Final Report

Biodiversity Assessment: Willatook Wind Farm, Willatook, Victoria

Prepared for

Willatook Wind Farm Pty Ltd

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Ecology and Heritage Partners Pty Ltd

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Disclaimer

Although Ecology and Heritage Partners Pty Ltd have taken all the necessary steps to ensure that an accurate document has been prepared, the company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report and its contents.

SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was commissioned by Willatook Wind Farm Pty Ltd (WWF)to conduct a Biodiversity Assessment at Willatook Wind Farm, Willatook, Victoria. Willatook Wind Farm Pty Ltd is seeking approval for a revised wind farm design, which is likely to involve the construction of up to 83 wind turbines, with a hub and tip height of up to 155 and 220 metres, respectively.

The purpose of this report is to update the 2011 prepared by Ecology and Heritage Partners (2011) to identify the extent and type of remnant native vegetation present within the revised study area, and determine the presence of significant flora and fauna species and/or ecological communities as determined through the recent vegetation assessments conducted during June and July 2017. In addition, this report only addresses implications associated with the revised wind farm design.

Study Area

The proposed Willatook Wind Farm site is located west of Willatook, Victoria, approximately 30 kilometres north of Port Fairy and 250 kilometres west of Melbourne in south-west Victoria. The survey area covers approximately 6,839 hectares.

Methods

Flora surveys

The flora assessment was undertaken over 11 days in June and July 2017, with previous assessments completed in November and December 2009, and February and March 2011.

The flora assessment was only undertaken within the survey area, with all observed vascular plants recorded, any significant records mapped and the overall condition of vegetation noted. Vegetation outside of the survey area was not assessed in detail. Remnant vegetation in the local area was reviewed to assist in determining the original vegetation within the study area.

Vegetation mapping was undertaken during the field survey through aerial photograph interpretation and using a hand-held Garmin global positioning system. The boundaries of each vegetation type were defined in this manner (accuracy ± 5 metres). A habitat hectare assessment was undertaken in conjunction with the flora survey. Vegetation within the study area was assessed according to the habitat hectare methodology, which is described in the Vegetation Quality Assessment Manual.

Fauna Surveys

The fauna assessments were undertaken between 2009 and 2011. First a desktop review of significant species recorded within 10 kilometres of the proposed study site was undertaken using the Atlas of Victorian Wildlife, the South-west Victorian Flocking Site Database and Birds Australia Atlas Data.

Following this, the fauna surveys consisted of Level 2 Bird Utilisation Surveys including fixed point count surveys to characterise the use of the study area by the region's avifauna, Bat Utilisation Surveys to record the presence of bats within the study area both within the Rotor Swept Area (RSA) and ground level and a range of targeted surveys.

Targeted surveys involved:

- A search of 10 kilometres surrounding the proposed wind farm, as well as within the study area, for breeding, flocking or foraging Brolgas *Grus rubicunda*;
- Targeted Southern Bent-wing Bat *Miniopterus schreibersii bassani* and Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* surveys;
- Nocturnal frog surveys, at appropriate times of the year, with a focus on Growling Grass Frog *Litoria raniformis* and Southern Toadlet *Pseudophryne semimarmorata*, and Brown Toadlet *Pseudophryne bibronii*;
- Trapping and active searching for Swamp Skink *Egernia coventryi*;
- Active searches for Fat-tailed Dunnart *Sminthopsis crassicaudata*;
- Tile grids to detect the presence of Striped Legless Lizards *Delma impar* and Fat-tailed Dunnart.

Surveys were undertaken at various times between November 2009 and July 2011 timed to coincide with periods of highest detectability for the targeted species.

Aquatic Fauna Survey

Fish populations were surveyed at each site using several survey techniques depending on the habitat, water quality and depth of each waterway. Ten bait traps with light sticks were set at dusk for two nights consecutively, and these were placed into microhabitats suitable for small-bodied fish species. Dip netting was conducted by sweeping a net through microhabitats that were suitable for small-bodied fish species. In addition, two fyke nets were set at dusk at each site for two consecutive nights. The cod end was elevated to provide an air pocket if any mammals or birds are trapped within a fyke net.

Results

Flora

One-hundred and fifty-three (153) flora species (97 indigenous and 56 non-indigenous or introduced) were recorded within the study area during the field assessment. Of these species, 10 species are protected and two are listed under the FFG Act.

Remnant native vegetation in the study area is representative of seven Ecological Vegetation Classes: Aquatic Herbland (EVC 653), Basalt Shrubby Woodland (EVC 642), *Heavier-soils* Plains Grassland (EVC 132_61), Plains Grassy Wetland (EVC 125), *Higher-rainfall* Plains Grassy Woodland (EVC 55_63), Stony Knoll Shrubland (EVC 649), and Tall Marsh (EVC 821). Each of these Ecological Vegetation Classes is listed as Endangered in the Victorian Volcanic Plain bioregion.

A total of 562.285 hectares of native vegetation is present within the study area, with 254.879 hectares of native vegetation mapped by Ecology and Heritage Partners, and an additional 307.406 hectares of 'Current Wetland' present (Table S1). Excluding the 'Current Wetland' layer, a total of 130.409 hectares of native vegetation is present (Table S1).

Table S1. Extent of EVCs mapped within the study area

EVC	All areas of mapped native vegetation (hectares)	Mapped native vegetation outside of the modelled Current Wetland (hectares)
Aquatic Herbland	0.039	0.039
Basalt Shrubby Woodland	0.675	0.675
Plains Grassland	3.014	2.993
Plains Grassy Wetland	195.406	73.692
Plains Grassy Woodland	8.479	8.479
Stony Knoll Shrubland	45.900	43.867
Tall Marsh	1.365	0.664
Current Wetlands*	307.406	431.875
Total	**562.285**	**562.285**

Note. * Current Wetlands area as modelled by DELWP. These areas may or may not contain patches of native vegetation as assessed by Ecology and Heritage Partners, but are treated as patches of native vegetation regardless.

Most of properties surveyed within the study area comprised of cleared agricultural land. Remnant native vegetation was generally limited to road reserves, with highly modified isolated occurrences also present within private property along waterways, gullies and stony knolls, which reflects historic and ongoing land-use practices (i.e. cropping and grazing).

There is confirmed habitat within the study area for the nationally significant Basalt Peppercress *Lepidium hyssopifolium* (recorded in 2011), and potential habitat for the nationally significant Clover Glycine *Glycine latrobeana*, Swamp Fireweed *Senecio psilocarpus*, Gorae Leek-orchid *Prasophyllum diversiflorum*, Maroon Leek-orchid *Prasophyllum frenchii* and Dense Leek-orchid *Prasophyllum spicatum*. In addition, there is the potential habitat for Swamp Flax-lily *Dianella callicarpa*, Basalt Leek-orchid *Prasophyllum viretrum* and Slender Bitter-cress *Cardamine tenuifolia*.

It is considered that most areas supporting remnant native vegetation can be avoided through detailed planning and (where practicable) re-alignment (i.e. detailed micro-siting). If impacts cannot be wholly avoided, it is anticipated that at the very least, impacts to native vegetation can be minimised through implementation of the measures detailed in Section 6.1

Fauna

One-hundred and three (103) terrestrial and avian fauna species were observed during the field surveys (Appendix 3.1). This consisted of 19 mammals (including 11 species of bat identified to species level), 76 birds, three reptiles and five frogs. Five of the observations of mammals and five birds were of species introduced to the study area.

Two nationally significant fauna species were recorded during the field surveys; one Southern Bent-wing Bat *Miniopterus schreibersii bassani* call was recorded during the Anabat surveys, and a Growling Grass Frog *Litoria raniformis* was heard from a wetland located to the east of the study area. In addition, two state significant species were recorded during bird surveys; Royal Spoonbill *Platalea regia* was seen in wet depressions on several occasions and Eastern Great Egret *Ardea modesta* was seen on the wetlands adjacent to the study area and Swamp Skink *Egernia coventryi* was also trapped in a wetland near the Moyne River.

Six fish species were collected along Moyne River within the study area and three species were collected in Kangaroo Creek. This included two nationally significant species Yarra Pygmy Perch *Nannoperca obscura* (collected within the Moyne River sites) and Dwarf Galaxias *Galaxiella pusilla* collected within the Kangaroo Creek.

Fauna species that utilise habitat within the proposed study area may be impacted by the construction of the wind farm infrastructure, as well as the operation of the wind farm. By avoiding wetlands and waterways, many of these impacts can be minimised, and any impact of the wind turbines on aerial fauna will be monitored via the implementation of a Bat and Avifauna Management (BAM) Plan.

Communities

One habitat zone of Plains Grassy Woodland - PGW2, comprising an area of 0.569 hectares is considered to meet the condition thresholds that define the nationally significant *Grassy Eucalypt Woodland of the Victorian Volcanic Plain* ecological community. This habitat zone is located within the road reserve of Macknights Road (Figure 3c), and is considered unlikely to be impacted by the proposed windfarm development.

No other significant communities are present due to the modified structure of vegetation, high weed cover and low species diversity.

Legislative and Policy Implications

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act - Commonwealth)

An EPBC Act referral to the Commonwealth Environment Minister should be submitted to determine potential impacts to matters of National Environmental Significance (NES) within the study area, specifically, to address potential impacts to the Southern Bent-wing Bat, Basalt Peppercress, Grassy Eucalypt Woodland of the Victorian Volcanic Plains community, and any other nationally significant flora and fauna likely to be impacted by the windfarm development.

Flora and Fauna Guarantee Act 1988 (FFG Act - Victoria)

The planning authority may consider flora, fauna and communities listed under the FFG Act when making decisions regarding the use and development of land. There is suitable habitat within the study area for several species listed or protected under the FFG Act. A permit under the FFG Act is not required for the removal of listed and protected species on private land. A permit under the FFG Act will be required for listed and protected species removal located on public land (i.e. roadside within the study area) if specimens cannot be avoided. If required, the proponent should allow up to six weeks to obtain a FFG Act permit through DELWP.

Environment Effects Act 1978 (Victoria)

It is understood that WWF intend to submit a referral to allow for an assessment of impacts under the *Environment Effects Act 1978.* Once the site layout is finalised, impacts to native vegetation will be quantified to further inform the referral.

Planning and Environment Act 1987

In accordance with Clause 61.01 of the Moyne Shire Planning Scheme, the Minister for Planning is the Responsible Authority for the use and development of land for a Wind Energy facility.

Once a a final site layout is prepared, impacts to native vegetation wil be ascertained, likely in accordance with the application requirements of the Detailed assessment pathway (Table S2).

Other Legislation and Policy

Implications relating to other local and State policy (*Wildlife Act 1975*, *Catchment and Land Protection Act 1994*, local government authorities) as well as additional studies or reporting that may be required (targeted surveys, Conservation Management Plan, Weed Management Plan, Construction Environment Management Plan) are provided in Section 4.

Recommendations

It is recommended that WWF:

1. Adopt the impact minimisation measures as outlined in this report;
2. Prior to construction, develop a Construction Environmental Management Plan (CEMP) with specific management actions to mitigate against potential impacts to areas of ecological value;
3. Develop a Weed Management Plan, which should be incorporated into the CEMP;
4. Prepare an EPBC Act referral to the Commonwealth Environment Minister to determine potential impacts to matters of NES within the study area;
5. Where required, microsite wind turbines to provide a 3.2-kilometre buffer around known and historical brolga nest-sites, or undertake analysis of existing Brolga home range data in consultation with DELWP to determine appropriate buffer distances for historical and current Brolga breeding sites.
6. Before commencement of construction, the preparation of a Bat and Avifauna Management Plan to the satisfaction of the responsible authority, in consultation with the DELWP. When approved, the BAM Plan must be endorsed by the responsible authority. The BAM Plan must include:
    a) A strategy for managing and mitigating bird and bat strike arising from the wind energy facility operation. The strategy must include procedures for the regular removal of carcasses likely to attract raptors to areas near wind turbines;
    b) A procedure for addressing significant impacts of birds and bat populations caused by the wind farm. This procedure must provide that the operator of the wind energy facility immediately investigates the possible causes of any significant impacts on bird and bat populations, and thereafter designs and implement measures to mitigate those impacts in consultation with the responsible authority and DELWP;
    c) A monitoring period of not less than two years to record, by species, any bird and bat strikes; and,
    d) A strategy to manage and/or monitor the wind farm beyond the two-year period depending upon the results of the two years period referred to above. The strategy must include provisions to take account of any changes to weather patterns during the initial two-year monitoring period.
7. Once a final site layout is prepared, conduct targeted surveys for Basalt Peppercress, Clover Glycine, Gorae Leek-orchid, Maroon Leek-orchid and Dense Leek-orchid within potential habitat if these areas cannot be avoided.

Table S2. Application requirements for a permit to remove native vegetation under the Detailed Assessment Pathway (*Victoria Planning Provisions* Clause 52.17 -3; DELWP 2017a).

No.	Application Requirement	Response within this report
1	Information about the native vegetation to be removed, including: • The assessment pathway and reason for the assessment pathway. • A description of the native vegetation to be removed. • Maps showing the native vegetation and property in context. • The offset requirements that will apply if the native vegetation is approved to be removed.	To be Confirmed
2	Topographic and land information relating to the native vegetation to be removed.	Refer to Section 1 and Figure 3 of this report.
3	Recent dated photographs of the native vegetation to be removed.	Refer to Section 4.1 of this report.
4	Details of any other native vegetation that was permitted to be removed on the same property with the same ownership as the native vegetation to be removed, where the removal occurred in the five-year period before the application to remove native vegetation is lodged.	Not Applicable
5	An avoidance and minimise statement.	To be Confirmed
6	A copy of any property vegetation plan that applies to the site.	Not applicable.
7	Where the removal of native vegetation is to create defendable space, a written statement explaining why the removal of native vegetation is necessary. This is not required when the creation of defendable space is in conjunction with an application under the Bushfire Management Overlay	Not applicable
8	If the application is under Clause 52.16, a statement that explains how the proposal responds to the Native Vegetation Precinct Plan	Not applicable
9	An offset statement explaining that an offset that meets the offset requirements for the native vegetation to be removed has been identified and how it will be secured	To be Confirmed
10	A site assessment report of the native vegetation to be removed, including: • A habitat hectare assessment of any patches of native vegetation, including the condition, extent (in hectares), Ecological Vegetation Class and bioregional conservation status. • The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any large trees within patches. • The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any scattered trees, and whether each tree is small or large.	Refer to Section 4 and Appendix 2.3 of this report.
11	Information about impacts on rare or threatened species habitat, including: • The relevant section of the Habitat importance map for each rare or threatened species requiring a species offset. • For each rare or threatened species that the native vegetation to be removed is habitat for, according to the Habitat importance maps: - the species' conservation status - the proportional impact of the removal of native vegetation on the total habitat for that species - whether their habitats are highly localised habitats, dispersed habitats, or important areas of habitat within a dispersed species habitat	To be Confirmed

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was commissioned by Willatook Wind Farm Pty Ltd (herein referred to as WWF) to conduct a Biodiversity Assessment at Willatook Wind Farm, Willatook, Victoria. Willatook Wind Farm Pty Ltd are seeking approval for a revised wind farm design, which is likely to involve the construction of up to 83 wind turbines, with a hub and tip height of up to 155 and 220 metres, respectively.

The revised activity is a reduced version of the original proposal, which involved the construction and operation of 145 wind turbines. The current proposal also significantly reduces the overall wind farm area, from approximately 8,604 hectares to 6,839 hectares (-21%).

The purpose of this report is to update the 2011 report prepared by Ecology and Heritage Partners (2011) to identify the extent and type of remnant native vegetation present within the revised study area, and determine the presence of significant flora and fauna species and/or ecological communities as determined through the recent vegetation assessments conducted during June and July 2017. In addition, this report only addresses implications associated with the revised wind farm design.

1.2 Previous Assessments

Ecology and Heritage Partners have completed the following ecological studies for the project since mid-2009:

- Preliminary Flora and Fauna Assessment for the Proposed Willatook Wind Farm, Willatook, Victoria (Ecology and Heritage Partners Pty Ltd October 2009):
    - Detailed desktop assessment
    - Preliminary field survey - 17 July 2009.
- Targeted Flora and Fauna Assessment, and Net Gain Analysis for the proposed Willatook Wind Farm, Willatook, Victoria (Ecology and Heritage Partners Pty Ltd May 2010):
    - Updated detailed desktop assessment
    - Flora surveys - 25 November, 1-3 December and 8-9 December 2009
    - Aquatic surveys - 15-18 December 2009
    - Bird utilisation surveys - 4-6 and 16-20 November 2009
    - Targeted Growling Grass Frog surveys - 16-20 November 2009
    - Targeted Brown and Southern Toadlet surveys - 18 March and 22 May 2010
    - Targeted bat surveys - 4 November 2009 - 27 January 2010
    - Targeted Swamp Skink surveys - 15-19 February 2010.
    - Targeted Striped Legless Lizard and Fat-tailed Dunnart surveys - 4th November 2009 - 19th February 2010
    - Brolga searches - 4th November 2009 - 19th February 2010

- Targeted Southern Bent-wing Bat *Miniopterus schreibersii bassanii* and Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* Surveys for the proposed Willatook Wind Farm, Willatook, Victoria (Ecology and Heritage Partners Pty Ltd March 2012):
    - Detailed desktop assessment
    - Targeted bat surveys - Spring 2010 (20 October - 22 November) and Autumn 2011 (09 February - 31 March 2011).
- Targeted Flora and Fauna Assessment, and Net Gain Analysis for the Proposed Willatook Wind Farm, Willatook, Victoria (Ecology and Heritage Partners Pty Ltd April 2011):
    - Updated detailed desktop assessment
    - Reported findings of the targeted surveys first included in the May 2010 and March 2012 reports. Included additional results for:
        - Flora surveys - 25 February and 3 March 2011
        - Aerial Brolga surveys - 7 October 2010
        - Targeted Brolga habitat surveys - 5-8 July 2011.
- Brolga Movements and Spatial Requirements During Breeding, South-West Victoria (Ecology and Heritage Partners Pty Ltd November 2013):
    - Consultation with relevant regulators and landowners
    - Detailed desktop assessment
    - Inspections of wetland areas within the study area and surrounding locality (10-kilometre buffer). Based on a lack of Brolga nests within the original search area, investigations were expanded into a broader 6,000 square-kilometre area
    - Determination of home ranges through statistical analysis (2012).

The refined wind farm area includes approximately 340 hectares of land not previously surveyed as part of the original Willatook Wind Farm Project. Ecology and Heritage Partners Pty Ltd completed vegetation mapping and a suite of fauna surveys across this area as part of the Shaw River Power Station Project between 2008 and 2009.

1.3 Scope and Objectives

The objectives of the flora and fauna assessment were to:

- Review the relevant flora and fauna databases and available literature;
- Conduct an up to date field assessment to identify the quality and extent of native vegetation within the study area;
- Provide maps showing any areas of remnant native vegetation and locations of any significant flora and fauna species, and/or fauna habitat (if present);
- Classify any flora and fauna species and vegetation communities identified or considered likely to occur within the study area in accordance with Commonwealth and State legislation;
- Document relevant environmental legislation and policy;

- Document any opportunities and constraints associated with the proposed works; and,
- Advise whether any additional flora and/or fauna surveys are required prior to works commencing (e.g. targeted surveys for significant flora and fauna species).

Where areas of remnant vegetation were present, the following tasks were completed to address requirements under the 'Guidelines for the removal, destruction or lopping of native vegetation' (Guidelines) (DELWP 2017a):

- A habitat hectare assessment of any areas of remnant native vegetation within the study area;
- Recommendations to address requirements under the Guidelines to minimise impacts to remnant vegetation; and,
- Provision of offset targets for any native vegetation, scattered trees and habitat for rare or threatened species proposed to be lost because of the proposed works.

1.4 Study Area

The proposed Willatook Wind Farm site is located west of Willatook, Victoria, approximately 30 kilometres north of Port Fairy and 250 kilometres west of Melbourne in southwest Victoria (Figure 1). The updated survey area covers approximately 6,839 hectares (Figure 2).

For the purposes of this report, the study area is the area defined in the Figures by the red 'study area' outline. The survey area is the area subject to additional vegetation surveys in 2017 and is defined by the yellow hatching shown in Figure 2.

The main land use is agricultural (i.e. livestock grazing, cropping), and widespread clearing of the study area and surrounds has resulted in native vegetation being largely restricted to roadside reserves.

According to the Department of Environment, Land, Water and Planning (DELWP) Native Vegetation Information Management (NVIM) Tool (DELWP 2018a), the study area occurs within the Victorian Volcanic Plain bioregion. It is located within the jurisdiction of the Glenelg Hopkins Catchment Management Authority (CMA) and the Moyne Shire Council municipality. Section 4.4.1 discusses zoning and overlays relevant to the study area.

2 METHODS

2.1 Desktop Assessment

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the study area. The following information sources were reviewed:

- The DELWP NVIM Tool (DELWP 2018a) and NatureKit (DELWP 2018b) for:
    - Modelled data for location risk, remnant vegetation patches, scattered trees and habitat for rare or threatened species; and,
    - The extent of historic and current Ecological Vegetation Classes (EVCs).
- EVC benchmarks (DELWP 2018c) for descriptions of EVCs within the relevant bioregion;
- The Victorian Biodiversity Atlas (VBA) for previously documented flora and fauna records within the project locality (DELWP 2018d);
- The Illustrated Flora Information System of Victoria (IFLISV) (Gullan 2017) for assistance with the distribution and identification of flora species;
- The Commonwealth Department of the Environment (DoEE) Protected Matters Search Tool (PMST) for matters of National Environmental Significance (NES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DoEE 2017);
- Relevant listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest Threatened and Protected Lists (DELWP 2018e; DELWP 2016);
- The Planning Maps Online (DELWP 2018f) and Planning Schemes Online (DELWP 2018g) to ascertain current zoning and environmental overlays in the study area;
- Other relevant environmental legislation and policies as required;
- Aerial photography of the study area; and,
- Previous ecological reports relating to the study area, including:
    - Preliminary Flora and Fauna Assessment for the Proposed Willatook Wind Farm, Willatook, Victoria (Ecology Partners Pty Ltd October 2009);
    - Targeted Flora and Fauna Assessment, and Net Gain Analysis for the proposed Willatook Wind Farm, Willatook, Victoria (Ecology Partners Pty Ltd May 2010);
    - Targeted Flora and Fauna Assessment, and Net Gain Analysis for the Proposed Willatook Wind Farm, Willatook, Victoria (Ecology Partners Pty Ltd April 2011);
    - Targeted Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat surveys for the proposed Willatook Wind Farm, Willatook, Victoria (Ecology Partners Pty Ltd March 2012);
    - Brolga Movements and Spatial Requirements During Breeding, South-West Victoria (Ecology and Heritage Partners Pty Ltd November 2013); and,

- Willatook Wind Farm Project - Summary of Ecological Assessments (Ecology and Heritage Partners Pty Ltd August 2017).

2.2 Field Assessment

A detailed flora assessment was undertaken in June and July 2017, to obtain information on flora and fauna values within the study area. The survey area (as shown in Figure 2) was walked and/or driven, with all observed vascular flora and fauna species recorded, any significant records mapped and the overall condition of vegetation and habitats noted. Ecological Vegetation Classes were determined with reference to DELWP pre-1750 and extant EVC mapping and their published descriptions (DELWP 2018c).

Where remnant vegetation was identified a habitat hectare assessment was undertaken following methodology described in the Vegetation Quality Assessment Manual (DSE 2004).

2.3 Removal, Destruction or Lopping of Native Vegetation (the Guidelines)

Under the *Planning and Environment Act 1987*, Clause 52.17 of the Planning Schemes requires a planning permit from the relevant local Council to remove, destroy or lop native vegetation. The assessment process for the clearing of vegetation follows the 'Guidelines for the removal, destruction or lopping of native vegetation' (Guidelines) (DELWP 2017a). The 'Assessor's handbook – applications to remove, destroy or lop native vegetation' (Assessor's handbook) (DELWP 2017b) provides clarification regarding the application of the Guidelines.

2.3.1 Assessment Pathway

Guidelines manage the impacts on biodiversity from native vegetation removal (DELWP 2017a). The assessment pathway for an application to remove native vegetation reflects its potential impact on biodiversity and is determined from the location and extent of the native vegetation to be removed. The location category (1, 2 or 3) has been determined for all areas in Victoria and is available on DELWP's Native Vegetation Information Management (NVIM) Tool (DELWP 2018a). Determination of assessment pathway is summarised in Table 1.

Table 1. Assessment pathways for applications to remove native vegetation (DELWP 2017a)

Extent		Location		
		1	2	3
Native Vegetation	< 0.5 hectares, and not including any large trees	Basic	Intermediate	Detailed
	Less than 0.5 hectares, and including one or more large trees	Intermediate	Intermediate	Detailed
	0.5 hectares or more	Detailed	Detailed	Detailed

Notes: For the purpose of determining the assessment pathway of an application to remove native vegetation the extent includes any other native vegetation that was permitted to be removed on the same contiguous parcel of land with the same ownership as the native vegetation to be removed, where the removal occurred in the five-year period before an application to remove native vegetation is lodged.

2.3.2 Vegetation Assessment

Native vegetation (as defined in Table 2) is assessed using two key parameters: extent (in hectares) and condition. For the purposes of this assessment, both extent and condition were determined as part of the habitat hectare assessment.

In addition, all mapped wetlands (based on the DELWP 'Current Wetlands' layer) must be included as native vegetation, with the modelled condition score assigned to them (DELWP 2017a).

Table 2. Determination of remnant native vegetation (DELWP 2017a)

Category	Definition	Extent	Condition
Remnant patch of native vegetation	An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native. OR An area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy.	Measured in hectares. Based on hectare area of the remnant patch.	Vegetation Quality Assessment Manual (DSE 2004).
Scattered tree	A native canopy tree that does not form part of a remnant patch.	Measured in hectares. A small tree is assigned an extent of 0.031 hectares (10m radius). A large tree is assigned an extent of 0.071 hectares (15m radius).	Scattered trees are assigned a default condition score of 0.2.

Notes: Native vegetation is defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'.

2.3.2.1 Current Wetlands (DELWP)

Wetlands can be difficult to map and assess accurately as they respond quite quickly to changes in environmental condition, especially rainfall. After a period of no or low rainfall they can disappear or appear very degraded. They do, however, recover rapidly after periods of increased rainfall. As a result, under the Guidelines all mapped wetlands (based on 'Current Wetlands' layer in the DELWP NVIM Tool) that are to be impacted must be included as native vegetation, with the modelled condition score assigned to them (DELWP 2017a).

Note that mapped wetlands do not apply if they are covered by a hardened, man-made surface, for example, a roadway. If covered by any vegetation including crops, bare soil, a mapped wetland must be treated as a remnant patch.

2.3.2.2 Tree Assessment

The Guidelines recognises that Large Trees are important environmental assets and these can be found in habitat zones, or as relicts of vegetation that formerly occupied the site (scattered trees). Small trees (i.e. not Large trees) are also considered to be environmental assets. The following benchmark Diameter at Breast Height (DBH) measurements apply to Large and Small trees within the EVCs present within the site (Table 3).

Table 3. Large and Small Tree benchmark measurements for EVCs within the study area

Bioregion	Ecological Vegetation Class	Large Tree DBH (cm)	Small Tree DBH (cm)
Victorian Volcanic Plain	Basalt Shrubby Woodland (642)	≥ 70	< 70
Victorian Volcanic Plain	Herb-rich Foothill Forest	≥ 70	< 70
Victorian Volcanic Plain	Plains Grassy Woodland (55_61)	≥ 80	< 80
Victorian Volcanic Plain	*Higher-rainfall* Plains Grassy Woodland (55_63)	≥ 70	< 70

2.3.3 Offsets

Offsets are required to compensate for the permitted removal of native vegetation. Further details regarding offset obligations associated with this assessment are provided in Section 3.3.2.

2.4 Avifauna and Bat Assessments

2.4.1 Bird Utilisation Surveys

Bird utilisation surveys are the most commonly used method for generating quantitative data on bird use of a potential wind farm site. The methods employed for the proposed Willatook Wind Farm bird utilisation surveys were designed to comply with the guidelines described in *AusWEA – Wind Farms and Birds: Interim Standards for Risk Assessment* (2005). According to these guidelines, bird utilisation surveys are undertaken to ascertain:

- The species composition of birds that use the study area;
- The frequency with which each of those species use the study area;
- The height at which each of these species fly in the study area; and,
- The distribution of these species across the landscape.

Bird utilisation surveys are a minimum requirement for all wind farm sites and are used to inform the design of higher-level investigations, if required. The total number of point counts will be determined based on both the habitat conditions of the study site and the number of turbines proposed, in addition to any existing data that has already been collected (e.g. detailed significant species data).

2.4.1.1 AusWEA Wind Farms and Birds: Interim Standards for Risk Assessment

The Australian Wind Energy Association (AusWEA 2005) has developed interim standards for risk assessment of birds for wind farm developments in Australia. This document outlines the type of investigations required, the order in which they should be undertaken and a systematic approach for assessing risk of bird impact at wind farms. This process allows for more detailed studies should a potentially significant risk be identified during preliminary studies.

The AusWEA (2005) interim standards recommend three levels of investigations, with each level involving increasing levels of detail. These levels include:

- **Level 1** investigations provide an initial assessment of the risk of significant bird impacts from the operation of the proposed wind farm; Level One investigations involve a regional overview, review of existing data, an indicative bird utilisation survey and roaming surveys.

- **Level 2** investigations refine the risk assessment from the Level One investigation, using more intensive methods. Level Two investigations involve roaming surveys and risk modelling.

- **Level 3** investigations are initiated if the results of the Level Two investigations indicate a greater than low level of residual risk of significant bird impacts from the operation of the proposed wind farm. Level Three investigations involve population assessment and population viability analysis.

The interim standards also recommend consultation with the wind farm developer and key representatives of agencies that assess and approve development to:

- Agree on the issues, questions and objectives of bird impact risk assessment studies;

- Agree on the consequence and, where relevant, likelihood criteria that apply to the results of the studies; and,

- Where required, agree on the nature and effectiveness of mitigation measures.

2.4.1.2 Fixed Point Bird Counts

A zoologist, experienced in bird identification, undertook the fixed-point count surveys to the specifications outlined below. 10 × 42 binoculars were used to identify the bird to species, or for some species, generic level (e.g.: non-calling Raven species).

The following was undertaken as part of the fixed-point bird counts:

- Nine locations were established at which to undertake fixed point counts. The locations chosen were to ensure that the entire study area was sampled and that a range of habitat types represented in that sample (Figure 6);

- The search radius from the point was at least 100 metres for small birds and up to 800 metres for large birds (e.g. birds of prey, waterbirds), or further, if accurate identification to species level was achievable, using prominent landmarks;

- The duration of each fixed-point count was 20 minutes;

- The height at which each bird flew through the survey area was estimated to the nearest 10 metres;

- The direction of flight of each bird was recorded to the nearest 45 degrees of the compass;

- Each point was surveyed at different times of day (e.g. early morning, late morning, early afternoon and late afternoon) to account for diurnal differences in bird activity; and,

- Each point was surveyed eight times over the course of survey period (except for locations 7, 8 and 9 which were surveyed on seven occasions).

2.4.1.3 Incidental observations and roaming surveys

In addition to bird species recorded during the fixed-point count surveys, incidental observations of bird species were recorded while travelling between point counts and during other field based activities. Birds seen adjacent to the study area were also recorded. Where suitable habitat for wading birds (principally Chradriiformes) and other waterbirds (ducks and herons) was observed, this habitat was

surveyed for these species as per the "Significant Impact Guidelines for 36 Migratory Shorebird Species" (DEWHA 2009).

This approach was also taken to detect rare and threatened species and species with specialised habitat requirements. Parts of the study area that have potentially suitable habitat for these rare or threatened species were targeted to ensure that these species were not overlooked.

2.4.1.4 Statistical Analyses

Species accumulation curves were generated from the point count data and presented as graphs. This, along with a measure of completeness provides an overall account of the survey efficacy in predicting the species likely to occur within the study area.

Completeness follows the methods of Watson (2003) which is widely used in the manufacturing industry and ecology based projects (Watson 2003), and is calculated as the actual richness (*A*) divided by the predicted richness (*P*) expressed as a percentage. The predicted species richness was calculated using the Michaelis–Menten richness estimator (Mmeans) using 1000 runs and estimates of 68, which uses the ratio of species seen once (singletons) to the species seen more than once (doubletons) to predict species richness (Colwell 2001).

Observations of birds were classified, according to their height, into four categories: ground; below Rotor Swept Area (RSA) (RSA; 1–40 metres high); at RSA (41 – 220 metres high), and; above RSA (higher than 220 metres).

2.4.2 Brolga Surveys

The Interim Guidelines for the Assessment of Potential Windfarm Impacts on the Brolga (DSE 2012) establish a stepped approach to determining the use of a proposed wind farm site by Brolga to assess the likely impact of the development on this species. Level 1 Assessments are triggered by the presence of Brolgas or their habitat within the proposed area (DSE 2012). Level 2 Assessments are triggered by the use of the proposed site by Brolgas for nesting or flocking or an assessment that the development may create a barrier between such areas (DSE 2012). The final step is a Level 3 Assessment, which if triggered, should mitigation measures, based on the findings of the Level 2 Assessment, not satisfy the DELWP's goal of a "zero net impact" on Victorian Brolga populations (DSE 2012).

Level 1 assessments were undertaken in the form of roaming Brolga surveys and database searches. These surveys led to a recommendation for Level 2 assessments, which were in the form of the detailed aerial surveys. Level 3 assessments have not been undertaken to date.

2.4.2.1 Roaming Surveys

All roads within a 20 kilometre radius of the proposed wind farm site were driven and suitable habitat searched for Brolgas and other significant bird species. Where access on properties outside of the study area could not be arranged, waterbodies that could potentially support a Brolga nest (i.e. swamps, dams and watercourses) were surveyed for the birds using 10 × 42 binoculars and a Zeiss 85mm Diascope, with a 20–60mm eye piece. Where access could be arranged (both within the study area and beyond), all historical Brolga records were visited and the habitat of the site assessed for its suitability for Brolga habitat.

2.4.2.2 *Aerial Surveys*

Aerial surveys were undertaken to enable inaccessible areas to be surveyed and to provide a more thorough investigation of the entire site area particularly in parts of the study area where mobility was difficult. The following methodology was employed for the aerial surveys. This methodology has been developed in conjunction with Inka Veltheim who was leading a three-year PhD project on Brolgas under the supervision of Richard Hill as part of the Victorian Brolga Research project and has been used in previous aerial Brolga surveys:

- North/south transects were flown in a light aircraft over the entire wind farm site and to a distance of 20 kilometres from the study area (Figure 8);
- Two observers searched a distance of approximately 500 metres from the plane on either side of the plane;
- All wetlands that contain suitable habitat for Brolga were marked with a GPS, with an estimation of their distance and direction from the transect;
- Nests of Brolga or Black Swan *Cygnus atratus* were recorded and marked with GPS as per the above method; and finally,
- These GPS points were related to wetlands based on aerial photography of the study area and visited on the ground, where possible, to look for Brolga nests.

2.4.2.3 *Consultation with naturalists and landowners*

On request, DSE (now DELWP) provided contact details for appropriate local naturalists that may have local knowledge of Brolga. DELWP provided the contact details for Sue Mudford who represents Trust for Nature and the Friends of the Brolga. Land-holders with historical records of Brolgas on properties surrounding the proposed wind farm were contacted by telephone by Wind Prospect. The purpose of these calls was to seek further information about Brolga habitat within the area and to seek permission for a visit by Ecology Partners in July 2011. This field work included an assessment of habitat within these properties in relation to its potential to support Brolgas in the future.

A survey of landowners involved in the proposal was also undertaken and further information was sought from neighbours through newsletters and other communications by Wind Prospect.

2.4.3 Bat Utilisation Survey

Anabat bat detectors (Titley Electronics, Ballina NSW) are the standard equipment used to survey microbat species. These instruments record the high frequency echolocation calls produced by microbats when they are in flight, and save these calls directly to a memory card. Different bat species produce distinguishable calls; therefore, detectors can be used to identify the species present in a given area. However, there is considerable variation within and between species, and all call identification needs to be undertaken by qualified personnel who have access to reference calls for that region and experience in identifying call characteristics.

Depending on the bat species and how far it projects its call, Anabat detectors can typically detect bat echolocation calls at between five and 20 metres. It is important to note that although detectors may give an index of overall bat activity levels, they cannot be used to determine bat abundance, as the number of individuals emitting the calls is not known.

Seven Anabat bat detectors were placed in Summer 2009 in different parts of the landscape that were representative of the bat habitat across the entire study area (Figure 6), including one Anabat that was attached to an anemometer tower at a height of approximately 42 metres. Anabats were deployed at a total of 18 sites over the survey period in a range of habitats, including open paddocks, adjacent to farm dams, near areas of remnant native vegetation (e.g. along waterways) and planted wind rows etc. The Anabat recording commenced on 30 October 2009 and ceased on 22 November 2009 and approximately 128 Anabat survey nights were completed.

2.4.3.1 Targeted Significant Bat Surveys

Eight Anabat bat detectors were deployed throughout the wind farm area in October and November 2010, and seven detectors were deployed in February and March 2011 to ensure that recording took place during the migratory period of the Southern-Bent Wing Bat. During each survey period, one detector was mounted on the anemometer tower with the microphone placed at a height of approximately 42 metres. This was paired with a detector at the same location, which was placed at ground level. The remaining detectors were deployed at ground level in suitable locations throughout the landscape which were likely to represent areas of greatest bat activity. Locations were chosen which were close to windrows or remnant trees, dams, watercourses and ridge-tops. Open paddock areas were not often chosen as bat activity in these areas was likely to be very low. Survey point locations are marked on Figure 10 and habitat at each point is described in Table 8.

Anabat detectors were moved weekly during the October–November (Spring) sampling season across 20 different locations and weekly to fortnightly during the February-March (Autumn) sampling season across 16 different locations. Batteries were changed weekly and calls downloaded from cards at this time. A total of 268 bat detector nights (i.e. the total number of detectors by the total number of nights, excluding nights where detectors malfunctioned) were undertaken during the current surveys.

At each monitoring point brief descriptions of habitat features were recorded such as vegetation features, landscape position and proximity to water.

2.4.3.2 Call Analysis

Identification of bat calls collected throughout the Willatook Wind Farm site were analysed by Rob Gration from Ecological Consulting Services, a recognised expert in bat call analysis. All nights of data were assessed for the calls of Southern Bent-Wing Bat and Yellow-bellied Sheathtail Bat. To identify calls of Southern Bent-wing Bat the call expert ran a trial with a filter to isolate calls with a frequency of 45-55Khz. 55 khz is approximately 5khz higher than the normal range of Southern Bent-Wing Bat. The filter was then refined to 45–50khz and used to isolate calls in this range for each site on the various survey dates. All filtered calls were then visually analysed. All Southern Bent-wing calls with a 95% degree of identification confidence were placed in a separate folder and counted. If one of the call complex cohorts (Little Forest Bat *Vespadelus vulturnus* or Chocolate Wattled Bat *Chalinolobus morio*) was positively identified it was recorded as present once only. All other calls were then assigned as call complex and their numbers recorded. A filter was also run for calls in the frequency range of Yellow-bellied Sheathtail Bat. Calls of this species were recorded as presence only and not the total number of calls.

Consultation with experts (Rob Gration and Terry Reardon) about how to analyse such a large data set to determine presence and distribution of all microbat species revealed that to analyse all nights of data

for all sites would be prohibitively time consuming and difficult. Consequently, it was decided to sub-sample the data, with only files from the nights with the best weather conditions analysed for each site. Records from the Bureau of Meteorology were assessed to select nights with the best conditions (mild nights 13+ degrees Celsius with little to no wind).

This survey methodology was established following consultation with DSE.

2.5 Terrestrial Fauna Assessments

2.5.1 Targeted Frog Surveys

Targeted surveys were undertaken to assess the presence and distribution of one nationally significant frog species (Growling Grass Frog *Litoria raniformis*), and two state significant frog species (Southern Toadlet *Pseudophryne semimarmorata* and Brown Toadlet *Pseudophryne bibronii*).

Sites were assessed during the day to determine the suitability for the species, and if considered suitable surveys were undertaken for two nights at each location as per the Biodiversity Precinct Planning Kit (DSE 2010a). However, if the target frog species was detected at a site (i.e. waterway, drainage line or farm dam) on the first night of survey, then subsequent targeted surveys at the sites were not warranted as the presence of the species has already been established (i.e. not undertaken). The following was undertaken as part of the targeted surveys:

- Nocturnal surveys were conducted on still nights when air temperatures were above 13°C, preferably within 24 hours of rain;
- Where possible, survey intensity/area at each wetland was the same during each visit;
- An initial period of five minutes was spent recording any calling frogs (all species) in and adjacent to wetlands;
- Surveyors then searched ground-level habitat including surface rocks, underneath hard litter, and at the base of vegetation for frogs;
- Surveyors used 30–50 watt 12 volt hand-held spotlights to locate calling males on floating vegetation in the waterbody and around the perimeter of wetlands. This technique is known to be reliable as the eyes of frogs will often reflect light back allowing them to be located.

Field surveys targeted areas that were identified as containing potential habitat for these species (e.g. farm dams, off-stream waterbodies, soaks and tributaries), together with sites where the target frog species had previously been recorded (DELWP 2018d; Figure 7). Surveys were also undertaken opportunistically at locations identified as containing potential habitat while driving between sites throughout the study area. Both diurnal and nocturnal surveys were carried out at selected locations, and survey techniques primarily involved spotlighting, listening for frog calls and active searching. A total of four sites across the study area were surveyed nocturnally, the locations of which are shown in Figure 6.

2.5.2 Swamp Skink

2.5.2.1 Trapping

The objective of the Swamp Skink *Lissolepis coventryi* surveys was to establish whether this species is present within the study area, and if so, to identify the distribution of the species throughout the study area.

Forty Elliott traps (A type) were deployed in two locations at opposite sides of the study area along a tributary of the Moyne River in the east and the along the Shaw River in the west where the target species were considered most likely to be detected (Figure 6). Traps were placed approximately five metres apart underneath suitable vegetation and adjacent to potential shelter sites (e.g. logs). Traps were baited with dough made from sardines and flour. The traps were checked twice every day at dawn and dusk and left in place for four days.

Elliott trapping and nocturnal surveys were conducted under the Ecology and Heritage Partner's research permit (#10004010) issued by DELWP under the *Wildlife Act 1975*.

2.5.2.2 Active Searching

Active searching was undertaken in potentially suitable microhabitats to detect Swamp Skinks within the study area. For example, field personnel routinely checked underneath ground cover and debris such as coarse woody debris, tin, etc., to locate and identify the species. In addition, binocular surveys (i.e. standing still and scanning suitable riparian habitats) were undertaken at a distance to detect basking individuals, although this was only undertaken at the two trapping sites as these areas provided the only potential habitat within the study area.

2.5.2.3 Fat-tailed Dunnart

During all field work, personnel routinely checked underneath ground cover and debris such as coarse woody debris, surface rocks and tin, etc., to locate Fat-tailed Dunnart *Sminthopsis crassicaudata*, and/or to identify other evidence such as their diagnostic scats and sits (nests) to confirm the presence of the species. Tile grids that were deployed primarily to survey for Striped Legless Lizard *Delma impar* (see below) were also checked for the presence of Fat-tailed Dunnart (i.e. the species is known to use roof tiles for refuge at other sites west of Melbourne (S. Cooney pers. obs.).

2.5.2.4 Striped Legless Lizard

Roof tile grids were established for reptiles that are known to use the tiles for both artificial cover and thermoregulation. This survey method is effective and non-destructive to habitats, and is an accepted method by DELWP to survey herpetofauna. Three tile grids, each consisting of 50 tiles, were laid in areas of suitable habitat that were suitable for ground dwelling reptiles (Figure 6). The tile grids were located in the western section of the study area, where rocky rises and stony knolls covered with modified native grassland and scrubland are prevalent. Tile grids were assembled in a 10 x 5 metres orientation, with five metres separating each tile from the next. Tiles in each grid were checked on several occasions over four months (i.e. throughout the study period), usually before 9.00am and preferably on days of cool or mild weather conditions when reptiles were most likely using them.

2.6 Aquatic Fauna Assessments

The objective of the targeted aquatic surveys was to establish whether significant fish species were present within the study area and to sample the study area to inform the determination of likely impacts on significant fish species as caused by the wind farm development.

Fish were surveyed using several techniques and equipment, including fyke nets, dip netting, and collapsible bait traps. Electrofishing was not used as fish survey method due to the high salinity at all survey sites. The techniques used at each site depended on the depth, habitat type and water quality conditions present. All fish (excluding exotic pest species) were returned to the water shortly after identification. Surveys were conducted under Department of Primary Industry (DPI) Fisheries permit number RP958 and DELWP permit number 10003271, issued with provisions under the *Flora and Fauna Guarantee Act 1988* (FFG Act).

Ten bait traps with light sticks were set at three sites in microhabitats suitable for small-bodied fish, and traps were set at dusk for two consecutively nights (Figure 6). Dip netting was conducted at multiple sites and involved sweeping a net through microhabitats that were suitable for small-bodied fish species. Two fyke nets were set at dusk at a total of two riverine sites for two consecutive nights. The cod end of the fyke net was elevated to provide an air pocket so that any trapped mammals or birds could breathe.

Due to the lack of historical Crayfish records within the area of the proposed wind farm, no targeted surveys for these species were undertaken.

2.7 Assessment Qualifications and Limitations

2.7.1 2017 Field Assessments

Data and information held within the ecological databases and mapping programs reviewed in the desktop assessment (e.g. VBA, PMST, Nature Kit Maps etc.) are unlikely to represent all flora and fauna observations within, and surrounding, the study area. It is therefore important to acknowledge that a lack of documented records does not necessarily indicate that a species or community is absent.

Ecological values identified on site are recorded using a hand-held GPS or tablet with an accuracy of +/- 5 metres. This level of accuracy is considered adequate to provide an accurate assessment of the ecological values present within the study area; however, this data should not be used for detailed surveying purposes.

Only the areas identified as 'Current Survey Area' as shown in Figure 2 were assessed as part of the 2017 field assessments.

The field assessment was undertaken during a sub-optimal season for the identification of flora and fauna species (winter). The 'snap shot' nature of a standard biodiversity assessment, along with sub-optimal timing of the survey, meant that migratory, transitory or uncommon fauna species may have been absent from typically occupied habitats at the time of the field assessment. In addition, annual or cryptic flora species such as those that persist via underground tubers may also be absent. Targeted flora or fauna surveys were not undertaken during the 2017 field assessments, as this was beyond the preliminary scope of the project. As such, the results pertaining the presence/absence of these species relies heavily on the results of the surveys previously undertaken between 2009 and 2012.

Nevertheless, the terrestrial flora and fauna data collected during the field assessment and information obtained from relevant desktop sources is considered adequate to provide an accurate assessment of the ecological values present within the study area.

2.7.2 Bird Utilisation Surveys

Although the surveys were undertaken during an optimal time of year (late spring/early summer) and during suitable weather conditions, it is possible that vagrant and rare species were overlooked due to the limited nature of the surveys. The calculation of completeness provides an indication that a high proportion of the species variation was detected. Weather during the study varied from hot and humid, to cold and windy.

The fixed-point bird counts may have suffered from some biases because of the use of estimation in determining the distance of birds from the observer. Horizontal distances became increasingly difficult to judge as the distance between the observer and the bird increased.

Vertical distances were also difficult to judge, depending on structures and other landmarks that could be used as a reference. However, the higher the bird the greater the likelihood of error. In addition, this difficulty was not consistent across species, with small and large species biasing the results in unknown directions.

To attempt to overcome these potential errors, and to calibrate the estimations of the observers, at each point count 200 metres was measured to use as a reference for the estimations that followed. To calibrate height, a land mark of known height (such as wind anemometer tower, power-line poles etc.) was used as a reference point. Whilst these precautions alleviated some of the bias in this process, the height and distance data need to be interpreted in a cautious manner, given the probability of a high degree of error in the data-set.

A further bias in the data-set is the over-representation of large birds. As the distance between the observer and the bird increases, smaller species are increasingly likely to be overlooked. This effect is also likely to be exacerbated by weather conditions with overcast, windy or wet conditions having a negative impact on the detectability of some birds.

2.7.3 Brolga Surveys

The surveys for Brolga undertaken represent an assessment of the abundance of Brolgas and Brolga habitat over a brief period. As conditions change over seasons and years the results of a similar survey as the one undertaken here are likely to change. Ecology and Heritage Partners has attempted to overcome this limitation by using many approaches to reach conclusions regarding the importance of the study area for Brolgas. This multifaceted approach, including desktop, field based and aerial surveys is likely to give an accurate impression of the use of the study area in the short term.

Furthermore, seasonal differences in rainfall and evaporation are likely to result in small changes in the timing of breeding by Brolgas and other birds, which makes the timing of surveys difficult to judge. For instance, the study area held more water in 2010, for a longer period than it held in 2009 (S. Cooney *pers. obs*.). Despite this, young are attached to nests and the nest surrounds well beyond the 31 days of incubation, therefore, despite the 2009 surveys being undertaken late in the traditional Brolga breeding season (November) it is unlikely that nests were missed in 2009. Subsequent surveys in 2010

and 2011 (a wet year of almost unprecedented degree (D. Gleeson *Pers. Comm*. 6 July 2011) have also improved the data set and combines to form the basis of our recommendations.

2.7.4 Bat Utilisation Survey

The weather conditions during the Spring 2010 survey period were extremely wet, with numerous rainfall events. On a number of occasions water got into the protective containers in which the Anabat detectors were placed and caused the detectors to switch off and/or malfunction. During this survey period some brands of compact flash cards malfunctioned (cards which the calls are saved) and the short life of some batteries was also a limitation. Access to locations within the wind farm area was limited by landholder permission to allow access and the wet conditions which prohibited driving into the centre of many properties.

The placement of detectors directly on the ground created some complications for analysis as the location of Anabats might also have resulted in fewer calls than if the detectors were mounted closer to the height at which the bats fly. Weller and Zabel (2002) found detectors placed at a height of 1.4 metres recorded 30% more calls than those placed on the ground. However, placement of detectors at ground-level is common practice, and there are limited options for raising detectors closer to the height of bat flight for long-term remote surveys.

The compact flash cards of detectors placed on the anemometer towers were frequently observed to be entirely filled with noise files. This is likely to have resulted from the constant sound of wind rushing past the guy wires and tower itself. There is no apparent solution for this, which is a limitation in placing detectors on anemometer towers.

Despite the above limitations it is considered that the methodologies applied during the current surveys, and the duration and intensity of the surveys were sufficient to provide an accurate assessment of the microbat species utilising the wind farm area, including Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat.

2.7.5 Targeted Surveys

All the surveys undertaken for the proposed wind farm were undertaken over a short period of time, albeit at time designed to maximise the likelihood of detecting target species. Changes to the quality and quantity of habitat for any of the target species are likely to occur over time and this would have an impact on the results of the survey. For some species, such as the aquatic surveys, the surveys should be considered samples, not exhaustive censuses of the populations within the study area. In these cases, general mitigation measures will be recommended based on the sample to apply to the entire population.

Despite the above limitations it is considered that the methodologies applied during the current surveys, and the duration and intensity of the flora and fauna surveys were sufficient to provide further information relating to the species within the study area and immediate surrounds.

Data from the surveys have been used to determine the type and likely level of potential impacts to significant species associated with the proposed wind farm development. In addition, survey methods, and survey seasonality and overall effort within the study area are considered sufficient to satisfy the objectives outlined above.

3 RESULTS

3.1 Vegetation Condition

3.1.1 Remnant Patches

Remnant native vegetation in the study area is representative of seven EVCs: Aquatic Herbland (EVC 653), Basalt Shrubby Woodland (EVC 642), *Heavier-soils* Plains Grassland (EVC 132_61), Plains Grassy Wetland (EVC 125), *Higher-rainfall* Plains Grassy Woodland (EVC 55_63), Stony Knoll Shrubland (EVC 649), and Tall Marsh (EVC 821).

A total of 562.285 hectares of native vegetation is present (Table 4). Excluding the 'Current Wetland' layer, a total of 130.409 hectares of native vegetation is present (Table 4).

The presence of these EVCs is generally consistent with the modelled pre-1750s and extant (2005) native vegetation modelling (DELWP 2018b). The remainder of the study area comprises introduced and planted vegetation, present as crop, pasture and windrows. Specific details relating to observed EVCs are provided below.

Table 4. Extent of EVCs mapped within the study area

EVC	Mapped native vegetation outside of the Current Wetland (hectares
Aquatic Herbland	0.039
Basalt Shrubby Woodland	0.675
Plains Grassland	2.993
Plains Grassy Wetland	73.692
Plains Grassy Woodland	8.479
Stony Knoll Shrubland	43.867
Tall Marsh	0.664
Current Wetlands*	431.875
Total	**562.285**

Note. * Current Wetlands area as modelled by DELWP. These areas may or may not contain patches of native vegetation as assessed by Ecology and Heritage Partners, but are treated as patches of native vegetation regardless.

Aquatic Herbland

Aquatic Herbland was recorded in one waterbody within the study area (Figure 3a), with this EVC being dominated by Tall Spike-sedge *Eleocharis sphacelata* with scattered occurrences of Pacific Azolla *Azolla filiculoides* and Duckweed *Lemna disperma* (Plate 1; Plate 2).

A high cover of the non-indigenous (but Victorian native) Water Couch *Paspalum distichum* was also present around the periphery of the patch.

Plate 1. Aquatic Herbland within the study area (Ecology and Heritage Partners Pty Ltd 27/06/2017).

Plate 2. Aquatic Herbland within the study area (Ecology and Heritage Partners Pty Ltd 27/06/2017).

Basalt Shrubby Woodland

Basalt Shrubby Woodland was largely confined to the road reserves within the study area (Figure 3), present as open woodland to eight metres dominated by Swamp Gum *Eucalyptus ovata*, Black Wattle *Acacia mearnsii* and Drooping She-oak *Allocasuarina verticillata*. The understorey comprises shrubs such as Blackwood *Acacia melanoxylon*, Prickly Tea-tree *Leptospermum continentale*, and Prickly Moses *Acacia verticillata*.

The ground layer was comprised of numerous native grass species, including Common Wallaby Grass *Rytidosperma caespitosa*, Kangaroo Grass *Themeda triandra*, Slender Tussock Grass *Poa tenera*, sedges such as Tall Sword-sedge *Lepidosperma elatius*, and Wattle Mat-rush. Austral Bracken *Pteridium esculentum* and Small Grass-tree *Xanthorrhoea minor subsp. lutea* were also generally present. However, the understorey throughout these areas was typically dominated by exotic grasses such as Yorkshire Fog-grass, Sweet Vernal-grass, Toowoomba Canary Grass and Perennial Ryegrass.

Plate 3. Basalt Shrubby Woodland within the study area (Ecology and Heritage Partners Pty Ltd 27/06/2017).

Plate 4. Basalt Shrubby Woodland within the study area (Ecology and Heritage Partners Pty Ltd 27/06/2017).

***Heavier-soils* Plains Grassland**

Plains Grassland was present within the study area as a derived grassland community from Basalt Shrubby Woodland and Plains Grassy Woodland (Figure 3). It should be noted that this community does not meet the criteria for the EPBC Act listed Natural Temperate Grassland of the Victorian Volcanic Plain (SEWPAC 2011), or the FFG Act listed Western (Basalt) Plains Grasslands Community.

Plains Grassland was dominated by perennial grasses, including Kangaroo Grass, Common Wallaby Grass, Common Wheat-grass and Rough Spear-grass *Austrostipa scabra*; along with native lilies and herbs such as Yellow Rush-lily, Sheep's Burr, Scaly Buttons *Leptorhynchos squamatus*, and Pink Bindweed *Convolvulus erubescens*. Weed species present in this area included Toowoomba Canary Grass *Phalaris aquatica*, Bearded Oat *Avena barbata*, Onion Grass *Romulea rosea* and Perennial Ryegrass *Lolium perenne*.

Plate 5. Plains Grassland within the study area (Ecology and Heritage Partners Pty Ltd 26/06/2017).

Plate 6. Plains Grassland within the study area (Ecology and Heritage Partners Pty Ltd 26/06/2017).

Plains Grassy Wetland

Plains Grassy Wetland was present throughout the study area, occupying low lying areas between stony knolls and on the flats (Figure 3).

Plains Grassy Wetland was typically dominated by Common Tussock Grass *Poa labillardierei*, with Rushes *Juncus* spp., Brown-back Wallaby-grass *Austrodanthonia duttoniana*, Variable Willow-herb *Epilobium billardierianum*, and Common Spike-sedge *Eleocharis acuta* also present. Numerous weed species were present including Yorkshire Fog-grass, Sweet Vernal-grass, Toowoomba Canary Grass, Onion Grass and Flatweed.

Much of the Plains Grassy Wetland was highly simplified as a result of grazing, and typically comprised a modified cover of Common Tussock Grass.

Plate 7. Plains Grassy Wetland within the study area (Ecology and Heritage Partners Pty Ltd 28/06/2017).

Plate 8. Plains Grassy Wetland within the study area (Ecology and Heritage Partners Pty Ltd 28/06/2017).

***Heavier-rainfall* Plains Grassy Woodland**

Heavier-rainfall Plains Grassy Woodland (EVC 55_63) was identified within the road reserves, and in the west of the study area. This variant of Plains Grassy Woodland occupies areas receiving greater than 700 mm annual rainfall (DSE 2004).

Plains Grassy Woodland within the road reserve was mainly present as Acacia or Sheoak dominated woodland to eight metres tall. The understorey was generally highly modified and dominated by exotic grass species such as Toowoomba Canary Grass, Cocksfoot, Sweet Vernal-grass and Yorkshire Fog-grass. The overstory was typically comprised a modified layer of mature and emergent Blackwood and Black Wattle. In the west of the study area (Figure 3), Plains Grassy Woodland was mainly present as patches of Manna Gum and River Red Gum over a predominately exotic understorey.

This vegetation did not meet the condition thresholds to qualify as Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Threatened Species Scientific Committee 2008).

Stony Knoll Shrubland

Stony Knoll Shrubland was present throughout the study area (Figure 3) with numerous rocky outcrops present. The majority of rocky outcrops throughout the study area are highly modified and have been subjected to extensive disturbance from agricultural activities (i.e. grazing, fertilizing), which has resulted in an extremely modified cover of opportunistic and primary colonising species such as Bristly Wallaby-grass *Rytidosperma setacea* and Austral Bracken, and is not representative of the pre-1750 Stony Knoll Shrubland EVC.

The vegetation cover typically included several indigenous grasses including Rough Spear-grass, Kangaroo Grass, Bristly Wallaby Grass, Weeping Grass, Grey Tussock Grass *Poa sieberiana* and Kidney Weed *Dichondra repens*. Several patches also included a modified cover of Sweet Bursaria *Bursaria spinosa* and Tree Violet *Melicytus dentatus*, with Austral Bracken also generally present. Several weed species were commonly observed, including Yorkshire Fog, Sweet Vernal-grass, Toowoomba Canary Grass, Perennial Ryegrass, Flatweed, Variegated Thistle *Silybum marianum*, Spear Thistle *Cirsium vulgare* and Cape Weed.

It should be noted that areas of Stony Knoll Shrubland recorded within the study area do not meet the condition thresholds to qualify as Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Threatened Species Scientific Committee 2008).

Plate 9. Plains Grassy Woodland within the study area (Ecology and Heritage Partners Pty Ltd 28/06/2017).

Plate 10. Plains Grassy Woodland within the study area (Ecology and Heritage Partners Pty Ltd 11/07/2017).

Plate 11. Stony Knoll Shrubland within the study area (Ecology and Heritage Partners Pty Ltd 12/07/2017).

Plate 12. Stony Knoll Shrubland within the study area (Ecology and Heritage Partners Pty Ltd 28/06/2017).

Tall Marsh

Within the study area, remnants of Tall Marsh were found within Back Creek, which enters the study area from the north (Figure 3b). Tall Marsh was dominated by Common Reed *Phragmites australis*, with scattered occurrences of Broad-leaf Cumbungi *Typha orientalis* also observed in the waterway (Plate 13). Vegetative cover was dense, with no other native, or non-native species observed within the patch.

Plate 13. Tall Marsh within the study area (Ecology and Heritage Partners Pty Ltd 28/06/2017).

3.1.2 Scattered Trees

Ninety-nine (99) scattered trees (52 Manna Gums, 15 River Red Gums, 1 Bog Gum and 31 Dead Stags) occur throughout the study area with the majority recorded in the western half of the study area (Plate 14; Plate 15) (Appendix 2.4). These trees would once have been part of the Plains Grassy Woodland EVC, however the understorey vegetation consists of predominantly introduced species (mainly exotic pasture grasses) and the trees no longer form a patch of native vegetation.

Plate 14. Scattered trees within the study area (Ecology and Heritage Partners Pty Ltd 13/07/2017).

Plate 15. Scattered trees within the study area (Ecology and Heritage Partners Pty Ltd 13/07/2017).

3.1.3 Introduced and Planted Vegetation

Areas not supporting remnant native vegetation have a high cover (>90%) of exotic grass species, many of which have been direct-seeded for use as pasture. Scattered native grasses are generally present in these areas, however they did not have the required 25% cover to be considered a remnant patch (Plate 16; Plate 17). Removal of embedded rock has also been undertaken to facilitate the direct seeding of pasture grasses.

Vegetation within the majority of private properties throughout the study area consisted of predominantly introduced vegetation. This included areas of improved and unimproved pasture dominated by common pasture weeds such as Onion Grass, Cape Weed, Burr Medic *Medicago polymorpha*, Squirrel-tail Fescue *Vulpia bromoides*, Silvery Hair-grass *Aira caryophyllea*, and Cocksfoot *Dactylis glomerata*. These areas often comprised a higher cover/abundance of noxious weeds such as Spear Thistle, Slender Thistle *Carduus pycnocephalus* and Perennial Thistle *Cirsium arvense*.

The majority of properties contained planted windrows of native and exotic trees. Planted native species not 'indigenous' to the local area were considered to be of low ecological significance.

Plate 16. Introduced grassland within the study area (Ecology and Heritage Partners Pty Ltd 14/07/2017).

Plate 17. Planted vegetation within the study area (Ecology and Heritage Partners Pty Ltd 13/07/2017).

3.2 Fauna Survey

3.2.1 Summary of surveys

One hundred and three terrestrial and avian fauna species were observed during the 2011 field surveys (Appendix 3.1). This consisted of 19 mammals (including 11 species of bat identified to species level), 76 birds, three reptiles and five frogs. Five of the observations of mammals and five birds were of species introduced to the study area. Observations during this survey added an additional 10 native avian species, 10 mammals (all of which are bats), and one frog species not previously documented in the local area.

Much of the study area was relatively dry during the initial survey period in 2009, despite waterbodies in adjacent properties holding water, although the conditions were much wetter during later targeted surveys in 2010 and 2011. However, some sections of the study area did support some waterbirds throughout all survey periods, including the state significant Royal Spoonbill *Platalea regia* which was seen in these areas on several occasions.

3.2.2 Fixed Point Bird Counts

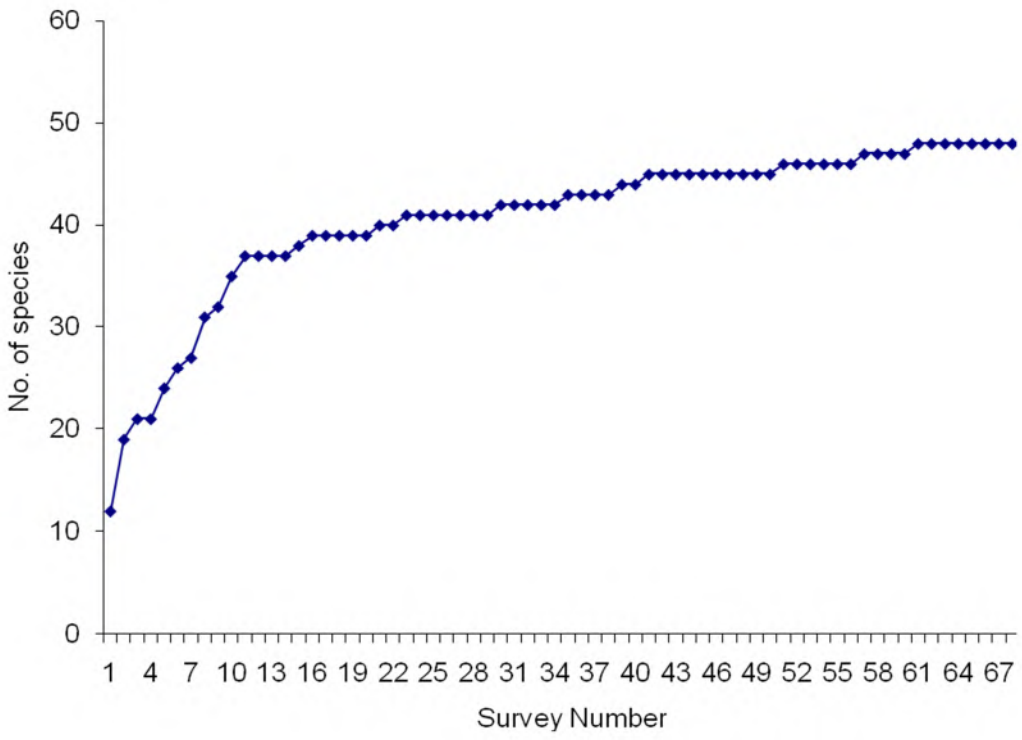
Forty-nine (49) species of birds were recorded, consisting of 2087 individual animals, during the 69 fixed point bird counts undertaken during the spring surveys (Table 5). One other species was identified to generic level (i.e. Raven species, either Little Raven *Corvus mellori* or Australian Raven *C. coronoides*).

The predicted species richness estimate for the point count surveys was 50 species (fewer than for the entire study area because of the differences in habitat surveyed and method of surveying i.e. active searching vs. stationary surveys), which converts to a completeness of 94% and means that approximately three unknown species were present in the study area during the study period, but not recorded during this survey. This high level of completion is reinforced by the species accumulation curve (Graph 1), which indicates that novel bird species were being added at a very slow rate once 35 surveys had been completed and most birds in the survey area had been detected.

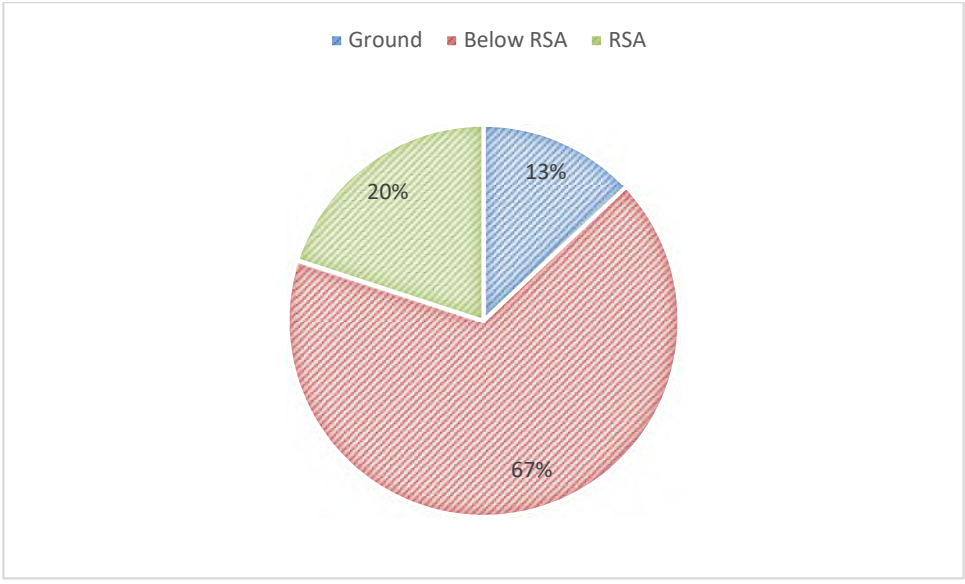
Five species of bird comprised 59.6% of all sightings during the survey period (Raven 29.0%; Australian Magpie *Gymnorhina tibicen* 12.1%; European Goldfinch *Carduelis carduelis*; 6.8%; Australian Pipit *Anthus novaeseelandiae* 5.6%; and European Skylark *Alauda arvensis* 5.1%). All of these species are common birds of agricultural environments in southern Victoria.

80% of bird observations made during the point counts were of birds that were either on the ground or flying below the RSA (Graph 2). A further 0.1% of observations were of birds flying above the RSA. The majority of birds seen in the RSA were flying directly through the survey area, although some raptor species (e.g. Nankeen Kestrel *Falco cenchroides* and Wedge-tailed Eagles *Aquila audax*) were seen circling over the study area, and others (Brown Falcon *Falco berigora*) were seen hovering during the point counts within the RSA. The species most commonly recorded within RSA was Raven spp. with 52.1% (213 individuals) of observations of this species within the RSA. While no other species is close to this in numbers, the Yellow-tailed Black Cockatoo was only recorded on nine occasions for a total of 26 birds, yet 88.5% of these birds were observed within the RSA as they moved across the landscape. All species observed within RSA are common birds of agricultural environments (i.e. modified habitats) in southern Victoria (Table 5).

No significant species were observed during the fixed point count surveys.



Graph 1. Species accumulation curve for spring fixed point count surveys of birds using the study area November–December 2009.



Graph 2. Percentage of birds recorded below, at or above rotor swept area (RSA) height (41-220 metres), Willatook Wind Farm, November–December 2009.

Table 5. Number of instances of bird species recorded in Point Count Surveys classified according the height at which they were detected.

Species	Ground	Below RSA	At RSA	Above RSA	Heard Only	Total
Australasian Pipit	11	20	6	0	28	55
Australian Magpie	37	61	8	0	12	118
Australian Raven	6	9	7	0	5	27
Australian Shelduck	0	2	1	0	0	3
Australian White Ibis	1	8	5	0	0	16
Australian Wood Duck	1	0	0	0	0	1
Banded Lapwing	0	0	1	0	0	1
Black-tailed Native-hen	1	0	0	0	0	1
Brown Falcon	0	8	5	0	0	13
Brown Goshawk	0	2	0	0	0	2
Brown Songlark	0	9	0	0	6	15
Brown Thornbill	0	3	0	0	1	4
Clamorous Reed Warbler	0	2	0	0	4	6
Common Starling	1	25	7	0	3	36
Crimson Rosella	0	1	0	0	0	1
European Goldfinch	1	49	11	0	1	66
European Skylark	0	5	0	0	45	50
Fairy Martin	0	2	0	0	1	3
Galah	0	2	2	0	0	4
Golden-headed Cisticola	0	6	3	0	2	11
Grey Shrike Thrush	0	0	0	0	3	3
Horsfield's Bronze-Cuckoo	0	1	0	0	1	2
House Sparrow	0	1	0	0	1	2
Laughing Kookaburra	0	0	0	0	2	2
Little Raven	10	41	18	0	2	71
Long-billed Corella	3	5	5	0	2	15
Magpie-lark	0	6	0	0	10	16
Masked Lapwing	2	0	0	0	0	2
Nankeen Kestrel	0	4	4	0	0	8
New Holland Honeyeater	0	1	0	0	0	1
Pacific Black Duck	0	3	1	0	0	4
Raven Spp.	11	82	100	0	1	194
Red Wattlebird	0	4	1	0	3	8
Red-rumped Parrot	0	1	0	0	0	1

Species	Ground	Below RSA	At RSA	Above RSA	Heard Only	Total
Rufous Songlark	0	1	0	0	2	3
Straw-necked Ibis	4	11	17	1	0	33
Stubble Quail	0	1	0	0	22	23
Sulphur-crested Cockatoo	0	1	0	0	0	1
Superb Fairy-wren	1	24	0	0	17	42
Wedge-tailed Eagle	0	2	7	0	0	9
Welcome Swallow	0	17	4	0	0	21
White-browed Scrubwren	0	1	0	0	0	1
White-faced Heron	0	12	4	0	0	16
White-fronted Chat	0	18	2	0	0	20
White-necked Heron	0	2	2	0	0	8
Willie Wagtail	0	9	0	0	6	15
Yellow-faced Honeyeater	0	3	0	0	1	4
Yellow-rumped Thornbill	2	5	0	0	4	11
Yellow-tailed Black Cockatoo	0	2	7	0	0	9
Total number of records	**92**	**472**	**228**	**1**	**185**	**978**

Note: this is not the number of birds seen, only the number of times one or more individuals were seen.

3.2.3 Brolga Surveys

3.2.3.1 Roaming surveys

The desktop review of historical records showed three records of Brolga from within the study area and a further three records within 2 kilometres of the study area (Figure 5; Figure 6). Four of these records are breeding records (two within and the two outside the study area), the other two records are non-breeding records and will not have an impact on the development. The two breeding records outside the study area have not been visited, however the two records within the study area fall within the same low-lying area as Cockatoo Swamp. This would not have provided suitable habitat in 2009, however, the wetter year in 2010 resulted in more suitable habitat (Appendix 4) and a Brolga nest was located near these records (see following section). On this basis, it is likely that the historical nests are located in an area that may support Brolga nests in the future.

The South-west Victoria Flocking Site Database shows the nearest flocking site, that meets the DELWP criteria for a flocking site (sites where five or more Brolga have been observed during the flocking season (January–May)) approximately 32 km north-east of the development boundary. This site is well beyond the impact of the current development and is not considered further.

3.2.3.2 Aerial surveys and ground-truthing

Twenty nests were identified from the aerial surveys (Figure 8). Of these nests, sixteen were confirmed as belonging to Black Swans, two nests, outside the study area, were unable to be accessed to confirm

the species that built them and one nest was confirmed as a Brolga nest in Cockatoo Swamp. The final nest, observed from the aerial surveys, is in the same location as an historical Brolga nest record from 1984 (Figure 8). When this site was visited in July 2011, no nests were observed, however suitable habitat for both swans and Brolgas remains. This potential Brolga nest site is approximately 6 kilometres from the nearest proposed turbine location.

The July 2011 field trip confirmed that two historical nest-sites are unlikely to provide suitable habitat for Brolgas in the future. The location of a nest from 1984, north of Woolsthorpe-Heywood Road, on the Allendale Property is in a shallow, drained depression, which is currently being grazed and supports only shallow water, pasture grasses and cows. A drainage line runs through the depression. The other nest, also from 1984, is on the Dyson property, north of School Road. It is not clear whether this historical record was associated with a wetland, however the current location holds no water and is elevated. Conversations with the land-holder confused the situation, with the owner, Gavin Dyson (*pers. comm*. 6 July 2011), assuming that we wanted to look at the north-east of his property, rather than the north-west, where the record is located. The north-east was wetter than the north-west although this wetland has recently been surrounded by plantation timber.

3.2.3.3 Landholder surveys

Sue Mudford, from Trust for Nature has also provided some information relating to nest sites near the proposed wind farm. There are five nest sites known from Pallisters Reserve, to the south-west of the wind farm, however all of these sites are more than 3 kilometres from the nearest turbine location (Figure 8).

3.2.4 Bat Utilisation

3.2.4.1 Southern Bent-wing Bat Miniopterus schreibersii bassanii

Southern Bent-wing Bat also known as Common Bent-wing Bat (southern subspecies) was identified as a distinct sub-species of the *Miniopterus schreibersii* complex by molecular and morphological analysis. The sub-species also has an echolocation call signature which is distinct from the other sub-species in the complex (Conole 2000).

Southern Bent-wing Bat is listed as Critically Endangered under the EPBC Act, Threatened within Victoria under the FFG Act and Endangered under the DELWP *Advisory List of Threatened Vertebrate Fauna in Victoria* (DEPI 2013). Overall, the sub-species is of national conservation significance. The Threatened Species Scientific Committee has identified that there is a high priority for the development of a Recovery Plan for the sub-species (Threatened Species Scientific Committee 2008).

Southern Bent-wing Bat is a cave-dwelling microchiropteran bat, with dark reddish-brown to dark brown back fur and slightly lighter belly fur. Areas of bare skin are pale brown. The sub-species has a short muzzle, domed head and broad, rounded and roughly triangular ears with a short rounded tragus. The wing has a bent appearance, resulting from the terminal phalanx of the third finger being 3-4 times as long as the middle phalanx (Churchill 1998, Menkhorst and Knight 2011).

The sub-species is distributed from western Victoria to south-eastern South Australia, with over 50 over-wintering (non-breeding) caves known throughout this distribution. Female bats migrate annually to one of two maternity caves, one near Warrnambool Victoria (Figure 9) and the other near Naracoorte

South Australia (DEWHA 2010). Little is known about the migration routes for the sub-species, however the main migration times are in October, when bats fly to the maternity cave and in February, when they return to non-breeding sites (Lumsden 2007).

Southern Bent-Wing Bat is distributed around wetlands and river basins (DEWHA 2010) with foraging areas comprising a range of habitat types including forested areas, volcanic plains, wetlands and coastal vegetation. Habitat preference is associated with the proximity of foraging habitat to suitable roosting caves, though the species occasionally roosts during the non-breeding season in human-made structures (Duncan *et al.* 1999).

The sub-species has undergone a severe population decline, as revealed by surveys of the population sizes at maternity caves. Population estimates suggest that the main maternity colony at Naracoorte underwent a reduction in the population size of approximately 67% within three generations (DEWHA 2010). Preliminary results of a study using an automated counting system based on thermal imaging technology indicate that some previous counts may have been underestimates but should not be interpreted as population growth (Lear *et a*l. 2012). Since breeding habitat for the sub-species is restricted to two maternity caves the geographic range of the sub-species is very restricted (DEWHA 2010).

3.2.4.2 Yellow-bellied Sheathtail Bat Saccolaimus flaviventris

Yellow-bellied Sheathtail Bat is a wide-ranging species, occurring over much of Australia. It is rarely collected during trapping surveys, which is likely to reflect the high heights and speeds at which it flies (Richards 1995). Consequently, little research has been undertaken on the species' ecology.

Yellow-bellied Sheathtail Bat is listed as Threatened within Victoria under the FFG Act. The species is of state conservation significance.

Yellow-bellied Sheathtail Bat is a tree-hollow roosting microchiropteran bat. It is a large species with glossy black fur on the back and contrasting white to yellow fur on the belly. The species has a flattened head and sharply pointed muzzle. Males have a large throat pouch (Richards 1995, Churchill 1998).

The species occurs in a wide variety of habitat types including wet and dry sclerophyll forest, woodland, shrubland, grassland, mallee and desert (Churchill 1998). The species has rapid flight with low manoeuvrability and has been observed to fly relatively high, foraging above the canopy (Rhodes and Hall 1997). Although it has been suggested that the species is migratory within the south-east portion of its range, this is based on reports of exhausted individuals which may have been diseased rather than exhausted from migration (Richards 1995). The species has previously been reported as occurring within southern Australian only between January and June. However, individuals have been recorded by Anabat surveys from western Victoria during October and November (Ecology and Heritage Partners Pty Ltd 2012).

Individuals roost in tree hollows, including the abandoned nests of Sugar Gliders *Petaursus breviceps* (Richards 1995), and are believed to be solitary for most of the year, occasionally forming small colonies (Rhodes and Hall 1997). They may be territorial and displays of chasing and vocalisation have been observed for the species (Rhodes and Hall 1997, Churchill 1998). Single young are born between December and mid-March (Churchill 1998).

Numbers of the species are believed to be decreasing. Possible threats to the species include Australian Bat Lyssavirus, feral honeybees taking over hollows and land clearance. The retention of large mature hollow-bearing eucalypts is likely to be important for the conservation of the species. (Rhodes and Hall 1997).

3.2.4.3 General Bat Surveys (2009)

Anabat detectors were allocated to six sections of the study area and regularly moved within these sections to maximise the detection of bats (Figure 6). One survey site was located at the wind anemometer tower within the study area and consisted of two recording devices: one at ground level and one mounted approximately 42 metres on the anemometer tower and within the proposed RSA. Site C was located in the north-east of the study area and this was the only site that recorded a significant bat species.

Eleven bat species were recorded during the initial (2009) Anabat surveys (Table 6). These species were determined from analysis of the Anabat bat detector data by Rob Gration of Environmental Consulting Services. This represents 33% of the total number of calls recorded by the devices.

A further 11% of calls could only be identified to complex level and could not be positively assigned to an individual species. However, these species are positively identified from other calls and are included in the list of species recorded within the study area. Finally, 56% of calls recorded by the Anabat bat detectors could not be assigned to any species. These recordings could not be analysed because of back-ground noise or poor resolution of the call itself (usually because of distance from the microphone).

A single call of one nationally significant species (Southern Bent-wing Bat), was recorded at Anabat Site C. However, another 27 calls were recorded that were identified to a species complex level that includes Southern Bent-wing Bat along with Chocolate Wattled Bat and Little Forest Bat. Twenty-six of these calls were at Site A in the southern part of the study area, where Chocolate Wattled Bat was recorded in relatively large numbers. No significant bat species were identified at the elevated Anabat site, which makes it likely that this species, and not the endangered Southern Bent-wing Bat, were responsible for these calls.

Table 6. Bat species recorded by Anabat bat detectors during initial (2009) surveys at the proposed Willatook Wind Farm site.

Survey Site		A	B	C	D	E	Low tower	High tower	Total
Identified to species level		**89**	**9**	**83**	**81**	**195**	**4**	**1**	**462**
Percentage of total calls identified		**21%**	**33%**	**34%**	**43%**	**38%**	**38%**	**8%**	**33%**
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	0	0	39	0	0	0	0	**39**
White-striped Freetail Bat	*Tadarida australis*	4	1	0	0	0	0	0	**5**
Southern Freetail bat	*Mormopterus sp4*	0	0	3	0	1	0	0	**4**
Eastern Freetail Bat	*Mormopterus sp2*	0	0	0	0	0	0	0	**0**
Gould's Wattled Bat	*Chalinolobus gouldi*	2	0	10	33	175	3	1	**224**
Chocolate Wattled Bat	*Chalinolobus morio*	46	8	16	37	18	1	0	**126**
Eastern Falsistrellus	*Falsistrellus tasmaniensis*	5	0	4	2	0	0	0	**11**
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	0	0	0	0	0	0	0	**0**
Southern Bent-wing Bat	*Miniopterus schreibersii bassani*	0	0	1	0	0	0	0	**1**
Large Forest Bat	*Vespadelus darlingtoni*	32	0	9	7	1	0	0	**49**
Little Forest Bat	*Vespadelus vulturnus*	0	0	1	2	0	0	0	**3**
Identified to call complex		**53**	**8**	**29**	**37**	**12**	**1**	**6**	**146**
Percentage ID to complex		**7%**	**45%**	**25%**	**15%**	**10%**	**8%**	**58%**	**11%**
***Mormopterus* spp**	*Mormopterus* sp2 & sp4	0	0	2	1	0	1	4	**8**
Gould's Wattled Bat/*Mormopterus* sp	*Chalinolobus gouldi/ Mormopterus* sp2 & sp4	1	0	5	6	5	0	2	**19**
Long-eared Bat	*Nyctophilus* sp	14	2	11	6	7	0	0	**40**
Little Forest Bat/Southern Bent-wing Bat/Chocolate Wattled Bat	*Vespadelus vulturnus / Miniopterus schreibersii bassani/ Chalinolobus morio*	26	1	0	0	0	0	0	**27**
Forest Bat sp	*Vespadelus darlingtoni / V. regulus / V. vulturnus*	12	5	11	24	0	0	0	**52**
Unidentified (poor quality)		501	11	99	92	61	4	4	**772**
Percentage		**72%**	**22%**	**40%**	**42%**	**53%**	**54%**	**33%**	**56%**

3.2.5 Targeted Bat Surveys (2010-2011)

Desktop Review

The database search of the VBA (DELWP 2018d) contained records for only two microbat species; White-striped Freetail Bat *Tadarida australis* and Southern Forest Bat *Vespadelus regulus* within a 10-kilometre radius of the study area (Table 7). No significant bat species are listed within 10 kilometres of the study area (DELWP 2018d). However, relatively detailed microbat surveys have been undertaken in this area, and the paucity of records suggests that these records have not yet been entered into the database.

Targeted surveys for the nearby Penshurst Wind Farm concentrated on assessing activity of Southern Bent-wing Bats throughout the area (Biosis Research Pty Ltd 2011). The sub-species is known to roost in nearby caves at Byaduk, approximately 15 kilometres from the Penshurst Wind Farm site (Figure 9). Using thermal imaging of bats exiting the caves it has been estimated that around 500 Southern Bent-wing Bats utilise the Byaduk caves (Mark Venosta, Biosis, *pers. comm*.). Activity of the sub-species was relatively high at sites across the wind farm and is likely to result from bats which roost within the caves utilising the suitable habitat within the wind farm site as part of their normal foraging range (Biosis Research Pty Ltd 2011).

Anabat surveys for microbats were undertaken in 2005 for the nearby Macarthur Wind Farm, which is directly to the north of the present study area (Richards 2005). These surveys recorded at least 10 microbat species (Long-eared Bat *Nyctophilus* sp. calls cannot be separated to species level), including Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat from the wind farm site and surrounding area (Table 8). The Macarthur Wind Farm site contains very similar habitat to the Willatook Wind Farm site, being composed primarily of cleared open paddocks with scattered clumps of Cyprus trees. Bat activity was found to be relatively low across the area and it was suggested that most individuals were not resident within the site and were likely to have been recorded whilst commuting to more suitable foraging areas. As such, Richards (2005) suggested that microbat mortality from turbines was likely to be low. Whilst Southern Bent-wing Bat was detected within the site, the detection rate was reported to be relatively low and as such, mortality with turbines was not considered a significant risk. However, ongoing monitoring of the impact on this was recommended. Three species were recorded flying at a height of 45 metres (turbine blade height); White-striped Freetail Bat *Tadarida australis*, Eastern Freetail Bat *Mormopterus* sp2 and Long-eared Bat (Richards 2005).

Table 7. Microbat species previously recorded at the Willatook Wind Farm area and surrounding area by Ecology and Heritage Partners, Richards 2005 and in the VBA.

Microbat species	2009 surveys	Richards 2005	DELWP 2018d
White-striped Freetail Bat *Tadarida australis*	✓	✓	✓
Southern Forest Bat *Vespadelus regulus*	-	✓	✓
Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*	✓	-	-
Southern Freetail bat *Mormopterus sp4*	✓	-	-
Eastern Freetail Bat *Mormopterus sp2*	✓	✓	-
Gould's Wattled Bat *Chalinolobus gouldi*	✓	✓	-
Chocolate Wattled Bat *Chalinolobus morio*	✓	✓	-
Eastern Falsistrellus *Falsistrellus tasmaniensis*	✓	-	-
Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis*	✓	-	-
Southern Bent-wing Bat *Miniopterus schreibersii bassanii*	✓	✓	-
Large Forest Bat *Vespadelus darlingtoni*	✓	✓	-
Little Forest Bat *Vespadelus vulturnus*	✓	✓	-
Eastern Broad-nosed Bat *Scotorepens orion*		✓	-
Long-eared Bat (unidentified) *Nyctophilus* sp.	✓	✓	-
Total number of species	**12**	**10**	**2**

Habitat Assessment

A summary of the survey points including habitat features, landscape position and proximity to water is provided in Table 8 and shown in Figure 10. Sites were chosen which represented a variety of habitat features and landscape positions that might attract foraging microbats. Many survey points were chosen to be adjacent to interconnecting pine, Cyprus or eucalypt windrows (and linear remnants of roadside vegetation, consisting predominantly of wattles, Swamp Gum and Manna Gum). Where possible survey points were located close to water, though some were distant to water sources, with the furthest being 2.7 km from permanent water.

Table 8. Summary of Anabat survey point locations and habitat features (Figure 10).

Season	Survey point	Dates surveyed	Habitat features	Landscape position	Proximity to water
Spring	WS1	20/10/10 – 27/10/10	Rocky rise	Overlooking paddock	0.4 km
	WS2	20/10/10 – 27/10/10	Cyprus windrow	Interconnected windrow network	1.2 km
	WS3	20/10/10 – 27/10/10	Eucalypt windrow	Interconnected windrow and roadside vegetation	0.2 km
	WS4	20/10/10 – 27/10/10 3/11/10 - 10/11/10 17/11/10-22/11/10	Tower low	Surrounded by open paddock	0.3 km
	WS5	20/10/10 – 27/10/10 27/10/10 – 03/11/10 10/11/10-17/11/10 17/11/10-22/11/10	Tower high	Surrounded by open paddock	0.3 km
	WS6	20/10/10 – 27/10/10	Open paddock	Hill side	0.5 km
	WS7	20/10/10 – 27/10/10	Cyprus windrow	Interconnected windrow and roadside vegetation	2.0 km
	WS1-2	27/10/10 – 03/11/10	Cyprus windrow	Interconnected windrow and roadside vegetation	0.4 km
	WS2-2	27/10/10 – 03/11/10	Remnant Acacias	Interconnected windrow and roadside vegetation on hill-top	2.2 km
	WS3-2	27/10/10 – 03/11/10	Pine windrow	Interconnected windrow and roadside vegetation	0.3 km
	WS6-2	27/10/10 – 03/11/10	Open paddock	Hill top	0.2 km
	WS7-2	27/10/10 – 03/11/10	Remnant Acacias	Roadside vegetation	2.5 km
	WS1-3	3/11/10 - 10/11/10	Remnant Acacias	Interconnected windrow and roadside vegetation near Back Creek	0.2 km
	WS2-3	3/11/10 - 10/11/10	Pine windrow	Interconnected windrow network near Back Creek	0.3 km
	WS3-3	3/11/10 - 10/11/10	Remnant Acacias	Roadside vegetation	0.3 km
	WS7-3	3/11/10 - 10/11/10	Pine windrow	Interconnected windrow and roadside vegetation	2.0 km

Season	Survey point	Dates surveyed	Habitat features	Landscape position	Proximity to water
	WS1-4	10/11/10-17/11/10 17/11/10-22/11/10	Overlooking stream	Tributary to Back Creek	At water
	WS2-4	10/11/10-17/11/10 17/11/10-22/11/10	Remnant Eucalypts	Interconnected roadside vegetation, close to Shaw River	0.3 km
	WS3-4	10/11/10-17/11/10 17/11/10-22/11/10	Eucalypt windrow	Interconnected windrow network, close to large dam/swamp	0.6 km
	WS6-4	10/11/10-17/11/10 17/11/10-22/11/10	Rocky rise	Overlooking paddock	2.7 km
	WS7-4	10/11/10-17/11/10 17/11/10-22/11/10	Remnant Acacias	Remnant patch within paddock, between Eucalypt plantation and Shaw River	0.9 km
Autumn	WA1	09/02/11-16/02/11	Remnant Acacias	Interconnected windrows and roadside vegetation	0.8 km
	WA2	09/02/11-16/02/11	Rocky rise	Overlooking paddock	0.5 km
	WA3	09/02/11-16/02/11	Planted trees in house yard	Close to eucalypt plantation	0.4 km
	WA4	09/02/11-16/02/11	Near bridge overlooking stream	Kangaroo Creek	At water
	WA5	09/02/11-16/02/11 16/02/11-24/02/11	Hill top	Overlooking Moyne River valley	0.2 km
	Tower low	09/02/11-16/02/11 16/02/11-24/02/11 24/02/11-03/03/11 03/03/11-10/03/11 10/03/11-18/03/11 18/03/11-31/03/11	Tower low	Surrounded by open paddock	0.3 km
	Tower high	09/02/11-16/02/11 16/02/11-24/02/11 24/02/11-03/03/11 03/03/11-10/03/11	Tower high	Surrounded by open paddock	0.3 km

Season	Survey point	Dates surveyed	Habitat features	Landscape position	Proximity to water
		10/03/11-18/03/11 18/03/11-31/03/11			
	WA6	16/02/11-24/02/11	Eucalypt windrow	Interconnected windrow and roadside vegetation	0.2 km
	WA7	16/02/11-24/02/11 10/03/11-18/03/11 18/03/11-31/03/11	Remnant Eucalypts	Interconnected roadside vegetation, close to Shaw River	0.3 km
	WA8	16/02/11-24/02/11	Bridge over Shaw River	Shaw River	At water
	WA9	16/02/11-24/02/11	Open paddock	Hill top	0.2 km
	WA10	16/02/11-24/02/11 10/03/11-18/03/11 18/03/11-31/03/11	Rocky rise	Ridgeline, overlooking open paddock	1.2 km
	WA11	24/02/11-03/03/11 03/03/11-10/03/11	Near dam and Cyprus windrow	Open area with scattered windrows	At water
	WA12	24/02/11-03/03/11 03/03/11-10/03/11	Remnant Acacias	Interconnected windrows and roadside vegetation	1.2 km
	WA13	24/02/11-03/03/11 03/03/11-10/03/11	Bridge over Moyne River	Moyne River	At water
	WA14	24/02/11-03/03/11 03/03/11-10/03/11	Remnant Acacias near drain	Interconnected windrows and roadside vegetation	At water
	WA21	10/03/11-18/03/11 18/03/11-31/03/11	Rocky rise	Overlooking paddock	0.5 km
	WA22	10/03/11-18/03/11 18/03/11-31/03/11	Small dam	Small farm dam near Back Creek	At water

3.2.6 Anabat Results

The call analyses revealed that both the nationally significant Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat occurred within the wind farm area, during both the Spring 2010 and Autumn 2011 survey periods (Figure 11). The filter to isolate Southern Bent-wing Bat calls also detected the presence of two other species that call in the same frequency range; Little Forest Bat and Chocolate Wattled Bat. Results of the call analyses for threatened species are presented in Table 9 and the location of significant species records shown in Figure 11. Survey points where neither threatened species nor any of the call complex species were detected are not included in the table or discussion.

Chocolate Wattled Bat was the most commonly detected species within the call complex. This species was detected at 14 locations during the Spring sampling period and was detected in two separate sampling periods at two of these. Chocolate Wattled Bat was detected at nine locations during the Autumn sampling and was detected in two sampling periods at one location. Little Forest Bat was not detected during the Spring survey but was recorded at three survey locations in Autumn and was detected in two separate sampling periods at one of these.

Southern Bent-wing Bat

Southern Bent-wing Bat was recorded at four locations during the Spring sampling period (Figure 10):

- WS2-4 over two consecutive sampling periods (3 and 32 calls),
- WS3-4 in one sampling period (30 calls),
- WS6 in one sampling period (2 calls) and
- WS7-3 in one sampling period (1 call).

The sub-species was detected at three locations during the Autumn survey period:

- WA7 in one sampling period (26 calls),
- WA1 in one sampling period (1 call) and
- WA 7 in one sampling period (4 calls).

Survey location WS2-4 is the same site as WA7. Overall this location had the highest Southern Bent-wing Bat activity with calls detected in mid-November and late March. This survey point is located on the western boundary of the study area near the corner of Fry's Road and MacKnights Road (Figures 10 and 11). The detector was located near roadside vegetation consisting of mature and recruiting Manna Gums and Swamp Gums with a midstorey of natives including Black Wattle. The Shaw River is around 300 metres to the east of where the detector was located. Good quality riparian vegetation supporting mature trees grows along the Shaw River in this area and scattered mature Swamp Gums are scattered within nearby paddocks. The habitat in this area is of much better quality within this section of the of the wind farm area than elsewhere, and may explain why Southern Bent-wing Bat was detected in this area on three separate occasions over four seasons. The Shaw River may also serve as a migration route for the sub-species. It must be recognised that this location was surveyed more intensively than most others (5 weeks in total over Spring and Autumn) and this would have increased the chance of detecting species here. However, the numbers of calls from the call complex recorded at the site were high overall, indicating that it is bat activity rather than just survey intensity contributing to the detection of Southern Bent-Wing Bat. In addition, although several detectors were placed in open paddocks in areas

typical of where turbines are proposed to be installed, Southern Bent-wing Bat was not detected at these locations.

Site WS3-4, where 30 Southern Bent-wing Bats were recorded in Spring is located near the corner of Poyntons and Coomete Road (Figures 10 and 11). This area is around 600 metres from 'Wild Dog Swamp' which is a BioSite of regional significance, also known as 'Willatook Wetland'. This swamp contains a considerable amount of water and is adjacent to a canalised section of the Moyne River. It represents the highest quality wetland within the wind farm area. The swamp and river may represent important foraging areas for microbats, including Southern Bent-wing Bat. The Shaw River and associated riparian vegetation may also represent part of the migration route for Southern Bent-wing Bat between the maternity cave near Warrnambool and the known over-wintering cave near Byaduk. This may be the reasons for a considerable number of calls being detected from these areas. Further detailed investigations would be required to determine the relative use and importance of these areas for the species.

The other sites where Southern Bent-wing Bat was recorded were well dispersed from those described above. Two occurred adjacent to areas where windrows interconnected with linear roadside remnant vegetation (WS7-3 and WA1) and the remaining location was next to a small farm dam (WA11).

No Southern Bent-Wing Bats were recorded from the detectors placed on the anemometer tower (either high or low) so no inferences can be made about the height at which the sub-species is likely to fly within the wind farm area.

The call complex (calls in the frequency range of Southern Bent-wing Bat which could not be identified to species) was recorded from nine locations in Autumn. It was recorded from 18 locations in Spring, with the complex recorded during two separate survey periods at five of these. The call complex was not recorded at either the high or low monitoring points on the anemometer tower during Spring. However, during Autumn it was recorded at the low monitoring point in two periods and at the high point in one period. Given that the call complex represents three different species which call in the same frequency range; Southern Bent-wing Bat, Chocolate Wattled Bat and Little Forest Bat, it is not possible to infer anything about Southern Bent-Wing Bat activity from these results.

Yellow-bellied Sheathtail Bat

Yellow-bellied Sheathtail Bat was detected from three survey locations during the Spring sampling period. The species was recorded during two separate sampling periods at location WS3-4, the same location where Southern Bent-Wing Bat was repeatedly recorded. Yellow-bellied Sheathtail Bat was also recorded from three survey locations during the Autumn survey, one of which was again location WA7 (WS3-4). As described above, this location appears to be an area of high bat activity.

Other locations where the species was detected include a hill-top overlooking the Moyne River valley (WA5) areas adjacent to linear vegetation (windrows and roadside remnants) (WS1-2 and WS7-2) and the small farm dam where Southern Bent-wing Bat were detected (WA11). Overall, the survey locations at which this species was detected were well dispersed throughout the wind farm and adjacent area (Figure 11).

No Yellow-bellied Sheathtail Bats were recorded from the detectors placed on the anemometer tower (either high or low) so no inferences can be made about the height at which the species is likely to fly within the wind farm area. However, this species is known to be relatively high-flying in relation to other microbat species.

Table 9. Threatened species survey results. Numbers indicate number of Southern Bent-wing Bat and call complex calls recorded (✓=recorded at site)

Season	Survey dates	Survey location	Southern Bent-wing Bat	Little Forest Bat	Chocolate Wattled Bat	Little Forest Bat	Call complex
Spring	20/10/10 – 27/10/10	WS1					1
		WS6	2		✓		124
		WS7			✓		0
	27/10/10 – 03/11/10	WS1-2			✓		9
		WS3-2			✓		44
		WS5					3
		WS6-2			✓		0
		WS7-2			✓	✓	0
	3/11/10 - 10/11/10	WS1-3			✓	✓	0
		WS2-3			✓		0
		WS7-3	1		✓		0
	10/11/10-17/11/10	WS2-4	3		✓	✓	47
		WS3-4	30		✓		657
		WS5			✓		0
		WS6-4			✓		0
		WS7-4			✓		0
	17/11/10-22/11/10	WS2-4	32		✓	✓	143
		WS3-4					1
		WS7-4			✓		0
Autumn	09/02/11-16/02/11	WA1	1	✓	✓		33
		WA2			✓		3
		WA4					2

Season	Survey dates	Survey location	Southern Bent-wing Bat	Little Forest Bat	Chocolate Wattled Bat	Little Forest Bat	Call complex
		WA5				✓	0
		Tower low			✓		0
	16/02/11-24/02/11	WA5					48
		WA6					74
		WA7					823
		WA8					35
		WA9					48
		WA10					27
		Tower low					1
	24/02/11-03/03/11	WA11	4	✓	✓	✓	235
		WA12					107
		WA13					23
		WA14			✓		55
		Tower low					4
	03/03/11-10/03/11	WA14		✓			137
		WA11		✓	✓		170
		WA13					4
		Tower high					1
	10/03/11-18/03/11	WA10					80
	18/03/11-31/03/11	WA7	26	✓	✓	✓	351
		WA21			✓		87
		WA22			✓		136
		Tower low			✓		0

3.2.7 Targeted Frog Surveys

Frog surveys were undertaken in four locations: three located outside the current the study area, and one within the study area (Figure 6). Two of the surveys sites were along the Shaw River to the east of the study area, the southern survey points close to a Eucalypt plantation just outside of the current study area. The third survey location within the study area was located along the Moyne River. The final survey location was in a large wetland, south of Coomete Road in the west of the study area.

3.2.7.1 Growling Grass Frog

Ad hoc diurnal and targeted nocturnal surveys were undertaken across the breadth of the study area (Figure 6). Despite these surveys being undertaken during the core breeding season, over ideal weather conditions, no Growling Grass Frogs were recorded within the study area. However, one frog was heard calling from a large swamp east of the study area on Poyntons Road, Willatook. This property and wetland is adjacent to the Moyne River, which is likely to be a dispersal corridor for this species. This species was not heard on subsequent visits to this wetland, which was visited most days whilst in the field (an additional 22 visits). Targeted Growling Grass Frog surveys undertaken for the Tarrone Power Station to the east of the study area (Biosis Research 2007) and the Shaw River Power Station (Ecology Partners 2009a) to west of the study area also failed to detect Growling Grass Frog.

Growling Grass Frogs may, therefore, use the study area on occasions and at different times of the year and in different seasons, dispersing frogs may move into the study area. However, it is understood that given that WWF is planning to avoid habitat that would support this species (i.e. waterways within the study area) and use mitigation measures to minimise its impact on such habitat (Section 6), there is unlikely to be a significant impact on this species.

3.2.7.2 Brown Toadlet and Southern Toadlet

No Brown Toadlets or Southern Toadlets were detected during the targeted surveys. During the second visit to the site, a known population of Southern Toadlets (Badhams Road, Toolong, near Warrnambool) was visited to confirm that they were active and calling on the advice of Garry Peterson (DELWP, Warrnambool). Although the frogs were calling at this site, they were not found calling within the study area.

3.2.8 Targeted Swamp Skink Surveys

Two sets of traps were established in areas of potentially suitable habitat in the west of the study area, with a location also outside the eastern extent of the current study area (Figure 6). These two areas represented the only likely habitat within proximity to the study area as they had the right mix of vegetation and permanent water to support the species. Other areas, such as Cockatoo Swamp, lacked the tussock grasses that support Swamp Skinks and are regularly grazed, rendering the habitat unlikely to support this species.

Traps were set for a total of 160 trap days. At the end of this period, one Swamp Skink *Egernia coventryi*, which was trapped in the eastern trap-line, was recorded. Prior to this record, the nearest recorded Swamp Skink in the VBA (DELWP (2018b) was from near Warrnambool, approximately 35 kilometres south of the study area, in 2003, although there is a more recent record from the Moyne River, approximately 10 kilometres from the current record (Ecology Partners 2009a). Active searching at the location of the two trap sites did not reveal any additional Swamp Skinks.

Changes in the hydrology of the study area would result in changes to the vegetation mix within the study area, which may allow Swamp Skinks to disperse to other locations within the study area. By restricting construction from swampy areas and watercourses, WWF can minimise the impact of the development on this species.

3.2.9 Targeted Fat-tailed Dunnart Surveys

Active searches for Fat-tailed Dunnart were conducted along collapsed sections of the stone walls in the study area. Despite the use of roof tiles and active searching in suitable habitat over several days no Fat-tailed Dunnarts were detected in the study area.

3.2.10 Targeted Striped Legless Lizard Surveys

The tile grids were checked on more than ten occasions between the start of the study period and its end. During this time, no Striped Legless Lizards were detected.

3.2.11 Aquatic Fauna Surveys

Six aquatic fauna species were recorded along the Moyne River and three species were recorded in Kangaroo Creek during the targeted surveys (Table 10). This included two nationally significant species, Yarra Pygmy Perch *Nannoperca* obscura (collected within the Moyne River sites) and Dwarf Galaxias *Galaxiella pusilla* collected within the Kangaroo Creek (Figure 7). The location of three survey sites, across the breadth of the study area enables us to make generalisations about the likely impact of the development on the broader aquatic habitats and measures that WWF can undertake to mitigate these impacts.

Table 10. Fish species collected within the study area.

Site	Common Name	Scientific Name
Moyne River d/s Nardoo Road	Short Finned Eel	*Anguilla australis*
	Southern Pygmy Perch	*Nannoperca australis*
	Yarra Pygmy Perch (Vu, L, v)	*Nannoperca obscura*
	Tupong	*Pseudaphritis urvillii*
Moyne River off Hopcrafts Road	Southern Pygmy Perch	*Nannoperca australis*
	Common Galaxias	*Galaxias maculatus*
	Mountain Galaxias	*Galaxias olidus*
	Yarra Pygmy Perch (Vu, L, v)	*Nannoperca obscura*
	Southern Pygmy Perch	*Nannoperca australis*
Kangaroo Creek downstream of Woolsthorpe-Heywood Road	Dwarf Galaxias (Vu, e, L)	*Galaxiella pusilla*
	Southern Pygmy Perch	*Nannoperca australis*
	Short Finned Eel	*Anguilla australis*

Note. Vu - Vulnerable Species (EPBC Act 1999), L - Listed Species (FFG Act 1988), v - Vulnerable Species (DEPI Advisory List, 2013), e - Endangered (DEPI Advisory List, 2013).

3.2.12 Fauna Habitats

The study area currently supports low quality habitat for a range of native fauna species, principally species adapted to modified environments (i.e. grassland and wetland dependent birds). In addition, there is habitat present for a small number of ground dwelling mammals, native reptiles and frogs.

While remnant native vegetation within the study area has been classified using EVCs, most fauna habitats can encompass a range of similar EVCs. As such, in the following section, habitat types located within the study area have been assigned a general designation by grouping similar EVCs. However, some habitat types do not relate to any EVC (e.g. exotic pasture, artificial dams), due to them not reaching native vegetation thresholds or being based on general habitat characteristics and not vegetation type.

The study area currently supports eight broad habitat types: modified grassland; modified woodland/remnant trees; rocky rises; rivers/creeks and riparian areas; swamp and marsh; planted vegetation; artificial waterbodies and ephemeral drainage lines; and exotic pasture grass and crops.

3.2.12.1 Modified Grassland (Corresponding EVC: Plains Grassland)

Overall habitat value - Remnant modified grasslands are of moderate habitat value for fauna. While the majority of remnants in the study area are floristically and structurally deficient, lacking key habitat components such as a diversity of flora species and suitable refuge sites, they are likely to act as 'stepping stones' of habitat for more mobile species (principally birds) adapted to modified environments.

Patches of native grassland habitat are also likely to facilitate fauna movement between sites of higher value throughout the landscape. Past extensive land clearing has resulted in fragmentation and isolation of this habitat type to mainly road reserves.

Description - This habitat type is largely restricted to road reserves. Characterised by the dominance of native grasses such as Kangaroo Grass and Wallaby Grass, these areas provide key habitat attributes which are otherwise completely lacking in the surrounding area. In some of these road reserves, there are also scattered Blackwood and Black Wattle, which provide additional habitat for avifauna.

Fauna - Due to the highly modified and degraded nature of surrounding habitats, grassland and grassy woodland remnants within road reserves potentially provide important habitat for native herpetofauna, such as Glossy Grass Skink *Pseudemoia rawlinsoni*, Blotched Blue-tongued Lizard *Tiliqua nigrolutea* and Eastern Three-lined Skink *Bassiana duperreyi*. Common open country species (primarily birds) are also likely to use this habitat.

Modified grasslands and grassy woodland also provide foraging habitat for diurnal raptors (e.g., Nankeen Kestrel *Falco cenchroides*, Black-shouldered Kite *Elanus axillaris*, Brown Falcon *Falco berigora*, Swamp Harrier *Circus approximans* and Brown Goshawk *Accipiter fasciatus*).

3.2.12.2 Modified woodland and scattered remnant trees (Corresponding EVCs: Basalt Shrubby Woodland; Plains Grassy Woodland)

Overall habitat value - Remnant woodland patches are of low to moderate habitat value for fauna. While the majority of the remnants within the study area are structurally deficient, lacking key mid-storey and understorey components, they are likely to act as 'stepping stones' of habitat for more mobile species (principally birds). Patches of habitat are also likely to facilitate fauna movement between sites throughout the otherwise cleared landscape.

Description – This habitat type is generally located in road reserves and a few patches are also present in the western extent of the potential additional area. In roadside reserves this habitat type is generally characterised by an overstorey supporting Blackwood, Black Wattle and eucalypts up to 15 metres high with a mid-storey of small shrubs and an understorey of either native or pastoral grasses and weeds. The remnant trees in the western side of the additional landholdings are characterised by mature eucalypts with an absent mid-storey and grazed understorey consisting of pastoral grasses and weeds.

Fauna – Given their isolation amongst a largely cleared and highly modified surrounding environment modified woodland and remnant trees provide an important source of habitat.

For example, this habitat type provides habitat for diurnal raptors (e.g., Nankeen Kestrel *Falco cenchroides*, Black-shouldered Kite *Elanus axillaris*), which use trees for perching, roosting and foraging activities.

More extensive woodland patches, such as those located within the western edge of the potential additional landholdings, will possibly support larger raptor species such as Wedge-tailed Eagle *Aquila audax*, Grey Goshawk *Accipiter novaehollandiae* and Southern Boobook *Ninox novaeseelandiae*. When in flower, remnant woodland trees provide an important nectar resource for a variety of honeyeaters and lorikeets. Southern Bent-wing bats may also use this habitat.

3.2.12.3 Rocky Rises/ Stony Knolls (Corresponding EVC: Stony Knoll Shrubland)

Overall habitat value – Rocky rises and stony areas are of low to moderate habitat value for native ground dwelling fauna. While the majority of these areas within the study area are floristically deficient and lack key native vegetation components, they provide ideal structural habitat for skinks and lizards in particular, and also act as 'stepping stones' of habitat for more mobile species adapted to modified environments, such as snakes and some ground dwelling mammals. Patches of this habitat type are also likely to facilitate fauna movement between other similar areas throughout the largely cleared and poor condition surrounding landscape.

Description - This habitat type largely occurs over much of the southern section of the study area along with smaller areas within the northern section. Characterised by embedded and surface rocks, these areas are located within stock paddocks, and have been subjected to vegetation clearing, weed and pasture grass invasion and trampling by stock.

In other areas, the rocky rises are smothered with a dense cover of Austral Bracken, which provide additional cover for herpetofauna and small mammals from both diurnal and nocturnal raptors. Property and paddock boundary fences that have been constructed or fortified through placement of rocks at their base also provide important refuge for herpetofauna.

Fauna – Due to the highly modified nature of most of these areas few native fauna, other than ground dwelling skinks, snakes, lizards and mammals are likely to use this habitat. These areas are also likely to provide an important foraging site for diurnal and nocturnal raptors.

3.2.12.4 Rivers, creeks and drainage lines (Corresponding EVC: Tall Marsh)

Overall habitat value - Rivers, creeks and their associated riparian areas are of moderate habitat value for native fauna.

While the majority of rivers, creeks and drainage lines within the study area are surrounded by agricultural land, most waterways currently support varying extents of native aquatic and terrestrial vegetation cover

(<25% cover). Those that are surrounded by dense native vegetation, and which hold water permanently throughout the year, are critical centres for fauna in the local area. Watercourses and ephemeral wetlands which hold water on a semi-permanent basis or only temporarily provide native fauna with important habitat, but favour different species at varying times of the year.

Description - This habitat type is located sporadically throughout the study and is highly diverse in form varying from ephemeral wetlands and drainage lines to permanent rivers. Although the majority of these wetlands occur in grazed paddocks some still support a range of aquatic and terrestrial vegetation which provide important habitat and foraging resources for native fish and wetland dependent birds.

Fauna – Due to the availability of water all of the watercourses within the study area provide important habitat for a suite of native fauna. Adjacent trees also provide additional habitat for diurnal and nocturnal raptors like Nankeen Kestrel, Swamp Harrier *Circus approximans* and Southern Boobook Owl, which use nearby trees for perching, roosting and foraging activities, overlooking creeks, rivers and riparian zones, where there is an abundance of prey animal activity.

3.2.12.5 Swamp and marsh (Corresponding EVC: Plains Grassy Wetland)

Overall habitat value – Swamp and marsh areas are of moderate habitat value for fauna, especially given that many existing comparable habitats have been either destroyed or degraded through ongoing agricultural practices. Even though the majority of remnants in the study area are floristically deficient, they possess key structural and hydrological attributes that enable them to support many significant fauna species.

The on-going incidence of moisture in these areas results in the formation of distinctive micro-habitats which are optimal for certain vegetation types and associated invertebrate activity.

The profusion of invertebrate fauna results in these areas being able to support vertebrate fauna represented by birds, mammals, reptiles and frogs.

Description – Cockatoo swamp forms the largest of these areas with other smaller areas occurring within farmland, and the floodplains of the Moyne and Shaw River. This habitat type is sporadically located throughout the study area and is characterised by low-lying areas within paddocks where stormwater run-off is continually collected after rainfall. These areas are identifiable even during dry conditions due to the presence of wetland associated vegetation species such as rushes and sedges. These species provide important refuge and secure foraging habitat for fauna species, in an otherwise totally modified surrounding environment.

The areas between sedge and rush tussocks typically comprise introduced pasture grasses and weeds. However, during extended periods of rainfall, these areas become temporarily submerged, and attract waterbirds in large numbers.

Fauna – Although most of these areas are highly modified and no significant species were identified in these areas during the surveys, under certain conditions, some of these areas could be comparable to ephemeral wetlands such that fauna species that are reliant on wetland areas may at times use these areas.

These potentially include the state significant Brolga *Grus rubicunda,* Eastern Great Egret *Ardea modesta*, Royal Spoonbill *Platalea regia*, as well as more common species such as the White-faced Heron *Egretta novaehollandiae* and Australian White Ibis *Threskiornis molucca*. Southern Bent-wing bats may also use this habitat.

3.2.12.6 Planted vegetation/ Windrows (Corresponding EVC: None)

Overall habitat value – Habitat value for planted vegetation ranges from low for juvenile or immature plantings, to moderate for mature plantings.

Description – An assortment of native and exotic trees and shrubs have been planted, principally along windrows throughout the study area. Many of these trees are mature and reach a height of up to 20 metres. The midstorey is generally absent, with an understorey predominately consisting of introduced pasture grasses and bare ground.

Fauna – Many of these trees provide an important foraging resource, primarily for Owls, Australian Magpie *Gymnorhina tibicen*, Wattlebirds, Miners and Cockatoos. Additionally, low growing shrubs would be used by smaller passerine species such as wrens, thornbills, and fantails for nesting and foraging purposes.

3.2.12.7 Artificial waterbodies (farm dams) and ephemeral drainage lines (Corresponding EVC: Aquatic Herbland)

Overall habitat value – Artificial waterbodies and ephemeral drainage lines are considered to be of low to moderate habitat value for fauna.

Description – Several artificial waterbodies and ephemeral drainage lines exist within the study area. They currently support low levels of emergent macrophytes and aquatic vegetation, with few refuge sites such as logs or rocks. The surrounding vegetation typically comprises introduced pasture grass or crops.

Fauna – Waterbirds such as Australian Wood Duck *Chenonetta jubata* or Pacific Black Duck *Anas superciliosa*, and frog species such as Common Froglet *Crinia signifera* and Spotted Marsh Frog *Limnodynastes tasmaniensis* are expected to use these habitats. Waterbodies and drainage lines supporting protective cover within, and around their margins, offer protection for more secretive birds such as crakes, rails and snipe. Southern Bent-wing bats may also use this habitat.

3.2.12.8 Exotic pasture and crops (Corresponding EVC: None)

Overall habitat value – This habitat is considered to be of low habitat value for fauna. The majority of the areas being grazed and providing very little in the way of potential refuge sites for ground dwelling reptiles, birds and mammals.

Description – This habitat occurs throughout much of the study area where native vegetation has been removed and land used for grazing livestock or crops. It comprises almost exclusively perennial pasture grass and grain crops, with a few isolated trees and windrow plantations scattered throughout.

Fauna – Few native species are known to use this habitat, principally birds adapted to modified habitats such as Richards Pipit *Anthus novaeseelandiae*, Australian Magpie and Galah *Eolophus roseicapilla*. Raptors (Brown Falcon, Nankeen Kestrel, Black-shouldered Kite) search for prey items over these areas, and introduced species (Common Starling *Sturnus vulgaris*, House Sparrow *Passer domesticus*) were also prevalent in this habitat during the survey.

Although introduced grass and crops does not provide important habitat for fauna, it does provide dispersal opportunities (cover) for reptiles, frogs and other species into more optimal habitats throughout the local area.

3.2.12.9 Migration Routes (Corresponding EVC: None)

Migration routes vary depending on the species involved in migration. At the study site, four of the six migratory species either observed, known to occur or thought to occur in the area (Eastern Great Egret, Cattle Egret *Ardea ibis*, Latham's Snipe *Gallinago hardwickii*, Clamorous Reed Warbler *Acrocephalus stentoreus*; Appendix 3.2) are wetland dependent birds. Although these species do not follow regular migration routes, similar to those of waterbirds and raptors in the northern hemisphere, they are likely to use suitable wetlands, such as the ephemeral wetlands within the study area, as stop-over points in their migration (Marchant and Higgins 1991). There is no suitable habitat for the other two, non-wetland, species (Short-tailed Shearwater *Puffinus tenuirostris*, which is a pelagic species and Orange-bellied Parrot *Neophema chrysogaster*, which migrates between Tasmania and areas of coastal saltmarsh along the southern coast-line of Australia (Higgins 1999) and therefore these species are unlikely to use the study area during migration.

3.3 Removal of Native Vegetation (the Guidelines)

The study area contains the following extent of native vegetation:

- 99 Scattered Trees (Appendix 2.4);
    - 66 Large Trees; and,
    - 33 Small Trees.
- 562.285 hectares of native vegetation (Table 11):

Table 11. Summary of native vegetation within the study area

EVC	Mapped native vegetation outside of the Current Wetland (hectares
Aquatic Herbland	0.039
Basalt Shrubby Woodland	0.675
Plains Grassland	2.993
Plains Grassy Wetland	73.692
Plains Grassy Woodland	8.479
Stony Knoll Shrubland	43.867
Tall Marsh	0.664
Current Wetlands	431.875
Total	**562.285**

3.3.1 Vegetation proposed to be removed

Once a site layout plan has been prepared, and impacts to native vegetation quantified, an assessment of impacts under the Guidelines will be conducted. In any case, it is likely that the assessment of impacts to native vegetation will fall under the Detailed assessment pathway (DELWP 2017a).

3.3.2 Offset Targets

Offset obligations will be quantified once native vegetation impacts are known.

3.4 Significance Assessment

3.4.1 Flora

One-hundred and fifty-three (153) flora species (97 indigenous and 56 non-indigenous or introduced) were recorded within the study area during the field assessment. Of these species, 10 species are protected under the FFG Act (DELWP 2016, 2018e),and one (Basalt Peppercress *Lepidium hyssopifolium*) is listed under both the FFG Act and the EPBC Act. A consolidated list of flora species recorded is provided in Appendix 2.1.

The VBA contains records of seven nationally significant and 20 State significant flora species previously recorded within 10 kilometres of the study area (DELWP 2018d) (Appendix 2.2; Figure 4). The PMST nominated an additional seven nationally significant species which have not been previously recorded but have the potential to occur in the locality (DoEE 2017). Most records are confined to existing road reserves or conservation reserves within the local area.

Of these species, there is confirmed habitat within the study area for Basalt Peppercress *Lepidium hyssopifolium*, which was previously recorded within the broader study area (Ecology Partners Pty Ltd 2011). At the time of the 2011 assessment, this species was not listed as nationally or state significant species, therefore the exact location within the study area was not recorded. Additionally, based on previous records within the broader landscape (within 10 kilometres of the study area), there is potential habitat in the study area for the nationally significant Clover Glycine *Glycine latrobeana*, Swamp Fireweed *Senecio psilocarpus*, Gorae Leek-orchid *Prasophyllum diversiflorum*, Maroon Leek-orchid *Prasophyllum frenchii* and Dense Leek-orchid *Prasophyllum spicatum*, as well as three additional State significant flora.

Recommendation

Given the confirmed presence of Basalt Peppercress in the study area, once a site layout plan has been prepared, targeted surveys are recommended prior to construction to quantify the distribution and location of the species within and adjacent to the development footprint. If potential habitat is proposed to be impacted, targeted surveys are recommended for the additional below species (Table 12) at an appropriate time of year to ascertain their presence within the study area. Otherwise, if potential habitat within the study area can be avoided through the appropriate siting of infrastructure, targeted surveys area unlikely to be required.

Table 12. Significant flora potentially occurring within the study area

Common Name	Scientific Name	Habitat	Survey Season	Significance
Clover Glycine	*Glycine latrobeana*	Grassland and grassy woodland habitats, less often in dry forests, and only rarely in heathland.	Oct - Dec	National
Swamp Fireweed	*Senecio psilocarpus*	Seasonally wet grasslands and swamps	Nov - Mar	National
Basalt Peppercress	*Lepidium hyssopifolium*	Grassy and woodland habitats	All year	National
Gorae Leek-orchid	*Prasophyllum diversiflorum*	Moist grassy sites along waterways and swamp margins on heavy black soils	Dec - Feb	National
Maroon Leek-orchid	*Prasophyllum frenchii*	Grassy and heathy vegetation on seasonally damp sites	Oct - Dec	National
Dense Leek-orchid	*Prasophyllum spicatum*	Heath and heathy woodlands on sandy to light clay soils	Oct - Nov	National
Swamp Flax-lily	*Dianella callicarpa*	Moist to wet soils in heathy and woodland habitats	Aug - Feb	State
Basalt Leek-orchid	*Prasophyllum viretrum*	Native grasslands on heavy basalt soils	Nov - Dec	State
Slender Bitter-cress	*Cardamine tenuifolia*	Moist soils near swamps and streams	Nov - Feb	State

3.4.2 Fauna

One-hundred and three (103) terrestrial and avian fauna species were observed during the field surveys (Appendix 3.1). This consisted of 19 mammals (including 11 species of bat identified to species level), 76 birds, three reptiles and five frogs. Five of the observations of mammals and five birds were of species introduced to the study area. A consolidated list of fauna species recorded is provided in Appendix 3.1.

The VBA contains records of 12 nationally significant, 23 State significant and 11 regionally significant fauna species previously recorded within 10 kilometres of the study area (DELWP 2018d) (Appendix 3.2; Figure 5). The PMST nominated an additional 13 nationally significant species which have not been previously recorded but have the potential to occur in the locality (DoEE 2017).

Although there is potential habitat for Growling Grass Frog, Yarra Pygmy-perch and Dwarf Galaxia within the study area, these habitats are located in low-lying areas highly unlikely to be directly impacted by the location of the wind farm infrastructure. As such, it is considered unlikely that these species will be significantly impacted by the wind farm.