Salt Creek Wind Farm:

Second Year Annual Report – Bat and Avifauna Management Plan 2019 / 2020

FINAL REPORT

Prepared for Tilt Renewables

16 November 2020

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Biosis project no.:	30622
File name:	30622.Salt Creek BAM plan Yr2 report.FIN01.20201116
Citation:	Biosis 2020. Salt Creek Wind Farm: Second Year Annual Report – Bat and Avifauna Management Plan 2019 / 2020. Report for Tilt Renewables Australia Pty Ltd. Veltheim, I, Gibson, M, Potts, C. Biosis Pty Ltd. Ballarat, VIC. Project no. 30622.

Document control

Version	Internal reviewer	Date issued
Draft version 01	MV	09/10/2020
Final version 01	IS	16/11/2020

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Tilt Renewables Australia Pty Ltd: Marita Giles
- Vestas Australian Wind Technology P/L: Cameron Aitken
- Farm manager
- Department of Environment, Land, Water and Planning for access to the Victorian Biodiversity Atlas

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- Josh Howard, Caitlin Potts, Jules Farquhar (field investigation)
- Lauren Harley (mapping)
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Contents

Tables

Figures

Part A – Brolga and bat utilisation monitoring program

1. Part A – Introduction

1.1 Project background and scope of assessment

Salt Creek Wind Farm (SCWF) was commissioned in July 2018 and consists of 15 turbines (150 metres maximum tip height), infrastructure, roads, a switch yard and a site office). The Bat and Avifauna Management Plan (BAM Plan) (Jacobs Group 2017) outlines monitoring and reporting requirements over a three year period, including a 'dry', 'intermediate' and 'wet' year, which are not required to be undertaken in consequent years.

Biosis Pty Ltd was commissioned by Tilt Renewables Australia Pty Ltd to undertake year 2 2019-2020 post-construction bird and bat utilisation monitoring program at the Salt Creek Wind Farm, as outlined in the Salt Creek Wind Farm Bat and Avifauna Management Plan (Jacobs Group 2017). The BAM plan fulfils Condition 33 (PL 06/304) of the Salt Creek Wind Farm planning permit granted as part of the Moyne Shire's approval of the wind farm development.

Specifically, the plan requires monitoring and reporting of:

- The Brolga (*Antigone rubicunda*) during flocking and breeding season.
- Southern Bent Wing Bat (*Miniopterus schreibsii bassanii*) and other microbat species identified using bat call detectors.
- Other species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Flora and Fauna Guarantee Act 1988* (FFG Act) and the *Advisory list of Threatened Vertebrate Fauna in Victoria – 2013* (the Advisory List).

The BAM Plan also includes a mitigation and management strategy with a zero net-impact objective for the above species, which requires mitigation and offsetting are implemented if a BAM Plan defined significant impact is recorded. Significant impact in the BAM Plan is defined as:

- A threatened bird or bat (or recognisable parts thereof) listed under the EPBC Act, FFG Act or on the Advisory List, is found dead or injured within the wind farm footprint once the operation of the first turbine within the wind farm has commenced.

Bird and bat strike monitoring program was undertaken by Elmoby Ecology (Part B – Introduction Section 5).

The year one BAM plan monitoring (Nature Advisory 2020) identified the need to implement a Grey-headed Flying-fox monitoring program, which was undertaken by Biosis Pty Ltd for the year 2 BAM plan monitoring. Scope for Grey-headed Flying-fox monitoring included:

- Monthly monitoring from October 2019 to April 2020 in proximity to the site of a potential temporary Grey-headed Flying-fox camp where the species was observed flying, located at Woodcutters Lane south of Salt Creek Wind Farm.

Additionally, carcasses of the Grey-headed Flying-fox were detected on the Salt Creek Wind Farm in March 2020, which triggered further investigations (Biosis 2020) and included surveys for the species' use of the wind farm and the surrounding suitable habitats.

This Second Year Annual Report – Bat and Avifauna Management Plan 2019 / 2020 for the Salt Creek Wind Farm outlines the results, implications and recommendations of the August 2019–June 2020 monitoring period to meet the Salt Creek Wind Farm BAM Plan requirements, and is divided into two sections:

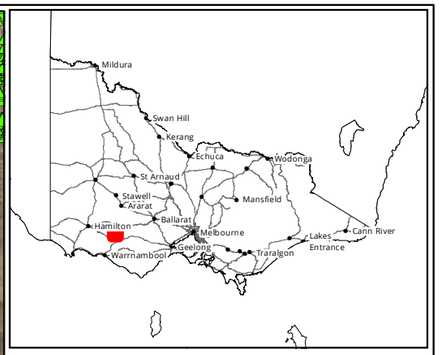
- Part A: Salt Creek Wind Farm: Brolga and bat utilisation monitoring program.

- Part B: Bird and bat strike monitoring program.

Implications and recommendations of findings for each distinct monitoring program activity are presented in Part A for the Brolga and bat utilisation program and in Part B for the bird and bat strike monitoring program. Part A includes a summary of Grey-headed Flying-fox observations detected during the detailed investigations into the species presence, movements and habitat within the wind farm and its surrounds.

1.2 Location of the study area

The study area is located approximately 55 kilometres north of Warrnambool, 22 kilometres south of Lake Bolac and approximately 190 kilometres west of the Melbourne central business district (Figure 1). It encompasses approximately 750 hectares of grazing land. The study area is within the Moyne Shire Council.



Legend

- Wind farm site boundary
- Site boundary - 3km buffer
- Site boundary - 5km buffer
- Wind turbine

Brolga records (VBA, 2018)

- Observation
- Breeding

Wetlands

- 2 - Freshwater meadow
- 3 - Shallow freshwater marsh
- 4 - Deep freshwater marsh
- 5 - Permanent open freshwater
- 6 - Semi-permanent saline
- 7 - Permanent saline
- 99 - No Category

Figure 1 Study area

0 0.5 1 1.5 2 2.5 Kilometers

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Scale: 1:60,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

biosis

Matter: 30622,
Date: 12 October 2020,
Checked by: IV, Drawn by: LH, Last edited by: lharley
Location: P:\30600s\30622\Mapping\30622_F1_StudyArea.mxd

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2. Part A – Methods

2.1 Determining seasonality of a monitoring year based on rainfall

The BAM plan specifies that utilisation monitoring should be undertaken in 'wet', 'intermediate' and 'dry' years to assess activities of birds and bats during years of variable rainfall. This determination can only be done at the end of a yearly monitoring period. DELWP developed a protocol to classify years into one of the three categories based on Bureau of Meteorology (BoM) 1980 to 2020 monthly rainfall data from the Lake Bolac Post Office Weather Station.

Biosis calculated mean and standard deviation of rainfall between 1980 and 2020 from May of one year to June of the following year, using rainfall data from the BoM Lake Bolac Post Office Weather Station. Years above or below one standard deviation of the 40-year mean were classified as 'wet' and 'dry' respectively. To determine the seasonality for the year two BAM plan monitoring program, we calculated the mean rainfall between May 2019 and June 2020. Where rainfall for the Lake Bolac Post Office weather station was missing for this annual period, data from the Westmere weather station was used.

Calculating rainfall from May to June in this context is based on an assumption that rainfall in months immediately preceding the known Brolga breeding season influence the water levels, inundation and retention of water in potentially suitable breeding wetlands for the species. Evidence from northern Australia indicates that Brolgas initiate breeding activity within or after a high rainfall fortnight and immediately after major seasonal rainfall event (Sundar et al. 2019). Brolgas in south-west Victoria would generally be expected to respond similarly to rainfall and initiate nesting after increased rainfall. Such rainfall generally occurs from April onwards within this region. However, a longer lead time may be expected in south-western Victoria compared with northern Australia, as most breeding wetlands are small (<10 ha) (White 1987, Myers 2001, Sheldon 2004, Veltheim et al. 2019), are vulnerable to cropping (Casanova & Casanova 2016) and have drainage channels through them (Corrick 1982), which is likely to affect the wetland filling and water retention to suitable levels for Brolga nesting initiation. It is therefore reasonable to expect that late autumn and winter rains (May onwards) are most influential in determining timing of Brolga breeding activity of a given breeding season in south-west Victoria.

2.2 Brolga utilisation monitoring program

2.2.1 Flocking season survey

Brolga flocking season surveys were undertaken for two consecutive days in each month from December 2019 to June 2020, except for March 2020 (Table 1), when a single day of survey was conducted. All mapped wetlands (DELWP 2016) within 5 kilometres of the Salt Creek Wind Farm were included (Figure 1).

Table 1 Brolga flocking season surveys August 2019–June 2020

Date	Name	Position and qualifications
19-20/12/2019	Joshua Howard	Ecologist, BAppSci (Hons)
21-22/1/2020	Joshua Howard	Ecologist, BAppSci (Hons)
21-22/2/2020	Joshua Howard	Ecologist, BAppSci (Hons)
19/3/2020	Joshua Howard	Ecologist, BAppSci (Hons)
20-21/4/2020	Joshua Howard	Ecologist, BAppSci (Hons)

Date	Name	Position and qualifications
18-19/5/2020	Joshua Howard Caitlin Potts	Ecologist, BAppSci (Hons) Project Zoologist, BEnvSci (Hons)
23-24/6/2020	Caitlin Potts	Project Zoologist, BEnvSci (Hons)

2.2.2 Breeding season survey

Brolga breeding season surveys were conducted for two consecutive days in each month from August to December 2019 and in July 2020 (Table 2). These surveys included all mapped wetlands within 3 kilometres of Salt Creek Wind Farm boundary (Figure 1) Where landholder permission to enter the properties was not granted, wetlands were surveyed from nearby roads, if possible.

Weekly surveys were conducted when a breeding attempt was recorded. The BAM plan (Jacobs Group 2017) has no definition for a 'breeding attempt', however we defined it as a pair at a nest (including observations of nest building). Weekly surveys were carried out from first observation to confirmation of nest and wetland abandonment, failed breeding attempt, or chick fledging. The nest and movements of the breeding pair were observed for two hours each week. The nest location, location of brolgas and their behaviour, including height and direction of flight were recorded, when observed.

Table 2 Brolga breeding season surveys August 2019–June 2020

Date	Name	Position and qualifications
19-20/8/2019	Joshua Howard	Ecologist, BAppSci (Hons)
30/8/2019	Joshua Howard	Ecologist, BAppSci (Hons)
4/9/2019	Joshua Howard	Ecologist, BAppSci (Hons)
18-19/9/2019	Joshua Howard	Ecologist, BAppSci (Hons)
15-16/10/2019	Joshua Howard	Ecologist, BAppSci (Hons)
22/10/2019	Joshua Howard	Ecologist, BAppSci (Hons)
19-20/11/2019	Joshua Howard	Ecologist, BAppSci (Hons)
19-20/12/2019	Joshua Howard	Ecologist, BAppSci (Hons)
3/7/2020	Caitlin Potts	Project Zoologist, BEnvSci (Hons)
9-10/7/2020	Caitlin Potts	Project Zoologist, BEnvSci (Hons)
16-17/7/2020	Caitlin Potts	Project Zoologist, BEnvSci (Hons)

2.3 Bat utilisation monitoring program

2.3.1 Detection methods

Microbats were surveyed using ultrasonic detectors, as specified in the Salt Creek Wind Farm BAM Plan. Detectors were installed at four turbine locations (turbines T02, T05, T10 and T13). One detector was installed on the turbine at a height of approximately 85 m, and one was installed near the ground (approximately 1m high). Ground detectors were installed on fence posts at the closest possible location to the turbine base (Figure 2).

Figure 2 SM2 detector mounted on a fence near Turbine 13

Detectors at turbine height were mounted by Goldwind technicians on the galvanized steel mesh platform on the turbine nacelle. The microphone was aimed to the rear of the turbine.

Detectors were configured to record in zero-crossing (ZC) format between 19:00 (7 pm) and 07:00 (7 am). Two types of detectors were used during the study:

- Wildlife Acoustics Song Meter SM4
- Titley Electronics Anabat Swift

It was necessary to use two types of detector models during the second monitoring period, due to issues with detector availability and supply. Monitoring periods and detectors used are detailed in Table 3.

2.3.2 Monitoring points and survey timing

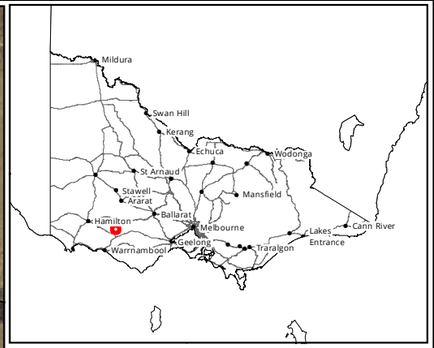
Monitoring was undertaken at the four locations during two periods, as detailed in Table 3 and Figure 3.

Table 3 Location and timing of ultrasonic bat monitoring (all dates inclusive)

Period	Turbine	Position	Detector type	Deployed	Collected	Total number of nights
1. October-December 2019	T02	Ground	Songmeter SM4	15/10/2019	19/12/2019	65
	T02	Turbine	Songmeter SM4	30/10/2019	10/12/2019	41
	T05	Ground	Songmeter SM4	15/10/2019	19/12/2019	65
	T05	Turbine	Songmeter SM4	30/10/2019	10/12/2019	41
	T10	Ground	Songmeter	15/10/2019	19/12/2019	65

Period	Turbine	Position	Detector type	Deployed	Collected	Total number of nights
			SM4			
	T10^	Turbine	Songmeter SM4	30/10/2019	10/12/2019	41
	T13^	Ground	Songmeter SM4	15/10/2019	19/12/2019	65
	T13	Turbine	Songmeter SM4	30/10/2019	10/12/2019	41
2. February-March 2020	T02	Ground	Anabat Swift	20/02/2020	28/04/2020	68
	T02	Turbine	Songmeter SM4	25/02/2020	27/04/2020	62
	T05	Ground	Anabat Swift	20/02/2020	27/04/2020	67
	T05	Turbine	Songmeter SM4	25/02/2020	27/04/2020	62
	T10	Ground	Anabat Swift	20/02/2020	27/04/2020	67
	T10	Turbine	Songmeter SM4	25/02/2020	27/04/2020	62
	T13	Ground	Anabat Swift	20/02/2020	28/04/2020	68
	T13^	Turbine	Anabat Swift	25/02/2020	16/04/2020	51

^Detectors which recorded no identifiable calls



Legend

- Wind farm site boundary
- Turbine access tracks
- Wind turbine
- Bat detector locations

Figure 3 Bat detector locations

0 0.2 0.4 0.6 0.8 1

Kilometers

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Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

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Matter: 30622,
Date: 23 September 2020,
Checked by: IV, Drawn by: LH, Last edited by: lharley
Location: P:\30600s\30622\Mapping\30622_F2_BatDetectors.mxd

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2.3.3 Call identification and analysis

Bat calls recorded on Songmeters were analysed using the automated identification software AnaScheme, developed by Matthew Gibson and widely used in the automated analysis of microbat vocalisations within Australia. The system allows for development of identification keys based on analysis of reference calls. The key used to analyse bat calls for this project was developed and tested by Lindy Lumsden and Peter Griffroen of Arthur Rylah Institute, DELWP (Key to bats of south-west Victoria, dated 20 June 2011).

The AnaScheme system applies a conservative approach to identifying calls in that only clear, high quality calls are assigned to a species. The system also counts recordings which match the criteria to be considered true bat calls, but may be of insufficient quality to identify to species level. This allows a measure of overall bat activity to be calculated.

Any calls identified by the system as significant or uncommon species were checked manually, by visual comparison with published reference calls by an experienced bat expert, to ensure accurate results.

Bat calls recorded on Anabat Swift detectors were analysed using Anabat Insight. Bat calls recorded on Anabat Swift detectors were viewed using Anabat Insight software (Titley Scientific). Call identification was undertaken manually using a library of identified reference calls within the South-western region of Victoria including confirmed calls of Southern Bent-wing Bats from Lindy Lumsden. Only calls of three or more good pulses were analysed.

Examples of calls identified to species level for both methods of analysis are provided in Appendix 1.

2.3.4 Limitations

During the October to December 2019 monitoring period two detectors did not record any calls due to equipment failure. These were at T10 on the turbine and T13 on the ground. During the February to April 2020 monitoring period the detector at T13 on the turbine did not record any calls however there were a significantly large number of files which were background noise. This may be due to the model of detector used compared to the other turbines.

2.4 Occurrence of BAM plan-defined significant impact – Grey-headed Flying-fox monitoring

A Grey-headed Flying-fox carcass was found at Salt Creek Wind Farm on 25 September 2018 (Nature Advisory 2020). The species is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act), and threatened under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act). The species is considered vulnerable in Victoria (DSE 2013).

The BAM plan (Jacobs Group 2017) mitigation and management strategy outlines the requirements to achieve a zero net-impact for species other than the Brolga and Southern Bent Wing Bat, which are listed under the *Environment Protection and Biodiversity Conservation Act 1999*, the *Flora and Fauna Guarantee Act 1988* and the Advisory list of Threatened Vertebrate Fauna in Victoria (DSE 2013). The BAM plan (Jacobs Group 2017) also outlines a requirement to undertake an investigation if a significant impact is identified, with the significant impact defined as:

"A threatened bird or bat (or recognisable parts thereof) listed under the EPBC Act, FFG Act or on the Advisory List, is found dead or injured within the wind farm footprint once the operation of the first turbine within the wind farm has commenced."

In response to the Grey-headed Flying-fox carcass find, a regular monitoring program for this species commenced in August 2019. Monthly monitoring at dusk was undertaken from August 2019 to April 2020

south of Salt Creek Wind Farm at Woodcutters Lane, where the species was recorded flying in March 2019, and where a suspected temporary flying fox camp was identified (BL&A 2019) (Figure 4). A detailed investigation was undertaken as a response to further Grey-headed Flying-foxes found within the wind farm between March 2020 and April 2020 (Biosis 2020), which also included increased frequency of carcass monitoring (Part B).

All surveys were undertaken at dusk, except for an additional dawn survey on 20/03/2020. A survey within the wind farm to record any Grey-headed Flying-foxes flying through was undertaken on 19/3/2020 in addition to surveying at Woodcutters Lane (Table 4).

Table 4 Grey-headed Flying-fox surveys August 2019–April 2020

Date	Survey type	Name	Position and qualifications
19/8/2019	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
18/09/2019	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
15/10/2019	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
19/11/2019	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
19/12/2019	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
21/1/2020	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
20/2/2020	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
10/3/2020	Fortnightly	Joshua Howard	Ecologist, BAppSci (Hons)
12/3/2020	Response to carcass find on SCWF	Joshua Howard	Ecologist, BAppSci (Hons)
19/3/2020	Monthly Response to carcass find on SCWF	Joshua Howard Ian Smales	Ecologist, BAppSci (Hons) Principal Zoologists, MSc
20/3/2020	Response to carcass find on SCWF	Ian Smales	Principal Zoologists, MSc
26/3/2020	Response to carcass find on SCWF	Joshua Howard Caitlin Potts	Ecologist, BAppSci (Hons) Project Zoologist, BEnvSci (Hons)
27/3/2020	Response to carcass find on SCWF	Joshua Howard Caitlin Potts	Ecologist, BAppSci (Hons) Project Zoologist, BEnvSci (Hons)
20/4/2020	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)
21/4/2020	Monthly	Joshua Howard	Ecologist, BAppSci (Hons)

Further detailed investigation of Grey-headed Flying-fox use of the wind farm and surrounding area was initiated in March 2020, after carcasses of the species were detected at the wind farm on 11 March 2020. The full details of these findings are presented in Biosis (2020), and a summary of the methods and results are presented in this report, focusing on survey locations for detecting Grey-headed Flying-fox. Daytime habitat assessments to document foraging resources and an attempt to find camp locations within 10–15 kilometres

of the Salt Creek Wind Farm were also undertaken, however these methods and results are not included in this annual report but are detailed in the Biosis (2020) detailed investigation report.

The aim of the site investigation was to document occurrence, numbers and behaviour of Grey-headed Flying-fox through:

- Dusk and dawn surveys to document their presence on the Salt Creek Wind Farm site.
- Evening surveys to document their presence in previously mapped suitable habitat (flowering Sugar Gum) within 5 kilometres of the wind farm.

2.4.1 Grey-headed Flying-fox surveys on and within 5 kilometres of the Salt Creek Wind Farm

Two observers undertook six dusk and dawn surveys within the Salt Creek Wind Farm between 19th March and 12th May 2020, to determine the presence and number of Grey-headed Flying-foxes flying through the wind farm (Table 5). The first three surveys occurred within a period of 10 business days. We selected survey locations within the wind farm based on turbine sites where Grey-headed Flying-fox carcasses had been detected by a detection dog and a handler (Elmoby/Skylos Ecology) (Table 5). Observers scanned the area with their eyes or binoculars until sunset and sunrise, and used a thermal imaging camera (FLIR E60) as light conditions diminished. One observer used the thermal camera to scan 360° around the survey location, scanning up and down from the horizon to detect Grey-headed Flying-foxes.

While undertaking the dusk and dawn surveys, observers listened out for Grey-headed Flying-fox calls, which could indicate their presence on the wind farm. The observers also visited suitable habitat within the wind farm, which consisted of a planted Sugar Gum wind-break (Table 6). Observers used binoculars, spotlights and a thermal camera to search the Sugar Gums for foraging and roosting Grey-headed Flying-fox, while listening out for their distinctive vocalisations. The survey locations were deemed sufficient to detect vocalising bats along the entire length of the wind-break where Sugar Gum was present. The survey duration on each occasion was 30-45 minutes and the survey extent was approximately 200 metres in each direction of the survey location point. On 1st April the entire wind-break was searched during the day, which informed the location of the evening survey. The evening survey on 1st April focused on the southern portion of the wind-break where Sugar Gum was present as the dominant species, and flowering.

For the investigation, two zoologists searched suitable habitat, and locations of previous Grey-headed Flying-fox observations (BL&A 2019, Biosis monthly BAM plan monitoring) each fortnight, within 5 kilometres north and south of the Salt Creek Wind Farm site (Table 7). These included:

- Cobra Killuc Wildlife Reserve
- Private property with Sugar Gum plantation west of Woodcutter's Lane
- Woorndoo-Streatham Road
- Bolac Plains Road
- Patch of woodland to the north of wind farm

Table 5 Grey-headed Flying-fox surveys on the Salt Creek Wind Farm - turbine locations

Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Time end (24 hr)	Location	Method	Latitude	Longitude	Air temperature (°C)	Wind speed (m/s)	Wind direction	Cloud cover
1	19/03/2020	7:31 19:41	21:05*	21:20	Entry gate to wind farm	Thermal camera	-38.932470	142.776528	17.1	3.1	WNW	Clear
1	19/03/2020	7:31 19:41	21:42	22:00	Turbine 10	Thermal camera	-37.925620	142.784374	17.8	3.1	W	Clear
1	19/03/2020	7:31 19:41	22:23	22:40	Between Turbine 1 and Turbine 2	Thermal camera	-37.904349	142.786648	17.1	4.7	W	Clear
1	19/03/2020	7:31 19:41	22:06	22:15	Turbine 4	Thermal camera	-37.909246	142.790425	17.4	5.3	W	Clear
2	26/03/2020	7:37 19:30	19:00	21:30	Between Turbine 1 and Turbine 2	Thermal camera	- 37.904349	142.786648	14.1 (start) 10.5 (end)	1.9 (start) 3.6 (end)	S-SSW	Clear
2	27/03/2020	7:38 19:29	6:30	7:30	Between Turbine 1 and Turbine 2	Thermal camera and eyes	-37.904349	142.786648	5.9 (start) 9.4 (end)	1.7 2.5	SE	Clear with fog
3	1/04/2020	7:43 19:21	18:50	21:00	Turbine 6	Thermal camera, binoculars and eyes	-37.916699	142.786683	16.0	10.7	W	Overcast, light rain

Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Time end (24 hr)	Location	Method	Latitude	Longitude	Air temperature (°C)	Wind speed (m/s)	Wind direction	Cloud cover
3	2/04/2020	7:44 19:19	6:45	8:00	Turbine 6	Thermal camera, binoculars and eyes	-37.916699	142.786683	13.3	10.5	S	Partly cloudy
4	14/04/2020	6:55 18:02	18:00	19:52	Turbine 8	Thermal camera and eyes	-37.917067	142.783494	15.5-16	2.5-3.056	N-NNE	Partly cloudy
4	15/04/2020	6:56 18:01	6:00	7:30	Turbine 8	Thermal camera and eyes	-37.917067	142.783494	14.8	5.6	N	Partly cloudy
5	27/04/2020	7:08 17:45	17:20	19:15	Turbine 7	Thermal camera and eyes	-37.916073	142.779489	13.9 (start) 9.8 (end)	3.6-1.9	NNE	Partly cloudy
5	28/04/2020	7:08 17:44	6:06	6:46	Turbine 7	Thermal camera and eyes	-37.916073	142.779489	6-5.8	3.6-3.1	NNE-N	Clear
6	11/05/2020	7:19 17:30	17:00	18:40	In between turbine 9 and 14	Thermal camera and eyes	-37.920705	142.774452	11.1-13.7	3.6-2.5	NNW-N	Overcast
6	12/05/2020	7:20 17:29	6:00	7:23	In between turbine 9 and 14	Thermal camera and eyes	-37.920705	142.774452	10.1-9.5	4.7	N	Partly cloudy

* Sugar Gum plantation on private property west of Woodcutter's Lane was the first observation location on this evening (see Table 7)

Table 6 Grey-headed Flying-fox surveys on the Salt Creek Wind Farm - Sugar Gum wind-break plantation between 4, 10, and 12

Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Method	Latitude	Longitude
1	19/03/2020	7:31 19:41	21:42 22:06	Thermal camera	-37.92562 -37.909246	142.78437 142.79043
2	26/03/2020	7:37 19:30	NA, not surveyed	NA, not surveyed	NA, not surveyed	NA, not surveyed
2	27/03/2020	7:38 19:29	NA, not surveyed	NA, not surveyed	NA, not surveyed	NA, not surveyed
3	1/04/2020	7:43 19:21	15:00	Eyes	Entire wind row -37.9048125 (start) -37.9197505 (end)	Entire wind row 142.7898686 (start) 142.7886327 (end)
3	1/04/2020	7:43 19:21	21:00	Spotlight, thermal camera	-37.9254649 (start) -37.9197505 (end)	142.7844461 (start) 142.7886327 (end)
4	14/04/2020	6:55 18:02	15:00 15:30	Spotlight, thermal camera	-37.925429 -37.909623	142.784209 142.790389
4	15/04/2020	6:56 18:01	20:00	Spotlight, thermal camera	-37.925429 -37.909623	142.784209 142.790389
5	27/04/2020	7:08 17:45	20:00	Spotlight, thermal camera	-37.909427 -37.921802	142.79045 142.78541
5	28/04/2020	7:08 17:44	7:30	Eyes	-37.909427 -37.925429	142.79045 142.784209

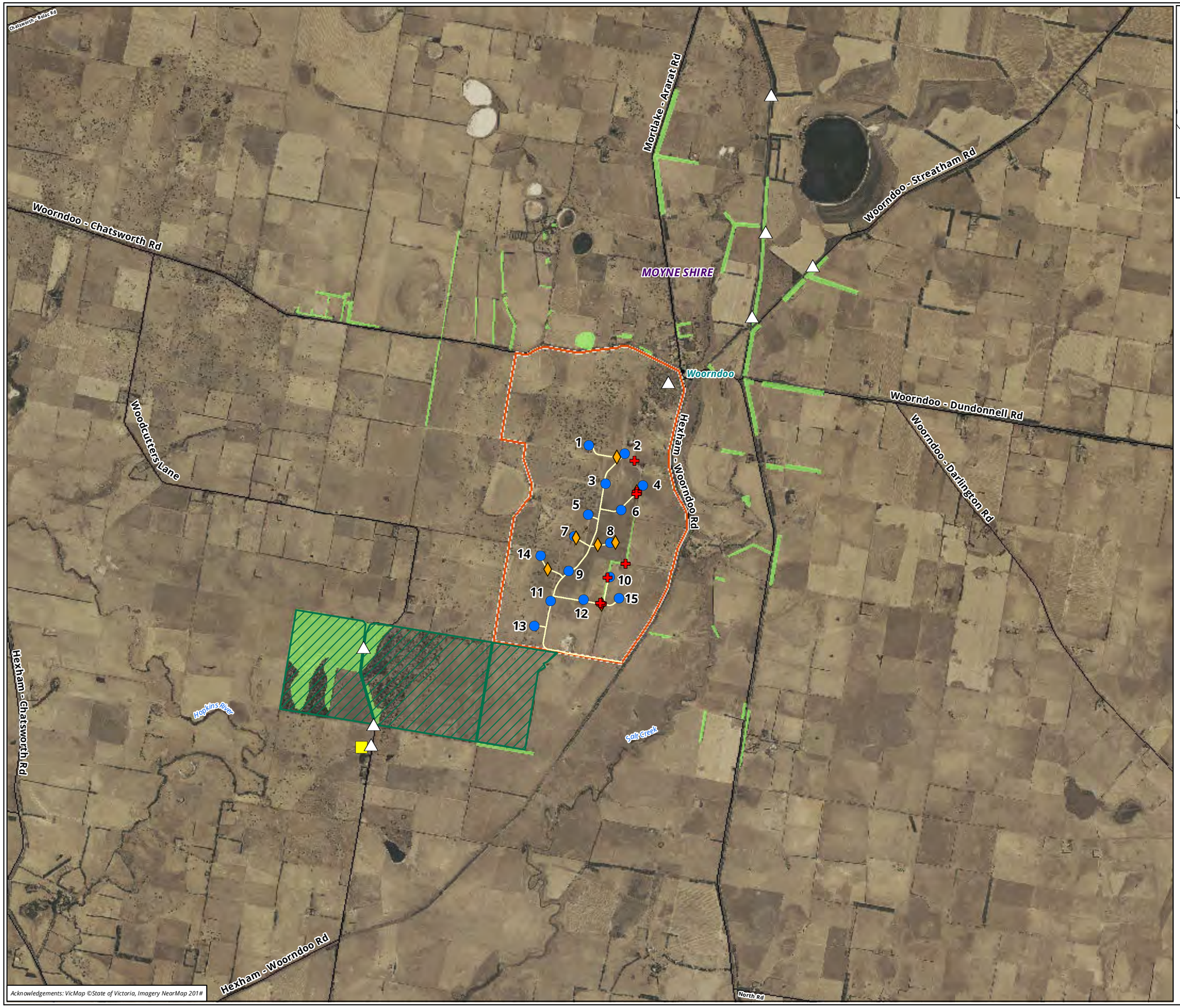
Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Method	Latitude	Longitude
6	11/05/2020	7:19 17:30	19:00	Spotlight, thermal camera	-37.909246 -37.92562	142.79043 142.78437
6	12/05/2020	7:20 17:29	8:15	Spotlight, thermal camera	-37.909623 -37.925429	142.790389 142.784209

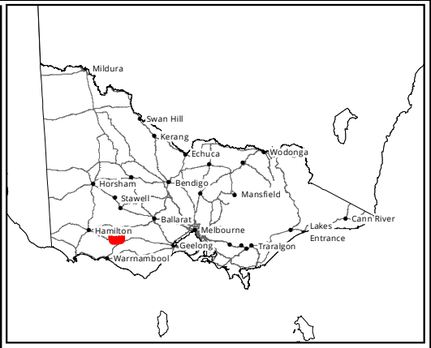
Table 7 Grey-headed Flying-fox surveys within 5 kilometres of the Salt Creek Wind Farm

Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Time end (24 hr)	Location	Method	Latitude	Longitude
1	19/03/2020	7:31 19:41	19:30	20:45	Woodcutter's Lane	Eyes and Thermal	-37.94658	142.74282
1	20/03/2020	7:31 19:41	6:33	6:55	Woodcutter's Lane	Eyes and binoculars	-37.94658	142.74282
3	1/04/2020	7:43 19:21	15:40	16:10	Woodland patch between northern edge of wind farm and Woorndoo-Chatsworth Road	Eyes and binoculars	-37.8934928	142.77950566
3	1/04/2020	7:43 19:21	22:25	22:45	Bolac Plains Road	Thermal camera	-37.8835972 -37.8714187 -37.8515834	142.8108180 142.8129627 142.8135112
3	1/04/2020	7:43 19:21	22:50	23:10	Woorndoo-Streatham Rd	Thermal camera	-37.8760830	142.8216990

Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Time end (24 hr)	Location	Method	Latitude	Longitude
3	2/04/2020	7:44 19:19	9:10	9:25	Woodcutter's Lane	Binoculars and eyes	-37.94658	142.74282
3	2/04/2020	7:44 19:19	9:30	10:15	Cobra Killuc Wildlife Reserve	Binoculars and eyes	-37.9436388 (start) -37.9288090 (end)	142.7431740 (start) 142.429437 (end)
4	15/04/2020	6:56 18:01	21:00	21:30	Cobra Killuc Wildlife Reserve	Thermal camera	-37.932702	142.74074
Monthly BAM plan survey	20/04/2020	7:00 17:54	17:20	19:20	Woodcutter's Lane	Thermal camera and eyes	-37.94658	142.74282
Monthly BAM plan survey	21/04/2020	7:01 17:52	5:30	7:00	Woodcutter's Lane	Thermal camera and eyes	-37.94658	142.74282
5	27/04/2020	7:08 17:45	15:30	16:00	Woodcutter's Lane	Eyes and binoculars	-37.947949	142.742551
5	27/04/2020	7:08 17:45	16:00	16:30	Cobra Killuc Wildlife Reserve	Eyes and binoculars	-37.932473	142.741124
6	11/05/2020	7:19 17:30	16:00	16:30	Cobra Killuc Wildlife Reserve	Eyes and binoculars	-37.932473	142.741124
6	11/05/2020	7:19 17:30	16:30	16:40	Woodcutter's Lane (2019 temporary camp location)	Eyes and binoculars	-37.947949	142.742551
6	11/05/2020	7:19	19:50		Cobra Killuc Wildlife Reserve	Thermal camera	-37.932473	142.741124

Survey number	Date	Sunset/sunrise time	Time start (24 hr)	Time end (24 hr)	Location	Method	Latitude	Longitude
		17:30		20:00		and eyes		





Legend

- Wind farm site boundary
- Cobra Killuc Wildlife Reserve
- Sugar Gum plantations mapped within 5 km of wind farm (BLA 2019)
- Turbine access tracks
- Sugar Gum plantation west of Woodcutters Lane
- Wind turbine
- Grey-headed Flying-fox survey locations - Sugar Gum wind row
- Grey-headed Flying-fox survey locations - Turbine locations
- Grey-headed Flying-fox survey locations - Outside wind farm

Figure 4 Grey-headed Flying-fox survey locations and suitable habitat within 5 km of Salt Creek Wind Farm

0 0.5 1 1.5 2

Kilometers

N

Scale: 1:56,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

biosis

Matter: 30622
Date: 26 May 2020,
Checked by: IV, Drawn by: LH, Last edited by: lharley
Location: P:\31900s\31923\Mapping\31923_F2_GHFFSurvey5km.mxd

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3. Part A – Results

3.1 Determining seasonality of a monitoring year based on rainfall

The total rainfall from May 2019 to June 2020 was 652.4 mm (Table 8, Table 9), resulting in an 'intermediate' rainfall year two 2019–2020 BAM plan monitoring period.

Table 8 Mean and standard deviation of rainfall at Lake Bolac Post Office weather station

Summary statistic	May 1980–June 2020	May 2019–June 2020
Mean	637	652
Standard deviation	114	24

Table 9 Determination of seasonality for year two 2019-2020 BAMplan monitoring

Seasonality determination	May 1980–June 2020
Dry	<522
Intermediate	522–751
Wet	>751

3.2 Brolga utilisation monitoring program

3.2.1 Flocking season survey

From December 2019 to June 2020 (inclusive) Brolga flocking surveys have been undertaken in every mapped wetland within 5 km of the wind farm boundary. No Brolga have been observed flocking at any wetlands within 5 km of the wind farm during this time. Flocking roost site is defined as meeting all of the criteria listed below (DSE 2011):

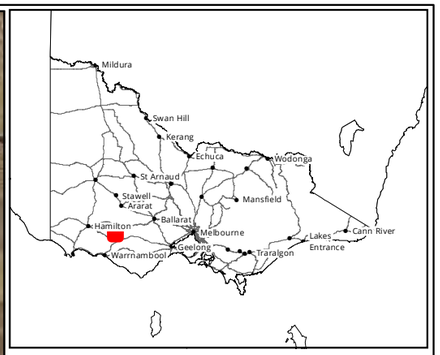
- More than one year of recording.
- One or more records of counts equal to or greater than 10 birds.
- Recorded in more than one month.

Six different wetlands were used by Brolgas during the 2019–2020 flocking season (Table 10, Figure 5). Each observation was of a pair, all recorded in May 2020 (Table 10). A breeding pair with a nest was recorded during the June 2020 flocking season survey. Detailed observations are presented in Appendix 2.

Table 10 Brolga flocking season surveys August 2019–June 2020

Date	Number seen	Wetland ID
18/5/2020	2	1
18/5/2020	2	29339
18/5/2020	2	30255
18/5/2020	2	29205

Date	Number seen	Wetland ID
19/5/2020	2	29339
18/5/2020	2	30253
24/6/2020	2 and nest	29340



Legend

- Wind farm site boundary
- Site boundary - 5km buffer
- BAM plan year 1 2018-2019 flocking survey observations (Nature Advisory 2020)

Brolga flocking season observations (Biosis 2019-2020)

- Brolga
- Brolga pair and nest

Brolga

- VBA records
- Flocking database records (Sheldon 2004)

Wetlands

- 2 - Freshwater meadow
- 3 - Shallow freshwater marsh
- 4 - Deep freshwater marsh
- 5 - Permanent open freshwater
- 6 - Semi-permanent saline
- 7 - Permanent saline
- 99 - No Category

Figure 5 Brolga flocking season observations December 2019 - June 2020

0 0.6 1.2 1.8 2.4 3 Kilometers

N

Scale: 1:60,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

biosis

Matter: 30622,
Date: 16 November 2020,
Checked by: IV, Drawn by: LH, Last edited by: lharley
Location: P:\30600s\30622\Mapping\30622_F5_BrolgaFlockingObs.mxd

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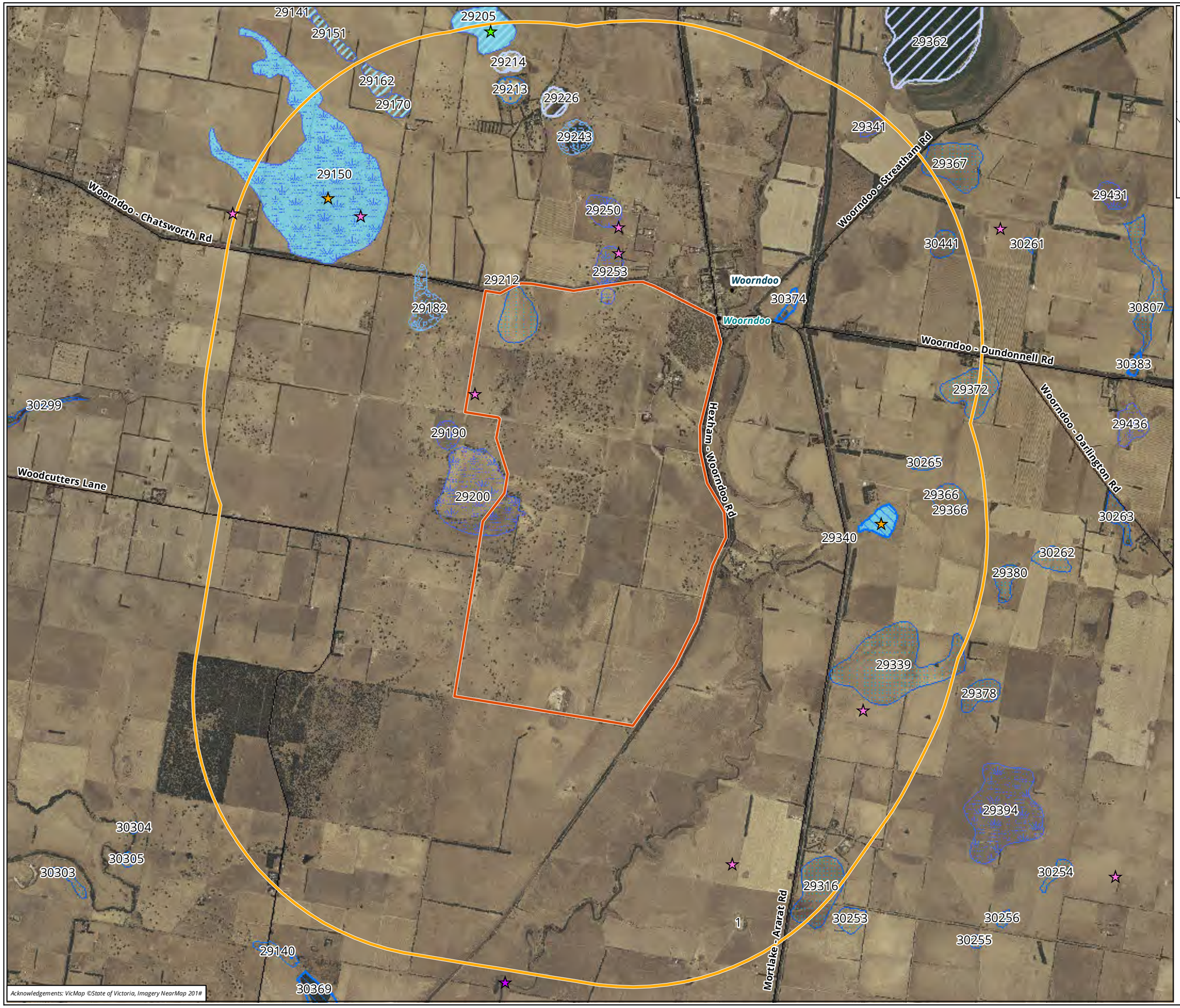
3.2.2 Breeding season survey

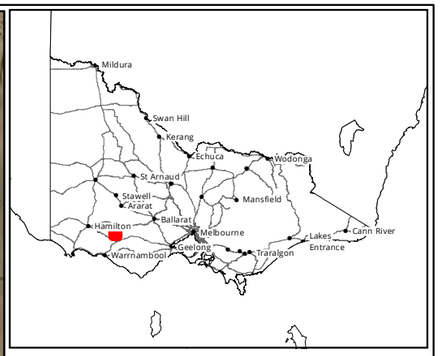
Brolga breeding season surveys were undertaken August 2019 to December 2019 and in July 2020, within 3 kilometres of the wind farm boundary. Brolga pairs were observed six times within these survey periods. Three of these observations included a breeding attempt, where the pair was observed with a nest (see definition in Section 2.2.2) (one pair was observed twice on consecutive days 15th and 16th October 2019) (Table 11). None of the observed breeding attempts were successful (Table 11). Breeding brolgas used two different wetlands during the breeding season surveys. One of these was first observed during the flocking season survey (June 2020) but was not seen using the wetland in July 2020 (Table 11, Figure 6). An additional nesting attempt within Salt Creek waterway was reported by a local landholder from 5th August 2019 (Figure 6), which subsequently failed due to the creek flooding and the pair was not present on the first observation round of second year monitoring on 20th August 2019. Detailed observations are provided in Appendix 3.

Table 11 Monthly brolga breeding survey results August 2019-December 2019 and July 2020 (see also Appendix 3), including results of weekly surveys triggered by a breeding attempt

Date	Number seen	Wetland ID	Notes
20/8/2019	2	29150	Sitting on a nest
30/8/2019	0	29150	No brolgas observed
4/9/2019	0	29150	No brolgas observed
15/10/2019	2	29510	Sitting on a nest
16/10/2019	2	29510	Sitting on a nest
22/10/2019	0	29150	No brolgas observed
19/11/2019	2	29205	Flew into the wetland, no active nest observed
20/11/2019	0	29205	No brolgas observed
19/12/2019	2	29205	Foraging
20/12/2020	0	29205	No brolgas observed
20/12/2020	0	29205	No brolgas observed
24/6/2020*	2	29340	Pair with nest
3/7/2020	0	29340	No brolgas observed
9/7/2020	0	29340	No brolgas observed

* Observation from flocking season survey (June 2020).





Legend

- Wind farm site boundary
- Site boundary - 3km buffer
- Wetlands used by brolgas during breeding season

Brolga

- VBA records
- Landholder record

Brolga breeding season observations (Biosis 2019 - 2020)

- Foraging
- Pair with nest

Wetlands

- 2 - Freshwater meadow
- 3 - Shallow freshwater marsh
- 4 - Deep freshwater marsh
- 5 - Permanent open freshwater
- 6 - Semi-permanent saline
- 7 - Permanent saline
- 99 - No Category

Figure 6 Brolga breeding season observations August 2019 - December 2019 and July 2020

0 0.4 0.8 1.2 1.6 2

Kilometers

N

Scale: 1:40,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

biosis

Matter: 30622,
Date: 16 November 2020,
Checked by: IV, Drawn by: LH, Last edited by: lharley
Location: P:\30600s\30622\Mapping\30622_F6_BrolgaBreedObs.mxd

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3.3 Bat call surveys

A summary of records of bat calls recorded during all sessions of bat-call monitoring is set out in Appendix 4. The following eight species of bats were identified from recordings of their ultrasonic calls:

- **White-striped Freetail Bat** *Austronomus australis*
- **Gould's Wattled Bat** *Chalinolobus gouldii*
- **Chocolate Wattled Bat** *Chalinolobus morio*
- **Eastern Falsistrelle** *Falsistrellus tasmaniensis*
- **Southern Bent-wing Bat** *Miniopterus schreibersii bassanii*
- **Large Forest Bat** *Vespadelus darlingtoni*
- **Little Forest Bat** *Vespadelus vulturnus*
- **Southern Forest Bat** *Vespadelus regulus*

At least two further species were recorded as present but were identified only to genus level. These cannot be definitively ascribed to particular species because the characteristics of the calls of various species within the same genus overlap. These are:

- **Freetail Bats** *Mormopterus* sp.
  Calls recorded during this study are most likely to be calls of the Southern Freetail Bat *Mormopterus* sp. 4 (undescribed) (Churchill 2008).
- **Long-eared Bats** *Nyctophilus* sp.
  Ultrasonic calls of the three Victorian Long-eared Bat species cannot be reliably distinguished. Most or all of the calls recorded at Salt Creek are likely to be from the Lesser Long-eared Bat *Nyctophilus geoffroyi*, while some may be from Gould's Long-eared Bat *Nyctophilus gouldi*. *Nyctophilus geoffroyi* has been recorded in the carcass searches. In Victoria, the threatened Greater Long-eared Bat *Nyctophilus corbeni* is limited to the north-west of the State.

Appendix 4 shows the number of recordings of these species and species-groups, and lists the numbers of calls recorded by each detector during each survey period. A large number of poor-quality calls could not be identified to species or species-group level and are not included in the summary. Many of those recordings were clearly bat calls, but were of insufficient duration or quality to allow confident identification. Additionally, most detectors recorded high levels of extraneous noise, which may have limited the potential for these detectors to record bat calls. Noise may be generated by a range of factors, including background noise, insects and potentially electrical interference.

Detectors mounted on turbine nacelles did record bat calls but showed substantially fewer calls were recorded from those detectors than from detectors close to the ground (Appendix 4). Turbine mounted detectors and ground detectors recorded a large number of files that were poor quality, or purely high frequency noise, which either did not represent bat calls or could not be identified. For the February-April 2020 period, these poor quality or noise recordings represented 78% of all recordings. For the November-December 2019 period, the proportion of noise calls was 98%.

3.4 Occurrence of BAM plan-defined significant impact – Grey-headed Flying-fox monitoring

In the second year of monitoring, Grey-headed Flying-fox were first observed on 20th February 2020, and subsequently until 23/3/2020 during the BAM plan monitoring (Table 12, Figure 7). Further observations of Grey-headed Flying-foxes were recorded as part of a detailed investigation into the species use of the wind farm and its surrounds (Biosis 2020). The last individuals of Grey-headed Flying-foxes in the area were observed on 14/04/2020 during a dusk survey on the wind farm.

The 20th February 2020 observation of Grey-headed Flying-fox triggered fortnightly dusk surveys at Woodcutters Lane, south of the Salt Creek Wind Farm. Detailed observations are presented in Appendix 5.

Table 12 Grey-headed Flying-fox surveys August 2019–April 2020, Woodcutters Lane

Date	Number of Grey-headed Flying-fox observed	Notes
18/09/2020	0	Dusk survey.
15/10/2020	0	Dusk survey.
19/11/2020	0	Dusk survey.
19/12/2020	0	Dusk survey.
21/1/2020	0	Dusk survey.
20/2/2020	6	Dusk survey. Observed from Woodcutters Lane flying north over Cobra Killuc Wildlife Reserve, at 21:00.
10/3/2020	825	Dusk survey. Observed flying south to north over Cobra Killuc Wildlife Reserve, between 20:40 and 21:10. Bats heard foraging in Cobra Killuc Wildlife Reserve.
12/3/2020	65	Dusk survey. Observed flying north over Cobra Killuc Wildlife Reserve 20:26-20:45.
19/3/2020	574	Dusk survey. Observed flying north over Cobra Killuc Wildlife Reserve and flying from further south than the BL&A (2019) identified potential 2018 temporary camp location. One Grey-headed Flying-fox was also observed near turbine 1 at 22:30.
20/3/2020	59	Pre-dawn survey. Observed flying south beyond BL&A (2019) identified potential 2018 temporary camp location.
20/4/2020	0	Dusk survey.
21/4/2020	0	Dawn survey.
18/5/2020	0	Dusk survey.

During the detailed investigation into Grey-headed Flying-fox occurrence at the Salt Creek Wind Farm in March-May 2020 investigation (Biosis 2020), we recorded the majority of bats between 13 March and 26 March 2020 (Table 13). In that period observations were of 65, 574 and 59 individuals recorded flying over Woodcutter's Lane, adjacent to the Sugar Gum plantation where BL&A (2019) reported a temporary camp in

early 2019, and 96 individuals flying through the wind farm on 26 March 2020. Observers also recorded a single bat on 19 March 2020 and 14 April 2020 flying over the wind farm (Table 13, Figure 7).

During the monthly Grey-headed Flying-fox survey Woodcutter's Lane on 10 March 2020, Immediately prior to the detailed investigation, Biosis ecologist Joshua Howard recorded 825 Grey-headed Flying-foxes flying from south and heading north/north-east towards Cobra Killuc Wildlife Reserve and the general direction of the wind farm.

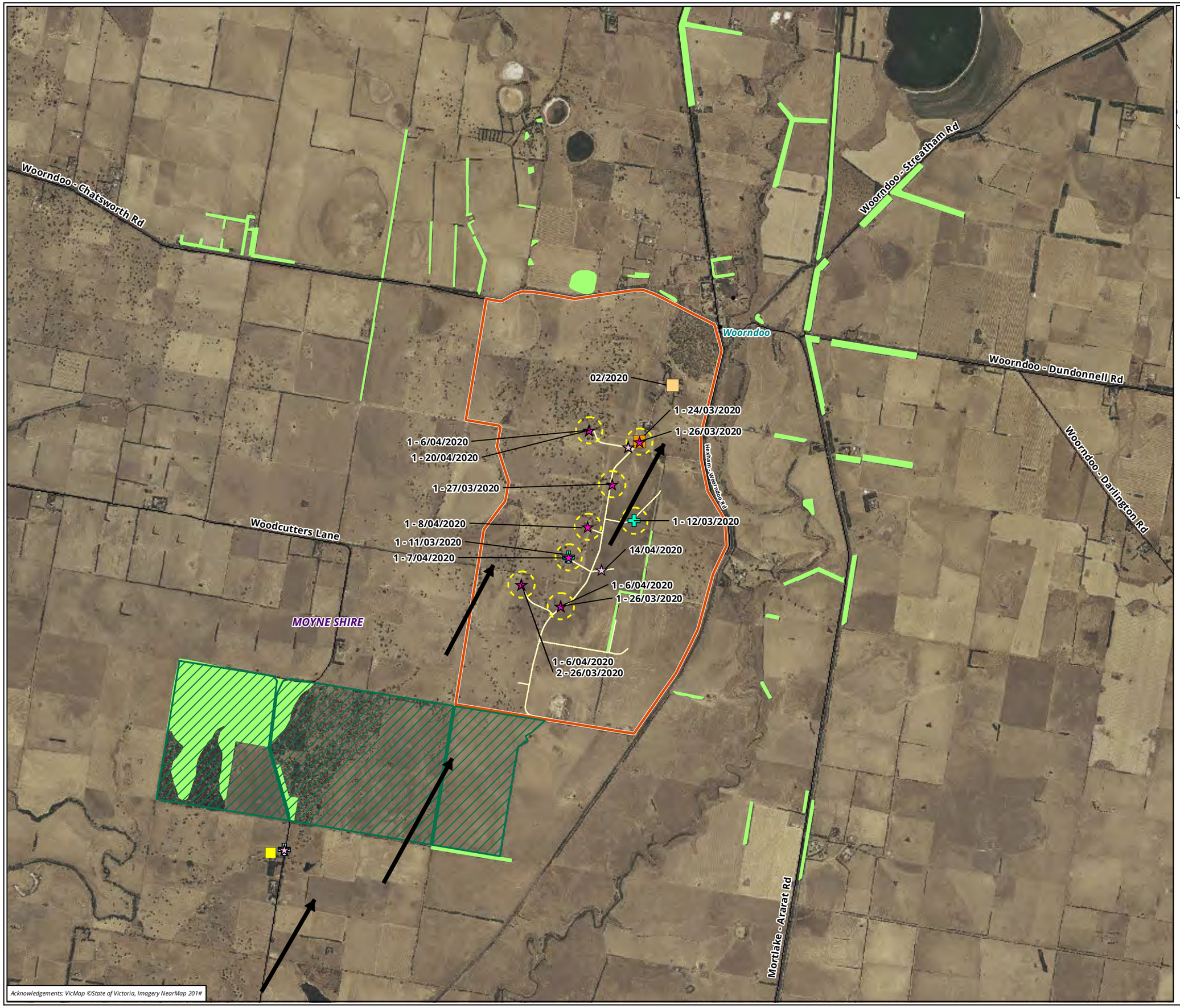
The farm manager at Salt Creek Wind Farm also reported having heard Grey-headed Flying-fox foraging in eucalypts in their front yard, within the wind farm site boundary, in February-March 2020.

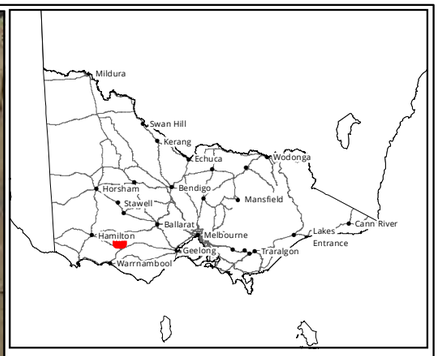
Table 13 Grey-headed Flying-fox records on and within 5 km of the Salt Creek Wind Farm, February-May 2020

Survey type	Survey type	Survey number	Date	Location	Number of bats	Flight direction	Flight height (m)	Notes
Biosis	**BAM monthly**	**NA**	20/02/2020	Woodcutter's Lane (2019 temporary camp location)	6	North	20	
Biosis	**BAM monthly**	**NA**	10/03/2020	Woodcutter's Lane (2019 temporary camp location)	825	NNE	10-30	Grey-headed Flying-foxes observed between 20:40 and 21:10, some possibly missed due to bats flying too fast for an accurate count. possible that some were missed (flying too fast, too many to accurately count). Survey location just north of creek between creek and Cobra Killuc WR. All bats were coming from south and heading NNE towards Cobra Killuc WR. Bats flying low 10-30 m overhead, Did not see any stop to forage in Cobra Killuc WR but could clearly hear bats foraging in Cobra Killuc WR from Woodcutter's Lane,
Elmoby/Skylos Ecology	**BAM monthly**	**NA**	11/03/2020	Turbine 7	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**BAM monthly**	**NA**	12/03/2020	Turbine 6	1	NA	NA	Carcass
Biosis	**BAM monthly**	**NA**	13/03/2020	Woodcutter's Lane (2019 temporary camp location)	65	North	30-50	Grey-headed Flying-fox observed between 20:26 and 20:45. Some individuals possibly not recorded due to poor visibility. Bats were flying south to north from further south than Sugar Gum stand in private property. Heading toward Cobra Killuc WR, flying 30-50m high. Could not see any bats in or near Sugar Gum stand to south of Cobra Killuc WR when still light.

Survey type	Survey type	Survey number	Date	Location	Number of bats	Flight direction	Flight height (m)	Notes
Biosis	**Mar-May 2020**	**1**	19/03/2020	Woodcutter's Lane (2019 temporary camp location)	574	North	10-50	Grey-headed Flying-foxes observed between 20:15 and 20:40 heading north. Bats were clearly flying from further south than the temporary camp location and heading further north towards Cobra Killuc Wildlife Reserve.
Biosis	**Mar-May 2020**	**1**	19/03/2020	Between Turbine 1 and Turbine 2	1	South	30	One bat seen through thermal camera, flying near River Red Gum trees to the west of the survey location.
Biosis	**Mar-May 2020**	**1**	20/03/2020	Woodcutter's Lane (2019 temporary camp location)	59	South	Not recorded	Bats flying from north to south, clearly heading further south than the temporary camp location.
Wind farm management	**Incidental**	**NA**	24/03/2020	Turbine 2	1	NA	NA	Carcass
Biosis	**Mar-May 2020**	**2**	26/03/2020	Between Turbine 1 and Turbine 2	96	North	30-50	96 bats flying south to north between 8:20pm-9pm, most observed between 8:20-8:45pm. A carcass was found on the road at approximately 21:45 near Turbine 3 when team was leaving the wind farm.
Elmoby/Skylos Ecology	**Mar-May 2020**	**1**	26/03/2020	Turbine 2	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**1**	26/03/2020	Turbine 14	2	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**1**	26/03/2020	Turbine 9	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**1**	27/03/2020	Turbine 3	1	NA	NA	Carcass

Survey type	Survey type	Survey number	Date	Location	Number of bats	Flight direction	Flight height (m)	Notes
Elmoby/Skylos Ecology	**Mar-May 2020**	**2**	6/04/2020	Turbine 14	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**2**	6/04/2020	Turbine 9	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**2**	6/04/2020	Turbine 1	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**2**	7/04/2020	Turbine 7	1	NA	NA	Carcass
Elmoby/Skylos Ecology	**Mar-May 2020**	**2**	8/04/2020	Turbine 5	1	NA	NA	Carcass
Biosis	**Mar-May 2020**	**4**	14/04/2020	Turbine 8	1	North	10-20	One bat observed with eyes and through thermal at 19:00. Bat was flying fast and came from the south-east circled over our head and then headed west, towards turbine 7.
Elmoby/Skylos Ecology	**Mar-May 2020**	**3**	20/04/2020	Turbine 1	1	NA	NA	Carcass





Legend

- Wind farm site boundary
- Cobra Killuc Wildlife Reserve
- Flight path
- Sugar Gum plantations mapped within 5 km of wind farm (BLA 2019)
- Turbine access tracks
- Sugar Gum plantation west of Woodcutters Lane
- Grey-headed Flying-fox records - Elmoby/Skylos

Grey-headed Flying-fox records

- BAM monthly - live
- BAM monthly - carcass
- Incidental - live
- Incidental - carcass
- Mar-May 2020 - live
- Mar-May 2020 - carcass

Figure 7 Grey-headed Flying-fox records - Salt Creek Wind Farm investigation 2020

0 0.5 1 1.5 2 N

Kilometers

Scale: 1:40,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

biosis

Matter: 30622,
Date: 16 November 2020,
Checked by: IV, Drawn by: LH, Last edited by: lharley
Location: P:\30600s\30622\Mapping\30622_F7_GHFF_Records2020.mxd

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4. Part A – Implications and recommendations

4.1 Brolga utilisation monitoring program

No brolgas were observed flocking within 5 kilometres of the Salt Creek Wind Farm during the December 2019 to June 2020 flocking season. Single pairs were found using five different wetlands within this area during the flocking season in May 2020, and one pair was found with a nest in June 2020. These observations do not meet all the three criteria required for a wetland to be defined as a flock roost site (DSE 2011):

- More than one year of recording.
- One or more records of counts to or greater than 10 birds.
- Recorded in more than one month.

The nearest known flocking area to Salt Creek Wind Farm are the Darlington/Dundonnell/Streatham (Salt Lake/Pink Lake/Blue Lake complex) approximately 16 kilometres east and Lake Bolac, approximately 18 kilometres north east of the wind farm. Brolgas are known to move from flocking areas to breeding areas in May-June (Arnol, White, & Hastings 1984, Veltheim 2018). The pair observed within 5 kilometres of the Salt Creek Wind Farm in May 2020 is most likely to be a breeding pair dispersing from a flocking area to a breeding area. Brolgas have been recorded flocking near Woorndoo outside of the flocking season previously in 2011, however the 2019–2020 monitoring program did not record brolga flocks during the breeding season. Similarly, no flocks or flock roost sites were identified in year 1 of the Salt Creek Wind Farm BAM plan monitoring 2018–2020. During the year 1 monitoring two brolgas were observed in four of the monthly flocking season surveys (Nature Advisory 2020).

In the year 2 BAM plan 2019–2020 monitoring period, brolga breeding activity was recorded three times. Each time the breeding attempt was unsuccessful as no chicks hatched or fledged. This is in contrast to no breeding activity recorded in the year 1 BAM plan 2018–2019 monitoring period (Nature Advisory 2020) and a single pair recorded at wetland 29150. Brolgas attempted to breed in this same wetland (29150) in the 2019 breeding season (Table 11). The year 1 2018–2019 monitoring period was deemed as 'dry' and year 2 2019–2020 was determined as 'intermediate'.

The higher rainfall in 2019–2020 compared with 2018–2019 may have resulted in increased water levels in wetlands potentially suitable for breeding within 3–5 kilometres of the Salt Creek Wind Farm. However it should be noted that no analyses have been undertaken, or are required under the BAM plan, to link local rainfall with wetland water levels or breeding wetland availability, nor to collect variables that could help understand breeding success or failure. Additionally, several variables could be contributing to the number of brolgas attempting to breed, or to failed breeding attempts. Nest initiation and breeding success of brolgas can be influenced by water levels in a wetland (which in turn may vary depending on the depth and area of the wetland, and whether it has a drain), disturbance, stock use of the wetland, inexperience of a breeding pair, influence of other brolga pairs or other species such as swans competing for nest sites, and native and introduced predators.

Therefore it is not possible to determine, or draw any conclusions on the reasons for differences in breeding attempts in year 2 BAM plan monitoring in 2019–2020 compared with year 1 2018–2019 or to determine why the breeding attempts in 2019–2020 were unsuccessful.

4.1.1 Recommendations for brolga utilisation program

There is no evidence to date of Brolga collisions with Salt Creek Wind Farm infrastructure (see Part B – Results) after two subsequent years of flocking and breeding season monitoring. Based on the carcass searches and the breeding and flocking season monitoring surveys, collision risk to Brolgas at Salt Creek Wind Farm is likely to be low. The current level of monitoring is sufficient to detect the species on the wind farm site in case of a collision mortality and to determine numbers of Brolgas present during flocking and breeding seasons. All Brolga nesting attempts have occurred beyond 3 kilometres and within 5 kilometres of the Salt Creek Wind Farm.

Based on monitoring to date:

- Continue flocking and breeding surveys as outlined in the BAM plan.
- Consideration should be given to trying to understand the lack of breeding attempts within 3 kilometres of turbines, by assessing the condition and suitability of wetlands for breeding within 3 kilometres and beyond 3 kilometres of the Salt Creek Wind Farm turbines.
- Consider undertaking an analysis to understand links between local rainfall and wetland availability, focusing on availability of potential Brolga breeding wetlands.

4.2 Bat utilisation monitoring program – microbat call survey

The bat call surveys detected the Southern Bent-wing Bat at ground level across three turbine locations (T02, T05, T10) and at turbine height (T02) in spring 2019 and at four turbine locations (T02, T05, T10, T13) and at turbine height (T02) in autumn 2020. A much higher number of calls was detected in autumn 2020 (727) compared with spring 2019 (49). Seven of the 49 calls in spring 2019 and 3 of the 727 calls in autumn 2020 were at turbine height. Number of calls overall for all species was higher in autumn 2020 than in spring 2019.

The number of Southern Bent-wing Bat calls detected in year 2 BAM plan 2019–2020 monitoring period is much higher than the number of calls detected in year 1 BAM plan 2018-2019 monitoring period (Nature Advisory 2020). In year 1, a total of five calls of the species, and 14 of the species complex, were detected at ground level at three turbines (T02, T10, T13). No calls were detected at turbine height.

The reason for the higher number of Southern Bent-wing Bat at the Salt Creek Wind Farm in year 2 of the monitoring program is unknown. An analysis of call numbers and weather variables such as rainfall may help understand if weather and increased rainfall in year two is a contributing factor to the increased call activity at the wind farm. However, a number of uncontrolled variables prevent making conclusions and numeric comparisons between years or seasons based on the bat call data. These include detector and microphone models, microphone sensitivity, installations methods and weather conditions, which can affect bat activity and detectability of sound. Therefore, based on the collected data no comparisons can be made between overall bat activity levels, and no inferences can be made between the higher number of calls detected and the overall higher bat mortality detected in year 2.

4.2.1 Recommendations for bat utilisation program – microbats

No confirmed Southern Bent-wing Bat mortalities have been recorded at the Salt Creek Wind Farm during year 1 (Nature Advisory 2020) or year 2 BAM plan monitoring (Part B). Although an increased number of the species' calls were detected, a small number were at turbine nacelle height. Therefore the risk of Southern Bent-wing Bat mortalities is likely to remain low, but may potentially increase to moderate in higher rainfall years if rainfall is a factor in increased activity levels and movements across the wind farm.

- Continue bat utilisation monitoring program for microbats using bat detectors as outlined in the BAM plan, with the understanding that comparisons between years is not possible with detector-collected

data. At best, the detectors can indicate the presence of particular species but cannot be used to infer number of individuals using a site.

- Increase the frequency of carcass monitoring to increase confidence in mortality estimates and in detecting any potential Southern Bent-wing Bat carcasses.

4.3 Occurrence of BAM plan-defined significant impacts – Grey-headed Flying-fox monitoring

Monthly dusk surveys at Woodcutters Lane were recommended in the year one BAM plan monitoring report (Nature Advisory 2020). These monthly surveys first detected Grey-flying Foxes flying north towards the Salt Creek Wind Farm on 20th February 2020. Subsequently, larger groups were observed until 20th March 2020 as part of the BAM plan monthly monitoring with 825 being the maximum number of individuals counted during this period. A Grey-headed Flying-fox carcass was recorded under a turbine within the wind farm on 11th March 2020, which is defined as a significant impact in the BAM plan, due to the species' EPBC Act listing. Subsequently another 12 Grey -headed Flying-fox collision mortalities were detected between 12th March and 20th April 2020 (Section 5). A detailed investigation into the occurrence, habitat use and habitat availability within the wind farm and its proximity was commenced after the initial mortality was detected. This investigation found the species was present and flying through the wind farm until 14th April 2020 (Biosis 2020).

4.3.1 Recommendations for occurrence of BAM plan-defined significant impacts – Grey-headed Flying-fox monitoring

Although the level of impact on the Grey-headed Flying-foxes at Salt Creek Wind Farm to date is not considered to represent a significant impact as defined under the EPBC Act (Biosis 2020), mortalities and injuries of this species from Salt Creek Wind Farm are defined as a significant impact under the BAM plan due to the species' EPBC Act listing. The studies completed to date indicate that the species moves through the wind farm in larger numbers during late summer–autumn, which are most likely to represent migratory movements, in response to weather and increased food availability within 10–15 kilometres of the wind farm at this time of the year. Southward movements in spring (September–October) also occur and have resulted in a mortality previously (Nature Advisory 2020).

The following recommendations are made in light of current knowledge and studies undertaken to date on the Salt Creek Wind Farm (BL&A 2019, Nature Advisory 2020, Biosis 2020, Elmoby Ecology 2020), and should apply within the required three year BAM plan timeframes:

- Monthly dusk surveys at Woodcutters Lane to record any foraging, flying or roosting Grey-headed Flying-Fox between October and April is recommended, increased to fortnightly counts if a camp is identified at this location (as per Nature Advisory 2020), and additionally at Cobra Killuc or within 35 kilometres south of the Salt Creek Wind Farm.
- If a camp or Grey-headed Flying-fox are found foraging, flying or roosting at the above locations, implement a fortnightly monitoring program within the Salt Creek Wind Farm to record any individuals flying through the wind farm.
- Fortnightly carcass monitoring for September to October and February to mid-April, based on Grey-headed Flying-fox activity within and outside of the Salt Creek Wind Farm 2018–2020 (Part B, Biosis 2020, Nature Advisory 2020). If carcasses are found, implement a fortnightly dusk and dawn monitoring on the Salt Creek Wind Farm.

- Monthly carcass searches on the Salt Creek Wind Farm as outlined in the BAM plan (Jacobs Group 2017), unless observations or carcass monitoring triggers other recommendations outlined here for fortnightly monitoring.

Recommendations made as a result of the detailed investigation into Grey-headed Flying-foxes within and 10–15 kilometres of the Salt Creek Wind Farm (Biosis 2020) should also be implemented:

- Commence monitoring of Sugar Gums within 10 km of Salt Creek Wind Farm, and River Red Gums within the wind farm, weekly from January to end of March. If greater than 10% of Sugar Gums commence flowering, implement fortnightly dusk monitoring for Grey-headed Flying-foxes and fortnightly carcass monitoring of all turbines. Coordinate carcass monitoring so it occurs within 24 hours of the dusk monitoring, to refine understanding of collisions in relation to numbers of individuals flying over the wind farm.
- Incorporate simultaneous dusk counts at multiple locations into the monitoring regime. Counters should be stationed at the same time, on the same day, at the Warrnambool camp, Connewarren Lane adjacent to the pine plantation and Hopkins River, Woodcutter's Lane and the wind farm, to understand numbers of Grey-headed Flying-foxes departing roosts in relation to numbers flying through the Salt Creek Wind Farm.
- If possible and feasible, liaise with the local community to obtain information about presence of Grey-headed Flying-foxes during Sugar Gum flowering events and at the time of expected south to north migration. This would provide more information to determine the regularity of the species' potential presence near the Salt Creek Wind Farm and the potential location of local roost site(s).
- Continue attempts to obtain Warrnambool Grey-headed Flying-fox camp count data from the Warrnambool City Council.

Part B – Bird and bat strike monitoring program

Report

Post Construction Bird and Bat Monitoring Results, Year 1: August 2019 to July 2020

Salt Creek Wind Farm, Victoria

Prepared by
Emma Bennett

for

Tilt Renewables Pty Ltd.

ELMOBY ECOLOGY

5. Part B – Introduction

5.1 Background

The purpose of this report is to summarise the findings of the second year of post construction bird and bat monitoring at the Salt Creek Wind Farm in accordance with the approved Bat and Avifauna Management Plan (BAMP). This plan was developed by Jacobs Group Pty Ltd in accordance with Condition 33 (PL 06/304) of the planning permit issued by the Shire of Moyne for the Salt Creek Wind Farm. Scavenging information for the second year of the study was obtained from the first year report prepared by Nature Advisory (2020).

Collection and use of specimens were conducted under the *Wildlife Act 1975* Research Permit number 10007321 allowing for the collection and storage of birds of bats found dead within the wind farm site and along roadsides for the purpose of scavenger and searcher efficiency trials.

5.2 Scope and Objective

As outlined in the Bat and Avifauna Management Plan, the primary scope of the bird and bat monitoring program is to:

- Monitor the impact of the Salt Creek Wind Farm on populations of significant avifauna species that may utilise the site, in particular:
- Brolga (*Antigone rubicunda*)
- Southern Bent Wing Bat (*Miniopterus schreibersii bassanii*), and
- Other species listed under the Environment Protection and Biodiversity Conservation Act 1999, the Flora and Fauna Guarantee Act 1988 and the Advisory list of Threatened Vertebrate Fauna in Victoria –2013 (the Advisory List).

And if required, to:

- Develop a Mitigation and Management Strategy for any biologically significant impacts on Brolgas and bats arising from the wind energy facility operations.

5.3 Study Area

The study area is located a 190km west of Melbourne, approximately 55km north of Warrnambool and 70km east of Hamilton. Access to the site is off Hexham-Woorndoo Road. The project site encompasses 750 hectares of grazing land located in the eastern section of the Salt Creek Merino Stud. The project site is predominantly cleared agricultural land used for livestock grazing. Each of the 15 turbines is included in the study (Figure 8).

Figure 8 Location of turbines for Salt Creek Wind Farm. Image courtesy of Google Maps

6. Part B – Methods

6.1 Data Analysis Overview

Quantifying bird and bat mortality from turbine collision is an ongoing management issue for wind energy facilities and different sites present different risks. Different monitoring requirements across Victoria means that data analysis must account for differences in survey effort, survey detection success and scavenger efficiency. Data analysis was undertaken by Symbolix Pty Ltd using Monte-Carlo simulations, which account for differences in effort. Full report and methods can be found in Appendix 6.

6.2 Carcass Persistence Trials

Persistence trials were undertaken in year one by Nature Advisory to determine the rate at which carcasses persist within the survey area. The primary method of removal of carcasses is scavenging by foxes, raptors, magpies and crows. Quantifying the rate of removal by scavengers is essential to understand how many carcasses are available for detection by observers and to provide correction factors for subsequent impact estimates.

Four carcass persistence trials were conducted in year 1 using a collective total of 61 carcasses, although data was lost from 21 samples due to camera difficulties, giving a total number used for analysis of 40 observations (Nature Advisory 2020). Whilst the sample size limits interpretation of seasonal or sample size/type effects, it does provide an adequate average annual estimate which was used for year 2 mortality estimates. Typically, small bats are scavenged faster than larger specimens, however as a range of small and large bats, as well as small to large birds were used, an average for all specimens is derived which may underestimate small bat fatality, but equally over estimate large bat and bird fatalities. Additionally, pest animal monitoring has shown a reduction in the presence of fox activity on site which may increase the persistence of carcasses in year 2, although this would require further persistence trials to quantify. Further details on carcass persistence trial methodology can be found in (Nature Advisory 2020).

6.2.1 Data Analysis

Survival analysis was used to determine the average time carcasses remained in the field before scavenging. As an exact time of removal is not known for all carcasses, survival analysis provides an interval in which the scavenge event has occurred and fits a curve to the data which is used to estimate the average survival percentage after a given length of time. Survival analysis is used to fit a curve to the data which provides an estimate of the survival percentage after a given length of time (Nature Advisory 2020).

6.3 Searcher Efficiency

Searcher efficiency trials are conducted to determine the likelihood of the survey team detecting a carcass during surveys if one is present. Carcasses are randomly distributed throughout the survey area at least one hour prior to the arrival of the search team. To ensure dogs are not tracking human footsteps, carcasses are thrown from a randomly designated point and allowed to land naturally. GPS coordinates of the throw location and direction of throw are recorded, and an indirect path is walked back to the vehicle. Whilst handlers are aware of the trial being undertaken, the trial is still considered blind as handlers are unaware of the number and type of carcasses present, which turbines are baited, nor which turbines remain unbaited thus providing sufficient blinding to validate the testing. To ensure additional effort is not made by the search

team, GPS tracking of the dogs and handlers record survey duration which can be compared to standard surveys to ensure the dog team does not spend longer looking in the present of an efficiency trial.

6.3.1 Data Analysis

Observer efficiency data was provided to Symbolix to allow for correction based on observational bias. The dog and handler teams engaged at Salt Creek Wind Farm are simultaneously engaged in work at other wind energy facilities and all searcher efficiency data was provided to Symbolix. One trial conducted at Salt Creek was compared with another trial conducted in 2020 and analysed for differences using binomial regression and differences between birds and bats using stepwise AIC selection.

6.4 Carcass Searches

Carcass surveys were conducted by trained detection dogs and their handlers monthly from August 2019 until July 2020, with additional fortnightly surveys from March 2020 to May 2020, at every turbine to a radius of 130m. Dogs search across the wind using transects approximately 20m apart depending on topography and are fitted with live tracking GPS collars to ensure coverage of the survey area. Finds are recorded by the handler and removed from the survey area. Amendments to the original BAM plan methodology were approved by the Moyne Shire on the 30/8/2019. Full details of survey methodology can be found in section 3.3.1.3 of the Bat and Avifauna Management Plan for Salt Creek Wind Farm (Jacobs 2017) with additional information provided in Appendix 7.

6.4.1 Data Analysis

The mortality estimation is done via two Monte-Carlo simulations, one for bats and one for birds. Each used 25000 simulations of the survey design. Random numbers of virtual mortalities were constructed, along with the scavenge loss time and carcass persistence (based on the measured confidence intervals). The proportion of virtual carcasses that were “found” was recorded for each simulation. Finally those trials that had the same outcome as the reported survey detections were collated, and the initial conditions (i.e. how many true losses) were reported on.

This simulator has been found to perform comparably to other theoretical estimators, but more easily incorporates changing or complex survey designs. Full details of the analysis can be found in Appendix 6.

7. Part B – Results

7.1 Searcher Efficiency

Searcher efficiency trials were carried out at Salt Creek Wind Farm and data was combined with additional surveys from Silverton Wind Farm from the same dog/ handler teams. There was no evidence that searcher efficiency differed between the sites nor the target (different sized birds or bats), thus data was aggregated into a single estimate to provide a stronger confidence of the mean. Searcher efficiency was 96% (Table 14) with a 95% confidence interval of [89%, 99%].

Table 14 Detection efficiency combined

Variable	Combined estimate
Number found	74
Number placed	77
Mean detectability proportion	0.96
Detectability lower bound (95% confidence interval)	0.89
Detectability upper bound (95% confidence interval)	0.99

7.2 Carcass Persistence

Four carcass persistence trials were conducted in each season of the first year with a total of 40 carcasses with complete data used for analysis. There were three carcasses remaining at the end of the trial, two large birds and one large bat. Due to the limited sample size, differences between classes (birds or bats) or seasons was not investigated and a combined survival curve for all birds and bats was derived (Figure 9). The survival curves show us that the mean time to total loss by scavengers is 5.9 days with a 95% confidence window of [4.1, 8.6] days.

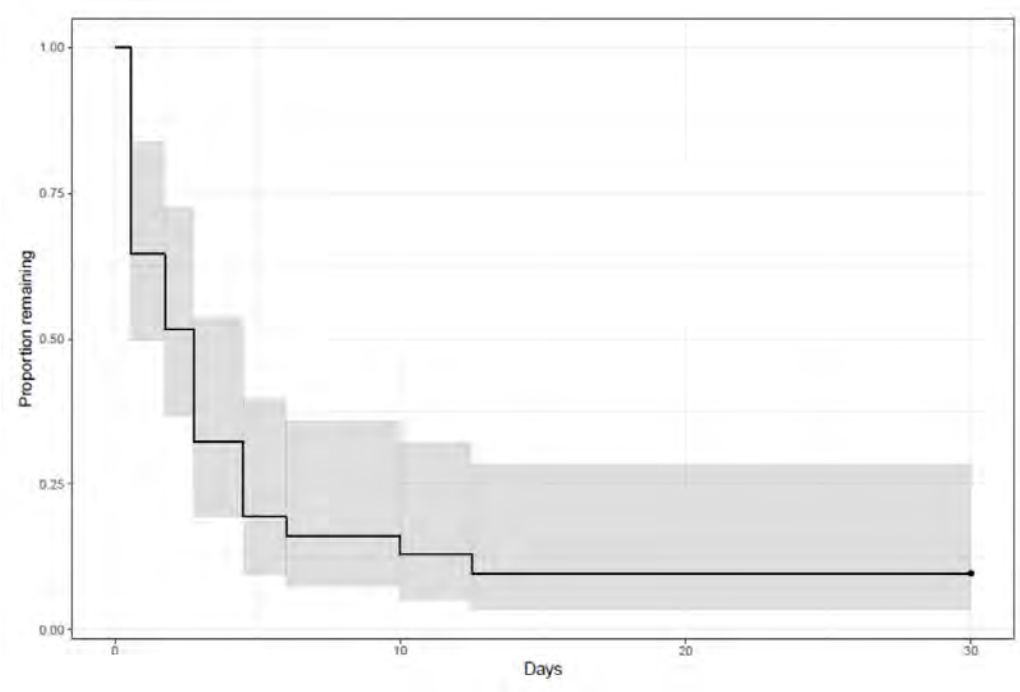

Figure 9 Survival curve showing persistence for all birds and bats cobined with 95% confidence interval shaded.

7.3 Carcass Searches

Carcass searches were carried out between August 2019 and July 2020 at every turbine. In total 223 turbine searches were carried at the 15 turbines (Table 15) covering 1184 hectares. During the month of August, two turbines were not surveyed due to the presence of active lambing.

Table 15 Carcass Survey Summary per month

Year	Date	Number of surveys
2019	Aug	13^
	Sep	15
	Oct	15
	Nov	15
	Dec	15
	Jan	15
2020	Feb	15
	Mar	30
	Apr	30
	May	30
	Jun	15
	Jul	15

^An agreement between Salt Creek Merino Stud Farm manager and detection dog handlers from Skylos Ecology was verbalised and teams are to avoid turbines with active lambing when working dogs.

A total of 65 bats and 47 birds or feather spots were found during routine mortality searches (Table 16). An additional 4 carcasses were found by dogs outside the survey area or by site staff (Table 17). Detailed list is provided in Appendix 7.

Table 16 Summary of species found during carcass searches

Species		Count
Bats	Eastern Falsistrelle	8
	Gould's Wattled Bat	4
	White-Striped Freetail Bat	34
	Large Forest Bat	2
	Lesser Long-eared Bat	1
	Little Forest Bat	2
	Grey-Headed Flying-fox	13
	Unidentifiable Bat	3
Birds	Straw-Necked Ibis	1
	Brown Falcon	1
	Peregrine Falcon	1
	Nankeen Kestrel	1
	Wedge-tailed Eagle	1
	Barn Owl	7
	corella sp.	6
	Crimson Rosella	1
	Striated Pardalote	1
	Spotted Pardalote	1
	Starling	3
	Eurasian Sparrow	2
	House Sparrow	2
	Australian Magpie	11
	raven sp.	1
	Unidentifiable bird	7
	Unidentified chick	1

Table 17 Summary of incidental finds outside 60m survey area

Species	Distance from Turbine	Turbine	Month	Condition
Straw Necked Ibis	20	7	Nov 2019	complete
Grey-headed Flying-fox	151	2	Mar 2020	Complete
corella sp.	141	13	May 2020	Feather spot
Eastern falsistrelle	140	15	May 2020	Complete

7.3.1 Mortality estimation for bats

During the survey period, a total of 65 bats were found at Salt Creek with 52 finds being micro bats from the two families Vespertilionidae (night bats) and Molossidae (freetail bats). The remaining 13 were fruit bats from

the family Pteropodidae. Finds were restricted between November and May, with around two thirds found during the 2 month period of March and April. The resulting estimate, taking into consideration carcass persistence and searcher efficiency, is a mean loss of 277 bats for the year. Based on the detected carcasses we can be 95% confidence that fewer than 373 individual bats were lost (Figure 10).

7.3.2 Comparison of bat mortality year 1 and 2

During the first year of surveys, a total of 23 bats were found providing an expected mean mortality of 196, and 95% confidence that fewer than 279 individuals were lost. Using the statistical test Kolmogorov-Smirnov to determine if there is a significant difference between the modelled distribution of years it was found that the distribution of year 1 is shifted left relative to year 2 and thus mortality is higher in year 2 relative to year 1 mortality.

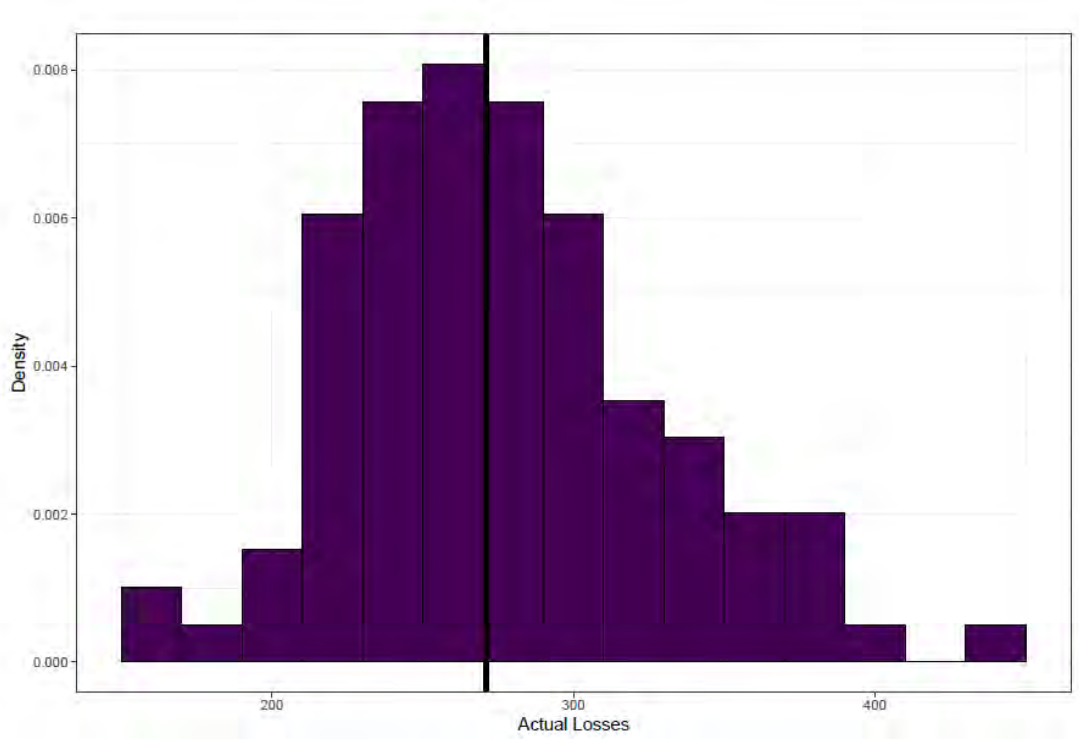

Figure 10 Empirical distribution of bat losses at Salt Creek Wind Farm

7.3.3 Mortality estimation for birds

During the survey period, a total of 47 birds were found at Salt Creek Wind Farm, with carcasses detected in each month and no temporal distribution evident. The resulting estimate taking into consideration scavenger removal and searcher efficiency is a mean loss of 202 birds for the period. Based on the detected carcasses we can be 95% confidence that fewer than 285 individual birds were lost (Figure 11).

7.3.4 Comparison of bird mortality year 1 and 2

During the first year of surveys, a total of 23 birds were found providing an expected mean mortality of 141, and 95% confidence that fewer than 202 individuals were lost. Using the statistical test Kolmogorov-Smirnov to determine if there is a significant difference between the modelled distribution of years it was found that the distribution of year 1 is shifted left relative to year 2 and mortality is higher in year 2 relative to year 1.

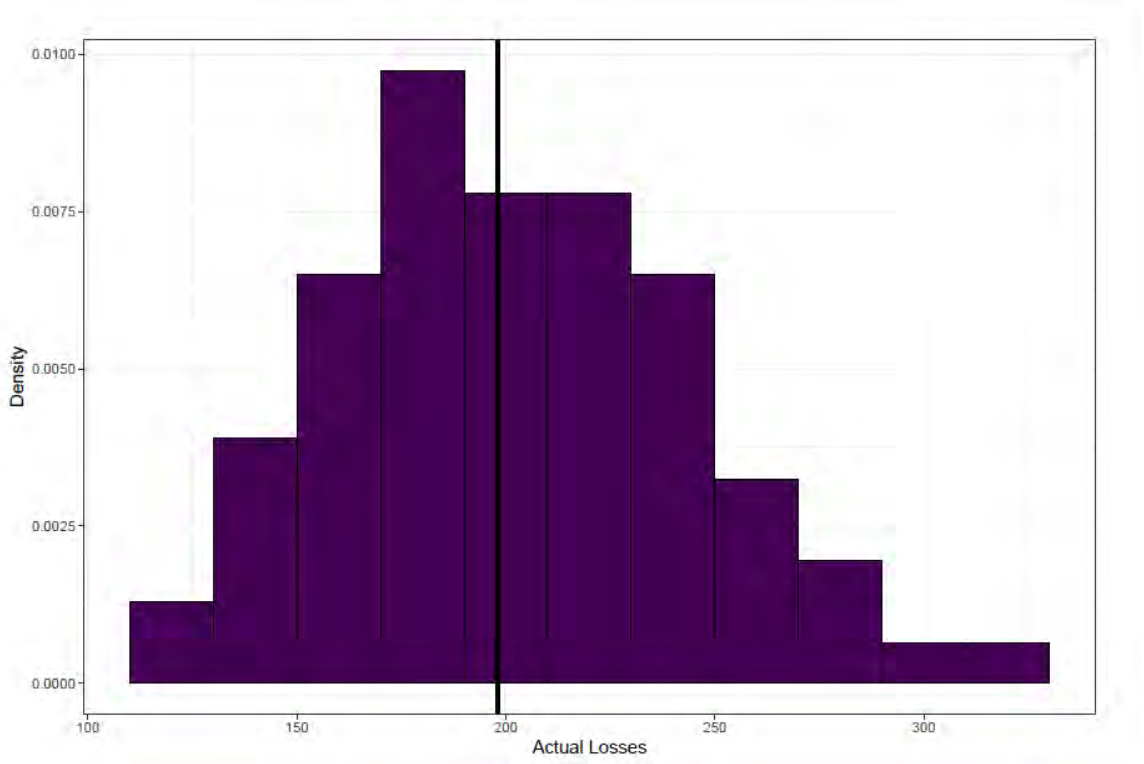

Figure 11 Empirical distribution of bird losses at Salt Creek Wind Farm

8. Part B – Discussion

8.1 Searcher Efficiency

Results from several trials indicated that combined searcher efficiency for detection of both birds and bats is 96% [89%, 99%] and consistent (and slightly higher) with other sites utilising dog/ handler teams. There was no difference in the detectability of birds and bats by the dog/ handler teams and this is primarily driven by dogs' use of olfactory detection rather than visual based searches. The use of dogs is particularly advantageous for small targets such as bats and small birds where evidence suggests that humans have low detection rates (Mathews et al. 2013).

8.2 Carcass Persistence

The influence of carcass persistence on final mortality estimates should not be underestimated. In Victoria it has been demonstrated that micro bats disappear at a faster rate than small to large birds which are removed faster than large raptors such as eagles. The sample size in this study is not sufficient to determine carcass specific persistence rates, thus here we acknowledge that scavenging times for bats is likely faster and likely slower for birds than 5.9 days used as a mean removal time. It is useful when comparing persistence to include studies undertaken at different locations where possible to increase sample size, particularly where similar removal rates exists, such as neighbouring wind farms or those under similar land use. Unpublished state-wide data prepared by Symbolix for DELWP suggests that the mean removal time for birds across western Victoria is 5.7 days, similar to this study, however the mean removal time for bats is 2.7 days. There is no available precedence to estimate the mean removal rate of Grey-headed Flying-foxes relative to other carcasses and insufficient carcasses available to undertake a valid trial. Evidence from the state-wide analysis suggests mice of similar weight make a valid proxy for microbats and thus rats or rabbits of a similar weight may be an option to better understand removal of GHFF.

8.3 Carcass Searches

8.3.1 Bat Mortality

Overall mortality estimates for bats at Salt Creek Wind Farm are 95% confident that no more than 373 bats were impacted during the second year of monitoring. The average number of bats likely to be impacted per turbine per year is 18.5, with a 95% confidence that less than 25 bats will be impacted. This is an increase on year 1 where an average of 13 bats per turbine, with a 95% confidence that fewer than 18.6 bats per turbine were impacted. This figure does not take into consideration the temporal patterns of bats and assumes that bats have an equal chance of being impacted throughout the year. More than two-thirds of all bats detected during year 2 surveys were found in March and April and no bats were found from June through to October. Previous experience suggests that the reported range of bat impacts in Victoria range between 7 and 11 bats per turbine, thus at Salt Creek Wind Farm mortality is high relative to wind farms in South Eastern Australia.

The diversity of bat species found at Salt Creek Wind Farm is indicative of the location of the site. Species such as White Striped Freetail Bats (*Tadarida australis*) are typical of farmlands and open areas, whilst the forest bats (*Vespadelus species*) are more frequently associated with forested sites which are less prevalent at this location. The presence of the grey headed flying fox (GHFF) in March and April coincided with higher microbat impacts in the same period. Further investigations around GHFF presence and movements around the wind farm can be found in Part A Section 3.4.

8.3.2 Bird Mortality

Overall mortality estimates for birds at Salt Creek Wind Farm are 95% confident that no more than 285 birds were impacted during the second year of monitoring. The average number of birds likely to be impacted per turbine per year is 13.5 birds, with a 95% confidence that less than 19 birds per turbine will be impacted. This is an increase on year 1 where an average of 9.4 birds per turbine, with a 95% confidence that fewer than 13.5 birds per turbine were impacted. This figure takes into consideration searcher efficiency and carcass persistence and is a reasonable estimation of the true impact. National averages for Australia have not been estimated, but a summary of 32 wind farms in Canada found an average of 8.2 ± 1.4 birds per turbine per year were impacted which is lower than the rate recorded for Salt Creek Wind Farm (Zimmerling et al. 2013). Previous experience suggests that the reported range of bird impacts in western Victoria range between 3 and 7 birds per turbine, thus at Salt Creek Wind Farm mortality is high relative to wind farms in South Eastern Australia.

8.3.3 Comparison of Mortality

The relatively high rates of mortality detected at Salt Creek Wind Farm compared to year 1 at Salt Creek and other wind farms in western Victoria may be due to several factors. Typically, carcass persistence is different for birds and bats and different rates are usually available for estimating the influence of scavengers, however, this was not available for this location. The BAM Plan for Salt Creek Wind Farm requires carcass persistence (or 'scavenger') trials to be undertaken only in year 1. Hence, while persistence rates may have differed between year 1 and year 2, particularly when it is noted that fox activity declined in year 2 (Tilt Renewables, pers. comm.), potential differences cannot be quantified. In addition, at many other sites in Victoria, pulse surveys for bats provide a 2-3 days search interval each month to reduce the influence of scavenging in final estimates. Pulse surveys reduce uncertainty and the 95% confidence range for bat estimates and may provide a different estimation from that calculated from single monthly surveys. Whilst searcher efficiency was higher in year 2, and thus more carcasses were detected, searcher efficiency trials conducted in each year attempt to standardise the data and should not result in significantly different mortality estimates.

Environmental variables, including differences in weather, may also have influenced the presence or activity, which, in turn may also have affected mortality rates for particular species.

8.4 Significant Impacts

Events considered a significant impact are outlined in section 4 of the endorsed Bat and Avifauna Management Plan for Salt Creek Wind Farm. The Grey-headed Flying-fox, listed as vulnerable under the Commonwealth EPBC Act and vulnerable in Victoria (DSE 2013) was detected during routine surveys. No other species listed under the Commonwealth EPBC Act , threatened under Victoria's FFG Act or species listed as vulnerable, endangered or critically endangered under the Advisory list of threatened vertebrate fauna in Victoria (DSE 2013) were found during carcass searches at Salt Creek Wind Farm.

9. Part B – Recommendations

9.1 Searcher Efficiency

Searcher efficiency trials have demonstrated high detection for both birds and bats. Due to the consistent high detection and ongoing assessments being conducted on the dog and handler teams, it is recommended that only one additional trial is undertaken for year 3 of the study to ensure levels are maintained. This exceeds requirements of the BAMP.

9.2 Carcass Persistence

To ensure the higher mortality figures are not a function of decreased scavenger activity on site it is recommended that two additional scavenger trials with a combined total of at least 30 carcasses be undertaken on site. These should include 10 medium birds, 10 GHFF proxies and 10 microbats. The results of these trials should be compared with year 1 results and the state-wide results (if available) to determine the influence of scavengers at Salt Creek Wind Farm. Seasonal influences are less important than spatially separating studies and thus trials should be at least 3 months apart. This is not a requirement of the BAMP however may be considered to strengthen the confidence of mortality estimates.

9.3 Mortality Survey

Increased survey frequency throughout March and April increased opportunities to detect the federally listed Grey-headed Flying-fox as well as other microbats. Given the high and variable scavenger rate on site, pulse surveys which seek to reduce the uncertainty of search interval on final bat mortality estimates may be warranted to determine if bat impacts are as high as estimated in this report. Pulse surveys typically occur 2-3 days after standard surveys with a reduced area to focus on microbat detection. Given the species of concern for this site is the GHFF, understanding the persistence of GHFF carcasses would better assist in determining the ideal search interval to maximise GHFF detection, without compromising microbat detection. At this site, bats were found from 2 to 150m from the base of the turbine, with only 1 grey headed flying fox and two-thirds of micro-bats found within 60m of the base of the turbine, which is the typical pulse survey radius. Due to the distribution of finds at this site, pulse surveys would need to cover the entire search area to provide useful information on GHFF. Without further understanding of scavenging rates at Salt Creek Wind Farm it is reasonable to continue with fortnightly surveys of the entire search area during late summer/early autumn as recommended Part A, Section 4.3.1, however this is unlikely to increase confidence on microbat estimates.

Investigations into the impacts on GHFF populations have been undertaken by Biosis (Part A) who recommend fortnightly carcass monitoring of carcasses for September to October 2020 and February to mid-April 2021, unless triggered earlier by the discovery of a GHFF carcass.

9.4 Climatic Conditions

It is difficult to forecast a wet year based on the criteria outlined by DELWP due to a number of factors. Most importantly, there have only been five years wetter than one standard deviation from the average since 1981, and only two since 1994, which were the years 2010 and 2011 and have been labelled as 1 in a 100 year rain events. Additionally, with a drying climate, it is likely that these events will become rarer.

Until January 2021, the Bureau of Meteorology is forecasting La Niña, which may be an appropriate method of estimating above average rainfall (leaving the one standard deviation method to the side). If the La Niña forecast is correct and wetter than average rainfall persists, then this may be the best opportunity to capture the impact of the wind farm during a period of increased wildlife activity.

Brolgas respond immediately to rainfall (Part A, Section 2.1). Increased rainfall due to a La Niña event may increase the availability of suitable brolga breeding habitat and activity, and may also influence bat activity if it increases the availability of wetland habitat and flowering of Sugar Gums. Given this information, it is proposed to continue with mortality monitoring in 2020-2021 given the forecasted wetter year and to monitor birds and bats (including Brolga and Grey-headed Flying-fox) over the next 12 months.

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Appendices

Appendix 1: Species reference calls used in bat call analysis

Southern Bent-wing Bat *Miniopterus schreibersii bassanii*

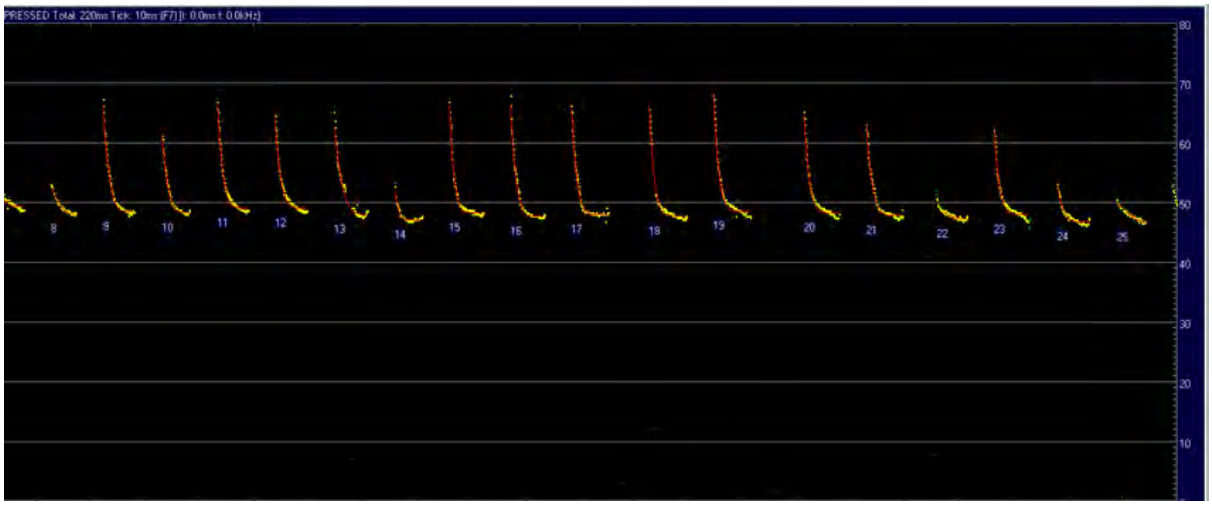

Figure 12 Example of Southern Bentwing Bat call in Anascheme.

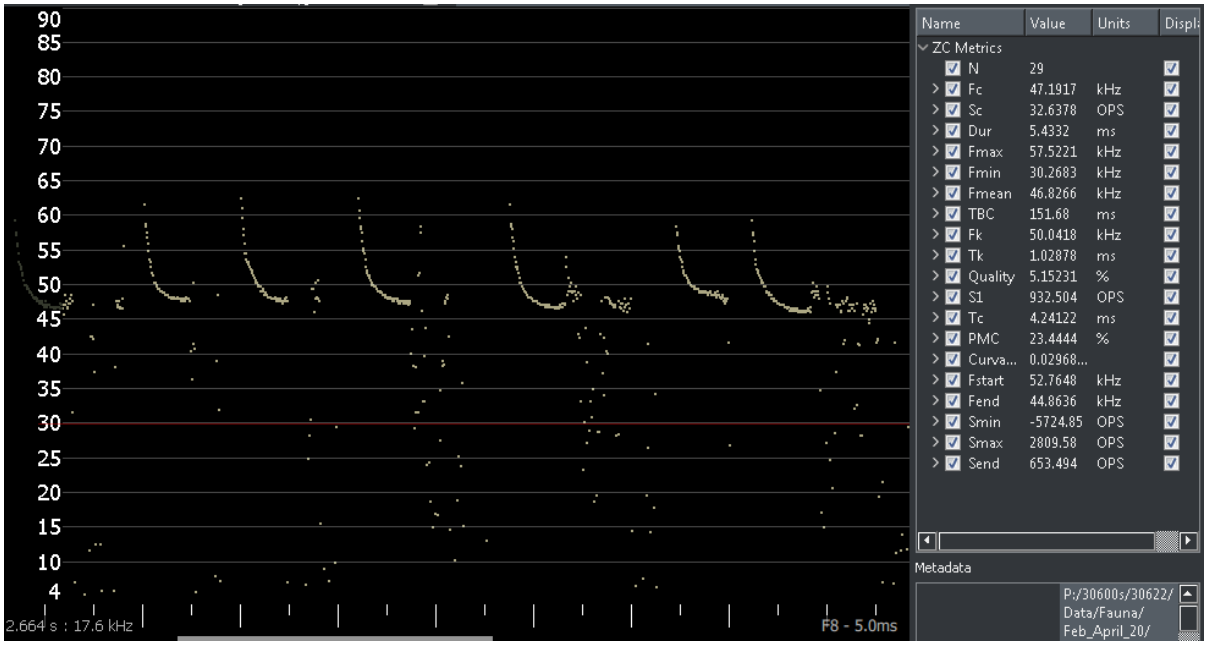

Figure 13 Example of Southern Bent-wing Bat call in Anabat Insight.

White-striped Freetail Bat *Austronomus australis*

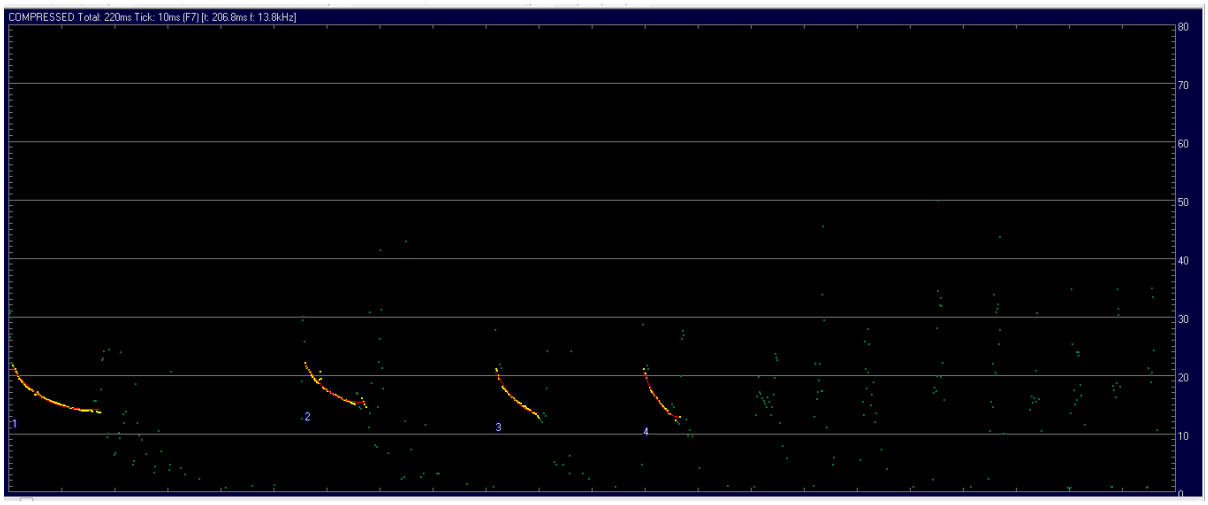

Figure 14 Example of White-striped Freetail Bat call in Anascheme.

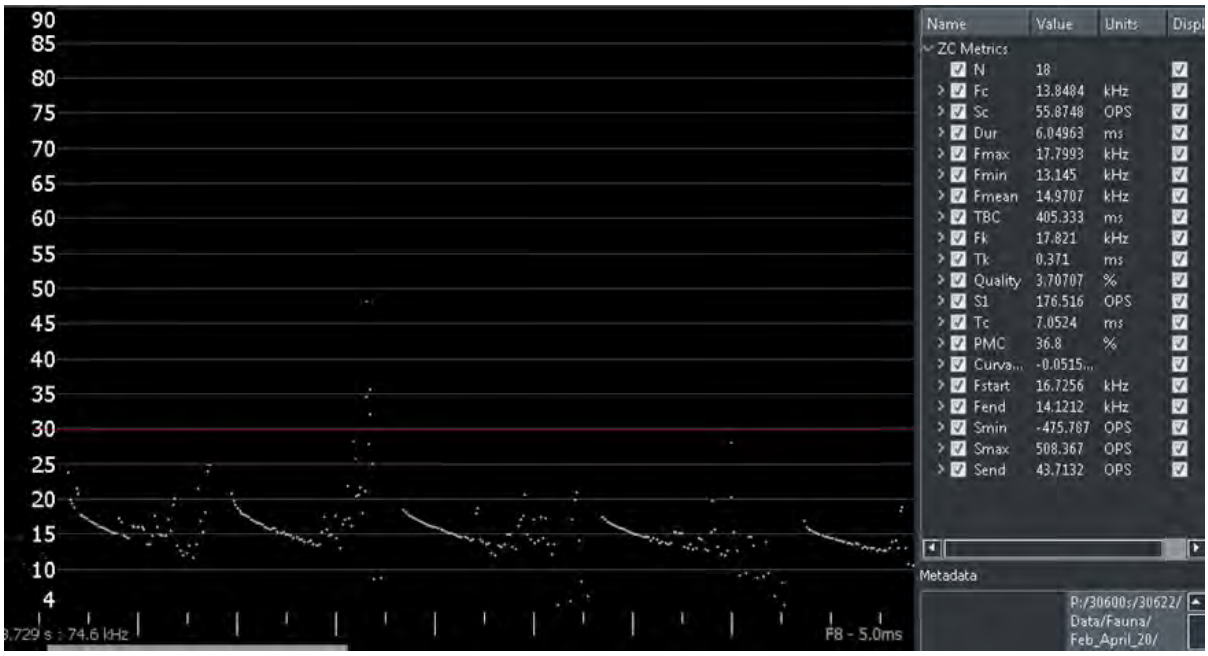

Figure 15 Example of White-striped Freetail Bat call in Anabat Insight.

Gould's Wattled Bat *Chalinolobus gouldii*

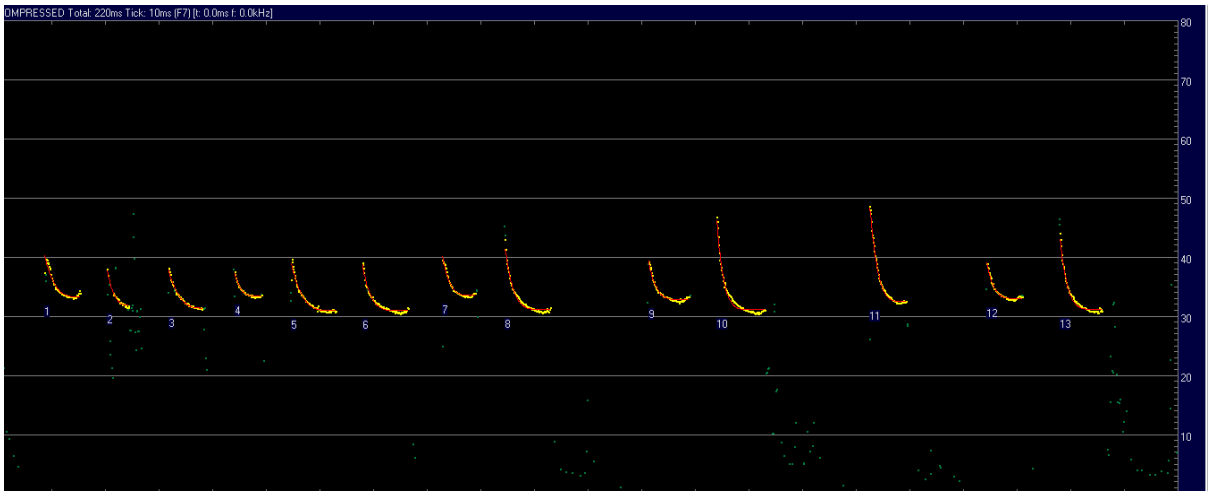

Figure 16 Example of Gould's Wattle Bat call in Anascheme.

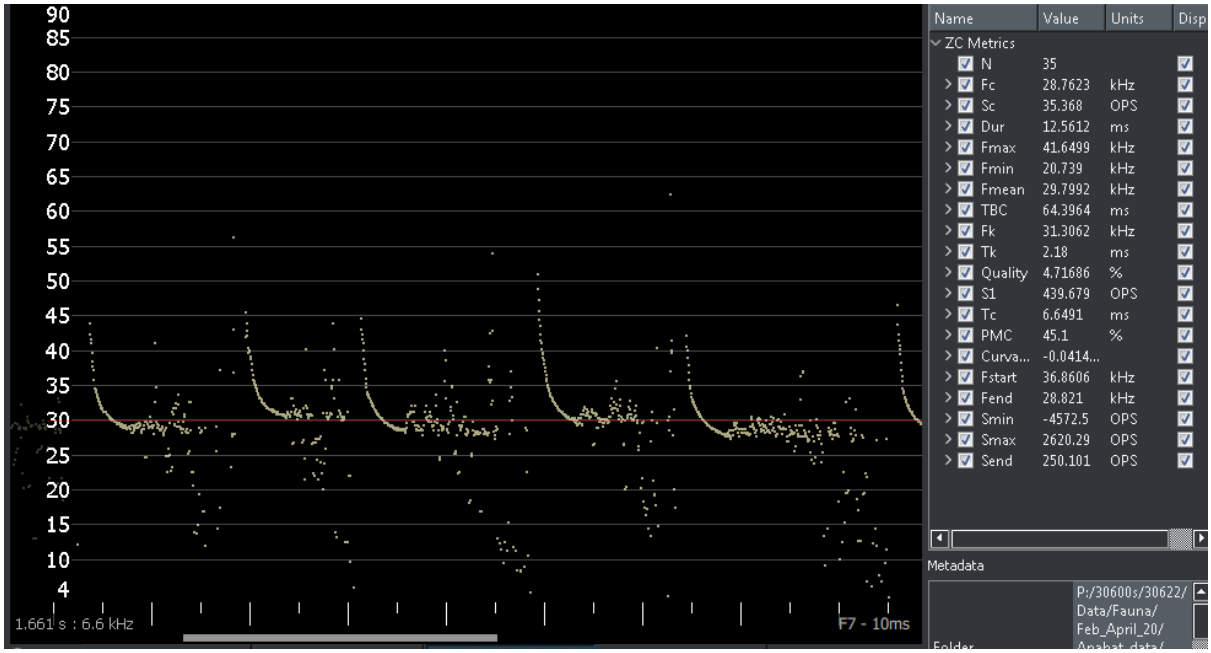

Figure 17 Example of Gould's Wattle Bat call in Anabat Insight.

Chocolate Wattled Bat *Chalinolobus morio*

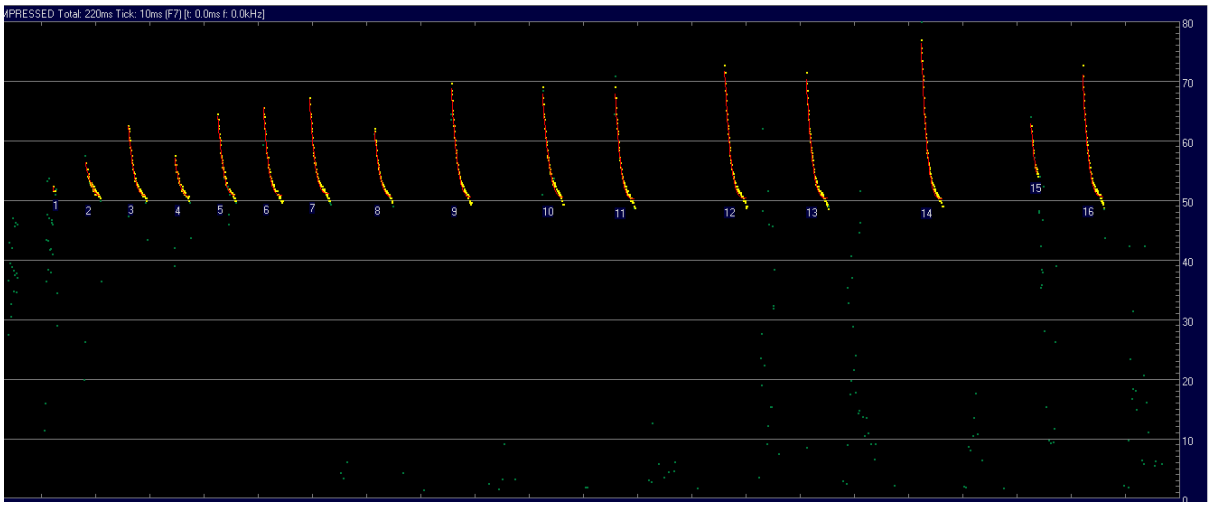

Figure 18 Example of Chocolate Wattle Bat call in Anascheme.

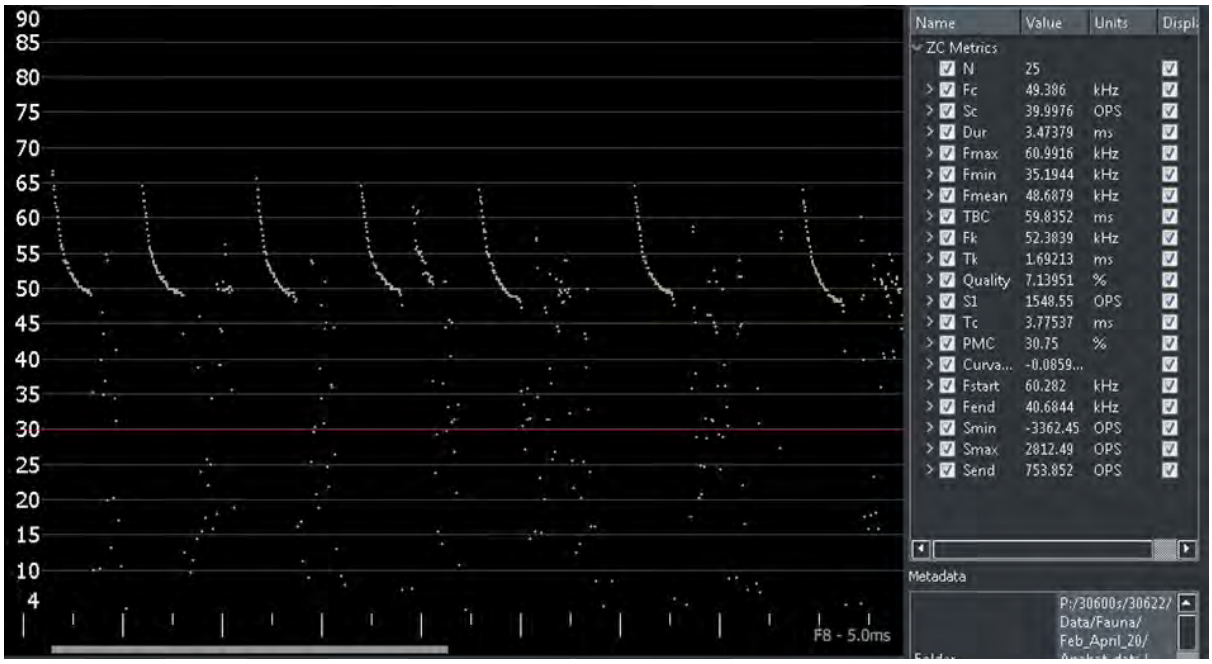

Figure 19 Example of Chocolate Wattle Bat call in Anabat Insight.

Eastern Falsistrelle *Falsistrellus tasmaniensis*

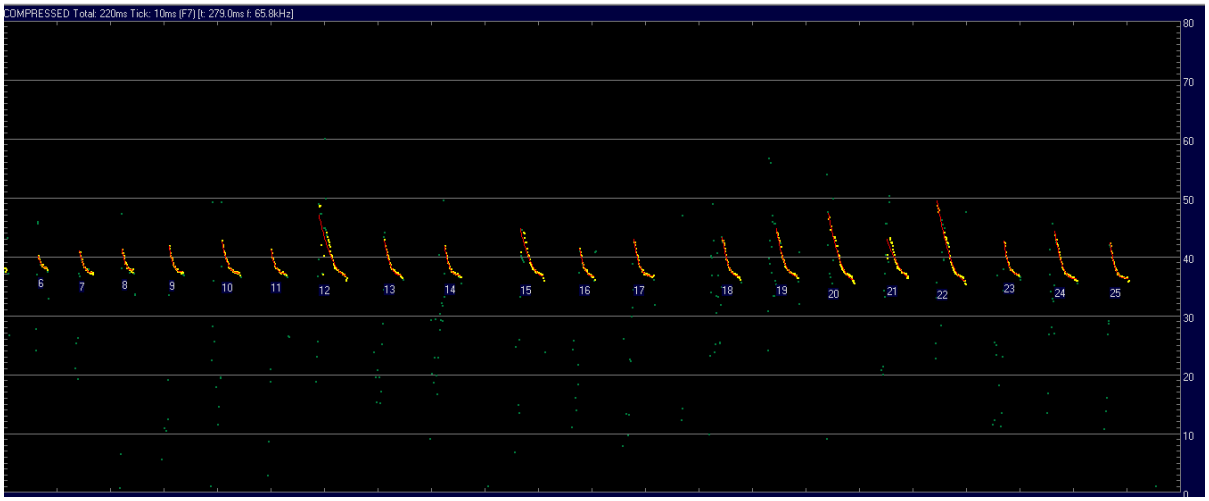

Figure 20 Example of Eastern Falsistrelle call in Anascheme.

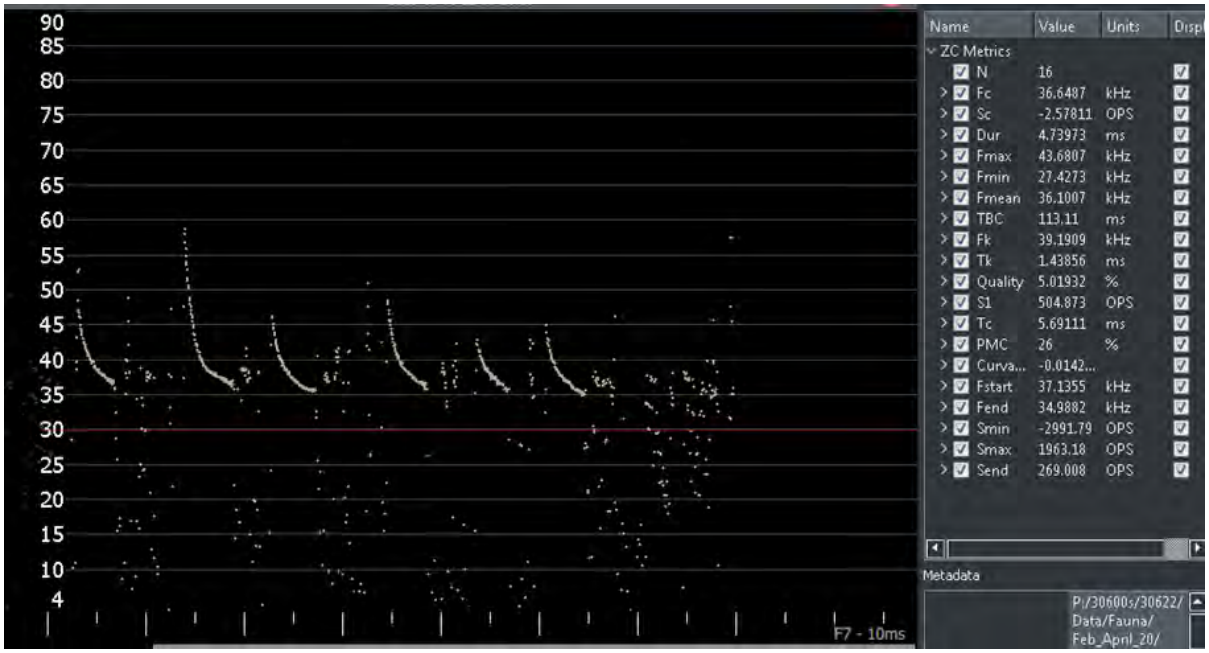

Figure 21 Example of Eastern Falsistrelle call in Anabat Insight.

Large Forest Bat Vespadelus darlingtoni

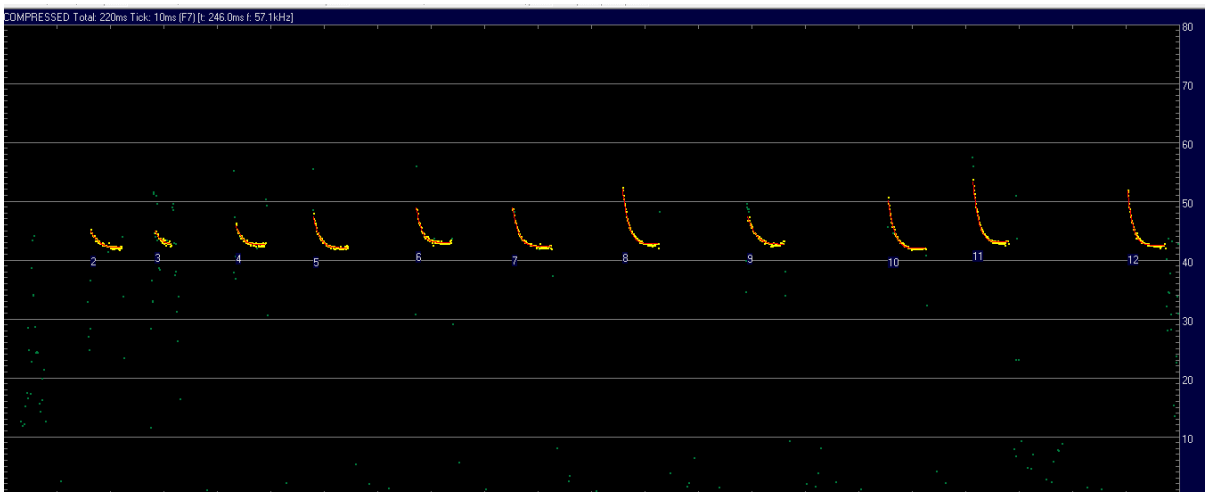

Figure 22 Example of Large Forest Bat call in Anascheme.

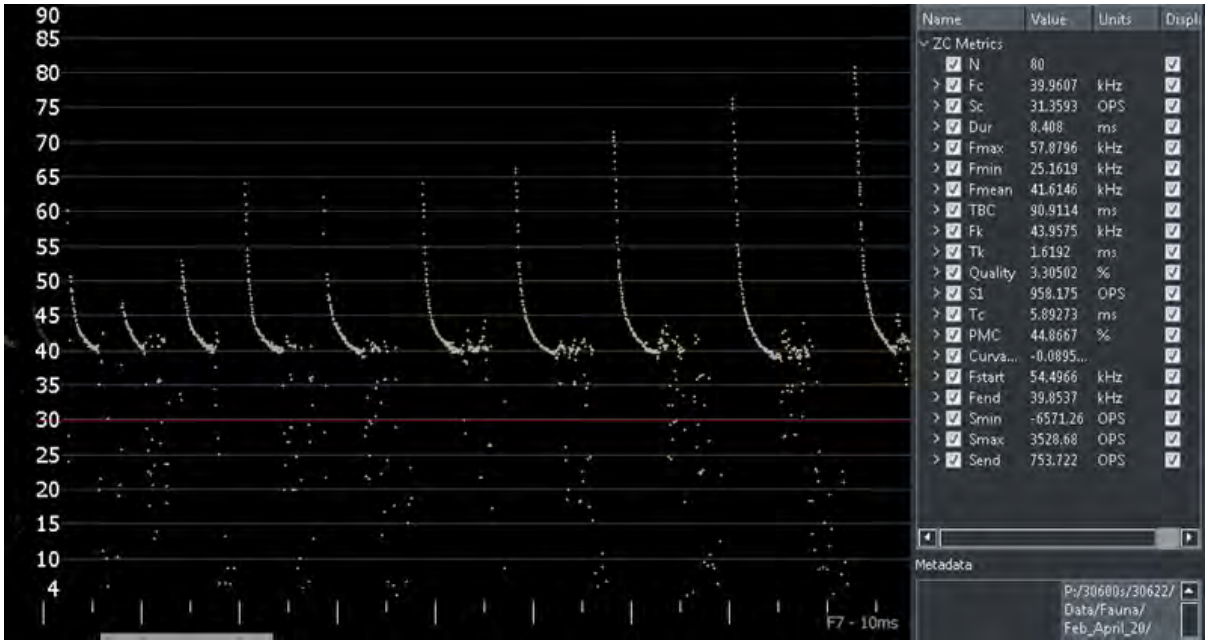

Figure 23 Example of Large Forest Bat call in Anabat Insight.

Little Forest Bat *Vespadelus vulturnus*

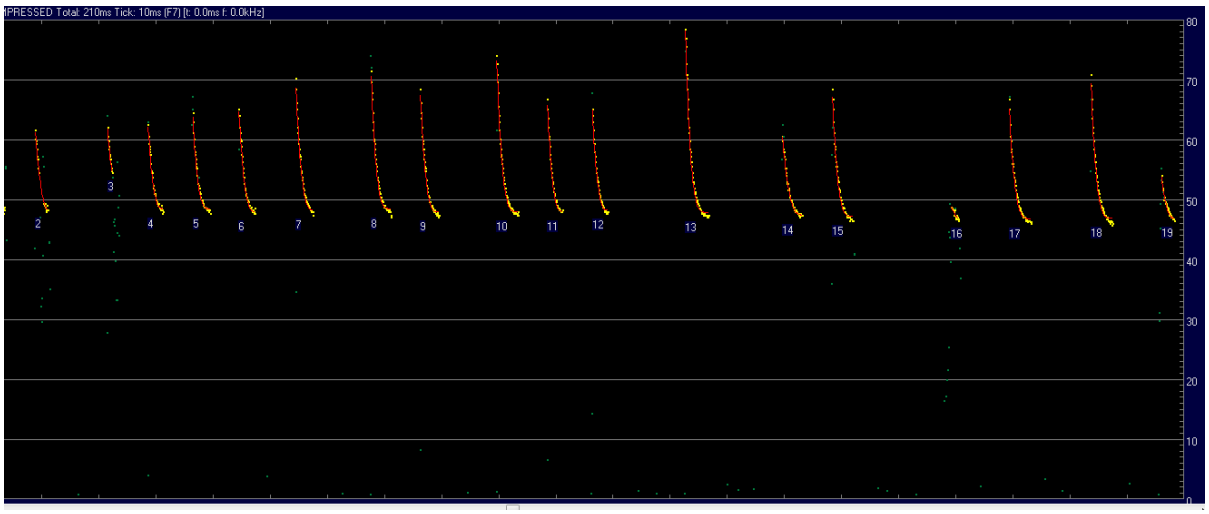

Figure 24 Example of Little Forest Bat call in Anascheme.

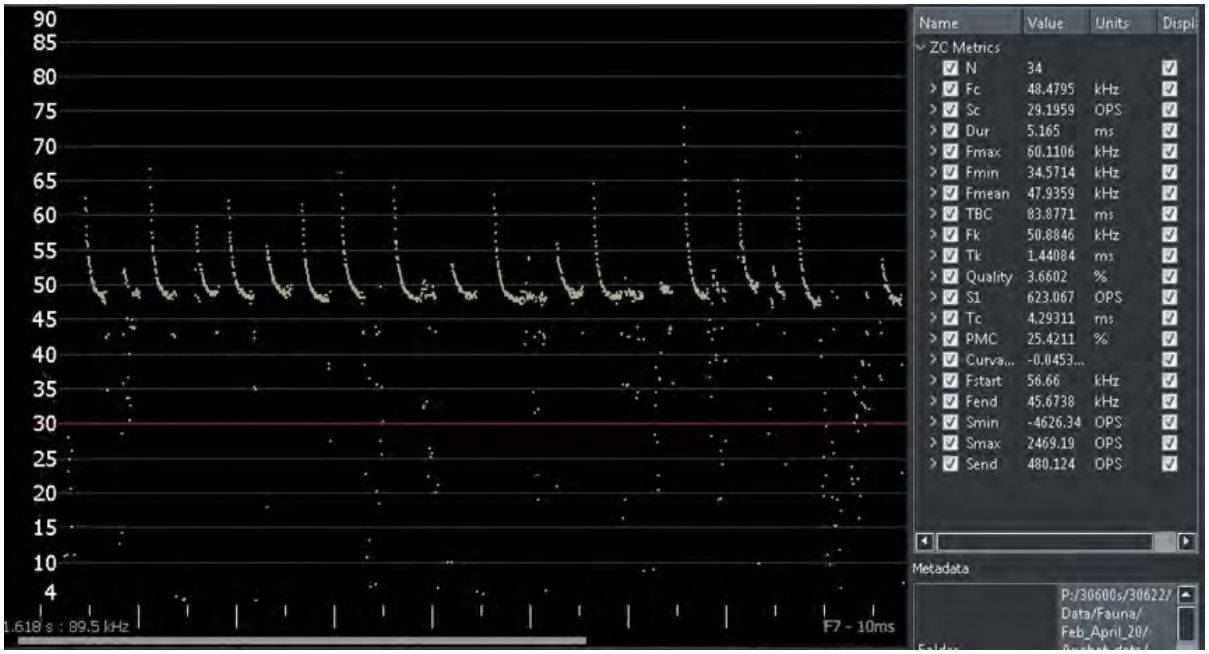

Figure 25 Example of Little Forest Bat call in Anabat Insight.

Southern Forest Bat *Vespadelus regulus*

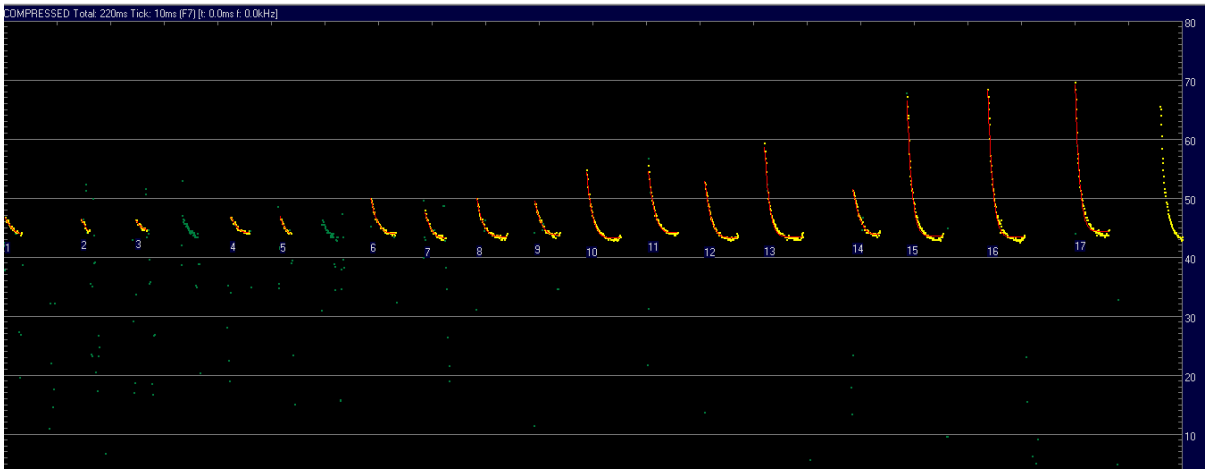

Figure 26 Example of Southern Forest Bat call in Anascheme.

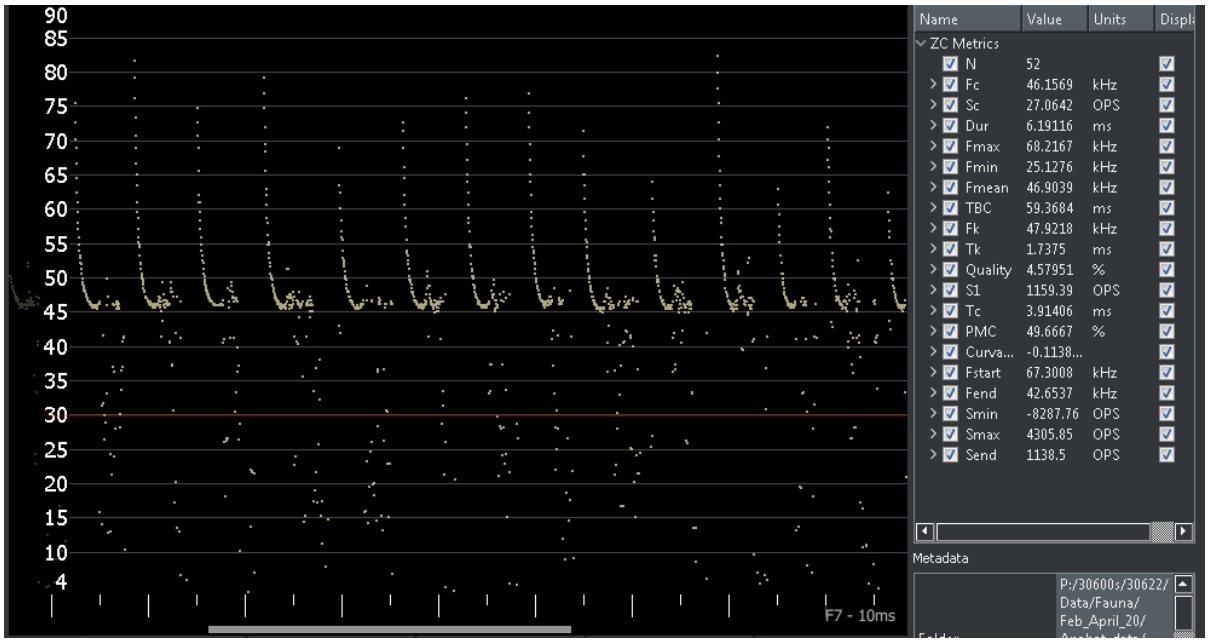

Figure 27 Example of Southern Forest Bat call in Anabat Insight.

Freetail Bats *Mormopterus* spp.

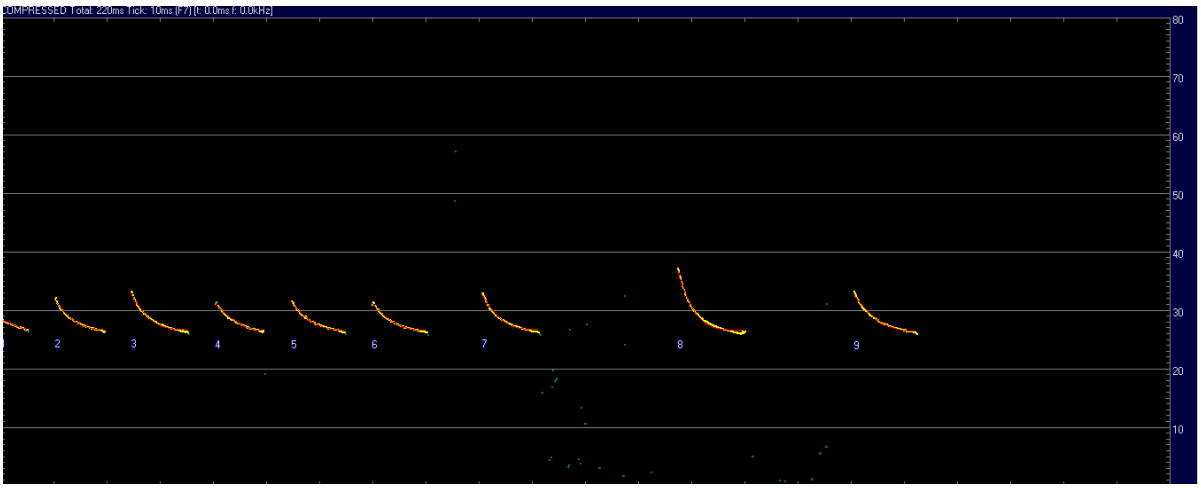

Figure 28 Example of Freetail Bat call in Anascheme.

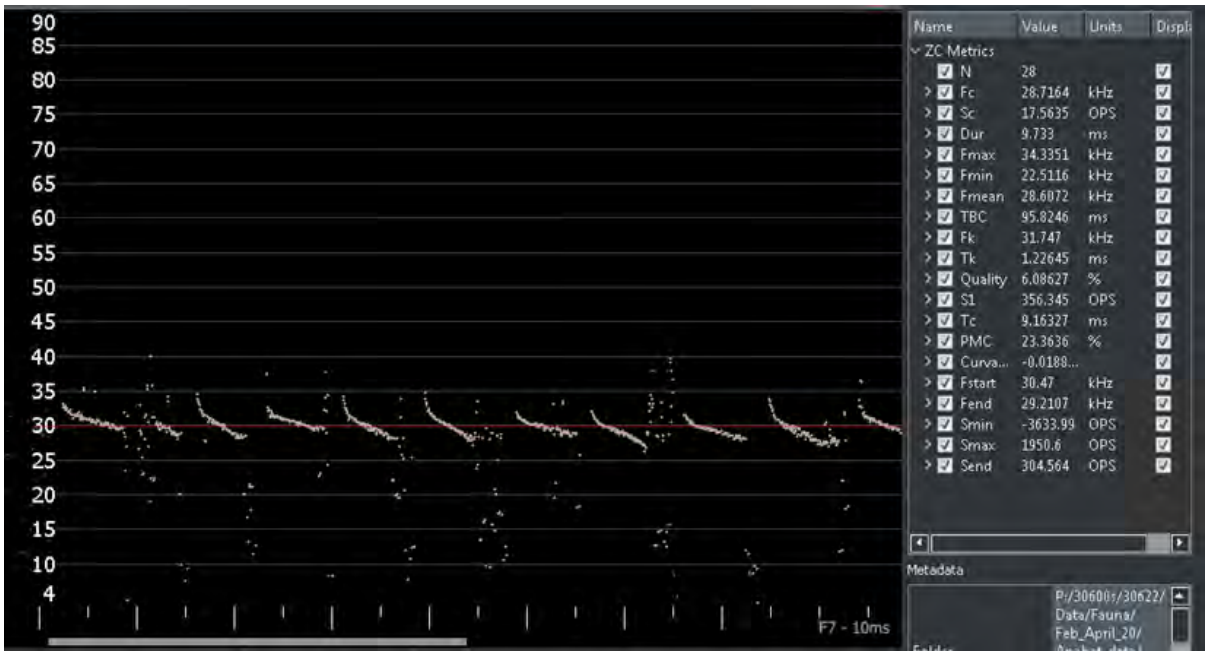

Figure 29 Example of Freetail Bat call in Anabat Insight.

Long-eared Bats *Nyctophilus* spp.

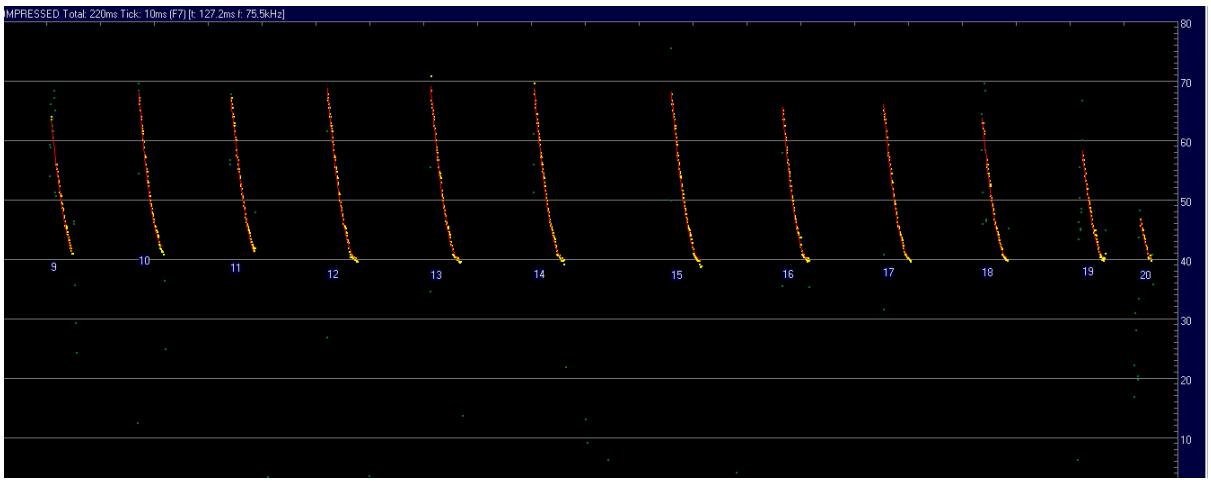

Figure 30 Example of Long-eared Bat call in Anascheme.

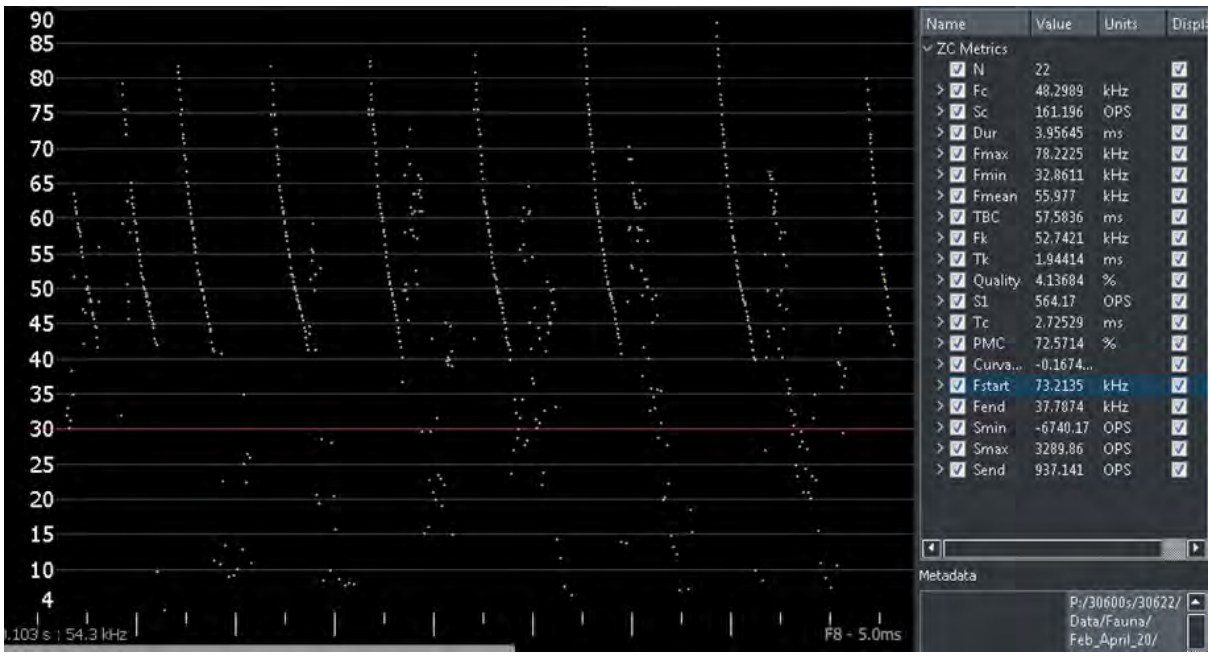

Figure 31 Example of Long-eared Bat call in Anabat Insight.

Appendix 2: Brolga flocking season survey detailed results

Weather observations

Date/Time	Ref no (wetland number)	Observer	No. of birds	Visibility	Cloud	Precipitation	Temperature (°C)	Wind (km/hr)
18/5/2020 **11:00** **11:15**	1 & 30255	Josh Howard and Caitlin Potts	2	Fine Fine	20 20	Nil Nil	15.7 15.7	22 22
18/5/2020 **12:15** **12:55**	29339	Josh Howard and Caitlin Potts	2	Fine Fine	Nil Nil	Nil Nil	16.6 17.3	20 22
19/5/2020 **10:17** **10:17**	20253	Josh Howard and Caitlin Potts	2	Overcast Overcast	60 60	Nil Nil	15.7 15.7	30 30
19/5/2020 **11:30** **11:30**	29339	Josh Howard and Caitlin Potts	2	Overcast Overcast	60 60	Nil Nil	17 17	24 24
24/6/2020 **10:30** **11:30**	29340	Caitlin Potts	2	Mist/fog Heavy cloud	100 100	Mist Nil	10.6 12	Light Light
3/7/2020 **12:30** **3:00**	29340	Caitlin Potts	0	Partly cloudy Partly cloudy	50 50	Light rain Nil	10.6 12	Medium Medium

Brolga observations

Date/Time	Ref no (wetland number)	No. of birds	Distance from nearest turbine (km)	Maximum, Minimum height	Behaviour	Broad habitat description	Breeding?	Notes
18/5/2020 11:00 11:15	1 & 30255	2	3.5	20,0	2 birds flew over 20 m high when survey of wetland 1 was being conducted. They were heading west then just before wetland 1, they circled back and heading east. They flew roughly 1-2 km away then disappeared below tree line. Observer drove in that direction and saw them foraging in pasture near wetland 30255 just south of nine mile lane. They flew off and headed south east (roughly 20m high) and lost sight of them below treeline to the south east.	Dry recently sown paddock near wetland 30255, near bank of dam	No	The pair of Brolga were not on open water and were not seen near any nest.
18/5/2020 12:15 12:55	29339	2	3	20,0	2 Brolga were seen foraging near dam to the east of wetland 29339. They took off and flew 20m high to the south west when disturbed by farm ute in the paddock. They continued to forage in the paddock after disturbed	Small dam near eastern boundary of wetland 29339 small amount of emergent vegetation, treeline nearby.	No	The pair of Brolga were not on open water and were not seen near any nest. Could have possibly been the same pair that were observed near wetland 1 and 30255 earlier in the day (18/5/20).

Date/Time	Ref no (wetland number)	No. of birds	Distance from nearest turbine (km)	Maximum, Minimum height	Behaviour	Broad habitat description	Breeding?	Notes
						However, they were only seen foraging in dry pasture near sheep.		
19/5/2020 10:17 10:17	20253	2	3.5	0,0	2 Brolga were seen foraging in dry pasture near wetland 30253.	Dry paddock, near dam.	No	The pair of Brolga were foraging in a dry paddock and not seen near any nest.
19/5/2020 11:30 11:30	29339	2	3	10,0	2 Brolga flew in from the south (roughly 10 m high) and started foraging in dry pasture near wetland 29339.	Dry paddock, near sheep.	No	The pair of Brolga were foraging in a dry paddock and not seen near any nest. One observer stayed and observed the birds foraging in the paddock while another observer drove back to wetland 30253. The pair of Brolga at 30253 were no longer present. So the pair seen in this survey at wetland 29339 could have been the same pair observed at wetland 30253.
24/6/2020 10:30 11:30	29340	2	2.5	0,0	Both Brolgas already at wetland. 1 brolga foraging on eastern bank of wetland. The other Brolga was standing on nest close to centre of wetland. Both starting walking towards each other, showing alert behaviour and walked towards northern bank of wetland.	Well vegetated wetland surrounded by cropped paddocks. Emergent vegetation within 50% of wetland.	Potentially	One brolga observed on nest, however no eggs were visible and when disturbed the brolga moved away from nest.

Wetland surveys

December 2020

Wetland number	Wetland description (December 2019)	Other Waterbirds recorded (December 2019)
1	Dam full, cattle in paddock	Pacific Black Duck
29150	Visible from road. Long pasture, no water observed	None observed
29162	Partially visible from road, no water observed	None observed
29170	Partially visible from road, no water observed	None observed
29182	Visible from road. Southern side completely dry, dam full on northern side	None observed
29190	Dry at the time of assessment, sheep grazing	None observed
29200	Dam full	None observed
29205	Drying out, 70% full shallow surface water	**Brolga (2),** Black Swan, Grey Teal, Pied Stilt, Masked Lapwing, Australian Shelduck, White-necked Heron
29212	Visible from road, drained, no water, grazed by sheep	None observed – no wetland present
29213	70% full	None observed
29214	70% full	None observed
29226	70% full, shallow	Pied Stilt, Masked Lapwing
29243	70% full	Black Swan, Pied Stilt, Grey Teal, Silver Gull, White-faced Heron, Australian Shelduck
29250	Dry	None observed
29252	Partially visible from road. Dam similar level to November	None observed
29253	Dam similar level to November	None observed
29316	Dam full, surrounding pasture dry	None observed
29339	Full	Pacific Black Duck
29340	Full	Black Swan, Pink-eared Duck, Pacific Black Duck, Grey Teal, Pied Stilt, Australasian Swamphen, Masked Lapwing
29341	No access and not visible from road	
29366	Drained and cropped, no wetland present	

Wetland number	Wetland description (December 2019)	Other Waterbirds recorded (December 2019)
29367	Visible from road. Drained and cropped, no wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	
30265	Drained and cropped, no wetland present	
30374	Visible from road, wetland 90% full	Hardhead, Eurasian Coot, Yellow-billed Spoonbill, Australian Wood Duck
30441	No access and not visible from road	
29183	Shallow saline lake (full)	Pied Stilt, White-faced Heron, Masked Lapwing, Silver Gull
29151	Visible from road, wetland dry	None observed
29141	Visible from road, wetland full	Pied Stilt, Grey Teal
29119	Visible from road, wetland dry	None observed
30299	Visible from road. Very shallow stream/drainage area, hardly any water, sheep grazing	None observed
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Visible from road, wetland 70% full	White-necked Heron, Grey Teal, Pied Stilt, Black Swan, White-faced Heron, Yellow-billed Spoonbill, Australian White Ibis
30369	Partially visible from road, large wetland full	Black Swan, Eurasian Coot
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	
30253	No access and only partially visible from road. Pasture around wetland	
30255	No access and only partially visible from road. Pasture around wetland	

Wetland number	Wetland description (December 2019)	Other Waterbirds recorded (December 2019)
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	
29394	No access and not visible from road	
29378	No access and not visible from road	
29380	No access and not visible from road, only visible from neighbouring property	
30262	No access and not visible from road	
30263	Visible from road, full dam	None observed
29436	Partially visible from road, appeared to have some water	None observed
30383	Partially visible from road, appeared to have some water	None observed
30807	No access and not visible from road	
30261	No access and not visible from road	
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Lots of birds, too far away to identify
29357	Landowner denied access	
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	No Brolga

January 2020

Wetland number	Wetland description (Jan 2020)	Other waterbirds recorded (Jan 2020)
1	Dam 80% full, cattle in paddock	Pacific Black Duck
29150	Long pasture, no water	None observed
29162	Partially visible from road, no water observed	None observed
29170	Partially visible from road, no water observed	None observed
29182	Southern side completely dry, dam 80% full on northern side	Australian Wood Duck, White-faced Heron, Pacific Black Duck
29190	Dry at the time of assessment, sheep grazing	None observed
29200	Dam 70% full	Australian White Ibis, Pacific Black Duck, Grey Teal
29205	Dry mudflat	White-faced Heron (7)
29212	Visible from road, drained wetland, no water, grazed by sheep	None observed – no wetland present
29213	Dry saline flat	None observed
29214	Dry saline flat	None observed
29226	Dry saline flat	None observed
29243	Dry	None observed
29250	Visible from road, wetland dry	None observed
29252	No access and not visible from road	None observed
29253	Visible from road. Dam water levels similar to January observations	None observed
29316	Visible from road, dam 80% full, pasture dry	None observed
29339	Wetland 50% full	Australian Wood Duck, White-necked Heron, White-faced Heron, Eurasian Coot
29340	Wetland 80% full	White-faced Heron, Black Swan, Yellow-billed Spoonbill, Australian White Ibis, White-necked Heron, Grey Teal, Pacific Black Duck, Hoary-headed Grebe, Magpie-lark, Australasian Swamphen, Pied Stilt
29341	No access and not visible from road	
29366	Drained and cropped, no wetland present	

Wetland number	Wetland description (Jan 2020)	Other waterbirds recorded (Jan 2020)
29367	Visible from road, drained and cropped, no wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	
30265	Drained and cropped, no wetland present	
30374	Visible from road, wetland 90% full	Eurasian Coot, Yellow-billed Spoonbill, Pacific Black Duck, Australasian Swamphen
30441	No access and not visible from road	
29183	Wetland 10% full, very shallow, very saline	Masked Lapwing
29151	Visible from road, wetland dry	None observed
29141	Visible from road, wetland dry	None observed
29119	Visible from road, wetland dry	None observed
30299	Very shallow stream/drainage area, hardly any water (less than December 2019)	None observed
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Southern side dry, northern side 80% full	Black Swan
30369	Partially visible from road, large wetland 80% full	Grey Teal (100), Hoary-headed Grebe, Pied Stilt, Australian Shelduck (50)
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	
30253	No access and only partially visible from road. Pasture around wetland	
30255	No access and only partially visible from road. Pasture around wetland	
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	

Wetland number	Wetland description (Jan 2020)	Other waterbirds recorded (Jan 2020)
29394	No access and not visible from road	
29378	No access and not visible from road	
29380	No access and not visible from road. Only visible from neighbouring property	
30262	No access and not visible from road	
30263	Visible from road, dam 80% full	None observed
29436	Partially visible from road, appeared to have some water	None observed
30383	Partially visible from road, appeared to have some water	None observed
30807	No access and not visible from road	
30261	No access and not visible from road	
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Lots of birds, too far away to identify
29357	Landowner denied access	
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	No Brolga

February 2020

Wetland Number	Wetland description (Feb 2020)	Other Waterbirds recorded (Feb 2020)
1	Dam 80% full, cattle in paddock	None observed
29150	Long pasture, no water	None observed
29162	Partially visible from road. No water observed	None observed
29170	Partially visible from road. No water observed	None observed
29182	Southern side completely dry, dam 30% full on northern side	Australian Wood Duck, White-faced Heron, Grey Teal
29190	Dry at the time of assessment, sheep grazing	None observed
29200	Dam 70% full	

Wetland Number	Wetland description (Feb 2020)	Other Waterbirds recorded (Feb 2020)
29205	Wetland 10% full	Australian Shelduck, Masked Lapwing, White-faced Heron
29212	Visible from road, Drained, no water, grazed by sheep.	None observed - no wetland present.
29213	Dry saline flat	None observed
29214	Wetland 10% full	None observed
29226	Wetland 20% full	None observed
29243	Small puddle in NE corner	None observed
29250	Visible from road, wetland dry	None observed
29252	No access and not visible from road	None observed
29253	Visible from road, no water observed	None observed
29316	Visible from road, dam 80% full, pasture dry	None observed
29339	Wetland 50% full	None observed
29340	Wetland 80% full	Black Swan, White-faced Heron, Masked Lapwing, Hoary-headed Grebe, Magpie-lark
29341	No access and not visible from road	
29366	Drained and cropped, no wetland present	
29367	Visible from road, drained and cropped, no wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	
30265	Drained and cropped, no wetland present	
30374	Visible from road, wetland 90% full	Black Swan, Australasian Swamphen, Australian White Ibis, Yellow-billed Spoonbill
30441	No access and not visible from road	
29183	Wetland 90% full, very shallow, very saline	Masked Lapwing
29151	Dry	None observed
29141	Dry	None observed
29119	Dry	None observed
30299	Very shallow stream/drainage area, more water present than either December or January	Masked Lapwing

Wetland Number	Wetland description (Feb 2020)	Other Waterbirds recorded (Feb 2020)
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Southern side dry, northern side 20-30% full, very shallow water	Grey Teal, Masked Lapwing, Magpie-lark
30369	Partially visible from road. Large wetland 80% full	Australian Shelduck, Grey Teal, Black Swan, Masked Lapwing
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	
30253	No access and only partially visible from road. Pasture around wetland	
30255	No access and only partially visible from road. Pasture around wetland	
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	
29394	No access and not visible from road	
29378	No access and not visible from road	
29380	Visible from neighbouring property, wetland 80% full, large wetland, little to no emergent aquatic vegetation	Australian Shelduck, Grey Teal, Yellow-billed Spoonbill
30262	No access and not visible from road	
30263	Dam 50% full, visible from road	None observed
29436	could not see any water from road	None observed
30383	could not see any water from road	None observed
30807	No access and not visible from road	
30261	No access and not visible from road	
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Lots of birds, too far away to identify
29357	Landowner denied access	

Wetland Number	Wetland description (Feb 2020)	Other Waterbirds recorded (Feb 2020)
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	No Brolga

March 2020

Wetland Number	Wetland description (March 2020)	Other Waterbirds recorded (March 2020)
1	Dam 80% full, cattle in paddock	None observed
29150	Long pasture, no water	None observed
29162	Partially visible from road. No water observed; wetland presumed dry.	None observed
29170	Partially visible from road. No water observed.	None observed
29182	Southern side completely dry, dam 30% full on northern side	Australian Shelduck, Grey Teal, Australasian Grebe, Little Pied Cormorant
29190	Dry at the time of assessment, sheep grazing	None observed
29200	Dam 70% full	None observed
29205	Wetland 5% full	White-faced Heron, Masked Lapwing, Australian Shelduck
29212	Visible from road, drained, no water, grazed by sheep.	None observed - No wetland present.
29213	Dry saline flat	None observed
29214	Dry saline flat	None observed
29226	Dry	None observed
29243	Dry	None observed
29250	Dry	None observed
29252	No access and not visible from road	None observed
29253	Visible from road, dam full, no surface water	None observed
29316	Visible from road, dam 80% full, pasture dry	None observed
29339	Both dams 50% full	Australasian Grebe

Wetland Number	Wetland description (March 2020)	Other Waterbirds recorded (March 2020)
29340	Wetland 50% full	White-faced Heron, Australian Shelduck, Grey Teal, Black Swan, Pacific Black Duck
29341	No access and not visible from road	
29366	Drained and cropped, no wetland present	
29367	Visible from road, drained and cropped. No wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	
30265	Drained and cropped, no wetland present	
30374	Wetland 70% full	Black Swan, Australasian Swamphen, Australian Wood Duck, Yellow-billed Spoonbill, Grey Teal, White-necked Heron
30441	No access and not visible from road	
29183	Wetland 20% full, very shallow, very saline	Masked Lapwing
29151	Dry	None observed
29141	Dry	None observed
29119	Dry	None observed
30299	Very shallow stream/drainage area	None observed
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Visible from road, both sides nearly dry, 10% full, very shallow water	Little Pied Cormorant
30369	Partially visible from road, large wetland 80% full	Australian Shelduck, Black Swan
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	

Wetland Number	Wetland description (March 2020)	Other Waterbirds recorded (March 2020)
30253	No access and only partially visible from road. Pasture around wetland	
30255	No access and only partially visible from road. Pasture around wetland	
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	
29394	No access and not visible from road	
29378	No access and not visible from road	
29380	Large wetland 80% full, little to no emergent vegetation	Australian Shelduck, Masked Lapwing
30262	No access and not visible from road	
30263	Visible from road, dam 50% full	None observed
29436	No water visible from road	None observed
30383	No water visible from road	None observed
30807	No access and not visible from road	
30261	No access and not visible from road	
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Lots of birds, too far away to identify
29357	No access and not visible from road	
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	No Brolga

April 2020

Wetland Number	Wetland description (April 2020)	Other Waterbirds recorded (April 2020)
1	Dam 80% full, cattle in paddock	Straw-necked Ibis, Australian White Ibis, Australian Shelduck
29150	Long pasture, no water	None observed
29162	Partially visible from road, no water observed, presumed dry	None observed
29170	Partially visible from road, no water observed	None observed
29182	Southern side completely dry, dam 80% full on north side	None observed
29190	Dry at the time of assessment, sheep grazing	None observed
29200	Dam 40% full	White-faced Heron
29205	Wetland 5% full	White-faced Heron
29212	Visible from road, drained, no water, grazed by sheep.	None observed - no wetland present
29213	Dry saline flat	None observed
29214	Dry saline flat	None observed
29226	Dry	None observed
29243	Dry	None observed
29250	Dry	None observed
29252	No access and not visible from road	None observed
29253	Dam 80% full, no surface water	Australian Shelduck
29316	Dam 90% full, pasture dry	White-necked Heron in pasture
29339	Both dams 50% full	Australian Shelduck
29340	Wetland 50% full	White-faced Heron, Australian Shelduck, Straw-necked Ibis, Masked Lapwing, Pacific Black Duck
29341	No access and not visible from road	
29366	Drained and cropped, no wetland present	
29367	Visible from road, Drained and cropped, no wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	

Wetland Number	Wetland description (April 2020)	Other Waterbirds recorded (April 2020)
30265	Drained and cropped, no wetland present	
30374	Visible from road, wetland 80% full	Masked Lapwing, Australasian Swamphen, Eurasian Coot
30441	No access and not visible from road	
29183	Wetland 70% full, very shallow, very saline	Masked Lapwing
29151	Dry	None observed
29141	Dry	None observed
29119	Dry	None observed
30299	Very shallow stream/drainage area	None observed
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Both sides nearly dry, 10% full, very shallow water	None observed
30369	Partially visible from road, large wetland 90% full	Australian Shelduck, Black Swan, Pied Stilt
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	
30253	No access and only partially visible from road. Pasture around wetland	
30255	No access and only partially visible from road. Pasture around wetland	
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	
29394	No access and not visible from road	

Wetland Number	Wetland description (April 2020)	Other Waterbirds recorded (April 2020)
29378	No access and not visible from road	
29380	Tractor in paddock, could not access. Observed from neighbouring property	Australian Shelduck
30262	No access and not visible from road	
30263	Dam 50% full	None observed
29436	No access and only partially visible from road. No water observed from road	None observed
30383	could not see any water from road	None observed
30807	No access and not visible from road	
30261	No access and not visible from road	
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Lots of birds, too far away to identify
29357	No access and not visible from road	
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	No Brolga

May 2020

Wetland Number	Wetland description (May 2020)	Other Waterbirds recorded (May 2020)
1	Wetland 80% full	**18/5/20 - 2 Brolga flew over at 10:45am (20 m height, heading west then circled just before wetland and headed east 1-2 km from wetland, disappeared below tree line)** Australian Shelduck, Pacific Black Duck, Chestnut Teal, Grey Teal
29150	Wetland 5% full	Australian Shelduck
29162	Could not see any water or birds from road	None observed
29170	Could not see any water or birds from road	None observed
29182	Visible from road, southern side 5% full, northern dam 80% full, no water in pasture	Australian Shelduck, Masked Lapwing, Black Swan, Pacific Black Duck
29190	Dry	None observed
29200	Dam 80% full	Pacific Black Duck
29205	50% full	**18/5/20 - 2 Brolga foraging in wetland for roughly 1 hour at 3:00-4:00pm weather: @4pm=17.6 degrees, 11 km/hr northerly winds, clear skies, 56% relative humidity.** Australian Shelduck, Masked Lapwing, White-faced Heron, Black Swan, Pacific Black Duck
29212	Visible from road, drained wetland, no water present	None observed – no wetland present
29213	Wetland 50% full	Masked Lapwing
29214	Wetland 50% full	Australian Shelduck
29226	Wetland 60% full	Masked Lapwing, Australian Shelduck
29243	Wetland 30% full	Masked Lapwing, Australian Shelduck, Black Swan
29250	Dry pasture	Straw-necked Ibis
29252	Partially visible from road, no water observed	Australian Wood Duck, Australian Shelduck
29253	Dam 80% full	Pacific Black Duck, Australian Shelduck, Australian Wood Duck, Straw-necked Ibis
29316	Dam 90% full, no water in pasture	White-necked Heron, White-faced Heron

Wetland Number	Wetland description (May 2020)	Other Waterbirds recorded (May 2020)
29339	Dams 80% full, no water in pasture	**18/5/20 - 2 Brolga foraging near eastern dam, flew 20 m high to the south-west when disturbed by farmer's ute in paddock. Continued to forage in paddock for roughly 1 hour** **weather @ 12:15pm 16.6 degrees, 20km/hr northerly wind, 62 % relative humidity, clear skies** **weather @ 12:55pm: 17.3 degrees, 22km/hr northerly wind, 56% relative humidity, clear skies** No other waterbirds seen **19/5/20 - 2 Brolga flew in from the south roughly 10 m high when spotted, then started foraging at 11:30am. Wetland 30253 revisited and Brolga were not in the area, so this pair may be the same pair moving between those two areas on both days. Weather: 17 degrees, 24km/hr northerly wind, mostly cloudy, 64% relative humidity.**
29340	Wetland 60% full	Pacific Black Duck, Grey Teal, Straw-necked Ibis
29341	No access and not visible from road	
29366	Drained and cropped, no wetland present	
29367	Visible from road. Drained and cropped, no wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	
30265	Drained and cropped, no wetland present	
30374	Visible from road, wetland 80% full	Yellow-billed Spoonbill, Eurasian Coot, Australian Wood Duck, Australian Shelduck
30441	No access and not visible from road	
29183	80% Full	Masked Lapwing, Australian Shelduck
29151	No water	None observed
29141	20% full	Australian Shelduck
29119	No water visible	None observed
30299	5% full, small puddle	Masked Lapwing
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Wetland 60% full	Australian Shelduck, Pacific Black Duck

Wetland Number	Wetland description (May 2020)	Other Waterbirds recorded (May 2020)
30369	Partially visible from road, wetland 90% full	Black Swan, Australian Shelduck, Pacific Black Duck
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	
30253	No access and only partially visible from road. Pasture around wetland	**19/5/20 - 2 Brolga in dry pasture foraging no water visible nearby, possible same pair that were near wetland 30255 on 18/5/20. Seen at 10:17 am. Weather: 15.7 degrees, 30 km/hr northerly wind, mostly cloudy, 68% relative humidity.**
30255	No access and only partially visible from road. Pasture around wetland	**18/5/20 - 2 Brolga foraging in recently sown paddock south of Nine Mile Lane near Wetland 30255 at 11 am. Likely to be the same pair that flew east from wetland 1, as they headed the exact direction of wetland 30255 and were seen there only 15 minutes after. The pair took off flying 20 m high to the south-east @ 11:15am. Weather: 15.7 degrees, 22 km/hr northerly wind, clear skies, 68% relative humidity.**
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	
29394	No access and not visible from road	
29378	No access and not visible from road	
29380	Visible from neighbouring property, wetland 90% full	Australian Shelduck
30262	No access and not visible from road	
30263	Wetland 60% full	Australian White Ibis
29436	Partially visible from road, wetland 80% full	Pacific Black Duck
30383	Partially visible from road, wetland 80% full	Pacific Black Duck, White-necked Heron
30807	No access and not visible from road	
30261	No access and not visible from road	

Wetland Number	Wetland description (May 2020)	Other Waterbirds recorded (May 2020)
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Lots of birds, too far away to identify
29357	Landowner denied access	
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	No Brolga

June 2020

Wetland Number	Wetland description (June 2020)	Other Waterbirds recorded (June 2020)
1	Dam 100% full, water in pasture with channels formed	Grey Teal, Masked Lapwing, Chestnut Teal
29150	Wetland 5% full, Black Swan nests observed	Black Swan
29162	Could not see any water or birds from road	
29170	Could not see any water or birds from road	
29182	Southern side 5% full, northern dam 80% full, water in pasture	Black Swan, Straw-necked Ibis, Pacific Black Duck, Australian Wood Duck, Masked Lapwing
29190	Water in pasture	
29200	Dam full, water in paddock	Black Swan, Australian White Ibis, Pacific Black Duck, Australian Wood Duck
29205	80% full, water in pasture	
29212	Visible from road, wetland drained, no water	
29213	Wetland 90% full	Australian Shelduck, Masked Lapwing
29214	Wetland 100% full	
29226	Wetland 90% full	Australian Shelduck
29243	Wetland 90% full, Black Swan nests observed	Australian Shelduck, Black Swan, Grey Teal, Australian Wood Duck
29250	Dry pasture	
29252	Could not see any water or birds from road	
29253	Dam 80% full	
29316	Dam 100% full, water in pasture with channels formed	Pacific Black Duck, Australia White Ibis, Straw-necked Ibis
29339	Dams 100% full, water in pasture	Pacific Black Duck, Australasian Grebe
29340	100 % full, some water in pasture	**24/6/2020 10:30am - 2 Brolgas at wetland. One foraging around edges of wetland, the other standing at nest. Both became aware of observer presence and walked towards each other before walking to edge of wetland. Remained alert before beginning to forage again.** **Weather: 11 degrees, light WSW winds, 100% cloud cover.** other birds: Black Swan, Australian Shelduck, Pacific Black Duck
29341	No access and not visible from road	Little Pied Cormorant
29366	Drained and cropped, no wetland present	

Wetland Number	Wetland description (June 2020)	Other Waterbirds recorded (June 2020)
29367	Visible from road, drained and cropped, no wetland present	
29372	Drained and cropped, farm dam near homestead. No wetland present	Australian Shelduck
30265	Drained and cropped, no wetland present	
30374	Wetland 100% full	Black Swan, Eurasian Coot, Australasian Swamphen, Australasian Grebe
30441	No access and not visible from road	
29183	100% full	Masked Lapwing
29151	No water	
29141	West wetland full, east wetland 5% full. Black Swan nests observed	Black Swan, Masked Lapwing, Australian Shelduck
29119	No water visible	
30299	Wetland 5% full, small puddle, limited view from road	Chestnut Teal
30304	No access and not visible from road	
30305	No access and not visible from road	
30303	No access and not visible from road	
29140	Wetland 100% full, some water in paddock	Pacific Black Duck, White-faced Heron, Black Swan, Grey Teal, Australian Shelduck
30369	Partially visible from road, wetland 100% full	Pacific Black Duck, Black Swan, Grey Teal, Australian Wood Duck, Australian Shelduck, White-faced Heron, Masked Lapwing, Eurasian Coot
29239	No access and not visible from road	
30375	No access and not visible from road	
29325	No access and not visible from road	
30252	No access and not visible from road	
30253	No access and only partially visible from road. Pasture around wetland	
30255	No access and only partially visible from road. Pasture around wetland	

Wetland Number	Wetland description (June 2020)	Other Waterbirds recorded (June 2020)
30256	No access and only partially visible from road. Pasture around wetland	
30254	No access and not visible from road	
29394	No access and not visible from road	
29378	No access and not visible from road	
29380	Visible from neighbouring property, wetland 90% full	Black Swan
30262	No access and not visible from road	
30263	Visible from road, wetland 100% full, some water over pasture	
29436	Partially visible from road, wetland 100% full	Straw-necked Ibis, Pacific Black Duck
30383	Partially visible from road, wetland 100% full	
30807	No access and not visible from road	
30261	No access and not visible from road	
29431	No access and not visible from road	
29362	Landowner denied access; limited visibility from road	Black Swan
29357	Landowner denied access	
Salt Creek (within waterway)	Breeding site in Salt Creek identified by landowner in early August	Black Swan

Appendix 3: Brolga breeding season survey detailed results

Weather observations

Date/Time	Ref no (wetland number)	Observer	No. of birds	Visibility	Cloud	Precipitation	Temperature (°C)	Wind (km/hr)
19/8/2019 **16:30** **17:05**	29150	Josh Howard	1	Overcast Partly cloudy	60 40	Showers on and off Sunny at end of survey	9.3 8.9	20 28
20/8/2019 **9:30** **11:30**	29150	Josh Howard	2	Overcast Overcast	100 100	Nil Nil	9.7 11.7	24 33
30/8/2019 **8:15** **10:15**	29150	Josh Howard	0	Fine Fine	Nil Nil	Nil Nil	3 8	11 9
4/9/2019 **9:50** **11:50**	29150	Josh Howard	0	Partly cloudy Partly cloudy	40 20	Nil Nil	12.3 15.5	17 28
15/10/2019 **13:45** **15:45**	29150	Josh Howard	2	Overcast Partly cloudy	100 80	Nil Nil	15.8 16	13 4
16/10/2019 **9:30** **11:20**	29150	Josh Howard	2	Heavy cloud Heavy cloud and rain	100 80	Nil Rain in last hour	11.6 12.8	4 15
22/10/2019 **10:30** **13:00**	29150	Josh Howard	0	Partly cloudy Fine	60 Nil	Nil Nil	12.2 17.4	9 2

Date/Time	Ref no (wetland number)	Observer	No. of birds	Visibility	Cloud	Precipitation	Temperature (°C)	Wind (km/hr)
19/11/2019 **14:00** **14:00**	29205	Josh Howard	2	Overcast Overcast	60 60	Nil Nil	21 21	15-20 15-20
19/12/2019 **13:20** **15:00**	29205	Josh Howard	2	Fine Fine	Nil Nil	Nil Nil	24.5 25.1	13 11

Brolga observations

Date/Time	Ref no (wetland number)	No. of birds	Distance from nearest turbine (km)	Maximum, Minimum height	Behaviour	Broad habitat description	Breeding?	Notes
19/8/2019 **16:30** **17:05**	29150	1	3.5	0,0	Foraging in shallow water on pasture.	Shallow surface water on pasture, lots of other waterbirds around, including swans and swan nests.	Could not see nest or other Brolga.	Lots of swans nesting nearby.
20/8/2019 **9:30** **11:30**	29150	2	3.5	0,0	Foraging in shallow water on pasture and sitting on nest.	Shallow surface water on pasture, lots of other waterbirds around, including swans and swan nests. Deeper water in eastern section of wetland, still very shallow.	Yes. Could see Brolga sitting intermittently on nest with egg.	Lots of swans nesting nearby. Pair foraging within 100 m of the nest, mainly to the west. Never flew away. Sat on nest from 15 minutes to 1 hour at a time. Same individual sat on nest. Left nest to forage 4-5 times in 2 hours. Both Brolga quickly ran back

Date/Time	Ref no (wetland number)	No. of birds	Distance from nearest turbine (km)	Maximum, Minimum height	Behaviour	Broad habitat description	Breeding?	Notes
								towards nest if they were foraging and other birds came too close to nest.
15/10/2019 13:45 15:45	29150	2	4	0,0	One bird intermittently sitting on a nest.	One bird intermittently sitting on a nest.	Yes	One bird sitting on a presumed nest, not moving far from nest. Other bird foraging within 50m and picking apart old swan nest. Bird on nest standing up every 15 minutes for about 5-10 minutes picking at nest. After 1.5 hours birds switched positions between foraging and nest sitting and at about 1.75 hours they both started foraging. Nest location roughly 500-600 metres further north than nest recorded in August surveys.
19/11/2019 14:00 14:00	29205	2	4.5	50, 0	2 birds were seen flying into northern end of wetland from a height of roughly 50m.	Shallow wetland, surrounded by pasture, dead timber and trees.	No	Brolga were seen flying into the northern end of the wetland. However at the time we did not have permission to access the wetland for survey. A farmer drove past and gave the contact details

Date/Time	Ref no (wetland number)	No. of birds	Distance from nearest turbine (km)	Maximum, Minimum height	Behaviour	Broad habitat description	Breeding?	Notes
								of the property owner to wetland 29205. We were able to gain permission to conduct a survey of the wetland on 20/11/2019. No Brolga were seen at the wetland on 20/11/19 and no nest could be seen. It was deemed that the Brolga were not breeding.
19/12/2019 13:20 15:00	29205	2	4.5	0,0	Foraging in shallow surface water.	Shallow wetland, surrounded by pasture, dead timber and trees, emergent vegetation around northern side of wetland.	No	The pair of Brolga were seen foraging, but did not sit on a nest, no nest seen. Probably the same pair of Brolga that were seen at the Wetland in November. The wetland was surveyed again on the 20/12/19 but the Brolga pair were not present at the wetland.

Wetland surveys

August 2019

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (August 2019)	Habitat quality	Other waterbirds recorded (August)
1	No	N/A	Small wetland/farm dam, full at time of assessment, with trees partially surrounding	Potentially suitable	Pink-eared Duck, Grey Teal, Masked Lapwing
29150	Yes (August 2019)	1984	Visible from road, shallow surface water on pasture, water in SE corner only	Suitable	Black Swan (lots of nests), Grey Teal, Masked Lapwing, **Brolga**
29162	No	N/A	Partially visible from road. Full wetland surrounded by pasture, shallow water over surrounding pasture, planted Cypress trees separating wetland 29162 and 29170	Potentially suitable	100+ Straw-necked Ibis
29170	No	N/A	Partially visible from road. Full wetland surrounded by pasture, shallow water over surrounding pasture, planted Cypress trees separating wetland 29162 and 29170	Potentially suitable	100+ Straw-necked Ibis
29182	No	N/A	Visible from road, shallow surface water, lots of dead timber and logs	Potentially suitable	Black Swan, Masked Lapwing, Grey Teal, Pacific Black Duck, Silver Gull, Australian Wood Duck, White-necked Heron
29190	No	N/A	Dry at the time of assessment, sheep grazing	Unlikely to be suitable	Australian Shelduck, Australian Wood Duck, Pacific Black Duck
29200	No	N/A	Dry at the time of the assessment. Cropped with small dam in NW corner	Unlikely to be suitable	Australian Shelduck, Australian Wood Duck, Pacific Black Duck
29205	No	N/A	Partially visible from road. Full, surrounded by trees and pasture, some dead timber	Potentially suitable	Black Swan
29212	No	N/A	Visible from road, drained wetland, no water, grazed by sheep	Unlikely to be suitable	None observed – No wetland present
29213	No	N/A	Partially visible from road, surrounded by trees and hard to see, full at time of assessment, surrounded by pasture	Potentially suitable	Masked Lapwing

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (August 2019)	Habitat quality	Other waterbirds recorded (August)
29214	No	N/A	Partially visible from road, surrounded by pasture	Potentially suitable	Australian Shelduck, Black Swan, Straw-necked Ibis
29226	No	N/A	Partially visible from road, 70% full at time of assessment. Surrounded by crops, dead timber, logs and pasture	Potentially suitable	Masked Lapwing, Australian Shelduck, Australian Wood Duck, Grey Teal, Magpie-lark, Whistling Kite overhead
29243	No	N/A	Partially visible from road, surrounded by pasture and several River Red-gums	Potentially suitable	Pacific Black Duck, Masked Lapwing
29250	No	1992	Partially visible from road. Shallow surface water on pasture, some emergent aquatic vegetation, sheep grazing on adjacent pasture	Potentially suitable	None observed
29252	No	N/A	Partially visible from road. Dam with some surface water in surrounding paddock	Potentially suitable	Australian Wood Duck
29253	No	1992	Visible from road. Full, shallow wetland, trees on southern side, otherwise pasture. Sheep grazing on paddock	Potentially suitable	Black Swan, Masked Lapwing
29316	No	N/A	Shallow wetland, full, visible from road, surrounded by pasture	Potentially suitable	White-faced Heron, Grey Teal (100+), Black Swan, Magpie-lark, Red-kneed Dotterel, Straw-necked Ibis, White-necked Heron
29339	No	1984	Pasture, minimal surface water except dam at eastern end. Sheep grazing	Potentially suitable	Grey Teal, Pacific Black Duck, Australian Shelduck, Little Pied Cormorant, White-faced Heron
29340	No	N/A	No access and not visible from road	Unsure	
29341	No	N/A	No access and not visible from road	Unsure	
29366	No	N/A	No access and not visible from road	Unsure	
29367	No	N/A	Visible from road, drained and cropped, no wetland present	Not suitable	
29372	No	N/A	Drained and cropped, farm dam near homestead. Not a wetland	Not suitable	
30265	No	N/A	No access and not visible from road	Unsure	

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (August 2019)	Habitat quality	Other waterbirds recorded (August)
30374	No	N/A	Full at time of assessment. Surrounded by Cocksfoot, island in middle, trees and shrubs around, pasture to the north	Potentially suitable	White-necked Heron, Eurasian Coot, Black Swan, Chestnut Teal, Little Grassbird, Pacific Black Duck, White-faced Heron, Masked Lapwing, Grey Teal
30441 **Salt Creek (within waterway)**	No Landowner has photos of Brolga near Nest (August 2019)	N/A N/A	No access and not visible from road Creek with water at time of assessment. No sign of Brolga or nest. Landowner believed nest washed away in mid-August 2019 after heavy rainfall	Unsure Potentially suitable	 No Brolga

September 2019

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (September 2019)	Habitat quality	Other waterbirds recorded (September 2019)
1	No	N/A	Small wetland/farm dam, full at time of assessment, trees partially surrounding	Potentially suitable	Pink-eared Duck, Pacific Black Duck, White-faced Heron, White-necked Heron, Masked Lapwing
29150	Yes (August 2019)	1984	Shallow surface water on pasture, water in SE corner only, less water than August	Suitable	Masked Lapwing, Black Swan, White-faced Heron, Yellow-billed Spoonbill
29162	No	N/A	Less surface water than in August, dams still full	Potentially suitable	Black Swan, Australian Shelduck, White-necked Heron, Yellow-billed Spoonbill
29170	No	N/A	Less surface water than in August, dams still full	Potentially suitable	Black Swan, Australian Shelduck
29182	No	N/A	Shallow surface water, lots of dead timber and logs	Potentially suitable	Grey Teal, White-faced Heron, White-necked Heron, Silver Gull, Australian Shelduck, Straw-necked Ibis
29190	No	N/A	Dry at the time of assessment, sheep grazing	Unlikely to be suitable	None observed
29200	No	N/A	Dam still full	Unlikely to be suitable	White-faced Heron, Australian Shelduck, Australian Wood Duck, Australasian

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (September 2019)	Habitat quality	Other waterbirds recorded (September 2019)
					Shoveler, Australasian Grebe, Chestnut Teal, Pacific Black Duck
29205	No	N/A	Full	Potentially suitable	White-necked Heron, Grey Teal, Pied Stilt, Australian Shelduck
29212	No	N/A	Visible from road, drained, no water, grazed by sheep	Unlikely to be suitable	None observed - no wetland present
29213	No	N/A	Full	Potentially suitable	Silver Gull
29214	No	N/A	Full	Potentially suitable	Black Swan, Silver Gull
29226	No	N/A	Still roughly 70% full	Potentially suitable	Black Swan, Grey Teal, Australasian Shoveler, Australian Shelduck
29243	No	N/A	Limited visibility due to Canola crop	Potentially suitable	None observed
29250	No	1992	From limited visibility appears to be dry	Potentially suitable	None observed
29252	No	N/A	Dam still full	Potentially suitable	Straw-necked Ibis, Australian Wood Duck
29253	No	1992	Full, shallow wetland, trees on southern side, otherwise pasture and surface water on pasture.	Potentially suitable	Pacific Black Duck, Grey Teal, Masked Lapwing, Straw-necked Ibis, Black Swan, White-faced Heron, Silver Gull
29316	No	N/A	Surface water dried out significantly - restricted to drainage lines, dam full	Potentially suitable	White-faced Heron, Grey Teal (100+), Black Swan, Magpie-lark, Red-kneed Dotterel, Straw-necked Ibis, White-necked Heron, Pacific Black Duck
29339	No	1984	2 dams full at either end of mapped wetland area	Potentially suitable	Straw-necked Ibis, Grey Teal, Pacific Black Duck, White-faced Heron, Australian Shelduck, Australian Wood Duck, Australasian Shoveler.
29340	No	N/A	Full wetland with emergent aquatic vegetation, partially surrounded by trees, island in middle of wetland, crop all around	Potentially suitable	Hoary-headed Grebe, Grey Teal, Pacific Black Duck, Little Pied Cormorant, Black Swan, Pied Stilt, Hardhead, Australasian

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (September 2019)	Habitat quality	Other waterbirds recorded (September 2019)
					Shoveler, Pink-eared Duck, Masked Lapwing, Eurasian Coot, White-necked Heron, Australian Wood Duck, Australian White Ibis, Australasian Swamphen
29341	No	N/A	No access and not visible from road	Unsure	
29366	No	N/A	Drained and cropped, no wetland present	Not suitable	
29367	No	N/A	Visible from road, drained and cropped, no wetland present	Not suitable	
29372	No	N/A	Drained and cropped, farm dam near homestead. No wetland present	Not suitable	
30265	No	N/A	Drained and cropped, no wetland present	Not suitable	
30374	No	N/A	Visible from road. Slightly less water than August	Potentially suitable, may be too deep	Eurasian Coot, Grey Teal
30441	No	N/A	No access and not visible from road	Unsure	
Salt Creek (within waterway)	Landowner has photos of Brolga near nest (August 2019)	N/A	Creek with water at time of assessment. No sign of Brolga or nest. Landowner believed nest washed away in mid-August 2019 after heavy rainfall	Potentially suitable	No Brolga

October 2019

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (October 2019)	Habitat quality	Other waterbirds recorded (October 2019)
1	No	N/A	Dam full, cattle in paddock	Potentially suitable	Straw-necked Ibis, White-faced Heron
29150	Yes (August 2019, October 2019)	1984	Wetland 10% full, significantly less water than September, sheep in paddock	Suitable	White-necked Heron, Yellow-billed Spoonbill, Pied Stilt, Black Swan (4), White-faced Heron, Grey Teal, Straw-necked Ibis, Australian Shelduck

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (October 2019)	Habitat quality	Other waterbirds recorded (October 2019)
29162	No	N/A	Dam full, no surface water in pasture	Potentially suitable	Grey Teal, Australian Shelduck
29170	No	N/A	Dam full, no surface water in pasture	Potentially suitable	Grey Teal, Australian Shelduck
29182	No	N/A	Significantly less water than September, more vegetation.	Potentially suitable	White-necked Heron, Masked Lapwing, Grey Teal, Pacific Black Duck, Australian Shelduck
29190	No	N/A	Dry at the time of assessment, sheep grazing	Unlikely to be suitable	None observed
29200	No	N/A	Dam still full, crops higher	Unlikely to be suitable	None observed
29205	No	N/A	Full	Potentially suitable	Grey Teal
29212	No	N/A	Visible from road. Drained, no water, grazed by sheep	Unlikely to be suitable	None observed - no wetland present
29213	No	N/A	Full	Potentially suitable	Grey Teal
29214	No	N/A	Full	Potentially suitable	Black Swan, Grey Teal
29226	No	N/A	70% full, crops higher	Potentially suitable	Grey Teal
29243	No	N/A	Canola crop too high, wetland not visible from road	Potentially suitable	
29250	No	1992	From limited visibility, wetland appears to be dry	Potentially suitable	None observed
29252	No	N/A	Partially visible from road. Dam lower than last time, sheep in paddock	Potentially suitable	None observed
29253	No	1992	Dam full, little to no surface water in paddock	Potentially suitable	Black Swan, White-necked Heron, Eastern Cattle Egret, White-faced Heron
29316	No	N/A	Surface water dried out significantly - restricted to drainage lines, dam full	Potentially suitable	Pacific Black Duck

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (October 2019)	Habitat quality	Other waterbirds recorded (October 2019)
29339	No	1984	2 dams full at either end of mapped wetland area, sheep on paddock	Potentially suitable	Australasian Grebe, Australian White Ibis, Little Pied Cormorant, Grey Teal, White-faced Heron
29340	No	N/A	Dam full and surrounded by crops, River Red-gum and emergent vegetation	Potentially suitable	Grey Teal, White-necked Heron, Black Swan, Eurasian Coot, Masked Lapwing, Australasian Shoveler, Pink-eared Duck
29341	No	N/A	No access and not visible from road	Unsure	
29366	No	N/A	Drained and cropped, no wetland present	Not suitable	
29367	No	N/A	Visible from road, drained and cropped, no wetland present	Not suitable	
29372	No	N/A	Drained and dropped, farm dam near homestead. No wetland present	Not suitable	
30265	No	N/A	Drained and cropped, no wetland present	Not suitable	
30374	No	N/A	Wetland 90% full	Potentially suitable, maybe too deep	Pacific Black Duck, Australasian Swamphen, Eurasian Coot, White-faced Heron, Australian Wood Duck, Grey Teal
30441	No	N/A	No access and not visible from road	Unsure	
Salt Creek (within waterway)	Landowner has photos of Brolga near nest (August 2019)	N/A	Creek with water at time of assessment. No sign of Brolga or nest. Landowner believed nest washed away in mid-August 2019 after heavy rainfall	Potentially suitable	No Brolga

November 2019

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (November 2019)	Habitat quality	Other waterbirds recorded (November 2019)
1	No	N/A	Dam full, cattle in paddock	Potentially suitable	None observed
29150	Yes (August 2019, October 2019)	1984	Not much surface water left, long pasture	Suitable	White-necked Heron

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (November 2019)	Habitat quality	Other waterbirds recorded (November 2019)
29162	No	N/A	Partially visible from road. No water observed	Potentially suitable	None observed
29170	No	N/A	Partially visible from road. No water observed	Potentially suitable	None observed
29182	No (Brolga pair observed foraging by Elmoby Ecology Nov 2019)	N/A	Same amount of water as October	Potentially suitable	White-necked Heron, Straw-necked Ibis, White-faced Heron, Yellow-billed Spoonbill, Grey Teal, Pacific Black Duck, Masked Lapwing, Australian Shelduck
29190	No	N/A	Dry at the time of assessment, sheep grazing	Unlikely to be suitable	Straw-necked Ibis
29200	No	N/A	Dam still full, crops higher	Unlikely to be suitable	Straw-necked Ibis
29205	No (Brolga pair observed foraging November 2019 and December 2019)	N/A	Full	Potentially suitable	Grey Teal, **Brolga (2),** Pied Stilt, Masked Lapwing, Straw-necked Ibis, Black Swan, White-necked Heron, White-faced Heron
29212	No	N/A	Visible from road. Drained, no water, grazed by sheep	Unlikely to be suitable	None observed - no wetland present
29213	No	N/A	Full	Potentially suitable	Black Swan, Pied Stilt
29214	No	N/A	Full	Potentially suitable	Black Swan, Pied Stilt
29226	No	N/A	Wetland 70% full	Potentially suitable	Grey Teal, Black Swan
29243	No	N/A	Canola crop too high, wetland not visible from road	Potentially suitable	None observed
29250	No	1992	From limited visibility appears to be dry	Potentially suitable	None observed
29252	No	N/A	Dam similar level to October	Potentially suitable	None observed
29253	No	1992	Dam similar level to October- sheep grazing adjacent paddock	Potentially suitable	Little Black Cormorant

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (November 2019)	Habitat quality	Other waterbirds recorded (November 2019)
29316	No	N/A	Dam full, surrounding pasture dry	Potentially suitable	Pacific Black Duck, Grebe sp.
29339	No	1984	Full	Potentially suitable	Australasian Grebe, White-necked Heron
29340	No	N/A	Dam full, surrounded by crops, River Red-gums and emergent vegetation	Potentially suitable	Grey Teal, Pink-eared Duck, Black Swan, Dusky Moorhen, Australasian Shoveler, Pacific Black Duck, Eurasian Coot, Pied Stilt
29341	No	N/A	No access and not visible from road	Unsure	
29366	No	N/A	Drained and cropped, no wetland present	Not suitable	
29367	No	N/A	Visible from road. Drained and cropped, no wetland present	Not suitable	
29372	No	N/A	Drained and cropped, farm dam near homestead. No wetland present.	Not suitable	
30265	No	N/A	Drained and cropped, no wetland present	Not suitable	
30374	No	N/A	Wetland 90% full	Potentially suitable, may be too deep	Eurasian Coot, Intermediate Egret
30441	No	N/A	No access and not visible from road	Unsure	
Salt Creek (within waterway)	Landowner has photos of Brolga near nest (August 2019)	N/A	Creek with water at time of assessment. No sign of Brolga or nest. Landowner believed nest washed away in mid-August 2019 after heavy rainfall	Potentially suitable	No Brolga

December 2019

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (December 2019)	Habitat quality	Other waterbirds recorded (December 2019)
1	No	N/A	Dam full, cattle in paddock	Potentially suitable	Pacific Black Duck
29150	Yes (August 2019, October 2019)	1984	Long pasture, no water	Suitable	None observed
29162	No	N/A	No water observed	Potentially suitable	None observed
29170	No	N/A	No water observed	Potentially suitable	None observed
29182	No	N/A	Southern side completely dry, dam full on northern side	Potentially suitable	None observed
29190	No	N/A	Dry at the time of assessment, sheep grazing	Unlikely to be suitable	None observed
29200	No	N/A	Dam full	Unlikely to be suitable	None observed
29205	No (Brolga pair observed foraging November 2019 and December 2019)	N/A	Drying out, 70% full shallow surface water	Potentially suitable	**Brolga (2),** Swan, Grey Teal, Pied Stilt, Masked Lapwing, Australian Shelduck, White-necked Heron
29212	No	N/A	Visible from road. Drained wetland, no water, grazed by sheep	Unlikely to be suitable	None observed – no wetland present
29213	No	N/A	70% full	Potentially suitable	None observed
29214	No	N/A	70% full	Potentially suitable	None observed
29226	No	N/A	70% full, shallow	Potentially suitable	Pied Stilt, Masked Lapwing
29243	No	N/A	70% full	Potentially suitable	Black Swan, Pied Stilt, Grey Teal, Silver Gull, White-faced Heron, Australian Shelduck
29250	No	1992	Dry	Potentially suitable	None observed
29252	No	N/A	Dam similar level to November	Potentially suitable	None observed

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (December 2019)	Habitat quality	Other waterbirds recorded (December 2019)
29253	No	1992	Dam similar level to November	Potentially suitable	None observed
29316	No	N/A	Dam full, surrounding pasture dry	Potentially suitable	None observed
29339	No	1984	Full	Potentially suitable	Pacific Black Duck
29340	No	N/A	Full	Potentially suitable	Swan, Pink-eared Duck, Pacific Black Duck, Grey Teal, Pied Stilt, Australasian Swamphen, Masked Lapwing
29341	No	N/A	No access and not visible from road	Unsure	
29366	No	N/A	Drained and cropped, no wetland present	Not suitable	
29367	No	N/A	Visible from road, drained and cropped, no wetland present	Not suitable	
29372	No	N/A	Drained and cropped, no wetland present	Not suitable	
30265	No	N/A	Drained and cropped, no wetland present	Not suitable	
30374	No	N/A	90% full	Potentially suitable, may be too deep	Hardhead, Eurasian Coot, Yellow-billed Spoonbill, Australian Wood Duck
30441	No	N/A	No access and not visible from road	Unsure	
Salt Creek (within waterway)	Landowner has photos of Brolga near nest (August 2019)	N/A	Creek with water at time of assessment No sign of Brolga or nest. Landowner believed nest washed away in mid-August 2019 after heavy rainfall.	Potentially suitable	No Brolga

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (July 2020)	Habitat quality	Other waterbirds recorded (July 2020)
1	No	N/A	Dam full, water in paddock and drainage lines, cattle in paddock	Potentially suitable	Pacific Black Duck, Chestnut Teal, Masked Lapwing, White-faced Heron
29150	No	1984 (observed nesting in August and October 2019)	Small area of wetland with water (15%), long pasture, 10 Black Swans on nests	Suitable	Black Swan, Australian Shelduck, Masked Lapwing, White-necked Heron, Pacific Black Duck, Grey Teal, White-faced Heron
29162	No	N/A	Partially visible from road. No water observed	Potentially suitable	None observed
29170	No	N/A	Partially visible from road. No water observed	Potentially suitable	None observed
29182	No	N/A	Southern side 30% full, dam full on northern side, pasture mostly dry	Potentially suitable	Black Swan, Masked Lapwing, Australian Shelduck, Grey Teal, Pacific Black Duck, Australian Wood Duck
29190	No	N/A	Dry at the time of assessment, sheep grazing	Unlikely to be suitable	None observed
29200	No	N/A	Dam full	Unlikely to be suitable	Australian Shelduck, Pacific Black Duck, White-faced Heron
29205	No	N/A	40% full shallow surface water, Black Swan nest observed	Potentially suitable	Black Swan, Masked Lapwing, Pacific Black Duck, Grey Teal, Chestnut Teal, Australian Shoveler, Australian Wood Duck
29212	No	N/A	Visible from road, drained, no water, grazed by sheep	Unlikely to be suitable	None observed - no wetland present
29213	No	N/A	90% full	Potentially suitable	Australian Wood Duck
29214	No	N/A	70% full	Potentially suitable	Black Swan
29226	No	N/A	80% full, shallow	Potentially suitable	Black Swan, Chestnut Teal
29243	No	N/A	60% full	Potentially suitable	Masked Lapwing, Black Swan, Australian Wood Duck, Chestnut Teal, Australian Shelduck

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (July 2020)	Habitat quality	Other waterbirds recorded (July 2020)
29250	No	1992	limited water in dam, pasture wet	Potentially suitable	None observed
29252	No	N/A	Partially visible from road. Dam 100% full, no water over pasture	Potentially suitable	None observed
29253	No	1992	Dam 100% full, no water over pasture	Potentially suitable	Australian Wood Duck, Australian White Ibis
29316	No	N/A	Dam full, water in drainage line and over some of the pasture present	Potentially suitable	Grey Teal, Pacific Black Duck
29339	No	1984	Full, crop plane flying low near site	Potentially suitable	Pacific Black Duck , Australian Wood Duck
29340	No	N/A	Full, water level had increased since last check and nest originally viewed with Brolgas appears smaller and degraded. Black Swan nesting in wetland	Suitable	Black Swan, Masked Lapwing, Chestnut Teal, Grey Teal, Pacific Black Duck, Australasian Swamphen, White-faced Heron, Little Pied Cormorant, Australasian Grebe
29341	No	N/A	Limited view, mostly dry cropped paddock	Unsure	
29366	No	N/A	Drained and Cropped, no wetland present	Not suitable	
29367	No	N/A	Visible from road, drained and cropped. No wetland present. Crop plane flying low over paddock	Not suitable	Australian Shelduck
29372	No	N/A	Drained and cropped, no wetland present	Not suitable	Masked Lapwing
30265	No	N/A	Drained and cropped, no wetland present	Not suitable	
30374	No	N/A	Visible from road, wetland 100% full	Potentially suitable, maybe too deep	Pacific Black Duck, Eurasian Coot, Australian Wood Duck, Australasian Swamphen
30441	No	N/A	No access and not visible from road	Unsure	

Wetland number	Confirmed breeding record?	Past breeding record (year)	Wetland description (July 2020)	Habitat quality	Other waterbirds recorded (July 2020)
Salt Creek (within waterway)	Landowner has photos of Brolga near nest (August 2019)	N/A	Creek with water at time of assessment. No sign of Brolga or nest. Landowner believed nest washed away in mid-August 2019 after heavy rainfall	Potentially suitable	Black Swans nesting

Appendix 4: Summary records of calls of bat species recorded during 2019 – 2020

Species	Ground (1 m)				Turbine (nacelle 85 m)				Total calls
	T02	T05	T10	T13	T02	T05	T10	T13	
November – December 2019									
Austronomus australis	62	64	232		62	42		57	519
Chalinolobus gouldii	51	133	48		3	3		1	239
Chalinolobus morio	51	26	41						118
Falsistrellus tasmaniensis	4	1	8						13
Miniopterus schreibersii bassanii	3	33	6		7				49
Mormopterus spp.	76	128	17		3	1		2	227
Nyctophilus sp.	25	22	7						54
Vespadelus darlingtoni	11	22	37		3				73
Vespadelus regulus	17	27	66					1	111
Vespadelus vulturnus	24	31	22		2	1			80
February – April 2020									
Austronomus australis	1510	1734	1060	1441	29	224	181		6179
Chalinolobus gouldii	330	1142	10933	600	1	16	7		13029
Chalinolobus morio	44	3	181	10					238
Falsistrellus tasmaniensis	16								16

Species	Ground (1 m)				Turbine (nacelle 85 m)				Total calls
	T02	T05	T10	T13	T02	T05	T10	T13	
Miniopterus schreibersii bassanii	25	12	624	63	3				727
Mormopterus spp.	113			2	13	8	17		153
Nyctophilus sp.	144	43	280	72		1			540
Vespadelus darlingtoni		211	1398	47					1656
Vespadelus regulus			49	71		2			122
Vespadelus sp.	87	146	402						635
Vespadelus vulturnus			14		2				16

Appendix 5: Grey-headed Flying-fox survey detailed results

Date	Time start	Time end	Number of bats	Wind (km/hr; direction)	Temperature	Precipitation	Cloud	Notes
19/8/2019			0	33 (WNW)	11.7		Overcast	
18/10/2019			0	15-25	18		Mostly cloudy	
19/11/2019			0	15-20	21		Overcast	
19/12/2019			0	4 (SE)	18.5		Clear	Wind direction: SE
21/1/2020	20:00	21:30	0	4 (W), 9 (SE)	21.1		Mostly clear	Wind direction: W
20/2/2020	20:40		6	15 (SSW)	14.1		Overcast	Sugar Gums flowering. Bats flying north over Cobra Killuc Wildlife reserve Parked just north of creek between creek and Cobra Killuc wildlife reserve.
10/3/2020	19:20	21:10	825	26 (SSE), 17 (E)	21.3, 16.8		Clear/smoky (from planned burns)	All bats were coming from south and heading NNE towards Cobra Killuc. They were flying low 10-30 m overhead, but did not see any stop to forage in Cobra Killuc. Sugar Gums were flowering in Cobra Killuc.

Date	Time start	Time end	Number of bats	Wind (km/hr; direction)	Temperature	Precipitation	Cloud	Notes
12/3/2020	19:00	21:05	65	0, 4	28, 20.1	Light rain at end	Mostly cloudy	Bats were flying south to north from further south than sugar gum stand in private property. Heading toward Cobra Killuc 30-50m high. Could not see any bats in or near sugar gum stand to south of Cobra Killuc when still light
19/3/2020	19:30	20:45	574	26 (W), 11 (NW)	22.9, 17.2		Overcast	Bats were clearly flying from further south than the temporary camp location and heading further north towards Cobra Killuc Wildlife Reserve.
20/3/2020			59					Woodcutter's Lane at dawn: Bats were flying south from 6:33-6:50am
20/4/2020	17:20	19:20	0	13 (SW), 7 (SW)	15.2, 12.1		Mostly cloudy	

Date	Time start	Time end	Number of bats	Wind (km/hr; direction)	Temperature	Precipitation	Cloud	Notes
21/4/2020	5:30	7:00	0	11 (N), 9 (N)	5.5, 5.7		Clear	

Appendix 6: Symbolix Report Salt Creek Wind Farm Mortality Estimate Year 2

symbolix

Salt Creek Wind Farm Mortality Estimate - Year 2

Prepared for Elmoby Ecology, 28 July 2020, Ver. 1.0

This report outlines an analysis of the mortality data collected at the Salt Creek Wind Farm from 2019-08-19 to 2020-07-15. The analysis is broken into the three related components below:

- Searcher efficiency / detectability – estimated from trials in January 2020 and May 2020
- Scavenger loss rates – consisting of trials in October 2018, November 2018, December 2018, February 2019, April 2019 and May 2019
- Mortality estimates - based on monthly surveys at 15 turbines, from 2019-08-19 to 2020-07-15

The data was collected and provided by Elmoby Ecology (except for year one data and scavenger efficiency trial data, which were provided by Nature Advisory) and is analysed "as-is". A brief summary of the data is provided below, and the ultimate focus of this report is a discussion of the potential mortality.

Available data

The data for the second year was collected, verified and provided to us from Elmoby Ecology[1]. Data for the first year and from scavenger efficiency trials was provided to us by Nature Advisory[2].

Methodology overview

Mortality through collision is an ongoing environmental management issue for wind facilities. Different sites present different risk levels; consequently different sites have different monitoring requirements. In order to estimate the mortality loss at a given site (in a way that is comparable with other facilities) we must account for differences in survey effort, searcher and scavenger efficiency. We used a Monte-Carlo simulation to achieve this.

The analysis used survey data to estimate the average time to scavenge loss and searcher

[1] DATA for symbolix SC Y2.xlsx
[2] Symbolix mortality spreadsheet SCWF 190801.xlsx

efficiency (and related confidence intervals). The algorithm then simulated different numbers of virtual mortalities. We could then estimate how many carcasses were truly in the field, given the range of searcher and scavenger efficiencies, and the survey frequency and coverage, and the true "found" details. After many simulations, we can estimate the likely range of mortalities that could have resulted in the recorded survey outcome.

This method has been benchmarked against analytical approaches (Huso (2011), Korner-Nievergelt et al. (2011)). Its outputs are equivalent but it is able to robustly model more complex survey designs (e.g. pulsed surveys, rotating survey list).

Searcher efficiency

Two searcher efficiency trials were held (2020-01-07 and 2020-05-11) at two different locations (Salt Creek and Silverton). Both used dogs as observers. A range of bird sizes were used, ranging from small (Sparrow) to medium (Brown falcon). Feather spots (e.g. Magpie wing) were also used. 1 small bird, 27 medium birds, and 4 feather spots were used. Bat carcasses of various species (including White Striped Freetail Bats and Eastern Falsistrelles) were used to determine bat detectability.

We found no evidence (using binomial regression) that the searcher efficiency differed between the surveys held at Salt Creek and Silverton ($z = 0.01$, $p = 0.99$).

The detectability trials used both bird (32 replicates) and bat carcasses (45 replicates). We found no evidence (via AIC) that searcher efficiency differed between bats and birds (small birds, medium birds, and feather spots combined). Therefore, bird and bat detection efficiencies are aggregated in the following mortality estimate.

Table 1 summarises the result.

Detectability for bats and birds is 96%, with a 95% confidence interval of [89%, 99%].

Table 1: Detection efficiencies for birds and bats.

Variable	Bats and Birds
Number found	74
Number placed	77
Mean detectability proportion	0.96
Detectability lower bound (95% confidence interval)	0.89
Detectability upper bound (95% confidence interval)	0.99

Scavenger efficiency

Scavenger efficiency trials were conducted on 2018-10-24, 2018-11-22, 2018-12-19, 2019-02-21, 2019-04-17 and 2019-05-23. Trials ran over 30 days. A range of bird sizes were used, ranging from small (Common Myna), to medium (Peregrine Falcon), to large (Australian Magpie). Both small (White-striped Freetail) and large (Grey-headed flying fox) bats were used.

Survival analysis (Kaplan and Meier (1958)) was used to determine the average time until complete loss from scavenge. Survival analysis was required to account for the fact that we do not know the exact time of scavenge loss, only an interval in which the scavenge event happened. By performing survival analysis we can estimate the average survival percentage after a given length of time, despite these unknowns.

Based on these surveys there is no evidence that birds and bats have significantly different scavenger rates, based upon AIC selection. Therefore, bird and bat scavenger rates are aggregated in the following mortality estimate.

Figure 1 shows a survival curve fitted to the combined cohort of bats and bird. The survival curves (solid lines) show the estimated proportion of the sets remaining at any given time. The shaded portions are the 95% confidence intervals on the estimates. For example, we see that we expect around 5% to 32% of carcasses to remain after ten days with the expectation being around 13%.

Under these assumptions, the mean time to total loss via scavenge is 5.9 days, with a 95% confidence window of [4.1, 8.6] days.

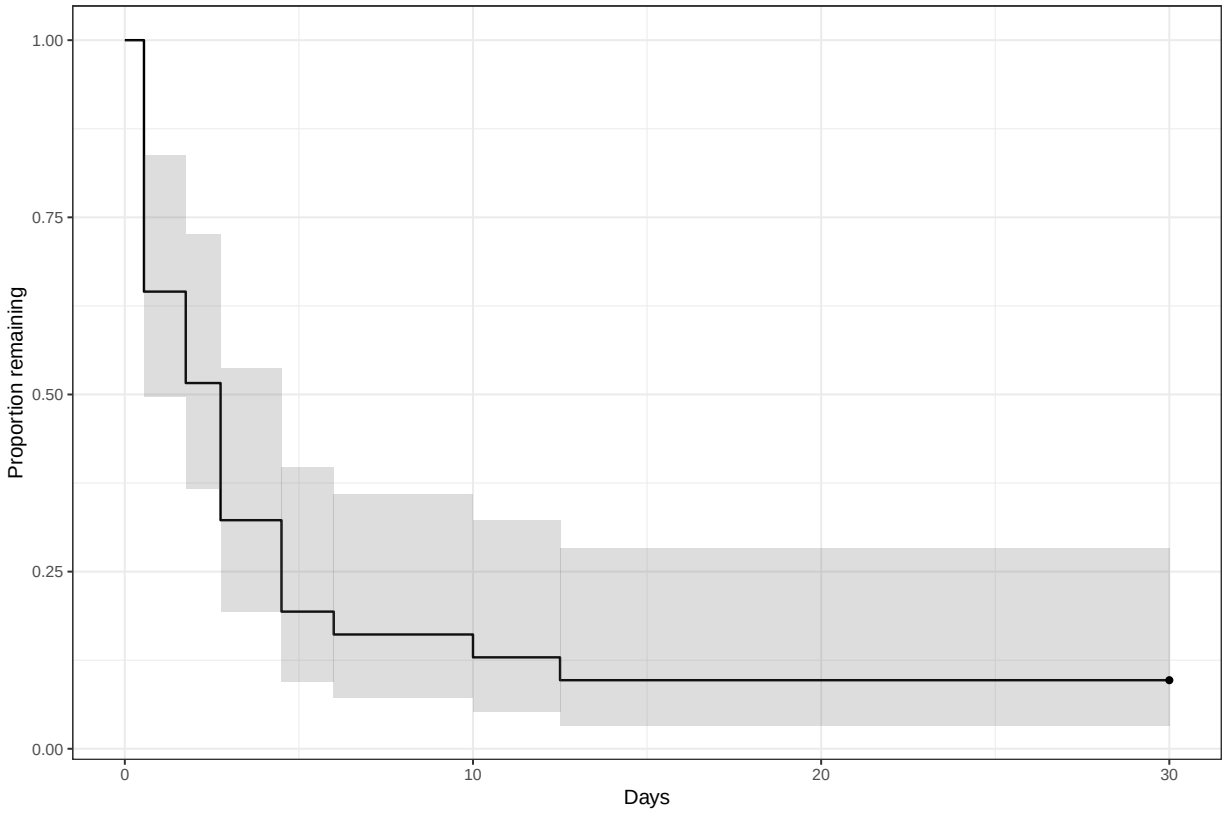

Figure 1: Combined survival curves for birds and bats, with 95% confidence interval shaded.

Other scavenger patterns

There are three general types of scavenger behaviour:

- "perfect"
- "olfactory"; and
- "visual"

These names are classifiers only, and not necessarily accurate descriptions of the actual processes employed by the scavenger. A "perfect" scavenger will find the carcass with constant efficiency, irrespective of the amount of time it has lain on the ground. "Visual" scavengers are more efficient in the earlier period post-mortem, and are less likely to find a carcass the longer it has lain there. "Olfactory" scavengers are the opposite of "visual" scavengers. They require the carcass to lie for some period, before their efficiency of detection increases.

Due to the small number of trials, we have focused on the mean loss rate, and not the shape. This means that we have assumed all scavengers to be "perfect", which is the middle of the two other types.

Mortality projection inputs

Carcass search data

The mortality estimate was based on a dated list of turbine surveys. The survey frequency is summarised in Table 2. Turbines were surveyed once a month, except for March to May when they were surveyed twice a month. All fifteen were surveyed out to a radius of 130 metres.

Table 2: Number of surveys per month.

Date	Number of surveys
2019 Aug	13
2019 Sep	15
2019 Oct	15
2019 Nov	15
2019 Dec	15
2020 Jan	15
2020 Feb	15
2020 Mar	30
2020 Apr	30
2020 May	30
2020 Jun	15
2020 Jul	15

Mortality estimate

Mortality estimation – methodology

With estimates for scavenge loss and searcher efficiency we then converted the number of bat and bird carcasses detected into an estimate of overall mortality at Salt Creek Wind Farm from 2019-07-19 to 2020-07-15 (we allow for collisions to occur up to a month prior to the first survey).

The mortality estimation is done via Monte-Carlo simulation. We used 25000 simulations with the survey design simulated each time. Random numbers of virtual mortalities were simulated, along with the scavenge time and searcher efficiency (based on the measured confidence intervals). The proportion of virtual carcasses that were "found" was recorded for each simulation. Finally, those trials that had the same outcome as the reported survey detections were collated, and the initial conditions (i.e. how many true losses there were) reported on.

The complete set of model assumptions are listed below.

- There were 15 turbines on site.
- Search frequency for each turbine was taken from a list of actual survey dates (see Table 2 for a summary).
- Mortalities were allowed to occur up to a month before the initial survey (2019-08-19) and until the final surveyed date (2020-07-15).
- Birds are on-site at all times during this period.
- Bats are on-site at all times during this period.
- Finds are random and independent, and not clustered with other finds.
- There was equal chance of any turbine individually being involved in a collision / mortality.
- We assumed an exponential scavenge shape ("perfect" scavengers).
- We took scavenge loss and search efficiency rates as outlined above.
- All 15 turbines were surveyed, and were searched out to a 130 metre radius. We estimated the "coverage factor" for the survey – i.e. the total fall zone surveyed for birds and bats (using estimates from Hull and Muir (2010)) - and adjusted this to account for the percentage of the search area that was actually searched in each survey. We assumed that the coverage factor was 99% for birds and 100% for bats.

Mortality projection results

After running the simulation we investigated the distribution of mortalities that could have resulted in the actual numbers found during the surveys. The breakdown of found carcasses per species in the second year of surveys are summarised in Table 3. In cases where the details of found carcasses differed between the survey data and carcass finds data provided, the carcass finds data was treated as master.

Table 3: Carcasses found during the second year of surveys.

Species	Bat	Bird	Feather Spot
White Striped Freetail Bat	34	0	0
Grey Headed Flying Fox	13	0	0
Eastern Falsistrelle	8	0	0
Gould's Wattled Bat	4	0	0
Unknown - Bat	3	0	0
Large Forest Bat	2	0	0
Small Forest Bat	2	0	0
Lesser Long Eared Bat	1	0	0
Unknown - Bird	0	4	3
Magpie	0	3	8
Corella	0	3	2
Starling	0	3	0
Eurasian Sparrow	0	2	0
House Sparrow	0	2	0
Chick	0	1	1
Crimson Rosella	0	1	0
Peregrine Falcon	0	1	0
Raven	0	1	0
Spotted Pardalote	0	1	0
Straw Necked Ibis	0	1	0
Striated Pardalote	0	1	0
Wedge-Tailed Eagle	0	1	0
Barn Owl	0	0	7
Brown Falcon	0	0	1
Cockatoo/Corella	0	0	1
Nankeen Kestral	0	0	1

There were also a small number of "incidental" finds (see Table 4), which were carcasses found outside the formal survey area. These finds are not included in the formal mortality estimate.

Table 4: Incidental finds (carcasses found outside the 130 m search area).

Species	Date
Straw Necked Ibis	2019-11-28
Grey Headed Flying Fox	2020-03-26
Corella	2020-05-05
Eastern Falsistrelle	2020-05-19

Bat mortality estimate – results

During the second year of surveys a total of 65 bats were found during formal surveys (Table 3). The resulting estimate of total mortality, accounting for searcher efficiency, scavenge rate, search area and timing of surveys is an expectation (mean) of 277 and a median of 271 bats lost on site over the twelve months.

Table 5 and Figure 2 display the percentiles of the distribution, to show the confidence interval in this average.

Based on the detected carcasses and measured detectability and scavenge rate, we expect that there was a total site loss of around 277 bats over the survey period, and are 95% confident that fewer than 373 individuals were lost.

Table 5: Percentiles of estimated total bat losses over the second year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
165	271	348	373	396	436

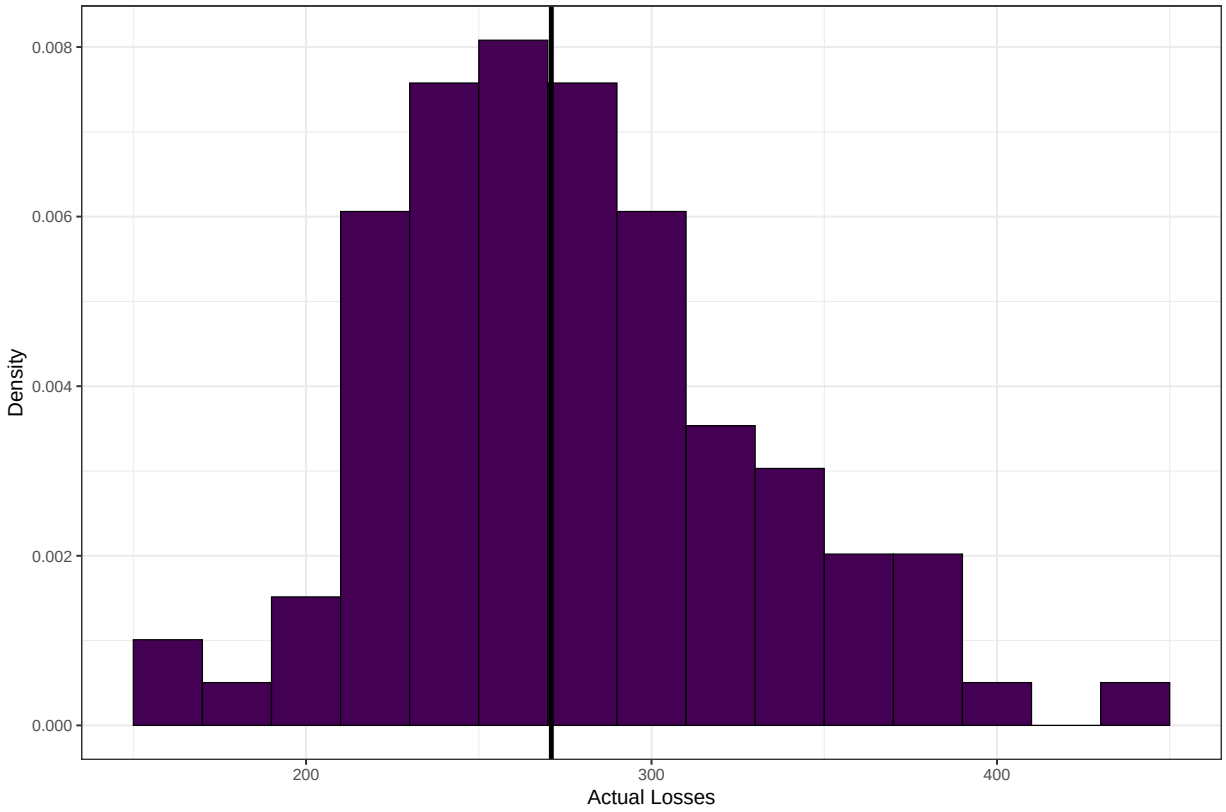

Figure 2: Histogram of the total losses distribution (bats), given 65 were detected on-site. The black solid line shows the median.

Bird mortality estimate - results

During the second year of surveys a total of 47 birds were found during formal surveys (Table 3). The resulting estimate of total mortality, accounting for searcher efficiency, scavenge rate, search area and timing of surveys is an expectation (mean) of 202 and a median of 198 birds lost on site over the twelve months.

Table 6 and Figure 3 display the percentiles of the distribution, to show the confidence interval in this average.

In determining the estimate, we have used the standard practice of assuming that all carcasses and all feather spots (regardless of size or composition) are attributable to the wind turbines.

Based on the detected carcasses and feather spots and measured detectability and scavenge rate, we expect that there was a total site loss of around 202 birds over the survey period, and are 95% confident that fewer than 285 individuals were lost.

Table 6: Percentiles of estimated total bird losses over the second year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
120	198	253	285	304	316

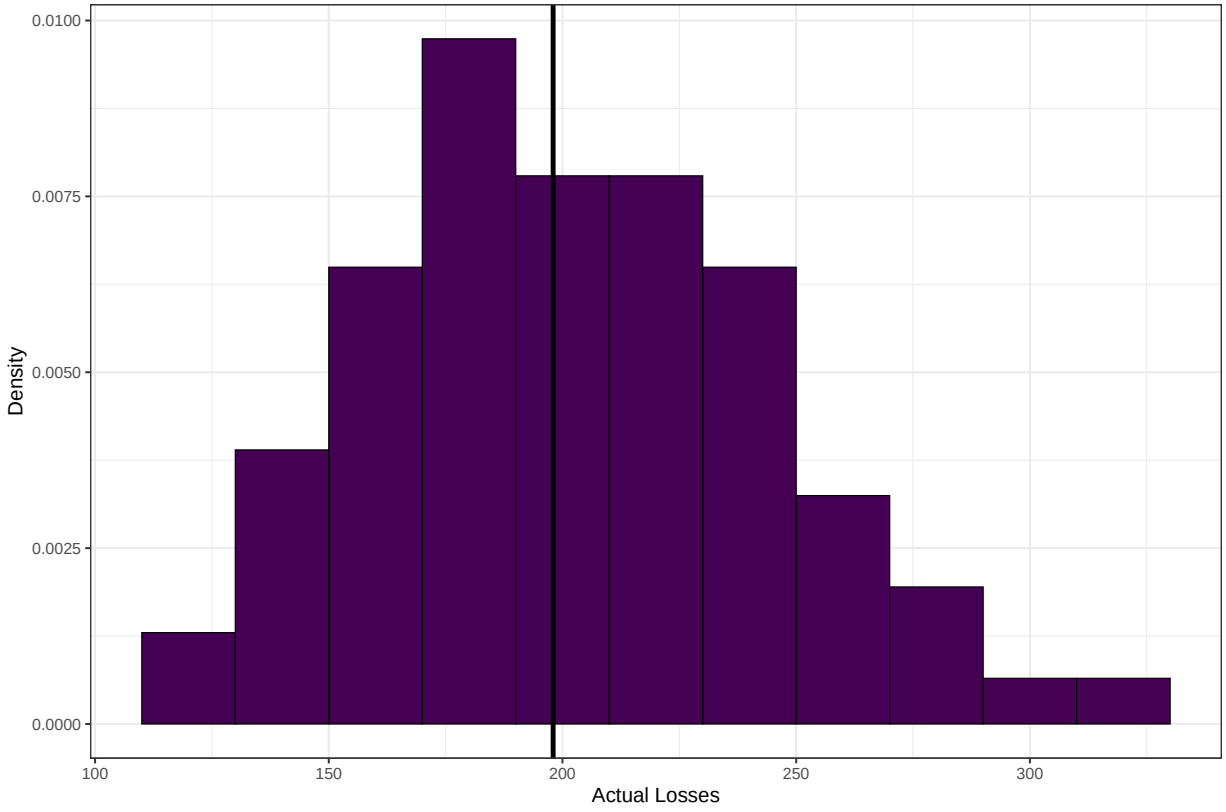

Figure 3: Histogram of the total losses distribution (birds), given 47 were detected on-site. The black solid line shows the median.

Comparison of year one and year two results

Bat results

During the first year of surveys (2018-06-23 to 2019-06-20) a total of 23 bats were found during formal surveys. The resulting estimate of total mortality is an expectation (mean) of around 196 bats over the survey period, and we are 95% confident that fewer than 279 individuals were lost. Note that the estimate for mortality in the first year assumed that bats were on-site from October to April only (Symbolix 2019).

In comparison, in the second year of surveys (2019-07-19 to 2020-07-15) a total of 65 bats were found during formal surveys. The resulting estimate of total mortality an expectation of

277 bats over the survey period, and we are 95% confident that fewer than 373 individuals were lost.

Statistical testing (using the Kolmogorov-Smirnov test) was used to determine if there was a significant difference between the modelled distribution of mortalities in year one and year two.

When considering all bat mortalities, we find the distribution of the first year to be shifted left, compared to the distribution of year two mortalities ($K = 0.604$ is greater than than the critical value, $K_{0.05} = 0.351$).

Assuming all model assumptions hold, this would imply that the true total number of bat losses in year one was significantly lower than the number of losses in year two.

Bird results

During the first year of surveys a total of 23 birds were found during formal surveys. The resulting estimate of total mortality is an expectation of around 141 birds over the survey period, and we are 95% confident that fewer than 202 individuals were lost.

In comparison, in the second year of surveys a total of 47 birds were found during formal surveys. The resulting estimate of total mortality an expectation of 202 birds over the survey period, and we are 95% confident that fewer than 285 individuals were lost.

Using the Kolmogorov-Smirnov test, we find the distribution of the first year to be shifted left compared to the distribution of year two mortalities ($K = 0.575$ is greater than than the critical value, $K_{0.05} = 0.351$).

Assuming all model assumptions hold, this would imply that the true total number of bird losses in year one was significantly lower than the number of losses in year two.

Concluding remarks

In evaluating the potential impact, it is important to remember that all mortality estimators have an inherent assumption that there is an unlimited supply of carcasses to be found. In particular, we did not apply an upper limit on the number of bats and birds that could be onsite, and we assumed that bats and birds were present all year round. The ecological feasibility of this assumption should be accounted for if using these results to comment on overall ecological impact.

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Appendix 7: Email: Use of Scent Detection Dogs in the Bird and Bat Strike Monitoring Program – Nature Advisory

9 August 2019

Moyne Shire Council

By Email

Attention: Michelle Granger, Moyne Shire Council
By email — mgrainger@moyne.vic.gov.au (phone 0427 752 086)

Dear Michelle,

RE: SALT CREEK WIND FARM
PROPOSED BAM PLAN AMENDMENT - FOR THE USE OF SCENT DETECTION DOGS IN THE BIRD AND BAT STRIKE MONITORING PROGRAM
BL&A/ NATURE ADVISORY PROJECT NO. 15101.9

Salt Creek Wind Farm (SCWF) was granted planning approval (Planning Permit No. PL06/304) on 8th June 2007 subject to conditions. One of these conditions stipulates the implementation of a Bat and Avifauna Management Plan (BAM Plan), which was developed by Jacobs (2017) and approved by DELWP in 2017. Tilt Renewables retained Brett Lane & Associates Pty Ltd to implement this plan, which we have been doing July 2018.

According to the BAM Plan, a bird and bat strike monitoring program must be undertaken to estimate the number of fatalities occurring at the wind farm as a result of collision with turbines. This is done via monthly physical searches under turbines to a radius of 132 metres (see Jacobs 2017 for detailed methods). Currently, the methods described involve human searchers walking transects in the radius under the turbine looking either side for birds and bats dead on the ground. DELWP were contacted about this matter in April 2019 and suggested we contact the Council to confirm the approach.

Nature Advisory would like to propose an amendment to this method wherein human searchers could be replaced by dogs under the control of a certified dog handler. Nature Advisory recently acquired a scent dog and has had four handlers trained by Mr Steve Austin (who also trained the dog – see https://www.steveaustindogtrainer.com/). These handlers are now certified by the Canine Detection Certification Council of Australia.

Paula et. al. (2011) found that dogs trained to find bird and bat carcasses under turbines were more accurate compared with humans in controlled trials (92% vs 9%) while Mathews

et. al. (2013) found that dogs found up to 53% more bats on the ground when compared with humans, and completed surveys over the same area in 25% less time. Therefore, in order to increase carcass detection, thereby increasing the accuracy of mortality estimation across the wind farm, and to reduce survey duration, it is proposed that our trained scent detection dog replace the current human searchers for carcass searches at the wind farm.

Amendments are proposed to the BAM Plan (Jacobs 2017) to provide for both the use of human searchers, and also in addition canine searchers. Thus, the following amendments are therefore proposed for consideration at the first Annual meeting:

- Section 3.3.1: Additional paragraph - Personnel implementing the searches using dogs will be described as; qualified ecologists trained in the handling of scent detection dogs and certified by the Canine Detection Council of Australia (see: https://www.caninedetectioncertificationcouncil.com.au/)

- Section 3.3.1.3: The search area using dogs will remain the same, i.e. a 132-metre radius, however the transects used to search the radius will be modified for the effective use of scent dogs. The following search method is proposed based on advice from expert dog trainer Steve Austin and our own recent field trials.
  - Under ideal conditions (moderate wind, no rain, mild temperature); 20 metre transects will be walked at a slow pace by the handlers into the wind allowing the dog to zig zag across the transect either side to a distance of 15 metres or more, and cover the entire search area. When walking with the wind (i.e. during the return transect); the handler will walk more slowly than when walking into the wind, allowing the dog to move ahead and zig zag back towards the handler.
  - The transects will be reduced in less ideal conditions that might affect the dog's ability to track scent (high wind, rain). The handler will make decisions on the reduction in transect size (e.g. 20 or 10 metres) based on advice from Steve Austin and research by Bennet (2014).
  - A GPS collar will be fitted to the dog which will allow the handler to track movements in real time and allow the handler to ensure the entire search area has been effectively covered by the dog.
  - Search areas will be loaded onto GPS prior to commencing searches to allow the handler to see the exact boundaries of the area and the dog's movements within it.
  - GPS data will be made available to DELWP on request.
  - Information to be recorded, carcass identification and removal and reporting described in section 3.3.1.3 of the BAM Plan during searches will remain the same.

- Section 3.3.3: Searcher efficiency trials will remain largely the same and will only be modified to account for the proposed change in search transect methodology described above. If dogs replace humans in the trial, search transects will be changed according to the above method and all other methods will remain unchanged. Efficiency trials will be conducted according to the amendments for each season the dog is used for the remainder of the BAM Plan implementation of bird and bat strike monitoring program. Separate statistical analysis will be undertaken for searches and efficiency trials undertaken by humans so far and scent dogs in the future, and will both be taken into account when estimating overall mortality at SCWF.

Aside from the above proposed amendments, the BAM Plan will continue to be implemented as it has been thus far.

As we wish to commence implementation of this more efficient and accurate method of detecting carcasses as soon as possible, your prompt attention to this would, be appreciated. We look forward to your feedback and if you have any enquiries please do not hesitate to call me.

Yours sincerely,

Bernard O'Callaghan
Senior Ecologist & Project Manager
Nature Advisory Pty. Ltd.

(03) 9815 2111 or Mob. 0437 711 328 | bernard@natureadvisory.com.au

References

Bennett E., 2014. Observations from the Use of Dogs to Undertake Carcass Searches at Wind Facilities in Australia, Wind and Wildlife: 113-123.

Mathews, et. al., 2013. Wind Energy and Wildlife Conservation, Effectiveness of Search Dogs Compared with Human Observers in Locating Bat Carcasses at Wind-Turbine Sites: A Blinded Randomized Trial, Wildlife Society Bulletin, 37(1): 34-40.

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Appendix 8: Summary of finds at Salt Creek year 2

All finds at Salt Creek wind Farm August 2019- July 2020

Date	Turbine Number	Species	Distance from turbine
19-August-2019	3	magpie	45
21-August-2019	9	magpie	58
17-September-2019	3	magpie	52
17-September-2019	8	unknown	11
18-September-2019	11	striated pardalote	20
15-October-2019	13	chick	105
16-October-2019	14	wedge-tailed eagle	78
11-November-2019	10	ID pending	115
11-November-2019	13	unknown	91
12-November-2019	1	white striped freetail bat	12
12-November-2019	7	chick (few days only)	82
09-December-2019	1	unknown	61
09-December-2019	6	house sparrow	100
09-December-2019	8	crimson rosella (juv)	58
10-December-2019	5	cockatoo/corella	47
10-December-2019	5	magpie	60
10-December-2019	7	magpie	55
10-December-2019	7	magpie	110
11-December-2019	15	magpie	125
06-January-2020	2	white striped freetail bat	7
06-January-2020	2	white striped freetail bat	39
06-January-2020	9	white striped freetail bat	63
06-January-2020	14	Eastern falsistrelle	21
06-January-2020	14	House Sparrow	41
06-January-2020	14	large forest bat	2
06-January-2020	14	white striped freetail bat	33
06-January-2020	14	white striped freetail bat	9
06-January-2020	14	white striped freetail bat	7
07-January-2020	5	Eastern falsistrelle	29
07-January-2020	5	unknown	29
07-January-2020	7	Eastern falsistrelle	89
07-January-2020	11	white striped freetail bat	36
07-January-2020	13	white striped freetail bat	68
03-February-2020	7	Brown Falcon	52
03-February-2020	8	white striped freetail bat	18
04-February-2020	1	Barn Owl	101
04-February-2020	1	Barn Owl	83
04-February-2020	4	Eurasian Sparrow	107

04-February-2020	5	Spottedd pardilote	12
04-February-2020	6	Eurasian Sparrow	104
04-February-2020	14	Starling	48
04-February-2020	15	Eastern falsistrelle	40
10-March-2020	1	Barn Owl	50
10-March-2020	11	white striped freetail bat	80
10-March-2020	14	WSFT	33
10-March-2020	14	WSFT	31
11-March-2020	4	Eastern falsistrelle	58
11-March-2020	7	Grey Headed Flying Fox	76
11-March-2020	10	magpie	128
12-March-2020	5	Lesser Long Eared bat	73
12-March-2020	5	WSFT	48
12-March-2020	6	Grey Headed Flying Fox	108
12-March-2020	8	white striped freetail bat	21
26-March-2020	2	Barn Owl	78
26-March-2020	9	grey Headed Flying Fox	107
26-March-2020	14	Gould's Wattled Bat	65
26-March-2020	14	grey Headed Flying Fox	99
26-March-2020	14	grey Headed Flying Fox	112
27-March-2020	3	grey Headed Flying Fox	13
27-March-2020	4	white striped freetail bat	46
28-March-2020	5	Barn Owl	116
28-March-2020	8	Gould's Wattled Bat	75
28-March-2020	8	large forest bat	27
06-April-2020	1	grey Headed Flying Fox	111
06-April-2020	1	white striped freetail bat	11
06-April-2020	3	Magpie	30
06-April-2020	9	grey Headed Flying Fox	126
06-April-2020	9	white striped freetail bat	21
06-April-2020	11	white striped freetail bat	62
06-April-2020	14	grey Headed Flying Fox	97
07-April-2020	4	white striped freetail bat	30
07-April-2020	7	grey Headed Flying Fox	114
07-April-2020	12	white striped freetail bat	20
07-April-2020	12	white striped freetail bat	27
07-April-2020	15	white striped freetail bat	39
07-April-2020	15	white striped freetail bat	36
08-April-2020	5	grey Headed Flying Fox	117
08-April-2020	6	Eastern falsistrelle	14
08-April-2020	8	Small Forest Bat	52
20-April-2020	1	Grey Headed Flying Fox	123
20-April-2020	1	Peregrine Falcon	30
20-April-2020	14	white striped freetail bat	88

21-April-2020	2	unknown	30
21-April-2020	2	white striped freetail bat	40
21-April-2020	9	Gould's Wattled Bat	68
21-April-2020	13	Unknown	53
21-April-2020	13	white striped freetail bat	69
21-April-2020	15	white striped freetail bat	18
21-April-2020	15	white striped freetail bat	65
22-April-2020	4	Gould's Wattled Bat	18
22-April-2020	4	white striped freetail bat	26
22-April-2020	5	Small Forest Bat	24
22-April-2020	6	unknown	123
22-April-2020	8	unknown	44
04-May-2020	1	Eastern falsistrelle	35
04-May-2020	1	unknown	57
04-May-2020	8	white striped freetail bat	111
05-May-2020	12	white striped freetail bat	32
05-May-2020	14	Raven	96
05-May-2020	14	white striped freetail bat	16
05-May-2020	14	white striped freetail bat	32
18-May-2020	1	Corella	50
18-May-2020	1	Corella	98
18-May-2020	1	Corella	112
18-May-2020	2	Corella	118
18-May-2020	4	Nankeen Kestral	42
16-June-2020	10	Barn Owl	110
13-July-2020	1	magpie	120
14-July-2020	11	Starling	113
14-July-2020	11	Starling	111
14-July-2020	13	Barn Owl	115
15-July-2020	4	magpie	54

Incidental Finds August 2019 to July 2020			
Date	**Turbine Number**	**Species**	**Distance from turbine**
05-May-2020	13	Corella	141
19-May-2020	15	Eastern falsistrelle	140
26-March-2020	2	grey Headed Flying Fox	151
28-November-2019	7	Straw necked Ibis	20

Grey Headed flying fox finds (including incidental find) August 2019 to July 2020

Date	Turbine Number	Species	Distance from turbine
11-March-2020	7	Grey Headed Flying Fox	76
12-March-2020	6	Grey Headed Flying Fox	108
26-March-2020	2	grey Headed Flying Fox	151
26-March-2020	14	grey Headed Flying Fox	99
26-March-2020	14	grey Headed Flying Fox	112
26-March-2020	9	grey Headed Flying Fox	107
27-March-2020	3	grey Headed Flying Fox	13
06-April-2020	14	grey Headed Flying Fox	97
06-April-2020	9	grey Headed Flying Fox	126
06-April-2020	1	grey Headed Flying Fox	111
07-April-2020	7	grey Headed Flying Fox	114
08-April-2020	5	grey Headed Flying Fox	117
20-April-2020	1	Grey Headed Flying Fox	123