WHITE ROCK WIND FARM
STAGE 1

BIRD AND BAT
ADAPTIVE MANAGEMENT PROGRAM

White Rock Wind Farm Pty Ltd

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Report No. 15009 (2.7)

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1. INTRODUCTION

White Rock Wind Farm is located in the New England Tablelands approximately 24km west of Glen Innes and 47 km east of Inverell (Figure 1). The wind farm straddles the Glen Innes Severn and Inverell Shires. Guyra Shire is to the south of the wind farm site (Figure 2). The wind farm is south of the Gwydir Highway and north of Maybole Road and varies in elevation from 1,000m to 1,400m.

In July 2012 the Minister for Planning & Infrastructure granted Project Approval MP10_160 for the White Rock Wind Farm under Section 75J of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project Approval was modified on 24 July 2015 and again on 1st April 2016 and authorises the construction and operation of up to 119 wind turbines and associated infrastructure, subject to the Terms and Conditions of the Project Approval. Stage 1 commenced construction in May 2016 and involves 70 wind turbines sites (Ffigure 2).

Condition C6 of the Project Approval requires the preparation of a Bird and Bat Adaptive Management Program (BBAMP) for the wind farm as set out below.

"**Bird and Bat Monitoring and Management**

C6. Prior to the commencement of construction, the Proponent shall 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;*
- *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 is, data may be required to be collected prior to the commencement of construction;*
- *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;*
- *d) identify 'at risk' bird and bat groups, seasons (such as wet seasons where bird species may be attracted to nearby wetlands) 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;*
- *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

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.

The Reports referred to under part (f) shall be submitted to the Secretary and OEH 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 reasonable and feasible mitigation measures as identified under part (e) where the need for further action is identified through the Bird and Bat Adaptive Management Programme, or as otherwise agreed with the Secretary."

This BBAMP fulfils the requirements of Condition C6 of the Project Approval and subject to BBAMP approval by DPE will be implemented for WRWF initially in relation to Stage 1 of WRWF development.

On 22 July 2015, the Secretary approved, under condition C6 of the Project Approval, the appointment of Brett Lane of Brett Lane and Associates Pty Ltd as the suitably qualified expert to undertake the Bird and Bat Adaptive Management Program.

1.1. BBAMP Objectives

The overall aim of this BBAMP is to provide a program for monitoring the impacts on birds and bats from WRWF –Stage 1 operation and an overall strategy for managing and mitigating any significant bird and bat impacts arising from the operation of WRWF.

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 conditions of approval, are detailed as follows:

- To implement a monitoring program capable of detecting any changes to the population of at risk birds and/ or bats that can reasonably be attributed to the operation of the project including pre- and post-construction presence;
- To directly record impacts on birds and bats through carcass surveys;
- To detail a decision-making framework that outlines the specific actions to be taken and possible mitigation measures implemented to understand and reduce any impacts on bird and bat populations that have been identified as a result of the monitoring, or in the event that an impact trigger[1] is detected;
- To detail specific monitoring for 'at risk' bird and bat groups, such as the Eastern Bent-wing Bat, other bats, and the Wedge-tailed Eagle, and include monthly

[1] Definition of 'impact trigger' and 'unacceptable impact' is detailed in section 7.1

mortality assessments, periodic local population censuses and bird utilisation surveys;

- To detail specific and 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:

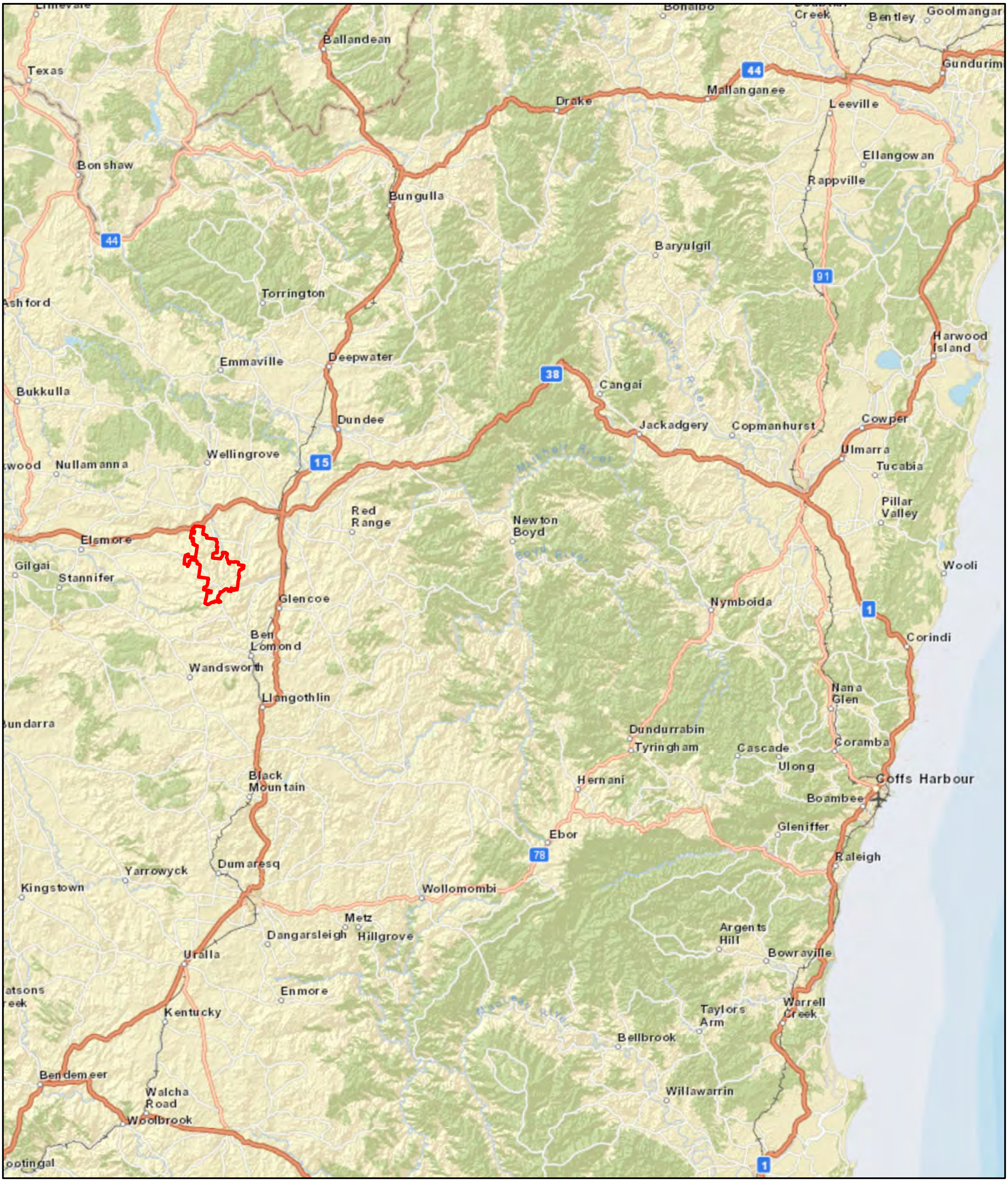
- Pre- and post-construction bat surveys (addressing the occurrence of the Eastern Bentwing Bat on the site)
- Post-construction carcass searches under operating turbines
- Statistical analysis of the results of carcass searches
- Reporting

This management 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 and assessment of issues. The expert approved by the Secretary of the DPE will be in charge of 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 Cullerin, Gullen Range, Taralga, Capital I and Woodlawn wind farms in NSW (BL&A 2011b &c, 2014), 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, 2011a, 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 with relevant experience who is approved by the Secretary of the Department of Planning and Environment (DPE).



Kilometers
0 10 20 40

Legend

Wind Farm boundary

Figure 1: Regional Location of White Rock Wind Farm		
Project: White Rock Wind Farm		
Client: Goldwind Australia		
Project No.: 15009	Date: 25/09/2015	Created By: M. Ghasemi

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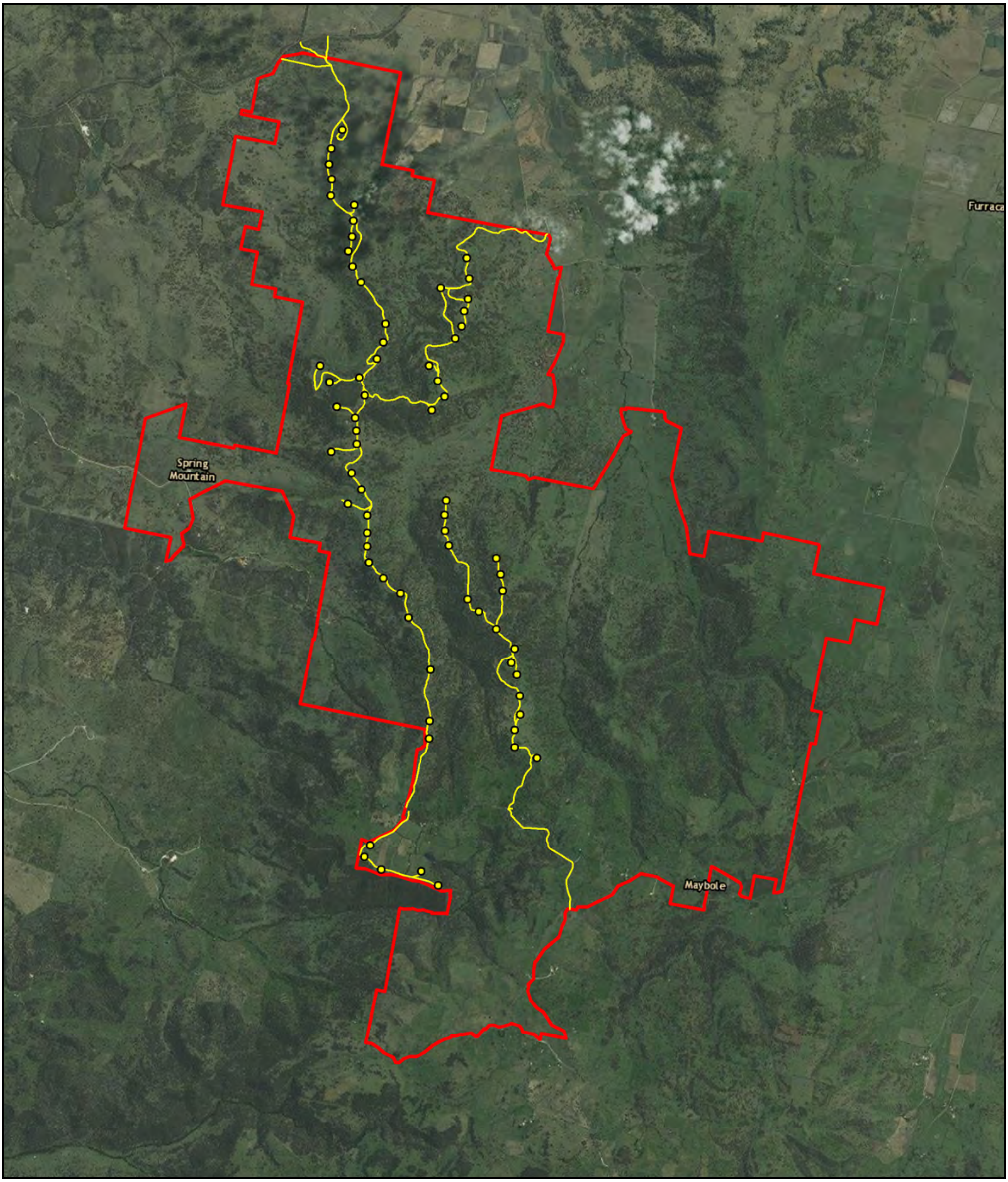

Legend

- Wind Farm boundary
- Tracks
- Turbines

Kilometers
0 1 2 4

Figure 2: White Rock Wind Farm layout		
Project: White Rock Wind Farm		
Client: Goldwind Australia		
Project No.: 15009	Date: 25/09/2015	Created By: M. Ghasemi

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1.2. Compliance Summary

The following table details which sections of the BBAMP addresses specific requirements outlined in the relevant Condition of Approval C6. The conditions of approval have been abbreviated but their full and correct wording can be found in the introduction.

Condition C6 for WRWF requires that this program be informed by AusWEA (2005), the Australian interim bird risk assessment standards for wind farms. The methods and reporting standards in this BBAMP have been adapted to reflect more recent technical development and regulatory input as well as the approval conditions.

Table 1: Sections within the BBAMP that respond to Condition of Approval C6 for White Rock Wind Farm.

Condition number	Abbreviated condition details	BBAMP Section/s
C6 (a)	*Incorporate an ongoing role for the suitably qualified expert*	1.1
C6 (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.*	4.1 to 4.4
C6 (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*	6.1, 6.2
C6 (d)	*identify 'at risk' bird and bat groups....and include monthly mortality assessments and periodic local population censuses and bird utilisation surveys;*	3.5
C6 (e)	*Identify potential mitigation measures and implementation strategies in order to reduce impacts on birds and bats....*	5
C6 (f)	*Identify matters to be addressed in periodic reports...*	4.7, 6.4
C6	*Submit reports to the Secretary on an annual basis ...*	4.7, 6.4

1.3. Site Description

White Rock Wind Farm site is located in the Northern Tablelands region of NSW (Figure 1). It lies on a series of higher ridges that have been used for decades for sheep and cattle grazing. These have been either completely or partly cleared of their original indigenous vegetation. As a consequence of the long grazing history, this vegetation lacks a diverse understorey and indigenous ground cover and introduced pasture grasses have come to dominate the ground cover. Much of the area has been subject either to past clearing or selective timber-getting. Consequently some of the trees are of a comparatively young age, or are of a species, that have less tendency to have hollows suitable for hollow-dependent fauna, such as the possums, gliders and large owls.

The avifauna of the site is typical of this part of NSW, with canopy-dwelling honeyeaters and insectivores dominating. The bat fauna has not been extensively studied. The slopes of some of the steeper ridges still support a relatively intact tree canopy that would provide fertile foraging areas for insectivorous bats. More details of the birds and bats of the site can be found in section 2 of this Program.

Habitat quality for birds and bats is considered to be low in the largely cleared parts of the site, moderate in most wooded areas and moderate to high in the wooded slopes in the southern and north-western parts of the site.

1.4. Pre-construction investigations of birds and bats at White Rock wind farm

- During the pre-approval and pre-construction phases of the development, investigations were undertaken by RPS Consultants. The data was collected during surveys between 25th September 2010 and the 1st October 2010. The methods and results of these investigations were included in the Ecological Assessment Report (RPS 2011) for the WRWF Environmental Assessment 2011 and are summarised in section 2.

1.5. Additional information

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

2. PRE-CONSTRUCTION BIRD AND BAT INFORMATION

The results of investigations documented in Section 1.4 above are summarised in this section of the BBAMP. This information has informed the risk assessment in Section 3.

2.1. Bird Utilisation Surveys (BUS)

2.1.1. BUS methodology

The methods and results of the Bird Utilisation Survey (BUS) are outlined in the report by RPS Consultants (2011). The data were collected during surveys between 25th September 2010 and the 1st October 2010, a time of year (spring) considered appropriate for gathering data representative of the bird fauna of the site.

One pre-construction bird utilisation survey was undertaken (RPS Consultants, 2011). This comprised:

- Recording bird species, flight height and behaviour at 18 different census sites placed in close proximity to proposed wind turbine locations
- Incidental observations while moving around the site:
- Call playback for Barking Owl, Masked Owl and Powerful Owl.
- Spotlighting from a vehicle.

2.1.2. Species Composition

Some 48 bird species were recorded from 18 survey sites. Thirty five of these were recorded from visual sightings and flight height data were collected. The remaining 13 species were recorded from calls and flight height data were not able to be collected. Table 3-2 in Appendix 1 provides the full list of birds identified, the number of times each species was recorded in each height zone, the preferred habitat type, typical movement pattern and typical flight speed category. Key findings included:

- A single threatened bird species, the Varied Sittella (*Daphoenositta chrysoptera)* was recorded on a single occasion. The Varied Sittella is listed as Vulnerable on the TSC Act.
- A single migratory species, the Rainbow Bee-eater (*Merops ornatus*), was recorded at two sites. The Rainbow Bee-eater is listed as a Migratory species on the EPBC Act.
- No other threatened or listed bird species were recorded within the White Rock Wind Farm site during the pre-construction bird utilisation surveys in 2010.
- Four species were recorded flying at rotor swept area (RSA) height i.e. 52 to 150m above ground level. These were:
  - The Wedge-tailed Eagle (*Aquila audax*)
  - Nankeen Kestrel (*Falco cenchroides*)
  - Galah (*Eulophus roseicapillus*)
  - Rainbow Lorikeet (*Trichoglossus haematodus*)
- Nine bird species were recorded in the height zone between 21 to 51 metres above ground level, which encompasses the lower part of the RSA.

- Twenty six bird species were recorded between zero and 20 metres above ground level, well below the height of the RSA.
- The most commonly recorded species were:
    - Red Wattlebird (*Anthochaera carunculata*)
    - Crimson Rosella (*Platycercus elegans)*
    - Rainbow Lorikeet (*Trichoglossus haematodus*)
    - Australian Magpie (*Gymnorhina tibicen*)

2.1.3. Notable observations from the BUS

Raptors

Two raptor species were recorded during the surveys, comprising fifteen observations in total. The two raptors were the Wedge-tailed Eagle and the Nankeen Kestrel. These were recorded flying at all height ranges.

Waterbirds

One waterbird species was recorded during the pre-construction BUS surveys, namely the Australian Wood Duck. None of the waterbirds observed at White Rock Wind Farm were threatened or listed species, either under Commonwealth or state legislation.

2.2. Bat Utilisation studies

2.2.1. Initial field survey – 2010

Methods

The methods and results of the pre-construction Bat Utilisation Studies at White Rock wind farm are outlined in the ecological Assessment Report (RPS Consultants, 2011). A total of 21 sites were sampled overnight using stationary ANABAT bat detectors during the period 25 – 30 September 2010. Survey locations were selected proximate to proposed wind turbines and sampled the range of habitat types and topographic locations within the wind farm site.

Results and species composition

Over the 21 recording nights, 128 bat calls were recorded representing an average of 6.1 calls / night, a relatively low figure. A total of five bat species were recorded during the survey period in 2010. These comprised the Eastern Bentwing-bat (EBB) (*Miniopterus schreibersii oceanensis*), Little Pied Bat (*Chalinolobus picatus*), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*) and White-stripe Freetail Bat (*Tadarida australis*). Of the five species recorded, a relatively high proportion were EBB calls.

Overall, sites in woodland vegetation (i.e. Ribbon Gum Woodland) had the highest levels of bat activity (as measured by number of detector passes) when compared with cleared sites with scattered trees. The Eastern Bentwing-bat was the most commonly recorded bat species and it was recorded at 11 out of 21 detector sites sampled. In forested habitats, this species flies above the canopy (greater than 18m at this site). Within open areas it has been recorded several metres from the ground (Churchill 2008).

There is no current evidence of caves supporting breeding colonies of bats within 30 km of WRWF. There is currently no evidence of bat roosting caves within the wind farm or within 30 km of it.

Threatened species

Of the five bat species recorded, two were threatened species. These were:

- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) – TSC Act-Vulnerable, was considered as recorded at 12 of 21 sites (8 sites confirmed, 2 sites probable, 1 site possible) within the study (see Appendix 1, Table 3-1). Under a precautionary principle all 'definite', 'probable' and 'possible' levels of identification were considered positive records.
- Little Pied Bat (*Chalinolobus picatus*) – TSC Act-Vulnerable, was recorded at the "possible" level of identification at two sites within the study area. Under a precautionary principle all 'definite', 'probable' and 'possible' levels of identification were considered positive records. This species has been listed as 'Vulnerable' under the TSC Act.

2.2.2. Intensive Pre-construction Bat survey - Spring 2015

As a response to the relatively high proportion of calls in the initial surveys being the Eastern Bentwing-bat, a more comprehensive survey was completed in November – December 2015 to identify bat utilisation of the site, particularly the use of the site by the Eastern Bentwing-bat and other listed bat species. This timing was chosen to focus on a period when the Eastern Bentwing-bat may have been migrating to its breeding caves (if they were in proximity to the wind farm).

Methods

The methods and results of the intensive pre-construction survey at White Rock wind farm are outlined in the White Rock Wind Farm, Bat Pre-construction Surveys, 2015 (BL&A 2016).

The survey period was between 17th November and 16th December 2015, totalling between 28 and 30 days per recording location. During the spring 2015 survey, a total of 40,821 recordings were made over the 230 detector-nights and analysed. A range of species were identified during the survey. However, only EPBC Act listed, TSC Act listed or unusual species were identified individually. The other species recorded were common and widespread species and only their presence or absence from sites was noted.

Of recordings, an estimated 36,739 calls, equating to 90%, were recognised as bat calls. The call detection rate averaged 160 calls per recording site per detector-night. This is a comparatively high number of general bat calls recorded when compared with other wind farm bat surveys of a similar survey effort (BL&A, unpubl. data) and may reflect the more extensive treed areas on the wind farm site.

Results

The overall level of bat activity during the survey was higher than during the initial, 2010 surveys, undertaken in late September, when the minimum evening temperature in Glen Innes (within 10 km and at lower elevation) was less than 10 degrees Celsius. The results of the 2015 survey are summarised below:

- Over 99% of the bats recorded during the survey were common and secure bat species;
- The survey confirmed at very low activity levels the following listed threatened species:
  - Eastern-bent Winged Bat (EBB) (*Miniopterus orianae oceanensis*) – TSC Act- Vulnerable;
  - Eastern Cave Bat (*Vespadelus troughtoni*) – TSC Act- Vulnerable; and
  - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – TSC Act- Vulnerable.
- The presence of the newly-recorded Eastern Cave Bat and Eastern False Pipistrelle is not unusual given the intensity of the survey. Both were recorded at very low activity levels indicating that a significant resident population of these bats is unlikely to be present on the wind farm. These species are now included in the risk assessment;
- The current survey confirmed the presence of the EBB on the WRWF site. However, the overall activity levels of the EBB recorded during the survey was comparatively low with a total of up to 25 potential EBB recordings over 230 detector-nights or 0.1 EBB recording per survey night. This confirms the initial finding that the EBB occurred at low activity levels (e.g. 14 calls over 21 nights confirmed in 2010);
- Given the survey results to-date, there is no indication that there is a large roosting cave for the EBB within WRWF or within 25 to 30 kilometres, given the usual flight distances of this species from its roosting caves. It is likely that the individuals moving through the WRWF site may be vagrants;
- This survey aimed to cover the spring-summer migratory movements of EBB. The study recorded no evidence of mass migratory movements at WRWF. The highest number of possible calls recorded in one night was nine. The closest maternity roosting site for EBB to WRWF is thought to be at Riverton, approximately 80km north of the wind farm site (RPS 2010);
- It is recommended that carcass searches be undertaken for two years post-construction. This will enable identification of any significant impact on these species; and
- Additional, targeted migration season carcass searches in addition to the regular carcass searches in the first two years are not warranted given the very low levels of activity during the spring migration season.

2.2.3. Conclusions from the pre-construction BUS and bat surveys

The conclusions from the BUS and bat surveys in the White Rock Wind Farm area are presented below.

In relation to birds:

- The study area comprised paddocks and grazing land with forested areas on the sides of many ridges dominated by an avifauna comprising common, widespread species characteristic of wooded farmland settings in south-eastern Australia.
- The study area supported two raptor species in low numbers: the Nankeen Kestrel and Wedge-tailed Eagle.
- One waterbird was recorded, namely the Australian Wood Duck. There are no significant wetlands anywhere near the wind farm site.
- Two species of listed birds were recorded utilising the study area: the Varied Sittella - TSC Act – Vulnerable; and the Rainbow Bee-eater (*Merops ornatus)* - EPBC Act –Migratory.

In relation to bats, the following species have been recorded at very low activity levels, reflecting the low likelihood that a significant population of them occurs on the wind farm site:

- Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*) – TSC Act- Vulnerable;
- Little Pied Bat (*Chalinolobus picatus*) – TSC Act- Vulnerable – possible records in low numbers
- Eastern Cave Bat (*Vespadelus troughtoni*) – TSC Act- Vulnerable; and
- Eastern False Pipistrelle (Falsistrellus tasmaniensis) – TSC Act- Vulnerable.

2.2.4. Establishing a baseline

The pre-construction bird and bat surveys do not provide sufficient detailed information for “Before-After-Control-Impact” (BACI) investigations pre- and post – construction to measure changes in utilisation of the wind farm by birds and bats (as per AusWEA 2005). However, the additional pre-construction bat surveys in 2015 did provide useful information to guide the risk assessment and scope the BBAMP.

Thus, for the risk assessment in Section 3, additional information has been utilized from other publically available reports (including planning documents from other proposed wind farms in the Glenn Innes region) on birds and bats found in the area. It is also includes species such as the Dusky Woodswallow was recorded on one occasion during the survey in spring and the Varied Sittella was recorded on one occasion during the survey in autumn.

3. RISK ASSESSMENT FOR WHITE ROCK WIND FARM

3.1. Introduction to the risk assessment

This risk assessment is an important step in the development of the BBAMP and after review of available information has been prepared for review by the Office of Environment and Heritage (OEH) as a basis for focussing the monitoring and investigations that will form part of this BBAMP on identified higher risk species and groups.

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 WRWF site and their likely behaviour on the site;

Section 3.3 provides an overview of the risk assessment method adopted, including the likelihood and consequence criteria and the risk matrix;

Section 3.4 presents the results and conclusions of the risk assessment and identifies the focus for the BBAMP for WRWF.

3.2. Introduction to the Risk Assessment for White Rock Wind Farm

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

- the NSW Bionet Atlas Search tool (OEH 2015a), using a 40 by 40 kilometre search region centred over the proposed WRWF site (searched in August 2015);

- the EPBC Act Protected Matters Search Tool (PMST) using a search region that included the proposed site and a 15km buffer zone (Department of the Environment 2015);
- the Ecological Assessment of the WRWF site in 2011 (RPS 2011);
- Pre-construction spring bat survey in 2015 (BL&A 2016)
- Assessments of the Bat Fauna at the nearby site of the proposed Glen Innes Wind Farm, NSW, approximately 5 km east of WRWF (Richards 2007, 2008); and
- Ecological Assessment for the nearby site of the proposed Sapphire Wind Farm, adjoining current study area to the north (EcoLogical 2011).

There are currently no operational wind farms within 50km of the study area.

3.3. Species and groups of concern

From these sources, a list of species with potential to occur on the WRWF site was generated (see Appendix 1). Of these, a short-list of species of concern was then generated based on the likelihood of occurrence on the WRWF site itself given the habitat present on that site.

The original site assessments (RPS 2011) identified threatened and listed migratory species likely to occur on the site, some of which were detected during on-site fauna survey work. Additional bat species were identified in the spring 2015 survey (BL&A 2016). Although this has been taken into consideration, a number of additional species and groups, including non-threatened species/groups, have been identified through the current review that were not originally considered. The rationale for the inclusion of the shortlisted species and groups can be found in Section 3.5. The short-listed species and groups are listed below.

EPBC Act Listed Migratory Species

- Fork tailed Swift
- White-Throated Needletail
- Rainbow Bee-eater
- Satin Flycatcher

EPBC Act listed threatened bats

- Large-eared Pied Bat (Vulnerable)
- Greater Long-eared Bat (Vulnerable)
- Grey-headed Flying-fox (Vulnerable)

TSC Act listed threatened birds

- Black Falcon (Vulnerable)
- Hooded Robin (south-eastern form) (Vulnerable)
- Diamond Firetail (Vulnerable)
- Little Lorikeet (Vulnerable)
- Little Eagle (Vulnerable)
- Scarlet Robin (Vulnerable)

- Spotted Harrier (Vulnerable)
- Turquoise Parrot (Vulnerable)
- Varied Sittella (Vulnerable)
- Dusky Woodswallow (Vulnerable)
- Brown Treecreeper (eastern subspecies) (Vulnerable)
- Speckled Warbler (Vulnerable)
- Barking Owl (Vulnerable)
- Powerful Owl (Vulnerable)

TSC Act listed threatened bats

- Yellow-bellied Sheathtail-bat (Vulnerable)
- Little Pied Bat (Vulnerable)
- Greater Broad-nosed Bat (Vulnerable)
- Eastern Bent-wing Bat (Vulnerable)
- Eastern False Pipistrelle (Vulnerable)
- Eastern Free-tail Bat (Vulnerable)

3.4. Eastern Cave Bat (Vulnerable) Risk Assessment Process

The objective of this risk assessment is to guide the development of the Bird and Bat Adaptive Management Program (BBAMP) for the White Rock Wind Farm by identifying those species or groups considered potentially at risk from either collision with turbines or disturbance by the operation of the wind farm. 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.

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, 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 ISO31000 Risk Assessment Standard (Rollason *et al* 2011).

The assessment requires criteria to be developed for likelihood and consequence. These criteria are provided in Table 2 and shows the risk levels used and how they are determined from the assessed likelihood and consequence levels.

Table 2: 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%)
5Unlikely	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 3: 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 4: 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. The reports below were used to determine the relevant likelihood and consequence of any impact.

3.5. Risk Assessment Results

Table 5 provides the results of the likelihood and consequence assessment based on the inputs from the aforementioned sources and includes the following information as part of the risk assessment process:

- Environmental value to be protected
- Reasons for Inclusion
- Threatened species status
- Hazard or source event
- Consequence score and likelihood scores
- Risk rating
- Comments relating to risk rating scores

Table 5 includes a summary of the previous findings for each considered species or group and their relevance to the assessment, which provides an explanation of why the particular likelihood and consequence ratings have been allocated.

The risk associated with wind turbine collision and indirect effects at the WRWF for most birds and bats was rated as **negligible**. The exceptions are described below.

The White-throated Needletail and Nankeen Kestrel (one of the 'other raptors' in Table 5) flies regularly at turbine height and flocks would pass over the WRWF site during the summer months. Collisions have been recorded at wind farms elsewhere in NSW and Australia. The risk to this species from the WRWF is considered to be **low** as the species is widespread and numerous in eastern and south-eastern Australia.

Given the occurrence of collisions involving the Wedge-tailed Eagle at many wind farms but a low incidence of disturbance and the presence of eagles at most wind farms, including successful breeding within 200 metres of operating turbines (BL&A, unpubl. data), risks to this species arise from likely collisions but not indirect disturbance. The risk to the Wedge-tailed Eagle from collision was therefore considered to be **moderate.**

Three bat species that have been recorded either at White Rock, Sapphire or Glen Innes Wind Farm sites and have been rated as having a **low** risk from collision with turbines. These are the Eastern Bent-wing Bat, Eastern Freetail Bat and Eastern Cave Bat.

Table 5: Bird and Bat Risk Assessment – White Rock Wind Farm

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
Birds							
Fork-tailed Swift *Apus pacificus*	Species or species habitat likely to occur within area	Listed Marine / Marine Migratory species EPBC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	Aerial, over inland plains, sometimes above foothills or in coastal areas, over cliffs and urban areas (Higgins 1999). Occurs over a wide part of Australia and infrequently in the area, often following weather fronts. Flies at turbine height. Collision likely to be infrequent due to irregularity of occurrence. Small numbers possibly affected do not represent a significant proportion of the total population, estimated as at least in the tens of thousands (Department of the Environment 2015b).
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Satin Flycatcher *Myiagra cyanoleuca*	Species or species habitat likely to occur within area	Listed Migratory species EPBC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	Occurs over a wide area of forests in Eastern Australia. Migrates across cleared ground between remnant treed vegetation. Numerous records in the wider region (BirdLife Australia 2015). Tends to move within treed habitats. Flight height on migration not known. Small numbers of individuals may migrate through the site and only a small proportion of these would collide with turbines. Small numbers that may be affected do not represent a significant proportion of the total population which occupies a large proportion of the forested country in south-eastern Australia (BirdLife Australia 2015) and likely numbers in the thousands.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
White-Throated Needletail *Hirundapus caudacutus*	Species or species habitat likely to occur within area	Listed Migratory / Marine species EPBC Act	Collision with operating wind turbines	Likely	Low	Low	Known to follow storm systems and fronts. Occasional mortality on other wind farms in its range and elsewhere. They typically fly 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 numerous in Australia (Department of the Environment 2015b), although no estimates of population are available.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Rainbow	Species was recorded on site foraging above	Listed Migratory / Marine species	Collision with operating wind turbines	Unlikely	Negligible	Negligible	Usually in open or lightly timbered areas, often near water. Occur in partly cleared land such as farmland

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
Bee-eater *Merops ornatus*	and within woodland canopies (RPS 2011)	EPBC Act	Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	and in sand-dunes, both coastal and inland (Higgins 1999). This species usually flies below RSA height. This species can fly at height, particularly when migrating. It has not been recorded colliding with wind turbines in Australia.
Brown Treecreeper *Climacteris picumnus*	This species was recorded at the Sapphire WF site (Eco Logical 2011) habitat may occur within area	Vulnerable TSC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	It occurs in woodlands dominated by eucalyptus, especially Stringybarks or other rough-barked eucalypts, usually with open grassy understorey (Higgins et al. 2001). This species usually occurs in the lower canopy and would not fly at RSA height.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Speckled Warbler *Chthonicola sagittata*	This species was recorded at the Sapphire WF site (Eco Logical 2011) habitat may occur within area	Vulnerable TSC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	It inhabits dry eucalypt forests and woodlands, especially those with box-ironbark eucalypt associations. It is also found in River Red Gum woodlands (Higgins and Peter 2002; Tzaros 2005). This woodland species does not fly at RSA height.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Little Eagle *Hieraaetus morphnoides*	Species or species habitat may occur within area, but was not recorded	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	The Little Eagle is distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range (Marchant and Higgins 1993).Turbine strikes of this raptor species could occur, however the species has not been recorded at the WRWF site although it was recorded approximately 10 km to the west of the wind farm in areas of lower elevation (O'Brien 2013). The species has not been recorded colliding with wind turbines and occurs in NSW at very low population densities so regular collision is unlikely. 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	
Black Falcon *Falco subniger*	Species or species habitat may occur within area	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	Negligible	This species occurs in woodlands, open country and terrestrial wetlands; in arid and semi-arid zones; mainly over open plains and undulating land with large tracts of low vegetation (Marchant and Higgins 1993).

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	Turbine strikes of this raptor species could occur, however the species has not been recorded at the WRWF site or other nearby areas surveyed recently for fauna. The species has not been recorded colliding with wind turbines and occurs in NSW at very low population densities so regular collision is unlikely. The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). Like other raptors, this species flies at RSA height but the lack of records and low frequency of occurrence make collision with turbines unlikely.
Hooded Robin (south-eastern form) *Melanodryas cucullata*	This species was recorded at the Sapphire WF site (Eco Logical 2011) habitat may occur within area	Vulnerable TSC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	Occur mostly in open Grey Box, White Box, Yellow Box, Yellow Gum and Ironbark woodlands with pockets of saplings or taller shrubs, an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter, with scattered fallen timber (Higgins and Peter 2002; Tzaros 2005). This species generally confines itself to areas of wooded country and does not fly at RSA height.
			Indirect disturbance, including barrier effects	Rare	Negligible	Negligible	
Diamond Firetail *Stagonopleura guttata*	Suitable habitat occurs within area. This species was recorded at the Sapphire WF site (Eco Logical 2011)	Vulnerable TSC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	Found in box-ironbark forests and woodlands and also occurs along watercourses and in farmland areas (Emison et al. 1987; Tzaros 2005). RPS (2011) concluded that it had a low chance of occurrence on the WRWF site. It has been recorded regularly inhabiting farmland around wind turbines in southern NSW where it has never been observed flying at RSA height.
			Indirect disturbance, including barrier effects	Rare	Negligible	Negligible	
Little Lorikeet *Glossopsitta*	Suitable habitat occurs within area.	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	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

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
pusilla	This species was recorded at the Sapphire WF site (Eco Logical 2011)		Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	large portion of the species' core habitat (OEH 2015b). Little Lorikeet are at risk colliding with turbines given their fast flight patterns and that they may fly at RSA height particularly when moving between feeding areas (EcoLogical 2011). There are no records of Little Lorikeets colliding with wind turbines. Their wide distribution and episodic occurrence in the area coinciding with eucalypt flowering events, which are sporadic, ensures they would only occasionally be likely to collide with turbines.
Scarlet Robin *Petroica multicolor*	Suitable habitat occurs within area. This species was recorded at the Sapphire WF site (Eco Logical 2011)	Vulnerable TSC 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 the nearby Sapphire WF site (EcoLogical 2011) indicate that Scarlet Robin flies at heights of 20 metres or less. This is below the RSA height.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Spotted Harrier *Circus assimilis*	Species or species habitat may occur within area	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	The Spotted Harrier prefers open woodlands that do not obstruct low flight, and natural and exotic grasslands in arid and semi arid areas (Higgins and Davies 1996). Turbine strikes may occur as there is one instance of the species colliding with a wind turbine. Due to the irregular occurrence of this species on the WRWF site, this will happen rarely. The widespread distribution of this species in Australia makes it highly unlikely that a rare collision event would have any population consequences.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Turquoise Parrot *Neophema pulchella*	Suitable habitat occurs within area. This species was recorded once at the Sapphire WF site (Eco Logical 2011)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	Negligible	Occur in eucalypt woodlands and open forests, with ground cover of grasses and sometimes low understorey of shrubs; usually in native grassy forests and woodlands composed of mixed assemblages of native pine and a variety of eucalypts. Also occur in savannah woodlands and riparian woodlands (Higgins 1999). This species flies fast and at a range of heights from high to low, depending on activity (Eco Logical 2011) and may be susceptible to colliding with turbines. It was not recorded at the WRWF site bit was once found once at Sapphire WF site (EcoLogical 2011).
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
Varied Sittella *Daphoenositta chrysoptera*	Recorded at WRWF (RPS 2011)	Vulnerable TSC 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 the past several decades. (OEH 2015b). It inhabits eucalypt forests and woodlands flying at canopy level. Varied Sittellas forage in groups, flying into the tree canopy and working down the branches and the trunk, probing through the bark in search of insects (Pizzey & Knight 2003). This species would not fly at RSA height.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Dusky Woodswallow *Artamus cyanopterus cyanopterus*	Recorded at WRWF BL&A 2017	Vulnerable TSC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	It is a partly migratory species that occurs in spring and summer in dry forest and woodland habitats in south-eastern Australia although some birds may be resident in northern New South Wales (Higgins et al. 2006). The species forages aerially in and around foliage and by sallying and screening and will join flocks of other aerial foragers such a White-browed Woodswallows Artamus superciliosus and Welcome Swallows Hirundo neoxena; it is known to sometimes forage at "great height" but this has not been quantified (Higgins et al. 2006). It is likely to forage at RSA height, putting it at risk from a collision with a turbine. Nevertheless, given its low frequency of occurrence at White Rock Wind Farm, its regional population would appear to be at little risk from the adverse affects of turbine mortality.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Barking Owl *Ninox connivens*	Species or species habitat may occur within area, but species was not recorded	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend into closed forest and more open areas. Although common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW (OEH 2015b). It is unlikely that this species commonly flies within the height range of the turbine blades for this proposal however, should turbine strike occur to individuals flying within the turbine blade height, it is highly likely that only a very small number of birds would be affected (RPS 2011).
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
Powerful Owl *Ninox strenua*	Species may occur within area, but was not recorded.	Vulnerable TSC 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 south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to the tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing (OEH 2015b). 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 their lives, Powerful Owls restrict their activities to forested habitat and do not fly often over open country. Dispersing juvenile owls may fly longer distances, including over open country, such as where turbines are located. The lack of records at WRWF and in nearby areas, possibly due to the sparse nature of the woodland in the area, make collision and disturbance an unlikely event.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Wedge-tailed Eagle *Aquila audax*	Recorded at WRWF (RPS 2011)	N/A	Collision with operating wind turbines	Almost Certain	Moderate	Moderate	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 New South Wales. Disturbance is not an issue, with the eagle breeding successfully as close as 200 metres from operating wind turbines. The regular incidence of collisions has the potential to affect the regional population (to be confirmed through further monitoring).
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Other raptor species	Recorded at WRWF (RPS 2011)	N/A	Collision with operating wind turbines	Likely	Low	Low	Turbine strikes by commonly occurring raptors, such as Brown Falcon and Nankeen Kestrel may occur, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these 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.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Waterbirds	Recorded at WRWF (RPS 2011)	N/A	Collision with operating wind turbines	Unlikely	Low	Negligible	Habitats on the WRWF site for waterbirds are limited to small farm dams. No large concentrations of waterbirds occur nearby. Experience at other wind

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	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 move across farmland frequently.
Bats							
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	Suitable habitat occurs within area. Recorded in low numbers at Sapphire WF site (Eco Logical 2011) and Glen Innes WF site (Richards 2008)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	Negligible	Known to occur in urban, agricultural semi-arid and tall wet forest habitats (OEH 2015b). Occurs in a range of habitats from rainforest to arid shrubland, roosts in tree-hollows. There are scattered records of this species across the New England Tablelands and North West Slopes. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. A very small number of this species was recorded at the nearby Glen Innes Wind Farm in 2007 (Richards 2008). There are no records of this species striking wind turbines to date, although it has the potential to fly at RSA height. The low numbers in the region make it unlikely to encounter turbines regularly or be regularly disturbed by them.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Little Pied Bat *Chalinolobus picatus*	Recorded in low numbers at WRWF (RPS 2011)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	Negligible	This species utilises a diverse range of woodland habitats for foraging. This species was recorded during field surveys at two sites within the WRWF site (RPS 2011). It is highly likely that only a very small number of bats would be affected (RPS 2011) as this species generally does not fly regularly at RSA height, confining its activities mostly to treed areas, presumably at canopy and sub-canopy height. It is unlikely regularly to occur at RSA height and therefore to collide with wind turbines.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Greater Long-eared Bat *Nyctophilus timoriensis*	Suitable habitat occurs within area. Recorded in small numbers at Sapphire WF site (Eco Logical 2011) and Glen Innes WF site (Richards 2008)	Vulnerable EPBC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	Occurs in dry woodland and shrubland communities in semi-arid regions (Menkhorst 1995). Not recorded on the WRWF site but considered likely to occur intermittently in low numbers (RPS 2011). As a small number of this species is likely to be affected, population impacts are not considered significant (RPS 2011).
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
Grey-headed Flying Fox *Pteropus poliocephalus*	Suitable habitat occurs within area.	Vulnerable EPBC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). The Grey-headed Flying-fox was not observed during surveys within the study area, but may occur on an intermittent basis during periods of heavy eucalypt flowering (RPS 2011). Few turbine strikes are expected for the life of the WRWF project.
			Indirect disturbance, including barrier effects	Rare	Negligible	Negligible	
Large-eared Pied Bat *Chalinolobus dwyeri*	Suitable habitat occurs within area. Recorded in low numbers at Glen Innes WF site (Richards 2008)	Vulnerable EPBC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	This species forages in tall open forests and the edges of rainforest. It roosts in caves, mine shafts and similar structures. It is unlikely to occur in the study area (RPS 2011).
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Greater Broad-nosed Bat *Scoteanax rueppellii*	Habitat may occur within area. Recorded at Sapphire WF site (Eco Logical 2011)	Vulnerable TSC Act	Collision with operating wind turbines	Rare	Negligible	Negligible	This species was not recorded during surveys at the WRWF site, however records exist in the region (EcoLogical 2011). This species is generally associated with forested riparian habitats such as in gullies along creeks and rivers below canopy height (OEH 2015b) and would be unlikely regularly to occur where turbines are located or at turbine height.
			Indirect disturbance, including barrier effects	Rare	Negligible	Negligible	
Eastern Bent-wing Bat *Miniopterus schreibersii oceanis*	Recorded at WRWF site (RPS 2011) and at Sapphire WF site (Eco Logical 2011)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	Negligible	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. This species may collide with turbines as it is known to fly at RSA height. The numbers on site are known to be low.. The nearest maternity site is c. 80 km away so impacts on breeding females are unlikely. Population consequences are therefore considered to be low to negligible.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Suitable habitat may occur within area. Recorded at Sapphire WF site (Eco Logical 2011) and Glen Innes WF site (Richards 2008)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Low	Negligible	Prefers moist habitats with trees taller than 20m. Roosts in tree hollows but has also been found roosting in buildings or under loose bark. Flies within or just below the canopy in gaps, along tracks, and also in open areas. (EcoLogical 2011)
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	

Value to be Protected	Reasons for Inclusion	Threatened species status	Hazard or Source Event	Likelihood of risk event	Consequence	Risk Rating	Comments
Eastern Freetail Bat *Mormopterus norfolkensis*	Suitable habitat may occur within area. Recorded at Sapphire WF site (Eco Logical 2011) and Glen Innes WF site (Richards 2008)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikely	Negligible	Negligible	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. It occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range (OEH 2015b). It flies preferably in open spaces in Woodland or forest (EcoLogical 2011). It has been recorded flying at RSA height (BL&A, unpubl. data) and may encounter turbines but none have been recorded colliding with operating wind turbines to date.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	
Eastern Cave Bat *Vespadelus troughtoni*	Recorded at Sapphire WF site (Eco Logical 2011)	Vulnerable TSC Act	Collision with operating wind turbines	Unlikey	Low	Negligible	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range. Very little is known about the biology of this uncommon species (OEH 2015b). It uses air space above creeks and in spaces between trees, interspersed with occasional rapid flights across paddocks (EcoLogical 2011). It is not known if it flies at RSA height in open country.
			Indirect disturbance, including barrier effects	Unlikely	Negligible	Negligible	

3.6. Conclusions from the Risk Assessment for White Rock Wind Farm

The knowledge generated at operating wind farms elsewhere in Australia (BL&A unpubl. data), indicate that bird and bat collision rates are typically less than two to four birds or bats per turbine per year. Based on this knowledge and the surveys of the WRWF and surrounding wind farm sites to date, this risk assessment indicates that no significant population-wide 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 WRWF 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 and a significant proportion of Australia's wind farms have experienced repeat fatalities of this species after operations have commenced.

White-throated Needletail is a migratory species considered to have similar flight behaviour to raptors. It should be noted that White-throated Needletail is listed as a migratory species under the EPBC Act and is unlikely to be locally common. Its conservation status is listed as secure both at a state and Commonwealth levels.

The bat utilisation survey for the WRWF recorded a relatively high usage of WRWF by bats, and detected the presence of low numbers of four species of bats listed as vulnerable in NSW under the TSC Act.

Many of the NSW threatened species (TSC Act) screened in this risk assessment are not at risk from the WRWF. Woodland birds and bats generally don't fly at RSA height and therefore do not regularly encounter turbines.

This risk assessment indicates that a small proportion of the species and groups of concern (two species of birds and the "raptors") have more than a negligible risk of being affected by collision with operating turbines once the WRWF is constructed. No birds or bats are assessed as being at risk from indirect effects, such as disturbance or barrier effects. The BBAMP for the WRWF will therefore focus on monitoring the collision risk to bats, Wedge-tailed Eagles and White-throated Needletails.

4. PLANNED PRE-CONSTRUCTION AND OPERATIONAL SURVEYS

A range of approaches will be utilised pre- and post-construction to meet the requirements of the relevant condition of approval (C6).

The main approaches to implementing the BBAMP will be:

- Establishing pre-construction baselines for species identified as "low-medium" risk in the risk assessment outlined in Section 3 above;
- 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 design) to detect birds and bats that collide fatally with wind turbines as a basis for an annual estimate of overall bird and bat mortality rates at the WRWF;
- Mitigation measures to reduce the possible interactions between birds and bats, and operating wind turbines.

A range of approaches will be utilised in future to meet the requirements of Condition C6, and more detailed descriptions of these approaches are described in this section of the BBAMP.

Sections 4.1 to 4.4 describe the survey methodologies (birds, bats and carcass surveys) that would be implemented once the BBAMP is approved by DPE and the wind farm becomes operational .

Pre-construction bat utilisation surveys have been carried out in September 2010 and November / December 2015 (spring and summer) to provide a basis for on-going adaptive management for bats, in particular surveys for the migratory Eastern Bent-winged Bat, which is listed as vulnerable under the TSC Act. Results of the 2015 survey have been reported (BL&A 2016).

Carcass-searches are expected to be carried out for a total of two years following commencement of the operational phase of the WRWF (potentially from late 2017), 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

Experience from other wind farms indicates that ongoing bird utilisation surveys (BUS) provide varying levels of information. A baseline was generated in the initial surveys in 2010 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 adequate for the purpose.

Thus, it is not recommended that additional "general" post-construction BUS surveys be undertaken at WRWF. More specific and targeted monitoring of "at risk" groups as presented below, and also monitoring (linked to impact triggers) would provide more useful information within an adaptive management framework for addressing the bird and bat impacts of the wind farm.

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

- **Wedge-tailed Eagles (WTE).** A moderate risk to WTE has been assessed (Table 5). Accordingly, it is important that mitigation measures are implemented, to reduce WTE being attracted to the vicinity of the turbines and that further information is compiled on the WTE population at the locality 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 above.
- **Threatened bats** (Eastern-Bent-winged Bat, Large-footed Myotis and/or Eastern False Pipistrelle).

Surveys for birds and bats are described in the Sections 4.2 and 4.3.

In the event that threatened birds (Scarlet Robin, Varied Sitella, Powerful Owl) 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.

4.2. Bird Surveys

4.2.1. Point Count Raptor and Needletail Utilisation Surveys

To provide information on the numbers and distribution of the Wedge-tailed eagle, raptors and Needletails on the WRWF site, eight point-based surveys (20 minutes duration) will be used to map flight paths of these species observed from key vantage points across the wind farm site. These points need to be chosen from a randomly located set of points, with the chosen point providing the best view of its nearby segment of the wind farm site and being practicable to access.

Information recorded will include, as a minimum:

- Date location and duration of observation period,
- 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, 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.

In addition to the formal, point-based counts, while moving about the wind farm, field personnel will record the same information for any observed flight paths of raptors or needletails.

In response to the OEH letter of 29 August 2016, a spring 2016 and autumn 2017 bird utilisation survey was conducted for White Rock Wind Farm. This was limited to the southern portion of the wind farm as construction was well underway in the northern portion. The finding of these surveys are outlined in the *Report 16064 (4.0) Pre-construction Bird Utilisation Survey Spring 2016 -Autumn 2017.* The conclusions from the this study included:

- The study area is largely made of cleared hilly farmland with scattered remnant trees or small copses and supported a low diversity and abundance of common, predominantly farmland birds.
- The diversity of birds was similar across seasons with common farmland birds dominating the species list.
- The most abundant raptor and waterbird species were the Nankeen Kestrel and Australian Wood Duck.
- The proportion of Wedge-tailed Eagles flying at RSA height was relatively high (87.5%) and were present in both spring and autumn.
- The study area supports very few other raptors or waterbirds, groups considered vulnerable to collision with operating wind turbines.
- Waterbirds were found to be largely confined to farm dams and were in low abundance with the exception of the Australian Wood Duck, which is a common farmland waterbird.
- Two species of threatened species were recorded in the surveys namely the Dusky Wood swallow- recorded on one occasion during the survey in spring; and the Varied Sittella- recorded on one occasion during the survey in autumn. Both species are considered to be at negligible risk from the operation of the wind farm. The risk assessment (Section 3) has been updated with the records of the Dusky Wood swallow. The Varied Sittella was already in the risk assessment.
- The two seasonal surveys adequately described bird life at the proposed wind farm and further pre-construction work is not required.

It is proposed that a spring survey a repeat survey of the BUS be completed in the first summer of wind farm operations (unless an impact trigger requires earlier investigation - see section 6).

4.3. Bat Surveys

The initial pre-construction bat survey for the WRWF in 2010 recorded a variety of bats however very few in total numbers, and a relatively high level of activity by the Eastern Bent-winged Bat, which is listed as vulnerable under the TSC Act in NSW. As the initial survey was completed in late September it was uncertain whether the level of activity provided a seasonal picture of bat movements on the site.

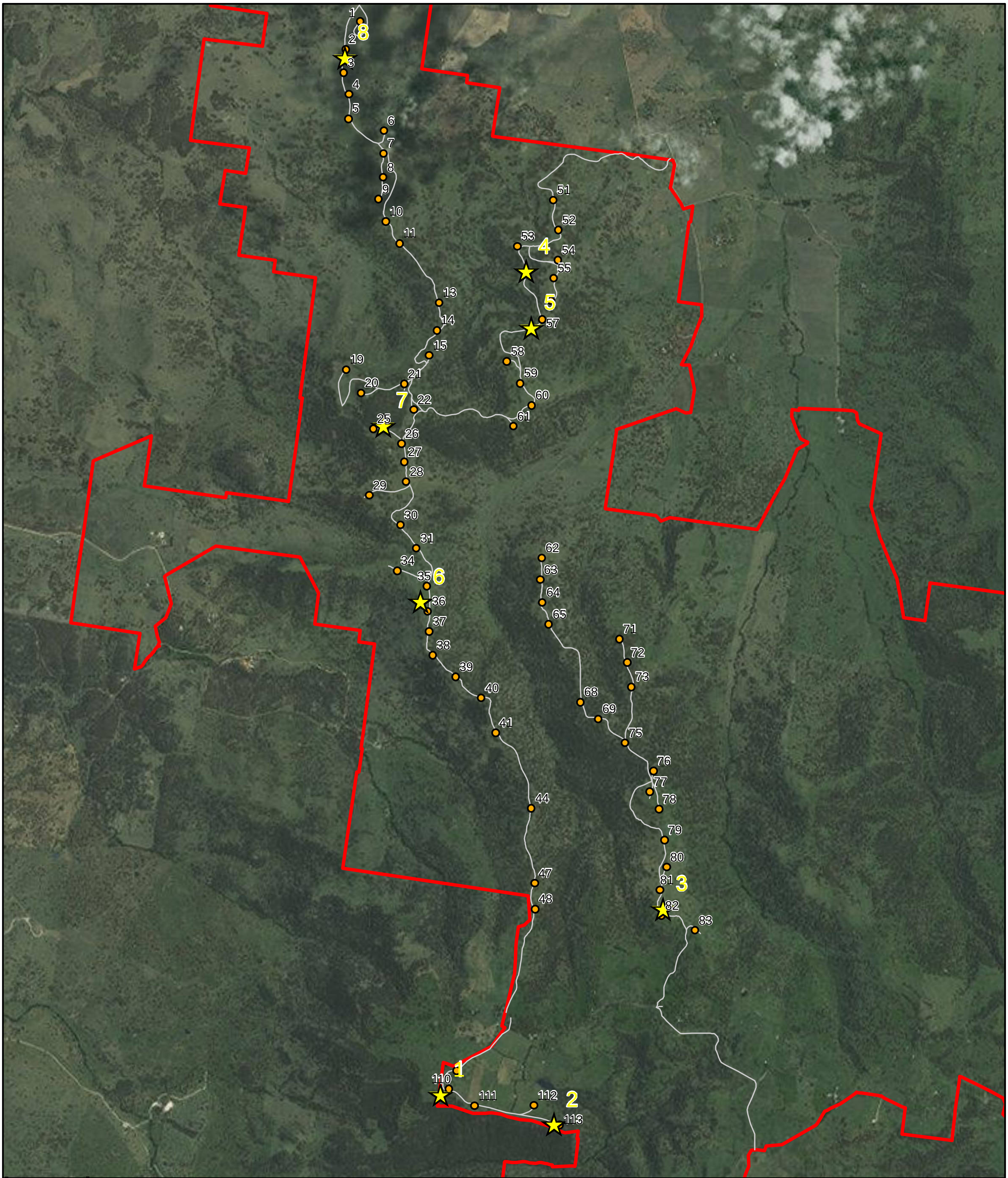
As a response to the relatively high level of calls of the Eastern Bentwing-bat in the initial surveys, an intensive survey was completed in November – December 2015 to identify bat utilisation of the site, particularly the use of the site by the Eastern Bentwing-bat and other listed bat species. This timing was seeking to focus on a period when the Eastern Bentwing-bat may have been migrating to its breeding caves.

The results provided in Section 2.2.2 are summarised below. The survey indicated:

- Over 99% of the bats recorded during the survey were common and secure bat species;
- The survey confirmed at very low activity levels the following species:
    - Eastern-bent Winged Bat (EBWB) (*Miniopterus orianae oceanensis*) – TSC Act-Vulnerable;
    - Eastern Cave Bat (*Vespadelus troughtoni*) – TSC Act- Vulnerable; and
    - Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – TSC Act- Vulnerable.
- No evidence of mass migratory movements at WRWF. The highest number of possible calls recorded in one night was nine. The closest maternity roosting site for EBB to WRWF is thought to be Riverton, approximately 80km north (RPS 2010);
- There is no evidence of known roosting sites for the threatened bat species within 30 km of WRWF;
- Additional, targeted carcass migration season searches in addition to the regular carcass searches in the first two years are not warranted given the very low levels of activity during the spring migration season.
- No additional post-construction bat utilisation surveys are considered necessary.

4.3.1. Post-construction bat utilisation surveys

The Spring 2015 pre-construction survey outlined in section 2.2.2 above did not identify high number of listed species, nor identify migratory bat species in high numbers. It is therefore proposed that the need for post-construction bat surveys will be guided by the results of the carcass searches. In this respect, if a significant impact trigger is identified through routine carcass monitoring (see Section 6), additional surveys may be needed to inform a management response.



Legend

- Songmeters
- Wind Farm boundary
- Tracks
- Turbines

0 0.5 1 2 Kilometers

Figure 3: Pre-construction bat survey locations (Nov - Dec 2015)

Project: White Rock Wind Farm

Client: Goldwind Australia

Project No.: 15009	**Date: 9/05/2016**	**Created By: M. Ghasemi**

N

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4.4. Carcass searches

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 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 has been designed to optimally detect key species of interest and also 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 these issues.

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 trials have been scheduled accordingly.

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 is still developing (since 1998), and the techniques described here are based on the number of 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.

Mortality detection is proposed to be carried out for two years of WRWF operation. 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 a 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

Turbines will be selected based on the rules below, which are based on a 'stratified random' sampling design.

- Each turbine within a stratum has an equal chance of being selected for the searches (randomly selected by number generation table);
- No stratum can have less than three turbines; and
- Once the turbines have been selected, the selection will not change.

The results from each stratum will be analysed separately to establish if there are differences in estimated mortality between them. They will then be combined for a whole-of-wind-farm mortality estimate using appropriate statistical methods for stratified estimates with constant selection probabilities within strata.

To ensure a valid dataset for statistical analysis, the mortality detection search will be based on 18 turbines (representing 25 % of the stage 1 turbines at the WRWF (see Symbolix letter - Appendix 3)), split into the four operational areas of WRWF (North east, North west, South East and South West – comprising the two chains of ridges).

The number of turbines searched has been determined based on what will provide the most accurate mortality rate given the high variability in detected carcasses shown on other wind farms, and that humans will have search limits (e.g. OH&S). Each turbine that is selected for the searches will have the following recorded:

- Location (easting, northing)
- Distance to nearest 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

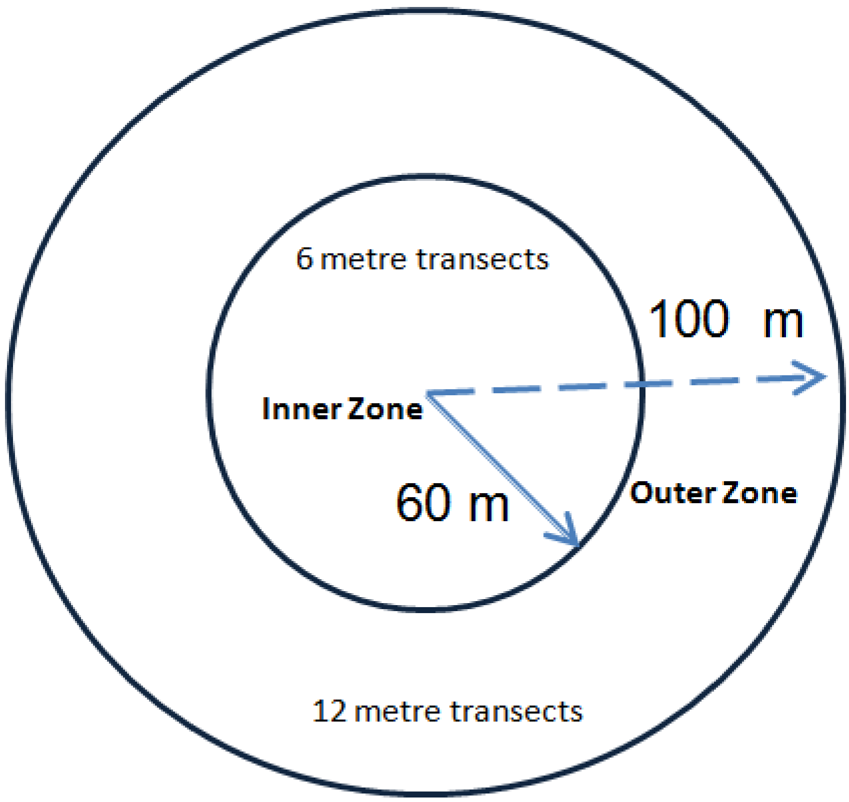
The search area beneath each turbine has been determined to best detect bats and medium to large bird carcasses, based on the turbine dimensions (Hull & Muir 2010). Based on the Hull and Muir model (2010) 95% of bat carcasses are found within 65 metres of the turbine, and carcasses of medium to large birds are reasonably evenly distributed out to 100 metres. Carcasses of very large birds (Wedge-tailed Eagle) may be found a little further out, but 95% are within 115 metres 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 60 metre radius from the turbine and transects are spaced every six metres across this circle (Figure 3).

The outer zone will comprise the zone between the 60 metre and 100 metre 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 12 metres 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.

In each stratum, all sampled turbines will be searched out to 100 metres once per month. A second follow-up search, a 'pulse search' will be undertaken to 60 metres once a month within several days of the first search to detect additional mortality of bats and birds. The selected turbines will be searched monthly and the order of turbines searched will be randomized, however the same turbines will be searched each month.

Figure 4: 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 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; and
- Weather (including recent extreme weather events, if any), visibility, maintenance to the turbine and any other factors that may affect carcass discovery.

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, wrapped in newspaper, put into a second plastic bag;
- The carcass will be clearly labelled to include the carcass to ensure that its origin can be traced at a later date, if required; and
- The 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 scavenger and/or detectability trials.

It may be necessary for the wind farm operator to obtain a permit from OEH under the *National Parks and Wildlife Act 1974* to handle and keep native wildlife (even dead wildlife) as part of the monitoring program. An application for this permit may need to be submitted in a timely manner to ensure approval has been obtained prior to commissioning of the turbines. It is likely that personnel undertaking activities consistent with this BBAMP once approved by DPE will not be acting illegally in handling and keeping wildlife carcasses. However, this will be clarified in advance of this requirement with OEH.

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. 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.

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 and fur 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/fur spots will all be recorded as a 'find'. However, the scavenger correction factor will not be applied to fur and feather spots as these are most likely to represent the remains of carcasses after they have been scavenged.

Scavenger trials will be undertaken twice for the first year of post-construction 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 6, below.

Table 6: 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, 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 (defined later) to determine the probability of scavenging loss, and the nature of scavenger removal (e.g. an early peak in scavenging, or scavenging that peaks after carcasses have been in place for a period of time). The search area for scavenger trials will be the same as in the search protocol (above) and will be located under operating turbines, selected based on the methodology outlined in section 4.4.2.

To determine potentially different scavenging rates on birds and bats, four size categories of carcass will be used. Different scavengers are active at different times of day and this will be accounted for by placing carcasses out during the early morning and late afternoon. This will reduce the potential for bias in the search intervals. Based on current mortality estimation software requirements, every endeavour will be made to find ten carcasses of each size category (Table 11). 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.

Table 7: Number of replicates for each scavenger trial

Time	Micro-bat	Small birds	Medium sized birds	Large birds (large raptor size)
Early Morning	5	5	5	5
Late Afternoon	5	5	5	5

The trials will be conducted at the same randomly-selected turbine sites used for mortality searches (see section 5.4.1). The first five carcasses of each category (twenty carcasses in total) will be randomly placed under different turbines in the morning (i.e. one carcass per turbine). Before placing the evening carcasses, the morning 20 will be checked, then each of the carcasses will be checked every 12 hours for the first three days, then daily for two days, then every 48 hours for the following four days and then every three days until they disappear or at the end of 30 days (see Table 11).

Table 8: Scavenger trial search timetable

Day (Time)
Day 1: Early morning
Day 1: Late afternoon
Day 2: Early morning
Day 2: Late afternoon
Day 3: Early morning
Day 3: Late afternoon
Day 4: Anytime
Day 5: Anytime
Day 7: Anytime
Day 9: Anytime
Day 12: Anytime
Day 15: Anytime
Day 18: Anytime
Day 21: Anytime
Day 24: Anytime
Day 27: Anytime
Day 30: Anytime

Additional procedures for scavenger trials are 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 very large bird and bat 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, depending on the search protocol for that turbine. 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.

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 birds that may collide with turbines.

4.4.4. Detectability (Observer) trials

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.

Detectability trials will be undertaken to assess the probability that a searcher will detect an existing carcass, given the prescribed mortality search protocol detailed for monthly carcass searches in section 5.4.2 (i.e. searching along the six metre and 12 metre transects). The most efficient use of time is therefore to conduct the detectability trials concurrently with the monthly searches. 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 4.4.3).

To account for observer variability in detecting carcasses, only personnel who have carried out monthly searches at WRWF 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 12 and explained below. The carcass controller (a person not involved in monthly carcass searches who can act consistent with this method) 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 how many are deployed under each turbine, however all bats should be located within the inner, 60 metre search zone.

Table 9: Number of replicates per season for detectability trials, given two factors of size and visibility

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

Table 9). Statistical confidence analysis indicates that this will result in a reasonably precise detectability estimate after one year, and optimal precision after two.

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. Additionally, the artificial substitutes will not attract scavengers and should not increase the likelihood of raptor collisions and the number of introduced predators on site. As these trials can be undertaken separately from scavenger trials, artificial substitutes may be ideal (i.e. mice substitutes for bats). Note, however, that it is considered to be more time efficient and cost effective to undertake scavenger and detectibility (observer) trials concurrently.

4.4.5. Incidental Carcass Protocol

Personnel at the White Rock Wind Farm may from time to time find carcasses within the wind farm site during normal day-to-day O&M activities. In this case, the carcass will be handled according to standard procedures outlined in section 4.3.2. 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 4) will be completed for each incidental carcass found.

4.4.6. Analysis of results and mortality estimation

The results of the mortality monitoring surveys 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.
- Any variation in the number of bird and bat strikes.

The results will be detailed in the annual report and will provide a basis for identifying 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 a 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 WRWF. The seasonal and annual mortality of each species (if estimates of individual species are possible) and size class detected will be calculated. If possible, the standard error and range of these estimates will be reported. Note that it may not be possible practically to provide this for each factor 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 selection and stratification of turbines. 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.

Results will be reported in a way that gives as much information as possible and with an accurate interpretation of the data. As stated above, it will be possible to provide the number, average (with attendant standard error) and other basic statistics of recorded fatalities per study population (e.g. size class) for the sampling time/effort. All species carcass data will be analysed and presented, if possible, with species-specific information.

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 working on 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. WRWFPL will ensure that it engages suitably qualified and trained people to supervise and implement the monitoring program.

Brett Lane and Associates, a suitably experienced and qualified ecologist, has been approved by DPE. Brett Lane 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 a qualified ecologist who is familiar with the techniques and has applied them at other sites. The searcher will receive training from the qualified ecologist in the following areas:

- Turbine searches i.e. transect spacing in inner and outer zones, number and location of turbines to search and transect search methods
- Equipment usage i.e. GPS
- Data recording
- 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 qualified ecologist, with searches being undertaken by the trained searcher.

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

Annual reports and all investigations resulting from an impact trigger (see section 6) will be prepared by a 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.

- Glen Innes Veterinary Surgery, 220 Herbert St, Glen Innes NSW 2370 Phone:(02) 6732 1988
- WIRES, 02 6778 4994 or 1300 094 737
- RSPCA: Glen Innes Volunteer Branch, Phone: 0487 824 790
- Northern Tablelands Wildlife carers: 1800-008-290

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 C6, reports will be submitted to the Secretary and OEH on an annual basis. An annual report will be prepared within three months of the completion of the first year of operation phase monitoring. This annual report will focus on presenting the results of the mortality searches, analysis and recommending refinements to monitoring activities, if required. The second annual report will present the first full analysis of data collected. 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 (avifauna impacted 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:
    - Whether indirect impacts on bird and bat use of the site are of significance at a regional, state or national level, or if species of concern have been affected.
    - 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.

- o Usage of the wind farm area by 'at risk' species and factors influencing this (ie. climatic, geographical and infrastructure).
- o Analysis of the effectiveness of the decision-making framework.
- o Recommendations for further monitoring.

4.7.1. Comparison of pre and post construction bat utilisation surveys

A pre-construction bat utilisation survey has been completed for WRWF. Post-construction monitoring of bats will be through the carcass searching regime. Should a significant number of bats be recorded as fatalities the possibility for additional post-construction bat utilisation surveys will be considered in the first two years.

4.7.2. Review of BBAMP and adjustment of monitoring regimes

The BBAMP will be reviewed on an annual basis in terms of its effectiveness together with consideration of the intensity of effort and resourcing, and emerging understanding of the level of risk to avifauna.

At the end of the first year of operation phase monitoring, an overall assessment will be made of all the data obtained during this phase, and details of the management practices implemented, as well as recommended adjustments to the second year of monitoring. The results of the review and its implications will be discussed with OEH.

Annual reports prepared beyond the first year will include the results of any monitoring activities undertaken for that year and a discussion regarding any impact triggers or unacceptable impacts identified, mitigation measures implemented and application of the decision making framework (see section 6). As this management plan is adaptive, further refinements to the program will be included in annual reports following the first year of post-construction monitoring and will be based on the outcomes of monitoring surveys and any impacts, in consultation 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 7 as a threshold of impact on birds or bats that triggers an investigation and/or management response. This section outlines measures that will be undertaken during operation of the wind farm to prevent or reduce the potential for an impact to occur, and addresses condition of approval 3.1 (e).

The overall objective of mitigation measures is to ensure that the operation of WRWF does not lead to unacceptable impacts on threatened or non-threatened birds and bats.

5.1. Carrion removal program and stock forage control

A moderate risk to WTE has been identified for WRWF. 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 chances of fatal collisions by this group of birds. Carrion is defined as the dead and decaying flesh of an animal that often serves as a food source for animals.

To provide for the regular removal of carcasses likely to attract raptors to areas near turbines the procedures below will be adopted.

- Designate a suitable person (such as a wind farm employee or landowner) to perform the function of Carrion Removal Coordinator who will undertake 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 large carcasses within 200 metres 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.
    - Any carcasses and/or remains found that are within 200 metres of turbines, will be collected and disposed of as soon as possible, in a manner that will avoid attracting raptors close to turbines. In addition, any other carrion observed in proximity to site roads and infrastructure will be collected and disposed of.
    - Consult with landowner or site or asset manager in relation to the appropriate disposal of collected carrion, to be located at least 200 metres away from the closest turbine.
    - Wind energy facility maintenance staff and landowners will be required to notify the Carrion Removal Coordinator immediately following identification of carrion on site in between monthly searches.
    - Carcass occurrence and removal will be recorded in a "management log book" maintained by WRWF asset manager.

- During lambing season (usually late autumn / winter) young lambs are susceptible to death. Therefore, if possible and subject to agreement of landowners, lambing will be restricted in paddocks at least 200 metres away from turbines to reduce the risk that raptors (Wedge-tailed Eagles in particular) are attracted close to the turbines.
- In order to reduce collision risks to birds, the practice of feeding stock close to turbines should be discontinued when the wind farm starts operation as it could cause unnecessary impacts. As such, with landowner agreement and where practicable, stock will not be fed grain within a 200 metre radius of wind turbines as this may also attract parrots and cockatoos that can then collide with turbines.
- Any feral animal control on the wind farm site should involve the removal and appropriate disposal of resulting carcasses.
- If a large number of rabbit or other feral animal carcasses or active rabbit presence are incidentally observed during monitoring surveys, it may be necessary to conduct an integrated rabbit control program (to reduce site attractiveness to Wedge-tailed Eagles) within 200 metres of turbines. Methods to control rabbits include borrow destruction, poisoning and shooting (DPI 2014). Any rabbit control program will require cooperation and agreement from the landowner.
- An annual summary of carcass removal, based on the 'management log' will be provided in the annual monitoring reports.

The need for continuation of the carcass removal program and effort required will be assessed after one year of operation. In general, the criteria for continuation will be based on the frequency of carcass finds. For example, if carcass frequency is particularly low (e.g. one or two per quarter) outside of turbine search zones (i.e. not beneath turbines) the intense program may be discontinued or reduced considerably, subject to agreement from OEH. Alternatively, if peaks occur at specific times with intervening periods of low numbers, the effort may be focussed on the peak periods.

5.2. Lighting on turbines and buildings

It has long been known that sources of artificial light attract birds, as evidenced by night-migrating birds in North America and Europe. Lighting is probably the most important factor under human control that affects mortality rates of birds and bats colliding with all structures (Longcore, et al. 2008). Most bird mortality at communication towers for example, occurs in poor weather with low cloud in autumn and spring, i.e. during migration periods (Longcore, et al. 2008).

It is postulated that bright lights may temporarily blind birds, particularly those accustomed to flying at night or in low light conditions causing them to fly toward the light source and collide with the structure (Gauthreaux and Belser 2006). They would appear prone to saturation of their retinas, causing temporary blindness when subjected to bright light (Beier 2006) and mortality of both birds and bats can result from collisions with lit structures. Birds can also become disoriented or 'trapped' in the field of light (Longcore *et al.* 2008).

Bats are also attracted to the increased numbers of insects that may congregate near bright light sources.

Measures to reduce the impact of lighting include using low pressure sodium or mercury lamps with UV filters to reduce brightness. The colour of lighting may also be important.

Some studies have found that red lights resulted in a lower mortality than white lights (Longcore *et al*. 2008), but more recent research on oil rigs at sea suggests that blue or green lights may result in lower mortality than red or white lights (American Bird Conservancy 2014).

For the above reasons, building lighting should be baffled and directed to avoid excessive light spillage and security lighting should be baffled to direct it towards the area requiring lighting and not skyward.

5.3. Marking of power lines

Any new section of powerlines constructed as part of the WRWF wind farm development will be inspected periodically by the wind farm staff. If regular bird mortality is detected, consideration will be given to marking the powerline to reduce the number of birds affected.

6. IMPACT TRIGGERS AND DECISION-MAKING FRAMEWORK

This section identifies the circumstances that will result in notification, further investigation and additional mitigation for both threatened and non-threatened birds and bats ('impact triggers'). If an impact trigger is met, there must be an investigation into the cause of the impact, and whether the event was likely to be a one-off occurrence or occur regularly.

The impact trigger may be an unacceptable impact in itself, or may lead to an unacceptable impact.

Note that the approach developed in this section is based on the preparation of numerous bird and bat monitoring programs for wind farms in both New South Wales and Victoria, and up to date feedback from regulators on the implementation of approved plans (see section 1.1 for details).

Ultimately, the asset manager will be responsible for implementation of this BBAMP and the decision-making that goes with it, with technical support provided by the approved expert.

6.1. Threatened Species

6.1.1. Definition of Impact Trigger and Unacceptable Impact

Generally, an impact trigger is where there is evidence of death or injury to birds and/or bats by collision or other interaction with turbines. Under this program, the circumstances that define an impact trigger and unacceptable impact for threatened birds and/or bats are detailed below.

Impact Trigger for Threatened Species: A threatened bird/bat species (or recognisable parts thereof) listed under the Commonwealth *EPBC Act* or NSW *Threatened Species Conservation Act 1995*, is found dead or injured under or close to a wind turbine during any mortality search or incidentally by wind farm personnel.

Definition of Unacceptable Impact on Threatened Species:

- Where population numbers are known and reported by OEH for the period concerned, an unacceptable impact is any impact that is likely to reduce the total species' population by more than 1% over a five year period; OR
- Where population numbers are not known, an unacceptable impact is more than three carcasses found of one threatened species over a two month period.

6.1.2. Decision Making Framework and Reporting

If a threatened species impact trigger occurs, further investigation will immediately be triggered and the decision making framework outlined below and in Figure 5 will be followed. This section complies with Condition 3.1 (c) of the conditions of approval.

- Immediate reporting of the occurrence of an impact trigger to WRWF's responsible manager, who will report it to the relevant statutory planner at OEH (Armidale) within two business days of it being recorded;
- Immediate investigation (to be completed within 10 days) by an appropriately qualified ecologist to determine the cause of death or injury. If the cause of death is considered to be due to turbine collision, an investigation will be undertaken to identify any

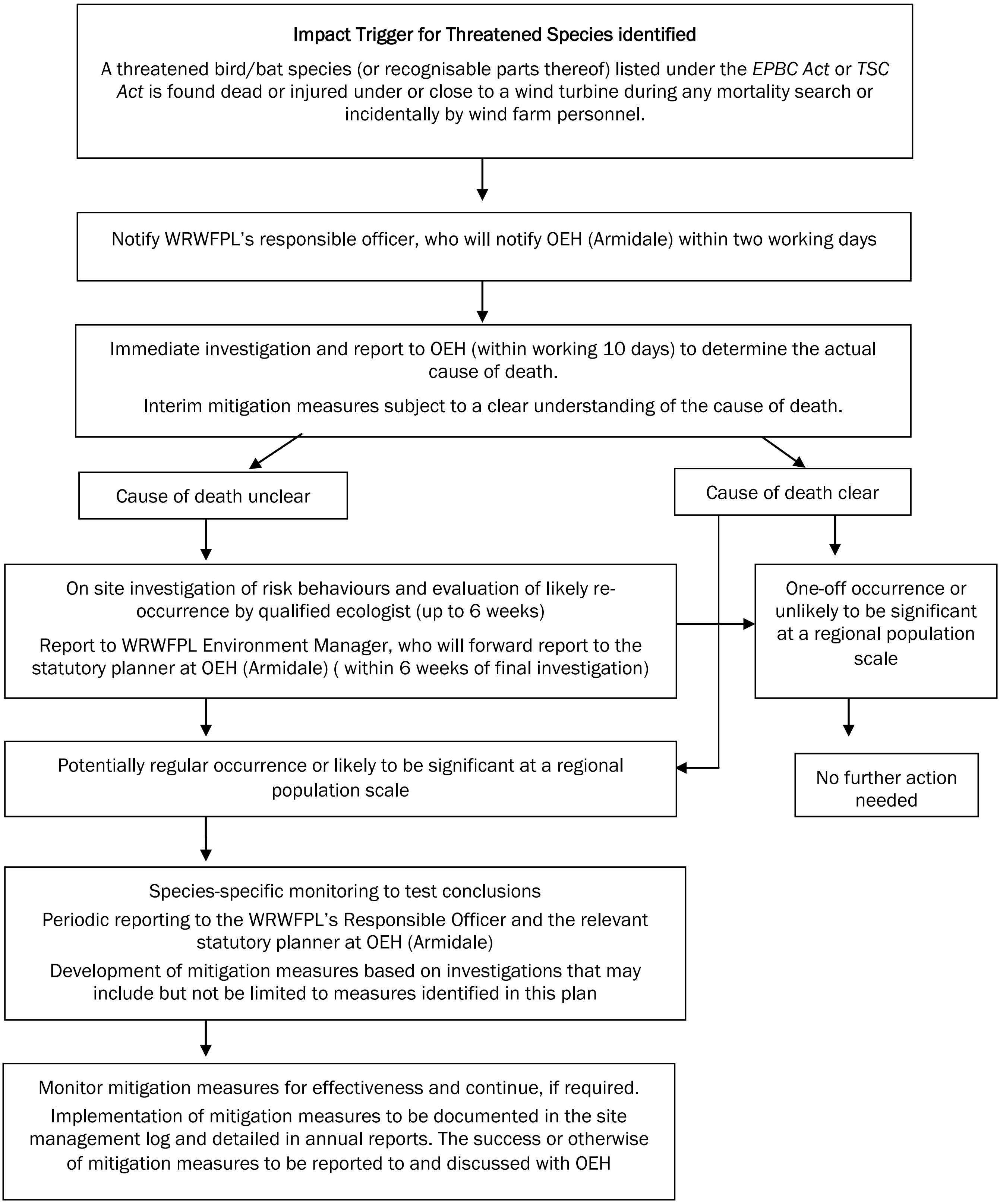
particular risk behaviours that could have led to the collision and an evaluation of the likelihood of further occurrences. The impact trigger may be one-off or cluster events.

- The rapid 10 day investigation will assess, if possible, the most effective mitigation and will ensure that the mitigation is implemented correctly and quickly. The investigation will aim to provide a clear understanding of the cause of the impact, where required, informed by on-site investigations of the occurrence of the species on the wind farm site.
- If following this investigation, the fatality is deemed to be a one-off occurrence or the ongoing risk is unlikely to be significant at a population scale, further action is not considered necessary. This decision will be made in consultation with OEH and will be determined based on available evidence and using a precautionary approach. Note that the successful execution of this requirement relies upon OEH providing timely and definitive input to this process.
- If the cause of the impact trigger is not clear, further on-site investigation of risk behaviours and evaluation of likely re-occurrence will be required over the following weeks. If these investigations suggest that the impact trigger was a one-off event or the ongoing risk is unlikely to be significant at a population scale, no further action would be necessary. This decision will be determined in consultation with OEH, based on available evidence.
- If the onsite investigation suggests that the impact trigger may be a regular occurrence, species-specific monitoring may be required. During the species-specific monitoring period, periodic reports will be provided to WRWF and OEH.
- Responsive mitigation measures will be developed and as agreed with relevant agencies implemented in a timely manner. Examples of mitigation measures may include but are not limited to those outlined in Sections 5 and 6.3.

Any evaluation of impacts and decisions regarding mitigation measures and further investigations required will be undertaken in consultation with OEH. Any required investigation, and recommended management and supplementary mitigation measures, will be documented in the project management log and detailed in annual reports. This log will be available for inspection by OEH or on the request of the Secretary DPE.

It is recommended that the DPE approved specialist for implementation of the BBAMP be responsible for implementation of this decision-making framework and to discuss decision making with OEH and DPE.

Figure 5: Decision making framework for identifying and mitigating impact triggers for threatened species



6.2. Non-threatened Species

6.2.1. *Definition of Impact Trigger and Unacceptable Impact*

The circumstances that define an impact trigger and significant impact for non-threatened birds and/or bats under this Management Plan is detailed below. Note that impacts on common farmland birds, including magpies, ravens, pipits, White Cockatoos, corellas and introduced bird species are not considered of conservation significance and are therefore not subject to adaptive mitigation or this impact trigger.

Impact Trigger for Non-threatened Species: A total of four or more bird or bat carcasses, or parts thereof, of the same species in two successive searches at the same turbine of a non-threatened species (excluding ravens, magpies, White Cockatoos, corellas, pipits and introduced species.

Where population numbers are known and reported by OEH for the period concerned, the definition of an unacceptable impact on non-threatened species is any impact that is likely to:

- lead to a greater than 50% reduction over a five year period in the immediate population (i.e. local population, where known) that utilises the wind farm; AND
- act in an ongoing way to reduce the wider, regional population (where known) by more than 30% over a five year period; OR
- reduce the total species' population (where known) by more than 10% over a five year period.

Where population numbers are not known, the definition of an unacceptable impact on non-threatened species is:

- More than four carcasses of one non-threatened species (including raptor species, magpies, ravens, pipits and introduced species) are found during both formal and incidental carcass searches in a two month period.

Note that although the impact trigger does not include ravens, magpies, White Cockatoos, corellas, pipits and introduced species, detected mortalities for these species will still be reported as part of the annual reporting process.

6.2.2. *Decision Making Framework*

In the event that an impact trigger for non-threatened species is detected the following steps will be followed:

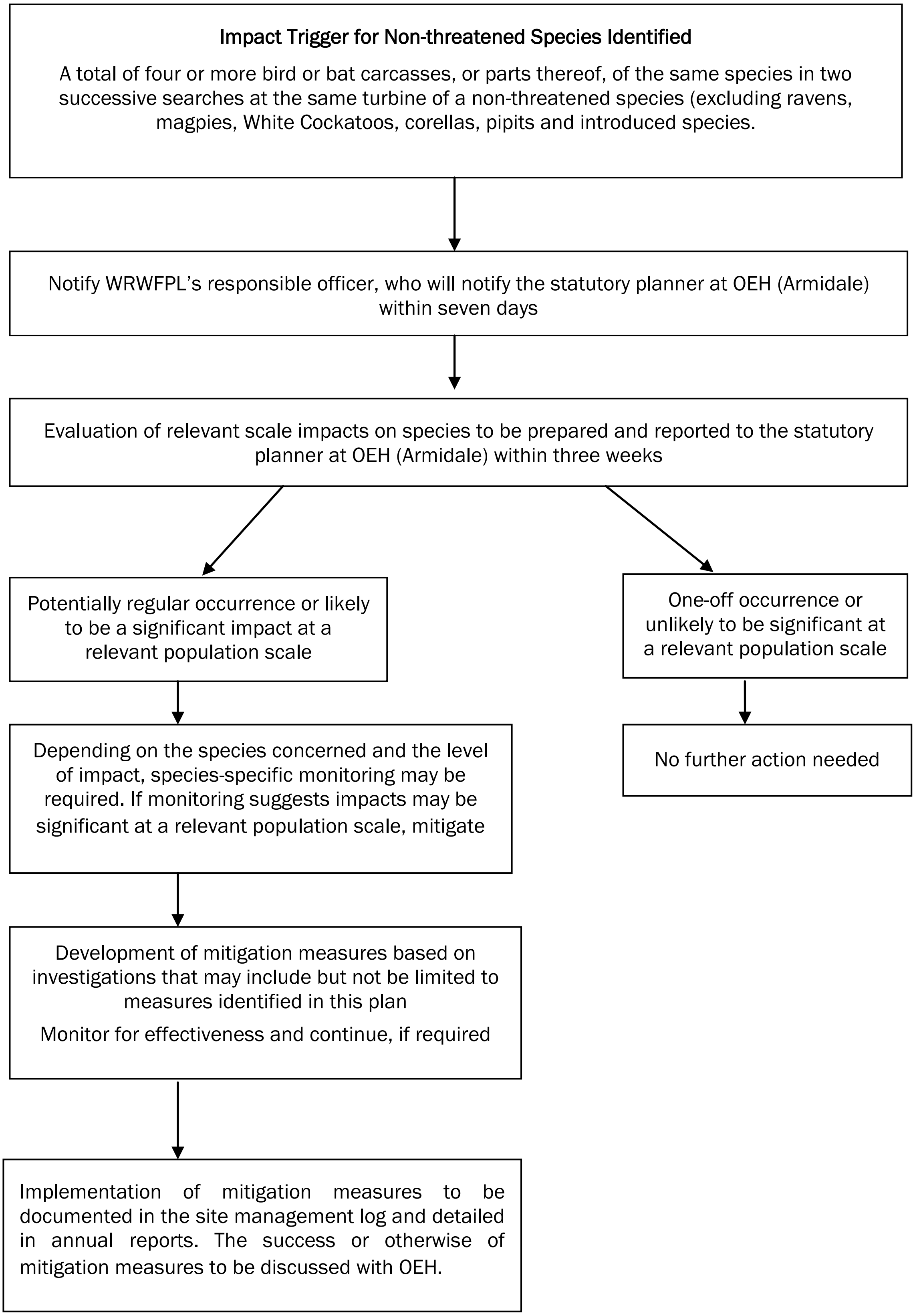
- OEH (Armidale) will be **notified** of the impact trigger within seven days of recording the event. An appropriate scale to consider population effects of the impact trigger will be agreed between OEH and the proponent on a case-by-case basis with consideration given to the species in question.
- An **evaluation** of impacts to the non-threatened species will be undertaken.
- A **report** on the investigation will be delivered to the relevant statutory personnel at OEH (Armidale) within three weeks.

If the evaluation indicates that the event was a one-off occurrence or is unlikely to be an unacceptable impact at a relevant population scale for the species in question, no further action will be necessary (as outlined in Figure 6).

If the event is deemed to be a potentially regular occurrence or likely to lead to an unacceptable impact on the species in question, species-specific monitoring may be required (Figure 6). If further monitoring confirms that impacts are likely to lead to an unacceptable impact on the species, mitigation measures will be required. Potential mitigation measures are outlined in section 7.3, however specific mitigation measures will be determined based on the species involved and the outcome of investigations.

Any evaluation of impacts and decisions regarding mitigation measures and further investigations required will be undertaken in consultation with and agreement from OEH. Any required investigation, and recommended management and supplementary mitigation measures, will be documented in the site management logs and detailed in annual reports. This log will be available for inspection by OEH or on the request of the Secretary DPE.

Figure 6: Decision making framework for identifying and mitigating impact triggers for non-threatened species



6.3. Supplementary Mitigation Measures

Supplementary mitigation measures will be implemented in consultation with OEH in the event that an impact trigger occurs. The purpose of supplementary mitigation measures will be to prevent the impact from continuing to occur. Specific mitigation measures will be implemented depending on the nature, cause and significance of any impact recorded and in response to the results of investigations of the event and of the species concerned on the wind farm site.

It is difficult at this stage to know what the cause of an unacceptable impact trigger will be, therefore possible examples of impacts and potential mitigation measures specific to the impact trigger, and the time taken to implement these measures, are detailed in Table 10: Supplementary mitigation measures in the event of an unacceptable impact trigger occurring. Note that in implementing mitigation measures, a suite of measures that may or may not include those in Table 10 would need to be implemented, depending on management response to particular circumstances.

Although it is unknown what supplementary mitigation measures may be required in response to a particular situation, some hypothetical examples are provided in Table 10 below. These are examples of potential issues not considered to-date but describe useful and tested responses from other wind farms in addressing the issues. Should these be implemented as a management response at WRWF the response of birds and bats to these measures will be recorded.

The purpose of investigations will be to identify clearly the most relevant and effective mitigation measures.

In the event that turbine shutdown is considered necessary by OEH, a species management strategy (e.g. for the Eastern Bent-winged Bat) will be prepared in consultation with OEH that sets out:

- Ongoing acceptable impacts, including the level of risk to the species' regional and overall populations, where known;
- The findings of detailed investigations undertaken in response to the impact trigger, focussing on the species' use of the immediate area around affected turbines;
- Clear scope for on-going monitoring to identify triggers for turbine shut-down;
- Agreed triggers for turbine shutdown and restart; and
- Reporting and consultation arrangements.

6.4. Specific management objectives, activities, timing and performance criteria

Table 11 summarises specific management objectives, activities, timing and performance criteria for the implementation of this BBAMP. It can be used for monitoring and reporting on the implementation of this plan.

Table 10: Supplementary mitigation measures in the event of an unacceptable impact trigger occurring

Hypothetical cause of impact	Mitigation Measure[2]	Likelihood of impact continuing following mitigation	Time to implementation
Foraging source identified that attracts threatened species and "at risk" species to impact areas	Consider the use of acoustics (ie. loud music/irregular noise) to discourage birds from foraging in this location where such noise would not impact neighbours	Low	Implement as soon as possible.
	Encourage species into alternative areas outside of the wind farm boundary, where available, through the use of social attraction techniques offsite (decoys and audio playback systems)		Implement according to agreed plan
Farming practice attracts threatened species to risky areas (e.g. grain feeding of stock)	Investigate whether farming practice is a contributing factor and if so, subject to landowner agreement relocate farming further from turbines to reduce risk	Low	Immediately
Wind/rain/fog causing low visibility	If low visibility at the site is identified as an issue, carcass searches may be repeated during periods of low visibility to measure mortality rates. Temporary shutdown of those turbines found to cause the problem may be necessary during periods of extreme low visibility – to be implemented only in the event that threatened species are experiencing unacceptable impacts.	Low	Immediately low visibility is identified as the cause of unacceptable impacts on threatened species.
Attraction to lights on the wind farm site	Avoid high intensity lighting within the wind farm site (e.g. use of light hoods) or switch off lighting temporarily while species is on or near the wind farm site. Alternative measures include: • Synchronise any flashing lights, • Use red rather than white or yellow lights, or • Remove lights, where practicable • All lights switched off except when needed for service work	Low	If lights can be switched off, this should occur immediately. Alternative measures should be implemented as soon as practicable after recording the impact trigger.
Attraction to small dams on site	Subject to landowner agreement, fill in dam and provide alternative stock watering arrangements	Low	Implement as soon as possible after recording the impact trigger if the dam is the cause of the problem.
Nest site close to turbine	Discourage nesting close to turbines	Low	Prior to breeding season.

[2] Note that the mitigation measures in this table are examples of what may be possible. Ultimately, the chosen mitigation measure will be identified as part of the impact-trigger investigations shown in Figures 5 and 6, and may not include any of these examples if they are not relevant.

Table 11: Specific management objectives, activities, timing and performance criteria

Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Completed (yes/no)
Baseline surveys	Obtaining pre-construction baseline bird and bat utilisation data	Pre-construction • Bird survey (planned) • Bat survey complete (in progress)	• Bird utilisation surveys (point count and transect surveys) undertaken as described in this BBAMP – 2016/2017 • Bat utilisation surveys undertaken as described in this BBAMP.	YES
	Obtaining post-construction bird and bat mortality data	Post-construction	• As per results of the mortality monitoring in this BBAMP.	
Mortality monitoring	18 turbines to be surveyed each month to 100 metres in accordance with the inner- and outer zone search protocol. The same turbines will be searched each month for a period of 12 months, following which the need for further surveys will be reviewed based on the results of the first year.	Post-construction – monthly until end of 12 months	• Post-construction mortality surveys undertaken monthly at at least 18 turbines for at least one year, with a review after the first years to determine if a change in the methodology is required.	
	Calculating annual mortality of birds and bats per turbine based on post-construction repetition of monitoring activities. Mortality estimates should include correction factors from scavenger and detector efficiency trials.	Post-construction – at the end of the full year of mortality monitoring	• Scavenger and detector efficiency trials undertaken • Estimates of mortality for birds and bats made after full year of monitoring	
Annual Reports	Preparation of Annual Reports to be submitted to Secretary and OEH for the first two years after the completion of a year's monitoring activities.	Post-construction – after years one and two.	• Annual reports for the first two years delivered within three months of completion of yearly monitoring. • Annual reports to include (but not be limited to) results of monitoring surveys for that year, any impact triggers or unacceptable impacts identified, mitigation measures implemented, application of the decision-making framework and recommendations for the following year. • Further annual reports upon agreement	
Mitigation measures to reduce risk	Carrion removal program - stock and kangaroo carcasses will be removed from within 200 metres of wind turbines on a monthly basis and disposed of.	During operation	• Carcasses removed • Activity recorded in management log book • Increase frequency of stock and kangaroo carcass removal and disposal if required	
	Subject to landowner agreement, restrict lambing to paddocks at least 200m from turbines.		• No increase in raptor mortality during lambing season	
	Subject to landowner agreement, stock will not be fed grain underneath turbines		• No increase in bird mortality due to grain underneath turbines	
Mitigation measures to reduce risk	Pest control program - Implement rabbit control if the carrion removal program suggests rabbit carcasses are an issue, subject to landowner agreement	During operation	• Monitor effectiveness of rabbit control and, where bird mortality is clearly related to rabbit numbers, increase the effectiveness of rabbit control	
	Habitat improvement or protection to encourage animals to use habitats away from turbines.	During operation	Protection of offset site located in woodland habitat.	
	Minimising external lighting. If required. There are only low levels of lighting on the wind farm during operation.		If mortality at turbines near light sources significantly exceeds that of activity at unlit turbines, type and duration of lighting will need to be reviewed, subject to security and OH&S limitations.	
	Remove permanent lights on buildings and sub-stations to avoid light spillage and visibility from above.			
	Baffle security lighting to avoid light spillage and visibility from above.			

Management objectives	Management activities and controls	Timing	Performance criteria for measuring success of methods	Completed (yes/no)
	Use of deterrents – Where required, overhead powerlines should have marker balls and/or flags where they cross waterways		No incidental records of bird mortality from power line collision around waterways.	

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Appendix 1: Birds and Bats known to occur within or near the proposed WRWF

Common Name	Scientific Name	Source	EPBC	TSC
Birds				
Swift Parrot	*Lathamus discolor*	PMST, Sapphire, WRWF	E, M	E
Black-throated Finch (southern subspecies)	*Poephila cincta cincta*	PMST, TSC, Sapphire, WRWF	E	E1,P
Regent Honeyeater	*Anthochaera phrygia*	PMST, TSC, Sapphire, WRWF	CE, E	E4A,P
Australian painted Snipe		PMST, WRWF, Sapphire	E, M	
Diamond Firetail	*Stagonopleura guttata*	TSC, Sapphire, WRWF		V,P
Little Lorikeet	*Glossopsitta pusilla*	TSC, Sapphire, WRWF		V,P
Scarlet Robin	*Petroica boodang*	TSC, Sapphire, WRWF		V,P
Spotted Harrier	*Circus assimilis*	TSC, Sapphire, WRWF		V,P
Turquoise Parrot	^^*Neophema pulchella*	TSC, Sapphire, WRWF		V,P,3
Varied Sittella	*Daphoenositta chrysoptera*	TSC, Sapphire, WRWF		V,P
Blue-billed Duck	*Oxyura australis*	TSC, WRWF		V,P
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	TSC, WRWF		V,P
Dusky Woodswallow	*Artamus cyanopterus*	TSC, WRWF		V,P
Speckled Warbler	*Chthonicola sagittata*	TSC, WRWF		V,P
Square-tailed Kite	^^*Lophoictinia isura*	TSC,Sapphire, WRWF		V,P,3, E
Black-necked Stork	*Ephippiorhynchus asiaticus*	TSC,WRWF		E1,P
Barking Owl	*Ninox connivens*	WRWF		V
Powerful Owl	*Ninox strenua*	WRWF		V
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	WRWF, Sapphire	M?	V
Bats				
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	WRWF, TSC, Sapphire, Glen Innes		V,P
Little Pied Bat	*Chalinolobus picatus*	WRWF, TSC		V,P
Greater Long-eared Bat,(sth-est form)	*Nctophilus corbeni*	WRWF, PMST, Sapphire, Glen Innes	V	V
Grey Headed Flying Fox	*Pteropus poliocephalus*	WRWF, PMST, Sapphire, Glen Innes	V	V
Large-eared Pied Bat	*Chalinolobus dwyeri*	WRWF, PMST, Sapphire, Glen Innes	V	V
Greater Broad-nosed Bat	*Scoteanax rueppellii*	WRWF, TSC, Sapphire, Glen Innes		V,P
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	WRWF, TSC, Sapphire		V,P
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	TSC, Sapphire, Glen Innes		V,P
Chocolate Wattled Bat	*Chalinolobus morio*	TSC, Glen Innes		P
Eastern Broad-nosed	*Scotorepens orion*	TSC, Glen Innes		P

Common Name	Scientific Name	Source	EPBC	TSC
Bat				
Gould's Long-eared Bat	*Nyctophilus gouldi*	TSC, Glen Innes		P
Gould's Wattled Bat	*Chalinolobus gouldii*	TSC, Glen Innes		P
Large Forest Bat	*Vespadelus darlingtoni*	TSC, Glen Innes		P
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	TSC, Glen Innes		P
Little Forest Bat	*Vespadelus vulturnus*	TSC, Glen Innes		P
White-striped Freetail-bat	*Austronomus australis*	TSC, Glen Innes		P
Southern Forest Bat	*Vespadelus regulus*	TSC,		P
Eastern Freetail-bat	*Mormopterus norfolkensis*	Sapphire, Glen Innes		V
Eastern Cave Bat	*Vespadelus troughtoni*	Sapphire		V
Golden-tipped bat	*Kerivoula papuensis*	Glen Innes		V
Large Bent-wing Bat	*Miniopterus schreibersii*	Glen Innes		V
Little Bent-wing Bat	*Miniopterus australis*	Glen Innes		V

Sources

PMST – Protected Matters Search Tool
TSC – New South Wales Threatened Species Conservation Act 1995
Glen Innes – recorded at Glenn Innes Wind Farm study area
Sapphire – recorded at Sapphire wind farm study area
WRWF – recorded at White Rock Wind Farm study area

EPBC status Key

CE Critically Endangered
E Endangered
V Vulnerable
M Migratory Species

TSC status Key

E1 Endangered (Threatened Species Conservation Act)
E4 Presumed Extinct (Threatened Species Conservation Act)
P Protected (National Parks & Wildlife Act 1974)
V Vulnerable (Threatened Species Conservation Act)

Appendix 2: Carcass Search Data Sheet

<table>
<tr><th colspan="5">WHITE ROCK WIND FARM - BIRD AND BAT MORTALITY MONITORING PROGRAM
CARCASS SEARCH DATA-SHEET*</th></tr>
<tr><td colspan="5">Please fill out all details above the heavy line for each site searched
All details below the line are required if a carcass is found
Do not move a carcass until the details below have been completed</td></tr>
<tr><td>White Rock WF</td><td colspan="4"></td></tr>
<tr><td>Date:</td><td colspan="4"></td></tr>
<tr><td>Start Time:</td><td colspan="4"></td></tr>
<tr><td>Finish Time:</td><td colspan="4"></td></tr>
<tr><td>Turbine Number:</td><td colspan="4"></td></tr>
<tr><td>Wind direction and strength in preceding 24 hours:</td><td colspan="4"></td></tr>
<tr><td>Any unusual weather conditions in last 48 hours?</td><td colspan="4"></td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Distance of Carcass from Tower(m):</td><td colspan="2"></td></tr>
<tr><td colspan="3">Bearing of Carcass from Tower (deg):</td><td colspan="2"></td></tr>
<tr><td>Preliminary Species Identification:</td><td colspan="4"></td></tr>
<tr><td>Photo Taken**</td><td colspan="4">Yes / No</td></tr>
<tr><td>Signs of injury:</td><td colspan="4"></td></tr>
<tr><td rowspan="2">How old is carcass estimated to be (tick category):</td><td><24 hrs</td><td>1-3 days</td><td>> 3 days</td><td>Other</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Other Notes
(ie. sex/age of bird):</td><td colspan="4"></td></tr>
<tr><td colspan="5">Post Find Actions:
1. Place carcass in sealable plastic bag then wrap it in newspaper and take to freezer at site office.</td></tr>
<tr><td colspan="5">* One form should be completed for each carcass found</td></tr>
<tr><td colspan="5">** Please attach photo to this form</td></tr>
</table>

Appendix 3: Symbolix letter

symbolix

To: Inga Kulik
Brett Lane & Associates
Via EMAIL

Ref #: BLAWRWFL20160422
Date: 22nd April, 2016
CC: NIL

Re: **Adjusting the Sampling Fraction of Mortality Monitoring**

Dear Inga,

This letter summarises our analysis of proposed carcass survey design options at White Rock Wind Farm; specifically changes to the number of turbines searched.

As you know, wind farms in Australia are closely monitored to determine their ecological impact, through regular mortality searches on site. Below is review of the potential impacts of modifying one of these monitoring plans. We consider the proposal to change the fraction of wind turbine generators (WTGs) sampled from 33% (23 of 70) to 25% (18 in 70).

It needs to be noted that the following is *not* an assessment of the White Rock Wind Farm's impact. It is only an assessment of the potential differences in performance of these two survey designs in otherwise identical circumstances.

The approach

Mortality estimators are applied to expand the detections of the mortality surveys to account for undetected mortalities. These expansions take into account scavenger losses, imperfect detectability, and effects of surveying a fraction of the farm site.

Changing any aspect of the design can be expected to manifest in one or more of the following:

- A difference in the number of detections from the survey program (assuming equivalent actual mortality):
    - A change in the probability of finding anything at all (i.e. changing the probability that a survey program will detect nothing).
    - A difference in the survey's detections overall
- A change in the projected mortality for the site:
    - A difference in the estimate of annual mortality
    - A difference in the confidence window of the mortality estimate (i.e. a more or less precise estimate).

It should also be noted, that the first two points should not affect the latter two. No "modern" mortality estimator (e.g. Huso, 2010; Korner-Nievergelt, 2011; Symbolix *unpubl.*) will faultily assume that zero detections amounts to zero mortality. The ability of a survey to repeatedly "detect" events though, does directly impact the efficacy of the survey to monitor for adaptive management triggers. So, an adverse change in the detection rate could be considered a negative performance change, even without it impacting the projection itself.

1/14 Akuna Dr, Williamstown North Victoria 3016 Telephone: +61 3 9397 2520 www.symbolix.com.au

ABN: 62 997 546 845

Methodology

In order to test the possibility of differences, the White Rock survey designs (18 versus 23 turbines) were loaded into a mortality simulator (Symbolix *unpubl.*).

Depending upon the test at hand, the laying down of simulated carcasses was manipulated to be either random in time, space and number, or fixed in number only (see results section below).

We simulated a random selection of 18 or 23 WTGS of the 70 on-site. The selected WTGs were maintained (i.e. repeatedly "virtually" sampled) for a year. We simulated a pulse design; surveying monthly to a large radius, with a three days later follow-up on the inner zone only.

The detectability and scavenger trial data employed to simulate an estimated mortality was the aggregate of a large body of data (11 sites and 185 detectability trials and 15 sites with 276 scavenger loss trials). This was done to minimize the variability due to these parameters, whilst ensuring that at least some meaningful and realistic variation was exhibited and attributed to this source. Minimising this source of noise in this way serves to highlight the differences attributable to the change in monitoring design, without generating undue expectations of the sort of confidence that such a mortality estimate is capable of producing.

All detectability and scavenger data was provided by Brett Lane & Associates and sourced from actual surveys at Australian sites.

We considered two different questions:

1. Given the same annual mortality, how would the two survey designs perform? In this case, we set the total annual mortality to be 100 bats, and simulate how many carcasses would be found (given the same survey area, searcher efficiency and scavenger rate, but different number of turbines).
2. If we find a set number of carcasses, how does our estimate of total mortality differ between the two survey designs. In this case, we consider the precision and the average of the estimate, to assess whether our projection is less certain. We consider the case where we find zero carcasses, and the case where we find 16 (a random, non-zero number).

Results

For a fixed known mortality [an unrealistic situation], how do the two surveys perform?

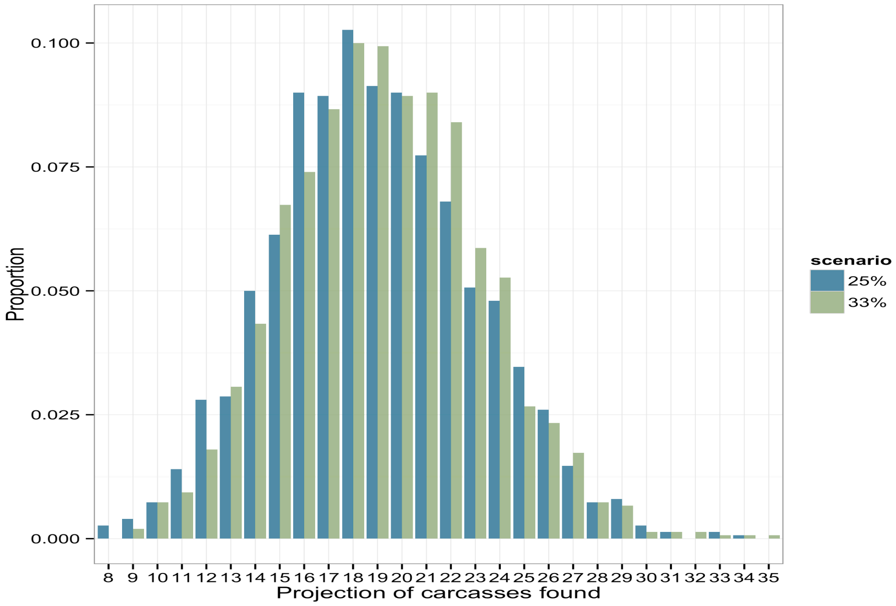

Figure 1: The distribution of detected carcasses, assuming 100 were struck in total. The detectability and scavenge rate are based on values for birds. The colours denote the proportion of turbines included in the survey.

The image above (Figure 1) simulates a constant and known number of carcasses deposited on the site, and projects the outcome of the two survey designs. The chart shows the (simulated) distribution of detected carcasses, given 100 mortalities and identical surveys (except for the number of turbines searched).

The two designs are, to all intents and purposes, identical. This is not surprising, given that the higher sampling fraction design only physically visits a few more WTGs than the alternate.

Surveying fewer sites results in slightly less detections overall. This is evident from left hand side of the plot, where we see that the blue bars are marginally taller than the green. This situation is typically reversed on the right hand side. This is the [minor] performance manifestation between the two designs.

To all intents and purposes, the actual number of detections between the two surveys is not practically different.

2. How is the mortality estimate affected: Case one - NOTHING is detected?

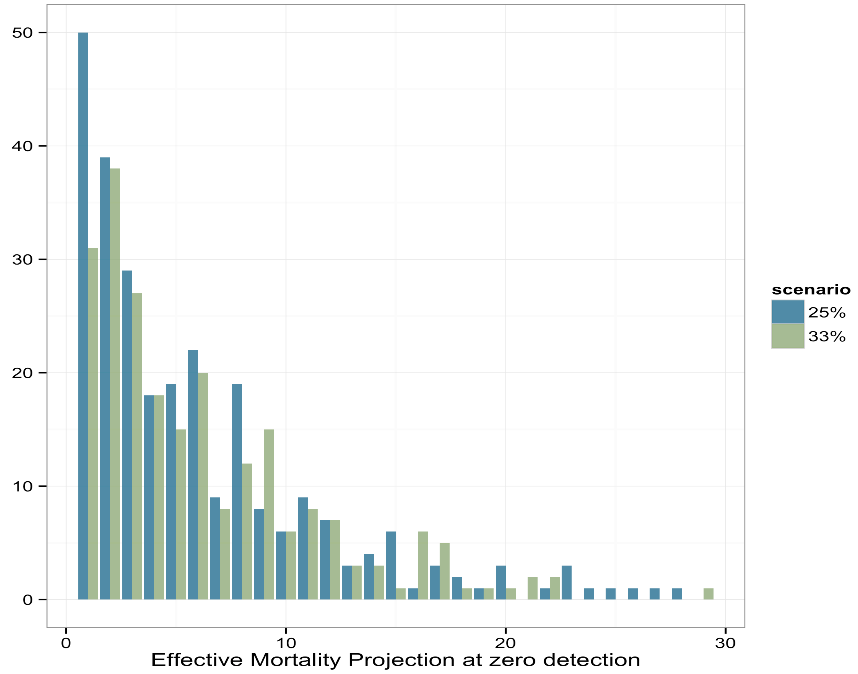

Figure 2: The mortality projection corresponding to zero (0) detections. The detectability and scavenge rate are based on values for birds. The colours denote the proportion of turbines included in the survey.

In Figure 2 we can see the annual mortality projections from every trial that detected nothing. Both survey designs will produce a mean of 6.1 deaths, with a standard deviation of ~5.5.

There is some noise in the chart, simply because neither survey design was particularly likely to detect nothing in the trials studied. Again, as noted, this figure is not an assessment of the White Rock site, but a measure of the proposed modifications to the management plan. The average of 6.1 is due to the tests imposed in this document and does not reflect site conditions at White Rock.

Note that there is a reported slightly elevated standard error for the 25% survey design (5.7 c.f. 5.2 for the higher sampling fraction; see Table 1). Whilst one would expect to see this elevation, the magnitude seen here is merely numerical noise. The chart above highlights to true, "real world" experience of these two designs.

Table 1: Distribution of projection results for Birds w/ zero (0) detections

Scenario	Min	25thQu	Median	mean	75th Qu.	Max	S.d
25%	1	2	4	6.13	8	31	5.72
33%	1	2	5	6.19	9	35	5.27

Even ignoring the fact that it is slightly easier to detect nothing with the smaller survey, again there is no practical difference in the mortality estimates between these two options.

How is the mortality estimate affected: Case two - something is detected?

If we extend the case to look at more realistic scenarios, where 16 detections are made, we generate precisely the same mortality projection for each design, being 105 with and standard error of 23.6.

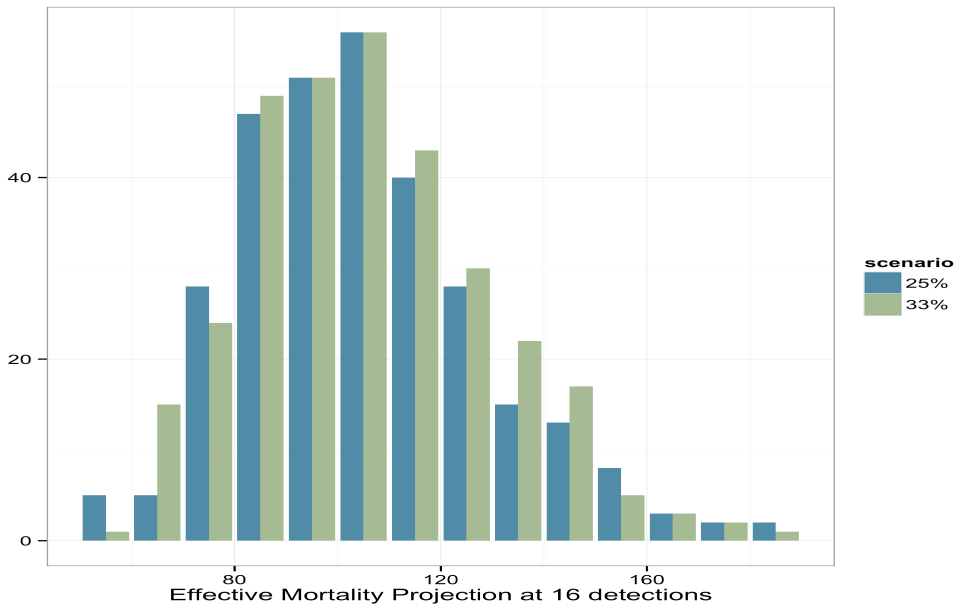

Figure 3: The mortality projection corresponding to 16 detections. The detectability and scavenge rate are based on values for birds. The colours denote the proportion of turbines included in the survey.

Table 2: Birds Projected Mortality distribution, given 16 detections

Scenario	Min	25thQu	Median	mean	75th Qu.	Max	S.d
25%	52	88	103	105	118	188	23.6
33%	50	88	103	105	120	185	23.5

For non-zero detections, there is no discernible difference in mortality projection between the two survey designs.

This should not be a surprise as the Mortality projections explicitly account for survey design, including sampling fractions, in their calculations.

Summary

Modifying the monitoring plan between 33% and a 25% WTG sampling fraction can be expected to achieve the following:

- A slight increase in the probability of a monitoring regime detecting nothing. However, the mortality projections are unaffected by this occurrence.
- A slight increase in the 95% confidence window for the range of credible mortality projections. However, the simulation shows that this increase is less than the current

variability, and will not be realistically detectable nor alter the outcomes of the interpretation.

In light of this, **we can see no tangible differences between the outcomes of the two survey regimes.**

Regards,

Stuart Muir
Symbolix Pty Ltd

References

[1] Huso, M. (2010) An estimator of wildlife fatality from observed carcasses. *Environmetrics.* 22(3): 318-329.

[2] Korner-Nievergelt, F., Korner-Nievergelt, P., Behr, O., Niermann, I., Brinkmann, R.,and Hellriegel,B. 2011. A new method to determine bird and bat fatality at wind energy turbines from carcass searches. *Wildlife Biology*. 17 (4): 350-363.