PROPOSED YARRAM WIND FARM
BIRD UTILISATION SURVEY

Synergy Wind Pty Ltd

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Brett Lane and Associates Pty Ltd was engaged by Synergy Wind Pty Ltd to undertake a bird utilisation survey at its proposed Yarram Wind Farm site about 12 km northwest of Yarram, in South Gippsland. The proposed wind farm site is a single rural holding used mainly for cattle grazing. The total area of the property involved is approximately 120 ha.

This investigation was focussed on a study area that included the wind turbine layout on the hilltops and elevated areas across the property.

This report summarises the results of the survey and it is divided into the sections described below.

Section 2 describes the proposed windfarm site;

Section 3 presents the results of the bird utilisation survey;

Section 4 discusses the significance of the proposed wind farm site for birds; and

Section 5 considers the implications of the survey findings.

This investigation was undertaken by a team comprising:

- Khalid Al-Dabbagh, Field Ecologist & Ornithologist; and
- Brett Lane, Principal Consultant.

2. SITE DESCRIPTION

The proposed wind farm consists of nine turbines located at various locations throughout the site.

The site is a single rural property of about 120 ha, located in South Gippsland, approximately 12 kilometres northwest of Yarram. The entire rural holding is cleared grazing land with a few areas of remnant, degraded native woodland, mainly in the form of large, scattered eucalypt trees. The areas of interest within the broader wind farm site are the hilltops and elevated country that run roughly north-south.

These hills are generally cleared of native vegetation and covered in exotic pasture grasses. Their elevation ranges between 120 m and 170 m above sea level.

The site was cleared of its original forest vegetation in the late 1800's and early 1900's. The landscape today consists of cleared land with scattered remnant indigenous trees and small patches of planted Blue Gums. Some areas of remnant native vegetation occur near the periphery of the wind farm site.

State forests and pine plantations occur about 1–3 km from the site, separated from it by cleared agricultural land on neighbouring properties. There were no major streams or open wetlands in the area, except for small, ephemeral streams that mostly run along the edge of the site and a number of small farm dams used for watering cattle. These farm dams lacked vegetation and were badly trampled by the cattle. They would not support any significant numbers of waterbirds.

The site lies within the Strzelecki Ranges Bioregion. The area is under the jurisdiction of the West Gippsland Catchment Management Authority (WGCMA). The local planning authority is the Shire of Wellington.

3. BIRD UTILISATION SURVEY

The bird utilisation survey was undertaken over six days in autumn (between 18th and 31st of May 2006).

3.1. Methods

3.1.1. Fixed-point bird count method

The fixed-point bird count method involved an observer stationed at a survey point for 15 minutes. During this period, all birds observed within 200 metres were recorded. Species, number, distance from the centre point and flight height were documented, with flight height being classified as below, at or above rotor swept area height (RSA height). RSA height lies between 20 and 110 metres above the ground.

A total of eight fixed point survey sites were established: four of these were considered to be "impact" sites and they were located on the proposed wind farm site, while four were considered to be reference sites and they were located in similar agricultural landscapes, several kilometres from the proposed wind farm site and were accessible via public roads. Most of the impact sites were established on elevated ground, either on top of or on the sides of hills, allowing a clear view of surrounding areas.

During the surveys, each point was counted ten times during the survey period. Points were counted at different times of the day to allow for time-of-day differences in bird movements and activity. Table 1 below indicates when each point was counted on each survey day. This schedule ensured that all points were visited at all times of day.

Table 1: Times of day when points* were counted during each survey day.

Days	Time of Day								
	8:00	**8:30**	**9:00**	**9:30**	**10:00**	**10:30**	**11:00**	**11:30**	**12:00**
1	1	2	3	4	R1	R2	R3	R4	1
2	2	3	4	R1	R2	R3	R4	1	2
3	3	4	R1	R2	R3	R4	1	2	3
4	4	R1	R2	R3	R4	1	2	3	4
5									R1
Days	**Time of Day**								
	12:30	**13:00**	**13:30**	**14:00**	**14:30**	**15:00**	**1530**	**16:00**	**16:30**
1	2	3	4	R1	R2	R3	R4	1	2
2	3	4	R1	R2	R3	R4	1	3	4
3	4	R1	R2	R3	R4	1	2	R1	R2
4	R1	R2	R3	R4	1	2	3	R3	R4
5	R2	R3	R4	1	2	3	4		

* See Figure 1 for survey point locations.

3.1.2. Locations of survey points

Figure 1 shows the location of the bird utilisation survey points (see following page).

Two of the reference points were located approximately 1 km apart along Kalladay Road, and the other two were sited along Whitelaws Track. The sites for the reference points were the nearest possible sites on public road that offered broadly similar landscape and visibility to the impact sites. It was practically difficult to find exactly the same conditions however, and the reference points included more old native eucalypts on the road reservation compared with the impact points on the wind farm site. While the impact points were mostly at top of hills in largely cleared farmland, the reference points included some areas of linear roadside vegetation surrounded by cleared farmland.

3.1.3. Incidental observations

In addition to the observations during formalised, fixed-point counts, incidental observations of birds were also made while moving about the proposed wind farm site. Emphasis was placed on observing birds that are found on water dams, creeks and down the valleys away from the observation points. Also, notes were made of bush birds observed in the remnant woodlands adjoining the points while travelling between the observation points and of raptors using the wind farm site for foraging. The results of these observations are presented in Appendix 1.

3.2. Limitations

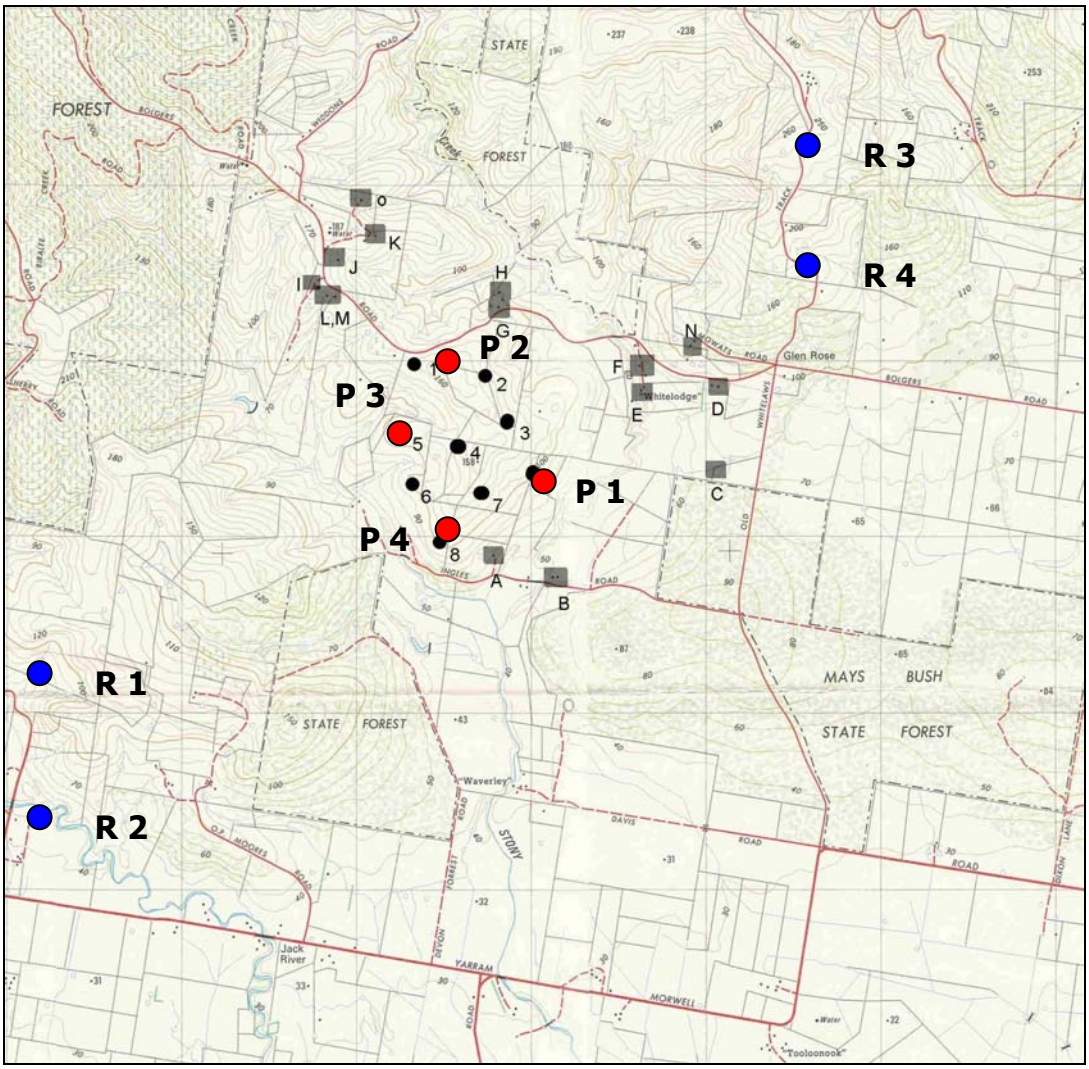
This bird utilisation survey was undertaken in late autumn 2006. At this time of year many birds form mobile flocks and the level of bird movements across agricultural land between forest blocks can often be comparable or higher than bird utilisation at other times of year (Brett Lane & Associates Pty Ltd, unpubl. data).

In this part of the landscape, with the habitat present on and near the proposed wind farm site, the absence of migratory species involves mostly species that, if present, would be confined to the forest environment and would not move across the proposed wind farm site. The only exception would be the White-throated Needletail (*Hirundapus caudacutus*), occasional flocks of which would occur over the site in late summer.

The bird species mix and relative species abundances recorded during the current survey is broadly comparable with results from full-year surveys elsewhere in southern Victorian agricultural landscapes (Brett Lane & Associates Pty Ltd, unpubl. data).

For these reasons, the utilisation rates and species abundances recorded during the current survey are considered to be representative of the site and a reasonable basis on which to assess the bird impacts of the proposed Yarram wind farm.

Figure 1: Map of the proposed Yarram windfarm site showing the approximate location of bird utilisation survey impact sites (Red circles), the reference sites (Blue circles) and the proposed wind turbine sites (Black circles). The positions of R 1 and R2 are approximate, since their real position on Kalladay Road is about a further kilometre to the west.



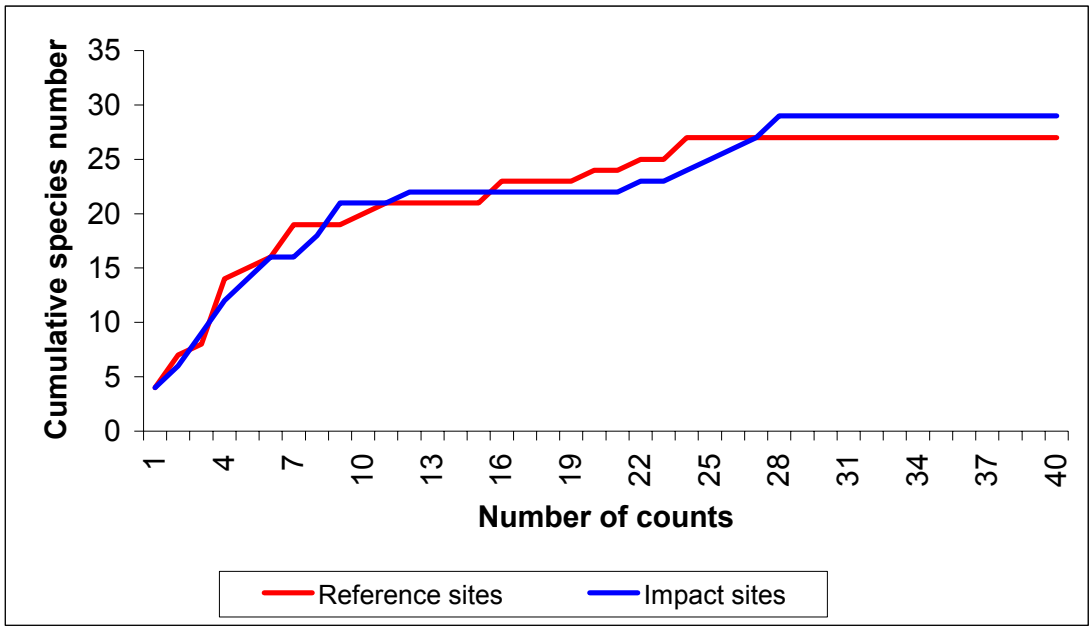
3.3. Results of the bird utilisation survey

This section of the report provides a description of the bird utilisation survey results.

3.3.1. Representativeness of the survey

The cumulative number of species observed from the consecutive fixed point bird counts conducted at the observation and reference points during the survey period has been plotted (see Figure 2). This revealed that the number of new species observed almost levelled off after about 10 counts, after which the occasional new species was found. Over 90% of species were found after less than 60% of the surveys. This suggests strongly that the sites collectively provided a representative picture of the diversity of bird species flying over the wind farm site during the period of the survey. Species recorded incidental to the fixed point counts either have very low utilisation rates or do not occur regularly on those parts of the wind farm site on which generators will be placed.

Figure 2: The cumulative number of species of birds recorded during consecutive counts at the observation points on the Yarram Wind farm.



The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (Brett Lane and Associates, unpubl. data). This showed that 82 to 100 percent (average 88 percent) of species actually seen in one hour of surveying were seen in the initial 15 minutes of observation. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys generated representative data on the bird species in the area during the survey. The results presented in Figure 2 suggest strongly that the 15 minute count interval was adequate.

3.3.2. Bird Observations

The species diversity and numbers of birds observed during the survey at the impact and reference sites are shown in Table 2. In general, 29 species of birds were observed utilizing the proposed wind farm site during the survey and 26 species were observed at the reference sites.

The bird species diversity on the impact and reference sites seems poor compared to the number of birds seen in the area during the broader bird survey (38 species) or with the species listed by the Atlas of Victorian Wildlife (58 species).

On the impact sites, species diversity and abundance was broadly similar between the four observation points (ANOVA; $F= 1.10$, $P<0.05$); therefore no strong differences in species composition and numbers occurred between the observation points on the proposed wind farm site. Species diversity and abundance at the reference sites, as in the impact sites, were similar between the four points (ANOVA; $F= 1.20$, $P<0.05$).

Table 2 presents a list of the species observed during the bird utilisation survey and the numbers in which they were seen in each height zone. The most abundant species at the impact sites were:

- Australian Magpie;
- European Goldfinch;
- Eastern Rosella;
- Crimson Rosella;
- Welcome Swallow;
- Richard's Pipit;
- Common Starling;
- Scarlet Robin; and
- Raven spp.

The first five species were followed by a set of another four species whose abundance exceeded 20 birds. The first five species in this list accounted for over 60 percent of the individual birds counted, and all 9 species accounted for over 80 percent of all individual birds counted at the impact sites during the survey. The abundant species were, predictably, common farmland birds, known to occur in farmland areas throughout southern Victoria and south-eastern South Australia, except for the Scarlet Robin, whose abundance is likely to be seasonal.

The order of abundance was almost similar between the four observation points with magpies being the most common resident farmland birds at all points except at point 4 (see Figure 1), where the rosellas were more common due to the presence of a cluster of mature eucalypt trees within the survey area.

At the reference sites, the most common species, in order of abundance, were:

- Australian Magpie;
- Crimson Rosella;

- Superb Fairywren;
- Grey Shrike-thrush;
- Welcome Swallow;
- Yellow-rumped Thornbill;
- Common Blackbird;
- Common Starling; and
- Brown Thornbill.

The first five species accounted for more than 55 percent of individual birds counted and the nine most abundant species accounted for more than 70 percent of individual birds counted during the five-day survey. The most abundant birds, as in the impact sites, were common farmland birds. However, the reference sites had more small bush birds and birds adapted to roadside vegetation, such as hedges and blackberry clumps, which were common within the survey area.

Table 3 shows the numbers of individual birds of each species observed flying at Rotor Swept Area (RSA) height. During the survey period, a total of 26 individual birds were observed flying at RSA height at the impact sites, or about 4.2 percent of the total number of birds observed during the five day survey.

The number at RSA height was similar between the four impact points. The most abundant species observed flying at RSA height throughout the study period were:

- Common Starling;
- Australian magpie; and
- Yellow-tailed Black-Cockatoo

These three species accounted for over 75 percent of the number of birds at RSA height. However, the important bird species flying at RSA height were again common farmland birds, of which one species, the Common Starling, is introduced. The number of birds observed flying at RSA heights is relatively poor compared to data collected from other wind farms in similar settings in Victoria (Brett Lane & Associates Pty Ltd, unpubl. data). Birds of Prey, or raptors, the group most likely to be observed regularly flying at such heights were not common, and only one individual, a Nankeen Kestrel, was observed flying at RSA heights.

A similar picture emerged from observations at the reference sites, with common farmland birds dominating the numbers flying at RSA heights, except that the most common bird at the reference sites was the Yellow-tailed Black-Cockatoo (Table 3). Cockatoos usually fly in flocks when travelling between foraging sites and usually ascend to greater heights than most other common birds.

Table 4 shows the distribution of bird numbers among the survey points. The total number of birds counted at the impact sites varied between a maximum total of 201 birds at point number 3 to a minimum total of 112 birds at points number 2, with an average total of 149 birds per point at the impact points.

The total numbers of birds observed at the four reference sites varied from 81 to 174 with an average total of 128 birds. The distribution of birds did not follow a specified pattern. The increased count at some of the points was due mainly to the presence of large eucalypts or other trees near or within the point search areas that tended to elevate their bird count.

The presence of birds at RSA height at each of the four impact points varied between 1.0 and 6.8 percent of the birds seen at the points. In common with the total number of birds at the observation points, there were no particular patterns of distribution of birds at RSA height among the impact points.

The same picture emerged from the observations at the reference points, with birds at RSA height varying between 0 and 8.9 percent of the total at the point. The slightly higher percentage of birds at reference point 1 was due to a small flock of the Yellow-tailed Black-Cockatoo flying over the observation point.

Birds of Prey (Raptors)

Few birds of prey were observed on the site. During the formal bird counts at both the impact and reference points, only two species were seen flying within the survey area. The first species was a single Nankeen Kestrel flying at impact point number 2, and the second raptor was a Peregrine Falcon flying at reference point number 1.

The Wedge-tailed Eagle, a raptor of special concern as it is known to collide with operating wind turbines, did not feature in the formal bird count at either the impact or the reference sites. However, a pair of eagles was seen on three occasions during the five-day survey period soaring and circling above the wind farm site. It is likely, therefore, that the wind farm area is part of the foraging range of one pair of eagles. It is of interest that the rate at which these birds were recorded is much lower than the rate at many other wind farm sites where bird utilisation surveys have been undertaken (Brett Lane & Associates Pty Ltd, unpubl. data), suggesting that the proposed Yarram Wind Farm site is unlikely to provide regular productive foraging habitat for this species.

Other raptors seen incidentally outside formal counting times included, the Brown Falcon and Brown Goshawk. The numbers of these raptors were very low compared to similar habitat settings in other parts of southern Victoria (based on previous similar surveys at wind farm sites elsewhere; Brett Lane & Associates Pty Ltd, unpubl. data).

Waterbirds

Small numbers of waterbirds were observed. The species seen most regularly on the impact points were common farmland ducks, such as, Australian Wood Duck and Pacific Black Duck. Other water birds, such as the White-faced Heron were only seen occasionally. The scarcity of waterbirds was not surprising since no sizeable wetlands occur in or close to the wind farm site. There were a number of small farm dams on the site that support small numbers of ducks.

Table 2: Summary of numbers of individual birds and their height distribution seen on surveys points at the proposed Yarram wind farm site. (T)-- below, (T) at, and (T)+ above rotor swept area.

A. Impact Sites

	P1				P2				P3				P4				Total				%
Species	**(T)--**	**(T)**	**(T) +**	**Total**	**(T)--**	**(T)**	**(T) +**	**Total**	**(T)--**	**(T)**	**(T) +**	**Total**	**(T)--**	**(T)**	**(T) +**	**Total**	**(T)--**	**(T)**	**(T) +**	**Total**	**Total**
Australian Magpie	35	4	0	39	48	1	0	49	24	2	0	26	19	0	0	19	126	7	0	**133**	**21.4**
European Gold Finch	0	0	0	0	12	0	0	12	88	0	0	88	0	0	0	0	100	0	0	**100**	**16.1**
Eastern Rosella	42	0	0	42	0	0	0	0	4	0	0	4	6	0	0	6	52	0	0	**52**	**8.4**
Crimson Rosella	5	0	0	5	0	0	0	0	9	0	0	9	30	0	0	30	44	0	0	**44**	**7.1**
Welcome Swallow	8	0	0	8	8	2	0	10	15	0	0	15	11	0	0	11	42	2	0	**44**	**7.1**
Richard's Pipit	0	0	0	0	31	0	0	31	9	0	0	9	0	0	0	0	40	0	0	**40**	**6.4**
Common Starling	12	4	0	16	0	0	0	0	0	0	0	0	16	6	0	22	28	10	0	**38**	**6.1**
Raven spp.	13	0	0	13	3	0	0	3	4	0	0	4	3	1	0	4	23	1	0	**24**	**3.9**
Scarlet Robin	0	0	0	0	2	0	0	2	18	0	0	18	4	0	0	4	24	0	0	**24**	**3.9**
Flame Robin	0	0	0	0	0	0	0	0	16	0	0	16	0	0	0	0	16	0	0	**16**	**2.6**
Noisy Miner	14	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	**14**	**2.3**
Australian Wood Duck	2	0	0	2	4	0	0	4	4	0	0	4	0	0	0	0	10	0	0	**10**	**1.6**
Grey Currawong	9	0	0	9	0	0	0	0	0	0	0	0	1	0	0	1	10	0	0	**10**	**1.6**
Willie Wagtail	1	0	0	1	1	0	0	1	8	0	0	8	0	0	0	0	10	0	0	**10**	**1.6**
Grey Shrike-thrush	3	0	0	3	1	0	0	1	0	0	0	0	5	0	0	5	9	0	0	**9**	**1.4**
Yellow-tailed Black Cockatoo	5	3	0	8	0	0	0	0	0	0	0	0	0	0	0	0	5	3	0	**8**	**1.3**
Grey Butcherbird	4	0	0	4	0	0	0	0	0	0	0	0	3	0	0	3	7	0	0	**7**	**1.1**
Brown-headed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6	6	0	0	**6**	**1.0**
Magpie-lark	2	0	0	2	0	0	0	0	0	0	0	0	2	2	0	4	4	2	0	**6**	**1.0**
Red Wattlebird	2	0	0	2	0	0	0	0	0	0	0	0	4	0	0	4	6	0	0	**6**	**1.0**
Laughing Kookaburra	0	0	0	0	0	0	0	0	1	0	0	1	3	0	0	3	4	0	0	**4**	**0.6**
Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	3	0	0	**3**	**0.5**
Grey Fantail	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	3	0	0	**3**	**0.5**
Galah	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	**2**	**0.3**
New Holland Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	**2**	**0.3**

Species	P1				P2				P3				P4				Total				%
	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	Total
Pacific Black Duck	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	2	0	0	**2**	**0.3**
White-eared Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	**2**	**0.3**
Jacky Winter	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	**1**	**0.2**
Nankeen Kestrel	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	**1**	**0.2**
Total	**159**	**11**	**0**	**170**	**112**	**4**	**0**	**116**	**201**	**2**	**0**	**203**	**123**	**9**	**0**	**132**	**595**	**26**	**0**	**621**	**100**

B. Reference sites

Species	R1				R2				R3				R3								%
	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	Total
Australian Magpie	20	0	0	20	26	2	0	28	25	0	0	25	30	2	0	32	101	4	0	**105**	**19.4**
Crimson Rosella	15	0	0	15	20	0	0	20	18	0	0	18	24	0	0	24	77	0	0	**77**	**14.3**
Superb Fairywren	36	0	0	36	0	0	0	0	5	0	0	5	10	0	0	10	51	0	0	**51**	**9.4**
Grey Shrike-thrush	3	0	0	3	10	0	0	10	6	0	0	6	11	0	0	11	30	0	0	**30**	**5.6**
Welcome Swallow	2	0	0	2	0	0	0	0	8	0	0	8	16	4	0	20	26	4	0	**30**	**5.6**
Yellow-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	25	25	0	0	**25**	**4.6**
Common Blackbird	9	0	0	9	8	0	0	8	0	0	0	0	6	0	0	6	23	0	0	**23**	**4.3**
Common Starling	10	5	0	15	6	0	0	6	0	0	0	0	0	0	0	0	16	5	0	**21**	**3.9**
Brown Thornbill	14	0	0	14	2	0	0	2	0	0	0	0	4	0	0	4	20	0	0	**20**	**3.7**
Raven spp.	4	0	0	4	8	6	0	14	0	0	0	0	2	0	0	2	14	6	0	**20**	**3.7**
Grey Currawong	5	0	0	5	5	0	0	5	9	0	0	9	0	0	0	0	19	0	0	**19**	**3.5**
White-browed Scrubwren	18	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	**18**	**3.3**
Scarlet Robin	0	0	0	0	0	0	0	0	2	0	0	2	15	0	0	15	17	0	0	**17**	**3.1**
Yellow-tailed Black Cockatoo	6	10	0	16	0	0	0	0	0	0	0	0	0	0	0	0	6	10	0	**16**	**3.0**
Grey Butcherbird	2	0	0	2	2	0	0	2	6	0	0	6	1	0	0	1	11	0	0	**11**	**2.0**
Willie Wagtail	0	0	0	0	1	0	0	1	0	0	0	0	10	0	0	10	11	0	0	**11**	**2.0**
Red-browed Finch	4	0	0	4	6	0	0	6	0	0	0	0	0	0	0	0	10	0	0	**10**	**1.9**
Grey Fantail	2	0	0	2	3	0	0	3	0	0	0	0	4	0	0	4	9	0	0	**9**	**1.7**
Laughing Kookaburra	2	0	0	2	2	0	0	2	0	0	0	0	2	0	0	2	6	0	0	**6**	**1.1**

Species	R1				R2				R3				R3								% Total
	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	(T)--	(T)	(T) +	Total	
Magpie-lark	0	0	0	0	4	0	0	4	0	0	0	0	2	0	0	2	6	0	0	**6**	**1.1**
Gang-gang Cockatoo	0	0	0	0	0	0	0		0	0	0		4	0	0	4	4	0	0	**4**	**0.7**
Jacky Winter	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	0	0	**4**	**0.7**
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	**2**	**0.4**
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	0	0	**2**	**0.4**
Red Wattlebird	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	2	0	0	**2**	**0.4**
Peregrine Falcon	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**	**0.2**
Totals	**153**	**15**	**0**	**168**	**103**	**8**	**0**	**111**	**81**	**0**	**0**	**81**	**174**	**6**	**0**	**180**	**511**	**29**	**0**	**540**	**100**

Table 3: Species flying at rotor swept area height during bird utilisation surveys at the Yarram wind farm site.

A. Impact Sites

Species	P1		P2		P3		P4		Total		% Birds at RSA	% of all RSA Birds	% RSA Bird of Total
	(T)	Total	(T)	Total	(T)	Total	(T)	Total	(T)	Total			
Common Starling	4	16	0	0	0	0	6	22	10	**38**	26.3	38.5	1.6
Australian Magpie	4	39	1	49	2	26	0	19	7	**133**	5.3	26.9	1.1
Yellow-tailed Black Cockatoo	3	8	0	0	0	0	0	0	3	**8**	37.5	11.5	0.5
Welcome Swallow	0	8	2	10	0	15	0	11	2	**44**	4.5	7.7	0.3
Magpie-lark	0	2	0	0	0	0	2	4	2	**6**	33.3	7.7	0.3
Raven spp.	0	13	0	3	0	4	1	4	1	**24**	4.2	3.8	0.2
Nankeen Kestrel	0	0	1	1	0	0	0	0	1	**1**	100.0	3.8	0.2
Totals	**11**	**170**	**4**	**116**	**2**	**203**	**9**	**132**	**26**	**621**	4.2	100.0	4.2

B. Reference Sites

Species	R1		R2		R3		R4		Total		% Birds at RSA	% of all RSA Birds	% RSA Bird of Total
	(T)	Total	(T)	Total	(T)	Total	(T)	Total	(T)	Total			
Yellow-tailed Black Cockatoo	10	16	0	0	0	0	0	0	10	**16**	62.5	34.5	1.9
Raven spp.	0	4	6	14	0	0	0	2	6	**20**	30.0	20.7	1.1
Common Starling	5	15	0	6	0	0	0	0	5	**21**	23.8	17.2	0.9
Australian Magpie	0	20	2	28	0	25	2	32	4	**105**	3.8	13.8	0.7
Welcome Swallow	0	2	0	0	0	8	4	20	4	**30**	13.3	13.8	0.7
Totals	**15**	**168**	**8**	**111**	**0**	**81**	**6**	**180**	**29**	**540**	5.4	100.0	5.4

Table 4. The number of birds counted at each of the survey points at Yarram wind farm. % Importance is the percentage of birds seen at the observation point out of all birds seen at all points; % at RSA height is the percentage of birds seen flying at RSA heights out of total birds seen at that observation point.

Observation Points	Number of birds at			Total	% Importance	% Birds at RSA height
	(T)--	(T)	(T) +			
P1	159	11	0	170	27.4	6.5
P2	112	4	0	116	18.7	3.4
P3	201	2	0	203	32.7	1.0
P4	123	9	0	132	21.3	6.8
Total Impact	**595**	**26**	**0**	**621**	**100.0**	**4.2**
R1	153	15	0	168	31.1	8.9
R2	103	8	0	111	20.6	7.2
R3	81	0	0	81	15.0	0.0
R4	174	6	0	180	33.3	3.3
Total Reference	**511**	**29**	**0**	**540**	**100.0**	**5.4**

4. CONSERVATION SIGNIFICANCE OF BIRD SPECIES OBSERVED

4.1. Criteria for conservation significance

The criteria for assessing conservation significance that have been used in this report are presented below.

- **National** conservation significance for birds applies to an area that supports a population of one or more bird species listed as nationally threatened by Garnett and Crowley (2000) or listed as critically endangered, endangered or vulnerable on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
- **State** conservation significance for birds applies to an area when it supports a population of at least one bird species threatened in Victoria, as listed by DSE (2003), or on the schedules to the Victorian *Flora and Fauna Guarantee Act 1988*.
- **Regional** conservation significance for birds applies to an area that supports a population of a species considered depleted in a particular bioregion based on an authoritative regional analysis, such as a Regional Biodiversity Assessment.

As it is not always possible to confirm the presence of some bird species, due to seasonal or behavioural difficulties in detection, the foregoing significance levels can be qualified by the word "**potential**" where habitat attributes are considered suitable for a species of a particular level of conservation significance.

4.2. Significance of the proposed wind farm site for birds

The avifauna recorded was mainly native, made up of common farmland and bushland birds, and at least three commonly occurring introduced bird species. The farmland birds were usually found in the cleared areas while bushland birds were mainly restricted to the scattered trees and the small woodlands. Bushland birds also moved between remnant woodlands, crossing over proposed wind turbine sites, usually flying low, beneath rotor swept area height.

No species of national, state or regional significance was observed on the proposed wind farm site during the bird utilisation survey, reflecting the highly altered nature of the habitat and the predominance of agricultural land uses. Remnant natural ecosystems are very limited in extent on the site and the avifauna of the area reflects this lack of indigenous habitat. Most of the site is therefore considered to be of local significance for birds.

The Atlas of Victorian Wildlife (AVW) recognised the possibility of one threatened bird species that occurs in forests close to the proposed wind farm site. The bird is the Sooty Owl (*Tyto tenebricosa*), a vulnerable species in Victoria that is listed on the schedule of the *Flora and Fauna Guarantee Act 1988*. The AVW contained one record of the bird from an area about 15.5 km to the north west of the proposed wind farm site. The Sooty Owl is a rare bird

that normally forages inside forests and would not utilize open areas for its activities (Higgins 1999). This owl is not likely to occur on the wind farm site.

5. IMPLICATIONS OF SURVEY FINDINGS

The proposed wind farm would comprise nine generators. This section of the report discusses the impacts that a wind farm at the site might have on birds and discusses the significance of this impact under relevant Commonwealth and state legislation.

5.1. Potential Impacts of the proposed wind farm on birds

Wind turbines may affect birds in three ways:

1. Birds may be killed or injured by colliding with rotors, towers, guy wires, or related structures.
2. Birds may avoid wind energy developments and surrounding habitat.
3. The footprint of the turbines, roads, power lines, and auxiliary buildings may directly impact habitat.

5.1.1. Mortality caused by wind turbines

The impact of operating wind turbines on birds appears to be small, but mortality does occur, although it appears to be very site-specific.

Table 5 summarises reported collision rates from a range of European and North American wind farms. The rate varied between 0.04 – 3.4 birds per turbine per year. A rate of 4.3 birds per turbine per year was recorded from two wind farms in the eastern U.S. outside California. However, variation among wind farms depends on several factors, including the amount of bird use, vegetation and other physical and biological characteristics of the specific wind farm and its surrounding area.

Studies at upland sites in the UK have generally reported very low collision rates, with some studies finding no collisions at all. This probably reflects the generally low bird densities present in these areas.

Overall it is clear that birds are generally able to avoid collisions and do not simply blindly fly into wind turbines. Collision rates typically in range of only 1 in 1,000-10,000 bird flights through wind farm, even in studies such as Zeebrugge where relatively high numbers of collisions have been reported.

Studies using radar tracking have helped to provide further information on birds' general ability to avoid collisions. Dirksen *et al*. (1998), for example, showed that Pochard *Aythya ferina* and Tufted Duck *Aythya fuligula* flew regularly through a wind farm in the Netherlands at night under moonlight but flew around the turbines at greater distance from them when it was dark and foggy.

Analysis of North American and European bird collisions at wind farms (Erickson *et al* 2001; Percival 2003; NWCC 2004) shows that bird species affected by operational turbines varied but mostly depended on the type of habitat on which the wind farm is built (Table 5). Most wind farm bird mortality was due to migrating birds. The Northern Hemisphere has a large number of both species and individuals of this bird group due to the large

area of land at high latitudes that becomes unsuitable for birds in winter. Australia's geography and latitude means that there are few night-migrating birds. For this reason, the numbers of birds likely to collide with operating wind farms in Australia would be about half that in Europe and North America.

It is also clear, however, that bird collisions with wind turbines can be a problem under some circumstances. It would seem from the evidence available from existing wind farms that there are two main types of sites that have had collision problems:

1. Sites with large raptors occurring regularly within the wind farm at the same height as the rotor blades. In Australia the main species that would fall into this category would be Wedge-tailed Eagle and Nankeen Kestrel.
2. Sites with very high densities of other birds flying at rotor height. These could include seabird breeding colonies and feeding concentrations, and wetlands (including coastal sites) with large waterfowl concentrations, and significant migration flyways (mainly a northern hemisphere phenomenon).

Table 5: Summary of bird mortality estimates for wind farms in Europe and North America (Sources: Erickson *et al* 2001; Percival 2003; NWCC 2004).

Site	Habitat	Species present	Size of Windfarm	Collision rate*
USA sites (review of 12 projects outside California)	Various	Various	Mixed	2.3 (1.5–4.3)
Altamont, California	Ranch land	Raptors	VL	0.05– 0.06
Buffalo Ridge (all phases), Minnesota, USA	Various	Waterfowl & passerines	L	2.83
Tarifa, S. Spain	Coastal Hills	Raptors, storks and many migrants	VL	0.34
Navarre, Spain	Inland hills	Various, including raptors and passerines	VL	0.34
Burgar Hill, Orkney	Coastal moorland	Upland species	S	0.15
Blyth, Northumberland	Coastal Shoreline	Shorebirds	S	2.52
Zeebrugge, Belgium	Coastal shoreline	Gulls, terns & migrants	M	11–29**
Bryn Tytli, Wales	Upland moorland	Upland species, including peregrine falcon	M	0.0
Cemmaes, Wales	Upland moorland	Upland species	M	0.04
Urk, Netherlands	Coastal-on dyke wall	Waterfowl	M	1.7
Oosterbierum, Netherlands	Coastal-on Dyke wall	Waterfowl & migrants	M	1.8
Kreekrak, Netherlands	Coastal-on dyke wall	Waterfowl	S	3.4
Ovenden Moor, S. Pennines	Upland moorland	Upland species	M	0.04
Tjaereborg, Denmark	Coastal	Waders and gulls	S	3.0

Site	Habitat	Species present	Size of Windfarm	Collision rate*
	grassland			
Nasudden, Gothland, Sweden	Coastal marsh & arable	Waterfowl, including breeding waders & migrants	L	0.7
Utgrunden	Offshore	Eiders	S	0.0

Collision rate = Number of birds killed per turbine per year; all rates are corrected for observer efficiency and scavenging rate.
** The study included high correction factors (detecting only 11% of collisions).
VL=very large (>200 turbines); L=large (50–200); M=medium (10–50); S=small (<10).

5.1.2. Australian Studies

Experience at wind farms in Australia is informative. Monitoring results in the public domain include:

- Codrington (14 generators): 3 birds (2.5 years, weekly, monthly or six-weekly searches);
- King Island (3 generators): 1 bird (5 years, weekly – monthly searches);
- Woolnorth (6 generators): 8 birds, <1 year, daily to weekly searches);
- Toora (12 generators): 2 birds and 5 bats (2 year seasonal sampling, annual average fortnightly searches); and

(Source: Meredith, C [2003] Australian Wind Energy Association presentation, Sydney, July 2003; Brett Lane and Associates Pty Ltd [2004b]).

Allowing for observer efficiency and scavenger correction, these figures corresponded to a collision rate of between one and four birds per generator per year.

The Australian wind farms, which were monitored for bird mortality, are mostly in agricultural settings although all are located on or close to the coast. Birds that fatally collided with turbines were mostly farmland birds, except at Woolnorth, where the list included three marine species. Bird mortality at these farms varied between 2 to 4 birds/turbine/year.

5.1.3. Indirect Habitat Disturbance

The second main potential impact of wind farms on birds is through displacement from an area around the wind turbines, effectively resulting in habitat loss. Numerous studies have investigated this potential problem, with a range of results. In many cases, no significant disturbance effect at all has been detected, including studies at upland, coastal and offshore wind farms (Percival 2003) (see Table 6). European studies suggest that most displacement involves migrating, resting and foraging birds. Studies have reported displacement effects ranging from 75 m to as far as 800 m away from turbines and up to 300m for breeding birds (Percival 2003; Strickland 2004). Often studies have had confounding factors, such as increased human disturbance, lack of habitat studies to determine birds' preferences in relation to wind farm location, and lack of proper statistical testing/experimental design.

While birds appear to avoid flying near turbines, the presence of these structures does not seem to deter birds from their foraging areas (Danish Wind Industry Association 2001). Breeding birds appear to have a greater tolerance to turbines than migrating birds. Local breeding populations of waterfowl, grouse, shorebirds, gulls and passerines were not significantly affected by the construction of turbines in a bog in the Orkney Islands (Meek *et al*. 1993). There were also little effect on breeding birds at other wind sites in Great Britain with many examples of birds in close proximity to wind turbines (Percival 1998).

Table 6: Table 2. Studies of the possible disturbance effects of wind farms on birds (after Percival 2003).

Site	Habitat	Species present	Size of Wind farm	Distance affected (m)
Tjaereborg, Denmark*	Coastal grassland	Waterfowl, mainly waders and gulls	S	Max 800
Urk, Netherlands	Coastal-on dyke wall	Waterfowl, including geese and swans	M	Max 300
Oosterbierum, Netherlands**	Coastal-on dyke wall	Waterfowl	M	Max 500
Vejlerne, Denmark	Farmland	Pink-footed Geese	L	1–200
Westermarsch, Germany	Farmland	Barnacle Geese	M	Max 600
Haverigg, Cumbria	Coastal grassland	Golden Plover, gulls	S	None
Blyth, Northumberland	Coastal shoreline	Cormorants, waders, gulls	S	None
Bryn Tytli, Wales	Upland moorland	Upland species, raptors	M	None
Carno, Wales	Upland moorland	Upland species	L	None
Ovenden Moor, NW England	Upland moorland	Golden Plover and Curlew	M	None
Nasudden, Gotland, Sweden	Coastal marsh	Waterfowl inc. geese and breeding waders	L	None
Various UK sites	Uplands	Lapwings, curlews, skylarks and pipits	M	None
Zeebrugge, Belgium	Coastal shoreline	Waterfowl	M	Up to 300
Novar	Upland Moorland	Upland species	M	None
Urgrunden	Offshore	Long-tailed Duck	S	None

* Breeding lapwing up to 300 m.
** No effect on breeding waders.
L=large (50–200 turbines); M=medium (10–50); S=small (<10).

5.1.4. Direct Habitat Disturbance

There are a variety of direct, long-term and short-term non-collision impacts that wind farms may have on birds. Direct loss of habitat results from the construction of turbine pads, roads and substations. Long-term habitat impacts results from the construction of relatively permanent structures that remove habitat for the life of the project and short-term impacts that occur

while habitat been disturbed temporarily during construction of the wind plant.

Examples of impacts could be found in studies from some American wind farms. Temporary impacts from the construction of roads, turbine pads and substation were 0.4, to 2.6 acres per turbine or 0.6 to 1.7 acres per MW. Long-term impacts from permanent facilities were o.7 to 1 acre per turbine, or 0.4 to 0.7 acres per MW (Strickland 2004). The overall magnitude of impacts and the potential for successful reclamation of sites depends on the ecological context and characteristics of the site, the type of turbines being built, and the design of reclamation plan. Flat sites require less topographic restructuring than rougher terrain, and arranging turbines in compact strings requires less road-building than widely dispersed turbines.

5.1.5. Mortality caused by wires

Bird collision and electrocutions caused by the wires associated with wind turbines and the guide ropes used to hold the wind measuring masts are also a concern (Kingsley and Whittam 2001). Birds that fly fast in flocks at low altitudes such as waterfowl and shorebirds appear to be particularly susceptible to collisions with wires (James and Haak 1979). In addition, to waterfowl, raptors are also frequent victims of wire kills (Olsen and Olsen 1980).

Several recommendations have been made to reduce wire-induced bird mortality (Kingsley and Whittam 2001):

- Lines should be built underground if possible;
- Line visibility should be increased by adding markers, and increasing the size of wire;
- Lines should not be built over water or other areas of high bird concentration;
- Lines should be made parallel to prevailing wind direction.

5.2. Legislative implications

5.2.1. *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act contains a list of threatened fauna species that are considered to be of national conservation significance. Any impacts on these species may potentially be deemed as significant and require approval under the EPBC Act.

The current bird utilisation surveys failed to record any EPBC Act listed threatened species. It is considered unnecessary for a Referral under the EPBC Act to be submitted since the construction and operation of wind turbines would have no impact on any threatened species. Impacts on listed migratory species (e.g. birds of prey) would be negligible due to the very low rates of utilisation by these species.

5.2.2. Flora and Fauna Guarantee Act 1988 (FFG Act)

The Victorian FFG Act lists threatened fauna species to provide for their protection and management. The FFG Act has limited direct application to private land. However, the State Planning Policy Framework (SPPF), as contained in each local planning scheme, does make reference to this Act. The local planning authority is likely to consider the FFG Acts implications when making decisions regarding changes in land use. The most relevant section of the SPPF is Clause 15.09, 'Conservation of native flora and fauna'.

The bird utilisation survey on the proposed Yarram Wind farm did not record any FFG listed species. The nearest such bird habitat to the wind farm site is a Sooty Owl reported by the Atlas of Victorian Wildlife to occur about 15.5 km away from the study site.

5.2.3. Department of Sustainability and Environment threatened species advisory list (DSE 2003)

The DSE's rare and threatened species advisory list (2003) includes fauna species known to be rare or threatened throughout the state and is maintained by government biologists. Although the advisory list has no statutory role, DSE will consider impacts on any species on the list when making a decision regarding development approval if they are involved as a referral authority.

No species listed on the Victorian rare and threatened species advisory lists have been recorded within the wind farm site on the impact sites.

5.3. Conclusions

This bird utilisation survey has been undertaken to enable a soundly based bird impact assessment of the proposed Yarram Wind Farm to be made. The conclusions from this investigation are summarised below.

- The proposed wind farm site is a largely altered agricultural landscape supporting a low diversity of predominantly opportunistic and adaptable native bird species and some introduced bird species.
- The site supports species and relative abundances of bird species comparable with similar farmland settings elsewhere in southern Victoria.
- The site supports few birds of prey or waterbirds, groups considered vulnerable to collision with operating wind turbines.
- The site lies within the territory of one pair of Wedge-tailed Eagles, which used the site with very low frequency during the bird utilisation surveys.
- Studies of wind farms in many parts of the world indicate that the rate of bird collisions is between 0.04 and 4 birds per turbine per year. Similar collision rates have been observed at Australian wind farms.
- The proposed Yarram Wind Farm is broadly comparable in terms of bird habitat characteristics and setting to other wind arms in southern Australia

and a similar level of mortality of common farmland birds is expected (i.e. between 9 and 36 birds per year).

- Areas surrounding the wind farm support similar habitat to the proposed wind farm and level of bird usage and species present are likely to be comparable. Therefore, indirect impacts from the proposed wind farm are likely only to affect common farmland species.
- No threatened species of birds were observed on or near the proposed wind farm site and none is expected to occur regularly in the area due to a lack of suitable habitat. Therefore, impacts on threatened birds are not expected from this proposal.
- Use of the proposed wind farm site by migratory species listed on the Commonwealth EPBC Act is very low and significant impacts on regional populations of these species are not expected to occur. A Referral under this Act is not considered necessary.

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APPENDIX 1.

The avifauna that occur or are likely to occur on the proposed Yarram Wind Farm site based on observations and the Atlas of Victorian Wildlife (AVW). X= seen in or near the site during this survey (during or incidental to formal point counts), R= seen in or near the wind farm site but not reported by the AVW, and *= introduced species.

Common Name	Scientific Name	Ecological Significance			Recorded
		EPBC	DSE	FFG	
Australian Magpie	*Gymnorhina tibicen*				X
Australian Raven	*Corvus coronoides*				X
Bassian Thrush	*Zoothera lunulata*				
Beautiful Firetail	*Stagonopleura bella*				
Brown Falcon	*Falco berigora*				
Brown Goshawk	*Accipiter fasciatus*				X
Brown Thornbill	*Acanthiza pusilla*				X
Brown-headed Honeyeater	*Melithreptus brevirostris*				X
Brush Bronzewing	*Phaps elegans*				
Common Blackbird	*Turdus merula*				X*
Common Bronzewing	*Phaps chalcoptera*				
Common Starling	*Sturnus vulgaris*				X*
Crescent Honeyeater	*Phylidonyris pyrrhoptera*				
Crested Shrike-tit	*Falcunculus frontatus*				
Crimson Rosella	*Platycercus elegans*				X
Eastern Rosella	*Platycercus eximius*				R
Eastern Spinebill	*Acanthorhynchus tenuirostris*				X
Eastern Whipbird	*Psophodes olivaceus*				
Eastern Yellow Robin	*Eopsaltria australis*				
European Goldfinch	*Carduelis carduelis*				X*
Fan-tailed Cuckoo	*Cacomantis flabelliformis*				
Flame Robin	*Petroica phoenicea*				R
Gang-gang Cockatoo	*Callocephalon fimbriatum*				R
Golden Whistler	*Pachycephala pectoralis*				X
Grey Butcherbird	*Cracticus torquatus*				X
Grey Currawong	*Strepera versicolor*				X
Grey Fantail	*Rhipidura fuliginosa*				X
Grey Shrike-thrush	*Colluricincla harmonica*				X
Jacky Winter	*Microeca fascianas*				
Large-billed Scrubwren	*Sericornis magnirostris*				
Laughing Kookaburra	*Dacelo novaeguineae*				X
Lewin's Honeyeater	*Meliphaga lewinii*				
Little Raven	*Corvus mellori*				X

Magpie-lark	*Grallina cyanoleuca*				R
Mistletoebird	*Dicaeum hirundinaceum*				
New Holland Honeyeater	*Phylidonyris novaehollandiae*				X
Olive Whistler	*Pachycephala olivacea*				
Peregrine Falcon	*Falco peregrinus*				X
Pied Currawong	*Strepera graculina*				
Pilotbird	*Pycnoptilus floccosus*				
Pink Robin	*Petroica rodinogaster*				
Red-browed Finch	*Neochmia temporalis*				X
Rose Robin	*Petroica rosea*				
Red Wattlebird	*Anthochaera carunculata*				R
Rufous Fantail	*Rhipidura rufifrons*				
Rufous Whistler	*Pachycephala rufiventris*				R
Satin Bowerbird	*Ptilonorhynchus violaceus*				
Scarlet Robin	*Petroica multicolor*				R
Silvereye	*Zosterops lateralis*				
Skylark	*Alauda arvensis*				*
Sooty Owl	*Tyto tenebricosa*		VU	L	
Southern Boobook	*Ninox novaeseelandiae*				
Spotted Pardalote	*Pardalotus punctatus*				
Straw-necked Ibis	*Threskiornis spinicollis*				R
Striated Thornbill	*Acanthiza lineata*				
Sulphur-crested Cockatoo	*Cacatua galerita*				R
Superb Fairy-wren	*Malurus cyaneus*				X
Superb Lyrebird	*Menura novaehollandiae*				
Tawny Frogmouth	*Podargus strigoides*				
Wedge-tailed Eagle	*Aquila audax*				X
Welcome Swallow	*Hirundo neoxena*				X
White-browed Scrubwren	*Sericornis frontalis*				X
White-naped Honeyeater	*Melithreptus lunatus*				
White-throated Treecreeper	*Cormobates leucophaeus*				X
White-eared Honeyeater	*Lichenostomus leucotis*				R
Willie Wagtail	*Rhipidura leucophrys*				X
Yellow-faced Honeyeater	*Lichenostomus chrysops*				
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				R
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*				X