

Preliminary Bird and Bat Management Plan Chalumbin Wind Farm

Prepared for:
Chalumbin Wind Farm Pty Ltd

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1.0 Introduction

1.1 Background

Chalumbin Wind Farm Pty Ltd (CWF), a subsidiary of Ark Energy Projects Pty Ltd (Ark), proposes to develop the Chalumbin Wind Farm Project (the Project) at a location approximately 15 km south-west of Ravenshoe in Far North Queensland within the Tablelands Regional Council Local Government Area (LGA), see **Figure 1.1**. The Project area encompasses the Glen Gordon and Woorooro properties plus adjoining road reserves. The Project footprint to construct and operate the Project (i.e. maximum area of disturbance) is a much smaller area within these land parcels, with up to 86 wind turbines proposed. Turbine towers will be up to 160 m tall and turbine blades may be as long as 90 m.

1.2 Purpose and Scope

The purpose of this Preliminary Bird and Bat Management Plan (BBMP) is to ensure appropriate processes and methods are in place during the operational phase of the Project to manage potential impacts to bird and bat species and identify species of particular concern.

This BBMP has also been prepared to comply with Performance Outcome 5 (PO5) under State Code 23: Wind Farm Development. Specifically, the objectives of this BBMP are to:

- Assess potential impacts to bird and bat species associated with the operation of the Project, as identified in the Ecological Assessment Report (EAR);
- Implement a monitoring program to deduce the impact of the Project on “at-risk” birds and bats that can reasonably be attributed to the operation of the Project;
- Directly record and document impacts on birds and bats through a statistically robust program of carcass searches;
- Present an agreed decision-making framework that identifies impact triggers that require a management response;
- Identify potential mitigation measures and other strategies to reduce impacts on birds and bats; and
- Identify matters to be included in periodic reporting on the outcomes of the implementation of this BBMP.

This BBMP is a dynamic document that is intended to function as an adaptive management tool. Management measures within this BBMP can be amended to respond to the results of monitoring programs such that impacts are managed appropriately. Any monitoring, training, data interpretation, reporting and the design of management measures associated with this BBMP will be undertaken by a suitably qualified ecologist.

The content of this BBMP, including the risk assessment framework and the proposed management measures, is developed based on approved plans for similar wind farm projects in Queensland, New South Wales and Victoria.

1.3 Commonwealth Requirements

The Project is currently being assessed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Recent wind farm approvals under the EPBC Act provide guidance on the likely requirements of DCCEEW in relation to the management of bird and bat impacts associated with wind farms.



Based on a review of approvals on similar projects it is understood that the BBMP should present the information detailed in **Table 1.1** in relation to the EPBC Act.

Table 1.1 Commonwealth Matters associated with this BBMP

	Expected condition	Reference within this report
a)	The BBMP environmental objectives, for relevant protected matter(s) and a reference to EPBC Act approval conditions to which the Plan refers.	<ul style="list-style-type: none"> • N/A – to be included when EPBC Act approval is granted.
b)	A table of commitments made in the Plan to achieve the objectives, and a reference to where the commitments are detailed in the Bird and Bat Management Plan.	<ul style="list-style-type: none"> • Table 1.1 (this table) - constitutes the completion of this objective.
c)	Reporting and review mechanisms, and documentation standards to demonstrate compliance with the Plan.	<ul style="list-style-type: none"> • Section 6.4 – provides reporting and review mechanisms
d)	An assessment of risks to achieving the Plan's environmental objectives and risk management strategies that will be applied.	<ul style="list-style-type: none"> • Section 8.0 – describes impact triggers and the decision-making framework for adapting mitigation measures to ensure achievement of the Plan's objectives.
e)	Impact avoidance, mitigation and/or repair measures, and their timing.	<ul style="list-style-type: none"> • Section 7.0 – describes mitigation and management measures to be implemented under the Plan. • Section 8.3 – describes the process for the implementation of supplementary mitigation measures. • Section 8.4 – details specific management activities, timing and performance criteria.
f)	<p>A monitoring program, which must include:</p> <ol style="list-style-type: none"> measurable performance indicators; trigger values for corrective actions; the timing and frequency of monitoring to detect changes in the performance indicators and timely detection of trigger values; mortality monitoring; and proposed corrective actions if trigger values are reached. 	<ul style="list-style-type: none"> • Section 6.0 – describes monitoring activities to occur during operation of the Project. • Section 8.0 – describes impact triggers and the decision-making framework for adapting mitigation measures to ensure achievement of the Plan's objectives. • Section 8.3 – describes the process for the implementation of supplementary mitigation measures.



Expected condition	Reference within this report
	<ul style="list-style-type: none"> • Section 8.4 – details specific management activities, timing and performance criteria.
g) Provide any links to other plans or conditions of approval (including State/Territory approval conditions).	<ul style="list-style-type: none"> • Section 1.4 – describes other documents that should be reviewed in parallel with this BBMP.
h) Details of mitigation measures to minimise impacts on EPBC Act listed threatened bird and bat species including but not limited to: <ol style="list-style-type: none"> i. measures to minimise impacts associated with lighting, such as preventing the attraction of EPBC Act listed threatened bird and bat species and prey species to locations with high risk of collision with turbines; ii. measures to minimise the risk of turbine collision with EPBC Act listed threatened bird and bat species, such as, but not limited to, bird and insect deterrents and low wind speed curtailment. 	<ul style="list-style-type: none"> • Section 7.0 – describes mitigation measures addressing lighting and turbine collision risks. • Section 8.3 – describes the process for the implementation of supplementary mitigation measures.
i) Details of how the effectiveness of mitigation measures will be monitored and reported as part of the annual compliance reporting	<ul style="list-style-type: none"> • Section 6.0 – describes monitoring activities to be undertaken during the operation of the Project. This includes carcass monitoring, activity monitoring and bird utilisation surveys. • Section 6.4 – describes monthly and annual reporting requirements.
j) Procedures for dealing with any EPBC Act listed threatened bird and bat species that require relocation or are injured on the wind farm site;	<ul style="list-style-type: none"> • Section 7.3 – discusses the management of injured bats or birds associated with operation of the Project.
k) A program of monitoring and reporting to determine the effectiveness of management measures and inform adaptive implementation of management measures to minimise the impacts to EPBC Act listed threatened bird and bat species.	<ul style="list-style-type: none"> • Section 8.0 – describes impact triggers and the decision-making framework for adapting mitigation measures to ensure achievement of the Plan’s objectives.
l) A process and trigger levels (including justification) for determining if a significant impact has occurred to EPBC Act listed bird and bat species.	<ul style="list-style-type: none"> • Section 8.1 – describes the impact triggers and decision-making framework for threatened species, including MNES species. • Section 8.4 – describes specific management objectives, activities, timing and performance criteria for



Expected condition	Reference within this report
	threatened species, including MNES species.

1.4 State Requirements

Based on a review of other wind farm approval conditions applied by the Queensland Department of State Development, Infrastructure, Local Government and Planning (DSDILGP), it is understood that the BBMP should present the information detailed in **Table 1.2**.

Table 1.2 State Matters associated with this BBMP

Expected condition	Reference within this report
a) Identification of 'at risk' bird and bat groups (i.e. all threatened and common species), seasons, and areas within the project area which may attract high levels of mortality.	<ul style="list-style-type: none"> • Section 4.0 – details species considered as a part of this Plan. • Section 5.0 – presents the risk assessment for each of the species considered as a part of this Plan.
b) Incorporate baseline data, including additional pre-operational surveys.	<ul style="list-style-type: none"> • Section 3.2 – describes pre-operational surveys undertaken to establish baseline data.
c) The identification of threshold (trigger) levels for species.	<ul style="list-style-type: none"> • Section 8.1.1 – defines impact triggers for threatened species. • Section 8.2.1 – defines impact triggers for non-threatened species. • Section 8.4 – describes the performance criteria for species addressed by this Plan.
d) Identification of mitigation measures and implementation strategies in order to reduce impacts on bird and bat groups.	<ul style="list-style-type: none"> • Section 7.0 – describes mitigation measures addressing lighting and turbine collision. • Section 8.3 – describes the process for the implementation of supplementary mitigation measures.
e) Monitoring requirements.	<ul style="list-style-type: none"> • Section 6.0 – describes monitoring activities to be undertaken during operational activities.
f) A decision-making framework, including the trigger for operational shut-down.	<ul style="list-style-type: none"> • Section 8.0 – describes the decision-making framework, including triggers for operational shut-down.



1.5 Project Description

1.5.1 Project Components

The Project is proposed to consist of up to 86 wind turbines, linking access tracks and associated infrastructure including a new Powerlink connection substation and wind farm collector substations, permanent meteorological monitoring masts (met masts), medium and high-voltage underground and overhead powerlines, temporary construction compound and stockpile areas, and temporary and permanent site offices for asset management and operation and maintenance facilities. Each turbine tower will be up to 160 m tall and turbine blades may be as long as 90 m; with a maximum tip height of 250 m above ground level. A full Project description is provided in the Planning Report for the Project, to support the Development Application.

1.5.2 Project Stages

The Project has three stages, and activities associated with each stage are summarised in the following sections.

1.5.2.1 Construction

Construction is expected to commence in mid 2023, subject to approvals and commercial considerations. The construction phase is expected to last for a period of approximately 24-30 months, with approximately 250 to 350 staff employed during the peak construction period.

1.5.2.2 Operations

The operational life of the wind farm is expected to be 30 years. Approximately 15 to 30 full-time jobs will be generated during operation, typically 10 to 20 technicians along with a Project Manager, administration, and other support roles. This will include environmental roles on an as-needed basis to assist in operational monitoring.

1.5.2.3 Decommissioning

Infrastructure may be repowered with new equipment for a further 30-year operating life, or decommissioned, with the site rehabilitated to facilitate continuation of the current land use (agriculture) or alternative land use. If decommissioned, most above-ground infrastructure apart from roads (which are left to benefit the landholders) will be removed (e.g., all turbines, transmission lines, etc). The land will then be rehabilitated in line with development permit conditions and specific landowner agreements. Some infrastructure may remain in-situ depending on landowner preferences.

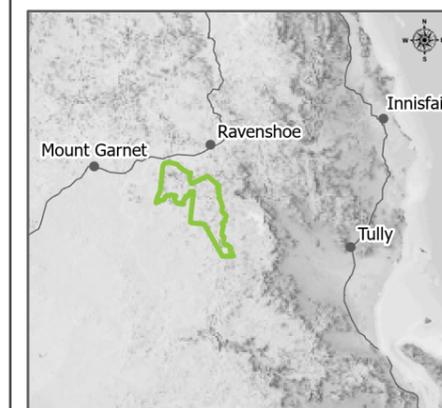
Chalumbin Wind Farm
Project Footprint

Figure 1.1

- Project Area Boundary
- Turbine
- ◆ Met-mast
- Facilities
- Clearance Envelope
- Stage 1
- Stage 2
- Lot Boundary
- Easement

Date: 17/10/2022
Project: EPU-004

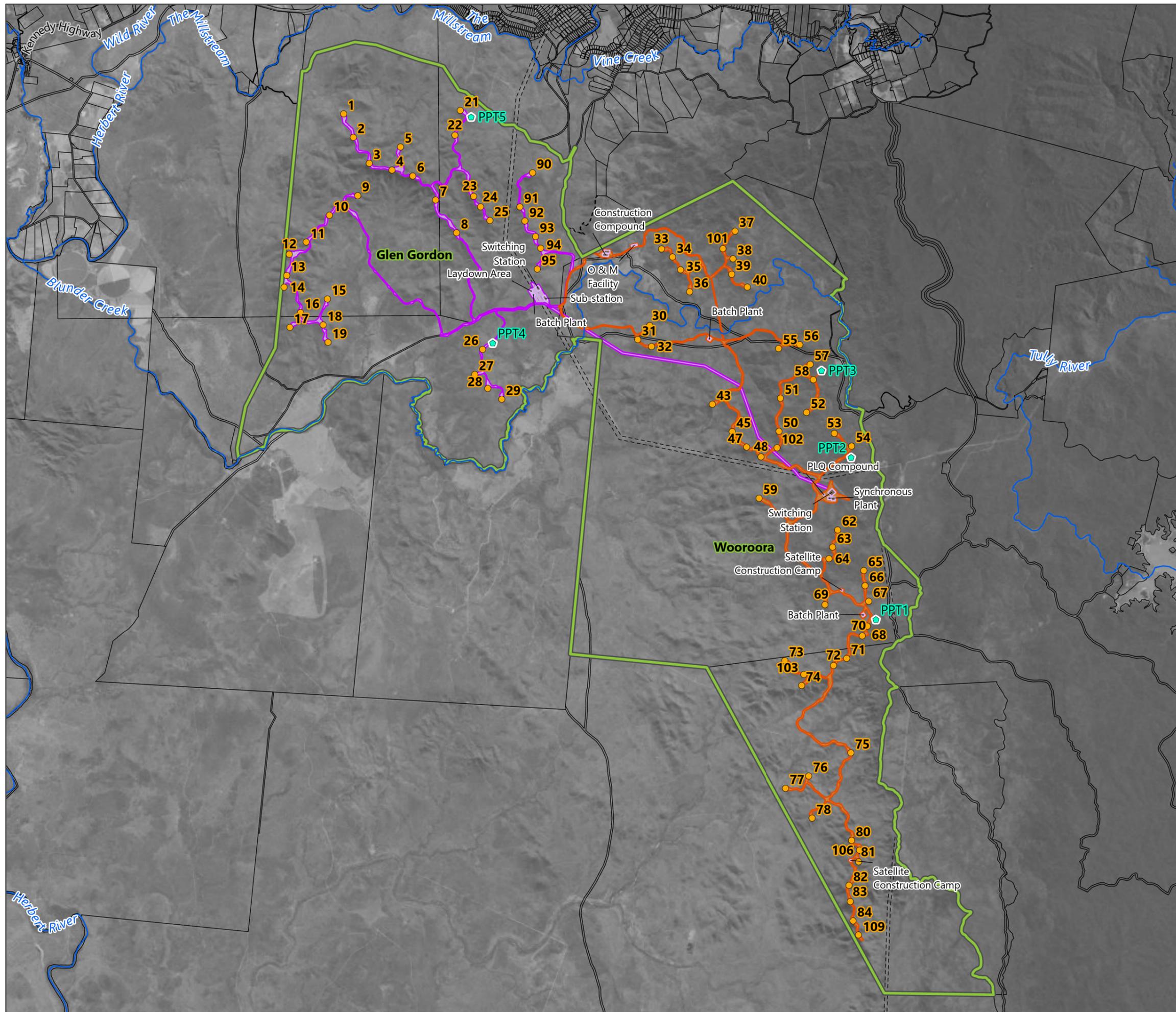
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Data Source(s):
Digital Cadastral Database - Department of Resources (2022)
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2.0 Relevant Legislation

2.1 Commonwealth Legislation

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

The EPBC Act is the Australian Government's central piece of environmental legislation that provides a legal framework to manage proposed actions that will or are likely to have an impact on Matters of National Environmental Significance (MNES) that includes nationally and internationally important flora, fauna, ecological communities and heritage places. Known MNES occur within the Project area including threatened flora, fauna and migratory species. A referral to the then Department of Agriculture, Water and the Environment (DAWE) (EPBC 2021/8983) was submitted on 23 July 2021. On 10 August 2021 DAWE determined that the Project is a controlled action and will be assessed by Public Environment Report.

This BBMP outlines MNES birds and bats which have potential to occur in the Project area and how potential impacts to those MNES will be mitigated and monitored.

2.2 State Legislation

2.2.1 Planning Act 2016

Under the *Planning Act 2016*, wind farm development is assessable development (a material change of use for a wind farm). In accordance with Part 21, Division 2, Table 1 of the *Planning Regulation 2017*, the Project requires assessment and decision by the Department of State Development, Infrastructure, Local Government and Planning (DSDILGP), represented by the State Assessment and Referral Agency (SARA), as assessment manager. The Project will be assessed against State Code 23: Wind Farm Development (State Code 23).

An ecological assessment that addresses prescribed matters at State level is required under State Code 23. Prescribed Matters of State Environmental Significance (MSES) have been addressed in the EAR (Attexo 2021a) to support the development application. In addition to this BBMP, a Preliminary Vegetation Management Plan (Attexo 2021b) and Preliminary Fauna Management Plan (Attexo 2021c) have been prepared to support the EAR.

State Code 23 contained in the State Development Assessment Provisions (SDAP) applies to a material change of use for a new or expanding wind farm. It is intended to protect individuals, communities and the environment from adverse impacts as a result of the construction, operation and decommissioning of wind farm development. The code provides additional supporting information and actions to assist applicants in demonstrating compliance with the performance outcomes (POs) or acceptable outcomes (AOs) of the code. PO5 relates to flora and fauna and requires a preliminary BBMP to be included as part of the development application.

Under the code, Bird Utilisation Surveys (BUS) are a requirement for proposed wind farms in Queensland if the site is likely to support significant bird species (as determined through desktop assessment and/or a scoping site visit) and need to be completed during relevant seasons with regards to the species being studied and the location of the site. The assessment of birds and bats forms a major part of ecological impact assessments for a wind farm project, due to the potential for collisions with wind turbines. The location and migratory paths of bird and bat populations or species may influence the final turbine footprint and wind farm layout.



2.2.2 Nature Conservation Act 1992

The purpose of the *Nature Conservation Act 1992* (NC Act) is to conserve flora and fauna and their habitats, by gazettal of protected areas including nature refuges; prescribing the threat status of wildlife; and placing restrictions on the taking or harm to native wildlife without a valid permit. Field and desktop assessments described in the EAR identified listed wildlife and associated habitat and likelihood of occurrence within the Project area, and habitat mapping was developed.

This BBMP outlines EVNT birds and bats which have potential to occur in the Project area and how impacts to those species will be mitigated and monitored. This BBMP also addresses those species that are listed Least Concern under the NC Act.



3.0 Methodology

The results of desktop studies and field surveys were interrogated to identify a list of target bird and bat species to be addressed in the BBMP. This list includes:

- Bird and bat species occurring in the Project area that are listed as threatened or migratory under the EPBC Act and/or the NC Act;
- Bird and bat species that are known to be particularly prone to collision with operating turbines or sensitive to disturbance from wind farms based on a review of available information (Thaxter et al. 2017; Attexo 2021a); and
- Any population of significance for a bird or bat species that occurs within the Project area, and may exhibit behaviours that put it at risk of impact from the operation of the Project.

3.1 Desktop Review

An initial desktop review of existing information on the Project area was undertaken to inform the approach of the BBMP. The search area (referred to as the Study area) was defined as the approximate boundary of the Project area (encompassing proposed wind turbine locations and all support infrastructure) with a 10 km buffer.

Sources for this desktop review included:

- DCCEEW's Protected Matters Search Tool (PMST) to identify potential MNES. Search results from May 2021 are provided in Appendix A of the EAR (Attexo 2021a);
- DCCEEW's Species Profiles and Threats database (SPRAT);
- DES WildNet database to identify previously recorded flora and fauna species, including non-native species. Search results from May 2021 are provided in Appendix A of the EAR (Attexo 2021a);
- DES mapping for essential habitat, protected plants trigger areas, wetlands, watercourses and drainage features;
- Queensland Department of Resources (DoR) regulated vegetation mapping (including remnant, high-value regrowth and non-remnant vegetation);
- Queensland State Planning Policy mapping for information on Matters of State Environmental Significance (MSES);
- eBird records of threatened and/or migratory birds;
- Atlas of Living Australia (ALA) database; and
- Published ecological information on threatened flora and fauna species where available.

Initial desktop searches were undertaken in September 2020 to inform field survey requirements; the desktop searches were repeated as part of the EPBC Referral and EAR reporting in order to account for potential updates to government datasets and recent threatened species records.

3.2 Field Surveys

An initial programme of timed bird counts was undertaken in January 2021 (wet season), prior to the Project footprint being identified. These surveys did not follow a Before-After-Control-Impact (BACI) design (as required by State Code 23) and hence have only been included in this BBMP in terms of the overall list of species recorded from the Project



area to date. Incidental observations of bird species whilst driving around the site and undertaking other types of surveys have also been recorded.

3.2.1 Bird Utilisation Surveys

Five Bird Utilisation Surveys (BUS) have been undertaken in accordance with the following:

- Wind Farms and Birds: Interim Standards for Risk Assessment Australian Wind Energy Association Report (Brett Lane and Associates 2005); and
- Clean Energy Council's Best Practice Guidelines (CEC 2018).

The BUS followed a BACI design as per the requirements of State Code 23 and were undertaken during the following periods:

- 19-27 of June 2021 (dry season);
- 5-17 October 2021 (dry season);
- 18-25 January 2022 (wet season);
- 6-14 April 2022 (wet season); and
- 9-17 August 2022 (dry season).

3.2.1.1 BUS Locations

BUS were undertaken at 21 locations across the Project area, comprising 17 impact sites and four control sites as listed in **Table 3.1** and shown in **Figure 3.1**. Survey sites were distributed as evenly as possible across the Project area to maximise coverage of potential wind turbine locations. Given the large extent of the Project area, and the ruggedness of the terrain, vantage-point surveys (VPS) were preferred over standard point count surveys as they maximise the observer's field of view across the Project area (Sutherland et al. 2004; SNH 2014). The sites for each VPS were located at the highest point in the landscape, with a viewshed radius of up to 1 km, depending on visibility. Control sites were located at least 1.5 km from proposed turbine locations, outside the wind farm development footprint and in areas of similar habitat.

Table 3.1 provides a description of the habitats associated with each survey point. Survey points were located in a selection of habitat types representative of the Project area which predominantly comprises open eucalypt woodland (84 %) with some rocky pavements, riparian corridors and small isolated patches of notophyll vine forest

Table 3.1 BUS Locations

Survey Site	Habitat Description	Photo	Relevant WTG Locations ¹
VPS1	Open woodland on an igneous hill with <i>Eucalyptus crebra</i> and <i>Corymbia intermedia</i> co-dominant, and an understorey comprising <i>Themada triandra</i> and <i>Lomandra longifolia</i> .		3, 4, 5 and 6
VPS2	Non-remnant (existing powerline easement) but with open Eucalypt woodland (<i>Eucalyptus portuensis</i> and <i>E. crebra</i> co-dominant) on either side.		95
VPS3	Open Eucalypt woodland with <i>Eucalyptus portuensis</i> , <i>C. intermedia</i> and <i>E. crebra</i> .		43 and 44
VPS4	Open Eucalypt woodland comprising <i>Eucalyptus reducta</i> with <i>E. portuensis</i> and <i>Corymbia intermedia</i> on shallow granitic and rhyolitic soils.		35 and 36

¹ within 1 km of the VPS and with Unhindered Line-of-sight

Survey Site	Habitat Description	Photo	Relevant WTG Locations ¹
VPS5	Non-remnant (existing powerline easement) but with <i>Corymbia intermedia</i> woodland with <i>Syncarpia glomulifera</i> on either side.		
VPS6	Non-remnant (existing powerline easement) but with <i>Corymbia intermedia</i> / <i>Eucalyptus resinifera</i> woodland with <i>Syncarpia glomulifera</i> on either side.		
VPS7	Open Eucalypt woodland of <i>Corymbia citriodora</i> and <i>Eucalyptus portuensis</i> adjacent to the existing powerline easement (which is non remnant).		
VPS8	Non-remnant (existing powerline easement) but with mixed woodland to open forest of <i>Eucalyptus crebra</i> , <i>Corymbia clarksoniana</i> and <i>C. citriodora</i> on a tertiary plateau to either side.		



Survey Site	Habitat Description	Photo	Relevant WTG Locations ¹
VPS9	Open Eucalypt woodland with <i>Eucalyptus portuensis</i> and <i>Corymbia citriodora</i> on granite uplands.		30 and 31
VPS10	Open Eucalypt woodland of <i>Eucalyptus crebra</i> and <i>Corymbia citriodora</i> , with <i>Themada triandra</i> in the understorey		75
VPS11	Exposed granite and rhyolite rock outcrop with recently burned <i>Lophostemon confertus</i> shrubland		47 and 48
VPS12	Non remnant (cleared pasture).		57



Survey Site	Habitat Description	Photo	Relevant WTG Locations ¹
VPS13	Open Eucalypt woodland on igneous hills.		21
VPS14	Non-remnant (existing powerline easement) but with open Eucalypt woodland (<i>Eucalyptus portuensis</i> , <i>Corymbia citriodora</i> and an understorey of <i>Themada triandra</i>) on either side.		90 and 91
VPS15	Open Eucalypt woodland on igneous hills		
VPS16	Open Eucalypt woodland of <i>Eucalyptus portuensis</i> and <i>Corymbia abergiana</i> , with an understorey of <i>Themada triandra</i> and <i>Xanthorrhoea johnsonii</i>		77



Survey Site	Habitat Description	Photo	Relevant WTG Locations ¹
VPS17	Low <i>Lophostemon confertus</i> shrubland on exposed granite and rhyolite.		12, 13 and 14
C1	Rocky pavement shrub complex with dominant <i>Lophostemon confertus</i> and <i>Xanthorrhoea johnsonii</i> in the understorey.		n/a control site on the north-western boundary of the Project area
C2	<i>Lophostemon confertus</i> low to medium closed forest on exposed rocky slopes, with silver <i>Coleus</i> in the understorey.		n/a control site located in the north-eastern part of the Project area
C3	Non-remnant (existing powerline easement) but with open <i>Corymbia intermedia</i> woodland with <i>Allocasuarina littoralis</i> on either side.		n/a control site located outside the Project area, to the east



Survey Site	Habitat Description	Photo	Relevant WTG Locations ¹
C4	Low woodland of <i>Eucalyptus portuensis</i> , <i>Corymbia intermedia</i> , <i>C. citriodora</i> and <i>E. crebra</i> .		n/a control site located on the south-western boundary of the Project area

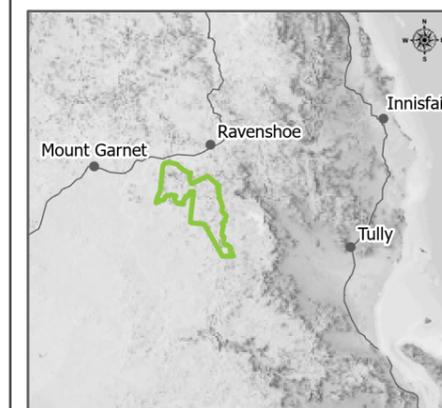
Chalumbin Wind Farm
Bird Utilisation Survey Sites

Figure 3.1

- Project Area Boundary
- Turbine
- Met-mast
- Clearance Envelope**
- Stage 1
- Stage 2
- Bird Utilisation Survey Site**
- + Control Site
- + Impact Site
- Watercourse
- Lot Boundary
- Easement

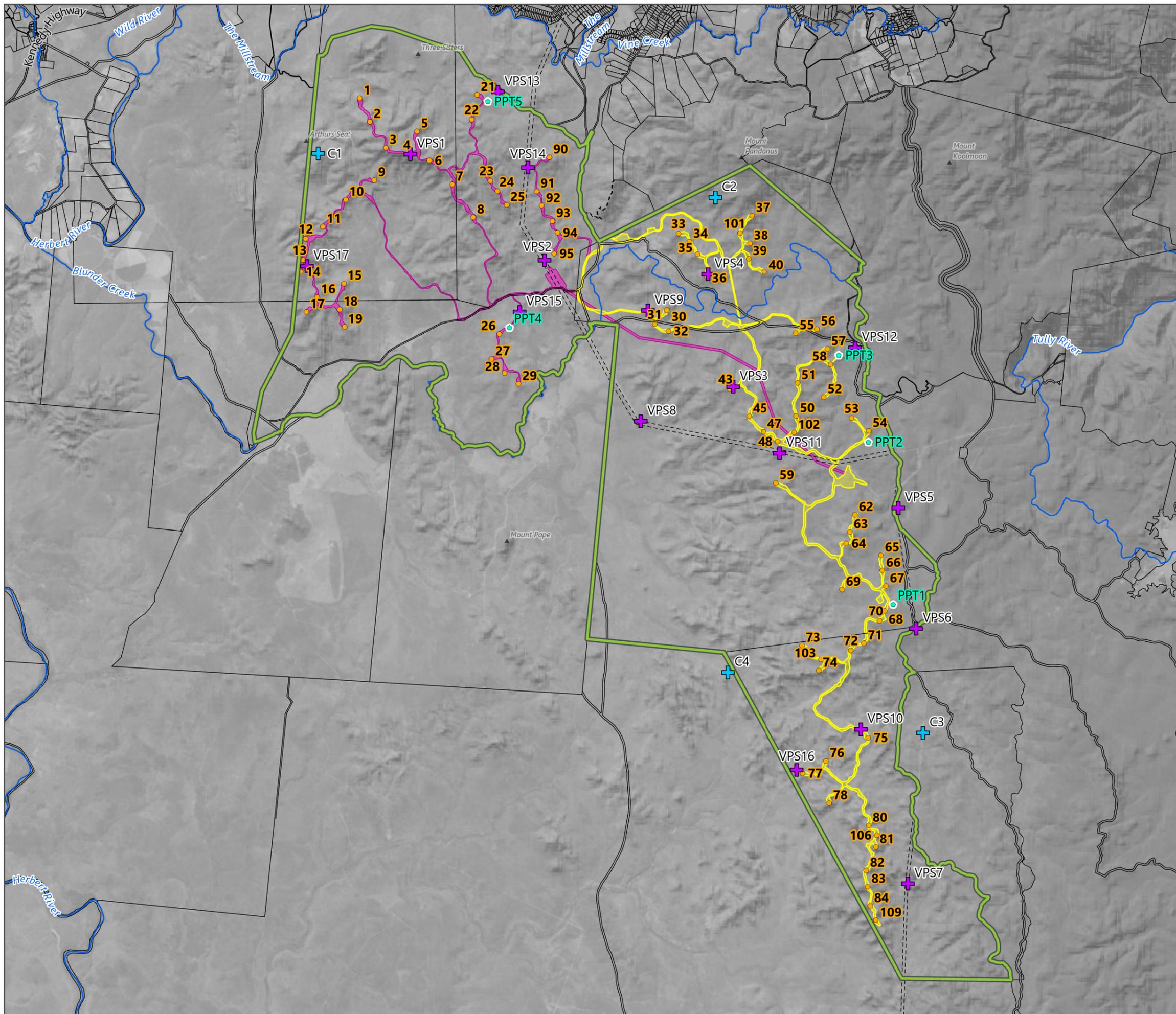
Date: 17/10/2022
Project: EPU-004

Author: TOD
Reviewed: NOD



Scale: 1:125,000@A3

Data Source(s):
Digital Cadastral Database - Department of Resources (2022)
Earthstar Geographics, © State of Queensland (Department of Resources) 2022





3.2.1.2 BUS Counts

A spotting scope with a variable, 25× to 50× magnification was used to maximise bird detection and identification and survey effort was a 20-minute period at each location, repeated twice (once in the morning up to 10am and once in the afternoon after 3pm,) (Strickland et al. 2011). This resulted in a total survey effort of 1,680 minutes or 28 person-hours per survey event.

Bird activity was stratified into height bands to accommodate the potential Rotor Swept Area (RSA) for the turbines, which has conservatively been identified as between 40 m and 265 m. Bands were identified as:

- Below the RSA: 0 m to 40 m;
- Within the likely RSA: 40 m to 265 m; and
- Above the RSA: > 265 m.

At each point the following was recorded:

- Survey site number;
- Date;
- Start and end time of the observation period;
- Species (or best possible identification);
- Number of individuals recorded;
- Distance from plot centre when first observed;
- Closest distance;
- Height above ground (as per the bands defined above);
- Behavioural activity (i.e. aerial pursuit of prey, ground searching, ambush predation, soaring, etc.); and
- Habitat and flight path.

The Best Practice Guidelines for Wind Energy Developments in Australia (Clean Energy Council 2018) indicate that BUS should be undertaken over four separate seasons prior to the commencement of construction in order to capture statistically significant data. A further three surveys are proposed for November 2022, February 2023 and May 2023.

3.2.2 Bat Surveys

3.2.2.1 Anabat Detectors

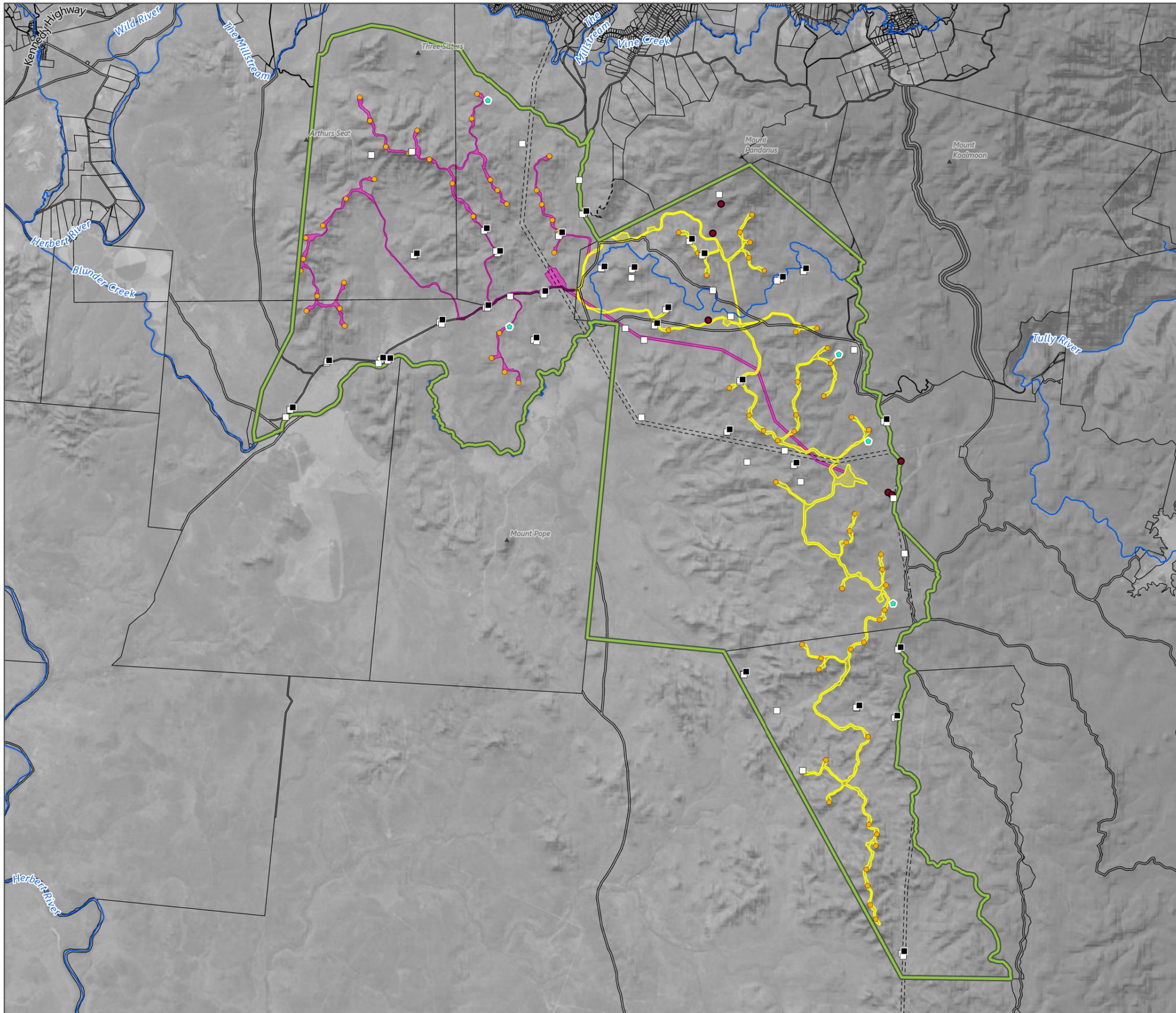
Microbats rely on echolocation for orientation and foraging, and though the calls of almost all species are outside the range of human hearing, they can be detected by a bat detector. Anabat Swift detectors were installed along potential flyways (e.g. along an animal track or adjacent to a waterway) and set to record bat calls between dusk and dawn each night. During the wet season (January 2021), six Anabats were deployed at five locations each, and for two consecutive nights at each location. During the dry season (June 2021), six Anabats were deployed at three locations each, for two consecutive nights at each location. In total, 96 survey nights at 48 locations (**Figure 3.2**) were achieved



using the Anabats and over 40,800 files were recorded. The resulting library of recorded calls was then processed by an experienced technician and identified to species level where possible.

3.2.2.2 Harp Traps

During the dry season surveys, harp traps were set in seven locations in flyways, at water sources (e.g. dams and creeks) and in forest openings. Traps were deployed for three nights at each of the survey locations (see **Figure 3.2**).

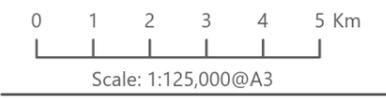
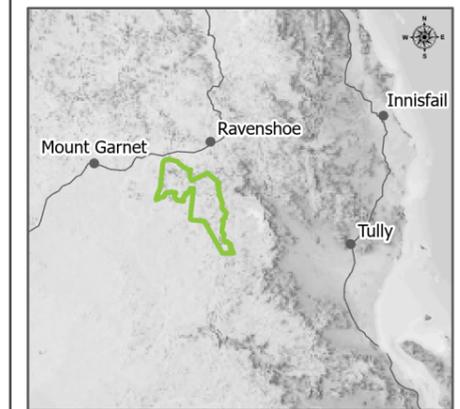


Chalumbin Wind Farm
 Bat Survey Locations

Figure 3.2

- Project Area Boundary
- Turbine
- ◆ Met-mast
- Clearance Envelope**
- Stage 1
- Stage 2
- Anabat (Wet Season)
- Anabat (Dry Season)
- Harp trap
- Watercourse
- Lot Boundary
- Easement
- Project Area Boundary

Date: 17/10/2022 Author: TOD
 Project: EPU-004 Reviewed: NOD



Data Source(s):
 Digital Cadastral Database - Department of Resources (2022)
 Earthstar Geographics, © State of Queensland (Department of Resources) 2022



3.3 Likelihood of Occurrence

An assessment was undertaken to determine the likelihood of occurrence within the Project area of conservation significant species (i.e. listed under the EPBC Act and/or the NC Act) identified in the desktop assessment. The likelihood of occurrence assessment was based on a review of species' distributions and habitat requirements, historical records for the broader region, and the results of the Project habitat assessments and field surveys.

Definitions used for the likelihood of occurrence applied included:

- **Known** – the species has been recently recorded in the Project area (within last 10 years).
- **Likely** – Project area is within the species' known range and suitable habitat occurs in the Project area.
- **Potential** – suitable habitat for a species occurs in the broader study area (comprising the Project area plus a 10 km buffer) but only marginal habitat is present in the Project area and/or the species has not been recorded in the desktop assessment. This includes cryptic, vagrant or transient species that have a reduced likelihood of occurrence but cannot be definitively discounted.
- **Unlikely** – a low to very low probability that a species occurs in the broader study area due to the lack of suitable habitat and/or the Project area is outside of the species' known range.

The results of this assessment are provided in the Project EAR (Attexo 2021a) and have formed the basis of the risk assessment presented in **Section 5.0**.



4.0 Field Survey Results

A full species list of birds and bats recorded in the Project area during the surveys is provided in **Appendix A**.

4.1 Birds

A total of 146 bird species have been recorded during the five BUS undertaken to date (June 2021, October 2021, January 2022, April 2022 and August 2022); this rises to 188 species when incidental observations across all surveys are also included. Species recorded were predominantly parrots and lorikeets, followed by songbirds.

Species richness was lowest in the June 2021 survey (65 species) compared with the January 2022 (73 species) and August 2022 surveys (77 species). The most abundant species recorded was the rainbow lorikeet.

There was a total of 48 species observed flying within RSA heights across all surveys with the highest number of species recorded in the August 2022 (30 species) survey, followed by the June 2021 (19 species) and April 2022 (18 species) surveys. The total number of birds observed within the RSA height was highest during the April 2022 survey, which may have been influenced by the large numbers of rainbow lorikeets observed, followed by the October 2021 and June 2021 (1380 counts, 267 counts and 144 counts respectively). None of the species observed flying within RSA height are of conservation significance.

Nine species of raptor were recorded during the BUS: Australian hobby (*Falco longipennis*), brown falcon (*Falco berigora*), brown goshawk (*Accipiter fasciatus*), collared sparrowhawk (*Accipiter cirrocephalus*), grey goshawk (*Accipiter novaehollandiae*), nankeen kestrel (*Falco cenchroides*), Pacific baza (*Aviceda subcristata*), peregrine falcon (*Falco peregrinus*) and wedge-tailed eagle. Regionally, these species are common and therefore their consideration in the risk assessment is not deemed necessary. However, it is recognised that some of these species are very long lived, with a low fecundity. Hence, during the operation of the wind farm, assessment of potential impacts to these more common species will be taken into consideration.

4.2 Bats

Wet season surveys for bats comprised the use of anabat recorders, whilst during the dry season surveys harp traps were used as well as anabats. The bat call analysis and trapping results revealed the most common bat species to be the little bent-winged bat (*Miniopterus australis*), eastern long-eared bat (*Nyctophilus bifax*), eastern blossom-bat (*Syconycteris australis*), eastern forest bat (*Vespadelus pumilus*) and eastern horseshoe bat (*Rhinolophus megaphyllus*). The following species were recorded during the field surveys and are most likely to fly within the RSA height:

- White-striped mastiff bat (*Austronomus australis*);
- Gould's wattled bat (*Chalinolobus gouldii*);
- Eastern bent-winged bat (*Miniopterus orianae oceanensis*);
- Eastern freetail bat (*Ozimops ridei*);
- Northern freetail bat (*Ozimops lumsdenae*); and
- Yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*).

These species are all listed as Least Concern under the NC Act.



5.0 Bird and Bat Risk Assessment

5.1 Introduction to the Risk Assessment

The aim of this risk assessment is to guide the development of the BBMP for the Project by identifying those species or groups considered potentially at risk from either collision with turbine blades or disturbance by operating turbines. The outcomes of this risk assessment enable more targeted monitoring and management measures to be included, focusing on species and groups at greater risk.

Wind farm impacts on birds and bats can arise from three potential pathways:

- Direct collision of birds and bats with transmission lines and towers or turbine blades within RSA height. This includes barotrauma for bats, which is internal tissue damage caused by the rapid air-pressure reduction near moving turbine blades;
- Indirect impacts including:
 - Disturbance effects that exclude birds and bats from habitat; and
 - Barrier effects that limit bird and bat movements between essential resources such as foraging and roosting areas.

5.2 Risk Assessment Process

The Risk Evaluation Matrix Model was used to measure the overall risk of a potential impact event (the likelihood of that event and, should it occur, its consequences) as prescribed by the ISO-31000 Risk Assessment Standard.

The assessment has been undertaken as follows:

- Species or groups of concern have been short-listed based on their likelihood of occurrence within the Project area (see **Section 3.3** and Appendix C of the Chalumbin Wind Farm EAR, Attexo 2021a), with the risk assessment only considering species that are known, likely or have the potential to occur;
- Two impact pathways have been assessed: direct collision with turbine blades and indirect impacts (incorporating both disturbance and barrier effects);
- Impact likelihood and impact consequence criteria have been developed and applied to each impact pathway for each species or group of concern, see **Table 5.1** and Table 5.2 respectively;
- The risk level for each species or group of concern from the two impact pathways has been determined using the risk matrix illustrated in **Figure 5.1**.



Table 5.1 Likelihood criteria

Likelihood	Description
Certain	It is very probable that the risk event could occur in any year (>95%)
Almost Certain	It is more probable than not that the risk event could occur in any year (>50%)
Likely	It is equally probable that the risk event could or could not occur in any year (50%)
Unlikely	It is less probable than not that the risk event could occur in any year (<50%)
Rare	It is improbable that the risk event could occur in any year. (<5%) The risk event is only theoretically possible or would require exceptional circumstances to occur.

Table 5.2 Consequence 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 ten years.	Extreme loss in numbers of individuals, leading to reduction in regional or state population viability for a period of at least 10 years

		Consequence				
		Negligible	Low	Moderate	High	Severe
Likelihood	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

Figure 5.1 Risk matrix

5.3 Species of Concern

Species of concern include the following:

- Bird and bat species listed as threatened or migratory under the EPBC Act and/or the NC Act;
- Species known to be particularly prone to collision with operating turbines or sensitive to disturbance from wind farms, based on an extensive literature review; and



- Species for which a population of significance occurs within the Project area and that may interact with operating turbines.

5.4 Risk Assessment Results

Table 5.3 provides the results of the risk assessment and includes the following information:

- Species or groups and reason for inclusion;
- Conservation status;
- Impact pathway;
- Likelihood and consequence scores; and
- Risk rating and commentary.

The risks associated with the majority of species with the potential to occur within the Project area have been assessed as negligible. Of the 46 species examined, six bird species and six bat species have been assigned a collision risk rating of low; one bird species and one bat species have been assigned a collision risk rating of moderate; and two bird species are at low risk of displacement or barrier effects.



Table 5.3 Risk Assessment by Species

Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Birds							
Australian painted snipe (<i>Rostratula australis</i>)	Potential to occur within the Project area	EPBC Act – Endangered, Migratory NC Act - Endangered	Collision with turbines, towers, power lines	Unlikely	Negligible	Negligible	<ul style="list-style-type: none"> The species is mostly nomadic, preferring shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, including lakes, swamps, pans, inundated or waterlogged grasslands or saltmarshes, dams, rice fields, sewage farms and bore drains with emergent grass, sedges, rushes, or reeds. It will also use modified habitats, e.g. low-lying woodlands converted to grazing pasture, sewage farms and irrigation schemes (del Hoyo et al., 2020). There are no known historical records within the Project area or the broader Study area² (ALA or Wildlife Online). The species was not observed during field surveys and there is limited suitable habitat within the Project area. There is suitable habitat within the Study area. The species has only been recorded at a few scattered locations in Queensland (Birdlife International 2016a). It is not a congregatory species therefore only a small number of individuals might be affected by collision with infrastructure. There is limited potential habitat on site therefore displacement and barrier effects are not anticipated.
			Displacement and barrier effects	Rare	Negligible	Negligible	

² The broader Study area is defined as the Project area plus a 10km buffer



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Barn swallow (<i>Hirundo rustica</i>)	Potential to occur within the Project area	EPBC Act – Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Negligible	Negligible	<ul style="list-style-type: none"> This is the most widely distributed and abundant swallow in the world. It overwinters in Australia but does not breed here. It migrates over a wide variety of habitats, including open water, freshwater marshes, savanna, farmland, cities, and towns. It is often seen in open coastal lowlands, but seems to avoid forested regions and high mountains. It often gathers in flocks to roost in marshes and migrants will concentrate over water surfaces (lakes, rivers, marshes) when poor weather reduces the abundance of flying insects and/or the ability to migrate (Brown and Brown 2020). The species has not previously been recorded within the Project area or broader Study area (ALA or Wildlife Online). The species was not observed during field surveys and there is limited suitable habitat within the Project area. There is suitable habitat within the Study area. The species is reported to feed almost entirely on flying insects, feeding low over the ground or water (SPRAT). If the species did occur in the Project area, collision with infrastructure is unlikely given its typical flight behaviour. With a global population of up to 487,000,000 individuals (Birdlife International 2019a), the loss of a small number of individuals would not affect population viability. The movements of this species are unlikely to be affected by the Project.
			Displacement and barrier effects	Rare	Negligible	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Black-faced monarch (<i>Monarcha melanopsis</i>) Spectacled monarch (<i>M. trivirgatus</i>) Satin flycatcher (<i>Myiagra cyanoleuca</i>) Rufous fantail (<i>Rhipidura rufifrons</i>)	Recorded in the Project area during field surveys	EPBC Act – Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> These species are either residents or partial, latitudinal migrants. They prefer lowland tropical and subtropical rainforest, gallery forest, eucalypt (<i>Eucalyptus</i>) woodland, swamp-forest and mangroves, coastal and monsoon scrub and regrowth areas. They are occasionally found in suburban parks and gardens and, in their non-breeding range, the edges of plantations. They move through the canopy during their migrations and most often forage at the low or middle reaches of the forest (Boles et al. 2020; Clement 2020a; 2020b; Gregory 2020). All of these species were recorded in low numbers during field surveys. Potential habitat is widespread across the Project area. Individuals are unlikely to collide or interact with project infrastructure, given their behaviour to move within or below the forest canopy (below RSA height). These species are unlikely to be displaced by the active turbines and/or infrastructure associated with the Project.
			Displacement and barrier effects	Unlikely	Low	Negligible	
Common greenshank (<i>Tringa nebularia</i>)	Potential to occur within the Project area	EPBC Act – Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> On migration, this species occurs at inland flooded meadows, dried-up lakes, sandbars and marshes. It winters in a variety of freshwater and marine wetlands, including estuaries, sandy or muddy coastal flats, saltmarshes, mangroves, swamps and lakes; as well as on artificial wetlands, such as sewage farms, dam lakes, saltworks and inundated rice crops. It is less often recorded on open
			Displacement and barrier effects	Rare	Low	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							<p>coastline, sometimes along quiet stretches of rivers (Van Gils et al. 2020e).</p> <ul style="list-style-type: none"> The species has been recorded within the Study area, within wetland to the west of the Project area (ALA). The most recent observation dates from 2015. It was not observed during field surveys and there is limited potential habitat within the Project area. Collision with Project infrastructure is unlikely but could involve multiple individuals as the species is congregatory. As the Australasian population is conservatively estimated at 100,000 individuals (Wetlands International 2021), the loss of a small number of individuals each year is not likely to be significant. There is a potential for the species to be displaced by wind farms as per other waterfowl (Hötcker 2017), however suitable habitat for this species does not occur within the Project footprint. Therefore, it is unlikely that individuals would be displaced from the area as a result of the Project.
Common sandpiper (<i>Actitis hypoleucas</i>)	Potential to occur within the Project area	EPBC Act - Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> Outside of the breeding season (July to April), the species is known to occur in a wide variety of habitats, e.g., coastal shores, estuaries, saltmarshes, inland wetlands, riverbanks, pools and tidal creeks in mangroves and rice fields; sometimes on grassland, along roadsides or in urbanised areas, including reservoirs and dam lakes. Large coastal mudflats are not favoured (Van Gils et al. 2020a). The species has been historically recorded within the Study area, approximately 8km to the west of
			Displacement and barrier effects	Rare	Low	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							<p>the Project area, with the last record dating from 1979 (ALA). There is limited suitable habitat within the Project area.</p> <ul style="list-style-type: none"> Collision with infrastructure is unlikely but could involve multiple individuals as the species forms flocks of up to 200 individuals prior to migration movements. As the Australasian population is conservatively estimated at 50,000 individuals (Wetlands International 2021), the loss of a small number of individuals each year is not likely to have population-level impacts. There is a potential for the species to be displaced by wind farms as per other waterfowl (Hötter 2017), however suitable habitat for this species does not occur within the Project footprint. Therefore, it is unlikely that individuals would be displaced from the area as a result of the Project.
Curlew sandpiper (<i>Calidris ferruginea</i>)	Potential to occur within the Project area	EPBC Act – Critically Endangered, Migratory NC Act -Critically Endangered	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species is a winter migrant, occurring chiefly on coast, on muddy or sandy surface of tidal flats, coastal lagoons, estuaries and saltmarshes. It may also be found inland, at muddy edges of marshes, large rivers, lakes, salt pans, irrigation schemes and flooded areas (Van Gils et al. 2020c). The species has not been previously recorded within the Project area or the broader Study area (ALA or Wildlife Online). There is limited habitat within the Project area but the species is occasionally recorded in the Tablelands (SPRAT).
			Displacement and barrier effects	Rare	Low	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							<ul style="list-style-type: none"> Collision with infrastructure is unlikely but could involve multiple individuals as the species is gregarious, often occurring in large flocks. As the Australasian population is conservatively estimated at 135,000 individuals (Wetlands International 2021), the loss of a small number of individuals each year is not likely to be significant. There is a potential for the species to be displaced by wind farms as per other waterfowl (Hötcker 2017), however suitable habitat for this species does not occur within the Project footprint. Therefore, it is unlikely that individuals would be displaced from the area as a result of the Project.
Fork-tailed swift (<i>Apus paificus</i>)	Recorded in Project area during field surveys	EPBC Act – Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Likely	Low	Low	<ul style="list-style-type: none"> This species is a long-distance migrant which winters in Australia, where it is common during October to April. Arrivals are noticeable because of the low altitude at which they fly. The species is known to follow storm systems and fronts (Chantler et al. 2020).
			Displacement and barrier effects	Rare	Negligible	Negligible	<ul style="list-style-type: none"> The species mostly occurs over inland plains but sometimes over foothills, settled areas, treeless grasslands, above rainforests, wet sclerophyll forest, open forest or plantations of pines (Higgins 1999). The species forages almost completely aerially, with heights from 1-3,000m above the ground (SPRAT). Four individuals of this species have been recorded over the course of five BUS in the Project area. Individuals could potentially collide with Project infrastructure at the species typically flies at or



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							above RSA height. The loss of a small number of individuals is not likely to be of significance because the species is still numerous. It is unlikely to be displaced by the active turbines given its aerial and highly mobile nature while in Australia.
Grey wagtail (<i>Motacilla cinerea</i>) Yellow wagtail (<i>M. flava</i>)	Potential to occur within the Project area	EPBC Act – Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Rare	Negligible	Negligible	<ul style="list-style-type: none"> Typically, habitat for the grey wagtail includes fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It will also inhabit more lowland watercourses, even canals, where there are artificial waterfalls, weirs, millraces or lock gates. In the non-breeding season it frequents a wider variety of habitats, including farmyards, sewage farms, forest tracks, tea estates, and even town centres (Tyler 2020a). Yellow wagtails inhabit a variety of damp or wet habitats with low vegetation, including marshes, waterside pastures and sewage farms (Tyler and Christie 2020). Neither species has been previously recorded within the Project area or the Study area (ALA or Wildnet). They were not observed during field surveys, however, there is some potential habitat for these species within the Project area. Collision with Project infrastructure is not likely given these species do not tend to fly high above the canopy, or fly very fast. The movements of this species are unlikely to be affected by the Project. There is no potential habitat within the Project footprint and hence displacement effects are not anticipated.
			Displacement and barrier effects	Rare	Negligible	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Latham's snipe (<i>Gallinago hardwickii</i>)	Potential to occur within the Project area	EPBC Act - Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Negligible	Negligible	<ul style="list-style-type: none"> Outside of the breeding season, it is found in a variety of permanent or ephemeral freshwater wetlands, generally with dense cover, including meadows, bogs, swamps, edges of creeks and rivers, flooded areas and rice paddies. On migration, it is rarely on beaches and other saline or brackish habitats. It is recorded in highlands in Australia during the non-breeding season (Van Gils et al. 2020d). The species is highly dispersive, moving in response to rainfall and availability of food (SPRAT). The species has been previously recorded within the Study area, to the west of the Project area, with the most recent records dating from 2015 (ALA). It was not observed during field surveys and there is limited potential habitat within the Project area. Collision with infrastructure is not likely given the absence of suitable habitat within the Project area. Should a collision occur, there would be little impact on the overall population which is estimated as a minimum of 25,000 birds (Wetlands International, 2021). There is a potential for the species to be displaced by wind farms as per other waterfowl (Hötker 2017), however suitable habitat for this species does not occur within the Project footprint. Therefore, it is unlikely that individuals would be displaced from the area as a result of the Project.
			Displacement and barrier effects	Unlikely	Negligible		
Macleay's fig-parrot (<i>Cyclopsitta</i>)	Potential to occur within	NC Act - Vulnerable	Collision with turbines, towers, power lines	Rare	Negligible	Negligible	<ul style="list-style-type: none"> The species frequents rainforests, gallery forests and adjacent open forests up to 750m asl. During the



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
<i>diophtalma macleayana</i>	the Project area		Displacement and barrier effects	Unlikely	Negligible	Negligible	<p>breeding season, territories are centred around feeding trees (<i>Ficus</i> species) whilst communal roosts are used outside of the breeding season (Forshaw 1992).</p> <ul style="list-style-type: none"> The species has not historically been recorded within the Project area but there are records from the Tully Falls and Koombooloomba National Parks (ALA) in the eastern extent of the broader Study area. The species was not recorded during field surveys but there is suitable habitat within the Project area. Collision with infrastructure probably rare as the species tends to fly within the canopy (below RSA height). Suitable habitat for this species occurs within the Project area but none of its preferred feeding trees were recorded within the Project footprint during the botanical surveys. It is considered unlikely that individuals would be displaced from the area.
Masked owl (<i>Tyto novaehollandiae kimberli</i>)	Recorded in the Project area during field surveys	EPBC Act – Vulnerable NC Act – Vulnerable	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This sedentary species is usually associated with tall open forest dominated by big trees suitable for nesting and roosting. It is more numerous where the greatest local forest and woodland diversity occurs, i.e., forest types with dry, open understorey, providing a variety of dense and sparse ground cover. Smaller numbers are patchily distributed away from coastal regions in wooded farmland, riparian woodland and isolated stands of large trees (Bruce and Marks 2020).
			Displacement and barrier effects	Unlikely	Negligible	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							<ul style="list-style-type: none"> This species was recorded within the Project area at two locations during field surveys. Habitat suitable for nesting is limited to riparian zones and the lower slopes with taller trees; foraging habitat is widespread across the Project area. Collision with Project infrastructure is unlikely given this species' propensity to hunt at or below the canopy layer (below RSA height). It does not tend to undergo migrations, with most movements attributable to juveniles dispersing. Similarly, it is unlikely that individuals would be displaced from the area as a result of the Project as habitat on ridgelines (where turbines are proposed) is less suitable for nesting.
Oriental cuckoo (<i>Cuculus opatus</i>)	Potential to occur within the Project area	EPBC Act – Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Negligible	Negligible	<ul style="list-style-type: none"> This species is a winter migrant. It is found in primary and secondary forest, savannas, gardens, monsoon rainforest, open Casuarina, Acacia, Eucalyptus or wet sclerophyll forest, and more occasionally swamps, mangroves and plantations (Payne and Kirwan 2020). The species has not been previously recorded within the Project area or the Study area (ALA or Wildlife Online). It was not observed during field surveys but suitable habitat occurs within the Project area. Migratory flight is typically at night and often at high altitude (likely above RSA height). The species is insectivorous, feeding within or below the canopy (below RSA height) when not migrating. Individuals are therefore not likely to collide with Project
			Displacement and barrier effects	Unlikely	Negligible	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							infrastructure. With a global population conservatively estimated at 5,000,000 birds (Birdlife International 2019b), the loss of a small number of individuals is not likely to be of significance. It is unlikely to be displaced by the active turbines.
Pectoral sandpiper (<i>Calidris melanotos</i>)	Potential to occur within the Project area	EPBC Act - Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species is a migrant mainly in the western hemisphere, with small numbers wintering regularly in south-east Asia and mainly Australia and New Zealand. It prefers fresh to saline wetlands, usually coastal or near coast, occasionally farther inland (Farmer et al. 2020). The species has not previously been recorded within the Project area or the broader Study area (ALA or Wildnet). It was not recorded during field surveys and limited suitable habitat occurs within the Project area. Collision with Project infrastructure is unlikely but could involve multiple individuals as the species is congregatory. There is a potential for the species to be displaced by wind farms as per other waterfowl (Hötcker 2017), however suitable habitat for this species does not occur within the Project footprint. Therefore, it is unlikely that individuals would be displaced from the area as a result of the Project.
			Displacement and barrier effects	Unlikely	Negligible	Negligible	
Peregrine falcon (<i>Falco peregrinus</i>)	Recorded in the Project	NC Act – Least Concern	Collision with turbines, towers, power lines	Almost certain	Low	Low	<ul style="list-style-type: none"> These species are sedentary and usually associated with tall open forest dominated by big trees suitable



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Australian hobby (<i>F. longipennis</i>) Brown falcon (<i>F. berigora</i>) Collared sparrowhawk (<i>Accipiter cirrocephalus</i>) Brown goshawk (<i>A. fasciatus</i>) Grey goshawk (<i>A. novaehollandiae</i>) Pacific baza (<i>Aviceda subcristata</i>) Whistling kite (<i>Haliastur sphenurus</i>) Black kite (<i>Milvus migrans</i>)	area during field surveys		Displacement and barrier effects	Unlikely	Negligible	Negligible	<p>for nesting and roosting. They are more numerous where greatest local forest and woodland diversity occurs, i.e., forest types with dry, open understorey, providing variety of dense and sparse ground cover. Smaller numbers are patchily distributed away from coastal regions in wooded farmland, riparian woodland and isolated stands of large trees; also pine plantations, and in N Australia Melaleuca swamps and mangrove edges (Bruce and Marks 2020).</p> <ul style="list-style-type: none"> • These raptor species were all confirmed within the Project area during field surveys. • All of these species to a greater or lesser extent fly high above the canopy at some time (within RSA height), and therefore have an increased potential to interact with the turbines and other Project infrastructure. Some of these species are known to collide with turbines (David et al. 2021; Debus and Kirwan 2020c; 2020d; Debus and Marks 2020; Debus et al. 2020; 2021; White et al. 2020). However, all are widespread and common, and population-level impacts as a result of collision with wind turbines is not anticipated. These species appear not to be deterred by the presence of operating wind turbines and most species occur regularly at other wind farms in Australia (Nature Advisory 2021).



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Red goshawk (<i>Erythrotriorchis radiatus</i>)	Potential to occur within the Project area	EPBC Act – Vulnerable NC Act – Endangered	Collision with turbines, towers, power lines	Unlikely	Moderate	Low	<ul style="list-style-type: none"> This species inhabits coastal and subcoastal open forest and woodland, often riparian, in the tropics and subtropics, from sea-level to c. 1000 m. It breeds in forest and tall woodland, near water, but wandering juveniles have been recorded in more diverse habitats such as denser rainforest or mangroves, or even agricultural land. This species has very large home ranges, with a high abundance of birds as a food source, with permanent water (Debus et al. 2020a). This species has not previously been recorded within the Project area but was known to nest historically to the south (within the broader Study area), where the last recorded sighting dates from 2007 (ALA). This species was not observed during field surveys but suitable nesting and foraging habitat is widespread across the Project area. The species primarily hunts within or just above the canopy however it is known to occasionally soar over woodlands and waterways, particularly during mating displays (SPRAT). Soaring individuals could therefore be at risk of colliding with Project infrastructure. The loss of individuals from a small population (est. 1,000) could be significant. This species is unlikely to be displaced by the active turbines and/or infrastructure.
			Displacement and barrier effects	Unlikely	Low	Negligible	
Sarus crane (<i>Grus antigone</i>)	Potential to occur within	NC Act – Least Concern	Collision with turbines, towers, power lines	Likely	Moderate	Moderate	<ul style="list-style-type: none"> Habitat for these species varies by season; they can use shallow freshwater marshes, with water less than



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Brolga (<i>G. rubicunda</i>)	the Project area		Displacement and barrier effects	Likely	Low	Low	<p>50 cm deep, but also use deeper marshes, wet meadows and brackish wetlands. They move to traditional flocking areas, including permanent wetlands, upland pastures and other drier foraging areas in summer, Dec–May. Partial dispersal to suitable nesting areas in ephemeral inland marshes coincides with the onset of the wet season. During the dry season, sarus cranes prefer upland agricultural fields and grassland (Archibald et al. 2020a; 2020b).</p> <ul style="list-style-type: none"> • Neither species has been previously recorded within the Project area but there is a known mixed-species roost at the Great Plains swamp to the west, within the broader Study area. This roost is regularly monitored by BirdLife Northern Queensland along with the Atherton Tablelands Key Biodiversity Area (KBA). The KBA comprises Lake Tinaroo and surrounds, is approximately 28km northeast of the Study area and was designated due to its population of over-wintering Sarus crane (Key Biodiversity Areas Partnership 2020). Neither species was observed during field surveys and there is limited potential habitat within the Project area, with few wetlands and no cropping. • Cranes as a group are susceptible to collisions with powerlines and, potentially, other wind farm infrastructure due to their large size and relative low mobility (Bernardino et al. 2018; Jenkins et al. 2010). Given the potential numbers of cranes over-wintering in the broader Study area, there is an



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							<p>increased likelihood that individuals could collide with Project infrastructure.</p> <ul style="list-style-type: none"> Studies have shown that other species of crane (in Texas) avoid habitats close to wind turbines, exhibiting reduced habitat use, more clumped distributions and more vigilant behaviour. It has also been suggested that long arrays of wind turbines may create partial barriers to some bird movements (Department of Sustainability and the Environment 2012).
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	Potential to occur within the Project area	EPBC Act - Migratory NC Act – Special Least Concern	Collision with turbines, towers, power lines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species is a migrant during the non-breeding season (August to November), using a wide variety of coastal and inland wetlands (many ephemeral), including coastal saltmarshes, intertidal mudflats, shallow brackish lagoons, flooded grassland, river mouths and rice fields. It often feeds amongst vegetation, on drier margins (Van Gils et al., 2020b). The species has not previously been recorded within the Project but has been recorded approximately 3.5km to the west, within the broader Study area. The most recent observation dates from 2015 (ALA). It was not observed during field surveys and there is limited suitable habitat within the Project area. Collision with infrastructure is unlikely. There is a potential for the species to be displaced by wind farms as per other waterfowl (Hötker 2017), however suitable habitat for this species does not occur within the Project footprint. Therefore, it is
			Displacement and barrier effects	Rare	Negligible	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							unlikely that individuals would be displaced from the area as a result of the Project.
Wedge-tailed eagle (<i>Aquila audax</i>)	Recorded within the Project area during field surveys	NC Act – Least Concern	Collision with turbines, towers, power lines	Almost certain	Low	Low	<ul style="list-style-type: none"> This species occurs over most terrestrial habitats, from sea level up to 2000 m, but avoids areas of dense human population, e.g., cities, intensive agriculture. It occupies open forest, woodland, scrub, savanna, plains, and deserts, typically in rough or remote country; it avoids dense rainforest. Breeding adults are sedentary while juveniles are dispersive. It nests in all wooded habitats, including monsoon rainforest, provided these are distant from human activity (Debus and Kirwan 2020b). At least two pairs were observed in the Project area during field surveys. The species is most exposed to collision risk at wind farms due to its common habit of soaring and looking downwards whilst foraging. Dispersing juveniles are also at risk of collision. Several birds of this species have been struck at other wind farms in eastern Australia. This is not anticipated to lead to population-level effects as the species is widespread and numerous. This species is unlikely to be affected by displacement as a result of the Project, with the species reported to be successfully breeding within 200m of operating wind turbines (Nature Advisory 2021).
			Displacement and barrier effects	Unlikely	Negligible	Negligible	
White-throated needletail	Recorded within the Project area	EPBC Act – Vulnerable, Migratory	Collision with turbines, towers, power lines	Likely	Low	Low	<ul style="list-style-type: none"> This species winters in both coastal and mountainous areas. It is known to winter above



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
<i>(Hirundapus caudacutus)</i>	during field surveys	NC Act – Vulnerable	Displacement and barrier effects	Unlikely	Negligible	Negligible	<p>1,800 m, and is common between 1,530–1,800 m (Chantler and Kirwan 2020). In Australia it is almost exclusively aerial and occurs over all types of habitat but is most often recorded above wooded areas (SPRAT).</p> <ul style="list-style-type: none"> This species was recorded in the Project area during field surveys, with one individual found deceased after seemingly colliding with existing transmission line infrastructure. This species typically flies at and above RSA height, and individuals could therefore collide with Project infrastructure. The loss of a small number of individuals each year is not considered to be of significance as it is still numerous in Australia. This species is unlikely to be displaced by the active turbines and/or infrastructure.
Bats							
Eastern bent-wing bat (<i>Miniopterus orianae oceanensis</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Likely	Low	Low	<ul style="list-style-type: none"> This species is found across a broad area of eastern Australia from Victoria to Cape York. The species was recorded as a moderately common species in the Project area during surveys. It would be considered most at risk from Project impacts where turbines are located close to maternity colonies, therefore targeted roost surveys were undertaken in the Project area however all potential areas were found to be unsuitable. This species is considered likely to fly within RSA height which would put it at risk of collision with
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							turbine blades; however this risk is lowered with the absence of maternity roosts. The Project is not expected to cause any indirect disturbance to the species.
Eastern blossom bat (<i>Syconycteris australis</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbine	Rare	Low	Negligible	<ul style="list-style-type: none"> This is a small fruit bat that locates fruit and nectar by sight and smell. It is usually restricted to dense patches of rainforest and rainforest remnants. This species was recorded in the Project area during field surveys. The species typically flies below canopy level and is therefore not at risk of collision. There is no rainforest habitat within the Project footprint and therefore indirect disturbance effects are not anticipated on this species.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Eastern forest bat (<i>Vespadelus pumilus</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Rare	Low	Negligible	<ul style="list-style-type: none"> This is a small insect-eating bat that is typically restricted to wet forest and rainforest areas. The species was recorded in the Project area during field surveys. It typically forages at or below tree canopy level and is therefore not at risk of collision. There is no rainforest and minimal wet forest habitat within the Project footprint and therefore indirect disturbance effects are not anticipated on this species.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Eastern freetail bat (<i>Ozimops ridei</i>)	Recorded in the Project	NC Act – Least Concern	Collision with turbines	Likely	Low	Low	<ul style="list-style-type: none"> This species is broadly distributed from Victoria and South Australia to Cape York in Queensland. It is a



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
	area during field surveys		Indirect disturbance including barrier effects	Unlikely	Low	Negligible	<p>small, fast flying species that forages in open space above the tree canopy.</p> <ul style="list-style-type: none"> This species was recorded in the Project area during field surveys. This species is likely to fly within RSA height and is therefore at risk of collision with turbines. As the species is common and widespread, this is not likely to result in population-level effects. The Project is not expected to cause any indirect disturbance to the species.
Eastern horseshoe bat (<i>Rhinolophus megaphyllus</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Rare	Low	Negligible	<ul style="list-style-type: none"> This species is distributed from Victoria to Cape York. It is a relatively slow flying bat that is found in association with dense vegetation and wet forest types.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species was recorded in the Project area during field surveys. The species typically forages within the canopy for insects (below RSA height) and is not likely to be at risk of collision with turbines or other Project infrastructure. It is not considered to be at risk from indirect disturbance.
Eastern long-eared bat (<i>Nyctophilus bifax</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Rare	Low	Negligible	<ul style="list-style-type: none"> This species is found in northern Queensland in woodlands and forests.
			Indirect disturbance	Unlikely	Low	Negligible	<ul style="list-style-type: none"> The species was recorded in the Project area during field surveys.



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
			including barrier effects				<ul style="list-style-type: none"> It typically flies below RSA height and is not likely to be at risk of collision with turbines or other Project infrastructure. The Project is not expected to cause any indirect disturbance to the species.
Gould's wattled bat (<i>Chalinolobus gouldii</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Almost certain	Low	Low	<ul style="list-style-type: none"> This species nests in tree hollows or buildings and flies within the canopy and sub canopy. It will pass over open areas and can forage up to 15 km from roosts.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	<ul style="list-style-type: none"> This species was recorded in the Project area during field surveys. This species has been recorded colliding with turbines at other wind farms. Juveniles disperse from December or January which may result in higher rates of collision. As a common and widespread species population impacts are unlikely. The Project is not expected to cause any indirect disturbance to the species.
Hoary wattled bat (<i>Chalinolobus nigrogriseus</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species is found across most of northern Australia and typically forages below or slightly above tree-top level.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species was recorded in the Project area during field surveys. The species typically flies below RSA height therefore collision with Project infrastructure is unlikely. The Project is not expected to cause any indirect disturbance to the species.



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
Little bent-wing bat (<i>Miniopterus australis</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species is found across a broad area of eastern Australia, from just south of the Queensland border to Cape York. It was recorded as a very common species in the Project area during field surveys. The species is considered unlikely to fly at RSA height therefore collision with Project infrastructure is unlikely. The Project is not expected to cause any indirect disturbance to the species.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	
Little red flying-fox (<i>Pteropus scapulatus</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Likely	Low	Low	<ul style="list-style-type: none"> This species was observed entangled on barbed wire fencing within the Project area and foraging habitat is widespread across the Project area. The species flies at RSA height when travelling to foraging sites from roosting sites which could result in collision with turbines. Given the high abundance of this species across its distribution the potential loss of the occasional individual is unlikely to be of ecological significance. The turbines are not considered to cause any indirect disturbance.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Northern broad-nosed bat (<i>Scotorepens sanborni</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Unlikely	Low	Negligible	<ul style="list-style-type: none"> This species is distributed in northern Queensland where it forages at or below tree canopy level. The species was recorded in the Project area during field surveys. This species typically flies below RSA height and therefore collision with Project infrastructure is
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							unlikely. The turbines are not considered to cause any indirect disturbance.
Spectacled flying-fox (<i>Pteropus conspicillatus</i>)	Potential to occur within the Project area	EPBC Act – Endangered NC Act - Endangered	Collision with turbines	Likely	Moderate	Moderate	<ul style="list-style-type: none"> This is a fruit and nectar-feeding bat found only in the Queensland Wet Tropics and adjacent environs. Camps are restricted to tropical rainforest areas. The species has suffered a serious population decline from an estimated 820,00 in 1985 to 80,00 in 2000. A severe heat event is thought to have further reduced the population by about half in late 2019. There is a reported spectacled flying-fox camp at Malaan, approximately 20km from the Project area but within the species' foraging range. The species has previously been recorded (in 1999) within Ravenshoe State Forest Reserve 1, which abuts the Project area to the north (ALA). The species was not observed during field surveys and there is minimal rainforest habitat to support a camp but foraging habitat is widespread across the Project area. The species is likely to fly within RSA height when travelling between camps and foraging areas. It could therefore be at risk of collision with Project infrastructure. Given the recent population decline experienced by this species, any loss of individuals could lead to a localised decline in population viability for this species. Indirect disturbance is not considered likely.
			Indirect disturbance including barrier effects	Unlikely	Low	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
White-striped freetail bat (<i>Austronomus australis</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Almost certain	Low	Low	<ul style="list-style-type: none"> This species roosts in trees and is widespread across Qld. It occurs in a variety of habitats, including urban areas, woodland, shrubland, open agricultural land with scattered trees, grasslands and deserts. It is fast flying and not designed for manoeuvrability. The species was recorded in the Project area during field surveys. This species often flies within RSA height (Churchill 2008). It is known to regularly collide with turbines at other wind farms in eastern Australia (Nature Advisory 2021). Given the high abundance of this species across its distribution, the loss of individuals is unlikely to pose a significant risk to the species' population. The Project is not expected to cause any indirect disturbance to the species.
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	
Yellow-bellied sheathtail bat (<i>Saccolaimus flaviventris</i>)	Recorded in the Project area during field surveys	NC Act – Least Concern	Collision with turbines	Likely	Low	Low	<ul style="list-style-type: none"> This species is a wide-ranging bat that occurs across northern and eastern Australia. It more commonly occurs in the northern areas of the country. It roosts in tree hollows, buildings and in treeless landscapes and is known to utilise mammals' burrows. It forages for flying insects and is known to fly high and fast over the tree canopy. This species was recorded in the Project area during field surveys. The species is known to fly within RSA height (Churchill 2008). This puts it at risk of collision with turbines however, given the high abundance of this species across its distribution, the loss of individuals
			Indirect disturbance including barrier effects	Unlikely	Negligible	Negligible	



Name	Reason for Inclusion	Threatened Species Status	Potential Hazard	Likelihood of risk event	Consequence	Risk Rating	Comments
							is unlikely to pose a significant risk to the species' population. Turbines are not considered to cause any indirect disturbance.

6.0 Commissioning and Operational Monitoring

Monitoring activities to be undertaken during commissioning and operational phases of the Project are centred on a regular carcass monitoring program designed to estimate the number of birds and bats colliding fatally with operating turbines. This measure will be used as a basis for an estimate of overall bird and bat mortality rates. Additional monitoring activities will include operational BUS and targeted monitoring surveys of 'at-risk' species, and will be used to assess any changes in population dynamics and behaviour of bird and bat species within the Project area that may be attributed to the Project.

6.1 Operational Bird Utilisation Surveys

The BUS outlined in **Section 3.2.1** will be repeated once the wind farm is fully operational and will be completed over the first year. These surveys will seek to demonstrate whether the site continues to be utilised by the range of species identified in the pre-commissioning surveys and to assess any changes in abundance or behaviour.

Depending on the outcomes of these surveys, additional BUS may be recommended in the first-year annual report.

6.2 Targeted Monitoring of 'At-risk' Species

Based on the results of the risk assessment described in **Table 5.3**, the following species or species groups have been identified as being 'at-risk', and will undergo targeted monitoring:

- Wedge-tailed eagle and other raptors;
- Fork-tailed swift;
- Masked owl (northern subspecies);
- Black-faced monarch;
- White-throated needletail;
- Sarus crane and brolga;
- Curlew sandpiper;
- Spectacled flying-fox;
- Eastern bentwing bat; and
- Eastern freetail bat.

Carcass monitoring, as described in **Section 6.3**, will be key in identifying collision impacts to any of these species or species groups; however, a targeted activity monitoring program will also be undertaken for these species to identify changes in behaviour or population dynamics. Details of these surveys are provided in **Section 6.2.1**.

6.2.1 Target Species Activity Monitoring

Once the Project is fully operational, monthly monitoring will be undertaken of flight movements of the targeted 'at-risk' species identified in 6.3. This observational data will contribute to determining whether operating turbines affect the behaviour of these species. As monitoring results will likely vary seasonally, consistent monitoring across all seasons will enable the identification of this variability and improve the effectiveness of the monitoring program.



Incidental observations of target 'at-risk' species and species groups will be incorporated into the monthly carcass monitoring program during the first two years of operation. Suitably trained personnel will record the following details for each observation:

- Date, location and duration of observation period;
- Time and duration of flight;
- Number of birds, and approximate age (if known);
- Flight height above ground (range);
- Habitat over which the flight was observed;
- Flight behaviour observed, included soaring, directional flight (flapping), kiting, circling, gliding and diving;
- Other occasional behaviours included feeding, territorial displays, fighting and perching; and
- The GPS location and status (active or non-active) of any raptor nests.

A monitoring data form is included in **Appendix B**. Flight paths will be plotted as accurately as possible on large-scale aerial photographs of the Project area.

6.3 Carcass Monitoring

Carcass monitoring involves opportunistic monitoring of the areas immediately around turbines for carcasses, and passive observations of bird or bat carcasses within the Project area (incidental finds). Monitoring of mortality from blade strike by wind farm personnel at operating wind farms is key to:

- provide supporting data that can inform adaptive management of the collision risk (i.e. patterns of mortality related to seasonal changes or local conditions); and
- detect mortality of threatened and non-threatened bird and bat species, which can be used to understand actual bird and bat impacts.

6.3.1 Methodology

To obtain accurate mortality rates, it is essential that the monitoring is scientifically and statistically robust. Carcass scavenging and carcass detectability, among other factors, can affect mortality rate estimates and must be measured and included in any estimate of overall mortality rates within the total Project area.

Cumulative results from both the scavenger and detectability methods will be analysed to provide the average estimated mortality of birds and bats, their standard error (variability) and ranges for the Project. Scavenged carcasses may increase the variability in mortality rate estimates therefore scavenger losses will be assessed following the detailed methodology provided in **Appendix C**. Mortality estimates are further refined by detectability trials as described in more detail in **Appendix D**. The need and frequency for future detectability trials will be reviewed by a suitably qualified ecologist.

Where possible, the mortality rate will be calculated for each species and size class detected. If possible, the standard error and range of these estimates will be reported. Note that it may not be possible practically to provide this due to the likely low number of carcasses detected and where this is an issue, it will be reported.



6.3.1.1 Survey Effort

This statistically designed sampling program will be carried out monthly for a total of 48 months. Data will be compiled and reviewed on an annual basis for inclusion in the annual report.

The Project design currently comprises a maximum 95 turbines. To achieve a suitable survey effort, it is proposed that a minimum of 25% of the turbines will be searched monthly, totalling at least 24 turbines a month. Where less than 24 turbines have been commissioned, all commissioned and operational turbines will be surveyed.

To facilitate the robustness of the survey effort, turbines will be stratified into groups (strata) based on their position within the Project area and elevations to account for species variability. Within each strata, a minimum of three turbines will be selected at random, with survey turbines remaining the same throughout the monitoring period.

The results of the carcass surveys for the first 24 months will be used to report on the impact of the wind farm on bird and bat species and to determine if further monitoring (or other activities) will be required in subsequent years to address identified risks and impacts.

6.3.1.2 Survey Approach

Carcass monitoring will be undertaken by suitably qualified and trained ecologists. A senior supervising ecologist will oversee activities to ensure monitoring efforts are effective and consistent, and will be responsible for providing advice where identification of carcasses is difficult (e.g. feather spots or a partial carcass).

Based on the Hull and Muir model (2010) 95 % of bat carcasses are expected to be found within 74 m of the turbine, and carcasses of medium to large birds are expected to be reasonably evenly distributed out to 122 m. Although very large birds (such as the wedge-tailed eagle) may potentially fall further from the turbine, 95 % of birds and bats are expected to be within 130 m of the turbine. Searches will therefore be limited to a maximum of 130 m.

Searches will be separated into inner and outer circular search zones (**Figure 6.1** Inner and Outer Carcass Search Zones Underneath Turbines), with the inner zone targeting the detection of bats and small, medium and large sized birds and the outer zone ensuring the adequate detection of carcasses of medium to larger sized birds. The inner zone will have a radius of 70 m from the turbine and survey transects will be spaced every 6 m measured at the outer diameter. The outer zone will comprise the zone between the 70 m and 130 m radius circles and search transects in the outer zone are spaced at 12 m measured at the outer diameter.

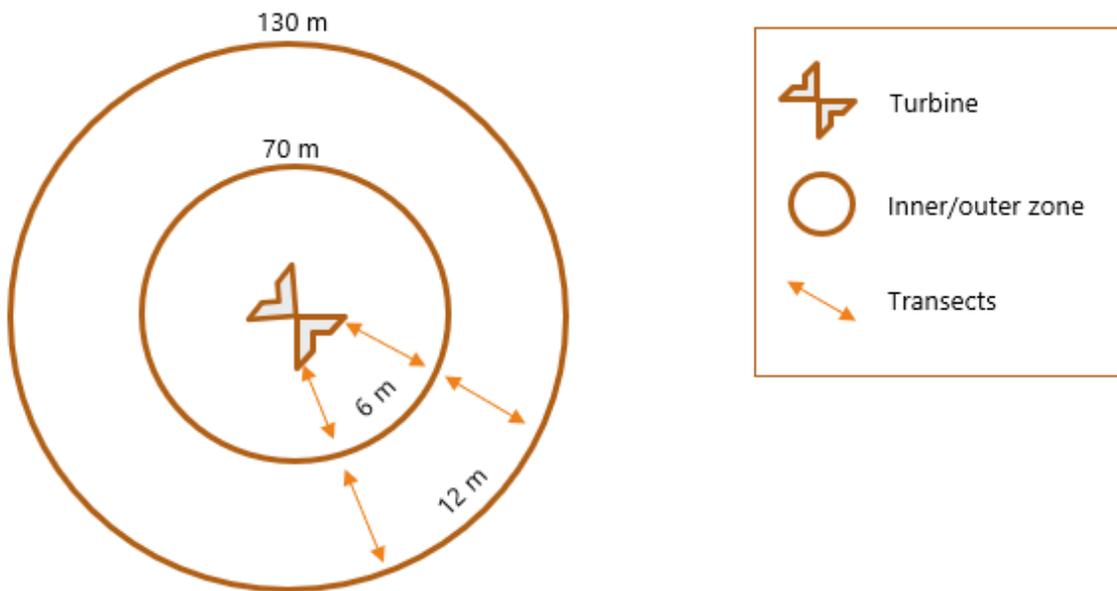


Figure 6.1 Inner and Outer Carcass Search Zones Underneath Turbines

6.3.1.3 Data recording

During surveys data will be classified against both strata and turbine number to facilitate the identification of patterns. At each carcass find the following data will be recorded in the Carcass Search Data Sheet (**Appendix E**).

- The GPS coordinates, and the distance in metres and the compass bearing of each carcass from the base of the closest turbine;
- Surface substrate and vegetation where the carcass was found to assist in predicting the statistical impacts of ground visibility on the monitoring program;
- Where possible: species, approximate age or maturity classification, sex, description of injury and estimated date of blade strike;
- Current weather, weather conditions for the week prior to find, visibility, maintenance of the turbine and any other factors that may affect carcass discovery; and
- One photograph of the carcass in its location, and a second close-up of the carcass for identification.

6.3.1.4 Analysis

Using the principles of statistical analysis outlined in Huso et al. (2016; 2017), the proposed program is designed to provide a suitably robust estimate of Project-related bird and bat mortality. This estimated mortality rate will be created by modelling actual carcass counts, estimated scavenger losses, estimated impact of detectability, and using sampling inference to account for the periods between turbine searches and unsearched turbines. The scavenger loss study methodology is described in more detail in **Appendix C**.

All data will be analysed to provide the average estimated mortality of birds and bats (and individual species where relevant), their standard error (variability) and ranges for the Project. The level of detail may vary as statistical measures become less meaningful if low number of carcasses are detected, however this will be reported as a limitation where necessary.



The resulting data will be analysed and included in the report discussed in **Section 6.4**, with reporting to summarise:

- The species, number, age and sex (if possible) of birds and bats being struck by the turbine blades;
- Results of scavenger and detectability trials;
- Estimated annual mortality rates for all birds and all bats (and for particular species, if required) including an estimate of the number of carcasses per turbine per year; and
- Any detected spatial or temporal variation in the number of bird and bat strikes.

6.3.2 Survey Considerations and Limitations

In order to ensure the robustness of carcass searches as a useful measure of bird and bat mortality relating to blade strike, a review of similar programs on other wind farm projects in Australia has provided insight into practical considerations associated with this monitoring approach, specifically in relation to carcass scavenging and detectability. These include:

- Previous studies have found very few carcasses under turbines in Australia when compared with Northern Hemisphere wind farms. This is thought to be due to carcass scavenging (Hull and Muir 2010; Bernardino et al. 2011; Bispo et al. 2013). Carcass scavenging studies will therefore be undertaken as **Appendix C** to assess the rate of scavenging on the Project site.
- It is known that detectability will be easier in short grass at the dry time of the year compared with in longer grass at the wet time of the year, and detectability trials will be scheduled at both times to provide representative correction factors.

6.3.3 Associated Procedures

6.3.3.1 Incidental Finds Procedure

In the event of an incidental carcass find within 130 m of a turbine occurring outside of the standard survey schedule, the following additional activities should be undertaken in addition to those described in **Section 6.3**:

- The onsite environmental advisor should be informed immediately, and the data should be recorded as per **Section 6.3.1.3**.
- If the species is not able to be immediately identified, photographs must be provided to a qualified ecologist for identification within 2 business days.

6.3.3.2 Carcass Handling Procedure

All construction and operation personnel will be made aware of this carcass handling protocol as part of their site training and induction. A NC Act authority (Scientific Purposes Permit) for keeping remains of native wildlife will need to be granted prior to commencement of this monitoring program. All carcasses will need to be removed to avoid double counting. Once all data has been recorded to satisfy the requirements of the methodology, the carcass will be handled according to the procedure described below:

- The carcass will be handled by personnel wearing rubber gloves, packed into a plastic bag and then placed in a second plastic bag;



- The carcass will be clearly labelled by including a copy of its completed Carcass Search Data Sheet in the second plastic bag to ensure that its origin can be traced at a later date, if required;
- The double-bagged carcass will be transferred to a dedicated on-site freezer (at the Project area office) for storage. The carcass will be held for a minimum of two weeks after the find to facilitate any identification requirements; and
- The NC Act authority (Scientific Purposes Permit) for keeping remains of native wildlife will detail the most appropriate disposal methods following freezer storage period is complete.

6.4 Reporting

Monthly monitoring reports will be provided to the Project operator for review and record keeping purposes. A Bat and Bird Monitoring Report will be provided to regulators annually for the first two years, with need for further reporting reviewed in collaboration with the regulator if required (i.e. if impact triggers are met). Apart from these routine reports, specific reporting will be generated in a timely way under this BBMP in response to an impact trigger (**Section 8.0**).

6.4.1 First Annual Report

The first annual report will be prepared within three months of the completion of the first year of monitoring and will focus on presenting the results of the carcass surveys, BUS, management measures implemented, and any recommended changes to monitoring or management practices. This report will also provide an assessment of significance (against the EPBC Act Significant Impact Guidelines 1.1) for any additional EPBC Act listed threatened bird or bat species that are yet to be assessed.

6.4.2 Second Annual Report

The second annual report will focus on a full statistical analysis of all data collected as per **Section 6.3**, and will be delivered no later than three months following the completion of year two of monitoring. This report will, at a minimum, include a description of the following:

- A description of the management activities undertaken over the 48-month period including, but not limited to:
 - Description of any stock, feral and native animal carcass removal as a part of predator reduction;
 - Details of any feral animal control programs undertaken by the landholder or other parties;
 - Bird risk reduction measures;
 - A description of any modifications to management activities that have been implemented, including a justification as to why; and
 - Any further recommendations for reducing mortality, if necessary.
- A record of the consistent approach to survey methodology as prescribed in this document;
- Results of carcass surveys, incidental carcass observations and BUS (if these have been undertaken as recommended in the first annual report) including, but not limited to:



- A statistically robust estimate of bird and bat mortality on a per turbine basis with allowances for carcass scavenging and detectability;
 - Whether the level of mortality was unacceptable for affected listed species of birds or bats of concern;
 - Usage of the Project area by species of concern at more than negligible risk and factors influencing this (i.e. climatic, geographical and infrastructure);
 - Analysis of the effectiveness of the decision-making framework;
 - Recommendations about further monitoring; and
 - An assessment of the temporal variation of bird and bat strikes, where this variation is considered notable.
- Review of impact triggers, and details of how the decision-making framework and relevant adaptive management measures have been applied.



7.0 Mitigation and Management

An 'impact trigger' is defined as a threshold of impact on bird or bat species that triggers an investigation and/or management response. The overall objective of mitigation measures is the prevention, avoidance and/or reduction of the risk of an impact trigger occurring or continuing to occur, such that the operation of the Project does not lead to significant impacts on threatened or non-threatened birds and bats.

This BBMP is adaptive and allows for the inclusion of new mitigation and management practices, with suitable justification, that may further reduce the risks associated with bird and bats species within the Project area.

7.1 Attractant Removal Program

Agricultural practices and human activities can influence the densities and behaviours of native birds within the Project area due to their attractant properties. Example activities that could elevate scavenger bird population densities and, by association, bird collision rates include:

- The distribution of cattle feed can increase bird activity within the Project area;
- The general mortality of livestock can attract scavenger species;
- Vehicles driving on Wooroora Road or other local farm tracks can result in wildlife deaths, with the resulting carcasses attracting scavengers such wedge-tailed eagles and other raptors into the Project area; and
- Hunting and trapping of invasive species such as pigs or wild dogs may leave carcasses distributed across the Project site, attracting scavengers such wedge-tailed eagles and other raptors into the Project area.

To reduce the concentration of raptor species including the wedge-tailed eagle being influenced by the anthropogenic activities described above, and to reduce the risk of raptors colliding with turbines, a regular carrion removal program will be implemented during operations focused on a minimum of 200 m around turbines. A Carrion Removal Coordinator (CRC) will be appointed to implement the program, and will be responsible for:

- Monthly targeted inspections of the Project site to search for any carcasses of livestock, mammal species or bird species that may attract raptors or other scavengers. Where these finds are bird species, these should be recorded as per the incidental finds procedure (**Section 6.3.3.1**). These searches will be focused within 200 m of each turbine, with additional efforts to occur along gazetted roads such as Wooroora Road and access tracks.
- Incidental and opportunistic observations occurring during general operational activities will provide regular information on the presence of carcasses so that collection can be undertaken to remove them in a timely manner. This can be coordinated through protocols established within the operational phase environmental management plan. Owing to the size and rugged terrain of the two host properties, it is not considered likely that the landholders will be able to contribute to this process.
- Coordinating with the landholder with regard to attractant activities such as cattle feed distribution and hunting. This includes commitments to ensure that feed is not distributed, and trapping does not occur, within 200 m of turbine sites.

All personnel will be required to notify the CRC within 24 hours of identification of a carcass within the Project area. All reported occurrences of a carcass and its removal will be recorded in a carcass removal register that will be maintained by the Project's Responsible Officer.

The carcass removal program will be implemented for a minimum of one year and its continuation will be assessed after one year of operation. The key criteria for continuation will be based on the frequency of carcass finds. As a



guide, if carcass frequency is considered low (one or two per quarter/turbine) outside of turbine search zones (**Section 6.3.1**) the program may be discontinued or reduced based on input from a suitably qualified person. Seasonal or geographical concentrations of carcass finds may also result in modification of the program to focus searches at key times or at key locations.

7.2 Lighting

Research has long shown light attract birds, as well as attracting food sources for birds and bats such as insects. As such, artificial lighting is one of the most important factors affecting the rates of structure collision for birds (Longcore, et al. 2008). It has been shown that lights have the potential to temporarily blind birds, particularly those accustomed to flying at night or in low light conditions. This may cause birds to fly towards the lights and collide with physical structures (Gauthreaux and Belser 2006). Aviation lighting is not proposed for the wind turbines associated with the Project.

7.3 Relocation and Care of Injured Birds or Bats

In some cases, birds or bats may be found to be injured but not killed as a result of the operation of the Project. When this occurs, the following process will be followed:

- The injured wildlife will be reported immediately to the Project Environment Manager;
- The Environment Manager will organise the salvage of the injured animal, and call the nominated local wildlife carer for retrieval;
- The species and location will be recorded as per the incidental finds procedure (**Section 6.3.3.1**); and
- Where the impacted species is listed as threatened at either a Commonwealth or State level, DES and/or DAWE will be notified.

This procedure will be further discussed as a part of the Project Operational Environmental Management Plan.



8.0 Impact Triggers and the Decision-making Framework

An Impact Trigger may be an unacceptable impact on its own or may, if it continues, lead to an unacceptable impact. Notification, further investigation and additional mitigation for both threatened and non-threatened birds and bats may be required following an Impact Trigger. If an impact trigger occurs, there must be an investigation of the cause of the impact and whether the event was likely to be a one-off occurrence or is more likely to occur regularly.

The Project operator is responsible for implementation of the BBMP and the associated decision-making process, with technical input provided by a suitably qualified ecologist. Regular reporting and consultation with relevant regulators is also required within the context of this adaptive management framework.

8.1 Threatened Species

8.1.1 Impact Triggers

The Impact Trigger for Threatened Species occurs if a bird or bat species listed as threatened or migratory under the EPBC Act (as defined within the Project approval conditions) or NC Act is found to have been killed or injured as a result of the Project. Specifically, this will be a carcass find under or within 200 m of a turbine during an active search or incidentally.

8.1.2 Adaptive Management Framework

When a threatened species impact trigger occurs, the adaptive management framework is actioned. This framework is defined by broad steps "Notify, Investigate and Respond" as shown in **Figure 8.1**. This framework will include the following activities:

- Reporting of the occurrence of an impact trigger to the Project's Responsible Officer, who will communicate the incident to DES and/or DAWE within two business days.
- Turbine carcass searches will be increased to include all turbines within 2 km of the confirmed strike. This intensification will be continued fortnightly for 6 weeks at which time it will return to the standard schedule.
- Interim mitigation measures to be implemented in consultation with a suitably qualified ecologist, DES and DAWE.
- An investigation being undertaken by a suitably qualified ecologist to determine the circumstances that lead to the death or injury within ten business days of an incident. In instances where the cause of death is a direct result of turbine blade collision, an investigation will be undertaken to identify the specific risk behaviours that likely resulted in the collision, and the likelihood of recurrence will be evaluated.
- The incident will be assessed as a significant impact (with reference to the *EPBC Act Significant Impact Guidelines 1.1* or the relevant Queensland Government Significant Residual Impact Guideline), and to assess if it is likely to be a one-off event or is a recurring risk.
- In the event that the incident is potentially a recurring risk, the following activities will be undertaken:
 - A species-specific monitoring and mitigation program will be undertaken, with periodic reports provided to DES and DAWE;
 - A review of the most effective practicable mitigation to address any confirmed recurring risks, with the approved mitigation to be implemented as soon as feasible; and



- If, once additional mitigation measures are implemented the impact trigger is recurring, operational curtailment may be considered in consultation with relevant regulators.
- If, in consultation with the relevant regulators, a fatality or injury is deemed to be a one-off occurrence or the ongoing impact to the species is not considered to be significant, further action will not be considered necessary.
- Any required investigation, and recommended mitigation measures will be summarised in the annual reports.

For any impact triggers that occur, performance criteria to assess the response to the occurrence of these impact triggers will be developed in the subsequent versions of the BBMP in order to measure the success of management and monitoring actions. Corrective actions will be defined in response to any performance criteria that are not met. This may include collision risk modelling if the ongoing monitoring suggests that is necessary or warranted. As per the State Code 23 Wind Farm Development Planning Guidance (DSDILGP, 2022) It is noted that collision risk modelling is generally only undertaken (and useful) where there is a quantitative dataset available for site-specific occurrence of significant species.

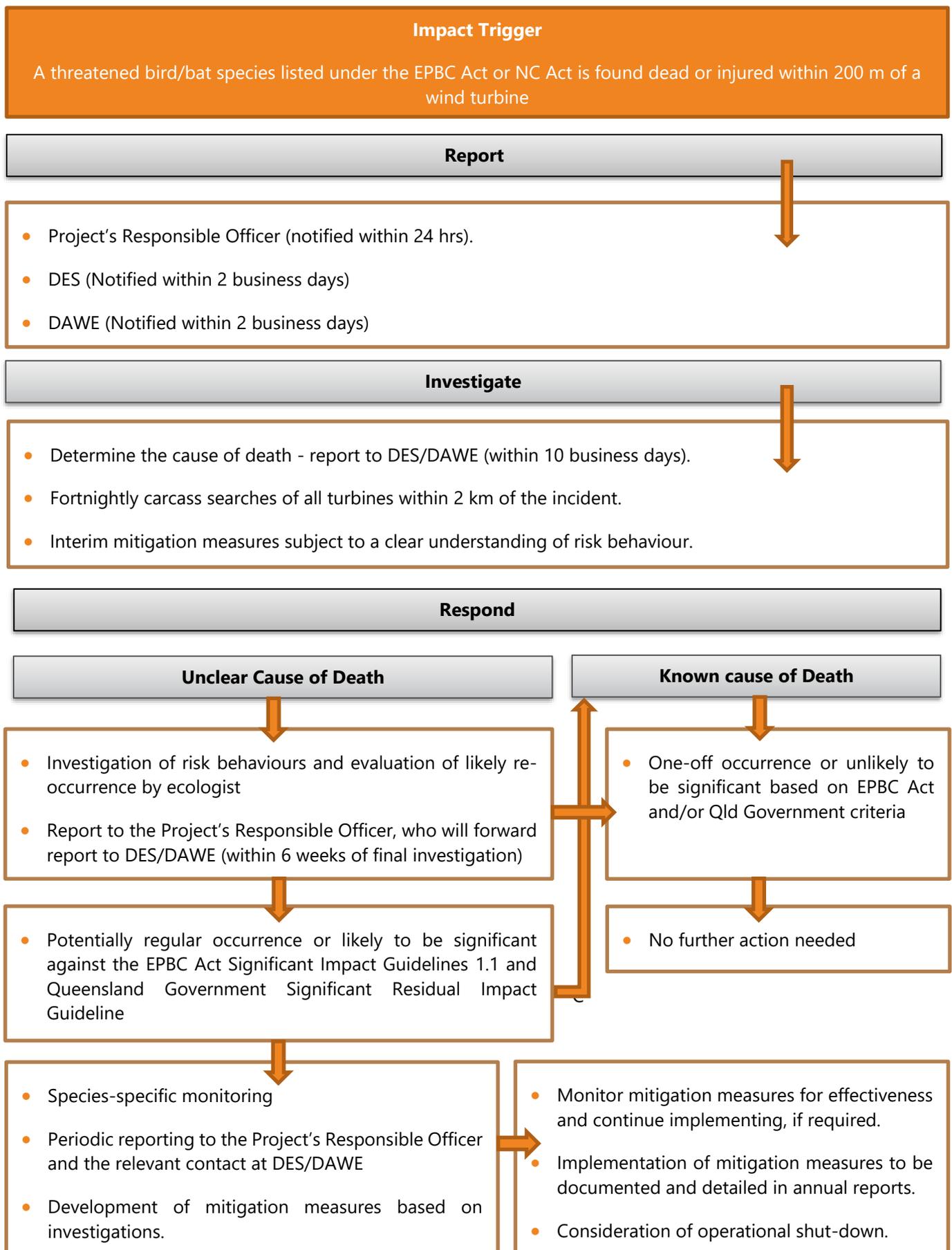


Figure 8.1 Threatened Species Adaptive Management Framework



8.2 Non-threatened Species

8.2.1 Definition of an Impact Trigger

The Impact Trigger for non-threatened species is defined as four or more bird or bat carcasses of a single species, or parts thereof, being found in two successive carcass searches at the same turbine. **Section 6.3** describes the carcass search schedule and methodology.

The definition of a significant impact on non-threatened species is any impact that is likely to reduce the viability of the population of the affected species in the bioregion. This is only relevant where the population numbers for a species are known, where habitat extent is known, and where this information has been formally reported by DES.

8.2.2 Decision-making Framework

When a non-threatened species impact trigger occurs, the adaptive management framework is actioned. This framework is defined by broad steps “Notify, Investigate and Respond” as shown in **Figure 8.2**. This framework will include the following activities:

- Within seven days of recording the impact trigger, DES will be notified;
- An evaluation of impacts to the bioregional population of the target non-threatened species’ will be undertaken; and
- An investigation report will be provided to DES within three weeks of the impact trigger.

If the impact trigger event is deemed to be a recurring risk, or likely to lead to a significant impact on the target species, species-specific monitoring will be implemented. If it is confirmed that impacts are likely to lead to a significant impact on the species, additional mitigation measures will be assessed against the risk. Potential mitigation measures are outlined in **Table 8.1**; however, the final mitigation measures will be determined based on the specific circumstances.

If the impact trigger event is classified as a one-off occurrence or is not a significant impact, no further action will be required (as outlined in **Figure 8.2**).

Any required investigation, and recommended mitigation measures, will be undertaken in consultation with DES and detailed in annual reports.

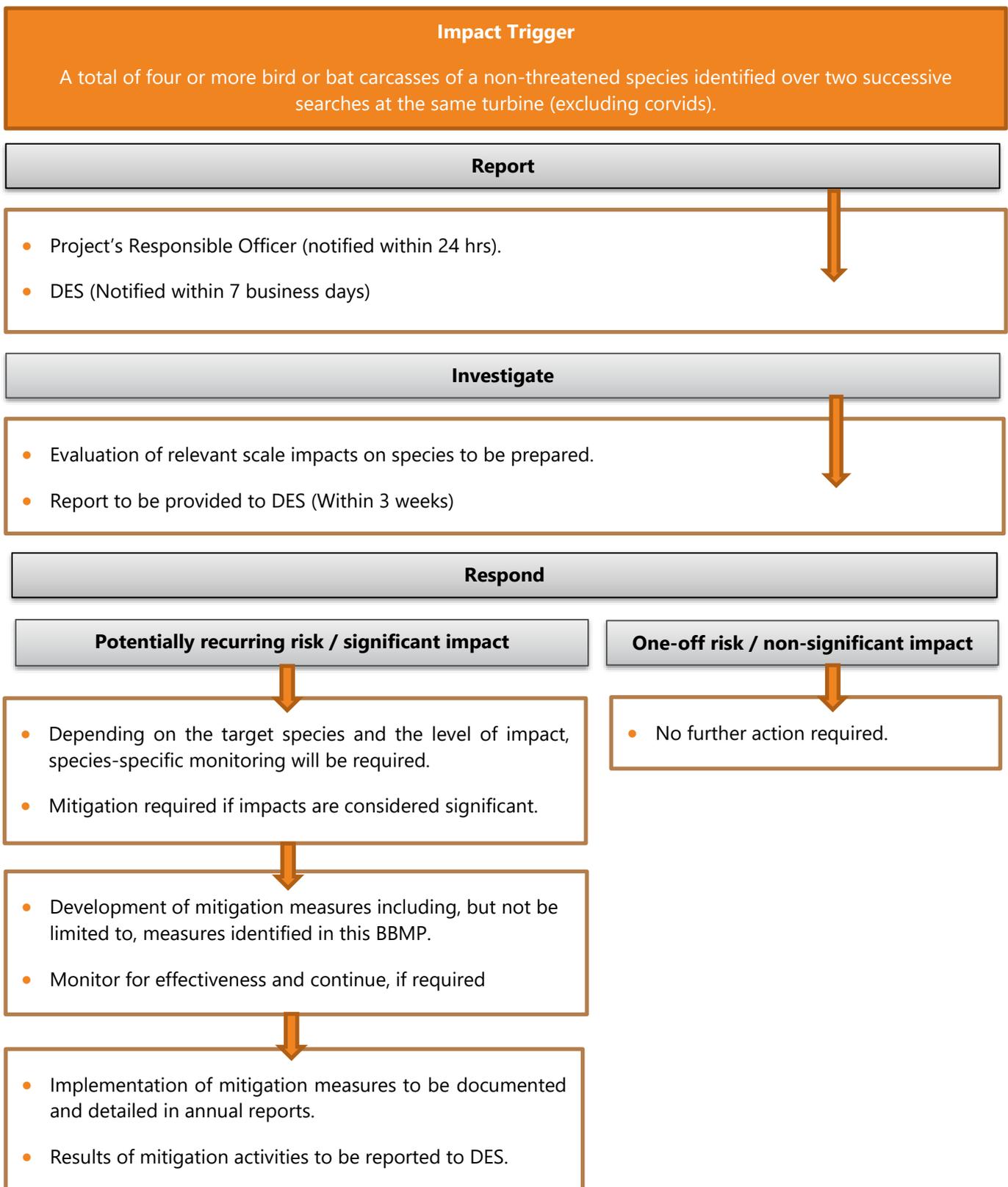


Figure 8.2 Least Concern Species Adaptive Management Framework



8.3 Supplementary Mitigation Measures

In the event that an Impact Trigger occurs, and current mitigation measures are considered inadequate, supplementary mitigation measures may be implemented. Specific additional mitigation measures will be implemented depending on the nature, cause and significance of the impact recorded and in response to the results of investigations of the event and of the species or species groups impacted.

Supplementary mitigation measures will be investigated on a case-by-case basis, with a list of common hypothetical examples listed in **Table 8.1**. Where a supplementary mitigation measure is required, the success of these measures will be monitored and recorded in accordance with the adaptive management framework in **Figure 8.1** and **Figure 8.2**.



Table 8.1 Hypothetical Supplementary Mitigation Measures

Hypothetical cause of impact	Mitigation measure ³	Likelihood of impact continuing	Time to implementation
Foraging source identified that attracts threatened species and 'at risk' species to impact areas	Consider the use of acoustics e.g. bird deterrent devices / irregular noise to discourage birds from foraging in this location where such noise would not impact neighbours	Low	Implement at appropriate times
	Encourage species into alternative areas outside of the Project boundary, where available, through the use of social attraction techniques off-site (decoys and audio playback systems)	Low	Implement according to agreed plan
	Remove the foraging resource proximate to turbines (in accordance with any necessary approvals)	Low	Implement according to agreed plan
Farming practice attracts threatened species to risky areas e.g. grain feeding of stock within 200 m of turbines	Investigate whether farming practice is a contributing factor, and if so, liaise with the landowner to relocate the farming practice further from turbines to reduce risk	Low	As soon as practical
Wind/rain/fog causing low visibility	If low visibility at the Project area is identified as contributing to the repeated mortality of threatened fauna from turbine strike, carcass searches may be repeated during periods of low visibility to measure mortality rates and to validate this hypothesis.	Low	During specific low visibility conditions identified as the cause of significant impacts on threatened species
Attraction to small dams on site	Subject to landowner agreement, fill in dam and provide alternative stock watering solution (e.g. establish replacement dam further from turbines)	Low	Implement as soon as possible after recording the <i>impact trigger</i> if the

³ Note these are examples the mitigation measures that may be possible. Ultimately the mitigation measures used will be chosen following the decision-making frameworks outlined in Figure 8.1 and Figure 8.2



Hypothetical cause of impact	Mitigation measure ³	Likelihood of impact continuing	Time to implementation
			dam is identified as the cause of the problem
Nest site close to turbine	Discourage nesting close to turbines in subsequent years	Low	Prior to breeding season



8.4 Specific Management Objectives, Activities, Timing and Performance Criteria

Mitigation of significant impacts to any species or species group will occur using measures evaluated as being most likely to reduce impacts to an acceptable level. Measures include those presented in **Table 8.1** where they are found likely to be effective for the specific impact.

To assist with monitoring and timing, **Table 8.2** also summarises specific management objectives, activities, timing and performance criteria for the implementation of the mitigation and management activities outlined in this BBMP.



Table 8.2 Management Objectives, Activities, Timing and Performance Criteria

Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Responsibility	Completed (yes/no)
Pre-construction surveys	Obtaining pre-construction baseline bird and bat utilisation data	Pre-construction <ul style="list-style-type: none"> Bird survey Bat survey 	<ul style="list-style-type: none"> BUS undertaken as summarised in this BBMP - see Section 3.2 Bat surveys undertaken as summarised in this BBMP- see Section 3.2 	Ecologist	Yes (partially)
Mortality monitoring	Incidental carcass searches and records	Commissioning and operational phases – ongoing	<ul style="list-style-type: none"> All incidental carcass finds of birds and bats recorded 	Operational staff of wind farm	No
	Up to 24 turbines to be surveyed each month to 130 m radius, in accordance with the inner and outer zone search protocol. The same turbines will be searched each month for a period of two years.	Operational phase (once commissioning completed) monthly until the end of two years	<ul style="list-style-type: none"> Operational phase mortality surveys undertaken monthly at 24 turbines, for at least two years, with a review after the first year to determine if a change in methodology is required 	Ecologist	No
	Calculating annual mortality of birds and bats per turbine, based on monitoring activities. Mortality estimates should include correction factors from scavenger and detector efficiency trials. The need for further surveys will be reviewed based on the results of the first two years of monitoring	Commissioning and Operational phases, at the end of each year of mortality monitoring	<ul style="list-style-type: none"> Scavenger and detector efficiency trials (2 of each) undertaken within the first year of monitoring 	Ecologist	No



Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Responsibility	Completed (yes/no)
Annual Reports	Preparation of Annual BBMP Reports	Operational phases – within three months of the completion of carcass searches in years one and two, and each following year of operations	<ul style="list-style-type: none"> Annual reports for the first two years delivered within three months of completion of yearly monitoring Annual reports to include (but not be limited to) results of monitoring surveys for that year, any Impact Triggers or significant impacts identified, mitigation measures implemented, application of the decision-making framework and recommendations for the following year Estimates of mortality for birds and bats made after 2 full years of monitoring and reported in the second annual report Further annual reports to DAWE as required 	Project's Responsible Officer + Ecologist	No
Mitigation measures to reduce risk	Carrion removal program – subject to landowner agreement, stock and kangaroo carcasses should be removed from within 200 m of turbines on a monthly basis and disposed of appropriately	During commissioning and operational phases	<ul style="list-style-type: none"> Carcasses removed Activity recorded in dedicated register Increase frequency of stock and kangaroo carcass removal and disposal if required 	Project's Responsible Officer	No
	Subject to landowner agreement, stock should not be fed grain within 200 m of a turbine		No increase in bird mortality due to grain feeding		No
	Pest control program – Implement feral pig or other pest control if the carrion removal program suggests such pests are		Monitor effectiveness of feral pig or other pest control, and where bird mortality is clearly related		No



Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Responsibility	Completed (yes/no)
	an issue, (subject to landowner consultation)		to their numbers, increase the effectiveness of control		
Mitigation measures to reduce risk	Minimising external lighting when required. There should only be low levels of lighting on the Project area during operation, where allowed.	During commissioning and operational phases	If mortality at turbines near light sources significantly exceeds that of activity at unlit turbines, type and duration of lighting will need to be reviewed, subject to security and OH&S limitations	Project's Responsible Officer	No
	Avoid or minimise permanent lighting on the turbine entrance, buildings and sub-stations to avoid light spillage and visibility from above				



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Appendix A

Bird and bat species recorded across all surveys



Family	Scientific name	Common name	NC Act	EPBC Act
Birds				
Acanthizidae	<i>Acanthiza reguloides</i>	Buff-rumped thornbill	LC	
Acanthizidae	<i>Gerygone palpebrosa</i>	Fairy gerygone	LC	
Acanthizidae	<i>Sericornis magnirostra</i>	Large-billed scrubwren	LC	
Acanthizidae	<i>Smicronis brevirostris</i>	Weebill	LC	
Acanthizidae	<i>Gerygone olivacea</i>	White-throated gerygone	LC	
Acanthizidae	<i>Acanthiza nana</i>	Yellow thornbill	LC	
Accipitridae	<i>Milvus migrans</i>	Black kite	LC	
Accipitridae	<i>Accipiter fasciatus</i>	Brown goshawk	LC	
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared sparrowhawk	LC	
Accipitridae	<i>Accipiter novaehollandiae</i>	Grey goshawk	LC	
Accipitridae	<i>Aviceda subcristata</i>	Pacific baza	LC	
Accipitridae	<i>Aquila audax</i>	Wedge-tailed eagle	LC	
Accipitridae	<i>Haliastur sphenurus</i>	Whistling kite	LC	
Aegothelidae	<i>Aegotheles cristatus</i>	Australian owlet-nightjar	LC	
Alcedinidae	<i>Ceyx azureus</i>	Azure kingfisher	LC	
Anatidae	<i>Chenonetta jubata</i>	Australian wood duck	LC	
Anatidae	<i>Anas superciliosa</i>	Pacific black duck	LC	
Anatidae	<i>Dendrocygna eytoni</i>	Plumed whistling-duck	LC	
Apodidae	<i>Aerodramus terraereginae</i>	Australian swiftlet	LC	
Apodidae	<i>Apus pacificus</i>	Fork-tailed swift	SL	M
Apodidae	<i>Hirundapus caudacutus</i>	White-throated needletail	V	V
Ardeidae	<i>Bubulcus ibis</i>	Cattle egret	LC	
Ardeidae	<i>Ardea intermedia</i>	Intermediate egret	LC	
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced heron	LC	
Ardeidae	<i>Ardea pacifica</i>	White-necked heron	LC	
Artamidae	<i>Gymnorhina tibicen</i>	Australian magpie	LC	
Artamidae	<i>Cracticus torquatus</i>	Grey butcherbird	LC	
Artamidae	<i>Cracticus nigrogularis</i>	Pied butcherbird	LC	
Artamidae	<i>Strepera graculina</i>	Pied currawong	LC	



Family	Scientific name	Common name	NC Act	EPBC Act
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted woodswallow	LC	
Burhinidae	<i>Burhinus grallarius</i>	Bush stone-curlew	LC	
Cacatuidae	<i>Calyptorhynchus banksii</i>	Red-tailed black-cockatoo	LC	
Cacatuidae	<i>Cacatua galerita</i>	Sulphur-crested cockatoo	LC	
Campephagidae	<i>Coracina lineata</i>	Barred cuckoo-shrike	LC	
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike	LC	
Campephagidae	<i>Coracina tenuirostris</i>	Cicadabird	LC	
Campephagidae	<i>Lalage leucomela</i>	Varied triller	LC	
Campephagidae	<i>Coracina papuensis</i>	White-bellied cuckoo-shrike	LC	
Caprimulgidae	<i>Caprimulgus macrurus</i>	Large-tailed nightjar	LC	
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu	LC	
Charadriidae	<i>Vanellus miles</i>	Masked lapwing	LC	
Climacteridae	<i>Climacteris picumnis</i>	Brown tree creeper	LC	
Climacteridae	<i>Cormobates leucophaea</i>	White-throated tree-creeper	LC	
Columbidae	<i>Geopelia humeralis</i>	Bar-shouldered dove	LC	
Columbidae	<i>Macropygia amboinensis</i>	Brown cuckoo-dove	LC	
Columbidae	<i>Phaps chalcoptera</i>	Common bronzewing	LC	
Columbidae	<i>Ocyphaps lophotes</i>	Crested pigeon	LC	
Columbidae	<i>Geopelia striata</i>	Peaceful dove	LC	
Columbidae	<i>Geophaps scripta peninsulae</i>	Squatter pigeon (northern subspecies)	LC	
Columbidae	<i>Lopholaimus antarcticus</i>	Topknot pigeon	LC	
Coraciidae	<i>Eurystomus orientalis</i>	Dollarbird	LC	
Corvidae	<i>Corvus coronoides</i>	Australian raven	LC	
Corvidae	<i>Corvus orru</i>	Torresian crow	LC	
Cuculidae	<i>Chalcites osculans</i>	Black-eared cuckoo	LC	
Cuculidae	<i>Cacomantis variolosus</i>	Brush cuckoo	LC	
Cuculidae	<i>Scythrops novaehollandiae</i>	Channel-billed cuckoo	LC	
Cuculidae	<i>Eudynamys orientalis</i>	Eastern koel	LC	
Cuculidae	<i>Cacomantis flabelliformis</i>	Fan-tailed cuckoo	LC	



Family	Scientific name	Common name	NC Act	EPBC Act
Cuculidae	<i>Centropus phasianinus</i>	Pheasant coucal	LC	
Cuculidae	<i>Chalcites lucidus</i>	Shining bronze-cuckoo	LC	
Dicruridae	<i>Dicrurus bracteatus</i>	Spangled drongo	LC	
Estrildidae	<i>Neochmia temporalis</i>	Red-browed finch	LC	
Eurostopodidae	<i>Eurostopodus argus</i>	Spotted nightjar	LC	
Eurostopodidae	<i>Eurostopodus mystacalis</i>	White-throated nightjar	LC	
Falconidae	<i>Falco longipennis</i>	Australian hobby	LC	
Falconidae	<i>Falco berigora</i>	Brown falcon	LC	
Falconidae	<i>Falco cenchroides</i>	Nankeen kestrel	LC	
Falconidae	<i>Falco peregrinus</i>	Peregrine falcon	LC	
Halcyonidae	<i>Dacelo leachii</i>	Blue-winged kookaburra	LC	
Halcyonidae	<i>Tanysiptera sylvia</i>	Buff-breasted paradise kingfisher	LC	
Halcyonidae	<i>Todiramphus macleayii</i>	Forest kingfisher	LC	
Halcyonidae	<i>Dacelo novaeguineae</i>	Laughing kookaburra	LC	
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred kingfisher	LC	
Hirundinidae	<i>Petrochelidon nigricans</i>	Tree martin	LC	
Maluridae	<i>Malurus melanocephalus</i>	Red-backed fairy-wren	LC	
Megapodiidae	<i>Alectura lathami</i>	Australian brush turkey	LC	
Megapodiidae	<i>Megapodius reinwardt</i>	Orange-footed scrubfowl	LC	
Meliphagidae	<i>Cissomela pectoralis</i>	Banded honeyeater	LC	
Meliphagidae	<i>Melithreptus gularis</i>	Black-chinned honeyeater	LC	
Meliphagidae	<i>Entomyzon cyanotis</i>	Blue-faced honeyeater	LC	
Meliphagidae	<i>Bolemoreus frenatus</i>	Bridled honeyeater	LC	
Meliphagidae	<i>Lichmera indistincta</i>	Brown honeyeater	LC	
Meliphagidae	<i>Myzomela obscura</i>	Dusky honeyeater	LC	
Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	Eastern spinebill	LC	
Meliphagidae	<i>Ptilotula fusca</i>	Fuscous honeyeater	LC	
Meliphagidae	<i>Microptilotis gracilis</i>	Graceful honeyeater	LC	
Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's honeyeater	LC	
Meliphagidae	<i>Philemon citreogularis</i>	Little friarbird	LC	



Family	Scientific name	Common name	NC Act	EPBC Act
Meliphagidae	<i>Philemon corniculatus</i>	Noisy friarbird	LC	
Meliphagidae	<i>Manorina melanocephala</i>	Noisy miner	LC	
Meliphagidae	<i>Myzomela sanguinolenta</i>	Scarlet honeyeater	LC	
Meliphagidae	<i>Gavicalis virescens</i>	Singing honeater	LC	
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked honeyeater	LC	
Meliphagidae	<i>Melithreptus albogularis</i>	White-throated honeyeater	LC	
Meliphagidae	<i>Caligavis chrysops</i>	Yellow-faced honeyeater	LC	
Meliphagidae	<i>Manorina flavigula</i>	Yellow-throated miner	LC	
Meropidae	<i>Merops ornatus</i>	Rainbow bee-eater	LC	
Monarchidae	<i>Monarcha melanopsis</i>	Black-faced monarch	SL	M
Monarchidae	<i>Myiagra rubecula</i>	Leaden flycatcher	LC	
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	LC	
Monarchidae	<i>Myiagra inquieta</i>	Restless flycatcher	LC	
Monarchidae	<i>Myiagra cyanoleuca</i>	Satin flycatcher	SL	M
Monarchidae	<i>Monarchus trivirgatus</i>	Spectacled monarch	SL	M
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian pipit	LC	
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	LC	
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied sittella	LC	
Oriolidae	<i>Sphecotheres vieilloti</i>	Australasian figbird	LC	
Oriolidae	<i>Oriolus sagittatus</i>	Olive-backed oriole	LC	
Orthonychidae	<i>Orthonyx spaldingii</i>	Chowchilla	LC	
Pachycephalidae	<i>Pachycephala pectoralis</i>	Golden whistler	LC	
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey shrike-thrush	LC	
Pachycephalidae	<i>Colluricincla megarhyncha</i>	Little shrike-thrush	LC	
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous whistler	LC	
Paradisaeidae	<i>Ptiloris victoriae</i>	Victoria's riflebird	LC	
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted pardalote	LC	
Pardalotidae	<i>Pardalotus striatus</i>	Striated pardalote	LC	
Petroicidae	<i>Eopsaltria australis</i>	Eastern yellow robin	LC	
Petroicidae	<i>Heteromyias cinereifrons</i>	Grey-headed robin	LC	



Family	Scientific name	Common name	NC Act	EPBC Act
Petroicidae	<i>Microeca fascinans</i>	Jacky winter	LC	
Petroicidae	<i>Poecilodryas superciliosa</i>	White-browed robin	LC	
Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little pied cormorant	LC	
Podargidae	<i>Podargus strigoides</i>	Tawny frogmouth	LC	
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian grebe	LC	
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned babbler	LC	
Psittacidae	<i>Platycercus elegans</i>	Crimson rosella	LC	
Psittacidae	<i>Alisterus scapularis</i>	King parrot	LC	
Psittacidae	<i>Parvipsitta pusilla</i>	Little lorikeet	LC	
Psittacidae	<i>Platycercus adscitus</i>	Pale-headed rosella	LC	
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow lorikeet	LC	
Psittacidae	<i>Aprosmictus erythropterus</i>	Red-winged parrot	LC	
Psittacidae	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted lorikeet	LC	
Psophodidae	<i>Psophodes olivaceus</i>	Eastern whipbird	LC	
Ptilonorhynchidae	<i>Chlamydera nuchalis</i>	Greater bowerbird	LC	
Rallidae	<i>Gallinula tenebrosa</i>	Dusky moorhen	LC	
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey fantail	LC	
Rhipiduridae	<i>Rhipidura rufifrons</i>	Rufous fantail	SL	M
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie wagtail	LC	
Strigidae	<i>Ninox connivens</i>	Barking owl	LC	
Strigidae	<i>Ninox novaeseelandiae</i>	Southern boobook	LC	
Sturnidae	<i>Acridotheres tristis</i>	Common myna	I	
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked ibis	LC	
Timaliidae	<i>Zosterops lateralis</i>	Silvereye	LC	
Turdidae	<i>Zoothera lunulata</i>	Bassian thrush	LC	
Turnicidae	<i>Turnix varius</i>	Painted button-quail	LC	
Tytonidae	<i>Tyto novaehollandiae kimberli</i>	Masked owl (northern subspecies)	V	V
Bats				
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	LC	
Miniopteridae	<i>Miniopterus australis</i>	Little Bentwing Bat	LC	



Family	Scientific name	Common name	NC Act	EPBC Act
Miniopteridae	<i>Miniopterus orianae oceanensis</i>	Eastern Bentwing Bat	LC	
Molossidae	<i>Austronomus australis</i>	White-striped Mastiff Bat	LC	
Molossidae	<i>Ozimops ridei</i>	Eastern Freetail Bat	LC	
Molossidae	<i>Ozimops lumsdenae</i>	Northern Freetail Bat	LC	
Pteropodidae	<i>Pteropus scapulatus</i>	little red flying-fox	LC	
Pteropodidae	<i>Syconycteris australis</i>	common blossom bat	LC	
Rhinolophidae	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	LC	
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	LC	
Vespertilionidae	<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	LC	
Vespertilionidae	<i>Nyctophilus bifax</i>	Northern long-eared bat	LC	
Vespertilionidae	<i>Scotorepens sanborni</i>	Northern Broad-nosed Bat	LC	
Vespertilionidae	<i>Vespadelus pumilus</i>	Eastern Forest Bat	LC	



Appendix B

Incidental monitoring data form for targeted 'at-risk' species



Appendix C

Scavenger loss methodology

18 July 2021

1.0 Introduction

In order to accurately ascertain the mortality and injury rates associated with the Chalumbin Wind Farm Project, it is important to calculate the rate at which carcasses are removed by scavenger species through the development of a 'correction factor'. Scavengers may include ground-based animals, such as foxes, wild dogs, and rats (more likely to detect carcasses by scent), as well as aerial scavengers such as birds of prey, magpies and corvids (more likely to detect them visually). The scavenger trials described below are designed to ascertain the scavenging rate, usually expressed as the average carcass duration in the field.

Definitions

Below describes the definitions used for the purpose of defining the carcass condition of those used in the scavenger studies. Intact or partial carcasses and feather/fur spots will all be recorded as a 'find'. However, the scavenger correction factor will not be applied to fur and feather spots as these are most likely to represent the remains of carcasses after they have been scavenged.

- **Intact carcass:** Defined as a carcass that does not appear to have been scavenged by a vertebrate scavenger.
- **A partially eaten carcass:** Defined as any skeletal or flesh remains found. Feather spots for birds and fur spots for bats will be defined by their presence and the absence of any other remains (a feather spot being a cluster of five or more feathers).

2.0 Timing

Scavenger trials will be undertaken twice during the first year of monitoring, once during the wet season (November to March) and once in dry season (April to October) to account for different vegetation conditions. This will presumably result in surveys being conducted both when the grass is long and one when the grass is short. The two periods for scavenger trials are shown in the **Table 2.1**. Conducting two scavenger trials at seasonally different times is designed to account for occasional seasonal changes in carrion use by some scavenger species.

Table 2.1 Timing of surveys

Vegetation condition	Timing of survey
Short grass	Dry season
Long grass	Wet season

3.0 Methodology

Each scavenger trial will be undertaken by suitably trained personnel familiar the BBMP, site policies and procedures, and survey methods. The search area for scavenger trials will be limited to 70 metres from the base of the turbine and will be located at four of the randomly selected operating turbines that are searched on a regular basis.



To identify different scavenging rates, three categories of carcass will be used (**Table 3.1**) based on a measurement of bill-to-tail (B2T). Based on current mortality estimation requirements, every endeavour will be made to find all carcasses required for each category however the final number will depend on carcass availability. Where a suitable number of carcasses are unavailable, the results of previous studies from other wind farm projects may be substituted.

Micro-bats or small birds ¹	Medium sized birds ²	Large birds (Large raptor sized) ³
Up to 10	Up to 5	Up to 5

¹< 20 cm B2T; ²Between 21 cm and 60 cm B2T; ³>61 cm B2T

Up to twenty carcasses in total will be randomly placed under the selected turbines during each seasonal survey. An infrared camera trap will be placed within 5 m and pointed at the carcass. The carcass will be checked on day 5, then checked at random for a further 30 days. On day 30, or when the carcass has been scavenged, camera images will be downloaded and analysed to assess timing of scavenge and scavenger species.

Additional information on scavenger trials is provided below.

- The 30-day limit for the study is based on studies from other wind farms that have found all carcasses have been scavenged within ten days;
- As much as possible, a mix of carcass sizes and colourations will be obtained for use in the scavenger trials to minimise any bias;
- Latex gloves will always be worn while handling carcasses to minimise contact with human scent, which may alter predator responses around carrion and to minimise disease risk to the handler;
- Carcasses used in the trials will have their coordinates recorded to ensure that they are not confused with an actual fatality found under a turbine during the trial searches;
- Notes will be taken on the state of remaining carcasses in each search.



Appendix D

Detectability methodology

Detectability Studies Methodology

18 July 2021

1.0 Introduction

Searchers undertaking carcass monitoring will primarily rely on their visual senses to detect carcass locations, and the effectiveness of these searches will need to be calculated to provide a suitably reliable estimate of turbine impacts. Seasonal carcass detectability studies will be undertaken in conjunction with carcass scavenger studies in the first year to provide a reliable measure detectability.

2.0 Timing

Two seasonal search categories have been defined to account for seasonal variability such as grass length, one in the wet season (November to March) and one in dry season (April to October) as shown in **Table 2.1**.

Table 2.1 Timing of detectability studies

Vegetation condition	Timing of survey
Short grass	Dry season
Long grass	Wet season

3.0 Methodology

Only personnel who have carried out monthly carcass searches at the project area will be involved in the detectability (searcher efficiency) trials. These detection efficiency results (the percentage of carcasses detected) will then be incorporated into later analyses that derive mortality estimates. Carcasses used in the detectability study will be the same ones used in the Carcass Monitoring Study, and these studies will be undertaken in parallel.

To identify the different detectability of species, three categories of carcass will be used (Table 3.1) based on a measurement of bill-to-tail (B2T). Every endeavour will be made to find all carcasses required for each category however the final number will depend on carcass availability.

Table 3.1 Carcass requirements per season

Season	Micro-bats or small birds ¹	Medium sized birds ²	Large birds (Large raptor sized) ³
Wet season – Long grass / vegetated	Up to 10	Up to 5	Up to 5
Dry season – Short grass	Up to 10	Up to 5	Up to 5

¹< 20 cm B2T; ²Between 21 cm and 60 cm B2T; ³>61 cm B2T

Up to twenty carcasses in total will be randomly placed under four randomly selected turbines during each seasonal survey. The carcass controller (a person not involved in monthly carcass searches) will throw each carcass into the air and allow it to land on the ground to simulate at least some of the fall and the potential ruffling of fur and feathers. The carcass controller will note the placement of carcasses (via GPS) and is free to decide where and how



many are deployed under each turbine. However, all carcasses will be located within the inner 70 metre search zone.

Carcass searchers will then search for 30 minutes per turbine, with the total number of 'finds' recorded against the total number of distributed carcasses.

Additional information on scavenger trials is provided below:

- The carcass controller (a person not involved in monthly carcass searches) will throw each carcass into the air and allow it to land on the ground to simulate at least some of the fall and the potential ruffling of fur and feathers. The carcass controller will note the placement of carcasses (via GPS) and is free to decide where and how many are deployed under each turbine. However, all carcasses will be located within the inner 70 metre search zone.
- As much as possible, a mix of carcass sizes and colourations will be obtained for use in the scavenger trials to minimise any bias;
- Latex gloves will always be worn while handling carcasses to minimise contact with human scent, which may alter predator responses around carrion and to minimise disease risk to the handler;
- Carcasses used in the trials will have their coordinates recorded to ensure that they are not confused with an actual fatality found under a turbine during the trial searches.



Appendix E

Carcass search data sheet

Chalumbin Wind Farm - Bird and Bat Mortality Monitoring Program Carcass Search Data-Sheet

Guide to completing the form:

- One form should be completed per carcass find.
- Please fill out all details above the heavy line for each site searched.
- All details below the line are required if a carcass is found.
- Do not move a carcass until the details below have been completed.

Date:				
Start Time:				
Finish Time:				
Turbine Number:				
Wind direction and strength in preceding 24 hours:				
Any unusual weather conditions in last 48 hours?				
<hr/>				
Distance of Carcass from Tower (m):				
Bearing of Carcass from Tower (magnetic deg):				
Preliminary Species Identification:				
Photo Taken (Yes/No)				
Signs of injury:				
How old is carcass estimated to be (tick category)?	<24 hrs	1-3 Days	>3 Days	Other
Other Notes (i.e. sex/age of bird) and substrate:				

Post Find Actions:

- Place carcass in sealable plastic bag then wrap it in newspaper and into another plastic bag (with copy of this sheet within) and take to freezer at site office.
- Contact project ecologist to confirm identification of carcass