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

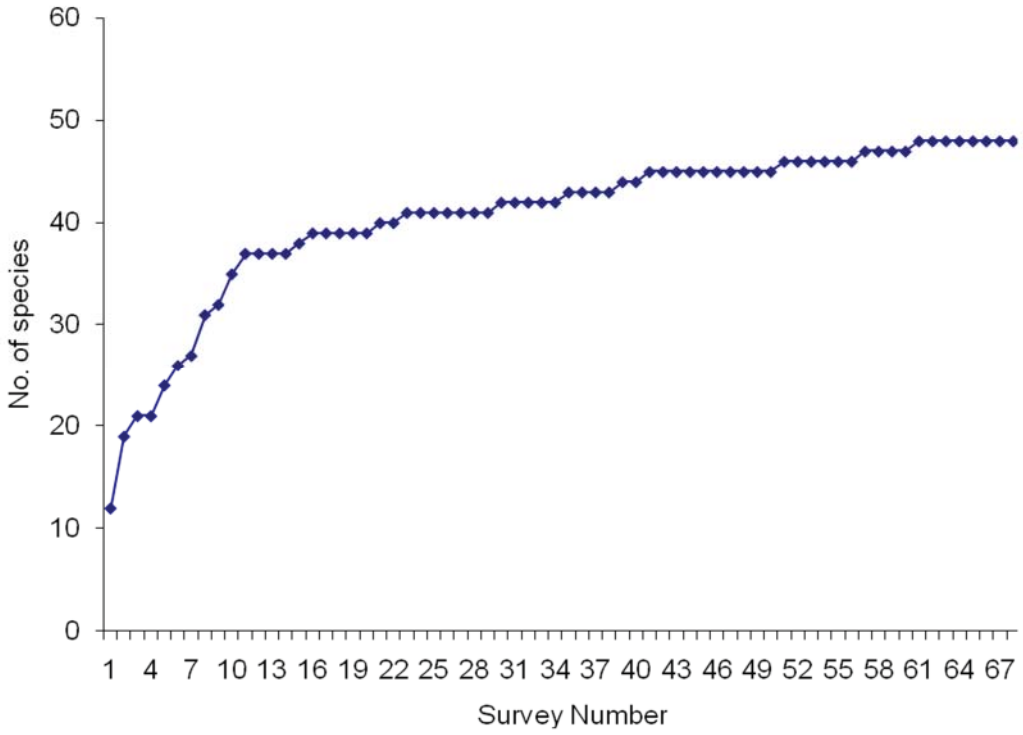
Forty-nine (49) species of birds were recorded, consisting of 2087 individual animals, during the 69 fixed point bird counts undertaken during the spring surveys (Table 5). One other species was identified to generic level (i.e. Raven species, either Little Raven *Corvus mellori* or Australian Raven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

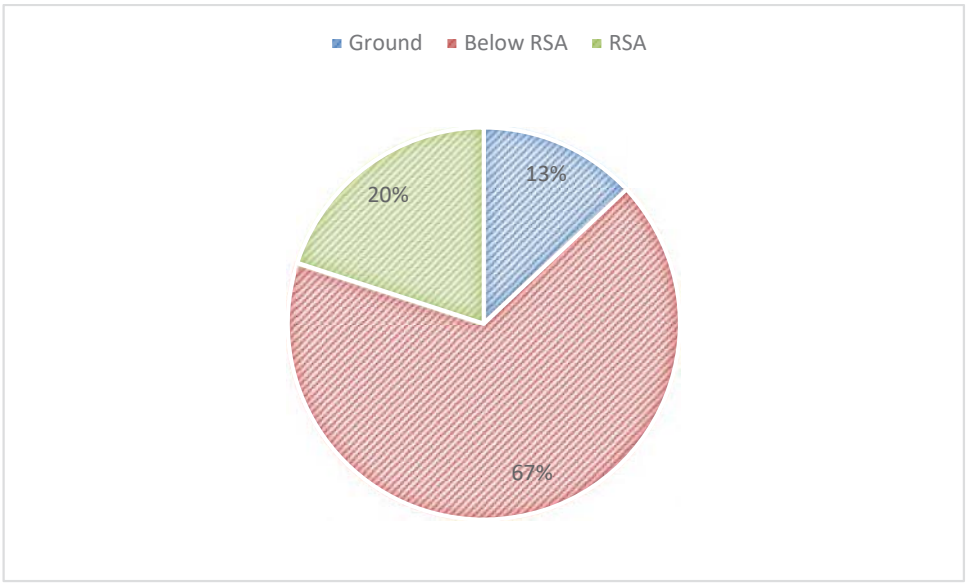
Five species of bird comprised 59.6% of all sightings during the survey period (Raven 29.0%; Australian Magpie *Gymnorhina tibicen* 12.1%; European Goldfinch *Carduelis carduelis*; 6.8%; Australian Pipit *Anthus novaeseelandiae* 5.6%; and European Skylark *Alauda arvensis* 5.1%). All of these species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

Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat

Both Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat were found to utilise the study area during both the Spring and Autumn survey periods. The records for each are well distributed throughout the wind farm area. However, the highest number of calls for Southern Bent-wing Bat occur around the Shaw River to the west of the wind farm area and over a high-quality swamp in the east of the study area.

Southern Bent-wing Bat was recorded within the study area during both the Spring and Autumn migration periods for the sub-species. It is therefore likely that individuals of the sub-species do migrate through the study area but it is not possible to determine how many individuals do so or whether they use routes through the area. The relatively high number of records near the Shaw River in the west of the wind farm area suggests that some bats may migrate along this route between the Warrnambool maternity cave and the Byaduk overwintering cave (Figure 9). Migration routes may change between years and as such, the number of Southern Bent-wing Bats moving through the area could vary between years.

From the larger numbers of calls detected around the Shaw River and the 'Red Dog Swamp' (Willatook Wetland) it seems likely that individuals of the sub-species are foraging in these areas. This swamp represents the best quality habitat of this type within the wind farm area. Consequently, the riparian habitat and more-permanent swamps in the area may provide important foraging habitat for the sub-species.

The nearest known Southern Bent-wing Bat roosting site is located at Yambuk, which is approximately 10–15 kilometres from the proposed wind farm site, although not all roosting caves have been mapped and bats may be coming from a closer cave. The relatively high number of records near the Shaw River in the west of the wind farm area suggests that some bats may migrate along this route between the Warrnambool maternity cave and the Byaduk overwintering cave. The volcanic nature of the landscape in this area has resulted in the formation of sink holes, some of which may provide subterranean cavities suitable for roosting by the sub-species.

In contrast to reported seasonality of records for Yellow-bellied Sheathtail Bat in Victoria, which suggested that the species is nomadic and occurs within the state between January and June, this species was found to be active in the study area in October and November. This suggests that the species is a permanent resident in the study area and is probably not nomadic. This finding is supported by other observations of the species where the species has been active in western Victoria during this time of year (Ecology and Heritage Partners Pty Ltd 2012). Yellow-bellied Sheathtail Bat requires large tree hollows for roosting. Although large mature trees are uncommon in the study area, which is primarily cleared pasture, they do occur within riparian woodland along the Shaw River, and some roadside reserves including McKnight's Road, Riordans Road, Old Dunmore Road, Hopcrafts Road and Rowbottoms Road. The species is reported to forage over diverse habitat types and as such, is unlikely to be restricted in its foraging range over the study area.

Recommendation

A detailed suite of fauna surveys has already been completed, and it is not considered that additional fauna surveys are required.

3.4.3 Ecological Communities

Four nationally listed ecological communities are predicted to occur within 10 kilometres of the study area (DoEE 2017):

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain;

- Natural Temperate Grassland of the Victorian Volcanic Plain;
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains; and,
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Implications

Grassy Eucalypt Woodland of the Victorian Volcanic Plain

Habitat zones PGW2, PGW3 and PGW4 of the Plains Grassy Woodland EVC are dominated by an overstory of Manna Gum, and a species rich understory comprised of perennial native species including Wattles, Spear-grasses, Wallaby-grasses and scattered herbs. Weed cover is relatively low (less than 50%). However, PGW2, PGW3 and PGW4 are discrete patches with areas of 0.265 hectares, 0.218 hectares, and 0.374 hectares respectively. Therefore, as they are less than 0.5 hectares in size, they do not meet the size threshold that defines the ecological community (SEWPaC 2011). One other habitat zone denoted as PGW2, comprising an area of 0.569 hectares does meet the minimum size threshold, and is considered to meet the condition thresholds that define the nationally significant *Grassy Eucalypt Woodland of the Victorian Volcanic Plain* ecological community (SEWPaC 2011). 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.

All other habitat zones of Plains Grassy Woodland do not meet the condition threshold for this community due to the modified structure of native vegetation, high weed cover, and low species diversity. Similarly, areas of Stony Knoll Shrubland within the study area also do not meet the condition thresholds to qualify as Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Threatened Species Scientific Committee 2008).

Natural Temperate Grassland of the Victorian Volcanic Plain

Plains Grassland was recorded within the study area as a derived grassland community from Basalt Shrubby Woodland. This derived grassland community does not meet the thresholds that define the Natural Temperate Grassland of the Victorian Volcanic Plain (SEWPaC 2011), due to the high weed cover, and low species diversity present in this EVC.

Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains

Although the field assessments were not conducted during the optimal season timeframe to assess the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains ecological community (October – December), due to the modified condition of Plains Grassy Wetland patches that have affinities with the community, it is considered unlikely that these patches would meet the thresholds that define the community. Further, it is unlikely that these patches will be impacted by the infrastructure associated with the proposed windfarm due to their position in the landscape (gullies, depressed areas, streamlines etc), and as such, there is unlikely to be any impact to this nationally significant ecological community.

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

No specimens of White Box or Blakely's Red Gum were recorded within the study area. Therefore, due to the lack of relevant indicator species, this community is not considered present.

No native vegetation within the study area met the description of any FFG Act-listed ecological community due the modified of structure of vegetation, and low species diversity.

4 LEGISLATIVE AND POLICY IMPLICATIONS

4.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a Commonwealth process for the assessment of proposed actions likely to have a significant impact on any matters of National Environment Significance (NES), described in Table 13.

Table 13. Potential impacts to matters of National Environmental Significance (NES)

Matter of NES	Potential Impacts
World Heritage properties	The proposed action will not impact any properties listed for World Heritage.
National heritage places	The proposed action will not impact any places listed for national heritage.
Ramsar wetlands of international significance	There are no Ramsar wetlands within proximity of the proposed windfarm. Provided management practices and construction techniques are consistent with Construction Techniques for Sediment Pollution Control (EPA 1991) and Environmental Guidelines for Major Construction Sites (EPA 1996), the proposed action is unlikely to impact the ecological character of any Ramsar wetland, or other downstream waterbodies.
Threatened species and ecological communities	There is confirmed presence of one flora species (Basalt Peppercress), potential habitat within the study area for five flora species (Clover Glycine, Swamp Fireweed, Gorae Leek-orchid, Maroon Leek-orchid and Dense Leek-orchid) and confirmed habitat for four fauna species listed under the EPBC Act (Yarra Pygmy-Perch, Dwarf Galaxia, Southern Bent-wing Bat and Growling Grass Frog) (Section 3.4.1 and 3.4.2). 0.569 hectares of the Grassy Eucalypt Woodland of the Victorian Volcanic Plains is present within the study area (PGW2 – Figure 3c).
Migratory and marine species	20 Migratory and/or Marine species have been recorded within 10 kilometres of the study area (DELWP 2018d; Appendix 3.1). However, the study area would not be classed as an 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines (DoE 2013).
Commonwealth marine area	The proposed action will not impact any Commonwealth marine areas.
Nuclear actions (including uranium mining)	The proposed action is not a nuclear action.
Great Barrier Reef Marine Park	The proposed action will not impact the Great Barrier Reef Marine Park.
Water resources impacted by coal seam gas or mining development	The proposed action is not a coal seam gas or mining development.

4.1.1 Implications

Given the confirmed presence of Basalt Peppercress in the study area, once a site layout plan has been prepared, targeted surveys are recommended to quantify the distribution and location of the species within and adjacent to the development footprint. Pending the preparation of a site layout plan, targeted surveys for additional significant flora should be undertaken if potential habitat is proposed to be impacted.

Habitat zone PGW2 of the Grassy Eucalypt Woodland of the Victorian Volcanic Plains ecological community is located in the road reserve of Macknights Road, and is unlikely to be impacted by the development (Figure 3c).

Positioning turbine infrastructure and access roads to avoid all the creeks and wetlands with remnant native vegetation, and industry standard sediment control during construction will ensure that significant species (i.e. Growling Grass Frog and Yarra Pygmy Perch and Dwarf Galaxias) that depend on these habitats are unlikely to be impacted by the proposed development.

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

Discussion on offsets relevant to the EPBC Act is provided in Section 6.2.1.

4.2 *Flora and Fauna Guarantee Act 1988* (Victoria)

The FFG Act is the primary legislation dealing with biodiversity conservation and sustainable use of native flora and fauna in Victoria. Proponents are required to apply for an FFG Act Permit to 'take' listed and/or protected flora species, listed vegetation communities and listed fish species in areas of public land (i.e. within road reserves, drainage lines and public reserves). An FFG Act permit is generally not required for removal of species or communities on private land, or for the removal of habitat for a listed terrestrial fauna species.

There is suitable habitat within the study area for several 'listed' flora species and 'protected' flora and fauna species listed under the FFG Act (Appendix 2.1; Section 3.4).

4.2.1 Implications

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.

4.3 *Environment Effects Act 1978* (Victoria)

The *Environment Effects Act 1978* provides for assessment of proposed actions that are capable of having a significant effect on the environment via the preparation of an Environment Effects Statement (EES). A project with potential adverse environmental effects that, individually or in combination, could be significant in a regional or State context should be referred. An action may be referred for an EES decision where:

- one of the following occurs:
    - Potential clearing of 10 hectares or more of native vegetation from an area that:
        - is of an EVC identified as endangered by DELWP;

        - is, of Very High conservation significance; or,
        - is not authorised under an approved Forest Management Plan or Fire Protection Plan.
    - Potential long-term loss of a significant proportion (1-5% depending on conservation status of species) of known remaining habitat or population of a threatened species within Victoria.
- or where two or more of the following occur:
    - Potential clearing of 10 hectares or more of native vegetation, unless authorised under an approved Forest Management Act or Fire Protection Plan;
    - Matters listed under the FFG Act:
        - Potential loss of a significant area of a listed ecological community;
        - Potential loss of a genetically important population of an endangered or threatened species;
        - Potential loss of critical habitat; or,
        - Potential significant effects on habitat values of a wetland supporting migratory birds.

4.3.1 Implications

Based on the current development plan, and the extent of native vegetation as mapped by Ecology and Heritage Partners (including overlap with areas mapped as Current Wetland), the study area contains the following values:

- 254.879 hectares of EVCs classified as Endangered (all EVCs within the study area are classified as 'Endangered'); and,
- 17.790 hectares of Very High conservation significance vegetation.

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.

4.4 *Planning and Environment Act 1987* (Victoria)

The *Planning and Environment Act 1987* outlines the legislative framework for planning in Victoria and for the development and administration of planning schemes. All planning schemes contain native vegetation provisions at Clause 52.17 which require a planning permit from the relevant local Council to remove, destroy or lop native vegetation on a site of more than 0.4 hectares, unless an exemption under clause 52.17-7 of the Victorian Planning Schemes applies (Appendix 1.5.3) or a subdivision is proposed with lots less than 0.4 hectares[1]. Local planning schemes may contain other provisions in relation to the removal of native vegetation (Section 4.4.1).

[1] In accordance with the Victorian Civil and Administrative Tribunal's (VCAT) decision Villawood v Greater Bendigo CC (2005) VCAT 2703 (20 December 2005) all native vegetation is considered lost where proposed lots are less than 0.4 hectares in area and must be offset at the time of subdivision.

4.4.1 Local Planning Schemes

The study area is located within the Moyne Shire Council municipality. The following zoning and overlays apply (DELWP 2017f, 2017g):

- Farming Zone (FZ);
- Road Zone – Schedule 1 (RZ1);
- Special Use Zone – Schedule 5 (SUZ5);
- Environmental Significance Overlay – Schedule 4 (ESO4);
- Environmental Significance Overlay – Schedule 5 (ESO5); and,
- Bushfire Management Overlay (BMO).

Implications

Under ESO4 and ESO5, a permit is not required to construct a building or construct and carryout works, except if the buildings or works are to be used for accommodation, including a dwelling. This is to ensure that the development of the Shaw River (ESO4) and Tarrone (ESO5) Power Stations are not constrained by the establishment of potentially conflicting accommodation uses and developments nearby.

4.4.2 The Guidelines

The State Planning Policy Framework and the decision guidelines at Clause 52.17 (Native Vegetation) and Clause 12.01 require Planning and Responsible Authorities to have regard for 'Guidelines for the removal, destruction or lopping of native vegetation' (Guidelines) (DELWP 2017). Where the clearing of native vegetation is permitted, the quantity and type of vegetation to be offset is determined using methodology specified in the Guidelines. The primary objective of the regulations is "no net loss in the contribution made by native vegetation to Victoria's biodiversity".

A permit will be referred to DELWP as a 'recommending authority' if vegetation removal is assessed under the detailed assessment pathway.

Table 14. Determination of the assessment pathway under the Guidelines (DELWP 2017a).

Extent of native vegetation	Location 1	Location 2	Location 3
Less than 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

4.4.3 Implications

Once a development 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.

Demonstration of impact avoidance and minimisation will be required to be demonstrated through the selective placement of turbines and access roads.

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.

4.5 *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria)

The *Wildlife Act 1975* (and associated Wildlife Regulations 2013) is the primary legislation in Victoria providing for protection and management of wildlife. Authorisation for habitat removal may be obtained under the *Wildlife Act 1975* through a licence granted under the *Forests Act 1958*, or under any other Act such as the *Planning and Environment Act 1987*. Any persons engaged to remove, salvage, hold or relocate native fauna during construction must hold a current Management Authorisation under the *Wildlife Act 1975*, issued by DELWP.

Implications

Authorisation for habitat removal may be obtained under the *Wildlife Act 1975* through a licence granted under the *Forests Act 1958*, or under any other Act such as the *Planning and Environment Act 1987*. Any persons engaged to remove, salvage, hold or relocate native fauna during construction must hold a current Management Authorisation under the *Wildlife Act 1975*.

4.6 *Water Act 1989* (Victoria)

The purposes of the *Water Act 1989* are manifold but (in part) relate to the orderly, equitable, efficient and sustainable use of water resources within Victoria. This includes the provision of a formal means of protecting and enhancing environmental qualities of waterways and their in-stream uses as well as catchment conditions that may affect water quality and the ecological environments within them.

Numerous ephemeral drainage lines and streams are present throughout the study area. Additionally, Shaw River (and several minor tributaries) are present in the west of the study area.

A 'works on waterways' permit from the Glenelg Hopkins CMA is likely to be required where any action impacts on waterways within the study area. Additionally, where structures are installed within or across waterways that potentially interfere with the passage of fish or the quality of aquatic habitat, these activities should be referred to DELWP with the Glenelg Hopkins CMA included for comment.

4.7 *Catchment and Land Protection Act 1994* (Victoria)

The *Catchment and Land Protection Act 1994* (CaLP Act) contains provisions relating to catchment planning, land management, noxious weeds and pest animals. Landowners are responsible for the control of any infestation of noxious weeds and pest fauna species to minimise their spread and impact on ecological values.

Weeds listed as noxious under the CaLP Act were recorded during the assessment. Similarly, there is evidence that the study area is currently occupied by several pest fauna species listed under the CaLP Act. A Weed Management Plan and a pest fauna eradication plan may be required.

5 POTENTIAL IMPACTS

Any loss of ecological values within the study area should be viewed in the context of the overall ongoing loss, fragmentation, and deterioration in the quality of remnant vegetation throughout many areas of south western Victoria. Indeed, much of the study area has undergone dramatic change as a result of land clearing for agriculture. Consequently, incremental losses of ecological values are likely to continue across many areas throughout, and in the vicinity of the study area.

5.1 Potential Impacts on Flora

The majority of the study area has been cleared of native vegetation and little of the pre-1750 extent of EVCs remain within the study area and immediate surrounds.

No national or State listed threatened flora species were recorded during the June and July 2017 field assessment; however, the nationally significant Basalt Peppercress was previously recorded within the broader study area (Ecology and Heritage Partners 2011). At the time of the 2011 assessment, this species was not listed as a nationally significant species, therefore their locality within the study area is unknown. Additional nationally significant flora species (Clover Glycine, Swamp Fireweed, Gorae Leek-orchid, Maroon Leek-orchid and Dense Leek-orchid) may possibly occur within the study area, as suitable habitat is present within the study area and road reserves.

The nationally significant *Grassy Eucalypt Woodland of the Victorian Volcanic Plain* ecological community is present within habitat zone PGW2 in the north of the road reserve of Macknights Road.

Potential impacts include:

- Removal and/or disturbance to areas supporting patches of remnant native vegetation, or isolated trees and shrubs.
- Removal and/or disturbance to areas supporting potential habitat for threatened flora species.
- Decreases in population sizes of local flora and fauna as a consequence of habitat loss. However, there are opportunities to increase the total available habitat via revegetation using locally indigenous species.
- Potential for further spread of noxious and environmental weeds from on-site activities and subsequent degradation of remaining native vegetation.
- Loss of planted native and exotic trees and shrubs, which provide foraging, nesting and breeding habitat for native birds.

However, 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 and fauna habitat can be minimised through implementation of the measures detailed in Section 6.1.

5.2 Potential Impacts on Birds

The primary focus of the impacts of wind farm on birds is related to the collision with wind turbines (Kuvlesky *et al.* 2007), although collision with powerlines associated with wind farms has also been recorded (Janss and Ferrer 2000; Kuvlesky *et al.* 2007). However, wind farms have the potential to directly and indirectly impact birds and other taxa in other ways as well. For example, in Europe, displacement through habitat loss is considered the main detrimental effect of wind farms on avian abundance (Kuvlesky *et al.* 2007). This effect has been shown to manifest itself on both grassland birds that use habitat under the wind turbines (Leddy *et al.* 1999) and birds of prey that are frequently encountered within RSA (Farfán *et al.* 2009), although it is likely to affect all bird species to some extent. This effect is likely to occur because of the noise, movement and human disturbance associated with wind turbines (Leddy *et al.* 1999). This type of research has not been conducted in Australia, therefore the impact that this type of disturbance will have on Australian grassland birds is not well known.

The impact of increased bird mortality as a result of collisions with wind turbines or powerlines will affect different species in different ways. Affected species that are short-lived, with high annual reproduction rates, are likely to be able to absorb this additional mortality with little impact to their overall population size at a regional or national level (Chamberlain *et al.* 2006). By contrast, affected species that are long-lived, slowly reproducing species are more vulnerable to this type of additive mortality and may be less able to maintain viable population sizes when faced by such stresses (Sæther and Bakke 2000).

Twenty percent of observations during these surveys were of birds within, or above, RSA (Graph 2), however all of the birds observed during the current point count surveys are common birds in south-eastern Australia (an additional bird species, the Brolga, was not observed during point counts but during aerial surveys and is discussed further in Section 5.3). Further, it cannot be assumed that all the birds observed within the study area will collide with the wind turbines, as birds are known to adapt their behaviour in the presence of wind turbines to avoid an obstacle, such as a wind turbine, in their flight path (Farfán *et al.* 2009; A. Organ, pers. comm.).

Overseas studies have shown that even collision-prone bird species avoid collisions with wind generators on most occasions (Winkelman 1992a; 1992b; Still *et al.* 1995). A range of avoidance rates of bird species from overseas studies range from 100% to 98% (Winkelman 1992; Still *et al.* 1995). In Australia, three avoidance rates are commonly used when calculating collision risk of birds at wind farms: 95%, 98% and 99%. Avoidance rates in Australia have previously been recorded at the Codrington Wind Farm in Victoria, where birds have regularly exhibited 100% avoidance of turbines.

Despite the specific composition of the birds observed using RSA, it is likely that other species recorded during both the fixed-point count and incidental surveys will occasionally fly within RSA and a varying degree of mortality is likely to be expected for these species. Of importance with regards to assessing the risk of turbine collision are those birds that are threatened on a regional, state or national level.

However, given the low proportion of bird flights within the RSA (fewer than a quarter of bird movements observed during the surveys), the abundance of those species most likely to fly within this area, the high level of avoidance behaviour exhibited by many species of birds, buffers around the limited areas of high quality habitat and the predominantly low quality habitat that comprises the rest of the study area it is unlikely that the construction of the Willatook Wind Farm will have a significant impact on the avifauna of the region.

The rainfall for the year in which the waterbird survey was undertaken was slightly drier compared to the average yearly rainfall (679.2 mm in 2009 vs. 702.9 mm mean amount of rain: Appendix 4; BOM 2010), with many waterbodies particularly low during the survey period. This resulted in a reduced amount of habitat that would provide suitable habitat for waterbirds. On this basis it was not considered necessary to undertake targeted surveys for threatened species such as Latham's Snipe, as per the Commonwealth guidelines and it is highly unlikely that nationally significant numbers of any threatened wetland species exist within the study area (e.g. at least 18 individual birds in a single wetland; DEWHA 2009).

Ongoing monitoring of bird populations and mortalities at the wind farm, once built, would be required to ensure that bird mortality is at a low level. This will take the form of a Bird and Avifauna Management (BAM) Plan (See Section 7).

5.3 Potential Impacts on Brolgas

Cranes, both overseas and in Australia, have been identified as being prone to collision with powerlines (Goldstraw and Du Guesclin 1991; Janss and Ferrer 2000; Kuvlesky *et al.* 2007), although this does not specifically relate to turbine collisions. Brolgas, as Australian representatives of the Crane family, are therefore also seen as being potentially significantly impacted by collisions with aerial infrastructure, such as wind turbines. Indeed, the impact of wind farms on Brolgas is one of the key environmental issues facing the industry in south-western Victoria (DSE 2012), given the limited distribution of Brolgas in Victoria.

Wind farms have the potential to impact on the Brolga in the following ways:

- Habitat loss by removal of wetlands and nearby pasture habitats as a result of the construction of wind farm infrastructure;
- Collision with wind turbines, power lines and monitoring equipment;
- Disturbance of birds leading to displacement and exclusion from areas of suitable habitat or changes in behaviour; and
- Creation of barriers to flying birds, interrupting migratory movements between important habitat areas or disrupting local flight paths.

Although no nests were located during the extensive surveys of potential habitat in the 2009 breeding season, further aerial surveys have revealed an active nest in the much wetter 2010 breeding season (Appendix 4; Figure 8). This nest was located near Cockatoo Swamp and close to two historical breeding records for the species. Another nest has been identified just beyond the boundary of the wind farm annex, west of the main study area.

On ground assessment of other historical nest records and potential Brolga nests, identified during the aerial surveys, failed to positively identify other breeding Brolga sites. Despite this, a potential nest has been identified in suitable habitat to the west of the study area and because of the amount of rainfall in 2011, most of the historical nest-sites retain potentially suitable habitat for nesting.

During the July 2011 field trip, large amounts of the country surrounding the proposed wind farm were inundated, and had been since the preceding summer (D. Gleeson, Pers. Comm. 6 July 2011). This resulted in parts of the landscape looking more suitable for Brolgas than they have in the previous two years of field work. The result of the field work during such a wet year, is a conservative approach to the assessment of the

likelihood of Brolga habitat occurring within the study area. This assessment of the amount of Brolga habitat within the study area remains low, despite relatively more suitable habitat occurring outside the study area.

The nearest flocking site is located near Penshurst, approximately 32km north of the study area. This site was identified by Sheldon (2004).

The Brolga Guidelines (DSE 2012) recommend that a 3.2 km and 5 km radius turbine-free buffer from breeding sites and flock roost sites respectively, will adequately meet the objectives set for these habitats. The Brolga guidelines also consider that smaller buffer distances could be acceptable if it can be demonstrated that they meet the objectives set for breeding and nesting habitats provided they meet with the satisfaction of DELWP.

As suggested in the Brolga Guidelines, WWF has consulted with DELWP regarding site design and appropriate turbine free buffer distances following the completion of Level 2 surveys. During this consultation DELWP advised the following:

- Turbine free buffers are not required for records of incidental Brolga sightings.
- Turbine free buffers should apply to both current and historical nest sites.
- Further detailed work such as home range surveys of nest sites within the study area is not recommended due to the small number of active nests (a single nest).
- Further detailed home range studies at the investigation area is also not recommended in the context of extensive existing data of this type already collected from across south-west Victoria.
- DELWP has advised that recent home range surveys undertaken by others near the investigation area indicate that smaller turbine free buffers may be justifiable and that further analysis of existing home range survey data would therefore confirm appropriate buffer distances of Brolga nest sites within and proximate to the study area.

It is recommended that WWF undertake the analysis of existing data as advised by DELWP and in consultation with DELWP.

5.4 Potential Impacts on the Southern Bent-wing Bat

Bats are susceptible to mortality caused by wind turbines (Arnett 2005; Bearwald *et al*. 2008, Kunz *et al*. 2007). In some habitats both a high number of individuals and species are struck by wind turbines, especially those bat species that undertake large scale annual migrations (Kunz *et al*. 2007; Kuvlesky *et al*. 2007; Cryan and Barclay 2009). Furthermore, bats may be attracted to wind turbines following vortices created by the blade tips and have been observed investigating all parts of the turbine (Horn *et al*. 2008; Cryan and Barclay 2009). There is also potential for bats to die as a result of barotrauma caused by changes in pressure produced by the rotating turbines (Bearwald *et al*. 2008, Cryan and Barclay 2009).

The detection of Southern Bent-wing Bats within the wind farm area during the known migration period for the sub-species (October to November and February to March), suggests that individuals of the sub-species are migrating through the area. However, it is not possible to determine what proportion of the population are migrating through this area, whether they are concentrated around certain migration routes or whether their migration paths are likely to vary from year to year. Southern Bent-wing Bats may have been foraging in

and around the areas in which they were detected and periodically move between feeding and temporary roost sites or they may merely be moving through the area to more suitable feeding areas. The larger number of records near the Shaw River and a more-permanent swamp, suggest that the sub-species may forage around areas of higher quality habitat. The nearest Southern Bent-wing Bat roosting site is located at Yambuk (near Warrnambool), which is approximately 10–15 kilometres from the proposed wind farm site, although not all roosting caves have been mapped and bats may be coming from a closer cave (L. Lumsden, DELWP, pers. comm.).

Anabat detectors can detect bat calls at between 5 and 20 metres depending on the bat species and how far it projects its echolocation call, therefore the Southern Bent-wing Bats that were recorded during the current survey were not flying within the rotor swept area (41 – 220 metres). Nevertheless, this sub-species is a fast aerial feeder, known to fly above the canopy, and this may bring it within the rotor swept height (Kutt 1995). Determining the exact proportion of the sub-species flying at this height appears to be extremely difficult, given that wind moving past the anemometer tower creates severe noise interference, and interfering with call detection. Additionally, the anemometer tower is just one point within an expansive area and is deliberately placed in the most open section of the wind-farm area. If the sub-species uses ground-based features (e.g. streams and remnant vegetation) to guide its migration routes, then open areas may not be utilised as extensively by the species during migration.

Given the relatively low numbers of Southern Bent-wing Bats detected within the Willatook wind farm area in comparison to the nearby Penshurst Wind Farm (Biosis Research Pty Ltd 2011), it seems unlikely that this particular wind farm alone would have a significant impact on the sub-species, particularly given that most wind turbines area sited within open paddocks away from most areas likely to see high levels of bat activity. However, the cumulative effects of wind farms proposed throughout south-western Victoria may have a significant impact on the Victorian population of Southern Bent-wing Bats. Four neighbouring wind farms include the operational Macarthur Wind Farm (140 turbines), and Hawkesdale Wind Farm (26 turbines), Woolsthorpe Wind Farm (up to 20 turbines), and Ryan Corner Wind Farm (56 turbines) already have planning approval. Minimising the cumulative impact of all wind farms on the sub-species requires a strategic approach which is well beyond the scope of the current assessment.

The results of monitoring from the WWF should be reviewed in the context of the results collected from other windfarms in the locality to assist in determining any cumulative effect on the sub-species. If required, a strategic population-wide approach could be undertaken to accurately determine and monitor the cumulative impacts of wind farms on Southern Bent-wing Bat. This approach could involve the long-distance tracking of individuals throughout south-western Victoria to the Warrnambool maternity roost over a period of years to determine the migration routes for the species. Methods including radio tracking and banding of individuals might be used to determine movement patterns. Radar tracking could be used to determine flight height and movements of groups of bats.

5.5 Potential Impacts on Yellow-bellied Sheathtail Bat

Yellow-bellied Sheathtail Bat is known to be a high-flying species of microbat and consequently may be at risk from collision and barotrauma from rotor blades. However, the species is widely dispersed across Australia and, as such, significant impacts to the species from this particular wind farm are unlikely.

As described for Southern Bent-Wing Bat, determining the cumulative effects of multiple wind farms on the species is beyond the scope of this assessment. As such a strategic state-wide approach to determine the

likely effects and necessary mitigation measures for the species may be required. Long-term monitoring of Yellow-bellied Sheathtail Bat fatalities at wind farms during operation and adaptive mitigation measures are recommended.

5.6 Potential Impacts on Threatened Frog Species

Although no threatened frog species were detected during the targeted surveys, the presence of Growling Grass Frogs adjacent to the study area and potentially suitable habitat within the study area means that this species may use the study area on some occasions. Surveys were undertaken at all the areas of suitable habitat during the current season, however the dynamic nature of wetlands means that this may change and more suitable habitat may occur in wetter years. In such years, Cockatoo Swamp may provide suitable habitat for Growling Grass Frogs, although the absence of populations in nearby waterways reduces this likelihood.

Potential direct and indirect impacts to threatened frog species and wetland habitats, as a result of the proposed development include:

- Increase in sedimentation and deterioration in water quality as a result of water runoff during construction;
- Direct mortality of frog species and associated habitats at any proposed waterway and drainage line crossings; and,
- Removal of habitat (e.g. riparian zone vegetation).

To mitigate against such impacts, 30 metre buffers should be established around existing waterbodies, including those that may potentially provide habitat for the frogs. These waterbodies must contain open, standing water with emergent and submerged vegetation, or be slow moving creeks with back-currents. In the study area this habitat is found along the Moyne and Shaw Rivers on a permanent basis and may occur in other places, such as Cockatoo Swamp (which is currently proposed to have a 200-metre buffer), on a seasonal basis.

5.7 Potential Impacts on Swamp Skink

Surveys for Swamp Skink were undertaken in all areas of potentially suitable habitat. As stated previously, due to the dynamic nature of wetlands—the type of habitat inhabited by Swamp Skinks—this area may change in wetter or drier years, although this is likely to be a slower process than for frogs because of the requirement for vegetative change to occur in conjunction with this change in hydrological condition.

Potential direct and indirect impacts to Swamp Skink and its habitats, as a result of the proposed development include:

- Increase in sedimentation and deterioration in water quality as a result of water runoff during construction;
- Direct mortality of Swamp Skinks and associated habitats at any proposed waterway and drainage line crossings; and,
- Removal of habitat (e.g. riparian zone vegetation).

To mitigate against such impacts, 30 metre buffers should be established around the Moyne and Shaw Rivers and the patch of revegetation on Nardoo Road where the species was recorded. If tracks and other infrastructure cannot be relocated and must cross these waterways the mitigations measures discussed in Section 6.1 should be implemented.

5.8 Potential Impacts on Aquatic Fauna

Surveys for aquatic fauna were undertaken in representative areas across the study area. The results from these areas should inform the treatment of all the major waterways across the study area, especially those with native riparian vegetation and the two named creek lines within the study area.

Potential direct and indirect impacts to aquatic fauna species and riparian habitats as a result of the proposed development include:

- Increase in sedimentation and deterioration in water quality as a result of water runoff during construction;
- Inhibition of species movement by crossings required for site access;
- Changes to surface/groundwater hydrology as a result of construction;
- Direct mortality of aquatic species and associated habitats at any proposed waterway and drainage line crossings; and,
- Removal of habitat (e.g. riparian zone vegetation).

In particular, care must be taken in the proximity of the Moyne River where Yarra Pygmy Perch were recorded and Kangaroo Creek where Dwarf Galaxias were recorded. Dwarf Galaxias and Yarra Pygmy Perch are small bodied species that occur within areas with a high abundance of macrophytes and in areas where there is a high abundance of trailing bank vegetations. Impacts on this habitat may be caused by direct removal and by the discharge or release of poor water quality into the system.

To mitigate against such impacts, 30 metre buffers should be established around waterbodies, that may potentially provide habitat for the significant fish species. In the study area this habitat is found along the Moyne and Shaw Rivers and well vegetated tributaries on a permanent basis and may occur in other places, such as Cockatoo Swamp (which is currently proposed to have a 200 metre buffer), on a seasonal basis.

5.9 Cumulative Impacts of Wind Farms in South Western Victoria

The Willatook Wind Farm will be one of eight wind farms that are currently proposed or operating in this part of South Western Victoria (Table 15). A number of other infrastructure developments are also in development for the region (for example the Shaw River Power Station). Three wind farms are currently operating to the south-west of the current study area (Macarthur, Yambuk and Codrington). Another three wind farms have construction approval (Hawkesdale Wind Farm, Woolsthorpe Wind Farm, and Ryan Corner). At least one more wind farm at Tarrone is also proposed.

Clearly cumulative impacts will only occur if all or some of the wind farms in various stages of planning and development are seen through to fruition. The result of these wind farm developments will be to increase the

number of turbines in the region, potentially increasing the likelihood of collisions between birds and wind turbines or displacing species from habitat that is no longer suitable because of the noise and visual interference of the wind farms.

Therefore, although some cumulative impacts may occur, the DELWP is the authority responsible for monitoring and acting to mitigate any such impacts as they occur. Despite this, ongoing monitoring of bird populations, through an extension of the Bird Utilisation Surveys conducted in this study, following commissioning of the wind farm, will enable the proponent to identify and mitigate cumulative impacts as other wind farms are brought on line.

Table 15. Wind farms proposed for the south-western Victorian region in the proximity of the proposed Willatook Wind Farm.

Wind Farm	Status	No. turbines	Distance/direction from closest Willatook WF turbine to closest other WF turbine (km)	Area within wind farm boundary (Hectares)
Willatook Wind Farm	Proposed	83	N/A	6,839
Yambuk Wind Farm	Operating	20	16.8km SW	786
Codrington Wind Farm	Operating	14	16.9km SW	494
Macarthur wind Farm	Operating	140	2.8km N	6,034
Hawkesdale Wind Farm	Approved	26	6.2km E	2,779
Ryan Corner Wind Farm	Approved	56	6.6km S	3,487
Woolsthorpe Wind Farm	Approved	20	9.3km E	777
TOTAL		**359**		**21,206**

5.10 The Impact of Climate Change

Climate change is likely to have an impact on both the flora and fauna of the study area. There has been recent speculation about the movement of wetlands south as the interior of Australia becomes increasingly arid. This conjecture is not supported by empirical data and it is likely that changes in Australia's climate will have unpredictable impacts on Australia's biodiversity, including birds (Pittock 2003). Changes that have already occurred as a result of the effect of climate change on birds include changes to distribution, phenology, morphology and physiology, behaviour, and abundance and population dynamics (Chambers *et al.* 2005).

As climate change is better understood it may be that developments such as wind farms need to be mindful of the impacts of this phenomenon, however at present, this is not possible. It should also be noted that wind farms are a 'clean' energy source with relatively very low carbon emissions.

6 MITIGATION MEASURES

6.1 Best Practice Mitigation Measures

Recommended measures to mitigate impacts upon terrestrial and aquatic values present within the study area may include:

- Minimise impacts to native vegetation and habitats through construction and micro-siting techniques, including fencing retained areas of native vegetation. If indeed necessary, trees should be lopped or trimmed rather than removed. Similarly, soil disturbance and sedimentation within wetlands should be avoided or kept to a minimum, to avoid, or minimise impacts to fauna habitats;
- All contractors should be aware of ecologically sensitive areas to minimise the likelihood of inadvertent disturbance to areas marked for retention. Habitat Zones (areas of sensitivity) should be included as a mapping overlay on any construction plans;
- Tree Retention Zones (TRZs) should be implemented to prevent indirect losses of native vegetation during construction activities (DSE 2011). A TRZ applies to a tree and is a specific area above and below the ground, with a radius 12 x the DBH. At a minimum standard a TRZ should consider the following:
    - A TRZ of trees should be a radius no less than two metres or greater than 15 metres;
    - Construction, related activities and encroachment (i.e. earthworks such as trenching that disturb the root zone) should be excluded from the TRZ;
    - Where encroachment exceeds 10% of the total area of the TRZ, the tree should be considered as lost and offset accordingly;
    - Directional drilling may be used for works within the TRZ without being considered encroachment. The directional bore should be at least 600 millimetres deep;
    - The above guidelines may be varied if a qualified arborist confirms the works will not significantly damage the tree (including stags / dead trees). In this case the tree would be retained and no offset would be required; and,
    - Where the minimum standard for a TRZ has not been met an offset may be required.
- Removal of any habitat trees or shrubs (particularly hollow-bearing trees) should be undertaken under the supervision of an appropriately qualified zoologist to salvage and translocate any displaced fauna. A Fauna Management Plan may be required to guide the salvage and translocation process;
- Where possible, construction stockpiles, machinery, roads, and other infrastructure should be placed away from areas supporting native vegetation, LOTs and/or wetlands;
- Wind turbines should be constructed no less than 30 metres (as per standard construction practice) from Moyne River, Kangaroo Creek and Shaw River and infrastructure that crosses these waterways should be designed to minimise impact across the waterways and tributaries that support native aquatic vegetation;
- Construction should have an environmental audit process in place for the construction works to be audited on a regular basis;

- All chemicals on site should be correctly bunded and stored following EPA Bunding Guidelines (EPA 1992).
- Ensure that best practice sedimentation and pollution control measures are undertaken at all times, in accordance with Environment Protection Authority guidelines (EPA 1991; EPA 1996; Victorian Stormwater Committee 1999) to prevent offsite impacts to waterways and wetlands; and,
- As indigenous flora provides valuable habitat for indigenous fauna, it is recommended that any landscape plantings that are undertaken as part of the proposed works are conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs.

In addition to these measures, the following documents should be prepared and implemented prior to any construction activities:

- Construction Environmental Management Plan (CEMP). The CEMP should include specific species/vegetation conservation strategies, daily monitoring, sedimentation management, site specific rehabilitation plans, weed and pathogen management measures, etc.;
- Weed Management Plan. This plan should follow the guidelines set out in the CaLP Act, and clearly outline any obligations of the project team in relation to minimising the spread of weeds as a result of this project. This may include a pre-clearance weed survey undertaken prior to any construction activities to record and map the locations of all noxious and environmental weeds;
- Significant Species Conservation Management Plan (CMP). A CMP will be required if significant species or their habitats are proposed to be impacted, and may include a salvage and translocation plan; and,
- Fauna Management Plan. This may be required if habitat for common fauna species is likely to be impacted and salvage and translocation must be undertaken to minimise the risk of injury or death to those species.

6.2 Offset Impacts

6.2.1 Commonwealth (EPBC Act)

The Australian Government's EPBC Act Environmental Offsets Policy (SEWPaC 2012) outlines a framework for the use of environmental offsets under the EPBC Act including when they can be required, how they are determined and the framework under which they operate. Clear guidelines on what constitutes a suitable offset are provided and should be considered as part of any proposed offset strategy. Suitable offsets must include the following:

1. It delivers an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development.
2. It is built around direct offsets but may include compensatory measures.
3. It is in proportion to the level of statutory protection that applies to the protected manner.
4. It is of a size and scale proportionate to the residual impacts on the protected manner.
5. It is additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.

6. It effectively accounts for and manages the risks of the offset not succeeding.
7. It is efficient, effective, timely, transparent, scientifically robust and reasonable.
8. It has transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

If impacted, offsets are likely to be required for Basalt Peppercress, Southern Bent-wing Bat, Yarra Pygmy Perch, Dwarf Galaxias, Growling Grass Frog, and/or the Grassy Eucalypt Woodland of the Victorian Volcanic Plains community.

However, it is anticipated that direct and indirect impacts can be avoided through detailed design and siting of windfarm infrastructure.

6.2.2 State (The Guidelines)

6.2.2.1 Offset Criteria

The Guidelines (DELWP 2017) require offsetting as the final step in considering the impacts of development on native vegetation. Emphasis is placed on avoiding and minimising impacts, and only after these steps have been taken should offsets be considered.

6.2.2.2 Offset Options

Potential offsets may be sourced using the following mechanisms:

- BushBroker: BushBroker maintains a register of landowners who are willing to sell offset credits. Offsets secured by Bushbroker are done so via a Section 69 Agreement under the *Conservation, Forest and Lands Act 1987*.
- Trust for Nature: Trust for Nature holds a list of landowners who are willing to sell vegetation offsets. Offsets secured by Trust for Nature are done so under the Victorian *Conservation Trust Act 1972*.
- Over-the-Counter Offsets Scheme: The Guidelines include the expansion of the "Over-the-Counter" (OTC) Offsets Scheme, allowing non-government agencies to establish themselves as OTC Facilities. OTC Facilities will broker native vegetation offsets (credits) between landholders (with offset sites) and permit holders (with offset requirements).

6.2.2.3 Offset Strategy

Ecology and Heritage Partners are a DELWP accredited OTC offset broker. Once a development plan is prepared, vegetation impacts are known and offset obligations have been quantified, Ecology and Heritage Partners will prepare a detailed offset strategy detailing how the offsets will be secured.

7 CONCLUSION

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 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.

Ecological values

Native Vegetation

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 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 16). Excluding the 'Current Wetland' layer, a total of 130.409 hectares of native vegetation is present (Table 16).

In addition, a total of 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.

Table 16. 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**

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.

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, Swamp Fireweed, Gorae Leek-orchid, Maroon Leek-orchid and Dense Leek-orchid. In addition, there potential habitat for the State significant Swamp Flax-lily, Basalt Leek-orchid and Slender Bitter-cress.

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 terrestrial and avian fauna species were observed during the 2011 field surveys, comprising 19 mammals (including 11 species of bat identified to species level), 76 birds, three reptiles and five frogs.

Four nationally significant fauna species were recorded during the field surveys; one Southern Bent-wing Bat call was recorded during the Anabat surveys, and a Growling Grass Frog was heard from a wetland located to the east of the study area. Dwarf Galaxias and Yarra Pygmy Perch were recorded within the Moyne River outside the study area. In addition, one State significant (Eastern Great Egret) and Regionally significant species (Royal Spoonbill) were recorded during bird surveys; Royal Spoonbill was seen in wet depressions on several occasions and Eastern Great Egret was seen on the wetlands adjacent to the study area and Swamp Skink was also trapped in a wetland near the Moyne River.

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 (SEWPaC 2011). 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 of structure of vegetation, high weed cover and low species diversity

Brolga

All the historical nest sites are likely to need to be buffered by 3.2 kilometres as per the DELWP Brolga Guidelines (DSE 2012), which have been upheld by two recent Panels Victoria deliberations. However, through further consultation with DELWP, it is possible that the 3.2 kilometre buffer may be reduced in this instance.

Targeted Significant Bat Surveys

Both the nationally significant Southern Bent-wing Bat and state significant Yellow-bellied Sheathtail Bat were recorded within the study area during both the Spring and Autumn survey periods. The presence of individuals of Southern Bent-wing Bat during the migration periods for the sub-species suggests that at least part of the

population is migrating through the wind farm area. During the present surveys, the highest number of calls for the sub-species occurred in the west of the study area near the Shaw River. It is possible that this represents a migration route for the species. The presence of Yellow-bellied Sheathtail Bat in both survey periods suggests that individuals of the species are permanent residents in the area and not nomadic, as previously suggested for the species in Victoria.

Given the lack of knowledge about both species, there remains the potential for impacts to the species, particularly on Southern Bent-wing Bat due to the limited distribution of the sub-species. Consequently, a referral to the Commonwealth Environment Minister under the EPBC Act is recommended.

It is recommended that a Bird and Bat Management (BAM) Plan be developed before commencement of construction, incorporating mitigation measures to limit impacts to both significant microbat species.

Recommendations

It is recommended that WWF:

1. Adopt the impact minimisation measures as outlined in the previous section;
2. Prior to construction, develop a CEMP with specific management actions to mitigate against potential impacts to areas of ecological value;
3. Prior to construction, 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. 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 generators;
    b. A procedure for addressing significant impacts of birds and bat populations caused by the wind energy facility operation. 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 must design 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, 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.

e. Once a development plan 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.

8 FURTHER REQUIREMENTS

Further requirements associated with development of the study area, as well as additional studies or reporting that may be required, are provided below (Table 17).

Table 17. Further requirements associated with development of the study area.

Relevant Legislation	Implications	Further Action
Environment Protection and Biodiversity Conservation Act 1999	There is confirmed presence of one flora species (Basalt Peppercress), potential habitat within the study area for five flora species (Clover Glycine, Swamp Fireweed, Gorae Leek-orchid, Maroon Leek-orchid and Dense Leek-orchid) and confirmed habitat for four fauna species listed under the EPBC Act (Yarra Pygmy-Perch, Dwarf Galaxia, Southern Bent-wing Bat and Growling Grass Frog). 0.569 hectares of the Grassy Eucalypt Woodland of the Victorian Volcanic Plains is present within the study area.	Once a development plan is prepared, targeted surveys are recommended to quantify the distribution and location of Basalt Peppercress within the study area. An EPBC Act referral to the Commonwealth Environment Minister should be submitted to determine potential impacts to matters of NES within the study area to address potential impacts to the Southern Bent-wing Bat, Basalt Peppercress, Grassy Eucalypt Woodland of the Victorian Volcanic Plains community, and any other flora and fauna likely to be impacted by the windfarm development.
Flora and Fauna Guarantee Act 1988	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.	Prepare and submit a FFG Act permit application to DELWP for the removal of protected flora on public land.
Environment Effects Act 1978	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.	Prepare and submit a referral under the *Environment Effects Act 1978* to DELWP.
Planning and Environment Act 1987	Once a development 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.	Planning Permit conditions are likely to include a requirement for: • Security of a compliant offset, as detailed in Section 3.2. • A Construction Environment Management Plan (CEMP). • A Significant Species CMP (as required).
Catchment and Land Protection Act 1994	Several weed species listed under the CaLP Act were recorded within the study area. To meet requirements under the CaLP Act, listed noxious weeds should be appropriately controlled throughout the study area.	Planning Permit conditions are likely to include a requirement for a Weed Management Plan.

Relevant Legislation	Implications	Further Action
Water Act 1989	A 'works on waterways' permit is likely to be required from the Glenelg Hopkins CMA where any action impacts on waterways within the study area.	Obtain a 'works on waterways' permit from Glenelg Hopkins CMA.
Wildlife Act 1975	Any persons engaged to conduct salvage and translocation or general handling of terrestrial fauna species must hold a current Management Authorisation.	Ensure wildlife specialists hold a current Management Authorisation.

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FIGURES

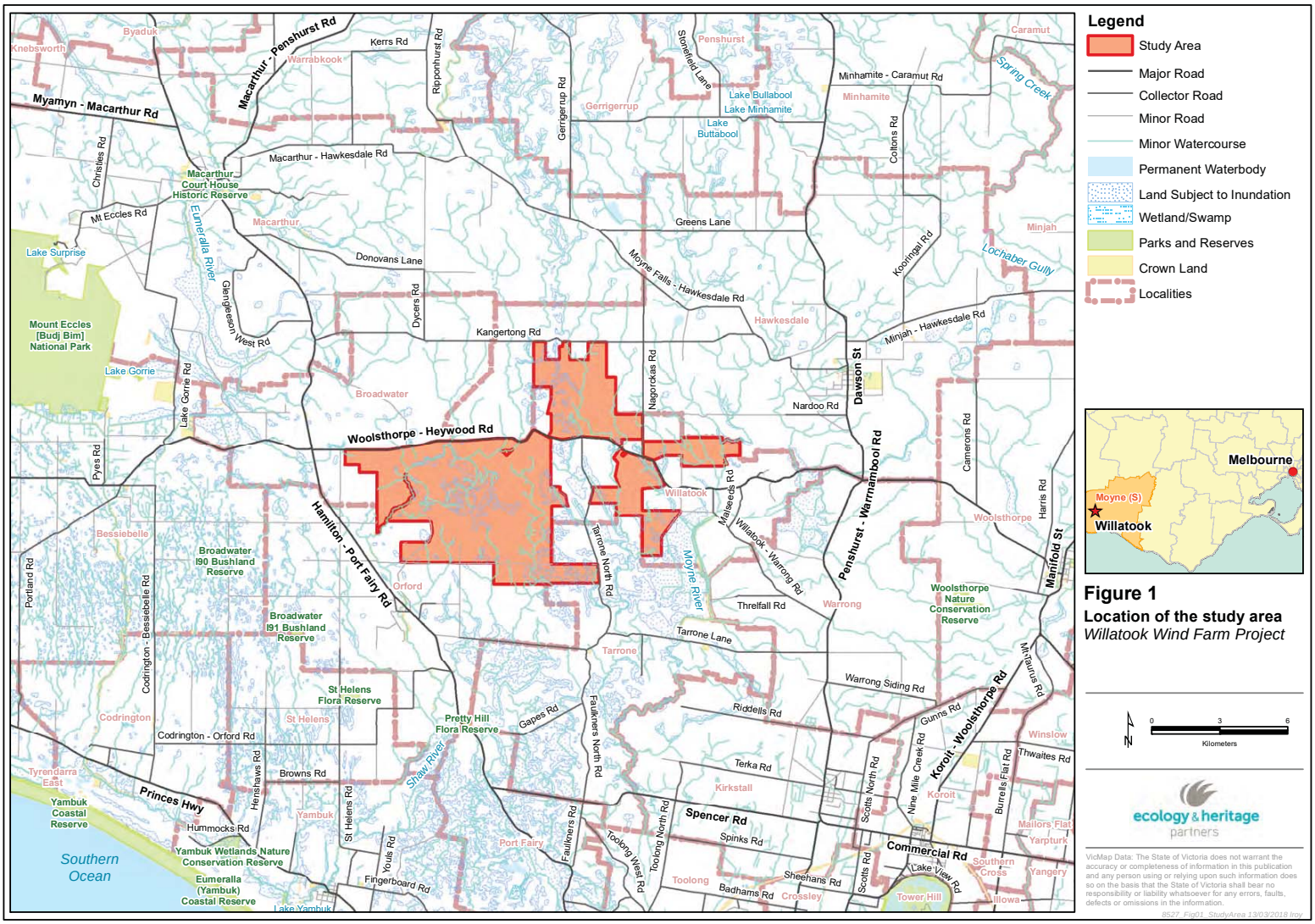

Figure 1

Location of the study area

Willatook Wind Farm Project

ecology & heritage partners

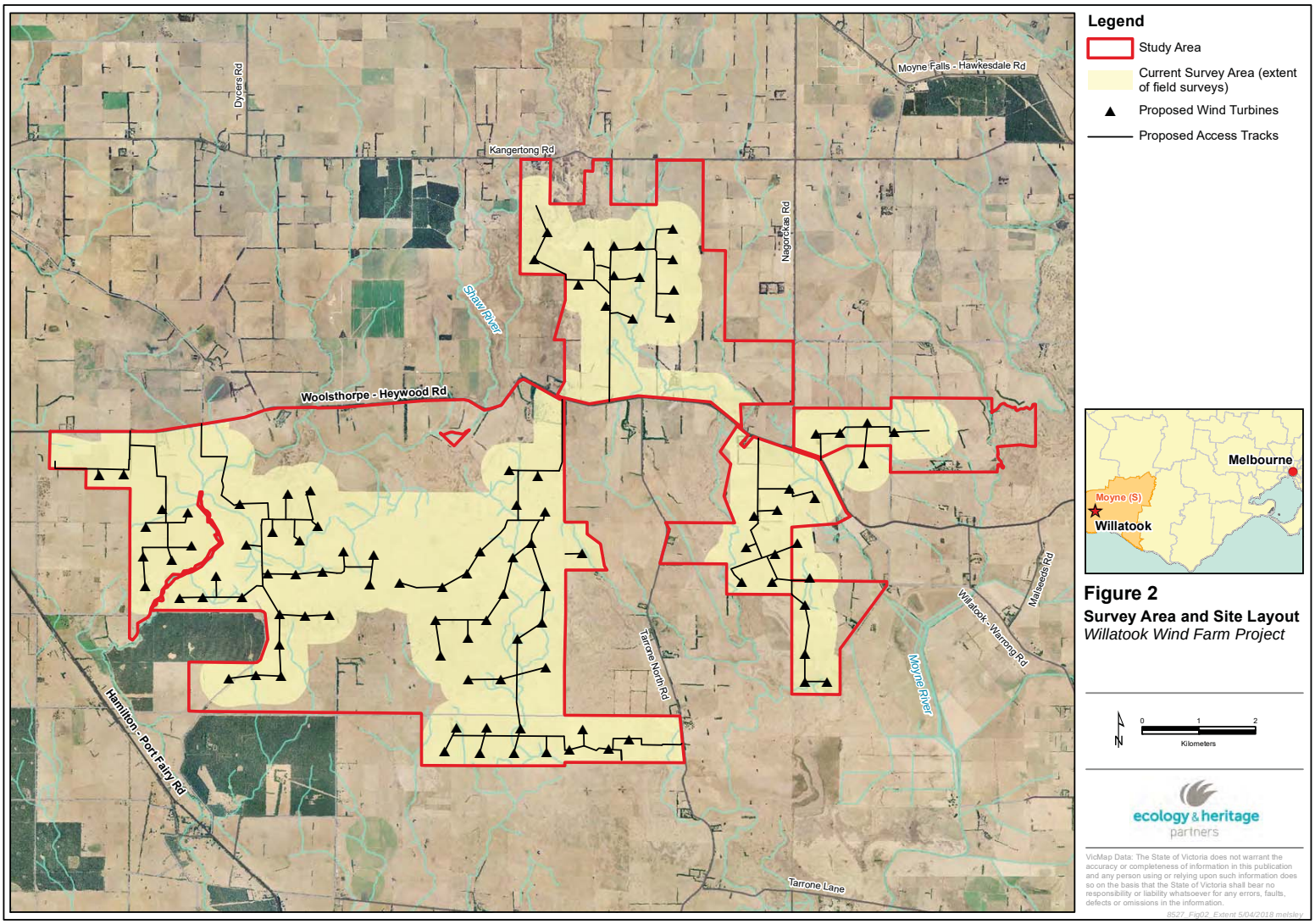

Figure 2

Survey Area and Site Layout

Willatook Wind Farm Project

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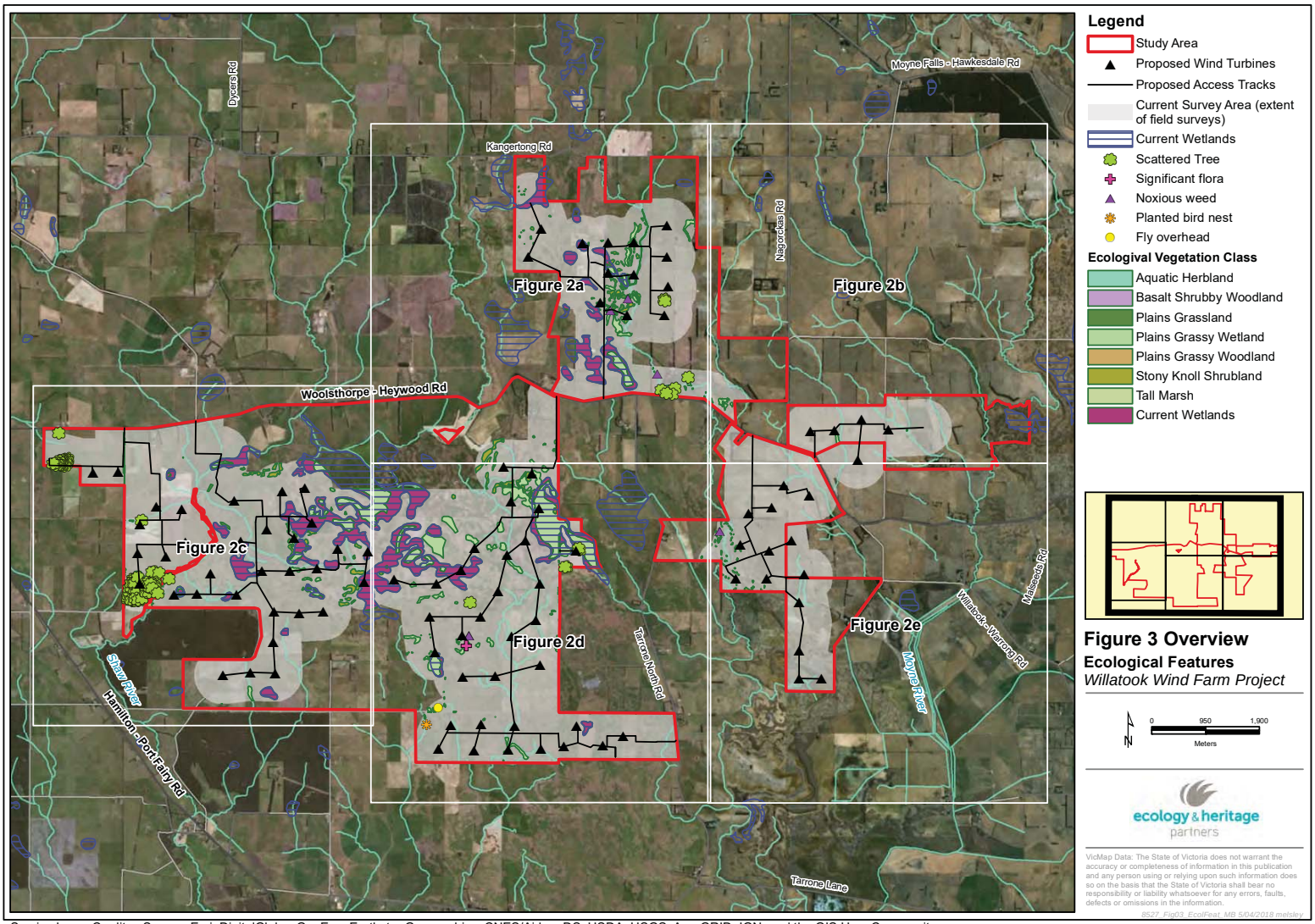

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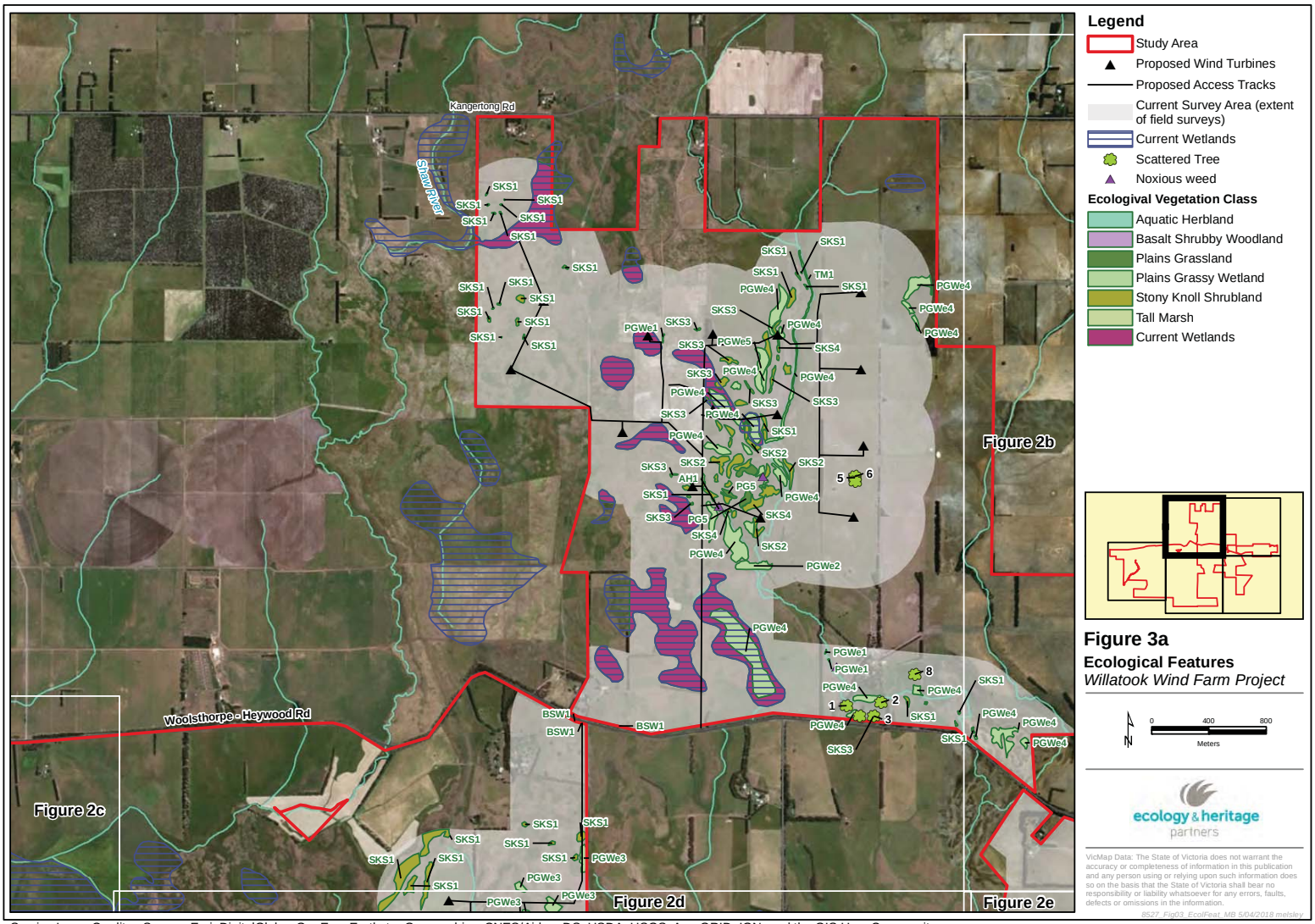

Figure 3a

Ecological Features

Willatook Wind Farm Project

ecology & heritage partners

8527_Fig03_EcolFeat_MB 5/04/2018 melsley

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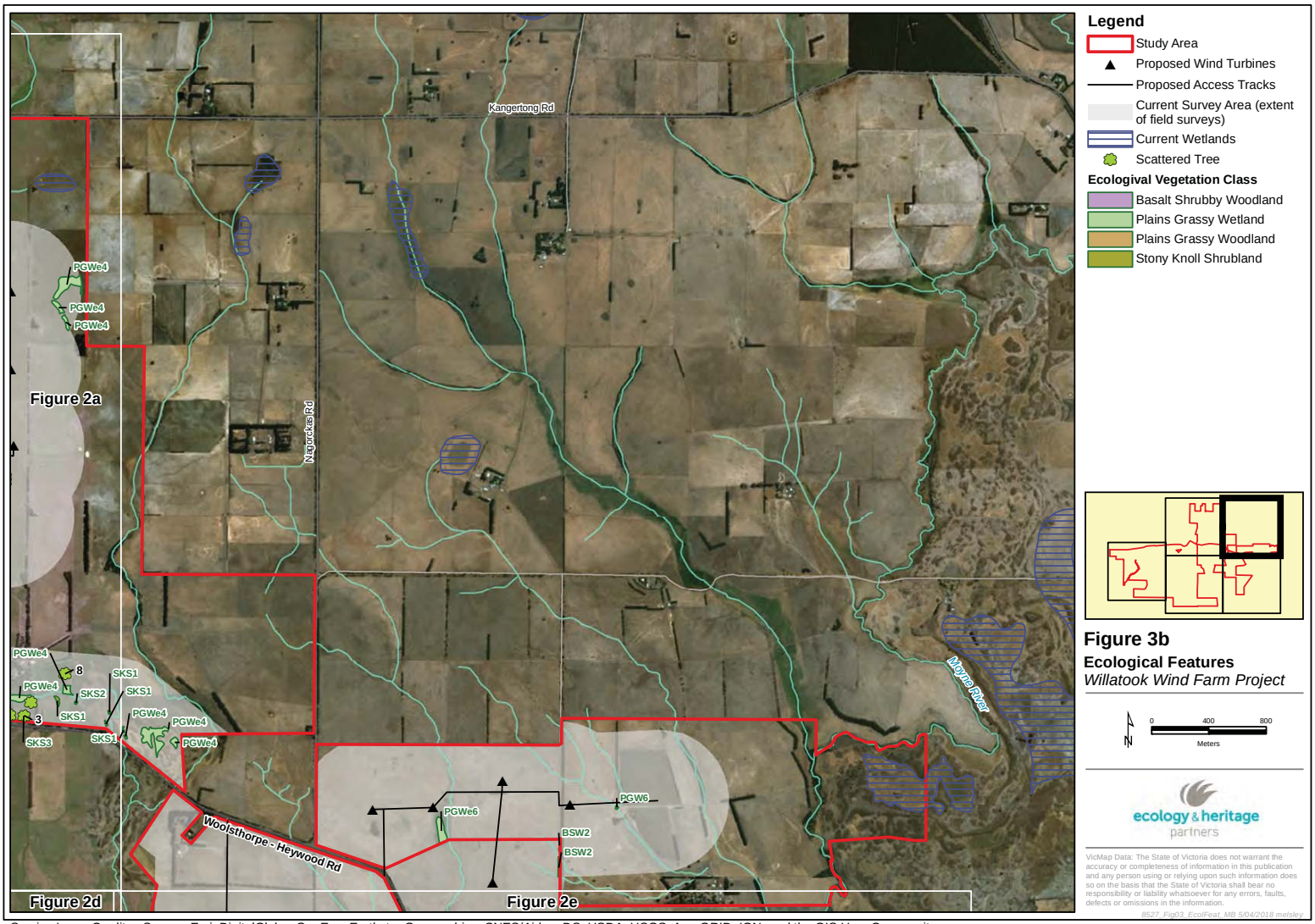

Figure 3b

Ecological Features

Willatook Wind Farm Project

ecology & heritage partners

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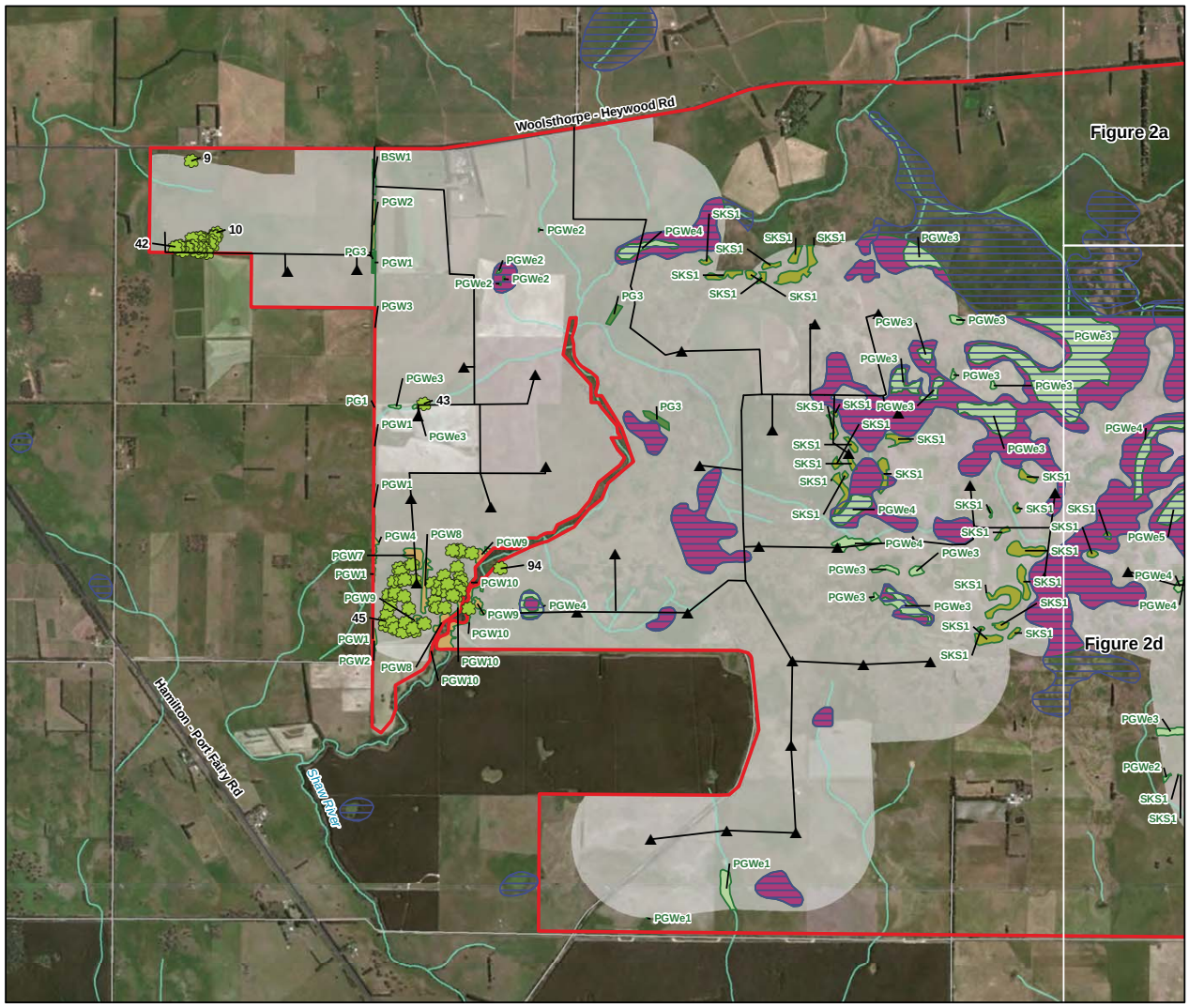

Legend

- Study Area
- Proposed Wind Turbines
- Proposed Access Tracks
- Current Survey Area (extent of field surveys)
- Current Wetlands
- Scattered Tree

Ecologival Vegetation Class

- Basalt Shrubby Woodland
- Plains Grassland
- Plains Grassy Wetland
- Plains Grassy Woodland
- Stony Knoll Shrubland
- Current Wetlands

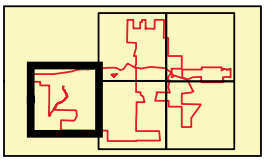

Figure 3c

Ecological Features

Willatook Wind Farm Project

N

0 400 800

Meters

ecology & heritage partners

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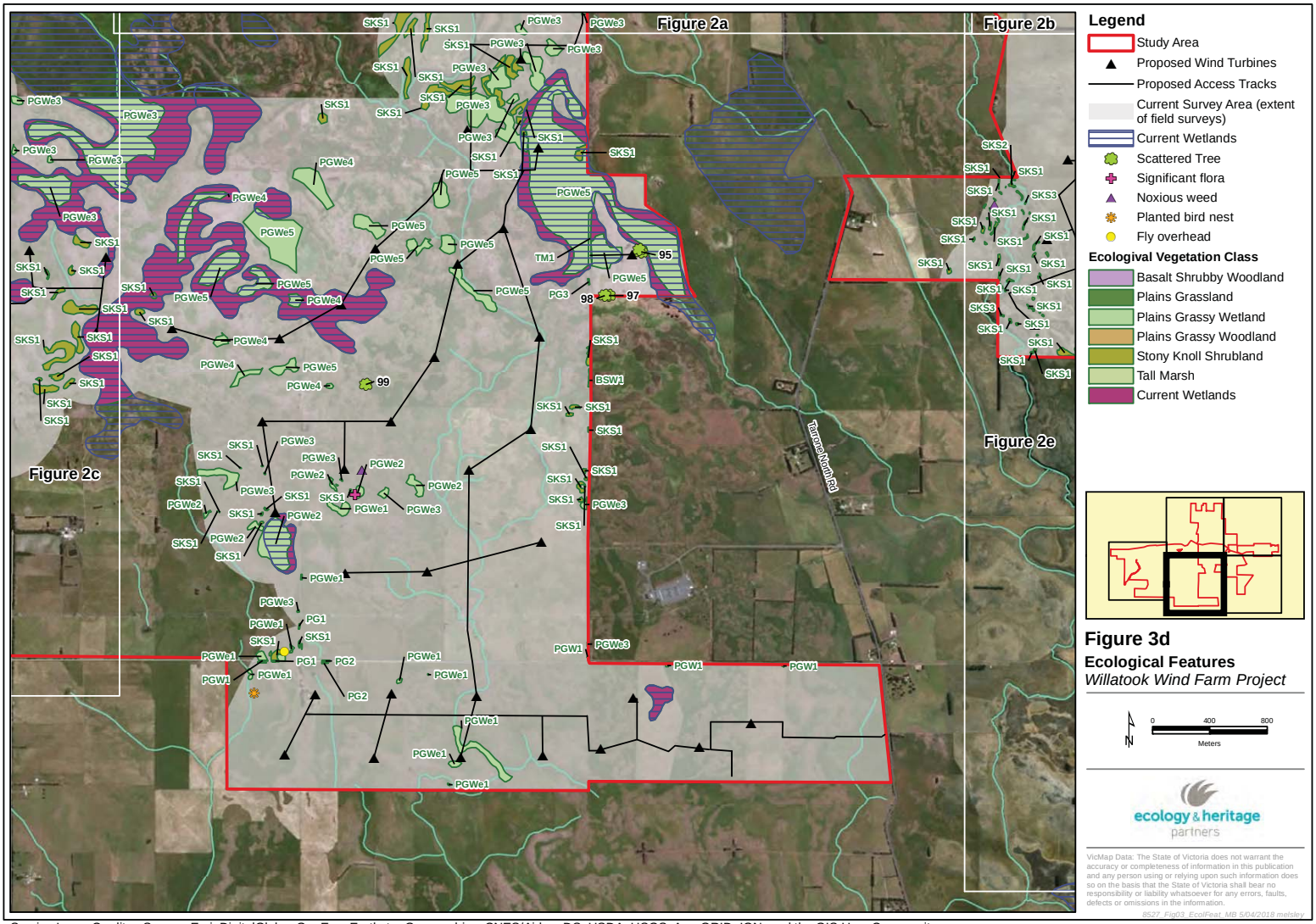

Figure 3d

Ecological Features

Willatook Wind Farm Project

ecology & heritage partners

8527_Fig03_EcolFeat_MB 5/04/2018 melsley

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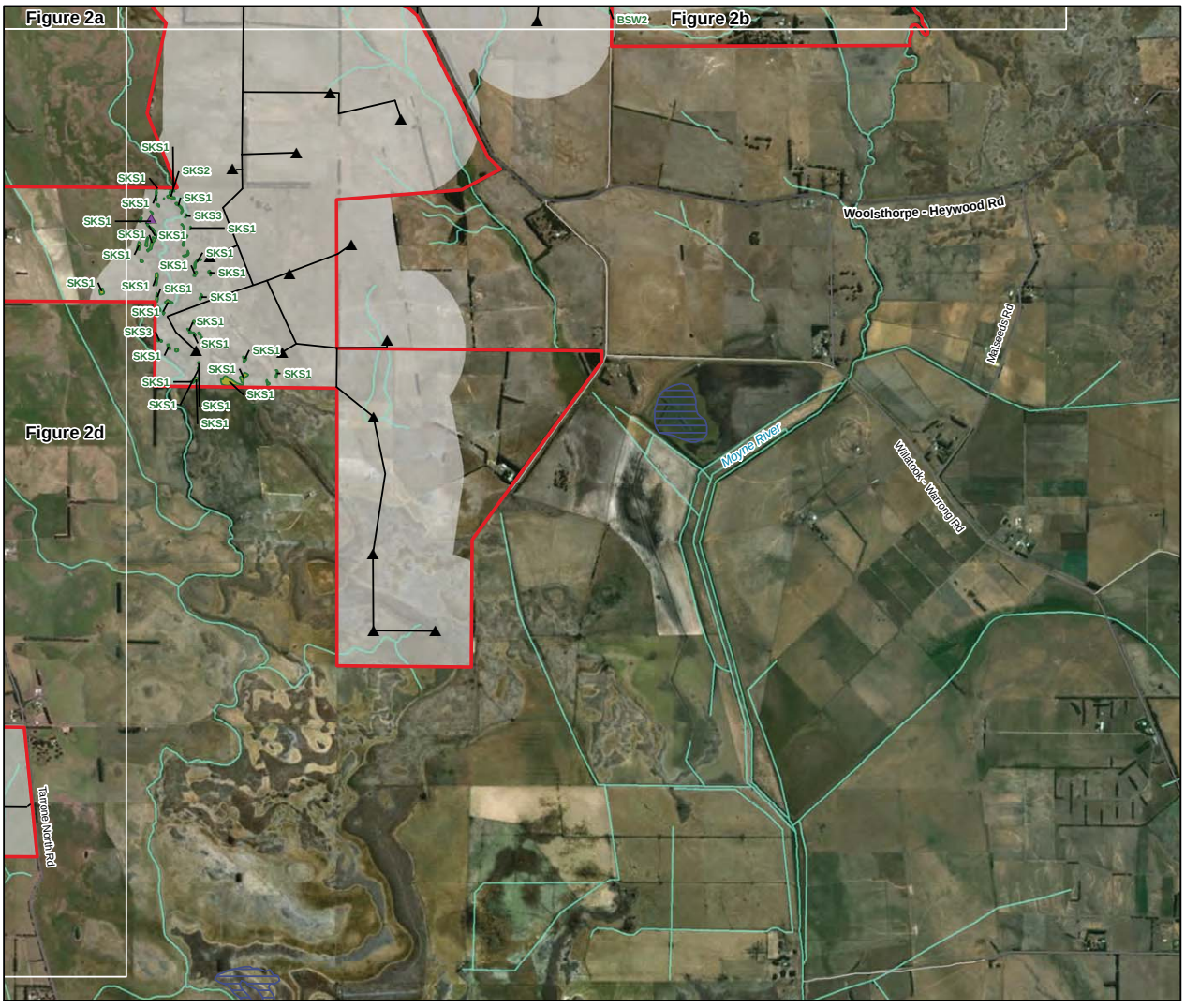

Legend

- Study Area
- Proposed Wind Turbines
- Proposed Access Tracks
- Current Survey Area (extent of field surveys)
- Current Wetlands
- Noxious weed

Ecologival Vegetation Class

- Basalt Shrubby Woodland
- Stony Knoll Shrubland

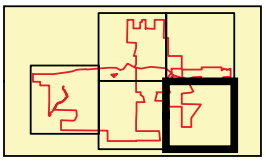

Figure 3e

Ecological Features

Willatook Wind Farm Project

N

0 400 800

Meters

ecology & heritage partners

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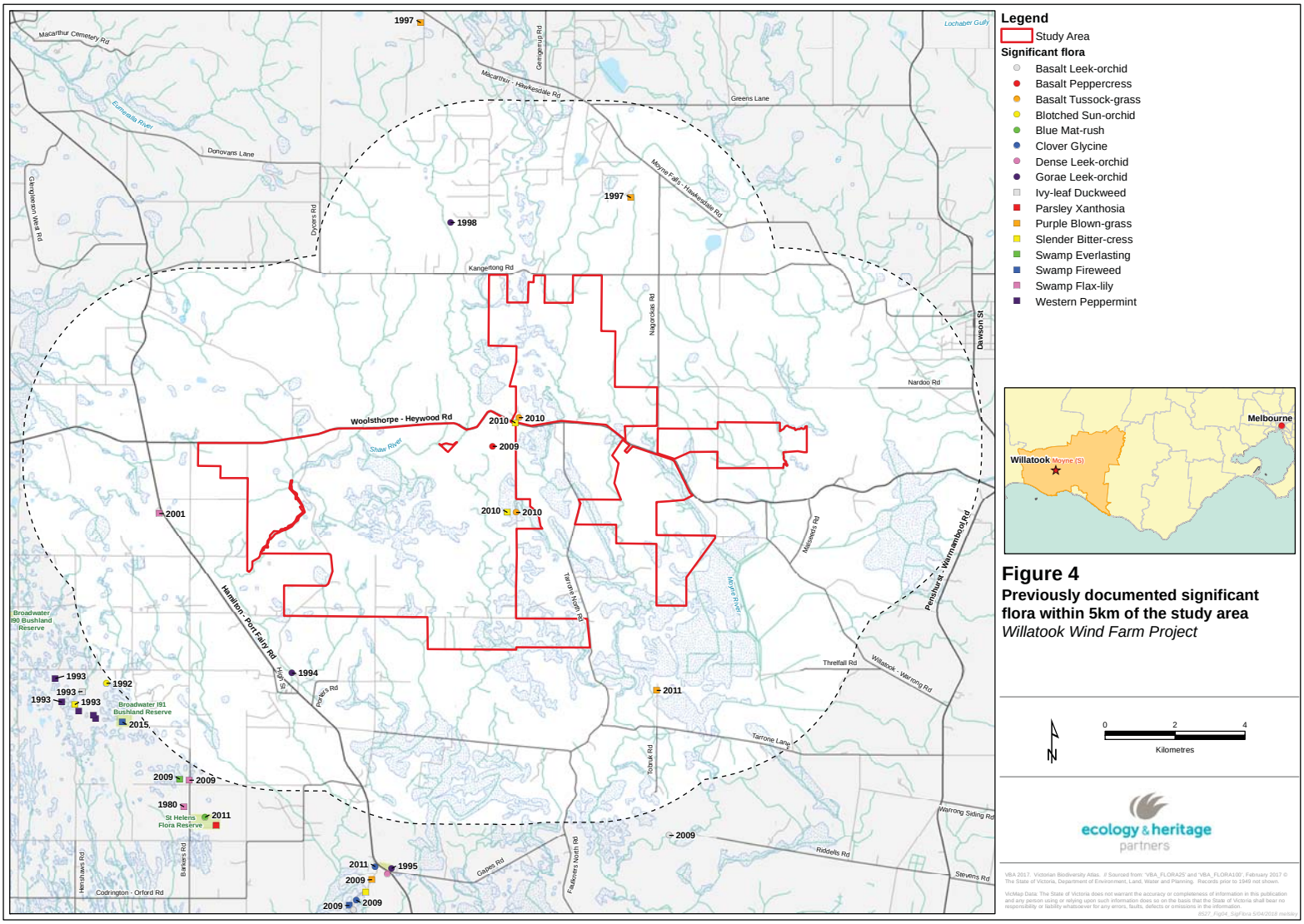

Figure 4

Previously documented significant flora within 5km of the study area

Willatook Wind Farm Project

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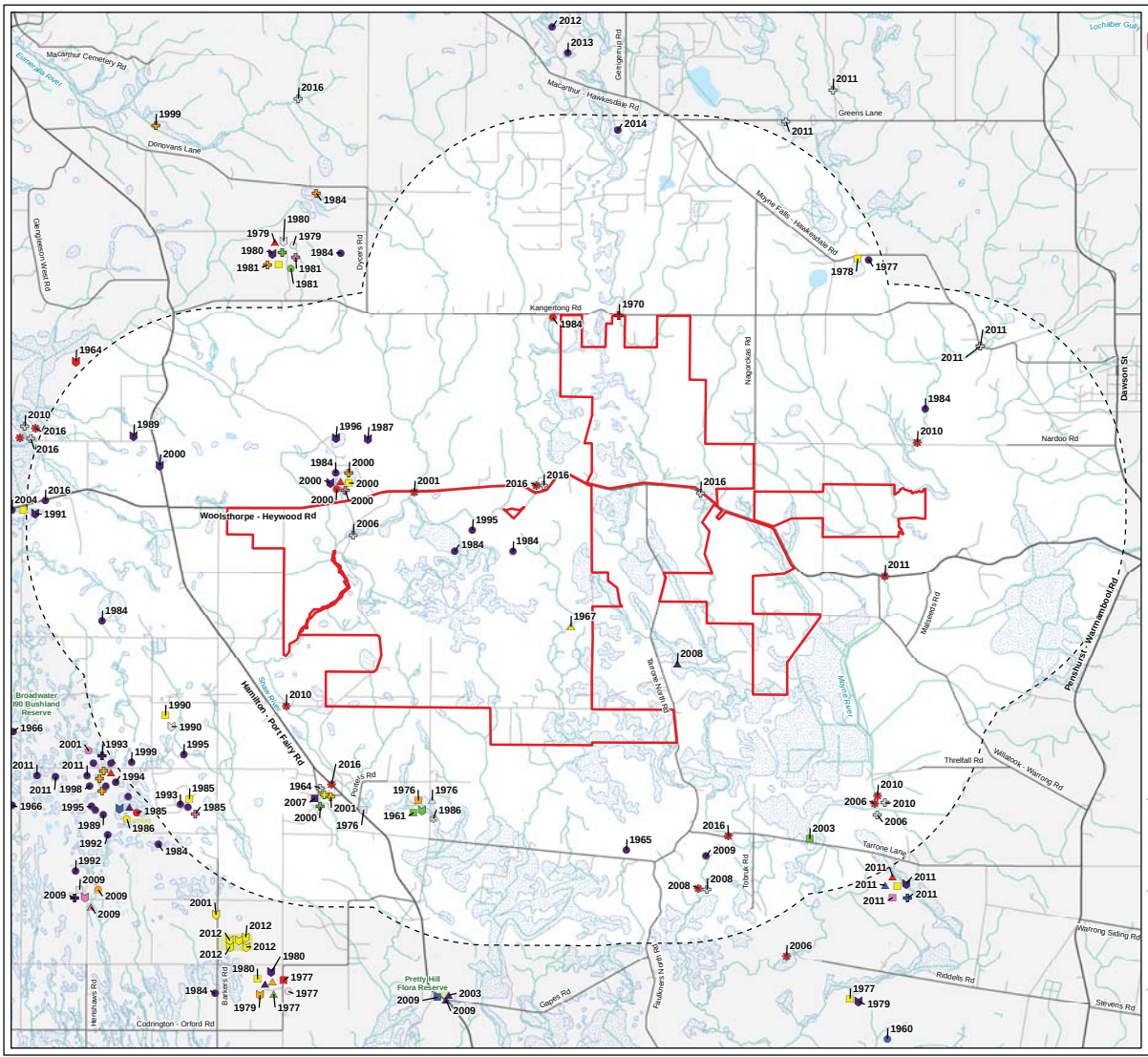

Legend

Study Area

Significant fauna

- Australasian Bittern
- Australasian Shoveler
- Australian Painted Snipe
- Baillon's Crake
- Black Falcon
- Black-faced Cormorant
- Blue-billed Duck
- Brolga
- Brown Toadlet
- Curlew Sandpiper
- Eastern Barred Bandicoot
- Eastern Great Egret
- Fat-tailed Dunnart
- Glossy Grass Skink
- Glossy Ibis
- Grey Goshawk
- Growling Grass Frog
- Hardhead
- Hooded Plover
- Hooded Robin
- Indian Yellow-nosed Albatross
- Intermediate Egret
- Lace Monitor
- Latham's Snipe
- Little Galaxias
- Macquarie Perch
- Musk Duck
- NE Grampians Bush Yabby
- Nankeen Night Heron
- Pacific Gull
- Pied Cormorant
- Powerful Owl
- Royal Spoonbill
- Ruddy Turnstone
- Sooty Oystercatcher
- Southern Brown Bandicoot
- Southern Toadlet
- Spot-tailed Quoll
- Tussock Skink
- Whiskered Tern
- White-throated Needletail
- Yarra Pygmy Perch

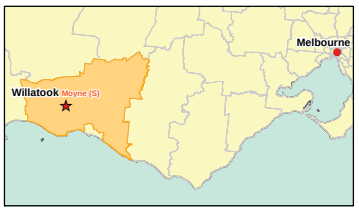

Figure 5

Previously documented significant fauna within 5km of the study area

Willatook Wind Farm Project

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Kilometres

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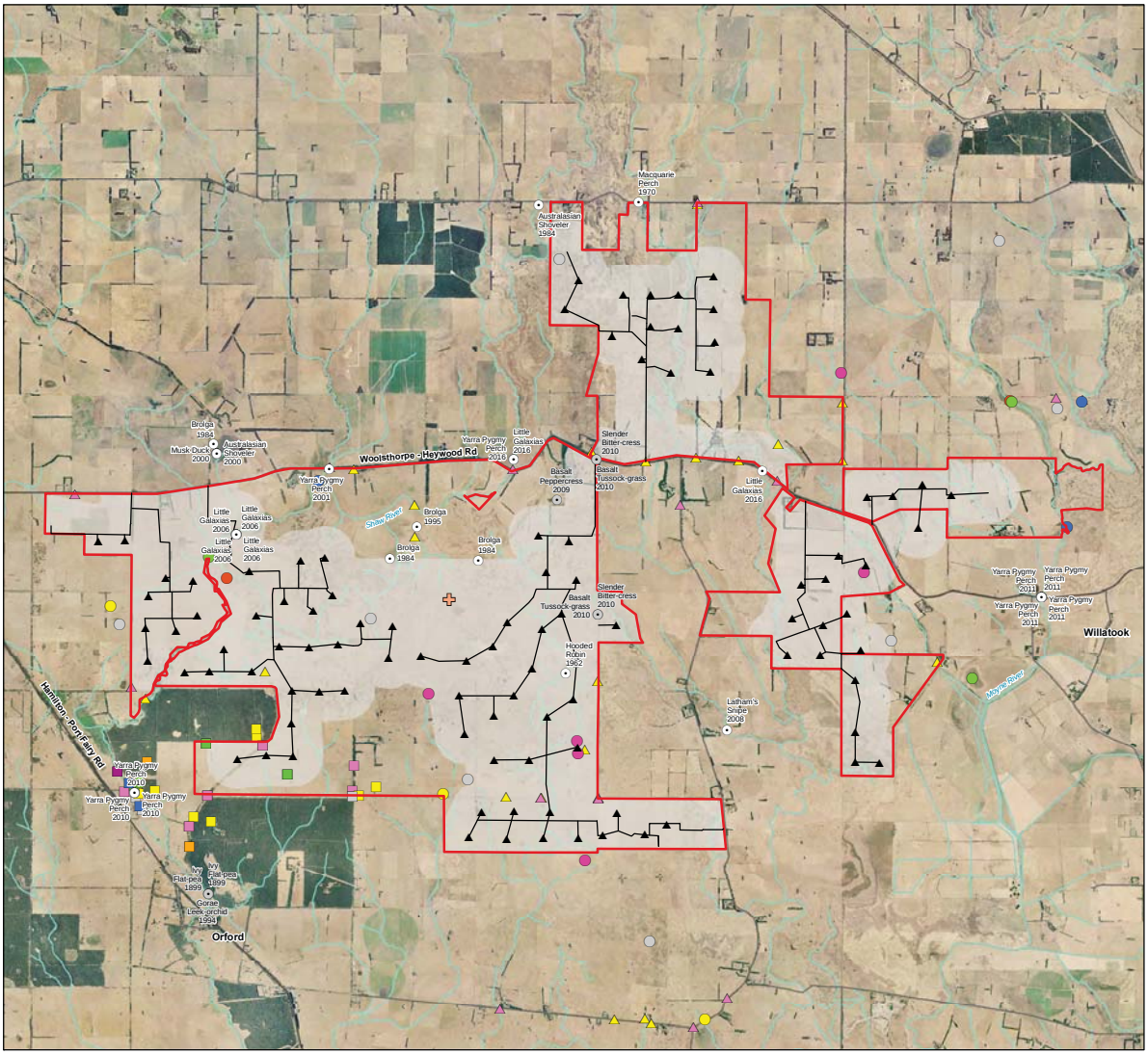

Legend

- Study Area
- Proposed Wind Turbines
- Current Survey Area (extent of field surveys)
- VBA Records (Flora)
- VBA Records (Fauna)

2009/10 Surveys

- Bird Utilisation Survey Sites
- Aquatic Survey Sites
- Targeted Frog Survey Sites
- Targeted Swamp Skink Survey Sites
- Targeted Striped Legless Lizard Survey Sites
- Anabat Locations

2010/11 Targeted Bat Surveys

- Autumn 2011 - Anabat Survey Locations
- Spring 2010 - Anabat Survey Locations

Aerial Nesting Surveys and Ground-truthing (2010/11)

- Brolga Nest Confirmed

Shaw River Surveys 2008/09

- Bird Utilisation Survey Site
- Targeted Frog Survey Sites
- Anabat Locations
- Aquatic Survey Sites
- Hair Tube Survey Sites
- Owl Call Play-back
- Spotlighting

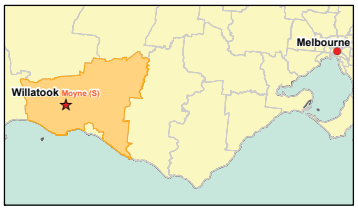

Figure 6

Fauna Survey Effort

Willatook Wind Farm Project

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Kilometres

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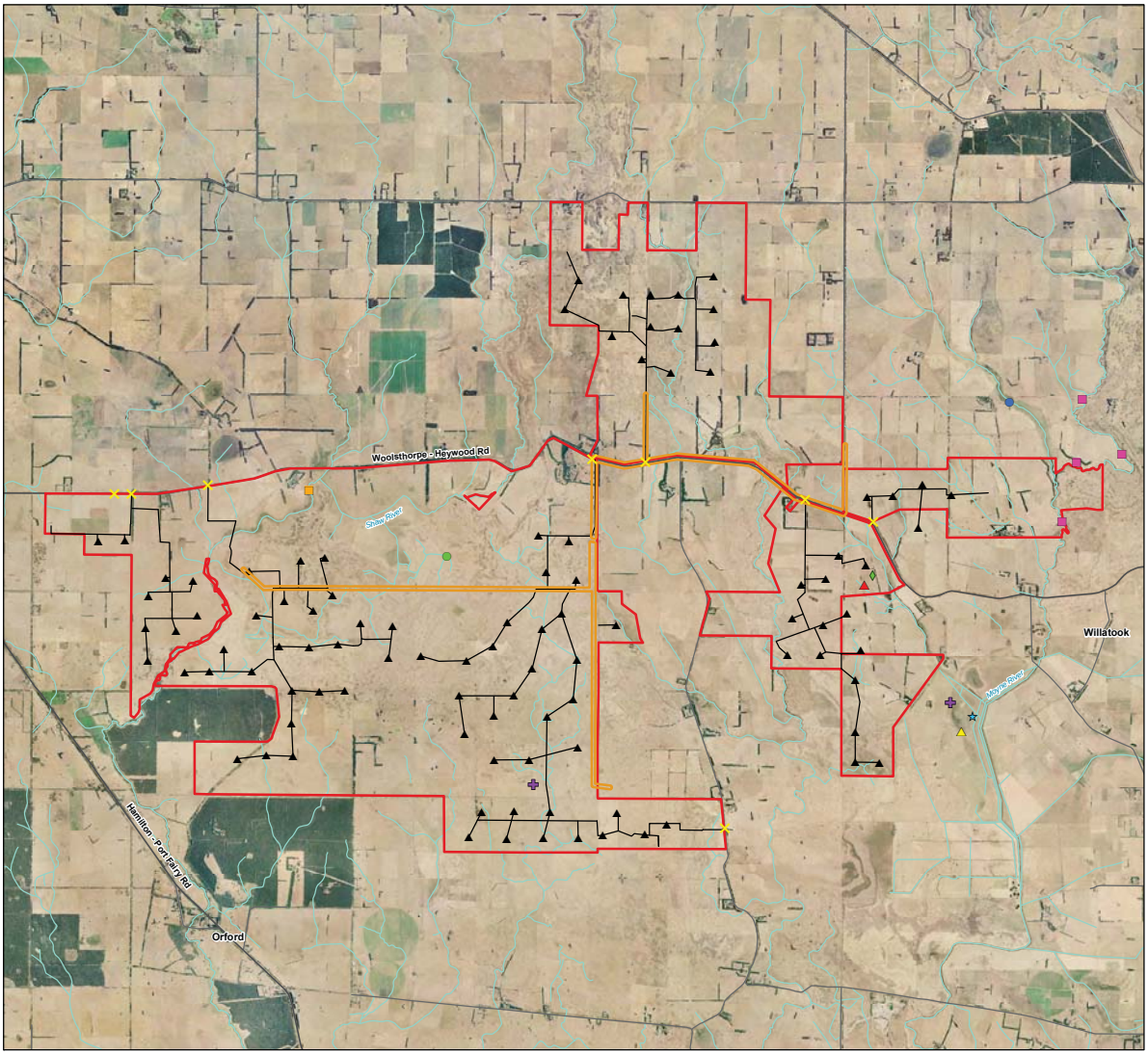

Legend

- Study Area
- Proposed Wind Turbines
- OHL Survey Areas
- Site Access Points
- Brolga
- Dwarf Galaxias
- Eastern Great Egret
- Growling Grass Frog
- Royal Spoonbill
- Southern Bent-wing Bat
- Swamp Skink
- Yarra Pygmy Perch
- Yellow-bellied Sheathtail Bat

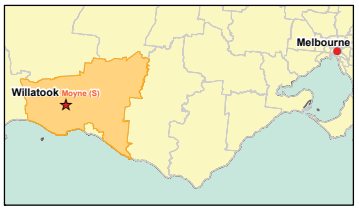

Figure 7

Significant Fauna Records

Willatook Wind Farm Project

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Kilometres

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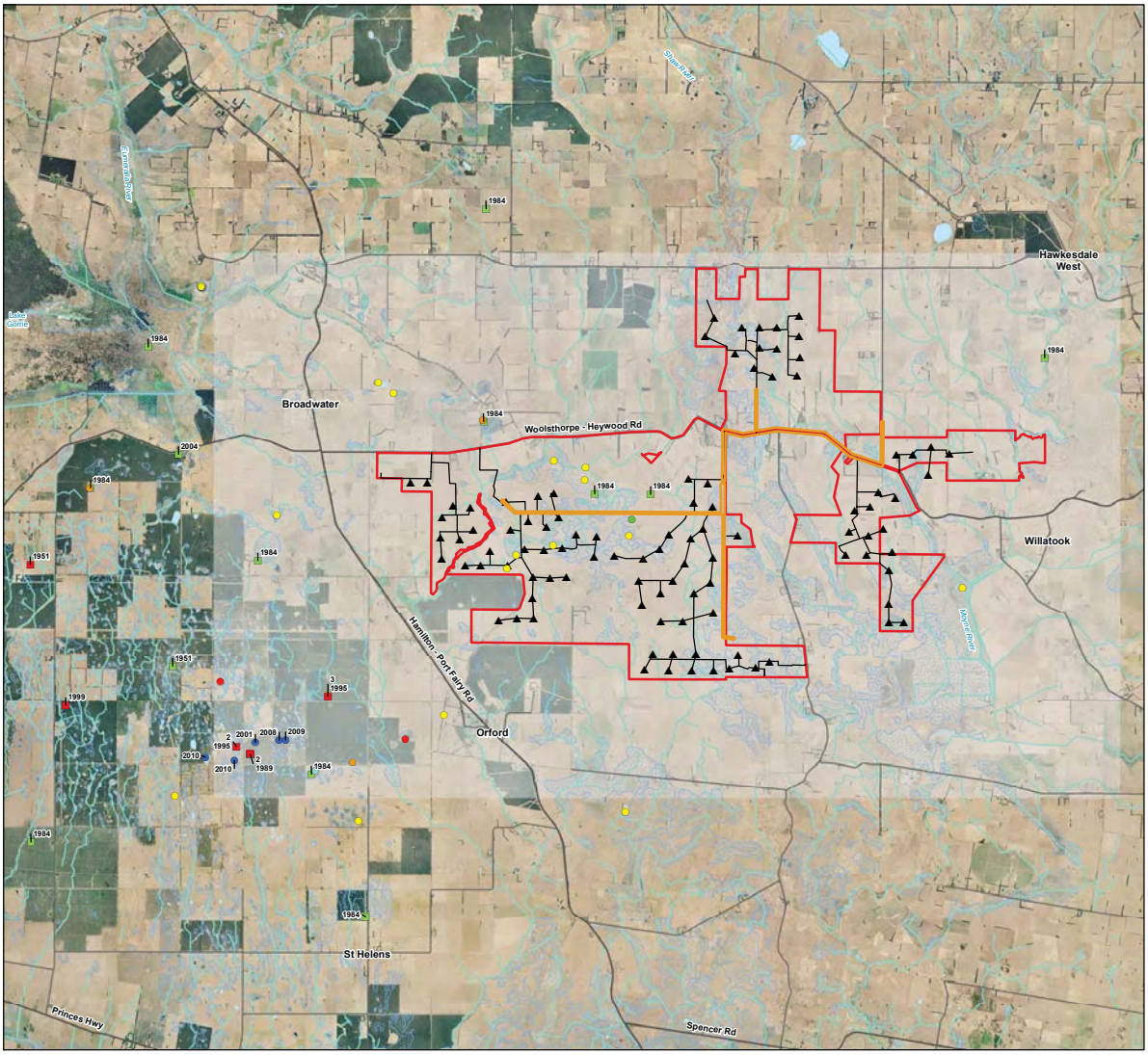
BS27_Fig07_SigFauna 5/04/2018 meisley



Legend

- Study Area
- Proposed Wind Turbines
- OHL Survey Areas
- Aerial Survey Area
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- South-west Victorian Flocking Sites Database (Sheldon 2004)

Nesting Sites Identified through Aerial Surveys (Ground Truthing Oct 2010 & June 2011)

- Brolga Nest Confirmed
- Swan Nest Confirmed
- Unconfirmed Nest
- No Access
- No Longer Suitable Habitat
- Trust for Nature Nests

Brolga Records (VBA)

- Breeding

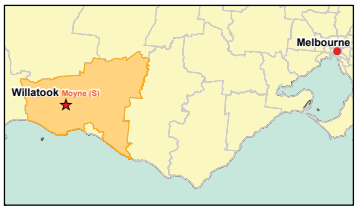


Figure 8

Results of the Aerial Nest Survey

Willatook Wind Farm Project

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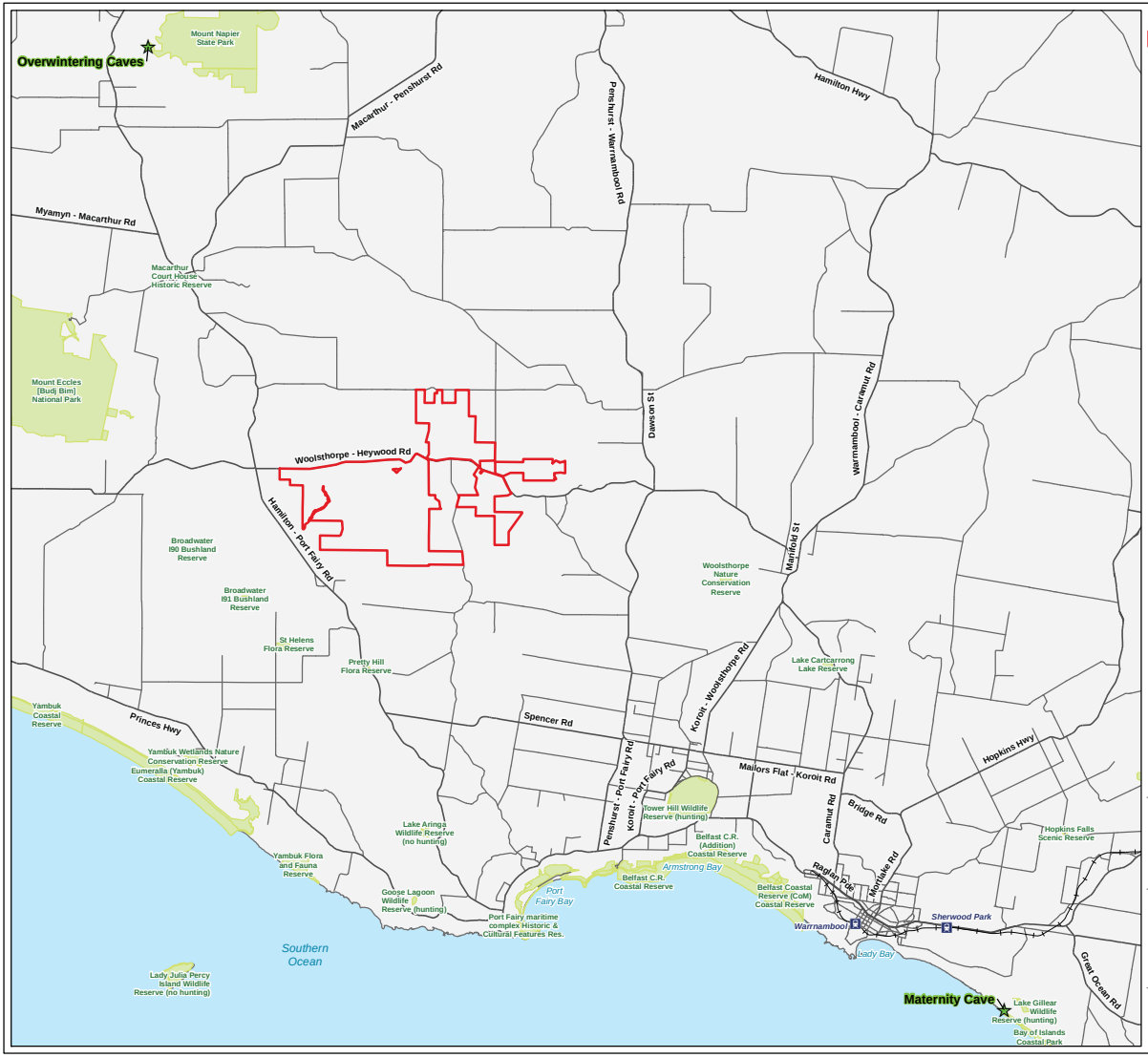
Kilometres

ecology & heritage partners



Legend

- Study Area
- Cave Locations

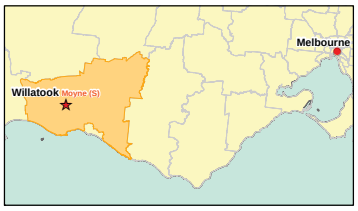


Figure 9

Location of Known Caves

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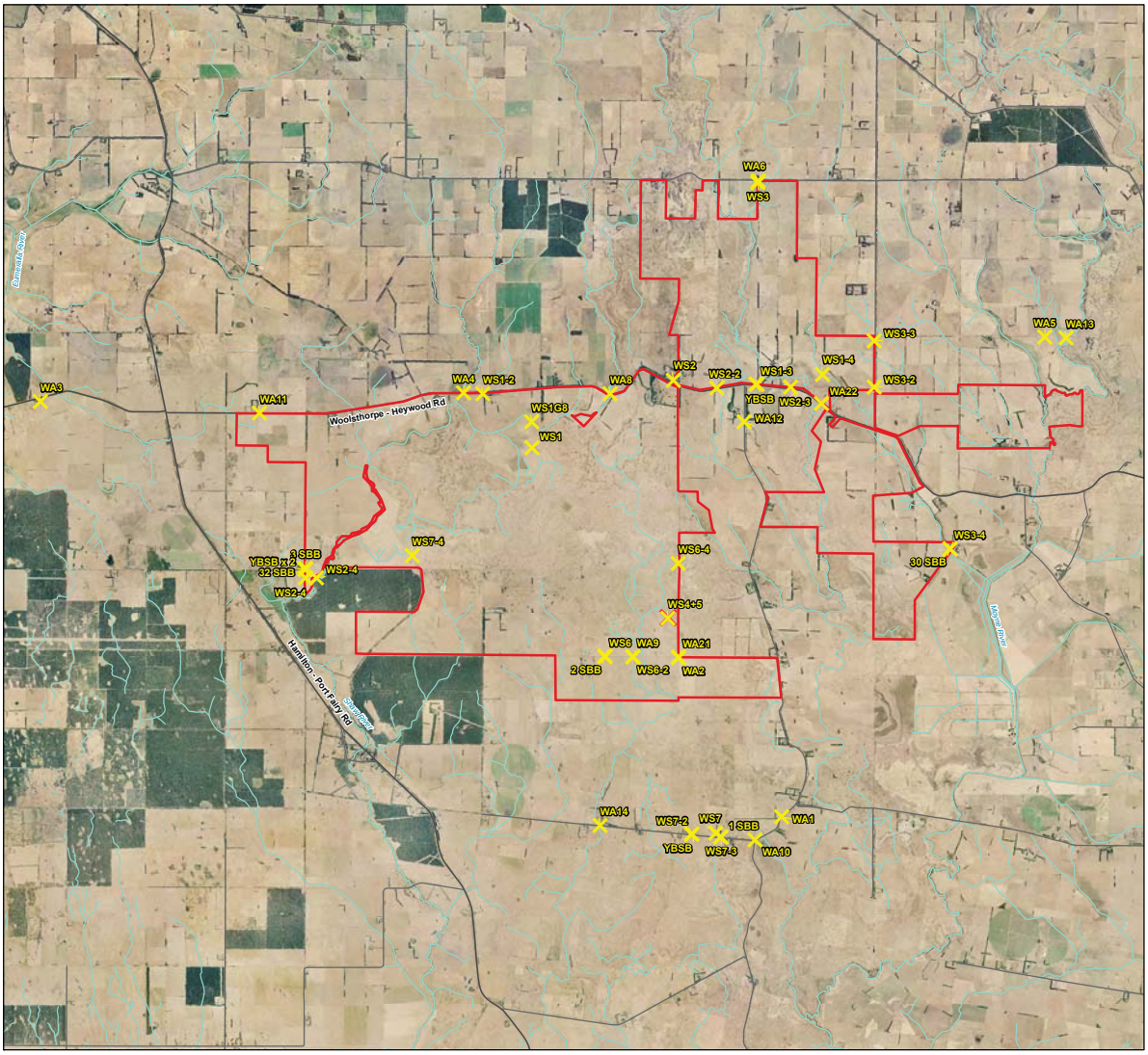
Kilometres

ecology & heritage partners



Legend

- Study Area
- Anabat Survey Locations
- Tower Low + High

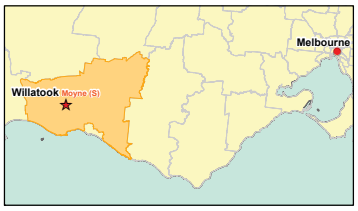


Figure 10

Location of Anabat Surveys (Spring 2010 and Autumn 2011)

Willatook Wind Farm Project

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Kilometres

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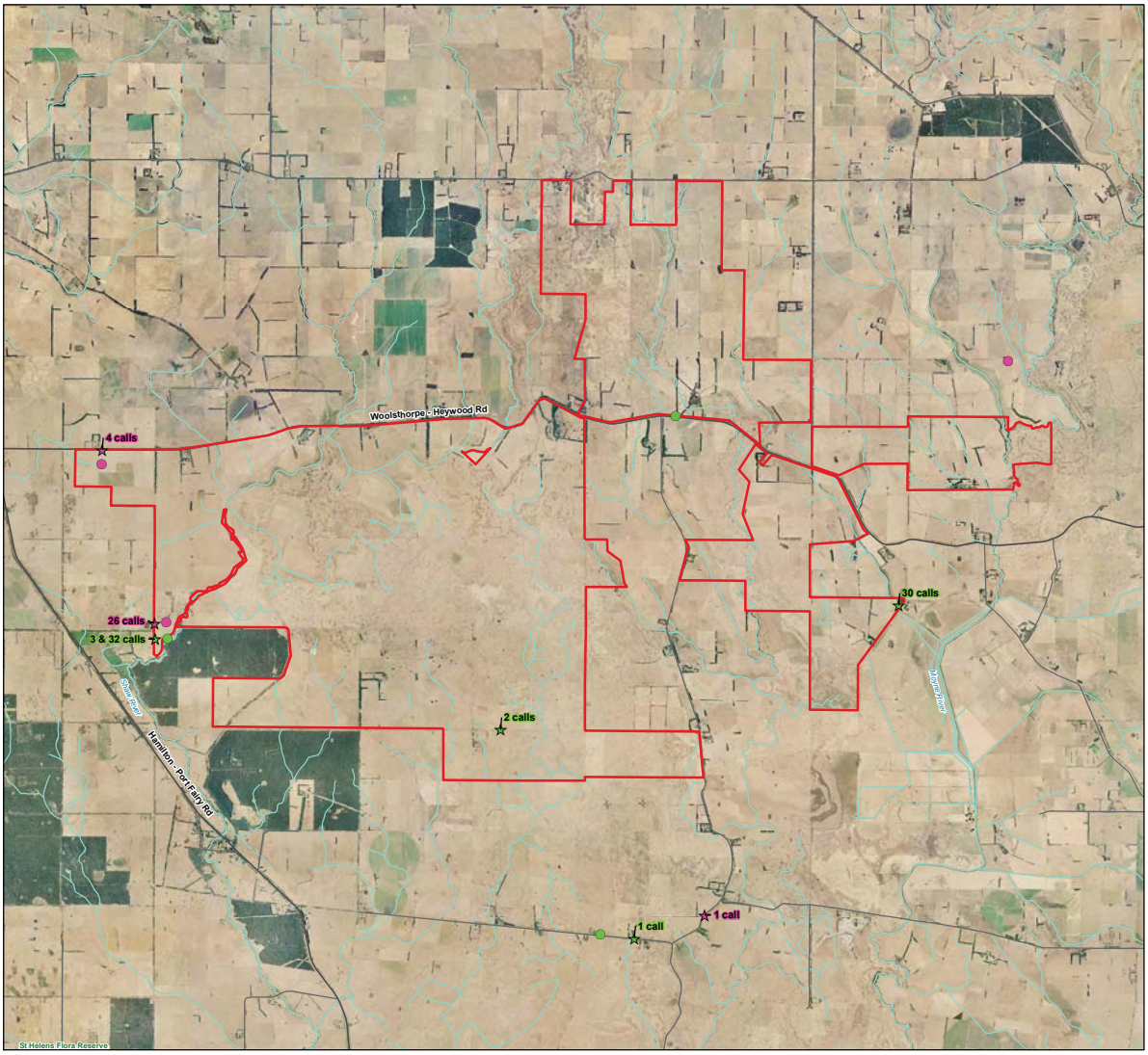

Legend

- Study Area
- Southern Bent-wing Bat (Autumn 2011)
- Yellow-bellied Sheathtail Bat (Autumn 2011)
- Southern Bent-wing Bat (Spring 2010)
- Yellow-bellied Sheathtail Bat (Spring 2010)

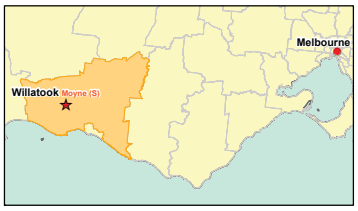

Figure 11

Significant Species Recorded from Anabat Surveys (Spring 2010 and Autumn 2011)

Willatook Wind Farm Project

N

0 1.5 3

Kilometres

ecology & heritage partners

APPENDICES

APPENDIX 1

Appendix 1.1 – Rare or Threatened Categories for Listed Victorian Taxa

Table A1.1. Rare or Threatened categories for listed Victorian taxa.

Rare or Threatened Categories
Conservation Status in Australia (Based on the EPBC Act 1999)
EX - Extinct: Extinct is when there is no reasonable doubt that the last individual of the species has died.
CR - Critically Endangered: A species is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
EN - Endangered: A species is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in the near future.
VU - Vulnerable: A species is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future.
R* - Rare: A species is rare but overall is not currently considered critically endangered, endangered or vulnerable.
K* - Poorly Known: A species is suspected, but not definitely known, to belong to any of the categories extinct, critically endangered, endangered, vulnerable or rare.
Conservation Status in Victoria (Based on DEPI 2014, DSE 2009 or DEPI 2013)
x - Presumed Extinct in Victoria: not recorded from Victoria during the past 50 years despite field searches specifically for the plant, or, alternatively, intensive field searches (since 1950) at all previously known sites have failed to record the plant.
e - Endangered in Victoria: at risk of disappearing from the wild state if present land use and other causal factors continue to operate.
v - Vulnerable in Victoria: not presently endangered but likely to become so soon due to continued depletion; occurring mainly on sites likely to experience changes in land-use which would threaten the survival of the plant in the wild; or, taxa whose total population is so small that the likelihood of recovery from disturbance, including localised natural events such as drought, fire or landslip, is doubtful.
r - Rare in Victoria: rare but not considered otherwise threatened - there are relatively few known populations or the taxon is restricted to a relatively small area.
k - Poorly Known in Victoria: poorly known and suspected, but not definitely known, to belong to one of the above categories (x, e, v or r) within Victoria. At present, accurate distribution information is inadequate.

Appendix 1.2 – Defining Ecological Significance

Table A1.2. Criteria for defining Ecological Significance ratings for significant flora, fauna and communities.

National Significance
Flora: National conservation status is based on the EPBC Act list of taxa considered threatened in Australia (i.e. extinct, critically endangered, endangered, vulnerable).
Fauna: National conservation status is based on the EPBC Act list of taxa considered threatened in Australia (i.e. Extinct, Critically Endangered, Endangered, Vulnerable). Fauna listed as Extinct, Critically Endangered, Endangered, Vulnerable, or Rare under National Action Plans for terrestrial taxon prepared for DoE: mammals (Woinarski *et al.* 2014), bats (Duncan *et al.* 1999), birds (Garnett *et al.* 2011), reptiles (Cogger *et al.* 1993), amphibians (Tyler 1997) and butterflies (Sands and New 2002).
Communities: Vegetation communities considered critically endangered, endangered or vulnerable under the EPBC Act and considering vegetation condition.
State Significance
Flora: Threatened taxa listed under the provisions of the FFG Act. Flora listed in the State Government's Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014).
Fauna: Threatened taxon listed under Schedule 2 of the FFG Act. Fauna listed as Extinct, Critically Endangered, Endangered and Vulnerable on the State Government's Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013). Listed as Lower Risk (Near Threatened, Conservation Dependent or Least concern) or Data Deficient under National Action Plans for terrestrial species prepared for the DoE: mammals (Woinarski *et al.* 2014), bats (Duncan *et al.* 1999), birds (Garnett *et al.* 2011), reptiles (Cogger *et al.* 1993), amphibians (Tyler 1997) and butterflies (Sands and New 2002).
Communities: Ecological communities listed as threatened under the FFG Act (DELWP 2017h). EVC listed as threatened (i.e. endangered, vulnerable) or rare in a Native Vegetation Plan for a particular bioregion and considering vegetation condition.
Regional Significance
Fauna: Fauna with a disjunct distribution, or a small number of documented recorded or naturally rare in the particular Bioregion in which the study area is located. A particular taxon that is has an unusual ecological or biogeographical occurrence or listed as Lower Risk – Near Threatened, Data Deficient or Insufficiently Known on the State Government's Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013).
Communities: EVC listed as depleted or least concern in a Native Vegetation Plan for a particular bioregion) and considering vegetation condition. EVC considered rare by the author for a particular bioregion.
Local Significance
Local significance is defined as flora, fauna and ecological communities indigenous to a particular area, which are not considered rare or threatened on a national, state or regional level.

Appendix 1.3 – Defining Site Significance

Table A1.3. Criteria for defining Site Significance ratings.

National Significance
A site is of National significance if: • It regularly supports, or has a high probability of regularly supporting individuals of a taxon listed as 'Critically Endangered' or 'Endangered' under the EPBC Act and/or under National Action Plans for terrestrial taxon prepared for the DoE. • It regularly supports, or has a high probability of supporting, an 'important population' as defined under the EPBC Act of one or more nationally 'vulnerable' flora and fauna taxon. • It is known to support, or has a high probability of supporting taxon listed as 'Vulnerable' under National Action Plans. • It is known to regularly support a large proportion (i.e. greater than 1%) of a population of a taxon listed as 'Conservation Dependent' under the EPBC Act and/or listed as Rare or Lower Risk (near threatened, conservation dependent or least concern) under National Action Plans. • It contains an area, or part thereof designated as 'critical habitat' under the EPBC Act, or if the site is listed under the Register of National Estate compiled by the Australian Heritage Commission. • It is a site which forms part of, or is connected to a larger area(s) of remnant native vegetation or habitat of national conservation significance such as most National Park, and/or a Ramsar Wetland(s).
State Significance
A site is of State significance if: • It occasionally (i.e. every 1 to 5 years) supports, or has suitable habitat to support taxon listed as 'Critically Endangered' or 'Endangered' under the EPBC Act and/or under National Action Plans. • It regularly supports, or has a high probability of regularly supporting (i.e. high habitat quality) taxon listed as 'Vulnerable', 'Near threatened', 'Data Deficient' or 'Insufficiently Known' in Victoria (,DSE 2013; DEPI 2014), or species listed as 'Data Deficient' or 'Insufficiently Known' under National Action Plans. • It contains an area, or part thereof designated as 'critical habitat' under the FFG Act. • It supports, or likely to support a high proportion of any Victorian flora and fauna taxa. • It contains high quality, intact vegetation/habitat supporting a high species richness and diversity in a particular bioregion. • It is a site which forms part of, or connected to a larger area(s) of remnant native vegetation or habitat of state conservation significance such as most State Parks and/or Flora and Fauna Reserves.
Regional Significance
A site is of Regional significance if: • It regularly supports, or has a high probability of regularly supporting regionally significant fauna as defined in Table 1.2. • Is contains a large population (i.e. greater than 1% or 5%) of flora considered rare in any regional Native Vegetation Plan for a particular bioregion. • It supports a fauna population with a disjunct distribution, or a particular taxon that has an unusual ecological or biogeographical occurrence. • It is a site which forms part of, or is connected to a larger area(s) of remnant native vegetation or habitat of regional conservation significance such as most Regional Parks and/or Flora and Fauna Reserves.
Local Significance
Most sites are considered to be of at least local significant for conservation, and in general a site of local significance can be defined as: • An area which supports indigenous flora species and/or a remnant EVC, and habitats used by locally significant fauna species. • An area which currently acts, or has the potential to act as a wildlife corridor linking other areas of higher conservation significance and facilitating fauna movement throughout the landscape.

Appendix 1.4 – Vegetation Condition and Habitat Quality

Table A1.4.1 Defining Vegetation Condition ratings.

Criteria for defining Vegetation Condition
High Quality: Vegetation dominated by a diversity of indigenous species, with defined structures (where appropriate), such as canopy layer, shrub layer, and ground cover, with little or few introduced species present.
Moderate Quality: Vegetation dominated by a diversity of indigenous species, but is lacking some structures, such as canopy layer, shrub layer or ground cover, and/or there is a greater level of introduced flora species present.
Low Quality: Vegetation dominated by introduced species, but supports low levels of indigenous species present, in the canopy, shrub layer or ground cover.

Table A1.4.2 Defining Habitat Quality.

Criteria for defining Habitat Quality
High Quality: • High degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hollow-bearing trees, and a dense understorey component. • High species richness and diversity (i.e. represented by a large number of species from a range of fauna groups). • High level of foraging and breeding activity, with the site regularly used by native fauna for refuge and cover. • Habitat that has experienced, or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • High contribution to a wildlife corridor, and/or connected to a larger area(s) of high quality habitat. • Provides known, or likely habitat for one or more rare or threatened species listed under the EPBC Act, FFG Act, or species considered rare or threatened according to DEPI 2014; DSE 2009 or 2013.
Moderate Quality: • Moderate degree of intactness, containing one or more important habitat features such as ground debris (logs, rocks, vegetation), mature hollow-bearing trees, and a dense understorey component. • Moderate species richness and diversity - represented by a moderate number of species from a range of fauna groups. • Moderate levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Habitat that has experienced, or is experiencing moderate levels of disturbance and/or threatening processes. • Moderate contribution to a wildlife corridor, or is connected to area(s) of moderate quality habitat. • Provides potential habitat for a small number of threatened species listed under the EPBC Act, FFG Act, or species considered rare or threatened according to DEPI 2014; DSE 2009 or 2013.
Low Quality: • Low degree of intactness, containing few important habitat features such as ground debris (logs, rocks, vegetation), mature hollow-bearing trees, and a dense understorey component. • Low species richness and diversity (i.e. represented by a small number of species from a range of fauna groups). • Low levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Habitat that has experienced, or is experiencing high levels of disturbance and/or threatening processes. • Unlikely to form part of a wildlife corridor, and is not connected to another area(s) of habitat. • Unlikely to provide habitat for rare or threatened species listed under the EPBC Act, FFG Act, or considered rare or threatened according to DEPI 2014; DSE 2009 or 2013.

Appendix 1.6 – *Flora and Fauna Guarantee Act 1988* Protected Species

Protected flora and fauna under the *Flora and Fauna Guarantee Act 1988* (FFG Act) are defined as those that have legal protection under the Act. Protected taxa includes plants and animals from three sources:

- plant or animal taxa (species, subspecies or varieties) listed as threatened under the FFG Act;
- plant taxa belonging to communities listed as threatened under the FFG Act; and,
- plant taxa which are not threatened but require protection for other reasons.

Note that representative plants of a given community are protected as well as the community itself (for example scattered Wallaby-grasses *Rytidosperma* spp. are protected in degraded areas previously supporting the listed Western [Basalt] Plains Grassland Community.

Table A1.6 provides a list of plant groups protected under the FFG Act. For threatened plant species likely to occur within the study area refer to Appendix and for listed communities (or representative species) likely to occur within the study area refer to Sections 3.4.1 and 3.4.3.

Table A1.6. Plant groups (Families, Genera and Kingdom Divisions) protected under the FFG Act (DELWP 2016).

Family/Genera	Common Name	Exclusions
Pteridophyta	Clubmosses, ferns and fern allies	Austral Bracken *Pteridium esculentum*
Asteraceae	Daisies	N/A
Ericaceae (formerly Epacridaceae)	Heaths	N/A
Orchidaceae	Orchids	N/A
Acacia	Wattles	*Acacia dealbata, Acacia decurrens, Acacia implexa, Acacia melanoxylon and Acacia paradoxa*
Baeckea	Baeckeas	N/A
Boronia	Boronias	N/A
Calytrix	Fringe-myrtles	N/A
Correa -	Correas	N/A
Darwinia	Darwinias	N/A
Eremophila	Emu-bushes	N/A
Eriostemon	Wax-flowers	N/A
Gompholobium	Wedge-peas	N/A
Grevillea	Grevilleas	N/A
Prostanthera	Mint-bushes	N/A
Sphagnum	Sphagnum mosses	N/A
Stylidium	Trigger-plants	N/A
Thryptomene	Thryptomenes	N/A
Thysanotus	Fringe-lilies	N/A
Xanthorrhoea	Grass-trees	N/A

APPENDIX 2 - FLORA

Appendix 2.1 – Flora Results

Legend:

CR/EN/VU Listed as Critically Endangered/Endangered/Vulnerable under the EPBC Act;

I Protected under the FFG Act (DELWP 2016);

L Listed under the FFG Act (DELWP 2017e);

e/v/r Listed as endangered/vulnerable/rare in Victoria under the Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014);

***** Listed as a noxious weed under the CaLP Act;

w Weed of National Significance;

- Not applicable

Table A2.1. Flora recorded within the study area.

Species	Common name	Conservation Status
INDIGENOUS SPECIES		
Acacia mearnsii	Black Wattle	I
Acacia melanoxylon	Blackwood	-
Acacia paradoxa	Hedge Wattle	-
Acacia verticillata	Prickly Moses	I
Acaena echinata	Sheep's Burr	-
Acaena novae-zelandiae	Bidgee-widgee	-
Acrotriche serrulata	Honey-pots	I
Adiantum aethiopicum	Common Maidenhair	I
Allocasuarina verticillata	Drooping Sheoak	-
Anthosachne scabra s.l.	Common Wheat-grass	-
Apium prostratum subsp. prostratum	Sea Celery	-
Arthropodium milleflorum s.l.	Pale Vanilla-lily	-
Arthropodium strictum s.l.	Chocolate Lily	-
Asperula subsimplex	Water Woodruff	-
Astroloma humifusum	Cranberry Heath	I
Austrostipa bigeniculata	Kneed Spear-grass	-

Species	Common name	Conservation Status
Austrostipa pubinodis	Tall Spear-grass	-
Banksia marginata	Silver Banksia	-
Baumea articulata	Jointed Twig-sedge	-
Burchardia umbellata	Milkmaids	-
Bursaria spinosa subsp. spinosa	Sweet Bursaria	-
Callitriche cyclocarpa	Western Water-starwort	-
Calocephalus lacteus	Milky Beauty-heads	-
Cardamine spp.	Bitter Cress	-
Carex appressa	Tall Sedge	-
Carex breviculmis	Common Grass-sedge	-
Carex inversa	Knob Sedge	-
Cassinia longifolia	Shiny Cassinia	-
Centella cordifolia	Centella	-
Centrolepis strigosa subsp. strigosa	Hairy Centrolepis	-
Chamaescilla corymbosa var. corymbosa	Blue Stars	-
Convolvulus erubescens spp. agg.	Pink Bindweed	-
Coronidium scorpioides s.s.	Button Everlasting	I
Cotula australis	Common Cotula	I
Crassula helmsii	Swamp Crassula	I
Deyeuxia quadriseta	Reed Bent-grass	-
Dianella revoluta var. revoluta s.l.	Black-anther Flax-lily	-
Dichelachne rara	Common Plume-grass	-
Dichondra repens	Kidney-weed	-
Drosera peltata subsp. peltata spp. agg.	Pale Sundew	-
Eleocharis acuta	Common Spike-sedge	-
Epacris impressa	Common Heath	I
Epilobium billardierianum	Variable Willow-herb	-
Eucalyptus camaldulensis	River Red-gum	-
Eucalyptus kitsoniana	Bog Gum	r
Eucalyptus ovata	Swamp Gum	-
Eucalyptus viminalis	Manna Gum	-
Gahnia radula	Thatch Saw-sedge	-
Geranium solanderi s.l.	Austral Crane's-bill	-
Gonocarpus tetragynus	Common Raspwort	-
Goodenia geniculata	Bent Goodenia	-
Gratiola peruviana	Austral Brooklime	-

Species	Common name	Conservation Status
Hibbertia riparia	Erect Guinea-flower	-
Hydrocotyle laxiflora	Stinking Pennywort	-
Hypericum gramineum spp. agg.	Small St John's Wort	-
Isolepis inundata	Swamp Club-sedge	-
Juncus procerus	Tall Rush	-
Juncus subsecundus	Finger Rush	-
Lepidium hyssopifolium	Basalt Peppercress	**EN, L, e**
Lepidosperma elatius	Tall Sword-sedge	-
Lepidosperma laterale var. laterale	Variable Sword-sedge	-
Lepidosperma longitudinale	Pithy Sword-sedge	-
Leptorhynchos tenuifolius	Wiry Buttons	
Leptospermum continentale	Prickly Tea-tree	-
Lobelia pedunculata s.l.	Matted Pratia	-
Lobelia pratioides	Poison Lobelia	-
Lomandra filiformis	Wattle Mat-rush	-
Lomandra nana	Dwarf Mat-rush	-
Luzula meridionalis var. flaccida	Common Woodrush	-
Lythrum hyssopifolia	Small Loosestrife	-
Melicytus dentatus s.l.	Tree Violet	-
Mentha diemenica	Slender Mint	-
Microlaena stipoides var. stipoides	Weeping Grass	-
Oxalis perennans	Grassland Wood-sorrel	-
Patersonia fragilis	Short Purple-flag	-
Pentapogon quadrifidus var. quadrifidus	Five-awned Spear-grass	-
Phragmites australis	Common Reed	-
Pimelea humilis	Common Rice-flower	-
Poa labillardierei	Common Tussock-grass	-
Poa morrisii	Soft Tussock-grass	-
Poa sieberiana var. sieberiana	Grey Tussock-grass	-
Poa tenera	Slender Tussock-grass	-
Pteridium esculentum	Austral Bracken	-
Rumex brownii	Slender Dock	-
Rytidosperma caespitosum	Common Wallaby-grass	-
Rytidosperma duttonianum	Brown-back Wallaby-grass	-
Rytidosperma laeve	Smooth Wallaby-grass	-
Rytidosperma racemosum var. racemosum	Slender Wallaby-grass	-

Species	Common name	Conservation Status
Rytidosperma setaceum var. setaceum	Bristly Wallaby-grass	-
Schoenus apogon	Common Bog-sedge	-
Themeda triandra	Kangaroo Grass	-
Thysanotus patersonii	Twining Fringe-lily	-
Tricoryne elatior	Yellow Rush-lily	-
Triglochin nana	Dwarf Arrowgrass	-
Wahlenbergia gymnoclada	Naked Bluebell	-
Wurmbea dioica	Common Early Nancy	-
Xanthorrhoea minor subsp. lutea	Small Grass-tree	I
NON-INDIGENOUS OR INTRODUCED SPECIES		
Acetosella vulgaris	Sheep Sorrel	-
Agrostis capillaris	Brown-top Bent	-
Agrostis stolonifera	Creeping Bent	-
Aira caryophyllea subsp. caryophyllea	Silvery Hair-grass	-
Aira cupaniana	Quicksilver Grass	-
Aira elegantissima	Delicate Hair-grass	-
Anthoxanthum odoratum	Sweet Vernal-grass	-
Arctotheca calendula	Cape weed	-
Asparagus asparagoides	Bridal Creeper	W*
Briza maxima	Large Quaking-grass	-
Bromus catharticus var. catharticus	Prairie Grass	-
Bromus diandrus	Great Brome	-
Callitriche stagnalis	Common Water-starwort	-
Carduus pycnocephalus	Slender Thistle	-
Centaurium erythraea	Common Centaury	-
Cerastium glomeratum s.l.	Common Mouse-ear Chickweed	-
Cirsium arvense	Perennial Thistle	*
Cirsium vulgare	Spear Thistle	*
Conium maculatum	Hemlock	*
Cupressus macrocarpa	Monterey Cypress	-
Cynosurus echinatus	Rough Dog's-tail	-
Dactylis glomerata	Cocksfoot	-
Galium aparine	Cleavers	-
Genista monspessulana	Montpellier Broom	W*
Holcus lanatus	Yorkshire Fog	-
Hypericum perforatum subsp. veronense	St John's Wort	*

Species	Common name	Conservation Status
Hypochaeris glabra	Smooth Cat's-ear	-
Hypochaeris radicata	Flatweed	-
Leontodon taraxacoides subsp. taraxacoides	Hairy Hawkbit	-
Lolium perenne	Perennial Rye-grass	-
Lysimachia arvensis	Pimpernel	-
Medicago lupulina	Black Medic	-
Medicago polymorpha	Burr Medic	-
Medicago sativa subsp. sativa	Lucerne	-
Mentha pulegium	Pennyroyal	-
Nassella neesiana	Chilean Needle-grass	**w***
Paspalum dilatatum	Paspalum	-
Phalaris aquatica	Toowoomba Canary-grass	-
Phleum pratense	Timothy Grass	-
Plantago lanceolata	Ribwort	-
Poa annua	Annual Meadow-grass	-
Romulea rosea	Onion Grass	-
Rosa rubiginosa	Sweet Briar	*
Rubus fruticosus spp. agg.	Blackberry	**w***
Rumex crispus	Curled Dock	-
Scolymus hispanicus	Golden Thistle	*
Setaria parviflora	Slender Pigeon Grass	-
Silybum marianum	Variegated Thistle	*
Sonchus oleraceus	Common Sow-thistle	-
Taraxacum officinale spp. agg.	Garden Dandelion	-
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover	-
Trifolium spp.	Clover	-
Trifolium striatum	Knotted Clover	-
Ulex europaeus	Gorse	**w***
Vulpia bromoides	Squirrel-tail Fescue	-
Vulpia myuros f. megalura	Fox-tail Fescue	-

Appendix 2.2 – Significant Flora Species

Table A2.2 Significant flora recorded within 10 kilometres of the study area

Likelihood: Habitat characteristics of significant flora species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area were assessed to determine their likelihood of occurrence. The likelihood of occurrence rankings are defined below.

1 - Known occurrence
- Recorded within the study area recently (i.e. within ten years)

2 - High Likelihood
- Previous records of the species in the local vicinity; and/or,
- The study area contains areas of high quality habitat.

3 - Moderate Likelihood
- Limited previous records of the species in the local vicinity; and/or,
- The study area contains poor or limited habitat.

4 - Low Likelihood
- Poor or limited habitat for the species however other evidence (such as a lack of records or environmental factors) indicates there is a very low likelihood of presence.

5 – Unlikely
- No suitable habitat and/or outside the species range.

Scientific name	Common name	Source	Total # of documented records	Last documented record	EPBC	FFG	VIC	Likely occurrence in study area	Survey Period
NATIONAL SIGNIFICANCE									
Glycine latrobeana	Clover Glycine	VBA	8	2011	VU	L	v	2	Oct-Dec
Ixodia achillaeoides subsp. *arenicola* #	Coast Ixodia	PMST	-	-	VU	-	v	4	-
Lachnagrostis adamsonii #	Adamson's Blown-grass	PMST	-	-	EN	L	v	4	Nov - Dec
Lepidium hyssopifolium s.s.	Basalt Peppercress	VBA	3	2009	EN	L	e	1	Dec-Feb
Poa sallacustris #	Salt-lake Tussock-grass	PMST	-	-	VU	L	v	4	Sep-Dec
Prasophyllum diversiflorum	Gorae Leek-orchid	VBA	6	1998	EN	L	e	2	Nov-Feb
Prasophyllum frenchii	Maroon Leek-orchid	VBA	1	1893	EN	L	e	2	Nov - early Dec

Scientific name	Common name	Source	Total # of documented records	Last documented record	EPBC	FFG	VIC	Likely occurrence in study area	Survey Period
Prasophyllum spicatum	Dense Leek-orchid	VBA	3	2000	VU	-	e	2	Oct-Nov
Pterostylis cucullata #	Leafy Greenhood	PMST	-	-	VU	L	e	4	-
Senecio psilocarpus	Swamp Fireweed	VBA	7	2015	VU	-	v	3	Nov-March
Taraxacum cygnorum #	Coast Dandelion	PMST	-	-	VU	L	e	4	-
Thelymitra epipactoides #	Metallic Sun-orchid	PMST	-	-	EN	L	e	4	-
Thelymitra matthewsii #	Spiral Sun-orchid	PMST	-	-	VU	L	v	4	-
Xerochrysum palustre	Swamp Everlasting	VBA, DELWP	2	2009	VU	L	v	3	Nov-March
STATE SIGNIFICANCE									
Austrostipa puberula	Fine-hairy Spear-grass	VBA	1	2011	-	-	r	3	-
Cardamine tenuifolia	Slender Bitter-cress	VBA	4	2010	-	-	P	3	-
Chorizandra australis	Southern Bristle-sedge	VBA	7	1904	-	-	k	3	-
Convolvulus angustissimus subsp. *omnigracilis*	Slender Bindweed	VBA	1	2012	-	-	k	3	-
Dianella callicarpa	Swamp Flax-lily	VBA	5	2012	-	-	r	3	-
Dianella sp. aff. *revoluta* (Minjah)	Basalt Flax-lily	VBA	1	2003	-	-	e	3	-
Diuris palustris	Swamp Diuris	VBA	1	1903	-	L	v	3	-
Eucalyptus falciformis	Western Peppermint	VBA	5	1993	-	-	r	4	-
Lachnagrostis punicea subsp. *filifolia*	Purple Blown-grass	VBA	6	2011	-	L	r	3	-
Lachnagrostis punicea subsp. *punicea*	Purple Blown-grass	VBA	2	1997	-	-	r	3	-
Lemna trisulca	Ivy-leaf Duckweed	VBA	1	1993	-	-	k	3	-

Scientific name	Common name	Source	Total # of documented records	Last documented record	EPBC	FFG	VIC	Likely occurrence in study area	Survey Period
Leptorhynchos elongatus	Lanky Buttons	VBA	1	1902	-	-	e	3	-
Lomandra glauca s.s.	Blue Mat-rush	VBA	1	2011	-	-	k	3	-
Platylobium triangulare	Ivy Flat-pea	VBA	2	1899	-	-	k	3	-
Poa labillardierei var. (Volcanic Plains)	Basalt Tussock-grass	VBA	2	2010	-	-	k	3	-
Prasophyllum viretrum	Basalt Leek-orchid	VBA, DELWP	10	2009	-	L	e	2	-
Rumex stenoglottis	Tongue Dock	VBA	1	2011	-	-	k	3	-
Thelymitra benthamiana	Blotched Sun-orchid	VBA	1	1992	-	-	v	3	-
Thelymitra exigua	Short Sun-orchid	VBA	1	2010	-	-	k	3	-
Xanthosia leiophylla	Parsley Xanthosia	VBA	1	2011	-	-	r	3	-
Desmodium varians	Slender Tick-trefoil	Shaw River Survey	-	-	-	-	k	1	-

Notes: EPBC = *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), FFG = *Flora and Fauna Guarantee Act 1988* (FFG Act), DEPI= Advisory List of Rare or Threatened Plants in Victoria (DEPI 2014), L = Listed, # = Records identified from EPBC Act Protected Matters Search Tool, Data source: Victorian Biodiversity Atlas (DELWP 2017d); Protected Matters Search Tool (DoEE 2017). Order: Alphabetical. .

Appendix 2.3 – Habitat Hectare Results

Table A2.3. Habitat Hectares results for remnant vegetation recorded within the study area.

Vegetation Zone		PGWe1	PGWe2	PGWe3	PGWe4	PGWe5	PGWe6	SKS1	SKS2	SKS3	SKS4	PG1
Bioregion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC / Tree		PGWe	PGWe	PGWe	PGWe	PGWe	PGWe	SKS	SKS	SKS	SKS	PG(HS)
EVC Number		125	125	125	125	125	125	649	649	649	649	132_61
EVC Conservation Status		En	En	En	En	En	En	En	En	En	En	En
Patch Condition	Large Old Trees /10	0	0	0	0	0	0	0	0	0	0	0
	Canopy Cover /5	0	0	0	0	0	0	0	0	0	0	0
	Under storey /25	5	10	5	5	10	10	5	15	10	10	5
	Lack of Weeds /15	0	6	2	2	4	9	2	4	4	2	4
	Recruitment /10	3	6	3	3	3	6	3	3	3	3	3
	Organic Matter /5	2	5	2	4	5	5	2	5	5	5	3
	Logs /5	0	0	0	0	0	0	0	0	0	0	0
	Treeless EVC Multiplier	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
	Subtotal =	13.60	36.72	16.32	19.04	29.92	40.80	16.32	36.72	29.92	27.20	20.40
Landscape Value /25		4	4	4	4	4	4	4	4	4	4	4
Habitat Points /100		18	41	20	23	34	45	20	41	34	31	24
Habitat Score		**0.18**	**0.41**	**0.20**	**0.23**	**0.34**	**0.45**	**0.20**	**0.41**	**0.34**	**0.31**	**0.24**
Total Area (ha)		6.086	9.273	56.082	42.736	80.394	0.836	36.569	3.890	3.324	2.117	0.125
Area (ha) to be removed		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Area (ha) to be retained		6.086	9.273	56.082	42.736	80.394	0.836	36.569	3.890	3.324	2.117	0.125
Total habitat hectares		**1.095**	**3.802**	**11.216**	**9.829**	**27.334**	**0.376**	**7.314**	**1.595**	**1.130**	**0.656**	**0.030**
Habitat hectares to be removed		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Habitat hectares to be retained		1.095	3.802	11.216	9.829	27.334	0.376	7.314	1.595	1.130	0.656	0.030
Conservation Significance	Cons. Status x Hab. Score	High	V. High	High	High	High	V. High	High	V. High	High	High	High
	Threatened Species	0	0	0	0	0	0	0	0	0	0	0
	Other Attributes	0	0	0	0	0	0	0	0	0	0	0
	Overall (highest rating)	**High**	**V. High**	**High**	**High**	**High**	**V. High**	**High**	**V. High**	**High**	**High**	**High**

Vegetation Zone		PG2	PG3	PG5	BSW1	BSW2	PGW1	PGW2	PGW3	PGW4	PGW6	PGW7
Bioregion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC / Tree		PG(HS)	PG(HS)	PG(HS)	BSW	BSW	PGW	PGW	PGW	PGW	PGW	PGW
EVC Number		132_61	132_61	132_61	642	642	55_61	55_61	55_61	55_61	55_61	55_61
EVC Conservation Status		En	En	En	En	En	En	En	En	En	En	En
Patch Condition	Large Old Trees /10	0	0	0	0	0	0	8	3	2	0	7
	Canopy Cover /5	0	0	0	0	0	0	5	3	5	4	4
	Under storey /25	5	5	5	15	5	5	15	15	15	5	5
	Lack of Weeds /15	9	0	4	0	4	0	9	9	9	4	2
	Recruitment /10	3	3	3	1	1	0	6	3	3	0	1
	Organic Matter /5	3	3	4	5	5	3	5	5	5	5	5
	Logs /5	0	0	0	2	0	0	5	0	5	0	5
	Treeless EVC Multiplier	1.36	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Subtotal =	27.20	14.96	21.76	23.00	15.00	8.00	53.00	38.00	44.00	18.00	29.00
Landscape Value /25		4	4	4	4	4	4	4	4	4	4	4
Habitat Points /100		31	19	26	27	19	12	57	42	48	22	33
Habitat Score		**0.31**	**0.19**	**0.26**	**0.27**	**0.19**	**0.12**	**0.57**	**0.42**	**0.48**	**0.22**	**0.33**
Total Area (ha)		0.078	1.348	1.462	0.547	0.128	0.967	0.834	0.218	0.347	0.036	0.920
Area (ha) to be removed		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Area (ha) to be retained		0.078	1.348	1.462	0.547	0.128	0.967	0.834	0.218	0.347	0.036	0.920
Total habitat hectares		**0.024**	**0.256**	**0.380**	**0.148**	**0.024**	**0.116**	**0.475**	**0.092**	**0.167**	**0.008**	**0.304**
Habitat hectares to be removed		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Habitat hectares to be retained		0.024	0.256	0.380	0.148	0.024	0.116	0.475	0.092	0.167	0.008	0.304
Conservation Significance	Cons. Status x Hab. Score	High	High	High	High	High	High	V. High	V. High	V. High	High	High
	Threatened Species	0	0	0	0	0	0	0	0	0	0	0
	Other Attributes	0	0	0	0	0	0	0	0	0	0	0
	Overall (highest rating)	**High**	**High**	**High**	**High**	**High**	**High**	**V. High**	**V. High**	**V. High**	**High**	**High**

Vegetation Zone		PGW8	PGW9	PGW10	TM1	AH1
Bioregion		VVP	VVP	VVP	VVP	VVP
EVC / Tree		PGW	PGW	PGW	WF	AH
EVC Number		55_61	55_61	55_61	74	653
EVC Conservation Status		En	En	En	En	En
Patch Condition	Large Old Trees /10	4	10	9	0	0
	Canopy Cover /5	4	5	5	0	0
	Under storey /25	5	5	10	5	15
	Lack of Weeds /15	2	0	2	4	6
	Recruitment /10	1	0	3	0	3
	Organic Matter /5	5	4	5	3	2
	Logs /5	3	0	3	0	0
	Treeless EVC Multiplier	1.00	1.00	1.00	1.36	1.36
	Subtotal =	24.00	24.00	37.00	16.32	35.36
Landscape Value /25		4	4	4	4	4
Habitat Points /100		28	28	41	20	39
Habitat Score		**0.28**	**0.28**	**0.41**	**0.20**	**0.39**
Total Area (ha)		1.587	1.151	2.392	1.365	0.040
Area (ha) to be removed		0.000	0.000	0.000	0.000	0.000
Area (ha) to be retained		1.587	1.151	2.392	1.365	0.040
Total habitat hectares		**0.444**	**0.322**	**0.981**	**0.273**	**0.016**
Habitat hectares to be removed		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Habitat hectares to be retained		0.444	0.322	0.981	0.273	0.016
Conservation Significance	Cons. Status x Hab. Score	High	High	V. High	High	High
	Threatened Species	0	0	0	0	0
	Other Attributes	0	0	0	0	0
	Overall (highest rating)	**High**	**High**	**V. High**	**High**	**High**

Appendix 2.4 – Scattered Trees

Table A2.4. Remnant scattered trees recorded within the study area.

Tree ID	Species	Common Name	DBH (cm)	Circumference (cm)	Size Class
1	*Eucalyptus viminalis*	Manna Gum	61	192	Small Tree
2	*Eucalyptus viminalis*	Manna Gum	70	220	Large Tree
3	*Eucalyptus viminalis*	Manna Gum	85	267	Large Tree
4	*Eucalyptus viminalis*	Manna Gum	75	236	Large Tree
5	N/A	Dead Stag	50	157	Small Tree
6	N/A	Dead Stag	50	157	Small Tree
7	N/A	Dead Stag	55	173	Small Tree
8	*Eucalyptus camaldulensis*	River Red Gum	75	236	Large Tree
9	*Eucalyptus viminalis*	Manna Gum	115	361	Large Tree
10	*Eucalyptus camaldulensis*	River Red Gum	100	314	Large Tree
11	*Eucalyptus camaldulensis*	River Red Gum	50	157	Small Tree
12	N/A	Dead Stag	43	135	Small Tree
13	N/A	Dead Stag	45	141	Small Tree
14	N/A	Dead Stag	110	345	Large Tree
15	N/A	Dead Stag	49	154	Small Tree
16	*Eucalyptus viminalis*	Manna Gum	80	251	Large Tree
17	N/A	Dead Stag	42	132	Small Tree
18	N/A	Dead Stag	55	173	Small Tree
19	N/A	Dead Stag	98	308	Large Tree
20	*Eucalyptus camaldulensis*	River Red Gum	80	251	Large Tree
21	N/A	Dead Stag	70	220	Large Tree
22	N/A	Dead Stag	67	210	Small Tree
23	N/A	Dead Stag	80	251	Large Tree
24	*Eucalyptus camaldulensis*	River Red Gum	92	289	Large Tree
25	N/A	Dead Stag	47	148	Small Tree
26	N/A	Dead Stag	66	207	Small Tree
27	N/A	Dead Stag	58	182	Small Tree
28	N/A	Dead Stag	42	132	Small Tree
29	N/A	Dead Stag	43	135	Small Tree
30	N/A	Dead Stag	50	157	Small Tree
31	N/A	Dead Stag	46	144	Small Tree
32	N/A	Dead Stag	110	345	Large Tree
33	N/A	Dead Stag	60	188	Small Tree

Tree ID	Species	Common Name	DBH (cm)	Circumference (cm)	Size Class
34	N/A	Dead Stag	80	251	Large Tree
35	N/A	Dead Stag	66	207	Small Tree
36	*Eucalyptus camaldulensis*	River Red Gum	65	204	Small Tree
37	N/A	Dead Stag	51	160	Small Tree
38	*Eucalyptus camaldulensis*	River Red Gum	72	226	Large Tree
39	*Eucalyptus camaldulensis*	River Red Gum	85	267	Large Tree
40	*Eucalyptus camaldulensis*	River Red Gum	77	242	Large Tree
41	*Eucalyptus camaldulensis*	River Red Gum	80	251	Large Tree
42	N/A	Dead Stag	50	157	Small Tree
43	*Eucalyptus camaldulensis*	River Red Gum	110	345	Large Tree
44	*Eucalyptus viminalis*	Manna Gum	140	440	Large Tree
45	*Eucalyptus viminalis*	Manna Gum	130	408	Large Tree
46	N/A	Dead Stag	50	157	Small Tree
47	*Eucalyptus viminalis*	Manna Gum	80	251	Large Tree
48	*Eucalyptus viminalis*	Manna Gum	70	220	Large Tree
49	*Eucalyptus viminalis*	Manna Gum	90	283	Large Tree
50	N/A	Dead Stag	60	188	Small Tree
51	*Eucalyptus viminalis*	Manna Gum	170	534	Large Tree
52	*Eucalyptus viminalis*	Manna Gum	120	377	Large Tree
53	*Eucalyptus viminalis*	Manna Gum	90	283	Large Tree
54	*Eucalyptus viminalis*	Manna Gum	87	273	Large Tree
55	*Eucalyptus viminalis*	Manna Gum	76	239	Large Tree
56	N/A	Dead Stag	70	220	Large Tree
57	*Eucalyptus viminalis*	Manna Gum	100	314	Large Tree
58	*Eucalyptus viminalis*	Manna Gum	79	248	Large Tree
59	N/A	Dead Stag	68	214	Small Tree
60	*Eucalyptus viminalis*	Manna Gum	120	377	Large Tree
61	*Eucalyptus viminalis*	Manna Gum	88	276	Large Tree
62	*Eucalyptus viminalis*	Manna Gum	90	283	Large Tree
63	*Eucalyptus viminalis*	Manna Gum	70	220	Large Tree
64	*Eucalyptus viminalis*	Manna Gum	95	298	Large Tree
65	*Eucalyptus viminalis*	Manna Gum	125	393	Large Tree
66	*Eucalyptus viminalis*	Manna Gum	69	217	Small Tree
67	*Eucalyptus viminalis*	Manna Gum	76	239	Large Tree
68	*Eucalyptus viminalis*	Manna Gum	130	408	Large Tree
69	*Eucalyptus viminalis*	Manna Gum	89	279	Large Tree
70	*Eucalyptus viminalis*	Manna Gum	120	377	Large Tree

Tree ID	Species	Common Name	DBH (cm)	Circumference (cm)	Size Class
71	*Eucalyptus viminalis*	Manna Gum	89	279	Large Tree
72	*Eucalyptus viminalis*	Manna Gum	100	314	Large Tree
73	*Eucalyptus viminalis*	Manna Gum	110	345	Large Tree
74	*Eucalyptus viminalis*	Manna Gum	90	283	Large Tree
75	*Eucalyptus viminalis*	Manna Gum	87	273	Large Tree
76	*Eucalyptus viminalis*	Manna Gum	77	242	Large Tree
77	*Eucalyptus viminalis*	Manna Gum	113	355	Large Tree
78	N/A	Dead Stag	70	220	Large Tree
79	*Eucalyptus viminalis*	Manna Gum	105	330	Large Tree
80	*Eucalyptus viminalis*	Manna Gum	68	214	Small Tree
81	*Eucalyptus viminalis*	Manna Gum	70	220	Large Tree
82	*Eucalyptus viminalis*	Manna Gum	120	377	Large Tree
83	*Eucalyptus viminalis*	Manna Gum	187	587	Large Tree
84	*Eucalyptus viminalis*	Manna Gum	90	283	Large Tree
85	*Eucalyptus viminalis*	Manna Gum	90	283	Large Tree
86	*Eucalyptus viminalis*	Manna Gum	77	242	Large Tree
87	*Eucalyptus viminalis*	Manna Gum	75	236	Large Tree
88	Eucalyptus viminalis	Manna Gum	80	251	Large Tree
89	Eucalyptus viminalis	Manna Gum	69	217	Small Tree
90	Eucalyptus viminalis	Manna Gum	80	251	Large Tree
91	Eucalyptus viminalis	Manna Gum	95	298	Large Tree
92	Eucalyptus viminalis	Manna Gum	98	308	Large Tree
93	Eucalyptus viminalis	Manna Gum	68	214	Small Tree
94	Eucalyptus viminalis	Manna Gum	78	245	Large Tree
95	Eucalyptus camaldulensis	River Red Gum	70	220	Large Tree
96	Eucalyptus camaldulensis	River Red Gum	58	182	Small Tree
97	Eucalyptus camaldulensis	River Red Gum	76	239	Large Tree
98	Eucalyptus camaldulensis	River Red Gum	56	176	Small Tree
99	Eucalyptus kitsoniana	Bog Gum	62	195	Small Tree

APPENDIX 3 - FAUNA

Appendix 3.1 – Fauna Results

Table A3.1. Fauna recorded within the broader study area (November 2009–March 2011), and previously recorded within 10 kilometres of the study area.

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
MAMMALS						
Short-beaked Echidna	*Tachyglossus aculeatus*	2005	5	-	-	-
Fat-tailed Dunnart	*Sminthopsis crassicaudata*	2003	1	-	-	-
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	2001	1	-	-	-
Common Brushtail Possum	*Trichosurus vulpecula*	2004	15	Total	-	S
Common Ringtail Possum	*Pseudocheirus peregrinus*	1999	5	Partial	-	-
Yellow-bellied Glider	*Petaurus australis*	1999	2	Total	-	-
Sugar Glider	*Petaurus breviceps*	1999	5	Total	-	-
Koala	*Phascolarctos cinereus*	2004	14	-	-	-
Black Wallaby	*Wallabia bicolor*	2006	5	-	-	S
Red-necked Wallaby	*Macropus rufogriseus*	2005	10	-	-	-
Eastern Grey Kangaroo	*Macropus giganteus*	2002	7	-	-	S
White-striped Freetail Bat	*Tadarida australis*	1999	1	Total	-	A
Southern Forest Bat	*Vespadelus regulus*	1993	2	Total	-	-
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	-	-	Total	-	A
Southern Freetail bat	*Mormopterus sp4*	-	-	Total	-	A
Eastern Freetail Bat	*Mormopterus sp2*	-	-	Total	-	A

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Gould's Wattled Bat	*Chalinolobus gouldi*	-	-	Total	-	A
Chocolate Wattled Bat	*Chalinolobus morio*	-	-	Total	-	A
Eastern Falsistrellus	*Falsistrellus tasmaniensis*	-	-	Total	-	A
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	-	-	Total	-	A
Southern Bent-wing Bat	*Miniopterus schreibersii bassanii*	-	-	Total	-	A
Large Forest Bat	*Vespadelus darlingtoni*	-	-	Total	-	A
Little Forest Bat	*Vespadelus vulturnus*	-	-	Total	-	A
Swamp Rat	*Rattus lutreolus*	2005	22	-	-	S
*Black Rat	*Rattus rattus*	1998	3	-	-	-
*House Mouse	*Mus musculus*	1995	7	-	-	S
*European Rabbit	*Oryctolagus cuniculus*	2005	11	-	-	S
*European Hare	*Lepus europeaus*	2005	3	-	-	S
*Red Fox	*Vulpes vulpes*	2005	12	-	-	S
*Cat	*Felis catus*	2002	4	-	-	S
BIRDS						
Brush Bronzewing	*Phaps elegans*	1994	1	-	-	-
Black-tailed Native-hen	*Gallinula ventralis*	2002	8	-	-	S
Dusky Moorhen	*Gallinula tenebrosa*	1993	3	-	-	-
Purple Swamphen	*Porphyrio porphyrio*	2001	11	-	Ma	S
Eurasian Coot	*Fulica atra*	2000	2	-	-	S
Australasian Grebe	*Tachybaptus novaehollandiae*	1999	2	-	-	S
Hoary-headed Grebe	*Poliocephalus poliocephalus*	2000	12	-	-	-
Short-tailed Shearwater	*Ardenna tenuirostris*	1960	1	-	Mi/Ma	-

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Great Cormorant	*Phalacrocorax carbo*	2000	3	-	-	-
Little Black Cormorant	*Phalacrocorax sulcirostris*	2000	1	-	-	-
Black-faced Cormorant	*Phalacrocorax fuscescens*	1960	1	-	Ma	
Pied Cormorant	*Phalacrocorax varius*	2000	2	-	-	-
Little Pied Cormorant	*Microcarbo melanoleucos*	2001	5	-	-	-
Whiskered Tern	*Chlidonias hybridus*	2000	9	-	Ma	-
Masked Lapwing	*Vanellus miles*	2006	45	-	-	S
Banded Lapwing	*Vanellus tricolor*	2000	3	-	-	S
Black-winged Stilt	*Himantopus himantopus*	2000	2	-	Ma	S
Latham's Snipe	*Gallinago hardwickii*	2003	1	-	Mi/Ma	-
Brolga	*Grus rubicunda*	2004	22	-	-	-
Australian White Ibis	*Threskiornis molucca*	2005	20	-	Ma	S
Straw-necked Ibis	*Threskiornis spinicollis*	2005	26	-	Ma	S
Royal Spoonbill	*Platalea regia*	1990	3	-	-	S
Yellow-billed Spoonbill	*Platalea flavipes*	2006	7	-	-	S
Eastern Great Egret	*Ardea modesta*	2006	4	-	Mi/Ma	S
White-faced Heron	*Egretta novaehollandiae*	2006	38	-	-	S
White-necked Heron	*Ardea pacifica*	2005	15	-	-	S
Nankeen Night Heron	*Nycticorax caledonicus*	2000	1	-	Ma	-
Australian Wood Duck	*Chenonetta jubata*	2001	9	Total	-	S
Black Swan	*Cygnus atratus*	2001	47	-	-	S
Australian Shelduck	*Tadorna tadornoides*	2002	34	Total	-	S

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Pacific Black Duck	*Anas superciliosa*	2006	21	-	-	S
Chestnut Teal	*Anas castanea*	2000	3	Total	-	-
Grey Teal	*Anas gracilis*	2000	9	Total	-	-
Australasian Shoveler	*Anas rhynchotis*	2000	3	-	-	-
Pink-eared Duck	*Malacorhynchus membranaceus*	1976	1	Partial	-	S
Hardhead	*Aythya australis*	2000	4	-	-	-
Blue-billed Duck	*Oxyura australis*	2001	1	-	-	-
Musk Duck	*Biziura lobata*	2000	5	-	Ma	-
Swamp Harrier	*Circus approximans*	2000	4	-	Ma	S
Brown Goshawk	*Accipiter fasciatus*	2000	4	-	Ma	S
Wedge-tailed Eagle	*Aquila audax*	2005	9	-	-	S
Little Eagle	*Hieraaetus morphnoides*	1989	2	-	-	-
Black Kite	*Milvus migrans*	1993	1	-	-	-
Whistling Kite	*Haliastur sphenurus*	-	-	-	-	S
Black-shouldered Kite	*Elanus axillaris*	2005	11	-	-	S
Australian Hobby	*Falco longipennis*	1989	1	-	-	-
Brown Falcon	*Falco berigora*	2005	20	-	-	S
Nankeen Kestrel	*Falco cenchroides*	2005	6	Partial	Ma	S
Southern Boobook	*Ninox novaeseelandiae*	1999	7	Total	Ma	-
Powerful Owl	*Ninox strenua*	1993	1	Total	-	-
Musk Lorikeet	*Glossopsitta concinna*	2000	2	Total	-	-
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	1999	3	Total	-	-

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	2001	10	Total	-	S
Sulphur-crested Cockatoo	*Cacatua galerita*	2005	19	Total	-	S
Long-billed Corella	*Cacatua tenuirostris*	2001	24	Total	-	S
Galah	*Eolophus roseicapilla*	2001	16	Total	-	S
Crimson Rosella	*Platycercus elegans elegans*	2005	31	Total	-	S
Eastern Rosella	*Platycercus eximius*	2002	21	Total	-	S
Red-rumped Parrot	*Psephotus haematonotus*	2005	6	Total	-	S
Blue-winged Parrot	*Neophema chrysostoma*	2003	5	Partial	Ma	-
Tawny Frogmouth	*Podargus strigoides*	1994	3	-	-	-
Laughing Kookaburra	*Dacelo novaeguineae*	2005	20	Total	-	S
Sacred Kingfisher	*Todiramphus sanctus*	2000	3	Partial	Ma	-
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	2001	4	-	Ma	-
Pallid Cuckoo	*Cuculus pallidus*	-	-	-	-	S
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	1999	2	-	Ma	S
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	1999	1	-	Ma	-
Welcome Swallow	*Hirundo neoxena*	2003	39	Partial	Ma	S
Tree Martin	*Hirundo nigricans*	2000	6	Total	Ma	-
Fairy Martin	*Hirundo ariel*	1999	1	Partial	-	S
Grey Fantail	*Rhipidura albiscarpa*	2003	28	-	-	S
Willie Wagtail	*Rhipidura leucophrys*	2005	45	-	-	S
Restless Flycatcher	*Myiagra inquieta*	2001	11	-	-	-
Jacky Winter	*Microeca fascinans*	2001	6	-	-	-

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Flame Robin	*Petroica phoenicea*	1999	3	-	Ma	-
Eastern Yellow Robin	*Eopsaltria australis*	2001	10	-	-	-
Golden Whistler	*Pachycephala pectoralis*	2001	8	-	-	-
Rufous Whistler	*Pachycephala rufiventris*	2001	4	-	-	-
Grey Shrike-thrush	*Colluricincla harmonica*	2001	28	Partial	-	S
Magpie-lark	*Grallina cyanoleuca*	2001	28	-	Ma	S
Crested Shrike-tit	*Falcunculus frontatus*	1993	1	-	-	-
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	2005	18	-	Ma	-
White-fronted Chat	*Epthianura albifrons*	2005	4	-	-	S
Weebill	*Smicrornis brevirostris*	1999	1	-	-	-
Striated Thornbill	*Acanthiza lineata*	2001	4	-	-	S
Yellow Thornbill	*Acanthiza nana*	1989	1	-	-	-
Brown Thornbill	*Acanthiza pusilla*	2005	21	-	-	S
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	2003	23	-	-	S
White-browed Scrubwren	*Sericornis frontalis*	2005	28	-	-	S
Striated Fieldwren	*Calamanthus fuliginosus*	1993	2	-	-	S
Brown Songlark	*Cincloramphus cruralis*	2001	5	-	-	S
Little Grassbird	*Megalurus gramineus*	2000	2	-	-	S
Clamorous Reed Warbler	*Acrocephalus stentoreus*	2005	1	-	Mi/Ma	S
Golden-headed Cisticola	*Cisticola exilis*	2005	5	-	-	S
Superb Fairy-wren	*Malurus cyaneus*	2005	48	-	-	S
Dusky Woodswallow	*Artamus cyanopterus*	2001	6	Partial	-	-

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Varied Sittella	*Daphoenositta chrysoptera*	2000	3	-	-	-
White-throated Treecreeper	*Cormobates leucophaeus*	2001	20	Total	-	-
Mistletoebird	*Dicaeum hirundinaceum*	1993	1	-	-	-
Spotted Pardalote	*Pardalotus punctatus*	2001	6	-	-	-
Silvereye	*Zosterops lateralis*	2000	9	-	Ma	-
White-naped Honeyeater	*Melithreptus lunatus*	2001	10	-	-	-
Brown-headed Honeyeater	*Melithreptus brevirostris*	1999	1	-	-	-
Eastern Spinebill	*Acanthorhynchus tenuirostris*	2000	1	-	-	-
Yellow-faced Honeyeater	*Lichenostomus chrysops*	2001	12	-	-	S
White-eared Honeyeater	*Lichenostomus leucotis*	2001	18	-	-	S
White-plumed Honeyeater	*Lichenostomus penicillatus*	2002	11	-	-	S
New Holland Honeyeater	*Phylidonyris novaehollandiae*	2001	30	-	-	S
Noisy Miner	*Manorina melanocephala*	2001	16	-	-	S
Little Wattlebird	*Anthochaera chrysoptera*	1993	2	-	-	-
Red Wattlebird	*Anthochaera carunculata*	2001	30	-	-	S
Australasian Pipit	*Anthus novaeseelandiae*	2001	14	-	Ma	S
Red-browed Finch	*Neochmia temporalis*	2000	5	-	-	-
Grey Currawong	*Strepera versicolor*	2000	8	-	-	-
Australian Magpie	*Gymnorhina tibicen*	2005	56	-	-	S
Bassian Thrush	*Zoothera lunulata*	1995	1	-	Ma	-
White-winged Chough	*Corcorax melanorhamphos*	-	-	-	-	S
Unknown Raven	*Corvus sp.*	1989	2	-	-	S

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
Forest Raven	*Corvus tasmanicus*	2001	9	-	Ma	-
Australian Raven	*Corvus coronoides*	1999	3	-	-	S
Little Raven	*Corvus mellori*	2005	36	-	Ma	S
Striated Pardalote	*Pardalotus striatus*	2001	6	Partial	-	-
Cattle Egret	*Ardea ibis*	2000	2	-	Mi/Ma	-
*Common Blackbird	*Turdus merula*	2001	19	-	-	S
*European Skylark	*Alauda arvensis*	2005	9	-	-	S
*House Sparrow	*Passer domesticus*	2001	20	-	-	S
*European Goldfinch	*Carduelis carduelis*	2001	28	-	-	S
Peregrine Falcon	*Falco peregrinus*	-	-	Partial	-	S
◊ Stubble Quail	*Coturnix pectoralis*	2005	3	-	Ma	S
White-winged Triller	*Lalage sueurii*	-	-	-	-	S
Little Corella	*Cacatua sanguinea*	-	-	Total	-	S
Common Bronzewing	*Phaps chalcoptera*	-	-	-	-	S
Rufous Songlark	*Cincloramphus mathewsi*	-	-	-	-	S
◊ Magpie Goose	*Anseranas semipalmata*	2007	11	-	-	-
◊ Sharp-tailed Sandpiper	*Calidris acuminata*	2007	5	-	-	-
◊ Curlew Sandpiper	*Calidris ferruginea*	2000	1	-	-	-
◊ White-winged Black Tern	*Chlidonias leucopterus*	2003	1	-	Ma	-
◊ Silver Gull	*Chroicocephalus novaehollandiae*	2006	11	-	Ma	-
◊ Kelp Gull	*Larus dominicanus*	2007	1	-	Ma	-
◊ Orange-bellied Parrot	*Neophema chrysogaster*	2005	14	-	Mi/Ma	-

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
◊ Eastern Barn Owl	*Tyto javanica*	2002	2	-	-	-
◊ Eastern Grass Owl	*Tyto longimembris*	2002	2	-	-	-
◊ Sacred Kingfisher	*Todiramphus sanctus*	2005	9	-	Ma	-
*European Greenfinch	*Carduelis chloris*	1999	1	-	-	S
*Common Starling	*Sturnus vulgaris*	2003	32	Partial	-	S
REPTILES						
Garden Skink	*Lampropholis guichenoti*	1999	3	-	-	-
Blotched Blue-tongued Lizard	*Tiliqua nigrolutea*	2001	3	-	-	S
Common Blue-tongued Lizard	*Tiliqua scincoides*	1997	4	-	-	-
White-lipped Snake	*Drysdalia coronoides*	2005	12	-	-	-
Tiger Snake	*Notechis scutatus*	2005	8	-	-	S
Eastern Three-lined Skink	*Bassiana duperreyi*	2005	9	-	-	S
Southern Water Skink	*Eulamprus tympanum tympanum*	2005	10	-	-	-
Lowland Copperhead	*Austrelaps superbus*	2005	9	-	-	-
Southern Grass Skink	*Pseudemoia entrecasteauxii*	2005	12	-	-	-
FROGS						
Southern Bullfrog	*Limnodynastes dumerilii*	1995	4	-	-	H
Striped Marsh Frog	*Limnodynastes peronii*	2005	8	-	-	H
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2005	7	-	-	H
Brown Toadlet	*Pseudophryne bibronii*	1976	2	-	-	-
Growling Grass Frog	*Litoria raniformis*	-	7	-	-	H
Common Froglet	*Crinia signifera*	2005	-	-	-	H
Southern Brown Tree Frog	*Litoria ewingii*	2005	27	-	-	H

Common Name	Scientific Name	Last Documented Record (AVW)	Total # of Documented Records (AVW)	Hollow Use	Mi/ Ma	2011 Surveys
FISHES						
Common Galaxias	*Galaxias maculatus*	1990	2	-	-	-
Mountain Galaxias	*Galaxias olidus*	1990	3	-	-	-
Southern Pigmy Perch	*Nannoperca australis*	2001	4	-	-	-
Tupong	*Pseudaphritis urvillii*	1990	2	-	-	-
Yarra Pygmy Perch	*Nannoperca obscura*	-	-	-	-	T
Short Finned Eel	*Anguilla australis*	-	-	-	-	T
Dwarf Galaxias	*Galaxiella pusilla*	-	-	-	-	T

Notes: * = Introduced Species, H=Heard, S = Seen, I = Incidental, T = Trapped / handheld, Mi = Migratory, Ma = Marine, ◊ = Birds Australia 'Bird Atlas Data Search Results'

Data Sources: Number and Date of records = Victorian Biodiversity Atlas (DELWP 2017d), Hollow Use: Victorian Fauna Database (Viridans 2014), Migratory and Marine: *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

Taxonomic order: Mammals (Strahan 1995 in Menkhorst and Knight 2004); Birds (Christidis and Boles, 2008); Reptiles and Amphibians (Cogger *et al*. 1983 in Cogger 1996); Fish (Nelson 1994); Mussels and Crustaceans (Alphabetical); Invertebrates (Alphabetical).

Appendix 3.2 – Significant Fauna Species

Table A3.2. Significant fauna within 10 kilometres of the study area.

Likelihood: Habitat characteristics of significant fauna species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area were assessed to determine their likelihood of occurrence. The likelihood of occurrence rankings are defined below.

1	High Likelihood	• Known resident in the study area based on site observations, database records, or expert advice; and/or, • Recent records (i.e. within five years) of the species in the local area (DELWP 2017d); and/or, • The study area contains the species' preferred habitat.
2	Moderate Likelihood	• The species is likely to visit the study area regularly (i.e. at least seasonally); and/or, • Previous records of the species in the local area (DELWP 2017d); and/or, • The study area contains some characteristics of the species' preferred habitat.
3	Low Likelihood	• The species is likely to visit the study area occasionally or opportunistically whilst en route to more suitable sites; and/or, • There are only limited or historical records of the species in the local area (i.e. more than 20 years old); and/or, • The study area contains few or no characteristics of the species' preferred habitat.
4	Unlikely	• No previous records of the species in the local area; and/or, • The species may fly over the study area when moving between areas of more suitable habitat; and/or, • Out of the species' range; and/or, • No suitable habitat present.

EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
FFG	*Flora and Fauna Guarantee Act 1988* (FFG Act)
DSE	Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013); Advisory List of Threatened Invertebrate Fauna in Victoria (DSE 2009)
NAP	National Action Plan (Cogger et al 1993; Duncan et al. 1999; Garnet et al 2011; Woinarski et al 2014; Sands and New 2002; Tyler 1997)

EX	Extinct	DD	Data deficient (insufficiently or poorly known
RX	Regionally extinct	L	Listed as threatened under FFG Act
CR	Critically endangered	EN	Endangered
#	Listed on the Protected Matters Search Tool	NT	Near threatened
VU	Vulnerable	CD	Conservation dependent
LC	least concern	RA	Rare

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
NATIONAL SIGNIFICANCE								
Swamp Antechinus #	*Antechinus minimus maritimus*	-	-	VU	L	NT	VU	4
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	1982	12	EN	L	EN	VU	4
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	2012	6	EN	L	NT	NT	4
Southern Bent-wing Bat	*Miniopterus schreibersii bassanii*	-	-	CR	L	CR	CR	1
Eastern Barred Bandicoot	*Perameles gunnii*	1976	2	EN	L	WX	CR	4
Long-nosed Potoroo #	*Potorous tridactylus tridactylus*	-	-	VU	L	NT	EN	4
Grey-headed Flying-fox #	*Pteropus poliocephalus*	-	-	VU	L	VU	VU	4
Heath Mouse #	*Pseudomys shortridgei*	-	-	EN	L	NT	EN	4
Indian Yellow-nosed Albatross	*Thalassarche carteri*	1977	1	VU	L	VU	-	4
Australasian Bittern	*Botaurus poiciloptilus*	1979	2	EN	L	EN	VU	4
Hooded Plover	*Thinornis rubricollis rubricollis*	1979	1	VU	L	VU	VU	4
Plains-wanderer #	*Pedionomus torquatus*	-	-	CR	L	CR	EN	4
Australian Painted Snipe	*Rostratula australis*	2009	2	VU	L	CR	VU	4
Eastern Curlew #	*Numenius madagascariensis*	-	-	CR	-	VU	-	4
Red Knot #	*Calidris canutus*	-	-	EN	-	EN	-	4
Curlew Sandpiper	*Calidris ferruginea*	1977	1	CR	-	EN	-	4
Swift Parrot #	*Lathamus discolor*	-	-	CR	L	EN	EN	4
Ground Parrot	*Pezoporus wallicus wallicus*	1907	1	-	L	EN	VU	4
Striped Legless Lizard #	*Delma impar*	-	-	VU	L	EN	VU	3
Growling Grass Frog	*Litoria raniformis*	1976	1	VU	L	EN	VU	2
Dwarf Galaxias #	*Galaxiella pusilla*	-	-	VU	L	EN	VU	1
Australian Grayling #	*Prototroctes maraena*	-	-	VU	L	VU	VU	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
Macquarie Perch	*Macquaria australasica*	1970	1	EN	L	EN	DD	4
Yarra Pygmy Perch	*Nannoperca obscura*	2016	66	VU	L	VU	VU	1
Glenelg Spiny Crayfish #	*Euastacus bispinosus*	-	-	EN	L	-	-	4
Golden Sun Moth #	*Synemon plana*	-	-	CR	L	CR	-	2
STATE SIGNIFICANCE								
Brush-tailed Phascogale	*Phascogale tapoatafa*	1946	1	-	L	VU	NT	4
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	-	-	-	L	DD	-	1
Dingo	*Canis lupus dingo*	1886	1	-	L	DD	-	4
Musk Duck	*Biziura lobata*	2000	9	-	-	VU	-	4
Australasian Shoveler	*Anas rhynchotis*	2000	5	-	-	VU	-	4
Hardhead	*Aythya australis*	2011	8	-	-	VU	-	2
Blue-billed Duck	*Oxyura australis*	2001	1	-	L	EN	-	4
White-throated Needletail	*Hirundapus caudacutus*	1986	3	Mi	-	VU	-	3 (flyover)
Eastern Great Egret	*Ardea modesta*	2011	12	-	L	VU	-	1
Intermediate Egret	*Ardea intermedia*	2011	1	-	L	EN	-	4
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*	2007	3	-	L	VU	-	3
Black Falcon	*Falco subniger*	1981	1	-	-	VU	-	4
Brolga	*Grus rubicunda*	2016	59	-	L	VU	-	2
Baillon's Crake	*Porzana pusilla palustris*	1986	1	-	L	VU	-	4
Ruddy Turnstone	*Arenaria interpres*	1964	1	-	-	VU	-	4
Powerful Owl	*Ninox strenua*	2009	5	-	L	VU	-	4
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*	1975	6	-	-	NT	NT	4
Hooded Robin	*Melanodryas cucullata cucullata*	1962	1	-	L	NT	NT	4

Common Name	Scientific Name	Last Documented Record (VBA)	# Records (VBA)	EPBC Act	FFG ACT	DSE (2013)	National Action Plan	Likelihood
Lace Goanna	*Varanus varius*	2009	1	-	-	EN	-	4
Tussock Skink	*Pseudemoia pagenstecheri*	2009	2	-	-	VU	-	4
Glossy Grass Skink	*Pseudemoia rawlinsoni*	2009	2	-	-	VU	-	4
Brown Toadlet	*Pseudophryne bibronii*	2009	4	-	L	EN	DD	4
Southern Toadlet	*Pseudophryne semimarmorata*	1976	2	-	-	VU	-	4
Western Crayfish	*Geocharax falcata*	2001	2	-	-	EN	-	4
REGIONAL SIGNIFICANCE								
Fat-tailed Dunnart	*Sminthopsis crassicaudata*	2003	2	-	-	NT	-	2
Pied Cormorant	*Phalacrocorax varius*	2000	3	-	-	NT	-	3
Black-faced Cormorant	*Phalacrocorax fuscescens*	1960	1	-	-	NT	-	3
Nankeen Night Heron	*Nycticorax caledonicus hillii*	2000	3	-	-	NT	-	2
Glossy Ibis	*Plegadis falcinellus*	2011	1	Mi	-	NT	-	2
Royal Spoonbill	*Platalea regia*	1990	5	-	-	NT	-	1
Sooty Oystercatcher	*Haematopus fuliginosus*	1979	1	-	-	NT	-	4
Latham's Snipe	*Gallinago hardwickii*	2009	5	Mi	-	NT	-	2
Whiskered Tern	*Chlidonias hybridus javanicus*	2011	11	-	-	NT	-	3
Pacific Gull	*Larus pacificus pacificus*	2011	1	-	-	NT	-	3
Spotted Quail-thrush	*Cinclosoma punctatum*	1951	1	-	-	NT	-	4

Data source: Victorian Biodiversity Atlas (DELWP 2017d); Protected Matters Search Tool (DoEE 2017).

Taxonomic order: Mammals (Strahan 1995 *in* Menkhorst and Knight 2004); Birds (Christidis and Boles, 2008); Reptiles and Amphibians (Cogger *et al.* 1983 *in* Cogger 1996); Fish (Nelson 1994).

APPENDIX 4

Appendix 4.1. Rainfall Statistics

Table A4.1. Rainfall statistics from the Hawkesdale Post Office weather station (Latitude: 38.11° S, Longitude: 142.32° E) (BOM 2018)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean *	34.6	32.9	44.9	56.1	65.8	68.9	77.3	82.3	73	65.4	52.9	46.9	703
2009	9	4.2	39.4	64.4	57.8	49.4	103.6	111.8	83.8	65.6	40.8	49.4	679.2
2010	20.2	53.8	50.6	52.2	31.2	64	62.8	170.8	101.2	74.4	60.8	91.6	833.6
2011	105.6	63.4	61.2	105.4	86.8	70.2	92	53	44.8	96.8	33	29.4	841.6
2012	29.4	19.8	71.2	24.2	91.8	92.8	104.8	91.4	62.2	37	25.4	31.2	681.2
2013	4.8	32.8	17.4	21.8	97	56.2	82	126.2	55	134.2	83.4	49	759.8
2014	17.4	15.8	34.6	80.6	59.2	123.8	71.6	49	35.6	41.4	22.4	29	580.4
2015	63.8	20	32.6	40	68.4	53.8	76.6	74	46.8	6.8	27.8	23.4	534
2016	29.6	33.6	35.4	38.6	100.2	77.4	110.4	68.8	145.8	95.8	27.6	40	803.2
2017	47	44.2	74.4	103.2	67.6	21	67	84.4	114.2	55	99.8	63.2	841

*** Long term mean from 1885**