Appendix E

Biodiversity Assessment Report

EPS

Biodiversity Assessment Report

Darlington Point Solar Farm

Prepared for ARUP (on behalf of Edify Energy)
Prepared by EPS

EPS
11299
August 2018

Contact Information and Declaration		
Declaration:	Submission of the Biodiversity Assessment prepared under the *Environmental Planning and Assessment Act 1979* in respect of a proposed Solar Farm. The opinions and declarations in this Biodiversity Assessment Report are ascribed to EPS and are made in good faith and trust that such statements are neither false nor misleading. In preparing this Biodiversity Assessment Report, EPS has considered and relied upon information obtained from the public domain, supplemented by discussions between key EPS staff, representatives from governing agencies and independents.	
Prepared by:	Toby Lambert Bachelor of Environmental Science Director - Ecology EPS PO Box 348 NELSON BAY NSW 2315 Ph: 02 4981 1600	T. Lambert. …………………………………….. Toby Lambert
Application Location	Sturt Highway, Darlington Point, NSW	

Quality Assurance & Version Control Table				
Project: Darlington Point Solar Farm				
Client:	Arup / Edify Energy			
Rev No.	**Date**	**Our Reference**	**Author**	**Reviewer**
V01	17 July 2017	*2017_07_17_11299_Darlington Point Biodiversity Assessment_ Draft*	D. Landenberger A. Midgley	T. Lambert
V02	20 December 2017	*20171220_11299_Darlington Point Biodiversity Assessment_ V02*	D. Landenberger A. Midgley	T. Lambert
V03	16 February 2018	*20180216_11299_Darlington Point Biodiversity Assessment_ V03*	D. Landenberger A. Midgley	T. Lambert
V04 Final	08 March 2018	*20180308_11299_Darlington Point Biodiversity Assessment_ V04*	D. Landenberger A. Midgley	T. Lambert
V05 Revised Final	13 April 2018	*20180413_11299_Darlington Point Biodiversity Assessment_ V05*	D. Landenberger A. Midgley	T. Lambert
V06 Revised Draft	1 August 2018	*20180730_11299_Darlington Point Biodiversity Assessment_ V06*	D. Landenberger A. Midgley	T. Lambert
V07 Revised FInal	8 August 2018	*20180808_11299_Darlington Point Biodiversity Assessment_ V06*	D. Landenberger A. Midgley	T. Lambert
Checked by	8 August 2018			A. Midgley
Approved by	8 August 2018			T. Lambert

EPS

Hunter	Sydney
9 Yacaaba Street,	Level 33, 264 George Street,
Nelson Bay NSW 2315	Sydney NSW 2000
(02) 4981 1600	(02) 9258 1985

Website: www.enviroproperty.com.au

Abbreviations and Acronyms

Abbreviation	Description
API	Aerial Photographic Interpretation
BAR	Biodiversity Assessment Report
BC Act	*Biodiversity Conservation Act 2016*
Biodiversity	Biodiversity is the genetic diversity, species diversity and ecosystem diversity. Biodiversity includes plants, animals, micro-organisms.
Bioregion	Division of Australia into bioregions based on dominant landscape attributes as defined by Thackway and Cresswell (1995)
BSA	*BioSecurity Act 2015*
Critical Habitat	Critical Habitat is an area containing threatened ecological communities, populations, species that is listed on the TSC Act and/or the EPBC Act
CMA	Catchment Management Authority
CSU	Charles Sturt University
Development Footprint	The area of land within the Development Site that is directly or indirectly impacted on by the construction and operation of the proposed DPSF project, including access tracks, construction and hardstand areas, firebreaks and associated infrastructure. Refer to definitions within FBA (OEH, 2014) Calculations for offsets are based on the impacts on biodiversity values associated with the development footprint.
Development Site	The area of land subject to the proposed DPSF project. Refer to definitions within FBA (OEH, 2014). For this project the Development Site and Development Footprint are the same.
DPI	Department of Primary Industries
DoEE	Commonwealth Department of the Environment and Energy
DPE	NSW Department of Planning and Environment
Ecological Community	A set of species occupying a specific area
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EP&A Act	*Environmental Planning and Assessment Act 1979*
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994*
IBRA	Interim Biogeographic Regionalisation of Australia
KTP	Key Threating Process as listed under the BC Act and/or the EPBC Act
LGA	Local Government Area
Likely	A chance or possibility of occurring within the development site (OEH, 2004)
Locality	The area within 10km of the development site

Abbreviation	Description
Local Population	Population of plants or animals within the development site, or within continuous habitat or enables exchange of genes
Migratory Species	Listed migratory species under the EPBC Act
MNES	Matters of National Environmental Significance as listed under the EPBC Act
Noxious Weed	Plant species listed on the *Noxious Weed Act 1993* for the development sites control area
NPW Act	*National Parks and Wildlife Act 1974*
NW Act	*Noxious Weed Act 1993*
OEH	Office of Environment and Heritage
PCT	Plant Community Type
PEA	Preliminary Environmental Assessment
Project	The Darlington Point Solar Farm
Ramsar Wetland	Internationally Important Wetlands
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services
Significant	Important as defined by the Threatened Species Assessment Guidelines (DEC, 2007)
SSI	State Significant Infrastructure
Study Area	Is the area that was surveyed for this report shown in Figure 1-1. While the FBA definition of Study Area is the area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly, the Study Area for this project is greater than those areas in which any impacts will occur, due to subsequent avoidance measures incorporated into the project design. It also includes two areas that weren't actually surveyed and will not be affected by the project, due to early site boundary discrepancies.
SEPP14	State Environmental Planning Policy - Wetland
Threatened Biodiversity	Species, populations, communities that are listed under the BC Act and/or the EPBC Act
TSC Act	*Threatened Species Conservation Act 1995*
Vegetation and Heritage Protection and Exclusion Zones	Areas of native vegetation within the Study Area in which it is proposed to avoid, retain and manage native vegetation.
Weed	Plant species that is not native to Australia and/or is a native species that is growing outside of its normal geographic range

Table of Contents

Table of Figures

List of Tables

List of Plates

Appendices

"THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY"

1 INTRODUCTION

EPS was engaged by Arup on behalf of Edify Energy to prepare a Biodiversity Assessment Report (BAR) for the construction of a 275 MW AC solar farm at Darlington Point (the project). This BAR provides a detailed assessment of the biodiversity issues for the project. The project is located 40 km south of Griffith on Donald Ross Drive, Darlington Point (Figure 1-1).

A Preliminary Environmental Assessment (PEA) was prepared for the project (Arup, 2017) to determine the general environment constraints and issues for the project. This BAR is to further assess in detail the biodiversity issues identified within the PEA and forms part of the Environmental Impact Statement (EIS).

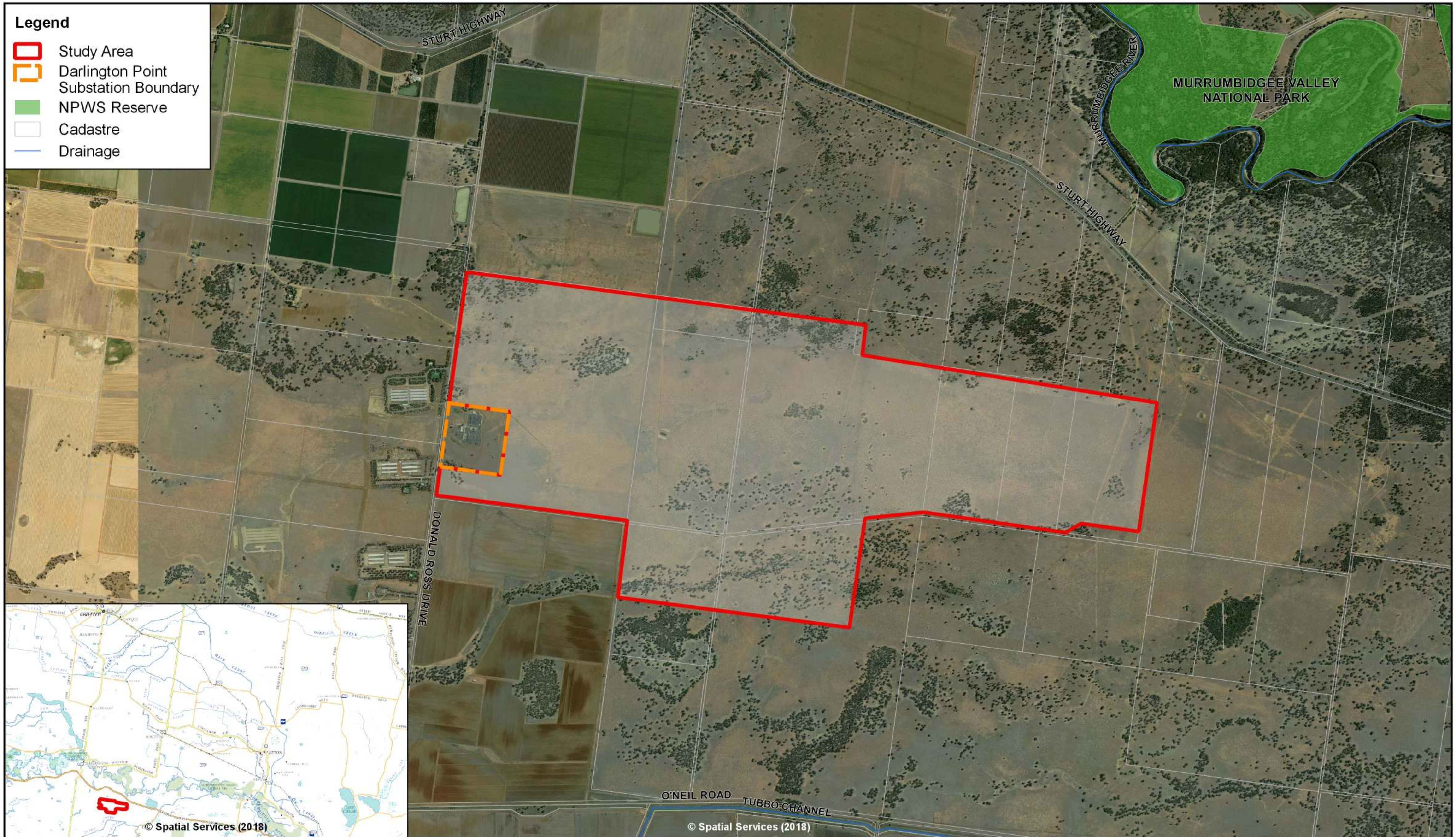
The project is a Major Project and the Framework for Biodiversity Assessment methodology (FBA) (Office of Environment and Heritage, 2014a) will be used to assess the impacts to biodiversity from the project and the biodiversity offsets requirements under the FBA, as required in the Secretary's Environmental Assessment Requirements.

1.1 Project Description

1.1.1 Overview

The proposed project is to accommodate up to 275 MW (AC) of solar generated electricity, including the provision of 100MW AC, for battery technology for energy storage (battery energy storage system – BESS) and resupply during peak demand. A detailed infrastructure layout will be developed during detailed design, however key features of the DPSF would include:

- Photovoltaic (PV) solar panels;
- Steel mounting frames with piled foundations;
- A single-axis tracking system;
- Direct current (DC) / alternating current (AC) inverter stations;
- Medium voltage electrical reticulation network;
- A 33/132kV switchyard and internal switchroom;
- A battery yard (100 MW AC) (BESS facility), consisting of individual power pack cubicles or skid-mounted/containerised power packs and modular inverters and MV transformers, including a connection to the above switchyard;
- Connection to Transgrid substation;
- Internal access tracks for operational maintenance; and
- Firebreaks, Office and Staff car park and security fencing.



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 30 000
Job Ref:	11299

Figure 1-1

Site Location Map

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure1_1_V04.qgs

Figure 1-2 shows the concept design layout with locations of the various larger-scale components of the project.

Expanded information on the construction and operational aspects of the project that inform how impacts to biodiversity will be considered in this BAR are provided later in this document in Section 7.

1.2 Purpose of the Biodiversity Assessment

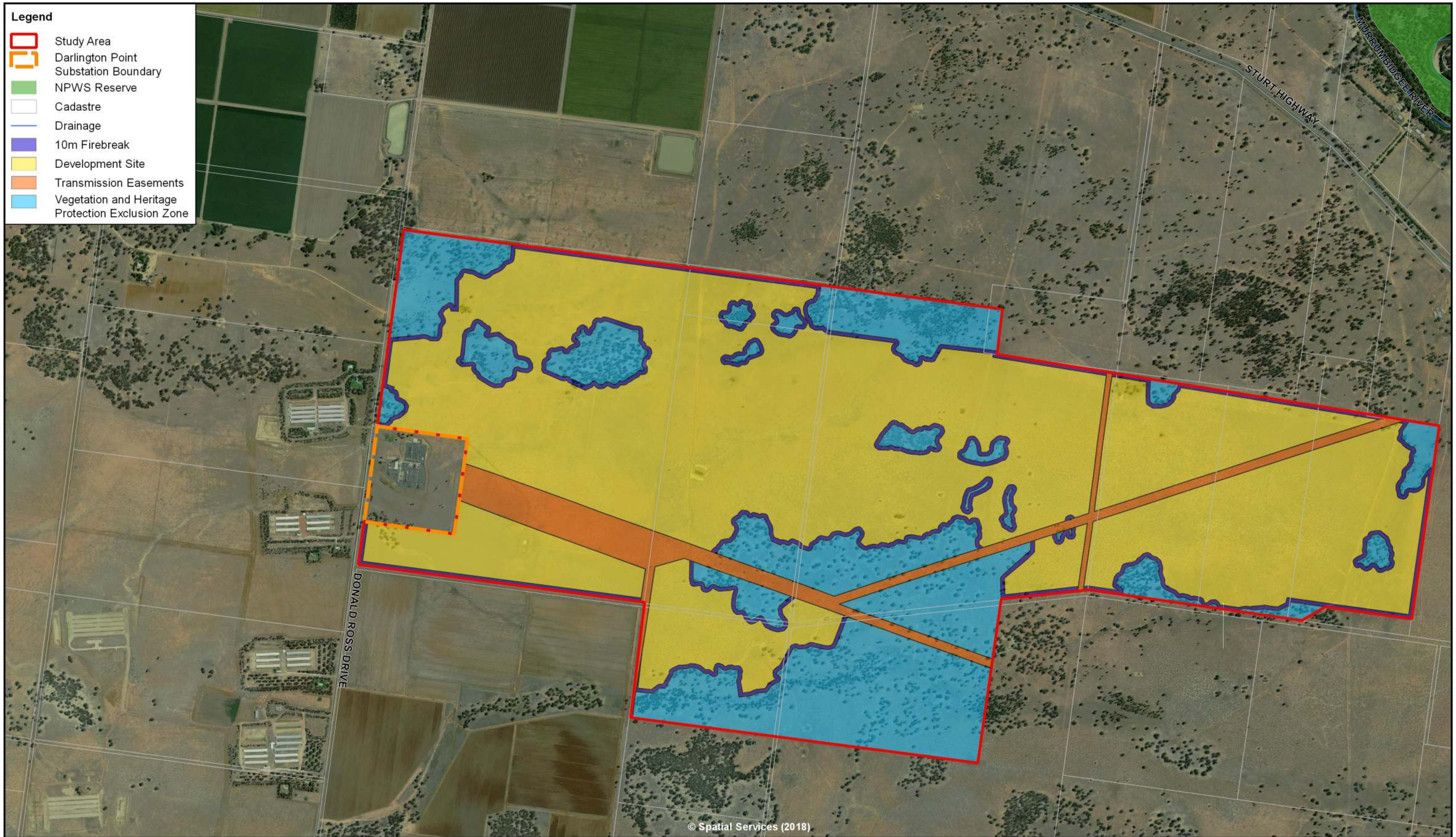
The purpose of this BAR is to describe the existing environment within the study area and the potential extent of the impact of the project on biodiversity within the development site. This BAR assesses the impact of the project under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It should be noted that the project was determined on 16th July 2018 by the Commonwealth to not be a controlled action.

The *Biodiversity Conservation Act 2016* (BC Act) came into force on 25th August 2017 and now supersedes the *Threatened Species Conservation Act 1995* (TSC Act). The BC Act requires all types of developments (Part 4 and Part 5 developments) to be assessed as to whether biodiversity offset scheme is to be applied. For all Major Projects the Biodiversity Offset Scheme applies.

However, a transitional arrangement has been implemented by the Office of Environment and Heritage to allow major project development applications to be considered under the previous TSC Act if they have substantially commenced before the 25th August 2017. Therefore, this project continues to be assessed under the FBA methodology (Office of Environment and Heritage, 2014a).

The objectives of the BAR are as follows:

- Undertake field surveys and vegetation condition mapping in accordance with the Framework for Biodiversity Assessment Methodology (2014a);
- Description of the biodiversity values that will be impacted and require offsets using the FBA; and
- Calculate the BioBanking Credits using the FBA methodology that are required to offset biodiversity impacted as a result of the project.



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 20 000
Job Ref:	11299

0 250 500 750 1000 Metres

Map Projection: GDA 1994 MGA Zone 55

Figure 1-2 **Proposed Development Site Location**

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS
ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20171219_11299_ARUP_Figure1_2_V03.qgs

1.3 Secretary's Environmental Assessment Requirements and agency requirements (SEARS)

This BAR has been prepared to satisfy the Secretary's Environmental Assessment Requirements (SEARs) provided by the Department of Planning and Environment (DP&E). The SEARs for this project were issued on 9th May 2017 (SSD 8392).

As part of the SEARs, the OEH outlined biodiversity and offsetting issues to be addressed for inclusion into the EIS. Project-specific Environmental Assessment Requirements issued by OEH in relation to threatened biodiversity that require assessment have been included in the BAR and include the following:

Fauna Species

- *Anthochaera phrygia* (Regent Honeyeater)
- *Circus assimilis* (Spotted Harrier) – nest trees only
- *Falco hypoleucos* (Grey Falcon) – nest trees only
- *Falco subniger* (Black Falcon) – nest trees only
- *Hieraaetus morphnoides* (Little Eagle) – nest trees only
- *Lophochroa leadbeateri* (Major Mitchell's Cockatoo) – nest trees only
- *Lophoictinia isura* (Square-tailed Kite) – nest trees only
- *Ninox connivens* (Barking Owl) – nest trees only
- *Polytelis swainsonii* (Superb Parrot) – nest trees only

Flora Species

- *Caladenia arenaria* (Sand-hill Spider Orchid)
- *Convolvulus tedmoorei* (Bindweed)
- *Diuris sp.* (Oaklands, D.L. Jones 5380) (Oaklands Diuris)
- *Lepidium monoplocoides* (Winged Peppercress)
- *Leptorhynchos orientalis* (Lanky Buttons)
- *Pilularia novae-hollandiae* (Austral Pillwort)
- *Sclerolaena napiformis* (Turnip Copperburr)
- *Swainsona plagiotropis* (Red Darling Pea)
- *Swainsona sericea* (Silky Darling Pea)

Endangered Ecological Communities

- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions

- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes

1.4 Definitions

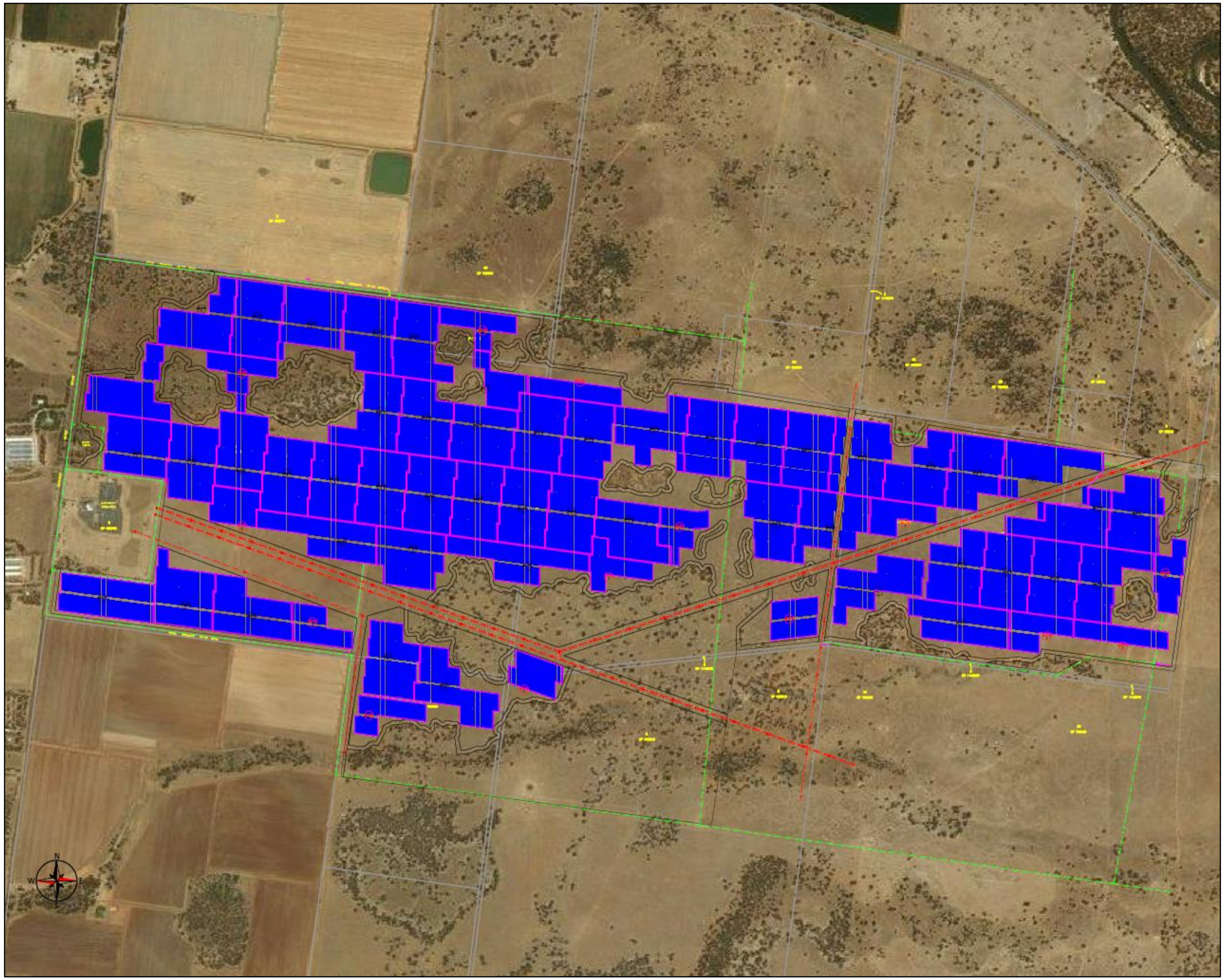
For the purposes of this BAR, two main types of areas are referred to. These are the "Study Area" and the "Development Site".

The Study Area was provided by Edify and covered the original maximum potential extent of the project. Seasonal biodiversity surveys have been completed throughout the study area in order to define the biodiversity values, inform biodiversity constraints and inform project avoidance measures. In this context, "Study Area" is similar to the definition in the FBA methodology however it extends much further in some instances than any direct or indirect impacts are likely to occur, because the project design has been modified to avoid large biologically important parts of the study area completely. The Study Area also includes two areas that weren't actually surveyed and will not be affected by the project, due to early site boundary discrepancies.

The Development Site is a term specified in the FBA methodology. The FBA methodology states that the Development Site is "*an area of land that is subject to a proposed Major Project that is under the EP&A Act".* Once the biodiversity surveys were completed within the study area, the design of the project was altered to avoid key biodiversity characteristics. The Development Site (for which impacts are to be offset in accordance with the FBA methodology) for the purposes of this report is only the area to be impacted by the project. For this BAR, the Development Site and the Development Footprint (in accordance with the FBA methodology) terminology is interchangeable. This is because the FBA methodology defines Development Footprint as "*the area of land that is directly impacted on by a proposed Major Project that is under the EP&A Act, including access roads, and areas used to store construction materials".* The Development Site for the purposes of this BAR includes all impacts associated with the project, including direct impacts (roads, firebreaks, switchyard, office and car park, battery facility, inverters and hardstand, piles) and indirect impacts (panel area, inter-panel area and surrounding areas within the solar array but not proposed to be altered by the project).

The Development Site is consistent with the indicative layout provided by Edify, as reproduced in Figure 1-3 below. The impact calculations provided by Edify of impact areas within the Development Site are based upon this indicative layout.

Figure 1-3 Indicative Project Layout and Development Site



1.5 Personnel and Licensing

The field surveys, BioBanking calculations and reporting completed for this BAR were conducted by a qualified biodiversity team. The personnel and their qualifications and roles are provided in Table 1-1.

Table 1-1 Personnel

Personnel	Qualifications	Position	Role
Toby Lambert	BEnvSc Accredited BioBanking Assessor No. 0034 Accredited BAM Assessor	Director – Ecology and Principal Ecologist	Project Manager BioBanking Calculations and Credit Review Technical Review Reporting
Deborah Landenberger	BSc (Hons) Accredited BioBanking Assessor No. 0158	Senior Ecologist	BioBanking Field Surveys BioBanking Calculations Flora Surveys Fauna Surveys Reporting
Dr Alan Midgley	BEnvMgt & Sc (Hons) PhD Accredited BAM Assessor	Ecologist / Bush Regenerator	BioBanking Field Surveys Targeted Flora Surveys Fauna Surveys Reporting
Kate Tierney	BEnvSc BLaws GDLP Accredited BAM Assessor	Ecologist	Targeted Flora Surveys Fauna Surveys
Amanda Lo Cascio	BSc MEnv	Bat Call Analyst	Analysis of Anabat bat call data

All personnel are licensed to conduct field surveys in accordance with a *National Parks and Wildlife Act 1974* (NP&W Act) Section 132 (c) Scientific Licence (SL100772) and the Department of Industries Animal Research Authority.

1.6 Investigative Approach

The BAR has sought to establish the likely impact of the solar farm on biodiversity values of the Development Site based on the specific site characteristics and development details and using the best available scientific and ecological resources. The impact assessment has been undertaken in accordance with the FBA.

The indicative design of the project has sought to avoid impact on wooded areas of the site, with the majority of the development footprint located within areas of Riverine Plains Grassland in varying conditions.

It is noted that the nature of the solar array structure that covers the majority of the solar farm area, is that it is supported on narrow steel piles that have limited direct impact on the ground. The panels will operate on a single access tracking system which will mean that shading under the panel area is variable over the course of the day. Significant space between adjacent rows also limits inter row shading. As such, assessing the actual impact of a solar panel array is not a straightforward exercise.

During the course of the project it became evident that there were some complex issues associated with the potential impacts upon native grassland as a result of installation of the solar panels and operation of the solar farm. Such issues revolved around factors such as:

- Existing use of the native grassland over many decades for stock grazing and the impacts such grazing and other existing agricultural use of the native grassland might already be having upon grassland integrity and growth;
- How seasonal and weather conditions impact growth of the native grassland and components;
- What impact installation of the solar panels and associated aspects might have on the native grassland and use of the grassland habitat by fauna;
- Might there be negative, neutral or positive impacts to the native grassland as a result of the solar panel installation;
- What impacts factors such as shading from the solar panels might have on the native grassland; and
- Are there opportunities to work with the ecology and natural seasons of the native grassland to avoid or minimise negative impacts while still being able to construct and operate the solar farm.

There are many examples of European and American solar projects resulting in a significant gain in biodiversity through approaches such as using native grass and herb seed mixes. Such seed mixes are now commercially available overseas specifically for solar projects due to their success in increasing native biodiversity while still allowing the project to be constructed and operated. Such international and Australian-based grassland studies / research of relevance are discussed further in Section 7.

There are no known specific project examples in Australia which have sought to quantify the indirect impacts of solar farm operation with a focus on Riverine Plains Grasslands or indeed native grasslands in general.

Riverine Plains Grassland does however have a long history of supporting the livestock grazing industry, and as such there is a depth of agricultural industry knowledge and scientific assessment available to understand and optimise grassland growth and management. This includes significant research on the biodiversity outcomes which ceasing grazing can have on these grasslands.

Therefore, technical input from Dr Jeff McCormick, Lecturer in Agronomy, Charles Sturt University and Dr Peter Orchard, Adjunct Senior Lecturer and Visiting Scientist Graham Centre for Agricultural Innovation, Charles Sturt University was sought to provide advice on the what impacts the construction and operation of a solar farm would be likely to have on the Riverine Plain Grasslands diversity, persistence and structure as well as the effect that targeted management practices would have on the grassland.

The results of the Charles Sturt University (CSU) technical report (McCormick & Orchard 2018, see Appendix 9) were used to aid in determining the likely overall ecological impacts to the native grasslands by EPS and to develop the site management plan and resultant calculation of biodiversity offset requirements as reported within this BAR.

It is to be followed by a wide range of proposed measures such as management of the grasslands to maximise native diversity, provision of appropriate biodiversity offsets and funding of continuing research and monitoring to better understand the outcomes upon biodiversity resulting from the project.

2 LEGISLATIVE CONTEXT

The following information outlines legislation that is applicable to the project.

2.1 Commonwealth

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The primary objective of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to 'provide for the protection of the environment, especially those aspects of the environment that are Matters of National Environmental Significance' (MNES). Environmental approvals under the EPBC Act may be required for an 'action' that is likely to have a significant impact on Matters of NES being:

- World Heritage Areas;
- National Heritage Places;
- Ramsar wetlands of international importance;
- Nationally listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth marine areas;
- Nuclear actions;
- Great Barrier Reef Marine Park; and
- A water resource in relation to coal seam gas development and large coal mining development.

Of potential relevance to the development site are nationally listed threatened species, ecological communities and listed migratory species. The MNES are assessed using the DoEE Matters of National Environmental Significance Significant impact guidelines 1.1 (Department of the Environment 2013). Conclusions are then reached in regard to whether a controlled action is likely and whether a referral to DoEE is required.

It should be noted that the project was determined on 16th July 2018 by the Commonwealth to not be a controlled action and requires no further assessment by DoEE.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

Under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), outlines the process in which a project can be declared a State Significant Development (SSD) by either a State Environmental Planning Policy or a Ministerial Order. The Minister of Planning is the consent authority for SSD. An Environmental Impact Statement (EIS) must be prepared and submitted to the Department of Planning. Before submission of the EIS the Department of Planning issues the Secretary's Environmental Assessment Requirements (SEARs) which outlines the environmental impacts that are required to be addressed. The SEARs require that the proponent apply the Framework for Biodiversity Assessment (FBA) to assess impacts to biodiversity.

Under the FBA a Biodiversity Assessment Report (BAR) is required to describe the environmental values on the site. A Biodiversity Offset Strategy (BOS) is required to outline the biodiversity offsets that are proposed to offset the project.

This project has been declared as a Major Project and will be assessed under the FBA as required in the SEAR's.

2.2.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The TSC Act is integrated with the EP&A Act and requires consideration of whether a development (Part 4 of the EP&A Act) or an activity (Part 5 of the EP&A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat. As the project is being assessed under the FBA process, a determination as to whether a 'significant impact' is not required.

The TSC Act was repealed in 2016 with the introduction of the *Biodiversity Conservation Act 2016*. Assessment under the new *Biodiversity Conservation Act 2016* is not required as this project is being assessed under the transitionary arrangements defined in the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*.

2.2.3 Biosecurity Act 2015

The *Biosecurity Act 2015* (BSA Act) has replaced the *Noxious Weed Act 1993* and all previously noxious weeds are now regulated by the BSA Act. Noxious weeds are renamed as priority weeds and are now regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. These weeds reduce diversity of native plant and animal species. The BSA Act is implemented and enforced by the Local Control Area for the Local Government Area (LGA).

2.2.4 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fisheries resources for the benefit of the state. These include conserving of key fish habitats, threatened aquatic species, populations and communities listed on the FM Act including Marine vegetation. The aims also include to promote ecologically sustainable development, viable commercial and recreational fishing, share fish resources and provide social and economic benefits for the wider community.

If a project is likely to harm or damage threatened species, populations or ecological communities and its habitat or damage critical habitat a licence is required under Section 220ZW of the FM Act.

3 METHODOLOGY

3.1 Database Review

A list of threatened species, populations and ecological communities that had been previously reported or modelled to occur within a defined radius of the study area was obtained by undertaking a search of the following online and publicly accessible databases. Preliminary database searches were undertaken on 29th March 2017. An assessment of the likelihood of occurrence for the threatened flora and fauna species recorded by the desktop assessment database searches are provided in Appendix 4.

3.1.1 Commonwealth

The investigation area or defined radius in which the federal search was undertaken included a 20 km radius of the study area.

- Commonwealth Department of the Environment Protected Matters search tool http://www.environment.gov.au/epbc/pmst/index.html; and
- Review of Weeds of National Significance (WONS) http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html.

Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are ecosystem that are wholly dependent or partially dependent on groundwater for their water requirements (Hatton & Evans, 1998). The Bureau of Meteorology have developed a search engine with the latest information on the location and characteristics of GDEs within Australia. This atlas provides mapping of known and predicted GDEs.

A database search of the Australian Atlas of Groundwater Dependent Ecosystems (BOM, 2017 http://www.bom.gov.au/water/groundwater/gde/map.shtml) was conducted to determine if the vegetation within or in the vicinity of the study area is groundwater dependent.

3.1.2 State

The investigation area, or defined radius in which the state search was undertaken included an entire search of all 'known', 'predicted' and 'recorded' species surrounding the study area. As a result, the 'recorded' species information includes sightings/records from this entire search area. The searches included threatened communities, Key Threating Processes (KTPs) and critical habitat. The raw data is provided in Appendix 1. The following database searches were conducted for the Project:

- NSW BioNet, 20km search - http://www.bionet.nsw.gov.au/;
- PlantNet 25 km buffer around Darlington Point - http://plantnet.rbgsyd.nsw.gov.au/search/spatial.htm;
- OEH Critical habitat register http://www.environment.nsw.gov.au/criticalhabitat/criticalhabitatprotectionbydoctype.htm; and
- Department of Primary Industries aquatic records viewer for Griffith LGA - http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer.

3.2 Literature Review

The following literature and reports were reviewed to inform this BAR:

- Preliminary Environmental Investigation (PEI) for Darlington Point Solar Farm (ARUP, 2017)
- Broad Scale Vegetation of Central Southern NSW (Office of Environment and Heritage, 2011);
- Plains Wanderer Habitat Mapping (Roberts, 2001)
- Department of Primary Industries Noxious weed for Griffith LGA Control (2017b) Area http://weeds.dpi.nsw.gov.au/WeedDeclarations?RegionId=153;
- Threatened Species, Populations, and Ecological Communities of NSW - http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx;
- OEH Vegetation Information System: Classification database (2015);

3.3 Consultation with OEH

Initial contact via phone conversation was made with Peter Ewin (Senior Team Leader Planning, South West) at the Office of Environment and Heritage (OEH) on 7th April 2017 to discuss the project and the biodiversity approach. Representatives for the project and EPS discussed the biodiversity aspects of the project on 27th April 2017 and 12th May 2017 with Peter Ewin. This was followed up by Peter Ewin inspecting the site on 24th July 2017 and a follow-up discussion on 1st August 2017.

Ongoing consultation with OEH is occurring to ensure that potential impacts to the project will be adequately offset to address the FBA assessment guidelines.

3.4 Field Surveys

The field surveys for the project were undertaken throughout the following periods:

- Five days from 3rd April to 7th April 2017;
- Seven days from 5th September to 11th September 2017; and
- Six days from 5th November to 10th November 2017.

The methodology used for the field survey is provided in the sections below.

3.4.1 Weather Conditions

Table 3-1 provides a summary of the weather conditions recorded at the Griffith weather station during the field surveys. Survey weather conditions consisted of the following:

- 3rd April to 7th April 2017 - cool to moderate temperature with no rain;
- 5th September to 11th September 2017 – very cool and windy to moderate temperature with no rain; and
- 5th November to 10th November – a single night-time rain event followed by clear mild to warm temperatures.

Table 3-1 Weather Conditions

Date	Temperature (C^0)	Wind Direction	Wind Speed Km/hr	Rain (mm)
03/04/2017	11-26°C	ENE	13	No Rain
04/04/2017	10-25°C	ENE	24	No Rain
05/04/2017	10-25°C	ESE	24	No Rain
06/04/2017	10-26°C	ESE	19	No Rain
07/04/2017	10-27°C	NE	19	No Rain
05/09/2017	5.4-15.2°C	WNW	35	No Rain
06/09/2017	4.8-15.1°C	WNW	28	No Rain
07/09/2017	2.0-17.2°C	W	24	No Rain
08/09/2017	5.3-16.5°C	WSW	31	No Rain
09/09/2017	1.5-17.7°C	W	22	No Rain
10/09/2017	-0.1-19.6°C	WNW	15	No Rain
11/09/2017	2.4-25.0°C	NW	13	No Rain
05/11/2017	3.9-27.7°C	E	13	No Rain

Date	Temperature (C^0)	Wind Direction	Wind Speed Km/hr	Rain (mm)
06/11/2017	12.5-23.6^{0}C	E	9	10.4mm
07/11/2017	7.8-22.8^{0}C	SSW	20	No Rain
08/11/2017	7.3-25.9^{0}C	SE	15	No Rain
09/11/2017	9.2-28.5^{0}C	NE	13	No Rain
10/11/2017	13.1-31.^{0}C	E	17	No Rain

*Weather conditions recorded by the Bureau of Meteorology at the Griffith Weather Station

3.5 Flora Survey Methods

3.5.1 BioBanking Survey Plot Methodology

The flora surveys were conducted using a number of methodologies as outlined below:

- Review of aerial photographs to assist in stratifying the study area and development site into vegetation types;
- BioBanking / FBA plots in accordance with the BioBanking Assessment methodology (Office of Environment and Heritage 2014b); and
- Assigning vegetation communities into Plant Community Types in accordance with the Office of Environment and Heritage VIS classification database version 2.1.

Thirty BioBanking plots were conducted in the study area and the following information was collected:

The BioBanking plots and transects comprise of a nested plot of a 20 x 20 m quadrat, nested within a 20 x 50 m plot and randomly placed within each vegetation zone. The BioBanking transect and plots data collected was conducted in accordance with the BBAM methodology as outlined below.

One 20m x 20m quadrat included the following:

1. Photographs;
2. GPS location of four corners of quadrat;
3. Identification of all plant species;
4. Abundance cover of individual species;
5. Abundance rating – counts of individual species;
6. Stratum and Layer in which species occurs;
7. Growth form of each individual species; and

8. Height, percentage foliage cover for dominant species in each floristic layer.

One 20 m x 50 m transect included the following;

1. Orientation of transect;
2. Photographs;
3. GPS location of start and end of transect;
4. Where practical mark beginning of transect;
5. Percentage foliage canopy cover;
6. Percentage foliage mid storey cover;
7. Percentage Native ground cover grasses;
8. Percentage ground cover shrubs <1m;
9. Percentage exotic species cover;
10. Percentage ground cover other (i.e. herbs);
11. Number of trees with hollows >5 cm in diameter; and
12. Length of fallen timber in metres with a diameter >10cm

3.5.2 Vegetation Zone Delineation and BioBanking Plots

The entire study area was initially inspected via vehicle to provide a preliminary assessment of the vegetation and the potential number of Plant Community Types (PCTs) and their condition in accordance with the Framework for Biodiversity Assessment Methodology (Office of Environment and Heritage 2014a).

The vegetation was mapped, with each community assigned to PCTs in accordance with VIS Classification database (Office of Environment and Heritage, 2015).

Table 3-2 outlines the zones for each PCT and the number of BioBanking plots completed. Table 3-3 outlines the GPS co-ordinates for the BioBanking Plots (Figure 4-4 in the next section shows the BioBanking plot locations overlayed over the Plant Community Types).

Table 3-2 PCTs, Zones and BioBanking Plots Completed

PCT Type	Condition	Area (ha) within study area	Number plots required by BBAM	BioBanking Plots Completed
Plains Grass grassland on alluvial mainly clay soils in the Riverina and NSW South-western Slopes Bioregions (PCT 45)	moderate to good - moderate	782 ha	7	9
Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina and Murray Darling Depression Bioregions) (PCT 16)	moderate to good - moderate	135 ha	6	8
Weeping Myall open woodland of the Riverina and NSW South-western Slopes Bioregions (PCT 26)	moderate to good - high	6 ha	3	5
Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South-western Slopes Bioregions (PCT 75)	moderate to good - moderate	16 ha	3	3
Plains Grass grassland on alluvial mainly clay soils in the Riverina and NSW South-western Slopes Bioregions (PCT 45)	moderate to good - poor	43.13 ha	3	3
White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT 28)	Moderate to good moderate	5.2 ha	3	2*

* This zone will not be impacted by the project and does not require strict adherence to the plot number requirement

All of the patches of White Cypress Pine open woodland will be retained as part of the project (within the Vegetation and Heritage Protection Zones) and are located outside of the development site for which the BioBanking calculation has been completed. As this PCT will not be impacted upon, the missing quadrat is unlikely to have an impact upon biobanking credit calculations as no credits are required to offset this PCT. Only the land within the development site will be developed, with a perimeter fence surrounding the development site to ensure no accidental clearing can occur.

Table 3-3 BioBanking Plot Locations

Date	Flora survey Type	Orientation of plot (degrees)	Eastings GDA55	Northings GDA55
Entire Survey Period	Random meanders and vegetation mapping	Entire study area	-	-
04/04/2017	Opportunistic survey and initial site assessment	Entire study area	-	-
04/04/2017	BioBanking Plot 1	61°	411790	6166626
04/04/2017	BioBanking Plot 2	150 °	412635	6166478
04/04/2017	BioBanking Plot 3	199 °	412627	6166089
04/04/2017	BioBanking Plot 4	8°	412860	6165542
04/04/2017	BioBanking Plot 5	264°	411985	6165089
04/04/2017	BioBanking Plot 6	124 °	415527	6165473
04/04/2017	BioBanking Plot 7	171 °	417085	6165476
04/04/2017	BioBanking Plot 8	242 °	416920	6165018
05/04/2017	BioBanking Plot 9	11°	415594	6164822
05/04/2017	BioBanking Plot 10	190 °	415123	6165090
05/04/2017	BioBanking Plot 11	259 °	414860	6165335
05/04/2017	BioBanking Plot 12	225 °	414873	6164929
05/04/2017	BioBanking Plot 13	224 °	414490	6164803
05/04/2017	BioBanking Plot 14	38 °	414266	6164433
05/04/2017	BioBanking Plot 15	304 °	413801	6164086
05/04/2017	BioBanking Plot 16	287 °	412911	6164164
05/04/2017	BioBanking Plot 17	19 °	413575	6164908
05/04/2017	BioBanking Plot 18	55 °	413322	6166257
05/04/2017	BioBanking Plot 19	25°	413792	6166230
05/04/2017	BioBanking Plot 20	98 °	413912	6165834
06/04/2017	BioBanking Plot 21	294°	414320	6166036
06/04/2017	BioBanking Plot 22	50 °	414281	6165588
06/04/2017	BioBanking Plot 23	44 °	414772	6165579
06/04/2017	BioBanking Plot 24	96 °	416930	6164664
06/04/2017	BioBanking Plot 25	6 °	413026	6166253
06/04/2017	BioBanking Plot 26	147 °	416458	6165353
06/04/2017	BioBanking Plot 27	140 °	416066	6165103
06/04/2017	BioBanking Plot 28	46 °	412968	6166461
06/04/2017	BioBanking Plot 29	90 °	411420	6166006
06/09/2017	BioBanking Plot 30	267^0	413323	6166256

3.5.3 Targeted Flora Surveys

Targeted seasonal flora surveys were conducted for the flora species identified by the BioBanking Calculator as species credit species that require targeted surveys in the study area. Species requiring further consideration in the SEARs were also targeted. A summary of the survey effort is provided in Tables 3-4 and 3-5.

Targeted surveys were conducted from the 5th - 11th September 2017 and 5th - 10th November 2017 for target species. Figure 3-1 and Figure 3-2 show the transects used to target these species.

Parallel transects were undertaken in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH, 2016). Due to the large area of the study area (over 900 ha) parallel transects were spaced from 50-100m in the grassland habitat.

Opportunistic surveys for all potential threatened flora species were conducted throughout the entire survey period.

Table 3-4 Targeted threatened flora species survey effort (calculator species)

Flora Species	Common Name	BC Act	EPBC Act	Flowering Period	Surveyed during flowering period Transect distance	Habitat surveyed	Survey Effort
Brachyscome muelleroides	Claypan Daisy	V	V	September to November	Yes 5th – 11th September Transect 50-100 m	Grassland and Woodland Entire Development site	110 hours
Brachyscome papillosa	Mossgiel Daisy	V	E	September to November	Yes 5th – 11th September Transect; 50-100m	Grassland and woodland Entire Development site	110 hours
Convolvulus tedmoorei	Bindweed	E	-	August to November	Yes 5th – 11th September Transect; 50-100m	Grassland and woodland Entire Development site	110 hours

Flora Species	Common Name	BC Act	EPBC Act	Flowering Period	Surveyed during flowering period Transect distance	Habitat surveyed	Survey Effort
Diuris tricolor	Pine Donkey Orchid	V	-	September to November	Yes 5th – 11th September Transect 50-100 m	Grassland and Woodland Entire Development site	110 hours
Lepidium monoplocoides	Winged Peppercress	E	E	November to February	Yes 5th – 10 November Transect 50-100 m	Woodland habitat	27 hours
Leptorhynchos orientalis	Lanky Buttons	E	-	September to November	Yes 5th – 11th September Transect 50-100 m	Grassland and Woodland Entire Development site	110 hours
Pilularia novae-hollandiae	Austral Pillwort	E	-	All Year	No Swamp habitat	-	-
Solanum karsense	Menindee Nightshade	V	V	August to December	Yes 5th – 11th September Transect 50-100 m	Grassland and Woodland Entire Development site	110 hours
Swainsona recta	Small Purple-pea	E	E	September to October	Yes 5th – 11th September Transect 50-100 m	Grassland and Woodland Entire Development site	110 hours

Table 3-5 Targeted threatened flora species survey effort (SEARs species – additional to calculator only)

Threatened Species	Flowering Period	Habitat on development site	Surveys completed
Sand-hill Spider Orchid *Caladenia arenaria*	Aug to Oct	Yes All woodland areas in development site	Parallel transect Surveys conducted in September and November.
Oakland Diuris *Diuris* sp. (Oaklands, D.L. Jones 5380)	November	Yes Yellow Box Woodland	Parallel transect Surveys conducted in November in Yellow Box Woodland.
Austral Pillwort *Pilularia novae-hollandiae*	All Year	No habitat Occurs in shallow swamps and waterways	No habitat considered to be present
Turnip Copperburr *Sclerolaena napiformis*	Nov to Feb	Yes All woodland areas in development site	Parallel transects were conducted in November.
Red Darling Pea *Swainsona plagiotropis*	Aug to Sept	Yes All woodland areas in development site	Parallel transects were conducted in September and November within the woodland.
Silky Darling Pea *Swainsona sericea*	Sept to Oct	Yes All woodland areas in development site	Parallel transects were conducted in September and November.

Table 3-6 Targeted threatened flora species survey effort (additional species considered to have potential – additional to calculator and SEARs only)

Threatened Species	Targeted Survey Period/habitat	Surveys completed	Recorded
Species Credit Species			
Slender Darling Pea (*Swainsona murrayana*)	Sept to Dec Woodland	Targeted parallel Surveys conducted in September and November Meets FBA guidelines	No

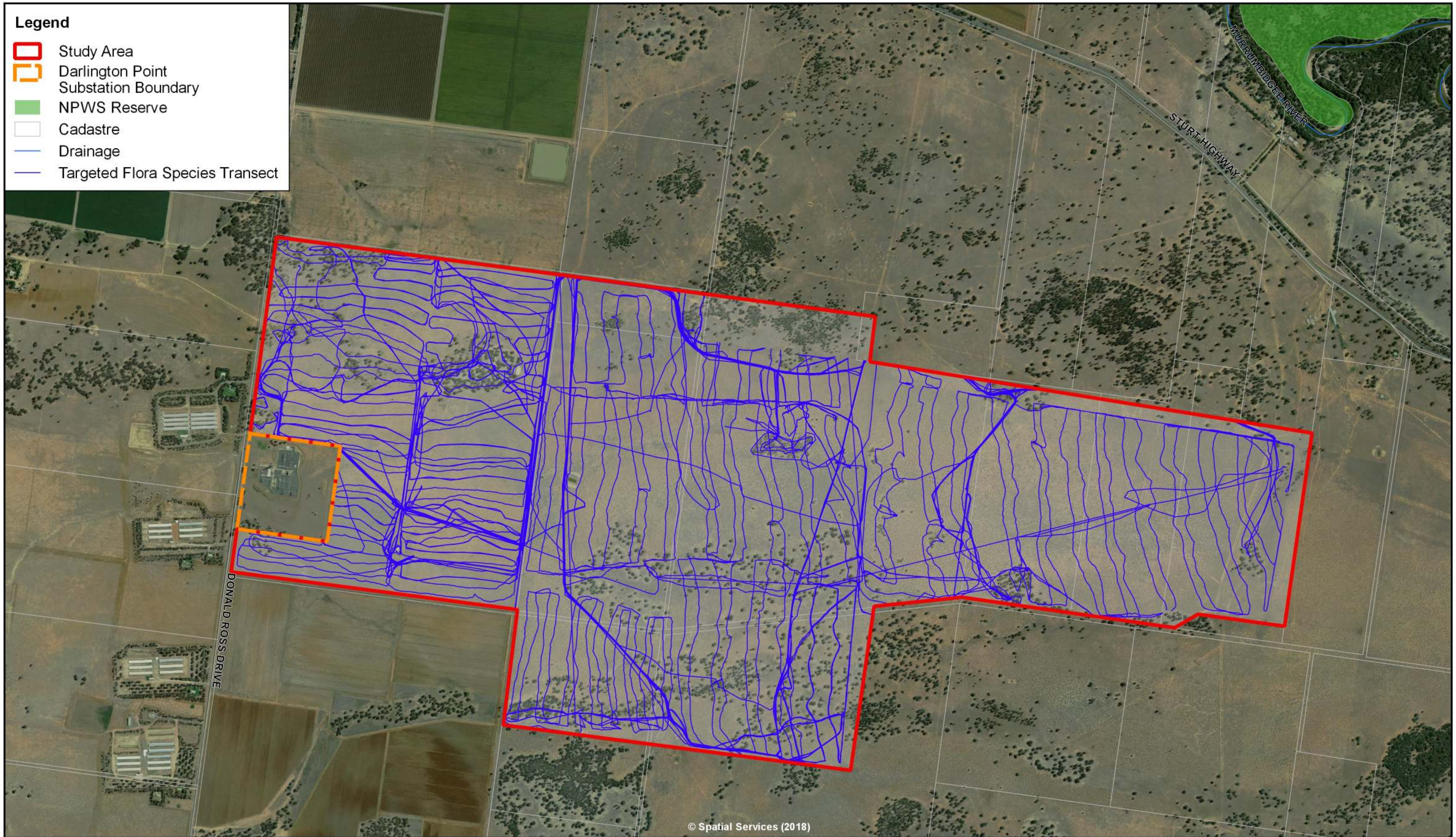
Lepidium monoplocoides

Lepidium monoplocoides predominant habitat is in the woodlands areas and has also been recorded within grassland communities. All the records recorded in the recovery plan have been in areas subject to flooding, some occur in small populations within roadside ditches. In the

Lepidium monoplocoides recovery plan it notes that this species has been recorded as flowering in both spring and summer. Extensive transect surveys have been conducted in September in both the woodland and grassland habitats. Grassland within the development site is dry and it is not regularly inundated or contain pockets of wet areas. The development site currently subject to high levels of grazing from rabbits, kangaroos, sheep and cattle and this is one of the noted high threats to this species.

Convolvulus tedmoorei

Johnson (2001) conducted a revision of the genus Convolvulus that concluded that *Convolvulus erubescens* is highly unlikely to occur in the area. Two records for *Convolvulus tedmoorei* have been recorded near the development site being from 1969. *Convolvulus erubescens* was in flower at time of survey. No seeds were recorded, however over 100 records for *Convolvulus erubescens* have been recorded within the area within a 20km x 20km radius of the development site on the OEH BioNet atlas database. This species is considered highly unlikely to occur within the development site as no records since 1969 have been recorded despite a large number of vegetation surveys being conducted by experienced botanists within Darlington Point and the wider district. Nevertheless, this species was targeted during the correct season throughout the entire study area.



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 20 000
Job Ref:	11299

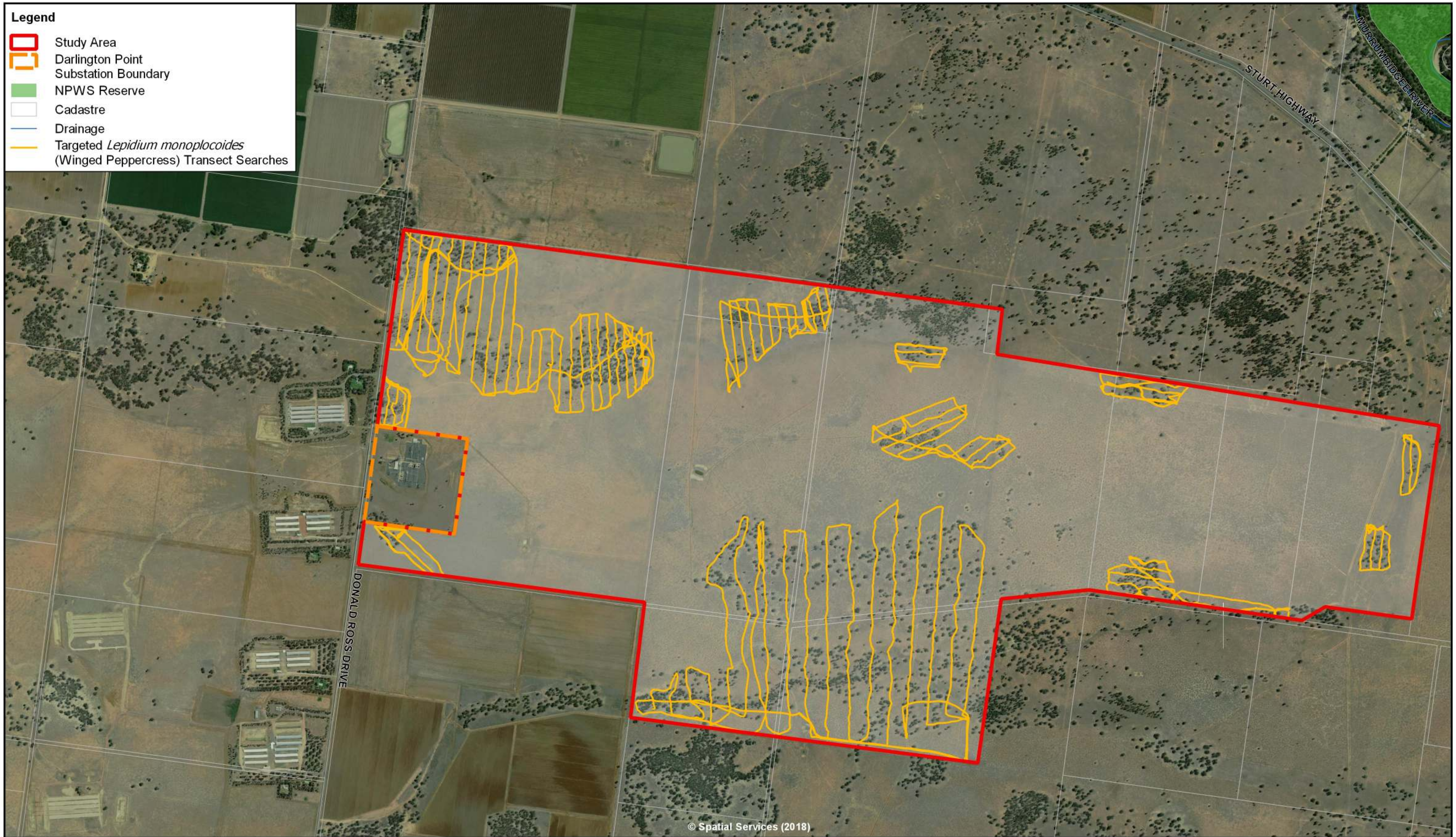
Figure 3-1 Targeted Flora Surveys (September 2017)

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure3_1_V03.qgs



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 20 000
Job Ref:	11299

0 250 500 750 1000 Metres

Map Projection: GDA 1994 MGA Zone 55

Figure 3-2 **Targeted Flora Surveys (November 2017)**

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure3_2_V04.qgs

3.6 Fauna Survey Method

3.6.1 Guidelines

The terrestrial fauna field surveys consisted of a combination of habitat assessment and targeted field surveys to identify the fauna habitat and/or recorded species within the study area. Fauna surveys included fauna habitat assessment, harp trapping, Anabat surveys, bird census, spotlighting, call playback, targeted surveys and opportunistic surveys. These surveys were generally conducted in consideration of the following guidelines:

1. NSW Threatened Biodiversity Survey and Assessment Guidelines – Working Draft (Department of Environment and Conservation 2004);
2. Survey Guidelines for Australia's Threatened Birds (Department of Environment Water, Heritage and the Arts 2010a); and
3. Survey guidelines for Australia's threatened mammals (Department of Sustainablility, Environment, Water, Populations and Communities, 2011).

3.6.2 Fauna Survey Effort

Fauna survey locations are provided in Figure 3.3. A summary of the fauna survey effort is provided in Table 3.5.

Table 3-7: Fauna Survey Effort

Dates	Survey Type	Survey effort
03-07 April 2017 05-11 September 2017 05-10 November 2017	Fauna habitat assessment and opportunistic surveys throughout study area	18 days
05-11 September 2017	Diurnal Bird census – dawn and dusk bird surveys conducted at multiple points each day	15 points surveyed dawn and dusk, approx. 20 minutes each 10-person hours
05-09 November 2017	Harp traps – 4 traps set for 5 nights	20 harp trap nights
07-10 September 2017 05-09 November 2017	Stationary Anabat surveys	Sept survey 216 Hours November survey 270 hours
09-10 September 2017 07, 09 November 2017	Spotlighting throughout woodland habitat	8-person hours

Dates	Survey Type	Survey effort
05-07 September 2017	Spotlighting throughout grassland habitat for Plains Wanderer	12-person hours
05-07 September 2017 09-10 September 2017 07, 09 November 2017	Call playback Masked Owl, Barking Owl, Bush-stone Curlew	9-person hours
05-11 September 2017	Hollow-bearing tree surveys – paddock trees only. Other treed areas not surveyed as proposed to be retained / protected.	Over 7 days
05-11 September 2017	Targeted Painted Honeyeater Surveys Random meanders over 5 days targeting mistletoes. Diurnal bird census points	Over 7 days

3.6.3 Fauna Habitat Assessment

To assess the fauna habitat present within the study area, habitat data was collected to determine the range of fauna that may utilise the area for roosting, breeding and/or foraging. Throughout the study area habitat searches involved opportunistic searches plus twenty-nine (29) habitat searches at each BioBanking plot location. At each of the fauna survey sites the following habitat attributes were recorded:

1. Presence of burrows, whitewash, owl pellets, scats, scratches and nests/drays;
2. Floristic structure of the canopy, mid stratum and ground layer;
3. Depth and composition of leaf litter;
4. Presence of rocks and rock shelves;
5. Presence of fallen timber
6. Assessment of paddock trees for potential hollows; and
7. Aquatic habitat such as depressions, farm dams and riparian vegetation.

3.6.4 Diurnal Bird Surveys

A total of thirty dawn and dusk diurnal bird surveys were undertaken at 15 survey locations. These consisted of stationary surveys for approximately 20 minutes each. Birds were identified either by call and/or observation. All birds observed and heard were recorded. Opportunistic observations and identification of calls were recorded during all other field surveys (e.g. BioBanking plots, targeted flora surveys) throughout the study area. Locations of the bird census points is provided in Figure 3-3.

Grey Falcon

The Grey Falcon is a species credit species whereby this species cannot be detected by habitat and requires targeted seasonal surveys. Consistent with the BioBanking calculator the Grey Falcon (*Falco hypoleucos*) can be surveyed throughout any time of the year. Three field surveys were conducted for the Grey Falcon during April, September and November. Surveys included nocturnal / diurnal bird surveys with opportunistic surveys during all the field survey periods. A particular focus was placed on this species known areas of habitat use, including dead branches high in Eucalypt trees and the use of abandoned nests of other birds.

Black-breasted Buzzard

The Black-breasted Buzzard is a species credit species whereby this species cannot be detected by habitat and requires targeted seasonal surveys. Riparian woodland along watercourses is not actually present within the study area but for precautionary reasons this species was retained in the BioBanking calculator for assessment purposes. More suitable habitat occurs to the north of the development site along the Murrumbidgee River. Consistent with the BioBanking calculator, the Black-breasted Buzzard (*Hamirostra melanosternon*) can be surveyed throughout any time of the year. Three field surveys were conducted for raptors including the Black-breasted Buzzard during April, September and November 2017. Surveys included nocturnal / diurnal bird surveys with opportunistic surveys during all the field survey periods. A particular focus was placed on this species known areas of habitat use, including dead branches high in Eucalypt trees (as referred to in the FBA calculator).

Glossy Black-cockatoo Riverina Population

The Glossy Black-cockatoo is a species credit species whereby this species cannot be detected by habitat and requires targeted seasonal surveys. A very low density of scattered *Allocasuarina luehmannii* (Bulloak) trees was present within the study area and so for precautionary reasons this species was retained in the BioBanking calculator for assessment purposes. Consistent with the BioBanking calculator, the Glossy Black-cockatoo (*Calyptorhynchus lathami*) can be surveyed throughout any time of the year. Three field surveys were conducted for birds including the Glossy Black-cockatoo during April, September and November. Surveys included nocturnal / diurnal bird surveys with opportunistic surveys during all the field survey periods.

Regent Honeyeater

The Regent Honeyeater is a species credit species whereby this species cannot be detected by habitat and requires targeted seasonal surveys. Generally, the areas of Black Box woodland and Yellow Box woodland provided low quality sparsely treed potential habitat for this species and there is a paucity of local records. More suitable habitat occurs to the north of the site along the Murrumbidgee River. Consistent with the BioBanking calculator, the Regent Honeyeater (*Anthochaera phrygia*) can be surveyed throughout any time of the year in the Riverina bioregion. Three field surveys were conducted during April, September and November. Surveys included nocturnal / diurnal bird surveys with opportunistic surveys during all the field survey periods.

Bird Species with a high likelihood of occurrence

Four other threatened bird species have been identified as having a high likelihood of occurrence. This assessment was based on the presence of suitable habitat (Appendix 4) using the methods outlined in Section 3.7. Other factors included a large number of recent records in the locality. Species requiring further consideration were also identified by OEH in the SEARs. These include the following:

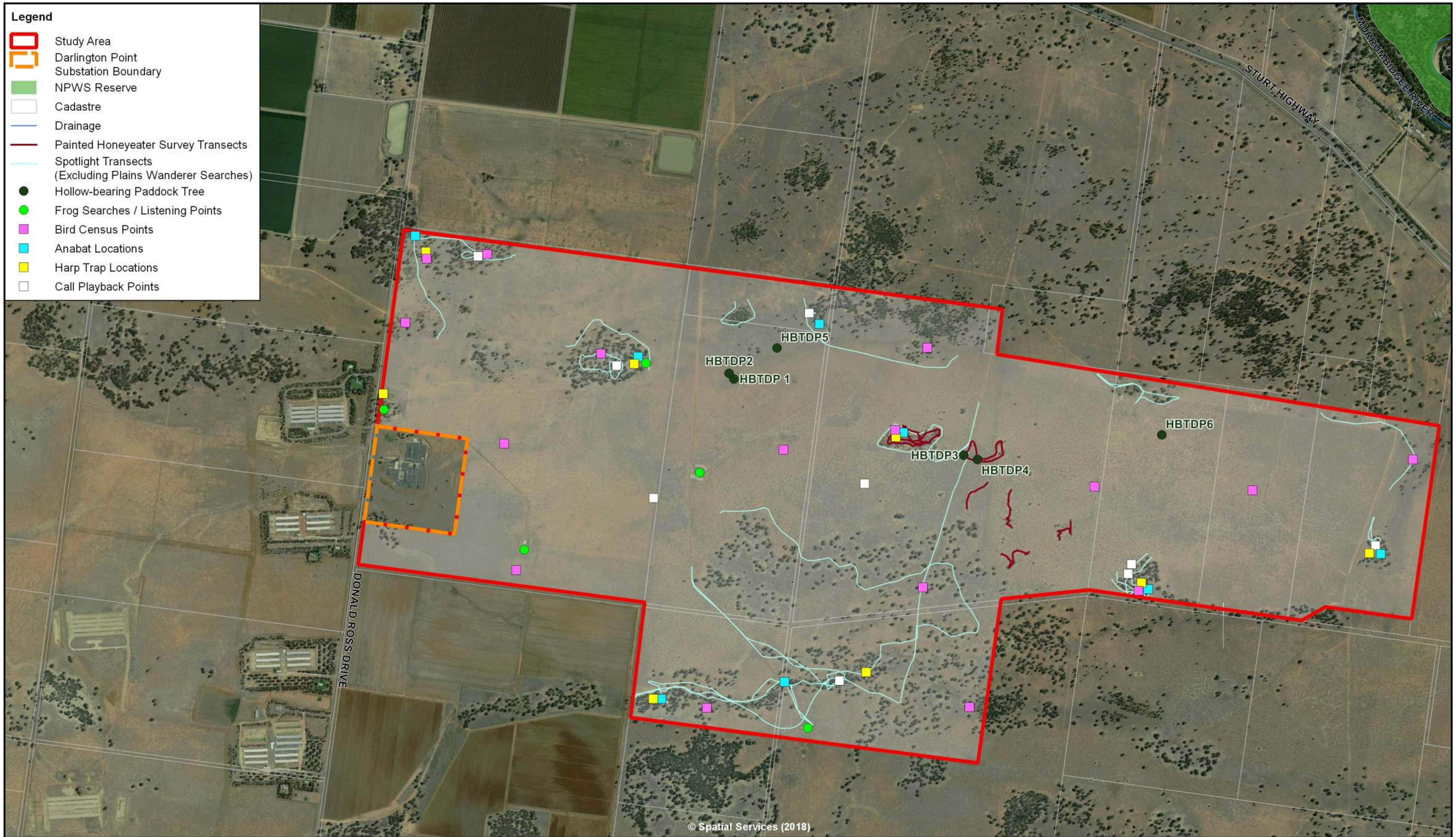
- Superb Parrot (*Polytelis swainsonii*);
- Grey-crowned Babbler (*Pomatostomus temporalis*);
- Painted Honeyeater (*Grantiella picta*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*);
- Little Eagle (*Hieraaetus morphnoides*);
- Black Falcon (*Falco subniger*); and
- Spotted Harrier (*Circus assimilis*)

Superb Parrot

A multitude of Superb Parrot records occur within close proximity to the study area along roadsides and areas of Eucalypt woodland. This species was targeted in preferred foraging habitat in Eucalypt woodland. If encountered, the location of this species was recorded with a GPS, and any nesting behaviour was noted, such as the use of tree hollows. Determination of tree hollow use by this species was limited to opportunistically observing from the ground if any individuals entered or exited a tree hollow, throughout the woodland within the study area.

Grey-crowned Babbler

Grey-crowned Babbler records also occur within close proximity to the study area. This species was targeted in preferred foraging and nesting habitat of Eucalypt woodland. If encountered, the location of this species was recorded with a GPS, in addition to any confirmed and potential Grey-crowned Babbler nests.



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 20 000
Job Ref:	11299

Figure 3-3

Fauna Survey Effort

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure3_3_V03.qgs

Varied Sittella

Varied Sittella has recent records within 1 km of the study area. This species was targeted in preferred foraging habitat of Eucalypt and *Acacia* woodland. If encountered, the location of this species was recorded with a GPS. Any cup-shaped nests that may potentially be utilised by this species were recorded.

Painted Honeyeater

Painted Honeyeater was specifically targeted in areas of preferred foraging habitat, including *Acacia pendula* (Weeping Myall) and Eucalypt woodland with flowering mistletoes of the genus *Amyema*. Random meander transects was conducted through all patches of Weeping Myall within the September field surveys. Refer to Figure 3-3 for survey locations.

Major Mitchell's Cockatoo

Major Mitchell's Cockatoo is a SEARs species requiring further consideration (nest trees only). This species was throughout woodland parts of the study area. If encountered, the location of this species was recorded with a GPS.

Little Eagle

Little Eagle is a SEARs species requiring further consideration (nest trees only). This species was throughout woodland parts of the study area. If encountered, the location of this species was recorded with a GPS.

Black Falcon

Black Falcon is a SEARs species requiring further consideration (nest trees only). This species was throughout woodland parts of the study area. If encountered, the location of this species was recorded with a GPS.

Spotted Harrier

Spotted Harrier is a SEARs species requiring further consideration (nest trees only). This species was throughout woodland parts of the study area. If encountered, the location of this species was recorded with a GPS.

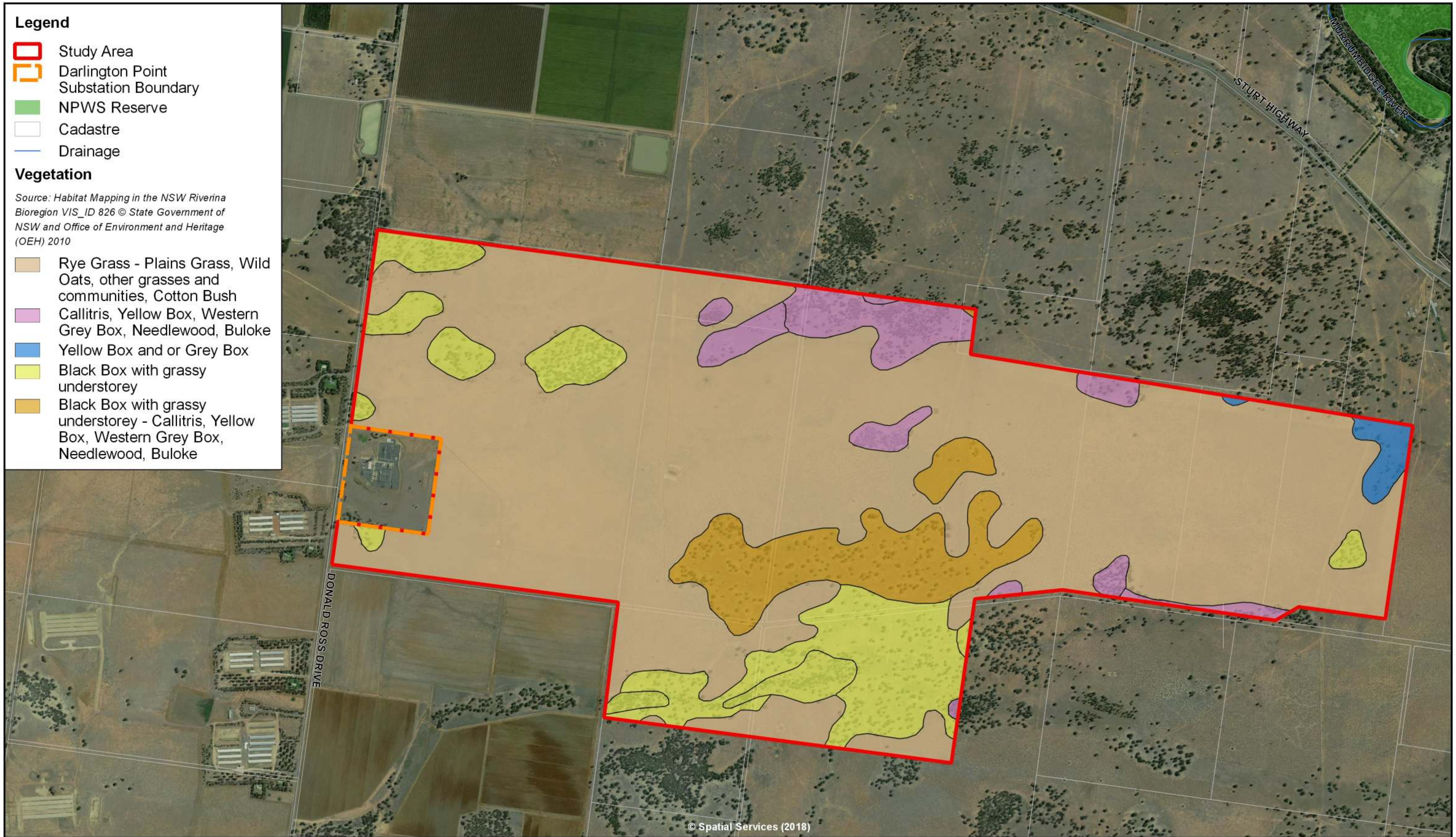
3.6.5 Nocturnal Bird Surveys

Nocturnal birds were also targeted using call playback and spotlighting. Call playback primarily targeted Barking Owl, Masked Owl and Bush Stone-curlew. Call playback was in accordance with standard methods (Debus 1995, Kavanagh & Debus 1994). At each location after the call was played a 10 to 15-minute listening period was undertaken followed by a spotlight search for the targeted species. Refer to Figure 3-3 for survey locations. Barking Owl was also listed in the SEARs as a species requiring further consideration (nest trees only).

Plains Wanderer Targeted Surveys

Habitat mapping for the Plains Wanderer has been undertaken for the Riverina region (Roberts, 2001). This project mapped the grassland within study area as being Rye grass- Plains Grass, Wild Oats, other grasses and communities and cotton bush (Figure 3-4). The habitat mapping was initially used to stratify the study area to conduct the targeted Plains Wanderer searches.

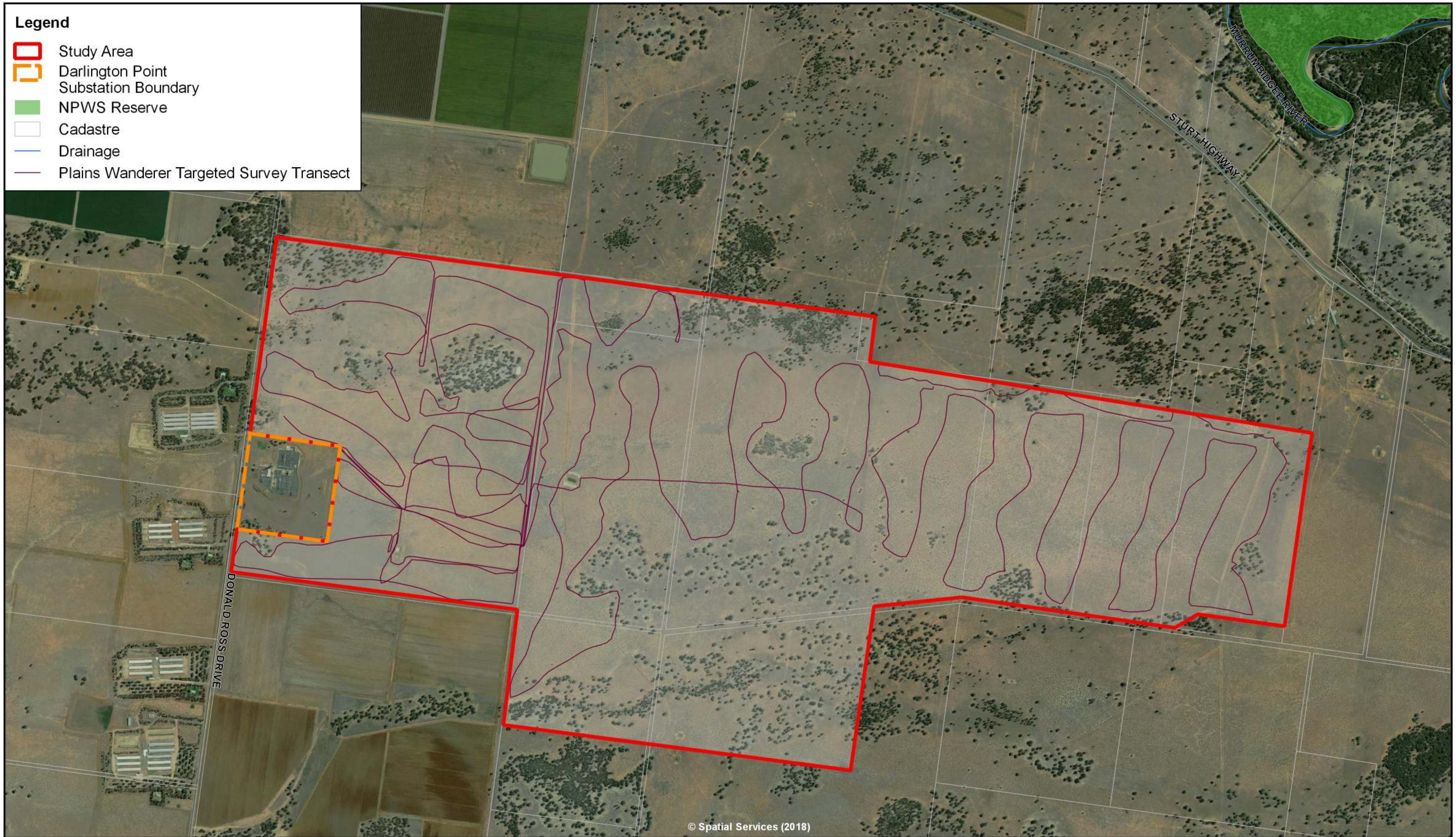
To target both Plains Wanderer and Bush-stone Curlew, nocturnal spotlighting surveys from both a moving vehicle and on foot were conducted. For Plains Wanderer, spotlighting transects approximately 200 m apart via vehicle were conducted within the grassland habitat. Vehicular transects were conducted due to the large area of native grassland (800 ha). However, where a higher diversity of native herbs and Australasian Pipits and/or Stubble Quails were flushed spotlighting on foot was conducted. The Plains Wanderer nocturnal transect searches are shown in Figure 3-5 and such surveys also maximised chances of detecting other threatened species.



Author:	S. Wilkin	0 250 500 750 1000 Metres	**Figure 3-4** **Plains Wanderer Habitat Mapping**
Reviewer:	T. Lambert		
A3 Scale:	1: 20 000		**Darlington Point Solar Farm | NSW Australia**
Job Ref:	11299	Map Projection: GDA 1994 MGA Zone 55	31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure3_4_V03.qgs



Author:	S. Wilkin	**Figure 3-5**	
Reviewer:	T. Lambert	**Plains Wanderer Targeted Surveys**	
A3 Scale:	1: 20 000	**Darlington Point Solar Farm | NSW Australia**	EPS ENVIRONMENTAL PROPERTY SERVICES
Job Ref:	11299	31 July 2018	

0 250 500 750 1000 Metres

Map Projection: GDA 1994 MGA Zone 55

3.6.6 Microchiropteran Bat Surveys

Bat surveys consisted of a combination of Anabat, Harp Trapping and Spotlighting surveys using ultrasonic Anabat detectors (Anabat Express Bat Detector - Titley Electronics, Ballina) and Harp Traps.

Stationary Anabat recorders were placed at eight sites throughout the study area (Figure 3-3) in locations of potential habitat to increase the potential of detection. These included near farm dams and within woodland / flyways.

The November Anabat surveys were performed in combination with Harp Trapping, whereby the Anabats were placed overnight adjacent to two of the harp traps. September Anabat Surveys were conducted in isolation, with no associated Harp Trapping.

Analysis of Anabat echolocation calls were completed by Amanda Lo Cascio. The call identification for the data was based on the call keys and descriptions for New South Wales (Pennay *et al.* 2004) with reference to descriptions published for southern Queensland (Reinhold *et al.* 2001).

The reliability of call identification was categorised as:

- Definite – one or more calls were there was no doubt on the identification of the species;
- Probable – most likely to be the species named, low probability of confusion with species that use similar calls; and
- Possible – call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

Harp Trapping

Harp trapping was conducted at eight different sites throughout the study area (Figure 3-3) in locations of potential habitat to increase the potential of detection. These included near farm dams and within woodland / flyways.

Harp traps were set-up prior to sunset, where they were left overnight to capture bats. The following morning, captured bats were carefully removed from the trap whilst wearing protective gloves and placed into labelled Calico bags. Bats were subsequently analysed and identified in accordance with the field ID Guide 'Australian Bats' (Churchill 2008), with a particular emphasis on determining the presence of the threatened Corben's Long-eared Bat and the Inland Forest Bat. Thereafter, captured bats were returned to the Calico bags and kept in a cool, dark place throughout the remainder of the day prior to release in the capture location after sunset.

Spotlighting

Spotlighting surveys for Yellow-bellied Sheathtail Bat were conducted by vehicle and on foot in areas of potential woodland habitat. The location of the spotlighting transects is shown in Figure 3-3.

3.6.7 Herpetofauna Searches

Herpetofauna searches were conducted during habitat assessments at BioBanking plot locations, and dams throughout the study area. Opportunistic observations of any frogs and/or reptiles were also recorded throughout the field surveys. Frogs were identified either by observation and/or calls.

3.6.8 Mammal Surveys

Nocturnal spotlighting surveys for over four nights were conducted by vehicle and on foot in areas of potential woodland habitat. Areas containing high numbers of tree hollows and blossoming Eucalypts were focused upon throughout these surveys.

Koala

The Koala is a species credit species whereby this species cannot be detected by habitat and requires targeted seasonal surveys. Generally, the areas of Black Box woodland and Yellow Box woodland provided low quality sparsely treed potential habitat for this species and there is a paucity of local records. Consistent with the BioBanking calculator, the Koala (*Phascolarctos cinereus*) can be surveyed throughout any time of the year. Three field surveys were conducted for fauna including the Koala during April, September and November 2017. Surveys included nocturnal / diurnal surveys with opportunistic surveys during all the field survey periods. In total, 18 days of specific targeted fauna surveys were completed, including for this species. Such surveys included habitat assessment, scat searches and both diurnal and nocturnal surveys.

Squirrel Glider

The Squirrel Glider is a species credit species whereby this species cannot be detected by habitat and requires targeted seasonal surveys. Generally, the areas of Black Box woodland and Yellow Box woodland provided low quality sparsely treed and sparse shrub-layer potential habitat for this species and there is a paucity of local records. Consistent with the BioBanking calculator, the Squirrel Glider (*Petaurus norfolcensis*) can be surveyed throughout any time of the year. Three field surveys were conducted for fauna including the Squirrel Glider during April, September and

November 2017. Surveys included nocturnal / diurnal surveys with opportunistic surveys during all the field survey periods. In total, 18 days of specific targeted fauna surveys were completed, including for this species. Such surveys included habitat assessment, tree scarring identification and nocturnal surveys.

3.6.9 Hollow-bearing Trees

During all survey events, all paddock trees within the Plains Grassland PCT were checked for hollows, with hollow bearing trees being recorded. For each hollow-bearing tree, the following attributes were recorded:

- Location recorded on GPS;
- Tree tagged and id number recorded;
- Tree species;
- Location of the hollow as follows:
  - Broken trunk;
  - Branch;
  - Trunk;
  - Spilt; and
  - Peel back.
- Hollow size and number:
  - Small hollow <10 cm;
  - Medium hollow 10 to 30 cm; and
  - Large hollow >30 cm.
- Diameter at breast height in cm;
- Percentage of tree dead;
- Height in metres;
- Presence of any scratches;
- Presence of any sap feeding scars; and
- Presence of any nests

3.7 Likelihood of Occurrence

To determine if threatened biodiversity has habitat within the development site four categories have been utilised as follows:

1. Low – no habitat within development site;
2. Moderate – Moderate quality habitat within the development site with limited amount of breeding, foraging and roosting habitat;
3. High – high quality habitat within the development site including breeding, foraging and roosting habitat. Previous records in close proximity or within the development site; and
4. Recorded – Species recorded during current field surveys.

An assessment of likelihood of occurrence for the threatened biodiversity recorded from the database searches is provided in Appendix 4.

3.8 Field Survey Limitations

Field surveys are conducted over a limited period of time, and not all species can be detected. These include mobile fauna species, migratory birds, fauna and cryptic flora species such as orchids and threatened fauna species that may forage or nest within the development site on a seasonal basis.

The vegetation and biobanking surveys were conducted in Autumn. While Spring is considered the ideal survey time to capture a greater number of herbaceous species, during the April surveys a greater biodiversity was observed in flowering herbs and shrubs than in the September surveys, as the development site was drier during the September period. This is shown in the BioBanking plot data, as 22 of the plot results were at or above their biobanking benchmark for floristic biodiversity in all of the vegetation zones (this excludes the poor quality grassland). Opportunistic observations of flowering species were conducted in September and November during the targeted surveys within both the grassland and woodland habitats and have been included in the reporting works. Therefore, a high number of flora species would have been detected as part of this project.

The flora and fauna species required under the BioBanking calculations have been surveyed during the appropriate season survey period for these species. The size of the development site means that not every single part of the area can be inspected in detail, but focused and targeted surveys have ensured that the areas in which threatened species had the most potential habitat were surveyed to a confident degree.

A total of 18 days (including some nights) was spent by two ecologists over three seasons across the development site. It is considered that this is an overall adequate level of survey of the development site.

4 EXISTING ENVIRONMENT

4.1 Landscape Context

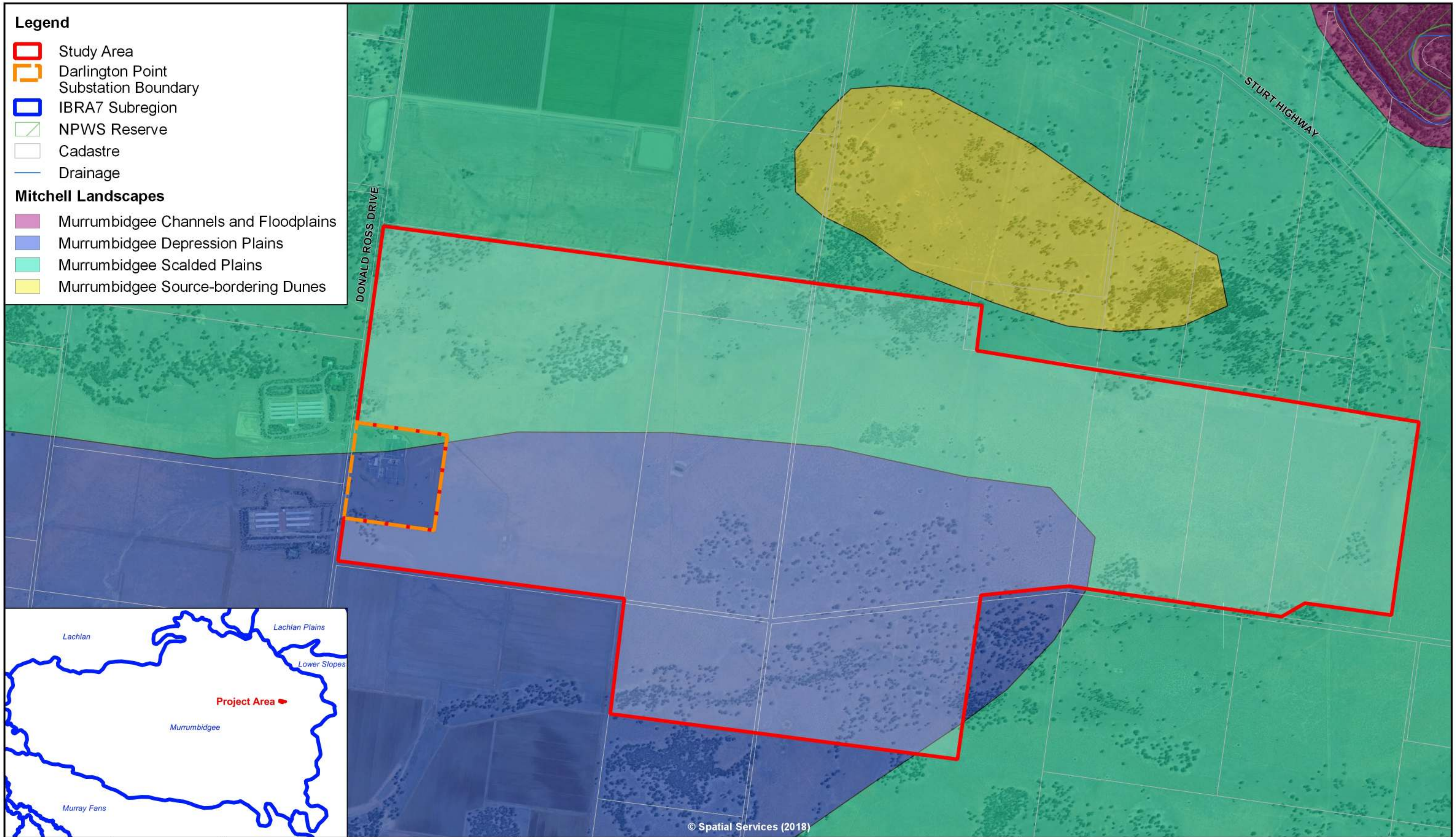
The Darlington Point Solar Farm is located within the Riverina Region of New South Wales. The development site occurs on the floodplain of the Murrumbidgee River in south western NSW. The development site occurs approximately 40 km south of Griffith at Darlington Point in the Murrumbidgee LGA.

The majority of the development site has been cleared for agricultural uses. The main land use is ongoing cattle and sheep grazing. The development site is dominated by grassland with fragmented areas of grassy woodland and open forest. Donald Ross Drive occurs along the western boundary of the development site and contains remnant native vegetation. Cropping occurs to the north west, west and south west of the development site.

A summary of the existing environment attributes is provided below in Table 4-1.

Table 4-1 Regional context

Criteria	Description
IBRA Bioregion	Riverina Bioregion Murrumbidgee Sub-bioregion
Local Government Area	Murrumbidgee Council
Botanical Region	South Western Plains
Local Land Service (Catchment Management Authority)	Riverina Local Land Service (Murrumbidgee CMA)
Mitchell Landscape (See Figure 4-1)	Majority in Murrumbidgee Scalded Plains, southern areas in Murrumbidgee Depression Plains
Elevation	20m – 100m
Geology	Quaternary alluvial deposits
Creeklines/Drainage Lines	Murrumbidgee River



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 20 000
Job Ref:	11299

Figure 4-1 **Mitchell Landscapes and IBRA Region**

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

4.2 Landscape Value Assessment

This landscape value assessment is in accordance with Appendix 4 of the Framework for Biodiversity Assessment (2014a).

4.2.1 Mitchell Landscape and IBRA subregion

Two Mitchell Landscapes occur within the development site, being Murrumbidgee Scalded Plains and Murrumbidgee Depression Plains. The dominant Mitchell Landscape, Murrumbidgee Scalded Plains was used for the landscape value assessment.

The development site is located within the Murrumbidgee IBRA sub-region.

Refer to Figure 4-1 for the locations of these areas.

4.2.2 Strategic Location

The development site does not meet any of the requirements listed in Table 10 Appendix 4 of the FBA and therefore the development site is not assessed as being in a strategic location.

4.2.3 Percent Native Vegetation Cover

Due to the area of native vegetation of the project that will be impacted on a larger assessment an inner circle size of 3,000 ha and a 30,000 ha outer assessment circle have been used to estimate the percentage native vegetation cover. A summary of the landscape assessment is provided in Table 4-2 and is shown in Figure 4-2.

Table 4-2 Percentage native vegetation

Attribute	Before Development	After Development
Outer Assessment Circle	41-45	36-40
Inner Assessment Circle	76-80	56-60

4.2.4 Connectivity Value

Connectivity of the native grassland occurs to the north, south and east of the development site. Donald Ross Drive occurs to the west of the development site in which a small area of woodland vegetation is connected to roadside vegetation. Due to the large area of connectivity of native grassland the width of connectivity is >500 m. The project will impact on a large area of the native grassland however the connectivity will remain >500m due to the extensive adjoining similar habitat .

Table 4-3 Connectivity Value

Attribute	Before Development	After Development
Connectivity Width (m)	>500	>500
Overstorey condition	PFC at Benchmark	PFC at Benchmark
Mid storey/groundlayer condition	PFC of mid-storey/ground cover at Benchmark	PFC of mid-storey/ground cover at Benchmark

4.2.5 Patch Size

Table 4-4 Patch Size

Mitchell Landscape	Percent Cleared	Area (ha) of patch	Patch size class	Patch Size Score
Murrumbidgee Scalded Plains	67%	260	>200	12

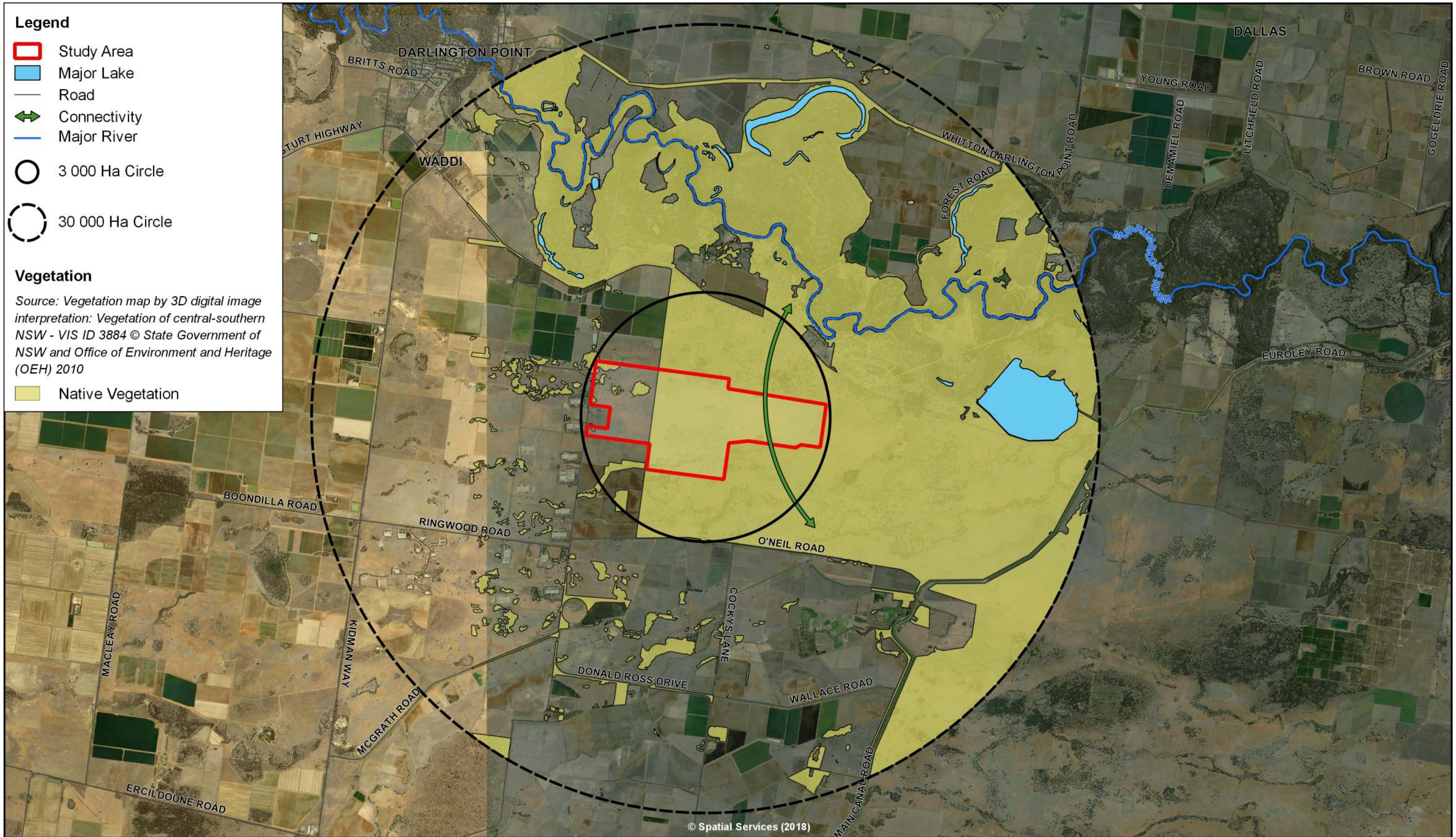
4.2.6 Geographic habitat features

Eight geographic habitat features were identified by the BioBanking calculator as follows:

- Glossy Black-cockatoo Riverina Population – Allocasuarina or Casuarina and / or tree hollows > 15 cm
- *Swainsona recta* – land containing a forb-rich grassy ground layer
- Black-breasted Buzzard – land within 40m of a riparian woodland on inland watercourses/ containing dead or dying eucalyptus
- *Lepidium monoplocoides* – land containing seasonally damp or waterlogged sites
- *Solanum karsense*- periodically flooded depressions with heavy soils
- Grey Falcon - land containing within 100 m of riparian woodland on inland rivers containing mature living eucalypts or isolated paddock trees overhanging water or dry watercourses
- *Brachyscome muelleroides* – land containing damp depressions, claypans and gilgai
- *Pilularia novea-hollandiae* – periodically waterlogged sites (including table drains and farm dams).

Periodically waterlogged sites do not occur within the development site and therefore this habitat feature for *Pilularia novea-hollandiae* does not occur.

The remaining habitat features all occur within the development site to some degree and thus they are retained in the calculator.



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 90 000
Job Ref:	11299

1 0 1 2 3 4 Kilometres

Map Projection: GDA 1994 MGA Zone 55

Figure 4-2

Landscape Value Assessment

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure4_2_V03.qgs

4.3 Plant Community Types

4.3.1 Broad Scale Vegetation Mapping

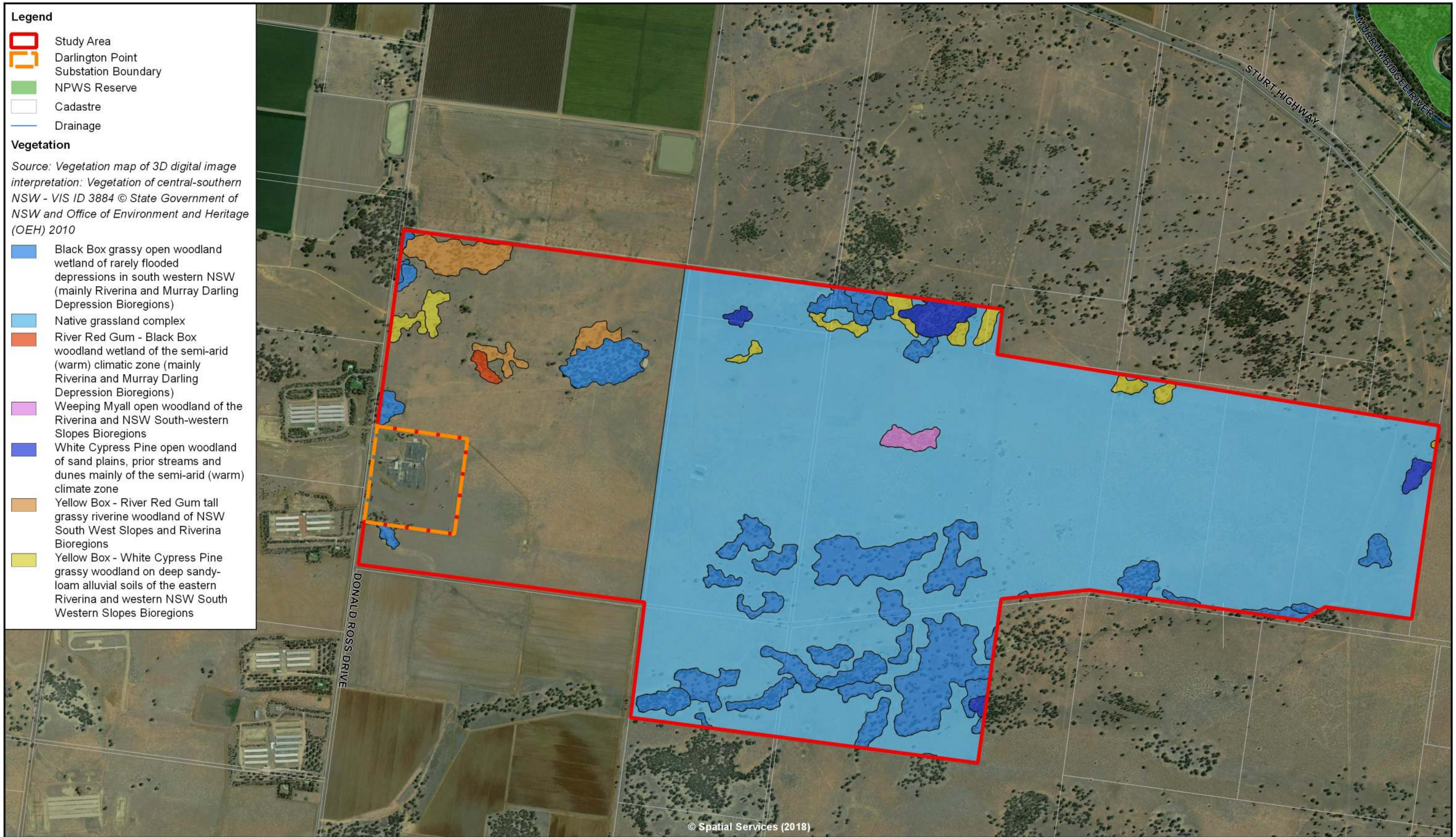
The Central South NSW Vegetation Mapping (OEH, 2011) has mapped seven vegetation communities (Figure 4-3) within the study area:

- Native Grassland Complex;
- Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW;
- Yellow Box – River Red Gum tall grassy riverine woodland of NSW South West Slopes and Riverina;
- Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregions;
- River Red Gum – Black Box woodland wetland of the semi-arid (warm) climatic zone (mainly Riverina and Murray Darling Depression Bioregion);
- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) Climate zone; and
- Weeping Myall Open Woodland of the Riverina and NSW South-western Slopes Bioregion

4.3.2 Study area Plant Community Types

Five Plant Community Types (PCTs) were recorded within the study area, in various forms and conditions. Table 4-5 below outlines the PCTs identified during the field surveys by EPS and the corresponding threatened ecological communities. Figure 4-4 shows the location and condition of the PCTs mapped within the study area. Of these, the White Cypress Pine open woodland and the Weeping Myall Open Woodland are the only PCTs that do not occur within the defined development site (as they have been avoided by the project and retained in the Vegetation and Heritage Protection Exclusion Zones) and thus these are not assigned specific zone numbers as the other PCTs are. Refer to Section 8 for areas of each management zone for affected PCTs as used in the final FBA calculation.

The field verified communities have been named in accordance with PCT terminology, the current NSW standard. A summary of each of the vegetation communities within the study area is provided in the sections below.



Author:	S. Wilkin
Reviewer:	T. Lambert
A3 Scale:	1: 20 000
Job Ref:	11299

0 250 500 750 1000 Metres

Map Projection: GDA 1994 MGA Zone 55

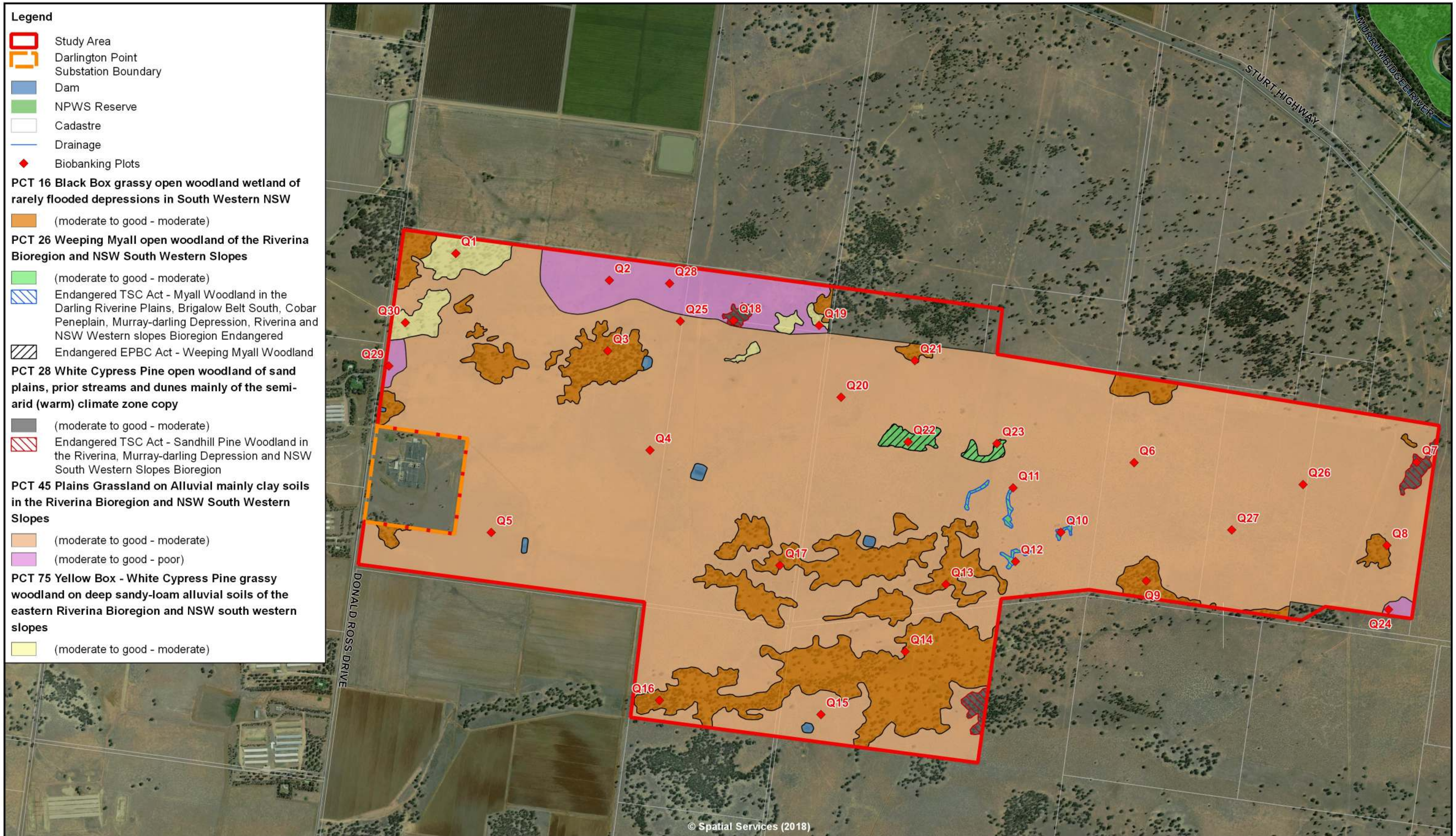
Figure 4-3 Central Southern NSW Vegetation Mapping

Darlington Point Solar Farm | NSW Australia

31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure4_3_V04.qgs



Author:	S. Wilkin		**Figure 4-4** Plant Community Types and Biobanking Plots
Reviewer:	T. Lambert		
A3 Scale:	1: 20 000	0 250 500 750 1000 Metres	Darlington Point Solar Farm | NSW Australia
Job Ref:	11299	Map Projection: GDA 1994 MGA Zone 55	31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure4_4_V04.qgs

Table 4-5 Plant Community Types

Field-verified Plant Community Type (PCT)	Vegetation Zone number in calculator	Area (ha) within Study Area	BioBanking Condition	Endangered Ecological Community (BC Act – formerly BC Act)	Endangered Ecological Community (EPBC Act)
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	3	781.6	Moderate to Good (Moderate) quality	Not listed	Not listed
Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16)	2	135.8	Moderate to Good (Moderate) quality	Not listed	Not listed
Weeping Myall Open Woodland of the Riverina and NSW South-western Slopes Bioregion (PCT 26)	N/A (no impacts)	6.2	Moderate to Good (High) quality	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-darling Depression, Riverina and NSW Western Slopes Bioregion	Weeping Myall Woodland (2 Patches meet the criteria for the federal listing)
Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregions (PCT 75)	1	16.1	Moderate to Good (Moderate) quality	Does not meet criteria for the State listing	Does not meet criteria for the federal listing
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	4	43.5	Moderate to Good (Poor) quality	Not listed	Not listed

Field-verified Plant Community Type (PCT)	Vegetation Zone number in calculator	Area (ha) within Study Area	BioBanking Condition	Endangered Ecological Community (BC Act – formerly BC Act)	Endangered Ecological Community (EPBC Act)
White Cypress Pine open woodland of sand plain, prior streams and dunes mainly on the semi-arid (warm) climate zone (PCT28)	N/A (no impacts)	5.2	Moderate to good moderate quality	Sandhill Pine Woodland in the Riverina, Murray-darling Depression and NSW South Western Slopes bioregion	Not listed
Farm Dams	N/A	1.92	-	-	-

4.3.3 Black Box Grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16)

Summary Grassy woodland dominated by *Eucalyptus largiflorens* the upper stratum with a sparse shrub layer understorey of saltbushes and a moderately grassy understorey cover dominated by a mixture of native herbs, grasses and exotic species. This community occurred in the north western and south portions of the study area. The extent of the community is approximately 135.8 ha within the study area and as mapped in Figure 4-4.

This community is not commensurate with any threatened ecological community listed either on the BC Act or the EPBC Act.

- **Canopy height** ranged from 10 to 12 m with percent foliage cover of 0-23%;
- **Mid stratum** height ranged from 0-0.6 with percent foliage cover of 0-5%;
- **Groundcover** height ranged from 0.1 to 0.8 m with percent foliage cover of 0-90%.

Dominant species were:

- ***Canopy*** *Eucalyptus largiflorens;*
- ***Mid stratum*** *Sclerolaena muricata and Mariana aphylla;*
- ***Groundlayer*** *Solanum esuriale, Oxalis perennans, Walwhalleya proluta, Rytidosperma duttonianum, Sida cunninghamii* and *Chloris truncata.* exotic species included, *Heliotropium europaeum**, *Lepidium africanus** and *Vulpia bromoides**.

Vegetation Community Condition

This PCT occurred in one BioBanking condition, being moderate to good - moderate. The majority of the BioBanking plots were within benchmark values. The length of fallen timber was generally below benchmark due to removal for grazing purposes. The native mid storey was absent which was likely to be a result of grazing pressures (Plate 4-1). Appendix 6 outlines the benchmark data for this community.

Plate 4-1 Black Box Grassy Open Woodland

4.3.4 Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregions (PCT 75)

Summary Grassy woodland dominated by *Eucalyptus melliodora* the upper stratum with a sparse shrub layer understorey of saltbushes and a moderately dense grassy understorey cover dominated by exotic grasses and exotic herbs. This community occurred in the north western and eastern portions of the study area. The extent of the community is approximately 16.1 ha within the study area and as mapped in Figure 4-4.

This community **is not** commensurate with the similar White Box, Yellow Box, Blakely's Red Gum Woodland listed as endangered on the BC Act. This is because the site is located in the Riverina Bioregion. The Riverina Bioregion is not included in the Final Determination as a Bioregion in which the TEC occurs, as follows: "*The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions."*

This community **does not meet** the criteria for the federally listed White Box Yellow Box Blakely's Red Gum grassy woodland and derived grassland listed as critically endangered on the EPBC Act. An assessment of this criteria is outlined in Section 5.3.3.

- **Canopy height** ranged from 10 to 12 m with percent foliage cover of 0-30%;
- **Mid stratum** height ranged from 0-0.9 with percent foliage cover of 0-5%;
- **Groundcover** height ranged from 0.1 to 0.6 m with percent foliage cover of 0-60%.

Dominant species were:

- ***Canopy*** *Eucalyptus melliodora and Callitris glaucophylla;*
- ***Mid stratum*** *Sclerolaena muricata and Mariana aphylla*
- ***Groundlayer*** *Solanum esuriale, Oxalis perennans, Walwhalleya proluta, Enchylaena tomentosa and Sida cunninghamii* exotic species included, *Heliotropium europaeum**, Marrubium vulgare**and *Vulpia bromoides**.*

Vegetation Community Condition

This PCT occurred in one BioBanking condition, being moderate to good - moderate. The majority of the understorey criteria was below benchmarks (Table 2 Appendix 6). Patches WB1 and WB2 were dominated by an exotic understorey. The remaining three patches (WB3, WB4, WB5) were small and were dominated by a high leaf litter content in some areas with high exotic understorey in other areas. The native mid storey was absent which was likely to be a result of grazing pressures.

Plate 4-2 Yellow Box White Cypress Pine Grassy Woodland

4.3.5 Weeping Myall Open Woodland of the Riverina and NSW South-western Slopes Bioregion (PCT 26)

Summary Grassy open woodland, the canopy consists of pure stands of *Acacia pendula.* The understorey consists of a low shrub layer of saltbushes with the ground layer consisted dominated by native grasses with interspersed with native herbs. This community occurred in the middle portion of the study area. This community occurred as six patches of *Acacia pendula*. The extent of the community is approximately 6.2 ha within the study area and as mapped in Figure 4-4.

Two patches of this community are commensurate with the endangered community of Weeping Myall Woodland listed as endangered on the EPBC Act (Figure 5-3).

All patches of this community are commensurate with the Myall Woodland in the Darling Riverine Plans Brigalow Belt South, Cobar Peneplain, Murray-darling Depression, Riverina and NSW Western Slopes Bioregion listed as endangered on the BC Act (Figure 5-3).

- **Canopy height** ranged from 4 to 6 m with percent foliage cover of 0-16%;
- **Mid stratum** height ranged from 0-0.6 with percent foliage cover of 0-5%;
- **Groundcover** height ranged from 0.1 to 0.6 m with percent foliage cover of 30-70%.

Dominant species were:

- ***Canopy*** *Acacia pendula;*
- ***Mid stratum*** *Sclerolaena muricata, Mariana aphylla and Mariana decalvans;*
- ***Groundlayer*** *Solanum esuriale, Boerhavia diffusa, Walwhalleya proluta, Enteropogon ramulosa, Rytidosperma duttonianum, Brachycome spp., Enchylaena tomentosa and Sida cunninghamii* exotic species included, *Heliotropium europaeum* and *Vulpia bromoides.*

Vegetation Community Condition

This PCT occurred in one BioBanking condition, being moderate to good - high. All of the criteria meet benchmarks or above with the exception of native ground cover shrubs (Table 3, Appendix 6). The native mid storey was absent which was likely to be a result of grazing pressures (Plate 4-3). Appendix 6 outlines the benchmark data for this community.

Plate 4-3 Weeping Myall Open Woodland

4.3.6 White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone - PCT 28

Summary Open Forest structure dominated by pure stands of *Callitris glaucophylla* in the upper stratum with no mid stratum and a sparse understorey cover dominated by weed species. This community occurred in two patches in the north western and north eastern portions of the study area. The extent of the community is approximately 5.2 ha within the study area and as mapped in Figure 4-4. The patch of this community in the north eastern portion contained a large rabbit warren.

This community is commensurate with Sandhill Pine Woodland in the Riverina, Murray-darling Depression and NSW South Western Slopes Bioregions listed as endangered on the BC Act.

- **Canopy height** ranged from 8 to 12 m with percent foliage cover of 0-70%;
- **Mid stratum** absent;
- **Groundcover** height ranged from 0.1 to 0.3 m with percent foliage cover of 0-20%.

Dominant species were:

- ***Canopy*** *Callitris glaucophylla;*
- ***Mid stratum*** *Absent*
- ***Groundlayer*** dominated by exotic species of *Heliotropium europaeum, Marrubium vulgare* and *Vulpia bromoides,* sparse native species included *Oxalis perennans* and *Rytidosperma duttonianum*

Vegetation Community Condition

This PCT occurred in one BioBanking condition, being moderate to good - moderate. The majority of the criteria met or were above the benchmarks (Table 4, Appendix 6). The native mid storey was absent, with low cover of native other species which was likely to be a result of grazing pressures (Plate 4-4).

Plate 4-4 White Cypress Pine open woodland

4.3.7 Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)

This community occurred in two conditions of moderate to good – moderate condition and moderate to good – poor condition. The extent of the community is approximately 824.8 ha within the study area and as mapped in Figure 4-4. Of this area 781.64ha was in moderate condition and 43.53 in poor condition.

Moderate to Good – Moderate condition

Summary Native grassland dominated by native grasses and herbs with minor occurrences of exotic species. This area has had light grazing and is slashed to provide feed for sheep and cattle. At the time of the survey recent rainfall had resulted in high density of native grass and tall height of grass. McCormick & Orchard (2018) stated that 686 mm of rainfall fell which was approximately 280 mm greater than average of 400 mm. This lead to unusually high heights of Plains Grass. The moderate quality condition of this community dominates the study area.

This community is not commensurate with any threatened ecological community.

- **Canopy height** 0-1%;
- **Mid stratum** absent;
- **Groundcover** height ranged from 0.5 to 1.5 m with percent foliage cover of 60-100%.

Dominant species were:

- ***Canopy*** *Scattered Paddock trees of Eucalyptus largiflorens;*
- ***Mid stratum*** *absent;*
- ***Groundlayer*** *Austrostipa aristiglumis, Rytidosperma duttonianum, Walwhalleya proluta Solanum esuriale and Mariana aphylla.*

The moderate to good – moderate condition meets the benchmarks for this PCT (Appendix 6). This condition had a high native diversity in the ground layer and cover with a low percentage cover of exotic species within the study area. The scattered paddock trees occurred in the canopy layer, the mid stratum was absent (Plate 4-5).

Moderate to Good – Poor condition

Summary exotic grassland dominated by exotic grasses and herbs. This condition occurred in areas of heavy grazing near dams and water troughs. The poor-quality condition of this community occurs in three patches in the study area.

This community is not commensurate with any threatened ecological community.

- **Canopy height** absent;
- **Mid stratum** absent;
- **Groundcover** height ranged from 0.1 to 0.5 m with percent foliage cover of 60-100%.

Dominant species were:

- ***Canopy*** *absent*
- ***Mid stratum*** *absent*
- ***Groundlayer*** *Heliotropium europium*, Lepidium africanus* and Lolium sp**

The moderate to good condition – poor contained a high percentage cover of exotics and low native diversity. The poor condition also contained areas of bare ground due to high grazing pressures. These majority of these areas occurred near dams and water trough. Plate 4-6 shows the moderate to good (poor) condition. Appendix 6 outlines the benchmark data for this community.

Plate 4-5 Plains Grassland Moderate to Good moderate condition

Plate 4-6 Plains Grassland Moderate to Good poor condition

4.3.8 Farm Dams

Six farm dams were present within the study area (Figure 4-4) and encompassed 1.9 ha. The majority of the dams were in poor condition, with no floating or fringing vegetation. All of these dams were heavily used by cattle and had very poor water quality. See Plate 4-7.

Plate 4-7 Farm Dams

4.4 Flora Species Recorded

Seventy-one flora species were recorded in the study area (Appendix 2) from 16 families. The most common family was Poaceae and Asteraceae. 27 species were exotic. No threatened flora species were recorded. Due to low rainfall and dry conditions in spring very few flora species were in flower. Only eight additional flora species were recorded flowering in September compared to April (Appendix 2).

No exotic species of flora are listed as Weeds of National Significance (WONS) or as priority weeds listed on the Biosecurity Act for the Griffith Control Area. One invasive species Bathurst Burr was recorded throughout the study area.

4.5 Fauna Species Recorded

Fifty-two species of fauna were recorded within the study area (Appendix 3). Refer to Appendix 10 for bat call analysis results. Fauna recorded included Birds (34) and Mammals (17). Four invasive species were recorded being Fox, Rabbit, Common Blackbird and Common Starling.

Two (2) species of threatened fauna were recorded during the field surveys. These were:

- Superb Parrot listed as vulnerable under both the BC Act and EPBC Act; and
- Grey-crowned Babbler listed as vulnerable under the BC Act.

The observations in relation to these recorded species are summarised hereunder. Refer to Figure 5-3 for locations of threatened recorded fauna.

4.5.1 Superb Parrot

The Superb Parrot was recorded at 16 locations, through observation and call.

Details as follows:

- Ten of these records were recorded throughout the study area, within Black Box Woodland, during the April, September and November surveys.
- Four of these records were recorded in the north-western extent of the study area during the April, September and November surveys, where this species was observed foraging on Yellow Box flowers; and
- Three additional records of this species occur just east of the substation and in the northern extent of the site, within native grassland. These birds were not utilising this habitat, rather they were recorded as 'flyovers', potentially moving between areas of treed habitat. Recorded during the September and November surveys.

4.5.2 Grey-crowned Babbler

The Grey-crowned Babbler was recorded at 23 locations within the study area, typically in families of 3-7 individuals, during bird surveys or while conducting other field surveys.

Details as follows:

- Within the Black Box Woodland, predominately in the southern section of the study area, this species was recorded in 19 separate localities, during the April, September and November surveys;
- Four nests were recorded in Black Box Woodland in the southeastern section of the study area during the April, September and November surveys;
- Within White Cypress Pine Woodland in the northern extent of the site, this species was recorded in one separate area, during the September surveys; and
- Within Yellow Box Woodland in the northwestern extent of the study area, this species was recorded in three separate areas, during the September and November surveys.

4.5.3 Microchiropteran Bats

In the September surveys in the eastern extent of the site a possible recording of the Large-footed Myotis (*Myotis macropus*) listed Vulnerable on the BC Act was recorded during Anabat surveys.

No threatened Microchiropteran Bats were captured during the Harp Trapping Surveys in November 2017. Common species of bats were captured during harp trapping such as and/or recorded using Anabat devices on site, including the common species Lesser Long-eared Bat (*Nyctophilus geoffroyi),* White-striped Freetail Bat (*Austronomus australis*) and Chocolate Wattle Bat *(Chalinolobus morio).*

During the November surveys in the north-western and south-eastern extent of the site, four probable recordings of Large-footed Myotis (*Myotis macropus*) listed as vulnerable on the BC Act were recorded during Anabat surveys. In the north-western and south-eastern extent of the site, four probable recordings of the threatened *Vespadelus baverstocki* (Inland Forest Bat) listed as vulnerable on the BC Act were also collected during the Anabat surveys.

4.6 Fauna Habitat

Three main fauna habitats were identified as occurring in the study area. These three habitats provide a range of roosting, breeding and foraging habitat for commonly occurring and threatened species of fauna. The three fauna habitats are as follows:

- Open Forest/Woodland habitat;
- Grassland; and
- Aquatic habitat.

4.6.1 Open Forest/Woodland

The open forest/woodland habitat within the study area includes the following Plant Community types:

- Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW;
- Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and NSW south western slopes;
- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone; and
- Weeping Myall open woodland of the Riverina Bioregion and NSW South Western slopes communities.

This habitat type contains a high density of hollow-bearing trees, fallen timber and leaf litter which provides habitat for a number of fauna species. This habitat occurred in patches throughout the study area interspersed with native grassland. The condition of the habitat is moderate to good and the vegetation within the study area has fragmented connectivity to greater regional vegetation patches to the south and north of the study area.

This habitat consisted of a mixture of open grassy woodland open forest structure the dominant canopy species included *Eucalyptus largiflorens* (Black Box)*, Eucalyptus melliodora* (Yellow Box)*, Callitris glaucophylla* (White Cypress Pine) and *Acacia pendula* (Weeping Myall)*.* The eucalypt species provide a range habitat resources including hollow-bearing trees which provide nesting opportunities for birds, arboreal mammals and roosting habitat for microchiropteran bats. The eucalypt species provide nectar resources for a range of nectivorous birds and mammals.

The understorey contained a mixture of low density shrub layer of Chenopodiaceae species and a ground cover of grasses. The low density of shrubs limits habitat for threatened woodlands birds such as the Speckled Warbler. The woodland and cleared land provides habitat for the insectivorous species such as microchiropteran bats and threatened birds such as the Grey-crowned Babbler. A leaf litter of 5 cm was recorded in parts of this habitat, although it was generally observed between 0 – 5 cm deep. Decorticating bark and fallen timber was typically observed frequently throughout this habitat. Three Mistletoes were observed in the south eastern patch of Weeping Myall within the study area, limiting feeding resources for species such as the Painted Honeyeater.

Threatened species that were observed within the eucalypt habitat include the Grey-crowned Babbler and Superb Parrot. Common species recorded in Open Forest/Woodland within the study area included Noisy Miner, Eastern Rosella, Australian Raven, Galah, Sulphur-crested cockatoo, Pied Butcherbird, Australian Magpie and Apostlebird.

4.6.2 Aquatic Habitat

The study area aquatic habitat includes six small farm dams. The farm dams provide marginal potential habitat for a range of amphibians and waterbirds. The Pacific Black Duck was observed within these farm dams. The farm dams are used for watering stock and are typically fringed by areas of disturbed grassland.

4.6.3 Grassland

The grassland habitat generally occurs in moderate quality and is dominated by the native grass *Austrostipa aristiglumis* (Plains Grass), which occurs densely up to a height of 2m (following exceptional good rain season). Small areas of this community were dominated by exotic species where high density of sheep and cattle grazing, particularly around the existing dam sites. Scattered trees, mostly consisting of juvenile regrowth with six larger paddock hollow-bearing trees also occur infrequently throughout the grassland habitat (as shown on Figure 3-3). The hollow-bearing trees provide habitat for hollow-dependant fauna, such as birds and bats. No fauna were observed utilising the hollows at the time of the field surveys. The project will remove these six isolated hollow-bearing trees.

The grassland habitat provides foraging habitat in the form of grasses, seeds, insects and saltbush fruits. The grassland provides foraging habitat for insectivorous micro bats, small mammals (e.g. house mouse), birds (e.g. Stubble Quail) and birds of prey (e.g. Peregrine Falcon and the Wedge-tailed Eagle). Other animals such as the Grey Kangaroo use this area as grazing habitat, where it also acts as foraging and refuge habitat for lizards and snakes.

The grassland was generally devoid of micro habitat features such as leaf litter, fallen timber and understorey shrubs. Commonly occurring species recorded in this habitat included Eastern Grey Kangaroo, Australian Raven, Peregrine Falcon and Australasian Pipit. Pest species recorded in this habitat included the European Rabbit and European Fox.

5 THREATENED BIODIVERSITY

5.1 Ecosystem Species

One ecosystem credit species, Grey-crowned Babbler, was recorded within the study area. This species was recorded in 23 locations with four nest sites within Woodland habitats (Figure 5-3). Further details on the records for this species is provided in Section 4.5.2.

Table 5-1 provides a list of the BioBanking calculator's predicted species for the development site and their likelihood of occurrence in the development site.

Table 5-1 Ecosystem Credit Species

Threatened Species	Tg Value	Recorded in the development site	Habitat Recorded in the development site	Likelihood of Occurrence?
Australian Bustard	2.6	No	Yes	Possible to occur breeding habitat recorded, grazing pressures would limit breeding opportunities.
Brolga	1.3	No	Yes	Likely Grassland habitat within the development site
Bush Stone-curlew	2.6	No	Yes	Likely Foraging and breeding habitat, grazing pressures would limit breeding opportunities.
Diamond Firetail	1.3	No	Yes	Likely Grassy woodland habitat within the development site and may support a small population of this species.
Grey-crowned Babbler	1.3	Yes	Yes	Recorded with nesting and forages within the development site.
Hooded Robin	1.7	No	Yes	Unlikely to occur as this species is sedentary and records within the vicinity of the development site are over 20 years old.

Threatened Species	Tg Value	Recorded in the development site	Habitat Recorded in the development site	Likelihood of Occurrence?
Little Eagle	1.4	No	Yes	Likely Grassland habitat within the development site. Prey species present within the grassland areas.
Little Lorikeet	1.8	No	Yes	Unlikely to occur closest record for this species is over 200 km to the south
Little Pied Bat	2.1	No	Yes	Likely open woodland foraging habitat occurs.
Magpie Goose	1.3	No	Yes	No wetland habitat occurs within the development site but may occasionally temporarily occur.
Major Mitchell's Cockatoo	1.9	No	Yes	May intermittently foraging habitat in the grassland areas. Roosting habitat, the development site is at the eastern end of this species distribution
Painted Honeyeater	1.3	No	Yes	Likely No mistletoe was recorded on the weeping myall trees. May fly over the development site on a seasonal basis.
Pied Honeyeater	1.3	No	Yes	Unlikely Limited foraging habitat in the form of saltbushes, no nectar resources on development site.
Regent Parrot (eastern subspecies)	1.8	No	Yes	This species is mostly restricted to River Red Gum Forests although could occur as part of its foraging range.
Spotted Harrier	1.4	No	Yes	Likely Grassland habitat within the development site. Prey species present within the grassland areas.
Square-tailed Kite	1.4	No	Yes	Unlikely, scattered records for this species which are over 30 years old.

Threatened Species	Tg Value	Recorded in the development site	Habitat Recorded in the development site	Likelihood of Occurrence?
Turquoise Parrot	1.8	No	Yes	Likely forging and breed habitat occurs within the development site. However, most recent record is from 1998 at Leeton.
Varied Sittella	1.4	No	Yes	Likely, recent records of this species within 1 km of the development site.
White-fronted Chat	0.8	No	Yes	No wetland habitat occurs within the development site but may occasionally temporarily occur.

5.2 Species Credits

Table 5-2 outlines the species credit species which have been identified by the BioBanking calculator that cannot be predicted to occur based on habitat assessment. Species credit species require targeted surveys to determine if they occur within the development site. Fifteen species credit species (Table 5-2) were identified by the BioBanking calculator as requiring targeted surveys. Target surveys were conducted for these species as part of the field surveys. One additional species credit species, the Superb Parrot, was recorded within the development site but not identified by the BioBanking Calculator. Therefore, this species was added to the BioBanking calculator to calculate the species credits required to offsets impacts to this species.

Section 3.5.3 outlines the targeted surveys conducted for these species.

Table 5-2 Species Credit Species

Common Name	Scientific Name	Survey Requirement	Habitat within development site?	Likelihood of Occurrence?	Recorded in the development site
Grey Falcon	*Falco hypoleucos*	All Year	Yes Woodland Grassland	High	No

Common Name	Scientific Name	Survey Requirement	Habitat within development site?	Likelihood of Occurrence?	Recorded in the development site
Black-breasted Buzzard	*Hamirostra melanosternon*	All year	No	Low	No
Glossy Black-cockatoo Riverina Population	*Calyptorhynchus lathami* – endangered population	All year	Yes Woodland	Low	No
Koala	*Phascolarctos cinereus*	All year	Yes Woodland	Low	No
Regent Honeyeater	*Anthochaera phrygia*	All year	Yes Woodland	Low	No
Squirrel Glider	*Petaurus norfolcensis*	All Year	Yes Woodland	Low	No
Superb Parrot*	*Polytelis swainsonii*	Sept to Nov	Woodland	High	Yes
Austral Pillwort	*Pilularia novae-hollandiae*	All year	No habitat only occurs in swampy areas	None	No
Bindweed	*Convolvulus tedmoorei*	Sept to Nov	Yes Woodland Grassland	Moderate	No
Claypan Daisy	*Brachyscome muelleroides*	Sept to Nov	Yes Woodland Grassland	High	No
Lanky Buttons	*Leptorhynchos orientalis*	Sept to Nov	Yes woodland and grassland	High	No
Menindee Nightshade	*Solanum karsense*	Aug to Dec	Yes Woodland Grassland	Low	No
Mossgiel Daisy	*Brachyscome papillosa*	Sept to Nov	Yes woodland and grassland	High	No
Pine Donkey Orchid	*Diuris tricolor*	Sept to Nov	Yes Woodland Grassland	High	No

Common Name	Scientific Name	Survey Requirement	Habitat within development site?	Likelihood of Occurrence?	Recorded in the development site
Small Purple-pea	*Swainsona recta*	Sept to Oct	Yes Woodland Grassland	Low	No
Winged Peppercress	*Lepidium monoplocoides*	Nov to Feb	Yes Woodland Grassland	High	No

*Note Superb Parrot was not identified by the BioBanking Calculator as requiring surveys, species was recorded in the development site

5.2.1 *Brachyscome papillosa, Brachyscome muelleroides, Convolvulus tedmoorei, Diuris tricolor, Leptorhynchos orientalis, Solanum karsense, Swainsona recta*

Methodology and survey effort for these seven species are outlined in Sections 3.5.3. The targeted surveys for these seven species were conducted in September. This field survey occurred during the flowering period of all of the species and meets the survey requirement in accordance with the BioBanking calculator requirements. The surveys were conducted throughout the entire development site within both woodland and grassland habitats (Figure 3-1).

None of these species were recorded during the surveys. Other species recorded flowering were *Leptorhynchos squamatus* subsp. *squamatus, Vittadinia gracilis, Leiocarpa panaetioides*, *Convolvulus erubescens* and *Solanum esuriale*.

5.2.2 *Lepidium monoplocoides*

Methodology and survey effort for this species is outlined in Sections 3.5.3. The targeted survey for this species was conducted within the required flowering time of November in accordance with the BioBanking calculator requirements, but it is also known to flower August to October (according to OEH species profile) and therefore the comprehensive September surveys are also applicable to this species. Parallel transects of 50 to 100m apart, as well as random meander surveys within the southern area of woodland habitat were conducted for this species (Figure 3-2).

This species was not recorded during the surveys. The exotic weed, *Lepidium africanum* was recorded during the field surveys.

5.2.3 Grey Falcon

This species can be surveyed for at any time of the year, Section 3.6 describes the detailed targeted surveys for this species. Three field surveys have been conducted for this project during April, September and November. Surveys included diurnal bird surveys and opportunistic surveys during all the field survey periods. This species was not recorded.

5.2.4 Black-breasted Buzzard

This species can be surveyed for at any time of the year, Section 3.6 describes the detailed targeted surveys for this species. Three field surveys have been conducted for this project during April, September and November 2017. Surveys included diurnal bird surveys and opportunistic surveys during all the field survey periods. This species was not recorded.

5.2.5 Glossy Black-cockatoo Riverina Population

This species can be surveyed for at any time of the year, Section 3.6 describes the detailed targeted surveys for this species. Three field surveys have been conducted for this project during April, September and November 2017. Surveys included diurnal bird surveys and opportunistic surveys during all the field survey periods. This species was not recorded.

5.2.6 Regent Honeyeater

This species can be surveyed for at any time of the year, Section 3.6 describes the detailed targeted surveys for this species. Three field surveys have been conducted for this project during April, September and November 2017. Surveys included diurnal bird surveys and opportunistic surveys during all the field survey periods. This species was not recorded.

5.2.7 Koala

This species can be surveyed for at any time of the year, Section 3.6 describes the detailed targeted surveys for this species. Three field surveys have been conducted for this project during April, September and November 2017. Surveys included habitat assessment, diurnal and nocturnal surveys and opportunistic surveys (for scats, scratchmarks etc) during all the field survey periods. This species was not recorded despite 18 days being spent covering the entirety of the study area. It is uncertain why this species was listed in the BioBanking Calculator as there are virtually no records of this unmistakable species occurring anywhere within the Murrumbidgee IBRA subregion except for around the township of Narrandera (where the population was reintroduced into a Koala Park). A single record also occurs approximately 11km to the south-west near Coleambally. Generally, it is considered that any Koalas locally would be restricted primarily to the Murrumbidgee River area further to the north.

5.2.8 Squirrel Glider

This species can be surveyed for at any time of the year, Section 3.6 describes the detailed targeted surveys for this species. Three field surveys have been conducted for this project during April, September and November 2017. Surveys included habitat assessment, nocturnal surveys and opportunistic surveys during all the field survey periods. This species was not recorded. It is uncertain why this species was listed in the BioBanking Calculator as there are no records of this species occurring anywhere within the Murrumbidgee IBRA subregion and the study area is located outside of this species known distribution as mapped by OEH on the species profile. It is only known to occur in the Murray Fans IBRA subregion within the Riverina.

5.2.9 Superb Parrot

This species was recorded in all the woodland habitats within the development site (Figure 5-3). It was observed foraging on Yellow Box blossom. The Black Box Grassy Open Woodland and Yellow Box – White Cypress Pine Grassy Woodland communities contain a large number of hollow-bearing trees which provide potential nesting habitat. This species was not observed nesting in any of these trees.

The BioNet Database Atlas shows that a high number of records for this species have been observed along the Murrumbidgee River, which contains *Eucalyptus camaldulensis* (River Red Gum) which are favored by this species for breeding (OEH Threatened Species Profiles 2017). It is likely that the main breeding for this species occurs in the River Red Gums along the Murrumbidgee River, which is approximately 1.5km away from the project at its closest point. The project will remove negligible areas of woodland and is unlikely to impact substantially upon this species, particularly its breeding habitat.

5.3 SEARs Species for Further Consideration

In accordance with the SEARs issued on the 9th May 2017 (SSD 8392) additional threatened species and endangered ecological communities are required to be addressed. These species were targeted in surveys but none were recorded. The threatened flora and fauna species are discussed below and the two threatened communities have been addressed in Section 5.4.

5.3.1 Fauna Species

Seven additional threatened fauna species are required to be assessed as to whether nest trees will be impacted upon. The Black Box Grassy Open Woodland and Yellow Box – White Cypress Pine Grassy Woodland communities contain a large number of hollow-bearing trees which provide potential nesting habitat for species listed in Table 5-3. None of these species were recorded within the study area.

Six isolated paddock hollow-bearing trees will be removed as part of the project.

Table 5-3 SEARs Threatened Fauna Species

Threatened Fauna Species	Recorded nest trees within development site?	Habitat in the development site?	Impacted by the project?
Regent Honeyeater *Anthochaera phrygia*	No	Yes Breeding and foraging habitat in woodland areas.	Low. Negligible woodland habitats will be removed by the project.
Spotted Harrier *Circus assimilis* Nest trees only	No	Yes Breeding and foraging habitat in woodland areas.	Low. Negligible woodland habitats will be removed by the project.
Black Falcon *Falco subniger* Nest trees only	No	Yes Breeding and foraging habitat in woodland areas.	Low. Negligible woodland habitats will be removed by the project.

Threatened Fauna Species	Recorded nest trees within development site?	Habitat in the development site?	Impacted by the project?
Little Eagle *Hieraaetus morphnoides* Nest trees only	No	Yes Breeding and foraging habitat in woodland areas.	Low. Negligible woodland habitats will be removed by the project.
Major Mitchell's Cockatoo *Lophochroa leadbeateri* Nest trees only	No	Yes Breeding and foraging habitat in woodland areas. Six hollow-bearing paddock trees occur in the grassland	Low. Negligible woodland habitats will be removed by the project. Six hollow-bearing paddock trees occur in the grassland but this species not recorded on-site.
Square-tailed Kite *Lophoictinia isura* Nest trees only	No	Yes Breeding and foraging habitat in woodland areas.	Low. Negligible woodland habitats will be removed by the project.
Barking Owl *Ninox connivens* Nest trees only	No	Yes Breeding and foraging habitat in woodland areas. Six hollow-bearing paddock trees occur in the grassland	Low. Negligible woodland habitats will be removed by the project. Six hollow-bearing paddock trees occur in the grassland but this species not recorded on-site.

5.3.2 Flora Species

Seven additional flora species are required to be assessed (Table 5-4). Six of these species have habitat such as Black Box Grassy Open Woodland, White Cypress Pine Open Woodland and Yellow Box – White Cypress Pine Grassy Woodland communities within the development site. Negligible impacts to these three communities which provide potential habitat for these species will occur as part of the project.

In addition, field surveys have been conducted during the flowering period, as listed in Table 5-4, for all these species in the targeted surveys. None of these species were recorded during any of the field surveys.

Table 5-4 SEARs Threatened Flora Species

Threatened Flora Species	FBA Survey Period required	Habitat in the development site	Recorded in the development site	Impacted by the Project
Sand-hill Spider Orchid *Caladenia arenaria*	Aug to Oct	Yes Woodland	No	Low. Negligible woodland habitats will be removed by the project.
Bindweed *Convolvulus tedmoorei*	Aug to November	Yes grassland and woodland	No	Low. Unlikely to occur, two records to the west of the project area from 1969.
Oakland Diuris *Diuris* sp. (Oaklands, D.L. Jones 5380)	November	Yes Yellow Box Woodland	No	Low. Negligible woodland habitats will be removed by the project.
Winged Peppercress *Lepidium monoplocoides*	Nov to Feb	Yes woodland and grassland	No	Low. Negligible woodland habitats, Grassland habitat to be removed.
Lanky Buttons *Leptorhynchos orientalis*	Sept to Nov	Yes Woodland and grassland	No	Low. Negligible woodland habitats, Grassland habitat to be removed
Austral Pillwort *Pilularia novae-hollandiae*	All Year	No Occurs in shallow swamps and waterways	No	Low. No habitat within development site
Turnip Copperburr *Sclerolaena napiformis*	Nov to Feb	Yes woodland	No	Low. Negligible woodland habitats will be removed by the project.
Red Darling Pea *Swainsona plagiotropis*	Aug to Sept	Yes Woodland	No	Low. Negligible woodland habitats will be removed by the project.

Threatened Flora Species	FBA Survey Period required	Habitat in the development site	Recorded in the development site	Impacted by the Project
Silky Darling Pea *Swainsona sericea*	Sept to Oct	Yes woodland	No	Low. Negligible woodland habitats will be removed by the project.

5.4 Species Identified by database searches that have the potential to occur

Database searches undertaken within a 20km radius recorded an additional five threatened fauna species and one threatened flora species that have not been identified by the SEARs or the BioBanking calculator as having the potential to occur within the development site (Tables 5-5 and 5-6). None of these species were recorded during the field surveys. The FBA does not require a significance assessment under the TSC Act for these species.

Table 5-5 Database species credit species

Threatened Species	FBA survey period required	Habitat	Recorded	Impacted by the Project?
Slender Darling Pea (*Swainsona murrayana*)	Sept to Dec	Woodland	No	Low. Negligible woodland habitats will be removed by the project.

Table 5-6 Database Ecosystem Credit Species

Threatened Species	Recorded in the project area	Habitat Recorded in the project area	Likelihood of Occurrence?
White-bellied Sea Eagle	No	Yes	Likely to occur breeding habitat recorded, grazing pressures would limit breeding opportunities.
Dusky Woodswallow	No	Yes	Unlikely Foraging and breeding habitat recorded in the project area. 20 yr old records within 50 km of the project area.
Flame Robin	No	Yes	Likely Grassland habitat within the project area
Southern Myotis	No	Yes	Likely Foraging and breeding habitat, grazing pressures would limit breeding opportunities.

Threatened Species	Recorded in the project area	Habitat Recorded in the project area	Likelihood of Occurrence?
Yellow-bellied Sheathtail-bat	No	Yes	Likely Grassy woodland habitat within the project area and may support a small population of this species.

5.5 Threatened Ecological Communities

Two threatened ecological communities were recorded in the study area. Both Weeping Myall Woodland and Sandhill Pine Woodland were identified in the SEARs and are required to be assessed as part of the project. The communities which were recorded within the study area include the following:

- Weeping Myall Woodland is listed as endangered on the both the BC Act and EPBC Act;
    - Six Patches of this community occur in the study area and have been numbered from WM1 to WM6 for assessment purposes
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered on the BC Act; and

5.5.1 EPBC Act Weeping Myall Woodlands

An assessment of the Weeping Myall Open Woodland of the Riverina Bioregion and NSW Southern Western Slopes recorded within the study area has been undertaken to determine if this community meets the criteria for the Weeping Myall Woodlands listed as endangered under the EPBC Act. The Weeping Myall Woodlands EPBC Act Policy Statement 3.17 (Department of the Environment Water Heritage and Arts, 2009) has been used to assess the patches Weeping Open Woodland of the Riverina Bioregion and NSW Southern Western Slopes recorded within the study area that may meet these criteria. Figure 5-1 outlines the assessment criteria for the Weeping Myall Woodlands (Table 5-6 and Figure 5-1). Figure 5-3 shows the location of the patches.

Two patches (WM1 and WM2) within the northern section of the study area meets the EPBC criteria for this community, while the remaining patches do not meet the criteria as they are less than 0.5ha in size.

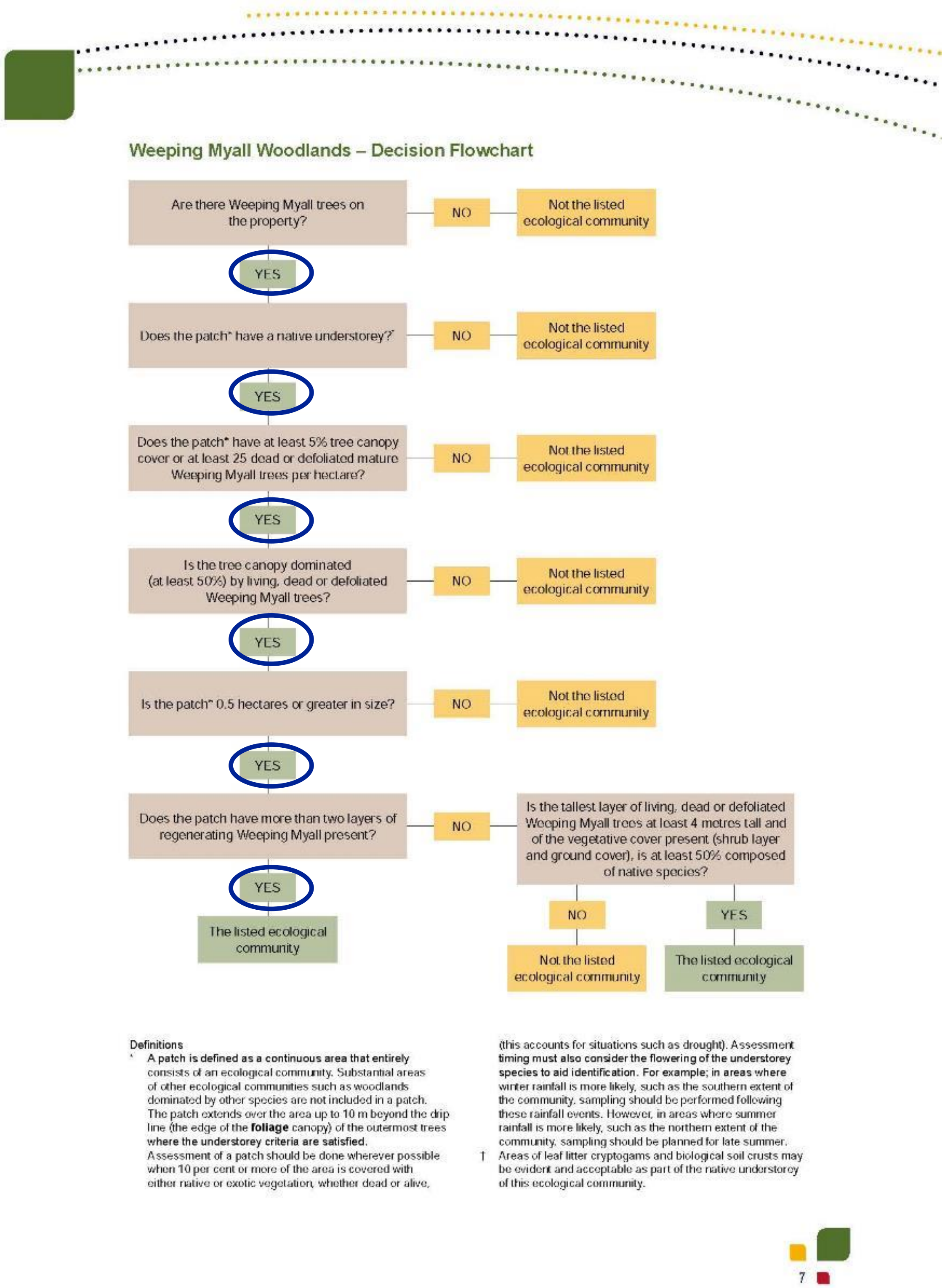
Table 5-6 EPBC Act Weeping Myall Woodlands Assessment

EPBC Act Policy statement criteria	Weeping Myall Woodlands Patches WM1, WM2	Weeping Myall Woodlands Patches WM3, WM4, WM5, WM6
Are there weeping myall trees present	Yes	Yes
Does the patch have a native understorey	Yes	Yes
Does the patch have at least 5% tree canopy	Yes	Yes
Is the canopy dominated by more than 50% cover of living and/or dead weeping myall trees	Yes	Yes
Is the patch greater than 0.5 ha	Yes	No
Does the patch have more than two layers of regenerating Weeping Myall trees present?	Yes	-
Do the patches meet the criteria for federal listing of Weeping Myall Woodlands?	**Yes**	**No**

To avoid any uncertainty, the EPBC Act-listed Weeping Myall Woodlands do not include a derived grassland component. As per the Listing Advice for Weeping Myall Woodlands ecological community:

"As it is not possible to determine whether the existing grasslands and shrubland were formerly associated with Weeping Myall Woodlands or whether they always existed as independent vegetation types, the grasslands and shrublands that now lack Weeping Myall trees are excluded from the current listing. In addition, any areas that are known to have been derived from Weeping Myall Woodlands, having lost the Weeping Myall overstorey, are not included."

Therefore, no grassy areas within the study area are included in the mapping of this threatened community and do not require further consideration.



Weeping Myall Woodlands – Decision Flowchart

Are there Weeping Myall trees on the property?
NO → Not the listed ecological community
YES

Does the patch* have a native understorey?†
NO → Not the listed ecological community
YES

Does the patch* have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees per hectare?
NO → Not the listed ecological community
YES

Is the tree canopy dominated (at least 50%) by living, dead or defoliated Weeping Myall trees?
NO → Not the listed ecological community
YES

Is the patch* 0.5 hectares or greater in size?
NO → Not the listed ecological community
YES

Does the patch have more than two layers of regenerating Weeping Myall present?
YES → The listed ecological community
NO → Is the tallest layer of living, dead or defoliated Weeping Myall trees at least 4 metres tall and of the vegetative cover present (shrub layer and ground cover), is at least 50% composed of native species?
NO → Not the listed ecological community
YES → The listed ecological community

Definitions

* A patch is defined as a continuous area that entirely consists of an ecological community. Substantial areas of other ecological communities such as woodlands dominated by other species are not included in a patch. The patch extends over the area up to 10 m beyond the drip line (the edge of the **foliage** canopy) of the outermost trees where the understorey criteria are satisfied. Assessment of a patch should be done wherever possible when 10 per cent or more of the area is covered with either native or exotic vegetation, whether dead or alive, (this accounts for situations such as drought). Assessment timing must also consider the flowering of the understorey species to aid identification. For example; in areas where winter rainfall is more likely, such as the southern extent of the community, sampling should be performed following these rainfall events. However, in areas where summer rainfall is more likely, such as the northern extent of the community, sampling should be planned for late summer.

† Areas of leaf litter cryptogams and biological soil crusts may be evident and acceptable as part of the native understorey of this ecological community.

7

Figure 5-1 Weeping Myall Woodlands Assessment Criteria for Patches WM1 and WM2

5.5.2 BC Act Weeping Myall Woodland Assessment

All patches WM1 to WM6 (Figure 5-3) of the Weeping Myall open woodland of the Riverina Bioregion and NSW Western Slopes mapped within the study area are definitively commensurate with the endangered community of Myall Woodland in the Darling Riverine Plans Brigalow Belt South, Cobar Peneplain, Murray-darling Depression, Riverina and NSW Western Slopes Bioregion listed as endangered on the BC Act.

As detailed in Section 4.3, the grassy areas within the study area have been definitively identified as *Plains Grass grassland on alluvial mainly clay soils in the Riverina and NSW South-western Slopes Bioregions* (PCT 45) and are not considered derived grassland communities for the reasons outlined below.

To avoid any uncertainty, the BC Act-listed Weeping Myall Woodland within the study area is not considered to include any derived grassy areas. Consistent with the wording in Section 5.5.1 above from the Commonwealth Listing Advice, it is not possible to determine whether the existing grasslands were formerly associated with Weeping Myall Woodlands (or indeed the Black Box grassy woodland or other woodland types) or whether they had always existed as independent vegetation types. The Commonwealth Listing Advice is informative on this issue and states:

"It has been suggested that much of the treeless grasslands and herblands which are widespread in the eastern Riverina are largely derived from Weeping Myall/Old Man Saltbush (Atriplex nummularia) shrublands or from Cotton Bush (Maireana spp.)/Bladder Saltbush (Atriplex versicaria) shrublands (Benson 1999; White et al. 2002; Moore 1953; Beadle 1981). Clearing and lopping for drought fodder has removed the Acacia pendula woodland and grazing combined with drought and changed fire regimes has eliminated the chenopod shrubs (White et al. 2002).

This posited history has been questioned as there is a paucity of reliable or readily interpreted documentation of the vegetation around the time of European settlement in the mid 19th century. However, all historical accounts suggest that land use and plant and animal introductions, post settlement resulted in rapid changes to the structure, function and composition of plant communities. The precise nature of these changes remains unknown."

The Final Determination for Weeping Myall Woodland states that "the structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history". The grassland areas within the study area do not contain any of these types of structure.

The NSW Vegetation Information System (VIS) also for example does not list PCT 45 as being Weeping Myall Woodland and the OEH website does not include PCT 45 as being one of the vegetation types which represent this TEC within the Riverina Interim Biogeographic Regionalisation of Australia.

In conclusion, there is no definitive (or even conservative) reason for any of the grassland areas within the study area to be included in the Weeping Myall Woodland TEC.

5.5.3 EPBC Act White Box Yellow Box Blakely's Red Gum Grassy Woodland Assessment

An assessment of the Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and NSW Western slopes recorded within the study area has been undertaken to determine if this community meets the criteria for the critically endangered community White Box Yellow Box Blakely's Red Gum grassy woodland and derived native grassland (Box Gum Woodland) listed under the EPBC Act. The White Box Yellow Box Blakely's Red Gum EPBC Act policy statement (Department of Environment and Heritage, 2006) has been used to assess the patches of Yellow Box – White Cypress Pine grassy woodland recorded within the study area that may meet these criteria (see Table 5-7 and Figure 5-2).

This assessment concluded that the Yellow Box – White Cypress Pine grassy woodland recorded within the study area **does not meet** the criteria for the federal listing of Box Gum Woodland. The reason being that the Yellow Box – White Cypress Pine Grassy Woodland patches WB1 and WB2 has less than 50% of native understorey cover and patches WB3, WB4 and WB5 are less than 2 ha and have less than 12 native species excluding grasses in the understorey (Table 5-4).

Table 5-7 EPBC Act Criteria for Box Gum Woodland

EPBC Act Policy statement criteria	Box Gum Woodland Patches WB1, WB2	Box Gum Woodland Patches WB3, WB4, WB5
Is or was previously the dominant overstorey species, White Box Yellow Box or Blakely's Red Gum	Yes	Yes
Does the patch have predominately native understorey (greater than 50% cover native species)	**No,** these patches were surveyed to have less than 30% of the understorey cover as native species.	Yes
Is the patch 0.1 greater in size	-	Yes
Does the patch have 12 more native species excluding grasses in the understorey	-	**No**, the patches have 4 native species excluding grasses
Is the Patch 2 ha or greater in size	-	**No**
Does the vegetation on study area meet the criteria for federal listing of Box Gum Woodland?	**No**	**No**

5.5.4 BC Act White Box Yellow Box Blakely's Red Gum Assessment

The Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and NSW Western slopes **is not** commensurate with the endangered ecological community White Box Yellow Box Blakely's Red Gum Woodland as listed on the BC Act. No derived native grassland form of this community is present within the study area.

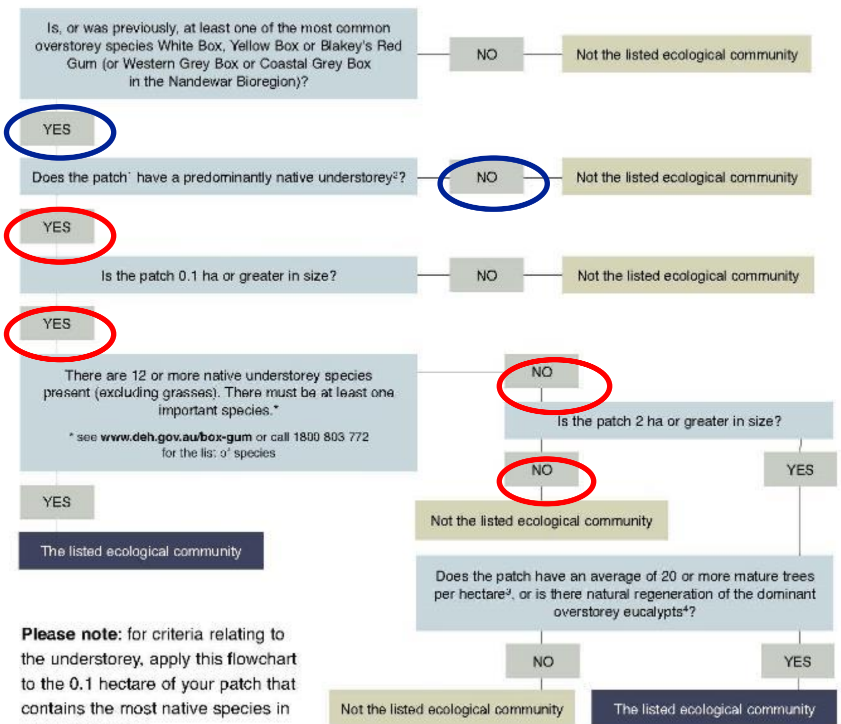
This is because the site is located in the Riverina Bioregion. The Riverina Bioregion is not included in the Final Determination as a Bioregion in which the TEC occurs, as follows: "*The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.*"

5.5.5 BC Act Sandhill Pine Woodland assessment

The two patches of White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone mapped (Figure 5-3) within the study area are commensurate with the endangered ecological community of Sandhill Pine Woodland in the Riverina, Murray-darling Depression and NSW South Western Slopes Bioregions.

The flowchart below represents the lowest condition at which patches are included in the listed ecological community. This is not the ideal state of the ecological community. Large patches, those that link remnants in the landscape, those that occur in highly cleared areas, those that contain rare, declining or threatened species, and those that represent the entire range of the ecological community, are important for the long-term future of the ecological community.

Determining if your land has an area of the listed ecological community



Please note: for criteria relating to the understorey, apply this flowchart to the 0.1 hectare of your patch that contains the most native species in the ground layer.

1 Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:

- an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
- the area over which the understorey is predominantly native.

Patches must be assessed at a scale of 0.1 ha (1000m²) or greater.

2 A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow. (At other times of the year, you can determine whether something is perennial or not is if it is difficult to pull out of the soil. Annual species pull out very easily.)

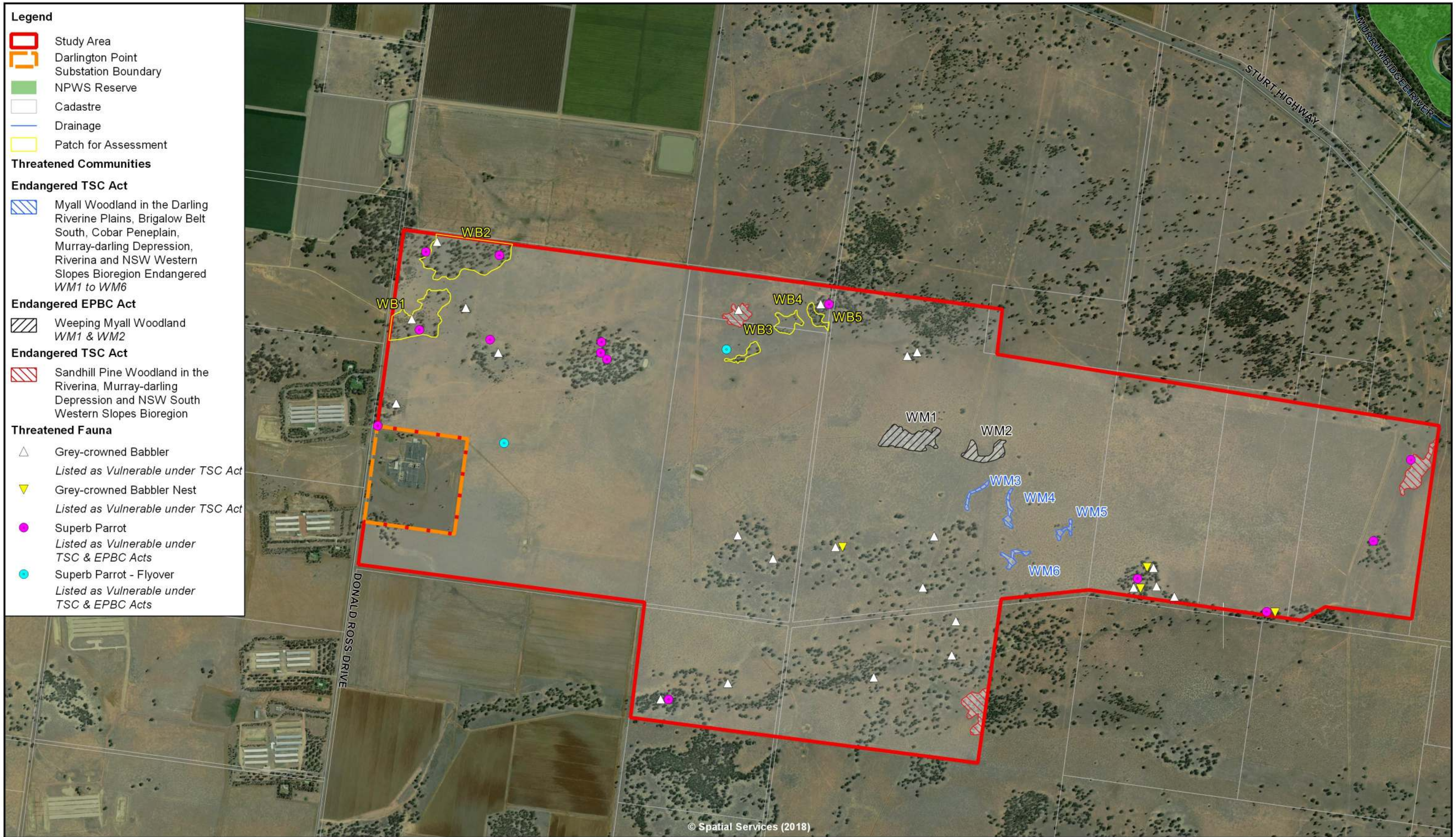
3 Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.

4 Natural regeneration of the dominant overstorey eucalypts when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

5

*Note Blue Circles are patches WB1, WB2, Red Circles are Patches are WB3-WB5

Figure 5-2 EPBC Act Box Gum Woodland Assessment



Author:	S. Wilkin	0 250 500 750 1000 Metres	**Figure 5-3** **Threatened Communities & Threatened Fauna Locations**
Reviewer:	T. Lambert		
A3 Scale:	1: 20 000		**Darlington Point Solar Farm | NSW Australia**
Job Ref:	11299	Map Projection: GDA 1994 MGA Zone 55	31 July 2018

EPS ENVIRONMENTAL PROPERTY SERVICES

E:\EPS_O365\OneDrive - ENVIRONMENTAL PROPERTY SERVICES AUST PTY LIMITED\Projects\11299 ARUP Darlington Point Solar Farm\Working\Plans_Mapping\20180731_11299_ARUP_Figure5_3_V04.qgs

5.6 EPBC Act Matters of National Significance

5.6.1 Threatened Flora

The EPBC Act protected matters search identified 2 threatened flora species, *Brachyscome papillosa* and *Swainsona murrayana* as having the potential to occur within the study area. Both of these species have been identified as having potential habitat within the study area (Appendix 4). September field surveys were undertaken during the flowering period for these species and they were not recorded.

5.6.2 Threatened fauna

The EPBC Act protected matters search identified 13 threatened fauna and 3 threatened fish species with potential habitat within a 20km radius of the study area (Appendix 1). Three birds and one species of bat were identified as having habitat within the study area (Appendix 4). These being, Painted Honeyeater, Plains Wanderer, Superb Parrot and Corben's Long-eared Bat.

Corben's Long-eared Bat

Harp Trapping (November Survey) and Anabat Surveys (September and November Surveys) targeting Corben's Long-eared Bat were conducted within woodland habitats (Figure 3-3), typically containing tree hollows, throughout the study area. A variety of common bat species were recorded / captured throughout these survey periods, including the common related species *Nyctophilus geoffroyi*. Large expanses of high quality habitat occurs to the north and south of the study area, which provides contiguous foraging, breeding and roosting habitat for this species.

The Corben's Long-eared Bat was not recorded within the study area following these targeted surveys.

Painted Honeyeater

Targeted searches for Painted Honeyeater were conducted within the Weeping Myall Woodland during the September field surveys. Three mistletoe plants were identified on two weeping myall trees in patch WM5. Surveys were conducted during dawn and dusk, with random meander searches carried out at various times during the day (Figure 3-3). Other woodland areas were searched during the threatened flora surveys. Eucalypt (*Amyema* species) mistletoes were recorded within the Black Box and Yellow Box vegetation types. A large patch of Weeping Myall Woodland was observed on Kidman Way between Griffith and Darlington Point. This community had large numbers of mistletoe in flower at the time of the survey. The Painted Honeyeater is likely to utilise this resource rather than the limited resources within the study area. All of the areas of Weeping Myall Woodland will be retained as part of the proposal and it is unlikely that the Painted Honeyeater would be affected by the project.

The Painted Honeyeater was not recorded within the study area.

Plains Wanderer

Habitat mapping for the Plains Wanderer has been undertaken for the Riverina region (Roberts, 2001). This project mapped the grassland within the study area as being Rye grass- Plains Grass, Wild Oats, other grasses and communities and cotton bush (Figure 3-4) which has been categorised as being unsuitable habitat. This description of the grassland concurs with the field assessment within the study area. The grassland within the study area lacks diversity of native daisy species and scalded areas which are required for primary and secondary habitat for this species. Figure 3-4 shows the Plains Wanderer habitat mapping with Figure 3-5 showing field transects used for the targeted field surveys. Therefore, it is unlikely that the Plains Wanderer would occur within the study area.

The Plains Wanderer was not recorded within the study area.

Superb Parrot

The Superb Parrot was recorded in 16 locations, primarily within woodland habitat of the Study Area and is listed as Vulnerable on the EPBC Act (Figure 5-3). This species was recorded during all the field surveys in April, September and November. Observations of this species include foraging in Black Box trees, Yellow Box trees and exotic grassland adjoining the study area. No nesting pairs were observed to be associated with the hollow-bearing trees, during the field surveys within the study area.

Koala Assessment

Two Koala policies have been used to assess the Koala as part of this EA, these include the following:

- NSW Recovery Plan for the Koala
- EPBC Act Referral Guidelines for the Koala

Two species of Koala secondary feed trees listed within the NSW Recovery Plan for the Koala were recorded within the Development Site, being *Eucalyptus largiflorens* (Black box) and *Eucalyptus melliodora* (Yellow box).

A single Koala record occurs approximately 11km southwest of the Development Site. A large population, containing hundreds of records for the Koala occurs approximately 40km east of the Development Site within and clustered around the township of Narrandera in the Koala Park in which Koalas were purposefully reintroduced.

No Koalas were observed during the field surveys. Scratches or scats were not recorded during the field surveys. The Development Site contains preferred secondary feed trees however, due to the fragmented nature of the site only limited habitat connectivity is available for Koala movements.

NSW Recovery Plan for the Koala

The NSW Recovery plan for Koala identifies seven management areas (KMAs), with lists primary, secondary and supplementary food trees for each KMA (Department of Environment and Climate Change, 2008). The Development Site is located in the Western Slopes and Plains KMA. The Koala secondary feed trees *Eucalyptus largiflorens* (Black box) and *Eucalyptus melliodora* (Yellow box) listed under this Management Area occur within the Development Site.

Federal Koala Assessment

Only a single Koala record occurs approximately 11km southwest of the Development Site which is over 10 years old. A large population of the Koala occurs approximately 40km to the east at Narrandera, where hundreds of records exist. Although only limited recent records occur for the Koala within the vicinity of the Development Site, an assessment under the EPBC Act referral guidelines for the Vulnerable Koala (Department of the Environment, 2014) has still been undertaken as a precautionary measure. As outlined in the Koala referral guidelines impact areas that score 5 or less are not critical to the survival to the Koala. The Development Site score was 4 and therefore the Development Site is not critical to the survival of the Koala. Although two secondary feed tree species were identified within the Development Area, in accordance with the flowchart on page 30 of the referral guidelines for the Koala a referral is not required.

Table 5-8 Koala habitat assessment tool

Attribute Score	Score	Inland	Coastal	Score
Koala Occurrence	+2 (high)	Evidence of one or more koalas within last 5 years	Evidence of one or more koalas within the last 2 years	No
	+1 (medium)	Evidence of one or more koalas within2 km of the edge of the impact area within the last 10 years.	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 5 years.	No
	0 (low)	None of the above	None of the above	0 - last record was from 2004 at the latest
Vegetation Composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species **OR** 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	Has forest or woodland with 2 or more known koala food tree species, **OR** 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	2 - Yes
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with 1 species of known koala feed tree.	Has forest or woodland with only 1 species of known koala food tree present.	No
	0 (low)	None of the above	None of the above	No
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 1000 ha	Area is part of a contiguous landscape ≥ 500 ha.	No
	+1 (medium)	Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha	Area is part of a contiguous landscape < 500 ha, but ≥ 300 ha.	No
	0 (low)	None of the above	None of the above	0 – Contiguous area of habitat connectivity is <500ha
Key Existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. **OR** Areas which score 0 for koala occurrence and have no dog or vehicle threat present		2 - No Koala mortality observed during the survey
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, **OR** Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.		

Attribute Score	Score	Inland	Coastal	Score
	0 (low)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, **OR** Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.		
Recovery Value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		No
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		No
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		0 - habitat is unlikely to be important for achieving interim recovery objectives
Total Score				**4**

5.6.3 Migratory Species

The EPBC Act protected matters database search identified one migratory marine species, two terrestrial migratory species and four migratory wetland species with the potential to occur within the study area (Appendix 1).

Three species have been assessed (Appendix 4) as having habitat within the study area, Latham's Snipe, Common Greenshank and Fork-tailed Swift. Under the EPBC Act listed migratory species have areas of important habitat. The EPBC Act Significant impact guidelines for Matters of National Significance (2013) defines important habitat for migratory species as:

- Habitat utilised by migratory species occasionally or periodically within a region that supports ecological significant proportion of the species; and /or
- Habitat that is of critical importance to the species at particular life-cycle stages; and/or
- Habitat utilised by a migratory species which is at the limit of the species range; and/or
- Habitat in an area where the species is declining.

Habitat within the study area for these species does not meet the above criteria and therefore the project is unlikely to impact upon any migratory species.

5.6.4 Wetlands of International Importance

Five wetlands of international importance were identified by the protected matters database search being Banrock Station Wetland Complex, Fivebough and Tuckbil Swamps, Hattah-kulkyne lakes, Riverland and The Coorong, and lakes Alexandrina and Albert wetland. Rivebough and Tuckbil swamps occur 20km upstream with the remainder over 400km upstream. As all these wetlands occur upstream the project is unlikely to have an impact upon these wetlands.

No other MNES are relevant to this project.

5.7 Threatened Aquatic Species and Communities

No threatened habitat, aquatic species, endangered populations or communities listed under the FM Act were recorded or have habitat within the study area.

6 AVOID AND MINIMISE IMPACTS

This section has been prepared to address the requirements of Chapter 8 of the FBA.

Section 8.3.2 of the FBA provides guidelines for the avoidance and minimisation of impacts to biodiversity values during the project life cycle. It is broken down into “Site selection and planning phase”, “Construction phase” and “Operational phase” and this structure is replicated below.

6.1 Site Selection and Planning Phase

A number of properties in close proximity to the existing Darlington Point substation were investigated for their suitability and availability as alternative sites for the DPSF. As the proposed DPSF is located on grazing land with native grassland coverage, the basis of the alternative site investigation was to identify any available alternative sites devoid of native vegetation, such as arable cropping land or other brownfield developments.

Edify Energy undertook discussions with adjacent landowners during the site selection and feasibility phase and did not identify any arable or brownfield land within a feasible radius of the Darlington Point substation as being available, commercially or otherwise, for lease or purchase. Notwithstanding the above and albeit with limited land alternatives proximate to the Darlington Point substation, Edify Energy has intentionally overlooked areas of high-value agricultural production within the Murrumbidgee and Coleambally Irrigation Areas, as it is considered counter-intuitive to displace material food crops with renewable energy facilities. In addition, it was considered that such an approach would have the potential to attract significant community concerns as has been evident at other proposed solar farm projects on productive arable lands in North Queensland and the Murray River region.

Therefore, in selecting the development site and progressing with the development of the project, Edify Energy has sought to achieve a balanced outcome, considering the limited but manageable impacts on the Riverine Plains Grasslands in parallel with the strong community support and significant social and economic benefits the project will bring to the Darlington Point community.

A preliminary ecological constraints investigation was originally conducted by Biosis (2017) to provide advice on ecological constraints of the development site and recommendations for further investigation. These recommendations included the identification and impacts of potential threatened species habitat, threatened TECs which may occur, and to conduct a biobanking assessment.

EPS was then engaged to conduct a detailed biodiversity assessment of the development site and to assess the impacts of the project. A summary and discussion of the project impacts is provided in Section 7. The results of the surveys and assessment of impacts informed the concept layout of the solar arrays to minimise the impact to biodiversity values of the development site.

The plains grassland community was unable to be avoided and was selected in preference to the woodland areas as the solar panels would not result in a total direct impact and a number of the woodland areas contained threatened vegetation. The plains grassland to be retained will still be maintained through management practices and continue to contain habitat for fauna and flora species.

A larger area of the grassy woodland vegetation was originally investigated to be removed as part of the original concept design for the project. This area of removal included all the Sandhill Pine Woodland and the majority of the Weeping Myall Woodland which both are listed as endangered under the BC Act. These areas are now to be retained by the development.

After the detailed biodiversity assessment outlined in this BAR, over 95% of the grassy woodland will be retained which includes all threatened communities identified within the development site. These changes to the design have reduced the impacts to threatened fauna and flora species and their habitats which includes the threatened Superb Parrot and Grey-crowned Babbler recorded within the development site.

In summary areas with the highest known biodiversity value being threatened ecological communities and threatened flora and fauna habitat, predominantly associated with the treed areas, were identified and avoided. The concept design includes the following mitigations:

- Retention of the majority of the woodland and open forest vegetation, identified as Vegetation and Heritage Protection Exclusion Zones; and
- Retention of the all the threatened communities listed as endangered under the EPBC Act and/or the BC Act recorded within the development site.

These changes resulted in a complex and non-optimal solar farm layout which has minimised the impacts of the project to threatened biodiversity with the development site. The confirmation that the project is not a controlled action under the EPBC Act appears to support the maximum avoidance approach taken as part of the site section and planning phase for the project.

Specifically, against the items outlined in Section 8.3.1.3 in the FBA, the following outcomes in Table 6-1 are achieved. The achieved outcomes are considered to be a best-practice example of the avoid and minimise principal. Further avoidance and minimisation could not be achieved without resulting in the project become uneconomical, with the resultant loss of economic and social benefits to the locality and State of NSW.

Table 6-1 Avoidance and minimisation assessment

Item	Response
The proponent must seek to avoid the direct impacts of the Major Project on all biodiversity values at the development site including impacts on:	
(a) endangered ecological communities (EECs) and critically endangered ecological communities (CEECs), and	Almost all threatened ecological communities have been avoided through the site planning phase. Two threatened ecological communities occur within the study area, being Weeping Myall Woodland and Sandhill Pine Woodland. Revision of the original development footprint has meant that all Weeping Myall Woodland and Sandhill Pine Woodland will be retained and protected within the Vegetation and Heritage Protection Exclusion Zones, which will be managed for biodiversity and heritage protection purposes only.
(b) PCTs that contain threatened species habitat, and	In general, all native PCTs contain some form of threatened species habitat. Given the social, economic and agricultural aspects outlined above in terms of the site selection process, and the fact that avoidance of the woodland areas on site had been prioritised, complete avoidance of the plains grassland is not achievable. It is however possible to construct the solar farm without substantial removal of the grassland, unlike it would be for woodland. While obviously considered to be of value for some threatened species habitat, the relative simplicity of the plains grassland structure compared to the woodlands, its low to medium quality and its historical and ongoing use for grazing meant that it was prioritised for development of the project. There are no areas within the study area that do not contain some form of native vegetation. The poor quality plains grassland along with other areas of plains grassland was therefore targeted for development. A proactive management program is proposed that would aim to minimise the impacts on the plains grassland under and around the panel areas and therefore maximise retention and management of threatened species habitat.
(c) areas that contain habitat for vulnerable, endangered or critically endangered threatened species or populations, as determined in accordance with Step 5 in Section 6.5, and	Two threatened species were recorded, being Superb Parrot and Grey-crowned Babbler. Both of these species are primarily reliant on the forested parts of the study area. These areas were therefore almost entirely avoided as part of the project design refinement. It is considered that this is demonstration in practice of this requirement to the highest level.
(d) an area of land that the Minister for environment has declared as critical habitat in accordance with section 47 of the TSC Act, and	No critical habitat occurs within the study area.

Item	Response
(e) the riparian areas of 4th order or higher streams and rivers, important wetlands and estuaries, and	No riparian areas of 4th order or higher or any important wetlands or estuaries occur within the study area.
(f) state significant biodiversity links	No state significant biodiversity links occur within the study area.

6.2 Construction Phase

A detailed explanation of construction activities is provided in section 2.6 of the EIS for the project by Arup (2018) and Section 7.2 of this BAR.

The impacts during the construction phase of the project are discussed in Section 7.3.

In order to minimise the impacts on biodiversity values during construction, a Biodiversity Management Plan (BMP) is to be prepared and will include measures such as:

- Measures to be implemented for biodiversity management, including protection of Vegetation and Heritage Protection Exclusion Zones and the biodiversity management regime;
- Construction of the perimeter fence around the development site.
- Seasonally-based program to monitor and report on the effectiveness of the measures; and
- Responsibilities for implementation of the plan.
- Plains Grassland Monitoring – development of a monitoring plan in consultation with CSU. This should include further baseline surveys prior to construction.
- Environmental induction prior to commencement of on-site works. This induction will encompass ecologically important matters on site and the procedures to protect flora and fauna.
- Trees and Vegetation and Heritage Protection Exclusion Zones / excluded areas to be retained should be clearly marked (e.g. fencing) to ameliorate unnecessary impacts to vegetation.
- A qualified ecologist is to conduct pre-clearing surveys before removal of any treed vegetation to remove any fauna and mark up hollow bearing trees to be removed. All trees proposed to be removed should be re-checked for hollows prior to clearing.
- A qualified ecologist will be required to be present during hollow-bearing tree removal to relocate any displaced fauna.

- Where possible, dead wood, hollow trunks and tree limbs should be relocated to woodland areas not to be cleared.
- Ensure all equipment is free of plant material and soil that may contain weeds or soil borne diseases. This is particularly important for the spread of Bathurst Burr which was recorded within the development site.
- [illegible]

These approaches will manage those aspects outlined in the FBA methodology, including the following:

Table 6-2 Construction phase assessment

Item	Response
The following matters should be considered in order to avoid and minimise impacts on biodiversity values during the construction phase:	
(a) method of clearing – using a method of clearing during the construction phase that avoids damage to retained native vegetation and reduces soil disturbance. For example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	Actual clearing required for the project will be minimal in terms of tree removal as even the areas of woodland proposed to be impacted are thinly wooded. Chain-saw is expected to be one of the preferred clearing mechanisms and all works will be undertaken in accordance with the CNVMP and BMP in an ecologically sympathetic manner.
(b) clearing operations – minimising direct harm to native fauna during actual construction operations through onsite measures such as undertaking pre-clearing surveys, daily fauna surveys and the presence of a trained ecologist during clearing events	As outlined above and in accordance with the CNVMP and BMP numerous such measures will be implemented.
(c) timing of construction – identifying reasonable measures that minimise the impacts on biodiversity. For example, timing construction activities for when migratory species are absent from the site, or when particular species known to or likely to use the habitat on the site are not breeding or nesting, can minimise the impacts of construction activities on biodiversity	Timing is not expected to be a significant constraint to construction of this project as very limited trees will require removal. The BMP and ecologist present as part of the construction works will ensure any further specific timing measures are identified.

Item	Response
(d) other measures that minimise inadvertent impacts of the Major Project on the biodiversity values – measures such as installing temporary fencing to protect significant environmental features such as riparian zones, promoting the hygiene of construction vehicles to minimise spread of weeds or pathogens, appropriately training and inducting project staff and contractors so that they can implement all measures that minimise inadvertent adverse impacts of the Major Project on biodiversity values	The CNVMP and BMP will specify the exact detailed measures however these will include protective fencing, hygiene protocols, training and inductions in order to ensure impacts are absolutely minimised.

6.3 Operational Phase

An explanation of operational activities is provided in section 2.7.2 of the EIS for the project by Arup (2018) and Section 7.4 of this BAR. Operational activities are expected to include preparation and implementation of the BMP along with related components such as:

- Plains Grassland Monitoring Program;
- Monitoring of potential lake effect impacts;
- Weed management;
- Adaptive management as proposed by CSU is implemented;
- Bushfire management.

Specifically, in relation to the FBA considerations:

Table 6-3 Operational phase assessment

Item	Response
The following matters should be considered in order to avoid and minimise direct impacts on biodiversity values at the operational phase:	
(a) seasonal impacts – whether there are likely to be any impacts that occur during specific seasons. Minimisation measures may include amending operational times to minimise impacts on biodiversity during periods when seasonal events such as breeding or species migration occur	The above measures are expected to ensure management of any seasonal impacts will occur in an appropriate manner, including adaptive management as necessary.
(b) artificial habitats – using 'artificial habitats' for fauna where they may be effective in minimising impacts on such fauna. These include nest boxes, glider-crossings or habitat bridges.	In general, artificial habitats are not likely to be warranted for this project. A large focus will be on managing and monitoring the plains grassland to ensure maintenance or improvement of its condition, thereby improving certain forms of grassland habitat throughout the study area.

7 Impact Summary

The FBA requires that an assessor assess the likely direct and indirect impacts of a development on biodiversity values. This section explores such aspects and provides information of likely conclusions that can be drawn.

7.1 Impact Areas

The development site consists of a number of different project components and areas, each which have different impacts during both construction and operation. The impacts of the various areas should therefore be considered separately and then aggregated into an overall impact and offset requirement. Table 7-1 summarises the direct and indirect impacts from the component areas.

Table 7-1 Component impact area summary

Area	Total Area (ha)	Description
Direct Impacts		
Roads	23.40	Internal access roads will be developed to allow for access to the arrays for operation and maintenance. These roads will be constructed on the existing grade with a gravel pavement and thus they result in a complete loss of the vegetation in the road area. The internal access road will include a perimeter road and internal spine roads to access inverters central to the arrays. It is expected that these will traverse the transmission easements and firebreaks wherever practicable.
Firebreak	16.40	A firebreak will be provided between the arrays and surrounding vegetation. The firebreak is a total of 10m which includes the perimeter road. The firebreak would be maintained regularly to provide a defendable space and it has been assumed that this would result in a complete loss of biodiversity value in these areas.
132/33kV Switchyard	0.28	The switchyard will be located on a bench which will be surfaced with gravel and electrical structures located on the bench. The bench area will result in a complete loss of habitat. The switchyard will be electrically connected to the existing Transgrid substation.
Office, Car Park, Other Amenities	0.10	Permanent car park and maintenance and operation buildings will be constructed resulting in a complete loss of habitat for this area.

Area	Total Area (ha)	Description
Battery Facility	2.00	The battery facility will consist of a number of concrete foundations and will result in a complete loss of habitat.
Inverters and Hardstand	0.33	The inverter container will be installed through the array and a hardstand area is likely to be retained adjacent to each. These areas will result in a complete loss of habitat.
Piles	0.32	Arrays are supported on piles which will result in a direct impact to the ground and thus complete loss of habitat in the pile area and the immediate surrounds.
Indirect Impacts		
Panel Area (Horizontal)	197.25	The solar array area is the largest component of the solar farm. The panel area is the total area directly underneath panel when the panels are in the horizontal position. Complete loss of native vegetation is not expected for this component.
Area directly between panel rows	394.73	This is the area directly between rows of panels. There is approximately 6m between the rows centre. Complete loss of native vegetation is not expected for this component.
Surrounding Areas	74.49	The “other” areas represent other areas of the solar farm which are not being used. This is largely irregular spaces on the edges of the development area which will not be impacted by roads or arrays. Many of these areas will retain connectivity with the surrounding woodland areas which have been avoided (e.g. included in Vegetation and Heritage Protection Zones). Complete loss of native vegetation is not expected for this component.
Total	709.29	

The retained vegetation (Vegetation and Heritage Protection Exclusion Zones) will be avoided by the project and have not been included. Similarly, the connection to the existing Transgrid substation and any augmentation works required within the Transgrid site will occur on the existing hardstand area and have therefore not been included.

7.2 Construction Methodology

The following describes the typical construction methodology for a large-scale single access tracking solar farm which is indicative for the purpose of accessing the impacts.

The photographs in the below section are of Edify Energy solar farm sites in Australia, built using the same construction practices expected to be deployed at the project site.

7.2.1 Temporary Construction Facilities

Establishment of the temporary construction facilities will be one of the first activities undertaken. This will include the construction of site offices, amenities and laydown areas. These areas will be graded and compacted and temporary buildings (offices and amenities) will be erected. A temporary carpark will be established. Primary facilities would be located near to the site entrance and will likely utilize the area planned for the installation of a battery energy storage system at a later date. Smaller satellite facilities are also likely to be established across the site given the extent of the site.

Following completion of construction, these areas would be reinstated with topsoil and rehabilitated.

7.2.2 Roads, Fencing and Firebreak

Internal roads will be cleared, graded and compacted and roads formed using imported materials. The roads will be created at the existing grade. The road surface will be gravel.

A solar farm fence will be established around the edges of the solar farm area. Steel posts will be either direct driven or drilled and grouted (vehicle mounted diesel/electric auger). Wire-mesh rolls at various points along the fence line will be rolled out and manually wire tied to posts. The fence will be a minimum of 10m from any structures to provide access for fire vehicles. The perimeter roads will be located within this easement.

Grassed areas within the firebreak would be regular managed to maintain a defendable area in the case of a bush fire.

7.2.3 Substation

Bulk earthworks will be undertaken to construct a flat, compacted and raised (above 1-in-100 year flood event) bench for the new DPSF 33/132kV switchyard. This will require the use of graders, diggers, haulage trucks and rollers. Imported materials will be used to construct the bench. The switchyard area is estimated to be 70 x 40m and situated directly off the main solar farm access road. The finished surface will be gravel.

Bulk items for the switchyard, such as transformers and circuit breakers etc, are delivered on specialist transportation and immediately craned into place on cast concrete foundations (refer Plate 7-1).

Plate 7-1 Indicative switchyard works

7.2.4 Solar Array – Piling

Piling requires the grass to be close cropped via mowing to allow the posts to be set out within allowable tolerances. Set-out is achieved manually, on-foot, via portable laser alignment and pin markers (e.g. coloured nails) are driven into the ground to indicate the position of each individual pile. Steel posts are delivered by forklift and set down proximate to each pin marker pending installation. A pneumatic/hydraulic piling rig moves along each row, with each pile being manually lifted into position by two labourers and driven to the required depth, checking for alignment throughout via laser situated at the end of the row. Due to the geotechnical conditions, no predrilling or digging is required, and piles will be directly driven into the ground.

The piling rig moves along each row, installing piles sequentially and then proceeds back along the neighbouring row. The project site may have 10-15 piling rigs working in sections across the site, with the total piling programme taking approximately 4 months.

Due to the nature of the piling work, it will not be undertaken in severe wet weather conditions.

Plates 7-2 and 7-3 show examples of the level of mowing required for pile set-out, the piling process and grassland regeneration immediately after completion of piling.

Plate 7-2 Piling set-out

Plate 7-3 Piling set-out area

7.2.5 Cable Installation

DC cables, which run from combiner boxes at the end of each row to the inverter station servicing each block of panels, are laid in trenches approximately 0.9m deep and dug by a compact trench digger. DC cables are laid manually by hand, from rolls of cable delivered to and stored on pallets at various laydown locations near each inverter station. The larger AC cabling from the inverter stations to the 33kV switchroom is laid via a cable laying machine, which trenches and lays cable simultaneously. Sand is backfilled immediately around the cables and removed soil is then reinstated over the laid cables and compacted. Vegetation will be re-established above cables.

7.2.6 Tracker installation

The tracking system is delivered to the laydown areas, unpackaged and deposited at strategic locations around the site by wheeled forklift.

Some sub-assembly occurs in situ, by hand, and then multiple (generally up to six) tracker sections are loaded onto a forklift. This forklift positions itself at the first row and the first section of tracking system is lifted into place and manually bolted into position. It then reverses to the adjacent, neighbouring row and also installs the first section on this row, continuing the process up to six times. The second section of the tracker is then loaded, the forklift moves down the row and installs the second section along each of the six rows, and so on until the tracker system is complete along the entire row length. The process then continues on the next six rows and so on.

This is shown in Plate 7-4 below.

Plate 7-4 Tracker Installation

7.2.7 Module Installation

PV modules are delivered to the central laydown areas and as with the tracker systems, unpacked, delivered by fork-lift on pallets to each row and deposited at the end of each row or in some instances, pallets may be deposited at staged locations along the row. Panels and DC harnesses are manually carried into position along each row and installed by hand (refer to Plate 7-5). Other than delivery of the panels, there is limited vehicular traffic along the rows during module install.

Plate 7-5 Module installation

7.2.8 *Inverter installation*

Where possible, inverters are delivered by side-lift trucks and placed directly onto the footings. If access requires otherwise, inverters are delivered by conventional low-loader and craned into position.

7.2.9 Commissioning

Commissioning will be largely undertaken remotely from the main control room. Some site works may be required for attendance at inverter control panels, and diagnostic checking of the arrays with hand-held multi-meters. This is undertaken by light vehicle and on foot.

7.3 Construction phase direct impacts

The direct impacts to biodiversity of the construction of DPSF is the removal of vegetation for construction. This occurs in the areas above noted as direct impact areas.

This will include:

- 0.5 ha direct impact to Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16) moderate to good – moderate;
- 2.67 ha direct impact to tree canopy layer and shrublayer of Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16) moderate to good – moderate;
- 0.16 ha direct impact to Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregions (PCT 75) moderate to good – moderate;
- 40.02 ha direct impact to Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) moderate to good moderate;
- 2.14 ha net impact Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) moderate to good poor – this was calculated from CSU study assessment impact as Plains Grassland under the solar panels (see assessment above).

As discussed in Section 6, the project has sought to minimise the need for the removal of vegetation.

7.4 Operational Phase Activities

During operations, the solar farm will only be lightly resourced. The solar farm system is highly automated and will be operated from the control room or remotely.

Maintenance activities with the potential to impact on biodiversity value include:

- Grasses in the firebreak will be regularly mowed to maintain a clear fire buffer.
- Grasses beneath panels and between rows will be required to be mowed periodically to maintain an acceptable fuel load within the solar farm which is to be managed as an asset protection zone. The frequency of the mowing will depend of the time of year and of the weather as the amount of rain has a material impact on the growth of grasses and hence the fire load. It is expected to be required a number of times per year. Mowing will be performed using a tractor or a specialised mowing vehicle.
- It is not expected that regular cleaning of solar panels will be required however in the event that performance is affected by dust build-up, cleaning would be undertaken from a vehicle which would traverse each row. This is not likely to occur more than once per year.
- Maintenance within the solar arrays would occur as and when faults occurs. It is likely to involve the replacement of panels, cable and electrical fittings. Light vehicles may be used to access between rows. Maintenance access is infrequent.
- Periodic light vehicle access along the site perimeter and along internal access roads (but not between panels) would be undertaken by maintenance workers to check for general integrity and security at the site.
- Drone flyovers will also be used for the same purpose, operated remotely from the control room.

7.5 Microclimate impacts under the Array

99% of the proposed solar arrays are to be located on the Plains Grassland community within the development site. The solar array area consists of the areas that are directly underneath the horizontal panels plus the areas directly between the rows.

Areas likely to be subject to partial indirect impacts from changes to microclimate are:

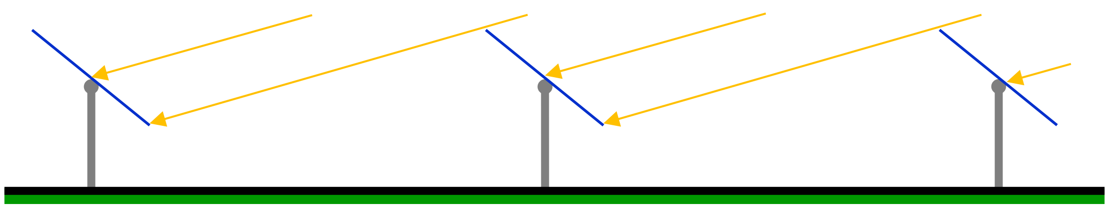
- 2.67 ha indirect impact to groundlayer of Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16) moderate to good – moderate;
- 182.15 ha indirect impact under the panels to Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) moderate to good moderate;
- 434.14 ha indirect impact between and around the panels to Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) moderate to good moderate;
- 12.11 ha net impact Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) moderate to good poor.

The microclimate may be modified by changes in environmental factors such as rainfall distribution, light availability (through changes in shading) and variations in temperature. These environmental factors are discussed below.

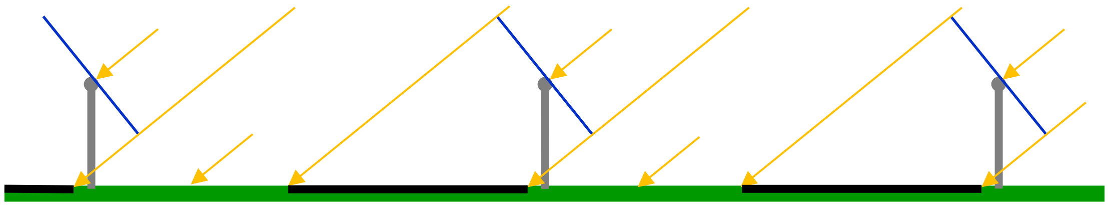
7.5.1 Shading and Radiation

An analysis has been undertaken to determine the extent of shading in the array areas. This model has determined shading levels on an hourly basis at 25cm intervals from the center of the row to the midpoint between rows. This analysis has been based on hourly solar geometry data and tracking system parameters from Edify Energy's yield model and contains 219,000 data points for a year.

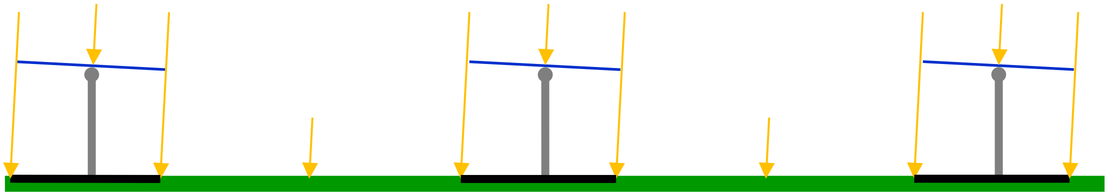
All areas within the solar arrays will be subject to partial shading. Directly beneath the center of the panel is the highest shading impact however still receives between 3 and 4 hours of direct sunlight per day in the mid-morning and mid-afternoon. The following figures show the impact of shading throughout a typical morning while the chart shows the average percentage of daytime hours which a location relative to the center row receives direct sunlight. Shaded areas of the solar array area are black whilst non-shaded are green.



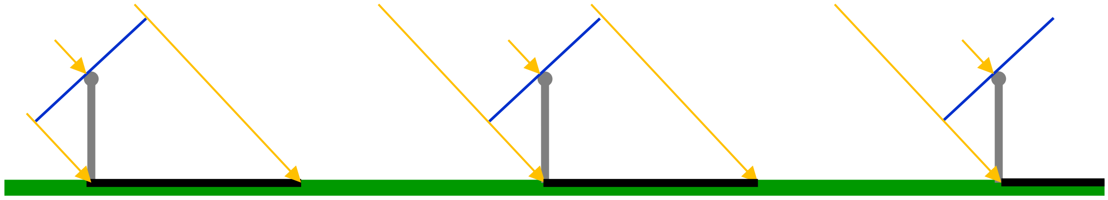
Summer Day 6:00am – Sun Inclination = 15.6°, Panel Inclination = 39.1° - Full shade



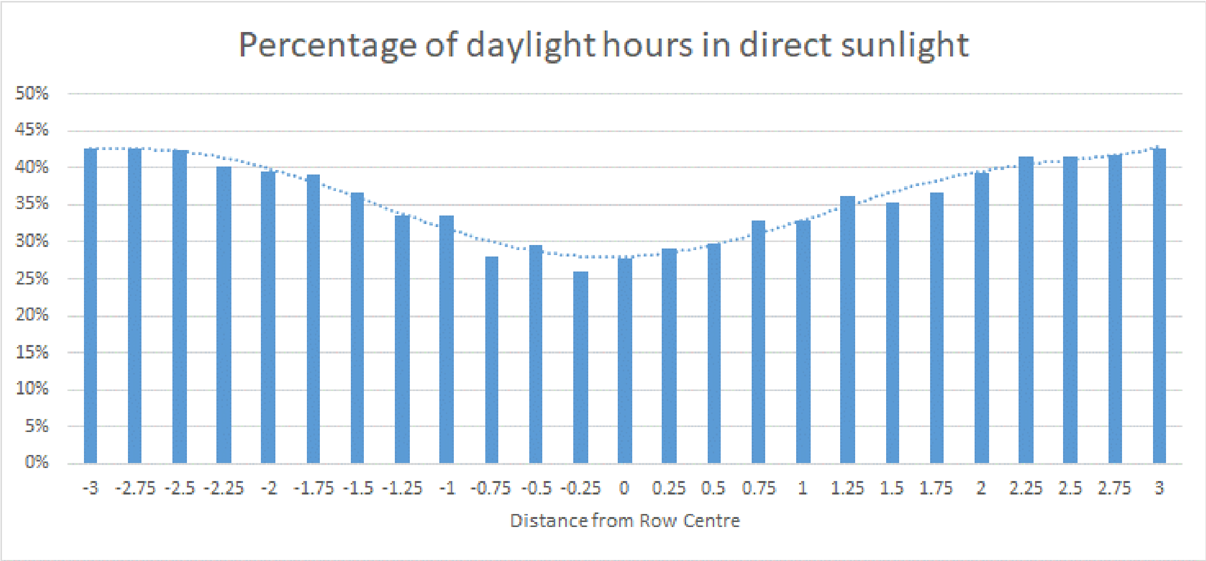
Summer Day 8:00am – Sun Inclination = 50.1°, Panel Inclination = 50.1° - Partial shade



Summer Day 12:00pm – Sun Inclination = 2.6°, Panel Inclination = 2.6° - Partial shade



Summer Day 12:00pm – Sun Inclination = 137°, Panel Inclination = 137° - Partial shade



In addition to considerations of direct shading, the microclimate of the grassland will be influenced by solar radiation levels. McCormick & Orchard (2018) calculated a reduction in solar radiation seen on the ground which accounts for the angle of the sun and diffuse irradiation in addition to the times of shading. They concluded that irradiance levels under the panels over a period of one year was likely to be reduced by 58-63% in the area underneath horizontal panels and likely to be reduced by 16-52% in the area between panels.

The impacts on shading on biodiversity are discussed in section 8.5.

7.5.2 Rainfall

The solar panels will likely result in a change in the rainfall distribution within the array area, as rainfall landing on the panels will run-off to the lower side of the panel. The vertically projected area under the panels will vary throughout the day as the panel tracks the sun and will vary from approximately 2m width per row (33% of the total array area) when horizontal in the worst case to approximately 1.2m per row (20% of the total array area) when the panel is in the extreme inclined position.

The panels will remain in the inclined position during night time hours in addition to earlier morning and later afternoon sun conditions, meaning the vertical rain distribution on the ground surface is likely to be modified. The rain shadow extent would also be affected by the direction of the prevailing rainfall and the incline position of the panels. One of the features of the soil in the area is the ability for water to move laterally through the soils (McCormick & Orchard, 2018). Another mitigating factor is the likely reduction in water losses from evaporation from the soil due to the increased shading. Therefore, the solar panels are unlikely to have a substantial impact upon water distribution and moisture levels under the panels.

In addition to the potential rain shadow, there could be a concentration of water at the edge of run off from the panels. However, given that the panels will use a tracking system (i.e. follow the sun), the impact of any potential erosion risk from this will be minimised as the drip line will be constantly moving throughout daylight hours and will shift from one side of the row to the other at solar noon. In addition any erosion risk will be mitigated by vegetation coverage.

7.5.3 Temperature

Temperature under the solar panels at the DPSF is likely to be reduced due to reduced level of solar radiation. This would have the effect of lower than average temperature in winter compared to summer (McCormick & Orchard, 2018). Barron-Gafford (2018) however reviewed a number of studies, which indicated that there is a small increase in temperature within the solar array. The study also noted however that maintaining grasses between and beneath the panels, provides a significant local cooling effect due to the transpiration of the vegetation. Given maintenance of vegetation cover at DPSF, overall any changes in temperature are likely to be minimal and not expected to material effect biodiversity.

7.5.4 Fauna Impacts

It is difficult to determine the impact of the changes to the microclimate to fauna that have habitat within the plains grassland. The impact to the fauna habitat from microclimate is dependent upon the degree of changes in the microclimate that will occur during the operational stage of the project and the sensitivity of species to these changes. Reduced temperature due to shading under the PV arrays may have impacts upon invertebrates and reptiles, limiting basking opportunities and reducing habitat for these species. Invertebrates, such as ants that are temperature sensitive would be impacted upon, these species are pollinator and seed dispersers for plant species within the grassland. The PV arrays will provide potential shelter for small ground dwelling fauna from raptors. In turn a reduction in hunting habitat will occur for raptor species. Lower temperatures may impact upon the ground dwelling birds such as the Australasian Pipit if their habitat may be too cold for breeding during spring.

In essence, there are expected to be positive impacts for some fauna and negative impacts for other fauna species. While there is some uncertainty in this regard, substantial active native grassland management, monitoring and adaptive management is proposed, to improve biodiversity outcomes within the solar array area, including outcomes for native fauna. This will be ascertained over time as part of the proposed monitoring regime.

7.6 Grassland Management Impacts

As outlined in Section 7.4, there will be a requirement to manage the fuel load within the solar farm arrays. This will involve mowing of the grasses. Mowing will be undertaken by a tractor or specialized vehicular mower. In addition to mowing there may be a small number of additional vehicle movements in the array rows.

The following management regime has been suggested by McCormick & Orchard (2018) to minimise the impacts of operation of the solar farm and enhance the native grasslands:

- *During winter graze sheep/mow. Primarily this will reduce the level of dry matter from annual growing species for summer fire hazard. The annuals will tend to have a greater palatability/digestibility than the natives at this stage and be preferentially grazed.*
- *Remove sheep/mow mid-August. This will allow annual grass seed heads to emerge evenly.*
- *Mow to 5-10 cm mid-September/October when annual grasses flowering. This will prevent seed set of exotic annual species enhancing native abundance as well as reducing combustible load.*
- *Destock/low stocking rate over summer. Enhance seed set of perennial native species.*
- *Only mow/graze during fire season if grassland growth will result in average dry matter exceeding 5000 kg/ha DM. This value was taken from the Murrumbidgee Irrigation Area Bush Fire Management Committee in regards to Asset Protection Zone (APZ) fuel load in forested areas, in the absence of a defined fuel load for grassland in the RFS guidelines."*

It is noted the above management regime will be adaptive based on the outcomes on the site and based on season to season variations in condition.

Mowing will have an impact of the grassland through removal of the upper levels of the vegetation and will alter the shading impact of the upper levels of the vegetation on the lower levels.

While the above regime could also include the use of grazing as an alternative to mowing, the other impacts of continued sheep grazing should be considered. Sheep are likely to congregate under panels causing an increase in nutrients in these areas. Lunt 2005 identifies that this localised increase in nutrients is likely to increase the competitive dominance of exotic annuals and negatively effect species diversity. It is therefore recommended that the use of grazing in place of mowing should be closely monitored and should be trialled before a complete transition to this regime. Grazing should only be considered if it is demonstrated that this would enhance biodiversity outcomes compared to mowing.

7.7 Fauna Habitat Loss

Direct fauna habitat loss as part of the proposal equates to the following:

- 42.16 ha of Grassland habitat;
    - 40.02 Plains Grassland Moderate to good moderate condition
    - 2.14 Plains Grassland moderate to good poor condition
- Maximum 3.33 ha ha of Woodland habitat; and
- 1.92 ha of Aquatic habitat.

The clearing and alteration of the native grassland within the direct impact areas will result in the loss of foraging, breeding and sheltering habitat for small grassland species such as ground foraging birds, macropods, Microchiropteran bats, skinks and snakes. The retention of the grassland in the under-panel area and between-panel areas, albeit in a modified form, would likely allow continued habitat for some of the ground dwelling species such as birds and reptiles.

The proposal will remove a comparatively negligible area of woodland habitat (maximum 3.33 ha) within the development site. Woodland removal will consist of the following:

- 0.5 ha of Black Box grassy open woodland plus 2.67 ha of tree canopy and shrub layer removal only (within the panel area);
- 0.16 ha of Yellow Box – White Cypress Pine grassy woodland

The clearing of this comparatively small area of native woodland habitat will result in the loss of minor foraging, breeding and sheltering habitat for some woodland species such as birds, arboreal mammals and microchiropteran bats. However, the retention of the vast majority of the woodland habitat that occurs on site would allow continued habitat for these woodland dwelling species.

Two out of six farm dams will be removed. All of the dams were devoid of vegetation and heavily used by cattle and had very poor water quality. The removal of these farm dams is unlikely to significantly impact foraging, breeding and sheltering habitat for fauna species which may occur within the development site.

7.8 Hollow-bearing Trees

The vast majority of trees (including those with hollows) within woodland areas of the site will be retained, however, six isolated paddock hollow-bearing trees are required to be removed by the project, within the grassland vegetation of the development site (Appendix 7). These trees have a combined 39 hollows. One of these trees contained a large stick nest in the upper branches of the tree likely to be a bird of prey nest. No bird species were recorded nesting in any of the hollows. The Superb Parrot was not recorded nesting within any of these trees. The vast majority of the open forest and woodland areas will be retained as part of the project.

7.9 Threatened Ecological Communities

No threatened ecological communities will be impacted upon by the proposal, they have been avoided and retained / protected within the Vegetation and Heritage Protection Exclusion Zones. Ten metre firebreaks have been provided around all Vegetation and Heritage Protection Exclusion Zones to provide a protective management interface. Any fencing will be at or outside of the dripline of the tree canopy layer of the threated ecological communities to ensure avoidance of impacts. Virtually no woodland will be impacted by implementation of the firebreaks.

7.10 Threatened Species Impacts

7.10.1 Grey-crowned Babbler

Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. In the western areas of NSW the Grey-crowned Babbler inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. The species builds conspicuous domeshaped nests and breeds co-operatively in sedentary family groups of 2-13 birds (Davidson and Robinson 1992). Grey-crowned Babblers are insectivorous and forage in leaf litter, on bark of trees, trunks and branches of eucalypts and other woodland trees, or on the ground, digging and probing amongst litter and tussock grasses.

This species was recorded at 23 locations in the Yellow Box, Black Box and White Cypress Pine woodland habitat within the study area (Figure 5-3). Four Grey-crowned Babbler nests were recorded in the study area. The study area provides foraging, roosting and breeding habitat for this species.

The proposal will remove only a negligible area of woodland habitat (maximum 3.33 ha) within the development site. The clearing of this small area of native woodland habitat will result in the loss of minor foraging, breeding and sheltering habitat for this species. No other areas of woodland habitat suitable for this species will be removed as part of the project.

7.10.2 Superb Parrot

The Superb Parrot is found throughout eastern inland NSW inhabiting Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in Box-Gum Woodland or isolated paddock trees. Tree species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box.

This species nests in small colonies in hollow-bearing trees, often with more than one nest in a single tree. They may forage up to 10 km from nesting sites, primarily in grassy box woodland. The Superb Parrot diet predominately consists of blossom, grass seeds and herbaceous plants.

The Superb Parrot was recorded at sixteen locations with the majority observed bordering the northwestern region of the development site (Figure 5-3). The Superb Parrot was recorded within the woodland and open forest habitat within the development site. The development site provides foraging, roosting and breeding habitat for this species.

The proposal will remove only a negligible area of woodland habitat (3.33 ha) within the development site. The clearing of this small area of native woodland habitat will result in the loss of minor foraging, sheltering and potential breeding habitat for this species. However, the woodland removal is not anticipated to extend into areas where the Superb Parrot was recorded during site surveys. No other areas of woodland habitat suitable for this species will be removed as part of the project.

Six isolated paddock trees containing hollows will be impacted upon by the project which contain potential nesting habitat for this species. This species is highly unlikely to utilise these isolated trees for nesting as they would be vulnerable to attack by prey species. Furthermore, although a negligible area of woodland habitat containing hollows will be removed as part of the project, large numbers of hollow-bearing trees will be retained within the development site and the locality of the development site.

7.11 Groundwater Dependent Ecosystems

The Atlas of Groundwater Dependent Ecosystem (BOM, 2017) has identified the Black Box Grassy Woodland community within the study area as having a high potential for being reliant on subsurface groundwater. The Project will involve the installation of poles to support the solar panels and would not be installed to a depth that is likely to interact with groundwater. Therefore, the project is unlikely to impact upon groundwater dependent ecosystems (GDEs).

7.12 Habitat Fragmentation and Connectivity

Habitat fragmentation is where removal of native vegetation causes an area of intact vegetation to become fragmented, resulting in loss of connectivity and a reduction in habitat availability. Types of fauna impacted include ground dwelling and arboreal mammals, ground dwelling birds and sedentary fauna.

The study area contains existing fragmented woodland areas in the south and west of the study area.

The proposal will remove only a negligible area of woodland habitat (maximum 3.33 ha) within the development site. No other areas of woodland habitat are proposed to be removed. The removal of this negligible area of woodland habitat is unlikely to further fragment the grassy woodlands and will retain connectivity to areas of existing woodland.

Some areas of the grassland community are likely to be removed where roads, the substation, the battery area and the firebreak are proposed. Where the solar array installation extent occurs, grassland will be modified to varying degrees. Direct impacts to vegetation will be restricted to solar array pole locations and cabling trenching. However, it is expected that after topsoil is returned to the cabling route, pre-existing vegetation will become re-established. Moderate impacts to the vegetation below the solar array installation may also occur as outlined in the CSU report (Appendix 9) and Section 7.1 of this report where a modified management regime will be implemented. Minor construction vegetation impacts are anticipated to occur in the between panel areas, however, beyond the construction stage impacts are not expected. A small area which contains the existing transmission line in the north east of the study area will be retained and connectivity to the north east will be retained.

Overall, grassland underneath the solar panels will be predominantly retained, albeit perhaps in a modified form, and will allow for movement of ground dwelling fauna across the study area. The movement of large macropods such as the Eastern Grey Kangaroo may be inhibited through the study area, however grassland areas occur to the east of the study area which will allow movement to the east of the study area.

7.13 Edge and Barrier Effects

Edge effects are areas that interface between native vegetation and modified landscapes. These areas result in changes to ecological function of native vegetation and can result in reduced availability of habitat for fauna species. These areas can increase weeds and the habitat for pest fauna species such as foxes and rabbits (Moenting & Morris, 2006).

The study area is within the modified agricultural landscape of the Riverina which contains areas of intense cultivated cropping areas particularly associated with the Murrumbidgee and Coleambally Irrigation Areas as well as areas of livestock grazing which are predominantly located on the grassland areas. Patches of remnant woodland vegetation remain throughout the Riverina area.

The project is located within grazed grassland areas and is surrounded by cultivated cropping to the north and south with grassland occurring to the east. Donald Ross Drive occurs to the west. The project will largely avoid removing areas of remnant woodland, with the solar farm layout predominantly located on the grasslands. The proposed biodiversity management regime (including a Biodiversity Management Plan) is aimed at improving the quality of the grassland, removing weed species and increasing native perennials such as Plains Grass. As such it is not anticipated that edge effects from an increase in weed species will occur.

As outlined in Section 7.7 above, the solar farm infrastructure may provide a barrier to movement for large ground animals such as the Eastern Grey Kangaroo, however grassland areas to the east of the study area will remain as habitat for large ground animals. It is unlikely that a significant physical impediment to the movement of small ground dwelling fauna under the solar panel area will occur.

Avifauna such as birds and bats are not anticipated to have any significant edge effects or barriers to movement between the higher value woodland habitat areas, which are surrounded by 10m firebreak areas. The grassland area will still be able to be accessed by avifauna. In terms of knowledge about how the solar farm infrastructure could impact their use of the grasslands, Montag *et al.* (2016) would seem to indicate that birds and bats will be able to continue to utilise the habitats present throughout the study area.

The project may result in removal of edge vegetation surrounding the development footprint and it is expected that this project could affect habitat used by both the Grey-crowned Babbler and Superb Parrot to a minor degree.

7.14 Injury and Mortality

An increase in mortality may occur during construction of the project, through collision with construction machinery and light vehicles. Mobile species such as birds can mostly avoid collision through moving out of the path of any vehicles. The removal of hollow-bearing tree has the potential to injure and result in the mortality of hollow dependent species such as the Superb Parrot, Common Brushtail Possum and microchiropteran bats. In addition, significant areas of grassland habitat will require slashing, in accordance with the CSU report and Section 7.1 of this report where a modified management regime will be implemented, and this has the potential to injure and result in the mortality of grassland-dwelling species such as the Australasian Pipit.

There is some potential for the operational solar farm to experience what is known as 'lake effect' whereby the reflection of light off photovoltaic panels resembles the constant reflective surface similar to a waterbody. Birds can experience injury and even mortality if the attempt to land (thinking they were water) on the surfaces of the panels. However, typical photovoltaic panels are designed to reflect approximately 2% of incoming sunlight. Subsequently, potential for bird collision risks due to the 'lake effect' are considered to be low.

Mitigation measures outlined in Section 10 will limit the effect of the project on such fauna species. Overall, the project and therefore the potential for injury or mortality to fauna is likely to be comparatively minor.

7.15 Sedimentation and Erosion

The proposal works may potentially contribute to sediment and erosion issues within the study area boundary as well as adjoining areas through construction processes and associative soil disturbance. Runoff containing excessive amounts of sediment can impact waterways, altering water quality and adversely affecting aquatic life.

Given the relatively modified nature of the development site and adjacent areas, the potential for impacts is negligible. This impact is likely to be mitigated if the measures outlined in Section 10 are adhered to.

7.16 Weeds

Twenty-seven species of weed were recorded within the study area. None of these species are listed on either the BS Act and/or are weeds of national significance. Other invasive weeds that were recorded include *Xanthium spinosum* (Bathurst Burr) *Marrubium vulgare* (Horehound). During construction, the project has the potential to spread weeds through the movements of heavy machinery and light vehicles.

The increase in weeds degrades the habitat for flora and fauna species and ecological communities. The Grey-crowned Babbler, were recorded in the study area in woodland habitat. The spread of weeds in this habitat may reduce the quality of the habitat for these species and other woodland bird species (Robinson *et al* 2001).

Invasion of native plant communities by exotic perennial grass is a key threatening process under the BC Act. The project has the potential to further spread weeds throughout the study area and exacerbate this KTP, if not appropriately mitigated.

If the mitigation measures outlined in Section 10 are implemented, then the impact of the project is unlikely to increase the spread of weeds recorded in the study area. It is in fact likely to reduce the presence of weeds within the study area.

7.17 Noise Impacts

Sound is important for fauna for communication, navigation, foraging and detecting prey species or danger. Changes in noise through a number of human induced noise sources, such as vehicle traffic, can affect fauna species ability to function (Forman et al, 2000). Adaption by animals to noise in their natural environment such as wind or other animals can cause them to change their behavior to function within their environment (Eve, 1991).

Heavy machine, vehicle movements and vegetation clearing will cause an increase in noise levels in the construction phase of the project. This increase in noise level may be detrimental to fauna and their ability to function in their environment. Noise might startle animals such as mammals and birds.

The increase in noise levels during construction will temporarily impact on fauna species. The establishment of the solar farm is unlikely to have a long-term impact on fauna within the study area because of increased noise.

7.18 Impact on Key Threatening Processes

Forty KTPs are currently listed on the BC Act and/or the EPBC Act. Of these the following have been assessed as having the potential to being increased by the proposal. These include the following:

- **Anthropogenic Climate Change** – minor incremental contribution to greenhouse gas in construction phase however operation of DPSF generates electricity from low carbon renewable energy reducing greenhouse gas emissions relative to fossil fuel generation;
- **Clearing of Native Vegetation** – The project will contribute to an incremental loss in native vegetation. Impact assessments for removal of vegetation and assessment of the need for biodiversity offsets is required;
- **Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L**.) – The project has the potential to increase grazing by rabbits through ongoing slashing of native grasses. However, much of the site will be managed through a modified regime which will slash grass to higher than standard levels;
- **Infection of native plants by *Phytophthora cinnamomi*–** No evidence of Phytophthora was recorded on any plant species, however the project may facilitate the transmission of this disease through machinery transportation;
- **Invasion of native plant communities by exotic perennial grasses –** The project has the potential to increase the spread of exotic perennial grasses through ongoing slashing of native grasses. However, much of the site will be managed through a modified regime which will slash grass to higher than standard levels;
- **Loss of hollow-bearing trees** – Six isolated paddock hollow-bearing trees containing 39 hollows will be impacted upon by the project; and
- **Removal of dead wood and trees –** fallen timber and dead trees were recorded throughout the development site. The project is likely to remove these during construction works. However, these will be relocated to other areas of the site.

Section 10 outlines proposed mitigation measures to address these KTP’s where possible.

8 FBA Assessment

8.1 Areas not requiring further assessment

The assessment of existing environment in Section 4.3 identified 6 PCTs within the study area. As outlined in Section 9.5 of the FBA areas that do not require assessment include areas that do not contain native vegetation, unless the SEARs issued for the project require an assessment.

An offset is not required for impacts to PCTs if it meets the following criteria:

- In a vegetation zone with a site value score of <17, and the PCT has not been identified as a EEC or CEEC;
- Not associated with threatened species habitat according to section 6.4 and are not identified as an EEC or CEEC.

The Plains Grassland in poor condition (Zone 4 in the calculator) has a site score of 16, which is less than 17 and therefore does not require further assessment or offsetting.

Farm dams that occur within the development site will not require assessment as they are devoid of native vegetation. Two out of six dams will be required to be removed. The farm dams will not require offsets as a result of the impacts from the project. The farm dams are mapped in Figure 4-4.

In addition, as outlined in Section 8.3, the White Cypress Pine and Weeping Myall woodland will not be impacted by the project or require to be offset and therefore have not been included in the development site or in the calculator for the purposes of determining credit requirements.

The remaining PCT's require further assessment and provision of biodiversity offsets.

8.2 PCTs Requiring Offsets

Three PCTs and related vegetation zones have been identified as occurring within the development site and requiring offsets. The following zones with a site value score of >17 will be impacted by the project:

- Zone 1 – Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW south Western Slopes Bioregion (PCT 75) Moderate to Good Condition – Moderate

- Zone 2 – Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 16) Moderate to Good Condition – Moderate
- Zone 3 – Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) – Moderate to Good Condition – Moderate

Thus, Zones 1, 2 and 3 are the only zones requiring offsetting to any degree. Along with Zone 4 (included in the calculator to demonstrate site value score of less than 17) these zones are the zones included in the calculator.

Note that the White Cypress Pine and Weeping Myall woodland will not be impacted by the project or require to be offset and therefore have not been included in the development site or in the calculator for the purposes of determining credit requirements.

8.3 PCTs Not requiring offsets

Two threatened ecological communities are listed as threatened under the EPBC Act and/or the BC Act.

- Weeping Myall Woodland is listed as endangered on the both the BC Act and EPBC Act;
    - Two patches WM1 and WM2 meet the criteria for listing of the endangered ecological community of Weeping Myall Woodlands under the EPBC Act and
    - Patches WM1 to WM6 meet the BC Act listing for Weeping Myall open woodland of the Riverina Bioregion and NSW Western Slopes
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered on the BC Act.

These zones will not be impacted as they have been avoided during project design development and are to be retained in Vegetation and Heritage Protection Exclusion Zones and as a result offsets are not required for these PCTs.

8.4 Threatened Species Offsets

8.4.1 Threatened flora

The following threatened flora have been identified as species credit species (Table 5-2) for assessment in the calculator.

- *Pilularia novae-hollandiae* (Austral Pillwort)
- *Convolvulus tedmoorei* (Bindweed)
- *Brachyscome muelleroides* (Claypan Daisy)
- *Leptorhynchos orientalis* (Lanky Buttons)
- *Solanum karsense* (Menindee Nightshade)
- *Brachyscome papillosa* (Mossgiel Daisy)
- *Diuris tricolor* (Pine Donkey Orchid)
- *Swainsona recta* (Small Purple-pea)
- *Lepidium monoplocoides* (Winged Peppercress)

All species were targeted as part of the seasonal surveys, although habitat was not considered to be present for Austral Pillwort.

Targeted field surveys were conducted in September 2017 and November 2017 within the flowering period for these species and the other potential species listed in the SEARs and recorded locally in the database searches, as outlined earlier in this BAR.

None of the flora species credit species were detected during the targeted field surveys and therefore these species are considered unlikely to be affected by the proposal. No offsets will be required for these species.

8.4.2 Threatened fauna species

Fauna Species Credit Species

The following threatened flora have been identified as species credit species (Table 5-2) for assessment in the calculator.

- Black-breasted Buzzard (*Hamirostra melanosternon*)
- Glossy Black-cockatoo Riverina Population (*Calyptorhynchus lathami*) – endangered population
- Koala (*Phascolarctos cinereus*)

- Regent Honeyeater (*Anthochaera phrygia*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Superb Parrot* (*Polytelis swainsonii*)

These species and the other potential species listed in the SEARs and recorded locally in the database searches were targeted during surveys, as outlined earlier in this BAR.

One species credit species, the Superb Parrot, was recorded within the development site. This species was recorded utilising woodland and open forest habitat throughout the development site. The Superb Parrot was not initially identified as a species credit species in the calculator and therefore was manually added into the Calculator for biodiversity offsets calculations. A maximum of 3.33 ha of woodland habitat for this species will be affected as part of the project. Such a reduction in woodland habitat is considered to be comparatively minor for the Superb Parrot, with large numbers of this species being recorded along the Murrumbidgee River less than 2 km to the north of the development site. Habitat for this species will still be available post-construction, with the majority of the woodland habitat identified for retention within the Vegetation and Heritage Protection Exclusion Zones. This species will require biodiversity offsets as a result of the project due to the removal of the maximum 3.33 ha of woodland habitat.

The three targeted field surveys in April 2017, September 2017 and November 2017 did not detect any other species credit species of fauna.

Ecosystem Credit Species

One ecosystem credit species was recorded, the Grey-crowned Babbler, in the development site. This species was recorded in family groups and nesting throughout woodland areas of the development site. The vast majority of its habitat will be retained post-construction in the Vegetation and Heritage Protection Exclusion Zones and offsets will be provided via provision of offsets for the ecosystem credits.

A further 17 ecosystem credit species of fauna were identified as having predicted habitat within the development site by the BioBanking calculator. Nine of these species were identified as having habitat (Table 5-1) within the development site. Offsets for these species will be provided via provision of offsets for the ecosystem credits.

For influencing ecosystem credit species in the biobanking calculator such as the Australian Bustard, the ecosystem credits provided as part of the required offsets will provide appropriate offsets. It can be seen in the credit calculation that the Australian Bustard (and other ecosystem credit species with lower Tg scores) are driving the credit requirement rather than the PCTs themselves. The ecosystem credit species such as the Australian Bustard have not actually been recorded (and for many species probably do not actually occur) within the development site and as such it is considered that the credits to be provided for such species are appropriate and reasonable.

8.5 Future Site Value in Solar Array Areas

The biodiversity offset credit calculation requires the future site value of each management zone within the development site to be determined. For the areas within the solar array, there will be partial impacts however there will not be a complete loss of the grassland ecosystem. The determination of the future site value for the grasslands within the solar array areas has been based on the likely impacts in these areas.

The major impacts on which the loss in site value has been based on is:

- Damage to grasslands from vehicle trafficking during construction;
- Microclimate impacts from solar arrays during operation; and
- Management of grasslands through mowing/grazing during operation.

8.5.1 Grassland damage during construction

There is likely to be some loss of vegetation ground cover due to trafficking during construction. The construction vehicle movements in this area however will be infrequent and the partial losses are expected to recover quickly. Seed bank trials have been undertaken from the proposed site which are presented in the CSU technical report. These trials have demonstrated the existence of a large diversity of seeds within the site soil and the ability of these plants to propagate from the seed bank albeit under replicated glasshouse conditions.

8.5.2 Microclimate Impact of Solar Arrays

Shading and radiation is considered the most material change to the microclimate under the solar array. The reduction in irradiation is predicted to cause an overall reduction in the growth rate (productivity) of the grasses [McCormick & Orchard (2018)]. It does not necessarily follow however that there will be a reduction in the diversity and abundance of the flora species within the Plains Grassland. While there is limited studies specifically about the impact of shading on all the component species of the grassland, there are many studies which demonstrate that diversity can occur across sites of varying overall productivity. Lunt (2005) concluded that superior competition from dominant species was a key cause of loss of diversity in highly productive ecosystems while this was not as significant a factor in less productive systems.

Annual species at the site are likely to be affected by the lower light conditions to a higher degree as they generally require higher light conditions compared with other species. Species diversity and abundance may increase due to the lower abundance of competing annual exotic species which will find it difficult to compete under lower light conditions. This will be further enhanced by the proposed management regime of selective mowing of the annual exotics prior to setting seed.

8.5.3 Grasslands Management Regime

While there will be a need to mow or graze the grassland to minimise fuel load for fire risks, it has been identified that maintaining a mowing or grazing regime may also be positive to the biodiversity outcomes of the site. Studies on the effect of grazing exclusion on native grasslands [Lunt (2005)] have found that at productive sites, grazing exclusion is associated with a reduction in species diversity. It was identified that a key reason for changes in the species diversity and abundance in Australian native grasslands is competitive dominance of species where superior competitors limit plant diversity and the abundance of non-dominant species.

McCormick & Orchard (2018) have developed a management regime designed to manage the dominant and exotic species through targeted mowing regimes. It is proposed that the management practices will be adapted based on monitoring of species within he grassland and based on the seasonal variations in weather such that less management is undertaken in unproductive years. These management techniques within the solar panel area can potentially increase the native species diversity, while maintaining structural integrity of the grasslands.

A review of literature on management of grasslands in Victoria (Wong & Morgan, 2007) found that the manipulation of grazing can maintain the status quo of the system and may have some positive outcomes for habitat complexity. Verrier & Patrick (2005) found that the use of slashing can increase cover of native species including rare and endangered species and reducing weed cover. These outcomes resulted from monitored adaptive management regimes.

8.5.4 International Studies about Solar Farm Impacts on Biodiversity

Montag *et al.* (2016) conducted a UK-based comparative study across several solar sites with the aim of determining the effects of solar farms on local biodiversity. Overall, the study established that the analysed solar farms exhibited a greater biodiversity of broad leaved plants, grasses, butterflies, bumblebees and birds when compared to nearby control areas.

Increased diversity was attributed to, in part, due to the selection of species-rich wild flower mixes used for site-reseeding. Of particular relevance to the current BAR, is the fact that even where agricultural grass mixes had been sown, biodiversity was still greater than control areas. In addition, re-seeded solar sites with conservation grazing exhibited higher plant diversity through natural processes as compared to the original seed mix.

A key point identified in this UK solar farm study is that the benefit to biodiversity is highly dependent upon the management regime employed at the site. Sites with the greatest biodiversity benefit utilised reseeding with a diverse seed mix post-construction combined with limited use of herbicides and employment of conservation grazing and / or a variable mowing regime.

Overall, this UK study provides a favourable conclusion in that informed management of solar farms can actually lead to increased biodiversity in comparison to typical agricultural land use practices.

Example site photos from the UK demonstrating these improved outcomes are provided below in Plates 8-1 to 8-2. These are sourced from the Montag *et al.* (2016) document.

Plate 8-1 UK example of diverse native vegetation in association with solar project

Plate 8-2 UK examples of mature grasses and native vegetation in association with solar project

8.5.5 Australian Studies about Solar Farm Impacts on Biodiversity

Within Australia, there are no known specific solar project examples which aim to identify the biodiversity status of grasslands post-construction. However, several Australian studies do provide pertinent information which can be gleaned to inform the potential impacts of solar farms, particularly upon native grasslands. Appendix 12 provides a brief summary of experience in grassland environments in Australia by the proponent Edify Energy.

Many of the Australian studies are agricultural focussed but are particularly relevant as given the long grazing history of the site, and their observations that cessation of grazing has been found in many cases to counterproductive to biodiversity outcomes. Despite the negative impacts that long term grazing has almost certainly had on the biodiversity outcomes of native grasslands such as those on the DPSF site, the potential impacts to biodiversity of cessation of all grazing in the solar farm area should not be discounted and will be monitored as part of the development site management regime.

Barlow (1998) highlights that much of the native grassland in Victoria occurs on private land, where it has occurred for some time. Indeed, it is identified that these areas can be effectively managed by continuing current management practices (e.g. grazing intensity), with the potential to improve native pasture to increase native species diversity.

Barron-Gafford (2018) reviewed a number of studies, which indicate that there is a small increase in temperature within the solar array. The study also noted however that maintaining grasses between and beneath the panels, provides a significant local cooling effect due to the transpiration of the vegetation.

A review of literature on management of grasslands in Victoria (Wong & Morgan, 2007) found that the manipulation of grazing can maintain the status quo of the system and may have some positive outcomes for habitat complexity. Verrier & Patrick (2005) found that the use of slashing can increase cover of native species including rare and endangered species and reducing weed cover. These outcomes resulted from of properly monitored adaptive management regimes.

Hodgkinson (2005) highlighted that mowing native grasslands can be problematic as it may not allow grasses and forbs to regularly reproduce viable seed for population persistence. However, it is highlighted that if an adaptive approach to native grassland management is adopted, it can allow for maintaining the integrity of native grasslands among competing land uses. This study also outlines that re-seeding with native species can be useful in areas where the native seed bank no longer occurs due to alternative land uses.

In managing native grassland, Eddy (2002) also highlights that all native plant species should be allowed to grow, flower and set seed at least every few years. In addition, it is recommended an adaptive approach to mowing, grazing and burning should be implemented to limit impacts on biodiversity. Overall, this study highlights how best to manage native grassland with the aim of increasing native species diversity in an environment of competing land uses.

Similarly, Lunt (2005) highlights that grazing regimes may provide a useful tool in native grassland management and maintaining biodiversity values, citing examples where grazing is used an effective grassland management tool (e.g. Terrick Terrick National Park).

8.5.6 Summary of approach to Future Site Value for Solar Array

For the grassland areas which are within the solar array area (i.e. under panel and between panels), the assessment of future site value has taken into account the likely reduction in growth and height of the vegetation due to shading and management by reducing the native ground cover score for each of grasses, shrubs and other.

While the impact of shading is expected to be less pronounced within the between row areas, there is limited granularity in the calculator scores (i.e. whole numbers only with no part increments) and thus ground cover for grasses and shrubs has been conservatively reduced to zero in both the between panel and under panel areas. Native ground cover other, has been reduced from 2 to 1 in both the panel and between row areas.

Despite the future site value scores applied in the calculator of 0 (grasses and shrubs), and 1 (native ground cover other), there is expected to be a high level of ground cover maintained in both areas and thus these future site score can be considered conservative for the solar array area as a whole, particularly in the between row areas where microclimate changes are lowest.

Both the international and Australian research indicates that provided suitable management occurs, with a focus on native species, management measures can actually increase native grassland and herbfield diversity and condition. Such an approach is proposed for this project, with a key focus being on ensuring native grassland diversity and condition does not decrease (and actually may increase). For these reasons the native plant species richness score has remained in the same category. Exotic plant cover category has been maintained and it is conservatively considered unlikely that the project will result in significant changes to this category (even despite proactive management through the proposed management regime).

The scoring of the individual management zones is outlined below in Sections 8.6 and 8.7.

8.6 Biodiversity Credit Requirement Calculations

Appendix 11 contains the Biodiversity Credit Report resulting from the assessment in this BAR.

Management zones were identified within each vegetation zone, depending on whether the type of impact was likely to be a direct impact (complete removal) or an indirect impact (underneath panels or between panels). Refer to Section 7.1 for the project components and whether they are considered to be direct or indirect impacts.

Refer to Table 8-1 for a summary of the inputs and credit requirements.

Table 8-1 Ecosystem Credits Required for Offset

Plant Community Type	Management Zone Number	Management Zone	Management Zone area (ha)	Calculated Loss	Loss in site value score	Ecosystem Credits required
Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregions (PCT 75)	1	WBYB - Direct	0.16	Direct impacts, 100% loss	72.92	9
Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16)	2	BB - Direct	0.50	Direct impacts, 100% loss	71.33	25
Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16)	3	BB - Panel	2.67	Mixture of direct (tree canopy, shrub layer) 100% loss and indirect (groundlayer) partial loss.	48.66	94
Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16)	4	BB – Non-Panel	4.97	Partial loss	48.66	175
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	5	PG Mod - Direct	40.02	Direct impacts, 100% loss	48.67	1,148

Plant Community Type	Management Zone Number	Management Zone	Management Zone area (ha)	Calculated Loss	Loss in site value score	Ecosystem Credits required
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	6	PG Mod - Panel	182.15	Minor loss	2.00	883
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	7	PG Mod – Non-Panel	434.14	Minor loss	2.00	2,106
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	8	PG Poor - Direct	2.14	Direct impacts, 100% loss	16.00	0
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	9	PG Poor - Panel	14.67	Minor loss	1.33	0
Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)	10	PG Poor – Non-Panel	14.67	Minor loss	1.33	0
	Total					4,440

Species credit species requirements for the Superb Parrot is 60 as outlined below in Table 8-2.

Table 8-2 Species Credit Species

Species		TS offset Multiplier	Species Credits Required
Superb Parrot	*Polytelis swainsonii*	1.8	60

8.7 Determination of Future Site Value Scores

For each of the management zones outlined above future site values scores have been determined based on an assessment of the particular impacts in the management zone. The impacts and approach for the site value scores is outlined in the following sections.

8.7.1 Management Zone 1 WBYB - Direct

Management Zone 1 is direct impacts to 0.16 ha of the Yellow Box – White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western NSW South Western Slopes Bioregions (PCT 75).

The impact to this zone will be a total permanent loss of the vegetation due to infrastructure (including internal gravel access roads, firebreaks where grass will be maintained as a fire buffer zone, switchyard bench, office and O&M buildings and carpark, battery facility, inverters and associated hardstands, piles direct impact and immediate surrounds).

The current and future site scores are as follows:

Table 8-3 Management Zone 1 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	0	Complete loss of vegetation
Native over-storey cover	3	0	Complete loss of vegetation
Native mid storey cover	0	0	Complete loss of vegetation
Native ground cover (grasses)	2	0	Complete loss of vegetation
Native ground cover (shrubs)	0	0	Complete loss of vegetation
Native ground cover (other)	1	0	Complete loss of vegetation
Exotic plant cover	1	0	Complete loss of vegetation
Number of trees with hollows	3	0	Complete loss of vegetation
Overstorey regeneration	3	0	Complete loss of vegetation
Total length of fallen logs	3	0	Complete loss of vegetation
	Current Site Value Score (out of 100) **72.92**	Future Site Value Score (out of 100) **0**	

8.7.2 Management Zone 2 BB - Direct

Management Zone 2 is direct impacts to 0.5 ha of the Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16).

The impact to this zone will be a total permanent loss of the vegetation due to infrastructure (including internal gravel access roads, firebreaks where grass will be maintained as a fire buffer zone, switchyard bench, office and O&M buildings and carpark, battery facility, inverters and associated hardstands, piles direct impact and immediate surrounds).

The current and future site scores are as follows:

Table 8-4 Management Zone 2 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	0	Complete loss of vegetation
Native over-storey cover	3	0	Complete loss of vegetation
Native mid storey cover	0	0	Complete loss of vegetation
Native ground cover (grasses)	0	0	Complete loss of vegetation
Native ground cover (shrubs)	1	0	Complete loss of vegetation
Native ground cover (other)	3	0	Complete loss of vegetation
Exotic plant cover	2	0	Complete loss of vegetation
Number of trees with hollows	0	0	Complete loss of vegetation
Overstorey regeneration	3	0	Complete loss of vegetation
Total length of fallen logs	3	0	Complete loss of vegetation
	Current Site Value Score (out of 100) 71.33	Future Site Value Score (out of 100) 0.00	

8.7.3 Management Zone 3 BB - Panel

Management Zone 3 is indirect impacts to 2.67 ha of the Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16).

The impact to this zone is the area which is vertically beneath the solar panels in the worst-case position where the panels are horizontal.

The current and future site scores are as follows:

Table 8-5 Management Zone 3 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	2	Native plant species has been reduced due to the removal of the overstorey cover and the possible impact on the species diversity.
Native over-storey cover	3	0	Complete loss of overstorey cover.
Native mid storey cover	0	0	None
Native ground cover (grasses)	0	0	None
Native ground cover (shrubs)	1	0	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (other)	3	2	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Exotic plant cover	2	2	No reduction expected.
Number of trees with hollows	0	0	None
Overstorey regeneration	3	0	Complete loss of overstorey cover.
Total length of fallen logs	3	0	All logs will be removed and relocated to other areas of the site.
	Current Site Value Score (out of 100) 71.33	Future Site Value Score (out of 100) 22.67	

8.7.4 Management Zone 4 BB – Non-panel

Management Zone 4 is indirect impacts to 4.97 ha of the Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16).

The impact to this zone is the area which is not directly impacted by any infrastructure. It consists of:

- Areas surrounding the solar farm block where the development has irregular edges. These areas will be unimpacted and the grassland will be retained in their current state and will remain connected to the surrounding woodland areas.
- Areas between array blocks which will be unimpacted by microclimatic impacts of solar panels.
- The areas which are located between the rows of panels. These areas will have mild shading impact as outlined in section 7.4.

The current and future site scores are as follows:

Table 8-6 Management Zone 4 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	2	Native plant species has been reduced due to the removal of the overstorey cover and the possible impact on the species diversity.
Native over-storey cover	3	0	Complete loss of overstorey cover (worst case scenario, likely to be some tree retention).
Native mid storey cover	0	0	None
Native ground cover (grasses)	0	0	None
Native ground cover (shrubs)	1	0	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (other)	3	2	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Exotic plant cover	2	2	No reduction expected.
Number of trees with hollows	0	0	None
Overstorey regeneration	3	0	Complete loss of overstorey cover.
Total length of fallen logs	3	0	All logs will be removed and relocated to other areas of the site.
	Current Site Value Score (out of 100) 71.33	Future Site Value Score (out of 100) 22.67	

8.7.5 Management Zone 5 PG Mod - Direct

Management Zone 5 is direct impacts to 40.02 ha of the Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)

The impact to this zone will be a total permanent loss of the vegetation due infrastructure including internal gravel access roads, firebreaks where grass will be maintained as a fire buffer zone, Switchyard bench, office and O&M buildings and carpark, Battery facility, Inverters and associated hardstands, Piles direct impact and immediate surrounds.

The current and future site scores are as follows:

Table 8-7 Management Zone 5 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	0	Complete loss of vegetation
Native over-storey cover	0	0	Complete loss of vegetation
Native mid storey cover	0	0	Complete loss of vegetation
Native ground cover (grasses)	1	0	Complete loss of vegetation
Native ground cover (shrubs)	1	0	Complete loss of vegetation
Native ground cover (other)	2	0	Complete loss of vegetation
Exotic plant cover	3	0	Complete loss of vegetation
Number of trees with hollows	0	0	Complete loss of vegetation
Overstorey regeneration	0	0	Complete loss of vegetation
Total length of fallen logs	0	0	Complete loss of vegetation
	Current Site Value Score (out of 100) 38.67	Future Site Value Score (out of 100) 0.0	

8.7.6 Management Zone 6 PG Mod - Panel

Management Zone 6 is indirect impacts to 182.15 ha of the Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)

The impact to this zone is the area which is vertically beneath the panels in the worst-case position where the panels are horizontal.

The current and future site scores are as follows:

Table 8-8 Management Zone 6 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	3	Native plant species expected to be maintained as discussed further in section 8.5.
Native over-storey cover	0	0	None
Native mid storey cover	0	0	None
Native ground cover (grasses)	1	0	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (shrubs)	1	0	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (other)	2	1	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Exotic plant cover	3	3	No significant change expected.
Number of trees with hollows	0	0	None
Overstorey regeneration	0	0	No change
Total length of fallen logs	0	0	All logs will be removed and relocated to other areas of the site.
	Current Site Value Score (out of 100) 38.67	Future Site Value Score (out of 100) 36.67	

8.7.7 Management Zone 7 PG Mod – non-panel

Management Zone 7 is indirect impacts to 434.14 ha of the Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)

The impact to this zone is the area which is not directly impacted but any infrastructure. It consists of:

- Areas surrounding the solar farm block where the development has irregular edges. These areas will be unimpacted and the grassland will be retained in their current state and will remain connected to the surrounding woodland areas.
- Areas between array blocks which will be unimpacted by microclimatic impacts of solar panels.

- The areas which are directly between the rows of panels. These areas will have mild shading impact as outlined in section 7.4.

The current and future site scores are as follows:

Table 8-9 Management Zone 7 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	3	3	Native plant species expected to be maintained as discussed further in section 8.5.
Native over-storey cover	0	0	None
Native mid storey cover	0	0	None
Native ground cover (grasses)	1	0	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (shrubs)	1	0	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (other)	2	1	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Exotic plant cover	3	3	No reduction expected.
Number of trees with hollows	0	0	None
Overstorey regeneration	0	0	No change
Total length of fallen logs	0	0	All logs will be removed and relocated to other areas of the site.
	Current Site Value Score (out of 100) 38.67	Future Site Value Score (out of 100) 36.67	

8.7.8 Management Zone 8 PG Poor - Direct

Management Zone 8 is direct impacts to 2.14 ha of the Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45).

The impact to this zone will be a total permanent loss of the vegetation due infrastructure including internal gravel access roads, firebreaks where grass will be maintained as a fire buffer zone, Switchyard bench, office and O&M buildings and carpark, Battery facility, Inverters and associated hardstands, Piles direct impact and immediate surrounds.

The current and future site scores are as follows:

Table 8-10 Management Zone 8 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	2	0	Complete loss of vegetation
Native over-storey cover	0	0	Complete loss of vegetation
Native mid storey cover	0	0	Complete loss of vegetation
Native ground cover (grasses)	2	0	Complete loss of vegetation
Native ground cover (shrubs)	0	0	Complete loss of vegetation
Native ground cover (other)	2	0	Complete loss of vegetation
Exotic plant cover	0	0	Complete loss of vegetation
Number of trees with hollows	0	0	Complete loss of vegetation
Overstorey regeneration	0	0	Complete loss of vegetation
Total length of fallen logs	0	0	Complete loss of vegetation
	Current Site Value Score (out of 100) 16.00	Future Site Value Score (out of 100) 0.00	

It should be noted that this zone does not generate a credit requirement as the existing site value score is less than 17.

8.7.9 Management Zone 9 PG Poor - Panel

Management Zone 9 is indirect impacts to 12.11 ha of the Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45).

The current and future site scores are as follows:

Table 8-11 Management Zone 9 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	2	2	Native plant species expected to be maintained as discussed further in section 8.5.
Native over-storey cover	0	0	None
Native mid storey cover	0	0	None
Native ground cover (grasses)	2	1	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (shrubs)	0	0	None
Native ground cover (other)	2	1	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Exotic plant cover	0	0	None
Number of trees with hollows	0	0	None
Overstorey regeneration	0	0	None
Total length of fallen logs	0	0	None
	Current Site Value Score (out of 100) 16.00	Future Site Value Score (out of 100) 14.67	

It should be noted that this zone does not generate a credit requirement as the existing site value score is less than 17.

8.7.10 Management Zone 10 PG Poor – Non-panel

Management Zone 10 is indirect impacts to 28.87 ha of the Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45)

The impact to this zone is the area which is not directly impacted but any infrastructure. It consists of:

- Areas surrounding the solar farm block where the development has irregular edges. These areas will be unimpacted and the grassland will be retained in their current state and will remain connected to the surrounding woodland areas.
- Areas between array blocks which will be unimpacted by microclimatic impacts of solar panels.
- The areas which are directly between the rows of panels. These areas will have mild shading impact as outlined in section 7.4.

The current and future site scores are as follows:

Table 8-12 Management Zone 10 Loss in Site Value Score

Attribute	Current Score (0-3)	Score with Development (0-3)	Justification
Native plant species	2	2	Native plant species expected to be maintained as discussed further in section 8.5.
Native over-storey cover	0	0	None
Native mid storey cover	0	0	None
Native ground cover (grasses)	2	1	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Native ground cover (shrubs)	0	0	None
Native ground cover (other)	2	1	Reduction to account for mowing and microclimate impacts as discussed further in section 8.5.
Exotic plant cover	0	0	None
Number of trees with hollows	0	0	None
Overstorey regeneration	0	0	None
Total length of fallen logs	0	0	None
	Current Site Value Score (out of 100) 16.00	Future Site Value Score (out of 100) 14.67	

It should be noted that this zone does not generate a credit requirement as the existing site value score is less than 17.

9 COMMONWEALTH IMPACT ASSESSMENTS

One threatened fauna species, Superb Parrot, and one endangered ecological community (Weeping Myall Woodlands) have been recorded within the development site. A further two birds, two species of plant and one bat species have potential habitat within the development site (Table 9-1).

Assessments of significance under the EPBC Act have been undertaken for threatened biodiversity listed under the EPBC Act. Refer to Table 9-1 and Appendix 8.

As Weeping Myall Woodlands and the Superb Parrot have been recorded within the development site, an EPBC referral was submitted, with the recommendation for a Not a Controlled Action Particular Matter determination, based on the biodiversity management regime to be applied to the project as outlined in Sections 6 and 10.

Table 9-1 EPBC Act Biodiversity

Species/ecological community	Recorded	EPBC Act Status	Likely significant impact?
Weeping Myall Woodlands	Yes	EEC	No
Superb Parrot	Yes	V	No
Painted Honeyeater	No	V	No
Plains Wanderer	No	CE	No
Slender Darling Pea (*Swainsona murrayana*)	No	V	No
Mossgiel Daisy (*Brachyscome papillosa*)	No	V	No
Winged Peppercress (*Lepidium monoplocoides*)	No	E	No
Corben's Long-eared Bat	No	V	No
Koala	No	V	No

No other Commonwealth MNES were recorded within the development site and therefore are not considered likely to be impacted by the project.

The project has been referred for assessment under the EPBC Act and received a decision of Not a Controlled Action (16th July 2018).

10 Mitigation Measures

Mitigation measures will be implemented to reduce the impact to biodiversity within and surrounding the development footprint as a result of the project.

Table 10-1 below outlines the mitigation measures for the project.

Table 10-1 Mitigation Measures

Impact Time	Mitigation Measure	Responsibility
Pre-construction	Prepare Biodiversity Management Plan that incorporates the mitigation strategies and include the biodiversity management regime as outlined in the CSU study and Section 6 of this report, before commencement of construction. This plan is to be incorporated in the Construction Environmental Management Plan. This plan will encompass, but is not limited to: • Measures to be implemented for biodiversity management, including protection of Vegetation and Heritage Protection Exclusion Zones and the biodiversity management regime; • Construction of the perimeter fence around the development site. • Seasonally-based program to monitor and report on the effectiveness of the measures; and • Responsibilities for implementation of the plan. Plains Grassland Monitoring – development of a monitoring plan in consultation with CSU. This should include further baseline surveys prior to construction.	Proponent / Owner Contractor
	Prepare a Construction Environmental Management Plan	Contractor Proponent/Owner
	Site workers to undertake an environmental induction prior to commencement of on-site works. This induction will encompass ecologically important matters on site and the procedures to protect flora and fauna.	Contractor
	Sediment and erosion measures should be implemented in accordance with approved guidelines to control any potential sediment runoff.	Contractor

Impact Time	Mitigation Measure	Responsibility
	Vegetation and Heritage Protection Exclusion Zones and trees identified to be retained should be clearly marked (e.g. fencing) to ameliorate unnecessary impacts to vegetation.	Contractor Ecologist
Construction	Stockpiling and storage of materials and machinery will be avoided within the dripline (extent of foliage cover) of any native tree	Contractor Proponent / Owner
	Application of water to roads and stockpiles where required to minimise dust generation.	Contractor Proponent / Owner
	A suitably qualified ecologist is to conduct pre-clearing surveys before removal of any treed vegetation to remove any fauna and mark up hollow bearing trees to be removed. All trees proposed to be removed should be re-checked for hollows prior to clearing.	Ecologist
	A suitably qualified ecologist will be required to be present during hollow-bearing tree removal to relocate any displaced fauna.	Ecologist
	Where possible, dead wood, hollow trunks and tree limbs should be relocated to woodland areas not to be cleared.	Contractor Ecologist
	Light vehicles should be restricted to existing internal roads to reduce impact upon injury and mortality to fauna. Injured fauna should be taken to the nearest vet for treatment.	Contractor
	Ensure all equipment is free of plant material and soil that may contain weeds or soil borne diseases. This is particularly important for the spread of Bathurst Burr which was recorded within the development site.	Contractor
	Implementation of a noise and vibration management plan.	Contractor
	[illegible]	Contractor Proponent / Owner
Post construction	Re-establishment of stabilised surfaces with native grass cover as soon as possible following construction.	Contractor
	'Lake Effect' – monitor site for bird injury or mortality, with a search for carcasses under and around areas with solar panels.	Contractor

Impact Time	Mitigation Measure	Responsibility
	The spread of noxious weeds should be managed (e.g. the invasive weed Bathurst Burr should be removed and be suitably disposed of offsite to reduce weed spread).	Contractor
	During the operational phase, the biodiversity management regime will focus on grazing and mowing that will reduce potential fuel load at times that are advantageous to native perennials and inhibiting exotic annual species. The following overarching biodiversity management regime is to be implemented: • During winter graze sheep/mow: primarily this will reduce the level of dry matter from annual growing species for summer fire hazard. The annuals will tend to have a greater palatability/digestibility than the natives at this stage and be preferentially grazed. • Remove sheep/mow mid-August: this will allow annual grass seed heads to emerge evenly. • Mow to 5-10 cm mid September/October when annual grasses flowering: this will prevent seed set of exotic annual species enhancing native abundance as well as reducing combustible load. • Destock/low stocking rate over summer: enhance seed set of perennial native species. • Only mow/graze during fire season if grassland growth will result in average dry matter exceeding 5,000kg/ha DM: this value was taken from the Murrumbidgee Irrigation Area Bush Fire Management Committee in regard to the APZ fuel load in forested areas, in the absence of a defined fuel load for grassland in the RFS guidelines. An adaptive management approach will be adopted whereby the management actions will be adjusted to optimise the grassland growth addressing on-site observations.	Contractor Proponent / Owner
	Implement the Biodiversity Offsets Package (BOP) recommendations as agreed with DP&E/OEH	Contractor Proponent / Owner
	For under-panel microclimate impacts, ensure that the adaptive monitoring plan outlined by CSU is conducted to ensure the management of the native grassland under the solar panels	Contractor Proponent / Owner

Impact Time	Mitigation Measure	Responsibility
	Impacts for bushfire protection are to be mitigated by minimising the frequency of the slashing to times as necessary only based on the fuel load. Targeting the timing of slashing to reduce the impacts ensure the retention of native flora abundance and diversity.	Contractor Proponent / Owner

11 Biodiversity Offset Strategy

11.1 Background

This BAR has outlined the threatened species, populations or ecological communities that are considered likely to be impacted by the project. The BAR and EIS outlines how avoidance has been considered as part of the consideration of project alternatives and minimisation of biodiversity impacts prioritised in the project design development and proposed site management regime.

To address the residual impacts of the project, following consideration of the potential for avoidance and for implementation of mitigation measures, Edify recognises that a biodiversity offset will be required and the approach to determining the offset is outlined in this BOS chapter of the BAR.

11.2 Biodiversity Offsets Regulations

11.2.1 Commonwealth

No biodiversity offsets are proposed in relation to EPBC Act requirements, as it was confirmed by DoEE on 16th July 2018 that a controlled action would not occur as a result of the project.

11.2.2 State

The biodiversity impacts of the project have been assessed in this BAR. The approach of this BOS is to assess requirements for biodiversity offsetting as would be required under the SSD Major Projects requirements.

SEARs were issued in May 2017 and these require biodiversity offsets to be developed with consideration of the FBA process.

Essentially, the FBA process requires biodiversity offsets, following avoidance and mitigation of impacts, to be determined utilising the BioBanking methodology and the NSW Biodiversity Offsets Policy for Major Projects.

11.3 Communities and species requiring offsetting

Refer to Section 8 for the detail in relation to the proposed commitments.

In summary, the following credits (or their equivalent value) are proposed to be provided:

- Plains Grass grassland: **4,137 credits**
- Black Box grassy open woodland: **294 credits**
- Yellow Box – White Cypress Pine grassy woodland: **9 credits**
- Superb Parrot: **60 credits**

11.4 Potential offset measures

Historically there have been a variety of options available for biodiversity offsetting, which have included:

Direct Offsets

- On-site offsets - protection and rehabilitation of on-site ecological communities and species
- Off-site offsets - sourcing and conserving off-site properties containing suitable ecological communities and species, including dedication to National Parks or Councils where deemed appropriate
- Third party off-site offsets – purchasing credits or funding a third party to provide offsets in an off-site location

Indirect (Supplementary) Offsets

- Funding land management activities by others
- Funding threatened species research and recovery

The FBA indicates that supplementary measures can only be used in lieu of offsets when offsets are not feasible and other options are needed.

NSW Biodiversity Offsets Fund

The FBA process has introduced an option of payment into a dedicated Biodiversity Offset Fund as an additional option for Major Projects.

11.5 Proposed offset strategy

It is recognised that at both a State and Commonwealth level, direct biodiversity offsets are preferred as the primary option for offsetting. It is also recognised that the preferred mechanism for this to occur is BioBanking. All avenues should be explored in sourcing the required offset land and ecosystem credits before considering other options such as indirect offsets or payment into the Biodiversity Offsets Fund.

11.6 Direct offset search criteria

Having already committed to prioritising like for like offsets, the search for biodiversity offsets will be guided by the NSW Biodiversity Offsets Policy for Major Projects reasonable steps for sourcing like for like offsets, including:

- checking the biobanking public register and having an expression of interest for credits on it for at least six months
- liaising with an OEH office (or Fisheries NSW office for aquatic biodiversity) and relevant local councils to obtain a list of potential sites that meet the requirements for offsetting
- considering properties for sale in the required area
- providing evidence of why offset sites are not feasible – suitable evidence may include:
    - the unwillingness of a landowner to sell or establish a biobank site
    - the cost of an offset site itself should not be a factor unless it can be demonstrated the landowner is charging significantly above market rates.

Specifically, the principles that will guide sourcing the offset land/s will include the following:

- To be able to generate sufficient credits to meet the offset requirement for the projects;
- To be located as close as possible to the impact area;
- To have like for like Plant Community Type;
- To have potential for improvement and / or regeneration;
- To be large remnants (preferably over 10ha) with low edge to area ratio;
- To be located in an appropriately zoned location (i.e. BioBanking would not significantly conflict with other pre-existing zoning objectives);
- To be additional to any existing conservation and management requirements;
- To be preferably connected via habitat linkages to other intact protected remnant areas; and
- To provide demonstrated or predicted habitat for threatened species.

A desktop assessment considering all of the above factors and including review of available vegetation mapping, zoning, background ecological reports and wildlife databases would be undertaken to assist in identifying preliminary candidate sites for further consideration.

11.7 Project commitment

Edify commits to working with DPE and OEH towards producing a Biodiversity Offset Package (BOP) that addresses previous advice and which provides an improved conservation outcome as a result of the impacts of the project. The primary commitments in developing the BOP are:

1. Direct offsets conserving like for like vegetation is the first preference, including the option of paying into the Biodiversity Offsets Fund;
2. The preferred conservation mechanism for the offset site is BioBanking / Stewardship Agreement;
3. Supplementary measures will only be considered if all other avenues in sourcing appropriate offsets have been exhausted (however it is noted that Edify would like to fund research of the project biodiversity impacts and this could satisfy part of the offset requirements);
4. The BOP will be developed in accordance with the criteria outlined in this Biodiversity Offset Strategy chapter of the BAR.

12 Conclusion

EPS has prepared this BAR in behalf of Edify Energy for the Darlington Point Solar Farm, NSW. The BAR outlines the assessment of the biodiversity impacts of the project in accordance with the FBA and outlines measures undertaken in the site selection and design development to avoid and minimise impacts and proposed mitigation measures for the construction and operation of the site to further avoid and minimise impacts. This BAR outlines the number of biodiversity credits that are generated to offset the residual impacts of the proposed Darlington Point Solar Farm.

Detailed ecological surveys have been undertaken throughout the study area using the BBAM and FBA methodology. These surveys provided detailed information on the potential impacts upon diversity. This information has been used to accurately calculate the potential impacts from the project.

Two endangered ecological communities listed under the BC Act were recorded being:

- Myall Woodland; and
- Sandhill Pine Woodland.

One endangered ecological community listed under the EPBC Act was recorded being:

- Weeping Myall Woodlands – Patches WM1 and WM2.

Two threatened fauna species were recorded within the study area:

- Superb Parrot listed as vulnerable under the BC Act and EPBC Act; and
- Grey-crowned Babbler listed as Vulnerable under the BC Act.

The project was designed to avoid areas with the highest biodiversity value being, threatened ecological communities and threatened flora and fauna habitat. These changes have been incorporated into the design to consider the following:

- Retention of the majority of the woodland and open forest vegetation which were of high importance, identified as Vegetation and Heritage Protection Exclusion Zones;
- Retention of the threatened communities listed as endangered under the EPBC Act and/or the BC Act recorded within the study area;
- Retention of the majority of structurally diverse flora and fauna habitat; and
- Installation of a 10m buffer surrounding the retained open forest and woodland habitats, for bushfire management but also to provide for a manageable interface between the development footprint and the Vegetation and Heritage Protection Exclusion Zones.

The Mitigation Measures chapter outlines the proposed mitigation measures for the project, including pre-construction, construction and operation measures. A strong focus on biodiversity management within a Biodiversity Management Plan and ongoing grassland monitoring is proposed.

McCormick & Orchard (2018) have proposed an approach to grassland management within the solar panel area that aims to increase the native species diversity, while maintaining structural integrity of the grasslands.

The FBA process requires biodiversity offsets, following avoidance and mitigation of impacts, to be determined for residual impacts utilising the BioBanking methodology and the NSW Biodiversity Offsets Policy for Major Projects.

In summary, the following credits are required to be offset:

- Plains Grass grassland: **4,137 credits**
- Black Box grassy open woodland: **294 credits**
- Yellow Box – White Cypress Pine grassy woodland: **9 credits**
- Superb Parrot: **60 credits**

The BOS chapter outlines how the credit requirement for the project might be satisfied.

Two matters of national environmental significance, listed under the EPBC Act were recorded within the study area, being the Superb Parrot and Weeping Myall Woodlands. A referral to the Commonwealth was submitted and DoEE confirmed on 16th July 2018 that the project does not constitute a controlled action.

13 References

Australian Weeds Committee 2017, *Weeds of National Significance,* viewed March 2016, <http://www.weeds.org.au/WoNS/>.

ARUP (2017), Preliminary Environmental Investigation (PEI) for Darlington Point Solar Farm.

Barlow, T. 1998, Grassy Guidelines - How to manage native grasslands and grassy woodlands on your property, Trust for Nature (Victoria).

Barron-Gafford, G (2018) *Statement of Evidence by Greg Barron-Gafford on Solar Heat Island Issues* Barron-Gafford Research Group Biogeography – Ecosystem Science.

Barron-Gafford, *et al* (2016) The Solar Heat Island Effect: Larger solar power plants increase local temperatures. *Nature Scientific Reports* **6:35070**

Bureau of Meteorology, 2017, Australian Atlas of Groundwater Dependent Ecosystems http://www.bom.gov.au/water/groundwater/gde/map.shtml

Bureau of Meteorology 2016, *Daily Weather Observations for Griffith, NSW*, Bureau of Meteorology http://www.bom.gov.au/climate/dwo/IDCJDW2053.latest.shtml

Churchill S., 2008 *Australian Bats*, Allen and Unwin, Sydney

Commonwealth of Australia (2016) National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*)

Cropper, SC 1993, *Management of Endangered Plants,* CSIRO Australia, Melbourne.

Department of Environment and Climate Change 2007, *Threatened species assessment guidelines. The assessment of significance,* Department of Environment and Climate Change, Hurstville.

Department of Environment and Climate Change 2008, *Landscapes (Mitchell) of NSW - Version 3,* Department of Environment and Climate Change, Hurstville

Department of Environment and Climate Change 2008c, *Managing Urban Stormwater: soils and construction, Vol 2D: main road construction*, Department of Environment and Climate Change NSW, South Sydney.

Department of the Environment and Heritage, 2006 *White Box, Yellow Box, Blakely's Red Gum Woodland and derived native grassland Policy Statement.* Department of the Environment and Heritage.

Department of the Environment, Water, Heritage and the Arts (2009), *Weeping Myall Woodlands, A nationally threatened ecological community, Policy Statement 3.17.* Department of the Environment, Water, Heritage and the Arts.

Department of Primary Industries, 2017 Noxious Weed for the Griffith Control Area, http://weeds.dpi.nsw.gov.au/WeedDeclarations?RegionId=153

Department of the Environment 2013, *EPBC Act Policy Statement 1.1: Significant impact guidelines - matters of national environmental significance*, Department of the Environment.

Department of the Environment 2017, *Protected Matters Search Tool,* Department of Sustainability Environment Water Population and Communities, 2016, http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf

Department of the Environment 2017 Australian Faunal Directory http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/home

Eddy, D. 2002, Managing Native Grassland, WWF Australia.

Eve, R 1991, 'The sound environment of a tropical forest bird community - order or chaos', *Revue D Ecologie La Terre Et La Vie*, vol. 46, pp. 191-220.

Forman, RTT, Sperling, D, Bissonette, JA, Clevenger, AP, Cutshall, CD, Dale, VH, Fahrig, L, France, R, Goldman, CR, Heanue, K, Jones, JA, Swamson, FJ, Turrentine, T & Winter, TC 2000, *Road Ecology. Science and Solutions,* Island Press, Washington.

Goldingay, RL 2009, 'Characteristics of tree hollows used by Australian birds and bats', *Wildlife Research*, no. 36, pp. 394-409.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1* (Revised Edition), University of New South Wales Press Ltd., Kensington.

Harden, G 2002, *Flora of New South Wales Volume 2* (Revised Edition), 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

Hatton, T & Evans, R 1998, *Dependence of ecosystems on groundwater and its significance to Australia*, Land and Water Resources Research and Development Corporation, Canberra.

Johnson, M, Reich, P & Mac Nally, R 2007, *'Bird assemblages of a fragmented agricultural landscape and the relative importance of vegetation structure and landscape pattern',* Wildlife Research, vol. 34, no. 3, pp. 185-93.

Keith, D 2004*, Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT* Department of Environment and Conservation, Hurstville.

Lunt, I.D. 2005. Technical Report 18. Effects of Stock Grazing on Biodiversity Values in Temperate Native Grasslands and Grassy Woodlands in SE Australia: A Literature Review. Environment ACT, Canberra.

McCormick, J & Orchard, P 2018*, Report to Edify Energy on the proposed solar voltaic farm at Darlington Point: Effects of solar voltaic farm installation and operation on Riverine Plain Grasslands,* Charles Sturt University.

Mavromihalis, J. (2010) National Recovery Plan for the Winged Peppercress *Lepidium monoplocoides.* Department of Sustainability and Environment, Melbourne.

Moenting, AE & Morris, DW. 2006 *Disturbance and habitat use: is edge more important than area?* Oikos, vol. 115, no, pp. 23-32.

Montag, H. Parker, G. & Clarkson, T. 2016. The Effects of Solar Farms on Local Biodiversity; A Comparative Study. Clarkson and Woods and Wychwood Biodiversity.

NSW Department of Environment and Conservation 2007, Field Data Sheets for BioMetric (Version 1.8), NSW Department of Environment and Conservation, Hurstville.

Office of Environment and Heritage (2011) *Vegetation mapping by 3-D digital aerial photo interpretation: vegetation of central-southern New South Wales.* Technical Report. NSW Office of Environment and Heritage, Queanbeyan.

Office of Environment and Heritage (2014a) *Framework for Biodiversity, NSW Biodiversity Offsets Policy for Major Projects.*

Office of Environment and Heritage (2014b), *BioBanking Assessment Methodology*

Office of Environment and Heritage (2015) *VIS Classification Database 2.1*

Office of Environment and Heritage (2016) *NSW Guide to Surveying Threatened Plants*

Office of Environment and Heritage 2017, *Threatened species, populations and ecological communities Profiles of NSW online database,* NSW Government, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx>.

Robinson, M 1998, *A field guide to frogs of Australia*, Second edition edn, Reed New Holland, Sydney.

Roberts, I & J, 2001, *Plains Wanderer Habitat Mapping (Pedionomus torquatus) Including Woody Vegetation and other Landscape features of the Riverina Plain.* A report prepared for the National Parks and Wildlife Service.

Robinson, D. Davidson, I. Tzaros, C. 2001 *Biology and Conservation of the Grey-crowned Babbler in Victoria*, Department of Natural Resources and Environment, East Melbourne.

Royal Botanic Gardens 2016, PlantNet - *The Plant Information Network System of Botanic Gardens Trust (version 2.0),* <http://plantnet.rbgsyd.nsw.gov.au/>.

Department of Environment 2017, SPRAT web site profiles
http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Swan, G, Shea, G & Sadlier, R 2004, *A Field Guide to Reptiles of New South Wales*, Reed New Holland, Sydney.

Thackway, R & Cresswell, ID 1995, *An Interim Biogeographic Regionalisation of Australia*, Australian Nature Conservation Agency, Canberra.

Verrier F.J. & Kirkpatrick, J.B. (2005) *Frequent Mowing is Better than Grazing for the Conservation Value of Lowland Tussock Grassland at Pontville, Tasmania.* Austral Ecology, **30,** 74-78.

Wilson, A & Lindenmayer, DB 1995, *Wildlife Corridors and the Conservation of Biodiversity: A Review,* National Corridors of Green Program, Green Australia Ltd., Canberra.

Wong N & Morgan J. *Review of Grassland Management in South-eastern Australia.* Parks Victoria Technical Series No. 39

Appendix 1

Database Searches

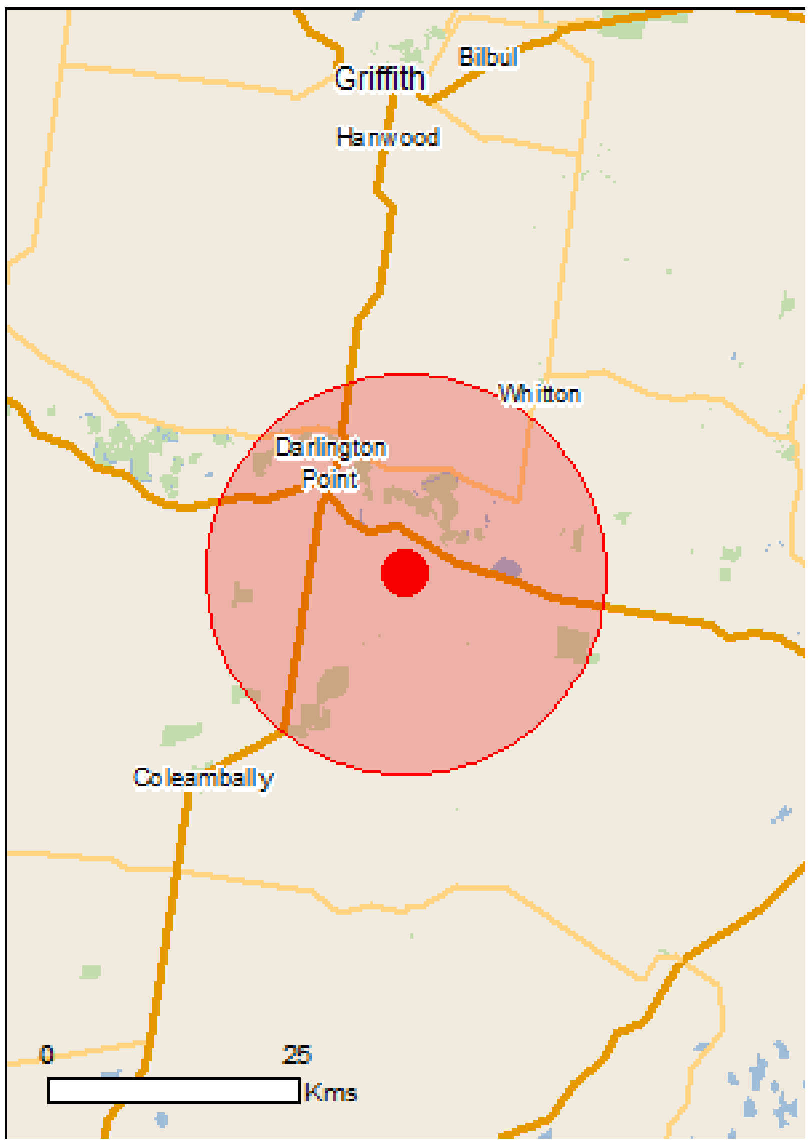
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

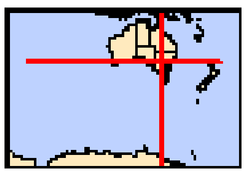
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 29/03/17 12:34:07



Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	5
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	18
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	29
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	500 - 600km upstream
Fivebough and tuckerbil swamps	10 - 20km upstream
Hattah-kulkyne lakes	300 - 400km upstream
Riverland	400 - 500km upstream
The coorong, and lakes alexandrina and albert wetland	500 - 600km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pedionomus torquatus		
Plains-wanderer [906]	Critically Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Extinct within area
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Galaxias rostratus		
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica		
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Frogs		
Litoria raniformis		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Brachyscome papillosa		
Mossgiel Daisy [6625]	Vulnerable	Species or species habitat likely to occur within area
Swainsona murrayana		
Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves

[Resource Information]

Name	State
Murrumbidgee Valley	NSW
Murrumbidgee Valley	NSW
South West Woodland	NSW

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus		
Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Sagittaria platyphylla		
Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Solanum elaeagnifolium		
Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.65168 146.06055

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -34.54 West: 145.96 East: 146.21 South: -34.76] returned a total of 629 records of 24 species.
Report generated on 29/03/2017 12:35 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Animalia	Amphibia	Myobatrachidae	3135	*Crinia sloanei*		Sloane's Froglet	V,P		1	
Animalia	Amphibia	Hylidae	3207	*Litoria raniformis*		Southern Bell Frog	E1,P	V	158	
Animalia	Aves	Anseranatidae	0199	*Anseranas semipalmata*		Magpie Goose	V,P		1	
Animalia	Aves	Anatidae	0216	*Oxyura australis*		Blue-billed Duck	V,P		2	
Animalia	Aves	Anatidae	0214	*Stictonetta naevosa*		Freckled Duck	V,P		6	
Animalia	Aves	Accipitridae	0218	*Circus assimilis*		Spotted Harrier	V,P		2	
Animalia	Aves	Accipitridae	0226	*Haliaeetus leucogaster*		White-bellied Sea-Eagle	V,P	C	27	
Animalia	Aves	Accipitridae	0225	*Hieraaetus morphnoides*		Little Eagle	V,P		2	
Animalia	Aves	Gruidae	0177	*Grus rubicunda*		Brolga	V,P		1	
Animalia	Aves	Burhinidae	0174	*Burhinus grallarius*		Bush Stone-curlew	E1,P		1	
Animalia	Aves	Rostratulidae	0170	*Rostratula australis*		Australian Painted Snipe	E1,P	E	1	
Animalia	Aves	Psittacidae	0277	*Polytelis swainsonii*		Superb Parrot	V,P,3	V	365	
Animalia	Aves	Climacteridae	8127	*Climacteris picumnus victoriae*		Brown Treecreeper (eastern subspecies)	V,P		16	
Animalia	Aves	Acanthizidae	0504	*Chthonicola sagittata*		Speckled Warbler	V,P		1	
Animalia	Aves	Meliphagidae	0598	*Grantiella picta*		Painted Honeyeater	V,P	V	3	
Animalia	Aves	Pomatostomidae	8388	*Pomatostomus temporalis temporalis*		Grey-crowned Babbler (eastern subspecies)	V,P		25	
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P		4	
Animalia	Aves	Artamidae	8519	*Artamus cyanopterus cyanopterus*		Dusky Woodswallow	V,P		6	
Animalia	Aves	Petroicidae	0382	*Petroica phoenicea*		Flame Robin	V,P		1	
Animalia	Mammalia	Emballonuridae	1321	*Saccolaimus flaviventris*		Yellow-bellied Sheathtail-bat	V,P		1	
Animalia	Mammalia	Vespertilionidae	1382	*Vespadelus baverstocki*		Inland Forest Bat	V,P		1	
Plantae	Flora	Asteraceae	6893	*Brachyscome papillosa*		Mossgiel Daisy	V,P	V	1	
Plantae	Flora	Fabaceae (Faboideae)	8538	*Swainsona sericea*		Silky Swainson-pea	V,P		2	
Plantae	Flora	Orchidaceae	4457	^^*Diuris tricolor*		Pine Donkey Orchid	V,P,2		1	

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Communities in selected area [North: -34.54 West: 145.96 East: 146.21 South: -34.76] returned 0 records for 4 entities.
Report generated on 29/03/2017 12:39 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Community				*Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions*		Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions	E3		K	
Community				*Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions*		Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	E3	E	K	
Community				*Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions*		Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	E3	E	K	
Community				*Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions*		Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	E3		K	

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Threats in selected area [North: -34.54 West: 145.96 East: 146.21 South: -34.76] returned 0 records for 32 species.
Report generated on 29/03/2017 12:42 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Threat				*Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands*		Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	KTP		P	
Threat				*Anthropogenic Climate Change*		Anthropogenic Climate Change	KTP	KTP	P	
Threat				*Bushrock removal*		Bushrock removal	KTP		P	
Threat				*Clearing of native vegetation*		Clearing of native vegetation	KTP	KTP	P	
Threat				*Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)*		Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	KTP	KTP	P	
Threat				*Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758*		Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	KTP	KTP	P	
Threat				*Competition from feral honey bees, Apis mellifera L.*		Competition from feral honey bees, Apis mellifera L.	KTP		P	
Threat				*Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners*		Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	KTP		P	
Threat				*Herbivory and environmental degradation caused by feral deer*		Herbivory and environmental degradation caused by feral deer	KTP		P	
Threat				*High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition*		High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	KTP		P	
Threat				*Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972*		Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	KTP	KTP	P	
Threat				*Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations*		Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	KTP	KTP	P	
Threat				*Infection of frogs by amphibian chytrid causing the disease chytridiomycosis*		Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	KTP	KTP	P	
Threat				*Infection of native plants by Phytophthora cinnamomi*		Infection of native plants by Phytophthora cinnamomi	KTP	KTP	P	
Threat				*Introduction of the Large Earth Bumblebee Bombus terrestris (L.)*		Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	KTP		P	

Threat	*Invasion and establishment of exotic vines and scramblers*	Invasion and establishment of exotic vines and scramblers	KTP		P
Threat	*Invasion and establishment of Scotch Broom (Cytisus scoparius)*	Invasion and establishment of Scotch Broom (Cytisus scoparius)	KTP		P
Threat	*Invasion and establishment of the Cane Toad (Bufo marinus)*	Invasion and establishment of the Cane Toad (Bufo marinus)	KTP	KTP	P
Threat	*Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.*	Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.	KTP		P
Threat	*Invasion of native plant communities by Chrysanthemoides monilifera*	Invasion of native plant communities by Chrysanthemoides monilifera	KTP		P
Threat	*Invasion of native plant communities by exotic perennial grasses*	Invasion of native plant communities by exotic perennial grasses	KTP		P
Threat	*Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW*	Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	KTP		P
Threat	*Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)*	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	KTP		P
Threat	*Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants*	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	KTP	KTP	P
Threat	*Loss of Hollow-bearing Trees*	Loss of Hollow-bearing Trees	KTP		P
Threat	*Loss or degradation (or both) of sites used for hill-topping by butterflies*	Loss or degradation (or both) of sites used for hill-topping by butterflies	KTP		P
Threat	*Predation and hybridisation by Feral Dogs, Canis lupus familiaris*	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	KTP		P
Threat	*Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)*	Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	KTP		P
Threat	*Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)*	Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	KTP	KTP	P
Threat	*Predation by the Feral Cat Felis catus (Linnaeus, 1758)*	Predation by the Feral Cat Felis catus (Linnaeus, 1758)	KTP	KTP	P
Threat	*Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758*	Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	KTP	KTP	P
Threat	*Removal of dead wood and dead trees*	Removal of dead wood and dead trees	KTP		P

NEW SOUTH WALES FLORA ONLINE

Search Result

Click on a name to see the page for that taxon.
* denotes an introduced species
+ denotes a species listed on the schedules of the Threatened Species Conservation Act (TSCA)
◊ denotes a ROTAP listed species
‡ denotes a gazetted weed.

TSCA listed species collected in a 25 km radius around Darlington Point (146,-34.56666)
Orchidaceae *Diuris* ◊+ *tricolor*

This page URL:
http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&spatquer=yes&forest=&npres=&cmas=&ibra=&lga=&nswsdiv=&maxy=&maxym=&maxyd=S&miny=&minym=&minyd=S&maxx=&maxxm=&maxxd=E&minx=&minxm=&minxd=E&near=Darlington+Point&state=NSW&range=0.24175&vasc=yes&threat=nswtsa

Appendix 2

Flora Species List

Table A1 Flora Plots 1 to 11

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Tree	Casuarinaceae	*Allocasuarina luehmannii*	Bulloak				*	*														<1	1								
Tree	Cupressaceae	*Callitris glaucophylla*	White Cypress Pine			*	*	*														100	22								
Tree	Fabaceae	*Acacia pendula*	Weeping Myall						*																			20	6	0-5	5
Tree	Myrtaceae	*Eucalyptus melliodora*	Yellow Box				*			20	6																				
Tree	Myrtaceae	*Eucalyptus largiflorens*	Black Box		*	*						<1	1	10 - 20	7									30	13	20	7				
Shrub	Asteraceae	*Xanthium spinosum*	Bathurst Burr	*	*	*			*					<1	1	<1	1	<1	6							5	20	<1	10		
Shrub	Chenopodiaceae	*Dissocarpus paradoxus*	-			*								<1	15									3	15						
Shrub	Chenopodiaceae	*Einadia hastata*	Berry Saltbush		*	*	*		*	<1	20			<5	1	<1	6	<1	10							<1	3	<1	15		
Shrub	Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush		*	*			*					<1	3	<1	20	<1	5									32	2	<5	50

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Shrub	Chenopodiaceae	*Maireana aphylla*	Leafless Bluebush		*	*	*		*	<1	15	<1	3					<1	10									<1	14		
Shrub	Chenopodiaceae	*Maireana brevifolia*	Small-leaf Bluebush				*		*																			<1	10		
Shrub	Lamiaceae	*Marrubium vulgare*	White Horehound	*	*	*	*	*	*	1	4	<1	3									<1	1	<1	2	1	1	1	1		
Shrub	Malvaceae	*Sida cunninghamii*	Ridged Sida		*	*	*		*	15	50	3	20	5	20	<1	15	<1	15	<1	1			4	80	<5	200+	<1	1	1	1
Grass	Poaceae	*Austrostipa aristiglumis*	Plains Grass		*	*	*	*	*	30	500+	50	1000+	<1	1	60	1000+	40	500+	50	1000+	1	1	30	100+	5	500+	3	15	10	30
Grass	Poaceae	*Austrostipa scabra*	Speargrass		*				*																						
Grass	Poaceae	*Avena fatua*	Wild Oats	*	*	*																									
Grass	Poaceae	*Chloris gayana*	Rhodes Grass	*	*																										
Grass	Poaceae	*Chloris truncata*	Windmill Grass		*	*						5	26			5	2	5	20	5	30										
Grass	Poaceae	*Cynodon dactylon*	Couch		*																										

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Grass	Poaceae	*Dichanthium sericeum*	Queensland Bluegrass						*																					5	30
Grass	Poaceae	*Enteropogon acicularis*	-		*	*	*	*	*							<5	3			<3	4	<1	20	10	100	<1	30	<1	20		
Grass	Poaceae	*Enteropogon ramosus*	Curly Windmill Grass		*	*			*							<5	5	5	100+											5	30+
Grass	Poaceae	*Eragrostis spp.*	-		*	*	*	*	*											5	50	5	50	5	20	<1	100+	5	50+	1	20+
Grass	Poaceae	*Lolium* spp.	Ryegrass	*	*		*			10	50+	30	50			5	2														
Grass	Poaceae	*Panicum effusum*	Hairy Panic		*																										
Grass	Poaceae	*Paspalum dilatatum*	Paspalum	*	*																										
Grass	Poaceae	*Rytidosperma duttonianum*	-		*	*	*		*	5	50	15	500	<1	5					25	1000+			15	100	5	500+	5	34	30	300+
Grass	Poaceae	*Vulpia bromoides*	Squirrel Tail Fescue	*		*	*		*	15	100+			<1	50									5	50	5	100+			3	4
Grass	Poaceae	*Walwhalleya proluta*	-		*	*	*	*	*	5	50+	5	100+	<1	20	5	100+	<5	50+	<5	20	<2	50	20	30+	5	100+	5	50	5	50

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Herb	Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed			*								<1	3																
Herb	Amaranthaceae	*Amaranthus* spp.	-	*		*																				<1	2				
Herb	Asteraceae	*Leiocarpa panaetioides*	Wooly Buttons		*							1	1					2	25												
Herb	Asteraceae	*Cirsium vulgare*	Spear Thistle	*		*			*																						
Herb	Asteraceae	*Conyza spp.*	Fleabane	*		*								<1	1																
Herb	Asteraceae	*Onopordum acanthium*	Scotch Thistle	*	*													<1	3												
Herb	Asteraceae	*Senecio* spp.	-	*	*							<1	2																		
Herb	Asteraceae	*Vittadinia gracilis*	Woolly New Holland Daisy		*	*			*			<1	20					5	100	<1	1										
Herb	Boraginaceae	*Heliotropium europaeum*	Potato Weed	*	*	*	*		*			1	1	5	30	<1	6	<5	30												
Herb	Boraginaceae	*Heliotropium amplexicaule*	Blue Heliotrope	*	*	*						1	1	<1	1	<1	20														

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Herb	Brassicaceae	*Brassica juncea*	Indian Mustard	*		*								<1	5																
Herb	Brassicaceae	*Lepidium africanum*	-	*	*	*	*		*	<1	5	1	1	<1	15									1	1					1	1
Herb	Callitrichaceae	*Callitriche* spp.	Starwort		*	*	*	*												<5	4	3	50	<5	30						
Herb	Campanulaceae	*Wahlenbergia stricta*	Australian bluebell		*		*					1	1							<1	2										
Herb	Chenopodiaceae	*Atriplex semibaccata*	Creeping Saltbush			*			*																						
Herb	Chenopodiaceae	*Chenopodium album*	Fat Hen	*		*								<1	10																
Herb	Chenopodiaceae	*Maireana decalvans*	Black Cotton Bush		*	*			*							<1	5													<5	100+
Herb	Chenopodiaceae	*Sclerolaena muricata*	Black Rolypoly		*	*	*	*	*	5	1	5	20	15	50	<1	11	<1	10			2	1	<1	3	5	50+	5	46	5	25
Herb	Cucurbitaceae	*Citrullus lanatus*	Watermelon	*		*	*	*	*													<1	5	1	1			<1	4	<1	4
Herb	Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*	*	*								<1	1																

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Herb	Malvaceae	*Sida corrugata*	Corrugated Sida		*	*	*	*		<1	15											<1	15	3	10						
Herb	Marsileaceae	*Marsilea* spp.	Nardoo		*	*								3	20	5	20														
Herb	Nyctaginaceae	*Boerhavia dominii*	Tarvine		*	*			*			1	1													<1	100				
Herb	Oxalidaceae	*Oxalis perennans*	-		*	*	*		*	3	20	<1	350+	<1	1	<1	20									<1	5				
Herb	Polygonaceae	*Polygonum aviculare*	Wireweed	*	*	*								5	15																
Herb	Polygonaceae	*Rumex brownii*	Swamp Dock		*	*	*	*	*	1	10													1	1						
Herb	Rubiaceae	*Asperula conferta*	Common Woodruff		*	*		*								<1	3							<5	15						
Herb	Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein	*	*																										
Herb	Solanaceae	*Solanum esuriale*	Quena		*	*	*	*	*					<1	1	<1	1	<1	6	<3	2	1	1	4	30	<5	200+	<1	100+		
Herb	Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*		*																									

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Rush	Juncaceae	*Juncus aridicola*	-		*	*	*							<1	10					<5	6	<1	10			<1	20				
Rush	Juncaceae	*Juncus flavidus*	-		*	*			*																			1	1		
Graminoid	Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		*															<5	3										
Climber	Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed		*																										

Table A2 Flora Plots 12 to 22

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Tree	Casuarinaceae	*Allocasuarina luehmannii*	Bulloak				*	*																							
Tree	Cupressaceae	*Callitris glaucophylla*	White Cypress Pine			*	*	*														0-4	24	20	8			10	1		
Tree	Fabaceae	*Acacia pendula*	Weeping Myall						*	<5	3																			0-10	19
Tree	Myrtaceae	*Eucalyptus melliodora*	Yellow Box				*																	20	5						
Tree	Myrtaceae	*Eucalyptus largiflorens*	Black Box		*	*						0-10	2	5	2			30	17	0-10	4							5	4		
Shrub	Asteraceae	*Xanthium spinosum*	Bathurst Burr	*	*	*			*	<1	9	1	2			1	1	<1	14	1	10							1	3		
Shrub	Chenopodiaceae	*Dissocarpus paradoxus*	-			*																									
Shrub	Chenopodiaceae	*Einadia hastata*	Berry Saltbush		*	*	*	*	*			<1	10	<1	14			5	20	1	5	5	80	2	15			1	20	<1	40
Shrub	Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush		*	*			*	1	100+	<1	100+							1	1									5	80
Shrub	Chenopodiaceae	*Maireana aphylla*	Leafless Bluebush		*	*	*		*	1	4	5	30	<1	6	<1	9			1	4							1	5	3	100

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Shrub	Chenopodiaceae	*Maireana brevifolia*	Small-leaf Bluebush				*		*											11	1										
Shrub	Lamiaceae	*Marrubium vulgare*	White Horehound	*	*	*	*	*	*	1	1											10	10	<1	2					<1	5
Shrub	Malvaceae	*Sida cunninghamii*	Ridged Sida		*	*	*		*	1	1	<1	100 +	4	100 +	<1	10			2	6					1	10	2	40		
Grass	Poaceae	*Austrostipa aristiglumis*	Plains Grass		*	*	*		*	5	13	5	50	5	26	80	300 +			5	23					80	500	1	10	<1	10
Grass	Poaceae	*Austrostipa scabra*	Speargrass		*				*																			3	40		
Grass	Poaceae	*Avena fatua*	Wild Oats	*	*	*																						1	1		
Grass	Poaceae	*Chloris gayana*	Rhodes Grass	*	*																										
Grass	Poaceae	*Chloris truncata*	Windmill Grass		*	*										<1	25			1	1										
Grass	Poaceae	*Cynodon dactylon*	Couch		*																										
Grass	Poaceae	*Dichanthium sericeum*	Queensland Bluegrass						*																						

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12 % Cover	Plot 12 Abundance	Plot 13 % Cover	Plot 13 Abundance	Plot 14 % Cover	Plot 14 Abundance	Plot 15 % Cover	Plot 15 Abundance	Plot 16 % Cover	Plot 16 Abundance	Plot 17 % Cover	Plot 17 Abundance	Plot 18 % Cover	Plot 18 Abundance	Plot 19 % Cover	Plot 19 Abundance	Plot 20 % Cover	Plot 20 Abundance	Plot 21 % Cover	Plot 21 Abundance	Plot 22 Cover %	Plot 22 Abundance
Grass	Poaceae	*Enteropogon acicularis*	-		*	*	*	*	*													2	30							3	100
Grass	Poaceae	*Enteropogon ramosus*	Curly Windmill Grass		*	*			*																			3	20		
Grass	Poaceae	*Eragrostis spp.*	-		*	*	*	*	*	3	10			5	24	1	26					5	50	20	200			5	60	<1	100
Grass	Poaceae	*Lolium* spp.	Ryegrass	*	*		*																								
Grass	Poaceae	*Panicum effusum*	Hairy Panic		*																										
Grass	Poaceae	*Paspalum dilatatum*	Paspalum	*	*																										
Grass	Poaceae	*Rytidosperma duttonianum*	-		*	*	*		*			5	30	5	100					10	7					20	70	2	10	30	200
Grass	Poaceae	*Vulpia bromoides*	Squirrel Tail Fescue	*		*	*	*	*	<1	10							<3	10			10	70	15	100			30	100	20	150
Grass	Poaceae	*Walwhalleya proluta*	-		*	*	*	*	*	5	100 +	5	50	5	60			5	100	5	30	<1	5			5	50	10	100	5	200
Herb	Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed			*																									

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Herb	Amaranthaceae	*Amaranthus* spp.	-	*		*																									
Herb	Asteraceae	*Leiocarpa panaetioides*	Wooly Buttons		*																										
Herb	Asteraceae	*Cirsium vulgare*	Spear Thistle	*		*			*	1	1	<1	15							1	2										
Herb	Asteraceae	*Conyza spp.*	Fleabane	*		*																									
Herb	Asteraceae	*Onopordum acanthium*	Scotch Thistle	*	*																										
Herb	Asteraceae	*Senecio* spp.	-	*	*																										
Herb	Asteraceae	*Vittadinia gracilis*	-		*	*			*							<1	4	1	3											<1	2
Herb	Boraginaceae	*Heliotropium europaeum*	Potato Weed	*	*	*	*		*															<1	1					<1	1
Herb	Boraginaceae	*Heliotropium amplexicaule*	Blue Heliotrope	*	*	*																									
Herb	Brassicaceae	*Brassica juncea*	Indian Mustard	*		*																									

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Herb	Brassicaceae	*Lepidium africanum*	-	*	*	*	*		*																			2	10		
Herb	Callitrichaceae	*Callitriche* spp.	Starwort		*	*	*																								
Herb	Campanulaceae	*Wahlenbergia stricta*	Australian bluebell		*		*																	2	10						
Herb	Chenopodiaceae	*Atriplex semibaccata*	Creeping Saltbush			*			*					<1	15					2	4							2	1		
Herb	Chenopodiaceae	*Chenopodium album*	Fat Hen	*		*																									
Herb	Chenopodiaceae	*Maireana decalvans*	Black Cotton Bush		*	*			*			5	30																		
Herb	Chenopodiaceae	*Sclerolaena muricata*	Black Rolypoly		*	*	*	*	*	10	100 +	4	60	<1	2	<1	5	10	27	5	14	<1	8	<1	1			2	20	5	30
Herb	Cucurbitaceae	*Citrullus lanatus*	Watermelon	*		*	*		*	1	5													<1	1			1	1	<1	2
Herb	Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*	*	*																									
Herb	Malvaceae	*Sida corrugata*	Corrugated Sida		*	*	*	*				1	1	<1	50+							<1	10			1	20	<1	10		

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Herb	Marsileaceae	*Marsilea* spp.	Nardoo		*	*																									
Herb	Nyctaginaceae	*Boerhavia dominii*	Tarvine		*	*			*	1	1	<1	3	<1	1																
Herb	Oxalidaceae	*Oxalis perennans*	-		*	*	*	*	*	1	1			<1	100 +	<1	16	<1	7	1	5	3	100	<1	100	1	10	1	20	<1	4
Herb	Polygonaceae	*Polygonum aviculare*	Wireweed	*	*	*																									
Herb	Polygonaceae	*Rumex brownii*	Swamp Dock		*	*	*		*	1	1					1	1	1	1												
Herb	Rubiaceae	*Asperula conferta*	Common Woodruff		*	*																									
Herb	Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein	*	*																										
Herb	Solanaceae	*Solanum esuriale*	Quena		*	*	*	*	*	5	200 +	1	100 +	4	100 +	5	300			2	70	<1	20	<1	20	<1	15	2	30	<1	30
Herb	Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*		*												1	1												
Rush	Juncaceae	*Juncus aridicola*	-		*	*	*																								

Life Form	Family	*Species*	Common Name	Exotic species	Grassland	Black Box	Yellow Box	Cypress Pine	Weeping Myall	Plot 12		Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	Cover %	Abundance
Rush	Juncaceae	*Juncus flavidus*	-		*	*			*																			1	1		
Graminoid	Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		*											<1	1														
Climber	Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed		*											1	1														

Table A3 Flora Plots 23 to 30

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Tree	Casuarinaceae	*Allocasuarina luehmannii*	Bulloak				*	*																	
Tree	Cupressaceae	*Callitris glaucophylla*	White Cypress Pine			*	*	*																	
Tree	Fabaceae	*Acacia pendula*	Weeping Myall						*	40	7														
Tree	Myrtaceae	*Eucalyptus melliodora*	Yellow Box				*																	10	6
Tree	Myrtaceae	*Eucalyptus largiflorens*	Black Box		*	*																			
Shrub	Asteraceae	*Xanthium spinosum*	Bathurst Burr	*	*	*			*	<1	4	<1	5									<1	1		
Shrub	Chenopodiaceae	*Dissocarpus paradoxus*	-			*																			
Shrub	Chenopodiaceae	*Einadia hastata*	Berry Saltbush		*	*	*	*	*	<1	4														
Shrub	Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush		*	*			*	<1	4														
Shrub	Chenopodiaceae	*Maireana aphylla*	Leafless Bluebush		*	*	*		*	2	100							<1	2						

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Shrub	Chenopodiaceae	*Maireana brevifolia*	Small-leaf Bluebush				*		*																
Shrub	Lamiaceae	*Marrubium vulgare*	White Horehound	*	*	*	*	*	*					1	1									1	20
Shrub	Malvaceae	*Sida cunninghamii*	Ridged Sida		*	*	*	*	*	<1	6			2	20	<1	3	<1	30			<1	4		
Grass	Poaceae	*Aristida sp.*					*																	5	100
Grass	Poaceae	*Austrostipa aristiglumis*	Plains Grass		*	*	*	*	*	5	20	<1	4	80	600	60	600	70	700	5	100	15	100	1	4
Grass	Poaceae	*Austrostipa scabra*	Speargrass		*				*	<1	6			1	1	5	60								
Grass	Poaceae	*Avena fatua*	Wild Oats	*	*	*		*						<1	20										
Grass	Poaceae	*Chloris gayana*	Rhodes Grass	*	*									<1	1			<1	5						
Grass	Poaceae	*Chloris truncata*	Windmill Grass		*	*										5	100	10	300						
Grass	Poaceae	*Cynodon dactylon*	Couch		*				*			4	15												

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Grass	Poaceae	*Dichanthium sericeum*	Queensland Bluegrass						*																
Grass	Poaceae	*Enteropogon acicularis*	-		*	*	*		*			<1	5												
Grass	Poaceae	*Enteropogon ramosus*	Curly Windmill Grass		*	*			*	5	20			5	60										
Grass	Poaceae	*Eragrostis spp.*	-		*	*	*		*	<1	10			5	300	5	100								
Grass	Poaceae	*Lolium* spp.	Ryegrass	*	*		*	*												80	1000	80	1000	5	100
Grass	Poaceae	*Panicum effusum*	Hairy Panic		*													<1	10						
Grass	Poaceae	*Paspalum dilatatum*	Paspalum	*	*							<1	1												
Grass	Poaceae	*Pennisetum clandestinum*	Kikuyu	*			*																	50	1000
Grass	Poaceae	*Rytidosperma duttonianum*	-		*	*	*		*	70	500+			1	1	5	100	15	200	<1	30	5	50	5	50
Grass	Poaceae	*Vulpia bromoides*	Squirrel Tail Fescue	*		*	*	*	*	<1	50													40	500

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Grass	Poaceae	*Walwhalleya proluta*	-		*	*	*		*	10	200					10	200	5	100						
Herb	Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed			*																			
Herb	Amaranthaceae	*Amaranthus* spp.	-	*		*																			
Herb	Asteraceae	*Leiocarpa panaetioides*	Wooly Buttons		*																				
Herb	Asteraceae	*Cirsium vulgare*	Spear Thistle	*		*		*	*																
Herb	Asteraceae	*Conyza spp.*	Fleabane	*		*		*																	
Herb	Asteraceae	*Onopordum acanthium*	Scotch Thistle	*	*			*																	
Herb	Asteraceae	*Senecio* spp.	-	*	*																				
Herb	Asteraceae	*Vittadinia gracilis*	-		*	*			*							1	1								
Herb	Boraginaceae	*Heliotropium europaeum*	Potato Weed	*	*	*	*		*			<1	20	<1	7			<1	5	3	40	5	100		

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Herb	Boraginaceae	*Heliotropium amplexicaule*	Blue Heliotrope	*	*	*																<1	3		
Herb	Brassicaceae	*Brassica juncea*	Indian Mustard	*		*																			
Herb	Brassicaceae	*Lepidium africanum*	-	*	*	*	*	*	*											<1	60	2	10	1	25
Herb	Callitrichaceae	*Callitriche* spp.	Starwort		*	*	*																		
Herb	Campanulaceae	*Wahlenbergia stricta*	Australian bluebell		*		*									<1	4	<1	4						
Herb	Chenopodiaceae	*Atriplex semibaccata*	Creeping Saltbush			*			*	<1	7														
Herb	Chenopodiaceae	*Chenopodium album*	Fat Hen	*		*																			
Herb	Chenopodiaceae	*Maireana decalvans*	Black Cotton Bush		*	*			*																
Herb	Chenopodiaceae	*Sclerolaena muricata*	Black Rolypoly		*	*	*		*	2	50	3	9							<1	8				
Herb	Cucurbitaceae	*Citrullus lanatus*	Watermelon	*		*	*		*	<1	3	5	14												

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Herb	Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*	*	*						<1	2												
Herb	Malvaceae	*Sida corrugata*	Corrugated Sida		*	*	*							2	10										
Herb	Marsileaceae	*Marsilea* spp.	Nardoo		*	*																			
Herb	Nyctaginaceae	*Boerhavia dominii*	Tarvine		*	*			*			1	1							<1	30	<1	15		
Herb	Oxalidaceae	*Oxalis perennans*	-		*	*	*		*			6	10			1	10			<1	20	<1	4		
Herb	Polygonaceae	*Polygonum aviculare*	Wireweed	*	*	*				<1	4	<1	3												
Herb	Polygonaceae	*Rumex brownii*	Swamp Dock		*	*	*		*					<1	10										
Herb	Plantaginaceae	*Veronica plebeia*	Creeping Speedwell			*	*																	1	4
Herb	Rubiaceae	*Asperula conferta*	Common Woodruff		*	*																			
Herb	Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein	*	*																	<1	30		

Life Form	Family	*Species*	Common Name	Exotic species	Native Grassland	Black Box	Yellow Box	White Cypress	Weeping Myall	Plot 23		Plot 24		Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
										% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance	% Cover	Abundance
Herb	Solanaceae	*Solanum esuriale*	Quena		*	*	*		*	2	70	<5	20	2	50	<1	4	3	30						
Herb	Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*		*																			
Rush	Juncaceae	*Juncus aridicola*	-		*	*	*																		
Rush	Juncaceae	*Juncus flavidus*	-		*	*			*			1	1			1	3	<1	20						
Graminoid	Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		*																				
Climber	Convolvulaceae	*Convolvulus erubescens*	Blushing Bindweed		*									<1	1										

Table A4 Opportunistic and flowering species recorded during targeted flora surveys

Growth Form	Family	Scientific Name	Common Name	Exotic Species	Native Grassland	Black Box Woodland	Yellow Box Woodland	White Cypress Woodland	Weeping Myall Woodland	Exotic Grassland
Grass	Poaceae	*Phalaris minor*	Lesser Canary Grass	Yes	Recorded	-	-	-	-	-
Herb	Asteraceae	*Calotis* spp.	-	No	Recorded	-	-	-	-	-
Herb	Asteraceae	*Lactuca serriola*	Prickly Lettuce	Yes	-	-	-	-	-	Recorded
Herb	Asteraceae	*Leptorhynchos squamatus* subsp. *squamatus*	-	No	Recorded	-	-	-	-	-
Herb	Asteraceae	*Sonchus oleraceus*	Common Sowthistle	Yes	-	-	-	-	-	Recorded
Herb	Fabaceae	*Trifolium arvense*	Haresfoot Clover	Yes	Recorded	-	-	-	-	Recorded
Herb	Goodeniaceae	*Goodenia* spp.	-	No	Recorded	-	-	-	-	-
Herb	Iridaceae	*Moraea setifolia*	Thread Iris	Yes	Recorded	-	-	-	-	-

Appendix 3

Fauna Species List

Life Form	Family	Species	Common Name	BC Act listed	EPBC Act listed	Introduced	Observation type
Bird	Accipitridae	*Aquila audax*	Wedge-tailed Eagle	-	-	-	O
Bird	Accipitridae	*Elanus axillaris*	Black-shouldered Kite	-	-	-	O
Bird	Accipitridae	*Haliastur sphenurus*	Whistling Kite	-	-	-	O W
Bird	Anatidae	*Anas superciliosa*	Pacific Black Duck	-	-	-	O
Bird	Anatidae	*Chenonetta jubata*	Australian Wood Duck	-	-	-	O
Bird	Ardeidae	*Ardea pacifica*	White-necked Heron	-	-	-	O
Bird	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	-	-	-	O W
Bird	Artamidae	*Cracticus tibicen*	Australian Magpie	-	-	-	O W
Bird	Artamidae	*Strepera graculina*	Pied Currawong	-	-	-	W
Bird	Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	-	-	-	O W
Bird	Cacatuidae	*Eolophus roseicapilla*	Galah	-	-	-	O W
Bird	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	-	-	-	O W
Bird	Columbidae	*Ocyphaps lophotes*	Crested Pigeon	-	-	-	O W
Bird	Corcoracidae	*Corcorax melanorhamphos*	White-winged Cough	-	-	-	O W
Bird	Corcoracidae	*Struthidea cinerea*	Apostlebird	-	-	-	O
Bird	Corvidae	*Corvus coronoides*	Australian Raven	-	-	-	O W
Bird	Falconidae	*Falco cenchroides*	Nankeen Kestrel	-	-	-	O W
Bird	Falconidae	*Falco peregrinus*	Peregrine Falcon	-	-	-	O
Bird	Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	-	-	-	O W
Bird	Hirundinidae	*Hirundo neoxena*	Welcome Swallow	-	-	-	O W
Bird	Meliphagidae	*Manorina melanocephala*	Noisy Miner	-	-	-	O W
Bird	Monarchidae	*Grallina cyanoleuca*	Magpie-lark	-	-	-	O W
Bird	Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit	-	-	-	O
Bird	Petroicidae	*Petroica goodenovii*	Red-capped Robin	-	-	-	O
Bird	Phasianidae	*Coturnix pectoralis*	Stubble Quail	-	-	-	O
Bird	Podargidae	*Podargus strigoides*	Tawny Frogmouth	-	-	-	O
Bird	**Pomatostomidae**	***Pomatostomus temporalis temporalis***	**Grey-crowned Babbler (eastern subspecies)**	**V**	**-**	**-**	**O W**
Bird	Psittacidae	*Northiella haematogaster*	Blue Bonnet	-	-	-	O W
Bird	**Psittacidae**	***Polytelis swainsonii***	**Superb Parrot**	**V**	**V**	**-**	**O W**
Bird	Psittacidae	*Psephotus haematonotus*	Red-rumped Parrot	-	-	-	O
Bird	Psittaculidae	*Platycercus eximius*	Eastern Rosella	-	-	-	O W
Bird	Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	-	-	-	O W
Bird	Sturnidae	*Sturnus vulgaris*	Common Starling	-	-	x	O W
Bird	Turdidae	*Turdus merula*	Common Blackbird	-	-	x	O
Mammal	Bovidae	*Bos taurus*	Cattle	-	-	x	O
Mammal	Bovidae	*Ovis aries*	Sheep	-	-	x	O
Mammal	Canidae	*Vulpes vulpes*	European Fox	-	-	x	O
Mammal	Leporidae	*Oryctolagus cuniculus*	Rabbit	-	-	x	O
Mammal	Molossidae	*Austronomus australis*	White-striped Freetail Bat	-	-	-	U
Mammal	Molossidae	*Mormopterus petersi*	Inland Free-Tailed Bat	-	-	-	T
Mammal	Molossidae	*Mormopterus planiceps*	Little Mastiff-bat	-	-	-	U
Mammal	Molossidae	*Mormopterus ridei*	Eastern Free-tailed Bat	-	-	-	U
Mammal	Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	-	-	-	O
Mammal	Macropodidae	*Macropus rufus*	Red Kangaroo	-	-	-	O
Mammal	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattle Bat	-	-	-	U T
Mammal	Vespertilionidae	*Chalinolobus morio*	Chocolate Wattle Bat	-	-	-	U T
Mammal	Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	-	-	-	T
Mammal	Vespertilionidae	*Scotorepens balstoni*	Inland Broad-nosed Bat	-	-	-	U T
Mammal	Vespertilionidae	*Scotorepens greyii*	Little Broad-nosed Bat	-	-	-	U
Mammal	Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	-	-	-	T
Mammal	Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	-	-	-	T
Mammal	Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	-	-	-	U T

Observation Type Codes (Atlas of NSW Wildlife Database): O – Seen; OW – Seen & heard, W heard, U – Ultrasonic recording, T – Trapped or netted

Appendix 4

Threatened Flora and Fauna

Table 1 Threatened species of fauna

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Amphibians							
Litoria raniformis	Growling Grass Frog	E1	V	This species is found mostly amongst emergent vegetation, including *Typha* sp. (bullrush), *Phragmites* sp. (reeds) and *Eleocharis* sp. (sedges), in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams. Additionally, this species can occur in open grassland, open forest, ephemeral and permanent non-saline marshes and swamps and steep-banked water edges (like ditches and drains) and gently graded edges containing fringing plants.	K	Low-moderate. *Typha* sp. (bullrush), *Phragmites* sp. (reeds) and *Eleocharis* sp. (sedges) were not recorded within the study area. Farm dams and open grassland do occur within the study area but are unlikely to provide preferred habitat for this species.	Low. No habitat on within the study area.
Crinia sloanei	Sloane's Froglet	V	-	Sloane's Froglet has been recorded from widely scattered sites in the floodplains of the Murray-Darling Basin, with the majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions in New South Wales. It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats.	1 (OEH Atlas Search)	Low - Moderate. The study area is located on floodplains of the Murray-Darling Basin, with areas of grassland, woodland and disturbed habitats that have potential for periodic inundation.	Low. No habitat within the study area.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Birds							
Botaurus poiciloptilus	Australasian Bittern	E1	E	Inhabits terrestrial and estuarine wetlands, generally where there is permanent water. The species prefers wetlands with dense vegetation, including sedges, rushes and reeds.	K	Low. Wetland habitat is absent from the study area.	Low.
Ardeotis australis	Australian Bustard	E1	-	In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams.	PR	Moderate. Grassland, grassy woodlands and dams occur within the study area.	Low.
Rostratula australis	Australian Painted Snipe	E1	E	Restricted to Australia. Most records are from the south-east, particularly the Murray Darling Basin. In NSW, many records are from the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	1 (OEH Atlas Search)	Low-moderate. The few farm dams that occur on within the study area provide limited potential habitat for this species.	Low. Removal of only a small portion of potential marginal habitat.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Ninox connivens	Barking Owl	V	-	Woodland and open forest including fragmented remnants and partly cleared farmland. Preferentially hunts small arboreal mammals such as squirrel gliders and ringtail possums. But as prey decreases becomes reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. Large tree hollows are used for nesting.	PR	Moderate. Woodland with large tree hollows and rabbits are present within the study area.	Low.
Oxyura australis	Blue-billed Duck	V	-	This species is endemic to south-eastern and south-western Australia. It prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. They feed on the bottom of swamps.	2 (OEH Atlas Search)	Low. Large permanent wetlands with deep water and swamps with dense aquatic vegetation are absent within the study area.	Low.
Grus rubicunda	Brolga	V	-	Found feeding in dry grasslands, plough paddocks and desert claypans. Also dependant on wetlands and shallow swamps. Distributed sparsely through central western NSW.	1 (OEH Atlas Search)	Moderate. Foraging habitat in the form of grasslands occur within the study area.	Low.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	The eastern subspecies lives in eastern NSW in eucalypt woodlands throughout central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species.	16 (OEH Atlas Search)	Moderate. Eucalypt woodland with an open grassy understorey occurs within the study area.	Low.
Burhinus grallarius	Bush Stone-curlew	E1	-	Wader-like bird that can be difficult to see in its lightly timbered, open forest or woodland habitat. Dry, open grassland and cropland, with cover nearby, may also provide habitat for the species.	1 (OEH Atlas Search)	Moderate. Open woodland and dry, open grassland occur within the study area.	Moderate.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Tringa nebularia	Common Greenshank	-	M	Occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats.	PR	Low. No habitat within the study area	Low.
Calidris ferruginea	Curlew Sandpiper	-	CE,M	This species is distributed around most of the coastline of Australia. Generally occupies littoral and estuarine habitats, and in NSW is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland.	PR	Low. Preferred littoral and estuarine habitats are absent from the study area.	Low.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Stagonopleura guttata	Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. Also in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Also found in riparian areas, and sometimes in lightly wooded farmland. Birds roost in dense shrubs or in smaller nests built especially for roosting.	PR	Moderate. Although grassy eucalypt woodland and grassland occurs within the study area, dense shrubs for roosting are absent. Grassland Habitat will be removed as part of the project. No individuals were recorded within the study area.	Moderate.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	This species habitat is within woodlands and dry sclerophyll forests dominated by Eucalypts and Mallee associations. This species feeds on insects and other invertebrates captured on the wing. Occasionally feeds on nectar, fruit and seeds. Distribution of this species is widespread in NSW from the coast to inland including the western slopes and plains.	6 (OEH Atlas Search)	Moderate. Only a negligible area of woodland habitat will require removal as part of the project.	Low.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Numenius madagascariensis	Eastern Curlew	-	CE,M	A large wader 55-61 cm. Have a very long curved black bill which is pink at the base. Has a prominent eye-ring. Primarily coastal distribution, species is found in all states including Tasmania. Rarely recorded inland, mainly found in estuaries such as Hunter river, Port Stephens Clarence river Richmond river.	PR	Low. No preferred habitat occurs within the study area.	Low.
Petroica phoenicea	Flame Robin	V	-	Prefers clearings or areas with open understorey. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. In winter birds migrate to drier more open habitats in the lowlands (valleys and western slopes and plains), inhabiting dry forests, open woodlands and pastures and native grasslands, with or without scattered trees. .	1 (OEH Atlas Search)	Moderate. Although breeding habitat is absent from the study area, preferred open woodland and native grassland with and without scattered trees is present.	Low. Only a negligible area of woodland habitat will require removal. Large areas of grassland will be impacted upon by the project however native grassland will be retained underneath the solar panels as part of the project.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Apus pacificus	Fork-tailed Swift	-	M	In NSW, the species is recorded in all regions. Many records occur east of the Great Divide. The Fork-tailed Swift is almost exclusively aerial with them foraging and roosting aerially. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes.	PR	Low-moderate. This species may fly over the study area while foraging for insects, however, treeless grassland which occurs over most of the study area is not regarded as this species primary habitat.	Low. Native grassland will be impacted upon by the project, however the grassland is not primary habitat.
Stictonetta naevosa	Freckled Duck	V	-	Found primarily in south-eastern and south-western Australia. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	6 (OEH Atlas Search)	Low-moderate. The few farm dams that occur within the study area provide limited potential habitat for this species.	Low. Loss of farm dams is unlikely to have an impact upon the habitat for this species.
Falco hypoleucos	Grey Falcon	E1	-	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse.	PR	Moderate. Foraging grassland habitat is available within the study area, however, wetlands and watercourses are absent from.	Moderate. Small areas of woodland habitat and a large area of grassland habitat will be removed.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Hamirostra melanosternon	Black-breasted Buzzard	V	-	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall. Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.	PR	Moderate. Timbered watercourses are absent from the study area, however, hunting habitat of grasslands and sparsely timbered woodlands occur extensively.	Low. Only a negligible area of woodland habitat will require removal as part of the project.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	25 (OEH Atlas Search)	Recorded within woodland that occurs within the study area.	Moderate. However only a small area of woodland habitat will be removed retaining the majority of foraging and nesting habitat.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Often perches on low dead stumps and fallen timber or on low-hanging branches. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1m to 5m above the ground.	PR	Low. Open eucalypt woodland near open areas are present within the study area. Old records for this species and unlikely to occur.	Low. Only a negligible area of woodland habitat will require removal as part of the project.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	-	M	Latham's Snipe is a non-breeding visitor to south-eastern Australia. This species occurs in permanent and ephemeral wetlands up to 2000m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation.	PR	Low-moderate. The few farm dams that occur within the study area provide limited potential habitat for this species.	Low. Removal of only a small portion of potential marginal habitat.
Hieraaetus morphnoides	Little Eagle	V	-	Found throughout the Australian mainland except in the most densely forested parts of the Dividing Range escarpment. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	2 (OEH Atlas Search)	Moderate. Open woodland and small areas of Acacia woodland occur within the study area.	Low. Only a negligible area of woodland habitat will require removal as part of the project.
Anseranas semipalmata	Magpie Goose	V	-	Mainly found in shallow wetlands (less than 1m deep) with dense growth of rushes or sedges. Often seen grazing on land; feeds on grasses, bulbs and rhizomes. Most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW. Often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation.	1 (OEH Atlas Search)	Low. No preferred shallow wetland habitat occurs within the study area.	Low. No habitat within the study area.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.	PR	Moderate. Treed and treeless habitats with exotic melons, saltbush, wattle, cypress pines and tree hollows occur within the study area. Hollow-bearing paddock trees will be removed as part of the project.	Moderate.
Calyptorhynchus lathami - endangered population	Glossy Black-Cockatoo, Riverina population	E2	-	Feeds almost exclusively on the seeds of *Casuarina* sp. and *Allocasuarina* sp. Open forest and woodlands up to 1000m with feed trees present. The population is largely restricted to hills and low ridges where suitable stands of its food plant Drooping Sheoak (*Allocasuarina verticillata*) remain.	PR	Moderate. The study area offers some limited potential habitat for this species, with only very occasional specimens of the *Allocasuarina leuhmannii* within the study area.	Low. Only a negligible area of woodland habitat will require removal as part of the project..
Glossopsitta pusilla	Little Lorikeet	V	-	Forages in flowering eucalypts and *Melaleuca* sp. Riparian habitats are particularly used, due to higher soil fertility and greater productivity. Nests in tree hollows.	PR	Low. The study area offers minimal habitat with the closest record over 300km to the south west on the NSW- VIC border	Low. Only a negligible area of woodland habitat will require removal as part of the project..

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Leipoa ocellata	Malleefowl	E1	V	The Malleefowl inhabits semi-arid regions of southern Australia. In New South Wales, it typically occurs west of the Great Dividing Range. Its distribution extends from Pilliga south-west to the districts of Griffith and Wentworth, although the species is absent from the southern parts of the Riverina region. Found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias. A sandy substrate and abundance of leaf litter are required for breeding. Densities of the birds are generally greatest in areas of higher rainfall and on more fertile soils where habitats tend to be thicker and there is an abundance of food plants.	PR	Low. The study area offers limited potential habitat for this species, but is lacking a sandy substrate and abundance of leaf litter.	Low. No habitat within the study area.
Tyto novaehollandiae	Masked Owl	V	-	Extends from the coast where it is most abundant to the western plains. Lives in dry eucalypt forests and woodlands from sea level to 1100m.	PR	Moderate. Dry eucalypt woodland with tree hollows are present within the study area. Records over 20 yrs old. No individuals were recorded during call playback survey.	Low. Only a negligible area of woodland habitat will require removal as part of the project, and records over 20ys old.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Pezoporus occidentalis	Night Parrot	-	Extinct within area	The night parrot is a highly elusive nocturnal ground dwelling parrot found in the arid and semi-arid zones of Australia. The night parrot was thought to be extinct but in 2013 it was rediscovered in Queensland (Pullen Pullen Reserve).	-	Low. Species is currently classified as extinct within the area.	Low. Species is assumed extinct, no habitat within the study area.
Grantiella picta	Painted Honeyeater	V	V	Nomadic species and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	3 (OEH Atlas Search)	Moderate. The study area contains small areas of preferred habitat and occurs within the known concentrated distribution of this species. Only 2 mistletoe plants were recorded in the weeping myall woodland. No individuals were recorded during targeted surveys.	Moderate. EPBC Assessment Required

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Certhionyx variegatus	Pied Honeyeater	V	-	Inhabits wattle shrub, primarily Mulga (*Acacia aneura*), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (*Eremophila* spp.); also from mistletoes and various other shrubs (e.g. *Grevillea* spp.); also eats saltbush fruit, berries, seed, flowers and insects.	PR	Low. Eucalypt woodlands and saltbush are present within the study area. However, emu-bushes and mistletoes were not recorded within the study area. The study area provides a small area of habitat which will chiefly be retained as part of the project.	Low. Limited habitat present and a small area of woodland habitat will be removed.
Pedionomus torquatus	Plains-wanderer	E1	CE	The Plains-wanderer occurs at scattered sites in Queensland, NSW, Victoria and SA. The distribution of the Plains-wanderer is severely fragmented. The Plains-wanderer occurs at a small number of sites scattered across south-eastern Australia. The Plains-wanderer inhabits sparse, treeless, lowland native grasslands with approximately 50% bare ground, most vegetation less than 5 cm in height, with some widely-spaced plants up to 30 cm high.	K	Moderate. The Plains grassland within the study area is approximately 100cm in height with less than 10% bare ground. The study area contains sub-optimal habitat for this species. The Native grassland provides sub-optimal habitat however it's structural form and native species diversity is not ideal habitat for this species. No individuals were recorded during targeted surveys.	Moderate. EPBC Assessment Required.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Anthochaera phrygia	Regent Honeyeater	E4	CE	Dry open forest and woodland. Particularly box-ironbark woodland and riparian forests of river sheoak. Feeds on the nectar from a wide range of eucalypts and mistletoes.	SEAR's requirement	Low. Woodland habitat occurs within the study area which will be retained as part of the project.	Low. Only a negligible area of woodland habitat will require removal as part of the project..
Polytelis anthopeplus monarchoides	Regent parrot (eastern subspecies)	E1	V	This species is restricted to the Murray River in the South Australia, Vic and NSW. Nests in riverine red gum forest and forages in mallee woodlands within 20km of nesting sites. The will forage on cereal crops and spilt grain.	PR	Low. This species is restricted to River Red Gum Forests along the Murray River. Primary habitat is Mallee Woodlands.	Low. No habitat within the study area.
Myiagra cyanoleuca	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies.	PR	Low. The study area may provide marginal habitat during migratory passage.	Low. Only a negligible area of woodland habitat will require removal as part of the project..
Chthonicola sagittata	Speckled Warbler	V	-	The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	1 (OEH Atlas Search)	Low. Large, relatively undisturbed remnants are absent from the study area.	Low. No habitat within the study area.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Circus assimilis	Spotted Harrier	V	-	Grassy open woodland, inland riparian woodland, grassland and shrub steppe. Most commonly found in native grassland but also in agricultural areas.	2 (OEH Atlas Search)	Moderate. The study area contains native grassland and grassy open woodland within an agricultural setting.	Moderate. Native grassland habitat will be removed..
Lophoictinia isura	Square-tailed Kite	V	-	Timbered habitats including dry woodlands and open forests. Prefers timbered watercourses. Specialist hunter of passerines and insects.	PR	Low-moderate. Preferred timber watercourse habitat is absent from study area.	Low. Only a negligible area of woodland habitat will require removal as part of the project.
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot mainly inhabits forests and woodlands dominated by eucalypts, especially River Red Gums (*Eucalyptus camaldulensis*) and box eucalypts such as Yellow Box (*Eucalyptus melliodora*) or Grey Box (*E. microcarpa*). The species also seasonally occurs in box-pine (*Callitris*) and Boree (*Acacia pendula*) woodlands (Webster 1998).	365 (OEH Atlas Search)	Recorded within woodland that occurs within the study area.	Moderate. EPBC Assessment Required
Neophema pulchella	Turquoise Parrot	V	-	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	PR	Moderate – habitat within study area, however most recent record is from 1998 at Leeton.	Low. Only a negligible area of woodland habitat will require removal as part of the project.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Daphoenositta chrysoptera	Varied Sittella	V	-	Eucalypt forests and woodlands, particularly those with rough-barked species, mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands.	4 (OEH Atlas Search)	Moderate. Small patches of Eucalypt and Acacia woodland occur within the study area, however, the study area chiefly consists of open grassland which is not preferred by this species. A record of this species occurs just east of the study area in woodland.	Low. Only a negligible area of woodland habitat will require removal as part of the project.
Epthianura albifrons	White Fronted chat	V	-	In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	PR	Low. The study area is not near waterways.	Low. No habitat within study area.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	Distributed along the coastline of Australia, also extending inland along some larger waterways. Habitat includes large areas of open water. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland and forest. Breeding territories are close to water, mainly in tall open forest or woodland, although nests are sometimes located in other habitats such as dense forest, closed scrub or in remnant trees on cleared land.	27 (OEH Atlas Search)	Moderate. The Murrumbidgee River occurs approximately 1.5km north of the study area. The study area consists of mainly grassland, a preferred foraging habitat for this species.	Moderate. Removal of only a small portion of potential habitat.
Motacilla flava	Yellow Wagtail	-	M	Non-breeding habitat only: mostly well-watered open grasslands and the fringes of wetlands. Roosts in mangroves and other dense vegetation.	PR	Low. No habitat within the study area.	Low. Only a negligible area of woodland habitat will require removal as part of the project.
Fish[3]							
Galaxias rostratus	Flathead Galaxias	CE (FM Act)[4]	CE	Flathead Galaxias are found in still or slow moving water bodies such as wetlands and lowland streams. The species has been recorded forming shoals. They have been associated with a range of habitats including rock and sandy bottoms and aquatic vegetation.	PR	Low. No habitat in the study area.	Low. Only a negligible area of woodland habitat will require removal as part of the project..

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Maccullochella peelii peelii	Murray Cod	-	V	The Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW to slow-flowing, turbid lowland rivers and billabongs. Murray Cod are frequently found in the main channels of rivers and larger tributaries. Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures.	PR	Low. No habitat in the study area.	Low. Only a negligible area of woodland habitat will require removal as part of the project..
Macquaria australasica	Macquarie Perch	E (FM Act)[4]	E	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks.	PR	Low. No habitat in the study area.	Low. Only a negligible area of woodland habitat will require removal as part of the projec..

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Mammals							
Phascolarctos cinereus	Koala	-	V	Found in eucalypt woodlands and forest foraging on preferred food trees.	PR	Moderate. The study area contains the secondary food tree species Yellow box *E. melliodora* and Black box *E. largiflorens*. However, the Koala or evidence of this species occurrence was not recorded.	Low. Only a negligible area of woodland habitat will require removal as part of the project. However an. EPBC Assessment has been conducted as a precautionary measure.
Petaurus norfolcensis	Squirrel Glider	V	-	Inhabits mature or old growth box, box-ironbark woodlands and river red gum forest west of the Great Dividing Range. Prefers mixed species stands with a shrub or Acacia midstorey. Uses tree hollows as den sites.	PR	Low-moderate. Black box woodland with numerous hollows occurs within the study area. However, shrub understorey is limited and no records occur in the locality. This species was not observed during nocturnal surveys.	Low. Removal of only a small portion of potential marginal foraging and nesting habitat.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is generally found within 200 km of Australia's eastern coast. Generally occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are commonly found in gullies, close to water, in vegetation with a dense canopy.	PR	Low-moderate. The study area is approximately 450km from Australia's eastern coast and consists primarily of native grassland. Roosting camps were not recorded on or near the study area.	Low. Removal of only a small portion of potential marginal foraging habitat.
Chalinolobus picatus	Little Pied Bat	V	-	This species is found in inland QLD and NSW. Habitat includes open forest, open woodland, mulga woodlands, mallee and bimbil box woodlands. Roosts in caves rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but needs access to nearby open water.	PR	Moderate. Potential foraging habitat within the study area.	Low. Removal of only a small portion of potential foraging habitat.
Myotis macropus	Large-footed Myotis	V	-	Forages over streams and pools catching insects and small fish by raking their feet across the water surface. Roost close to water in caves, mine shafts, tree hollows and man-made structures.		Moderate. Unlikely to forage within the study area, however hollow-bearing trees provide roosting habitat for this species.	Moderate. Only a negligible area of woodland habitat will require removal as part of the project. Hollow-bearing Paddock trees will also be removed as part of the project.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Nyctophilus corbeni	Corben's Long eared Bat	-	V	Inhabits a variety of vegetation types, including mallee, bull-oak (or Buloke) *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	PR	Moderate. The study area borders the known/predicated distribution for this species. However, preferred woodland vegetation communities are present within the study area for foraging. Tree hollows suitable for roosting are also present within the study area. Woodland areas will be chiefly retained, with some hollow-bearing paddock trees requiring removal.	Moderate. Only a negligible area of woodland habitat will require removal as part of the project. Hollow-bearing Paddock trees will also be removed as part of the project. EPBC Assessment Required
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees.	1 (OEH Atlas Search)	Moderate. Tree hollows and mammal (rabbit) burrows suitable for roosting occur within the study area. Suitable foraging habitat occurs within the study area.	Moderate. Only a negligible area of woodland habitat will require removal as part of the project. Hollow-bearing Paddock trees will also be removed as part of the project.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Vespadelus baverstocki	Inland Forest Bat	V	-	The habitat requirements of this species are poorly known but it has been recorded from a variety of woodland formations, including Mallee, Mulga and River Red Gum. Most records are from drier woodland habitats with riparian areas inhabited by the Little Forest Bat. Fly rapidly and cover an extensive foraging area and are presumed to feed on flying insects. Roosts in tree hollows and abandoned buildings.	1 (OEH Atlas Search)	Low-moderate. Mallee, Mulga and River Red Gum woodland formations are absent from the study area. Preferred riparian areas are absent from the study area.	Low. Removal of only a small portion of potential habitat.

Notes

1: V= Vulnerable, E1 = Endangered species, E2 = Endangered population, E4a = Critically endangered as listed on the BC Act

2: V = Vulnerable, E = Endangered, CE = Critically Endangered as listed under the EPBC Act.

3 PR = Predicted, K = Known by database searches by EPBC Act Protected Matters Search

4 E (FM Act) = Endangered under the *Fisheries Management Act*; CE (FM Act) = Critically Endangered under the *Fisheries Management Act*.

Table 2 Threatened species of flora

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Brachyscome papillosa	Mossgiel Daisy	V	V	Mossgiel Daisy is known to occur mainly from Mossgiel to Urana, in south-western NSW with sites around Jerilderie, Hay Plain, Willandra Lakes, and north to Ivanhoe. The species is found primarily in clay soils on Bladder Saltbush (*Atriplex vesicaria*) and Leafless Bluebush (*Maireana aphylla*) plains.	1	High. The study area contains clay soils and the associative species *Maireana aphylla* was recorded during field surveys. However, no specimens of this species were recorded despite targeted surveys.	Low. No individuals of this species were recorded during the targeted surveys.
Swainsona murrayana	Slender Darling-pea	V	V	Found in heavy soils and is also found on grey and red to brown clay and clay-loam soils in Bladder Saltbush, herbland, Black Box woodland and grassland communities and is frequently associated with *Maireana* species.	PR	Moderate. The study area contains clay soils, preferred vegetation communities for this species and the associative species *Maireana aphylla* was recorded during field surveys.	Low. No individuals of this species were recorded during the targeted surveys.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Swainsona recta	Small Purple-pea	E1	E	Before European settlement Small Purple-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum *Eucalyptus blakelyi*, Yellow Box *E. melliodora*, Candlebark Gum *E. rubida* and Long-leaf Box *E. goniocalyx*. Grows in association with understorey dominants that include Kangaroo Grass *Themeda triandra*, poa tussocks *Poa* spp. and spear-grasses *Austrostipa* spp.	PR	Moderate. *E. melliodora* occurs within the study area as well the associated *Austrostipa* spp.	Low. No individuals of this species were recorded during the targeted surveys.
Swainsona sericea	Silky Swainson-pea	V	-	Found in Natural Temperate Grassland and Snow Gum *Eucalyptus pauciflora* Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines Callitris spp.	2	Moderate. The study area contains temperate grasslands, Box-Gum woodland and the associative species *Callitris glaucophylla* was recorded during field surveys.	Low. No individuals of this species were recorded during the targeted surveys.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Diuris tricolor	Pine Donkey Orchid	V	-	The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitris* spp.). It is found in sandy soils, either on flats or small rises. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta*, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species.	1	Moderate. The study area contains sclerophyll forest, in which *Callitris glaucophylla* occurs, amongst grassland. However, sandy soils do not dominate the study area. A record of this species occurs just west of the study area.	Low. No individuals of this species were recorded during the targeted surveys.
Leptorhynchos orientalis	Lanky Buttons	E1	-	Grows in woodland or grassland, sometimes on the margins of swamps. Communities include a Bimble Box plain in red-brown soil, dense *Acacia pendula* woodland with herbaceous understorey on red clay to clay-loam, open grassland areas on red soils, and red clay plains at the edge of a Canegrass swamp. Associated species include *Eucalyptus populnea* subsp. *bimbil*, *Acacia pendula*, *Eragrostis australasica*, *Lepidium monoplocoides*, *Enchylaena tomentosa*, *Minuria leptophylla*, *Rhodanthe floribunda*, *R. pygmaea* and *Ptilotus spathulatus*.	PR	Moderate. Open grassland and *Acacia pendula* woodland occur within the study area.	Low. No individuals of this species were recorded during the targeted surveys.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Lepidium monoplocoides	Winged Peppercress	E1	E	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) *or Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses.	PR	Moderate. Grassland and woodland habitat occur within the study area.	Low. No individuals of this species were recorded during the targeted surveys.
Pilularia novae-hollandiae	Austral Pillwort	E1	-	Austral Pillwort grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous.	PR	Low. Shallow swamps and waterways are absent from the study area.	Low. No habitat for this species within the study area.
Convolvulus tedmoorei	Bindweed	E1	-	Grows in self-mulching grey clay soils on the floodplains of the Darling and Murrumbidgee Rivers. Disturbance regimes are not known, although the species may require periodic flooding of its habitat to maintain the wet conditions suitable for seed set and germination.	PR	Low. The study area is not suitable habitat for this species.	Low. No individuals of this species were recorded during the targeted surveys.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	Habitat Description	Records[3]	Likelihood of occurrence	Potential Impacts
Brachyscome muelleroides	Claypan Daisy	V	V	Grows in damp areas on the margins of claypans in moist grassland with *Pycnosorus globosus*, *Agrostis avenacea* and *Rytidosperma duttoniana*. Also recorded from the margins of lagoons in mud or water, and in association with *Calotis anthemoides*.	PR	Moderate. Parts of the grassland contain wet depressions.	Low. No individuals of this species were recorded during the targeted surveys.
Solanum karsense	Menindee Nightshade	V	V	Grows in occasionally flooded depressions with heavy soil, including level river floodplains of grey clay with Black Box and Old Man Saltbush, and open treeless plains with solonized brown soils. Habitats are generally lake beds or floodplains of heavy grey clays with a highly self-mulching surface. Also found on sandy floodplains and ridges and in calcareous soils, red sands, red-brown earths and loamy soils.	PR	Moderate. River Floodplains and Black Box occur within the study area.	Low. No individuals of this species were recorded during the targeted surveys.

Notes

1: V= Vulnerable, E1 = Endangered species, E2 = Endangered population, E4a = Critically endangered as listed on the BC Act,

2: V = Vulnerable, E = Endangered, CE = Critically Endangered as listed under the EPBC Act.

3: PR = Predicted by EPBC Act database searches

Appendix 5

Threatened Ecological Communities

Community Name	NSW BC Act status	EPBC Act status	Habitat Description	Records	Likelihood of occurrence	Potential Impacts
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	E3	E	The woodlands are distributed widely across the bioregions, occurring in tracts or as patches within open forests or woodlands dominated by other species. A feature common to many areas where the woodlands occur is the presence of clayey and/or alkaline sub-soils. In many of the South Australian areas, massive calcrete underlies the sub-soil at depths of less than one metre.	PR	Low. The study area is not representative of this EEC.	Not Recorded.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	E3	CE	It is characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs (where shrub cover comprises less than 30% cover), and a dominance or prior dominance of White Box (*Eucalyptus albens*) and/or Yellow Box (*E. melliodora*) and/or Blakely's Red Gum (*E. blakelyi*) trees. In the Nandewar bioregion, Grey Box (*E. microcarpa* or *E. moluccana*) may also be dominant or co-dominant. In the woodland state, tree cover is generally discontinuous and of medium height with canopies that are clearly separated.	PR	No areas of this community meet the federal criteria for this community. The state listing of this community does not occur within the Riverina Bioregion and therefore this EEC does not occur within the study area.	Not Recorded.

Community Name	NSW BC Act status	EPBC Act status	Habitat Description	Records	Likelihood of occurrence	Potential Impacts
***Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions**	E3	-	The community occurs on red-brown, sandy loam soils as scattered patches grading into surrounding woodlands of Belah and Rosewood, White Cypress Pine or sandplain mallee. typically has an open canopy of shrubs or small trees, sometimes with scattered mid-stratum shrubs, and with a sometimes sparse, but highly variable ground layer dominated by grasses, chenopods and herbs. The shrub/tree layer is dominated by *Acacia melvillei*, either in pure stands or with a range of other less abundant trees or tall shrubs. These may include Nelia (*Acacia loderi*), Western Rosewood (*Alectryon oleifolius* subsp. *canescens*), Belah (*Casuarina pauper*) and Sugarwood (*Myoporum platycarpum*).	K	Low. The study area is not representative of this EEC.	Not Recorded.
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	E3	E	Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, *Eucalyptus microcarpa* (Inland Grey Box), is often found in association with *E. populnea* subsp. *bimbil* (Bimble or Poplar Box), *Callitris glaucophylla* (White Cypress Pine), *Brachychiton populneus* (Kurrajong), *Allocasuarina luehmannii* (Bulloak) *or E. melliodora* (Yellow Box), and sometimes with *E. albens* (White Box).	K	Low. *Eucalyptus microcarpa* is absent from the study area and the study area is not representative of this EEC.	Not Recorded.

Community Name	NSW BC Act status	EPBC Act status	Habitat Description	Records	Likelihood of occurrence	Potential Impacts
***Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* (TSC Act)** **Weeping Myall Woodland (EPBC Act)**	E3	E	Has an open to sparse tree canopy up to 10 metres tall dominated by *Acacia pendula* (Myall or Boree), which may occur in pure stands, particularly south of the mid-Lachlan River district, or in combination with other trees such as *Casuarina cristata, Acacia homalophylla* (Yarran), *A. oswaldii* (Miljee), *Alectryon oleifolius* (Rosewood), *Apophyllum anomalum* (Warrior bush) and *Capparis* spp. The mistletoe, *Amyema quandang*, is common on the branches of *Acacia pendula* throughout. *Atriplex nummularia* (Old man saltbush) was historically one of the dominant understorey shrubs in the south, but is now uncommon in the community (Moore 1953). Other chenopod shrubs, such as *Atriplex semibaccata* (Creeping saltbush), *Enchylaena tomentosa* (Ruby saltbush), *Maireana aphylla* (Cotton bush), *M. decalvens* (Black cotton bush), *M. excavata*, *M. pentagona* (Hairy bluebush), *Rhagodia spinescens* (Thorny saltbush) and *Sclerolaena muricata* (Black rolypoly), are among the most frequent shrubs in the understorey of Myall Woodland south of the mid Lachlan district.	K	All recorded patches of this community meet the TSC Act listing. Two Patches, WM1 and WM2, meet the criteria for EPBC Act listing.	Recorded. EPBC Act Significance assessment was conducted as a precautionary measure.

Community Name	NSW BC Act status	EPBC Act status	Habitat Description	Records	Likelihood of occurrence	Potential Impacts
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	E3	-	Typically occupies red-brown loamy sands with alkaline sub-soils on the alluvial plain of the Murray River and its tributaries, and on parts of the sandplain in south-western NSW. In the Riverina bioregion and the far south-western portion of the NSW South Western Slopes bioregion, the community is typically associated with prior streams and aeolian source-bordering dunes, which are scattered within an extensive alluvial clay plain dominated by chenopod shrublands. When tree abundance is assessed at the hectare scale, White Cypress Pine is the most abundant tree species in Sandhill Pine Woodland.	K	Recorded White Cypress Pine open woodland is commensurate with this threatened community.	Recorded. Significance Assessments is not required as these areas will not be impacted.

Appendix 6

BioBanking Benchmarks

BioBanking Benchmark Data

Table 1 Comparison of *Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion* present within study area against PCT 45 benchmarks - Zones 3 and 4

Biobanking Plot/Condition	Plant Species Diversity	Native Over Storey % Cover	Native Mid Story % Cover	Native Ground Grasses	Native Ground Shrubs	Native Ground Other	Exotic Species %	Number of Trees with Hollows	Over Storey Regeneration	Length of Fallen Timber
Benchmark	***8***	***1-2***	***8-25***	***15-38***	***5-30***	***10-33***	***N/A***	***0***	***N/A***	***5***
Low Condition – Zone 4										
Q2	9	***0***	***0***	10	***0***	***2***	64	0	0	***0***
Q24	***7***	***0***	***0***	16	***0***	12	74	0	0	***0***
Q28	***5***	***0***	***0***	20	***0***	***2***	78	0	0	***0***
Q29	***5***	***0***	***0***	26	***0***	20	54	0	0	***0***
Moderate Condition – Zone 3										
Q4	18	***0***	***0***	46	8	***6***	6	0	0	***0***
Q5	12	***0***	***0***	46	6	***4***	8	0	0	***0***
Q6	12	***0***	***0***	82	***0***	***0***	2	0	0	***0***
Q15	12	***0***	***0***	76	***0***	10	2	0	0	***0***
Q20	***7***	***0***	***0***	98	***0***	***2***	0	0	0	***0***
Q25	10	***0***	***0***	80	***4***	12	0	0	0	***0***
Q26	12	***0***	***0***	82	***0***	***6***	0	0	0	***0***
Q27	12	***0***	***0***	78	***0***	***6***	2	0	0	***0***

Note:1. Italics and bold are below the lower value of the benchmark

2. Italics, bold and underlined are 25% lower than the benchmark

Table 2 Comparison of *Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW* present within the study area against PCT 16 benchmarks – Zone 2

Biobanking Plot/Condition	Plant Species Diversity	Native Over Storey % Cover	Native Mid Story % Cover	Native Ground Grasses	Native Ground Shrubs	Native Ground Other	Exotic Species %	Number of Trees with Hollows	Over Storey Regeneration	Length of Fallen Timber
Benchmark	***11***	***9-22***	***10-26***	***9-13***	***10-33***	***10-36***	***N/A***	***0***	***N/A***	***60***
Moderate to Good – Moderate Condition – Zone 2										
Q3	16	***7.5***	***<u>0</u>***	***<u>2</u>***	***<u>0</u>***	32	4	3	1	***<u>20</u>***
Q8	12	22.5	***<u>0</u>***	***8***	***<u>0</u>***	***<u>2</u>***	38	4	1	***<u>5</u>***
Q9	12	10.5	***<u>0</u>***	14	***<u>6</u>***	***8***	12	4	1	70
Q13	12	16.5	***<u>0</u>***	34	***<u>0</u>***	***<u>2</u>***	0	1	1	***<u>10</u>***
Q14	13	22	***<u>0</u>***	68	***<u>4</u>***	14	0	2	1	60
Q16	***<u>7</u>***	23	***<u>0</u>***	***8***	10	14	0	3	1	***<u>10</u>***
Q17	13	10.5	***<u>0</u>***	38	10	20	0	2	1	***<u>10</u>***
Q21	19	16.5	***<u>0</u>***	54	***<u>0</u>***	***<u>2</u>***	4	5	1	70

Note:1. Italics and bold are below the lower value of the benchmark

2. Italics, bold and underlined are 25% lower than the benchmark

Table 3 Comparison of *Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion* present within the study area against PCT 26 benchmarks

Biobanking Plot/Condition	Plant Species Diversity	Native Over Storey % Cover	Native Mid Story % Cover	Native Ground Grasses	Native Ground Shrubs	Native Ground Other	Exotic Species %	Number of Trees with Hollows	Over Storey Regeneration	Length of Fallen Timber
Benchmark	***15***	***5-33***	***8-23***	***3-10***	***10-20***	***0-50***	***N/A***	***0***	***N/A***	***27***
Moderate to Good – Moderate Condition										
Q10	15	11.5	***<u>0</u>***	30	12	6	0	0	1	***<u>10</u>***
Q11	***12***	10	***<u>0</u>***	72	***<u>6</u>***	10	0	0	1	***<u>10</u>***
Q12	***12***	10	***<u>0</u>***	56	***<u>2</u>***	18	0	0	1	100
Q22	14	8.5	***<u>0</u>***	40	22	16	0	0	1	***<u>20</u>***
Q23	16	12.5	***<u>0</u>***	76	***<u>4</u>***	12	0	0	1	60

Note:1. Italics and bold are below the lower value of the benchmark

2. Italics, bold and underlined are 25% lower than the benchmark

Table 4 Comparison of *Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion* present within the study area against PCT 75 benchmarks – Zone 1

Biobanking Plot/Condition	Plant Species Diversity	Native Over Storey % Cover	Native Mid Story % Cover	Native Ground Grasses	Native Ground Shrubs	Native Ground Other	Exotic Species %	Number of Trees with Hollows	Over Storey Regeneration	Length of Fallen Timber
Benchmark	***5***	***13-23***	***8-10***	***10-20***	***10-60***	***25-80***	***N/A***	***2***	***N/A***	***10***
Moderate to Good – Moderate Condition – Zone 1										
Q1	7	15	***<u>0</u>***	12	***<u>0</u>***	***<u>8</u>***	52	2	1	40
Q19	8	37	***<u>0</u>***	20	***<u>0</u>***	***<u>2</u>***	14	5	1	60
Q30	5	5	0	11	0	1	88	1	1	5

Note:1. Italics and bold are below the lower value of the benchmark

2. Italics, bold and underlined are 25% lower than the benchmark

Table 5 Comparison of *White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zones* within the study area against PCT 28 benchmarks

Biobanking Plot/Condition	Plant Species Diversity	Native Over Storey % Cover	Native Mid Story % Cover	Native Ground Grasses	Native Ground Shrubs	Native Ground Other	Exotic Species %	Number of Trees with Hollows	Over Storey Regeneration	Length of Fallen Timber
Benchmark	***5***	***13-23***	***8-10***	***10-20***	***10-60***	***25-80***	***n/a***	***2***	***n/a***	***10***
Moderate to Good – Moderate Condition										
Q7	14	15	***<u>0</u>***	24	***<u>0</u>***	***<u>8</u>***	40	2	1	40
Q18	9	25	***<u>0</u>***	16	***<u>0</u>***	***<u>10</u>***	66	***<u>0</u>***	1	50

Note:1. Italics and bold are below the lower value of the benchmark

2. Italics, bold and underlined are 25% lower than the benchmark

Appendix 7

Hollow-bearing Tree Data

HBT #	DBH (cm)	Species	Number & Size of Hollows					Notes
			Very Small < 5cm	Small 5 – 10cm	Medium 10 – 20cm	Large 20 – 30cm	Extra Large 30cm+	
HBT1	30, 45 [multi-stem]	*Eucalyptus melliodora*	-	1	1	1	1	Contains stick nest – potentially bird of prey.
HBT2	40, 35, 60, 25 [multi-stem]	*Eucalyptus melliodora*	-	3	1	1	-	N/A
HBT3	120	*Eucalyptus largiflorens*	-	3	12	-	-	N/A
HBT4	90	*Eucalyptus largiflorens*	-	3	3	3	-	N/A
HBT5	85	*Allocasuarina luehmannii*	-	1	2	1	-	N/A
HBT6	130	*Eucalyptus largiflorens*	-	-	2	-	-	N/A
Totals			**0**	**11**	**21**	**6**	**1**	

Appendix 8

EPBC Act Significance Assessments

Critically Endangered Species

Plains Wanderer – EPBC Act Assessment	**Response**
Profile: Plains Wanderer is listed as critically endangered and migratory on the EPBC Act. The Plains Wanderer is found in scattered sites throughout NSW, Vic, QLD and SA. The habitat for this species is lowland native grassland that occurs on red-brown clay soils. Preferred habitat is on areas where the ground layer has approximately 50% bare ground with vegetation less than 5 cm in height (Commonwealth of Australia, 2016). Diet includes native grasses, chenopods, native herbs, with invertebrates making up approximately 40% of their diet.	
Lead to a long term decrease in size of a population	This species was not recorded within the study area despite extensive targeted spring surveys. Approximately 600 ha of native grassland, dominated by *Austrostipa aristiglumis* (Plains Grass), which provides potential foraging and breeding habitat occurs within the study area. The grassland within the study area contains a high diversity of native grasses but lacks the diversity of native daisy species and scalded areas which are required for primary and secondary habitat for this species. A study by Charles Sturt University found that the overall impacts of the solar array on grassland diversity, habitat and fire risk would be variable throughout the study area. CSU states that the average structure of the Plains Grassland dominated area should only be reduced by a maximum of 20%. The other areas of native grassland in the under-panel area will be allowed to continue to grow to close to its natural 50cm height on a frequent / regular basis. CSU states that the between-panel area should not significantly change once it is recovered from construction. Monitoring will be conducted to adapt the management measures in response to seasonal variations. The panel area will not be permanently mown or grazed, only as recommended by CSU (usually in winter, mid Sept – Oct and if required in summer when dry matter exceeds 5t/ha). Therefore, it is considered that the proposal is unlikely to lead to a long term decrease in the size of the population.
Reduce the area of occupancy of the species	The Plains Wanderer has not been recorded within the study area. Areas of native grassland will be slashed and maintained in accordance with the adaptive management approach outlined in the CSU expert report. Although this will technically reduce the quality of potential foraging and breeding habitat for this species, CSU states that the average structure of the Plains Grassland dominated area should only be reduced by a maximum of 20%.

Plains Wanderer – EPBC Act Assessment	Response
	The other areas of native grassland in the under-panel area will be allowed to continue to grow to close to its natural 50cm height on a frequent / regular basis. CSU states that the between-panel area should not significantly change once it is recovered from construction. Therefore, the proposal is unlikely to reduce the area of occupancy for the Plains Wanderer.
Fragment an existing population into two or more populations	Currently the native grassland vegetation has limited connectivity to vegetation adjoining the study area as it consists of cropping lands and exotic pasture areas. Some areas of the native grassland community are likely to be removed where roads, the substation, the battery area and the perimeter APZ are proposed. Where the solar array installation extent occurs, grassland will be modified to varying degrees. Complete removal of vegetation will be restricted to solar array pole locations and cabling trenching. However, it is expected that after topsoil is returned to the cabling route, pre-existing vegetation will become re-established. Moderate impacts to the vegetation below the solar array installation may also occur in accordance with the grassland CSU report and Section 7.1 of this report where a modified management regime will be implemented. Minor construction vegetation impacts are anticipated to occur in the between panel areas, however, beyond the construction stage impacts are not expected. The proposal is therefore unlikely to fragment any existing populations.
Adversely affect habitat critical to the survival of a species	The grassland within the study area lacks diversity of native daisy species and scalded areas which are required for primary and secondary habitat for this species. Although potential habitat may occur within the study area, it is considered that the study area is unlikely to contain habitat critical to the survival of this species.
Disrupt the breeding cycle of a population	The Plains Wanderer recovery plan has identified that the primary 'stronghold' of this species is the Riverina region of south-western New South Wales. Although the study area is located within this region the proposal is unlikely to disrupt the breeding cycle of this species as it is not considered primary or secondary habitat for this species and no individuals were recorded during targeted surveys.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Plains Wanderer has not been recorded within the study area. Areas of native grassland will be slashed and maintained in accordance with the adaptive management approach outlined

Plains Wanderer – EPBC Act Assessment	Response
	in the CSU expert report. Although this will technically reduce the quality of potential foraging and breeding habitat for this species, CSU states that the average structure of the Plains Grassland dominated area should only be reduced by a maximum of 20%. The other areas of native grassland in the under-panel area will be allowed to continue to grow to close to its natural 50cm height on a frequent / regular basis. CSU states that the between-panel area should not significantly change once it is recovered from construction. Therefore, the proposal is unlikely to reduce the area of occupancy for the Plains Wanderer. Existing Plains Grassland will be retained in small areas under existing transmission lines in the north east of the study area and along the edges of the solar panels allowing for connectivity throughout the study area. Although the study area is located within the Riverina region, a stronghold for the species, no individuals were recorded, and the grassland is not considered preferable habitat for the species. Therefore, the proposal is unlikely to result in the decline of this species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species habitat	The Plains Wanderer recovery plan highlights that predation by European foxes (*Vulpes vulpes*) is considered a major threat to the species in New South Wales. Foxes were observed within the native grassland throughout all surveys, but it is unlikely that the proposal will exacerbate their use of the study area. The proposal is unlikely to introduce other invasive species such as introduced predators that are potentially harmful to the Plains Wanderer. Potentially native plant diversity might increase, which might be advantageous for this species.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.
Interfere with the recovery of the species	The Department of the Environment and Energy has developed a recovery plan for this species. The objectives of this recovery plan are as follows: • Reverse the long-term population trend of decline and increase the numbers of Plains Wanderers to a level where there is a viable, wild breeding population, even in poor breeding years; and to • Enhance the condition of habitat across the Plains-wanderers’ range to maximise survival and reproductive success, and provide refugia during period of extreme environmental fluctuation.

Plains Wanderer – EPBC Act Assessment	Response
	The recovery plan identifies critical foraging habitat of sparse, treeless, lowland native grasslands which usually occur on hard red-brown clay soils. Grassland structure is much more important than floristic composition with the species showing a strong preference for sites with approximately 50% bare ground and most vegetation less than 5 cm in height and some widely-spaced plants up to 30 cm. The plains grassland within the study area contains less than 50% bare ground and generally occurs to a height between 50cm and 150 cm. The structure of the grassland within the study area is not considered preferable habitat for the species. Areas of native grassland will be slashed and maintained in accordance with the adaptive management approach outlined in the CSU expert report. Although this will technically reduce the quality of potential foraging and breeding habitat for this species, CSU states that the average structure of the Plains Grassland dominated area should only be reduced by a maximum of 20%. The other areas of native grassland in the under-panel area will be allowed to continue to grow to close to its natural 50cm height on a frequent / regular basis. CSU states that the between-panel area should not significantly change once it is recovered from construction. It is considered that the proposal will modify a non-preferred area of potential foraging and breeding grassland habitat for this species. This proposal is unlikely to interfere with the recovery of this species.
Conclusion	The proposal is unlikely to result in a significant impact upon the Plains Wanderer.

Endangered Species

Lepidium monoplocoides – EPBC Act Assessment	Response
Profile: *Lepidium monoplocoides* (Winged Peppercress) is listed as Endangered in the EPBC Act. This species occurs within the Murray Darling Depression, Riverina, Darling Riverine Plains and Cobar Peneplain bioregions in western NSW and Vic. Habitat is generally arid to semi-arid areas with rainfall between 200-450mm annually. Vegetation communities include grasslands, wetlands and floodplain woodlands dominated by *Eucalyptus coolabah* and *Eucalyptus largiflorens* and chenopod shrublands (Mavromihalis, 2010). In the southern range it has been recorded in samphire communities and temperate woodlands. Locations where the species occur tend to be ephemeral, and it may be opportunistic and be able to take advantage of seasonally available habitat.	
Lead to a long term decrease in the size of a population	This species was not recorded within the study area, despite targeted surveys. The Black Box Grassy Open Woodland, Yellow Box White Cypress Pine grassy woodland, Weeping Myall Woodland and White Cypress Pine open woodland provide habitat for this species. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal however as this species was not recorded and larger areas of habitat will be retained the proposal is unlikely to lead to a long term decrease in the size of the population.
Reduce the area of occupancy of the species	This species was not recorded within the study area. Therefore, the proposal is unlikely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations	This species was not recorded within the study area and the proposal will not fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species	The study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of a population	This species was not recorded within the study area. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal however as this species was not recorded and larger areas of habitat will be retained it is considered that the proposal is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	This species was not recorded within the study area. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal. However this area is small and the proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Lepidium monoplocoides – EPBC Act Assessment	Response
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species habitat	The proposal is unlikely to introduce invasive species such as exotic plant species that are potentially harmful to this species.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.
Interfere with the recovery of the species	The Department of the Environment and Energy has developed a recovery plan for this species. The objectives of this recovery plan are as follows: • Determine distribution, abundance and population structure • Determine habitat requirements • Manage threats to populations • Identify key biological functions • Determine growth rates and viability of populations • Establish a seed bank • Build community support for conservation The proposal is unlikely to impact upon any of these objectives as only a small area of potential habitat will be removed as part of the proposal.
Conclusion	The proposal is unlikely to result in a significant impact upon *Lepidium monoplocoides*.

Vulnerable Species

In accordance with the Matters of National Environmental Significance, Significance Impact Guidelines v1.1 (Department of Environment, 2013) the significance assessment for vulnerable species listed under the EPBC Act requires to assess as to whether the population within the study area is an important population. An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

An assessment as to whether species being assessed are an important population has been conducted for the significance assessment.

***Brachyscome papillosa* – EPBC Act Assessment**	**Response**
Key source populations for either breeding or dispersal	*Brachyscome papillosa* occurs throughout a large expanse of south-western NSW. This species was not recorded within the study area and it is likely to be wind dispersed and pollinated by small insects. The modification of grassland habitat and the removal of a small amount of woodland habitat is unlikely to impact upon the breeding mechanisms for this species. Therefore, it is unlikely that the study area would be a key source for either breeding or dispersal for this species.
Populations that are necessary for maintaining genetic diversity; and/or	As this species was not identified as occurring within the study area, despite suitable habitat, it is unlikely the study area contains populations that are necessary for maintaining genetic diversity within the locality.
At or near the limit of the species range.	*Brachyscome papillosa* is known to occur mainly from Mossgiel to Urana, in south-western NSW with sites around Jerilderie, Hay Plain, Willandra Lakes, and north to Ivanhoe. The Study area occurs in Darlington Point in NSW and is not at the limit of this species range.
Is the population within the study area part of an important population for *Brachyscome papillosa*	No, the study area does not form part of an important population for this species.

***Brachyscome papillosa* – EPBC Act Assessment**	**Response**
Profile: *Brachyscome papillosa* (Mossgiel Daisy) is listed as Vulnerable on the EPBC Act. This species mainly occurs from Mossgiel to Urana in south-western NSW, with sites around Jerilderie, Hay Plain, Willandra Lakes, Darlington Point and north to Ivanhoe. This species flowers from June to December and occurs primarily on clay soils in chenopod shrublands, grasslands and grassy woodlands.	
Lead to a long term decrease in size of an important population	This species was not recorded within the study area, despite targeted surveys. However, a negligible area of woodland habitat (8.3 ha) will require removal as part of the proposal. A study by Charles Sturt University found that the overall impacts of the solar array on grassland diversity, habitat and fire risk would be variable throughout the study area. CSU states that the average structure of the Plains Grassland dominated area should only be reduced by a maximum of 20%. The other areas of native grassland in the under-panel area will be allowed to continue to grow to close to its natural 50cm height on a frequent / regular basis. CSU states that the between-panel area should not significantly change once it is recovered from construction. Monitoring will be conducted to adapt the management measures in response to seasonal variations. The panel area will not be permanently mown or grazed, only as recommended by CSU (usually in winter, mid Sept – Oct and if required in summer when dry matter exceeds 5t/ha). However, any potential populations within the study area are not considered to be an important population and it is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	This species was not recorded in the study area and therefore the proposal will not reduce an area of occupancy of an important population.
Fragment an existing important population into two or more populations	This species was not recorded within the study area and is not considered to be an important population and the proposal will not fragment an existing population into two or more important populations.
Adversely affect habitat critical to the survival of a species	The study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of an important population	This species was not recorded within the study area. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal. In addition, native grassland will be modified as part of the proposal in accordance with the expert report produced by CSU.

Brachyscome papillosa – EPBC Act Assessment	Response
	However, as this species was not recorded and larger areas of habitat will be retained it is considered that the proposal is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species is likely to decline	This species was not recorded within the study area. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal. In addition, native grassland will be modified as part of the proposal in accordance with the expert report produced by CSU. The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The proposal has the potential to spread weeds that maybe harmful to this species, however mitigation measures will be implemented such as weed control as part of the construction process. Therefore, it is unlikely to introduce invasive species such as exotic plant species that are potentially harmful to this species.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.
Interfere with the recovery of the species	The proposal will remove or modify potential habitat for this species, however, it is unlikely to interfere with the recovery of this species.
Conclusion	The proposal is unlikely to result in a significant impact upon this species.

***Swainsona murrayana* – EPBC Act Assessment**	**Response**
Key source populations for either breeding or dispersal	*Swainsona murrayana* occurs throughout a large expanse of western NSW. This species was not recorded within the study area and it is likely to be dispersed by ants and pollinated by insects. The proposal is unlikely to impact upon the breeding mechanisms for this species. Therefore, it is unlikely that the study area would be a key source for either breeding or dispersal for this species.
Populations that are necessary for maintaining genetic diversity; and/or	As this species was not identified as occurring within the study area, despite suitable habitat, it is unlikely the study area contains populations that are necessary for maintaining genetic diversity within the locality.
At or near the limit of the species range.	*Swainsona murrayana* is known to occur west of Echuca in Vic and extends through western NSW to south western QLD. The Study area occurs in Darlington Point in NSW and is not at the limit of this species range.
Is the population within the study area part of an important population for *Swainsona murrayana*	No, the population/habitat within the study area is not part of an important population.

***Swainsona murrayana* – EPBC Act Assessment**	**Response**
Profile: *Swainsona murrayana* (Slender Darling-pea) is listed as Vulnerable on the EPBC Act. Occurs west of Echuca in Vic and extends through western NSW to south western QLD. Grows on a variety of soil types including heavy soils in depressions and also found in grey, red brown and clay soils. Vegetation communities include chenopod shrublands, Black Box woodlands and grasslands and is frequently associated with *Maireana* species (SPRAT *Swainsona murrayana* Profile). Flowering period is August to November.	
Lead to a long term decrease in size of an important population	The Black Box Grassy Open Woodland, Yellow Box White Cypress Pine grassy woodland and native grasslands provide habitat for this species. This species was not recorded within the study area, despite targeted surveys. However, a negligible area of woodland habitat (8.3 ha) will require removal as part of the proposal. A study by Charles Sturt University found that the overall impacts of the solar array on grassland diversity, habitat and fire risk would be variable throughout the study area. CSU states that the average structure of the Plains Grassland dominated area should only be reduced by a maximum of 20%. The other areas of native grassland in the under-panel area will be allowed to continue to grow to close to its natural 50cm height on a frequent / regular basis. CSU states that the

Swainsona murrayana – EPBC Act Assessment	Response
	between-panel area should not significantly change once it is recovered from construction. Monitoring will be conducted to adapt the management measures in response to seasonal variations. The panel area will not be permanently mown or grazed, only as recommended by CSU (usually in winter, mid Sept – Oct and if required in summer when dry matter exceeds 5t/ha). However, any potential populations within the study area are not considered to be an important population and it is unlikely to lead to a long term decrease in the size of an important population.
Reduce the area of occupancy of an important population	This species was not recorded in the study area and therefore the proposal will not reduce an area of occupancy of an important population.
Fragment an existing important population into two or more populations	This species was not recorded within the study area and the proposal will not fragment an existing population into two or more important populations.
Adversely affect habitat critical to the survival of a species	The study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of an important population	This species was not recorded within the study area. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal. In addition, native grassland will be modified as part of the proposal in accordance with the expert report produced by CSU. However, any potential populations within the study area are not considered to be an important population. It is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species is likely to decline	This species was not recorded within the study area. A negligible area of woodland habitat (8.3 ha) will be impacted by the proposal. In addition, native grassland will be modified as part of the proposal in accordance with the expert report produced by CSU. The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The proposal has the potential to spread weeds that maybe harmful to this species, however mitigation measures will be implement such as weed control as part of the construction process. Therefore, it is unlikely to introduce invasive species such as exotic plant species that are potentially harmful to this species.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.

Swainsona murrayana – EPBC Act Assessment	Response
Interfere with the recovery of the species	The proposal will remove or modify potential habitat for this species, however, it is unlikely to interfere with the recovery of this species.
Conclusion	The proposal is unlikely to result in a significant impact upon this species.

Painted Honeyeater – EPBC Act Assessment	Response
Key source populations for either breeding or dispersal	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. Breeding habitat is small nests which occur on dropping eucalypts, she-oaks, paperbark or mistletoe branches. The large intact areas of eucalypt woodland within the study area will be retained as part of the proposal, with only a negligible area of woodland habitat (8.3 ha) to be impacted upon by the proposal. Large areas of grassy woodlands and open forest occur to the north of the study area on the Murrumbidgee River, which provides better quality breeding habitat. Whilst the study area does contain breeding habitat within the study area it is unlikely that the study area contains key source populations of this species for either breeding or dispersal.
Populations that are necessary for maintaining genetic diversity; and/or	The foraging habitat within the study area is limited due to the disturbed and fragmented nature of the habitat, and the low abundance of mistletoes within the study area. Better quality habitat for this species occurs to the north along Kidman Way toward Griffith and to the east near Broke within the Howes Valley. As this species was not identified as occurring within the study area, with only a small area of suitable habitat, it is unlikely the study area contains populations that are necessary for maintaining genetic diversity within the locality.
At or near the limit of the species range.	The Painted Honeyeater occurs throughout NSW. The Study area occurs in Darlington Point in NSW and is not at the limit of this species range.
Is the population within the study area part of an important population for Painted Honeyeater	No, the population/habitat within the study area is not part of an important population

Painted Honeyeater – EPBC Act Assessment	Response
Profile: The Painted Honeyeater is listed as Vulnerable on the EPBC Act. Nomadic bird that occurs at low densities throughout its range. Greatest concentrating of birds and almost all breeding of birds on the inland slopes of the Great Dividing Range in NSW, Victoria and in Southern QLD. Inhabits Boree, Brigalow and Box-gum Woodlands and Box-Ironbark Forests. This species nests in trees and mainly feeds on mistletoe flowers. It is nomadic, making seasonal movements for flowering mistletoes.	
Lead to a long term decrease in size of an important population	The proposal will not impact upon any area of Weeping Myall Woodland. The proposal will remove only a negligible area of Eucalypt woodland habitat (8.3 ha). Breeding habitat is likely to be confined to the inland slopes of the Great Dividing Range in NSW. Habitat for this species is located in the Weeping Myall and Eucalypt woodland with flowering mistletoes. The foraging habitat within the study area is limited due to the disturbed nature of the habitat, and the low abundance of mistletoes within the study area. Better quality habitat for this species occurs to the east near Broke within the Howes Valley. This species may occur within the study area intermittently, potentially acting as a small part of the foraging habitat for this species. The potential population within the study area is not considered to be an important population. Therefore, the proposal is unlikely to lead to a long term decrease in size of an important population.
Reduce the area of occupancy of an important population	The Painted Honeyeater was not recorded within the study area despite targeted surveys. This species is highly mobile and the habitat within the study area would be a small part of the range of this species. Furthermore, the potential population is not an important population for the Painted Honeyeater. It is unlikely that the proposal will reduce the occupancy of an important population.
Fragment an existing important population into two or more populations	The proposal is unlikely to fragment populations as the proposal will remove only a negligible area of Eucalypt woodland habitat (8.3 ha). Otherwise, no area of habitat will be impacted upon and the potential population is not considered to be important.
Adversely affect habitat critical to the survival of a species	The study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of an important population	The habitat is considered to be of low importance, and is unlikely to disrupt the breeding cycle of an important population, as the main breeding location for this species occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and in Southern QLD. The potential population within the project is not considered to be an important population.

Painted Honeyeater – EPBC Act Assessment	Response
Modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species is likely to decline	The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area. In addition, six (6) isolated paddock hollow-bearing trees will be impacted upon by the project. The removal of these hollow-bearing trees is minor and is unlikely to modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area for this species. Therefore, the proposal is unlikely to cause invasive species to be established within the study area.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.
Interfere with the recovery of the species	The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area and therefore, will not interfere with the recovery of this species.
Conclusion	The proposal is unlikely to result in a significant impact upon the Painted Honeyeater.

Is the Superb Parrot part of an important population?	Response
Is the population within the study area a key source populations for either breeding or dispersal?	One of the Superb Parrot's main breeding sites is in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. This species nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. The Superb Parrot was recorded throughout woodland within the study area during the breeding period. However, use of tree hollows for breeding was not observed and it is expected that nesting mostly occurs along the Murrumbidgee corridor, approximately 2km north of the study area.
Is the population within the study area necessary for maintaining genetic diversity? and/or	The habitat within the study area provides foraging resources in the form of Eucalypt woodland. This species was observed and heard frequently during field surveys in most of the woodland areas within the study area. The Superb Parrot was also recorded flying over the study area to access resources within and surrounding the study area. It is likely that this population is important for genetic diversity, as the population observed within the study area is part of the population that occurs on The Murrumbidgee River.
Is the population at or near the limit of the species range?	The Superb Parrot is found throughout eastern inland NSW. The Study area occurs in Darlington Point in NSW and is not at the limit of this species range.
Is the population within the study area part of an important population for Superb Parrot	Yes, the population/habitat within the study area is considered to be part of an important population.

Superb Parrot – EPBC Act Assessment	Response
Profile: The Superb Parrot is listed as Vulnerable on the EPBC Act. The Superb Parrot occurs throughout eastern inland Australia. Core Breeding areas are bound by Cowra and Yass in the east and Grenfell, Cootamundra and Coolac in the west. Birds in this region migrate to the north coast during winter to the Namoi and Gwydir Rivers. The Murrumbidgee and Edward Rivers riparian vegetation provides habitat in western NSW in which they are present all year round. Habitat consists of grassy woodlands including Inland Box-Gum, Box Cypress Pine, Boree Woodlands, River Red Gum Forest Yellow Box, Apple Box Black Box and Red Box communities. Diet includes grass seeds, insects, nectar and herbaceous plants.	
Lead to a long term decrease in size of an important population	This species occurs within the study area potentially year-round. The habitat within the study area provides foraging resources in the form of Eucalypt woodland and the potential breeding habitat of hollow-bearing trees. The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area. This equates to removal of 5% of the woodland habitat available within the study area. Six (6) isolated hollow-bearing trees that occur within the grassland areas will be impacted upon by the proposal. Retention of this species habitat was prioritised during the project design. The study area forms a small part of the foraging habitat and breeding habitat for this species. A large expanse of native vegetation occurs along the Murrumbidgee River in which a large number of records for this species has been observed (OEH atlas database). Therefore, the proposal is unlikely to lead in a long-term decrease in size of an important population.
Reduce the area of occupancy of an important population	This species is highly mobile and the habitat within the study area would be a small part of the range of this species. It is unlikely that the proposal will reduce the occupancy of an important population.
Fragment an existing important population into two or more populations	The proposal area of removal occurs on the fringes of the existing areas of woodland habitat within the study area. Therefore, the project will not fragment an important population into two or more populations
Adversely affect habitat critical to the survival of a species	The study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of an important population	Hollow-bearing trees were observed within the eucalypt woodland habitat which provide potential breeding habitat for this species. Six (6) isolated paddock hollow-bearing trees will be impacted upon by the project. No Superb Parrots were observed breeding within any of the hollow-bearing trees within the study area. The removal of these hollow-bearing trees is unlikely to disrupt the breeding cycle of this species. The Murrumbidgee River is likely to be the core breeding area

Superb Parrot – EPBC Act Assessment	Response
	for the Superb Parrot as a large number of records from the OEH database atlas for this species has been observed.
Modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species is likely to decline	The proposal will remove 8.5 ha (5%) of woodland habitat within the study area with 280 ha (95%) of woodland habitat being retained. Six (6) isolated paddock hollow-bearing trees will also be impacted upon by the project. The removal of these hollow-bearing trees is minor and is unlikely to modify, destroy, remove or isolate or decrease the availability of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Only a negligible area of woodland habitat (8.3 ha) will be impacted upon by the proposal. Therefore, the proposal is unlikely to cause invasive species to become established within the study area.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.
Interfere with the recovery of the species	The Department of the Environment and Energy has developed a recovery plan for this species. The objectives of this recovery plan are as follows: • Determine population trends in the Superb Parrot. • Increase the level of knowledge of the Superb Parrot's ecological requirements. • Develop and implement threat abatement strategies • Increase community involvement in and awareness of the Superb Parrot recovery program. The impacts of the project in the form of the removal of a negligible area of woodland habitat (8.3 ha) and the removal of six (6) isolated hollow-bearing trees is considered to be relatively minor in nature and is not expected to interfere with the recovery of this species.
Conclusion	The proposal is unlikely to result in a significant impact upon the Superb Parrot.

Is the Koala part of an important population?	Response
Is the population within the study area a key source populations for either breeding or dispersal?	Two species of Koala secondary feed trees listed under the Western Slopes and Plains Management Area were recorded within the study area, being *Eucalyptus largiflorens* (Black box) and *Eucalyptus melliodora* (Yellow box). However, no scratches or scats were recorded during the field surveys. A single Koala record occurs approximately 11km southwest of the Study area from 1980 to 2004. A large population, containing 100's of records for the Koala occurs approximately 40km east of the Study area within and clustered around the township of Narrandera. Therefore, it is likely that the population 40km to the east is a key source for breeding.
Is the population within the study area necessary for maintaining genetic diversity? and/or	Two species of Koala secondary feed trees listed under the Western Slopes and Plains Management Area were recorded within the study area, being *Eucalyptus largiflorens* (Black box) and *Eucalyptus melliodora* (Yellow box). However, no scratches or scats were recorded during the field surveys. As no Koalas were recorded and the main population occurs 40km to the east, the Study area is not considered necessary for maintaining genetic diversity.
Is the population at or near the limit of the species range?	The Koala occurs in fragmented populations throughout Australia from North-east Queensland to Eyre Peninsula in SA. In NSW it occurs on the central and north coast with some populations in the west of the Great Divide. The Study area occurs in Darlington Point in NSW and is not at the limit of this species range.
Is the population within the study area part of an important population for the Koala	No the population within the study area is not part of an important population.

Koala – EPBC Act Assessment	Response
Profile: The Koala is listed as Vulnerable on the EPBC Act. Found in eucalypt woodlands and forest foraging on preferred food trees. Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred and supplementary feed tree species in the Western Slopes and Plains include *Eucalyptus camaldulensis, Eucalyptus chloroclada, Eucalyptus blakelyi, Eucalyptus largiflorens* and *Eucalyptus melliodora*	
Lead to a long-term decrease in size of an important population	The Study area does not contain an important population. No Koalas, or any evidence of the presence of Koalas, was recorded within the Study area during the field surveys. As no Koalas were recorded and the main population occurs 40km to the east of the project it is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The Study area does not contain an important population. The Koala is not known to currently occupy the Study area and therefore, the project is unlikely to reduce the occupancy of an important population.
Fragment an existing important population into two or more populations	The Study area does not contain an important population. The Koala is not known to currently occupy the Study area and therefore, the project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of the species	The Study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of an important population	The Study area does not contain an important population. A large Koala population occurs 40km to the east of the Study area which is likely to be important for breeding. No Koalas or evidence of Koalas were recorded within the Study area. Therefore, the project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project will remove a small area of potential habitat for this species which will result in the decrease in the availability of habitat. The decrease in habitat is small in comparison to the availability of habitat in the surrounding area. Therefore, the project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	The project is unlikely to introduce invasive species that will impact upon this species.
Introduce disease that may cause the species to decline	The project is unlikely to introduce disease that will impact upon this species.

Koala – EPBC Act Assessment	Response
Interfere substantially with the recovery of the species	The project will remove a small area of potential habitat and as such this could be seen to interfere with the recovery of this species. However, given the extent of habitat to be retained within the Study area as well as the extent of surrounding habitats, the project is not expected to interfere with the recovery of this species.
Conclusion	The project is unlikely to result in a significant impact upon the Koala and a Referral is not required.

Corben's Long-eared Bat – EPBC Act Assessment	Response
Key source populations for either breeding or dispersal	Corben's Long-eared Bat roosts in hollows mainly in dead trees or dead spouts of live trees. It inhabits a variety of vegetation types including Box/ironbark cypress pine vegetation which occur within the study area. The woodland areas within the study area contain roosting and breeding habitat for this species. Targeted Harp trapping did not record any individuals of this species within the study area, and it is unlikely that the study area contains key source populations of this species for either breeding or dispersal.
Populations that are necessary for maintaining genetic diversity; and/or	The study area provides potential foraging, roosting and breeding habitat, within woodland habitat. Only a negligible area of woodland habitat (8.3 ha) will be impacted upon by the proposal. As this species was not identified as occurring within the study area, with only a select area of suitable habitat, it is unlikely the study area contains populations that are necessary for maintaining genetic diversity within the locality.
At or near the limit of the species range.	Corben's Long-eared Bat occurs in south central Queensland, central western New South Wales, North-western Victoria and eastern South Australia. The Study area occurs in Darlington Point in NSW and is not at the limit of this species range.
Is the population within the study area part of an important population for Corben's Long-eared Bat	No, the population/habitat within the study area is not part of an important population.

Corben's Long-eared Bat – EPBC Act Assessment	Response
Profile: Corben's Long-eared Bat (*Nyctophilus corbeni*) listed as Vulnerable on the EPBC Act. This species occurs in south central Queensland, central western New South Wales, North-western Victoria and eastern South Australia. Roosts in hollows mainly in dead trees or dead spouts of live trees. Inhabits a variety of vegetation types including Box/ironbark cypress pine vegetation. Diet includes insects such as beetles, moths, grasshoppers and crickets.	
Lead to a long term decrease in size of an important population	This species was not recorded within the study area, despite extensive targeted Harp trapping. The habitat within the study area provides potential foraging, roosting and breeding habitat within woodland in the Study area. The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area. Only six (6) isolated hollow-bearing trees that occur within the grassland areas will be impacted upon by the proposal. Therefore, the proposal is unlikely to lead to a long term decrease in size of an important population. Furthermore, the potential population is not considered to be an important population.
Reduce the area of occupancy of an important population	This species was not recorded within the study area and is not known to currently occupy the study area and therefore, the proposal is unlikely to reduce the occupancy of an important population. Furthermore, the potential population is not considered to be an important population.
Fragment an existing population into two or more populations	The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area. Only six (6) isolated hollow-bearing trees that occur within the grassland areas will be impacted upon by the proposal and this species was not recorded. Therefore the project will not fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of the species	The study area is not critical habitat for the survival of this species.
Disrupt the breeding cycle of an important population	A large number of hollow-bearing trees were observed within the eucalypt woodland which provide breeding habitat for this species. The proposal will remove only a negligible area of woodland habitat (8.3 ha) within the study area. Only six (6) isolated hollow-bearing trees that occur within the grassland areas will be impacted upon by the proposal. The removal of these hollow-bearing trees is unlikely to disrupt the breeding cycle of this species. Furthermore, the population within the study area is not considered to be important.
Modify, destroy, remove or isolate or decrease the availability or quality of	The proposal will modify and will require removal of 8.3 ha of potential habitat for this species, which will result in the decrease in the availability of habitat.

Corben's Long-eared Bat – EPBC Act Assessment	Response
habitat to the extent that the species is likely to decline	The decrease in habitat is small in comparison to the availability of habitat in the surrounding area. Therefore, the proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The proposal is unlikely to cause invasive species to be established within the study area.
Introduce disease that may cause the species to decline	The proposal is unlikely to introduce disease that will impact upon this species.
Interfere with the recovery of the species	This species was not recorded during targeted surveys and the proposal is unlikely to impact significantly upon areas of woodland habitat. Therefore, the proposal is unlikely to interfere with the recovery of this species.
Conclusion	The proposal is unlikely to result in a significant impact upon Corben's Long-eared Bat.

Endangered Ecological Communities

Weeping Myall Woodland – EPBC Act Assessment	Response
Profile: Weeping Myall Woodland is listed as Endangered on the EPBC Act. This community occurs on inland alluvial plains west of the Great Dividing Range in NSW and QLD. Occurs on black, brown, red-brown, grey-clay and clay loam soils. This community structure varies from open woodland to woodlands with the canopy being 4-12m high. The overstorey is dominated by *Acacia pendula* (Weeping Myall). The understorey varies from shrubby to grassy and can contain a high diversity of native shrubs, grasses and herbs. The groundlayer varies depending upon grazing regimes.	
Reduce the extent of the ecological community	Two patches (WM1 and WM2) within the northern section of the study area meets the criteria for this community, with the remaining patches not meeting the criteria as they are less than 0.5ha in size. These two patches will not require removal as part of the project as they were prioritised for retention as part of the project design. Therefore, the proposal will not reduce the extent of the community at the Commonwealth level.
Fragment or increase fragmentation of an ecological community	The proposal will not fragment Commonwealth-listed patches of Weeping Myall Woodland. It is considered unlikely that the results of the project will increase the existing fragmentation of this community in the locality.
Adversely affect habitat critical to the survival of an ecological community	The Conservation Advice for this community identifies that areas that meet the moderate or higher condition class are critical to the survival of this community. All of the community present at the Commonwealth level within the project boundary are to be retained, and will therefore not reduce habitat critical to the survival of the community at a Commonwealth level.
Modify or destroy abiotic (non-living) factors necessary for the community's survival, including reduction in groundwater, or substantial alterations to surface water drainage patterns	The proposal is not likely to result in a reduction of groundwater. However, the proposal will require the establishment of solar panels. These solar panels are unlikely to result in substantial alterations to surface water. Significant modification of other abiotic factors necessary for the community's survival is unlikely to occur.
Cause a substantial change in the species composition of an occurrence of an ecological community, including decline or loss of functionally important species *(i) assisting invasive species, that are harmful to the listed ecological community to become established* *(ii) causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community*	i) Currently there is only minor weed incursion in this community. The project will implement management measures to ensure that the weeds that currently occur outside this community are not further spread into retained areas of this community. (ii) The current land use of agricultural practices, with the use of herbicides may be currently occurring within and nearby to the community. Best practice sediment, erosion and pollutant control procedures will be implemented by

Weeping Myall Woodland – EPBC Act Assessment	Response
which kill or inhibit the growth of species in the ecological community	the project. Therefore, the project is unlikely to inhibit the growth of species that occur within this community.
Interfere with the recovery of an ecological community	The proposal is unlikely to interfere with the recovery of this ecological community as all patches that meet the criteria at a Commonwealth level are to be retained as part of the proposal. This community also occurs more extensively in occurrence in the locality.
Conclusion	The patches of this community that meet the EPBC Act listing for Weeping Myall Woodland are to be retained as part of the proposal. It is therefore considered that the project is unlikely to result in a significant impact on this endangered ecological community.

Appendix 9

Charles Sturt University Report

Report to Edify Energy on the proposed solar voltaic farm at Darlington Point.

Effects of solar voltaic farm installation and operation on Riverine Plain Grasslands

Authors

Dr Jeff McCormick BScAgr Hons (Syd), PhD (CSU).
Lecturer in Agronomy, Charles Sturt University.

Dr Peter Orchard BScAgr Hons (Nottingham), MScAg (UNE), PhD (UNE). Adjunct Senior Lecturer and Visiting Scientist Graham Centre for Agricultural Innovation, Charles Sturt University.

Date 11/4/2018

Author biography

Dr Jeff McCormick

Dr McCormick has lectured at Charles Sturt University since 2016 in pastures and rangelands as well as weed and pesticide science. In 2012, Dr McCormick moved to New Zealand and taught plant science at Lincoln University. Prior to that he worked at NSW DPI on pasture establishment in the mixed farming zone as part of the EverCrop program funded by Future Farm Industries CRC.

Dr Peter Orchard

Since 2013 Dr Orchard has been a member of the Graham Centre for Agricultural Innovation an alliance between CSU and NSW DPI where he conducts research into pastures and landscape biodiversity. Dr Peter Orchard was formerly with NSW DPI (1987-2013). At retirement (June 2013) he held the position of State-wide Manager Pasture and Rangelands Research and Extension.

Dr Jeff McCormick

Dr Peter Orchard

Executive summary

Charles Sturt University (CSU) were appointed by Edify Energy to provide specialist input into the impact assessment and proposed site management of Riverine plains grasslands for the Darlington Point Solar Farm (DPSF) project.

Management recommendations have been developed in relation to the three aims given in the Management Strategy section regarding maintenance of grassland diversity, habitat value (structure and ground cover) and fire risk.

The report, based on observations of the site together with the available scientific literature, concludes that the overall impacts of the photovoltaic solar (PV) array on grassland species diversity, habitat values and fire fuel load for the site would not be significant and in certain aspects such as weed management potentially highly positive.

Given the dynamic nature of biological systems, monitoring will be essential and an adaptive management approach implemented based on, and responsive to, seasonal/annual conditions. This will be critical during the early stages when the solar plant has been set up and the grassland is re-establishing.

There will be a need from the site development phase onwards for a focus on monitoring annual exotic weeds numbers and the strategic imposition of interventions via grazing, mowing and possibly herbicides to maintain and improve the present condition.

Introduction and Scope

Charles Sturt University (CSU) were appointed by Edify Energy to provide specialist input into the impact assessment and proposed management of Riverine Plains Grasslands for the Darlington Point Solar Farm (DPSF) project. Common species found within the region include a range of native grasses, herbs and shrubs. Additionally, ingress of exotic grasses (mainly annual) and dicotyledonous weeds has occurred as a result of the 200 year history of pastoralism/grazing.

The scope of this study was to determine what impacts the construction and operation of a PV system would have on the Riverine Plain Grasslands diversity, persistence and structure. This included a determination of current botanical composition and dry matter and what effect changes in light availability and management practices would have on the grassland.

Methodology

The site proposed for the photovoltaic solar array at Darlington Point for Edify Energy was visually inspected by Dr Jeff McCormick and Dr Peter Orchard on November 24 and December 11, 2017.

Botanical Composition

Six (6) transects were taken across the Tubbo Station section and three (3) transects across the Anderson's block as shown in Figure 1. Transect locations were selected to broadly represent the grassland area of the site. Approximately 11 km of transects were conducted across the site. Botanical composition sample were taken every 100 m by ranking the greatest three species in order of dry matter using a modified dry-weight-rank method (t'Mannetje and Haydock 1963).

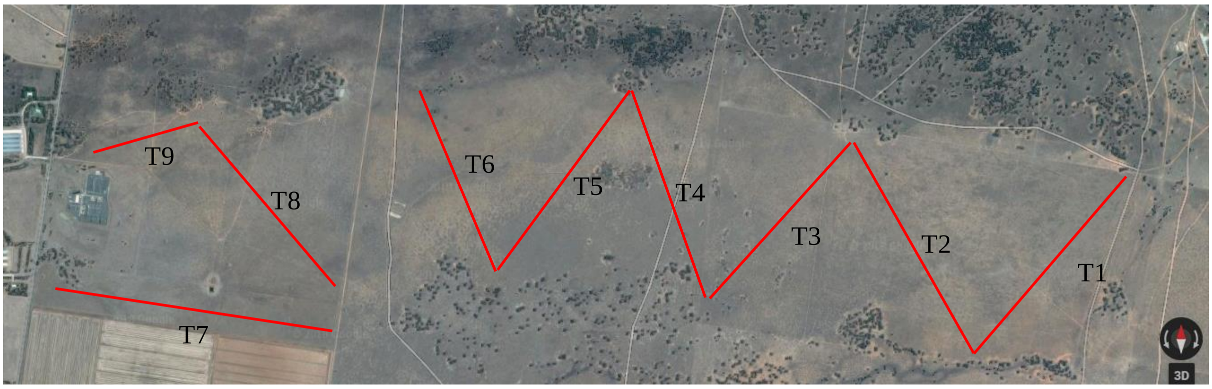


Figure 1. Darlington Point Solar Farm (DPSF) project site with approximate position of transects

Seed Bank Assessment

Twenty one surface soil samples were taken across the site on the transects to determine the seeds present in the soil. The samples were taken at approximately 2 cm depth using a 20 cm x 25 cm spade and placed in plastic bags. These were then transferred into plastic containers located in a glasshouse with air temperature kept at 22°C and regularly watered to ensure seed germination. Seedlings species were counted at regular intervals as they germinated and grew. The glasshouse temperature was selected to allow both winter and summer species to germinate.

Dry matter assessment

An assessment of grassland species composition by dry matter was undertaken during the 11 December site visit using the visual estimation method developed by Haydock and Shaw (1975) and commonly used with landholder extension programs (Prograze) to determine grazing management strategies. Whilst grazing management strategies usually focus on optimum grazing yields, the same techniques can also be applied to functional management strategies for habitat and fire management. A single large tussock of plains grass was cut at several heights to determine the vertical distribution of dry matter.

Current status of the site – visual observations

Site assessment and conditions

Riverine Plains Grassland dominates the solar farm site and are common in the riverlands of the Murrumbidgee. The majority of Riverine Plains Grassland in the region would have historically been used for grazing of sheep and/or cattle as has the proposed solar farm site. The site is typical for the region and reflects past seasonal conditions with greater growth following the 2016 growing period.

At the first visit the site on 24 November, the site was very dry with minimal green growth and only residual plant dry matter. Between the visits approximately 100 mm of rainfall fell resulting in increased growth from grasses observed on 11 December (Figure 2) with Plains grass (*Austrostipa aristiglumis),* Wallaby grass *(Rytidosperma duttonianum*) Windmill grass (*Chloris truncata)* and Rigid panic (W*alwhalleya proluta)* particularly responding to the rainfall.

Figure 2. Field site at Darlington Point December 11, 2017 with noticeable green tinge following 100 mm of rainfall.

Biodiversity / botanical composition

A range of native and exotic grass and broad leaf species were identified across the site (Table 1). Old Plains grass seed heads approached 2 m in height and was reflective of the different season experienced in the region in 2016 where 686 mm of rainfall fell which was approximately 280 mm greater than average of

400mm. This year only 244 mm of rainfall had fallen during the normal growing season excluding the 100 mm experienced in December. The current reproductive growth of Plains grass still contained its seed and was 50 cm tall reflecting the season. Wallaby grass was present throughout the site. Seed heads were still obvious at a height of 20-30 cm although most seeds had been dispersed. Rigid panic was also present in some sites at high numbers but generally had already lost the seed head. Wild oats was the dominant exotic annual grass still standing but there were no seeds present in the heads. Some areas had high concentrations of vulpia and barley grass. Annual ryegrass appeared to be present in high numbers but was prostrate on the ground and was difficult to identify. Native herbs such as *Sida corrugata* and Chocolate lily were present on site but at low abundance. This may well be related to the current dryness at the site being not sufficient for continued growth of the species late in spring.

Table 1. Plant species identified at Andersons and Tubbo Station

Common name	Scientific name	Origin and growth habit
Plains grass	*Austrostipa aristiglumis*	*Native perennial*
Wallaby grass	*Rytidosperma duttonianum*	*Native perennial*
Rigid panic	*Walwhalleya proluta*	*Native perennial*
Annual ryegrass	*Lolium rigidum*	*Exotic annual*
Barley grass	*Hordeum leporinum*	*Exotic annual*
Vulpia	*Vulpia bromoides*	*Exotic annual*
Spear grass	*Austrostipa scabra*	*Native perennial*
Windmill grass	*Chloris truncata*	*Native annual*
Wild oats	*Avena fatua*	*Exotic annual*
Roly Poly	*Bassia divaricata*	*Native perennial*
Patersons curse	*Echium plantagineum*	*Exotic annual*
Corrugated Sida	*Sida corrugatus*	*Native perennial*
Chocolate lily	*Dichopogon strictus*	*Native perennial*
Cudweed	*Gnaphalium lueto-album*	*Exotic annual*
Silverleaf nightshade	*Solanum elaeagnifolium*	*Exotic annual*
Bathurst Burr	*Xanthium spinosum*	*Exotic annual*
Tussock Rush	*Juncus aridicola*	*Native perennial*
Lambs tails	*Ptilotus exaltatus*	*Native perennial*

The botanical composition determined by the dry rank method across nine transects across Tubbo and Anderson properties, are summarised in Table 2. The dominant species on site was Plains grass ranging from 42-70% of dry matter on the transects and averaged 56% over the entire site. Wallaby grass ranged from 4-40% and Rigid Panic was apparent on individual transects. These three native species contributed greater than 75% of the dry matter across each transect. Wild oats was the most obvious annual exotic species. It remained upright but had lost all of its seed. There were sporadic patches of barley grass through the site. Vulpia appeared prominently in the botanical composition as it remained standing but had lost its seed. It is thought that vulpia may be in much higher density but that much of it was on the ground. Annual ryegrass did not feature in the botanical composition but it was noted as lying on the ground. It was difficult to determine as it had begun to deteriorate.

Table 2. Botanical composition determined by the dry rank method across nine transects

	Botanical composition (%)								
	Tubbo Station						**Anderson's**		
Species Trans	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Plains grass	70	56	46	48	42	49	54	70	66
Wallaby grass	22	32	40	18	20	13	4	12	23
Rigid Panic				22	13	15	19		
Wild oats		1		11	14	11	17	15	9
Vulpia	7	2		2	12	3	5		
Speargrass		2	14						2
Barley grass		6							
Windmill								3	
Tussock Rush	2								

Dry matter present on site.

Dry matter was assessed on December 11, 2017 across the site using nine transects that were at similar locations to the botanical composition data (Figure 1). Site dry matter averaged 2878 kg/ha and ranged from 944-4052 kg/ha (Table 3). Tubbo Station (transect 1-6) and Andersons (transect 7-9) differed in the amount of dry matter. Differences between the properties can be easily related to historical grazing management with Tubbo Station appearing to have a low stocking rate of sheep whereas there was apparently a higher grazing intensity on the Anderson block with cattle. Cattle and sheep differ in grazing preferences with cattle likely to graze the stems of the plains grass and trample it. Sheep will generally avoid such material resulting in the larger dry matter of Plains grass on Tubbo Station. Minimum levels of dry matter were less than 500 kg/ha where ground cover was low. Highest points of dry matter were 9000 kg/ha in the densest Plains grass swards.

Table 3. Average dry matter across nine transects at Tubbo Station and Andersons block.

Transect	kg/ha
1	3991
2	2829
3	3768
4	3246
5	2655
6	3172
7	4052
8	1249
9	944
Average	2878

A single large tussock of plains grass was cut at several heights to determine the vertical distribution (where the percentage) of dry matter (Figure 3). Twenty nine percent (29%) of the total biomass was under 10 cm in height with a further 30% of dry matter between 10-30 cm.

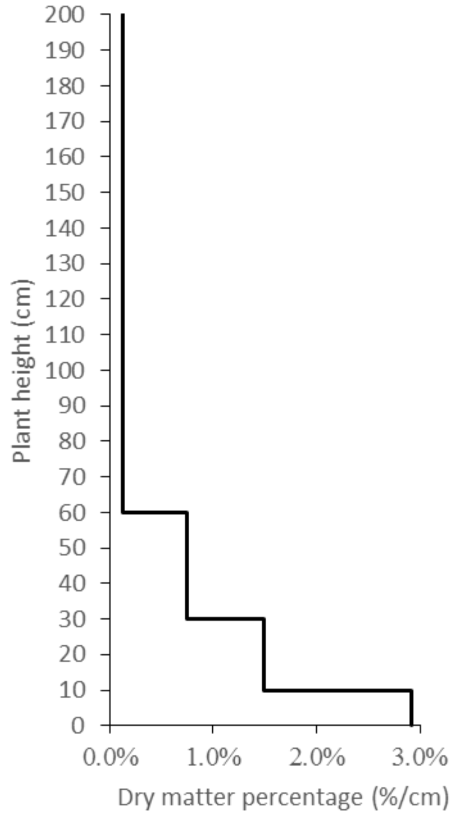


Figure 3. Percentage of dry matter in a single Plains grass tussock relative to height

Construction Phase Impacts

Persistence of perennial grasses

It is understood that during the construction period that the site would need to be mown but there would not be widespread grading of the site. Mowing at 10 cm is unlikely to effect the persistence of the perennial native grass species present as the new growing points in the grasses are below that level. Mowing will impact native shrubs within the grassland community but they will persist and regrow following the construction phase. If there are areas where shrubs are in high density then mowing could be done strategically to minimise impact.

High traffic over the site during construction is another risk with potential to impact on the persistence of the grassland. Vehicle traffic over the site could cause some damage to the grassland but it is likely that these will be able to recover. Management strategies could be implemented to reduce the risk to the grassland community such as only allowing construction to occur when soil conditions are dry. Even if there is some plant death the seed bank (see below) will enable grassland to recover quickly with sufficient seasonal conditions. There will be little impact on the annual species as these will have set seed and be senescing in late spring. Mowing in late summer after all native species have set seed will minimize the effect on persistence.

Seed bank assessment

The 21 soil samples were assessed over a period of four months and an average of 441 plants/m^2 emerged. Monocotyledon species (Poaceae and Juncaceae families) were the primary vegetation type with 89% of all species from the seed bank. Individually, the most common species was Annual ryegrass (56%), followed by Windmill grass (17%) and Juncus spp. (14%). For the native grass species present Rigid panic (17 plants/m^2) and Wallaby grass (3 plants/m^2) were the most common. Wild oats emerged with only 1 plant/m^2 but this is presumably due to a chemical seed dormancy still present after maturity. Dicotyledonous species were lower in number and included: Cut-leaf medic (*Medicago laciniata*, 14 plants/m^2) Caustic creeper (*Euphorbia drummondii*, 9 plants/m^2), Haresfoot clover (*Trifolium arvense*, 3 plants/m^2), Woolly clover (*Trifolium tomentosum* 2 plants/m^2), Sowthistle (*Sonchus oleraceus*, 2 plants/m^2), Paterson's curse (*Echium plantagineum* 1 plant/m^2), Narrow-leaf clover (*Trifolium angustifolium* 1plant/m^2), *Sida spp*. 1 plant/m^2. It would be expected that over time other broadleaf species would continue to emerge but they often have specific seed dormancy regimes.

The key conclusion from the seed bank assessment is that under current management practices (sheep grazing) there is an abundance of species within the soil seed bank (Figure 4). Of note is the dominance of annual ryegrass which competes vigorously with all other species within the community reducing diversity across the site. Management strategies to reduce the dominance of annual ryegrass and other exotic annual grass species have been identified below (see Physical impacts on the grassland community).

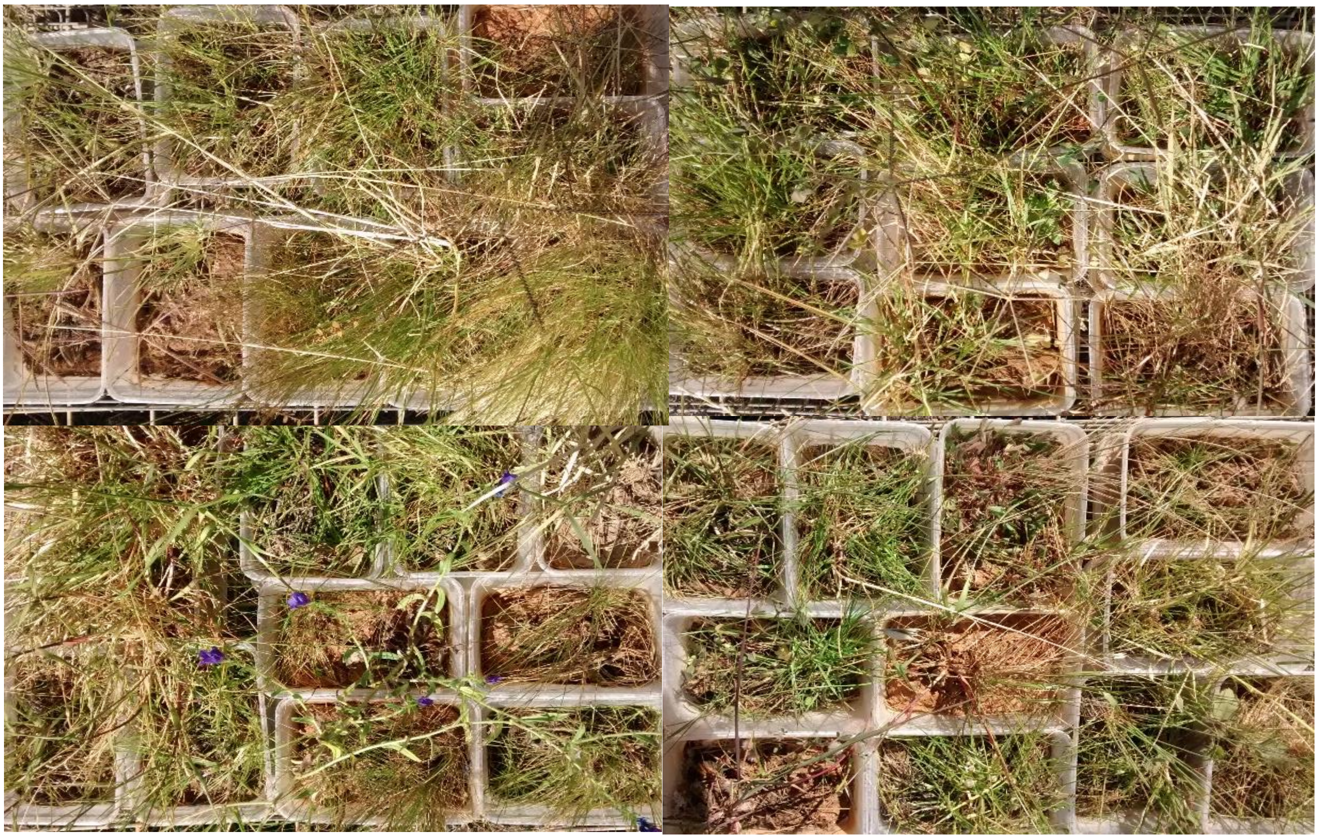


Figure 4. A snapshot of the seed bank assessment after four months.

Operational Phase Impacts

Biophysical constraints under a solar array.

Growth and development of grasslands like all plant species is primarily determined by soil water, temperature and light. The construction of a photovoltaic solar array will change the light conditions of the grassland but understanding the current limits to growth at Darlington Point is essential. Using a simple Growth Index model (Fitzpatick and Nix 1970) gives an indication to the growing conditions available at the site for all species within the Riverine Plain Grassland community. A low value indicates limitations to growth whereas a value of one denotes there are no limitations to growth. An index was calculated for light, soil water and temperature. These values were multiplied together to calculate a Growth Index. More complex crop growth models could have been used but they are not calibrated for the species present and the light calculations for growth do not have increased capacity to take shading into account. The site at Darlington Point has significant limitations on growth due to soil moisture throughout the year (Figure 5) but most particularly during the summer period. Low temperatures during the winter strongly reduce growth. In comparison (under normal circumstances) light is generally not the limiting factor for growth.

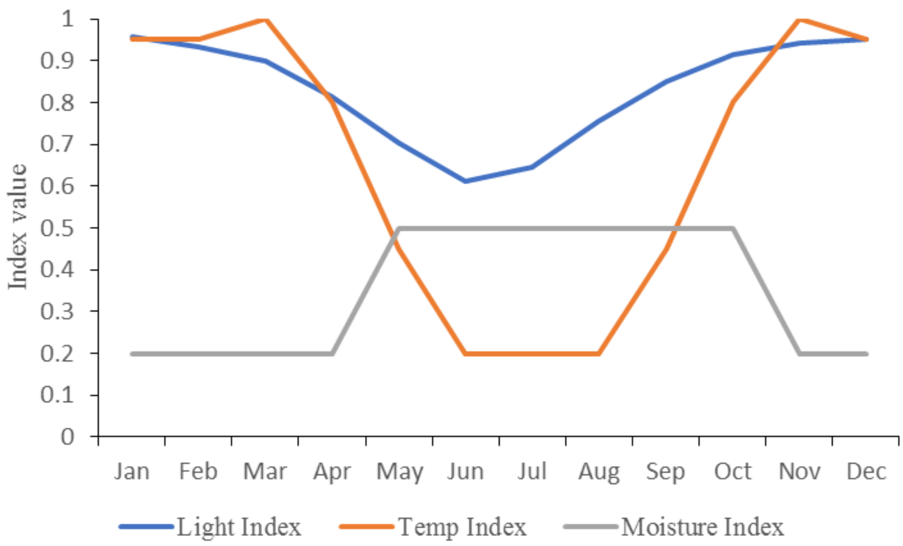


Figure 5. Indices for soil moisture, temperature and light at Darlington Point.

Light availability was determined by constructing shading diagrams for winter and summer at two hour periods from 8am to 4pm throughout the day at 0.5 m increments between solar panels to predict whether or not the grassland would be in shade (Figure 6).

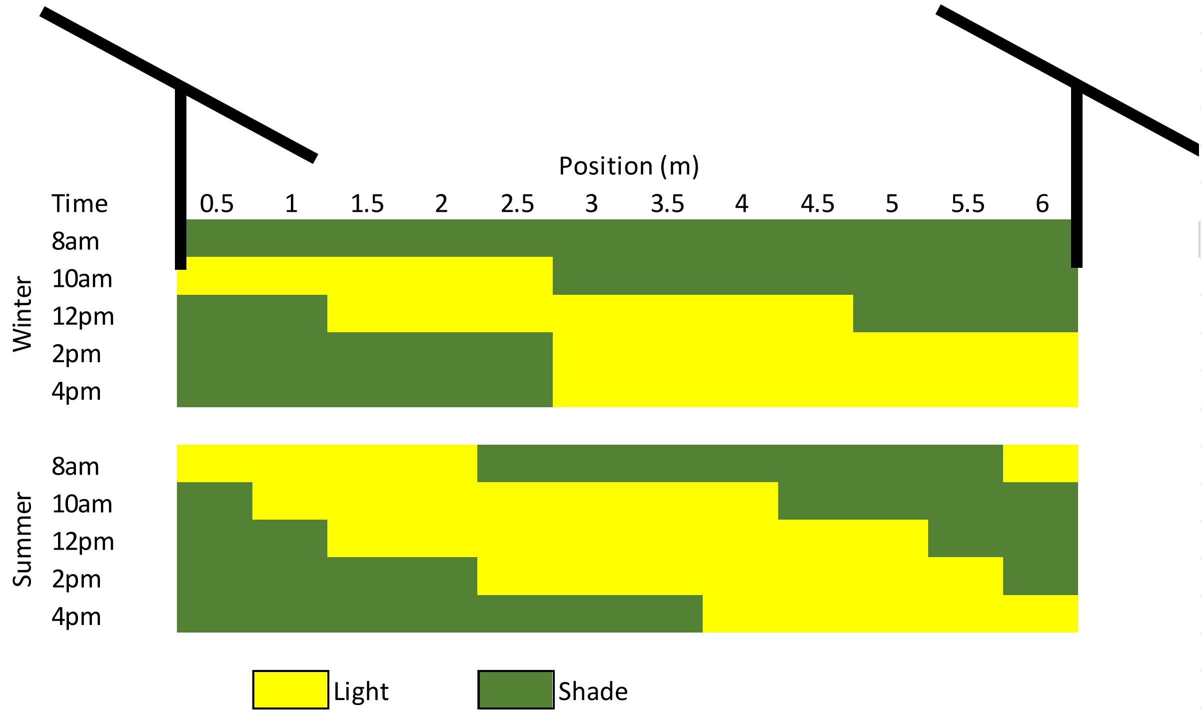


Figure 6. Shade diagram for photovoltaic solar array spaced 6 m apart. Pivoting panels placed 1.5 m above the ground and 2 m in width.

Light level was calculated by using minute solar radiation data from Wagga Wagga (Bureau of Meteorology) with shaded areas only accumulating diffuse radiation while sunlit areas accumulated total radiation (direct + diffuse radiation). This was accumulated over the day and calculated as a proportion of total radiation with the monthly average daily radiation reduced by the equivalent amount. This value was then used to calculate the light index as used by Fitzpatrick and Nix (1970).

Under the panels light was reduced across the year by 58 – 63% compared to a reduction in light between the panels across the year from 16-52%. This indicated that immediately below the panels there is still significant levels of light which will enable plant growth and development to occur. Incorporating these values into the Growth Index calculation indicated that grassland growth directly under the panels (i.e. Figure 5, position 0-1m; 5-6m) may be reduced by a maximum of 33% compared to an unshaded area, whilst between panels (i.e. Figure 5, 1-5 m) the growth may be reduced by 13%. Growth is not limited as much as the reduction in light because it is only the most limiting resource in May (Figure 7). In every other month soil water or temperature are more limiting than light. The potential reduction in growth between the panels (< 500 kg/ha) is unlikely to be observable due to the limited difference and the large variation across the site.

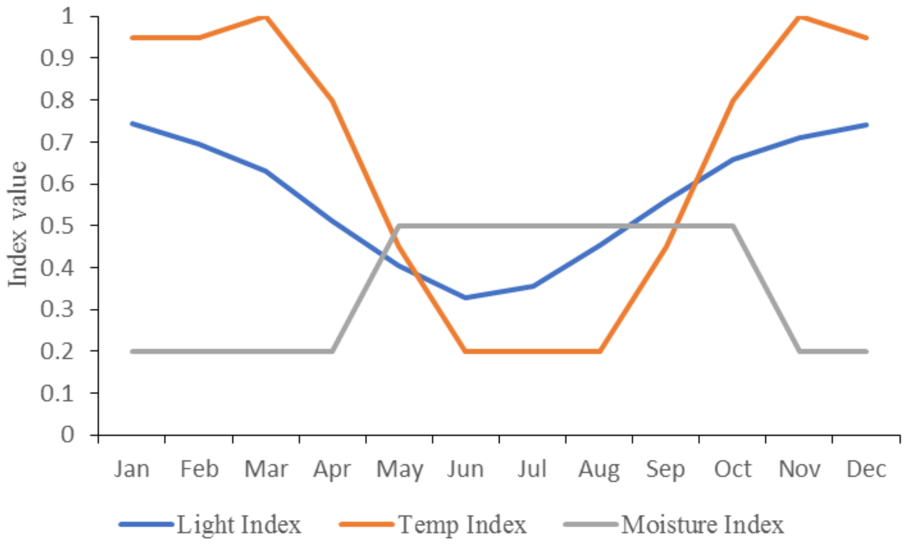


Figure 7. Indices for soil moisture, temperature and light at Darlington Point directly under the PV panels

Shaded conditions may in fact benefit some dicotyledonous species with planophile leaves as a horizontal leaf is more effective in utilising light in a lower light conditions although there is no specific information on most native species in the Riverina Plains Grassland. Shading will have some effect on plant morphology and likely to cause a degree of etiolation due to natural internal changes within the plants. No studies are available to predict these changes in terms of botanical composition although annuals are likely to be more affected as greatest impact will occur in lower light conditions of winter-early spring when they are more actively growing. The tendency to increase elongation and change leaf-stem ratios will be to potentially increase accessibility and digestibility of these species to stock and hence allow more effective grazing control in late winter-early spring. This simple model does not have the ability to deal with changes in leaf morphology under shaded conditions and it is well documented that leaf/stem morphology adapts to lower light conditions. Reductions in growth to decreased light are not simply linear and plants compensation/adaptation for lower light conditions will limit growth impacts.

The changes in soil moisture under photovoltaic panels are impossible to predict as it depends on the angle of the panel and direction of the rainfall at each event. The soil type at the site is commonly used for irrigation around the district. One of the features of the soil is the ability for water to move laterally both at surface and subsurface levels. Thus, it is unlikely that the photovoltaic panels will create marked changes in soil moisture.

Temperature is likely to be reduced under the photovoltaic panels due to a reduced load of solar radiation. In winter growth may be reduced due to average lower temperatures but in spring growth may be increased as the evaporative demand would be reduced allowing more efficient use of soil moisture. This combination of effects is likely to have a greater effect on exotic annuals than the native perennials.

The predicted growth index comparison between an unshaded area versus directly under the panels is shown in Figure 8.

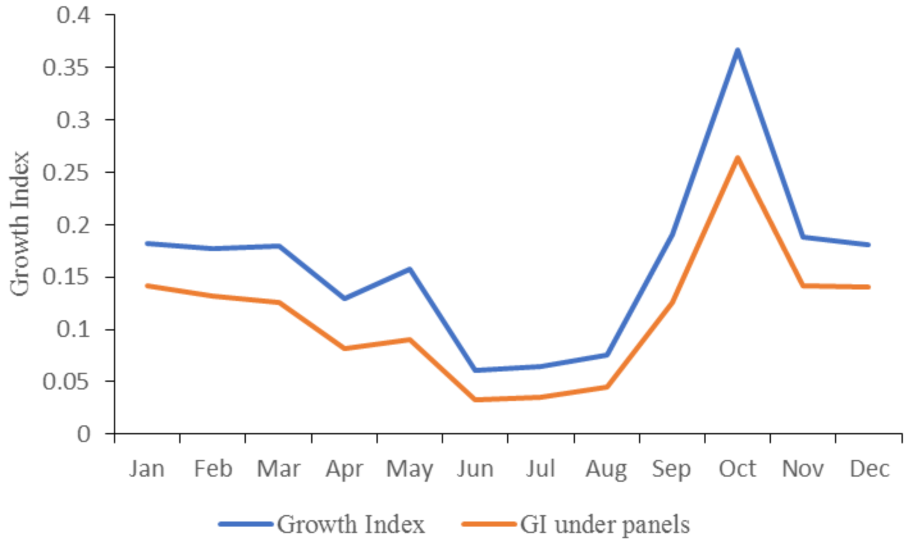


Figure 8. Comparison of predicted growth index between an unshaded area versus directly under the panels.

Physical impacts on the grassland community

During the operational phase there will be ongoing management of the solar voltaic farm of both the assets (solar panels) and the grasslands.

The management of assets will include monitoring and inspections during day to day operations with periods of maintenance if required. Most monitoring of the photovoltaic panels can be conducted remotely either by computer systems and/or drones. Vehicle inspections will primarily be conducted within the formed roads within the site. Inspection or maintenance of the panels will primarily be conducted on foot as it is impractical to move vehicles between the rows of solar panels. Intensity of traffic across the site will not increase compared to current management practices of an extensive grazing property. Therefore the grassland community will not be affected by the asset management during the operational phase.

During the operational phase of the site a grassland management strategy will need to be implemented. The primary aims of this strategy would be:

- To enhance native species within the pastures (diversity and abundance)
- Provide sufficient structure within native grasses for habitat
- Reduce fuel load during the fire danger season.

The primary management tools to achieve the aims of the management strategy will focus on grazing and mowing that will reduce potential fuel load but that they will occur at times that are advantageous to the native perennials while inhibiting the exotic annuals. To achieve the aims of the management strategy with the tools available the following management strategy is suggested:

- **During winter graze sheep/mow**. Primarily this will reduce the level of dry matter from annual growing species for summer fire hazard. The annuals will tend to have a greater palatability/digestibility than the natives at this stage and be preferentially grazed.

- **Remove sheep/mow mid August.** This will allow annual grass seed heads to emerge evenly.
- **Mow to 5-10 cm mid September/October when annual grasses flowering**. This will prevent seed set of exotic annual species enhancing native abundance as well as reducing combustible load.
- **Destock/low stocking rate over summer.** Enhance seed set of perennial native species.
- **Only mow/graze during fire season if grassland growth will result in average dry matter exceeding 5000 kg/ha DM.** This value was taken from the Murrumbidgee Irrigation Area Bush Fire Management Committee in regards to Asset Protection Zone (APZ) fuel load in forested areas, in the absence of a defined fuel load for grassland in the RFS guidelines.

Note that the above management actions may vary slightly over years and that observations on the physiological/phenological state of the annuals will be required to give more precise/effective control via an adaptive management approach. Bathurst Burr and Silver leaf nightshade have been identified on the site and will require monitoring in the future. Integrated Weed Strategies would need to be implemented for these weeds. If broad acre spraying was required i.e. infestations were large, most suitable herbicides would impact native broadleaf plants in the grasslands.

It is likely that there will be no change in species diversity or that abundance will be reduced under the panels due to changes in the light conditions, irregular light traffic or following the annual management strategy. It is clear that grass within the Riverine Plain Grassland community will not be affected if management is implemented according to the suggested strategy. This is because management actions such as mowing will occur at a time when exotic annual grasses are reproductive whereas the perennial native grass species will still be in a vegetative stage. Currently the annual exotic grass species are the most competitive species within the grassland which limits native abundance. Reducing abundance of exotic annual grasses will enhance native grass and forb abundance. Changes in grassland botanical composition have previously been demonstrated for wallaby grass and wiregrass grasslands in northern NSW (Lodge and Whalley 1985) and redgrass grass based grasslands in central NSW (Thapa *et al.* 2011). Both of these examples focussed management strategies on the flowering and recruitment period of the species to ensure that the desired species had an advantage over the undesirable species. As for other species in the grassland community a complete list of non-grass species was compiled and species were analysed for growth habit, timing of flowering and predicted effects of site establishment and annual operations on individual species (Appendix 1). It is expected most native forbs within the grassland community will be unaffected by the annual management plan as either they are lower than 10 cm in height and/or flowering will occur after the exotic annual grasses. Annual forbs are also indeterminate in that if some flowers were to be lost the plant will be able to regrow reproductive structures as compared to grass which are determinant and therefore do not have the ability to regrow reproductive structures. This will enhance native forb abundance as they are short in height and sheep will be removed during the time of flowering. Annual mowing would be detrimental to shrubs across the site and therefore should not be conducted on shrubs. It is suggested that due to sporadic abundance of these species it would be possible to avoid them during a mowing operation. The only requirement for trimming would be if they were greater than 50 cm in height and began to interfere with the PV panels. Native grass and forb abundance will increase with the implementation of the suggested management strategy due to the selective pressure against exotic annual species whereas avoiding mowing shrubs will ensure persistence.

Structure of the grassland is an important concept for the functioning of the ecosystem for a range of species but it is poorly defined. There has been no documented benchmark for what height a grassland should be to provide sufficient structure. Plains grass is the tallest species present in the grassland and was observed to grow up to 2 m tall although growth in 2017 was limited to 0.5 m tall. Only 18% of dry matter was above 60 cm (Figure 3). In most seasons Plains grass will not reach 2 m in height due to seasonal conditions. Although growth under the PV panels has been estimated to be reduced by 33% it is unlikely the effect on the value of the structure of the grassland is linear i.e. for every decrease in growth results in an equal decrease in grassland structure value. Rather it is suggested that the response of structure value to decreasing growth is likely to be curvilinear so that although growth may be reduced by 30% the effect on the value of the grassland structure is likely to be decreased by less than 20%. The installation of PV panels and implementation management strategy will reduce the potential height of Plains grass but this species only represents 56% of species across the site as a percentage of available dry matter (Table 3). Other species are much shorter than the Plains Grass and are unlikely to be affected greatly.

Summary of effects of the installation and operation of a photovoltaic panels at Darlington Point

The construction phase of the PV is unlikely to have a significant effect on persistence of the Riverine Plain Grassland community due to construction being limited to heavy and light vehicle traffic and a significant source of seed available in the seed bank. Any disturbance that may be caused should be recovered within 12 months of an average season.

During the operation of the facility it has been assessed that growth under the panels is likely to be reduced by 33% but this is unlikely to have significant effects on diversity, abundance or ground cover of the native species. In fact implementing the suggested management strategy is likely to enhance the diversity, abundance and ground cover of the grassland as the management strategies will reduce the effect of exotic annual grasses that compete strongly against the native species. The component likely to be effected under the PV panels is the value of the grassland structure. This is unlikely to be a linear response to the reduced growth under the panels rather it is likely to be less than 20% although this is difficult to predict as there are no benchmarks on grassland structure.

Conclusion

Management recommendations have been developed in relation to the three aims given in the Management Strategy section. The authors recognise that site observations in mid-spring would have been beneficial in characterising the exotic annual grass components of the system.

However the report, based on observations of the site together with the available scientific literature, concludes that the overall impacts of the photovoltaic solar array on grassland diversity, habitat value and fire risk should be low and in certain aspects such as weed management potentially highly positive.

Given the dynamic nature of biological systems monitoring will be essential and an adaptive management approach implemented based on, and responsive to, seasonal/annual conditions. This will be critical during the early stages when the solar plant has been set up and the grassland is re-establishing.

There will be a need from the site development phase onwards for a focus on monitoring annual exotic weeds numbers and the strategic imposition of interventions via grazing, mowing and possibly herbicides to maintain and improve the present condition.

Appendix 1. Non-grass species description and effect of site establishment and management.

Data sourced from Cunningham et al (2015), Plants of Western NSW and PlantNET (The NSW Plant Information Network System).

Common Name	Scientific Name	Lifecycle	Growth habit	Flowering time	Site establishment impact?	Annual management impact?
Australian Bluebell	*Wahlenbergia stricta*	Perennial	Tall forb	Winter/Spring	None [#1]	Yes [#2]
Berry Saltbush	*Einadia hastata*	Perennial	Low lying shrub	February	None [#3]	None [#3]
Black Cotton Bush	*Maireana decalvans*	Perennial	Erect or spreading shrub	Summer	Yes [#4]	Yes [#5]
Black Rolypoly	*Sclerolaena muricata*	Short-lived perennial	Sub-shrub	All year	Yes [#4]	Yes [#5]
Blushing Bindweed	*Convolvulus erubescens*	Perennial	Creeping prostrate forb	Late spring/Early autumn	None [#3]	None [#3]
Chocolate Lily	*Dichopogon strictus*	Perennial	Tall forb	Spring-Early summer	None [#3]	None [#6]
Common Woodruff	*Asperula conferta*	Perennial	Small forb	Spring/Early summer	None [#3]	None [#6]
Corrugated Sida	*Sida corrugata*	Perennial	Prostrate forb	Spring/Summer	None [#3]	None [#6]
Creeping Saltbush	*Atriplex semibaccata*	Perennial	Prostrate shrub	Summer	None [#3]	None [#3]
Curious Saltbush	*Dissocarpus paradoxus*	Annual/Short lived perennial	Sub-shrub	Spring/Early summer	Yes [#4]	Yes [#5]
Lambs Tails	*Ptilotus exaltatus*	Perennial	Small forb	Spring-Summer	None [#3]	None [#6]
Leafless Bluebush	*Maireana aphylla*	Perennial	Shrub	Spring/Early summer	Yes [#4]	Yes [#5]
Nardoo	*Marsilea spp.*	Perennial	Prostrate fern	Spring -Autumn	None [#3]	None [#3]
Quena	*Solanum esuriale*	Perennial	Small forb	All year	None [#3]	None [#6]
Ridged sida	*Sida cunninghamii*	Perennial	Prostrate forb	Summer/Autumn	None [#3]	None [#3]
Ruby Saltbush	*Enchylaena tomentosa*	Perennial	Shrub	Spring-Early summer	Yes [#4]	Yes [#5]
Spiny-headed Mat-rush	*Lomandra longifolia*	Perennial	Rush	Spring-Early summer	None [#7]	None [#6]
Starwort	*Callitriche spp.*	Annual	Prostrate forb	Spring-Early summer	None [#3]	None [#3]
Swamp Dock	*Rumex brownii*	Perennial	Tall forb	Spring	None [#3]	None [#6]
Tarvine	*Boerhavia dominii*	Perennial	Prostrate forb	Summer/Autumn	None [#3]	None [#3]
Tussock Rush	*Juncus aridicola*	Perennial	Rush	Summer/Winter	None [#7]	None [#6]
Tussock Rush	*Juncus flavidus*	Perennial	Rush	Summer/Winter	None [#7]	None [#6]
Woolly New Holland Daisy	*Vittadinia gracilis*	Perennial	Small shrub	All year	Yes [#4]	Yes [#5]
Wooly Buttons	*Leiocarpa panaetioides*	Perennial	Sub-shrub	Spring-Autumn	Yes [#4]	Yes [#5]

[#1]Unlikely to be present during site establishment, [#2]Flowers at similar time to annual grasses. Should re-flower after mowing, [#3]Most of the plant will be below mower height, [#4]Shrub will regrow following mowing, [#5]Shrub can be avoided with annual management, [#6]Later flowering than annual grasses, [#7] Will regrow after mowing.

References

Cunningham, G. M., Mulham. W. E., Milthorpe, P. L., Leigh, J. H. (2015).Plants of Western NSW. CSIRO.

Fitzpatrick, E. A., Nix, H. A. (1970). Climatic factor in Australian grassland ecology. In Australian Grasslands. Editor Moore, R. M. Canberra, ACT: Australian National University. Chapter 1 pp 3-26

Haydock, K. P., Shaw, N. P. (1975). The comparative yield method for estimating dry matter yield of pasture. Australian Journal of Experimental Agriculture and Animal Husbandry 15(76) 663 – 670.

Keith, D. A. (2004). Ocean shores to desert dunes. The native vegetation of New South Wales and the ACT. Department of Environment and Conservation NSW.

Lodge, G. M., Whalley, R. D. B. (1985). The manipulation of species composition of natural pastures by grazing management on the northern slopes of New South Wales. The Australian Rangeland Journal 7(1) 6 – 16

PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au [accessed 6 April, 2018]

Thapa, R., Kemp, D. R., Michalk, D. L., Badgery, W. B., Simmons, A. T. (2011). Seedling recruitment of native perennial grasses within existing swards. Crop and Pasture Science, 62, 591-602.

t'Mannetje, L., Haydock, K. P. (1963). The dry-weight-rank method for the botanical analysis of pasture. Grass and Forage Science, 18, 268-275.

Appendix 10

Bat Call Analysis Results

<u>Identification of echolocation call sequences recorded at Darling Point, Riverina Region NSW.</u>

Data

Data was received by email on the 23 October 2017, and was analysed using AnalookW v4.1z. Data was received from two detectors over four nights from the 7th - 10th September 2017. In total 743 Anabat call sequence files were received, 713 of which were marked as recognisable microbat calls. Results per detector, per night are presented in Table1.

Reference Library

Call identification for this data set was based on call keys and descriptions for New South Wales (Pennay et al 2004) with reference to descriptions published for southern Queensland (Reinhold et al 2001).

Analysis

The reliability of identification is as follows;

<u>Definite</u>; one or more calls were there is no doubt about the identification of the species

<u>Probable</u>; most likely to be the species named, low probability of confusion with species that use similar calls

<u>Possible</u>; call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

Temperature logs were not provided with the data set. Temperature has been shown to have a significant effect on microbat foraging activity (see for example Threlfall et. al. 2012). While some call sequences were recognised as bat calls the quality was not sufficient to assign species identification. These species have been recorded or are considered likely to occur in the surrounding area (NPWS Atlas and Atlas of Living Australia Data November 2017).

Table 1 - Anabat recording results	Detector 1 – SN440535			
Species name	**20170907**	**20170908**	**20170909**	**20170910**
Austronomus australis	X		X	
Mormopterus planiceps	X			
Mormopterus ridei	X	X		X
Chalinolobus gouldii		X		X
Scotorepens balstoni				X
Vespadelus vulturnus	X	X		X
Chalinolobus morio		X	X	
Vespadelus vulturnus	X			X
Species composites/groups identified				
Chalinolobus gouldii or Mormopterus species	#			#
Mormopterus planiceps/Mormopterus petersi/Mormopterus ridei	#			
Scotorepens balstoni/Chalinolobus gouldi				#
Scotorepens balstoni/Scotorepens greyii				#
Vespadelus darlingtoni/Vespadelus vulturnus				
Vespadelus regulus/Vespadelus vulturnus/Chalinolobus morio	#	#		#
Myotis macropus/Nyctophilus species				

Probability assigned values are discussed in report
X definite
probable
* possible

Table 1 - Anabat recording results	Detector 2 - SN440641			
Species name	**20170907**	**20170908**	**20170909**	**20170910**
Austronomus australis	X		X	X
Mormopterus planiceps	X		X	X
Mormopterus ridei	X		X	X
Chalinolobus gouldii	X		#	
Scotorepens balstoni	X			
Vespadelus vulturnus		X		
Chalinolobus morio	X	X		
Vespadelus vulturnus	X		X	X
Species composites/groups identified				
Chalinolobus gouldii or Mormopterus species	#		#	#
Mormopterus planiceps/Mormopterus petersi/Mormopterus ridei				#
Scotorepens balstoni/Chalinolobus gouldi	#			#
Scotorepens balstoni/Scotorepens greyii	#			#
Vespadelus darlingtoni/Vespadelus vulturnus				#
Vespadelus regulus/Vespadelus vulturnus/Chalinolobus morio			#	#
Myotis macropus/Nyctophilus species				*

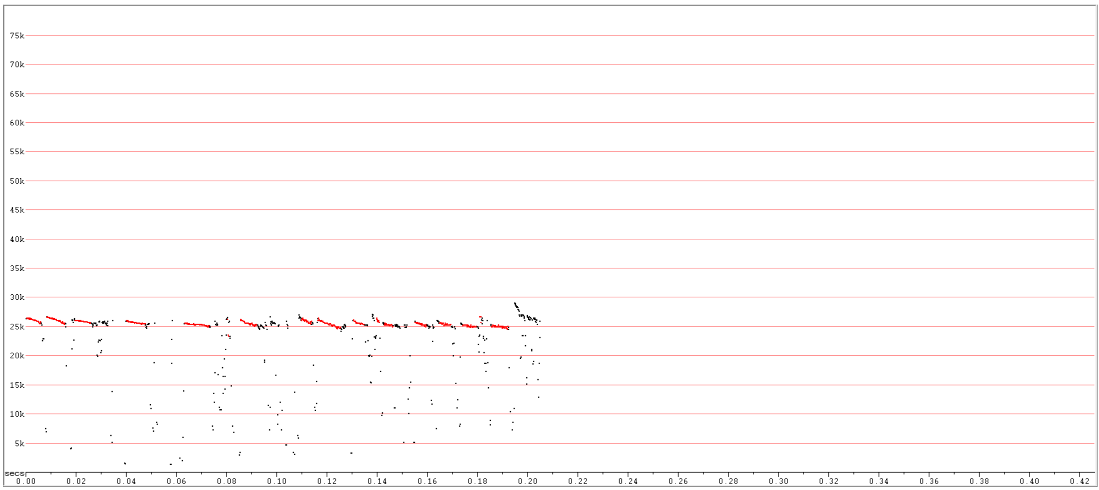
Probability assigned values are discussed in report
X definite
probable
* possible

Call Examples (calls have been edited and filtered for reporting purposes)

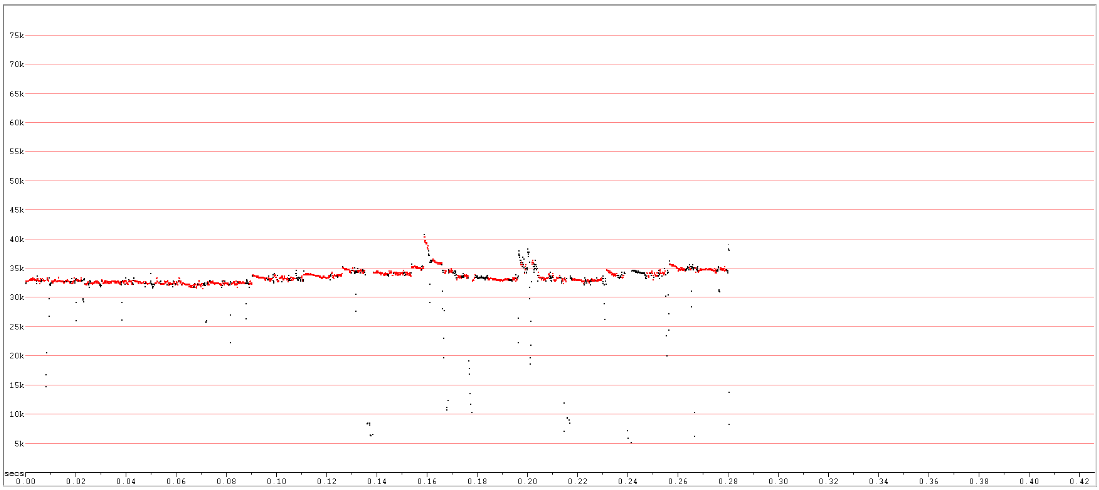
Section 1.

Species positively identified

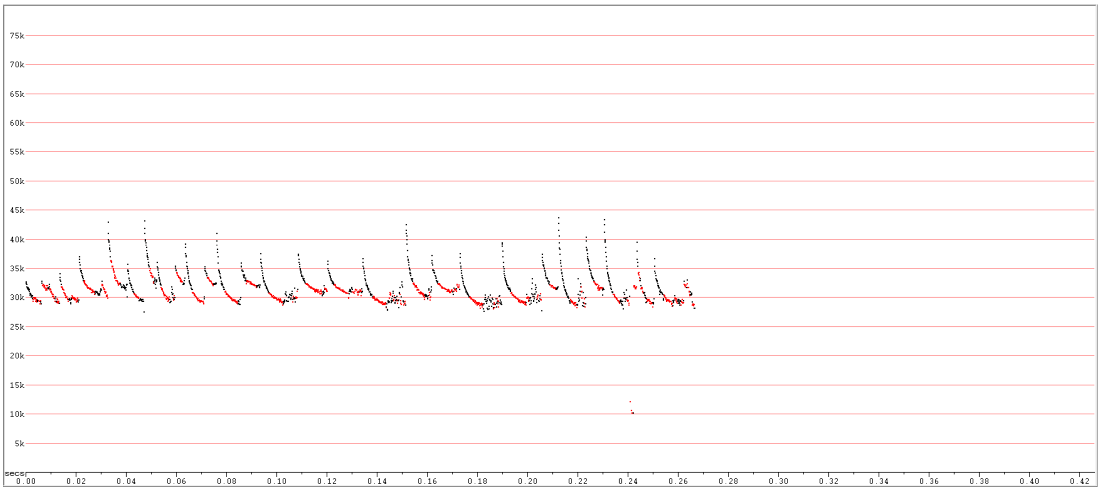
Definitely *Austronomus australis*. The characteristic frequency if this species is between 10 – 15 kHz. This species may be confused with *Saccolaimus flaviventris* at its lower harmonics.



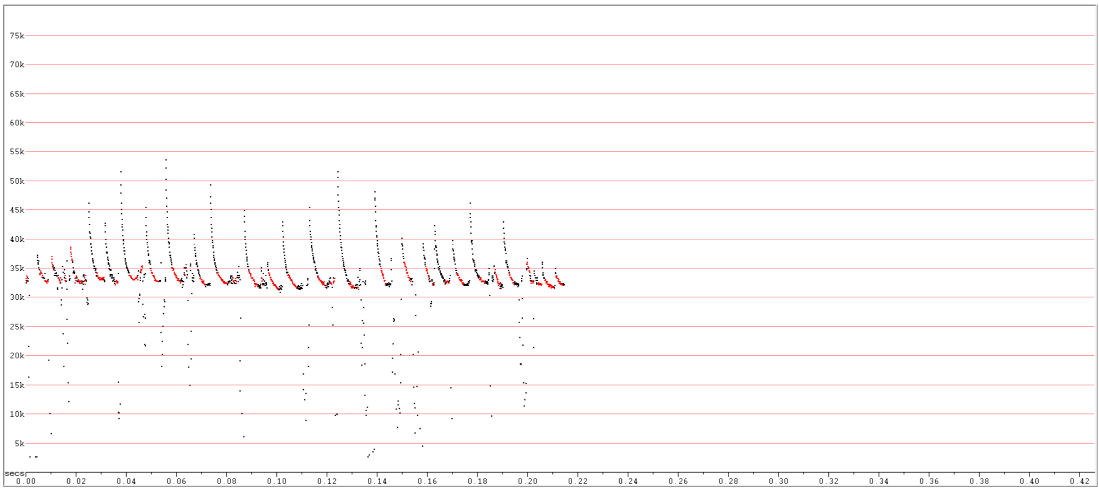
Definitely *Mormopterus planiceps*. Published descriptions of calls for this species report that it calls between 26 – 30.5 kHz, although it has been recorded lower at around 24 kHz (pers. com. Greg Ford November 2015). The calls will be flat in the lower ranges and curved at the higher limits, and dependant on activity and environment.



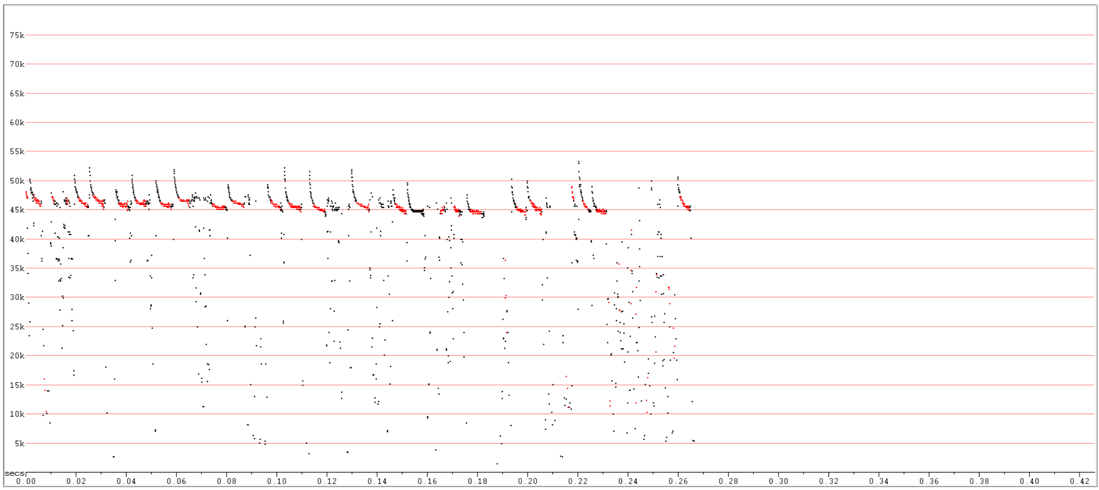
Definitely *Mormopterus ridei*. The species calls between 31 – 36 kHz. Calls of this species may overlap with *Mormopterus planiceps* or *Mormopterus petersi* in its lower frequencies.



Definitely *Chalinolobus gouldii*. The call sequence is curved average characteristic frequency is between 25 and 34 KHz. Consecutive pulses alternate in frequency.



Definitely *Scotorepens balstoni*. A curved call with a characteristic frequency between 28 and 35 kHz. The tail is usually down sweeping or absent, frequency of the knee 33 – 37 kHz which distinguishes it from other species calling in the same frequency.



Definitely *Vespadelus vulturnus*. The species exhibits a curved call with a characteristic frequency of 44.5 - 51 kHz in the Riverina Region.

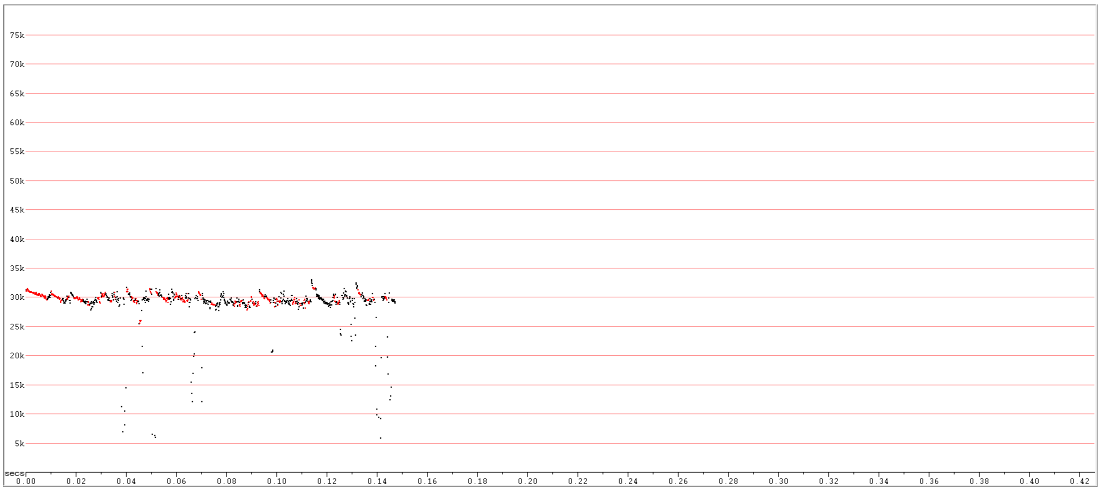
Definitely *Chalinolobus morio*. The species exhibits a curved call with a down sweeping tail with a characteristic frequency between 48.5 – 51.5 kHz.

Section 2.

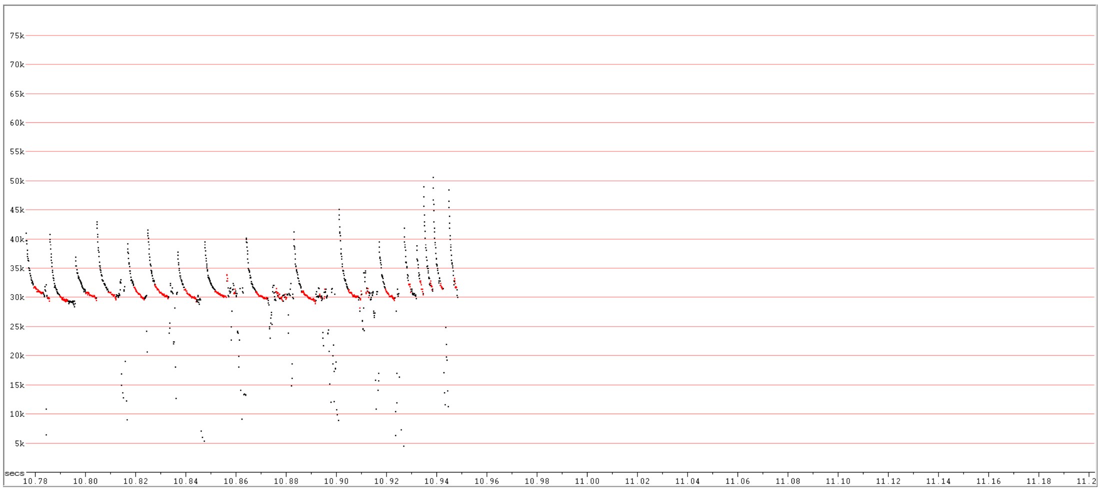
Species composites/groups identified

A species listed here that is not also listed in the species positively identified should be considered as possibly present. Likelihood of occurrence and call identification issues for these species are discussed below each call example.

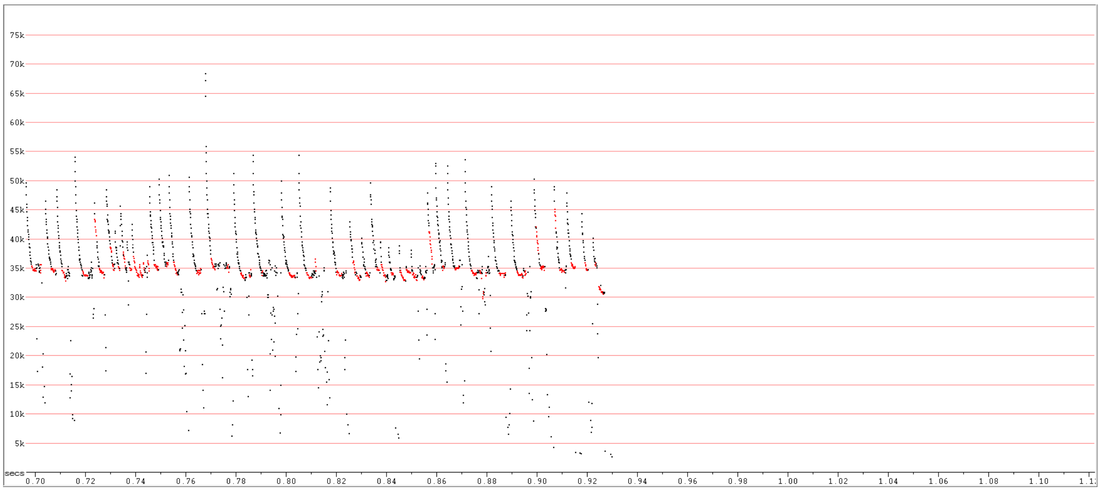
Probably *Chalinolobus gouldii* /*Mormopterus* sp. Frequency ranges overlap in the species, *C. gouldii* usually has steep, curved pulses that alternate in frequency compared to flat or shallow-curved pulses with no alternation in *Mormopterus* species. *Mormopterus ridei, M. planiceps* or *M. petersi* are all possible in the area.



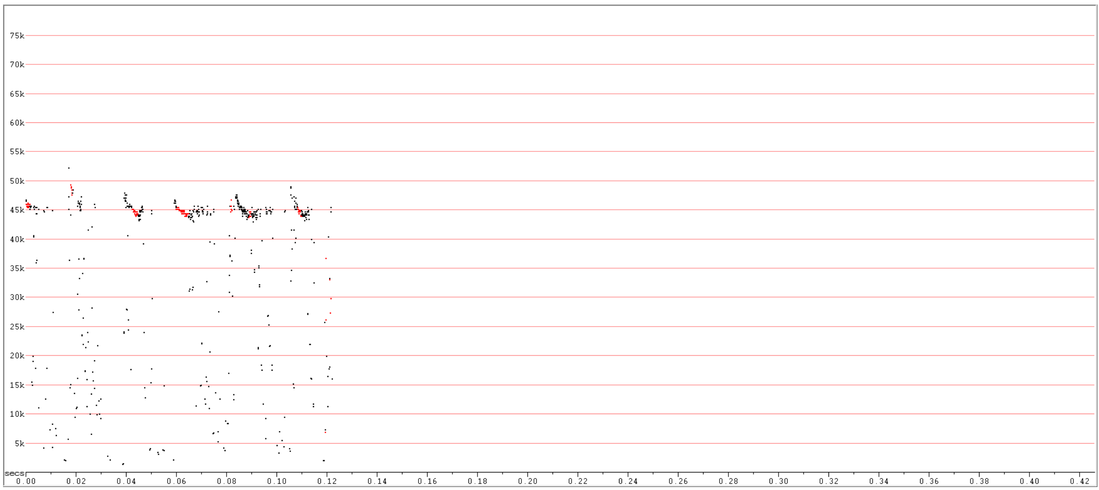
Probably *Mormopterus planiceps/Mormopterus petersi/Mormopterus ridei*. The small free-tailed bats generally produce call pulses that are either flat or slightly-curved and readily distinguished from most other species. Some of the calls recorded in the data set could be attributed to any of the three species where they overlap around 30 kHz. Details present in the call sequence are not sufficient to ascertain whether the call was representative of the species at either the upper or lower ends of its range.



Probably *Chalinolobus gouldi*/*Scotorepens balstoni*. *C. gouldii* (26.5 34 kHz) has steep and curved pulses that usually alternate in frequency by 2-3 kHz. *S. balstoni* produces pulses of similar shape that overlap in frequency (29 – 34 kHz), but which lack frequency alternation. Some calls in the data set were lacking sufficient information so as to assign positive species identification.



Probably *Scotorepens balstoni/Scotorepens greyii*. There is insufficient detail to assign species identification in the above call sequence. The species overlap between at approximately 35 kHz.



Probably *Vespadelus darlingtoni/Vespadelus vulturnus*. The calls of this species overlap at around 44 kHz.

Probably *Vespadelus regulus/Vespadelus vulturnus/Chalinolobus morio*. Calls of insufficient pulse structure or detail were attributed to a composite group were they overlap in frequency around 50 kHz.

Possibly *Myotis macropus/Nyctophilus species*. Probably *Myotis macropus/Nyctophilus* species. *M. macropus* calls can be differentiated from Nyctophilus species by having a pulse interval less than 75ms, an initial slope of greater than 400 OPS and often displaying a single change in slope (kink) in the central part of the pulse. This call is uncompressed. *Myotis macropus*, *Nyctophilus geoffroyi* and *Nyctophilus gouldi* have been recorded in the region (NPWS Atlas and Atlas of Living Australia Data September 2017). *Nyctophilus* bats generally produce distinctive calls, however the species within the genus cannot be reliably differentiated from call data. *N. geoffroyii,* N. *gouldi* and *N. corbeni (formerly N. timoriensis* south-eastern form) occur in the area (see Figure 1 - Distribution map for *N. corbeni*).

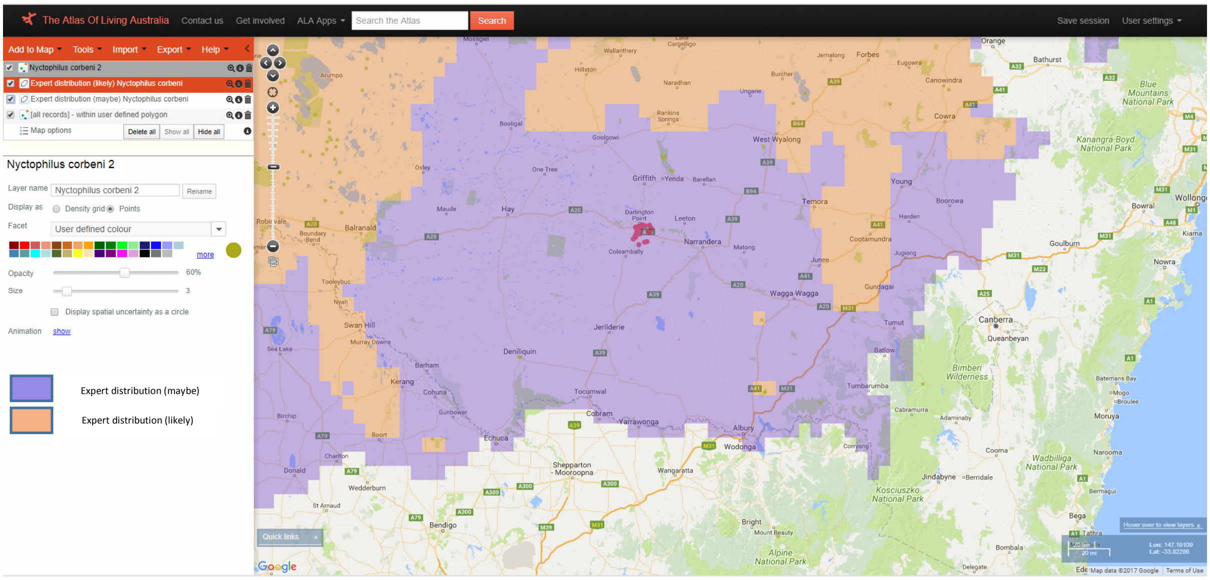


Figure 1. Distribution Map for *N. corbeni* (Source: Atlas of Living Australia 3/11/2017).

References

Churchill, S. 2008, Australian Bats, Allen and Unwin, Sydney.

Pennay, M., B. Law & L. Reinhold (2004). Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats. Hurstville: NSW Department of Environment and Conservation.

Reardon T. B., McKenzie N. L., Cooper S. J. B., Appleton B., Carthew S. & Adams M. (2014) A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats Mormopterus (Chiroptera : Molossidae). Australian Journal of Zoology 62, 109-36.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001) Key to the bat calls of southeast Queensland and north-east New South Wales. Forest Ecosystem Research and Assessment Technical paper 2001-07, Department of Natural Resources and Mines, Queensland.

Threlfall CG, Law B, Banks PB. 2012. Influence of landscape structure and human modifications on insect biomass and bat foraging activity in an urban landscape. PLoS ONE 7, e38800

Disclaimer

<u>Identification of echolocation call sequences recorded at Darling Point, Riverina Region NSW.</u>

Data was received by email on the 15 November 2017, and was analysed using AnalookW v4.1z. Information was received from two detectors over five (5) nights from the 5th - 9th November 2017. In total 6833 Anabat call sequence files were received, 5224 of which were marked as recognisable microbat calls by the use of a filter (Please see below).

Results per detector, per night are presented in Table 1. A list of species positively identified in the field was provided are indicated by a '+' in Table 1.

Reference Library

Call identification for this data set was based on call keys and descriptions for New South Wales (Pennay et al 2004) with reference to descriptions published for southern Queensland (Reinhold et al 2001).

Analysis

The reliability of identification is as follows;

<u>Definite</u>; one or more calls were there is no doubt about the identification of the species

<u>Probable</u>; most likely to be the species named, low probability of confusion with species that use similar calls

<u>Possible</u>; call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

The filter (All Bats) used in this analysis used particular parameters set to include sequence files that passed certain criteria including smoothness, duration and characteristic frequency. The filter is a generalised filter that includes parameters suitable for the microbat species of Australia (Titley, 2009). Subsequent to identifying species that passed the All Bats filter all files were scanned manually in an attempt to identify calls from species such as *Nyctophilus* species who are more likely produce weaker or fragmented calls or to extract calls for identification that didn't pass parameters such as a minimum number of pulses i.e. 3 calls within 5 seconds. While some call sequences were recognised as bat calls the quality was not sufficient to assign species identification.

These species have been recorded or are considered likely to occur in the surrounding area (NPWS Atlas and Atlas of Living Australia Data November 2017).

Table 1 - Anabat recording results	Detector 1 – SN440535				
Species positively identified	**20171105**	**20171106**	**20171107**	**20171108**	**20171109**
Austronomus australis	X	X	X	X	X
Saccolaimus flaviventris	#				
Mormopterus planiceps	X	X		X	X
Mormopterus ridei	X	X	X	X	X
Chalinolobus gouldii	#	X		X	X
Scotorepens balstoni (+)	X	#			#
Scotorepens orion	#				
Scotorepens greyii	#			X	#
Vespadelus darlingtoni (+)	#			X	
Vespadelus vulturnus (+ tentative)	X				X
Chalinolobus morio(+)	*		X		
Species composites/groups identified					
Chalinolobus gouldii/Mormopterus species	#	#	#	#	#
Mormopterus planiceps/Mormopterus petersi (+)	#	#		#	#
Mormopterus planiceps/Mormopterus peters/Mormopterus ridei					#
Scotorepens balstoni/Chalinolobus gouldi	#	#	#	#	#
Scotorepens balstoni/Scotorepens greyii	#				#
Scotorepens orion/Scotorepens greyii	#				#
Vespadelus darlingtoni/Vespadelus vulturnus	#				
Vespedelus baverstocki/Vespadelus vulturnus	#				#
Vespadelus regulus (+ tentative) /Vespadelus vulturnus		#		#	
Vespadelus regulus/Vespadelus vulturnus/Chalinolobus morio	#	#		#	#
Myotis macropus/Nyctophilus species (+)		#			

Probability assigned values are discussed in report
X definite
probable
* possible

Table 1 - Anabat recording results	Detector 2 - SN440641				
Species positively identified	**20171105**	**20171106**	**20171107**	**20171108**	**20171109**
Austronomus australis	X		X	X	X
Saccolaimus flaviventris		*	*		*
Mormopterus planiceps	X	X	X	X	X
Mormopterus ridei	X			X	X
Chalinolobus gouldii	X	X	X	X	X
Scotorepens balstoni (+)	X	X	X	X	X
Scotorepens orion					
Scotorepens greyii	X			X	X
Vespadelus darlingtoni (+)					#
Vespadelus vulturnus (+ tentative)	X	X	X	X	X
Chalinolobus morio(+)	X	X	X	X	X
Species composites/groups identified					
Chalinolobus gouldii/Mormopterus species	#	#	#	#	#
Mormopterus planiceps/Mormopterus petersi (+)	#		#	#	#
Mormopterus planiceps/Mormopterus peters/Mormopterus ridei					
Scotorepens balstoni/Chalinolobus gouldi	#	#		#	#
Scotorepens balstoni/Scotorepens greyii	#			#	#
Scotorepens orion/Scotorepens greyii	#				
Vespadelus darlingtoni/Vespadelus vulturnus	#				
Vespedelus baverstocki/Vespadelus vulturnus	#			#	
Vespadelus regulus (+ tentative) /Vespadelus vulturnus	#				
Vespadelus regulus/Vespadelus vulturnus/Chalinolobus morio		#		#	#
Myotis macropus/Nyctophilus species (+)		#		#	#

Probability assigned values are discussed in report
X definite
probable
* possible

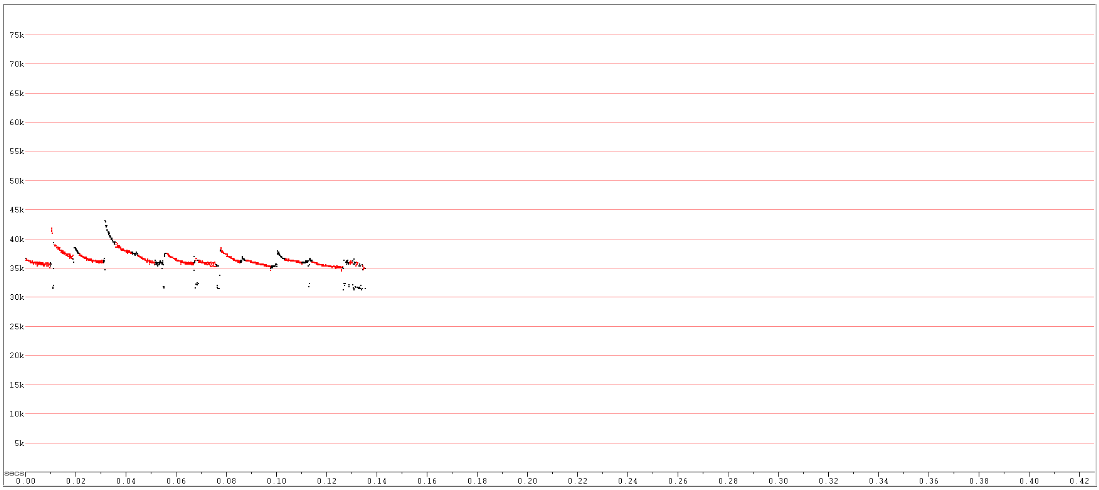
Call Examples (calls have been edited and filtered for reporting purposes)

Section 1.

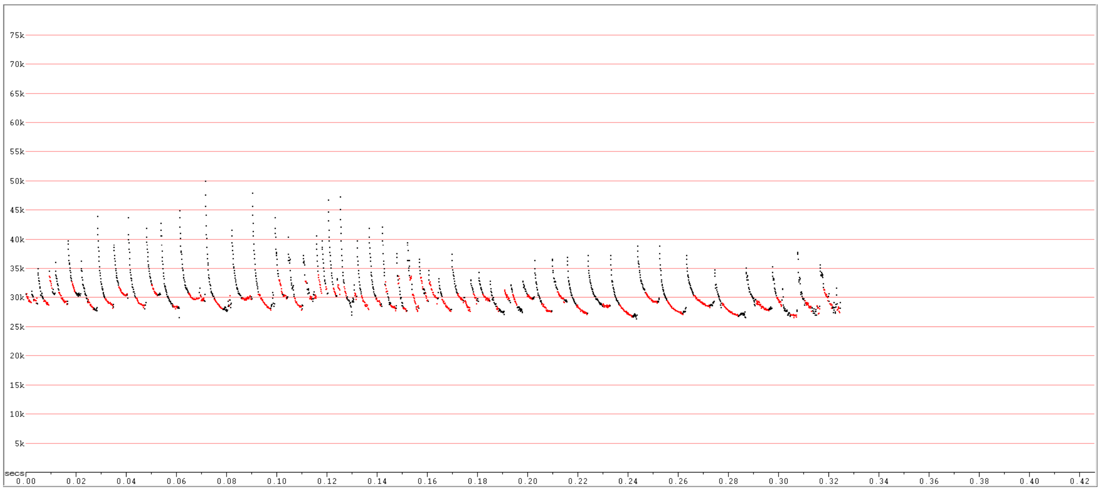
Species positively identified

Definitely *Austronomus australis*. The characteristic frequency if this species is between 10 – 15 kHz. This species may be confused with *Saccolaimus flaviventris* at its lower harmonics.

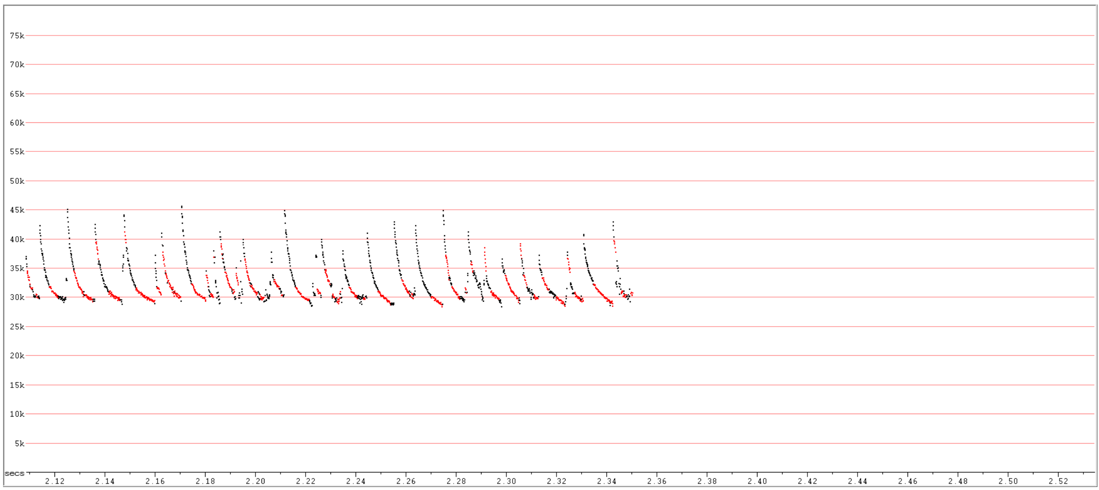
Definitely *Mormopterus planiceps*. Published descriptions of calls for this species report that it calls between 26 – 30.5 kHz, although it has been recorded lower at around 24 kHz (pers. com. Greg Ford November 2015). The calls will be flat in the lower ranges and curved at the higher limits, and dependant on activity and environment.



Definitely *Mormopterus ridei*. The species calls between 31 – 36 kHz. Calls of this species may overlap with *Mormopterus planiceps* or *Mormopterus petersi* in its lower frequencies.



Definitely *Chalinolobus gouldii*. The call sequence is curved average characteristic frequency is between 25 and 34 KHz. Consecutive pulses alternate in frequency.



Definitely *Scotorepens balstoni*. A curved call with a characteristic frequency between 28 and 35 kHz. The tail is usually down sweeping or absent, frequency of the knee 33 – 37 kHz which distinguishes it from other species calling in the same frequency.

Definitely *Scotorepens greyii*. Curved call with a characteristic frequency between 35 – 40 kHz.

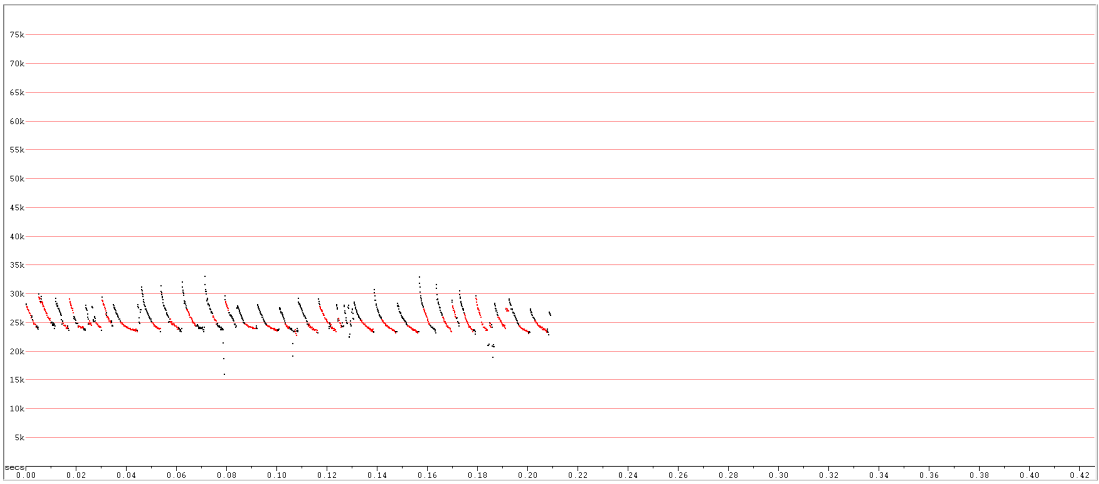
Definitely *Vespadelus vulturnus*. The species exhibits a curved call with a characteristic frequency of 44.5 - 51 kHz in the Riverina Region.

Definitely *Chalinolobus morio*. The species exhibits a curved call with a down sweeping tail with a characteristic frequency between 47.5 – 53 kHz.

Section 2.

Species composites/groups identified

A species listed here that is not also listed in the species positively identified should be considered as possibly present. Likelihood of occurrence and call identification issues for these species are discussed below each call example.

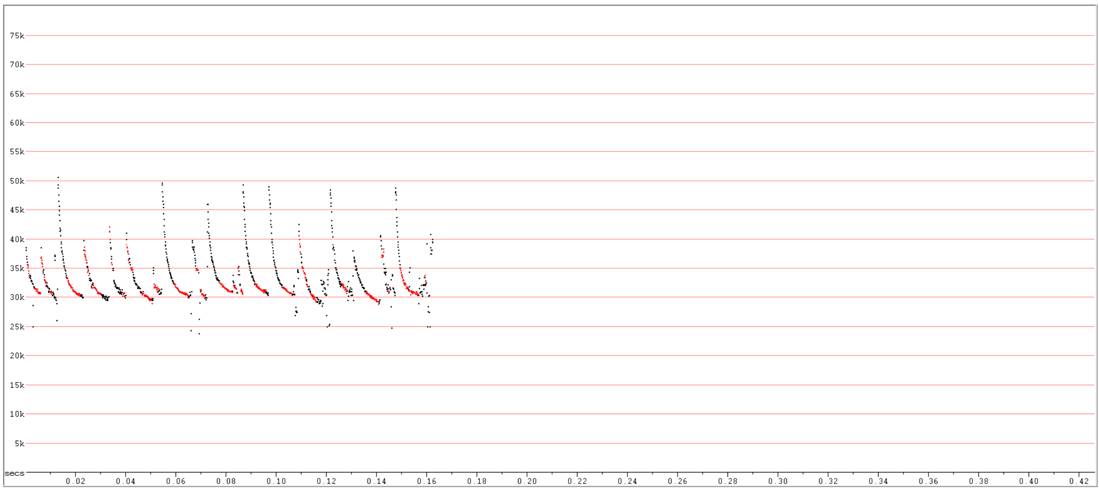


Probably *Saccolaimus flaviventris*. While the frequency for the species is between 17.5 – 22.5 kHz the overlap curved shape of the pulses suggest S. flaviventris calling at a higher frequency possibly in clutter. *Mormopterus planiceps* was present in other sections of this call sequence.

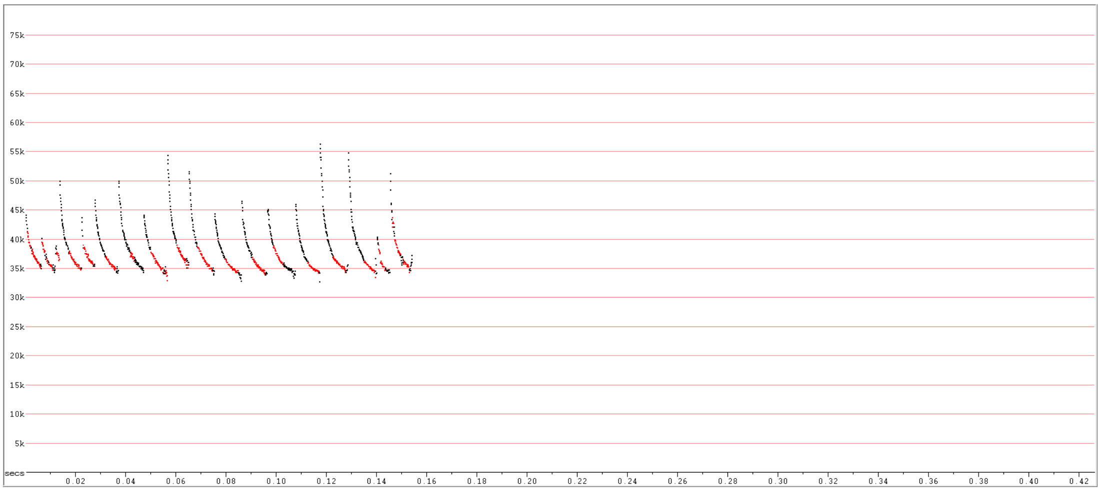
Probably *Mormopterus planiceps/Mormopterus petersi*.

Probably *Mormopterus planiceps/Mormopterus petersi/Mormopterus ridei*. The small free-tailed bats generally produce call pulses that are either flat or slightly-curved and readily distinguished from most other species. Some of the calls recorded in the data set could be attributed to any of the three species where they overlap around 30 kHz. Details present in the call sequence are not sufficient to ascertain whether the call was representative of the species at either the upper or lower ends of its range.

Probably *Chalinolobus gouldii* /*Mormopterus* sp. Frequency ranges overlap in the species, *C. gouldii* usually has steep, curved pulses that alternate in frequency compared to flat or shallow-curved pulses with no alternation in *Mormopterus* species. *Mormopterus ridei, M. planiceps* or *M. petersi* are all possible in the area.



Probably *Chalinolobus gouldi*/*Scotorepens balstoni*. *C. gouldii* (26.5 34 kHz) has steep and curved pulses that usually alternate in frequency by 2-3 kHz. *S. balstoni* produces pulses of similar shape that overlap in frequency (29 – 34 kHz), but which lack frequency alternation. Some calls in the data set were lacking sufficient information so as to assign positive species identification.

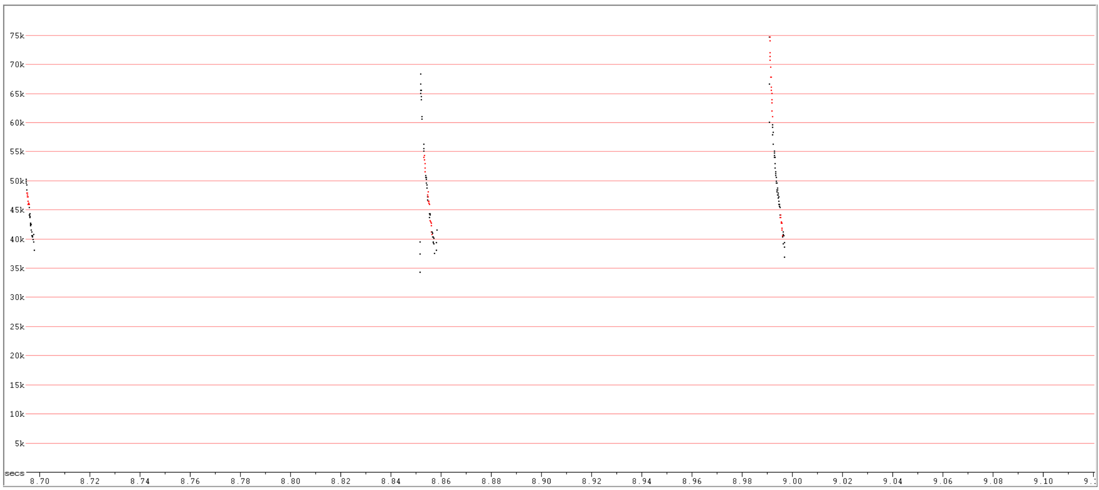


Probably Scotorepens orion. Although the species is not generally expected in the area, the overall shape of this call suggests S. orion. The closet record to the study area was recorded at -33.816, 145.633 in ≈ 1982 (T. Reardon ALA 30.11.17).

Probably *Vespadelus darlingtoni*. The species calls between 40 – 44 kHz in the Riverina region.

Probable *Vespadelus baverstocki/Vespadelus vulturnus*. The species overlap at 44 kHz and have been recorded in the area (NPWS Atlas and Atlas of Living Australia Data November 201717)

Probably *Vespadelus regulus/Vespadelus vulturnus/Chalinolobus morio*. Calls of insufficient pulse structure or detail were attributed to a composite group were they overlap in frequency around 50 kHz.



Possibly *Myotis macropus/Nyctophilus species*. Probably *Myotis macropus/Nyctophilus* species. *M. macropus* calls can be differentiated from Nyctophilus species by having a pulse interval less than 75ms, an initial slope of greater than 400 OPS and often displaying a single change in slope (kink) in the central part of the pulse. This call is uncompressed. *Myotis macropus*, *Nyctophilus geoffroyi* and *Nyctophilus gouldi* have been recorded in the region (NPWS Atlas and Atlas of Living Australia Data September 2017). *Nyctophilus* bats generally produce distinctive calls, however the species within the genus cannot be reliably differentiated from call data. *N. geoffroyii,* N. *gouldi* and *N. corbeni (formerly N. timoriensis* south-eastern form) occur in the area (see Figure 1 - Distribution map for *N. corbeni*).

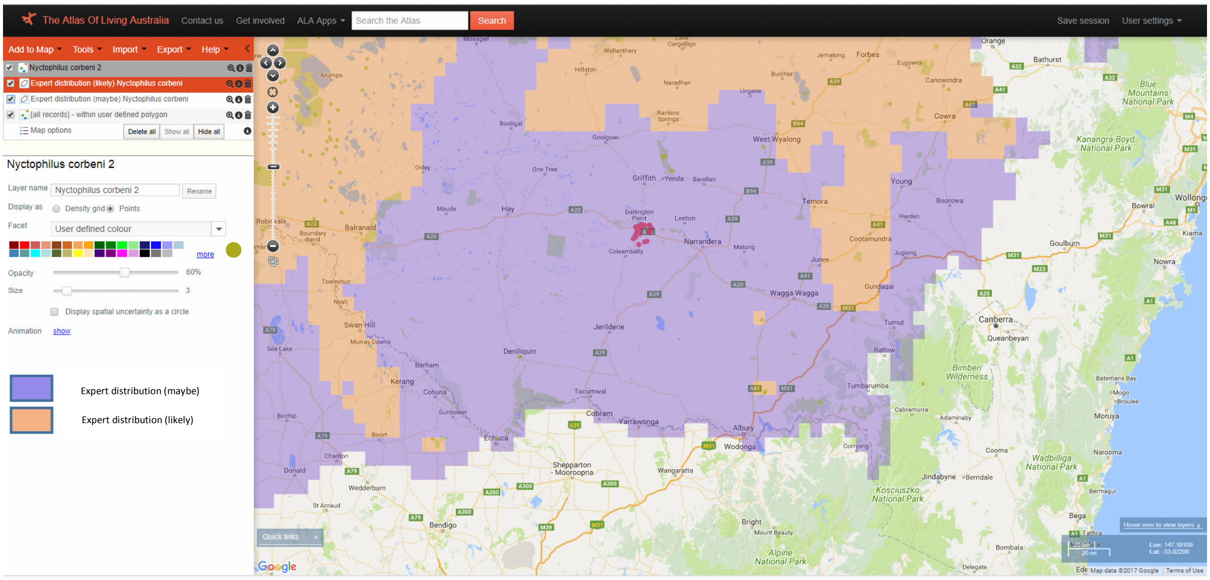


Figure 1. Distribution Map for *N. corbeni* (Source: Atlas of Living Australia 30/11/2017).

References

Churchill, S. 2008, Australian Bats, Allen and Unwin, Sydney.

Pennay, M., B. Law & L. Reinhold (2004). Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats. Hurstville: NSW Department of Environment and Conservation.

Reardon T. B., McKenzie N. L., Cooper S. J. B., Appleton B., Carthew S. & Adams M. (2014) A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats Mormopterus (Chiroptera : Molossidae). Australian Journal of Zoology 62, 109-36.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001) Key to the bat calls of southeast Queensland and north-east New South Wales. Forest Ecosystem Research and Assessment Technical paper 2001-07, Department of Natural Resources and Mines, Queensland.

Threlfall CG, Law B, Banks PB. 2012. Influence of landscape structure and human modifications on insect biomass and bat foraging activity in an urban landscape. PLoS ONE 7, e38800

Disclaimer

Appendix 11

BioBanking Credit Report

BioBanking Credit Calculator

Ecosystem credits

Proposal ID : 034/2018/4878MP

Proposal name : Darlington Point Solar Farm - August 2018 Final

Assessor name : Toby Lambert

Assessor accreditation number : 034

Tool version : v4.0

Report created : 07/08/2018 15:57

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
Circle 1	14.20	MR649_Moderate/Good_Medium	Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina Bioregion and western NSW South Western Slopes Bioregion	Moderate/Good_Medium	Yes	WBYB - Direct	0.16	72.92	0.00	72.92	9	7	Little Pied Bat	100.00	2.10	9
Circle 1	14.20	MR518_Moderate/Good_Medium	Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Moderate/Good_Medium	Yes	BB - Direct	0.50	71.33	0.00	71.33	0	25	Australian Bustard	58.33	2.60	25
Circle 1	14.20	MR518_Moderate/Good_Medium	Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Moderate/Good_Medium	Yes	BB - Panel	2.67	71.33	22.67	48.66	0	94	Australian Bustard	41.66	2.60	94
Circle 1	14.20	MR518_Moderate/Good_Medium	Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Moderate/Good_Medium	Yes	BB - Non-panel	4.97	71.33	22.67	48.66	0	175	Australian Bustard	41.66	2.60	175
Circle 1	14.20	MR589_Moderate/Good_Medium	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Moderate/Good_Medium	Yes	PG Mod - Direct	40.02	38.67	0.00	38.67	0	1,148	Australian Bustard	33.33	2.60	1,148
Circle 1	14.20	MR589_Moderate/Good_Medium	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Moderate/Good_Medium	Yes	PG Mod - Panel	182.15	38.67	36.67	2.00	0	883	Australian Bustard	25.00	2.60	883
Circle 1	14.20	MR589_Moderate/Good_Medium	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Moderate/Good_Medium	Yes	PG Mod - Non-panel	434.14	38.67	36.67	2.00	0	2,106	Australian Bustard	25.00	2.60	2,106
Circle 1	14.20	MR589_Moderate/Good_Poor	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Moderate/Good_Poor	Yes	PG Poor - Direct	2.14	16.00	0.00	16.00	0	30	Australian Bustard	33.33	2.60	0

Assessment circle name	Landscape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
Circle 1	14.20	MR589_Moderate/Good_Poor	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Moderate/Good_Poor	Yes	PG Poor - Panel	12.11	16.00	14.67	1.33	0	53	Australian Bustard	16.66	2.60	0
Circle 1	14.20	MR589_Moderate/Good_Poor	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Moderate/Good_Poor	Yes	PG Poor - Non-panel	28.87	16.00	14.67	1.33	0	127	Australian Bustard	16.66	2.60	0

BioBanking Credit Calculator

Species credits

Proposal ID :	034/2018/4878MP
Proposal name :	Darlington Point Solar Farm - August 2018 Final
Assessor name :	Toby Lambert
Assessor accreditation number :	034
Tool version :	v4.0
Report created :	07/08/2018 15:57

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Polytelis swainsonii	Superb Parrot	1.80	No		3.33	0.00	No	60

Appendix 12

Australian Project Grassland Experience

There are many international examples which have demonstrated improvements in biodiversity at solar farm sites following development of the solar farm which has typically been achieved through revegetation and management of the site. While there is not published research on Australian solar projects, there are numerous solar farms now constructed in Australia and observations can be made from these sites.

Edify Energy's experience with Australian Solar Farms is that the low impact nature of the solar panel array structures allows for grasses to recover in these areas quickly following construction and that a number of animal species continue to use the site as a habitat. Some photos from these sites are shown below.

While this project experience is across a range of climates and vegetation types in Queensland and Victoria, it is noted that the species and the ecosystems present at the Darlington Point Solar Farm site are different to those at other solar farms and it cannot be assumed that the site would be impacted in the same manner. This experience nevertheless suggests that there is potential for a similar outcome to be achieved at Darlington Point Solar Farm and that a complete loss of the vegetation communities and habitats at the site is not certain.

The following photographs depict the grassland rehabilitation between and under panels within circa 2 to 4 weeks of completion of construction of those arrays. It can be seen that within the 2-4 week period grass regrowth is substantial and this is likely due to the minimal ground disturbance that occurs during construction of the arrays.

The second photo shows the tracker system drive shaft being just visible, which prevent vehicular thoroughfare access between panel rows.

Under-panel grass retention / regeneration

Under-panel grass retention / regeneration.

Under-panel grass retention / regeneration in an Australian solar project.