

Draft Report

Detailed Ecological Investigations of the Proposed Darlington Wind Farm, Darlington, Victoria

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GLOSSARY

Acronym	Description
AVW	Atlas of Victorian Wildlife
CalP	<i>Catchment and Land Protection Act 1994</i>
CAMBA	China Australia Migratory Bird Agreement
CMA	Catchment Management Authority
DAWE	(former) Commonwealth Department of Agriculture, Water and Environment.
DBH	Diameter at Breast Height
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DELWP	Victorian Department of Environment, Land, Water and Planning
DEPI	(former) Victorian Department of Environment and Primary Industries
DF	Proposed Development Footprint is proposed the impact area (See Section 2.4.1 Definitions).
DoEE	(former) Commonwealth Department of Environment and Energy
EES	Environment Effects Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EVC	Ecological Vegetation Class
FFG Act	<i>Flora and Fauna Guarantee Act 1988</i>
FIS	Flora Information System
GGF	Growing Grass Frog
GHU	General Habitat Unit
GPG	Global Power-generation
GPGA	Global Power-generation Australia
ha	Hectares
HabHa	Habitat Hectare
JAMBA	Japan Australia Migratory Bird Agreement
LT	Large Tree
MNES	Matters of National Environmental Significance
NVIM Tool	Native Vegetation Information Management Tool (DELWP)
P&E Act	<i>Planning and Environment Act 1987</i>
PMST	Protected Matters Search Tool (DoEE)
ROKAMBA	Republic of Korea Migratory Bird Agreement
SA	Study Area (Proposed Windfarm boundary – red line (Figure 1) consists of 12 properties -7,600 ha)
SBWB	Southern Bent-wing Bat
SHU	Species Habitat Unit
SLL	Striped Legless-Lizard
ST	Small Tree
TEC	Threatened Ecological Community (State and National)
TPZ	Tree Protection Zone

Acronym	Description
TRZ	Tree Retention Zone
VBA	Victorian Biodiversity Atlas (DELWP)

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SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was engaged by Global Power Generation Australia Pty Ltd (herein referred to as GPGA) to provide a summary of the ecological investigations that have been undertaken prior to and following the referral decision under the State *Environment Effects Act 1978* (EE Act) for the proposed Darlington Wind Farm, Darlington, Victoria. GPGA is proposing to submit a planning permit application to facilitate the use and development of a wind farm.

In 2007, a wind farm development proposal for Darlington proposed by TME Australia Pty Ltd was referred to the Minister for Planning (Referral Number 2007R00021) under the EE Act. This proposal was for up to 150 turbines with a total capacity of 450 MW maximum power output, within a study area of approximately 8,800 hectares. In 2008, the Minister's decision was that an Environment Effects Statement (EES) was not required for that proposed wind farm development. However, the decision was subject to a condition for further ecological assessments for significant species and targeted Brolga surveys during the breeding, migration, and flocking seasons. To meet this condition several ecological assessments were conducted for the study area over the 14 years since 2007. These assessments include reviews of the relevant flora and fauna databases, detailed field assessments over multiple survey years (2007, 2008, 2009, 2010, 2012, 2013, 2019, 2020 and 2021), seasons and conditions.

In 2021, the number and layout of turbines proposed, as well as the project boundary was revised. The revised project comprised an area of 9,000 hectares and 61 turbines. As such, a review of the Minister's 2008 EES Referral Decision was undertaken, to determine whether the revised wind farm proposal would require a new EES Referral. As part of this process, a package of information was submitted to DELWP in December 2021. Following this, the project team engaged with DELWP in early 2022 to discuss the changes to the project boundary and number of turbines proposed. It was agreed that additional assessment works would be required to enable DELWP to determine whether the existing EES decision could be upheld, or whether EES re-referral would be required. GPGA ultimately decided to submit a new EES Referral. During the preparation of the new EES Referral, the project area was reduced to 7,640 hectares. The study area was then reduced further in September 2022 to approximately 7,600 hectares, to remove a small section of the study area from within the Darlington no-go flocking zone northeast of the study area.

The detailed ecological investigations include vegetation mapping and condition assessments, terrestrial flora and fauna surveys, and targeted surveys for significant flora and fauna species. The information gathered as part of the field surveys has been used to determine the likely or potential impacts to ecological values within and/or adjacent to the study area, including an assessment of whether any significant flora and fauna species and/or ecological communities would be impacted by the project.

A separate referral will be made to the Victorian Government under the EE Act. The Minister for Planning will decide if an EES is required for the proposed wind farm under the EE Act. This report will be submitted with the EES Referral to inform of the ecological impacts that are associated with the proposed wind farm. This report addresses the changes in the proposed development since the last EES decision and how the original conditions were implemented.

Methods

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the study area. Multiple field assessments were conducted by Ecology and Heritage Partners Pty Ltd and Brett Lane and Associates Pty Ltd between 2007 and 2022.

The surveys sought primarily to assess the extent and condition of native vegetation communities and potential flora and fauna habitat, with consideration given to significant ecological communities and species of conservation concern, such as threatened and migratory species. These assessments included Level 1-3 Brolga assessments, targeted surveys for significant flora and fauna species, bird utilisation surveys, fixed-point and roaming bird surveys, vegetation assessments and mapping, wetland assessments, and community consultation on local flora and fauna.

Existing Values

The project area is representative of many areas within the Victorian Volcanic bioregion with large areas of improved pastures, crops, wetlands and native grasslands, scattered patches of remnant vegetation. Much of the study area has been cleared of native vegetation, with the exception of some road reserves and some small remnant areas of moderate to good quality native vegetation, usually present in drainage lines, ephemeral depressions and other areas where ploughing and direct seeding of pasture grasses has not occurred. Less than two hectares of native vegetation is likely to be impacted by the proposed development as turbines will be situated in areas that no longer support native vegetation to minimise impact. However, more than 10 hectares of area mapped as DELWP modelled current wetlands are proposed to be impacted. Most of the modelled wetland areas are highly modified (i.e. have previously been drained and are now extensively cropped and grazed) and do not support native vegetation. For the purpose of determining the extent of impacts and the required offsets under the native vegetation Guidelines these areas have been assessed as native vegetation (DELWP 2017). Similarly, wetlands and waterways that usually occur in the low-lying areas, will be avoided. Several wetlands mapped in previous studies in 2007 and 2014 have since been drained and ploughed and so are no longer considered remnant patches.

A total of 161 vascular flora species including 90 indigenous species and 71 non-indigenous flora species were recorded within the study area. Four Nationally listed flora species Hoary Sunray *Leucochrysum albicans* ssp. *Tricolor*, Matted Flax-lily *Dianella amoena*, Clover Glycine *Glycine latrobeana* and Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*, and three State-listed species Wavy Swamp Wallaby-grass *Amphibromus sinuatus*, Small Milkwort *Comesperma polygaloides*, and Pale Swamp Everlasting *Coronidium gunnianum* were observed within the study area, but not within the proposed development footprint.

Three nationally significant fauna species were recorded within the study area, including Southern Bent-wing Bat *Miniopterus orianae bassanii*, Growling Grass Frog *Litoria raniformis* and Striped Legless Lizard *Delmar impar*. Four EPBC Act-listed migratory fauna species were also recorded within the study area, Latham's Snipe *Gallinago hardwickii*, Clamorous Reed Warbler *Acrocephalus stentoreus*, Common Greenshank *Tringa nebularia* and Sharp-tailed Sandpiper *Calidris acuminata*...

Eight State significant fauna species were also recorded, including Brolga *Grus rubicunda*, Little Eagle *Hieraaetus morphnoides*, Musk Duck *Biziura lobate*, Australasian Shoveler *Anas rhynchotis*, Australian Gull-billed Tern *Gelochelidon macrotarsa*, Common Greenshank *Tringa nebularia*, Wood Sandpiper *Tringa glareola* and Tussock Skink *Pseudemois pagenstecheri*.

Three significant ecological communities were also recorded within the study area. These include two nationally significant communities: Natural Temperate Grassland of the Victorian Volcanic Plain, and Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains and one State-significant community is: Western (Basalt) Plains Grasslands Community.

The study area is within the Victorian Volcanic Plain bioregion. The native vegetation identified within the study area includes five EVCs: Plains Grassland (EVC 132_61), Aquatic Herbland (EVC 653), Plains Grassy Woodland (EVC 55_61), Plains Sedgy Wetland (EVC 647), and Plains Grassy Wetland (EVC 125). These EVCs all have a Bioregion Conservation Status (BCS) of Endangered, except Plains Sedgy Wetland which is considered Vulnerable.

Proposed impacts and potential for significant effects on the environment

Most mapped patches of native vegetation within or adjacent to the impact area were of moderate-high quality, based on the habitat condition score for each habitat zone using the Vegetation Quality Assessment (VQA) method (DELWP 2017). The Habitat Conditions Scores for these patches ranged from 0.58 to 0.2.

A total of 32.43 hectares is proposed to be impacted by the proposed development, comprising 1.08 hectares of mapped native vegetation (i.e. Plains Grassy Wetland, Plains Grassy Woodland) and approximately 31.35 hectares of current wetlands (i.e. DELWP's modelled wetland). Most of the modelled wetland areas are highly modified (i.e. have previously been drained and are now extensively cropped and grazed) and do not support native vegetation. For the purpose of determining the extent of impacts and the required offsets under the Guidelines these areas have been assessed as native vegetation (DELWP 2017). Several wetlands mapped in previous studies in 2007 and 2014 have since been drained and ploughed and so are no longer considered remnant patches. The study area is also in Location 3 for the proposed vegetation removal 0.456 General Habitat Units (GHU) and Species Habitat Units (SHU) for 15 species are required for offsets for native vegetation removal associated with the proposed development.

Project impacts can be avoided and minimised to acceptable levels through revision of the development footprint to avoid the PGWe patches and current modelled wetlands. The wind farm infrastructure layout has not been finalised, and therefore there are opportunities to further reduce the extent of native vegetation proposed to be impacted.

Key ecological values identified within the project area and project locality are summarised in Table S1. The proposed development footprint has been revised based on the results of the ecological surveys to date to avoid significant impacts on threatened species and communities, native vegetation and fauna habitat, wetlands and watercourses, and migratory and marine species.

Table S1. Summary of the ecological values that occur in or adjacent to the study area and the impact area.

Species Diversity	<p>The large (approximately 7,600 hectares) study area supports a moderately diverse assemblage of plants and animals, with 161 vascular flora species recorded including 78 indigenous species and 71 non-indigenous flora species. In addition, 121 fauna species were recorded during the field surveys of the study area and surrounding habitat.</p>
Remnant Vegetation	<ul style="list-style-type: none"> • A total of 494.60 hectares of mapped native vegetation within or adjacent to the proposed windfarm boundary. Within the proposed development footprint there is 1.08 hectares of native vegetation (PGWe and PGW) mapped. • The area of native vegetation and current wetlands likely to be impacted by the proposed wind farm is approximately 32.43 hectares (i.e. including the impact area and the associated buffer areas applied to the proposed development area and current wetlands and one small scattered tree). • Mapped native vegetation is represented by five EVCs of the Victorian Volcanic Plains bioregion: <ul style="list-style-type: none"> ○ Aquatic Herbland (EVC 653) (AQH) ○ Heavier-soils Plains Grassland (EVC 132-61) (PG) ○ Plains Grassy Woodland (EVC 55_61) (PGW) ○ Plains Grassy Wetland (EVC 125) (PGWe) ○ Plains Sedgy Wetland (PSWe) • Impacts to native vegetation have been largely avoided through design refinements of the development footprint. PGWe (1.04 hectares) and PGW (0.04 hectares) is the only impacted vegetation with the current development footprint, and most of this is within buffer areas so may not be impacted. The development footprint could be further revised, particularly some access tracks can be relocated, to avoid impacting more than 10 hectares of all native vegetation. In addition, wetland assessments will be conducted to confirm and map the extent of current modelled wetlands, as many have been modified. • There are 951.30 hectares of current wetlands mapped within the wind farm boundary and 31.35 hectares within the proposed development footprint.
Wetlands	<ul style="list-style-type: none"> • There is one Wetland of International Importance, Western District Lakes, that occurs 12.7 kilometres from the proposed Darlington Wind Farm boundary. • There are many DELWP modelled current wetlands throughout the study area and surrounds and within the construction footprint. Many of the modelled wetlands are no longer present or have been reduced in size due to draining, channelling, damming, and cropping. Of these wetland areas, 31.36 hectares are potentially impacted by the proposed development footprint.
Significant Ecological Communities	<p>Three significant ecological communities were recorded within the study area. These include two Nationally significant communities:</p> <ul style="list-style-type: none"> • Natural Temperate Grassland of the Victorian Volcanic Plain, SA 13.1679 ha; DF: 0.00 ha • Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains SA: 287.25 ha; DF: 0.00 ha; and <p>One State-significant community:</p> <ul style="list-style-type: none"> • Western (Basalt) Plains Grasslands Community SA (19.6376 ha), DF: 0.00 ha; <p>Impacts to significant ecological communities have all been avoided through refinements to the development footprint. Not all of the Plains Grassy Wetland qualifies as the Seasonal Herbaceous Wetland (SHW) community as the SHW has size and diversity thresholds. All of the Plains Grassland EVC (PG) is equivalent of the Natural Temperate Grassland (NTG) community. The Western (Basalt) Plains Grassland (WPG) community is equivalent to all of the Plains Grassland mapped within the study area. No NTG or WPG is within the proposed development footprint and associated buffers. A 50-metre buffer applies to the SHW community to protect it from impacts.</p>

Significant Flora Species	<ul style="list-style-type: none"> The known occurrence of four Nationally significant flora species within the study area: <ul style="list-style-type: none"> Hoary Sunray <i>Leucochrysum albicans</i> ssp. <i>tricolor</i>. Matted Flax-lily <i>Dianella amoena</i>, Clover Glycine <i>Glycine latrobeana</i>, and Spiny Rice-flower <i>Pimelea spinescens</i> ssp. <i>spinescens</i> Three State significant flora species, in addition to the above, were recorded: <ul style="list-style-type: none"> Small Milkwort <i>Comesperma polygaloides</i>; Wavy Swamp Wallaby Grass <i>Amphibromus sinuatus</i>; Pale Swamp Everlasting <i>Coronidium gunnianum</i>.
Significant Fauna Species	<ul style="list-style-type: none"> The known occurrence of three nationally significant fauna recorded within the study area: <ul style="list-style-type: none"> Southern Bent-wing Bat <i>Miniopterus orianae bassanii</i>; Striped Legless Lizard <i>Delmar impar</i>; Growling Grass Frog <i>Litoria raniformis</i>. The known occurrence of eight State significant fauna, in addition to the above, recorded within the study area: <ul style="list-style-type: none"> Brolga <i>Antigone rubicunda</i>; Little Eagle <i>Hieraaetus morphnoides</i>; Musk Duck <i>Biziura lobate</i>; Australian Shoveler <i>Anas rhynchotis</i>; Australian Gull-billed Tern <i>Gelochelidon macrotarsa</i> Wood Sandpiper <i>Tringa glareola</i> Common Greenshank <i>Tringa nebularia</i> Tussock Skink <i>Pseudemois pagenstecheri</i>. The known occurrence of six migratory/ marine species recorded within the study area: <ul style="list-style-type: none"> Latham's Snipe <i>Gallinago hardwickii</i> (EPBC Act Migratory); Double-banded Plover <i>Charadrius bicinctus</i> (EPBC Act Migratory) Clamorous Reed Warbler <i>Acrocephalus stentoreus</i> (EPBC Act Migratory); Sharp-tailed Sandpiper <i>Calidris acuminata</i> (EPBC Act Migratory/Marine species). Common Greenshank <i>Tringa nebularia</i> (EPBC Act Migratory species) Wood Sandpiper <i>Tringa glareola</i> (FFG Act-Migratory/Marine species).
Legislative Requirements	<ul style="list-style-type: none"> A referral should be submitted to the Commonwealth according to the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) to determine whether the proposed development will have a significant impact on matters of National Environmental Significance. A referral under the <i>Environment Effects Act 1994</i> should be submitted to determine whether the proposed development will trigger the requirement for an Environment Effects Statement.

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by Global Power Generation Australia Pty Ltd (herein referred to as GPGA) to provide a summary of the ecological investigations that have been undertaken prior to and following the referral decision under the State *Environment Effects Act 1978* (EE Act) for the proposed Darlington Wind Farm, Darlington, Victoria. It is understood that GPGA is proposing to submit a planning permit application to facilitate the use and development of a wind farm.

1.1.1 Referral under the EE Act

On 23 November 2007, a wind farm development proposal for Darlington submitted by TME Australia Pty Ltd, was accepted by the Minister for Planning (Referral Number 2007R00021) under the EE Act (Tract 2021). This proposal was for up to 150 turbines with a total 450 MW maximum power output capacity, within an approximate area of 8,800 hectares. The technical investigations concluded the project would not result in any significant impacts to the environment, although the project would have an impact on the local area, but these impacts were deemed minimal (Tract 2021).

On 9 January 2008, the Minister's decision was that an Environment Effects Statement (EES) was not required for the proposed development (DSE 2008a). However, the Reasons for Decision under the EE Act 1978, was subject to several conditions, including for further ecological assessments for significant species and targeted Brolga surveys during the breeding, migration, and flocking seasons (DSE 2008a). The results of these surveys would then inform any statutory decision as to the approval of the wind farm. The reasons for this decision were that:

- *'The study area consists of mostly cleared agricultural land and so there is scope to avoid adverse effects of the turbines on significant and sensitive areas.'*
- *Preliminary ecological investigations found that other than the Brolga it is unlikely other fauna would be significantly affected by the development.*
- *There is scope to adjust the wind farm design to avoid areas found to be important for the brolga during breeding, migration and flocking.*
- *Landscape value and amenity effects were considered only locally significant and could also be mitigated with appropriate design.*
- *The potential effects can be assessed through the planning permit process under the Planning and Environment Act 1987'.*

In December 2021, a review of the 2007 Darlington Wind Energy Facility EES decision (Reference no. 2001R00021) was requested by GPGA (Tract 2021), to determine whether the revised wind farm proposal required a new EES referral. Following engagement with DELWP in February 2022, it was agreed that a new EES referral would be made.

The Ministerial Guidelines for EES supplement the requirements of the *Environment Effects Act 1978*. The guidelines provide detail about the administration of the EES process. They set out the process for a proponent or decision-maker to refer projects to the Minister for a decision about the need for an EES.

The EES Guidelines also provide an important role in interpreting the provisions of the Act and set out the process for:

- Scoping and preparing an EES.
- Public review of an EES.
- Considering public submissions.
- Requiring a supplementary statement.
- Making the final assessment.
- Coordinating other statutory processes.

Whilst the EES Guidelines provide guidance for decision-makers, it is not a statutory document nor is it enshrined through legislation. The Guidelines highlight that flexibility is built into the EES process, noting the EES process offers options for the Minister's response to a referral.

The purpose of this report is to provide a summary of significant species and ecological communities identified in the study area through detailed desk-based and field assessments (including targeted surveys) that have been undertaken as part of the previous EES referral, and more recently, over the past two years to inform the statutory assessment and approval process for the project.

The detailed ecological investigations include vegetation mapping and condition assessments, terrestrial flora and fauna surveys, and targeted surveys for significant flora and fauna species. The information gathered as part of the field surveys has been used to determine the likely or potential impacts to ecological values within and/or adjacent to the study area, including an assessment of whether any significant flora and fauna species and/or ecological communities would be impacted by the project.

A new referral will be made to the Victorian Government under the EE Act. The Minister for Planning will decide if an EES is required for the proposed wind farm under the EE Act. This report will be submitted with the EES Referral to inform of the ecological impacts that are associated with the proposed wind farm development. This report addresses the changes in the proposed development since the last EES decision and how the original conditions were implemented.

1.1.2 *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) referral*

Matters of NES (National Environmental Significance) have previously been identified within the study area and the proposed development may impact one or more of these matters. As such, the project will be referred to the Commonwealth Environment Minister under the EPBC Act. This will determine whether the project is a 'controlled action' under the Act and if the project needs to be formally assessed under the EPBC Act.

1.2 Objectives

The objectives of the detailed ecological assessment were to:

- Review the relevant flora and fauna databases and available literature;
- Collate and summarise all the previous ecological assessments undertaken as part of the project;
- Undertake up to date field assessment of the quality and extent of native vegetation and modelled wetlands within the study area;
- Undertake targeted surveys for significant flora and fauna species, and ecological communities;

- Provide maps showing areas of native vegetation, wetlands, and locations of significant flora and fauna species and ecological communities;
- Provide an assessment of likely or potential impacts to flora and fauna species and ecological communities listed under the relevant Commonwealth and State legislation, and Government policy; and,
- Where native vegetation is proposed to be impacted address the requirements under the State Guidelines (DELWP 2017).

1.3 Study Area

1.3.1 Definitions

For the purpose of this report the following definitions apply:

- Project: the proposed wind farm development.
- Project area: the area that the proposed wind farm is within (including previous development footprints and study area boundaries and the roads through the area).
- Proposed development footprint: the area to be directly affected by the construction and/or operation of the assessed project components (i.e., direct vegetation clearance). This area includes buffers applied to the development areas. The buffers applied are 100 metre buffers to proposed wind turbines, 25 metre buffer applied to roads and access tracks.
- Study area or 'site': the area within the proposed wind farm boundary.
- Survey area: the area encapsulated by direct field assessments.
- Study area and surrounds: the area within a 10-kilometre radius of the study area and subject to desktop review of ecological values, and indirect impacts of construction and/or operation of the project.

The study area is in Darlington, in the central west of Victoria, approximately 200 kilometres west of Melbourne's CBD (Figure 1). The site is bisected by the Hamilton Hwy and bound by Mt Fyans Lane to the north, Castle Carey Road, and Darlington – Terang Road to the south and east and Six Mile Lane to the west. The study area consists of privately-owned properties with 12 separate landholders involved. Investigations focused on the area within the proposed wind farm boundary and an area up to 10 kilometres surrounding this study area, collectively referred to as the 'study area' and 'surrounds'. The proposed wind farm area is generally flat with some undulating areas of depressions and drainage lines between a few dispersed stony knolls. Much of the study area has been converted to farmland, primarily improved pasture, and crops, with similar habitats beyond the wind farm boundary.

The Mount Emu Creek flows from north to south to the east of the wind farm, and the entire study area has several drainage lines, floodplains and swampy areas scattered throughout, some of which flow into Mount Emu Creek. Many of these features have been modified by agricultural activities, including extensive draining of wetland areas, channelling of creeklines and the creation of dams.

The proposed wind farm includes low-lying floodplain areas and raised basalt formations, formed by prehistoric lava flows. Many of the drainage lines and floodplains are modified due to agricultural activities including cropping and damming.

One wetland of International Importance (Ramsar Wetland), Western district Lakes, occurs 12.7 kilometres from the study area boundary (DCCEEW 2022). Major wetlands within 20 kilometres of the Darlington wind Farm site include Lake Bernie Bolac; Lake Sheepwash; Lake Gellie and Long Dam. Several other ephemeral wetlands, including marshes, freshwater meadows and farm dams occur within 20 kilometres of the study area. In addition, the study area contains seasonally inundated drainage lines and pasture. Artificial waterbodies including dams also provide habitat for waterbirds and other water dependent species.

The primary land use is agriculture, consisting of improved pasture utilised for grazing and cropping. According to the Department of Environment, Land, Water and Planning (DELWP) NatureKit Map (DELWP 2022a), the study area is located within the Victorian Volcanic Plain bioregion, Glenelg Hopkins Catchment Management Authority (CMA) and Moyne Shire Council. There are agricultural and residential buildings within the study area and surrounds.

1.4 Project Description

It is understood that the Darlington area was chosen for the proposed wind farm due to its consistent, strong winds and also due to the availability of the existing high voltage transmission line that runs through the study area. The use of this transmission line coupled with the proposed turbines and on-site substation will allow for the efficient dispatching of energy generated from the proposed wind farm into the national electricity network (Tract 2021).

The 2007 proposed wind farm development was for up to 150 turbines within an approximate 8,800 hectares study area (Tract 2021), while the current wind farm proposal has been reduced 60% down to a maximum of 61 turbines, and the study area has also reduced to 7,590 hectares (GPGA 2022). This reduction in turbines and subsequent decrease in turbine density and their repositioning were proposed to avoid significant effects of the development on significant species, in particular Brolga that flock to Lake Bernie Bolac, northeast of the study area. The proposed infrastructure layout is indicative and will be finalised based on recommendations following the completion of the ecological assessments and input from other technical assessments and experts.

The proposed Darlington Wind Farm involves the installation of up to 61 turbines and associated infrastructure, primarily the expansion of existing roads and access tracks, throughout the study area (GPGA 2022). The maximum height of each turbine is up to 240 metres and the rotor diameter up to 172 metres. Each turbine is expected to have a capacity of up to 7.2 MW, giving a total capacity of the wind farm of approximately 400 Megawatt (MW).

The development footprint (including buffers) covers 516.49 hectares of the study area. The development footprint has a 100-metre diameter buffer placed on the proposed turbine locations. The turbine construction pads and laydown areas are all located within the 100 metre buffer area. A 25-metre buffer has been applied to each side of the proposed access roads and cabling development, providing a 50-metre wide impact footprint. The proposed sub-station and site office buildings have been given a 25-metre buffer to allow for construction impacts.

Although offset requirements will be calculated for the whole construction footprint including these buffer areas, it is not expected that the developments will impact all vegetation within these buffer areas, so any offset calculations should be considered as a worst-case scenario.

The development of the proposed wind farm will result in the removal of native vegetation and has the potential to impact significant species. The development footprint has been revised several times based on the ecological assessments to avoid areas of high ecological value, native vegetation, wetlands, and habitat for significant fauna species and other species including Brolga *Grus rubicunda*. GPGA requested figures to show areas of “no-go” and “avoid if possible” to inform the placement of turbines and associated roads and infrastructure and to avoid areas of ecological significance including patches of native vegetation and fauna habitat.

DRAFT

2 METHODS

The following outlines the methods used to determine the presence and extent of ecological values across the study area. Due to the large scale of the study area, field surveys focussed on areas with native vegetation within or directly adjacent to the infrastructure layout.

2.1 Nomenclature

Common and scientific names of vascular plants follow the Victorian Biodiversity Atlas (VBA) (DELWP 2022e) and the Census of Vascular Plants of Victoria (Walsh and Stajsic 2007). Vegetation community names follow DELWP's Ecological Vegetation Classes (EVC) benchmarks (DELWP 2022c). The names of aquatic and terrestrial vertebrate and invertebrate fauna follow the VBA (DELWP 2022e).

2.2 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 NatureKit Map (DELWP 2022a) and Native Vegetation Information Management (NVIM) Tool (DELWP 2022b) 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 EVCs.
- EVC benchmarks (DELWP 2022c) 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 2022d);
- The Atlas of Living Australia (ALA) for previously documented flora and fauna records within the project locality (ALA 2022);
- The Illustrated Flora Information System (FIS) of Victoria (IFLISV) (Gullan 2017) for assistance with the distribution and identification of flora species;
- eBird database for previous records of avian species in the reserve (The Cornell Lab 2022);
- The DCCEEW Protected Matters Search Tool (PMST) for matters of NES protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DCCEEW 2022);
- Relevant listings under the *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest Threatened and Protected Lists (DELWP 2019, 2022e);
- The online VicPlan Map (DELWP 2022f) to ascertain current zoning and environmental overlays;
- Aerial photography of the study area;
- Previous assessments and reports relevant to the study area, as outlined in the reference list for Ecology Partners, Ecology and Heritage Partners and Brett Lane and Associates.
- Literature review of significant species, wind farm impacts and potential mitigation measures.

- Interim Guidelines for the Assessment, Avoidance, Mitigation and Offsetting of Potential Wind Farm Impacts of the Victorian Brolga Population (DSE 2011a);
- Brolga Assessment and Mitigation Standards (DELWP 2020).

2.3 Ecological Field Surveys

2.3.1 Summary

Ecological investigations have been conducted for the study area over the 14 years since 2007. These investigations include reviews of the relevant flora and fauna databases. Detailed field assessments were undertaken over multiple survey years (2007, 2008, 2009, 2010, 2012, 2013, 2019, 2020 and 2021), seasons, and conditions. These assessments were undertaken to determine the extent and quality of native vegetation within the study area and to record flora and fauna species present and their habitat. A summary of the field surveys is provided (Table 1).

The study area was walked, and all observed vascular flora and fauna species within or adjacent to the impact area were recorded. Any observations of significant species were mapped, and the overall condition of vegetation and habitats were also noted. Ecological Vegetation Classes (EVCs) were determined with reference to DELWP pre-1750 and extant EVC mapping and their published descriptions (DELWP 2022c). Where remnant vegetation was identified a habitat hectare assessment was undertaken using the methodology described in the Vegetation Quality Assessment Manual (DSE 2004). Native vegetation was classified in accordance with the definitions provided in Table 2, as defined in the *'Guidelines for the removal, destruction or lopping of native vegetation'* (the Guidelines) (DELWP 2017).

Table 1. Summary of field surveys completed within the study area as part of the detailed ecological investigations.

Category	Survey dates	Number of survey days and approximate hours (based on 7.5 hr days)
General flora and general fauna assessments	<ul style="list-style-type: none"> - 12 and 13 September 2007 - 5, 6, and 9 October 2007 - 19 November and 21 December 2009 - 9-12 December 2013 - 17-19 December 2013 - 25-29 October 2021 	<p>In 2007, five days, two people, 75 hours. Preliminary flora and fauna assessment to assess potential for impact (Brett Lane and Associates 2007).</p> <p>In 2009, two people, 33 days.</p> <p>In 2013, seven days, two people, 105 hours.</p> <p>In 2021, five days, two people, 75 hours.</p>
Native vegetation and Large Tree assessments	<ul style="list-style-type: none"> - 9-12 December 2013 - 17-19 December 2013 - 25-29 October 2021 	<p>In 2013, 7 days – two people, 105 hours</p> <p>In 2021, 5 days – two people, 75 hours</p>
Significant flora species surveys	<ul style="list-style-type: none"> - 5, 6, 9 October 2007 (Brett Lane) - 18-19 August 2021 - 8-10 September 2021 - 25-29 October 2021 	<p>In 2007, 3 days, two people, 45 hours</p> <p>In 2021, Winter and Spring targeted flora surveys (e.g. Spiny Rice-flower).</p> <p>Nine days, two people, 135 hours.</p>
Brolga surveys	<ul style="list-style-type: none"> - August 2008 - 19-20, and 23-27 Nov 2009 (Brolga nest searches) - 8, 10 and 11 December 2009 (Focal Brolga nest surveys) 	<p>In 2008, targeted Brolga flocking season investigations (Brett Lane and Associates 2008b).</p> <p>In 2008 and 2009, Brolga breeding and flocking (Brett Lane and Associates 2009).</p> <p>8-11 December 2009 Focal Brolga nest surveys and aerial Brolga nest surveys</p>

Category	Survey dates	Number of survey days and approximate hours (based on 7.5 hr days)
	<ul style="list-style-type: none"> - 9 Dec 2009 (Aerial Brolga nest searches) - 24 Sept 2012 - 7 Jan 2013 - 2 October to 30 November 2012 - Spring 2020 - 18-19 August 2021, - 8 -10 September 2021, - October, November, December 2021 	<p>In 2009/10, Level 1 Assessment (Ecology and Heritage Partners, 2010).</p> <p>In 2009/10 Level 3 Assessment with population viability analysis (PVA) (McCarthy 2009) and collision risk assessment (Biosis 2009).</p> <p>In 2012 and 2013 Level 1 and Level 2 Assessment, Brolga behaviour and movement assessed, Brolga breeding (four nests assessed), community consultation for Brolga locations past and present, Roaming surveys for Brolga and wetland assessments and Home range Analysis (Symbolix 2013).</p> <p>In 2019, 2020 and 2021, Wetland assessments and Level 1 Brolga surveys.</p>
Striped Legless Lizard surveys	<ul style="list-style-type: none"> - 29-30 September 2021 - 20-21 October 2021 - 8-10 November 2021 - 24-25 November 2021 - 13-16 December 2021 - January and February 2022 	<p>In 2021/22. 12 grids. Checked seven times each grid. 210 hours of surveys. Also, additional time for the initial survey for potential habitat, deployment of the grids and collect the grids at the completion.</p>
Corangamite Water Skink surveys	<ul style="list-style-type: none"> - 20 October 2021 - 9-11 November 2021 - 13-16 December 2021 	<p>4 days, two people, surveyed 20 sites (Figure 5).</p>
Targeted Growling Grass Frog surveys	<ul style="list-style-type: none"> - 9-11 November 2021 - 13-16 December 2021 - January 2022 	<p>4 days and 3 nights (2 surveyors).</p>
Bird Utilisation Surveys (winter and spring)	<ul style="list-style-type: none"> - 23-27 November 2009 - 7-11 December 2009 - September to December 2012 - 8-12 November 2021 	<p>In 2009, BUS and Migratory wader surveys, 10 days (Ecology and Heritage Partners 2012).</p> <p>In 2012, 4 days. Two people, 60 hours</p> <p>In 2021, 2 people 5 days.</p>
Fixed Point Bird Counts	<ul style="list-style-type: none"> - 7-11 December 2009 	<p>In 2009, 5 locations. (Ecology and Heritage Partners 2012).</p>
Targeted surveys for migratory waterbirds	<ul style="list-style-type: none"> - 23-27 November 2009 - 26 -30 November 2012 	<p>In 2010, Targeted surveys for migratory bird species. (Ecology and Heritage Partners 2010).</p> <p>In 2012, all wetlands, dams and lakes surveyed (Ecology and Heritage Partners 2014).</p>
Bats surveys	<ul style="list-style-type: none"> - 16-21 December 2009 (Ecology and Heritage Partners 2014) - 4 October 2019 deployed and retrieved 1 November 2019 - 19 November 2019 to 21 December 2019 - 27 September 2021, 15 song meters deployed for 7 weeks (collected on 26 November 2021) - 24 January 2022, 15 song meters were deployed for 7 weeks (collected 16 March 2022). 	<p>In 2009 and 2010, targeted bat surveys detected SBWB within the study area (Brett Lane and Associates 2009) (Ecology and Heritage Partners 2010). The four song meters deployed recorded SBWB on one Songmeter and five other bats species across the four Songmeters.</p> <p>In 2021/22, 15 Song meters deployed for two periods of seven weeks. Two people, six days, .90 hours to deploy, and retrieve.</p> <p>Total recording hours: 17,640. A total of 15 song meters out for two periods of seven weeks with 12 hours recording per day. Seven of the 15 Songmeters recorded SBWB on them.</p>

2.3.2 *Permits and Licences*

All fieldwork was carried out under the appropriate licences, including a Research Permit (10008283) and Scientific Procedures Fieldwork Licence (SPFL 20005) issued by DELWP under the *Wildlife Act 1975*, and an Animal Research permit issued by the Wildlife and Small Institutions Animal Ethics Committee (22.13 and 05.17). A permit to work with the roadside reserve was obtained from the Moyne Shire Council to establish tile grid surveys for Striped Legless Lizard.

2.3.3 *Native Vegetation Assessment*

Several field assessments have been undertaken with the aim of determining native vegetation quality and extent within or directly adjacent to the impact area. Vegetation assessments were undertaken to obtain information on flora and fauna values within the study area. The study area was walked and/or driven, with all observed vascular flora and fauna species within or adjacent to the impact area recorded, any significant records mapped, and the overall condition of vegetation and habitats noted. Remnant vegetation in the local area was also investigated to assist in determining the pre-European vegetation within the study area. EVCs were determined with reference to DELWP pre-1750 and extant EVC mapping and their published descriptions (DELWP 2022b, 2022c).

The field assessment was conducted by ecologists accredited by DELWP in the habitat hectare method (DSE 2004) to quantify the quality and extent of native vegetation values within the study area, identify flora and fauna habitat values within the study area, and to determine conditions with reference to findings of the desk-based assessment. The surveys sought primarily to assess the extent and condition of native vegetation communities and potential flora and fauna habitat, with consideration given to significant ecological communities and species of conservation concern, such as threatened and migratory species.

2.3.4 *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 2017). The 'Assessor's handbook – applications to remove, destroy or lop native vegetation' (Assessor's handbook) (DELWP 2018) provides clarification regarding the application of the Guidelines.

Where remnant vegetation was identified a habitat hectare assessment was undertaken following methodology described in the Vegetation Quality Assessment Manual (DSE 2004). Native vegetation was assessed based on the assessment pathway outlined in Table 2 and classified in accordance with the definitions provided in Table 3, as defined in the Guidelines (DELWP 2017). Native vegetation (as defined in Table 3) is assessed using two key parameters: extent (in hectares) and condition. For the purposes of this assessment, both condition and extent were determined as part of the field assessments. In addition, the type and general condition of all vegetation was assessed, and a determination made as to whether it qualifies for further consideration under local, State, or National legislation and policy.

Assessment Pathway

The Guidelines manage the impacts on biodiversity from native vegetation removal using an assessment-based approach. Two factors – extent and location – are used to determine the assessment pathway associated with an application for a permit to remove native vegetation. 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 2022b). Determination of the assessment pathway is summarised in Table 2.

Table 2. Assessment pathways for applications to remove native vegetation (DELWP 2017).

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.

Large Tree and Habitat Assessment

The vegetation survey assessments also quantified the number of scattered trees and Large Trees within native vegetation patches in or adjacent to the impact area, as well as to collate data pertaining to the presence of hollows and/or nests and significant 'habitat trees' that may provide habitat for fauna.

Table 3. Determination of remnant native vegetation (DELWP 2017)

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. 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. Each Large scattered tree is assigned an extent of 0.071 hectares (30m diameter). Each Small scattered tree is assigned a default extent of 0.031 hectares (10 metre diameter)	Scattered trees are assigned a default condition score of 0.2 (outside a patch).

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

A field assessment was conducted on 9 to 12 December, 17 to 19 December 2013 and 25-29 October 2021 to map EVCs and habitat for significant fauna within the study area. Records of significant terrestrial flora and fauna within the study area were collected opportunistically during this time, as well as occurrences of listed ecological communities.

Road reserves were not included in the study area in 2013 and were therefore not subject to the preliminary assessment, however general observations were made of ecological values in the road reserves. The road reserves were assessed between 25 and 29 October 2021. The 2021 assessment also reassessed the EVCs and habitat for significant flora and fauna and determined the condition scores and mapping extent of native

vegetation patches. The native vegetation assessments focused predominately within the development footprint plus a buffer area of 50 metres either side of roads and buildings proposed for development and 100 metre radius buffer for each proposed turbine location. These buffer areas were assessed to provide flexibility for revision of the development footprint at the early stages of design to allow for vegetation mapped to be avoided without additional vegetation surveys being required until the final footprint is developed.

2.3.5 *Current Wetlands (DELWP)*

Wetlands can be difficult to map and assess accurately as they respond quite quickly to changes in environmental condition, especially rainfall (DELWP 2017). After a period of no or low rainfall they can disappear or appear degraded, and yet recover quickly following increased rainfall. As a result, under the Guidelines (DELWP 2017) all mapped wetlands (based on 'Current Wetlands' layer in the DELWP NatureKit Map) that are to be impacted must be included as native vegetation, with the modelled condition score assigned to them (DELWP 2017). 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, in most circumstances, a mapped wetland must be treated as a patch of native vegetation, with the modelled condition score applied to the area of impact (DELWP 2017). Many wetlands within the study area have been substantially disturbed, drained or cropped, and therefore no longer function as wetlands.

The current modelled wetlands were assessed to check their condition and confirm their extent within the study area and surrounds and to assess their quality in terms of fauna habitat for significant species including Brolga and Latham's Snipe.

2.3.6 *Terrestrial Fauna Surveys*

In 2009, a desktop assessment of relevant fauna databases and a review of previous ecological reports for the Darlington area was undertaken (Ecology and Heritage Partners 2009). Data and information held within the ecological databases and mapping programs reviewed in the desktop assessment are unlikely to represent all flora and fauna present within and surrounding the study area. In 2021 and 2022, an additional review was undertaken and the previous ecological assessments for the proposed development were collated.

Fauna habitat within the study area includes natural water bodies (Plate 1 and 2), dams, native and introduced vegetation, logs, cracked soils, embedded and surface rocks, rock piles and rock walls (created by landowners), other artificial structures such as farm sheds, haystacks, stock troughs, windrows, plantations. Fauna surveys were undertaken concurrently with the vegetation assessments and large tree assessments between, as well as during, the bird utilisation surveys and targeted flora and fauna surveys (Table 1 and 4) (Figure 2). The study area was visually assessed and active searching under and around ground debris for reptiles, frogs and small mammals was undertaken. Binoculars were also used to scan the area for birds, and observers listened for calls and searched for other signs of fauna such as nests, remains of dead animals, droppings, and footprints. Potential habitat for fauna was assessed, with an emphasis on waterbodies and other habitats that may provide shelter, food, or other resources for significant species. At most locations, assessment was made on foot by walking into the areas considered likely to support the highest-quality and representative habitat.

A summary of the fauna survey techniques and a description of the survey methods is provided below (Table 4). Targeted Fauna surveys for significant fauna were undertaken during the optimal survey period outlined in the species-specific guidelines to maximise the likelihood of detecting significant fauna identified as having the potential to occur within the impact area.

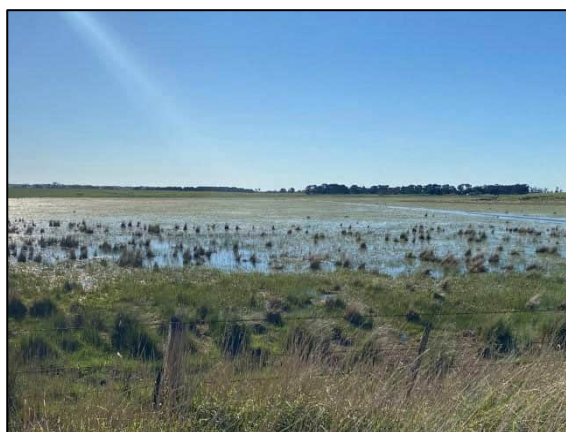


Plate 1. Waterbodies in the study area provide habitat for a variety of fauna species (Ecology and Heritage Partners 30/09/2021).



Plate 2 Permanent and seasonally inundated areas provide fauna habitat within the study area. (Ecology and Heritage Partners 12/04/2021).

Table 4. Summary of fauna survey techniques and total fauna survey effort.

Survey technique	Target species	Sites	Survey effort
Targeted Surveys	Brolga	Nest sites, flocking sites, nest watching, breeding wetland habitat assessments, roaming surveys, community consultation	Multiple survey periods and methods from 2012-2021 (See Table 1). Level 1 and 2 Assessments. Roaming surveys involve driving all roads within a 10-kilometre radius of the study area.
Targeted Surveys – Tile Grids (SLL)	Striped Legless Lizard Tussock Skinks (Incidental under tiles)	12 Sites (Figure 5)	12 grid locations comprising 50 tiles at each. A total of seven grid checks. Surveys undertaken in accordance with the national Survey Guidelines for Australia's Threatened Reptiles (DSEWPac 2011).
Targeted Surveys of potential habitat (CWS)	Corangamite Water Skink	Check 20 sites	Multiple areas supporting potential habitat (i.e. piles of rocks near waterbodies) for the species searched between 9 and 11 November 2021. Surveys were undertaken in accordance with the national Survey Guidelines for Australia's Threatened Reptiles (DSEWPac, 2011).
Bat detectors (Song meters) (SBWB)	Southern Bent-wing Bat	In 2010 and 2019, Four sites (three within and one outside the study area) in a selection of habitat types. In 2021 (Spring and Summer surveys), 15 sites (all within the study area in a selection of habitat types) song meters deployed for seven weeks at each site in each season (Spring and Summer) (Figure 5)	Bat detectors deployed between 2 and 4 October 2019 and retrieved 1 November 2019. Song meters deployed start of September 2021 and collected end of November 2021. Deployed again for seven weeks from 24 January 2022 to 16 March 2022 (Figure 5).
Bird Utilisation Surveys (BUS)	All Bird Species	10 sites. 6 repeat surveys to 8 sites completed to date (Figure 5)	20-minute surveys at each site. Completed 6 repeat surveys to 8 sites to date. Recording species, count, height and direction of flight. Surveyed at different types of the days

Survey technique	Target species	Sites	Survey effort
Targeted Growling Grass Frog surveys -	Growling Grass Frog	At least 40 waterbodies across the study area that have potential to support Growling Grass Frog were surveyed at four locations and listened for during other field surveys during the calling period.	Two nocturnal survey periods between November and December 2021 and February 2022. - 13-16 December 2021 January 2022 Surveys involved call playback at areas of suitable habitat (Figure 5).
Fixed Point Bird Surveys	All Bird Species	Five locations surveyed in 2009 In 2021/22 10 locations surveyed	Search radius of 100 metres for small birds and 800 metres for large birds. 20-minute surveys. Species, height flying, and direction of flight recorded. All sites surveyed at multiple times of the day (Ecology and Heritage Partners 2012) (Figure 5).
Targeted surveys for Migratory Shorebirds	All Migratory Shorebird species	Waterbodies surveyed by walking 10-40 metres apart. Rapid assessment of wetland quality as habitat. Roaming bird surveys were also conducted and surrounding waterbodies assessed.	2 October -30 November 2012. 8-10 September 2021 November and December 2021 See Table 1

2.3.7 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. Bird utilisation surveys were conducted in Winter 2019 and the second survey will be conducted in Spring 2019. All bird species are recorded including non-significant raptor species of public concern: Wedge-tail Eagle *Aquila audax*, White-bellied Sea-eagle *Haliaeetus leucogaster*.

The methods employed for the bird utilisation surveys at the proposed Darlington Wind Farm site 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).

2.5.1.1 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.

2.3.8 *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).

In 2012, Five locations were established as outlined below for 2021/22 surveys (Ecology and Heritage Partners 2012). In 2021/2022:

- Eight locations were established for the fixed-point counts. The locations chosen were to ensure that a range of habitat types were represented in the sample, including two outside of the study area near waterbodies (Figure 5);
- 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 the survey period.

2.3.9 Incidental observations and roaming surveys

In addition to bird species recorded during the fixed-point count surveys, incidental observations were recorded while travelling between point counts and during other field-surveys. Birds seen adjacent to the study area were also recorded. Where suitable habitat for wading birds and other waterbirds (ducks and herons) was observed, this habitat was surveyed for these species as per the "Significant Survey Guidelines for 36 Migratory Shorebird Species" (DEWHA 2009). Bird surveys outside of the study area were also undertaken to detect the presence of water-dependent species including migratory birds and Brolga. This approach was also taken to detect significant species and species with specialised habitat requirements in areas that have potentially suitable habitat for these significant species. All roads within a 10-kilometre radius of the proposed wind farm site were driven and suitable habitat searched for Brolgas and other significant bird species. Waterbodies that could potentially support a Brolga nest (i.e. swamps, dams and watercourses) will be surveyed using 10 × 42 binoculars and a Zeiss 85mm Diascope, with a 20–60mm eye piece.

2.4 Targeted Significant Species Surveys

The known or likely presence of significant flora (Figure 3) and fauna (Figure 4) species within the revised infrastructure layout and associated buffers was assessed as part of the additional site surveys in 2021 and 2022 (Appendix 1.2 and Appendix 2.2) (DELWP 2021, DAWE 2021, DCCEEW 2022). Targeted surveys were then conducted to identify these species that may be impacted by the project, to inform potential project approvals. In 2022, DELWP confirmed that as the proposed development had revised the turbine number and development footprint and study area boundary from that proposed in 2007, a new EES Referral would be required to be submitted. The targeted flora and fauna surveys were conducted to meet the 2008 condition.

The number and location of individuals, or extent of a population was marked with a Global Positioning System (GPS) device to an accuracy of +/- five metres and transposed onto aerial photography. The targeted surveys primarily focused in the proposed infrastructure layout that was provided by GPGA.

2.4.1 Targeted Flora Surveys

Based on previous ecological assessments of vegetation across the study area and databases searches (DELWP 2022d, DCCEEW 2022), targeted surveys were undertaken throughout the infrastructure footprint and associated buffer areas, and in areas where native vegetation had been recorded during Winter and Spring 2021, and previous site surveys (Ecology and Heritage Partners 2015).

Targeted flora surveys were undertaken by a team of experienced botanists / ecologists with knowledge of the target species. Linear transects between two to six metres wide, depending on vegetation density and species detectability, were systematically walked along road reserves and tracks in areas where significant species had the highest potential to occur within the infrastructure layout (i.e. area supporting native vegetation). Incidental records of the target species were made during the initial vegetation and Large Tree assessments and bird utilisation surveys.

Targeted Spiny Rice-flower *Pimelea spinescens* ssp. *spinescens* surveys were undertaken between September and February 2021/22, and in Winter (i.e. 18 and 19 August, and 8 and 10 September 2021) when the species was flowering when and detection was highest. Targeted flora surveys were undertaken during optimal survey conditions and coincided with the flowering and/or seeding times to optimise detection of the species.

EPBC Act-listed flora species:

- River Swamp Wallaby-grass *Amphibromus fluitans* (November -March)
- Curly Sedge *Carex tasmanica* (September to November);
- Matted Flax-lily *Dianella amoena* (October to February) (previously recorded in the study area);
- Small Golden Moths *Diuris basaltica* (September to October);
- Trailing Hop-bush *Dodonaea procumbens* (September to December);
- Clover Glycine *Glycine latrobeana* (September to December);
- Adamson's Blown-grass *Lachnagrostis adamsonii* (November to December);
- Spiny Pepper-cress *Lepidium aschersonii* (September to May);
- Basalt Pepper-cress *Lepidium hyssopifolium* (November-May)
- White Sunray *Leucochrysum albicans* var. *tricolor* (September to February);
- Spiny Rice-flower *Pimelea spinescens* ssp. *spinescens* (April to August) (previously recorded in the study area);
- Salt-lake Tussock-grass *Poa sallacustris* (September to December);
- Dense Leek-orchid *Prasophyllum spicatum* (October-December);
- Maroon Leek-orchid *Prasophyllum frenchii* (October to November);
- Fragrant Leek-orchid *Prasophyllum suaveolens* (September to October);
- Basalt Rustyhood *Pterostylis basaltica* (November to January);
- Green-striped Greenhood *Pterostylis chlorogramma* (July-August)
- Metallic Sun-orchid *Thelymitra epipactoides* (September to December);
- Spiral Sun-orchid *Thelymitra matthewsii* (August to October); and
- Swamp Everlasting *Xerochrysum palustre* (November -March).

FFG Act listed flora species:

- Spreading Water-mat *Althenia patentifolia* (November – January);
- Wavy Swamp Wallaby-grass *Amphibromus sinuatus* (November – January)– previously recorded within the study area;
- Wimmera Woodruff *Asperula wimmerana* (August-October);
- Cut-leaf Burr-daisy *Calotis anthemoides* (September-December);
- Small Milkwort *Comesperma polygaloides* (November-January) – previously recorded within the study area;
- Pale Swamp Everlasting *Coronidium gunnianum* (November-June)– previously recorded within the study area;
- Derrinallum Billy-buttons *Craspedia basaltica* (August-November);

- Pale Flax-lily *Dianella longifolia* (August -January);
- Golden Cowslips *Diuris behrii* (September-November);
- Clumping Golden Moths *Diuris gregaria* (September-October);
- Purple Diuris *Diuris unctate* var. *punctata* (October-November);
- Pale-flower Crane's-bill *Geranium* sp. 3 (September-January);
- Creeping Rush *Juncus revolutus* (December -April);
- Salt Blown-grass *Lachnagrostis robusta* (November-January);
- Purple Blown-grass *Lachnagrostis semibarbata* var. *filifolia* (October-January);
- Purple Blown-grass *Lachnagrostis semibarbata* var. *semibarbata* (November – January);
- Giant Honey-myrtle *Melaleuca armillaris* subsp. *armillaris* (October-February);
- Plains Yam-daisy *Microseris scapigera* (September-February);
- Forked Rice-flower *Pimelea hewardiana* (June-October);
- Wind-flattened Tussock-grass *Poa physoclina*;
- (Mortlake) Western Gaping Leek-orchid *Prasophyllum* sp. aff. *correctum* (October-November);
- King Greenhood *Pterostylis baptistii* (August-November);
- Leprechaun Greenhood *Pterostylis conferta* (October-November);
- Cygnet Greenhood *Pterostylis spissa* (October-November);
- Brackish Plains Buttercup *Ranunculus diminutus* (September-February);
- Grassland Sun-orchid *Thelymitra basaltica* (September-November); and,
- Basalt Sun-orchid *Thelymitra gregaria* (September-November).

2.4.2 Targeted Fauna Surveys

Targeted surveys were undertaken for national and State significant species that have either been recorded during the previous ecological surveys undertaken for the project (Ecology and Heritage Partner 2015), or that have previously been recorded within the study area or local area (DELWP 2022d). Surveys were undertaken for species that had a moderate to high likelihood of occurrence within the study area. Incidental significant fauna records were made during all site surveys. Targeted surveys were undertaken for four EPBC Act-listed fauna species within and immediately adjacent to the study area:

- Southern Bent-wing Bat (previously recorded),
- Striped Legless Lizard,
- Growling Grass Frog; and
- Corangamite Water Skink.

Targeted surveys were undertaken for three FFG Act-listed fauna species within and surrounding the study area:

- Brolga (previously recorded) (Section 2.4.3 -2.4.5).
- Tussock Skink (surveys at SLL locations) (Section 2.4.2)
- Latham's Snipe (previously recorded) (Section 2.4.6)

Targeted Southern Bent-wing Bat Surveys

Southern Bent-wing Bat was identified as a distinct sub-species of the *Miniopterus schreibersii* complex by molecular and morphological analysis (Cardinal and Christidis 2000; Reinhold *et al.* 2000 as cited in DEWHA 2008). The sub-species has an echolocation call signature which is distinct from the other sub-species in the complex (Conole 2000). The sub-species has undergone a severe population decline, as revealed by surveys of the population sizes at maternity caves (van Harten *et al.* 2022). Population estimates suggest a reduction in the population of approximately 67% within three generations (Reardon 2001a; Reardon 2001b and Reardon 2001c cited in DEWHA 2008). As breeding habitat for the sub-species is restricted to two maternity caves and the species geographic range is therefore very restricted (DEWHA 2008).

Southern Bent-wing Bat is a small, insectivorous, cave-dwelling micro chiropteran bat, 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, and the other near Naracoorte South Australia (DEWHA 2008).

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 often recorded around wetlands and river basins (DEWHA 2008) with foraging areas comprising a range of habitat types from forested areas, volcanic plains, to wetlands and coastal vegetation. The proximity of foraging habitat to suitable roosting caves during the breeding season is an important factor controlling distribution, though the species occasionally roosts during the non-breeding season in human-made structures (Duncan *et al.* 1999, DSEWPac 2012).

Southern Bent-wing Bat were recorded within the proposed Darlington wind farm study area as part of general bat surveys conducted in Summer 2009 (Ecology and Heritage Partners 2012). As bat species may collide with turbines, detailed targeted surveys were undertaken to quantify the extent of habitat used by the species within the wind farm. Southern Bent-wing Bat surveys were conducted in Spring and Summer 2021/2022 to quantify seasonal variation in the species movements (this species is inactive over winter). Bat surveys were undertaken in accordance with the *Survey guidelines for Australia's threatened bats* (DEWHA 2010).

The standard techniques for determining the identity of bats (both tree and cave-roosting bats) in a given area are bat detectors, harp trapping and the use of mist nests around waterpoints. Bat detectors are the main method used to survey for bats as part of proposed wind farm projects, as harp traps are inefficient to use in open areas. Anabat bat detectors linked to CF Storage Zcaims (Titley Electronics, Ballina NSW) record the high frequency calls or echolocation, produced by the bats 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 experienced personnel and those who have a thorough understanding of the range of bat calls produced within particular species. Identification of bat calls collected throughout the study area were analysed by Rob Gration of Ecological Consulting Services Pty Ltd, a leading exponent of this type of work. Depending on the species of bat and how far it projects its call, Anabat bat detectors can typically detect bat echolocation calls at between five and 20 metres.

Four bat detectors were placed in Summer 2009 (Figure 2) (Ecology and Heritage Partners 2012) Southern Bent-wing Bat was detected on one of these four detectors within the study area. Fifteen Songmeter bat detectors (Songmeter SM4BAT FS) were deployed across study area in Spring and Summer 2021/22 in locations chosen, based on geography and habitat type and suitability to capture a representative sample of the study area (Figure 5). Songmeters were installed for a period of seven weeks for each survey period. Habitat features included woodland, farm dams, scattered trees, remnant understorey vegetation with no overstorey and open pasture or crops. To account for variation in bat activity levels between nights and between sites, each site was sampled for five consecutive nights. Songmeter detectors are a form of bat call recorders that are a standard equipment used in bat detector surveys to record the high frequency calls or echolocation, produced by the bats 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. Windrows (Plate 3), scattered trees, and areas beside dams were targeted as these areas likely provide good foraging habitat for bats and provide a stand for the Songmeter to place them off the ground.

Where no trees were present (e.g. beside dams) a star picket was used to raise the Songmeter (Plate 4). Weller and Zabel (2002) found detectors placed at a height of 1.4 metres recorded 30% more calls than those placed on the ground.

Analysis of recorded echolocation calls was conducted by a recognised bat call expert with familiarity with the species and other microbats of western Victoria. Songmeter bat call analysis was conducted by EcoAerial (2022). Analysis of calls of significant bat species was undertaken using a decision tree (45-55kHz) approach to concentrate on calls that can be attributed to Southern Bent-wing Bat complex and 18-23kHz for Yellow-bellied Sheath-tail Bat. The decision tree includes species within the Southern Bent-wing Bat call complex [i.e. Little Forest Bat (*Vespadelus vulturnus*) and Chocolate Wattled Bat (*Chalinolobus morio*)]. Bat call analysis was undertaken using Analook Insight (Ver 2.0.2-8-g50df387) software.



Plate 3. A Songmeter deployed in a row of planted Eucalyptus within the study area (Ecology and Heritage Partners 30/09/2021).



Plate 4 A Songmeter positioned on a star-picket beside a farm dam. (Ecology and Heritage Partners 12/04/2021).

Targeted Striped Legless Lizard Surveys

Striped Legless Lizard occupy areas of native and introduced grassland, particularly where a high percentage of the native Kangaroo Grass *Themeda triandra* tufts are present. Striped Legless Lizard are typically restricted to lowland tussock grassland habitat (Coulson 1990) in temperate south-eastern Australia, where the species has a limited and patchy distribution. Much of these grassland areas have been modified and disturbed through development and agricultural practices so much of the original habitat for Striped Legless Lizard is fragmented and reduced (Webster *et al.* 2003). As a result, this species is likely to occur in small, isolated populations due to the limited and severely fragmented nature of remaining habitat (Webster *et al.* 2003).

Since European settlement, the distribution of Striped Legless Lizard has declined, and the species is known to have disappeared from many areas. Within Victoria, an estimated 95% of native lowland grasslands have been substantially altered since European settlement, including Western (Basalt) Plains Grassland community, the primary grassland habitat known to support Striped Legless Lizard. Western Plains Grasslands typically occur on cracking clay soils with at least some surface rock, which provides ideal shelter for Striped Legless Lizard (Cogger *et al.* 1996; Coulson 1995).

The use of roof tile grids to survey for the Striped Legless Lizard has been demonstrated to be effective in detecting this species and it is a widely accepted method by the Commonwealth (DCCEEW).

Targeted surveys for Striped Legless Lizard were undertaken in accordance with the *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPac 2011):

- 12 grid locations were selected in suitable habitat within and surrounding the study area (Figure 5);
- Areas with stock were avoided, as were areas close to roads and access areas on farms to prevent lizards being harmed or dying from the tiles being stood on by stock or impacted by vehicles.
- Signage was installed at the start, end and in the middle of each tile grid to warn people to not interfere or disturb the tiles;
- Tiles were laid in grids consisting of 50 tiles, at five metre spacing between tiles, positioned in vegetated areas with a northerly aspect;

- Tile grids were installed, and a few weeks were left before the first tile check for presence in late September 2021.
- Tiles were checked eight times between the end of September 2021 and February 2022.

In addition to tile checks, the survey included active searching where Zoologists searched under rocks and logs that provide refuge for Striped Legless Lizard. The location and number of each tile grid, date and weather conditions for each survey and location and number of any Striped Legless Lizard were recorded. Any non-target species identified and recorded. A permit to place Striped Legless Lizard tile grids within the road reserves surrounding the study area was obtained from the Moyne Shire Council. The location of tile grids was marked using a GPS and signage was installed at the start, middle and end of each grid to prevent damage or disturbance to the tiles by people working in the areas.

Targeted Corangamite Water Skink Surveys

The Corangamite Water Skink is listed as Endangered under the EPBC Act (DCCEEW 2022). There is limited information available on the distribution and habitat on this species (DSEWPac 2011). The only published information on the species' biology is in the original description by Hutchinson and Rawlinson (1994). It is recorded as a diurnal heliothermic skink that is extremely wary and difficult to approach (DSEWPac 2011). It is recorded from grassy open woodland and cleared pastures dotted with ephemeral swamps and lakes, on rocky basaltic soils. The lizards inhabit rocky mounds that provide moist sheltering sites. It is usually observed from a distance perched on a rock pile or dry-stone wall and appears to be active from mid-spring (September/October) to late autumn probably most active under warm but not overly dry conditions. Presumably active late morning to afternoon in the temperate months of the year, gradually changing to early and probably late afternoon in the hotter months of the year (DSEWPac 2011).

To survey this species, likely suitable habitat (e.g. piles of rocks) were searched by observation using binoculars to detect the presence of the species. Rock piles and dams have been noted throughout the study area during previous field assessments (Figure 2 and 5). Corangamite Water Skink was surveyed at multiple locations within the study area (Figure 5).

Targeted Growling Grass Frog Surveys

Although formerly widely distributed across southern eastern Australia, including Tasmania (Littlejohn 1963, 1982; Hero *et al.* 1991), the species has declined markedly across much of its former range. This has been most evident over the past two decades and in many areas, particularly in south and central Victoria, populations have experienced apparent declines and local extinctions (Mahony 1999; Organ pers. obs.).

The species is largely associated with permanent or semi-permanent still or slow flowing waterbodies (i.e. streams, lagoons, farm dams and old quarry sites), supporting an extensive cover of emergent, submerged and floating vegetation (Robertson *et al.* 2002; Organ 2003).

Growling Grass Frog is also known to inhabit temporarily inundated waterbodies for breeding purposes providing they contain water over the breeding season (Organ 2003). Growling Grass Frog has the potential to be recorded from all dams and waterways within the study area, however, it is unlikely to be a permanent resident in many of these areas due to the lack of permanent water present. Targeted surveys for GGF undertaken to determine whether any significant impacts are likely to occur on the species and associated habitats (i.e. waterways, wetlands and / or dams within the study area) based on the proposed development footprint. Nocturnal surveys for frogs were conducted when Growling Grass Frog is most active.

The survey was conducted with reference to the prescribed methodology detailed in the following guidelines:

- *Significant Impact Guidelines for the Vulnerable Growling Grass Frog (Litoria raniformis) EPBC Act Policy Statement 3.14* (DEWHA 2009); and
- *Survey Guidelines for Australia's Threatened Frogs* (DEWHA 2010).

The survey method is outlined below:

- Two nocturnal surveys (spotlighting, active searching, call play-back) were undertaken by two qualified zoologists visiting each site of the four Growling Grass Frog sites (Figure 5) on three occasions, targeting both adults and metamorphs;
- Where possible, frogs will be assigned to an age class and/or sex, based on size (i.e. specimens >65 mm, adult female; 50–60 mm, adult male; 30–50 mm, sub-adult; <30 mm, metamorph). Frogs will not be captured during the survey and the age class and/or sex of individuals will be recorded only from eye shine;
- The location of all Growling Grass Frogs detected was marked with a hand-held GPS;
- For all frogs observed, notes on their location and behaviour will be taken. Evidence of breeding will be indicated by the presence of calling males, or observations of amplexus, tadpoles and/or metamorphs; and
- Nocturnal surveys were conducted on still nights when air temperatures were above 15°C, and within 24 hours of rain;
- An initial period of five minutes was spent recording any calling frogs (all species) in and adjacent to wetlands;
- The advertisement call was broadcast to elicit a response from any adult males present;
- Experienced personnel used “Olight” LED hand-held spotlights (up to 1020 lumens/8.4 volts) to locate any calling males on floating vegetation in the waterbody and around the perimeter of wetlands; and,
- Surveyors actively searched ground-level habitat including surface rocks, underneath hard litter, and at the base of vegetation for frogs.

Latham's Snipe *Gallinago hardwickii*

Targeted migratory shorebird survey method is provided below (Section 2.4.6).

Tussock Skink *Pseudemoia pagenstecheri*

Tussock Skink typically occur in tussock grasslands with few or no trees in south-eastern Australia (Wilson and Swan 2017). It is a small-sized skink, growing up to 62 mm in length and are brown or olive in colour with black vertebral and laterodorsal stripes. Breeding males develop an orange to red mid-lateral stripe (Wilson and Swan 2017).

Tussock Skink are typically active throughout the year when conditions are favourable, they are a diurnal species that bask on fallen logs, rocks and tussocks. During times of inactivity, due to poor weather, they will shelter beneath surface stones, fallen tree limbs, and in the grass tussocks (Turner 2012). Tussock Skink have been found to be most common in grassland habitats with an open structure, as opposed to dense stands of ungrazed or infrequently burnt tussock grasslands, or those that have been heavily grazed (Turner 2012).

The species prefers tussock grasslands with a relatively open structure to allow suitable basking opportunities. The floristic composition of the grasslands does not appear to be as important as the presence of well-formed tussocks, as Tussock Skink have been found occupying grassland dominated by exotic species (Turner 2012).

Active searching (rock rolling) and tile surveys (i.e. consistent with the Striped Legless Lizard surveys outlined above) were undertaken for Tussock Skink throughout the study area.

2.4.3 Brolga Surveys

Background and Distribution

Brolga *Antigone rubicunda* (formerly *Grus rubicunda*) is a large, grey crane, with long neck, legs, and bill. Adults have a red head, which the juveniles lack until they are older. Brolgas stand up to 1.8 metres tall and has a wingspan of 1.7-2.4 metres (Marchant and Higgins 1993). Brolgas are long-lived species; that form lifelong monogamous pair bonds and begin forming bonds at the age of three or four (Marchant and Higgins 1993).

Brolga are considered generally abundant and widespread and occurs across northern and south-eastern Australia (Marchant and Higgins 1993; Nevard *et al.* 2020). The total Australian population of Brolga is estimated to be 20,000 to 100,000 (USGS 2006). The Brolga is one of the two species of crane (family Gruidae) that occurs in Australia. Both Brolga and Australian Saurus Crane *Antigone Antigone gillae* (the other crane species) are known to readily interbreed with one another where they co-occur, forming a Sarolga (Nevard *et al.* 2020).

In Victoria, the species has a more limited distribution occurring in western Victoria, including in Darlington, and on the Northern Plains adjacent to Murray River (Emison *et al.* 1987). In Victoria, the Brolga is listed as endangered under the FFG Act (DELWP 2022). An FFG Act action statement has been prepared for the species (Du Guesclin 2003). The species is also listed as 'migratory' under the EPBC Act.

Agricultural development and activities which alter habitat suitability have contributed to the decline in numbers and range of Brolga in Victoria as wetland habitat has been drained or converted to cropping and grazing (Arnold *et al.* 1984; Emison *et al.* 1987; Du Guesclin 2003).

In the 1980s and 1990s, the Victorian population estimate for the species was 600 to 650 individuals (Arnold *et al.* 1984; Du Guesclin 2003) and counts during the 2006/07 flocking season estimated 465-576 individuals (Du Guesclin 2007), which is a reduction of approximately 13% of the total Victorian population over the past couple of decades (Ecology and Heritage Partners 2021).

Windfarm Guidelines and Assessments

Due to the perceived risk posed to Brolga by wind farms in Victoria, the Victorian Department of Environment and Primary Industries (DEPI) has developed guidelines for wind farm developments specifically in relation to Brolga in Victoria (DSE 2012). 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. The draft standards (DELWP 2020) also provide information that is required as part of the assessment of proposed wind energy facilities on Brolga. These guidelines outline a conservative approach to assessing and managing the effects of both individual wind farms and the cumulative impacts of the wind industry on the Victoria Brolga population. The objective of the guidelines is to ensure that there is no 'net effect' of wind farms on the Brolga, with the goal of achieving a positive effect for the population.

The guidelines identify key habitat features for Brolga which require consideration and protection – these being breeding sites and flocking sites (DSE 2012). Victorian Brolga are currently protected with developments that could potentially impact them needing to address standards outlined under the Interim Guidelines for the Assessment, Avoidance, Mitigation and Offsetting of Potential Wind Farm Impacts on the Victorian Brolga Population 2011 (the ‘Interim Guidelines’).

DELWP is currently reviewing feedback on the Brolga Assessment and Mitigation Standards for Wind Energy Facilities (the ‘draft Standards’), which are in development and due for release in early-2022. Currently, transitional provisions exist for projects commenced before the new Standards are released.

Under DEPI guidelines a breeding site is defined as ‘the nest of a Brolga breeding pair and the perimeter of the surrounding wetland’ (DSE 2012a). Wetlands that are deemed to contain suitable habitat for breeding, and that have a previous Brolga breeding record, require a turbine-free buffer to be placed around the wetland. Brolga breeding records that do not occur in wetlands do not require the application of a turbine-free buffer.

Breeding

A Brolga breeding site is defined as any wetland (historic or current) which has potential to be used for nesting purposes (Ecology and Heritage Partners 2009). However, this excludes previously occupied nest sites which have been permanently modified to prevent appropriate wetland filling (i.e. drained, dammed upstream etc) (Ecology and Heritage Partners 2009). Breeding habitat of the Brolga consists of shallow freshwater marshes of less than 0.5 metres deep and freshwater meadows less than 0.3 metres deep with sedge- or herb-dominated emergent vegetation (Arnol *et al.* 1984; Marchant and Higgins 1993). Shallow freshwater marshes have been found to be preferred breeding habitat, and breeding has also been observed from shallows of deep marshes and permanent open water (Arnol *et al.* 1984). Breeding occurs in wetlands with shallow water, amongst vegetation often on islands or raised mounds (Du Guesclin 2003, Marchant and Higgins 1993). Breeding sites appear to be traditional and may be used for a number of years (Arnold *et al.* 1984; Higgins and Marchant 1993). One to three eggs are laid, with two eggs being the most common clutch size. Re-laying may occur if eggs are lost. Young stay with parents for approximately a year.

In Victoria, Brolgas breed between July and December, where they nest in a variety of shallow wetlands or in the shallows of deeper wetlands, among tussock-grass, sedge or in grassy tidal flats (Marchant and Higgins 1993). Wetlands which retain suitable conditions may be used repeatedly over long periods of time, but wetlands which appear suitable may not be used in any given year due to a variety of reasons (e.g. local water levels during courtship, availability of other breeding sites, presence of other pairs). In southern Australia, eggs are generally found in nests until mid-November, although in wet seasons this may extend until March (Marchant and Higgins 1993). Brolga chicks are not fully feathered until they are 80–90 days old and are unable to fly until they are approximately 14 weeks old (Marchant and Higgins 1993). During this period the chicks and parental birds remain close and therefore are recognisable as a current year’s nesting attempt.

During breeding, Brolga pairs establish exclusive territories which they vigorously defend from other Brolgas (Marchant and Higgins 1993). This defended territory includes the wetland containing the nest and surrounding foraging areas, and may be up to 256 hectares in size, although there was no indication of how this value was derived (Arnol *et al.* 1984).

Avoiding all potential impacts to Brolga breeding home ranges is a key goal when designing wind turbine facilities, and one component of this is the application of turbine-free buffers around breeding sites which occur in wetlands suitable for breeding (DSE 2012a).