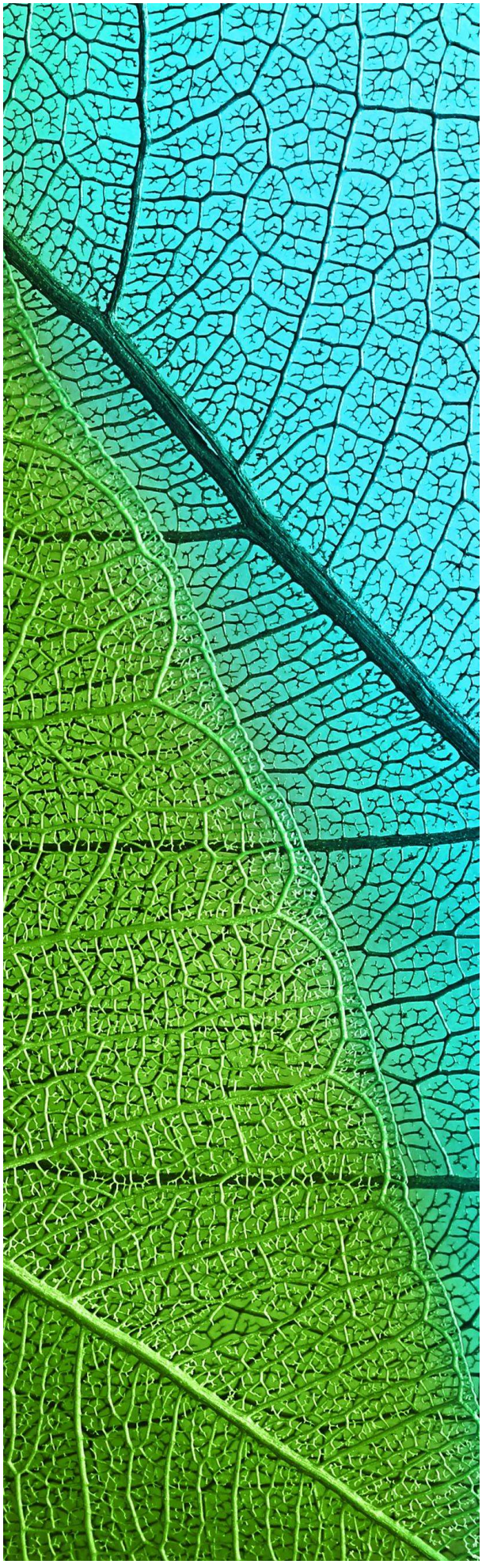

Flyers Creek Wind Farm

Bird and Bat Adaptive Management Program

Prepared for Flyers Creek Wind Farm Pty Ltd

July 2025
Report No. 18090 (4.7)

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1. Introduction

1.1. Background

The Flyers Creek Wind Farm (FCWF) is located approximately 20 kilometres (km) south of Orange and approximately four km south of the village of Forest Reef in the Blayney Shire local government area, in the central table lands of New South Wales (Figure 1). Project Approval was granted on 14 March 2014 (MP_0252) and there have been four subsequent planning modifications approved.

The FCWF approval is for up to 38 wind turbines with a maximum tip height of 160m, access tracks, power lines and all associated infrastructure. Approved wind turbine dimensions are a maximum tip height of 160m, rotor diameter of up to 140m and a minimum lower tip height of 20m above the ground.

Project Approval Condition D4 requires the preparation of a Bird and Bat Adaptive Management Program (BBAMP). This BBAMP has been prepared to address Condition D4. An initial draft was submitted for review to the Biodiversity and Conservation Division (BCD) of the Department of Planning, Industry and Environment (DPIE) (formerly Office of Environment and Heritage (OEH)) that addressed the comments from North-west Division of BCD dated 17 December 2019 as attached in Appendix 1. Version 4.6 was subsequently approved by the Secretary of the Department of Planning, Industry and Environment (DPIE) on the 14th of February 2020.

This Revision 4.7 includes minor updates to include details of planning modifications to the project and a review of monitoring and management measures in accordance with Schedule E Condition E11.

1.2. Requirements of BBAMP

The specific requirements of the BBAMP from the project approval are presented in the compliance table below, together with how this plan responds to these requirements.

Table 1: Project Approval, Condition D4 Compliance Table

D4. Prior to the commencement of operation, the Proponent shall, in consultation with the OEH, prepare and submit for the approval of the Secretary a **Bird and Bat Adaptive Management Program**, which takes into account bird / bat monitoring methods identified in the current editions of AusWEA *Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia* and *Wind Farm and Birds: Interim Standards for Risk Assessment*. The Program shall be prepared and implemented by a suitably qualified expert, approved by the Secretary. The Program shall incorporate Monitoring, and a Decision Matrix that clearly sets out how the Proponent will respond to the outcomes of monitoring. It shall:	
(a) *incorporate an ongoing role for the suitably qualified expert;*	Section 4.5 (see letter in Appendix 2)
(b) *set out monitoring requirements in order to assess the impact of the Project on bird and bat populations, including details on survey locations, parameters to be measured, frequency of surveys and analyses and reporting. The monitoring program shall be capable of detecting any changes to the population of birds and / or bats that can reasonably be attributed to the operation of the Project, that*	Section 2, 3, 4.2, 4.3, 4.4

is, data may be required to be collected prior to the commencement of operation;	
(c) *incorporate a decision-making framework that sets out specific actions and when they may be required to be implemented to reduce any impacts on bird and bat populations that have been identified as a result of the monitoring;*	Section 6
(d) *identify 'at risk' bird and bat groups (inclusive of the Superb Parrot), seasons, and/or areas within the Project site which may attract high levels of mortality and include monthly mortality assessments and periodic local population census' and bird utilisation surveys;*	Section 3
(e) *identify potential mitigation measures and implementation strategies in order to reduce impacts on birds and bats such as minimising the availability of raptor perches, swift carcass removal, pest control including rabbits, use of deterrents, and sector management including switching off turbines that are predicted to or have had an unacceptable impact on bird / bat mortality at certain times; and*	Section 5
(f) *identify matters to be addressed in periodic* ***reports*** *in relation to the outcomes of monitoring, the application of the decision-making framework, the mitigation measures identified, progress with the implementation of such measures, and their success.*	Section 4.7
The Reports referred to under part (f) shall be submitted to the Secretary and OEH (now BCD) *on an annual basis for the first five years of operation and every two years thereafter (unless otherwise agreed to by the Secretary), and shall be prepared within two months of the end of the reporting period. The Secretary may, at the request of the Proponent at anytime, vary the reporting requirement or period by notice in writing to the Proponent.* *The Proponent is required to implement feasible and reasonable mitigation measures as identified under part (e) where the need for further action is identified through the Bird and Bat Adaptive Management Program, or as otherwise agreed with the Secretary.*	

This BBAMP fulfils the requirements of Project Approval Condition D4 and will be implemented during the commissioning and operation of the FCWF. It includes two years of carcass searches and associated trials (not explicitly required by the Project Approval) to test whether regular impacts on species of concern occur and to quantify the impact of the project on birds and bats.

1.3. BBAMP Objectives

The overall aim of this BBAMP is to provide a program for monitoring the potential impacts of the wind turbines on birds and bats and a strategy for managing and mitigating any significant bird and bat impacts arising from the operation of FCWF.

This is achieved by establishing monitoring and management procedures consistent with the methods outlined by the Australian Wind Energy Association (AusWEA 2005) and endorsed in the Clean Energy Council's Best Practice Guidelines (CEC 2013).

The specific objectives of this BBAMP, derived from the Project Approval, are set out below.

- To implement a monitoring program to estimate the impact of the project on at-risk birds and/ or 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 decision-making framework that identifies impact triggers requiring a management response, unacceptable impact thresholds[1] and the kinds of management activities that should be considered;
- To detail potential 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 decision-making framework, mitigation measures and their success.

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

- Pre-operational bird and bat utilisation surveys;
- Operational phase carcass searches under operating turbines;
- Statistical analysis of the results of carcass searches; and
- Reporting.

This program uses an adaptive management approach. Therefore, management measures can be amended to ensure more effective management and mitigation are implemented in response to the findings of monitoring. Personnel undertaking the carcass searches will be adequately trained to undertake the monitoring. The expert approved by the Secretary DPHI will be in charge of the design of monitoring, as well as training of personnel, data analysis, interpretation, formulating adaptive management measures and reporting.

This BBAMP is based on the experience gained from the preparation and implementation of approved management plans to monitor and mitigate the impacts of wind farm operation on birds and bats at numerous wind farms in New South Wales and Victoria. At the time of writing, BL&A has prepared and/or implemented approved management plans for White Rock, Cullerin, Gullen Range, Taralga, Bodangora, Capital I and Woodlawn wind farms in NSW (BL&A 2011a & c, 2014, 2016), and Bald Hills, Macarthur, Berrybank, Crowlands, Hawkesdale, Lal Lal, Mt Gellibrand, Mt Mercer, Mortlake South and Ryan's Corner wind farms in Victoria (BL&A 2009, 2011b, 2012a-d, 2013a-c).

The approach developed for monitoring impacts on birds and bats has been refined from experience gained from other BBAMPs, their preparation, data review, and feedback from regulators and approval authorities. This BBAMP has incorporated learning and experience from past plans, and incorporates the latest approaches to monitoring wind farm impacts on birds and bats.

In order to ensure the efficacy of this adaptive management program, all activities undertaken will be subject to regular review and reporting by the suitably qualified expert approved by the DPHI.

[1] Definitions of 'impact trigger' and 'unacceptable impact' is detailed in section 6.2.1.

Refer to Appendix 2 for approval of Mick Callan (Director of Habitat Innovation) as a suitably qualified expert for the implementation of this BBAMP.

1.4. Consultations in the development of the BBAMP

This BBAMP was submitted for review to the Biodiversity and Conservation Division (BCD) of the Department of Planning, Housing and Industry (DPHI) (formerly Department of Planning, Industry and environment) (DPIE)). Version 4.6 of the report addressed the comments from North-west Division of BCD dated 17 December 2019 and is as attached in Appendix 1. Version 4.6 was submitted for approval by the Secretary of the Department of Planning, Housing and Industry and approved by the Secretary on the 14th of February 2020.

This current BBAMP Version 4.7 has been updated to include further information on the most recent planning modification (Mod 5) which occurred post approval of the BBAMP. The full list of planning modifications are summarised below:

The Flyers Creek windfarm was issued NSW Minister for Planning's Project Approval (MP 08_025) on the 4th of March 2014. Details of modifications (to date) to these conditions are as follows:

- Modification (Mod) 1 – determined on 13 March 2015 – Change in time frame permitted for satisfaction of the Deferred Commencement Conditions from 12 months to 18 months;
- Mod 2 – determined on 14 September 2015 – Removal of approved transmission line from the wind farm substation to the electricity network from Flyers Creek Wind Farm;
- Mod 3 – determined on 30 November 2017 – Reduction in the number of turbines from 42 to 38 and removal of associated land; an alternative alignment for the approved 33 kilovolt (kV) overhead power line; and minor changes to access tracks and cabling;
- Mod 4 – determined on 22 August 2019 – Increase to wind turbine envelope, reinstatement of 132 kV power line and switching station to connect the wind farm to the electricity grid, and minor clarifications to project components; and
- Mod 5 – determined on 15 October 2021 – Increase the maximum width of a section of the cleared easement corridor from 45m to 70m and minor realignment of the 132kV power line route.

The Modification 5 project design changes have not materially triggered changes to the technical content of the BBAMP from Version 4.6 to this current Version 4.7.

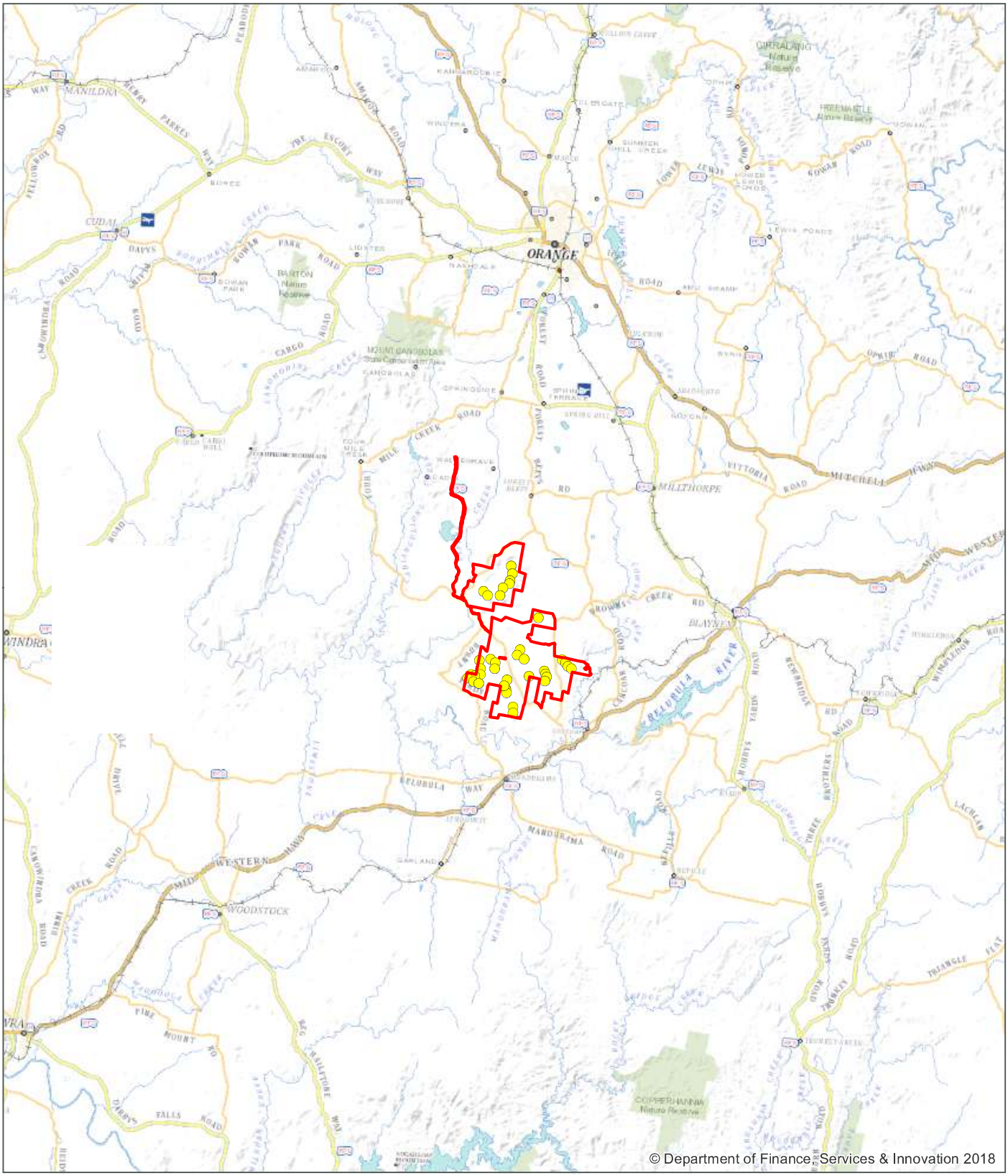

Figure 1: Regional overview for Flyers Creek Wind Farm

Project: Flyers Creek Wind Farm **Client**: Flyers Creek Wind Farm Pty Ltd **Date**: 21/11/2019

Project boundary

Wind turbine locations

N

Metres

0 5,600

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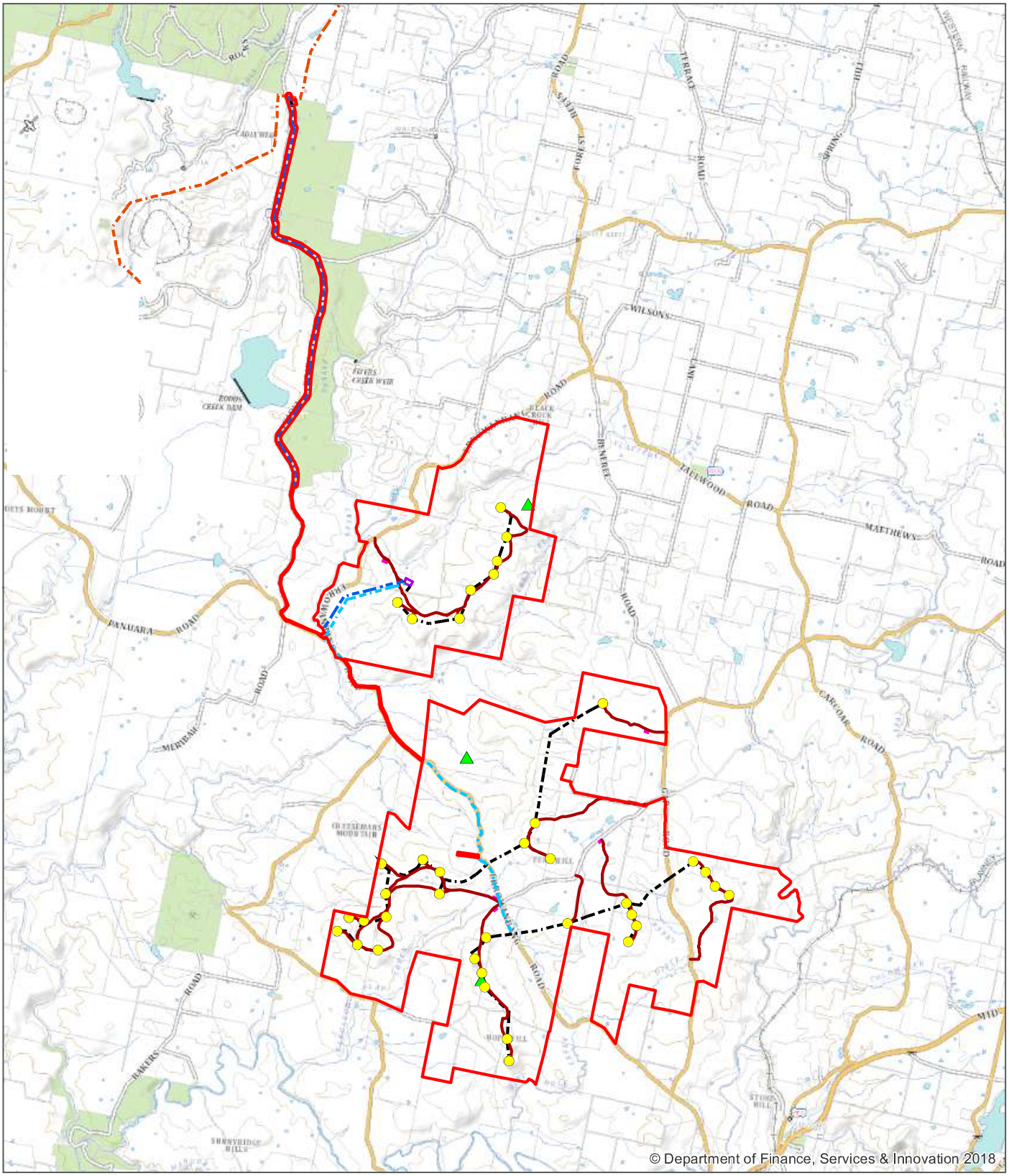

Figure 2: Flyers Creek Wind Farm layout

Project: Flyers Creek Wind Farm **Client**: Flyers Creek Wind Farm Pty Ltd **Date**: 21/11/2019

- Project boundary
- Wind turbine locations
- Met mast
- Substation and O&M facility
- Switching station
- 132kV power line
- 132 kV power line
- 33kV power line
- Access tracks
- Cabling
- Orange North to Cadia Power Line
- Laydown area options

N

Metres 0 1,600

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1.5. Site Description

The site is located on undulating to moderately steep ridge country at an altitude of approximately 800 – 950 metres (m) in a rural area that has been extensively cleared for grazing. Rural residential development is scattered throughout the locality. The nearby Cadia Valley Operations (CVO) mine is widely visible from within the project site and represents a significant modification to the landscape.

The turbine sites are proposed to be on the higher elevations along the ridges within the project area. Elevations of the turbine sites will likely vary from around 780m to 960m (AHD). Most of the ridges have been extensively cleared but some areas proposed for turbine placement do include isolated large mature trees of up to 20 to 25m in height.

There is very little natural forest or woodland vegetation remaining. Most paddocks have been improved pasture, and some cropping occurs on the more level valley floors.

Most of the remnant trees, patches of trees and occasional patch of native grassland in the area are part of the one plant community, the Yellow Box – Blakely's Red Gum Woodland. The most common trees are Yellow Box *Eucalyptus melliodora*, Bundy *Eucalyptus goniocalyx* and Blakely's Red Gum *Eucalyptus blakelyi*. Broad-leaved Peppermint *Eucalyptus dives* is scattered across the southern part of the area on soils derived from old sedimentary rocks, where also Red Stringybark *Eucalyptus macrorhyncha* forms occasional stands.

Some public roadsides support stands of trees, often only old trees. Along these roads there is very little native ground cover in any areas and native shrubs are quite rare. There is very little native understorey vegetation.

Small farm dams are scattered across the area but there are no large wetlands in the area and most watercourses are ephemeral. To the west, about five kms away, the CVO Mine site contains several large artificial settling ponds, while to the east, about 18 kms away, is Carcoar Dam.

The most important habitats for fauna are the remnant paddock trees and stands of woodland that provide foraging and breeding sites for birds. Tree hollows are a particularly important resource for many bird species.

1.6. Pre-construction investigations of birds and bats at Flyers Creek Wind Farm

During the pre-approval and pre-construction phases of the development, investigations of fauna were undertaken by Kevin Mills & Associates (KMA) (KMA 2011) and Greg Richards & Associates (GRA) (GRA 2010 & 2011). The methods and results of these investigations were included in the FCWF Environmental Assessment, specifically, Appendix D – Flora and Fauna Assessment (KMA 2011) and Appendix E – Avifauna – Bats (GRA 2010 & 2011) and are summarised in section 2.

BL&A undertook two additional pre-construction surveys for the FCWF. These were:

- Targeted Superb Parrot Survey in October 2018 (BL&A 2018a); and
- Bird Utilisation Survey in October 2018 (BL&A 2018b).

1.7. Additional information

This BBAMP was prepared by a team from Brett Lane & Associates Pty Ltd including; Eamon O'Meara (Zoologist), Jackson Clerke (Zoologist), Bernard O'Callaghan (Senior Ecologist and Project Manager) and Brett Lane (Principal Consultant).

2. Pre-construction Bird and Bat Information

The results of investigations documented in Section 1.6 are summarised in this section of the BBAMP. This information has informed the risk assessment in Section 3.

2.1. KMA Flora and Fauna surveys

General surveys were carried out by KMA (2011) and the methods used are outlined in their ecological assessment report. The data were collected from three survey periods during November 2008, February 2009 and October 2010. These were considered optimal times (spring and summer) to sufficiently detect fauna.

Bird surveys on proposed wind farm sites are particularly important, so special attention was given to identifying and recording this fauna group. The considerations and procedures set out in the documents titled Wind Farm and Birds. Interim Standard for Risk Assessment (AWEA 2005) and Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999 Policy Statement 2.3. Wind Farm Industry (DEWHA 2008) were followed.

The bird surveys included the general recording of species noted above, along with some targeted surveys throughout the study area. In those areas, transects were walked and/or partially driven on ridges and other places in the study area, and all birds, their numbers and their flight heights were recorded during all targeted surveys. This also targeted the EPBC Act listed Superb Parrot.

A tree hollow survey was undertaken along the ridges where the turbines would be located. The survey involved walking a transect recording all trees with hollows, their species name, dch (measurement of tree size – trunk diameter at chest height) and GPS location. Hollows were divided into trunk and branch hollows and into size classes, i.e. <10 cm, 10-20 cm, and >20 cm.

Targeted bird counts at 23 sites spread throughout the study area recorded 1,292 observations of 57 species over a total observation time of 14.8 hours.

85 % were seen below 20min height. This is approximately the height of the tallest trees in the area. Few birds fly higher than 50m from the ground, only 1.5 percent of observations. Larger birds of prey are the main birds seen at higher levels.

The study area contains numerous small farm dams. There are only a few that are of any substantive size. Two dams on the property 'Nullawonga' (located north of Halls Road) are somewhat larger. The dam nearest the homestead is particularly attractive to waterbirds. Counts at this dam on 23rd and 24th February 2009 recorded large numbers of waterbirds.

Threatened species recorded included:

- Superb Parrot
- Diamond Firetail
- Varied Sittella
- Little Eagle

Other considered likely to occur from the surrounding region were:

- Swift Parrot

- Brown Treecreeper White-fronted Chat
- Flame Robin
- Little Lorikeet
- Speckled Warbler
- Scarlet Robin

Although some of these species are likely to occur on the wind farm site occasionally, the critical habitat elements required by the species are mostly absent from the area. The CVO mine site and the surrounding land support extensive areas of forest and woodland, and are quite different to the land on which the wind farm is proposed to be located. KMA (2011) concluded there would be no significant impacts upon listed fauna species.

A full listing of fauna species recorded during the 2012-14 surveys is presented in Appendix 3 of KMA (2011).

2.2.GRA - Bat surveys

The bat surveys were undertaken by GRA in 2010 and 2011 in two stages: firstly, at meteorological towers where bat activity at 50-60m high was compared with that at ground level, then secondly at a range of woodland remnants that varied in habitat quality.

All ten sampling sites were monitored with AnabatTM echolocation call detection systems where calls were recorded from dusk to dawn, either for 9 consecutive nights (Stage 1) or 11 consecutive nights (Stage 2). The ten monitoring sites were within the project area or very close to the project boundary.

Ten bat species were recorded overall during the bat fauna assessment, including one threatened species, from a total of 280 calls at towers and 7120 calls at woodland remnants.

Therefore, bat utilisation for the site's representative of the proposed wind turbine locations (i.e. the wind monitoring masts) was significantly lower than for the remnants woodlands which are predominantly located at lower elevations away from proposed turbine locations.

In addition, the bat utilisation recorded ~50 m above ground level on the masts, representative of the rotor swept area, was lower still. Thus, it was shown that open pasture with scattered trees was very poor habitat for bats, and the highest level of activity was recorded in high quality woodland remnants, such as those with a shrubby understorey from which grazing by livestock was excluded.

The Yellow-bellied Sheathtail Bat, listed as Vulnerable under the NSW Biodiversity Conservation Act (BC Act) 2016, was recorded at one of the towers in the centre of the project area, and at two high quality woodland remnants. All records were from just a few calls, and only on occasional nights during the survey period. Based on extensive previous studies, it was shown that major populations of this species in the region require much larger tracts of habitat than would be found in the wind farm project area, which was supported by the low level of recording this species.

Other threatened species that have previously been surveyed in the region included Large Bentwing Bat and Large Footed Myotis.

See GRA (2010) for the full list of species.

2.3. Pre-construction BUS and Superb Parrot Surveys

BL&A undertook two pre-construction surveys in Spring 2018. The results of these surveys are outlined below:

2.3.1. Bird utilisation surveys

The BUS for the FCWF was completed from the 21 – 26 October 2018 by a BL&A Zoologist. In summary the survey findings included:

- The study area is largely made of historically cleared (> 100 years) undulating hills supporting a low diversity and abundance of common, predominantly farmland birds;
- The utilisation rates of Wedge-tailed Eagle were relatively low in the study period. The utilisation rate of Wedge-tailed Eagle averaged at 0.026 eagles per hectare per hour throughout the survey period. The utilisation of other raptors was found to be very low;
- The study area supports very few other raptors, and no waterbirds which are considered vulnerable to collision with operating wind turbines;
- Twenty-eight species of farmland birds were recorded utilising the study area;
- One species of threatened bird, the Superb Parrot, was recorded utilising the study area;
- No other listed species (EPBC Act or BC Act) were recorded; and
- This survey adequately described bird life at the proposed wind farm and further pre-construction work is considered as necessary.

The pre-construction bird utilisation survey has satisfied the requirement for 'obtaining pre-construction baseline bird utilisation data'.

2.3.2. Superb Parrot Survey

The Superb Parrot survey was conducted from the 18 - 26 October 2018 in conjunction with the BUS described above. This survey recorded groups of Superb Parrot moving through the proposed project area and breeding in proximity to the FCWF. The results are outlined in the Report "Superb Parrot Targeted Survey" (BL&A 2018b) which has been lodged with BCD and DPIE in November 2019.

In summary, the Superb Parrot were not recorded to undertake behaviour that we considered to be "risk behaviour".

3. Risk Assessment for Flyers Creek Wind Farm

3.1. Introduction to the risk assessment

The aim of this risk assessment is to guide the development of the BBAMP for the FCWF by identifying those species or groups considered potentially at risk from either collision with turbines or disturbance from operating turbines. The outcomes of this risk assessment enable more targeted monitoring and management measures to be included in the BBAMP, focussing 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 operating wind turbine blades or towers at rotor swept area (RSA) heights;
- 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.

The risk assessment has followed the procedure for risk assessment of AS/NZS ISO 31000 2009. The assessment has been undertaken as follows:

- Species or groups of concern have been short-listed based on their likelihood of occurrence at the site;
- Two impact pathways have been assessed: a) collision with turbines; and b) indirect effects (including both disturbance and barrier effects);
- Impact likelihood criteria have been developed and applied to each impact pathway for each species or group of concern;
- Impact consequence criteria have been developed and applied to each impact pathway for each species or group of concern; and
- The risk level for each species or group of concern from the two impact pathways has been determined consistent with a risk matrix.

This chapter presents the results of this risk assessment under the headings below.

Section 3.2 summarises the sources of information used to understand the likelihood of occurrence of each species or group on the FCWF site and their likely behaviour on the site;

Section 3.3 lists the species of concern that have been subject to this risk assessment.

Section 3.4 provides an overview of the risk assessment method adopted, including the likelihood and consequence criteria and the risk matrix;

Section 3.5 presents the results and conclusions of the risk assessment and identifies the focus for the BBAMP for FCWF.

3.2. Sources of Information

To ascertain the species of concern that may occur on the FCWF site the following sources were used:

- The NSW Bionet Atlas Search tool (OEH 2018a), using a 40 by 40 km search region centred over the proposed FCWF site, with limits being North: -33.36 West: 148.84 East: 149.26 South: -33.71 (searched in October 2018)
- The EPBC Act Protected Matters Search Tool (PMST) using a search region that included the proposed site with a 15 km radius from the approximate central point of -33.54°S, 149.06°E (DoEE 2018a);
- Bird Utilisation Survey completed from the 21 – 26 October 2018 (BL&A 2019a);
- The Superb Parrot survey was conducted from the 18 - 26 October 2018 (BL&A 20019b); and
- The Ecological Assessment of the FCWF site (KMA 2011, GRA 2010).

3.3. Species and groups of concern

Species of concern are those that are known, likely or have the potential to occur on the wind farm site that are listed as threatened or migratory on biodiversity legislation or that are known to be particularly vulnerable to wind turbine impacts. These species have been the subject of this risk assessment. They include the following:

- Species listed as threatened on legislation or according to an authoritative source;
- Species known to be particularly prone to collision with operating turbines or sensitive to disturbance;
- Species for which a population concentration, or a population of significance, occurs on the site and that species may exhibit "risk behaviour" and potentially interact with the operation of wind turbines;
- Native bird and bat species known to occupy the FCWF site considered to have moderate to high collision risk by KMA (2011) and GRA (2010/2011); or
- Species recorded during BL&A surveys and reporting (BL&A 2019a and 2019b).

From the foregoing information sources, a list of species with potential to occur in the search region was generated. Of these, a shortlist of species of concern was then generated based on the likelihood of occurrence on the FCWF site itself given the habitat present on the site, the known habitat preferences of species and the regularity of occurrence of the species in the search region (see

Appendix 3).

Non-threatened migratory wetland bird species were omitted from the likelihood of occurrence table given KMA (2011) assessment of their occurrence concluding that though some of these species occur on the site from time to time, there is no important habitat on the site for such species and the habitat on the site does not support an ecologically important proportion of a population of such species.

Non-threatened listed marine species were also omitted given the considerable distance of FCWF from the coast.

The site assessments considered listed threatened species likely to occur on the site, some of which were detected during on-site survey work. This BBAMP considers additional species and groups, including non-threatened species/groups, that were identified in the review of EPBC and NSW listed matters and are now considered in this BBAMP.

The short-listed species and groups are listed in Table 2.

Table 2: Risk assessment - Assessed bird and bat species

EPBC Act Listed Migratory Species
▪ Fork–tailed Swift
▪ ***EPBC Act listed threatened birds***
▪ White-throated Needletail
EPBC Act and BC Act listed threatened birds
▪ Painted Honeyeater (Vulnerable – EPBC & Vulnerable – BC) ▪ Regent Honeyeater (Critically Endangered – EPBC & BC) ▪ Swift Parrot (Endangered – EPBC & Critically Endangered BC Act) ▪ Superb Parrot (Vulnerable – EPBC & Vulnerable – BC)
EPBC Act and BC Act listed threatened bats
▪ Corben's Long-eared Bat (Vulnerable – EPBC & BC Act) ▪ Grey-headed Flying-fox (Vulnerable – EPBC & BC Act) ▪ Large-eared Pied Bat (Vulnerable – EPBC & BC Act)
BC Act listed threatened birds
▪ Barking Owl (Vulnerable) ▪ Black Falcon (Vulnerable) ▪ Black-chinned Honeyeater (eastern subspecies) (Vulnerable) ▪ Brown Treecreeper (eastern subspecies) (Vulnerable) ▪ Diamond Firetail (Vulnerable) ▪ Dusky Woodswallow (Vulnerable) ▪ Flame Robin (Vulnerable) ▪ Gang-gang Cockatoo (Vulnerable) ▪ Grey-crowned Babbler (eastern subspecies) (Vulnerable) ▪ Hooded Robin (south-eastern form) (Vulnerable) ▪ Little Eagle (Vulnerable) ▪ Little Lorikeet (Vulnerable) ▪ Powerful Owl (Vulnerable) ▪ Scarlet Robin (Vulnerable) ▪ Speckled Warbler (Vulnerable) ▪ Varied Sittella (Vulnerable)

BC Act listed threatened bats
▪ Eastern Bent-wing Bat (Vulnerable) ▪ Southern Myotis (Vulnerable) ▪ Yellow-bellied Sheathtail Bat (Vulnerable)
Bird species (NSW National Parks and Wildlife Act)
▪ Raptors – includes Black-shouldered Kite, Black Kite, Brown Falcon, Brown Goshawk, Nankeen Kestrel, Wedge–tailed Eagle, Aus. Hobby, Peregrin Falcon ▪ Waterbirds – includes ducks, herons, swans, ibis and other wetland associated species
Bat species (NSW National Parks and Wildlife Act)
▪ Common bat species – includes Freetail bats, Wattled Bats, Forest Bats

A risk assessment was undertaken for each of the foregoing species and groups.

3.4. Risk Assessment Process

The risk assessment process was based on the Risk Evaluation Matrix Model used to measure the overall risk of a potential impact event, in this case birds or bats striking wind turbine blades or being deterred from using part of the wind farm due to disturbance or barrier effects. The assessment is based on the *likelihood* of that event, and, should it occur, its *consequences*. This model is currently used across a wide range of industry sectors, in particular for assessing environmental risk.

The Risk Evaluation Matrix Model also complies with the AS/NZS ISO 31000 Risk Assessment Standard 2009.

The assessment requires criteria to be developed for likelihood and consequence. These criteria are provided respectively in Table 3 and Table 4.

Table 5 shows the risk levels used and how they are determined from the assessed likelihood and consequence levels.

Table 3: Likelihood criteria for a risk event to occur

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 4: 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

Table 5: Risk matrix defining risk level based on likelihood and consequence

		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*

The relevant likelihood and consequence levels were determined by using data recorded from the wind farm site and with reference to any available information on the local and regional status of the species and bird groups concerned.

3.5. Risk Assessment Results

Table 6 provides the complete results of the risk assessment, including evaluation of the impacts of the project on each species against the foregoing likelihood and consequence criteria. It includes the following information as part of the risk assessment process:

- Environmental value to be protected
- Reasons for Inclusion
- Threatened species status
- Hazard (i.e. turbine collision or indirect disturbance)
- Consequence and likelihood scores for each hazard
- Risk rating
- Comments relating to risk rating scores

The risk associated with wind turbine collision and indirect effects at the FCWF for most assessed bird and bat species was rated as **negligible**. The exceptions are described below.

The Little Eagle was confirmed on the FCWF site during the pre-construction survey of 2012-14 (KMA 2011). This species has shown a 50% decline in numbers in NSW over three generations and is considered to have a low recruitment rate (Debus 2017). It may occur at FCWF at low frequency and/or density, but should a collision occur this would have moderate consequences. The risk to the Little Eagle was therefore considered to be **low**.

The White-throated Needletail flies regularly at turbine height and flocks may pass over the FCWF site during the summer months. Collisions have been recorded at wind farms elsewhere in NSW and eastern Australia. Although the species population is declining due to deforestation and loss of

habitat in the species breeding countries (Siberia and Japan) (Tarburton 2014), it is unlikely that occasional loss of individuals due to collision with turbines would contribute to this decline significantly. The risk to this species from the FCWF is considered to be **low** as the species is currently widespread and numerous in eastern and south-eastern Australia.

Given the occurrence of collisions involving Wedge-tailed Eagle (WTE) at many wind farms, this species is addressed in this risk assessment. There is a low incidence of disturbance and WTEs occur at most wind farms, including successfully breeding within 200m of operating turbines (BL&A, unpubl. data). Thus, risks to this species arise from likely collisions but not indirect disturbance. The risk to the Wedge-tailed Eagle was therefore considered to be **low**.

Based on experience at other wind farms in eastern Australia, collisions of more commonly occurring raptor species are likely. Commonly occurring raptor species recorded to collide with turbines include Nankeen Kestrel, Brown Falcon and Black-shouldered Kite while other species which were recorded at FCWF such as Peregrine Falcon are known to collide but with a much lower frequency (BL&A, unpubl. data). These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW (BL&A, unpubl. data). Overall, the risk from collision with turbines to these raptors is considered to be **low** as these species are widespread and common, making population impacts unlikely.

Some commonly occurring bat species, particularly White-striped Freetail Bat and Gould's Wattled Bat, are known to collide with turbines at other wind farms in eastern Australia. Other non-listed species recorded at FCWF (GRA 2010) have also been recorded to collide with turbines at other wind farms (BL&A unpub data) but less frequently than the aforementioned species. Overall, the risk to non-listed bat species is considered to be **low** given that they are widespread and common.

No threatened bat species was considered to have a risk rating above **negligible**.

Table 6: Bird and Bat Risk Assessment – Flyers Creek Wind Farm

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Bird Species							
Barking Owl (*Ninox connivens)*	Site occurs within the species range, some suitable habitat exists	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	There is some potential for the species to occur as there is suitable habitat and the site falls within the species range. Collision is likely to be very infrequent, if at all, due to the species' tendency to stick to treed habitats or to fly below turbine height over open habitats where it often obtains prey (OEH 2018b)
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Black Falcon (*Falco subniger*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Mostly occurs in the western plains and in the drier lowland parts of NSW. There is one record in BioNet for the search region (OEH 2018a), so the species may occasionally reach the area. Collision is likely to be very infrequent due to infrequent occurrence. Consequences would be low due to the widespread distribution of the species (all of northern and eastern Australia; Menkhorst et al. 2017).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Black-chinned Honeyeater *(Melithreptus gularis gularis*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	Records of the species occur within the search region, though these are few, and suitable habitat exists on site. The species is unlikely to collide with turbines as it forages within the canopy for insects on branches and foliage (OEH 2018b). Barrier effects are unlikely to occur from the wind farm as the habitat on the site is already fragmented and the species would usually fly below turbine height.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Brown Treecreeper (*Climacteris picumnus victoriae*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	It occurs in woodlands dominated by eucalyptus, especially stringybarks or other rough-barked eucalypts, usually with an open, grassy understorey (Higgins *et al.* 2001). This species has potential to occur at the FCWF site since there are many records from the search region (OEH 2018a). Usually occurs in the lower canopy and is unlikely to fly at RSA height.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Diamond Firetail (*Stagonopleura guttata*)	Presence confirmed on site (KMA 2011)	Vulnerable - BC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	Found in woodlands, dry open forests and lightly timbered farmland where it feeds on native grasses (Higgins et al. 2006). the species was confirmed on site (KMA 2011) and it has been recorded regularly in farmland around wind turbines in southern NSW where it has never been observed flying at RSA height or colliding with turbines (BL&A unpublished data).
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)	Presence confirmed on site (KMA 2011)	*Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Occurs in dry open sclerophyll forests and woodlands, usually dominated by eucalypts. Often found on the edges or in clearings of forest and woodland and sometimes recorded in shrubland and heathland and other various modified landscapes (Higgins et al. 2006). The species presence was confirmed on site (KMA 2011). This species may occasionally fly at RSA height but usually flies within the canopy. Any collision would likely have minimal population impact since this species is still moderately common across most of its range.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Flame Robin (*Petroica phoenicea*)	Species recorded in search region (OEH 2018a, KMA	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Breeds in forests in south-eastern Australia, usually in the hills or high-country. Migrates in autumn and winter to lower altitudes and more open habitat, such as farmlands, plains and some urban areas (Higgins and Peter 2002). There are a

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard	Likelihood of Risk Event	Consequence	Risk Rating	Comments
	2011); potential to occur within area		Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	few records from the search region (OEH 2018a). Collisions with turbines have yet to be recorded, but an isolated collision would not impact the population greatly.
Fork-tailed Swift (*Apus pacificus*)	Species or species habitat likely to occur within area (DoEE 2018)	Listed migratory species - EPBC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	This species is aerial, over inland plains, sometimes above foothills or in coastal areas, over cliffs and urban areas (Higgins 1999). It occurs over much of Australia and likely infrequently in the WF area, often following weather fronts. it flies at turbine height. Collision is likely to be infrequent due to the irregularity of its occurrence – there are no records to date from the search region (OEH 2018a). Small numbers possibly affected do not represent a significant proportion of the total population, estimated as at least in the tens of thousands and stable across its range (DoEE 2018b).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	This species occurs in forest along the coast and ranges from the Hunter Valley of NSW to south-west Victoria; it moves to lower altitudes in autumn-winter (Higgins 1999). There are nine records from the search region (OEH 2018a). This species is known to fly at turbine height, but appears to occur rarely around FCWF. Therefore, collisions are likely to be infrequent and limited in their overall impact on its population.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	Records exists for this species within the search region and suitable habitat occurs on site in the form of box Eucalypts. None were recorded on site (KMA 2011) but they have the potential to occur occasionally. The species is known to only make short flights within the canopy however (OEH 2018b) so collision is unlikely with turbines.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Hooded Robin (*Melanodryas cucullata cucullata*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	This species occurs mostly in lightly timbered habitats such as dry woodlands with an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter, with scattered dead and fallen timber for foraging perches (Higgins and Peter 2002). Five records have been recorded from the search region (OEH 2018a). As a perch and pounce forager from branches or logs/posts to the ground, this species is unlikely to fly at RSA height and so is unlikely to be impacted by the operating wind turbines.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Little Eagle (*Hieraaetus morphnoides*)	Presence confirmed on site (KMA 2011)	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Moderate	Low	The Little Eagle is distributed throughout the Australian mainland except in the most densely forested parts of the Great Dividing Range (Marchant and Higgins 1993). Turbine strikes of this raptor species could occur and the species has been recorded flying over the FCWF study area (KMA 2011) and in the wider search region (OEH 2018a). It is expected that regular collision is unlikely in NSW given its very low population densities. In the 1990s, the Little Eagle was estimated globally as numbering tens of thousands to as many as 100 000 birds (Ferguson-Lees & Christie 2001), but in recent decades, the Little Eagle is believed to have undergone a moderate reduction in population size in NSW (OEH species listing advice).
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Little Lorikeet (*Glossopsitta pusilla*)	Species recorded in search region (OEH 2018a);	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat. There is one record from the search region

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard	Likelihood of Risk Event	Consequence	Risk Rating	Comments
	potential to occur within area		Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	(OEH 2018b). Little Lorikeet are at risk colliding with turbines given they may fly at RSA height, particularly when moving between feeding areas. However there are no records of Little Lorikeets colliding with wind turbines that BL&A are aware of. Their wide distribution and episodic occurrence in the area coinciding with eucalypt flowering events, which are sporadic. This would ensure they would only occasionally collide with turbines.
Painted Honeyeater (*Grantiella picta*)	Species or species habitat likely to occur within area (DoEE 2018)	Vulnerable EPBC Act Vulnerable BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	This species is strongly associated with mistletoe around the margins of open forests and woodlands; it occurs from Gulf of Carpentaria to southern Victoria and eastern South Australia, mostly inland of the Great Divide (Higgins *et al.* 2001). There are no records from the search region (OEH 2108a). This species usually flies within the tree canopy and would rarely visit the FCWF site.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Powerful Owl (*Ninox strenua*)	Site occur within the species range (OEH 2018b)	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	The Powerful Owl occurs mainly on the coastal side of the Great Dividing Range from Mackay to the extreme south-east of South Australia. This species inhabits open and tall wet sclerophyll forests with sheltered gullies and old growth forest with dense understorey. It is also found in dry forests with box and ironbark eucalypts and River Red Gum. Large old trees with hollows are required by this species for nesting (Higgins 1999; Soderquist *et al.* 2002). For most of its life, the Powerful Owl restricts its activities to forested habitat and does not fly often over open country. Dispersing juvenile owls may fly longer distances, including over open country, such as where turbines are located. There are no records from the search region however suitable habitat does exist. The small number of birds that possibly inhabit FCWF and nearby areas, and the limited activity beyond forested areas make collision and disturbance unlikely.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Regent Honeyeater (*Anthochaera phrygia*)	Species or species habitat known to occur within area (DoEE 2018)	Critically endangered EPBC Act Endangered BC Act	Collision with operating wind turbines.	Rare	Moderate	Negligible	Inhabits dry eucalypt forests and River Sheoak near rivers and creeks on inland slopes of the Great Dividing Range; also occurs intermittently along the NSW coast in Swamp Mahogany forest. It could also occur in small remnant patches or in mature trees in farmland or partly cleared agricultural land (Higgins *et al.* 2001; OEH 2018b). This species usually flies within the tree canopy and would rarely visit the FCWF site.
			Indirect disturbance, including barrier effects.	Rare	Negligible	Negligible	
Scarlet Robin (*Petroica boodang*)	Presence confirmed on site (KMA 2011)	Vulnerable - BC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	The Scarlet Robin lives in open forests and woodlands in Australia. During winter, it will visit more open habitats such as grasslands and will be seen in farmland and urban parks and gardens at this time. Flight height studies at another wind farm in NSW (BL&A unpub data)) indicate that Scarlet Robin flies at heights of 20 metres or less. This is below the RSA height; there are unlikely to be measurable impacts on its population.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Speckled Warbler (*Chthonicola sagittata*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	It inhabits dry eucalypt forests and woodlands, especially those with box-ironbark eucalypt associations and abundant fallen timber. It is also found in River Red Gum woodlands (Higgins and Peter 2002). There are eight records in the search region (OEH 2018a). This species inhabits the lower vegetation strata and the ground and it is not known to fly at RSA height.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard	Likelihood of Risk Event	Consequence	Risk Rating	Comments
Superb Parrot (*Polytelis swainsonii*)	Presence confirmed on site (KMA 2011)	Vulnerable EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Occupies open woodlands of the inland slopes and southern Riverina of New South Wales and north-central Victoria. Breeding occurs in large eucalypts with hollows in the Riverina and south-west slopes regions; a proportion of the population moves north in autumn-winter (Higgins 1999; OEH 2018b). It is likely that breeding may occur in the area (KMA 2011). Although listed under EPBC and BC Acts, Garnett et al. 2010 did not consider the species threatened citing new information that the population is over 10,000 birds and not declining.
		Vulnerable BC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Swift Parrot (*Lathamus discolor)*	Species or species habitat may to occur within area	Critically endangered EPBC Act Endangered BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	In NSW it is a non-breeding autumn-winter visitor from its breeding grounds in Tasmania. It prefers a narrow range of eucalypts including Boxes, Ironbarks, Blakely's Red-gum, Swamp Mahogany, Blackbutt, Red Bloodwood and Spotted Gum (Higgins 1999; OEH 2018b). It spends winter mostly inland of the Great Dividing Range but some years reaches the coast (Higgins 1999; Kennedy and Tzaros 2005). Potential to pass through the site however there are no records from FCWF or the surrounding region (OEH 2018a).
			Indirect disturbance, including barrier effects.	Unlikely	Unlikely	Negligible	
Varied Sittella (*Daphoenositta chrysoptera*)	Presence confirmed on site (KMA 2011)	Vulnerable - BC Act	Collision with operating wind turbines.	Rare	Negligible	Negligible	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over recent decades (OEH 2018b). It inhabits eucalypt forests and woodlands flying at canopy level. The Varied Sittella forages in groups, flying into the tree canopy and working down the branches and trunks, probing through the bark in search of insects (Pizzey & Knight 2003). This species is unlikely to fly at RSA height.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Wedge-tailed Eagle (*Aquila audax*)	Presence confirmed on site (KMA 2011)	N/A	Collision with operating wind turbines.	Almost certain	Low	Low	The Wedge-tailed Eagle is the species most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Several birds of this species have been struck at other wind farms in NSW. Disturbance is not an issue, with the eagle breeding successfully as close as 200 metres from operating wind turbines.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
White-throated Needletail (*Hirundapus caudacutus*)	Species or species habitat likely to occur within area	Vulnerable and Listed migratory species - EPBC Act	Collision with operating wind turbines.	Likely	Low	Low	This species is known to follow storm systems and fronts. Occasional mortality has been reported at other wind farms where it occurs. It typically flies at and above RSA height. Loss of a small number of individuals each year is not considered to be of significance as the species is still numerous in Australia. Tarburton (2014) states there has been a significant decline in population, primarily due to forest clearing in Siberia. Occasional collisions with turbines would be unlikely to significantly exacerbate species decline at FCWF, however there may be a cumulative affect across wind farms within its range. Although this is beyond the scope of this assessment. Although not yet recorded around the wind farm (OEH 2018a), it is considered likely to occur there regularly.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Other raptors	Common occurring raptor species were recorded at the FCWF site (KMA 2011)	N/A	Collision with operating wind turbines.	Almost certain	Low	Low	Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Black-shouldered Kite are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard	Likelihood of Risk Event	Consequence	Risk Rating	Comments
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW.
Waterbirds	Common occurring waterbird species were recorded at the FCWF site (KMA 2011)	N/A	Collision with operating wind turbines.	Unlikely	Low	Negligible	Habitats on the FCWF site for waterbirds are limited to small farm dams. No large concentrations of waterbirds occur nearby. Experience at other wind farms in NSW indicates few waterbirds collide with turbines, even near large waterbird concentrations (e.g. Lake George), where birds confine most of their activities to the wetlands and don't often move across farmland.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Bat Species							
Corben's Long-eared Bat (*Nyctophilus corbeni*)	Species or species habitat may to occur within area	Vulnerable EPBC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	There are no records for this species occurring on site and none were detected during surveys. However, some suitable habitat exists for the species on site, so it may potentially occur. The species is known to hunt within the canopy for insects on trunks and tree limbs, it is even known to hunt on the ground (OEH 2018b). Therefore, it foraging habits are highly unlikely to bring it into contact with turbines
		Vulnerable BC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unikely	Low	Negligible	This species roosts in caves during the day, dispersing over a range of habitats at night. Its feeding areas tend to be associated with forests, wetlands and waterways (OEH 2018b). This species could collide with turbines as it is known to fly occasionally at RSA height. The species was not detected during the migration period (KMA 2011), but given records in the search region, it is likely that small numbers of individuals pass through the wind farm area on migration between maternity caves and the wintering sites. No breeding caves occur close to the wind farm so impacts on breeding individuals are unlikely. Large numbers of the species passing through the site are also unlikely given the distance to known maternity caves (Wee Jasper) and the area the species disperses over. Population consequences are therefore considered to be low.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Species or species habitat likely to occur within area	Vulnerable EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	This fruit bat occurs in the eastern mainland states from southern Queensland to Victoria, mostly along the coast and Great Diving Range (Churchill 2008). The species occupies large roosting colonies or camps numbering hundreds or thousands, often congregating in large towns or cities and other locations with abundant year-round food supply (Churchill 2008). There are no records from the search region however a camp of the species has been recorded in Orange in 2017 (DoE 2018b), approximately 30km north of the site, so it is likely the species would at least occasionally occur in the area. The habitat at the wind farm would provide sub-optimal foraging habitat and it is unlikely to attract large numbers and only during local Eucalypt flower seasons. The loss of an occasional individual from turbine strike would not impact the overall population significantly.
		Vulnerable BC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Species recorded in search region (OEH 2018a);	Vulnerable EPBC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. There is one record of this species within the search region and as such has the potential to

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard	Likelihood of Risk Event	Consequence	Risk Rating	Comments
	potential to occur within area	Vulnerable BC Act	Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	occur at the site. It was not recorded during surveys. It is thought to forage within the canopy (OEH 2018b) which would not bring it into contact with turbines and make collisions unlikely. Little is known about the species population so impacts are difficult to estimate. However, its flight habits make this event unlikely and therefore risk to the species is presumed negligible.
Southern Myotis (*Myotis macropus*)	Species recorded in search region (OEH 2018a); potential to occur within area	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Negligible	Negligible	There are multiple records of this species in the search region and so it has the potential to occur on site. It is known to forage over streams and pools catching insects and small fish by raking their feet across the water surface (OEH 2018b). There is very little aquatic habitat on site apart from small farm dams, it unlikely that this species would occur on site frequently or fly at turbine height. Risk is negligible.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	Presence confirmed on site (KMA 2011)	Vulnerable - BC Act	Collision with operating wind turbines.	Unlikely	Low	Negligible	This species inhabits a range of habitats across northern and eastern Australia. It may be susceptible to turbine blade collision as it is known to fly above the canopy when foraging. The species was detected at several sites but with a low number of calls. The GRA (2010) report states that the species numbers are associated with the size of contiguous habitat. As such habitat is generally restricted at the site, large numbers are unlikely. Therefore, frequent collision is considered to be unlikely and population impacts low.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	
Non listed bat species	Commonly occurring bat species confirmed on site (KMA 2011)	N/A	Collision with operating wind turbines.	Almost certain	Low	Low	Several common bat species were identified at FCWF (GRA 2010) that although are not threatened, such as White-striped Freetail bat and Gould's Wattled Bat, are known to collide with turbines at other operational wind farms in NSW. As these are widespread and common species population impacts are unlikely to be significant.
			Indirect disturbance, including barrier effects.	Unlikely	Negligible	Negligible	

Notes: BC Act = Biodiversity Conservation Act; EPBC Act = Environment and Protection of Biodiversity and Conservation Act; * = Preliminary Determination by the NSW Scientific Committee.

3.6. Conclusions from the Risk Assessment for Flyers Creek Wind Farm

The surveys of the FCWF and surrounding wind farm sites to date, combined with the knowledge generated at operating wind farms elsewhere in Australia (BL&A unpubl. data), indicate that collision rates are typically very low and this risk assessment indicates that no significant population impacts are anticipated for species of concern.

Raptors are known to be vulnerable to collision with operating wind turbines. A number of raptor species have been recorded at the FCWF site during surveys. The Wedge-tailed Eagle is the most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Little Eagle (BC Act listed), Nankeen Kestrel, Brown Falcon, Brown Goshawk, Black-shouldered Kite and Peregrine Falcon may also be at low risk from collision with turbines.

White-throated Needletail is a migratory species considered to have similar flight heights to raptors, which bring it into turbine rotor heights. It should be noted that White-throated Needletail is listed as a threatened (vulnerable) and migratory species under the EPBC Act. It is unlikely to be locally common. Its conservation status is listed as secure both at a state and Commonwealth level.

The Superb Parrot was recorded at FCWF and was recorded breeding in on the wind farm in areas that were not in close proximity to turbines. A summary of the findings are provided in BL&A report (BL&A 2019b). This report concluded that the Superb Parrot was not observed to exhibit risk behaviour within the FCWF site.

Many of the species listed under the BC Act screened in this risk assessment are not evaluated to be at risk from the operation of FCWF. Most threatened woodland birds and bats do not regularly fly at RSA height and therefore do not encounter turbines very often.

This risk assessment indicates that a small proportion of the species and groups of concern (four out of 25 birds or bird groups and one out of seven bats or bat group) have more than a negligible risk rating of being affected by collision with operating turbines once the FCWF is constructed. No birds or bats are likely to be at risk from indirect effects, such as disturbance or barrier effects.

The BBAMP for the FCWF will therefore focus on monitoring for collisions with turbines of the White-throated Needletail, Little Eagle, Wedge-tailed Eagle, other raptors and common bat species (particularly White-striped Freetail Bat).

4. Operational Phase Surveys

A range of approaches will be utilised post-construction, i.e. the operational phase of the project, to meet the requirements of the relevant condition of approval (D4).

The main approaches to implementing the BBAMP will be:

- Specific management contingencies for key species and groups identified in the risk assessment and/or initiated due to a specific impact trigger (see section 6);
- A statistically robust carcass–monitoring program (random or stratified random sampling design) to detect birds and bats that collide fatally with wind turbines as a basis for an estimate of overall bird and bat mortality rates at the FCWF; and
- Mitigation measures to reduce the possible interactions between birds and bats, and operating wind turbines.

Sections 4.1 to 4.3 describe the survey methodologies to be implemented during FCWF operations.

Carcass-searches are expected to be carried out for a total of two years following commencement of the operational phase of the FCWF with a review and compilation of all monitoring data gathered in the first year to determine if further, more targeted, surveys will be required in the second year, or if reduced monitoring effort is justified.

4.1. Monitoring 'at risk' groups

Baseline information was generated in the initial surveys in 2008-10 and in 2018 provided information on bird utilisation of the site. A review of this information combined with information from other sources has been collated in the risk assessment and is considered to provide an adequate pre-construction baseline to compare future changes.

The key "at risk" groups have been identified through the risk assessment (see Section 3). These include:

- **Wedge-tailed Eagles (WTE).** A low risk to WTE has been assessed (Table 6). Accordingly, it is important that mitigation measures are implemented, where practicable, to reduce WTE being attracted to the vicinity of the turbines and that further information is compiled on the WTE population on the wind farm site and the flight behaviours that could present a risk to WTE.
- **Other raptors and White-throated Needletail**. On site occurrence of these species will be recorded during the targeted eagle surveys described below.

In the event that threatened birds or threatened bats are found during carcass searches, or incidentally, an appropriate response will be identified in consultation with OEH, as described in the procedure in Section 6 of this BBAMP.

4.1.1. Birds of Prey (Raptors)

This group includes the diurnal raptors than have been recorded at FCWF, namely Little Eagle (listed Vulnerable in NSW), Wedge-tailed Eagle and Other raptors (Black-shouldered Kite, Brown Falcon, Brown Goshawk, Nankeen Kestrel, Black Kite). It will also apply to any other species of diurnal raptor that may occur at FCWF in future (e.g. Peregrine Falcon).

After operations commence, monthly monitoring of eagle flight movements and breeding activity is required to determine whether operating turbines affect the behaviour of Wedge-tailed and Little Eagles in particular. This raptor monitoring can be incorporated into the initial two-year monthly carcass monitoring program and will initially operate for the first two years of operational monitoring.

Monitoring will involve searching for flying eagles from the turbine search sites during searches (one scan every minute or so of searching) and incidental recording of raptors when moving between search sites.

Information recorded will include, as a minimum:

- Date location and duration of observation period (i.e. carcass search vs incidental),
- Time and duration of flight,
- No. and age of birds,
- Flight height above ground (range),
- Flight behaviour,
- Habitat over which the flight was observed,
- Flight behaviour observed included soaring, directional flight (flapping), kiting, circling, gliding and diving, and
- Other occasional behaviours included feeding, territorial displays, fighting and perching.

Flight paths will be plotted as accurately as possible on large-scale aerial photographs of the site.

In addition, nesting activity will also be recorded. Based on eagle flight behaviour observed while on site it will be possible to locate prospective areas within the wind farm for these nests. Any eagle nest locations will be recorded with GPS and revisited during the breeding season to monitor nesting activity and outcome (in August and November for Wedge-tailed Eagle).

The monitoring of birds as outlined above is likely to vary with potentially higher utilisation in spring-summer-autumn. However, consistent monitoring across all seasons will enable the identification of possible seasonal changes.

A series of adaptive management measures are proposed in this BBAMP to reduce the potential for high numbers of raptors to use the site. These are outlined in Section 5 of this document.

4.1.2. Migratory Bird Species

White-throated Needletail typically flies at and above RSA height. The initial two-year monthly carcass monitoring (during the appropriate season, October to early April) will monitor their presence and any impacts likely to occur from the FCWF (see section 3.3).

In addition, during the monthly carcass monitoring searches, if a flock of Needletails moves through the site, the numbers of birds and the zone of movement (where ascertainable) will be plotted on the large-scale aerial photographs of the site.

The same information will be recorded for any observed flight paths of Needletails as described above for raptors.

4.1.3. Other species of concern

All other bird species were considered to be at a 'negligible' risk rating. These species would be subject to the standard protocols post construction, i.e. any bird found during the carcass searches (Section 4,4) or by wind farm staff incidentally would be reported and stored in a freezer on site for confirmation of its identity and for use in trials.

4.2. Operational Bird Utilisation Surveys

Pre-construction surveys were conducted at FCWF. These surveys will be repeated one time when the wind farm is operational, with monitoring in Spring-Summer to replicate the 2018 surveys. These surveys will seek to demonstrate whether the site continues to be utilised by the range of species identified in the pre-construction surveys.

4.3. Bat Surveys

Initial pre-construction phase surveys reported a variety of bat species including one BC Act listed species, Yellow Bellied Sheathtail Bat. A number of threatened species are also considered likely to occur on site. Only the common bat species, particularly White-striped Freetail Bat were assessed as above a negligible risk (Table 6), therefore operational phase bat surveys are not considered necessary.

If an impact trigger occurs during routine carcass monitoring (see Section 6), additional surveys will likely be needed to inform a management response.

4.4. Carcass monitoring program

The purpose of carcass searches is to determine the actual impact of the wind farm on birds and bats by attempting to estimate the annual number of birds and bats that collide fatally with turbines. Mortality rates can be estimated for all bird species combined, and all bat species combined. If threatened species are found underneath a turbine, the mortality rate for that particular threatened species may also be estimated, subject to sufficient data being available.

Mortality is defined as any dead bird or bat detected under a wind turbine and within a distance of the turbine in which carcasses could potentially fall if struck. Detection can be either during the formal carcass searches (designed to generate an estimate in accordance with a statistically rigorous sampling design) or at other times (incidental observation, often by wind farm operational staff). A protocol is triggered whenever a carcass is found, either within the formal searches or incidentally to collect consistent and useful data on the fatality event (see below).

Collision by birds and bats with wind turbines will be monitored through a statistically rigorous carcass-search program for a minimum period of two years. This will involve systematic, monthly searches for dead bird and bat carcasses under a random selection of turbines (see details below). This will ensure statistically useable and robust results are generated from the carcass monitoring program that include an estimate of both bird and bat mortality rates, together with an estimate of sampling precision.

It will be assumed that any intact dead bird or bat, or bird feather spot (defined as a clump of five feathers or more), detected beneath a turbine has died as a result of collision or interaction with a turbine, unless there are obvious signs of another cause of death (e.g. being shot). Feather spots

will be assumed to be remains of a bird carcass after scavenging and the scavenger correction factor will not be applied to them (see later).

Ongoing monitoring of mortality from blade strike at operating wind farms typically serves to (i) provide data that can inform adaptive management of the collision risk (i.e. patterns of mortality related to seasonal changes or local conditions); and (ii) detect mortality of threatened and non-threatened bird and bat species, which can be used to understand actual bird and bat impacts.

The search protocol (see Section 4.4.2 below) has been designed to detect optimally species and groups of concern that have a higher than negligible risk of impact, as well as any other species that have fatally collided with turbines. The consistent application of this protocol will ensure that statistically robust, spatially and temporally consistent data are collected on bird and bat mortality.

To derive accurate mortality rates, it is essential that the program is scientifically and statistically robust. A number of factors, such as carcass scavenging and carcass detectability, can affect mortality rate estimates and must be measured and included in any estimate of overall mortality rates.

A scavenged carcass may increase the variability in mortality rate estimates and thus carcasses will be assessed for possible scavenging and rates will be estimated from experimental trials (section 4.4.3).

Human detectability of carcasses is also a potential confounding variable and protocols have been developed to control for this factor in the final mortality estimates. Section 4.4.4 provides more detail on this issue.

The practical considerations that have informed the design of the carcass search program and associated trials are listed below.

- Very few carcasses are found under wind turbines in Australia compared with Northern Hemisphere wind farms (i.e. on average, less than half the number in the Northern Hemisphere based on BL&A data across ten wind farms);
- Carcasses of a suitable range of sizes for scavenger and detectability trials are difficult to source and usually involve a combination of carcasses found under turbines and those found along roads and other legal sources. It is illegal to source un-cleaned carcasses from poultry producers.
- For statistical reasons, it is likely to be very difficult to determine more than the grossest of differences in scavenging rate or detectability across the year and there is no evidence in the literature for significant differences between seasons in scavenger activity. Therefore, annual scavenger and detectability correction factors will be generated and applied.
- 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 have been scheduled accordingly (see Section 4.4.4).

Similar methods have been recommended in a number of other approved bird and bat monitoring programs in New South Wales and Victoria (see section 1.1 for examples). Implementation of bird and bat monitoring programs in Australia continues to develop (since 1998), and the techniques described here are based on lessons from a number of such programs already implemented (e.g.

Hull *et al.* 2013, BL&A unpubl. data from ten projects), knowledge of experimental design and statistical analysis, and recent feedback from the regulatory authorities.

After two years of mortality monitoring, a detailed report will be prepared reviewing the mortality detection program and providing recommendations for the future in response to confirmed issues.

The following sections outline:

- **Turbine site selection for survey** (Section 4.4.1): how the wind turbines will be selected for the search
- **Search protocol** (section 4.4.2): the size of area beneath turbines to be searched and how this area will be systematically searched and results recorded
- **Scavenger rates and trials** (Section 4.4.3): definition of scavenging and how experimental trials will be conducted
- **Detectability and trials** (Section 4.4.4): definition of detectability and the experimental trial methodology
- **Incidental search protocol:** (Section 4.4.5): outlining the procedure to be adopted in the event of an incidental carcass or feather spot find by wind farm personnel outside the formal carcass-searches.
- **Analysis and mortality estimation** (Section 4.4.6): general outline of how the data will be analysed to gain estimates of bird and bat mortality.

4.4.1. Turbine Selection

The FCWF will comprise up to 38 turbines. Fifty percent of these will be searched during every scheduled search, including those in the north portion of the layout. This totals 19 turbines.

Each turbine will have the following recorded:

- Location (easting, northing)
- Distance to nearest other turbine
- Identification number of nearest turbine
- Local vegetation (type, height, and density during each search to document change in vegetation cover over time)
- Distance to key habitat feature, such as dam/wetland or waterway, or woodland remnant.

4.4.2. Search protocol

The search area beneath each turbine has been determined to best detect bats and medium to large bird carcasses, based on the turbine dimensions (Hull & Muir 2010). Based on the Hull and Muir model (2010) 95% of bat carcasses are found within 65m of the turbine, and carcasses of medium to large birds are reasonably evenly distributed out to 100m. Carcasses of very large birds (Wedge-tailed Eagle) may be found a little further out, but 95% are within 115m of the turbine.

Given this evidence, inner and outer circular search zones have been designated. The inner zone targets the detection of carcasses of bats and small to medium and large sized birds. In the inner

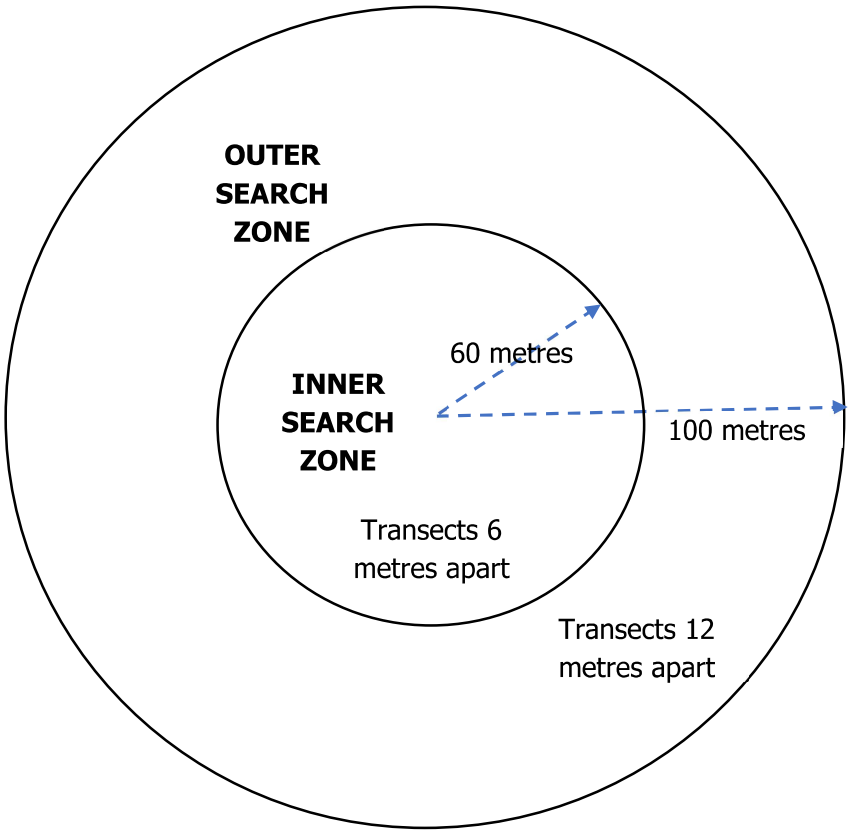
zone, a circle is formed with a 60m radius from the turbine and transects are spaced every 6m across this circle (Figure 3).

The outer zone will comprise the zone between the 60m and 100m radius circles. Although they are still recorded in the inner zone, the outer zone will ensure the adequate detection of carcasses of medium to larger sized birds, which can fall further away from turbines. Search transects in the outer zone are spaced at 12m and carried out from the edge of the inner zone out to the edge of the outer zone (see Figure 4). Given that the defined transect spacing and total search area are based on experience and evidence from previous studies (e.g. Arnett *et al*. 2005, Hull and Muir 2010) they are considered to be ample to detect bats and the bird species of concern arising out of the risk assessment.

All turbines will be searched out to 100m once per month. A second follow-up search, a 'pulse search' will be undertaken to 60monce a month within several days of the first search to detect additional mortality of bats and birds. The order of turbines searched will be randomized between searches.

All searchers will operate under the supervision of a qualified ecologist experienced in wind farm bird and bat monitoring, who will ensure adequate training in the monitoring methods and reporting requirements.

Figure 3: Inner and outer carcass search zones underneath the turbines



Carcass detection protocol

If a carcass is detected (a 'find') the following variables will be recorded in the carcass search data sheet (see Appendix 2):

- GPS position, distance in metres and compass bearing of the carcass from the base of the wind turbine tower;
- Substrate and vegetation, particularly if it was found on a track or hard-stand area without vegetation as this may assist in quantifying the number of carcasses not found in areas where ground cover makes carcasses less visible;
- Species, age, number, sex (if possible) signs of injury and estimated date of strike;
- Weather (including recent extreme weather events, if any), visibility, maintenance to the turbine and any other factors that may affect carcass discovery; and
- If the species is not able to be immediately identified as there is not a qualified ecologist on-site (i.e. an incidental find), photographs will be provided to the qualified ecologist within 2 business days of the find for identification and the ecologist must reply within 5 business days for the possible reporting of an impact on a threatened species within 2 business days of confirmation.

The carcass will be handled according to standard procedures, as follows:

- The carcass will be removed from the site to avoid re-counting;
- The carcass will be handled by personnel wearing rubber gloves, packed into a plastic bag, then wrapped in a sheet of newspaper then 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; and
- The double-bagged and wrapped carcass will be transferred to a freezer at the site office for storage so a second opinion on the species identity may be sought, if necessary, and for use in later scavenger and detectability trials.

It will not be necessary to obtain a permit to handle and keep native wildlife. In November 2017 the Threatened Species Conservation Act 1995 and parts of the National Parks and Wildlife Act 1974 were repealed and replaced by elements in the Biodiversity Conservation Act 2016 (BC Act).

Under section 2.8 (1)(a) of the BC Act, planning approvals under the Environmental Planning and Assessment Act 1979 provide a defence for activities that are necessary for carrying out development in accordance with the relevant approval.

As the possession of the carcasses, or injured wildlife, is required by the development approval associated with the wind farm (i.e. as prescribed in the approved BBAMP), an additional defence (in the form of a BC licence) is not required. The previous defence under the National Parks and Wildlife Act 1974 was limited to harm, whereas the defence under the BC Act now also includes possession.

4.4.3. Scavenger rates and trials

It will be important to ascertain the rate at which carcasses are removed by scavengers. This can be used to develop a 'correction factor' that informs the estimate of wind farm impacts on birds and

bats (mortality rate). Scavengers can include ground-based animals, such as foxes and rats (more likely to detect carcasses by scent), as well as aerial scavengers such as birds of prey and ravens (more likely to detect them visually). The scavenger trial described below is designed to ascertain the scavenging rate, usually expressed as average carcass duration in the field.

An intact carcass will be defined as a carcass that does not appear to have been scavenged by a vertebrate scavenger. A partially eaten carcass will be any skeletal or flesh remains found. Feather spots will be defined by their presence and the absence of any other remains (a feather spot being a cluster of five or more feathers). Intact or partial carcasses and feather spots will all be recorded as a 'find'. However, the scavenger correction factor will not be applied to feather spots as these are most likely to represent the remains of carcasses after they have been scavenged.

Scavenger trials will be undertaken twice for the first year of operational phase monitoring. The objective of having two trials is to account for different vegetation conditions, so one will be held when the grass is long and one when the grass is short. The two periods for scavenger trials are shown in the Table 8, below.

Table 7: Timing for scavenger trials

Vegetation condition	Likely time period	Weather	Stocking
Short grass	Winter (July)	Cold weather	Heavy stock levels
Long grass	Late Spring (November)	Follow rain and higher temperatures	Light stock levels

After the scavenger trials conducted in the first year, the need and frequency of further scavenger and detectability trials will be reviewed and discussed with OEH.

Scavenger Trials

Scavenger Trials will be undertaken by a trained person (see Section 4.5) to determine the rate of loss by scavengers, and the nature of removal by scavengers (e.g. an early peak in scavenging a peak after carcasses have been in place for a period of time). The search area for scavenger trials will be 60m from the base of the turbine within the inner search zone and will be located under randomly selected operating turbines.

To identify potentially different scavenging rates, three categories of carcass will be used (Table 8). Based on current mortality estimation software requirements, every endeavour will be made to find all carcasses of each category. Improvements on this method would require an impractical and unlikely availability of required carcass numbers, and do not lead to a commensurate improvement in the statistical power of estimates. In addition, large birds (raptor size) may be substituted with data from previous grouped studies with approval from OEH.

Table 8: Number of replicates for each scavenger trial

Observer	Micro-bat	Medium sized birds	Large birds (large raptor size)
Observer 1	10	5	5

Observer 2	10	5	5

Twenty carcasses in total will be randomly placed under different turbines for each observer. The carcasses will be checked daily for the first five days, then every 48 hours for the following four days and then every three days until day 18 followed by every four days until they disappear or at the end of 30 days (see Table 9).

Table 9: Scavenger trial search timetable

Day
Day 1
Day 2
Day 3
Day 4
Day 5
Day 7
Day 9
Day 12
Day 15
Day 18
Day 22
Day 26
Day 30

Additional information on scavenger trials is provided below.

- The timing of searches is based on experience and regulatory approval at a number of other wind farms (BL&A unpublished records) where scavenger trials have been undertaken that show almost all carcasses have been scavenged within five to ten days. More frequent monitoring than that proposed herein will not significantly affect consideration of scavenging and its impact on mortality estimates.
- A mix of small and medium to carcasses (if available) will be obtained for use in the scavenger trial. Where carcasses of the species of concern cannot be found, a similar-sized and coloured substitute will be used to reduce bias by visual predators.
- Latex gloves will be worn at all times while handling carcasses to minimise contact with human scent, which may alter predator responses around carrion and to minimise disease risk to the handler.
- At each trial site, one carcass (or more) will be placed randomly within the 60-metre search area. Carcasses will be thrown in the air and allowed to land on the ground to simulate at least some of the fall and allow for ruffling of fur or feathers.
- Carcasses used in the trial 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 evidence remaining at sites where carcasses have been scavenged (e.g. scavenger scats, bones, feathers, animal parts and type of scavenging) if visible, such as tearing, pecking, complete removal of carcass, partial removal of carcass, bird or mammal predator evidence).
- Notes will be taken on the state of remaining carcasses in each search.

Conduct of two scavenger trials at seasonally different times is designed to account for occasional winter/spring increase in carrion use by some scavenger species. Previous studies have found that Red Foxes are reliant on rabbits and carrion in agricultural and forested areas (e.g. Brunner *et al.*

1975, Catling 1988, Molsher *et al.* 2000). Feral cats show little but uniform use of carrion throughout the year, whereas fox prey type is dependent on availability (Catling 1988). Catling (1988) found that foxes ate more carrion in winter/spring compared with summer/autumn, when they fed on adult rabbits. However, Molsher *et al.* (2000) found that there was no overall significant difference between seasons for carrion use. Seasonal differences only occurred in other prey types (not carrion), such as lambs, invertebrates and reptiles, as these are only available at certain times of the year.

Scavenger trials for large raptors will only be conducted once per year due to lack of availability of suitable carcasses for a technically sound trial. Experience from other wind farms indicates a low level of scavenging of these carcases and a high level of detectability that is consistent across the year (BL&A, unpubl. data).

The number of carcasses per animal and size category is based on obtaining a reasonable level of statistical confidence in the estimate of average carcass duration, as reflected in software requirements for current mortality estimation processes, whilst seeking to minimise the number of carcasses used, as they can be difficult to source. Large numbers of carcasses (e.g. on-site, road-kill) are difficult to obtain and it may be very complicated to find alternative sources (e.g. farmed and culled animals). It is also possible that large numbers of carcasses, more size categories and more replicates may attract more scavengers to the area. Previous studies (e.g. Molsher *et al.* 2000) have shown that fox prey use is related to availability and therefore more foxes may be attracted to the area if more carcasses are used, thereby biasing the resulting correction factor. In addition, raptors are potentially more susceptible to collision when preying on carrion beneath turbines. However, it is necessary to conduct these trials under turbines as some scavengers may alter their behaviour in response to the turbines. The final scavenger trial design is therefore a necessary compromise between high numbers of trials and practicality whilst ensuring a statistically-valid trial design without altering either the behaviour of scavengers or the number of birds that may collide with turbines.

4.4.4. Detectability (Observer) trials

Detectability trials are conducted to test the rate at which the trained searchers detect carcasses under wind turbines. This enables a correction factor to be applied in calculating the rate at which turbines strike birds and bats.

As outlined above, all searches will be supervised by a qualified ecologist and undertaken by trained ecologists or personnel trained and regularly assessed by the ecologist.

The most efficient use of time is to conduct the detectability trials concurrently with the scavenger trials during the first day of placing the carcasses. As humans are reliant on visual cues to determine carcass location, the two visibility categories of low and high grass cover will be compared (as described in section 4.4.4).

To account for observer variability in detecting carcasses, only personnel who have carried out monthly searches at FCWF will be involved in the detectability trials. Detection efficiency (percentage of carcasses detected) will then be incorporated into later analyses that derive mortality estimates. The number of carcasses to be employed in each trial is detailed in Table 10 and explained 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 bats should be located within the inner, 60 metre search zone.

Table 10: Number of replicates per season for detectability trials, given two factors of size and visibility

Season	Micro-bat	Medium sized birds	Large birds (large raptor size)
Long grass / vegetated	10	5	5
Short grass	10	5	5

Analysis indicates that there is a large confidence interval on the estimate of searcher efficiency, even for a high number of trials (plus or minus ten percent even with 50 replicates). This means that only relatively large seasonal changes in detection (~20 - 30% or more) will be resolvable from normal background variation. Sampling will be undertaken during the two periods that represent the greatest change in vegetation cover (therefore visibility), using a number of carcasses that is logistically manageable and aligned with the number and timing of scavenger trials. Statistical confidence analysis indicates that this will result in a reasonably precise detectability estimate after one year, and optimal precision after two, although as second year of trials is not currently planned.

Any substitute carcasses for these trials will be of both similar size, colour and form to the species being represented or species of concern (i.e. brown mice rather than birds should be substituted for bats as birds do not have the same body shape, colour and appearance).

If sufficient carcasses cannot be obtained, then stuffed, realistic-looking artificial substitutes may be used. As humans are entirely visual searchers, it is not essential to use real carcasses as long as the substitutes appear similar once on the ground. It is considered to be more time efficient and cost effective to undertake scavenger and detectability (observer) trials concurrently.

4.4.5. Incidental Carcass Protocol

Personnel at the FCWF may from time to time find carcasses within the wind farm site during day-to-day operations and maintenance activities. In this case, the carcass will be handled according to the carcass detection protocol outlined in section 4.4.2. All wind farm personnel will be made aware of this carcass handling protocol as part of their HS&E training and induction. If the find is made within five days prior to a scheduled carcass search, the carcass will be left *in situ* but photographed and its position recorded (GPS). A carcass search data sheet (Appendix 2) will be completed for each incidental carcass found (whether removed or not).

This incidental carcass protocol is valid or the life of the wind farm project.

4.4.6. Analysis of results and mortality estimation

The results of the carcass searches will be analysed in order to provide information on:

- The species, number, age and sex (if possible) of birds and bats being struck by the turbines;

- Separate 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.

The search results will be detailed in the first annual report and the detailed analysis and estimates in the second annual report. The latter will identify if further detailed investigations or mitigation measures are required.

Statistically robust projections of bird and bat mortality for the entire wind farm site will be presented, based on the data collected from mortality searches. It is acknowledged that this is a current and dynamic aspect of research and that the outcomes from such programs may be equally dynamic. The current program is designed to provide an acceptably accurate and precise estimate of wind farm related bird and bat mortality within two years, so the full analysis and estimate will be provided in the second annual report, together with recommendations on the scope of future monitoring, if required.

All data will be analysed to provide the average estimated mortality of birds and bats, their standard error (variability) and ranges for the FCWF. The mortality rate of each species (if estimates for individual species are possible) and size class detected will be calculated after two years. 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. Where this is an issue, it will be reported. Mortality estimates will also take into consideration the actual operational time of the turbines (obtained from the project operator).

The estimated mortality rate will be generated by modelling the scavenger losses and results of the human detectability trials, and using sampling inference to account for the periods between turbine searches. The data from the scavenger and detectability trials will be analysed using relevant techniques based on Generalised Linear Modelling (GLM) and (censored) Survival Analysis. Censored measurements are only partially known, such as the exact time of mortality or the exact time to scavenge loss (see, for example, Kaplan & Meier (1958)). In addition to providing mortality estimates, this analysis will determine if any of the factors (i.e. size class or habitat stratification of turbine sites) are significant, where possible.

4.5. Personnel Involved

This section of the plan outlines the personnel involved and any training required for the field work and report writing necessary for this BBAMP. All personnel implementing this Plan will be trained thoroughly, including background theoretical training, knowledge of policies and other administrative matters (e.g. OH&S) and technical and field methods. FCWF will ensure that it engages suitably qualified and trained people to supervise and implement the monitoring program.

BL&A has been approved by DPIE as suitably experienced and qualified ecologists in relation to the implementation of this BBAMP. A suitably qualified ecologist with experience in supervising wind farm bird and bat monitoring programs will oversee in detail and be leading site implementation of the program, including the carcass searches, searcher efficiency trials and scavenger trials. Any person undertaking searches will be trained and supervised by the approved ecologist familiar with the techniques. The searcher will receive training from the qualified ecologist in the following areas:

- Turbine searches, including transect spacing in inner and outer zones, number and location of turbines to search and transect search methods;
- Equipment usage, such as GPS;
- Data recording;
- Carcass storage; and
- Species identification

The qualified ecologist will supervise the initial carcass search to ensure that field methods are being undertaken correctly and undertake an audit in the first three months to ensure that methods are being implemented correctly. The qualified ecologist will also be responsible for identifying any recorded carcasses from photographs or from specimens transferred to the freezer on site after searches.

The first searcher efficiency trial will be initiated and set up by the ecologist, who will also train a separate person (the 'carcass controller') to run searcher efficiency trials. Training will include:

- Correct preparation and handling of trial carcasses;
- Correct methods for the random placement of trial carcasses within a randomly selected sub-set of the search areas; and
- The need to place trial carcasses without the searcher knowing they are being placed.

If for some reason the searcher is unable to undertake the monthly searches as planned (due to illness etc) a back-up person will be identified in advance. If a back-up person is required to undertake searches, they will also be trained and supervised by a qualified ecologist and will participate in searcher efficiency trials.

The scavenger trials will be set up by the approved qualified ecologist, with searches being undertaken by the trained searcher.

Analysis of mortality data will be undertaken by the approved qualified ecologist with support from a statistician.

Annual reports and all investigations resulting from an impact trigger (see section 6) will be prepared by the approved qualified ecologist and subject to an internal peer review process.

4.6. Injured Bird and Bat Protocol

All on-site staff and monitoring personnel will be advised of the correct procedure for assisting injured wildlife. Wind farm personnel who find injured wildlife will be required to report the find to the wind farm site manager, who will be required to place the animal immediately into a dark place (e.g. box or cloth bag, if safe to do so) for transfer to the nearest wildlife carer or veterinarian.

Contact details of local veterinary staff and wildlife carers are provided below to ensure that if injured wildlife are found and cannot readily be released back to the wild, they are treated accordingly and in a timely manner.

- Orange Veterinary Hospital, 57 Molong Rd, Orange NSW 2800, Phone: (02) 6361 8388
- Cowra Veterinary Centre, 32 Grenfell Rd, Cowra NSW 2794, Phone: (02) 6341 3113
- WIRES, 02 6778 4994 or 1300 094 737

This Injured Bird and Bat Protocol is valid for the operational life of the wind farm.

4.7. Reporting and Review Meetings

In accordance with Project Approval Condition D4 (f), reports will be submitted to the Secretary and BCD on an annual basis for the first five years of operation. An annual report will be prepared within two months of the end of the reporting period. This annual report will focus on presenting the results of the mortality searches, any management measures implemented and recommending refinements to monitoring activities, if required. The second annual report will present the first full analysis of data collected and will be presented within two months of the end of the second year of monitoring. Matters to be addressed in this full report include, but will not be limited to:

- A brief description of the management prescriptions implemented and identification of any modifications made to the original management practices;
- The survey methods (including list of observers, dates and times of observations);
- Results of carcass searches and incidental carcass observations;
- Estimates of bird and bat mortality rates (per turbine per year) based on statistical analysis;
- Seasonal and annual variation in the number and composition of bird and bat strikes, where detectable;
- Any other mortality recorded on site but not during designated carcass searches (i.e. incidental records by site personnel);
- Identification of any unacceptable impacts or impact triggers, and application of the decision-making framework and relevant adaptive management measures;
- A summary of livestock carcass removal for the purposes of predator reduction;
- Details of any landowner feral animal control programs and their timing;
- A discussion of the results, including:
    - Bird risk reduction measures;
    - Any further recommendations for reducing mortality, if necessary;
    - Whether the level of mortality was unacceptable for affected listed ('at risk') species of birds or bats;
    - Usage of the wind farm area by species of concern at more than negligible risk and factors influencing this (ie. climatic, geographical and infrastructure);
    - Analysis of the effectiveness of the decision-making framework; and
    - Recommendations about further monitoring.

After the first two years of monitoring, the need for continuing the carcass monitoring program will be reviewed based on the results of the first two years of monitoring and recommendations of its continuation will be made in the second annual report. This will be done in discussion with OEH.

5. Mitigation Measures to Reduce Risk

Mitigation involves the prevention, avoidance and/or reduction of the risk of an impact trigger occurring or continuing to occur. An '*impact trigger*' is defined in Section 6 as a threshold of impact on birds or bats that triggers an investigation and/or management response. This section outlines such measures and addresses condition of approval D4 (e).

The overall objective of mitigation measures is to ensure that the operation of FCWF does not lead to significant impacts on threatened or non-threatened birds and bats. Any future novel or new mitigation measures that are identified to be of potential benefit for birds and bats at the FCWF should be incorporated into the plan as part of adaptive management, in consultation with the OEH.

5.1. Carcass (carrion) removal program and stock forage control

Land-use and stock management below and around turbines can influence the presence and behaviour of native birds on site. Examples that could elevate bird collision rates include:

- Grain feeding can attract parrots and cockatoos; and
- Carrion and rabbits can attract raptors.

This section proposes possible mitigation measures to address these matters.

A moderate risk to Wedge-tailed Eagle has been identified for FCWF. The eagle and other raptors forage for carrion (and the fresh or decaying flesh of a dead animal) and also on small mammals and rabbits. In order to reduce the risk of raptors colliding with turbines, a regular carrion removal program will be implemented during operations, to reduce the attractiveness of the site to raptors and therefore reduce the potential for fatal collisions by this group of birds. This program will focus on an area of a minimum of 200maround turbines, where safe, feasible and practical. The procedures below will be adopted.

- A designated suitable person will be appointed (such as a wind farm employee or landowner) to perform the function of Carrion Removal Coordinator who will ensure the activities described below.
    - Monthly inspections of the wind farm site to search for any stock, introduced or native mammal and bird carcasses (to be recorded as incidental finds) that may attract raptors (e.g. kangaroos, pigs, goats, foxes, rabbits, dead stock). This search will be undertaken via vehicle and visual checks in addition to using binoculars to look for larger carcasses within 200m of each turbine.
    - Additional, opportunistic observations by operators during normal inspections and work routines and by landowners as they travel around their properties provides further opportunity to identify and report carcasses of stock or feral animals so that timely collection can be undertaken to remove them. This can be addressed by operator and landowner protocols within the operational phase environmental management plan and associated procedures.
    - Any carcasses and/or remains found that are within 200mof turbines, will be collected and disposed of as soon as possible, in a manner that will avoid attracting raptors close to turbines.