WAMBO WIND FARM

Developed by

Cubico SUSTAINABLE INVESTMENTS

Renewable Energy Partners

Bird and Bat Management Plan

Wambo Wind Farm – Stage 1

03 November 2023

Project No.: 0532612

The business of sustainability

ERM

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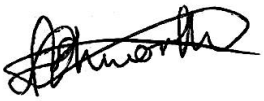
Signature Page

03 November 2023

Bird and Bat Management Plan

Wambo Wind Farm – Stage 1



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Acronyms and Abbreviations

Name	Description
ALA	Atlas of Living Australia
BACI	Before-After-Control-Impact
BBMP	Bird and Bat Management Plan
BUS	Bird Utilisation Surveys
CEMP	Construction Environmental Management Plan
CRM	Collision Risk Modelling
DAWE	Department of Agriculture, Water and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of the Environment and Science
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EoA	Evidence of Absence
ERM	Environmental Resources Management Australia Pty Ltd
GenEst	Generalised Estimator
Ha	Hectare
HSEQ	Health, Safety, Environment Quality
MW	Megawatts
NC Act	*Nature Conservation Act 1992*
PMST	Protected Matters Search Tool
PVA	Population Viability Analysis
RE	Regional Ecosystem
RSA	Rotor Swept Area
SARA	State Assessment and Referral Agency
SPRAT	Species Profile and Threats Database
VM Act	*Vegetation Management Act 1999*
WO	Wildlife Online
WTG	Wind Turbine Generator

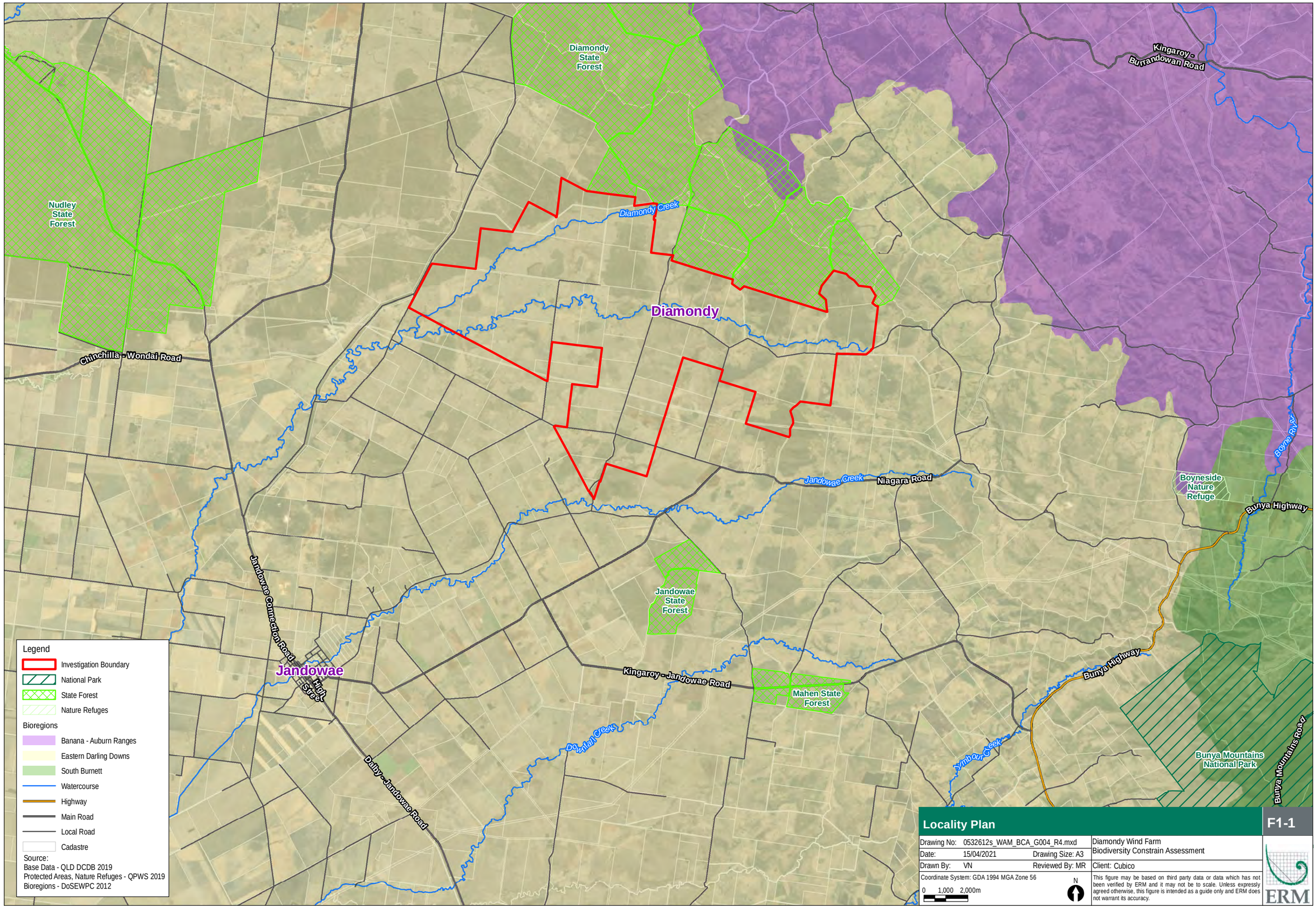
1 INTRODUCTION

1.1 Background

A Material Change of Use Development Permit was obtained to construct Wambo Wind Farm. The proposed wind farm is located approximately 15 km north-east of the town of Jandowae in the Western Downs Region (south-east) of Queensland, as shown in **Figure 1-1**. Wambo Wind Farm will comprise of up to 110 wind turbines, with an installed capacity of up to 660 megawatts (MW) over an area of 12,995 hectares (ha) (the Study Area), with an indicative layout of turbines and related infrastructure shown in **Figure 1-2**.

The proposed action was referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) on 31st July 2020 – EPBC Reference 2020/8727. Following requests for additional information on 26th of August 2020 and 19th October 202 and subsequent discussions with the Proponent, the Project was determined to be a 'Controlled Action' on 17th of January 2021 and confirmed the assessment approach to be by Preliminary Documentation on 23rd of February 2021. The Project was approved subject to conditions in October 2020 by the Queensland Government under the *Planning Act 2016* 2007-17946 SDA. The Changed Decision Notice 2210-31751 SPD was made for Stage 1 on the 13th October 2020, followed by the Changed Decision Notice 2210-31751 SPD for stage 2 on the 26th September 2023.

This updated final Bird and Bat Management Plan (BBMP) has been prepared for Stage 1 of the Project and provides guidance on the management of at-risk bird and bat species specific to Stage 1. A subsequent BBMP will be prepared for stage 2, construction of which will begin after Stage 1 in Q1 2024.


Diamondy State Forest
Kingaroy - Burrandowan Road
Nudley State Forest
Diamondy Creek
Diamondy
Chinchilla - Wondai Road
Boyne River
Boyneside Nature Refuge
Jandowae Creek
Niagara Road
Bunya Highway
Jandowae State Forest
Jandowae Connection Road
Jandowae
High Street
Kingaroy - Jandowae Road
Mahen State Forest
Bunya Highway
Dalby - Jandowae Road
Dowman Creek
Dymbour Creek
Bunya Mountains National Park
Bunya Mountains Road
Legend
Investigation Boundary
National Park
State Forest
Nature Refuges
Bioregions
Banana - Auburn Ranges
Eastern Darling Downs
South Burnett
Watercourse
Highway
Main Road
Local Road
Cadastre
Source:
Base Data - QLD DCDB 2019
Protected Areas, Nature Refuges - QPWS 2019
Bioregions - DoSEWPC 2012
Locality Plan
F1-1
Drawing No: 0532612s_WAM_BCA_G004_R4.mxd
Date: 15/04/2021
Drawing Size: A3
Drawn By: VN
Reviewed By: MR
Diamondy Wind Farm
Biodiversity Constrain Assessment
Client: Cubico
Coordinate System: GDA 1994 MGA Zone 56
0 1,000 2,000m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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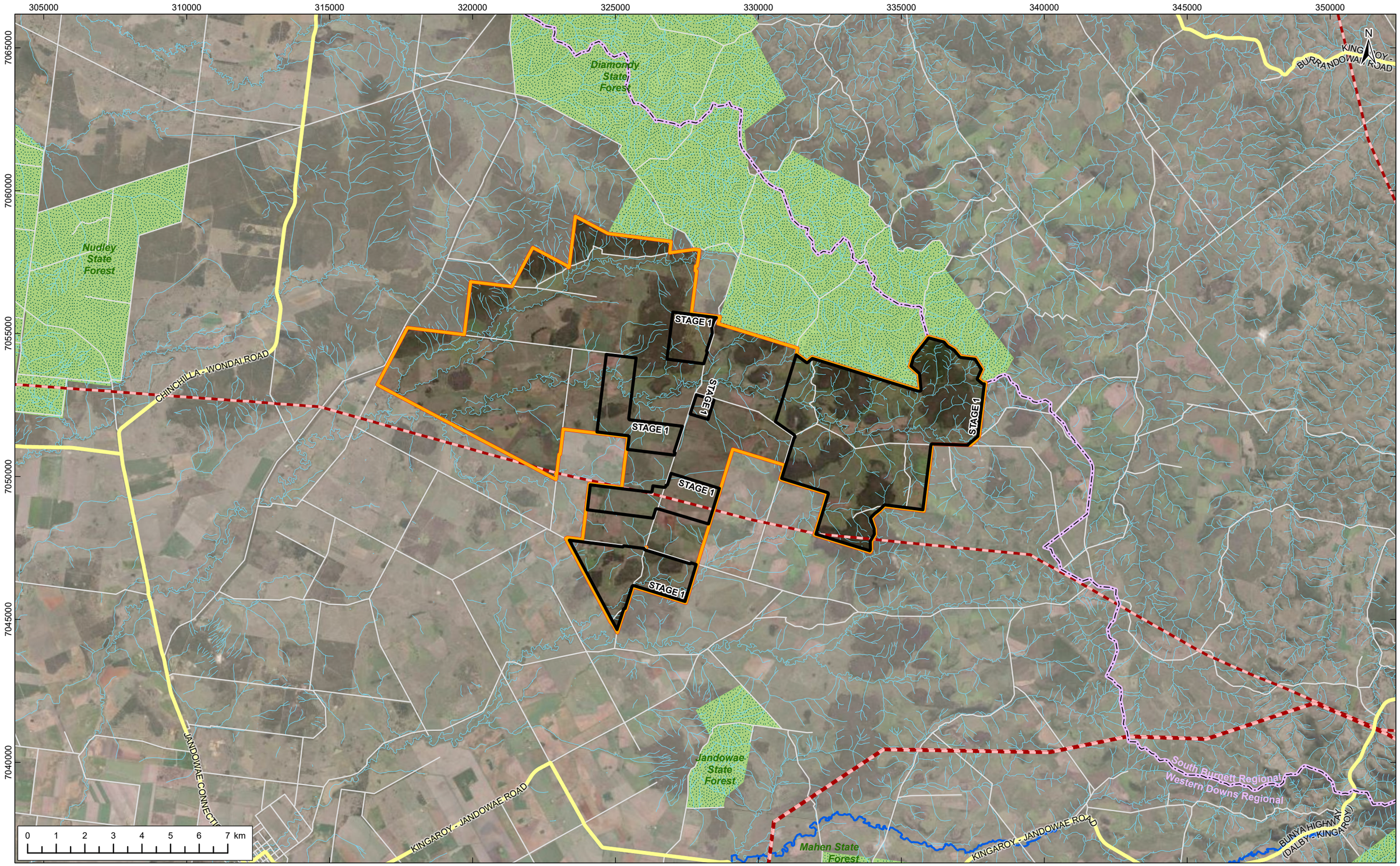
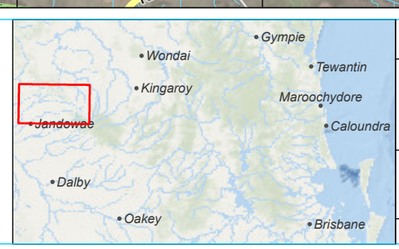


WAMBO WIND FARM

Project boundary (stage 1 & 2)
Stage 1 area
Existing 132kV powerline
Conservation area
Watercourse - major
Watercourse - minor
State controlled road
Local road
Local government area



PROJECT
Wambo Wind Farm

TITLE
Figure 1-2: Stage 1 and Stage 2 of the Wambo Wind Farm

DATE	STATUS	PRODUCED
18/10/2023	IFU	AC
SCALE	DATUM	APPROVED
1:125,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE WMWF_0035_01A BBMP Fig1-2 Wambo WF
REV 02B

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1.2 Requirements

As per the Conditions of Approval received by the State Assessment and Referral Agency (SARA), Condition 10 states the following:

(a) Prepare a Bird and Bat Management Plan (BMMP) certified by a suitably qualified ecologist. The BBMP must include:

Identification of 'at risk' bird and bat groups (i.e. all threatened and common species), seasons and areas within the project site which may attract high levels of mortality

Incorporate baseline data, including additional pre-operational surveys, Collison Risk Modelling and Population Viability Analysis

Identification of threshold trigger levels for species

Identification of mitigation measures and implementation strategies in order to reduce impacts on birds and bat groups

Monitoring requirements

A decision-making framework, including the trigger for operational shut-down.

(b) Provide the BBMP required by (a) of this condition to Queensland Treasury (windfarms@dsdmip.qld.gov.au)

(c) Operate the development in accordance with the BBMP.

1.3 Bird and Bat Management Plan Objectives

The objectives of this BBMP are to minimise and manage the impact of operation of the wind turbines associated with the Wambo Wind Farm on birds and bats that occur within the vicinity of the wind farm. Specifically, this BBMP aims to:

- Implement a monitoring program to understand the impact of the Wambo Wind Farm to at-risk birds and bats;
- Detail potential mitigation measures and implementation strategies to minimise impacts to birds and bats;
- Establish an adaptive management framework for managing and mitigating impacts on birds and bats;
- Document an agreed decision-making framework that identifies impact triggers leading to a management response;
- Identify any additional measures that can be used to manage impacts based on the outcomes of ongoing monitoring; and
- Offset mortality impacts to listed threatened species where applicable.

The BBMP will be adaptive in response to outcomes of surveys and potential species triggers that could result due to impacts to bird and bats from turbine collisions within the Study Area. This adaptive management framework will involve consultation with DCCEEW for a management response following identification of mortality considered to meet trigger levels for at risk species.

This BBMP will be implemented from operation commencement and it is proposed to be implemented across the first two years of operation for Stage 1, commensurate with the level of potential risk to birds and bats resulting from the Wambo Wind Farm. An additional BBMP will be prepared for stage 2 of the Wambo Wind Farm.

1.4 Site Description

The Study Area is located in the Queensland Brigalow Belt bioregion and includes a range of landscape features typical of the region, from flat alluvial plains to undulating slopes of grassland with patches of eucalypt dominant and codominant open woodland. The Study Area is separated into Stage 1 and 2 development footprints that will be constructed and commence operation consecutively. Stage 1 is predominantly located within the centre and eastern sides of the project (Figure 1-3). Stage 2 is predominantly located within the western portion of the Study Area, with some areas overlapping with Stage 1.

There are a number of surface water sources throughout the Study Area, in the form of farm dams as well as drainage lines with associated riparian vegetation. The dominant land use for the Study Area is agriculture, consisting of cattle grazing with some cultivation. The agricultural enterprises use a number of land management techniques that have shaped the vegetation communities that occur within the Study Area, with frequent cool burns used to encourage grassy understorey within eucalypt dominated forests and woodlands, selective logging in some areas to support fencing and additional farm revenue and pulling of regrowth vegetation to maintain grasslands for grazing. There are some areas cultivated for crops, in alluvial flats, as well as Leucaena plantations that are used as additional fodder for stock. In the centre of the Study Area, there is a private plantation of Chinchilla white gum (*Eucalytpus argophloia*). The Chinchilla white gum is a naturally occurring rare species, known from only a small population that occurs across a few square kilometres, north of Jandowae/Nudley State Forest and south of Barakula State Forest. The plantation occurs approximately 25 km outside of the known distribution of the species.

Vegetation communities occur as remnant and regrowth vegetation across the Study Area. Where remnant vegetation is mapped as Regional Ecosystems (RE) (under the *Vegetation Management Act 1999* (VM Act)), it was noted that mapped units are generally consistent with on the ground observations. However, the RE extents, and where appropriate floristic composition, have been updated where appropriate from ground surveys to appropriately inform habitat mapping for MNES. The majority of the Study Area (9,035 ha or 69.5% of the 12,995 ha Study Area) consists of non-remnant grasslands and cleared areas supporting small to medium agricultural enterprises.

The condition of vegetation communities within the Study Area is modified as a result of current and previous land management practices (agriculture and cattle grazing) with most woodlands dominated by a grassy understorey, including introduced grass species. Vegetation communities generally occur in small to medium sized patches throughout the landscape, with some areas in the north and eastern sections connected to larger patches, including Diamondy State Forest, adjacent to the Study Area. Two ephemeral watercourses and associated linear fragments of riparian vegetation, namely Diamondy Creek and Jingi Jingi Creek intersect the Study Area, while other linear fragments of vegetation occur infrequently along gully lines.

320000 325000 330000 335000 340000

7055000 7050000 7045000

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 53 WTG 28 WTG 32 STAGE 1
WTG 34 WTG 12 WTG 73 WTG 35 WTG 05 WTG 26 WTG 27 WTG 24 WTG 17 WTG 18 WTG 36 WTG 21 WTG 13 WTG 11 WTG 19 WTG 76

Diamondy State Forest
South Burnett Regional
Western Downs Regional

Canaga Creek
Diamondy Creek
Jingi Jingi Creek
Flat Creek
Mount Ivory Creek
Sandy Creek

OLD BURRANDOWAN ROAD
CURDS ROAD
WOLLETTS ROAD
JOLIMONT ROAD
DIAMONDY ROAD
MOUNTPIPE DODGE ROAD
BENJAMINS ROAD
MCGILLS ROAD
IRONPOT ROAD
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
JINGHI ROAD
SARGENTS ROAD
MOUNT IVORY CREEK ROAD
WEILCAMP LANE
NIAGARA ROAD
COORANGA NORTH-NIAGARA ROAD

N

0 1 2 3 4 km

WAMBO WIND FARM

Project boundary (stage 1 & 2)
Stage 1 area
Stage 1 development footprint
Stage 1 wind turbine
Met mast location

Construction compound & laydown area (stage 1 & 2 shared area)
O & M facility (stage 1 & 2 shared area)
Substation/switchyard (stage 1 & 2 shared area)
Battery storage (BESS)

Existing 132kV powerline
Conservation area
Watercourse - major
Watercourse - minor
Local government area

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Gympie
Wondai
Tewantin
Kingaroy
Maroochydore
Jandowae
Caloundra
Dalby
Oakey
Brisbane

PROJECT
Wambo Wind Farm

TITLE
Figure 1-3: Wambo Wind Farm Stage 1 Layout

DATE	STATUS	PRODUCED
18/10/2023	IFU	AC
SCALE	DATUM	APPROVED
1:65,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE WMWF_0035_01A BBMP Fig1-3 WF Layout REV 02B

2. PRE-OPERATIONAL BIRD AND BAT INFORMATION

Seven separate field surveys were undertaken during flora and fauna investigations related to the Wambo Wind Farm, from November 2019 to May 2023. The field surveys included bird and bat surveys, which were used to identify 'at-risk' species to be considered during the operation of Wambo Wind Farm. Information from desktop sources was also used to inform an understanding of the ecology of 'at-risk' species to support the development of management measures, as defined in this BBMP.

2.1 Pre-Operational Survey Methods

Prior to field surveys, a number of desktop sources were reviewed to identify ecological values that may occur within the Study Area. Desktop analysis was also used to guide development of field survey sampling techniques, followed by a field survey program to collect data to describe on-ground conditions. The information from the desktop sources and field surveys were used to assess and document the likelihood of occurrence and potential occurrence of bird and bat species within the Study Area. The desktop sources used in the assessment are presented in **Table 2-1**.

Table 2-1 Desktop Sources

Information Source	Name	Data Description
DCCEEW	PMST	The search tool provides predictive results of MNES based on mapping of known and potential species distribution, habitat, ecological communities and wetlands. The 'Likely' and 'Possible' outputs are based on modelling results, with 'Known' results being based on actual, known records within the area. The features highlighted by the search are considered further through a likelihood of occurrence assessment (see Appendix B). Search area: -26.648388, 151.258670 (with a 20 km buffer around this middle point of the Study Area).
DNRME	Regional Ecosystem Version 8.0 mapping	This product maps remnant vegetation communities across Queensland and identifies communities listed as endangered, of concern or least concern status.
DNRME	Property Maps of Assessable Vegetation mapping (published 4 May 2017)	This product provides certified property scale maps indicating where landholders can clear regrowth in 'Category X' areas without further approval.
Queensland Government	MSES version 4.1 mapping	This product maps areas of MSES as defined under the Qld State Planning Policy.
DNRME	Queensland Globe	A Google Earth based product that allows viewing of spatial data and imagery covering Queensland.
Department of Science, Information Technology and Innovation (DSTIA)	Wildlife Online (WO)	A database that contains records of wildlife sightings including threatened flora and fauna species (protected under the NC Act) that have been provided to the agency by Government departments and external organisations. Search area: -26.648388, 151.258670 (with a 20 km buffer around this middle point of the Study Area).
ala.org.au	Atlas of Living Australia (ALA)	Australia national biodiversity database (supported by the National Collaborative Research Infrastructure Strategy, CSIRO). Database contains records accessed through an interactive spatial portal. Threatened species are searched to identify known records in proximity to the Study Area.
Western Downs Regional Council	Western Downs Planning Scheme 2017	The Westerns Downs Planning Scheme 2017 provides information relating to biodiversity, and wetland and waterway corridors.

Information Source	Name	Data Description
GHD	GHD Constraints Report 2019	This recent report details the ecological constraints found in the Study Area from desktop searches. This report helped to inform research into the potential MNES, MSES and local government environmental matters which could be present in the site.
AECOM	Cooper's Gap Windfarm EIS 2016 (Chapter 12 Ecological Assessment)	This report is an ecological assessment conducted for Cooper's Gap Windfarm which sits adjacent to the east of the Study Area. It was used to gain information on ecological values surrounding the Study Area. This included information on migratory bird flight paths as well as vegetation, threatened ecological communities (TEC) and birds and bats. It was also used to inform the likelihood of occurrence assessment, particularly in relation to threatened species presence/records in the locality.
AECOM	Dulacca Renewable Energy Project – Fauna Technical Report and Flora Technical Report (2019)	This report is an ecological assessment conducted for Dulacca Windfarm which sits approximately 100 km to the west of the Study Area. It was used to gain information on ecological values with regards to the Study Area. This included information on migratory bird flight paths as well as vegetation, TECs and birds and bats. It was also used to inform the likelihood of occurrence assessment, particularly in relation to threatened species presence/records in the locality.
DCCEEW	Species Profile and Threats Database (SPRAT)	The SPRAT profiles and associated conservation advice documents were consulted for the following reasons: They provide detailed information for the likelihood of occurrence assessment on: Species distribution; and Species habitat preferred and general. The conservation advice documents are particularly important for assessing TECs found in field surveys, against the listed TEC guidelines.

The criteria used for the likelihood of occurrence assessment are outlined in **Table 2-2.** Recent records within the locality are defined as less than 20 years. The outcomes of the likelihood of occurrence assessment for the Study Area are found in **Appendix B**.

Table 2-2 Likelihood of Occurrence Criteria

	Preferred habitat exists	General habitat exists[1]	Habitat does not exist[2]
Records within Study Area (based on site surveys and recent (last 20 years) records)	Known	Known	Known
Records in the locality[3]	Likely	Potential	Unlikely
No records in the locality, but Study Area is within known distribution	Potential	Potential	Unlikely
No records in the locality, and Study Area is outside of distribution	Unlikely	Unlikely	Unlikely

[1]Habitat may be considered general, but not preferred because: some desired habitat features may be absent; habitat has poor connectivity; or habitat is disturbed.

[2]Based on sources reviewed and/or field survey results.

[3] 'Locality' refers to a 10 km buffer of the Study Area.

A summary of field surveys related to bird and bat surveys undertaken in Nov 2019, Dec 2020, Jan 2021,Feb 2021, Jan/Feb 2023 and May 2023, the techniques used and survey effort undertaken, are summarised in **Table 2-3.** The survey design including targeted surveys for those listed threatened and migratory species with potential to occur in the Study Area was developed on the basis of the following survey guidelines:

- Survey Guidelines for Australia's Threatened Birds (Department of the Environment, Water, Heritage and the Arts [DEWHA], 2010a);
- Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (Department of the Environment [DoE], 2015);
- Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Department of the Environment and Science [DES], 2018);
- National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus* (DAWE, 2021); and
- Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010b).

The full detail on how the surveys adhered to guidelines is provided in a survey guideline adequacy assessment in **Appendix C**. The conditions for the four survey periods is provided in **Table 2-4** to **Table 2-7.**

Table 2-3 Bird and Bat Surveys Undertaken within the Study Area

Dates	Target	Techniques	Survey Effort
26-29 November 2019	Bird Surveys	■ Bird Utilisation Surveys using the Band Model (SNH, 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 16 individual surveys
	Bat Surveys	■ Bat detection via the use of ultrasonic devices (Anabats)	■ Five Anabats locations recording for four consecutive nights
7-11 December 2020	Bird Surveys	■ Bird Utilisation Surveys using the Band Model (SNH 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 90 BUS surveys ■ 10 opportunistic bird surveys
	Bat Surveys	■ Bat detection via the use of ultrasonic devices (Anabats)	■ Five Anabats locations recording for four consecutive nights
18-22 January 2021	Bird surveys	■ Bird Utilisation Surveys using the Band Model (SNH 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 90 BUS surveys ■ 15 opportunistic bird surveys
15-19 February 2021	Bird surveys	■ Bird Utilisation Surveys using the Band Model (SNH 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 47 BUS surveys ■ six opportunistic bird surveys
	Bat surveys	■ Bat detection via the use of ultrasonic devices (Anabats)	■ Five Anabats locations recording for four consecutive nights
	Harp trapping	■ Harp trapping for species that are indistinguishable in their calls (Schulz, 1999). ■ This was done following anabat's detecting potential listed threatened species (*Nyctophyllis spp.*)	■ Five harp traps deployed for four nights (20 trap nights)

Dates	Target	Techniques	Survey Effort
July 2021	Bird Surveys	■ Bird Utilisation Surveys using the Band Model (SNH 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 26 BUS surveys
January/February 2023	Bird Surveys	■ Bird Utilisation Surveys using the Band Model (SNH 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 58 BUS surveys
May 2023	Bird Surveys	■ Bird Utilisation Surveys using the Band Model (SNH 2012; Band et al., 2007) ■ Roaming bird surveys between survey areas.	■ 32 BUS surveys
		■	■

Table 2-4 Daily Weather Observations at Dalby Airport for November 2019

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C	mm	°C	%			°C	%		
25/11/19	15.8	33.5	0	25.8	39	*NE*	13	32.3	17	*ENE*	17
26/11/19	19.8	35.0	0	26.1	46	*N*	28	33.2	22	*NNW*	22
27/11/19	19.5	37.2	2.8	27.9	45	*WNW*	17	36.2	11	*WNW*	28
28/11/19	20.8	35.9	0	28.1	44	*N*	22	35.1	22	*NNE*	11
29/11/19	21.1	37.1	0	27.9	39	*NNE*	20	36.8	16	*N*	11

Dir = wind direction
Spd = wind speed
RH = relative humidity
Source: *Australian Government Bureau of Meteorology, www.bom.gov.au*

Table 2-5 Daily Weather Observations at Dalby Airport for December 2020

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C	mm	°C	%			°C	%		
07/12/20	21.7	34.2	3.8	26.4	62	*NNW*	22	33.7	33	*WNW*	28
08/12/20	19.6	27.7	13.8	21.8	49	*SW*	28	25.3	28	*SW*	24
09/12/20	9.7	32.1	0	25.4	43	*ENE*	22	30.9	21	*S*	9
1012/20	16.1	33.3	0	24.3	48	*NE*	11	31.3	20	*NNW*	9
11/12/20	18.5	22.9	0	21.7	63	*SE*	15	19.7	69	*E*	19

Dir = wind direction
Spd = wind speed
RH = relative humidity
Source: *Australian Government Bureau of Meteorology, www.bom.gov.au*

Table 2-6 Daily Weather Observations at Dalby Airport for January 2021

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C	mm	°C	%			°C	%		
18/01/21	20.4	29.1	18	26.2	62	*ENE*	4	22.4	88	*S*	22
19/01/21	18	30.3	39.8	21.6	75	*WSW*	13	29.9	40	*SSE*	13
20/01/21	18.8	30.7	0.2	25.4	57	*E*	28	28.7	41	*ENE*	30
21/01/21	17.8	28.2	0	22.7	61	*E*	24	27.3	46	*ESE*	13
22/01/21	16	29.8	0	22.5	62	*W*	7	27.9	35	*ESE*	7

Dir = wind direction
Spd = wind speed
RH = relative humidity
Source: *Australian Government Bureau of Meteorology, www.bom.gov.au*

Table 2-7 Daily Weather Observations at Dalby Airport for February 2021

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C	mm	°C	%			°C	%		
15/02/21	17.3	32.8	0	25.3	47	*ESE*	20	31.4	23	*S*	22
16/02/21	14.2	32.1	0	25.5	45	*ESE*	26	30.6	29	*ESE*	24
17/02/21	14.9	30.9	0	24.1	51	*SE*	20	29.7	33	*SE*	22
18/02/21	16.1	30.6	0	24.4	51	*SE*	30	29.1	37	*E*	30
19/02/21	18.1	31.7	0	25.3	56	*ESE*	24	28.3	46	*SSE*	24

Dir = wind direction
Spd = wind speed
RH = relative humidity
Source: *Australian Government Bureau of Meteorology, www.bom.gov.au*

Table 2-8 Daily Weather Observations at Dalby Airport for July 2022

	Temp		Rain
	Min	Max	
	°C	°C	mm
16/07/22	0	23.5	0
17/07/22	4.7	21.5	0
18/07/22	10.6	21.6	0
19/07/22	2.3	22.2	0
20/07/22	5.3	21.8	0

Table 2-9 Daily Weather Observations at Dalby Airport for August 2022

	Temp		Rain
	Min	Max	
	°C	°C	mm
30/08/22	12.9	19.2	0
31/08/22	10.3	20.7	4
01/09/22	10.1	22.9	0.2
02/09/22	12	18.3	0
03/09/22	12.1	17.2	37

Table 2-10 Daily Weather Observations at Dalby Airport for January/February 2023

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C	mm	°C	%			°C	%		
30/01/23	-	35.2	0	28.9	47	*N*	22	34.5	26	*NW*	20
31/01/23	21.6	33.7	0	27.1	58	*NNW*	30	32.1	37	*NW*	26
01/01/23	21.7	34.8	6.8	26.3	67	*SW*	11	33.6	30	*WSW*	13
02/01/23	23	34.3	0	28.2	56	*ENE*	9	28.1	55	*N*	17
03/01/23	18.6	38.1	1.6	29.5	55	*NNW*	24	37.7	18	*NNW*	28

Dir = wind direction
Spd = wind speed
RH = relative humidity
Source: *Australian Government Bureau of Meteorology, www.bom.gov.au*

Table 2-11 Daily Weather Observations at Dalby Airport for May 2023

	Temp		Rain	9:00 AM				3:00 PM			
	Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
	°C	°C	mm	°C	%			°C	%		
29/05/23	-1.1	18.7	0	10.3	58	*SSW*	26	18.1	29	*SW*	24
30/05/23	-0.4	20.8	0	10.7	62	*SSW*	9	20.1	29	*SSE*	9
31/05/23	-0.4	20.8	0	10.7	62	-	-	22.1	24	*WSW*	7
01/06/23	4	23.9	0	16.7	54	*NW*	13	22.6	27	*SSW*	9
02/06/23	3.8	25.5	0	14.5	61	*SE*	11	24.5	30	*E*	15

Dir = wind direction
Spd = wind speed
RH = relative humidity
Source: *Australian Government Bureau of Meteorology, www.bom.gov.au*

2.1.1 Bird Surveys

Bird surveys were conducted in accordance with the time and effort required by the survey guideline requirements.

It is also noted that specific requirements for species listed in the *Survey Guidelines for Australia's Threatened Birds* (as listed under the EPBC Act) (DEWHA, 2010a) were considered in designing the field survey program, however, the *Survey Guidelines for Australia's Threatened Birds* (DEWHA, 2010a) does not contain specific methodology for the white-throated needletail or glossy ibis.

The Queensland State Code 23 also recommends Before-After-Control-Impact (BACI) design principle for surveys where the Study Area is determined to support significant bird species. The aim of the BACI design is to compare environmental variables before and after a human activity and between the area affected by the development (impact) and an unaffected area (control) (Stewart-Oaten, 1986). In this instance, data from control and impact areas, before and after the construction of the windfarm, will be undertaken to determine if there are any avian impacts as a result of the Wambo Wind Farm.

The BACI designed bird surveys include BUS such as point, waterbody and birds of prey surveys at both control locations (outside of the Wambo Wind Farm boundary) and impact locations (within the Wambo Wind Farm boundary). Field survey locations from the seven field surveys are provided in Figure 2-1, and include both control and impact locations.

A Collision Risk Modelling has been undertaken in accordance with the Band Collision Risk Modelling Method (Band, 2007) and is presented in this BBMP, from data collected across all surveys.

The following sections detail the specific BUSs undertaken throughout the Study Area. Additionally, the full list of bird species targeted over the seven survey periods, their survey guideline requirements and survey adequacy is provided in **Appendix C.**

Point Surveys

Point surveys were conducted to target diurnal woodland and riparian bird species. Two ecologists traversed suitable woodland and riparian habitats and conducted 30 minute timed surveys for all birds in an approximate 2 ha area.

Waterbody surveys

Waterbody surveys were conducted in order to target aquatic species and woodland species utilising the waterbody. Observations were made from a stationary position, and birds were identified by call detection and visual observations. The Study Area contained several artificial waterbodies, likely to act as important water sources in the landscape, particularly during dry conditions.

Birds of Prey Surveys

Birds of prey surveys were undertaken to target the listed threatened species such as the red goshawk (*Erythrotriorchis radiatus*) and generally occurring birds of prey. Birds of prey surveys were undertaken at vantage points (e.g. large hills and extensively cleared areas) at mid-morning when birds of prey become increasingly active. Such surveys were delivered as fixed-point bird count surveys.

In consideration of the field survey effort detailed above and the detailed guideline and legislative requirements further described above, these efforts are considered to have been performed in accordance with all relevant guidelines and requirements. Further, State legislation requires the use of Bird Utilisation Surveys in accordance with the Band Model and implementation of Before-After-Control-Impact design, which has been implemented as detailed above. As such, survey methods and efforts are considered adequate against the guideline and legislative requirements and provide a valid representation of species use within the Study Area.

2.1.2 Bat Surveys

Microbat surveys were conducted to determine the presence/absence of microchiropteran bats within the Study Area. One ultrasonic bat detector (Anabats) was placed at each of the five survey zones in the Study Area. These devices were used to detect ultrasonic signals from microchiropteran bat species in the Study Area, for four consecutive survey nights.

The bat detectors were placed across representative remnant vegetation/habitat types. This included riparian woodlands and eucalypt open forest or woodlands. The detectors were specifically placed in areas that were in close proximity to potential flight paths/water sources (farm dams). The survey locations were selected on the basis that they provided the greatest likelihood of detecting an abundance and diversity of bat species.

The survey requirements and recommended survey effort and methods for bats is as follows:

- *Survey guidelines for Australia's threatened bats (DEWHA, 2010b);*
  - Trapping methods such as harp traps are recommended. Such effort is not precisely stated, but studies have found that the use of 20 or more traps a night a good for detection (Schulz, 1999).
  - Echolocation call detection to be carried out for a recommended 30-60 minutes per night for four to five survey nights.
  - Recommended that a variety of trapping and call detection methods are used together, where possible.

The 2019, 2020 and 2021 surveys were carried out in accordance with echolocation call detection requirements. Harp trapping was used in the 2021 survey effort, due to the presence of potential threatened *Nyctophillus spp*. being detected by anabats in December 2020. Harp trapping was undertaken in 2021 at the location where *Nyctophillus spp*. were detected by anabats to determine presence of *Nyctophillus spp*.

Anabat and Harp Trapping

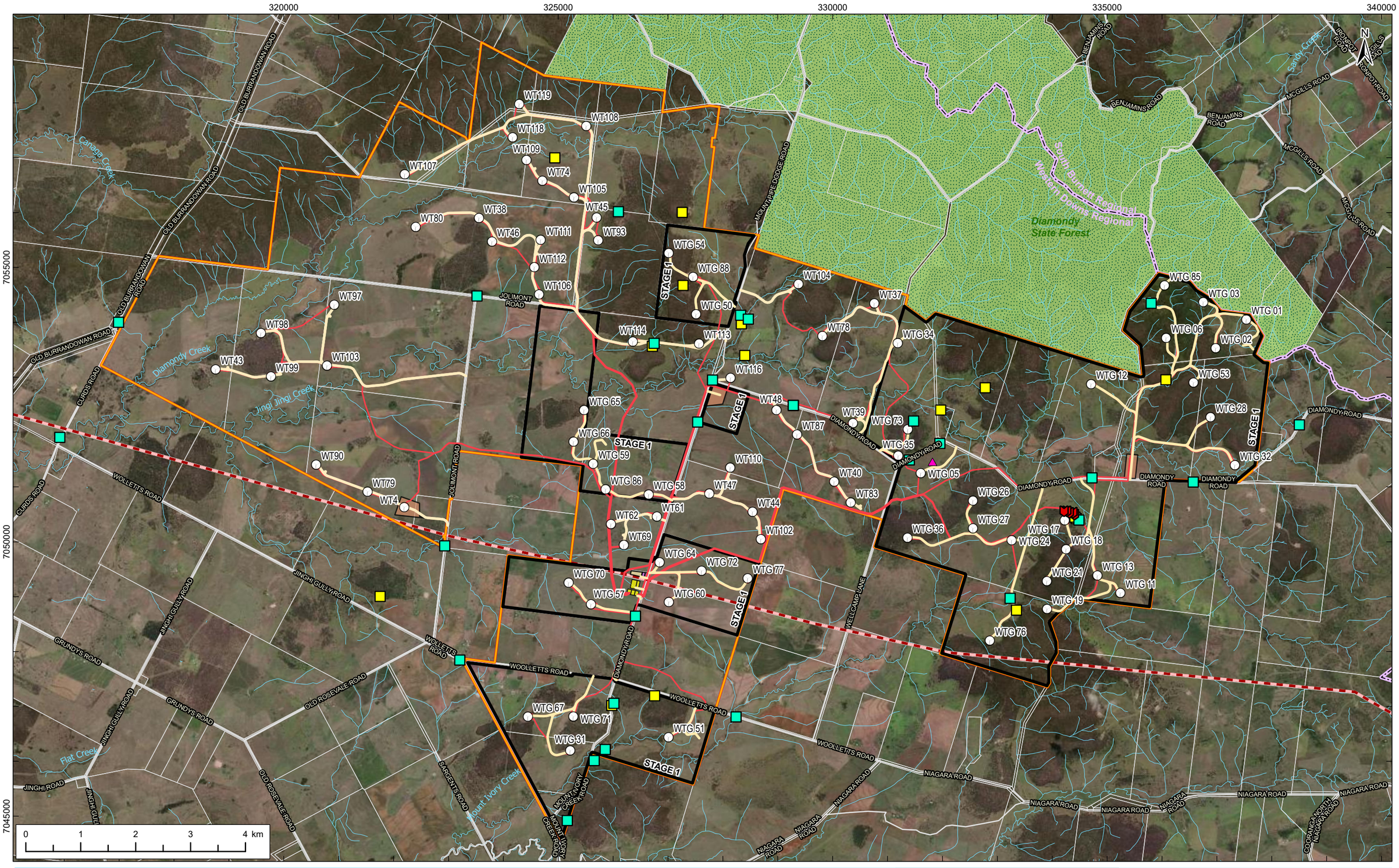
The echolocation calls of microchiropteran (insectivorous) bats will be recorded using four ultrasonic detectors (Anabats) and stored on compact flash memory cards for later computer analysis and identification. The detector locations will be selected based on:

- Attempts to maximise diversity of bat species detected; and
- The degree to which the locations represent fauna habitat types within the site.

Prior to field placement, each detector will be calibrated and set to operate at a uniform sensitivity level (at a level of 7, where the maximum is 10). Detectors will be placed in suitably open areas (to maximise acoustic clarity) with the microphone directed upwards at a 45° angle from the ground (approximately 1.5 m off the ground). Detectors will be deployed before dusk on day 1, left overnight for two nights to record calls, then collected and moved to other locations. All bat calls recorded will be downloaded and sent to a qualified and experienced bat-call analyst for identification.

The locations chosen to target bat species in an easy to detect manner within the Study Area included along flyways as well as near waterholes. This included drainage lines, between tree canopies and along tracks in elevated parts of the Study Area that are potential flight paths, as well as dams, waterways and strips of vegetation in lower parts of the Study Area.

Harp trap locations were chosen where anabats detected the presence of potential listed threatened species. The harp traps were set up in areas determined as suitable flyways by a suitably qualified ecologist and at heights suitable for detection (approximately 1.5-2 m off the ground). The bat survey locations can be found in **Figure 2-1.**



WAMBO WIND FARM

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- Bat (Anabat) survey location
- Bird (BUS) survey location
- Harp trap location
- Project boundary (stage 1 & 2)
- Stage 1 area
- Wind turbine
- Access track
- Cable corridor
- Met mast location
- Construction compound & laydown area (stage 1 & 2 shared area)
- O & M facility (stage 1 & 2 shared area)
- Substation/switchyard (stage 1 & 2 shared area)
- Battery storage (BESS)
- Existing 132kV powerline
- Conservation area
- Watercourse - major
- Watercourse - minor
- Local government area

PROJECT: **Wambo Wind Farm**

TITLE: **Figure 2-1: Bat and Bird Survey Locations**

DATE	STATUS	PRODUCED
19/10/2023	IFU	AC
SCALE: 1:65,000 @ A3	DATUM: GDA 1994 MGA Zone 56	APPROVED: M.Rookwood
FILE: WMWF_0035_01A BBMP Fig2-1 BB Survey Locations		REV: 01A

2.2 Pre-Operational Survey Results

2.2.1 Birds

A combined total of 128 bird species were identified across the seven field surveys. This is considered to have met the requirements described by the onshore windfarm interim guidance on bird and bat management (DAWE, 2022), and the QLD State Code 23 for sampling across seasons, and a 24-month period. Listed threatened species observed across the seven survey periods included only the white-throated needletail (*Hirundapus caudacutus*). The rufous fantail (*Rhipidura rufifrons*) was the only listed migratory species observed across the seven surveys. The white-throated needletail was recorded during the December 2020 bird surveys on two separate occasions, in small flocks flying at heights above 700 m across the Study Area. The rufous fantail was recorded on a single occasion during the January 2023 survey with two individuals recorded ten metres off the ground.

Birds observed were largely classed as woodland bird species, and were recorded in a variety of habitats including non-native grasslands, eucalyptus woodlands, riparian corridors, rocky outcrops, and waterbodies. In general, bird abundance was regarded as low in 2019 due to a previous extensive period of drought, and then moderate following rainfall during spring 2020 prior to the 2020/2021 December-January field investigation period. Bird abundance and diversity remained low to moderate throughout the remaining field survey efforts.

The outcomes of the desktop and field surveys informed a likelihood of occurrence for listed bird species within the Study Area. **Table 2-8** summarises the outcome of the likelihood of occurrence assessment for bird species listed as threatened and/or migratory under the EPBC Act and NC Acts identified from desktop sources and information obtained from the seven field surveys. The white-throated needletail and rufous fantail were observed while the glossy ibis was considered likely to occur in the Study Area. Fourteen bird species have been identified with potential to occur, due to species distributions overlapping the Study Area, and so their potential occurrence cannot be ruled out. However, in the absence of records in the locality or Study Area, or specific habitat requirements observed in the Study Area, and that the Study Area is located at the edge of the current known distribution of some species, potential habitat has been mapped for only eleven of these species. The full detailed likelihood of occurrence can be found in **Appendix B.** Mapping of potential habitat for the white-throated needletail, rufous fantail, and glossy ibis in the Study Area is provided in **Figure 2-2, Figure 2-3** and Figure 2-4 respectively. Mapping of potential habitat for the seven species with potential to occur in the Study Area, is provided in **Figure 2-5.**

Table 2-12 Likelihood of Occurrence for Listed Threatened Birds within the Study Area

Species Name	Common Name	EPBC Act Status	NC Act Status	Habitat in the Study Area	Likelihood of Occurrence
Birds					
Actitis hypoleucos	common sandpiper	M	SLC	Yes - potential habitat of farm dams.	Potential
Anthochaera phrygia	regent honeyeater	CE	CE	Yes - potential habitat associated with poplar box *and E. tereticornis* woodlands associated with creek lines.	Potential
Apus pacificus	fork-tailed swift	M	SLC	No - no specific habitat requirements observed.	Potential
Calidris acuminate	sharp-tailed sandpiper	M	SLC	No - no specific habitat requirements observed.	Potential
Calidris ferruginea	curlew sandpiper	CE, M	CE	Yes - potential habitat of farm dams.	Potential
Calidris melanotos	pectoral sandpiper	M	SLC	No - no specific habitat requirements observed.	Unlikely
Cuculus optatus	oriental cuckoo	M	SLC	No - no specific habitat requirements observed.	Unlikely
Erythrotriorchis radiatus	red goshawk	E	E	Yes - potential habitat in the form of riverine habitats containing tall old trees and taller forests and woodlands (northern area of Study Area)	Potential
Gallinago hardwickii	Latham's snipe	M	SLC	No - no specific habitat requirements observed.	Potential
Geophas scripta scripta	southern squatter pigeon	V	V	No - no specific habitat requirements observed.	Potential
Grantiella picta	painted honeyeater	V	V	Yes - potential habitat of Brigalow woodlands.	Potential
Hirundapus caudacutus	white-throated needletail	V, M	V	Yes – potential habitat of eucalypt forests associated with wooded ridges in elevated areas.	Known
Lathamus discolour	swift parrot	CE	E	No - no specific habitat requirements observed.	Unlikely
Monarcha melanopsis	black-faced monarch	M	SLC	Yes - potential habitat of semi deciduous vine-thicket.	Potential
Monarcha trivirgatus	spectacled monarch	M	SLC	No - no specific habitat requirements observed.	Unlikely

Species Name	Common Name	EPBC Act Status	NC Act Status	Habitat in the Study Area	Likelihood of Occurrence
Motacilla flava	yellow wagtail	M	SLC	Yes - potential habitat of open grasslands associated with farm dams.	Potential
Myiagra cyanoleuca	satin flycatcher	M	SLC	Yes - potential habitat of eucalypt forests associated with waterways.	Potential
Pandion haliaetus	osprey	M	V	No - no specific habitat requirements observed.	Unlikely
Falco hypoleucos	grey falcon	V	V	Yes - potential habitat of eucalypt forests associated with waterways.	Potential
Plegadis falcinellus	glossy ibis	M	SLC	Yes – potential habitat of farm dams.	Likely
Rhipidura rufifrons	rufous fantail	M	SLC	Yes – Potential habitat with semi-evergreen vine thicket and eucalypt vegetation with dense understory, particularly adjacent to contiguous vegetation such as Diamondy State Forest	Known
Rostratula australis	Australian painted snipe	E	E	Yes - potential habitat of farm dams	Potential
Turnix melanogaster	black-breasted button-quail	V	V	No - no specific habitat requirements observed.	Unlikely

Status listing per EPBC and NC Acts: CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory; LC = Least Concern; SLC = Special Least Concern; NT = Near Threatened.

320000 325000 330000 335000 340000

7055000 7050000 7045000

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 53 WTG 28 STAGE 1 WTG 32
WTG 34 WTG 12 WTG 73 WTG 35 WTG 05 WTG 26 WTG 27 WTG 24 WTG 38 WTG 17 WTG 18 WTG 21 WTG 13 WTG 11 WTG 19 WTG 76

Diamondy State Forest
South Burnett Regional
Western Downs Regional

Canaga Creek
Diamondy Creek
Jingi Jingi Creek
Sandy Creek
Flat Creek
Mount Ivory Creek

OLD BURRANDOWAN ROAD
JOLIMONT ROAD
MOUNTAPE DODGE ROAD
DIAMONDY ROAD
CURDS ROAD
WOLLETTS ROAD
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
SARGENTS ROAD
MOUNT IVORY CREEK ROAD
WELLCAMP LANE
BENJAMINS ROAD
MCGILLS ROAD
IRONPOT ROAD
NIAGARA ROAD
COORANGA NORTH NIAGARA ROAD
JINGHI ROAD

0 1 2 3 4 km

N

WAMBO WIND FARM

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- Project boundary (stage 1 & 2)
- Stage 1 area
- Wind turbine
- Access track
- Cable corridor
- Met mast location
- Construction compound & laydown area (stage 1 & 2 shared area)
- O & M facility (stage 1 & 2 shared area)
- Substation/switchyard (stage 1 & 2 shared area)
- Battery storage (BESS)
- Existing 132kV powerline
- Conservation area
- Watercourse - major
- Watercourse - minor
- Local government area
- White-throated Needletail habitat

PROJECT: **Wambo Wind Farm**

TITLE: **Figure 2-2: Bird & Bat Management Plan**
Potential Habitat for the White-throated Needletail in the Study Area

DATE	STATUS	PRODUCED
13/11/2023	IFU	AC
SCALE	DATUM	APPROVED
1:65,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE: WMWF_0035_2-2_B White-throated Needletail BBMP REV: 02B

320000 325000 330000 335000 340000

7055000 7050000 7045000

N

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1
WTG 34 WTG 73 WTG 35 WTG 05 WTG 36
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 12 WTG 53 WTG 28 STAGE 1 WTG 32
WTG 26 WTG 27 WTG 24 WTG 17 WTG 18 WTG 21 WTG 13 WTG 11 WTG 19 WTG 76

Canoga Creek
Diamondy Creek
Jingi Jingi Creek
Flat Creek
Mount Ivory Creek
Sandy Creek

South Burnett Regional
Western Downs Regional
Diamondy State Forest

OLD BURRANDOWAN ROAD
JOLIMONT ROAD
CURDS ROAD
WOLLETTS ROAD
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
JINGHI ROAD
SARGENTS ROAD
MOUNT IVORY CREEK ROAD
MOUNTPIPE DODGE ROAD
DIAMONDY ROAD
WELLCAMP LANE
BENJAMINS ROAD
MCGILLS ROAD
IRONPOT ROAD
NIAGARA ROAD
COOKANGA NORTH ROAD

0 1 2 3 4 km

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- Project boundary (stage 1 & 2)
- Stage 1 area
- Wind turbine
- Access track
- Cable corridor
- Met mast location
- Construction compound & laydown area (stage 1 & 2 shared area)
- O & M facility (stage 1 & 2 shared area)
- Substation/switchyard (stage 1 & 2 shared area)
- Battery storage (BESS)
- Existing 132kV powerline
- Conservation area
- Watercourse - major
- Watercourse - minor
- Local government area
- Glossy ibis habitat

Gympie, Wondai, Tewantin, Kingaroy, Maroochydore, Jandowae, Caloundra, Dalby, Oakey, Brisbane

PROJECT: **Wambo Wind Farm**

TITLE: **Figure 2-3: Bird & Bat Management Plan**
Potential Habitat for the Glossy ibis in the Study Area

DATE	STATUS	PRODUCED
13/11/2023	IFU	AC
SCALE	DATUM	APPROVED
1:65,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE: WMWF_0035_2-3_B Glossy Ibis BBMP REV: 02B

320000 325000 330000 335000 340000

7055000 7050000 7045000

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1
WTG 34 WTG 73 WTG 35 WTG 05 WTG 26 WTG 27 WTG 36 WTG 24 WTG 17 WTG 18 WTG 21 WTG 13 WTG 11 WTG 19 WTG 76
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 12 WTG 53 WTG 28 WTG 32 STAGE 1

Diamondy State Forest
South Burnett Regional
Western Downs Regional

Canaga Creek
Diamondy Creek
Jingi Jingi Creek
Flat Creek
Mount Ivory Creek
Sandy Creek

OLD BURRANDOWAN ROAD
JOLIMONT ROAD
MOUNTPIPE DODGE ROAD
DIAMONDY ROAD
CURDS ROAD
WOLLETTS ROAD
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
SARGENTS ROAD
MOUNT IVORY CREEK ROAD
WELLCAMP LANE
BENJAMINS ROAD
MCGILLS ROAD
IRONPOT ROAD
NIAGARA ROAD
COOKANGA NORTH ROAD
JINGHI ROAD

0 1 2 3 4 km

N

WAMBO WIND FARM

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- Project boundary (stage 1 & 2)
- Stage 1 area
- Wind turbine
- Access track
- Cable corridor
- Met mast location
- Construction compound & laydown area (stage 1 & 2 shared area)
- O & M facility (stage 1 & 2 shared area)
- Substation/switchyard (stage 1 & 2 shared area)
- Battery storage (BESS)
- Existing 132kV powerline
- Conservation area
- Watercourse - major
- Watercourse - minor
- Local government area
- Rufous fantail habitat

Gympie, Wondai, Tewantin, Kingaroy, Maroochydore, Jandowae, Caloundra, Dalby, Oakey, Brisbane

PROJECT: **Wambo Wind Farm**

TITLE: **Figure 2-4: Bird & Bat Management Plan**
Potential Habitat for Rufous Fantail in the Study Area

DATE	STATUS	PRODUCED
13/11/2023	IFU	AC
SCALE	DATUM	APPROVED
1:65,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE: WMWF_0035_2-4_C 110 Rufous Fantail Habitat BBMP REV: 02C

320000 325000 330000 335000 340000

7055000 7050000 7045000

N

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1
WTG 34 WTG 73 WTG 35 WTG 05 WTG 36 WTG 26 WTG 27 WTG 24 WTG 76
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 12 WTG 53 WTG 28 WTG 32 STAGE 1
WTG 17 WTG 18 WTG 21 WTG 13 WTG 11 WTG 19

Canoga Creek
Diamondy Creek
Jingi Jingi Creek
Flat Creek
Mount Ivory Creek
Sandy Creek

South Burnett Regional
Western Downs Regional
Diamondy State Forest

OLD BURRANDOWAN ROAD
JOLIMONT ROAD
MOUNTPIPEDODGE ROAD
BENJAMINS ROAD
MCGILLS ROAD
IRONPOT ROAD
DIAMONDY ROAD
CURDS ROAD
WOLLETTS ROAD
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
JINGHI ROAD
SARGENTS ROAD
MOUNT IVORY CREEK ROAD
WELLCAMP LANE
NIAGARA ROAD
COOYANGA NORTH NIAGARA ROAD

0 1 2 3 4 km

WAMBO WIND FARM

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- Project boundary (stage 1 & 2)
- Stage 1 area
- Wind turbine
- Access track
- Cable corridor
- Construction compound & laydown area (stage 1 & 2 shared area)
- O & M facility (stage 1 & 2 shared area)
- Substation/switchyard (stage 1 & 2 shared area)
- Battery storage (BESS)
- Existing 132kV powerline
- Conservation area
- Watercourse - major
- Watercourse - minor
- Local government area
- Australian Painted Snipe, Common Sandpiper & Yellow Wagtail
- Black-faced Monarch
- Curlew Sandpiper
- Painted Honeyeater
- Red Goshawk
- Regent Honeyeater, Satin Flycatcher & Grey Falcon

Gympie, Wondai, Tewantin, Kingaroy, Maroochydore, Jandowae, Caloundra, Dalby, Oakey, Brisbane

PROJECT: **Wambo Wind Farm**

TITLE: **Figure 2-5: Bird & Bat Management Plan**
Potential Habitat for Listed and Migratory Birds and Bats in the Study Area

DATE	STATUS	PRODUCED
13/11/2023	IFU	AC
SCALE	DATUM	APPROVED
1:65,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE: WMWF_0035_2-5_B Listed and Migratory Birds and Bats BBMP REV: 02B

Woodland and Open Forest Species

The majority of birds recorded during field surveys were woodland-dwelling, low-flying species. These species require woodland dominated by *Eucalypt, Callitris* and *Acacia spp.*, often with hollows for nesting and roosting habitat (BirdLife, 2019). Woodland areas are often associated with a large amount of fallen timber and leaf matter on the ground. The woodland bird species require this habitat feature as it allows their food source of insects and small-reptiles to be available in sufficient abundance (BirdLife, 2019). Additionally, woodlands often are associated with a moderate grass layer which acts as a sheltering resource when foraging on the ground (BirdLife, 2019). Woodland species were generally only observed flying to the maximum height of the woodland canopy (up to 30 m maximum).

Raptors

A total of four raptor species were observed during field surveys. These species were:

- Black kite (*Milvus migrans*);
- Brown falcon (*Falco berigora*);
- Nankeen kestrel (*Falco cenchroides*); and
- Wedge tail eagle (*Aquila audax*).

Wedge tail eagle sightings were often only over cleared agricultural areas, close to water sources (farm dams). This species was also located in the mid-north section of the Study Area, perched within an *E. crebra* open forests. The species was often recorded soaring in pairs most commonly at heights ranging from 100-400 m above the ground. This species was recorded in the rotor swept area (RSA) of the wind turbines and has therefore been included as part of the collision risk modelling (CRM).

Nankeen kestrel sightings were only recorded in the eastern part of the Study Area. This species was seen hovering at heights greater than 50 m above the ground over cleared agricultural areas as well as over sparse open forests dominated by *E. crebra*. Thus, this species was recorded within the RSA and has been included as part of the CRM.

An individual black kite was observed flying low (approximately 30 m above the ground) in the central southern portion of the Study Area. This species was observed above road side vegetation dominated by *E. crebra* and *E. populnea*.

The brown falcon was observed during the 2019 and 2023 field surveys but not within the rotor swept path.

These raptor species mostly prefer woodland and open area habitat (Olsen, 1995). They fly at heights in order to hunt out prey on the ground in open/cleared areas or within woodlands and sparse open forests (Olsen, 1995).

Migratory Species

A total of two migratory species were observed during field surveys and one likely to occur. These species were:

- White-throated needletail (*Hirundapus caudacutus*)
- Rufous fantail (*Rhipidura rufifrons*)
- Glossy ibis (*Plegadis falcinellus*)

The white-throated needletail was recorded within the Study Area in two small flocks, at heights of 700 m above the ground. These sightings were made in the mid-west sections of the Study Area. This species does not breed in Australia, only spending the non-breeding season in Australasia. The white-throated needletail flies at heights anywhere between 1 to 1000 m above the ground, often in

large flocks that comprise over thousands of birds (Higgins, 1999). It is known to be highly aerial but can roost occasionally in wooded areas, as well as in open forest and rainforest areas (Higgins, 1999). This species was recorded flying at heights more than 700 m above the Study Area and so is considered as an aerial visitor to the Study Area, unlikely to use the area for roosting. However, habitat mapping has been conservatively prepared for eucalypt wooded areas associated with elevated areas in the Study Area. This is because clusters of records in the locality are associated with Barakula State Forest and Bunya Mountains National Park which have heavily vegetated areas at high elevation.

The rufous fantail is considered known to occur within the Study Area following a detection during the January/February 2023 survey period. The species mostly utilities moist forests in east and south-eastern Australia often dominated by wet sclerophyll forests, particularly those in gullies, but is known to utilise dry eucalypt vegetation with dense understories for dispersal (Higgins, Peter, & Cowling, 2006). Areas in the northeast of the Project confirmed to possess semi-evergreen vine thicket have been identified as potential habitat for the rufous fantail. Vegetation adjacent to the contiguous vegetation of the Diamondy State Forest is also considered potential habitat following field verification of habitat suitability and the presence of rufous fantail detections provided by ALA and eBird.

The glossy ibis is considered likely to occur within the Study Area based on records and the presence of preferred habitat. There is one record from 2014 for the glossy ibis within the 10 km buffer of the Study Area, occurring near Jandowae. Its habitat for foraging and breeding is usually associated with freshwater lakes, salt or muddy marshes or irrigated crop land (Marchant & Higgins, 1990). There are some dams within the Study Area which have a low probability of being foraging and breeding habitat for this species, given the disturbed nature of the farm dams as a result of access by cattle. This species has core breeding areas within the Murray-Darling Basin in NSW and Victoria, as well as the Macquarie Marshes of NSW (DoE, 2020). Therefore, it is likely to only occasionally frequent the Study Area, as no core breeding habitat is present.

In support of developing a greater understanding of white-throated needletail habitat requirements at the Study Area, further information that may be obtained for the species during the implementation of this BBMP will be made available to specific species research programs on request.

2.2.2 Bats

The full echolocation analyses for the anabats deployed during the 2019, 2020 and 2021 field investigations can be found in **Appendix D.** A total of 2,501 calls were detected as bat calls were detected in 2019 (dry season) and 57,842 calls were detected over the December 2020 and February 2021 field investigations (wet season). The bat species detected were given a likelihood of occurrence of possible, probable or definite based on the analyst's ability to determine their distinctive calls. The most diverse areas of bat call data came from the south-eastern and north-western sampling locations within the Study Area. These areas were characterised as being within 1 km of a water source (farm dam) with open forests or woodlands dominated by *E. crebra.*

A total of 20 bat species (including two bat family groups) were recorded in the Study Area (Table 2-13). There was only one bat species, Corben's long-eared bat (*Nyctophilus corbeni*), detected that was listed as Vulnerable under the EPBC Act that with potential to occur within the Study Area. Nyctophilus calls cannot be differentiated to species level via echolocation analysis, and so harp trapping was also undertaken, which failed to detect the species. This is further discussed in **Section 2.2.2.1.**

The desktop searches and field surveys informed the likelihood of occurrence for listed threatened bat species under the EPBC Act in the Study Area, with only three listed threatened species with potential to occur within the Study Area (Table 2-14)**Table 2-10**) due to overlapping distributions with the Study Area and their potential presence cannot be ruled out. This is conservative, as there is a lack of records of these species in the locality, and the species were not recorded during the field survey

campaign despite targeted surveys in accordance with guideline requirements. The full likelihood of occurrence for bat species can be found in **Appendix B**.

While the grey-headed flying fox has been recorded from two camps more than 54 km from the Study Area (Cooyar 60 km and Dalby 54 km), and there are no records within 30 km of the Study Area, the SPRAT profile includes a map that considers potential foraging habitat overlaps with the Study Area. The *National Recovery Plan for the Grey-Headed Flying-Fox* (DAWE, 2021) includes a potential foraging map that does not overlap with the Study Area indicating the Study Area is at the western limit of the distribution of the species. Despite the inconsistency, potential habitat for this species has been mapped, and provided in **Figure 2-5**.

Table 2-13 Results of Echolocation Analysis

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Survey Period Recorded	Likelihood of Species Occurrence
Austronomus australis	white-striped free-tailed bat	-	LC	2019, 2020, 2021	Definite
Chalinolobus gouldii	Gould's wattled bat	-	LC	2019, 2020, 2021	Definite
Chalinolobus nigrogriseus	hoary wattled bat	-	LC	2019, 2020	Definite
Miniopterus australis	little bent-wing bat	-	LC	2019, 2020, 2021	Definite
Miniopterus orianae[1]	large bent-wing bat	-	LC	2019	Definite
Mormopterus ridei	eastern free-tailed bat	-	LC	2019	Definite
Myotis macropus	mouse-eared bat, large-footed myotis	-	LC	2020, 2021	Possible
Nyctophilus bifax	eastern long-eared bat	-	LC	2020	Possible
Nyctophilus corbeni	Corben's long-eared bat	V	V	2021	Possible
Nyctophilus gouldi	Gould's long-eared bat	-	LC	2021	Possible
Nyctophilus geoffroyi	lesser long-eared bat	-	LC	2021	Possible
Nyctophilus sp	long-eared bat species	-	LC	2020, 2021	Possible
Ozimops ridei	molossid bat	-	LC	2020, 2021	Definite
Rhinolophus megaphyllus	eastern horseshoe bat	-	LC	2019	Definite
Saccolaimus flaviventris	yellow-bellied sheath tail bat	-	LC	2019, 2020	Definite
Scoteanax rueppellii	greater broad-nosed bat	-	LC	2020, 2021	Possible
Scotorepens balstoni	western broad-nosed bat	-	LC	2020, 2021	Possible
Scotorepens sp	broad-nosed bat species	-	LC	2020	Possible
Vespadelus darlingtoni	large forest bat	-	LC	2021	Probable

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Survey Period Recorded	Likelihood of Species Occurrence
Vespadelus pumilis	eastern forest bat	-	LC	2019, 2020, 2021	Probable

[1] synonymous with *Miniopterus schreibersii oceanensis* and *Miniopterus orianae oceanensis*.

The freetailed bats recorded (family Molossidae) include white-striped free-tailed bat (*Austronomus australis*), eastern free-tailed bat (*Mormopterus ridei*) and *Ozimops ridei*. Australian molossids have been recorded from habitats of closed forest to desert. The habitat must supply roosting sites which may be buildings, hollow trees or rock crevices in rocky outcrops, river banks or even under stones. These species feed on a range of insects from moths to hard-shelled beetles (Allison, 1989).

The wattled bats recorded, Gould's wattled bat (*Chalinolobus gouldii*) and hoary wattled bat (*Chalinolobus nigrogriseus*), can be found in a wide range of habitats, including forests and woodlands and typically roost in tree hollows. These species prefer a diet of moths and beetles, but will eat other insects if available (Churchill, 2008).

The bent-winged bats recorded, little bent-wing bat (*Miniopterus australis*) and large bent-wing bat (*Miniopterus orianae)* occupy well-timbered habitats, often in wetter areas or in close proximity to water features. These species typically roost in caves or other man-made structures and show a dietary preference for moths (Churchill, 2008).

Broad nosed bats have been detected by the anabats within the Study Area. The western broad-nosed bat (*Scotorepens balstoni*) is found within roosts and forages within open woodlands and dryland woodland habitats. The greater broad-nosed bat (*Scoteanax rueppellii)* is found across a variety of habitats including woodland as well as moist and dry eucalypt forest and rainforest, where it is found to prefer tall wet forests (Churchill, 2008). Broad-nosed bats are insectivores (Churchill, 2008).

The mouse-eared bat has been recorded within the Study Area. This species occurs in forests and woodlands very close to waterbodies, such as Rive Red Gum forests. It is one of Australia's two 'fishing' bats which feeds by trawling its adapted feet across the surface of the water for aquatic fish and invertebrates (Campbell, 2009).

Nyctophilus species are found over a variety of habitats. The lesser long-eared bat (*Nyctophilus geoffroyi*) occupying tropical to alpine woodlands, mangroves, urban areas, wet and dry sclerophyll forests and rain forests (Churchill, 2008). Corben's long-eared bats (*Nyctophilus corbeni*) are found within semi-evergreen vine thicket, dry schlerophyll forests, Callitris forest and open forests with poplar box (Churchill, 2008). The eastern long-eared bats (*Nyctophilus bifax*) reside under the loose bark of melaleuca, in tree hollows as well amongst dense foliage of vegetation. Gould's long-eared bat (*Nyctophilus gouldi*) is a generalist, and resides across a range of wet and dry sclerophyll forests and woodlands, roosting under loose bark and in tree hollows (Menkhorst, 2011).

While Nyctophilus calls cannot be differentiated to species level via echolocation analysis, harp trapping was undertaken in areas where echolocation analysis indicated the presence of *Nyctophilus sp*. Based on the field investigations, harp trapping confirmed only the common species of Nyctophilus were present within the Study Area.

The large forest bat (*Vespadelus darlingtoni*) was recorded in the Study Area. Large forest bat live predominately in eucalypt forests, subalpine woodland to alpine moors, where they feed upon insects and spiders and where colonies of up to 60 may roost in hollows of old eucalypts (Hall, 2008).

The sheathtail bat recorded, yellow-bellied sheathtail bat (*Saccolaimus flaviventris*), has a diet preference for beetles, and is found in nearly all habitats, utilising large tree hollows for roosting (Armstrong & Lumsden, 2017). The eastern-horseshoe bat (*Rhinolophus megaphyllus*) and eastern-forest (*Vespadelus pumilis*) bat are similar in that they are both found in closed forests habitats, with a diet consisting of a wide variety of insects (Armstrong & Aplin, 2017).

Table 2-14 Likelihood of Occurrence for Listed Threatened Bats within the Study Area

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Potential Habitat within the Study Area	Likelihood of Occurrence
Nyctophilus corbeni	Corben's long-eared bat	V	LC	No - no specific habitat requirements observed.	Potential
Chalinolobus dwyeri	large-eared pied bat	V	V	No - no specific habitat requirements observed.	Potential
Pteropus poliocephalus	grey-headed flying-fox	V	V	Yes - potential foraging habitat has been mapped as eucalypt forests and woodlands, containing flowering species	Potential

Status listing per EPBC and NC Acts: V = Vulnerable; LC = Least Concern.

320000 325000 330000 335000 340000

7055000 7050000 7045000

N

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
STAGE 1
WTG 34 WTG 73 WTG 35 WTG 05 WTG 26 WTG 27 WTG 36 WTG 24 WTG 17 WTG 18 WTG 21 WTG 13 WTG 11 WTG 19 WTG 76
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 12 WTG 53 WTG 28 WTG 32 STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1

OLD BURRANDOWAN ROAD
CANOGA CREEK
MOUNTPIPEDODGE ROAD
JOLIMONT ROAD
DIAMONDY CREEK
JINGI JINGI CREEK
CURDS ROAD
WOLLETTS ROAD
DIAMONDY ROAD
BENJAMINS ROAD
SANDY CREEK
IRONPOT ROAD
MCGILLS ROAD
SOUTH BURNETT REGIONAL
WESTERN DOWNS REGIONAL
DIAMONDY STATE FOREST
WELLCAMP LANE
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
JINGHI ROAD
FLAT CREEK
SARGENTS ROAD
MOUNT IVORY CREEK
MOUNT IVORY CREEK ROAD
NIAGARA ROAD
COORANGA NORTH NIAGARA ROAD

0 1 2 3 4 km

WAMBO WIND FARM

Disclaimer:
White Wind Project No 1 Pty Ltd and Cubico Sustainable Investments Australia Pty Ltd make no warranty in relation to the accuracy, reliability, completeness or suitability of the data and does not accept liability for any loss, damage or costs, including consequential damage, in relation to any use of the data in this map.

- Project boundary (stage 1 & 2)
- Stage 1 area
- Wind turbine
- Access track
- Cable corridor
- Met mast location
- Construction compound & laydown area (stage 1 & 2 shared area)
- O & M facility (stage 1 & 2 shared area)
- Substation/switchyard (stage 1 & 2 shared area)
- Battery storage (BESS)
- Existing 132kV powerline
- Conservation area
- Watercourse - major
- Watercourse - minor
- Local government area
- Grey-headed Flying-fox habitat

Gympie, Wondai, Tewantin, Kingaroy, Maroochydore, Jandowae, Caloundra, Dalby, Oakey, Brisbane

PROJECT: **Wambo Wind Farm**

TITLE: **Figure 2-6: Bird & Bat Management Plan**
Potential Habitat for the Grey-headed Flying-fox within the Study Area

DATE	STATUS	PRODUCED
13/11/2023	IFU	AC
SCALE: 1:65,000 @ A3	DATUM: GDA 1994 MGA Zone 56	APPROVED: M.Rookwood

FILE: WMWF_0035_2-6_B Grey-headed Flying-fox BBMP REV: 02B

Harp trapping

Harp trapping was undertaken within suitable habitats to determine which of the Nyctophilus species may be present in the Study Area. Corben's long-eared bat habitat requirements in Queensland include semi-evergreen vine thicket, dry schlerophyll forests, Callitris forest and poplar box open forests (Churchill, 2008). Three different bat species (three individual bats) were caught in the harp trap locations. These species were:

- Greater broad-nosed bat (*Scoteanax rueppellii*);
- Gould's long-eared bat (*Nyctophilus gouldi*); and
- Lesser long-eared bat (*Nyctophilus geoffroyi*).

All three of these species are not listed under either the EPBC Act or NC Act. Because two common Nyctophilus species were captured by the harp traps in areas were *Nyctophilus sp*. calls were recorded with anabats, it was concluded that these species were those previously recorded by the anabats in these locations. Thus, Corben's long-eared bat was concluded as having the potential to occur in the Study Area. This potential occurrence conclusion was also based on the absence of recent records within the Study Area/locality. The closest record is 25 km away from the Study Area from 2002, in the Bunya Mountains National Park.

3. BIRD AND BAT COLLISION RISK MODELLING

This section details the bird and bat utilisation surveys (BUS) and collision risk modelling (CRM) undertaken for the Wambo Wind Farm.

Listed Threatened Bird Species

A combined total of 128 birds were identified across the seven field surveys, with one listed threatened species, the white-throated needletail (*Hirundapus caudacutus*), recorded during the December 2020 survey from two small flocks flying at more than 700 m above the Study Area.

The following subsection demonstrates how the BUS survey data was utilised to inform the turbine collision assessment, incorporating non-threatened species in order to overcome data deficiencies and demonstrate the adequately performed assessment.

Listed Threatened Bat Species

A total of 20 bat species were recorded during field investigations but no threatened bat species were located during any of the field investigations.

Bird Collision Risk Modelling

The Band CRM (Band, 2007) has been used to predict the total number of bird collisions that may result from the development of the Wambo windfarm. This method of CRM requires the input of parameters that describe species-specific biometrics, flight speeds and characteristics and the expected amount of flight activity in the Study Area. It also requires the input of wind turbine specific information such as the turbine blade size and pitch, turbine height and rotor rotation period as well as the proportion of time the turbines will be operational in the Study Area (Band, 2007).

The CRM calculation has been made over two stages:

- Stage 1: the number of birds colliding per annum = the number of birds flying through the rotor swept area; and
- Stage 2: the probability of the birds flying through the rotor swept area being hit (Band, 2007).

Stage 1 depends on bird surveys at vantage points used to gather information on frequency of bird flights in the area swept by the rotors (Band, 2007), and has been informed from data across seven survey periods and a dry and wet season. Stage 2 depends on the characteristics of the bird such as length and wingspan, as well as the breadth and pitch of the turbine blades, rotation speed of the turbine and average flight speed of birds identified as flying in the RSA (Band, 2007).

The following sections detail the turbine and bird species parameters relevant to the Study Area.

Windfarm and Turbine Parameters

The turbine parameters for the selected turbine model, are displayed in **Table 3-1.**

Table 3-1 Turbine Parameters

WTG Parameters	WTG Specifications
Number of WTG	110
WTG Hub Height	166 m
WTG Rotor Diameter	162 m
Rotor Swept Area (RSA) Height	85-247 m
Number of Blades	3
Chord Width of Blade	4.5m
Average Pitch Angle of Rotor	45 degrees
Average Rotation Period of WTG	8.2 seconds
Total Area Surveyed	4,991 ha
Development Footprint (with a 100m buffer to account for a conservative impact)	3,238.2 ha

Bird utilisation surveys have been undertaken across Stage 1 and stage 2 throughout all survey periods and so the CRM model developed for this BBMP will be inclusive of stage 2. Owing to the ongoing finalisation of the stage 2 development footprint, the footprint used in the initial EPBC Act Approval documentation has been selected for use in this model as seen in the above table.

Bird Species Parameters

Seasonal (wet and dry season) monitoring of up to 16 point locations were undertaken and have been used in the calculations for the CRM. In total there was 6,820 minutes of bird survey time undertaken throughout the seven field investigation periods used within the CRM. The 16 point locations as well as opportunistic bird survey (conducted in areas during habitat and vegetation assessments) were distanced throughout the Study Area in all identified habitat types. This included:

- Poplar box woodlands and fringing riparian vegetation;
- Brigalow woodland and open forest;
- Semi-evergreen vine thicket;
- Ironbark dominated woodlands;
- Spotted gum dominated open woodlands;
- Open paddocks and agricultural fields; and
- Areas close to watercourses (farm dams).

Bird movements that are not located in the RSA, such as low flying woodland dwelling birds, are not at risk of collision. Therefore, such species at these heights are not included in the CRM. This includes the rufous fantail. Despite confirmed presence following field survey effort, the rufous fantail is not known to forage or fly beyond the height of the canopy and so any impacts of the Project to the species will occur only due to loss of habitat and so it has not been included in the collision risk model. Of the 128 bird species recorded in the bird surveys, six species were recorded flying in the rotor swept range of 80-250 m.

The swamp harrier (*Circus approximans*) and Australian white ibis (*Threskiornis moluccus*) were also recorded within the RSA however because they were only recorded once in this area during the survey period, they have not been included into the CRM (due to insufficient data).

It is also noted that two flocks of approximately 10 of the listed species, the white-throated needletail (*Hirundapus caudacutus*), were recorded at heights greater than 700 m (ranging from 700-950 m). Thus, this species was not included in the CRM as it is regarded as an infrequent visitor and was observed flying well beyond the RSA range.

Bird Flights through the RSA

In order to determine the amount of birds flying through the rotor swept area, species specific information for the six species recorded in the rotor swept area must be known. This information includes:

- Bird length and wingspan; and
- Bird average flight speed.

The information specific to each of the six species has been summarised below.

Wedge tail eagle

The bird length for the wedge-tail eagle has been calculated to be 110 cm and is based upon the Tasmanian subspecies information (BirdLife International, 2016). Another source suggests the average size is 95 cm (Smales & Muir, 2005). Thus from these sources, the average of the species is 1.03 m in length. The wingspan has been calculated on average to be 2.3 m and the flight speed based on the Tasmanian wedge-tailed eagle is 16.7 m/s (Smales & Muir, 2005).

Straw-necked ibis

The straw-necked ibis is 59-75 cm in length (average of 67 cm) and has a wingspan from 100-120 cm (average of 110 cm) (Matheu et al., 2020). There is no written literature on the flight speed of the straw-necked ibis, however there is known speeds for the glossy ibis and Australian white ibis. The glossy ibis is 48-66 cm long, has a wingspan from 80-105 cm and an average flight speed of 12.5 m/s (Davis & Kricher, 2020). The Australian white ibis is 65-75 cm long, has a wingspan of 110-125 cm and an average flight speed of 10.7 m/s (Heath et al., 2009). As the straw-necked ibis sits between these two species in length and wingspan, an average flight speed was taken for the straw-necked ibis from these two species. This was calculated as 11.6 m/s.

Little Corella

The little corella is a small cockatoo that is approximately 40 cm long with a wingspan of up to 1 m (Marchant & Higgans, 1999). The species is known to fly at least 70km/h (19 m/s) (Marchant & Higgans, 1999).

Galah

The galah is approximately 35 cm in length with a wingspan of 75 cm (Marchant & Higgins, 1999). This species is known to fly at least 70 km/hr (19 m/s) (Marchant & Higgins, 1999).

Sulphur-crested cockatoo

The sulphur-crested cockatoo is on average 50 cm in length with a wingspan of up to 103 cm (Simpson & Day, 2010). This species is known to fly at speeds of up to 70 km/hr however when observed during the Study Area, they were flying at approximately 40-50 km/hr (approximately 13 m/s).

Torresian crow

The torresian crow is approximately 48-53 cm in length with an average wingspan of 100 cm. The average speed of a crow is 30-40 km/hr (12 m/s) of which the species was observed flying at within the Study Area

Collision Risk Modelling Results

For the six species included in the model, collision risk has been calculated as the number of collisions per species per annum (**Table 3-2)**. It is expected that birds in practice show a high level of avoidance of wind turbines (Band, 2007). However, avoidance rates have not been calculated for all species and research is necessary to determine each species-specific avoidance rate. For this CRM, 95%, 98% and 99% avoidance rates have been used to calculate collision numbers per annum for the six species. These avoidance rates are what is typically used in CRM exercises (Smales, 2005; SNH, 2000).

Table 3-2 CRM Estimated Collision Numbers per Annum

Estimated annual number of collisions (based on a rotor swept range of 50-220 m)			
Turbine avoidance rate	**95%**	**98%**	**99%**
Wedge-tail eagle	0.5127	0.2051	0.1025
Straw-necked ibis	0.0786	0.0762	0.0754
Little Corella	0.0077	0.0074	0.0074
Galah	0.0807	0.0783	0.0775
Sulphur-crested cockatoo	0.0859	0.0832	0.0824
Torresian crow	0.4142	0.1657	0.0828
Total	**1.1798**	**0.6159**	**0.428**

The above models provide an indication of the worst-case scenario based on bird utilisation data collected across relevant seasons. Some variation in bird utilisation and abundance is expected between seasons, however this is unlikely to create significant fluctuations in collision risk.

4. BIRD AND BAT RISK ASSESSMENT

A bird and bat risk assessment has been undertaken as part of this Ecological Assessment. This risk assessment was informed by the likelihood of occurrence results from desktop and field results as well as the collision risk modelling data and outputs. The CRM can be found in **Section 3.1.7.**

The CRM was informed by the BUS undertaken at 18 spots throughout the Study Area, as well as numerous opportunistic surveys undertaken at random points via the Band model (Band, 2000). These surveys recorded parameters including the bird species, height of flight of each bird and the distance of the bird species to the observer. A total of 128 bird species were recorded during the field surveys and six of these species were recorded within the RSA. None of these six species were listed under the EPBC Act or NC Act. The results of this collision risk modelling were used to inform the risk assessment.

The risk assessment was based on the Risk Evaluation Matrix Model which complies with the AS/NZS ISO 31000 Risk Assessment Standard: 2018. This risk assessment takes into account the likelihood of an event (collision with wind turbines and indirect barrier effects), and the consequences should the event occur. Through calculating the likelihood and the consequence, an overall risk rating is assigned to each species and is the risk of potential impact to a species as a result of the operation of the windfarm. Such impacts include the direct collisions with wind turbines as well as indirect impacts such as the deterrence of migratory flightpaths.

The following tables detail the likelihood (**Table 4-1**) and consequence of risk criteria (**Table 4-2**), as well as the risk rating result table (**Table 4-3**).

Table 4-1 Likelihood of Event Criteria

Likelihood	Description
Certain	It is expected to occur in most circumstances. The risk event could occur in any year (>95%).
Almost Certain	It will probably occur in most circumstances. The risk event could occur in any year (>50%).
Likely	It may occur at some time. It is equally probable that the risk event could or could not occur in any year (50%).
Unlikely	It could occur at some time. It is probable than not that the risk event could occur in any year (<50%).
Rare	It may occur in exceptional circumstances. It is improbable that the risk event could occur in any year (<5%).

Table 4-2 Consequence of Event Criteria

Negligible	Low	Moderate	High	Severe
Occasional individuals lost but no reduction in local or regional population viability.	Repeated loss of small numbers of individuals but no reduction in local or regional population viability.	Moderate loss in numbers of individuals, leading to minor reduction in localised or regional population viability for between one and five years.	Major loss in numbers of individuals, leading to reduction in regional or state population viability for between five and 10 years.	Extreme loss in numbers of individuals, leading to reduction in regional or state population viability for a period of at least 10 years.

Table 4-3 Risk Matrix of Risk Level Based on Likelihood and Consequence

Likelihood	Consequence				
	Negligible	Low	Moderate	High	Severe
Certain	Negligible	Low	High	Severe	Severe
Almost Certain	Negligible	Low	Moderate	High	Severe
Likely	Negligible	Low	Moderate	High	High
Unlikely	Negligible	Negligible	Low	Moderate	High
Rare	Negligible	Negligible	Negligible	Low	Low

Table 4-4 details the results of the risk assessment for bird and bat species protected under the EPBC and NC Acts that were determined as having known, likely and potential habitat present within the Study Area. From this assessment, it was determined that the below listed species are considered at 'low' risk of impact from the windfarm:

- white-throated needletail; and
- glossy ibis.

These species were considered at low risk due to the likely and known occurrences within the Study Area. Neither of these species were recorded in the RSA of the windfarm and so were not analysed in the CRM. Additionally only two observations of the white-throated needletail were recorded over the seven field investigations from 2019-2021, at heights above 700 m. The glossy ibis has been concluded as likely to occur within the Study Area as records occur in the locality and preferred habitat of cultivated land associated with farm dams is present. However, this species has not been recorded in the Study Area and the species often forages on the ground for insects and aquatic insects (BirdLife, 2021c). All other bird and bat species are considered to have 'negligible' risk of impact.

The following procedures and mitigation measures while aimed at reducing impacts to the listed threatened species identified as 'at risk' in the Study Area, will have benefits to those species considered as having 'negligible risk'. This BBMP has been developed commensurate with the low level of risk to birds and bats in the Study Area.

Table 4-4 Bird and Bat Risk Assessment

Species	Threatened Species Status		Likelihood of Event	Consequence of Event	Risk Rating	Comments
	EPBC Act	NC Act				
Birds						
Calidris gerruginea curlew sandpiper	CE, M	E	Unlikely	Negligible	**Negligible**	This species occurs along the coast or on large inland lakes and swamps (Higgins & Davies, 1996). There is no suitable lake or swamp habitat present within the Study Area. Additionally, there are no records of the species within the Study Area of the broader locality. It is therefore considered unlikely to collide with turbines or suffer any indirect impacts.
Actitis hypoleucos common sandpiper	M	SLC	Unlikely	Negligible	**Negligible**	This species occurs at coastal wetlands, in the muddy margins and rocky shores. It can also inhabit banks of lakes, pools, billabongs and dams (Higgins & Davies, 1996). There is no suitable wetland or rocky shore habitat present within the Study Area. Additionally, there are no records of the species within the Study Area of the broader locality. It is therefore considered unlikely to collide with turbines or suffer any indirect impacts.
Anthochaera Phrygia regent honeyeater	CE	CE	Unlikely	Negligible	**Negligible**	This species primarily occurs in box-ironbark woodland, where it feeds on nectar and, to a lesser extent, insects and their exudates (lerps and honeydew). It mainly feeds on nectar from eucalypts and mistletoes. Only potential habitat of eucalypt forests are present in the Study Area. This species has not been recorded within the Study Area or the broader locality. It is therefore considered unlikely to collide with turbines or suffer any indirect impacts.
Erthrotriorchis radiatus red goshawk	V	V	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution for the species and potential habitat of woodlands and eucalypt forests are present, but no records exist for the species in the Study Area or locality. Therefore, it is considered unlikely that the windfarm will have an impact to this species.
Grantiella picta painted honeyeater	V	V	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area occurs within the distribution for the species and potential habitat of open forests and woodlands are present. However, there is a lack of preferred mistletoe as well as a lack of records within the Study Area/locality. This species is known to fly within the tree canopy and so is considered unlikely to be impacted by the windfarm.

Species	Threatened Species Status		Likelihood of Event	Consequence of Event	Risk Rating	Comments
	EPBC Act	NC Act				
Rostratula australis Australian painted snipe	E	V	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution for the species and potential habitat associated with farm dams is present. However, no records for the species occur within the Study Area/locality. This species has been considered as unlikely to be impacted by the windfarm.
Motacilla flava yellow wagtail	M	SLC	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within their distribution and contains potential habitat of open grasslands associated with farm dams. However, no records for the species exist within the Study Area/locality. This windfarm is considered unlikely to have any impact on this species.
Plegadis falcinellus glossy ibis	M	SLC	Likely	Low	**Low**	This species has been concluded as likely to occur within the Study Area. This is because of the Study Area is within the distribution for the species, a record exists within the locality south-west of the Study Area from 2019, and preferred habitat of cultivated areas associated with farm dams are present. This species has core breeding areas within the Murray-Darling Basin in NSW and Victoria, as well as the Macquarie Marshes of NSW (DoE, 2020). Therefore, it is likely to only occasionally frequent farm dams in Study Area, as no core breeding habitat is present. Therefore, it is unlikely that this species will be impacted by the windfarm.
Monarcha malanopsis black-faced monarch	M	SLC	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution for the species and a record exists in the locality from 2009 (south of the Study Area). However, no preferred rainforests ecotones are present, only potential habitat associated with semi-evergreen forests are present. Therefore, it is unlikely that this species will be impacted by the windfarm.
Myiagara cyanoleuca satin flycatcher	M	SLC	Unlikely	Negligible	**Negligible**	The species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within its distribution, and potential habitat of eucalypt forests is present, however no records exist within the Study Area/locality (closest record is over 30 km south from 2005). This species forages mainly in the mid to upper canopy (BirdLife, 2021a), and so it is unlikely to be impacted by the windfarm.
Rhipidura rufifrons Rufous Fantail	M	SLC	Unlikely	Low	**Negligible**	This species has been concluded as known to occur within the study area. This species is primarily restricted to denser eucalypt forests, particularly those along wetter drainage lines, creeks and waterways with a dense understory. Preferred foraging and dispersal habitat is typically no higher than the canopy and so this species is unlikelt to be impacted by the windfarm.

Species	Threatened Species Status		Likelihood of Event	Consequence of Event	Risk Rating	Comments
	EPBC Act	NC Act				
Hirundapus caudacutus white-throated needletail	V, M	V	Likely	Low	**Low**	This species has been concluded as known to occur within the Study Area. This is because the species was observed flying above the Study Area, at heights of 700 m and above in 2020. The species was not recorded within the RSA height, and is said to exhibit highly aerial behaviour while on migration in Australia. There is evidence that this species can stop to forage within elevated eucalypt forests while in Australia. It has also been observed roosting on wooded ridges. However, the behaviour of the species in the Study Area was flying well above RSA height. This species may fly through the RSA of the windfarm, however this is predicted to be an infrequent occurrence and not expected to have a significant impact to the population. Therefore while turbine collisions may occur, it is considered as a low consequence and low risk rating to the species.
Apus pacificus fork-tailed swift	M	SLC	Unlikely	Low	**Negligible**	This species is concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution of the species, however no records for the species within the Study Area/locality. The species is noted to be an almost exclusively aerial flyover species within its Australian distribution, often foraging at heights well beyond the RSA. The species utilises a wide variety of habitats across its Australian distributed but is known to utilise open agricultural land.
Falco hypoleucos grey falcon	V	V	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because the Study Area is within the distribution of the species however no records occur for the species within the Study Area/locality. There is potential habitat in the form of lowland tree-lined riparian areas, but no suitable acacia shrublands. Overall, it is unlikely to collide with turbines or suffer any indirect impacts.
Bats						
Chalinolobus dwyeri large-eared pied bat	V	V	Unlikely	Negligible	**Negligible**	This species has a wide distribution from Shoalwater Bay in Northern Queensland to Ulladulla in NSW. Juveniles leave the nest between late February and March and so collision risks are higher in these months. There is also a lack of appropriate cave and overhanging sandstone cliffs which this species prefers to roost in, within the Study Area. This species was not recorded within the Study Area and has not been recorded in the broader locality. Population impacts for this species are unlikely due to the widespread distribution of the species, and the lack of species records in the Study Area/locality. Therefore it is considered unlikely to collide with turbines in the Study Area or suffer any indirect impacts.
Nyctophilus corbeni	V	V	Unlikely	Negligible	**Negligible**	This species has been concluded as having the potential to occur within the Study Area. This is because potential habitat of white cypress pine and ironbark

Species	Threatened Species Status		Likelihood of Event	Consequence of Event	Risk Rating	Comments
	EPBC Act	NC Act				
Corben's long-eared bat						woodlands are present, and the Study Area is within the distribution for the species. However, no records for the species occur within the Study Area/locality, with the closest record being 25 km from the Study Area, in the Bunya Mountains National Park, from 2002. Additionally, this species is slow-flying and prefers to fly through the understorey of vegetation in search for non-flying prey, often foraging on the ground (OEH, 2021). It is therefore considered unlikely to collide with turbines in the Study Area or suffer any indirect impacts.
Pteropus poliocephalus grey-headed flying fox	V	-	Unlikely	Negligible	**Negligible**	This species has been concluded as potential to occur within the Study Area as it is over 50 km from the closest flying-fox colony and over 30 km from the nearest record. Additionally, this species is slow-flying and prefers to forage and fly within understorey vegetation (OEH, 2021). It is therefore considered unlikely to collide with turbines in the Study Area or suffer any indirect impacts.

Status listing per EPBC and NC Acts: CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory; LC = Least Concern; SLC = Special Least Concern.

5. MITIGATION MEASURES

This section details the mitigation measures that will be implemented for potential impacts arising out of the operation of Stage 1 of the Wambo Wind Farm. Although the collision risk model that informs these mitigation measures has been prepared based on data collected across Stage 1 and stage 2 combined, these mitigation measures are specific to Stage 1. Mitigation measures specific to stage 2 will be outlined within the stage 2 BBMP. Impact triggers which are described **in Section 6**, act as a measure to determine when additional mitigation measures should be implemented. Mitigation measures will be reviewed throughout the monitoring period, and at the end of the two-year monitoring period a suitably qualified ecologist will oversee and determine whether any adjustments should be made.

The adaptive management approach is outlined in **Section 7.3**. The measures in **Table 5-1** have been designed so that species (locally abundant, least concern and listed species) are not significantly impacted by the Wambo Wind Farm. If changes to the mitigation measures are likely to result in a new or increased impact to any EPBC species (i.e. beyond minor variations or updates to the BBMP), impacts may need to be referred to the Minister in accordance with Section 143A of the EPBC Act, following a self-assessment.

The main causes of impact to listed species for the Wambo Wind Farm are considered as:

- Collision of birds and bats with blades of operating turbines is likely to occur, with non-listed species most at risk. The white-throated needletail and glossy ibis are listed species considered at low risk of collision;
- Fatality and injury caused by the rapid air pressure reduction of moving turbine blades, barotrauma, is likely to occur, with non-listed species most at risk;
- Promotion of water and foraging resources that result in attracting birds and bats into the vicinity of the wind turbines. This could result in higher rates of collision and injury/death. Nesting may occur close to turbines; and
- Lighting on turbines and buildings causing an increase in bird and bat prey. This may result in increased bird and bat abundance in the vicinity of the turbines and increase collision risk.

The management objectives for this BBMP, to address potential impacts are:

- Baseline monitoring surveys – prior to operation of the Wambo Wind Farm (seven surveys have been completed and were used to inform the collision risk modelling within this BBMP);
- Operational monitoring surveys – to be undertaken at selected turbines throughout the operation of the Wambo Wind Farm, to estimate mortality of bird and bat species as well as record species within the Study Area;
- Reporting – to be undertaken in the first and second year of operation, and agreed upon timeframes thereafter with the Department of Climate Change, Energy, the Environmnet and Water (DCCEEW), and DES. Such reports will include mortality estimates, incident findings, mitigation measure effectiveness or inefficiencies; and
- Mitigation measures to reduce risks such as minimising mortality, keeping grain and waterbody sources a distance from turbines as well as lighting spillage controls in and around turbines.

Table 5-1 details the management objectives, mitigation measures and controls and subsequent timing of such controls for this BBMP. It also details the measures of success for these controls, as well as corrective actions that will be implemented if the controls are not meeting such criteria. Specifically, the management objectives aim to minimise the impact of mortality associated with collisions with turbines. Despite these measures, a residual risk remains.

Implementation of the mitigation measures reduces the risk of collisions, in the event that an impact triggers is observed to EPBC Act listed species, consultations with DCCEEW will occur.

Table 5-1 Proposed Mitigation Measures, Timing, Performance Criteria and Corrective Actions

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
Baseline surveys	■ Baseline bird and bat data to be obtained from BUS, anabat and harp trapping surveys.	■ Seven surveys: December 2020, January 2021, February 2021, July 2021, August 2022, January/February 2023 and May 2023.	■ BUS to be undertaken in areas already chosen, in accordance with the method described in this BBMP. ■ Bat surveys to be undertaken in areas already chosen, in accordance with the method described in this BBMP.	■ Bird and bat surveys have been undertaken in accordance with the method and timing described in this BBMP.
Operational phase mortality monitoring	■ All turbines to be searched in the inner and outer search areas each month. ■ Mortality estimates to be made for each searched turbine for birds and bats. Such mortality estimates to be made upon considering factors like detector efficiency trials and scavenger trials. ■ Operational phase monitoring in response to any impact triggers and consultation with the Department.	■ Operational phase – monthly searches.	■ Mortality surveys to be undertaken at 14 turbines within areas identified as habitat for listed species, within the Stage 1 Area. Reviews on locations will be undertaken after the first year of operation, and updated if appropriate. ■ Scavenger and carcass detectability trials to be undertaken in accordance with the methods described in this BBMP. ■ Mortality estimates to be undertaken and analysed per the methods described in this BBMP. Such estimates will be included in monitoring reports. ■ Responses to impact triggers will be reported and analysed by a suitably qualified ecologist as described in this BBMP.	■ If operational phase surveys are not commenced during this phase, they will be commenced as soon the error is realised and as reasonably possible. ■ If mortality estimates are not undertaken, they will be added to an amended/updated report. ■ Where responses to impact triggers are not implemented, they will be undertaken as soon as this is realised and as reasonably possible.

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
Monitoring reporting	■ Preparation and submission of monitoring reports to DES and DCCEEW	■ After the first year of operation, after year 3 (reporting on years 2-3), and subsequent reporting as agree upon by consultations with DCCEEW/DES.	■ Monitoring reports to be completed at allocated times, within three months of the years monitoring program completion. ■ Such monitoring reports will include: mortality estimates and carcasses findings/locations, mitigation measure effectiveness or inefficiencies, incident reporting, any impact triggers, recommendations for ongoing monitoring activities etc. ■ Ongoing monitoring reporting to occur based on a outcomes of the two-year monitoring program included in this BBMP and by agreement between the landowner, Proponent and DES/DCCEEW.	■ Where monitoring reports are not prepared, or lack information necessary, this report/information is to be prepared and presented to DCCEEW/DES as soon as reasonably practicable.
Mitigation measures to reduce risk - Movement of water and foraging resources that result in attracting birds and bats into the vicinity of the wind turbines.	■ Subject to agreement with landowners, determine a system which will allow for grain feeders to be placed outside of a 200 m radius of the turbines where possible. These grain feeders should be placed as practicable to avoid creating a collision risk for parrots and cockatoos. ■ Carcass removal should be undertaken by suitably qualified personnel. This includes operation and construction staff, carcass searches and landowners if suitable training has been provided. Such carcasses should be appropriately recorded for GPS locations, photos taken and then disposed of in a safe manner.	■ During operational phase.	■ Carcasses/carrion to be removed when found and this is to be reported in an incident report. All measures taken to reduce risk are to be recorded on the date they are implemented – in the same incident report. ■ No increase or continuation of bird/bat mortality due to grain or carcass presence under turbines.	■ Where mortality of birds due to presence of carcasses or grain occurs, options will be undertaken to immediately rectify the problem, including increasing methods to reduce grain and/or carcass occurrences around turbines. ■ Increased consultation with landholders on grain-feeding locations.

Management Objective	Management Activities and Controls	Timing	Performance Criteria for Measurement of Success	Corrective Action
	■ Feral animal carcass removal and appropriate disposal within 200 m of a turbine. If large amount of pests are recognised as a problem near turbines, integrated pest management may be required after consultation and cooperation of landowners. ■ Monthly searches for any stock or introduced species and bird carcasses that may attract larger raptor species. ■ Reporting on carcass removal based on Wambo Wind Farm's carcass removal register/data sheets. ■ Subject to Landowner agreement, provide alternative stock watering arrangements (e.g. establish replacement water sources further from turbines).			
Mitigation measures to reduce risk – Removal/adjustment of lighting on turbines and buildings causing an increase in bird and bat prey.	■ Yellow or white light is proposed: - At entrance door to each wind turbine, office building, substation - As portable and temporary lighting required to ensure the safety of workers. - Aligned with State DA requirements for monitoring masts. ■ Switch off unnecessary lights when not needed (building lights turned off when not in use). ■ Synchronise any flashing of lights.	■ During operational phases.	■ Bird and bat mortality to be low at unlit turbines/infrastructure.	■ Type and placement of lights will be reviewed in response to bird/bat mortality rates.

6. BIRD AND BAT MONITORING

It is noted that the design for the bird and bat monitoring program has been based on the desktop and bird and bat field investigations conducted for the Wambo Wind Farm. The design of the monitoring program includes potential habitat that has been mapped for 'low' risk of impact species, the white-throated needletail, and glossy ibis. Following a detection habitat mapping has also been undertaken for the listed migratory species the rufous fantail despite possessing a 'negligible' risk of impact. This is also applicable to other potentially occurring species with negligible risk of impact, such as the grey-headed flying-fox, where potential habitat occurs in the Study Area (**Table 2-8**). The following sections detail the methods and locations for the bird and bat monitoring program.

6.1 Bird and Bat Monitoring at Commencement of Operation

Bird and bat surveys during the commencement of operation of Stage 1 will target the two species identified as 'at low risk' in **Section 4,** as well as those listed species with potential to occur in the Study Area. Bird surveys will occur during the first two years of operation for Stage 1 and will include two wet season and two dry season surveys. Additional surveys post operation will be undertaken in stage 2 and will be detailed in the stage 2 BBMP. Monitoring during the commencement of operation of the Wambo Wind Farm will be consistent with techniques used during previous field surveys.

It should be noted that all but two bird and bat species were considered to be 'negligible' as per the risk assessment undertaken in **Section 4**, and as such, any bird found during carcass searches or by Operations staff will be reported and stored in a freezer on-site for confirmation of species (refer to **Section 6.3**) and for use in scavenger trials.

The location of the operational phase bird and bat surveys has been informed by the habitat mapping prepared for the species determined as known, likely or having the potential to occur within the Study Area.

The monitoring during operation will be based on two main approaches. The first is to monitor bird and bat activity and ongoing mortality searches that aim to determine impacts (collisions) occurring during the first two years of operation. The second is to inform specific response to impact triggers that may result to bird and bat species, which will include increase monitoring surveys and carcass searches, investigation of risk behaviours and subsequent risk mitigation. This adaptive management approach is further detailed as a part of **Section 7.**

6.2 Carcass Search Methodology

As part of the monitoring program, carcass searches will be performed to determine the actual impact of Wambo Wind Farm on birds and bats. The results of the monitoring will be used to review the risk assessment if necessary and to identify and determine if any further monitoring of bird and bat species is required and to update mitigation measures or adaptive management approaches.

Wambo Wind Farm Stage 1 is to comprise of approximately 42 turbines. At the commencement of operation of Stage 1, it is proposed that a minimum of 14 of the Stage 1 turbines will be searched monthly across two strata: forests/woodlands and open areas. It is noted that turbines within 150 m of forests/woodlands will be counted as occurring within the forests/woodland strata. There is approximately a 50/50 split of the proposed turbines to be built in forests/woodlands and open areas across stage one. It is proposed that 7 randomly selected turbines within each stratum will be searched at 6 weekly intervals from late Autumn to early Spring, and 3 weekly intervals from early Spring to late Autumn (a total of 14 turbines in Stage 1, or approximately 33% of turbines constructed) with increased monitoring in warmer months aligned with increased potential for migratory species to occur within the Study Area. The selected 14 turbines will be revisited over the course of the first two years of operation for Stage 1 and the first two years of operation for Stage 2. An additional 14 turbines will be monitored from the Stage 2 footprint to total 28 turbines monitored across the, up to, four-year monitoring period. It is noted that there is an anticipated one year overlap in Stage 1 and

Stage 2 operational footprint may mean that the total monitoring period may be over three years, however, this will encompass the first two years of operation for each of the stages. Monitoring visits will ensure that carcass searches are able to gain high accuracy on data regarding the mortality associated with turbine strike. The order of selected turbines searched will be random during each monitoring event. The same approach will apply for Stage 2 and will be detailed within the stage 2 BBMP. Locations of turbines selected for monitoring for Stage 1 and Stage 2 are provided in **Figure 6-1,** note only the turbines in the Stage 1 footprint are relevant to this report.

All carcass searches will be undertaken by suitably qualified personnel with appropriate skills in both bird and bat identification as well as in the handing of deceased species. Searches within areas and near selected turbines will target birds and bats of medium to large size as per the Hull and Muir Model (2010), which uses the Monte Carlo simulation. The model suggests that 95% of bat carcasses should be present within 74 m of a turbine, and the carcasses for birds of medium to large sizes would be distributed to distances up to 122 m. Some species (larger birds) may be found further out from this model, however 95% are expected to occur within an approximate 122 m search area from each selected turbine (Hull & Muir, 2010). This model was based upon parameters of a 72 m rotor radius and 120 m hub height. Based on the principles adopted in Hull and Muir (2010), the following search areas have been designed for birds and bats for the Wambo Wind Farm, with its approximate hub height of 166 m and turbine rotor radius of 81 m:

- Bats and small to medium sized birds, including some large sized birds: 100 m radius around the turbine. Transects will be spaced every 6 m from the turbine; and
- Medium to large sized birds (and some larger bats): 100-150 m radius around the turbine. Transects in this search area will be 12 m apart, undertaken from the inner (100 m) to outer (150 m) sections of the search area.

It should be noted that in search areas of turbines that are difficult to access for safety reasons, due to dense vegetation or slope considerations, exceptions may be made as to where transects will be conducted. This will include searching within access tracks and hard-stand areas only. Such exceptions will be noted for reporting purposes.

320000 325000 330000 335000 340000

7055000 7050000 7045000

WTG 54 WTG 88 WTG 50 STAGE 1
WTG 65 WTG 66 WTG 59 WTG 86 WTG 58 STAGE 1
WTG 64 WTG 72 WTG 77 WTG 70 WTG 57 WTG 60 STAGE 1
WTG 67 WTG 71 WTG 31 WTG 51 STAGE 1
WTG 34 WTG 73 WTG 35 WTG 05 WTG 36 WTG 26 WTG 27 WTG 24 WTG 17 WTG 18 WTG 21 WTG 19 WTG 13 WTG 11 WTG 76
WTG 85 WTG 03 WTG 01 WTG 06 WTG 02 WTG 12 WTG 53 WTG 28 WTG 32 STAGE 1

Canoga Creek
Diamondy Creek
Jingi Jingi Creek
Flat Creek
Mount Ivory Creek
Sandy Creek

South Burnett Regional
Western Downs Regional
Diamondy State Forest

OLD BURRANDOWAN ROAD
CURDS ROAD
WOLLETTS ROAD
JOLIMONT ROAD
DIAMONDY ROAD
MOUNTPIPEDODGE ROAD
BENJAMINS ROAD
MCGILLS ROAD
IRONPOT ROAD
JINGHI GULLY ROAD
GRUNDYS ROAD
OLD ROSEVALE ROAD
JINGHI ROAD
SARGENTS ROAD
MOUNT IVORY CREEK ROAD
WEILCAMP LANE
NIAGARA ROAD
COORANGA NORTH-NIAGARA ROAD

N

0 1 2 3 4 km

WAMBO WIND FARM

Disclaimer:
White Wind Project No 1 Pty Ltd and Cubico Sustainable Investments Australia Pty Ltd make no warranty in relation to the accuracy, reliability, completeness or suitability of the data and does not accept liability for any loss, damage or costs, including consequential damage, in relation to any use of the data in this map.

- Project boundary (stage 1 & 2)
- Stage 1 area

Monitoring locations
- Cleared stratum turbines
- Vegetation stratum turbines
- Stage 1 wind turbine

Access track
Cable corridor
Met mast location
Construction compound & laydown area (stage 1 & 2 shared area)
O & M facility (stage 1 & 2 shared area)
Substation/switchyard (stage 1 & 2 shared area)
Battery storage (BESS)
Existing 132kV powerline
Conservation area
Watercourse - major
Watercourse - minor
Local government area

PROJECT
Wambo Wind Farm

TITLE
Figure 6-1: Survey Locations for Monitoring

DATE	STATUS	PRODUCED
18/10/2023	IFU	AC
SCALE	DATUM	APPROVED
1:65,000 @ A3	GDA 1994 MGA Zone 56	M.Rookwood

FILE WMWF_0035_01A BBMP Fig6-1 Survey Locations for Monitoring
REV 01A

6.2.1 Recording Information and Carcass Handling Procedures

The following information is to be recorded if a carcass is detected during the carcass searches:

- Position of the carcass in relation to the turbine;
- Comments on the vegetation type and area where the carcass was located, including if the species was found on an access path or on the turbine hard-stand area;
- Details on the individual found such as species, age, sex, number of individuals, the injury description as well as the estimate time of death if found deceased. If the carcass is unable to identified, this will be taken to appropriate facilities for DNA testing to be undertaken;
- Photos must be taken of the area and of the individual found. Such photos will need to be sent to an appropriately qualified ecologist within two business days so they can adequately undertake identification; and
- Weather details on the find date, as well as details taken of the weather conditions in the time preceding the find date of the carcass, including wind speeds, temperate and rainfall amounts.

The carcass found will need to be handled in accordance with the following procedure:

Carcass is to be safely removed from the site with appropriate personal safety equipment to be worn by personnel. This personal safety equipment includes thick rubber gloves and a long sleeved shirt, a face mask if possible and appropriate eye wear. The carcass should be placed in a plastic bag, then wrapped in newspaper and placed into a second plastic bag. The removal of the carcass from the area ensures that recounting of the same carcass does not occur at a later date.

Labelling of the carcass plastic bag to ensure the species is easily identifiable later and all information is correct. This includes placing a completed datasheet with the above listed information into the outer plastic bag.

The carcass bag will then be placed into an appropriate freezer compartment, likely within the Wambo Wind Farm site office. This will keep the carcass for future examination if required by a suitably qualified ecologist, if the original retrieval was made by an unqualified operation staff member. Frozen specimens will also able to be used for detectability trials at a later date.

It is noted that an NC Act authority, a Scientific Purposes Permit must be obtained in order to remove the carcasses from the Study Area. This will need to be obtained for the monitoring program and can be referred to in order to get more detail on the disposal methods of the carcasses. Should any carcasses be found at Wambo Wind Farm during construction, commissioning and maintenance activities, the carcass should be handled as above.

6.2.2 Scavenger Rates and Trials

The scavenger trial is adopted to ascertain at what rate naturally occurring scavengers remove carcasses from the Study Area. These trials will be developed such that they are adopted twice within the first year following operation commencement, with each trial undertaken across 30 days. This will ensure that the difference in vegetation conditions is accounted for within the trials; wet season with long grass and dry season with short grass. Such periods are also going to be associated with different stocking levels across seasons.

Scavenger trials will be undertaken in the inner search area of the turbines selected for carcass search trials (100 m radius from the turbine).

Four different categories of carcasses will be used for the scavenger trials. Such carcasses will be those that are found during mortality trials. Additionally, small mice can be used in place of micro-bats if these carcasses are not able to be found. The four different categories will help to ascertain the different scavenger rates in the search area.

The two categories and the number of replicates that will be used for each trial are:

- Micro-bats and small birds: seven replicates/trial; and
- Medium sized birds: 6 replicates/trial.

At each of the 14 randomly selected turbines used for the carcass searches, a total of 28 carcasses will be randomly placed under the turbines. The carcasses will be checked as follows:

- Each day for the first five days;
- Every two days from day six to 10;
- Every three days from day 11 to 19; then
- Every four days from day 20 until they disappear or until the end of the 30-day trial period.

Wambo Wind Farm operation staff will be trained over a five-day period to undertake the scavenger trials following trial establishment by a suitably qualified ecologist.

Additional procedures to follow for scavenger trials is detailed below:

- Timing of searches has been based on the detailed experience and regulatory approval of other windfarms where scavenger trials have been undertaken that show almost all carcasses have been scavenged within a period of 5-10 days. Additionally, GPS coordinates will be taken for all carcasses placed during the scavenger trials, so as not to confuse these with any naturally occurring carcasses in the search areas;
- A mix of carcass sizes of bird and bats (small, medium to very large) will be obtained to use in scavenger trials from prior searches of the Study Area. If a carcass of species at risk or of concern cannot be located for the trial, a substitute of the same colour and size will be used in its place;
- Thick latex gloves must be worn at all times when handling the bird and bat carcasses. This will ensure that both the safety of the personnel but also that human scent will not replace the scent of the carcass which will alter scavenger behaviour and find rates;
- One carcass at minimum will be placed randomly within the 100 m search area at each trial site. This carcass will be thrown in the air in order to recreate the natural landing of a carcass from impact with a wind turbine, such that feathers or fur may become dislodged or ruffled from the impact of the simulated fall;
- Detailed observations will be taken at the search areas where carcasses have been scavenged, including the composition of the carcass and weather any types of scavenging behaviour has been present (feathers, bones dispersed, pecking, tearing, partial removal of carcasses, as well as scats and tracks of potential predators); and
- The final state of the carcass will be recorded at the end of the survey period.

Scavenger trials will be conducted across seasons to account for different rates of scavenging that has been observed across seasons (Catling 1988; Molsher et al., 2000).

An alternative to the method used above is to use motion sensor cameras that could monitor scavenger activity. In this case a star picket (approximately 1 m high) will be placed in the ground approximately 4 m away from the carcass, with a camera attached. This camera will record any scavenging activity over the course of 30 days from placement. This method gathers the exact time and method of scavenging and thus eliminates any uncertainties in the results analysis. The scavenger trials will be conducted at the same locations as those chosen in **Section 6.3**.

Additional scavenger trials will be completed across the 68 turbines included in the stage 2 layout. A total of 22 turbines (33%) will be identified by the stage 2 BBMP and will be equally distributed across cleared pastoral land and remnant forests. The same methodologies identified above will be applied across these additional stage 2 turbines and will be discussed further in the stage 2 BBMP.

6.2.3 Detectability Trial

Detectability trials will be conducted at the same time as scavenger trials, conducted during the first day of placing carcasses. These detectability trials will be conducted to test the efficiency of searchers in finding the carcasses for the stage 1 Study Area. Additional detectability trials will be completed across stage 2 and will be detailed in the stage 2 BBMP. The detectability trials will be conducted twice in the first year of operation, sampling across the wet (September-April) and dry (April-September) seasons. This sampling will represent the greatest change in vegetation cover. Such detectability trials will also be conducted for handlers and dogs, if they are to be used for the Wambo Wind Farm. The detectability trials will be conducted by personnel who have been involved in the monthly carcass searches.

The detection efficiency that is determined from the detectability trials will be incorporated into mortality rates and analyses to account for the error associated with human detection of carcasses. This detectability analysis will be documented in the report at the end of the Stage 1 two-year monitoring period in accordance with this BBMP.

Carcasses will be randomly placed in the inner search area of a turbine (100 m zone) and their location noted by the suitably qualified ecologist. The efficiency will be recorded as the number of successful finds by a searcher against the actual carcasses placed by the suitably qualified ecologist. The categories, number of carcasses and replicates to be used in the detectability trials across the wet and dry season is presented in **Table 6-1.**

Table 6-1 Number of Replicates of Bird and Bat Carcasses for Detectability Trials

Time	Micro—at - Small birds	Medium sized birds	Large raptor size birds
Wet season: (long grass)	**7**	**7**	**3**
Dry season: (short grass)	**7**	**7**	**2**

If there are shortages for bird and bat carcasses for the detectability trials, appropriate substitute species will be used to represent specific target carcass categories.

6.2.4 Results Analysis and Presentation

It is proposed that a 12 month monitoring report and a final monitoring report (end of two-year monitoring period) for each stage will be prepared. Data that will be analysed and documented in the reports will include information on carcass identification and timing, the results of the trials (scavenger and detectability) so that factors influencing mortality can be determined. Mortality rates should be expressed as the number of carcasses discovered per turbine per year and any spatiotemporal variation across the Study Area and seasons should be presented and discussed.

Data analysis will estimate mortality rates of birds and bats within the Wambo Wind Farm, taking into account standard error and variation. Appropriate software packages will be used to inform variables needed to be determined during the carcass, detectability and scavenger trials which will subsequently inform the survey design. The following software packages and statistical principles are proposed for Wambo Wind Farm, with specific variables to be measured and data input requirements (and associated assumptions) considered in the final monitoring design:

- Logistical regression (general liner modelling) to be used to determine searcher efficiency. This will account for significance;
- The proportion of the area searched to be estimated using the Monte-Carlo Simulation method as described in Hull and Muir (2010), as mentioned in **Section 6.3**;

- Mortality will be estimated using the Hortvitz-Thompson style estimator from Huso (2011);
- Survival analysis (survival regression to account for interval censoring) to be calculated using Generalised Estimator (GenEst) (or similar). GenEst is used to estimate the total number of individuals that are present within an area in a given time period, when their detection probability may not be known. This program is used as counts of carcasses alone is not an accurate way to measure the true number of fatalities in an area due to those that may be missed in the process. This method also allows for comparisons across locations and years taking into account the rate of detection.
    - GenEst includes tools for estimating searcher efficiency, carcass persistence, and other detection probability parameters from experimental field trials. GenEst is not an evidence of absence-type estimator and is not going to be used in circumstances where few carcasses are found. This is where the EoA program will be adopted; and
- Evidence of Absence (EoA). This program can be used in order to help determine potential fatalities which may have occurred, with respect to the survey effort, even in the absence of a carcass being located.

Statistical analyses will assist in determining potential significant differences across size categories of species, vegetation composition or across seasons.

Documented results will inform adaptive management on whether additional mitigation measures are necessary and whether specific turbines in the Study Area pose higher risks to birds and bats than others. Such adaptive management will occur in consultation with the Department.

6.3 BBMP Personnel and Associated Training Requirements

All personnel involved in the implementation of the BBMP will be familiar with this BBMP, relevant Wambo Wind Farm policies and procedures, and other important administrative matters such as health and safety documents. Wambo Wind Farm will be responsible for ensuring that suitably qualified and trained people are engaged to supervise and implement the formal monitoring program as defined in this BBMP. Beyond the formal period of monitoring, Wambo Wind Farm will be additionally responsible for ensuring ongoing reporting of incidental finds and the engagement of relevant specialists where triggered by this BBMP.

Training will be provided to all personnel that will be undertaking carcass searches, species identification and handling. Such training will be delivered by suitably qualified ecologists who are specialists in the field of bird and bat carcass retrievals. The training will include trial establishment, transect search techniques, selection of specific turbines for monitoring, species identification, carcass handling practices and PPE management. The qualified ecologist will be involved in the initial search program of the turbines to oversee and assist with the carcass search, handling and identification. So that the BBMP is being implemented and monitoring routinely performed to standard, the suitably qualified ecologist will undertake an audit after the first 6 months of the commencement of the implementation of this BBMP.

The suitably qualified ecologist will be available to identify any carcasses that Wambo Wind Farm personnel are unable to identify, either from frozen specimens or from photographs taken at the search area.

Training will be provided to assigned operational personnel which on how to properly prepare and handle carcasses and how to randomise the placement of carcasses in trial areas.

Scavenger trials will be developed by the suitably qualified ecologist, who will supervise the searches undertaken by trained operational personnel.

The suitably qualified ecologist will undertake data analysis and prepare the 12-month interim and two-year final monitoring reports.

Training will be provided by the suitably qualified ecologist to operational personnel involved in the monitoring program and trials, with refresher training available if requested or deemed necessary during the two-year implementation period of the BBMP.

6.4 Handling Protocol and Training: Injured and Deceased Species

Operational personnel involved in the search for wildlife will be appropriately trained in handling and assisting with injured or deceased wildlife. All injured or deceased wildlife found during the first two years of operation will be reported to the Wambo Wind Farm's Responsible Officer. Once reported, it will be the responsibility of the Responsible Officer to organise for the retrieval and/or treatment of the individual. Such a protocol will involve defining the correct handling procedures, personal protective equipment, transportation and wildlife hospital treatment arrangements.

Bats can carry many forms of diseases including Hendra virus and Australian Bat Lyssavirus. Extra precaution and care will need to be taken when handling bat species (Queensland Government, 2020). In this circumstance, professionals should be called to handle injured bat species. Information sources to contact in case of an injured bat include the RSPCA (1300 264 625) and the Department of Environment and Science (1300 130 372). Appropriate and contemporary advice on the best practice for movement of individuals will be provided by these organisations.

6.5 Reporting of Bird and Bat Data

Monitoring reports will be produced in the first and second year of operation. Monthly summaries of data from carcass searches and detectability trials will also be provided as attachments to the monitoring reports.

If impact triggers are met during monitoring and trials, then additional monitoring may be proposed by the suitably qualified ecologist after the initial two year monitoring period has concluded.

The data to be analysed and results documented in the two monitoring reports include:

- Results of the carcass searches and observations, including the methods adopted during survey searches (dates and times of searches also reported);
- Discussion of the results of the report and how this should impact upon management and mitigation measures, such as high mortality;
- Analysis of bird and bat mortality rates via statistical tests, confirming the amount of deaths per annum. This should also take into account and variability of bird and bat carcasses found during different seasons;
- Descriptions of the search areas including the presence of any introduced flora and fauna (specifically feral cats and foxes) that may impact the carcasses or species;
- Any construction or operational personnel carcass finds, including the turbine where the carcass was found, date and time;
- Impact trigger identification, or identification of any species or risk levels that may need to be adaptively adjusted within the bird and bat risk assessment (**Table 4-4**); and
- Analysis of the effectiveness of the mitigation measures in place and whether changes or adjustments need to be made. This will include an analysis of the effectiveness of the impact trigger framework also to ensure that all impacts are being appropriately considered and accounted for in a reasonable manner.

7. SPECIES IMPACT TRIGGERS AND ADAPTIVE MANAGEMENT

This section outlines the species-specific impact triggers associated with interactions with turbines and the decision-making framework and adaptive management where a response is required.

Impact triggers and response requirements will be different for both listed and non-listed species. The impact triggers have been prepared following the approach implemented by multiple BBMP's across Queensland, New South Wales and Victoria.

The Proponent will be responsible for ensuring implementation of this BBMP and the adaptive management approach. A suitably qualified ecologist will support decision-making elements and provide advice where Regulator consultation (State and Commonwealth) is required.

7.1 Listed Threatened and Migratory Species

7.1.1 Impact Trigger Requirements

Where a listed threatened and/or migratory bird or bat species is found dead within the search area of a turbine (proximity that can be attributed to turbine collision) during implementation of this BBMP, or via an incidental find, then the impact trigger methodology as described below applies. Additionally, if a breeding area for these species is located within 200 m of a turbine, then an impact trigger will occur. There are no known breeding behaviours for the low 'at risk' species within the Study Area or locality. Listed threatened and/or migratory species are those that are listed under the EPBC Act and NC Act.

Where a single carcass of a listed threatened and/or migratory species is detected within the Study Area, a decision-making framework will be implemented. This includes additional surveys being undertaken within two weeks of the carcass find by a suitably qualified ecologist, and where data is available, a population viability analysis (PVA) will be undertaken. A report will be prepared by a suitably qualified ecologist and presented to the Department for next steps of mitigation and management.

7.1.2 Decision-making Framework

If the impact trigger requirements are met for the Wambo Wind Farm the following decision-making framework will be followed:

1. The bird or bat carcass must be immediately reported to the Wambo Wind Farm Responsible Officer, including information such as the species type, the area where the species was found and any other contributing factors that appear appropriate. Photos must be taken of the carcass or injured species so that correct identification can be carried out. The Wambo Wind Farm Responsible Officer will assess whether the death/ injury can be directly attributed to a turbine strike. Where there is adequate evidence that the death/injury is not related to turbine strike, no further action is required;
2. A suitably qualified ecologist will undertake an analysis to determine the presence of the impact trigger either in person or through analysis of the carcass and/or photographic evidence. The ecologist will assess whether the death/injury can be directly attributed to a turbine strike. Where there is conclusive evidence the death/ injury is not related to turbine strike, no further action is required;
3. If the impact trigger has been confirmed by the ecologist, the Wambo Wind Farm Responsible Officer will report the trigger to the Department of Environment and Science (DES) and/or DCCEEW within two business days.
4. The suitably qualified ecologist will undertake a detailed investigation in order to determine the events that caused the death or injury of the listed species. This investigation will include a population viability analysis (PVA) where data is available for the species. Once this investigation is concluded and if it is deemed that turbine collision or interference with the

turbine has caused the death/injury, other factors like species behaviour will also be considered.

a. If the evaluation undertaken by the suitably qualified ecologist reveals the impact trigger to be a one-off event and unlikely to occur again, a significant impact on the population's viability is unlikely and no further action will be required. This significant impact will be determined through following the relevant guidelines including but not limited to the *Significant Impact Guidelines –.1 - Matters of National Environmental Significance* per the EPBC Act (DEWHA, 2013). Species-specific guidelines may apply.

b. If the evaluation undertaken by the suitably qualified ecologist (including a PVA) reveals the impact trigger may lead to a significant impact to the species, species-specific monitoring will likely be recommended and implemented. This monitoring will be informed by the ecologist, with a minimum six-week period of fortnightly monitoring. These monitoring exercises will need to be supervised and reported by the suitably qualified ecologist, who will include in the report any recommendations for additional mitigation measures to manage or reduce the impact to the species, in accordance with the adaptive management measures. DES and/or DCCEEW will be consulted on the next steps in the course of action to best close-out the response.

c. If the evaluation undertaken by the suitably qualified ecologist cannot determine the cause of the impact trigger beyond reasonable doubt, further monitoring (fortnightly for six-weeks) may be proposed to determine re-occurrences/extent of the impact. As with the previous steps, if the additional monitoring confirms a one-off occurrence to the species, then no further action except advising the relevant authority is required. If more than a one-off occurrence is observed, then step 3.b) above applies.

5. Adaptive management will be implemented in order to ensure a timely reduction or mitigation of the impact to the species. Further monitoring of the effect of these additional mitigation measures and their impact would be undertaken by suitably qualified ecologist to determine and report on their effectiveness. The BBMP will be updated to include any additional or adjusted mitigation measures. As part of the adaptive management strategy, a number of mitigation measures may be considered, such as:
   - Acoustics to discourage foraging birds at particular locations;
   - Encourage species into alternative low-risk areas using social attraction techniques (decoys and audio playback systems);
   - Removal of foraging habitat where appropriate; and
   - Investigate alternative stocking arrangements.
6. All evaluations and decisions regarding mitigation measures for the impacted species will be reported to DES and/or DCCEEW, with consultations to ensure the best course of action is applied for the Wambo Wind Farm and species affected. Outcomes will also be reported in the monitoring reports that are prepared by the ecologist to the Proponent.
7. Offsets may be required where the significant impact to the species cannot be effectively mitigated by other measures. Offsets may be in form of financial offsets or research-based offsets where an appropriate institution can undertake species specific research. Offsets will need to be considered and developed in accordance with *EPBC Act Environmental Offsets Policy* (DSEWPC, 2012). Any offset consultations will need to be undertaken with the relevant authority.
8. If the above mitigation options including offsets are determined to not be effective and there are ongoing impacts, limited operational shutdown (e.g. low wind speed curtailment) may be considered by the Proponent as a last resort. The decision-making framework for operational shutdown will be informed by the following considerations:

- Potential for additional/ ongoing collisions by listed threatened species, including level of risk to the species' across multiple seasons;
- The location of impacting turbines and potential habitats, time of day and seasonal visitation by the species, wind speeds across seasons, low speed curtailment etc.;
- There is a demonstrated benefit to the species resulting from the operational shutdown or low wind speed curtailment; and
- Identification of a clear scope for on-going monitoring to identify specific triggers for operational shut-down of specific turbines at specific wind speeds and times of day or year.

7.2 Non-Threatened (Protected and Locally Abundant) Species

7.2.1 Impact Trigger Requirements

The impact trigger for the non-listed threatened species in this BBMP will be a total of five or more bat or bird carcasses of the same species that are recorded at the same turbine during two or more consecutive searches.

The definition of a significant impact to a non-listed threatened species is an impact that is likely to reduce the viability of the population of the species within that bioregion. Sometimes the population numbers for a species are not known or reported. In the case where such information is not publically available, a suitably qualified ecologist will undertake an assessment of the potential impact to a species in the bioregion to determine whether the impact will reduce population viability.

7.2.2 Decision-making Framework

If the impact trigger requirements are met for the Wambo Wind Farm, the following decision-making framework will be followed:

1. DES will be notified of the trigger (including species, time and area) within seven days of the trigger event.
2. A suitably qualified ecologist will undertake an analysis to determine if the impact trigger will cause a significant impact on the viability of the population of a species within the bioregion. This assessment will take into account factors like the distribution of the species, known population size and habitat requirements, as well as any literature on specific threats to the species within the bioregion.
3. A report on the findings of the analysis will be prepared by the suitably qualified ecologist and presented to the Wambo Wind Farms Responsible Officer and subsequently then presented to DES within three weeks of the impact triggering event (this date may be subject to change upon consultation with DES).
    a. If the evaluation undertaken by the suitably qualified ecologist reveals the impact trigger to be a one-off event and unlikely to occur again, no further action will be required.
    b. If the evaluation undertaken by the suitably qualified ecologist reveals the impact trigger may lead to a significant impact to the population viability of a species in the bioregion, species-specific monitoring will likely be recommended and implemented. These monitoring exercises (fortnightly for six-weeks) will need to be observed and reported on by the suitably qualified ecologist, who will then determine if any additional mitigation measures are necessary to manage or reduce the significant impact upon the species. Such measures will be decided upon through adaptive management approach.
4. The investigations and mitigation measures recommended in the case of a significant impact will need to be included in the monitoring reports, in accordance with this BBMP.

7.3 Adaptive Management

In the event of a significant impact being triggered to a bird or bat species, adaptive management principles will be applied. Application of adaptive management will be upon written recommendation (from the reporting requirement of the impact trigger response) by a suitably qualified ecologist, in accordance with this BBMP.

Adaptive management will take into consideration the species impacted, the area of impact and other factors such as population dynamics, in order to determine the most appropriate solution.

Additional mitigation measures, should they be required, and potential effects will be monitored and documented within the monitoring reports, in accordance with this BBMP, and presented to the Department for their advice on next steps for management.

7.4 Specific Management Objectives, Activities, Timing and Performance Criteria

Table 7-1 summarises management objectives, activities, timing and responsible parties for the implementation of this BBMP. This table should be referred to for reporting and monitoring purposes throughout the two-year monitoring period. It is noted that adaptive management may require an adjustment to the requirements in **Table 7-1** under the direction of a suitably qualified ecologist.

Table 7-1 Summary of Management Objectives, Activities, Responsible Parties and Timing

Stage	Management Actions	Responsibility	Timing
Pre-Development	The two-stage impact and disturbance mitigation process will be implemented. Areas of remnant and regrowth vegetation will be avoided at the design and micro-siting phases	Proponent	Design
	Design of a turbine with a blade sweep area >40 m above ground level to provide a collision-free foraging zone within the canopy and 20 m above the canopy	Proponent	Design
	Locating turbines away from key bird and bat habitats (waterways and drainage lines)	Proponent	Design
	Initial field surveys for bird and bats will be undertaken. Impacts areas to be selected as part of the Before and After Control Impact (BACI) designed bird surveys. Collision risk modelling to be undertaken	Proponent	Design
Pre-Construction	Pre-clearing surveys shall be undertaken prior to clearing efforts within the marked boundaries. These pre-clearance surveys will form part of the micro-siting process, which will closely analyse potential infrastructure locations. If potential habitat for bats, such as riparian areas and dense woodlands, occur in such locations, development layout will be adjusted. Control areas to be selected as part of BACI designed bird surveys. Surveys will then be undertaken in the control and impact areas prior to construction beginning. These surveys will include BUS such as point, waterbody and bird of prey surveys, in order to determine species presence in the rotor swept area and bat surveys will be conducted via the use of echolocation call detectors and harp trapping	EPC Contractor	Prior to Construction
	Targeted surveys to identify important habitat features of value to birds and bats in the Study Area, in particular, identify raptor nesting sites so that turbine location can be adjusted as part of micro-siting requirements to minimize collision risk	EPC Contractor	Prior to Construction
Construction	All clearing shall be within clearly marked boundaries and in accordance with the Development Permit	EPC Contractor	At all times
	Where trenching and excavations are created which may entrap fauna, suitable escape measures are put in place, and excavation are checked for fauna before backfilling	EPC Contractor	At all times
	Include toolbox talks for site specific bird and bat information during the project	EPC Contractor	Daily
	Ensure appropriate waste management (lidded bins), including food scraps, to reduce potential for feral species to become established on-site	EPC Contractor	At all times
	BACI surveys conducted at impact and control areas during construction to determine bird and bat composition, abundance and density at control and development areas. This includes BUSs and use of bat survey techniques	EPC Contractor	Bi-annually to Quarterly
Monitoring	Daily inspections by spotter / catcher during clearing, specifically hollow trees, roosting sites, and rocky outcrops and caves for birds and bats	EPC Contractor	Daily

Stage	Management Actions	Responsibility	Timing
	Weekly site inspections to review flora and fauna control measures during clearing and construction	EPC Contractor	Weekly
	Annual auditing of Construction Environmental Management Plan (CEMP) during construction	EPC Contractor	Quarterly
	BACI surveys to be conducted in the operation phase at control and impacts areas, to determine the 'after' development effect on bird and bat composition, abundance and density.	EPC Contractor	Bi-annually to Quarterly
	Mortality monitoring: at one third of Stage 1 turbines monthly for two years	Ecologist and trained personnel	Monthly
	Scavenger and detectability trials: two of each, undertaken within the first year of monitoring.	Ecologist and trained personnel	Detectability = monthly Scavenger = biannually
	Adaptive management and inclusion of additional mitigation measures as a result of impact triggers as a result of recommendations from a suitably qualified ecologist	Proponent	
	Low wind speed curtailment required when wind speeds are below the manufacturer's cut in speed of 3 m/s (i.e. feathered to prevent turning or other mechanism)	Proponent	At all times
Reporting	Sightings and incidents reported in daily Pre-starts	EPC Contractor	Daily
	Fauna spotter-catcher will keep an inventory of any bird and bat species encountered with details of species, capture and release condition and capture and release GPS co-ordinates during construction. This also includes carcass reporting and notification	Spotter Catcher	Daily
	Injured native fauna to be reported to Health, Safety, Environment Quality (HSEQ) Manager	Site Manager	Within 24 hours
	Preparation of monitoring BBMP reports: one within three months of the first year of monitoring, and one within three months of the second year of monitoring	Ecologist	Year 1 and Year 2 then as required.
	Monitoring report after two years: estimates of mortality for bird and bat species across the monitoring period. Taking into account detectability and scavenger trial results	Ecologist	As required
Corrective Action	All near misses and incidents will be investigated to establish root cause. Where necessary corrective actions will be developed to improve existing processes	All Personnel	As required

7.5 Assessment of Significant Residual Risk

As part of the ecological investigation completed when an impact trigger is detected, the significance of impact will be assessed by a suitably qualified ecologist with reference to the EPBC Act *Significant Impact Guidelines –.1 - Matters of National Environmental Significance.*

It is proposed that the method for assessment for identifying if an impact will exceed an indicative significant impact threshold will quantify the number of mortalities of each species based on the carcass search results (see **section 6.3** Carcass Search Methodology) that reaches or exceeds an ecologically significant proportion of a population over a defined time period (referred to as a "significant impact threshold").

As described in the referral guideline for 14 birds listed as migratory species under the EPBC Act (Commonwealth of Australia, 2015), an ecologically significant proportion of a population is defined as being 0.1% of the estimated national population size for a species. Where this is exceeded, offsets may be required for the significant residual impact.

A high-level review of species population ecology has been used to establish an indicative significant impact estimate, that considers the number of mortality events and time frame considered as potentially significant to the species identified at 'low' risk in this BBMP. Those species currently identified as 'negligible' risk that may still be at risk of collision if found to be present (red goshawk, fork-tailed swift, grey falcon, and grey-headed flying fox) have also been provided with indicative significant impact thresholds. Although the rufous fantail is known to occur within the Project Area, the species is not known to move beyond the maximum canopy height and so is not considered to be at risk of turbine collision. Therefore, an indicative significant impact threshold has not been identified for the rufous fantail.

Generational time, defined as the average interval between the birth of an individual and the birth of its offspring, is approximately ten years for most species identified as having a potential future risk in this BBMP. These generational times can be used as an indication of the time required for a population to replace individuals lost to turbine collisions. The species ranges and population sizes have also been considered for these estimates presented in this BBMP, with those having larger populations. Table 7-2 provides an indicative significant impact threshold associated with five low and potentially low risk listed threatened bird and bat species in the Project Area.

Table 7-2 Indicate Significant Impact Thresholds for EPBC Act Listed Birds and Bats

Species	Australian Population Estimates	Indicative Significant Impact Threshold (0.1% of population)
White-throated Needletail	41,000	41 mortalities over a five-year period
Fork-tailed Swift	100,000	100 mortalities within a five-year period
Red Goshawk	1,000	1 mortality within a one-year period
Grey Falcon	1,000	1 mortality within a one-year period
Glossy Ibis	144,000	144 mortalities within a five-year period
Grey-headed Flying Fox	680,000	680 mortalities within a five-year period

These significant impact thresholds are indicative only, and the actual significant impact assessment and associated advice will be provided by a qualified ecologist aligned with the investigation process outlined in Section 7.1. These indicative thresholds may exhibit fluctuations through time as updated species population estimates become available and it is expected that contemporary information be used during an investigation, as required throughout the life of this BBMP.

7.6 BBMP Monitoring and Implementation Risks

There are certain factors that may impact the carcass searches and monitoring for the BBMP. Such factors include weather events that restrict access to search areas, including significant flooding and storms (electrical activity), as well as heatwaves and bushfires. Other incidents include risks to health and safety like the unlikely event of a turbine suffering a malfunction in weather events or due to mechanical failures. Access issues may also play a contributing factor to the hindering of search efforts, especially if vegetation becomes unmanageable to traverse.

There will also be stop work cues in which operational and construction personnel may cease their operations due to safety concerns. In this unlikely event, all BBMP monitoring will also cease.

In light of recent events, travel restrictions that may arise out of pandemic (COVID-19) outbreaks may also cease monitoring events and stop the implementation of mitigation and management measures.

If these factors arise and monitoring per the usual BBMP cannot proceed, limitations or changes to the original BBMP will be recorded during reporting periods.

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APPENDIX A PMST RESULTS

Australian Government
Department of the Environment and Energy

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.

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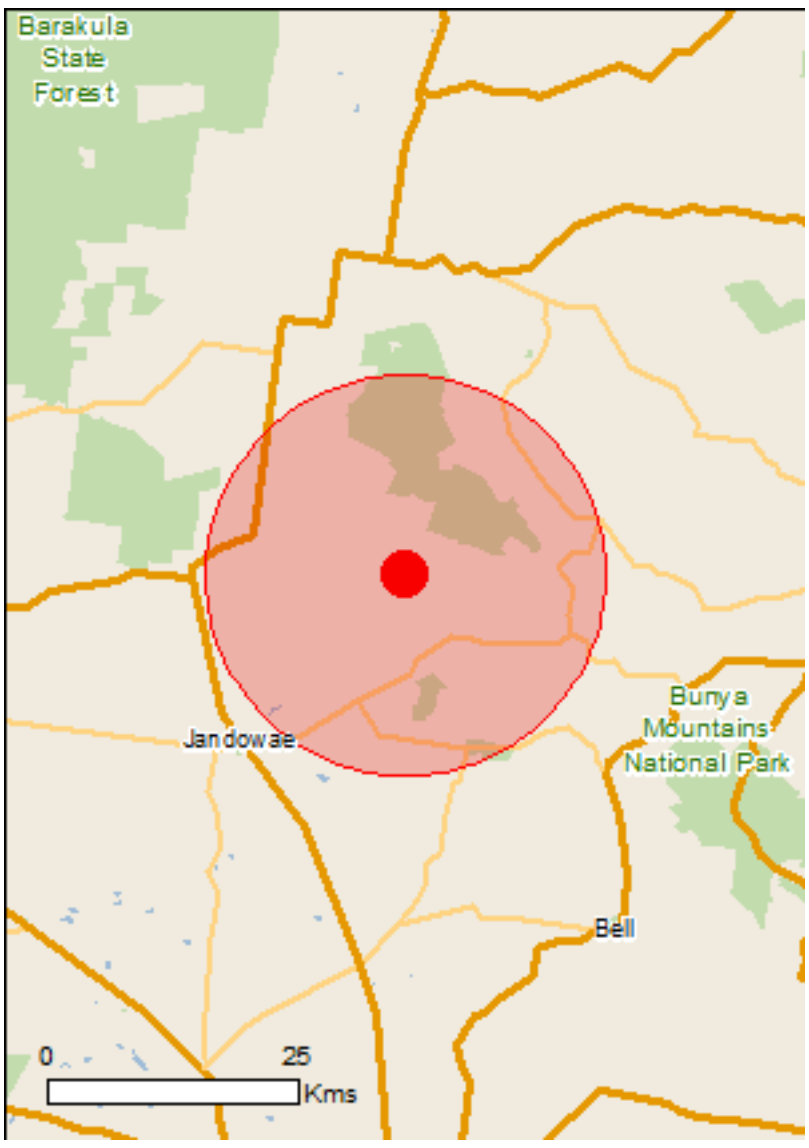

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Coordinates
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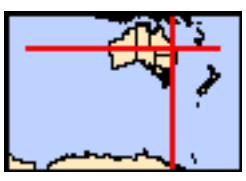

Summary

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:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	36
Listed Migratory Species:	14

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:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	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:	None
Regional Forest Agreements:	None
Invasive Species:	19
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	1300 - 1400km
Narran lake nature reserve	400 - 500km upstream
Riverland	1200 - 1300km
The coorong, and lakes alexandrina and albert wetland	1400 - 1500km

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
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	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		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	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 known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Other		
Adclarkia cameroni Brigalow Woodland Snail [83886]	Endangered	Species or species habitat likely to occur within area
Adclarkia dulacca Dulacca Woodland Snail [83885]	Endangered	Species or species habitat likely to occur within area
Plants		
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat may occur within area
Denhamia parvifolia Small-leaved Denhamia [18106]	Vulnerable	Species or species habitat may occur within area
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. velutina Tall Velvet Sea-berry [16839]	Vulnerable	Species or species habitat likely to occur within area
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area
Polianthion minutiflorum [82772]	Vulnerable	Species or species habitat likely to occur within area
Rhaponticum australe Austral Cornflower, Native Thistle [22647]	Vulnerable	Species or species habitat likely to occur within area
Sophora fraseri [8836]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat likely to occur within area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Tympanocryptis condaminensis Condamine Earless Dragon [87888]	Endangered	Species or species habitat may 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		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat likely to occur within area
[Monarcha trivirgatus](#) Spectacled Monarch [610]		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 likely to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

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		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Anseranas semipalmata](#) Magpie Goose [978]		Species or species habitat may occur within area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Ardea alba](#) Great Egret, White Egret [59541]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to 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 likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		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 likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

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
Anas platyrhynchos Mallard [974]		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
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		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

Name	Status	Type of Presence 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
Sus scrofa Pig [6]		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		
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		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

-26.64839 151.25867

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.

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APPENDIX B LIKELIHOOD OF OCCURRENCE

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Birds (including listed migratory species)					
Regent honeyeater (*Anthochaera phrygia)*	CE, CE	It primarily occurs in box-ironbark woodland, but also occurs in other forest types. The species primarily feeds on nectar and, to a lesser extent, insects and their exudates (lerps and honeydew). It mainly feeds on nectar from eucalypts and mistletoes and it prefers taller and larger diameter trees for foraging. Box ironbark woodland is largely absent in the Study Area but potential general habitat associated with eucalypt dominated remnant vegetation is present.	Yes	No	Potential to occur ■ Study Area is within the distribution for the species ■ Only general habitat present in the form of remnant eucalypt dominated forests and woodlands. ■ No records within the Study Area/locality (closest record is the Bunya Mountains National Park, 25 km southeast of the Study Area).
Curlew sandpiper (*Calidris ferruginea*)	CE, M	This species can occur inland, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters. No preferred watercourses with mud or sand flats are present but potential general habitat associated with farm dams are present.	Yes	No	Potential to occur ■ Study Area is within the distribution for the species (may occur) ■ Only potential general habitat in the form of farm damns is present. ■ No records within the Study Area/locality (closest record is the Bunya Mountains National Park, 25 km southeast of the Study Area).
Red goshawk (*Erythrotriorchis radiatus*)	V, V	This species prefers wooded and forested lands of tropical and warm-temperate Australia. Forests of intermediate density are favoured, or ecotones between habitats of differing densities, e.g. between rainforest and eucalypt	Yes	No	Potential to occur ■ Study Area is within the distribution for the species.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		forest, between gallery forest and woodland, or on edges of woodland and forest where they meet grassland, cleared land, roads or watercourses. This species has a large home range. No preferred ecotones are present within the Study Area but potential general habitat in the form of wooded eucalypt forests are present.			■ Potential general habitat in the form of wooded eucalypt forests are present. ■ No records within the Study Area/locality. Closest record is over 40 to the south west of the Study Area, near Chinchilla (n.d.).
Southern squatter pigeon (*Geophaps scripta scripta*)	V, V	Squatter pigeon (southern) habitat is generally defined as open-forests to sparse, open-woodlands and scrub that are mostly dominated by Eucalyptus, Corymbia or Callitris species. Additionally they also favour remnant regrowth or partly modified vegetation communities that are within 3 km of water bodies. Preferred habitat close to permanent bodies of water is not present however general habitat of grasslands and remnant Callitris. Corymbia Eucalypt vegetation is present. However these are not often within 3 km of permanent water bodies.	Yes	No	Potential to occur ■ Study Area is within the distribution for the species (may occur) (Department of Environment and Resource Management, 2012). ■ Only potential general habitat of remnant Eucalypt, Callitris and Corymbia forests is present. ■ No records within the Study Area/locality.
Painted honeyeater (*Grantiella picta*)	V, V	The painted honeyeater lives in dry, open forests and woodlands. The species usually occurs in areas with flowering and fruiting mistletoe and flowering Eucalypts. This species	Yes	No	Potential to occur ■ Study Area is within the distribution for the species (likely to occur) (SPRAT).

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		prefers woodlands with a large number of mature trees as these host more mistletoe. There is a lack of preferred mistletoe present but general habitat of open forest and woodland habitat is present.			■ Only potential general habitat of open forests and woodlands is present, with a lack of mistletoe. ■ No records within the Study Area/locality Closest record 15 km south-east in Jandowae (ALA; 2012).
White-throated needletail (*Hirundapus caudacutus*)	V and M, V	According to Higgins (1999), this species occurs over most types of habitat, but are recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (as cited in DSEWPC, 2019b). Whilst rare, they have been recorded on wooded ends of ridges, roosting after dark high in the eucalypt tree canopies (Tarburton, 1993). Species likely to fly aerially over the Study Area, which contains no rainforest vegetation. The Study Area does contain potential general habitat in the form of eucalypt forests, particularly in the elevated northern area of the Study Area where it adjoins the Diamondy State Forest. It may also roost and forage in such general woodland habitat on wooded ridges.	Yes	Yes (locality, 2002) and located above the Study Area during 2020 surveys	Known to occur ■ Study Area is within the distribution of the species. ■ Species likely to fly aerially over the Study Area, which also contains potential general habitat in the form of eucalypt forests, particularly in the northern area of the Study Area where it adjoins the Diamondy State Forest. It may also roost and forage in such general woodland habitat on wooded ridges (although not observed during surveys), where it is easily able to take flight again after landing. ■ This species was located during the 2020 field survey and records exist within the locality (Diamondy State Forest record from 2002). This species was targeted during surveys for the Cooper's Gap and Dulacca Windfarms but no individuals were recorded.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Swift parrot (*Lathamus discolor*)	CE, E	This bird mainly occurs in the eucalypt forests where it forages on flowers and psyllid lerps. This species mainly occurs on inland slopes and occasionally is found on the coast. The majority of the species, outside its breeding habitat in Tasmania, is found in flowering eucalypt woodlands Victoria and New South Wales. Preferred habitat of flowering eucalypts with psyllid lerps not found within the Study Area, but general habitat of eucalypt forest is present.	Yes – Study Area is on the westernmost edge of range for the species.	No	Potential to occur ■ Study Area is right on the edge of the western distribution where this species may occur (with half the Study Area occurring outside of this species distribution). ■ Potential general habitat in the form of eucalypt forests is present within the Study Area. ■ No records within the Study Area/locality. The most recent records for this species in Queensland, occur east of the Great Dividing Range.
Australian painted snipe (*Rostratula australis*)	E, V	The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Marchant & Higgins (1993) stated that the Australian painted snipe can use modified habitats, such as low-lying woodlands converted to grazing pasture, sewage farms, dams, bores and irrigation schemes, however they do not necessarily breed in such habitats (as cited in DoE, 2019d). No preferred wetland habitat with in the Study Area but potential general habitat of farms are present.	Yes	No	Potential to occur ■ Study Area is within the distribution of the species. ■ Potential general habitat of farm damns present within the Study Area. ■ No records for the species exist within the Study Area/locality.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Black-breasted button-quail (*Turnix melanogaster*)	V, V	The black-breasted button-quail is restricted to rainforests and forests, mostly in areas with 770-1200 mm rainfall per annum. Smyth et al. (2001) found that in south-eastern Queensland, they are recorded on rare occasions in open eucalypt forest (as cited in DoE, 2019e). It also occurs within semi-evergreen vine thicket habitats. There are no preferred rainforest habitats within the Study Area but potential habitat in the form of semi-evergreen vine thicket is present.	No – Study Area occurs outside of western extent of range.	No	Unlikely to occur ■ Study Area is not within the species distribution as it sits just to the west of the species westernmost range. ■ Potential general habitat of semi-evergreen habitat present within the Study Area. ■ No records for the species exist within the Study Area/locality. Closest records are from the Bunya Mountains National Park (25 km southwest of the Study Area, from 2019) and no records further west.
Common sandpiper (*Actitis hypoleucos*)	M, SLC	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The common sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. No preferred coastal or wetland habitats, with suitable muddy or rocky margins, present within the Study Area. General habitat of farm dams is present.	Yes - species may occur	No	Potential to occur ■ Study Area is within the species distribution, where it may occur. ■ Potential general habitat of farm dams is present within the Study Area. ■ No records for the species exist within the Study Area/locality.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Oriental cuckoo (*Cuculus optatus*)	M, SLC	The species is found in forest canopy, open wooded areas and orchards, often in hill country, also in coniferous forest and in birch (Betula) above the treeline. The species may occur in association with remnant and regrowth RE types 11.3.2, 11.3.25, 11.9.4, 11.9.5, 11.9.5a, 11.9.10, 11.3.19, 11.5.1 within a project area. The species winters in many different countries, including the coastal parts of northern and eastern Australia (BirdLife International, 2015). General habitat present within the Study Area, associated with REs 11.3.2 and 11.9.5.	No	No	Unlikely to occur ■ Study Area is not within the species distribution. ■ Potential general habitat associated with REs 11.3.2 and 11.9.5 present within the Study Area. ■ No records for the species exist within the Study Area/locality.
Spectacled monarch (*Monarcha trivirgatus*)	M, SLC	The spectacled monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves. No preferred or general habitat of thick understorey in rainforests, or wet gullies with associated vegetation, is present within the Study Area.	No – Study Area occurs outside of western extent of range.	No	Unlikely to occur ■ Study Area is not within the species distribution as it sits just to the west of the species westernmost range. ■ No preferred or general habitat present within the Study Area. ■ No records for the species exist within the Study Area/locality.
Yellow wagtail (*Motacilla flava*)	M, SLC	Habitat requirements for the yellow wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams,	Yes	No	Potential to occur ■ Study Area is within the distribution for this species. ■ Potential preferred habitat of open grasslands associated with farm dams present within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves (Garnett et al., 2010). This species may occur in association with non-remnant vegetation. Potential preferred habitat of open grasslands associated with farm dams present within the Study Area.			■ No records for the species exist within the Study Area/locality.
Pectoral sandpiper (*Calidris melanotos*)	M, SLC	In Australasia, the pectoral sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. No preferred or general habitat of shallow fresh or saline wetlands or coastal habitats present within the Study Area.	Yes	No	Unlikely to occur ■ Study Area is within the distribution for this species. ■ No preferred or general habitat of shallow fresh or saline wetlands or coastal habitats present within the Study Area. ■ No records for the species exist within the Study Area/locality.
Osprey (*Pandion haliaetus*)	M, V	This species occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are found in lakes, large waterholes, beaches, coastal cliffs as well as inshore waters, bays and reefs. No preferred or general habitat associated with coastal or wetland areas is present within the Study Area.	Yes	No	Unlikely to occur ■ Study Area is within the distribution for this species. ■ No preferred or general habitat associated with coastal or wetland areas is present within the Study Area. ■ No records for the species exist within the Study Area/locality.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Fork-tailed swift (*Apus pacificus*)	M, SLC	In Australia, they occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. Potential general habitat over dry open habitats present. There is a lack of preferred coastal and riparian heathland or swamp habitat.	Yes	No	Potential to occur ■ Study Area is within the species distribution. ■ Potential general habitat over dry open habitats present. ■ No records for the species occur within the Study Area/locality. The closest record is 20 km south of the Study Area, from 2015. The species was recorded from surveys at Dulacca Windfarm, over 80 km to the west of the Study Area.
Black-faced monarch (*Monarcha melanopsis*)	M, SLC	The black-faced monarch mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. Preferred habitat of rainforest environments is not present in the Study Area however, some potential general habitat of semi deciduous vine-thicket but not within a rainforest ecotone.	Yes	Yes (locality, 2009)	Potential to occur ■ Study Area is within the species distribution. ■ Potential general habitat of semi-evergreen habitat present within the Study Area. ■ No records for the species occur within the Study Area. The closest record is south of the Study Area, within the locality from 2009.
Satin flycatcher (*Myiagra cyanoleuca*)	M, SLC	Satin flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in drier woodlands and open forests.	Yes	No	Potential to occur ■ Study Area is within the species distribution. ■ Potential general habitat of eucalypt forests present within the Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		There is general habitat of eucalypt forests present but a lack of preferred breeding, foraging habitat of densely vegetated areas.			■ No records for the species occur within the Study Area. The closest record is approximately 30 south of the Study Area from 2005, in Bell.
Rufous fantail (*Rhipidura rufifrons*)	M, SLC	In east and south-east Australia, the rufous fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as tallow-wood (*Eucalyptus microcorys*) and mountain grey gum (*E. cypellocarpa*). When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including spotted gum (*E. maculata*), yellow box (*E. melliodora*), ironbarks or stringybarks, often with a shrubby or heath understorey. Potential general habitat of eucalypt forests present, but a lack of wet sclerophyll forests for preferred habitat within the Study Area.	Yes	No	Potential to occur ■ Study Area is within the species distribution. ■ Potential general habitat of eucalypt forests present. ■ No records for the species occur within the Study Area or locality.
Glossy ibis (*Plegadis falcinellus*)	M, SLC	Preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Generally roosts in trees or shrubs in areas close to water bodies. Preferred habitat of cultivated areas under irrigation, associated with farm dams is present within the Study Area.	Yes	Yes (locality, 2019)	Likely to occur ■ Study Area is within the species distribution. ■ Preferred habitat of cultivated areas under irrigation, associated with farm dams is present within the Study Area. ■ No records for the species occur within the Study Area. A record exists within the locality, south-west of Study Area near Jandowae, from 2019.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Sharp-tailed sandpiper (*Calidris acuminata*)	M, SLC	Prefers habitat on muddy edges of freshwater wetlands or brackish wetlands. Can be found at dam inland. Will often occupy coastal mudflats when ephemeral terrestrial wetlands have dried out. Preferred and general habitat of muddy edges on freshwater or brackish wetlands is not present within the Study Area.	Yes	Yes	Potential to occur ■ Study Area is within the species distribution, where the species may occur. ■ No preferred or general habitat of wetlands with muddy flats present. ■ No records for the species occur within the Study Area. A record exists within the locality, south-west of Study Area near Jandowae, from 2007.
Latham's snipe (*Gallinago hardwickii*)	M, SLC	They usually occur in open, freshwater wetlands that have some form of shelter (usually low and dense vegetation) nearby. They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters, but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains. This species has been said to occur very rarely in small patches of habitat such as roadside ditches and alpine bogs (Higgins & Davies, 1996). There is a lack of preferred/general wetland and watercourse features throughout the Study Area, with the necessary forms of shelter.	Yes	Yes (locality, 2015)	Potential to occur ■ Study Area is within the species distribution. ■ No preferred or general habitat of wetlands with appropriate shelter vegetation present. ■ No records for the species occur within the Study Area. A record exists within the locality, south-west of Study Area near Jandowae, from 2015.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
Mammals					
Large-eared pied bat (*Chalinolobus dwyeri*)	V, V	Sandstone cliffs and fertile wooded valley habitat within close proximity of each other are considered as habitat critical to the survival of the large-eared pied bat (DECC, 2007). Rainforest and moist eucalypt forest habitats on other geological substrates (viz. rhyolite, trachyte and basalt) at high elevation are also considered to be important for this species (DERM, 2011c). Some populations of the large-eared pied bat would rely in part on the TEC of Brigalow (*Acacia harpophylla* dominant and co-dominant). The large-eared pied bat requires the presence of diurnal roosts in order to shelter. Roosts are utilised during the day and also at night. Potential general habitat of brigalow present but a lack of sandstone cliffs, and woodland valley areas for roosting.	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species. ■ Potential general habitat of brigalow present but a lack of sandstone cliffs, and woodland valley areas for roosting and preferred habitat requirements. ■ No records occur within the Study Area/locality.
Northern quoll (*Dasyurus hallucatus*)	E, -	The northern quoll occurs in a range of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, sugarcane farms and in urban areas. They are most abundant in hilly or rocky areas close to permanent water.	Yes	No	Potential to occur ■ Study Area is within the distribution of the species (the western side of the Study Area is where the species may occur, and the eastern side is where it is likely to occur. Cooper's Gap Windfarm reported that the Study Area was on the southern limits of its retracting range.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		The preferred habitat of rocky areas close to permanent water are scarce within the Study Area, however potential general habitat of rocky areas within dry sclerophyll forests associated with remnant eucalypt woodlands are present. These rocky areas are infrequent throughout the Study Area.			■ Potential general habitat of rocky crevices in dry sclerophyll forests are present within the Study Area. ■ There are no recent records within the Study Area/locality. The closest record is from Bunya Mountains National Park from 1993. (20 km away). Additionally, this species was not recorded during the Cooper's Gap Windfarm targeted surveys, which led to the conclusion that it was possible, but very unlikely, for the species to occur.
Corben's long-eared bat (*Nyctophilus corbeni*)	V, V	This microbat species has a scattered distribution mostly within the Murray-Darling Basin, but with some records outside of this area. It is more common in box, ironbark and cypress pine woodland on the western slopes and plains. Its stronghold seems to be the Pilliga scrub. It roosts in tree hollows, crevices and under loose bark. Potential preferred habitat of cypress pine and ironbark woodland is present in a small area within the south of the Study Area.	Yes	No	Potential to occur ■ Study Area is within the distribution of the species. ■ Preferred habitat of cypress pine and ironbark woodland present within the Study Area. ■ No records exist within the Study Area/locality. The closest record is 25 km from the Study Area, in the Bunya Mountains National Park, from 2002. The species was confirmed in the Cooper's Gap Windfarm assessment based on a recording of a potential Nyctophilus species from songmeter devices. No further trapping efforts were undertaken.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
					The 2021 survey effort for the Wambo Windfarm undertook harp trapping in the area where *Nyctophilus* spp. were recorded by anabats. Such harp trapping found two common *Nyctophilus* spp., *Nyctophilus geoffroyi* and *Nyctophilus gouldi*, and no *Nyctophilus corbeni* was recorded.
Greater glider (*Petauroides volans*)	V, V	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is more common in taller, montane older forests which have an abundance of hollows. Potential preferred habitat of tall, mature eucalypt forests present within the Study Area, although large trees with large hollows are present at low densities..	Yes	Yes (Study Area, 2020; locality, 2002)	Known to occur ■ The Study Area occurs within the distribution for the species. ■ Potential preferred habitat of tall, mature eucalypt forests present within the Study Area, with large hollow bearing trees present at low densities. ■ This species was recorded in the southern portion of the Study Area in the 2020 field investigations (spotlighting). The species was found on a mature ironbark tree with hollows. There is also records in the locality, with the closest record north of the Study Area, in Diamondy State Forest from 2002.
Koala (*Phascolarctos cinereus*)	V, V	Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by Eucalyptus species as explained by Martin & Handasyde 1999 (as cited in, DoE, 2019h). Koala habitat can be broadly defined as any	Yes	Yes (locality, 2018)	Known to occur ■ The Study Area occurs within the distribution for the species.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees. Potential preferred habitat of eucalypt forests, and preferred food trees, present within the Study Area.			■ Potential preferred habitat of eucalypt forests, and preferred food trees, present within the Study Area. ■ This species has been recorded within the locality in 2018. Additionally, landowners within the Study Area have reported seeing koalas within the past 10 years. Such sightings were limited to two landholders in the central and eastern portion areas of the Study Area. Thus the species is confirmed as occurring within the Study Area, but following extensive searches for the species it was concluded to occur at low densities due to infrequent but regular observations of (scats and scratches).
Grey-headed flying fox (*Pteropus poliocephalus)*	V, -	It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. Ebv (1998) explained that the primary food source is blossom from Eucalyptus and related genera but in some areas it also utilises a wide range of rainforest fruits (as cited in, DoE, 2019i). The listing advice for this species says that individuals can travel up to 50 km from their	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species however is on the outer western limits of the species range, which extends to Dalby, Kingaroy and the Bunya Mountains (AECOM, 2016). ■ The Study Area is approximately 57 km south-west from the closest colony (per the interactive flying-fox viewer of the Department of Environment). Thus, the Study Area is unlikely to be important foraging habitat.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		known roosting camps, in order to forage. They generally roost within 20 km of food sources which include the nectar and pollen of Eucalyptus, Melaleuca and Banksia native trees. Potential general foraging habitat present in eucalypt woodlands and riparian areas. However, the Study Area is approximately 57 km south-west from the closest colony (per the interactive flying-fox viewer of the Department of Environment). Thus, the Study Area is unlikely to be important foraging habitat.			■ No records occur within the Study Area/locality. The closest record is over 30 km east of the Study Area from 2017, in Kumbia. This species was concluded as likely to occur within the Cooper's Gap Windfarm with no records of the species. This conclusion was because the flying fox camp was within 50 km of the Cooper's Gap Study Area.
Spotted-tailed quoll *(Dasyurus maculatus maculatus)*	E, V	This species generally requires more mature wet forests. However it has been found in a range of habitats which include open and closed eucalypt woodlands, sub-alpine woodlands and coastal heathlands. Like the northern quoll, it requires denning habitats, normally in the form of rocky escarpments. There are no preferred wet sclerophyll forests present within the Study Area, however potential general habitat of open eucalypt woodlands associated with remnant vegetation, as well as some rocky escarpments are present.	Yes	No	Potential to occur ■ The easternmost portion of the Study Area sits in the westernmost edge of the species distribution (where the species may occur). ■ There is potential general habitat of open eucalypt woodlands with some rocky outcrops present within the Study Area. ■ There are no recent records within the Study Area/locality. Only one record is within the locality and that is from 1990. This species was not found during the Cooper's Gap targeted surveys however, landholders for

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
					this windfarm had reported sightings of the species in 2008.
Short beaked echidna (*Tachyglossus aculeatus)*	- , SLC	This species requires termite mounds and ant nests for foraging. Found in dry inland areas in various woodland types as well as in agricultural areas. Echidnas seek shelter under thick bushes, in hollow logs or amongst rocks. Potential general habitat of woodlands present. Preferred habitat of rocky and thick bush lacking within the Study Area.	Yes	Yes (Study Area, 2020)	Known to occur ■ The Study Area is within the distribution for this species. ■ Potential general habitat of woodlands present. ■ Found within the Study Area and records within the locality (2019).
Snails					
Brigalow woodland snail (*Adclarkia cameroni*)	E, V	Stanisic (2011) describes the brigalow woodland snail (family Camaenidae) to be endemic to south-east Queensland, where it occurs in a small number of remnant and scattered *Acacia harpophylla* (brigalow) and eucalypt woodland patches (such as road verges and riparian corridors) on the Condamine River floodplain (as cited in, DSEWPC, 2019f). One known population is from St Ruth's Reserve on the Condamine River. Potential preferred habitat of Brigalow woodland and eucalypt forests throughout Study Area.	Unknown	No	Unlikely to occur ■ The distribution for this species has been described as occurring in a small number of remnant and scattered brigalow and woodland patches, especially in the areas around Dalby and Chinchilla (Stanisic, 2011). ■ Potential preferred habitat of Brigalow woodland and eucalypt forests occur within Study Area. ■ No records for this species exist within the Study Area/locality. Extensive searches in habitat found snail shells that were identified by Craig Eddie as a commons species. The

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
					closest record exists 120 km north-west of the Study Area near Dulacca (AECOM, 2019), and this species was not documented as occurring within the Cooper's Gap Windfarm. Additionally, of the only 19 known records of this species, only seven were live individuals (Stanisic, 2013).
Dulacca woodland snail (*Adclarkia dulacca*)	E, E	This species inhabits a variety of remnant and scattered habitats, such as vine thicket and *Acacia harpophylla* woodland patches on rocky outcrops with clay to loam soils, as well as Eucalyptus species and *Acacia shirleyi* woodlands on ridges. This species occurs in a small number of isolated populations in the areas between Miles and Dulacca, and south to Meandarra. Potential preferred habitat of brigalow woodlands and vine thicket present is present in locations throughout the Study Area.	No	No	Unlikely to occur ■ The Study Area is outside the known distribution for the species. ■ Potential preferred habitat of brigalow woodlands and vine thicket present is present in locations throughout the Study Area. ■ No records exist for this species within the Study Area/locality. The closest records for this species are from Miles, which is 80km east of the Study Area, and 140 km west of the Study Area, where the species was found during extensive searches of the Dulacca Windfarm Study Area (AECOM, 2019). Both of these populations occur within the distribution of the species.
Reptiles					
Five-clawed worm-skink (*Anomalopus mackayi*)	V, E	This species is found on low open grassland with scattered trees to open grassy dry Eucalyptus and Callitris forest/woodland. This	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species.

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		skink is often found beneath logs. They occur on red-black to deep cracking black clay loam or sandy soils (including areas that are inundation prone and adjacent rises). Potential preferred habitat exists, vegetation communities associated with 11.8.5 which has been mapped within one patch in the Study Area. Additionally, potential general habitat in the form of Callitris pine habitat also occurs within the Study Area.			■ RE 11.8.5 was mapped as occurring in one small patch in the southern part of the Study Area. However upon ground-truthing in 2021, this patch was concluded to contain ironbark, brigalow and other species not characteristic for RE 11.8.5. Potential general habitat in the form of Callitris pine habitat also occurs in a small patch in the south of the Study Area, but outside of the project footprint. ■ No records in occur for the species within the Study Area/locality. The closest record is over 27 km south of the southernmost portion of the Study Area, from 2002.
Adorned delma *(Delma torquata)*	V, V	This species normally inhabits eucalypt-dominated woodlands and open-forests in Queensland Regional Ecosystem Land Zones (LZ). The regional ecosystems it prefers are ones dominated by poplar box (*Eucalyptus populnea*) on alluvial plains, lemon-scented gum (*Corymbia citriodora*) open forest on coarse-grained sedimentary rocks and poplar box/brigalow (*Acacia harpophylla*) open forests on fine-grained sedimentary rocks. Potential preferred habitat of Poplar Box, Brigalow woodlands and open forests is present within the Study Area. However,	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species. ■ Potential preferred habitat of Poplar Box, Brigalow woodlands and open forests is present within the Study Area. This species was considered likely to occur within the Cooper's Gap windfarm based on the presence of rocky features on the eastern edge of this Study Area. Such rocky features are lacking within the Wambo Study Area.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		preferred rocky areas are lacking within the Study Area.			■ No records for this species occur within the Study Area/locality. The closest record is over 25 km south east of the most southern-eastern portion of the Study Area, from 2016.
Yakka skink (*Egernia rugoa)*	V, V	The yakka skink is known to occur in open dry sclerophyll forest, woodland and scrub. The core habitat of this species is within the Mulga lands and Brigalow belt south bioregions. It is known from rocky outcrops and san plain areas with dense ground vegetation. Potential preferred habitat for dry sclerophyll forests and vegetation within the Brigalow belt south bioregion is present in the Study Area. However there is a lack of rocky outcrops and sand plains with dense vegetation.	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species. ■ Potential preferred habitat for dry sclerophyll forests and vegetation within the Brigalow belt south bioregion is present in the Study Area. However, there is a lack of rocky outcrops and sand plains with dense vegetation. ■ No records exist for this species within the Study Area/locality. There is a record over 20km to the west of the Study Area from 1999, in Nudley State Forest. Additionally, active searches within suitable habitat in the Cooper's Gap Windfarm failed to detect any sign of this species.
Dunmall's snake (*Furina dunmalli*)	V, -	This species is found in forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (*Acacia harpophylla*), other Wattles (*A. burowii, A. deanii, A. leioclyx*), native Cypress (Callitris spp.) or Bull-oak (*Allocasuarina luehmannii)*.	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		There is potential preferred habitat of Brigalow and Callitris forests present within the Study Area.			■ There is potential preferred habitat of Brigalow and Callitris forests present within the Study Area. ■ No records for this species occur within the Study Area/locality. The closest record is over 40 km away to the east of the Study Area, from 1996. Extensive searches for this species were undertaken in suitable habitat within the Cooper's Gap Study Area, and the species was not recorded.
Golden tailed gecko (*Strophurus taenicauda*)	-, NT	The golden-tailed gecko lives in open woodland and open forest where it shelters under loose bark and hollow limbs. Almost all known records of this species have occurred within the Brigalow Belt bioregion (Cogger, 2014). Potential general habitat of Brigalow forest present. However, due to the highly disturbed landscape within the Study Area, there is a lack of preferred habitat.	Yes	No	Potential to occur ■ The Study Area occurs within the distribution for this species. ■ Potential general habitat of Brigalow forest present. However, due to the highly disturbed landscape within the Study Area, there is a lack of preferred habitat. ■ No records occur within the Study Area/locality. The closest record is over 13 km away, in the Nudley State Forest, from 2018.
Plants					
Ooline (*Cadellia pentastylis*)		Ooline grows in semi-evergreen vine thickets and sclerophyll vegetation on undulating terrain of various geology, including sandstone, conglomerate and claystone. The species forms a closed or open canopy, as a dominant	Yes	No	Potential to occur ■ The Study Area is within the known distribution for the species.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		or commonly with white box (*Eucalyptus albens*) and white cypress pine (*Callitris glaucophylla*), with an open understorey and leaf litter dominating the forest floor. There is potential preferred habitat of semi-evergreen vine thickets present within small patches in the Study Area.			■ There is potential preferred habitat of semi-evergreen vine thickets present within small patches in the Study Area. ■ There are no records for the species within the Study Area/locality.
King blue-grass (*Dichanthium queenslandicum*)	E,V	*Dichanthium queenslandicum* occurs on black cracking clay in tussock grasslands mainly in association with other species of blue grasses, but also with other grasses restricted to this soil type. *Dichanthium queenslandicum* in mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains. There is no potential general or preferred habitat present due to the lack of associated species and appropriate tussock grasslands.	Yes	No	Potential to occur ■ The Study Area is within the known distribution for the species. ■ There is no potential general or preferred habitat present due to the lack of associated species and appropriate tussock grasslands. ■ There are no records within the Study Area/locality. The closest record is over 35 km south of the Study Area from 1951, on the road side and in grasslands between Dalby and Jandowae.
Bluegrass (*Dichanthium setosum*)	V,LC	Associated with heavy basaltic black soils and red-brown loams with clay subsoils. Often found in moderately disturbed areas. Threats relate to heavy grazing, clearing for pasture improvement and cropping, fire, introduced grasses and road widening. Associated species include White Box (*Eucalyptus albens*), Silver-leaved Ironbark (*E.*	Yes	No	Potential to occur ■ The Study Area is within the known distribution for the species. ■ There is potential general habitat of cleared grazing land present within the Study Area. There is a lack of preferred species within

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		melanophloia), Yellow Box (*E. melliodora*), Manna Gum (*E. viminalis*), Amulla (*Myoporum debile*), Purple Wire-grass (Aristida ramosa), Kangaroo Grass (*Themeda triandra*). There is potential general habitat of cleared grazing land present within the Study Area. There is a lack of preferred species within such general habitat to make it preferred.			such general habitat to make it potential preferred habitat. ■ There are no records within the Study Area/locality.
Tall velvet sea-berry (*Haloragis exalata subsp. velutina)*	V,V	This species has been recorded from eucalypt forests, from rainforest margins and grasslands from near sea-level to 1000 m altitude. The species has been recorded growing on brown heavy clay (Carnarvon National Park), shallow rock loam (Bunya Mountains National Park), and basaltic soils. Associated species include *Eucalyptus tereticornis, Angophora subvelutina*, and *Acacia irrorata*. There is potential preferred habitat of *Eucalyptus tereticornis* woodlands present within the Study Area.	Yes	No	Potential to occur ■ The Study Area is within the known distribution for the species. ■ There is potential preferred habitat of *Eucalyptus tereticornis* woodlands present within the Study Area. ■ There are no records within the Study Area/locality. The closest record is over 40 km south-east of the Study Area from 2008, within the Bunya Mountains National Park.
Belson's panic (*Homopholis belsonii)*	V,E	It occurs on rocky hills supporting white box (*Eucalyptus albens*) and in wilga (*Geijera parviflora)* woodland; flat to gently undulating alluvial areas supporting belah (*Casuarina cristata*) forest; and soils and plant communities of poplar box (*E. populnea*) woodlands. It may also be associated with	Yes	No	Potential to occur ■ The Study Area is within the known distribution of the species. ■ There is potential preferred habitat of poplar box and brigalow woodlands or open forests

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		shadier areas of brigalow (A*cacia harpophylla*), myall (*A. melvillei*), and weeping myall (*A. pendula*) communities; in mountain coolibah (*E. orgadophila*) communities; and on roadsides. There is potential preferred habitat of poplar box and brigalow woodlands or open forests present within the Study Area. However, there is a lack of rocky hills in such areas.			present within the Study Area. However, there is a lack of rocky hills in such areas. ■ There are no records within the Study Area/locality. The closest record is from 2016 and is over 22 km away from the southern portion of the Study Area on a roadside near the Bunya Mountains National Park.
Wandering pepper-cress (*Lepidium peregrinum)*	E, LC	This species grows in riparian open forest dominated by *Eucalyptus camaldulensis* and *Casuarina cunninghamiana* with a variably dense shrubby understorey of *Hymenanthera dentata*, *Bursaria spinosa, Acacia fimbriata, A. floribunda, Callistemon viminalis* and *Leptospermum brachyandrum*. This species was most abundant in the tussock grassland fringe of the riparian open forest. There is potential habitat in preferred *Eucalyptus camaldulensis* riparian areas, within the Study Area.	Yes	No	Potential to occur ■ The Study Area occurs within the known distribution for the species. ■ There is potential habitat in preferred *Eucalyptus camaldulensis* riparian areas, within the Study Area. ■ There are no records for the species within the Study Area/locality.
Austral cornflower (*Rhaponticum australe*)	V, V	Grows in eucalypt open forest with a grassy understory and in grasslands on black clay soil. It is often found on roadsides and on road or rail reserves associated with *Chloris gayana*, *Cirsium vulgare*, *Eucalyptus tereticornis* and *Angophora floribunda*.	Yes	No	Potential to occur ■ The Study Area is within the distribution for the species.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		Potential habitat in the form of preferred *Eucalyptus tereticornis* woodlands are present in the Study Area.			■ There is potential preferred habitat of *Eucalyptus tereticornis* woodlands present in the Study Area. ■ There are no records within the Study Area/locality. The closest record is over 15 km south of the Study Area and is from 1995.
Sophora fraseri	V, V	*Sophora fraseri* is a subtropical shrub that normally grows in wet sclerophyll forest and a range of rainforest types. It has been reported growing in hilly terrain on hillslopes at altitudes at altitudes from 60 to 660m, mostly shallow stony to shaly soils, of loam to clay texture derived from sandstone or basalt rocks. Associated species include: *Corymbia citriodora*, *Eucalyptus carnea*, *E. microcorys, E. acmenoides, E. propinqua* and *Lophostemon confertus.* There are no suitable rainforest and wet sclerophyll habitats present within the Study Area for general and preferred habitat requirements.	Yes	No	Potential to occur ■ The Study Area is within the distribution for the species. ■ There are no suitable rainforest and wet sclerophyll habitats present within the Study Area, to meet general and preferred habitat requirements for the species. ■ There are no records for the species within the Study Area/locality.
Toadflax (*Thesium australe*)	V, V	This species grows in grassland or woodland, often in damp sites. Examples of associated vegetation includes: open woodland with *Eucalyptus tereticornis* and *E. tindaliae* on skeletal soils; on heavy alluvium soil in grassy	Yes	Yes (locality, 2010)	Potential to occur ■ This Study Area is within the distribution of the species. ■ There is potential general habitat of grasslands and E. tereticornis and E.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		E. populnea woodland; on black cracking clay in grassland of *Dichanthium sericeum*; and grassland dominated by *Themeda triandra* and *Heteropogon contortus* on basaltic, rocky soils. Potential general habitat of grasslands and *E. tereticornis and E. populnea* woodlands are present in the Study Area. There is no preferred habitat due to lack of moist, damp sites.			populnea woodlands are present in the Study Area. There is no preferred habitat due to lack of moist, damp sites. ■ There are no records within the Study Area but there is no record within the locality from 2010, 5 km to the east of the Study Area.
Cyperus clarus	-, V	Grows in grassland or open woodland, in heavy soils derived from basalt. The species is associated with grasslands where *Aristida leptopoda* and *Panicum queenslandicum* occur on deep alluvial black clay; in *Eucalyptus melanophloia* woodland with mid-dense ground stratum of *Chrysopogon fallax* and growing with *Stemmacantha australis* in mountain coolibah woodland on basalt ridges. Potential preferred habitat within *E. melanophloia* woodland is present within a small patch in the Study Area.	Yes	Yes (locality, 2000)	Likely to occur ■ The Study Area occurs within the distribution for the species. ■ There is potential preferred habitat within *E. melanophloia* woodland is present within a small patch in the Study Area. ■ A record exists within the locality, approximately 5 km south of the Study Area from 2000. This species has not been recorded in the Study Area despite extensive searches..
Queensland western white gum (*Eucalyptus argophloia)*	V, V	Occurs on flat to undulating country at 300-340m above sea level. It prefers deep, dark, heavy clay soils, often with strong gilgai (melon hole) development. It has been recorded growing in Brigalow woodland and forest communities associated with belah, poplar box	Yes	Yes (Study Area, 2021). This species occurs as part of a privately owned	Known to occur ■ The Study Area is within the known distribution for the species.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		and inland grey box. Only found in a small area north-east of Chinchilla. Potential preferred habitat among Brigalow woodlands are present within the Study Area.		planation in the Study Area.There are no records within the locality,	■ There is potential preferred habitat among Brigalow woodlands are present within the Study Area. ■ This species occurs as part of a privately owned planation within the Study Area, thus resulting in its known occurrence. It does not exist within remnant or regrowth vegetation that will be impacted by the Project, which is habitat for listed species. There are also no records within the locality,
Hando's wattle (*Acacia handonis*)	V, V	The species grows in lateritic soil of grey sand or clayey silt with ironstone gravel, in gently undulating country. Often on stony ridges, in eucalypt woodland and open forest. The species occurs in an open forest with a sparse to dense shrub layer. Dominant trees are *Eucalyptus fibrosa subsp. nubila* and *E. watsoniana subsp. watsoniana. E. tenuipes* may be present, especially on hillcrests. There is a lack of preferred/general habitat within the Study Area as there are no necessary hillcrests with associated species present.	No	No	Unlikely to occur ■ The Study Area is within the species known distribution. ■ There is a lack of preferred/general habitat within the Study Area as there are no necessary hillcrests with associated species present. ■ There are no records for the species within the Study Area/locality.
Gurulmundi heath-myrtle (*Micromyrtus carinata)*	-, E	*Micromyrtus carinata* inhabits the tops of laterised ridges, on shallow to deep, yellow or red sands. Associated species and vegetation include: heath dominated by this species and	No	No	Unlikely to occur ■ The Study Area is not within the species known distribution.

Species name	Status (EPBC and NC Act)	Habitat requirements	Distribution in Study Area	Records in the Study Area/ locality	Comment on likelihood of occurrence in Study Area
		Triodia sp., *Homalocalyx polyandrus, Corymbia trachyphloia* and *Eucalyptus exserta* also present; pale red-brown sand over hard brown loam with associated species including recently burnt Callitris sp. / *E. exserta* woodland with sparse understorey of Melichrus sp.; low open shrubland of *Acacia triptera*; and *Acacia triptera* shrubland with scattered *Melaleuca nodosa*. There is a lack of preferred/general habitat within the Study Area as there are no laterised ridges and associated species present.			■ There is a lack of preferred/general habitat within the Study Area as there are no laterised ridges and associated species present. ■ There are no records for the species within the Study Area/locality.

Status listing per EPBC and NC Acts: CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory; LC = Least Concern; SLC = Special Least Concern; NT = Near Threatened.

Sources of habitat information for all species, unless otherwise stated, were gathered from DoEE Conservation Advice and SPRAT database: (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl). Each of these is listed in the references species, specific to the subcategory (eg. Flora, fauna and migratory).

APPENDIX C SURVEY ADEQUACY ASSESSMENT

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Memo

Client	Cubico Sustainable Investments
Project	Wambo Wind Farm
Date	27 January 2021
Reference	0532612
Subject	EPBC Act Survey Effort and Adequacy

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
Birds (including migratory species)				
Falco hypoleucos Grey falcon	There are no targeted survey guidelines for this species. This species is rare with a very large distribution so has been hard to find during previous targeted survey efforts. However, they normally are found in treeless areas except along watercourses and often are found over grasslands (Venn, 2003). Nests are located in tall eucalypts close to watercourses	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet)	The survey periods were carried out extensively over spring and summer in a range of locations across the Study Area. This included areas of grasslands and close to watercourses, specifically where any nests for this species may occur. *No guidelines but survey effort considered adequate*

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Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area. *A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours*	
Apus pacificus Fork-tailed swift	**Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015)** No survey guidelines specific to the fork-tailed swift – however, recommended to focus survey efforts from high vantage points. This species is found across a range of habitats (non-breeding habitats only), from inland plains to wooded areas. It is exclusively aerial.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry)	The surveys for this species were taken at high vantage points across the Study Area. Additionally, the 160 survey hours were conducted over a range of habitats, including over grassland plains and wooded forest areas. *No guidelines but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area. *A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours*	
Calidris ferruginea Curlew sandpiper	**Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017)** This species is present during the non-breeding season through September to March. Migratory shorebird surveys are recommended for four survey periods in areas of suitable habitat where replication is necessary. Suitable habitat for this species inland can include wetlands and watercourses but is mainly in coastal areas. This survey guideline is mainly for assessing the species at low and high tides, which is not applicable to the Study Area.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across	Surveys were conducted in the appropriate season. Survey effort was conducted in a range of habitats throughout the Study Area by suitably qualified ecologists, within and around breeding habitat areas. *Guideline requirement as it relates to the Study Area met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			14 sampling locations in the Study area. *A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours*	
Rostratula australis Australian painted snipe	**Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Searches are recommended through suitable wetland or watercourse areas, with detected via sighting and flushing at dawn and dusk. Targeted stationary observations – 10 hours for 5 days Land-based area searches or line transects – 10 hours for 3 days.	2019, 2020, 2021, 2022, 20232019, 2020, 2021	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys were conducted near suitable watercourse environments with sighting and flushing undertaken for extensive survey periods at dawn and dusk. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Grantiella picta Painted honeyeater	There are no Commonwealth guidelines for surveys for this species, however survey guidance is provided in Queensland Department and Environment and Science targeted survey guidelines (Rowland 2012.). Area searches are recommended for this species, but there is currently no published information on detection probabilities for the species (Rowland, 2012). Surveys should be conducted throughout woodlands were mistletoe is present and where there is fruit and detection of this species' call should also be undertaken. Area searches to be conducted for a minimum of 4 hours over 4 survey days.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	The surveys were conducted in suitable woodland habitats, particularly where mistletoe was present. Surveys were conducted for extensive periods of time and detection of bird calls was also undertaken. *No guideline but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Rhipidura rufifrons Rufous fantail	**Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015)** No specific survey guidelines, however in breeding season, a two hectare survey in 20 minutes in preferred habitat such as moist forests or eulcaypt forests as well as Brigalow woodlands, should be undertaken. During migration surveys should be taken over standardised time periods and observers should recognise calls as well as the species.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys were conducted in the appropriate season. Survey effort was conducted in a range of habitats throughout the Study Area by suitably qualified ecologists, within and around breeding habitat areas. *No guidelines but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Myiagra cyanoleuca Satin flycatcher	**Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015)** No specific survey guidelines, however in breeding season, a two hectare survey in 20 minutes in preferred habitat such as eucalypt forest and open grassy woodlands, should be undertaken. During migration surveys should be taken over standardised time periods and observers should recognise calls as well as the species.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys were conducted in the appropriate season. Survey effort was conducted in a range of habitats throughout the Study Area by suitably qualified ecologists, within and around breeding habitat areas. *No guidelines but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Hirundapus caudacutus White-throated needletail	No survey guidelines specific to White-throated needletail, but consideration given to: **Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Observations should be made as late as possible in the evening of birds coming into roost in tall trees along ridge tops.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	The surveys conducted in the spring/summer seasons occurred in a suitable time period for the white throated needle tail (October to April). The white-throated needle tail was observed during the 2020 spring survey. *No guidelines but survey effort considered adequate, as species was detected.*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Plegadis falcinellus Glossy Ibis	**Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015)** No survey guidelines specific to the glossy ibis – however, recommended to focus survey efforts near waterholes.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	The survey periods were within the breeding period for the glossy ibis, and while potentially suitable shallow water is present in small isolated dams/waterholes in the Study area (primarily turkey nest dams and small creeks); suitable wetland habitats and wet sclerophyll forests are generally absent. *No guidelines but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Motacilla flava Yellow wagtail	**Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015)** No specific survey guidelines, however if surveys of these species are to be undertaken, they should occur across appropriate habitat between November and March. Persons surveying should be appropriately trained in bird identification as these species can be easily mistaken for more common, resident species. Breeding habitat - an area survey, preferably a two hectare survey in 20 minutes.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys were conducted in the appropriate season. Survey effort was conducted in a range of habitats throughout the Study Area by suitably qualified ecologists, within and around breeding habitat areas. *No guidelines but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Cuculus saturatus Oriental cuckoo	**Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015)** No specific survey guidelines, but appropriate methods of survey for the oriental cuckoo in non-breeding areas and the five breeding migrant flycatchers in breeding habitat is an area survey, preferably a two hectare survey in 20 minutes, over sufficient survey plots to estimate a density, and hence the population size across the proposed development area. Surveys should be undertaken in an appropriate season - spring or summer in southern Australia. No set survey guidelines: Breeding habitat - an area survey, preferably a two hectare survey in 20 minutes.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys were conducted in the appropriate season. Survey effort was conducted in a range of habitats throughout the Study Area by suitably qualified ecologists, within and around breeding habitat areas. *No guidelines but survey effort considered adequate*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Erythrotriorchis radiatus Red goshawk	**Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Search for their characteristic nests within patches of the tallest forest. In sub-coastal woodland, these areas can initially be identified from aerial photos and then searched during follow-up ground surveys. Further inland requires ground searches along river banks for nests within the tallest trees. Driving slowly through tropical woodland tracks and scanning groups of tall trees for nests can also be effective. In eastern Australia's ranges, searching for nests is more difficult but soaring birds can sometimes be located from vantage points such as mountain tops. Some success has been had surveying this species using call playbacks during the breeding season. Area searches for 80 hours over 10 days.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys were carried out in tall forests and searching for characteristic nests along river banks and in the tallest trees. 160 hours of survey effort across 19 days exceeds minimum recommended survey requirement. No call playback used during surveys. *Guideline requirement met for survey effort, although call playback not used*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Geophaps scripta scripta Southern squatter pigeon	**Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Area searches or transect surveys in suitable habitat. Flushing surveys also likely to be useful. Area searches or transect surveys for 15 hours over 3 days. Flushing surveys for 10 hours over 3 days.	2019, 2020, 2021, 2022, 2023, 2021	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area.	Surveys conducted throughout Study area and near isolated patches of short, grassy understorey of eucalypt woodlands. Permanent bodies of water are scarce in the Study Area; however, surveys were located near water bodies and flushing surveys undertaken while traversing between sites. . *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
			A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours	
Turnix melanogaster Black-breasted button quail	**Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Area searches of suitable habitat with detection of flushing birds or hearing of foraging scratching. Also search for platelets, although not conclusive unless birds also sighted. Land-based area searches for 15 hours over 3 days.	2019, 2020, 2021, 2022, 2023	Four separate survey events were undertaken across the Spring and Summer from Spring 2019 to Summer 2021: 2019 survey – Spring 2020 survey – Spring 2021 surveys (x2) – Summer. Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area. *A total of 250 separate bird surveys, by two ecologists totalling 160 survey hours* . Searches for platelets in State mapped vine-thicket were undertaken for a period of 10 person hours.	Clusters of semi-evergreen vine thicket RE (11.8.3) are mapped within the Study Area and are described as suitable habitat for the black-breasted buttonquail. These areas were searched during vegetation community assessments for evidence of the species including platelets. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
Lathamus discolor Swift parrot	**Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Area searches or transect surveys of suitable habitat, preferably in the early morning and afternoon when birds are most active and vocal. Detection by sighting or call. Slow-moving vehicle transects also effective in expansive areas, detecting loud, distinctive 'clinking' call that can be heard over noise of engine. Targeted surveys of patches of heavily flowering eucalypts may be useful. Area searches or transect searches – 20 hours for 8 days. Target searches of habitat – 20 hours for 8 days. The timing of these surveys on the mainland should be conducted between March and July.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area. *A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours*	Targeted searches were undertaken between March to July with surveys conducted within eucalypt forests and woodlands. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
Xanthomyza phrygia Regent honeyeater	**Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA, 2017)** Area searches in suitable habitat, preferably in the morning but other times may also be appropriate. Detection by call is possible when birds are most vocal (outside the breeding season). Otherwise, detection is by sighting. Targeted searches of woodland patches with heavily flowering trees is useful, especially around water points such as dams and creek lines. Also, check among flocks of other blossom nomads such as lorikeets and other honeyeaters. Broadcast surveys immediately before and during the breeding season may also be useful. Area searches for 20 hours over 10 days. Targeted searches for 20 hours over 5 days.	2019, 2020, 2021, 2022, 2023	Eight separate survey events were undertaken across the Wet and Dry seasons from Spring 2019 to Autumn 2023: 2019 survey – Spring (Dry) 2020 survey – Spring (Wet) 2021 surveys (x2) – Summer (Wet) 2021 surveys – Winter (Dry) 2022 survey – Winter (Dry) 2023 survey – Summer (Wet) 2023 survey – Autumn (Dry) Dawn and dusk timed surveys (20 mins), bird utilisations surveys across 14 sampling locations in the Study area. *A total of 343 separate bird surveys, by two ecologists totalling 228 survey hours*	Surveys conducted during Spring and Summer in the suitable time period for the regent honeyeater. Surveys were undertaken in habitat consistent with box-ironbark eucalypt associations and along creeks, water bodies and river systems. *Guideline requirement met*
Mammals				

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
Pteropus poliocephalus Grey-headed flying-fox	**Survey guidelines for Australia's threatened bats (DEWHA, 2010)** Flying foxes are recognised easily from a distance while they roost or are in flight, and have distinctive audible calls that are heard most frequently in the early morning or under sunny conditions. Other signs include their distinctive odour and droppings. Both the ground and foliage should be examined for flying fox scats. Field surveys conducted by qualified botanist to confirm vegetation communities in the Study Area and presence of food plants. Conduct walking transects (100 m apart) looking for feeding and flying bats as well as detecting their smell. Alternative methods may include nighttime audio recordings made at selected sites or fruiting food plants within the Study Area.	2019, 2020, 2021	Vegetation community assessments to determine presence of suitable habitat and food trees. Spotlight surveys undertaken in spring and summer survey looking for nocturnal species, including feeding flying foxes. *Four ecologists conducted spotlight surveys across 6 nights across two survey periods.*	No flying fox camps are located within 50 km of the survey site. The Study Area is approximately 57 km north-west from the closest colony (per the interactive flying fox viewer of the Department of Environment). A small flying fox camp is located in Jandowae (15 km west of the southern most part of the Study Area) and observed to consist of <100 black flying foxes and there are no reports of grey-headed flying fox using this camp. Additionally, spotlighting was conducted in suitable foraging habitat. *Guideline requirement met*
Nyctophilus corbeni South-eastern long-eared bat	**Survey guidelines for Australia's threatened bats (DEWHA)** Call detection is not efficient for this species as the calls of this species are not distinguishable reliably from other sympatric Nyctophilus species using anabat detectors.	2019, 2020, 2021	Anabat detectors and harp traps were used to detect *Nyctophilus* species. *A total of 5 anabats were deployed for a total of 12 nights (60 detection nights)near waterbodies (Novembe-February) and harp traps across 4 nights in the 2021 summer survey.*	Survey were undertaken during the recommended season with appropriate survey effort. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
	Surveys best undertaken during October through to April. Harp traps and mist nets are most effective for detecting this species. Harp trap recommendation is for 20 trap nights and/or 20 mist-net traps, both for a minimum of five nights (per 50 hectares).			
Chalinolobus dwyeri Large-eared pied bat	**Survey guidelines for Australia's threatened bats (DEWHA)** A combination of survey efforts is recommended for this species. This includes unattended bat detectors for 16 detector nights for a minimum of four nights and attended bat detectors for six detector hours for a minimum of three nights. It is also includes harp traps and/or mist nets for 16 trap or net nights for a minimum of four nights. Surveys are best undertaken from October through to March.	2019, 2020, 2021	Anabat detectors were used to detect any Chalinolobus species. *A total of 5 anabats were deployed for a total of 12 nights (60 detection nights) near waterbodies (November/February) and harp traps across 4 nights in the 2021 summer survey.*	Survey were undertaken during the recommended season with appropriate survey effort. *Guideline requirement met*
Phascolarctos cinereus Koala	**Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DES, 2018)** Requires two person, 30 minute spotlight searches of 100 x 100 m survey site. This can include spotlighting up one side of the 100 x 100	2019, 2020, 2021	Diurnal surveys of incidental fauna sightings and secondary indications of potential presence, including scats, scratches, diggings, tracks or other signs were conducted.	The habitat assessments identified potential koala habitat within the Study Area. While no koalas were observed from spotlight surveys, or diurnal surveys, the species was considered known to be present based on landowner sightings and the presence of

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
	m area and then spotlighting back the other side of the 100 x 100 m area Scat and sign search can coincide with the systematic diurnal active searches, within 50 x 50 m quadrates of the survey site. **EPBC Act referral guidelines for the vulnerable koala (DoE, 2014)** Strip transects which involve diurnal distance sampling and density searches. Nocturnal spotlighting for smaller sites to determine presence and density. Scats – Spot Assessment Technique which involves looking at food trees for presence of koala scats.		Specific koala scat surveys undertaken at each habitat assessment location for each survey period using the Spot Assessment technique. *One ecologist for six 20 minute surveys, for three days (May/June)* Spotlighting was conducted for six nights across spring and summer surveys.	koala scats and potential scratch marks located within the Study Area. *Guideline requirement met*
Petauroides volans Greater glider	**Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DES, 2018)** Requires two 30 person minute spotlight searches of 100 x 100 m survey site across multiple nights. This can include spotlighting up one side of the 100 x 100 m area and then spotlighting back the other side of the 100 x 100m area.	2019, 2020, 2021	Survey effort involved spotlighting in transects throughout areas identified as containing mature eucalypt forests with hollow-bearing trees. *Spotlight surveys were undertaken across 6 nights by four ecologists in Spring and Summer surveys.* *Four ecologists for 3 hours, for two nights (December).*	The habitat assessments identified potential greater glider habitat within the Study Area. Survey efforts met the guideline as over 5 km of transects were surveyed throughout suitable habitat. Scat and scratch searches were also undertaken within the Study Area. This species was found during the survey effort.

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
	Scat and sign search can coincide with the systematic diurnal active searches, within 50 x 50 m quadrates of the survey site. **Survey Guidelines for Australia's Threatened Mammals (DSEWPC, 2011)** Bright moonlight aids in detecting greater gliders. Spotlighting should be at least two 200 m transects per 5 ha sites. It is also recommended there be 100 m between survey transects.		Scat and scratch mark searches were conducted throughout identified habitat within the Study Area. *Four ecologists over 5 days (November/ December).*	*Guideline requirement met*
Dasyrus maculatus Spot-tailed quoll	**Survey Guidelines for Australia's Threatened Mammals (DSEWPC, 2011)** Sampling units of 100 hectares are appropriate for this species with a large home range. Daytime searches for potentially suitable habitat resources like caves and hollow logs should be undertaken. Such daytime searches should also incorporate searching for signs of activity like tracks and scats. Hair sampling device surveys using a mixture of sardines, tuna oil and flour for bait is also recommended. Baited camera traps using 'chuditch' bait is also a most cost effective survey method and allows	2019, 2020, 2021	Daytime searches were conducted in areas of suitable habitat to search for habitat resources as well as signs of activity. *Four ecologists over 10 days across two survey events.* Camera trapping was undertaken in suitable habitat areas. *Camera traps were deployed for a total of 50 trap nights using 'chuditch' bai across a Spring and Summer surveyt.*	Daytime searches in areas were rocky crevices and hollow logs were found throughout the Study Area were conducted. Searches through such areas for any signs of the species were also carried out to determined the presence of any scats and tracks. Camera traps were then deployed in areas of suitable habitat to determine species presence/absence. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
	for consistent data (M Schulz pers. obs.; Nelson 2008).			
Dasyurus hallucatus Northern quoll	**Survey Guidelines for Australia's Threatened Mammals (DSEWPC, 2011)** Cage trapping is the most effective method for detecting this species and is best conducted through May to August (10 cage traps for four consecutive nights spaced in an area of 5 hectares – replication necessary for larger areas). However, in large survey areas, Elliott trapping surveys are also recommended (25 Elliott traps for four consecutive nights). Additionally or complementary techniques to survey for this species include daytime searches for potentially suitable habitat resources, such as areas associated with a gully or a ridge and potential den sites. Remote cameras in potentially suitable habitat is also recommended for sampling in remote areas. Hair tubes and spotlighting are also suggested as potential surveying methods for this species.	2019, 2020, 2021	Daytime searches were conducted in areas of suitable habitat to search for habitat resources as well as signs of activity. *Four ecologists over 10 days across two survey periods.* Camera trapping was undertaken in suitable habitat areas. *Camera traps were deployed for 20 trap nights nights using 'chuditch' bait (December).* Spotlight surveys undertaken in spring and summer survey looking for nocturnal species,and searches for potential den sites has been undertaken.. *Four ecologists conducted spotlight surveys across 6 nights across two survey periods.*	Daytime searches and camera trapping were undertaken in suitable habitat for this species (eg. rocky outcrops/crevices and within and around hollow logs). 20 camera trap nights and hair tube sampling undertaken across spring and summer surveys. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
Snails				
Adclarkia cameroni Brigalow woodland snail	**Australian land snails. A field guide to eastern Australian species (Stanisic, 2010)** The best survey period is from October to March. Night surveys are recommended as the species is nocturnal but due to the difficulty of this effort, daytime searches of preferred habitat can be effective. The survey effort for recording presence/absence is recommended to be for two person hours in preferred snail microhabitat.	2019, 2020, 2021	Microhabitat searches in Brigalow woodlands were carried out for signs of the species. *Two ecologists for 5 hours, over two days (December).*	Following the recent 2020 December survey, the area of mapped Brigalow within the Study Area was ground-truthed to be only small patches. The survey was carried out in the recommended survey period and microhabitat searches were extensive to determine presence/absence of this species in the small Brigalow patches. *Guideline requirement met*
Adclarkia dulacca Dulacca woodland snail	**Australian land snails. A field guide to eastern Australian species (Stanisic, 2010)** The best survey period is from October to March. Night surveys are recommended as the species is nocturnal but due to the difficulty of this effort, daytime searches of preferred habitat can be effective. The survey effort for recording presence/absence is recommended to be for two person hours in preferred snail microhabitat.	2019, 2020, 2021	Microhabitat searches in Brigalow woodlands were carried out for signs of the species. *Two ecologists for 5 hours, over two days (December).*	Survey efforts involved microhabitat searches within forest debris, over-turning logs and moving aside accumulated leaves. The survey was carried out in the recommended survey period and microhabitat searches were extensive to determine presence/absence of this species in the small Brigalow patches. *Guideline requirement met*
Reptiles				

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
Furina dunmalli Dunmall's snake	**Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSEWPC, 2011)** Recommended methods are active searching of sheltering sites (under large objects on the ground such as rocks, logs or human-made debris), pitfall trapping, or road driving at night (particularly after wet weather). However, all of these methods are likely to yield low returns. Actively look for reptiles whilst driving along roadways in your study area. Especially following heavy rainfall events and during warm evenings for snakes.	2019, 2020, 2021	Opportunistic searches whilst driving extensively through the Study Area, both during the day and after spotlighting at night. *Five ecologists opportunistically searching roads, over nine days total.* Searches via over-turning rocks and shifting of leaf litter in areas of suitable habitat for this species. *Two ecologists for two hours per day, for nine days.*	Survey efforts involved searching for this species via hand-searching and up-turning rocks in suitable habitat areas, especially with dense leaf litter and microhabitat features. Surveys were conducted for extensive periods within such suitable habitat. Searches also involved opportunistic roadside observations during the day when travelling through site and also at night after spotlighting efforts. *Guideline requirement met*
Egernia rugosa Yakka skink	**Yakka skink, *Egernia rugosa*. Targeted species survey guidelines (Ferguson, 2014)** Searching microhabitats, such as carefully turning woody debris, rocks and artificial debris, raking the soil surface or leaf litter beneath trees and looking beneath peeling bark for reptiles or their sloughs. Recommended 20 minutes searching per hectare Search 20% of suitable habitat when 50 ha or more (e.g. 10 ha per 50 ha); OR 40% when less	2019, 2020, 2021	Searches via over-turning rocks and shifting of leaf litter in areas of suitable habitat for this species. Brigalow, ironbark and poplar box communities were searched extensively in the Study Area, where suitable habitat was greater than 50 ha. *Two ecologists for two hours per day, for nine days.*	Survey efforts involved searching for this species via hand-searching and up-turning rocks in suitable habitat areas, especially with dense leaf litter and microhabitat features. Surveys were conducted for extensive periods within such suitable habitat (likely equivalent to 20% or greater of the total suitable habitat greater than 50 ha within the Study Area). *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
	than 50 ha present (e.g. 2 ha per 5 ha of suitable habitat).			
Delma torquata Adorned delma	**Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSEWPC, 2011)** Combination of hand-searching under rocks and pitfall trapping is recommended (Porter, 1998). Although pitfalling is less effective than rock turning for this species (Porter, 1998). Tile grids have also been suggested as supplementary techniques for surveying, with grids of 50 tiles placed at 5 m intervals in suitable habitat.	2019, 2020, 2021	Searches via over-turning rocks and shifting of leaf litter in areas of suitable habitat for this species. *Two ecologists for two hours per day, for nine days.*	Survey efforts involved searching for this species via hand-searching and up-turning rocks in suitable habitat areas, especially with dense leaf litter and microhabitat features. Surveys were conducted for extensive periods within such suitable habitat. No pitfall of tile grids were used as hand-turning rocks was recommended as an effective method for locating this species. *Guideline requirement met*
Anomalopus mackayi Five-clawed worm skink	**Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSEWPC, 2011)** Appropriate survey methodology for detecting the presence of the long-legged worm skink is searching sheltering sites in combination with pitfall trapping at a time of year when the species is most likely to be active. If the survey is a targeted search for this species, a series of pitfall trap lines each comprising six 10 litre buckets spread along a 15 metre fence could be employed, however the species is more likely to burrow between the soil and the bucket.	2019, 2020, 2021	Searches via over-turning rocks and shifting of leaf litter in areas of suitable habitat for this species. *Two ecologists for two hours per day, for nine days.*	Microhabitat searches for this species were conducted in grasslands and woodlands (RE 11.8.5) known to be suitable habitat for this species. Pitfall trapping was not undertaken as it was deemed unlikely to provide evidence of species presence in the large Study Area. *Guideline requirement met*

Target Species	Survey Guidelines and Requirements	Field Investigation Period	Sampling Technique/ Effort	Comment on Survey Adequacy
	A successful technique has been to deploy artificial structures, such as bales of hay of different thicknesses, over a long period (over 6 months) and periodically check underneath.			

APPENDIX D ECHOLATION ANALYSIS FOR BAT SURVEYS

Bat Call Analysis Report

Prepared for ERM

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Document Records - Quality

TITLE	Bat Analysis Report
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Draft Version A	18/12/2019	Jasmine Vink, Ecologist	Kelly Matthews, Director	Client

Table of Content

TABLES

FIGURES

1.0 Introduction

1.1 Background

An assessment on the likelihood of the presence of microbat species using echolocation detectors (Anabat Swift) was conducted during an ecological survey undertaken by ERM. The detectors recorded data from the 26th November 2019 to the 29th November 2019. The survey site is located near Diamondy. **Figure 1** illustrates the approximate location of the anabat insight detector location.

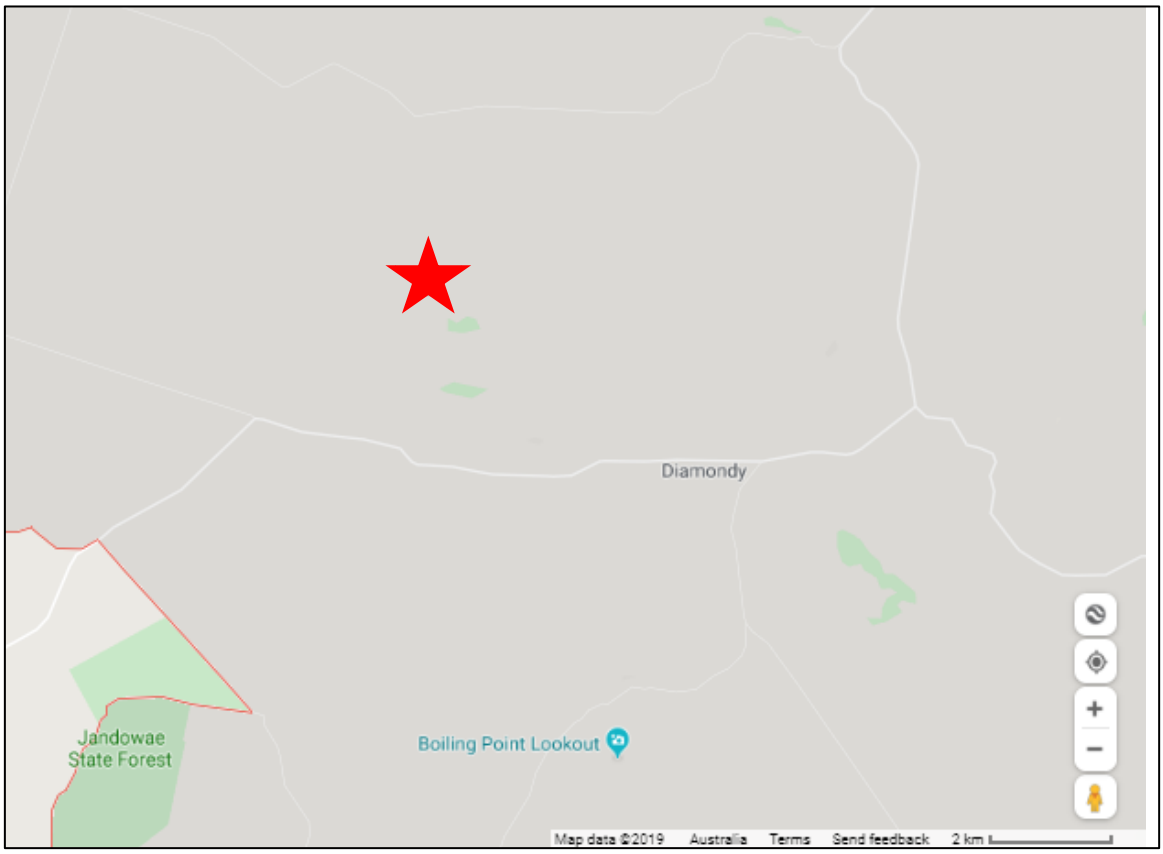

Figure 1: Location of Anabats Swift recording (Google Map)

1.2 Scope of Works

The specific scope of works for this report includes the following:

- Outline the methodology used to survey microbat species within the subject site;
- Analyse and provide an assessment of the likelihood of occurrence of threatened microbat species listed under State and Commonwealth legislation; and,
- Identify of local statutory considerations relevant to ecological aspects (relevant to bats) of the site.

2.0 Methodology

2.1 Capture

Data was collected over four night from five detectors staring on the 26th November 2019 to the 29th November 2019. The original call files display Australian Eastern Standard Time. The majority of calls were considered to be of medium to good quality calls.

Data was received on the 3th December2019 and was analysed using Anabat Insight. In total, 7,255 call sequence files were recorded and marked as containing 2,501 clear, recognisable bat calls.

2.2 Call Identification

Call identification for this dataset was based on call keys and descriptions published for Queensland (Reinhold, 2001) and Northern Territory (PWCNT, 2002) with reference to descriptions for New South Wales (Pennay *et al.*, 2004).

Species' identification was further refined using the probability of occurrence of each species based on their geographic distribution (Churchill, 2008, Van Dyck and Strahan, 2008). Species nomenclature used in this report follows Churchill (2008).

The reliability of identification is as follows:

- **Definite** - one or more calls where there is no doubt about 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.

2.3 Survey Limitations

The ability to detect call and accurately identify them to species level can vary greatly with the surrounding environment and the location of the echolocation device. The survey undertaken as part of this assessment only represents a 'snapshot' in time and therefore, may not provide a true indication of species presence at the site. Hence, this survey should not be regarded as conclusive evidence that certain protected microbats species do not occur at the site.

2.4 National Standard

The format and content of this report complies with the nationally accepted standards for the interpretation and reporting of bat call (Reardon, 2003), which is currently available from the Australasian Bat Society at www.ausbats.org.au.

3.0 Results

3.1 Total of Species Recorded

A total of 2,501 call sequence files were marked as recognised bat calls.

A total of nine microbat species were definitely identified being present on site. A summary of the species recorded per device on site is provided in **Table 1**. The microbats species calls are separated by devices. Device M7 recorded the most species and individual (more than 60% of the dataset).

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Table 1: Summary of Bat Calls per Anabat Swift

Species	NC Act	EPBC Act	M3	M4	M5	M6	M7
Austronomus australis	LC	NOC	-	-	-	Definite	Definite
Chalinolobus gouldii	LC	NOC	Definite	-	Definite	Definite	Definite
Chalinolobus nigrogriseus	LC	NOC	-	Definite	Definite	Definite	Definite
Miniopterus australis	LC	NOC	Definite	-	Definite	Definite	Definite
Miniopterus orianae oceanensis	LC	NOC		Possible	Definite	Possible	Definite
Mormopterus ridei	LC	NOC	Definite	-	-	Definite	Definite
Saccolaimus flaviventris	LC	NOC	-	Definite	Definite	Definite	Definite
Rhinolophus megaphyllus	LC	NOC	Definite	-	-	Definite	Definite
Vespadelus pumilus	LC	NOC	-	-	-	Definite	Definite

LC: Least Concern, NOC: Not of Concern, NR: Not recorded, , V: Vulnerable

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3.2 Samples of Calls / Sequences Files

Samples of call extracted from the dataset for each species identified is provided in the following figures.

Figure 2: Definite *Austronomus australis*

This bat is easily recognised by its constant frequency calls range in bandwidth from 10.5 to 15 kHz (Pennay *et al.*, 2004).

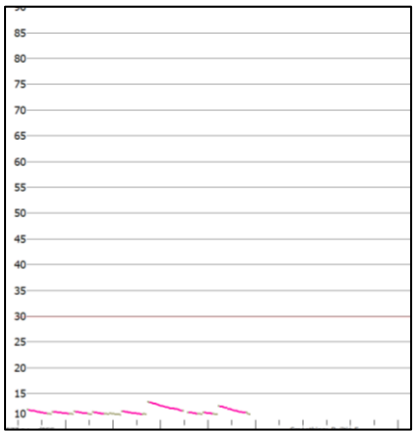


Figure 3: Definite *Chalinolobus gouldii*

Curved shape with characteristic frequency 28 to 31kHz . Pulse alternate in frequency.

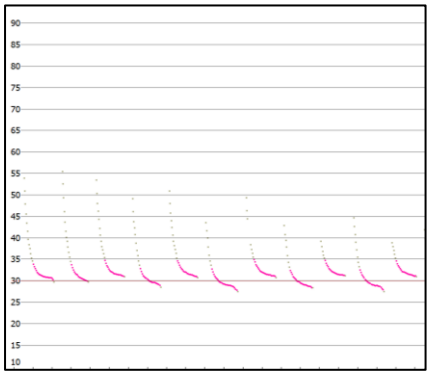


Figure 4: Definite *Chalinolobus nigrogriseus*

Curved shape with characteristic frequency 37 to 40kHz (Reinhold *et al,* 2001). Usually has no tail. Characteristic section and tail take up at least 2/3 if the time of the pulse when in search phase.

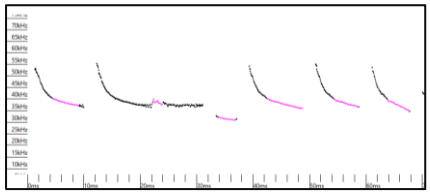


Figure 5: Definite *Miniopterus australis*

This species displays a characteristic frequency between 54.5 – 64.5 kHz with a curved, usually down-sweeping tail (Pennay *et al* 2004). It overlaps in frequency with *Vespadelus pumilus* between 57 – 58 kHz but the latter exhibits curved up-sweeping tail.

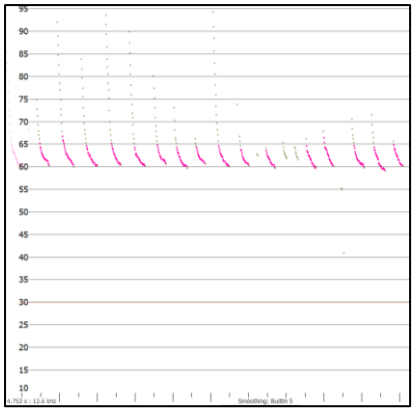
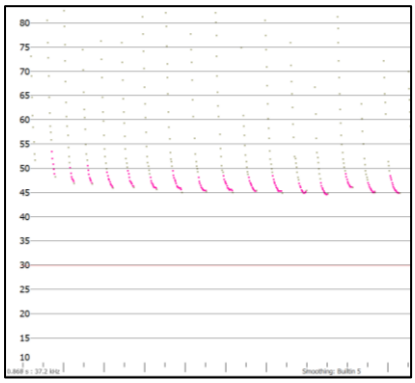


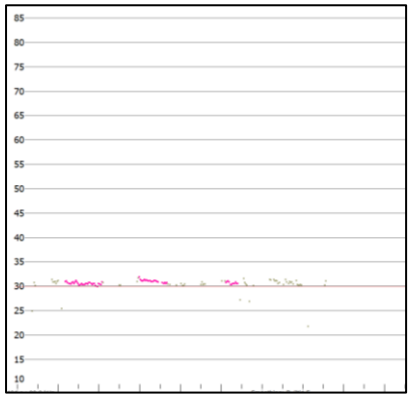
Figure 6: Possible *Miniopterus orianae oceanensis*



The species call is characterised by its relatively long curved pulse with a small down-sweeping tail and its frequency 43-47kHz (Reinhold, 2001).

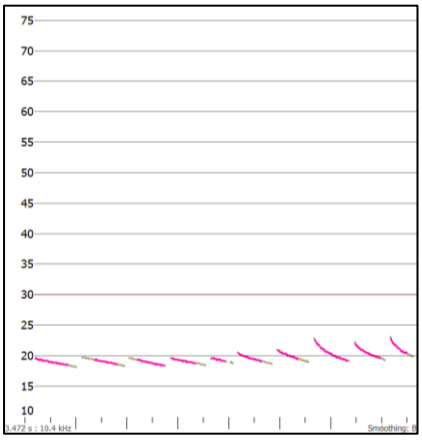
Pulse shape and time between calls usually variable within a sequence.

Figure 7: Definite *Mormopterus ridei*



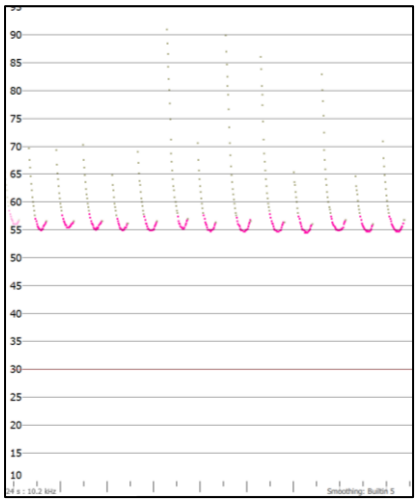
This species exhibits a characteristic frequency between 28.5 – 31 kHz (Pennay *et al*, 2004). This call can be confused with other species. The call is flat and occasional pulses in a sequence may have a higher frequency but not in a regular up and down patterns.

Figure 8: Probable *Saccolaimus flaviventris*



This species displays a curved pulse, characteristic frequency between 17.5 to 22.5 kHz (Pennay *et al*, 2004). Dominant harmonics are between 18-20 kHz.

Figure 9: Definite *Vespadelus pumilus*



This species displays a characteristic frequency between 50 – 58 kHz and has a prominent up-sweeping tail (Pennay *et al.*, 2004).

Calls of this species may be easily confused with *V. troughtoni*, unless the end frequency is higher than 54 kHz, which is representative of *V. pumilus.*

4.0 Conclusion

A total of nine microbat species were confirmed at the Project Area. The presence of threatened microbat species was not recorded on site during the field investigations.

All bats identified on the site were expected to be present within the region. Bat activity levels at the site are considered to be similar compared to other surveys within similar areas in the surrounding region.

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5.0 References

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

PENNAY, M., LAW, B. A. & REINHOLD, L. 2004. Bat calls of New South Wales: Region based guide to the echolocation calls of microchiropteran bats. *In:* NSW DEPARTMENT OF ENVIRONMENT AND CONSERVATION (ed.). Hurstville.

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VAN DYCK, S. & STRAHAN, R. 2008. *The Mammals of Australia (Third Edition); ,* Sydney, New Holland.

Bat Call Analysis Report

Prepared for ERM

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Document Records - Quality

TITLE	Bat Analysis for the site at Jandowea
FILED AS	ME21001_ERM bat report

Revision	Date	Prepared by (name/title)	Reviewed by (name/ title)	Approved by (name/title)
Version A	10/01/2021	Kelly Matthews, Principal Ecologist	Kelly Matthews, Principal Ecologist	Client
Version B	1/3/2021	Kelly Matthews, Principal Ecologist	Kelly Matthews, Principal Ecologist	Client

Table of Content

TABLES

FIGURES

1.0 Introduction

1.1 Background

Green Tape Solutions / Melomys were commissioned to undertake bat surveys and analysis for ERM. It is understood that the Project site is located near Jandowae in Queensland.

1.2 Scope of Works

The specific scope of works for this report includes the following:

- Outline the methodology used to survey microbat species within the subject site; and,
- Present the findings of all of the bat call surveys conducted at the project site.

2.0 Methodology

2.1 Capture

Data was collected over eight nights from 7 to 10 December 2020 and 15 to 19 February 2021 using five Anabats Swift. The original call files display Australian Eastern Standard Time. The majority of calls were considered to be of medium to good quality calls.

Data was received on the 23 December 2020 and 19th February 2021 with the devices and was analysed using Anabat Insight. In total, 57,842 sequence files were recorded.

2.2 Call Identification

Identifications were made by categorising call shape and frequency, with a species match given in consideration to region, known bat distributions, and habitats present. The focus of the bat surveys was to assess the presence of bat species found within the Project Area, and to assess the potential for rare and threatened species to occur.

Call identification for this dataset was based on call keys and descriptions published for Queensland (Reinhold, 2001) and Northern Territory (PWCNT, 2002) with reference to descriptions for New South Wales (Pennay *et al.*, 2004).

Species' identification was further refined using the probability of occurrence of each species based on their geographic distribution (Churchill, 2008, Van Dyck and Strahan, 2008). Species nomenclature used in this report follows Churchill (2008).

The reliability of identification is as follows:

- **Definite** - one or more calls where there is no doubt about 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.

2.3 Survey Limitations

The ability to detect calls and accurately identify them to species level can vary greatly with the surrounding environment and the location of the echolocation device. The survey undertaken as part of this assessment only represents a ‘snapshot’ in time and therefore, may not provide a true indication of species presence at the site. Hence, this survey should not be regarded as conclusive evidence that certain microbats species do not occur at the site.

2.4 National Standard

The format and content of this report complies with the nationally accepted standards for the interpretation and reporting of Anabat and Songmeter data (Reardon, 2003), which is currently available from the Australasian Bat Society at www.ausbats.org.au.

3.0 Results

3.1 Total Species Recorded

The original call files display Australian Eastern Standard Time. The majority of calls were considered to be of medium to good quality calls.

A total of 57,842 sequence files were analysed. A proportion of these files (28,223) in this dataset contained background noise or resulted in poor quality calls that did not provide bat calls for analysis. While some call sequences were recognised as bat calls, the quality was not sufficient to assign species identification.

Six (6) microbat species were definitely confirmed through call identification as being present on site. another nine (9) species) could also occur on site but couldn't not be confirmed.

A summary of the species identified through bat call analysis are provided in **Tables 1 and 2**.

Table 1: Summary of bat call analysis (December 2020 Survey)

Species	NC Act	EPBC Act	M1	M2	M4	M5	M6
Austronomus australis	LC	NOC	Definite	Definite	Definite	Definite	Definite
Chalinolobus gouldii	LC	NOC	Definite	-	Definite	-	Definite
Chalinolobus nigrogriseus	LC	NOC	Definite	-	Definite	-	
Miniopterus australis	LC	NOC	Definite	Definite	Definite	Definite	
Myotis macropus	LC	NOC	Possible	-	-	-	-
Nyctophilus corbeni	V	V	Possible	-	-	-	-
Nyctophilus bifax	LC	NOC	Possible	-	-	-	-
Nyctophilus gouldi	LC	NOC	Possible	-	-	-	-
Nyctophilus geoffroyi	LC	NOC	Possible	-	-	-	-
Ozimops ridei	LC	NOC	Definite	-	-	Definite	-
Saccolaimus flaviventris	LC	NOC	Definite	Definite	-	-	-
Scoteanax rueppellii	LC	NOC	Possible	-	-	-	-
Scotorepens balstoni	LC	NOC	Probable	-	Probable	-	-
Scotorepens sp	LC	NOC	Possible	Possible	-	-	Possible
Vespadelus pumilus	LC	NOC	Probable	-	Probable	-	-

LC: Least Concern, NOC: Not of Concern, NR: Not recorded, V: Vulnerable,

Table 2: Summary of bat call analysis (February 2021)

Species	NC Act	EPBC Act	M1	M2	M4	M5	M6
Austronomus australis	LC	NOC	Definite	Definite	Definite	Definite	Definite
Chalinolobus gouldii	LC	NOC	Definite	-	Definite	-	Definite
Miniopterus australis	LC	NOC	-	Definite	Definite	Definite	
Myotis macropus	LC	NOC	Possible	-	Possible	-	-
Nyctophilus corbeni	V	V	Possible	-	Possible	-	-
Other Nyctophilus sp.	LC	NOC	Possible	-	Possible	-	-
Ozimops ridei	LC	NOC	-	Definite	Definite	Definite	Definite
Saccolaimus flaviventris	LC	NOC	Definite	Definite	Definite	-	Definite
Scoteanax rueppellii	LC	NOC	-	Possible	Possible	-	-
Scotorepens balstoni	LC	NOC	Probable	Probable		Probable	-
Vespadelus darlingtoni	LC	NOC	Probable	Probable	-	-	Probable
Vespadelus pumilus	LC	NOC	-	Probable	Probable	-	Probable

LC: Least Concern, NOC: Not of Concern, NR: Not recorded, V: Vulnerable,

3.2 Samples of Calls / Sequences Files

Samples of call extracted from the dataset for each species identified is provided in the following figures.

Figure 1: Definite *Austronomus australis*

This bat is easily recognised by its constant frequency calls range in bandwidth from 10.5 to 15 kHz (Pennay *et al.*, 2004).

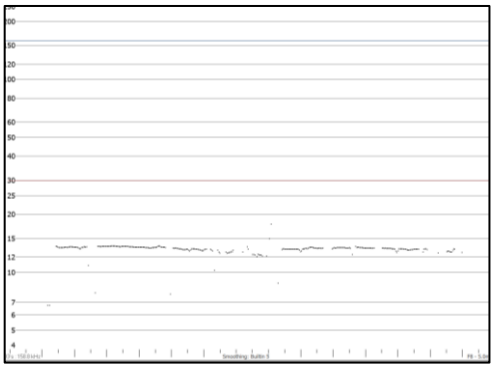


Figure 2: Definite *Chalinolobus gouldii*

Curved shape with characteristic frequency 28 to 31kHz. Pulse alternate in frequency.

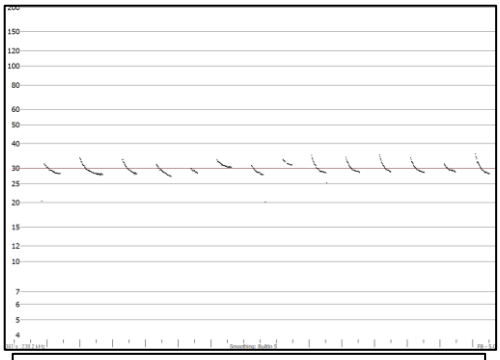


Figure 3: Definite *Chalinolobus nigrogriseus*

Curved shape with characteristic frequency between 37 to 40 kHz. Usually with no tail or occasionally up sweeping tail. *C. nigrogriseus* have relatively longer characteristic and tail sections, usually 2/3 or more of the total pulse (Pennay *et al* 2004).

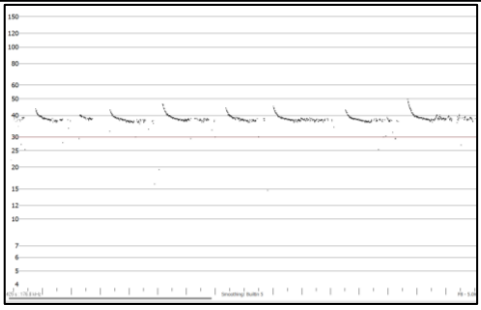


Figure 4: Definite *Miniopterus australis*

This species displays a characteristic frequency between 54.5 – 64.5 kHz with a curved, usually down-sweeping tail (Pennay *et al* 2004). It overlaps in frequency with *Vespadelus pumilus* between 57 – 58 kHz but the latter exhibits curved up-sweeping tail.

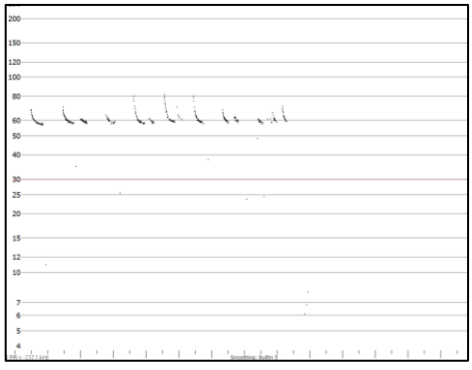
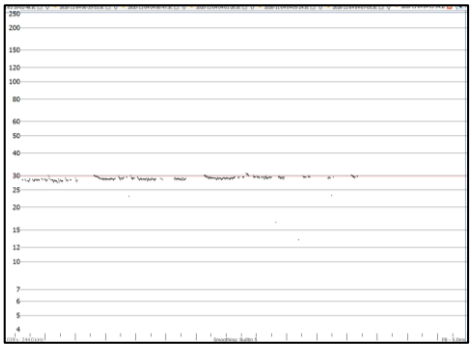


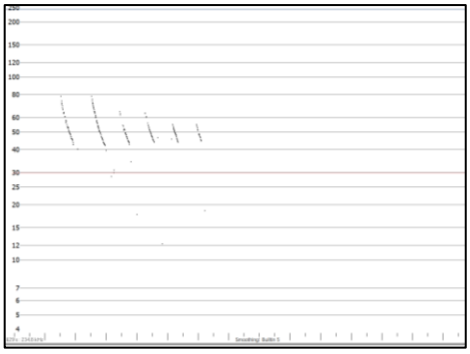
Figure 5: Definite *Ozimops ridei*



Calls from *Ozimops sp*. were differentiated by the presence of mainly flat pulses. *Ozimops ridei* was differentiated from *Micronomus norfolkensis* in long call sequences with few alternating pulses.

Ozimops ridei calls are flat and sometimes a bit curved with frequency a bit lower than 30kHz.

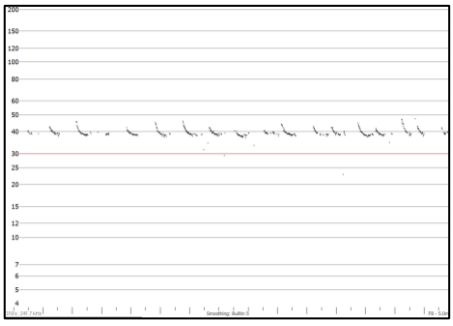
Figure 6: Possible *Myotis macropus*



Near-vertical pulse dropping to about 30 to 35-50kHz. *M. macropus* mostly have a pulse interval of less than 75ms and usually have one kink close to the middle so that the second part has a lesser slope than the first (Reinhold, 2001).

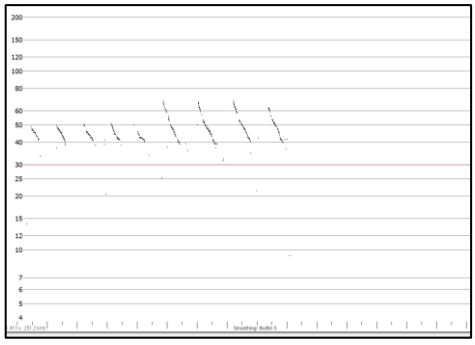
This call can be confused with *Nyctophilus sp* calls. The latest have usually a pulse interval greater than 95ms and are slightly more complicated structure with two kinks instead of one.

Figure 7: Probable *Scotorepens sp.*



Curved. Up-sweeping tail common. Characteristic frequency 36 to 41.5 kHz. (Reinhold, 2001).

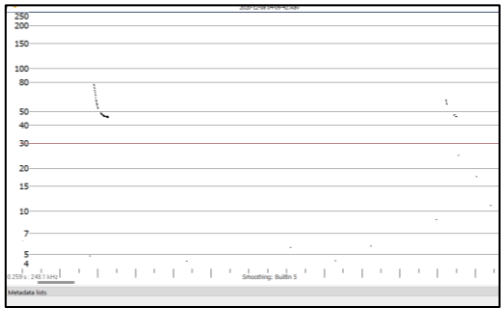
Figure 8: Possible *Nyctophilus sp*



This species displays a near-vertical pulse, characteristic frequency between 80 and 35KHz (Pennay *et al*, 2004).

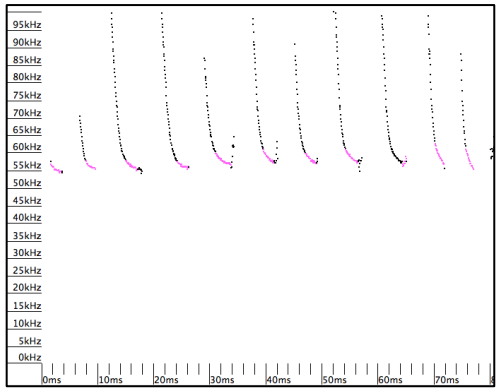
There are four species which could possibly occur within the Project Area, one of which is Vulnerable under the EPBC Act and NC Act. The call of these species cannot be distinguished from each other.

Figure 9: Probable *Vespadelus darlingtoni*



Characteristic frequency varies gradually over distribution from 38 to 46 kHz (n = 89). Curved, tail absent or up-sweeping, characteristic section often long. In general, characteristic frequency decreases from the north east to the south east, west of the south east the characteristic frequency increases.

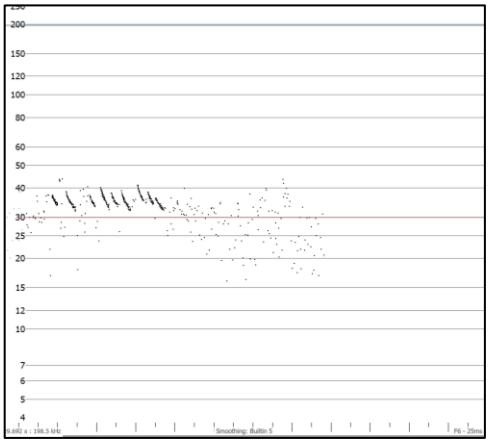
Figure 10: Probable *Vespadelus pumilus*



This species displays a characteristic frequency between 50 – 58 kHz and has a prominent up-sweeping tail (Pennay *et al*, 2004).

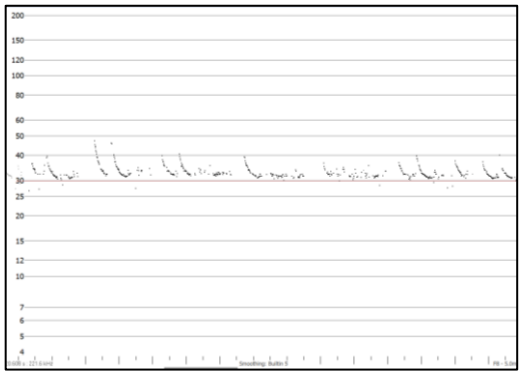
Calls of this species may be easily confused with *V. troughtoni,* unless the end frequency is higher than 54 kHz, which is representative of *V. pumilus*.

Figure 11: Possible *Scoteanax rueppellii*



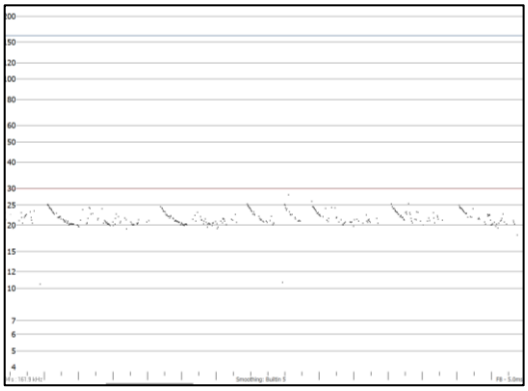
Curved. Seems to mostly have no tail. Characteristic frequency 33 to 36 kHz (n = 12). Frequency of the knee higher than 37 kHz (Reinhold, 2001).

Figure 12: Probable *Scotorepens balstoni*



Curved. Tail variable, but an up-sweeping tail seems to become more prominent with greater duration. Characteristic frequency 31 to 35 kHz (n = 28). Frequency of the knee 33 to 37 kHz. Distinguished from Chalinolobus gouldii by lack of frequency alternation (Reinhold, 2001).=

Figure 13: Definite *Saccolaimus flaviventris*



Curved, characteristic frequency 18 to 21.5 kHz. Other species that could overlap do not occur in this area.

4.0 Conclusion

Six (6) microbat species were definitely confirmed through call identification as being present on site. another nine (9) species) could also occur on site but couldn't not be confirmed. All bats identified on the site were expected to be present within the region. Bat activity levels at the site are similar compared to other surveys within similar areas in the surrounding region.

Calls of the threatened *Nyctophilus corbeni* were potentially recorded on site. Its calls could not be distinguishable reliably from other sympatric Nyctophilus species using detectors and processing with zero-crossing analysis. We recommend to undertake harp trap survey to capture the bats and enable confirmation of its presence on site.

5.0 References

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PENNAY, M., LAW, B. A. & REINHOLD, L. 2004. Bat calls of New South Wales: Region based guide to the echolocation calls of microchiropteran bats. *In:* NSW DEPARTMENT OF ENVIRONMENT AND CONSERVATION (ed.). Hurstville.

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