Lothian are provided for information purposes only.

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8 *Lothian, A. (2000) Landscape Quality Assessment of South Australia. Department of Geographical & Environmental Studies. University of Adelaide. PhD*

9 *Lothian, A.(2008). Visual Impact Assessment of Wind Farms in South Australia. Geographical Research, 46/2, 196 - 207*

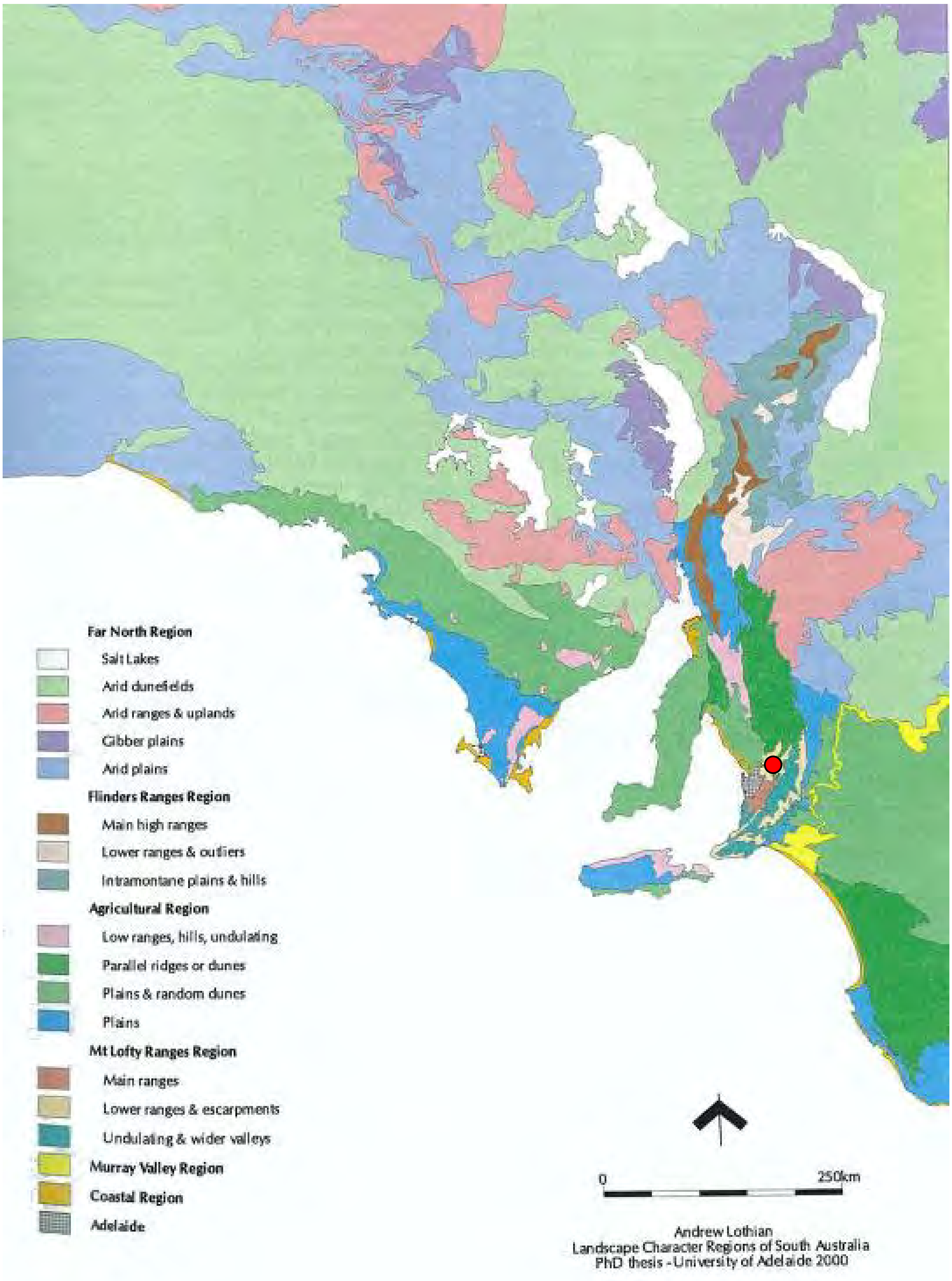

Figure 49: Landscape Character Regions of South Australia (Lothian, 2000 with red dot indicating wind farm location)

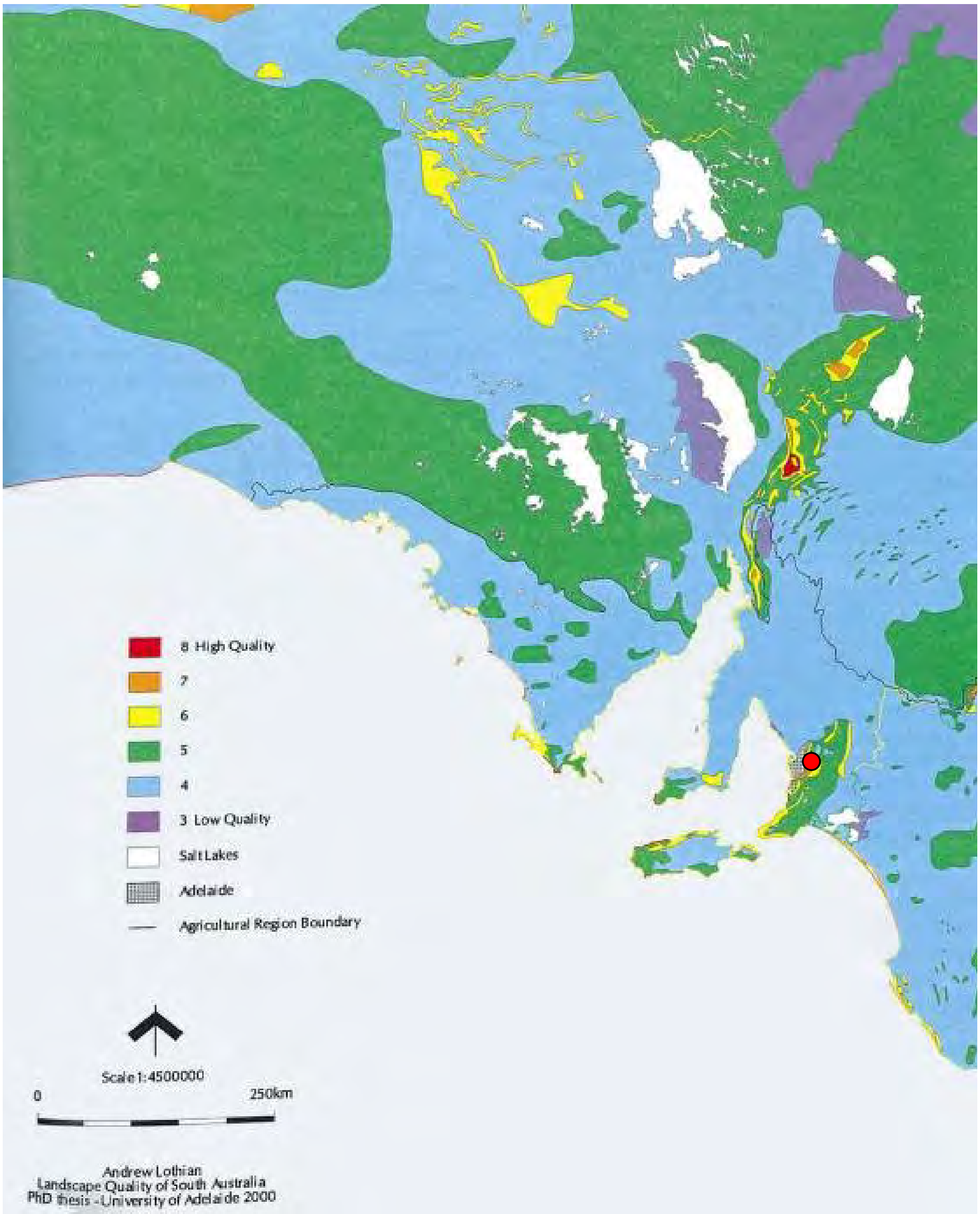

Figure 50: Landscape Quality of South Australia (Lothian, 2000 with red dot indicating wind farm location)

07 Cumulative Visual Effect

7.1 Description of Cumulative Visual Effect

Cumulative visual effects can be defined as the additional changes caused by a proposed development in conjunction with other similar developments[10] in the landscape or site locality or as the combined effect of a set of developments, taken together. The following assessment has considered the cumulative effects of other existing and potential development in the regional locality of the Twin Creek Wind Farm.

To understand the degree of cumulative visual effect the following descriptions have been provided to depict the different types of cumulative visual effects

- Combined Visibility:
  When a proposed wind farm is located within a visible distance to existing developments, the observer from a particular viewpoint may be able to see more than the one form of development.
- Succession:
  When the observer has to turn to see the various developments from the same viewpoint. The developments cannot be seen at the same time; they are in a different arc of view. However, the cumulative visual impact will have a degree of perceptive value.
- Sequential Effects:
  When the observer has to move or travel through the landscape to view the various developments within the same field of view. Sequential effects should be assessed for travel along regularly used routes (major roads). Different degrees of sequential effect will be evident
- Frequent Effects:
  Frequent sequential effects occur when the developments appear within the same field of view regularly with short time periods in between. The speed of travel and distance between large scale infrastructure developments will be determinants of the significance of the effect.

7.2 Discussion of Cumulative Visual Effect

Throughout the wider regional landscape context of the Northern Mount Lofty Ranges and Mid North, wind farms exist or are proposed as clustered developments increasing and decreasing in visual prominence as a result of each wind farm's layout and location rather than as a combined cumulative visual effect. The absence of visual presence of existing or proposed wind farms in the regional locality around the Twin Creek Wind Farm means that any cumulative visual effect would be described as sequential. At the time of the assessment the consultant team are aware of the closest development being the Waterloo Wind Farm.

The distance between the Twin Creek Wind Farm and the expanded Waterloo Wind Farm is 28 kilometres at its nearest point. At this distance, the visual effect is negligible, and the ability to view both wind farms in the same view is limited if possible at all particularly due to the underlying topography and vegetation of the locality. Furthermore, the Zone of Theoretical Visual Influence (ZTVI) illustrates the enclosed nature of the Twin Creek locality which limits the perceived sequential visual experience of the Twin Creek Wind Farm and other wind farms in the area.

The potential sequential cumulative visual effect is negligible and will not impact on the underlying character of the landscape or elevate the visual effect of the Twin Creek proposal.

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[4] *http://www.snh.org.uk/pdfs/strategy/cumulativeeffectsonwindfarms.pdf [Accessed 01 September 2015]*

08 Viewer Sensitivity

The preceding assessment considers the visual effect of the wind farm from various locations having regard to the existing landscape quality and the degree of visual change on the existing environment. It does not measure the extent to which a viewer's response or sensitivity to landscape changes and how this influences the perception of visual effect.

The Wind Farms Planning Bulletin Planning SA (2002) identifies potential viewers and the possible sensitivity that may be experienced by the public, ranging from the eco-tourist, who may experience a devaluing of the landscape, to members of the local community, who might stand to benefit from the development. However, the Planning Bulletin also concedes that "Given the potential impact on the visual amenity of an area, a diverse range of public response can be expected".

Fundamental to the viewer's sensitivity is the degree to which visual change is perceived or experienced and whether this is seen as a positive or negative visual effect. Therefore, it is likely that local residents, who are most familiar with the landscape, will experience a greater degree of change than occasional visitors to the area. However, whether the change is perceived as positive or negative will depend on the viewer's opinions. It is evident that many people like the look of turbines considering them sculptural and majestic or positive signs of climate change action, while some view them as an industrial blight.

By contrast, the majority of tourists may perceive no change and see the wind farm as part of the existing visual environment.

The truth may be that within all user groups, be they locals, tourists, walkers or weekenders, a spectrum of opinions can be expected based on differing views on the receiving landscape, the visual appeal of turbines and renewable energy itself. The final level of viewer sensitivity becomes the personal preference of the viewer as to whether the visual change is positive or negative, as an assessment of social or demographic groups can only be subjective, it does not form part of this discussion.

09 Conclusion

The landscape assessment and ZTVI illustrate that the Twin Creek Wind Farm will be developed in a modified rural landscape with defined visual character. The topography of the Nain Ranges, Greenock Ranges, Light Ranges, Barossa Ranges and Mount Rufus create a visual envelope to the west and north of the proposed development farm. To the south, local landforms and existing belt of vegetation associated with Barossa Valley limit the visibility of the proposed wind farm.

Throughout the regional locality around the proposed wind farm, the existing land use is agricultural with small woodland pockets of vegetation. Within this visually contained rural landscape, the proposed layout of the Twin Creek Wind Farm forms a compact cluster of 51 wind turbines.

The potential visual effect is most notable from the east and west with the proposed wind turbines situated on the ridges of the Central Tablelands. The scale of the proposed development in relation to the vertical scale of the underlined topography is prominent to visibility if individual wind turbines. From local and sub-regional locations within five kilometres of the proposed wind farm, the screening provided by local ridgelines and vegetation belts is limited, and the majority of the wind farm is visible. The resulting visual effect produces a degree of visual change in the order of 43% to 48% which is described as substantial with the visual character of the locality being altered. However, the sensitivity of the underlying landscape to change is low due to the agricultural character.

Further away from the proposed development local ridgelines and tree belts create visual screens that fragment or remove the visual effects of the proposed wind turbines. The combination of topography and vegetation increases the screening reducing the degree of visual change that ranges from 23% to 33% and is describe as moderate.

At distances of over ten kilometres, the degree of visual changes reduces significantly, and the degree of change is reduced to a range of 12% to 17%, particularly to the north east and south west and is describe as slight.

The associated infrastructure; substations and transmission line, will provide localised impacts to their immediate site localities. These visual effects will be limited to shorter distances (contained viewsheds) to the east and south east or Truro. There will be no visual effect from the township of Truro. Transient experiences will be witnessed along local roads within the south east of the regional site with a small section of the Sturt Highway being impacted by the substation terminal connection to the existing 275kv line. Depending on the viewpoint, local landforms will provide visual screening. Furthermore the reduced vertical scale of the gantries and transmission pylons in contrast to the turbines, meaning the associated infrastructure will only slightly contribute to the overall level of visual change in the regional landscape.

09 Conclusion

The visual assessment and visual effect interpolation mapping illustrated the relationship between distance and visual effect and the significance of local of ridgelines in reducing the visibility of the proposed wind farm in the wider locality. The visual effect is represented as bands of visual change radiating from the proposed wind farm. The consistency of the existing landscape character means that distance and visual absorption are the dominant variables in mitigating the visual effect.

Although, the visual effect is likely to be moderate to substantial within the local to subregional area, the containment of the effect can be attributed to the visual character of the landscape coupled with uniformity of the agricultural character, meaning that the proposed Twin Creek Wind Farm can be accommodated without significantly altering the underlying landscape character

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