

# Biala Wind Farm

## First Annual Report on the Implementation of the Bird and Bat Adaptive Management Program

**Prepared for Newtricity Developments  
Biala Pty Ltd**

June 2022  
Report No. 17162.5 (8.2)



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# 1. Introduction

The Biala Wind Farm (BWF) is located 14.5 kilometres southwest of Crookwell and 8.5 kilometres east of Biala in the southern tablelands of New South Wales (NSW). Approval for the construction of the Biala Wind Farm was granted to Newtricity Developments Biala Property Ltd by the Department of Planning and Environment (DPE) on 12<sup>th</sup> April 2017 for a 31-turbine wind farm, subject to conditions.

Condition 21 (a) to (e) of consent schedule 3 of the NSW approval requires the preparation of a Bird and Bat Adaptive Management Program (BBAMP). The BBAMP was prepared to address all elements of the development consent schedule 3 Condition 21 and submitted for review by the Biodiversity, Conservation and Science Directorates (BCS) before finalisation and approval by the Secretary of the DPE.

Biala Wind Farm Pty Ltd engaged Nature Advisory (formerly Brett Lane and Associates) to implement the BBAMP. The specific objectives of this BBAMP, derived from the conditions of approval, are set out below.

- To implement a monitoring program to estimate the impact of the project on at-risk birds and bats that can reasonably be attributed to the operation of the project, including pre and post-construction (operational) phases data collection;
- To directly record impacts on birds and bats through carcass surveys;
- To document an agreed notification framework that identifies impact triggers requiring a management response, unacceptable impact thresholds and the kinds of management activities that should be considered;
- To detail mitigation measures and related implementation strategies to reduce impacts on birds and bats; and
- To identify matters to be addressed in periodic reports on the outcomes of monitoring, the application of the notification framework, mitigation measures and their success.

The strategy employed to ensure that any impact triggers and unacceptable impacts are detected includes the following:

- Pre-operational bird and bat utilisation surveys;
- Operational phase carcass searches under operating turbines;
- Operational bird and bat utilisation surveys;
- ‘At risk’ species monitoring;
- Statistical analysis of the results of carcass searches; and
- Reporting.

According to the BBAMP, the first two years of operation of the BWF will provide focused monitoring to inform impacts and mortality estimates on birds and bats at the wind farm. In addition, monitoring of ‘at risk’ species will also be undertaken to inform of ongoing risk from wind farm operations.

This document is the first annual report of activities undertaken at BWF. It focuses on presenting the results of the mortality searches, any management measures implemented and recommends refinements to monitoring activities. At the end of the second year of post-construction monitoring, a second annual report presenting a full analysis of all data collected under operation phase surveys will be completed. This will include Bird Utilisation Surveys (BUS), Bat surveys and monitoring ‘at-risk’ species including; Powerful Owl and Superb Parrot, in addition to bird and bat mortality impact assessments and estimates.

This first annual report includes the following sections:

**Section 2** provides the survey methods to determine the impact on birds and bats, and raptors detected at the site during the first year operational period.

**Section 3** provides results on the impact on birds and bats, and raptors detected at the site during the first year operational period.

**Section 4** discusses the first year of monitoring at Biala Wind Farm and provides recommendations.

This investigation was undertaken by a team from Nature Advisory comprising Kaitlyn Spooner (Zoologist), Nashieli Garcia Alaniz (Senior Zoologist), Grace Fieg (Zoologist), Phillip Allen (Zoologist), Gavin Thomas (Senior Zoologist), Michael Sebastian (Zoologist), Jackson Clerke (Zoologist and Project Manager) and Inga Kulik (Director).

## 2. Survey methods

This section outlines the methods for the first 12 months of the carcass search program implementation at BWF.

### 2.1. Carcass searches

The mortality detection program was implemented to determine the wind farm's impact on birds and bats at the site during the operational phase. Birds and bats are known to collide with operating turbines at wind farms and this program has been designed to monitor potential impacts provide procedures to determine whether any would be deemed as unacceptable under the BBAMP Section 6.

The results of the carcass search program will be used to estimate the overall impact BWF is having on birds and bats through direct mortality (Section 4.4.6 of the BBAMP). These estimates will be based on mortality observed during the 24-month survey period and correction detectability and scavenger rate trials.

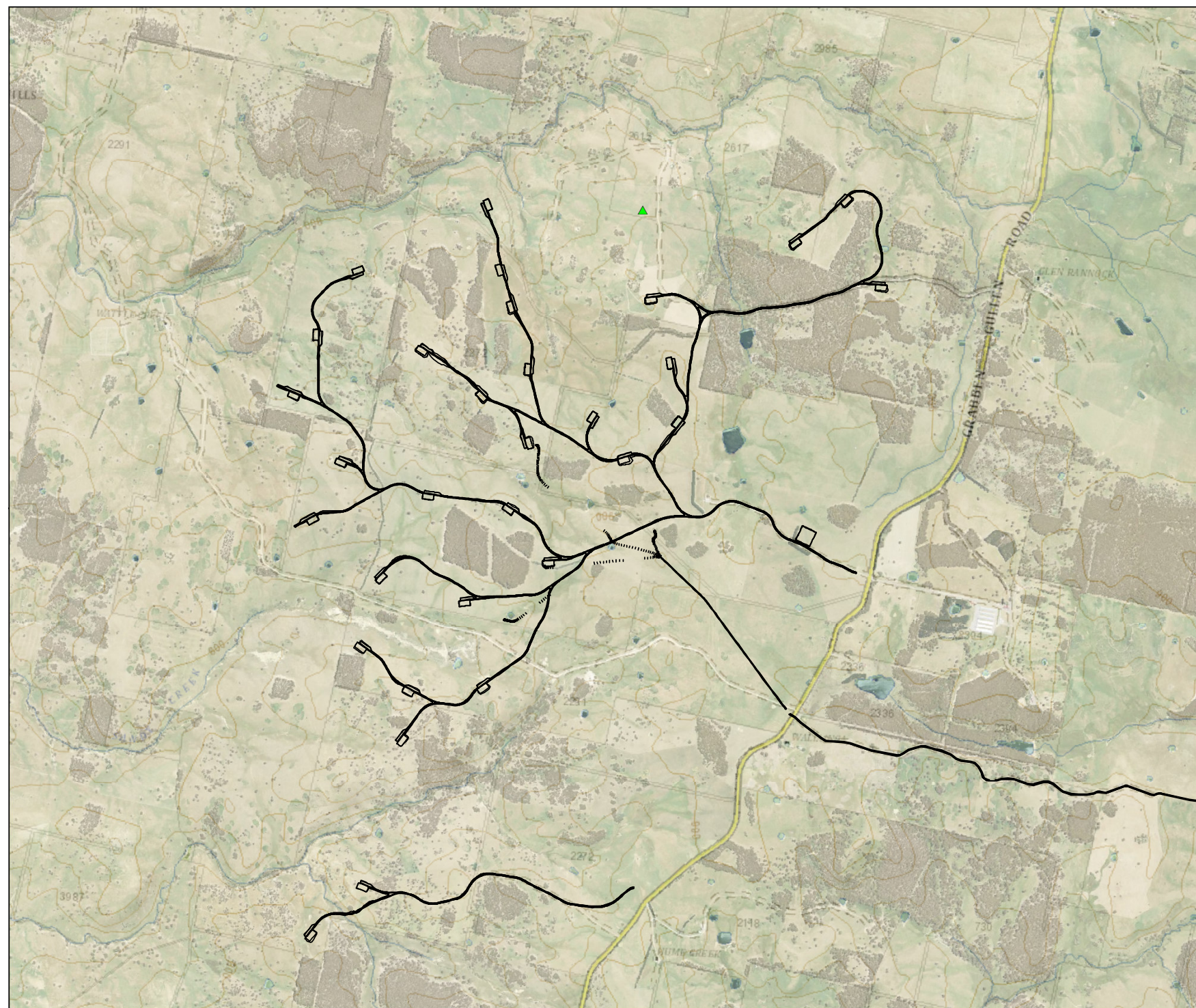
Monitoring at BWF began as 'Pre-operation phase' surveys in November 2020 and continued until February 2021, during which all turbines were searched prior to the majority of turbines being operational. The pre-construction phase was designed to capture any impacts that may have occurred as a result of turbines coming on line before the wind farm was fully operation. The formal mortality detection program at BWF commenced in March 2021 and this report covers a period of 12 months from March 2021 to April 2022. During the months of July and August 2021 searches did not take place due to Covid-19 lockdown restrictions.

As stated in the BBAMP plan, carcass searches are expected to be carried out for two years immediately following the erection of the turbines (i.e., once turbines are spinning). Carcass searches have required a staggered monitoring approach as some turbines began operating before others and not all were operating consistently during monitoring (see Section 3.1).

The mortality detection search during the first year was based on all the 31 turbines established at Biala Wind Farm (Figure 1), including (Northeast (T01-T06), Northwest (T07-T17), Central (T18 – T29) and Southwest (T30 – T31), comprising all the ridges of the wind farm.

Sections 4.4 of the BBAMP include a detailed description of the survey methodologies and protocols, and are summarised below.





### Figure 1: Layout of Biala Wind Farm

## Project: Biala Wind Farm

**Client:** Beijing Jingneng Clean Energy (Hong Kong) Co. Limited

**Date:** 13/03/2020


### Legend

- Development layout

▲ Met mast



Metres



0 250 500



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Turbines are initially searched to a radius of 120 metres once per month (where possible), followed by a 60-metre radius “pulse” search two to three days after the first search in the same month, to detect additional mortality of bats and birds. Pulse searches are undertaken from September to March.

All mortality detection searches were undertaken by trained and experienced zoologists from Nature Advisory. The methods for searches include:

- The inner zone: walking transects are spaced six meters apart and carried out up to 60- meters from the turbine tower; nearly all microbats and the majority of small to medium birds are expected to be found in this inner zone (Hull and Muir 2010); and
- The outer zone is between 60 and 120 metres of the turbine tower base to detect the medium and larger birds; walking transects are spaced 12 meters apart (Figure 2).

A mortality report (BBAMP Appendix 2) was completed when a dead bird or bat was detected under a turbine, and a photograph of the carcass was taken. When only feathers were seen, this was recorded as a feather spot. Feather spots are assumed to represent a bird that has collided with a turbine and was later scavenged.

On finding a dead bird, feather-spot or dead bat the searcher:

- Collected the information outlined in the mortality report;
- Removed it from the site to avoid re-counting; and
- Transferred fresh carcasses to a freezer at the site office for storage so they could be identified or identity verified and used later in observer efficiency and scavenger trials (see below).

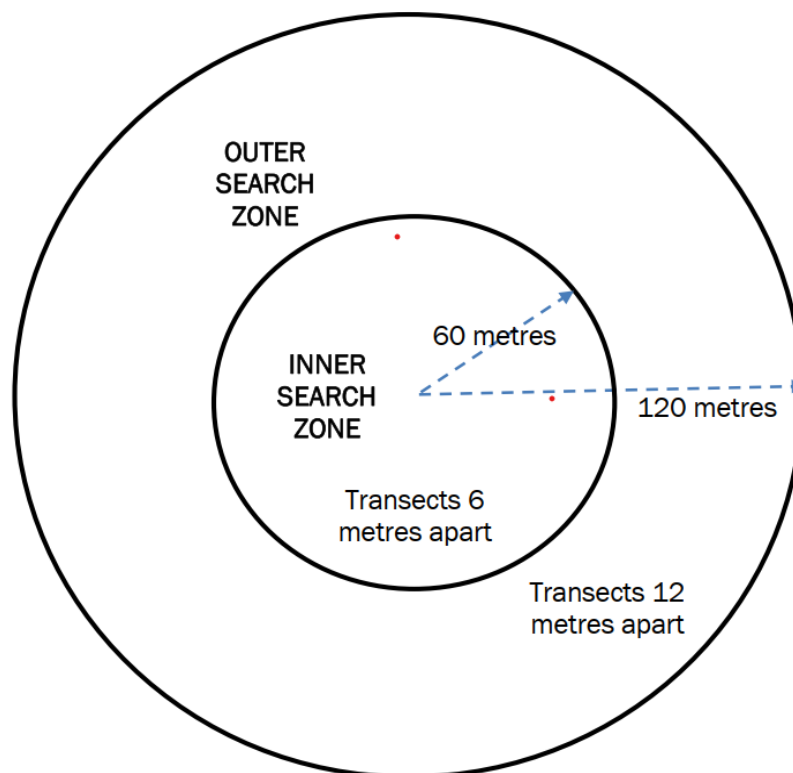


Figure 2: Inner and outer carcass search zones underneath the turbines.

An incidental record is a carcass found under a turbine outside of the formal mortality detection program (e.g. by wind farm personnel during routine inspections of infrastructure or turbine searches under a



turbine not selected for monthly searches). These are not included in mortality estimates to be undertaken at the completion of the 24-month monitoring program but are included in annual reporting.

## 2.2. Detectability (Observer) trials

Detectability trials are conducted to test the average rate that the trained searchers detect carcasses under wind turbines. It is not expected that searchers will find every carcass under turbines each monthly survey, given the difficulties of varying terrain and vegetation. As such, the results of the trial enable a correction factor to be applied to mortality estimates that accounts for carcasses that were potentially missed. A detailed description of the methodology is included in Section 4.4.4 of the BBAMP.

Detectability trials were supervised by a qualified ecologist ‘carcass controller’ and undertaken by searchers regularly conducting the carcass monitoring program. To account for observer variability in detecting carcasses, only personnel conducting monthly searches at BWF undertook the detectability trials. Detection efficiency (percentage of carcasses detected) will be incorporated into later analyses that derive mortality estimates.

Two efficiency trials were expected to be undertaken during the first 12 months of the monitoring program, however was unable to be reasonably achieved due to Covid 19 lockdowns and movement restrictions. This led to difficulty in moving Nature Advisory staff between the ACT and NSW, a lack of resources due to rolling staff illnesses and being unable to access BWF due to OHS policy. One trial has been undertaken to date and another is planned early in the next 12 months of monitoring. It is not expected that undertaking the trial during the second year of monitoring, as opposed to the first, will have any impact on this correction factor viability in mortality estimates.

During the trial that has been undertaken, ecologists who regularly undertake carcass searching at BWF had 20 carcasses each placed under turbines they searched without knowledge of locations. Each trial comprised ten bats and ten birds (Table 1) for each searcher. The detection of each carcass was recorded along with the carcass type, turbine number, and searcher.

Table 1: Number of carcasses employed in efficiency trails specifying vegetation condition

Searcher	Date	Turbine	No. of Birds	No. of Bats	Vegetation condition
Searcher 1	27/04/2022	19	2	3	Short to medium grass
	28/04/2022	12	2	3	Tall clumps of grass, raining during the search
		14	3	2	Short grass, raining during the search
	29/04/2022	7	3	2	Medium grass
Searcher 2	27/04/2022	20	2	3	Short to medium grass
	28/04/2022	9	2	3	Short grass, raining during the search
		11	3	2	Short grass, raining during the search
	29/04/2022	8	3	2	Short to medium grass

### 2.3. Scavenger trial

Scavenger trials are designed to ascertain the rate at which scavengers remove carcasses from under turbines at BWF. The result is used to develop a correction factor to account for the number of birds and bats carcasses that may be potentially removed by scavengers before searchers are able to find them during a given monthly search. Scavengers can include ground-dwelling animals, such as foxes and rats (more likely to detect carcasses by scent), and aerial scavengers such as birds of prey and Ravens (more likely to notice them visually).

Scavenger trials were expected to be undertaken twice during the first year of operational phase monitoring. Unfortunately, this could not be reasonably achieved during the first 12 months of monitoring at BWF. Again, due to Covid restrictions on movement of staff and rolling illnesses, undertaking the trials was necessarily delayed.. An additional problem for conducting scavenging trials has been acquiring sufficient fresh carcasses to monitor scavenging rates. The majority of carcasses found on site during surveys and have been decayed beyond appropriate use for trials and sourcing appropriate substitutes outside of the wind farm proved difficult, particularly during Covid lockdowns and restriction periods. This issue will be resolved by transporting fresh carcasses sourced from culling programs on invasive species, and mortalities from other wind farm sites, interstate to BWF to use as substitutes. Trials will be completed within the second 12 months of monitoring. It is not expected that this will impact the viability of the results as correction factors.

Section 4.4.3 of the BAMP details the methods for scavenger trials. The approach described in the BAMP places the carcass in the search area, and then an observer comes back regularly to check on whether the carcass has been scavenged. A modified and improved methodology has been adopted for the scavenger trials where a motion sensor camera is used to monitor scavenger activity. A camera will be attached to a tree, fence post or star picket approximately three to four metres away from each randomly placed carcass. The camera will record any scavenging activity in detail.

The carcass will then be left for 30 days, after which the camera will be collected, and scavenging activity reviewed. If the carcass remains on day 30, it will be recorded as not scavenged. The recorded information will capture the exact time and date and provide a photograph of which scavenger has taken the carcass. This method extends the method detailed in the BBAMP and will provide better quality information for the more detailed mortality analysis.

### 2.4. Raptor monitoring

Incidental monthly monitoring of raptor flights and breeding activity has been undertaken as raptors, particularly Wedge-tailed Eagle, have been identified in Section 4.1 of the BBAMP as 'at risk' at BWF.

The raptor monitoring was incorporated into the monthly mortality detection monitoring and aims to inform the ongoing level of risk to the local population to potential impacts.

Incidental reporting of all raptors observed is conducted across each field visit. Documentation of all raptor flights observed was plotted on a map. The following data was documented for each flight recorded during the monitoring program.

- Species;
- Number of birds
- Time first observed
- Time the bird/s flew out of sight or landed
- The location of the bird (either Air, perched or ground)
- Height of the bird when first observed

- The height range of the bird (minimum and maximum heights)
- The landscape the bird was observed in (either valley, slope or ridge)
- Flight behaviour (soaring, gliding, hovering, flapping, displaying, resting, mobbing, or foraging).



### 3. Results

In line with the approved BBAMP to ensure a valid dataset for statistical analysis, the mortality detection search was based on all 31 turbines at BWF. This report covers the first-year monitoring period from March 2021 to April 2022.

Mortality detection was planned to be undertaken at each turbine once every month following the methods formerly described. However, the sampling effort could not be carried out uniformly as the operation of turbines was not regular during the monitoring months from September 2021 to January 2022. Turbine operation during these months was inconsistent across all turbines due to the requirements for BWF to commission all turbines without exceeding AEMO's total export limit. This limit was equivalent to 10 turbines operating per month, with some minor overlap as selected turbines operating changed. The 10 turbines operating over the previous month leading up to the monthly search were searched as part of the monthly monitoring program.

Additional 'hold-point' testing conducted during February and March 2022 at some operating turbines meant that certain turbines could not be accessed during surveys as they could not be switched off (BWF OHS policy is that turbines can not be approached while operating).

This limitation was discussed with BCS and the staggered approach was agreed to continue until each turbine has been searched for a total of 24 monthly surveys each. At that time a baseline data set will be complete and analysed to generate mortality estimates for BWF. The staggered approach will not affect the viability of the mortality estimates and will be accounted for during analysis (Symbolix pers. comm .17/12/2022).

Table 2 details the number of times each turbine has been sampled during the 12 months of monitoring, including initial and pulse search sampling. For example, Turbine 11 has only been completely searched for five monthly surveys and so will require an addition seven to reach the first 12 months of monitoring. As stated above, each turbine will be searched a total of 24 times (plus corresponding pulse searches) at which time mortality estimates will be possible.

Table 2: Number of times each turbine has been sampled (initial and pulse search)

Turbine number	Number of searches completed		Remaining	
	Initial	Pulse	Initial	Pulse
1	6	2	6	4
2	9	3	3	3
3	7	3	5	3
4	9	4	3	2
5	11	4	1	2
6	9	2	3	4
7	10	6	2	0
8	9	4	3	2
9	6	3	6	3
10	12	3	0	3
11	5	1	7	5
12	8	1	4	5
13	8	1	4	5
14	9	3	3	3

Turbine number	Number of searches completed		Remaining	
	Initial	Pulse	Initial	Pulse
15	9	1	3	5
16	9	2	3	4
17	7	1	5	5
18	11	5	1	1
19	6	3	6	3
20	7	3	5	3
21	8	2	4	4
22	10	4	2	2
23	11	3	1	3
24	9	1	3	5
25	10	2	2	4
26	10	1	2	5
27	10	3	2	3
28	8	2	4	4
29	8	2	4	4
30	6	2	6	4
31	6	2	6	4

### 3.1. Carcass searches

A total of 74 bird and bat remains, comprising 22 bird carcasses, 17 feather spots, and 35 bat carcasses, were recorded beneath turbines at BWF during the 12-month monitoring period. Results of bird and bat mortality detection are summarised in Table 3

Table 3: Bird and bat mortality detection at BWF during the 12-month monitoring period

Season	Bird	Feather Spot	Bat	Total per season
Winter	6	0	0	6
Spring	9	0	1	10
Summer	6	6	15	27
Autumn	1	11	19	31
<b>Total per group</b>	<b>22</b>	<b>17</b>	<b>35</b>	<b>74</b>

#### 3.1.1. Bird mortality

A total of 39 bird strikes were recorded within the BWF site during the 12-month monitoring. A total of 11 different species were detected, and two remains were not possible to identify the species due to the decomposed state. Detected bird mortality at Biala Wind Farm is summarised in Table 5 below, with species listed in ranked order of the number of carcasses found. Detailed information on each bird carcass and feather spot recorded during the monitoring period can be found in Appendix 1: Bird mortality data obtained during the first 12 months of monitoring.

Table 4: Bird mortality recorded at Biala Wind Farm during the first-year monitoring period.

Species	Carcass	Feather spot	Incidentals	Total per species
Crimson Rosella	–	10	–	10
Australian Magpie	9	2	–	11
Brown Goshawk	3	–	–	3
Black-shouldered kite	2	–	–	2
Nankeen kestrel	2	–	–	2
Sulphur Crested Cockatoo	1	3	–	4
Unidentified bird sp.	1	1	–	2
Australian Wood Duck	1	–	–	1
Laughing Kookaburra	1	–	–	1
Little Pied Cormorant	1	–	–	1
Common Starling	1	–	–	1
Australian Ibis	0	1	–	1
<b>Total</b>	<b>22</b>	<b>17</b>	<b>–</b>	<b>39</b>

### 3.1.2. Bat mortality

A total of 35 bat strikes were recorded within the BWF site during the 12-month monitoring. Bat mortality primarily occurred during summer and autumn. Seven different species were detected, and two remains of microbats were not possible to identify to species level due to the decomposed and damaged state of remains. Detected bat mortality at BWF is summarised in Table 5 below, with species listed in ranked order of the number of carcasses found. Detailed information on each bat carcass recorded during the monitoring period can be found in Appendix 2.

Table 5: Bat mortality detection at Biala Wind Farm during the first-year monitoring period.

Species	Carcass	Incidentals	Total per species
White striped Freetail bat	16	2	18
Gould Wattled Bat	3	–	3
Large Forest bat	3	–	3
Southern Forest Bat	3	1	4
Unidentified microbat	3	–	3
Little Red Flying Fox	2	–	2
Chocolate Wattled Bat	1	–	1
Little Forest Bat	1	–	1
<b>Total</b>	<b>32</b>	<b>3</b>	<b>35</b>

### 3.1.3. Impact trigger summary

One non-threatened species trigger was detected during the monitoring program to date, which is defined under the BBAMP Section 6.2 as:

*“Impact Trigger for Non-threatened Species: The trigger is defined as a total of four or more bird or bat carcasses, or parts thereof, of the same species in two successive searches at*



*the same or adjacent turbine(s) of a non-threatened species (excluding species mentioned above)."*

BCS was notified of the trigger on the 23<sup>rd</sup> June 2021. The non-threatened impact trigger occurred as three Crimson Rosella carcasses were found under turbine 13 and one Crimson Rosella carcass was found under turbine 14, immediately adjacent to turbine 13 during April and May 2021.

The procedure for a trigger outlined in Section 6 of the BBAMP was followed and a desktop investigation was undertaken (Nature Advisory 2021b). The investigation concluded that while there is a possibility that further Crimson Rosella fatalities will occur at Biala Wind Farm given the species successful breeding rates and a stable population, such fatalities are unlikely to have a significant impact on the species at a local, regional or national scale, and it is considered that this trigger is likely to be a one-off event. No additional actions were recommended.

No threatened species were recorded during mortality searches at BWF.

#### 3.1.4. Incidental Powerful Owl find

During further surveys on site for Superb Parrot and Powerful Owl suitable hollow investigations, a deceased Powerful Owl was detected in woodland approximately 360 metres from turbine Turbine 1 on the 15<sup>th</sup> October 2021. BCS was notified of find, however the find is not considered a turbine related mortality, given the distance from turbines.

Superb Parrot and Powerful Owl surveys will be reported on in the second annual report, as per the BBAMP.

### 3.2. Detectability trials

One detectability trial was undertaken during the first year (April 2022) by one ecologists who regularly performed carcass searching at BWF. Results showed that 80% of birds and 80% of bats were detected (Table 6). Additional detectability trials will be undertaken in the second year of monitoring.

Table 6: Efficiency trial undertaken at BWF indicating the percentage of birds and bats detected.

Searcher	Birds	Bats	Total
Searcher	80%	80%	80%

### 3.3. Scavenging trials

The scavenger trial scheduled for short grass during cold weather is being currently undertaken, and results will be presented in the next annual report. The second scavenger trial of year one is planned to be carried out in early spring (September) to finish this first sampling cycle on each vegetation condition and obtain the correction factor.

### 3.4. Raptor monitoring

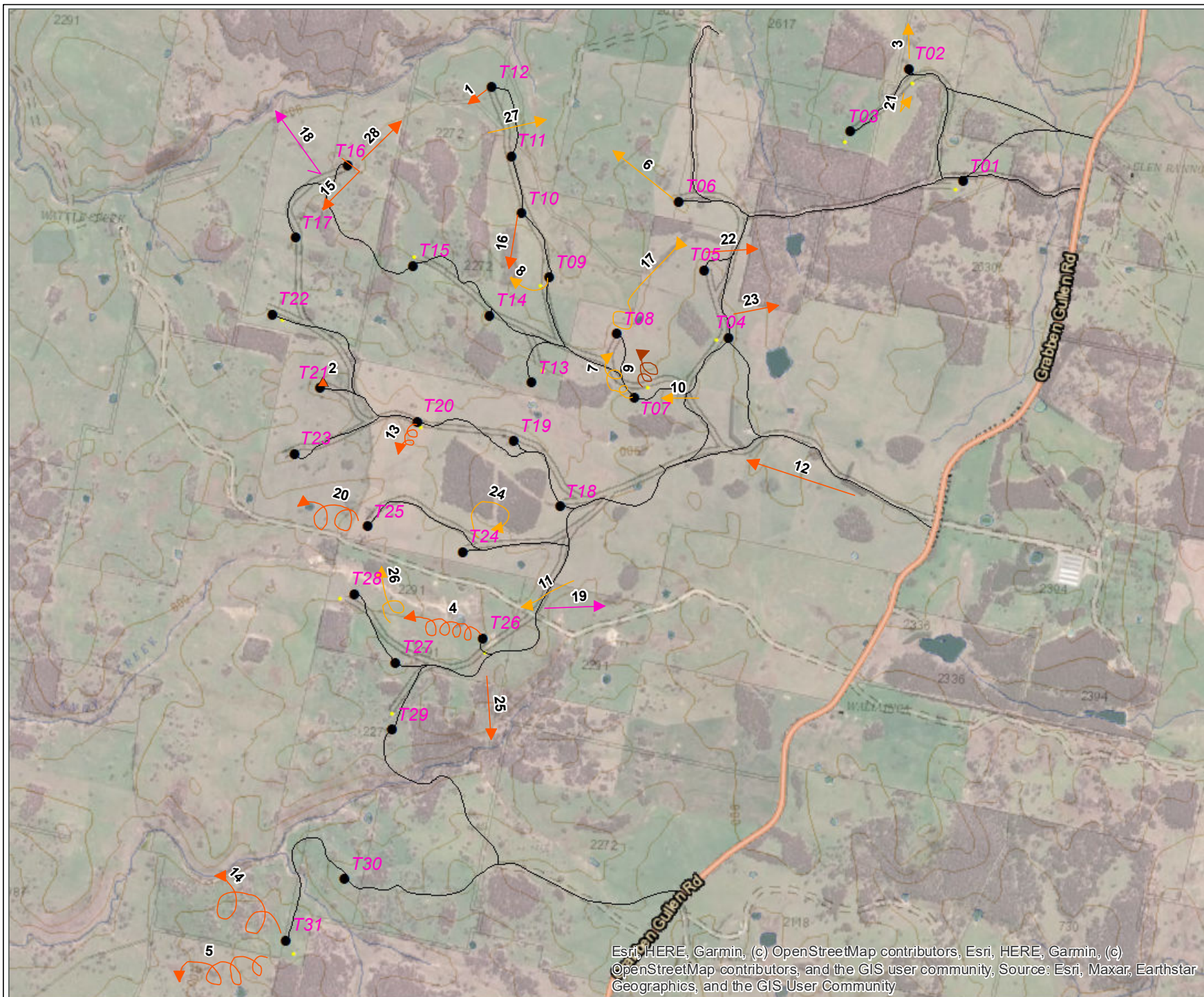
Four raptor species have been observed flying at the BWF site during the first-year monitoring period (Table 7). Twenty-five movements from 29 individuals were recorded, and flight paths have been plotted and presented in Figure 2. Detailed information on each raptor observation is presented in Appendix 3: Raptor observation during the first 12 months of monitoring

Table 7: Summary of raptor flight observed at Biala Wind Farm during the first-year monitoring period

Species	Number of individuals
Black-shouldered Kite	3
Brown Falcon	1
Nankeen Kestrel	9
Wedge-tailed Eagle	12
Total	25

The Wedge-tailed Eagle, Nankeen Kestrel and Black-shouldered Kite were the three most abundant raptor species recorded at BWF. Brown Falcon was observed on one occasion. Wedge-tailed Eagle was most commonly observed flying at rotor swept area (RSA) height (above 40 metres), which would increase its likelihood of collision with turbines. Nankeen Kestrel and Black-shouldered Kite were more often seen below RSA height.

No breeding activity was observed during incidental surveys for any raptor species.



**Figure 3: Raptor flight paths at Biala WF during the first-year monitoring period**

**Project:** Biala Wind Farm  
**Client:** Beijing Jingneng Clean Energy (Hong Kong) Co. Limited  
**Date:** 16/06/2022

- Proposed access track
- Proposed turbines
- Black-shouldered Kite
- Brown Falcon
- Nankeen Kestrel
- Wedge-tailed Eagle
- Perched**
- ▲ Wedge-tailed Eagle

N

Metres

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## 4. Discussion and recommendations

The highest impacts on birds at BWF to date have occurred for Crimson Rosella, Sulphur Crested Cockatoo and Australia Magpie. An impact trigger was also recorded for Crimson Rosella. Each is a very common and widespread species adapted to farmland environments in NSW. None have had populations quantified but all are considered as 'least concern' in terms of their threatened status (BirdLife International 2022). Sulphur Crested Cockatoo and Australian Magpie population trends are thought to be decreasing while Crimson Rosella is increasing (BirdLife International 2022). It is not expected that any direct impacts detected on the species identified from BWF would affect the viability of the population in the bioregion (south-eastern highlands) at this stage.

There have been seven reported raptor collisions in total at BWF including Nankeen Kestrel and Black-shouldered kite. In addition, monitoring of raptors reported Wedge-tailed Eagle twelve times with flight height within RSA height of BWF turbines, indicating regular at-risk behaviour. However, no carcasses of this species have been detected during carcass searches to date. Raptor mitigation measures outlined in Section 5.1 should continue.

For bats; the highest impacts were detected for White-striped Freetail Bat, Southern and Large Forest Bats and Gould's Wattled Bats. Several studies (Symbolix 2020, Moloney *et al.* 2019, Smales 2012) have identified these species as being particularly commonly impacted by wind farm operation and being over-represented in mortality data across several wind farms. Observations by Nature Advisory (unpublished data) at various wind farms in other parts of these species' range are consistent with these findings. This is related to the foraging habits of these species, as they will fly many times the height of the tree canopy in pursuit of high-flying insects (O'Neill and Taylor 1986, Hull and Cawthen 2012), which brings them into RSA of turbines.

Currently, population estimates for these species are not available, and neither are population estimates for microbats more generally. Since each is accepted as being common and widespread (Churchill 2008, Museum Victoria Staff 2016), it seems unlikely that impact detected to date at BWF would affect the viability of the population in the bioregion at this stage. Impacts will likely continue during the warmer months of the year.

### 4.1. Recommendations

There are no changes proposed for the monitoring program.

The monitoring program under BWF BBAMP will continue until all turbines have been searched for a 24-month period with corresponding pulse searches (Oct-March).

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## Appendix 1: Bird mortality data obtained during the first 12 months of monitoring

Date	Common Name	Scientific Name	Carcass type	Threatened Status	Turbine number	Distance from turbine (m)	Bearing from the turbine (°)	Notes
24/03/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	19	116	126	>3 days, end of the wing
24/03/2021	Australian Magpie	<i>Gymnorhina tibicen</i>	Bird	NA	19	116	126	>3 days, end of the wing
27/03/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	25	48	165	Scattered primary feathers and some body feathers >3days
27/03/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	25	48	165	Scattered primary feathers and some body feathers >3days
27/04/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	13	24	140	colouring and size indicate crimson rosella, >3days
27/04/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	14	110	250	colouring and size indicate crimson rosella, >3days
24/05/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	11	88	120	Colouring indicate juvenile CR
25/05/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	13	69	100	colouring and size indicate crimson rosella
25/05/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	13	99	25	Most likely same feathers spread out by strong winds
26/05/2021	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	NA	25	56	180	>3 days
27/05/2021	Australian Magpie	<i>Cracticus tibicen</i>	Feather Spot	NA	25	44	0	>3 days
23/06/2021	Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	Bird	NA	6	60	180	Black back and top of wings, white belly, webbed feet <70cm in size, Headless
27/09/2021	Laughing Kookaburra	<i>Dacelo novaeguinea</i>	Bird	NA	18	8	150	>3 days, adult.
18/10/2021	Black-shouldered kite	<i>Elanus axillaris</i>	Bird	NA	7	78	45	>3 days, adult.
18/10/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	14	42	100	Only one wing is remaining.
19/10/2021	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	22	59	310	Only one wing is remaining.
19/10/2021	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Bird	NA	16	33	100	Only feathers and a few bone remnants remain.
20/10/2021	Nankeen kestrel	<i>Falco cenchroides</i>	Bird	NA	7	42	155	>3 days old; head, wings, and one leg remaining.
16/11/2021	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	NA	16	65	215	Very old and scavenged. Parts of wings, tail feathers, ad feet are remaining. Barred primaries.
17/11/2021	Australian Wood Duck	<i>Chenonetta jubata</i>	Bird	NA	7	66	40	Only one wing is remaining. Wing in good condition.
18/11/2021	Nankeen Kestrel	<i>Falco cenchroides</i>	Bird	NA	8	96	200	Only a few feathers and parts of the body remain.
14/12/2021	Unidentified bird spp.	NA	Feather Spot	NA	14	50	90	A small clump of small brown feathers, including small flight feathers.
15/12/2021	Magpie	<i>Cracticus tibicen</i>	Bird	NA	16	71	140	Some bones, end of wing with feathers attached.
16/12/2021	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	13	34	90	A clump of long flight/tail feathers. Not collected.
19/01/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	9	25	225	Bearing estimated (SW recorded). Ribcage and wings remain.
19/01/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	NA	9	33	130	Bearing estimated (SE recorded). 20+ feathers
19/01/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	9	36	335	One leg and some tail feathers remaining.
19/01/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	25	60	90	Several wing feathers are attached.
22/02/2022	Australian Ibis	<i>Threskiornis moluccus</i>	Feather Spot	NA	2	27	105	5-6 grey and white down feathers.
23/02/2022	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	NA	7	40	310	Very old and scavenged, >3 days. A few inner feathers and bones are remaining.
23/02/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	9	2	5	Magpie head. Old. Scattered feathers around.
23/02/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	NA	9	48	35	More than ten feathers.
25/02/2022	Unidentified bird sp.	NA	Bird	NA	22		240	Just one blue, green and grey wing.
29/03/2022	Brown Goshawk	<i>Accipiter fasciatus</i>	Bird	NA	7	32	10	About 20 wing feathers and part of the body remain. Old
6/04/2022	Australian Magpie	<i>Cracticus tibicen</i>	Bird	NA	23	55	260	1-3 days old. Partially decomposed/scavenged.
7/04/2022	Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Feather Spot	NA	2	59	290	20 + feathers.
27/04/2022	Crimson Rosella	<i>Platycercus elegans</i>	Feather Spot	NA	25	52	NA	20-30 wing and inner feathers.
28/04/2022	Black-shouldered kite	<i>Elanus axillaris</i>	Bird	NA	10	24	250	Wings and legs are remaining.
28/04/2022	Common Starling	<i>Sturnus vulgaris</i>	Bird	NA	12	54	230	Mostly intact, 1-3 days old. It was raining at the time of collection.

## Appendix 2: Bat mortality data obtained during the first 12 months of monitoring

Date	Common Name	Scientific Name	Threatened Status	Turbine number	Distance from the turbine (m)	Bearing from the turbine (°)	Notes
24/03/2021	Little Red Flying Fox	<i>Pteropus scapulatu</i>	NA	28	118	310	Heavily scavenged, ribcage back, forearm splintered >3days
24/03/2021	Little Red Flying Fox	<i>Pteropus scapulatu</i>	NA	28	118	310	Heavily scavenged, ribcage back, forearm splintered >3days
24/03/2021	White-striped Free tail bat	<i>Tadarida australis</i>	NA	24	95	258	
25/03/2021	Goulds Wattled Bat	<i>Chalinolo busgouldii</i>	NA	6	48	230	Heavily decomposed, most fur missing
25/03/2021	Goulds Wattled Bat	<i>Chalinolo busgouldii</i>	NA	6	48	230	Heavily decomposed, most fur missing
25/03/2021	White-striped Free tail bat	<i>Tadarida australis</i>	NA	24	95	258	
26/03/2021	Large Forest bat	<i>Vespadelus darlingtoni</i>	NA	15	35	120	no signs of trauma
26/03/2021	Large Forest bat	<i>Vespadelus darlingtoni</i>	NA	15	35	120	no signs of trauma
29/03/2021	White-striped Free tail bat	<i>Tadarida australis</i>	NA	8	29	120	intact <24hours
29/03/2021	White-striped Free tail bat	<i>Tadarida australis</i>	NA	8	29	120	intact <24hours
19/10/2021	Microbat	<i>Unidentified</i>	NA	16	58	185	Very old; too deteriorated to identify species. Forearm length 36 mm.
16/12/2021	Large Forest bat	<i>Vespadelus darlingtoni</i>	NA	10	23	130	Adult, <24 hours since death
20/01/2022	White-striped Freetail bat	<i>Tadarida australis</i>	NA	8	13	30	Intact, fresh. Free-tail.
21/01/2022	White-striped Freetail bat	<i>Tadarida australis</i>	NA	8	18	260	Intact. 1-2 days old.
21/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	19	38	50	Intact. Fresh.
22/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	1	10	130	Old, > 3 days
22/02/2022	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	NA	1	14	230	Tiny microbat. > 1 day old. FA 34
22/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	2	37	200	Fresh, < 1 day old.
22/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	2	8	130	Fresh, < 1 day old.
22/02/2022	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	NA	2	24	285	Fresh. FA 36.
22/02/2022	Little Forest Bat	<i>Vespadelus vulturnus</i>	NA	2	21	330	Fresh. FA 33.
22/02/2022	Southern Forest Bat	<i>Vespadelus regulus</i>	NA	7	11	160	Old, > 1 day. Chocolate brown fur on back. FA 34.
24/02/2022	Southern Forest Bat	<i>Vespadelus regulus</i>	NA	31	14	310	FA 31 mm.
24/02/2022	Unidentified microbat	NA	NA	14	95	110	FA: 45mm
25/02/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	22		131	
25/02/2022	Evening bat species	<i>Vespertilionidae</i> sp	NA	17	55	165	Very old, > 3 days. Part of one wing and part of body remaining. No head. FA indistinguishable
5/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	27	2	190	Fresh, intact. <1 day old.
5/04/2022	Southern Forest Bat?	<i>Vespadelus regulus</i>		28	8	105	FA 35mm. > 1 day old.
5/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	1	48	220	>3 days old. Found and reported by wind farm staff.
6/04/2022	Southern Forest Bat?	<i>Vespadelus regulus</i>	NA	22	4	150	FA 35. Found and reported by wind farm staff.
6/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	22	4	150	1 day old. Found and reported by wind farm staff.
6/04/2022	White-striped Free tail bat	<i>Tadarida australis</i>	NA	29	18	140	Fresh, <1 day old, intact
27/04/2022	White-striped Freetail Bat	<i>Tadarida australis</i>	NA	20	48	160	Fresh, intact.
28/04/2022	White-striped Freetail bat	<i>Tadarida australis</i>	NA	15	23	0	No sign of injury. <1 day old.
28/04/2022	White-striped Freetail Bat	<i>Tadarida australis</i>	NA	9	0	210	Inside the fence enclosing the base of the turbine.



## Appendix 3: Raptor observation during the first 12 months of monitoring

Date	Species	Species count	Start time	End time	Location	Height	Height range of bird	Habitat flew over	Behaviour
26/04/2021	Wedge-tailed Eagle	2	12:05	12:10	Air	200	100 - 200	Cleared	Soaring and powered flight (flapping)
30/04/2021	Wedge-tailed Eagle	1	7:30	7:37	Perched	10	10	Cleared	
26/05/2021	Nankeen Kestrel	1	8:45	8:47	Perched and Air	2		Cleared/woodland	Perching and powered flight (flapping)
26/05/2021	Wedge-tailed Eagle	1	12:30	12:35	Air	100	100 - 200	Cleared/woodland	Soaring and powered flight (flapping)
27/05/2021	Wedge-tailed Eagle	1	10:40	10:45	Air	50	50 - 100	Woodland and cleared	Soaring and feeding
23/06/2021	Nankeen Kestrel	1	10:54	10:56	Air	50	40 - 50	Gully	Soaring and hovering
23/06/2021	Nankeen Kestrel	1	12:30	12:35	Air	30	30 - 40	Cleared	Hovering and diving
20/10/2021	Nankeen Kestrel	1	12:10	12:12	Air	25	15-25	Cleared	Powered flight and hovering
20/10/2021	Brown Falcon	1	16:30	16:33	Air	30	5-30	Cleared	Soaring
17/11/2021	Nankeen Kestrel	1	10:50	10:55	Perched and Air	20	15-25	Cleared	Powered flight and perching
18/11/2021	Nankeen Kestrel	1	13:07	13:08	Air	25	20-30	Cleared	Powered flight and gliding
14/12/2021	Wedge-tailed Eagle	1	10:37	10:38	Air	60	50-70	Cleared	Soaring, Powered Flight
20/01/2022	Wedge-tailed Eagle	2	15:50	15:53	Air	70	40-70	Cleared	Soaring
24/02/2022	Wedge-tailed Eagle	1	10:49	10:53	Air	150	150	Ridge	Soaring
25/02/2022	Wedge-tailed Eagle	1	11:00	11:01	Air	70	40-70	Cleared, woodland	Powered flight and soaring
31/03/2022	Wedge-tailed Eagle	1	12:38	12:40	Air	50	30-70		Gliding
31/03/2022	Nankeen Kestrel	1	15:25	15:26	Air	30	20-30	Cleared	Hovering, powered flight
6/04/2022	Black-shouldered Kite	1	9:19	9:20	Perched and Air	40	10-40	Cleared.	Gliding, Perching, Eating
6/04/2022	Black-shouldered Kite	2	13:58	14:01	Air	10	0 - 30	Cleared	Hovering, powered flight, and hunting
6/04/2022	Wedge-tailed Eagle	2	16:07	16:09	Air	150	100-200		Soaring
7/04/2022	Nankeen Kestrel	1	11:05	11:12	Perched and Air	12	12 - 15	Woodland	Perching, powered flight
7/04/2022	Wedge-tailed Eagle	2	14:05	14:06	Air	13	13-18	Woodland	Powered flight
8/04/2022	Wedge-tailed Eagle	1	12:27	12:27	Air	15	15-30	Woodlands	Gliding, perching
28/04/2022	Nankeen Kestrel	1	12:48	12:52	Air	40	30 - 60	Cleared	Powered flight and hovering.