

# Hexham Wind Farm

# Flora and Fauna Assessment

# Prepared for Hexham Wind Farm Pty Ltd

February 2022 Report No. 18088 (10.4)



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# 1. Executive summary

Hexham Wind Farm Pty Ltd engaged Nature Advisory Pty Ltd to conduct a flora and fauna assessment of a 16,104 hectare area of land in the Western Victorian localities of Hexham, Caramut, Ellerslie, Minjah and Woolsthorpe for the proposed Hexham Wind Farm (HWF).

This investigation was commissioned to provide information on the extent and condition of native vegetation in the investigation area as well as any potential impacts on flora and fauna matters listed under the state *Flora and Fauna Guarantee Act* 1988 (FFG Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

This report outlines any implications under relevant national, state and local legislation and policy frameworks and will provide information of Flora and Fauna within the Study area to accompany the Environment Effects Statement (EES) Referral. A separate report will be provided on potential impacts on the Brolga from this proposed wind farm.

HWF proposes to install up to 108 wind turbines with a maximum blade tip height of 250 metres and minimum blade tip height of 40 metres as well as a rotor diameter of up to 190m.

The following ecological investigations have been undertaken to date:

- Vegetation and flora surveys (Section 5)
- Fauna overview assessment (Section 6)
- Bird utilisation survey (Section 7)
- Migratory birds assessment (Section 8)
- Bat assessment (Section 9)
- Growling Grass Frog assessment (Section 10)
- Matters of Environmental Significance (Section 11)

Results of these investigations are summarised below.

#### Vegetation and Flora Surveys

Vegetation within the HWF investigation area was assessed in accordance with the Victorian Guidelines for the removal, destruction and lopping of native vegetation (the 'Guidelines'). This assessment found vegetation consisting of 257 habitat zones from twelve Ecological Vegetation Classes (EVCs), totalling 63.5 hectares of native vegetation in patches.

During targeted flora surveys, one flora species listed under the FFG Act – Purple Blown-grass – was recorded during targeted surveys in November 2021. No other flora species listed under the EPBC Act or FFG Act were recorded within the targeted survey area, and all other listed flora species are now considered unlikely to occur within the proposed development footprint area.

Three EPBC Act listed ecological communities – Grassy Eucalypt Woodland of the Victorian Volcanic Plain (GEWVVP), Natural Temperate Grassland of the Victorian Volcanic Plains (NTGVVP) and Seasonal Herbaceous Wetland of the Temperate Lowland Plain (SHWTLP) – were recorded during targeted surveys.

The proposed HWF development footprint will have the following impacts:

- The loss of 4.977 hectares of native vegetation from patches;
- The loss of three large and one small scattered trees;



- 1.591 hectares of the EPBC Act listed community Natural Temperate Grassland of the Victorian Volcanic Plains;
- 0.662 hectares of the EPBC Act listed community Seasonal Herbaceous Wetland of the Lower Temperate Plains
- Impacts to NTGVVP would constitute a significant impact under the EPBC Act and will require offsetting under the EPBC Act Environmental Offsets Policy

Offsets required to compensate for the proposed removal of native vegetation from the investigation area are provided below.

- 1.523 general habitat units and must include the following offset attribute requirements:
  - Minimum strategic biodiversity value (SBV) of 0.306
  - Occur within the Glenelg Hopkins CMA boundary or the Moyne Shire Council municipal district.
  - Include protection of at least 3 large trees.

The following FFG Act protected flora taxa are susceptible to impacts from the proposed development on public land at the entrance point to the wind farm and from public road reserves:

- Purple Blown-grass ((endangered under the FFG Act)
- Buloke (protected under the FFG Act)
- Black Wattle (member of a genus protected under the FFG Act)
- Onion-orchid (threatened species listed under the FFG Act)
- Sun Orchid (member of a genus protected under the FFG Act)

A Protected Flora Permit would be required from DELWP to remove the above-mentioned plant taxa from public land.

### Fauna Overview Assessment

Initial fauna assessments of the HWF site were undertaken between 2011 and 2012 with additional targeted surveys for fauna in 2018 and 2019, focussing on species likely or with potential to occur based on desktop review of recent information.

The study site is highly modified and dominated by grazing and cropping land. EHP (2014) described seven fauna habitats across the study area, including; modified grassland, woodland and scattered trees, planted vegetation, rivers, creeks and drainage lines, swamps and marshes and artificial waterbodies. These were all found to be low, low-moderate or moderate in habitat quality.

The current review of existing information and online databases (EHP 2014, DELWP 2019, DAWE 2021a) found a total of 15 listed species under the EPBC Act and 10 additional species listed under the FFG Act were recorded, or their habitat was predicted to occur, in the search region (an area that extends 10km from the wind farm boundary).

Species listed under the EPBC Act considered likely to occur included:

- Migratory bird species: Common Greenshank, Curlew Sandpiper, Double-banded Plover, Fork-tailed Swift, Latham's Snipe, Red-necked Stint, Sharp-tailed Sandpiper and Whitethroated Needletail;
- Two listed threatened bat species: Grey-headed Flying-Fox and Southern Bent-wing Bat;
- One listed threatened reptile species: Striped Legless Lizard; and



• One listed threatened frog species: Growling Grass Frog.

Additional threatened fauna species listed only under the FFG Act considered likely to occur on the site included:

- Seven bird species: Australasian Shoveler, Black Falcon, Blue-billed Duck, Brolga, Freckled Duck, Hardhead and Musk Duck;
- One bat species: Yellow-bellied Sheathtail Bat; and
- One reptile species: Tussock Skink.

Targeted surveys have been undertaken to determine the occurrence and current extent of listed species at the wind farm, including Bird utilisation surveys, migratory bird surveys, bat surveys, fish surveys, Golden Sun Moth surveys and Growling Grass Frog habitat assessments.

#### Bird utilisation survey

A total of 68 species of birds were recorded in the study area during bird utilisation surveys (BUS) undertaken in 2018-19. Including surveys from 2011, 97 bird species were recorded in the study area.

Species diversity was higher during spring (Spring 58; Summer 45), while bird abundance was much higher in summer (Spring 1,818; Summer 2,911). This was due to common resident birds, such as ravens, starlings and cockatoos collecting in large flocks while foraging, flowering of Sugar Gum which attracted large number of nectar-feeding birds and the natural build-up of population numbers following recruitment.

Most bird sightings (94.4%) occurred below rotor swept area (RSA) height (<40m) during the two surveys. No birds were observed during surveys flying above RSA height (>250m).

The only threatened species observed during the BUS was the FFG Act listed Brolga. One pair was seen foraging in an open paddock. The Brolga was studied in more detail by undertaking breeding and flocking surveys in and around Hexham Wind Farm. Results of the Brolga studies are presented in a separate report. Other protected species were recorded incidentally within the study area including Hardhead, Latham's Snipe and Sharp-tailed Sandpiper. EHP (2014) reported five threatened species including Brolga, Hardhead, Great Egret, Black Falcon and Royal Spoonbill.

Eight raptor species were recorded during the two seasonal BUS with Brown Falcon, Nankeen Kestrel and Whistling Kite being the most recorded species. Wedge-tailed Eagle activity on the site was very low with two birds observed in Spring and again in Summer.

#### Migratory birds survey

Most wetlands were found to be ephemeral and too well vegetated with dense growth of reed, rush, sage, and introduced grasses on the edges and dense growth of water ribbon and emergent and submerged vegetation, particularly the sections that are expansions of the Muston Creek. In most cases vegetation was taller than 30 cm and as such were unsuitable for most migratory shorebirds, which require more open shorelines and shallow open water or mud in which to forage.

Three EPBC Act-listed migratory shorebird species (Sharp-tailed Sandpiper, Latham's Snipe and Double-banded Plover) were detected on the HWF site during targeted surveys conducted by Nature Advisory in 2018/19.

None of the three species of listed migratory shorebird recorded were in numbers that would be above the threshold significance levels (DoEE 2017). Latham's Snipe may occur in a wider variety



of sites than other migratory shorebirds, even though it has only been confirmed at one site on the proposed wind farm. Due to the limited extent of suitable habitat, numbers on the HWF site are unlikely to exceed 0.1 percent of the flyway population (i.e. a population of national importance) and no wetland is likely to support at least 18 individuals of Latham Snipe (DoEE 2017).

Based on these findings, it was concluded that there will be no significant impacts on migratory shorebirds from the HWF development.

#### Bat assessment

A total of 3,776 nights of bat call detection was undertaken at over 80 unique sites on the proposed Hexham Wind Farm and its surrounds seasonally in five years between 2010 and 2020, including extensive recording at height from two wind monitoring masts.

Calls from nine species of bats were recorded during these bat surveys. Seven of the species recorded were common species and two species recorded were listed threatened bats, namely the Southern Bent-wing Bat (EPBC Act and FFG Act Critically endangered) and Yellow-bellied Sheathtail Bat (FFG Act Vulnerable).

Out of tens of thousands of recorded bat calls from all surveys, 168 were attributable to Southern Bent-wing Bat with 76 calls recorded in Spring 2010 and 72 calls in Summer/Autumn 2019. 610 Yellow-bellied Sheathtail Bat calls were recorded, 561 of these were recorded in Spring 2010 with lower numbers in Spring 2018 (4 calls) and Summer/Autumn 2019 (10 calls).

The majority of recorded attributable Southern Bent-wing Bat calls were from treed and wetland habitats: specifically, along the Muston's Creek and associated treed habitats.

The Gould's Wattled Bat, White-striped Freetail Bat and Yellow-bellied Sheathtail Bat were recorded at heights of 42 to 50 metres. The Southern Bent-wing Bat was not recorded at this height.

Bat activity was consistently greater closer to the ground than at height for most species. Where simultaneous paired ground and at-height recording occurred, the vast majority of bat calls were recorded from the ground-based detector, indicating that for most of the time, these species forage below Rotor Swept Area (RSA).

At a minimum turbine blade tip height of 40 metres the risk of interactions between bats and rotating turbine blades is considered to be lower than at operating wind farms in western Victoria which have minimum rotor tip heights lower than this.

Having regard to the foregoing findings, collision risk for threatened bat species is considered very low and no significant impact is expected from the proposed HWF on the Southern Bent-wing Bat or Yellow-bellied Sheathtail Bat populations.

The Grey-headed Flying Fox (EPBC Act Vulnerable, FFG Act Vulnerable) has been recorded in small numbers (5-10 individuals) during targeted surveys in February 2022 with a camp assumed to be within a plantation to the east of the proposed wind farm site, south of Hamilton Highway.

There are limited food resources at the proposed HWF that would attract the Flying Fox to the area. Food resources at the HWF include blossoms of remnant eucalypts and planted Sugar Gum (*Eucalyptus cladocalyx*) and the fruit of any planted fruit trees that may be around farm houses.

Further investigations are underway to determine the number of Flying Foxes using the assumed camp east of the wind farm site, their flight directions and possible food sources within and beyond the wind farm site. Mitigation measures will be developed based on this information.



#### Fish surveys

Targeted surveys for Australian Grayling, Yarra Pygmy Perch and Dwarf Galaxias were undertaken by EHP from 21 to 24 November 2011 using bait traps and fyke nets set overnight as well as active searches through dip netting within suitable habitat (EHP 2014). None of these species were recorded.

#### Golden Sun Moth surveys

EHP undertook targeted Golden Sun Moth surveys in December 2011 and January 2012 at the request of the Department of the Environment and Primary Industries (DEPI) although preliminary fauna surveys determined that there was a low likelihood of occurrence due to low number of records in the local area and lack of high-quality suitable habitat (EHP 2014). No Golden Sun Moth were observed during the surveys, although they were observed flying at reference sites outside the study area on the survey dates.

#### Growling Grass Frog habitat assessment

Surveys to map suitable habitat for the Growling Grass Frog (GGF) were undertaken in November 2011 and November 2018 across the study area, checking all wetlands and waterways. This habitat mapping was used to inform the layout of the wind farm to ensure suitable habitats were avoided wherever possible.

GGF was heard calling during the assessment in January 2019 within three separate sections of Mustons Creek. It is therefore assumed that the GGF may use the Mustons Creek for most parts of the year utilising the sections that retain sizable water pools. Mustons Creek connects to the Hopkins River to the east of the study area and therefore provide continuous habitat for the GGF. Several other smaller tributaries of the Mustons Creek within the study area could possibly provide habitat for the frog during the wet season and form a continuous network of wetland habitats for this threatened species. In addition, the large lake (wetland 29405) and associated dams could possibly play a part in the GGF distribution within the study area, but most dams lack proper habitat, are usually impacted by livestock and are of low value for the frogs (see Appendix 12 and Figure 16).

It is considered that, provided the known sites for GGF are avoided and minimal habitat is altered at creek crossing points during the construction and operation of the wind farm, there should be minimal impact on the local population of GGF.

### Matters of National Environmental Significance

EPBC Act listed species and ecological communities considered likely to occur or recorded in the study area were assessed against general or species-specific criteria for significant impacts.

#### Listed flora and fauna species

It was found that all listed flora and fauna species recorded or likely to occur on the wind farm site were unlikely to be impacted significantly by the development given the current development footprint and proposed design and mitigation measures.

#### Listed ecological communities

It was determined that the EPBC Act listed community of the EPBC Act listed communities Natural Temperate Grassland of the Victorian Volcanic Plains (1.591 hectares proposed removal) and Seasonal Herbaceous Wetland of the Lower Temperate Plains (0.662 hectares proposed removal)



may be significantly impacted by the project. The final extent of removal of these communities will be determined once the layout has been finalised.



# 2. Introduction

# 2.1. Background and Scope

Hexham Wind Farm Pty Ltd engaged Nature Advisory Pty Ltd to conduct a flora and fauna assessment of a 16,104 hectare area of land in the Western Victorian localities of Hexham, Caramut, Ellerslie, Minjah and Woolsthorpe for the proposed Hexham Wind Farm (HWF). The wind farm site is bound by the Hamilton Highway to the north, the Woolsthorpe-Hexham and Hexham-Ballangeich roads to the east, Gordons Lane to the south and the Warrnambool-Caramut Road to the west. The proposed HWF site is referred to herein as the 'study area'.

This investigation was commissioned to provide information on the extent and condition of native vegetation in the investigation area according to Victoria's *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017a), herein referred to as 'the Guidelines', as well as any potential impacts on flora and fauna matters listed under the state *Flora and Fauna Guarantee Act* 1988 (FFG Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). This report outlines any implications under relevant national, state and local legislation and policy frameworks.

The preliminary findings of the initial investigation identified that a referral was required under the Victorian *Environmental Effects Act 1978.* This report will provide information of Flora and Fauna within the Study area to accompany the Environment Effects Statement (EES) Referral. A separate report will be provided on potential impacts on the Brolga from this proposed wind farm.

Specifically, the scope of the investigation included:

- Review of existing information on the flora and native vegetation of the investigation area and surrounds, including:
  - Victorian Biodiversity Atlas administered by the Department of Environment, Land, Water and Planning (DELWP);
  - The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) Protected Matters Search Tool; and
  - o DELWP Native Vegetation Information Management system (NVIM).
- Site surveys were undertaken involving:
  - Characterisation and mapping of native vegetation on the site, as defined in Victoria's Guidelines for the Removal, Destruction or lopping of Native Vegetation (the 'Guidelines');
  - Assessment of native vegetation in accordance with the Guidelines, including habitat hectare assessment and/or scattered tree assessment;
  - Compilation of flora species lists for the site;
  - o Assessment of the nature and quality of native fauna habitat;
  - Bird and bat utilisation surveys; and
  - Assessment of the likelihood of occurrence of EPBC Act and *Flora and Fauna Guarantee Act 1988* (FFG Act) listed flora, fauna and communities on the site.

This investigation was undertaken by a team from Nature Advisory, comprising Elinor Ebsworth (Senior Ecologist), Verity Fyfe (Botanist), Dean Karopoulos (Botanist), Arend Kwak (Botanist), Khalid



Al-Dabbagh (Zoologist), Jackson Clerke (Zoologist), Curtis Doughty (Senior Zoologist), Peter Lansley (Zoologist), Nhung Nguyen (Senior GIS Analyst), Emma Wagner (GIS Analyst), Inga Kulik (Senior Ecologist & Project Manager), Bernard O'Callaghan (Senior Ecologist & Project Manager) and Brett Lane (Principal Consultant).

# 2.2. Proposed development

HWF proposes to install up to 108 wind turbines. Each wind turbine will comprise a tower, nacelle and blades with a maximum blade tip height of 250 metres and minimum blade tip height of 40 metres. The maximum and minimum parameters above have been adopted for this EES Referral, allowing a 'worst case' assessment of environmental and social impacts. The towers will be mounted onto a concrete foundation and there will be an adjacent hardstand area of up to approximately 50 m x 60 m. Turbines will be positioned with a high regard for landscape amenity, existing land use, ecological constraints and cultural heritage values, and in accordance with relevant legislation.

Table 1 outlines the planned project infrastructure and associated current design on which this investigation was based.



#### Table 1: Project summary

Infrastructure	Current Design (approximate dimensions)
	The turbine envelope proposed includes:
Turbine dimensions	<ul> <li>Overall maximum tip height of up to 250 m</li> <li>Rotor diameter is up to 190 m</li> <li>Minimum tip height 40 m</li> </ul>
On-site quarry	To be investigated post EES referral
Onsite access tracks	61 km of gravel access track. A 10 m disturbance area has been applied to the tracks within areas of native vegetation
Turbine Footings and Crane Hardstand and Assembly areas	Turbine footings 27 m x 27 m and crane hardstands and assembly areas 50 m x 60 m
Temporary Construction Facilities	<ul> <li>Batching Plant (50 m x 100 m)</li> <li>Construction compound (200 m x 200 m)</li> <li>Storage/Laydown areas 300 m x 6 m</li> </ul>
Internal Transmission Line	A 20m wide disturbance footprint has been applied. No external transmission line will be required
Collector Substation	80 m x 80 m
Operations and Maintenance Facility	100 m x 100 m
Battery storage	Up to 2 ha
On-site cabling	Approximately 132 km of underground cabling with approximately 71 km of trenching with a 5m wide work area
Wind Monitoring Masts	Up to 5 wind monitoring masts, each up to 169 m high

Agriculture is the predominant land use in the study area consisting mostly of grazing along with some cropping and this would continue after construction. The proposed development footprint consists of 421 hectares (ha), which is 2.6% of the site. Construction of the wind farm is expected to take approximately two years to complete, followed by an operational life of at least 25 years.

### 2.3. Scope of work and timeline of ecological surveys

The specific area investigated, referred to herein as the 'investigation area', comprised the proposed infrastructure layout plus the following buffers:

- 25 metres each side of the centreline provided by Hexham Wind Farm for vehicle tracks;
- 15 metres each side of the centreline provided by Hexham Wind Farm for cables; and
- 100 metres from the centrepoint provided by Hexham Wind Farm for Turbines.

Table 2 outlines surveys completed to inform this assessment of impacts resulting from the proposed Hexham Wind Farm.



# Table 2: Surveys completed (to February 2022)

Survey – field assessment	Date		
Flora and vegetation assessments	-		
Targeted flora surveys and Net Gain Assessment (EHP)	<ul> <li>7-10 June 2011</li> <li>2-4 November 2011</li> <li>7-9 November 2011</li> <li>5-9 December 2011</li> </ul>		
Native vegetation Assessments	<ul><li>13-28 November 2018</li><li>8-11 November 2021</li></ul>		
Targeted surveys for threatened ecological communities and listed flora species	<ul> <li>28-30 November 2018</li> <li>10-11 January 2019</li> <li>22-25 November 2021</li> </ul>		
Bird studies			
Bird utilisaton surveys	<ul> <li>28 November - 2 December 2011</li> <li>20-22 February 2012</li> <li>29 October - 2 November 2018</li> <li>4 - 8 March 2019</li> </ul>		
Migratory water bird habitat assessment and targeted surveys	<ul> <li>18-20 December 2018</li> <li>9-11 January 2019</li> <li>30-31 January 2019</li> <li>26-28 February 2019</li> <li>27-29 February 2019</li> </ul>		
Bat studies			
Bat surveys – general and targeted Southern Bent-wing Bat Grey-Headed Flying Fox (GHFF)	<ul> <li>21 October - 23 November 2010</li> <li>10 February - 31 March 2011</li> <li>25 October - 18 December 2018</li> <li>5 February - 25 April 2019</li> <li>18 February 2020 - 1 May 2020</li> <li>14-16 Feb 2022 (GHFF targeted surveys)</li> </ul>		
Reptile and mammal studies			
Striped legless Lizard and Fat-tailed Dunnart habitat assessment	<ul> <li>28 November - 2 December 2011</li> <li>20-22 February 2012</li> </ul>		



Survey – field assessment	Date		
Aquatic fauna studies	-		
Growling Grass Frog habitat assessment	<ul><li>21-24 November 2011</li><li>13-28 November 2018</li></ul>		
Aquatic surveys (fish)	<ul> <li>21-24 November 2011</li> </ul>		
Invertebrate studies			
Golden Sun Moth Surveys	<ul><li>16, 19 December 2011</li><li>6 January 2012</li></ul>		



# **3. Regulatory Context**

This section of the report summarises the applicable legislation and planning provisions that apply to this project. Commonwealth, state and local controls are considered.

## 3.1. Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act protects a range of matters of national environmental significance (MNES) and matters protected by international treaties. These matters include a list of threatened species, ecological communities and migratory species that are considered to be of national conservation significance. Any impact on such species or ecological communities that is considered significant requires the approval of the Federal Minister for the Environment.

If there is a possibility of a significant impact on nationally threatened species or communities or listed migratory species, a Referral under the EPBC Act should be considered. The Minister will decide after 20 business days whether the project will be a 'controlled action' under the EPBC Act, in which case it cannot be undertaken without the approval of the Minister. This approval depends on a further assessment and approval process (lasting between three and nine months, depending on the level of assessment).

## 3.2. State Legislation and Policy

### 3.2.1. Planning and Environment Act 1987

State planning provisions are established under the Victorian Planning and Environment Act 1987.

Clause 52.17 of all Victorian Planning Schemes states that:

A permit is required to remove, destroy or lop native vegetation, including dead native vegetation.

A permit is not required if:

- If an exemption in Table 52.17-7 specifically states that that a permit is not required.
- If a native vegetation precinct plan corresponding to the land is incorporated into the planning scheme and listed in the schedule to Clause 52.16.
- If the native vegetation is specified in a schedule to Clause 52.17.

#### Exemptions

Exemptions listed in Table 52.17-7 relevant to the investigation area include:

 <u>Planted vegetation</u>: Native vegetation that is to be removed, destroyed or lopped that was either planted or grown as a result of direct seeding. This exemption does not apply to native vegetation planted or managed with public funding for the purpose of land protection or enhancing biodiversity.

#### Application requirements

Any application to remove, destroy or lop native vegetation must comply with the application requirements specified in the Guidelines (DELWP 2017a).

When assessing an application, Responsible Authorities are also obligated to refer to Clause 12.01-2 (Native vegetation management) in the Planning Scheme which in addition to the Guidelines, refers to the following:

Assessor's handbook – applications to remove, destroy or lop native vegetation (DELWP 2018d).



• Statewide biodiversity information maintained by DELWP.

The application of the Guidelines (DELWP 2017a) are explained further in Appendix 1.

#### Referral to DELWP

Clause 66.02-2 of the planning scheme determines the role of DELWP in the assessment of native vegetation removal permit applications. If an application is referred, DELWP may make certain recommendations to the responsible authority in relation to the permit application.

Any application to remove, destroy or lop native vegetation must be referred to DELWP if:

- The impact to native vegetation is in the Detailed Assessment Pathway;
- A property vegetation plan applies to the site; or
- The native vegetation is on Crown land which is occupied or managed by the responsible authority.

### 3.2.2. Flora and Fauna Guarantee Act 1988 (FFG Act)

The Victorian *Flora and Fauna Guarantee Act* 1988 (FFG Act) lists threatened and protected species and ecological communities (DELWP 2017b, DELWP 2017c). The FFG Act has limited direct application to private land.

Any removal of threatened flora species or communities (or protected flora) listed under the FFG Act from public land requires a permit under the Act, obtained from DELWP. Application forms for Protected Flora Permits can be obtained from DELWP offices or from their customer service centre or website. Should listed species or communities be affected by access points on public roads, a permit under this Act will be required for their removal.

### 3.2.3. Environmental Effects Act 1978 (EE Act)

One or a combination of a number of criteria may trigger a requirement for a Referral to the Victorian Minister for Planning who will determine if an Environmental Effects Statement is required according to the *Ministerial Guidelines for Assessment of Environmental Effects under the* Environment Effects Act 1978 (DSE 2006).

The criteria related to flora, fauna and native vegetation which trigger a Referral are outlined below.

<u>One or more</u> of the following would trigger a Referral:

- Potential clearing of 10 hectares or more of native vegetation from an area that:
  - Is of an Ecological Vegetation Class identified as endangered by the Department of Sustainability and Environment (in accordance with Appendix 2 of Victoria's Native Vegetation Management Framework); or
  - Is, or is likely to be, of very high conservation significance (as defined in accordance with Appendix 3 of Victoria's Native Vegetation Management Framework); and
  - Is not authorised under an approved Forest Management Plan or Fire Protection Plan
- Potential long-term loss of a significant proportion (e.g. 1 to 5 percent depending on the conservation status of the species) of known remaining habitat or population of a threatened species within Victoria
- Potential long-term change to the ecological character of a wetland listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'



 Potential extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems, over the long term

<u>Two or more</u> of the following would also trigger a Referral:

- Potential clearing of 10 hectares or more of native vegetation, unless authorised under an approved Forest Management Plan or Fire Protection Plan
- Matters listed under the Flora and Fauna Guarantee Act 1988:
  - Potential loss of a significant area of a listed ecological community; or
  - Potential loss of a genetically important population of an endangered or threatened species (listed or nominated for listing), including as a result of loss or fragmentation of habitats; or
  - Potential loss of critical habitat; or

Potential significant effects on habitat values of a wetland supporting migratory bird species.

#### 3.2.4. Catchment and Land Protection Act 1994 (CaLP Act)

The Catchment and Land Protection Act 1994 (CaLP Act) requires that land owners (or a third party to whom responsibilities have been legally transferred) must take all reasonable steps on their land to:

- Avoid causing or contributing to land degradation which causes or may cause damage to land of another landowner;
- Conserve soil;
- Protect water resources;
- Eradicate regionally prohibited weeds;
- Prevent the growth and spread of regionally controlled weeds;
- Prevent the spread of, and as far as possible eradicate, established pest animals; and
- Prevent the spread of regionally controlled weeds and established pest animals on a roadside that adjoins the landowner's land.

### **3.3. Local Laws and Regulations**

The investigation area is located within the Moyne local government area. It is currently zoned Farm Zone (FZ) in the Moyne Planning Scheme, with Road Zone Schedule 1 (RDZ1) along the Hamilton Highway and the Warrnambool-Caramut Road.

Local planning provisions apply under the Victorian Planning and Environment Act 1987.

### 3.3.1. Local Planning Policies

Local Planning Policy (LPP) 22.02: Environment is relevant to the current investigation. Pertinent sections of LPP 22.02 are detailed below.

The objectives of LPP 22.02-2: Rare and threatened species are to:

- Maintain and enhance biodiversity in Moyne.
- Recognise the location of Victorian Rare and Threatened Flora and Fauna Species including but not limited to those listed under Schedule 2 of the Flora and Fauna Guarantee Act 1988.



 Maintain and enhance the habitat, particularly the critical habitat, of Victorian Rare and Threatened Flora and Fauna species including but not limited to those listed under Schedule 2 of the Flora and Fauna Guarantee Act 1988.

Under LPP 22.02-2 it is policy that in considering a planning permit application:

- The responsible authority refers to 'Selected Biodiversity Components LGA of Moyne' DNRE, May 1996 to determine whether the land could potentially contain the habitat of a Victorian Rare and Threatened Flora or Fauna species.
- Should the land be identified to potentially contain the habitat of a Victorian Rare and Threatened flora or fauna species, the responsible authority shall obtain comment from the Department of Natural Resources and Environment and other appropriate bodies, to determine whether and under what conditions the proposed development should proceed.
- Clearing of remnant vegetation and habitat corridors in areas identified as habitat for Victorian Rare and Threatened Flora or Fauna species will be strongly discouraged.

The objective of LPP 22.02-5: Pest Plant Management is to contain the spread of noxious and pest weeds and to progressively reduce the areas affected.

Under LPP 22.02-5It is policy that the responsible authority will take into account the management and removal of pest weeds on land and where possible, include conditions or requirements to achieve the objectives of this policy.

LPP 22.02-6: Steep Land applies to all land having a slope greater than 20%. The objective of LPP 22.02-6 is to ensure that the use and development of land with a greater than 20% slope takes into account environmental constraints such as erosion and fire hazards.

Under LPP 22.02-6 it is policy that:

- The design and location of buildings and works should ensure that there is no increase in the potential for erosion or land slip.
- The need for earthworks is minimised and any necessary earth works are undertaken in accordance with advice from the Department of Environment, Land, Water and Planning.
- Removal of natural vegetation is minimised.
- The location and design of access roads or drives should cause minimum visual impact and should be generally in accordance with advice from the Department of Environment, Land, Water and Planning.
- The design and siting of buildings and works should minimise the risk of loss of life and property in the event of a wildfire.

Local provisions can override state provisions.

3.3.2. Overlays

No overlays relevant to this investigation cover the investigation area.

### 3.4. Other Guidelines

In addition to the foregoing policy and legislative instruments, a number of wind farm specific guidelines have been consulted and key directions from these applied in formulating the investigations of flora and fauna impacts described in this report. These include:

- Wind Farms and Birds: Interim Standards for Risk Assessment (AusWEA 2005).
- Policy and planning guidelines Development of wind energy facilities in Victoria (DELWP March 2019)



- Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (CEC 2018).
- Survey guidelines for Australia's threatened bats Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (DEWHA 2010).



# 4. Site description

# 4.1. Location

The proposed Hexham Wind Farm (HWF) comprises 16,104 hectares of land in the Western Victorian localities of Hexham, Caramut, Ellerslie, Minjah and Woolsthorpe, approximately 20 kilometres west of Mortlake and 200 kilometres west of Melbourne's CBD. The wind farm site is bound by the Hamilton Highway to the north, the Woolsthorpe-Hexham and Hexham-Ballangeich roads to the east, Gordons Lane to the south and the Warrnambool-Caramut Road to the west. The proposed HWF site is referred to herein as the 'study area'.

### 4.2. Geology and Hydrology

The study area supported basaltic soils derived from newer volcanic flows, with alluvium associated with watercourses. The landscape was gently undulating with a number of permanent watercourses, the most major of which is Mustons Creek in the northern portion of the site, which flows into the Hopkins River to the east of the study area, and Drysdale Creek in the south, which continues to the coast near Warrnambool. Numerous tributaries (many of them unnamed) of Mustons and Drysdale creeks occur within the study area.

## 4.3. Vegetation

The study area and surrounding land supports agriculture, including dryland cropping and sheep and cattle grazing, with a relatively low density of associated residences. Widespread historical clearing of the study area and surrounds for agriculture has resulted in native vegetation being largely restricted to roadside reserves and watercourses.

Vegetation in the investigation area consisted primarily of exotic pasture or dryland crops, with several planted wind-breaks on the edge of paddocks, some of which included native species. Within private property native vegetation comprised small patches of species depauperate grassland, wetland and woodland along the edges of farm tracks, in lower-lying areas in pasture and along watercourses. Most (if not all) woody vegetation had been removed in these patches. Patches of native vegetation along roadsides included grassland and woodland, which lacked canopy species but did support some woody species (primarily wattles, including Black Wattle and Blackwood). The highest quality native vegetation was found along the wide road reserve of the Hexham-Ballangeich Road.

### 4.4. Fauna habitat

The majority of the study area has been highly modified by past and on-going agricultural practices. Most private properties have been cleared of original native vegetation in favour of grazing and cropping lands and associated planted wind rows.

Native vegetation is primarily restricted to roadsides, waterways and wetland areas. Many of these are also highly modified and contain a high abundance of invasive species vegetation.

The below habitat assessment is based on Nature Advisory field visits described in this report and extrapolated from EHP (2014).

The investigation area supported the seven general fauna habitat types.



#### Modified Native Grasslands

Native grasslands occurred in various forms throughout the study area, such as; grasslands of moderate to high quality in patches along roadsides and farming tracks, in remnant patches within grazing lands, in some native woodland windrow areas where agricultural practices are limited and disturbance does not occur as frequently, and in wetland areas of riparian vegetation or swamps/marches.

These grasslands varied greatly in habitat quality and structure between sites and depending on the ecosystems they existed in and the level of disturbance and modification they experience. These grasslands may provide habitat to some grassland specialists and foraging opportunities to other fauna.

#### Modified Woodland and scattered trees

Modified woodland patches are scattered throughout the study area and generally support highly modified understoreys for agricultural purposes. They consist typically of open woodlands with trees approximately 20 metres tall. These areas occur along roadsides, riparian zones and in patches within agricultural areas. They support limited connectivity but provide an important source of habitat in an otherwise highly modified landscape,

Scattered River Red-gum (*Eucalyptus camaldulensus*) also occur throughout the study area providing limited habitat and foraging opportunities. Many of these however provide hollows, an essential habitat component of many fauna species.

#### Planted vegetation

Linear shelter belts, or windrows, have been planted throughout the study area, typically bordering paddocks intended for agricultural purposes. These consist of a mix of native species, some endemic to the area and others not, and non-native species. Though these typically lack the ecological structure required for high quality habitat such as understorey and mid-storey or hollows, they provide some shelter and foraging opportunities for bird and microbat species.

### Rivers, creek and drainage lines

Waterways occurred throughout the study area. Major waterways include Hopkins River, Muston's Creek and Salt Creek while minor waterways occurred throughout private property consisting of small highly modified drainage lines serving to drain water from naturally occurring wetlands and depressions.

Some of these areas would hold water year-round while other may be ephemeral. They support limited and modified wetland and riparian vegetation but could provide essential habitat for some fauna species, such as water birds, microbats and aquatic species.

#### Swamps and marshes

These habitats are of moderate value to fauna where they still exist, particularly as much of the original comparable habitat has been modified or drained. Typically lacking floristic diversity, the hydrology of the habitat still supports many fauna species. Characterised by sedges and rushes, the low-lying areas are typically inundated during the wetter months. These areas are mostly grazed whenever possible

#### Artificial waterbodies

A large number of dams occur throughout private property across the study area, supplying water for stock and agricultural purposes. As such many of these lack vegetation, are highly impacted by



frequent stock utilisations and therefore provide low quality habitat for native fauna. Though some provide limited fringing and emergent vegetation and may still be utilised by bird life and microbat species occasionally. These are typically surrounded by agricultural land and lack connectivity with other habitats.

#### Exotic pasture and crops

Of low value for fauna, this habitat is largely grazed for farming purposes and provides little habitat or shelter for fauna. This habitat covers much of the study area and consists mostly of pasture grass and cereal crops.

## 4.5. Groundwater dependent ecosystems

The potential occurrence of ground water dependent ecosystems (GDEs) within the study area will be investigated during the Development Application or EES process.

The aim of this assessment will be to determine the likelihood that GDEs occur within the study area using existing vegetation, habitat and hydrological data and to assess the potential for impacts on them from the proposed HWF project.

Specifically, the scope of the investigation will include:

- Review of potential GDEs mapping including those prepared by the Bureau of Meteorology and the Victorian Government;
- Identification of potential sites for GDEs within HWF;
- A desktop assessment of these sites, including:
  - Ecological Vegetation Class (EVC) mapping
  - Status of these habitats during the dry season.

### 4.6. Land-use history

Most of the study area has been used for sheep and cattle farming for over 150 years. The site has been subject to extensive removal of native vegetation in the past. Fertiliser has been extensively applied for many years on the site and, in places, the site has been cultivated for pasture improvement and cropping.



# 5. Vegetation and Flora Surveys

### **KEY FINDINGS**

Vegetation within the HWF investigation area was assessed in accordance with the Victorian Guidelines for the removal, destruction and lopping of native vegetation (the 'Guidelines'). This assessment found vegetation consisting of 257 habitat zones from twelve Ecological Vegetation Classes (EVCs), totalling 63.5 hectares of native vegetation in patches. This area included 14.456 hectares of DELWP mapped wetlands which are treated as native vegetation according to the Guidelines.

Native vegetation within the proposed development footprint that provides potential habitat for listed flora species has been surveyed in detail for threatened flora species at the appropriate time of year, with surveys being conducted in November 2018, January 2019 and November 2021. Targeted surveys were undertaken to coincide with the flowering time for the following listed species:

- Adamson's Blown-grass (Lachnagrostis adamsonii) EPBC Act: endangered, FFG Act: endangered
- Basalt Sun-orchid (Thelymitra gregaria), FFG Act: protected
- Clover Glycine (Glycine latrobeana), EPBC Act: vulnerable, FFG Act: vulnerable
- Curly Sedge (Carex tasmanica), FFG Act: endangered
- Cut-leaf Burr-daisy (Calotis anthemoides), FFG Act: protected
- Hairy Tails (Ptilotus erubescens), FFG Act: critically endangered
- Purple Blown-grass (Lachnagrostis punicea subsp. filifolia), FFG Act: endangered
- Small Milkwort (Comesperma polygaloides), FFG Act: critically endangered
- Trailing Hop-bush (Dodonaea procumbens), EPBC Act: vulnerable
- White Sunray (Leucochrysum albicans subsp. tricolor), EPBC Act: endangered, FFG Act: endangered

During these surveys, one flora species listed under the FFG Act – Purple Blown-grass – was recorded during targeted surveys in November 2021 in habitat zones IH and II, two small wetland patches within road reserves of Woolsthorpe-Hexham Road (see Figure 2-11). No other flora species listed under the EPBC Act or FFG Act were recorded within the targeted survey area, and all other listed flora species are now considered unlikely to occur within the proposed development footprint area.

Native vegetation within the proposed development footprint was surveyed for threatened ecological communities in November 2018, January 2019 and November 2021. During these surveys, impacted areas belonging to the EVCs Higher Rainfall Plains Grassy Woodland (EVC 55\_63), Basalt Shrubby Woodland (EVC 642), Heavier-soils Plains Grassland (EVC 132\_61) and Plains Grassy Wetland (EVC 125) were compared against the condition thresholds for listed ecological communities. Three EPBC Act listed ecological communities – Grassy Eucalypt Woodland of the Victorian Volcanic Plain (GEWVVP), Natural Temperate Grassland of the Victorian Volcanic Plain (GEWVVP), Natural Temperate Grassland of the Victorian Volcanic Plain (SHWTLP) – were recorded within this targeted survey area. No other threatened ecological communities listed under the EPBC Act or FFG Act are considered to have the potential to occur within the proposed development footprint area that was surveyed.



#### Impacts and implications

The proposed HWF development footprint will have the following impacts:

- The loss of 4.977 hectares of native vegetation from patches;
- The loss of three large and one small scattered trees;
- 1.591 hectares of the EPBC Act listed community Natural Temperate Grassland of the Victorian Volcanic Plains;
- 0.662 hectares of the EPBC Act listed community Seasonal Herbaceous Wetland of the Lower Temperate Plains
- Impacts to NTGVVP would constitute a significant impact under the EPBC Act and will require offsetting under the EPBC Act Environmental Offsets Policy

The following FFG Act protected flora taxa are susceptible to impacts from the proposed development on public land at the entrance point to the wind farm and from public road reserves:

- *Purple Blown-grass* ((endangered under the FFG Act)
- Buloke (protected under the FFG Act)
- Black Wattle (member of a genus protected under the FFG Act)
- Onion-orchid (threatened species listed under the FFG Act)
- Sun Orchid (member of a genus protected under the FFG Act)

A Protected Flora Permit would be required from DELWP to remove the above-mentioned plant taxa from public land.

## 5.1. Introduction

The aim of the vegetation surveys was to identify native vegetation and ascertain whether EPBC Act and FFG Act listed threatened flora species and ecological communities have the potential to be present in the HWF development footprint. The information from these surveys has been used to inform the proposed wind farm layout by applying the 'avoid' and 'minimise' principles in accordance with the Guidelines.

The vegetation surveys covered an 'investigation area' that was larger than and contained the actual development footprint. This provided an overview of the occurrence of habitats for threatened flora species on and near the development footprint.

Targeted flora surveys during the appropriate seasons in proposed impact areas that are suitable habitat for threatened flora species provide greater certainty on the presence of these species. Targeted surveys for spring-flowering threatened species were undertaken in areas of suitable habitat during October 2018 (to coincide with the flowering time for these species). Targeted surveys for Trailing Hop-bush were undertaken in areas of suitable habitat during January 2019 (to coincide with the flowering time for this species).

This section of the report presents the results of the vegetation and flora surveys. The methods used and sources of information are considered first. The native vegetation that lies within the investigation area is then described, including vegetation mapping. The impacts on vegetation and potential impacts to threatened species are considered next, followed by mitigation measures for reducing the impacts of the project. Implications of the project under applicable legislation and planning policies are also summarised.

For the purposes of assessing the impacts of the project on vegetation and threatened flora species, the layout described in Section 2.2 was used.



Table 3 below summarises the compliance of the information in this report with the application requirements of the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017a).

Application requirement		Response	
1.	Information about the native vegetation to be removed	See Section 5.4.1	
2.	Topographic and land information relating to the native vegetation to be removed	See Section 4.2	
3.	Recent, dated photographs of the native vegetation to be removed	See Appendix 5	
4.	Details of any other native vegetation approved to be removed, or that was removed without the required approvals, on the same property or on contiguous land in the same ownership as the applicant, in the five year period before the application for a permit is lodged	It is understood that no native vegetation has been removed in relation to the current project within the last five years	
5.	An avoid and minimise statement	Please see Section 5.4.5	
6.	A copy of any Property Vegetation Plan contained within an agreement made pursuant to section 69 of the <i>Conservation</i> , <i>Forests and Lands Act 1987</i> that applies to the native vegetation to be removed	It is understood that no Property Vegetation Plan applies to any of the native vegetation proposed for removal	
7.	Where the removal of native vegetation is to create defendable space, a written statement explaining why the removal of native vegetation is necessary. This statement is not required when the creation of defendable space is in conjunction with an application under the Bushfire Management Overlay.	The removal of native vegetation is not to create defendable space	
8.	If the application is under Clause 52.16, a statement that explains how the proposal responds to the Native Vegetation Precinct Plan considerations (at decision guideline 8).	The application is not being made under Clause 52.16	



	Application requirement		Response		
9.		An offset statement providing evidence that an offset that meets the offset requirements for the native vegetation to be removed has been identified, and can be secured in accordance with the Guidelines.	See Appendix 8		
Additional requirements for applications in the Detailed Assessment Pathway					
10		A site assessment report of the native vegetation to be removed, including:	See Section 5.4.1, Appendix 2 and Appendix 3		
		<ul> <li>A habitat hectare assessment of any patches of native vegetation, including the condition, extent (in hectares), Ecological Vegetation Class and bioregional conservation status.</li> </ul>			
	10.	• The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any large trees within patches			
		<ul> <li>The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any scattered trees, and whether each tree is small or large.</li> </ul>			
11		Information about impacts on rare or threatened species habitat, including:	See Appendix 7		
		<ul> <li>The relevant section of the Habitat importance map for each rare or threatened species requiring a species offset.</li> </ul>			
	11.	• For each rare or threatened species that the native vegetation to be removed is habitat for, according to the Habitat importance maps:			
		- the species' conservation status			
		<ul> <li>the proportional impact of the removal of native vegetation on the total habitat for that species</li> </ul>			
		<ul> <li>whether their habitats are highly localised habitats, dispersed habitats, or important areas of habitat within a dispersed species habitat.</li> </ul>			



# 5.2. Methods

This section describes the methods used for the vegetation survey and determination of the presence of habitat for listed flora species, including sources of information reviewed to ensure a comprehensive consideration of native vegetation and flora species was undertaken.

### 5.2.1. Existing information

Existing information used for this investigation is described below.

#### Existing reporting and documentation

The existing documentation below, relating to the investigation area was reviewed.

- Moyne Planning Scheme
- Hexham Wind Farm Detailed Flora and Fauna Investigations (EHP 2014)

#### Native vegetation

Pre-1750 (pre-European settlement) vegetation mapping administered by DELWP was reviewed to determine the type of native vegetation likely to occur in the investigation area and surrounds. Information on Ecological Vegetation Classes (EVCs) was obtained from published EVC benchmarks. These sources included:

- Relevant EVC benchmarks for the Victorian Volcanic Plains bioregion<sup>1</sup> (DSE 2004a);
- NatureKit (DELWP 2018a).

#### Listed matters

Existing flora species records and information about the potential occurrence of listed matters was obtained from an area termed the 'search region', defined here as an area with a radius of ten kilometres from the approximate centre point of the investigation area (coordinates: latitude 38° 03' 08" S and longitude 142° 35' 07" E).

A list of the flora species recorded in the search region was obtained from the Victorian Biodiversity Atlas (VBA), a database administered by DELWP.

The online EPBC Act Protected Matters Search Tool (DoEE 2015) was consulted to determine whether nationally listed species or communities potentially occurred in the search region based on habitat modelling.

### 5.2.2. Field methods

#### Native vegetation assessment 2018-2021

The native vegetation assessment was conducted from the 13<sup>th</sup> to 28<sup>th</sup> November 2018. Additional native vegetation assessments beyond the earlier survey area where impacts were proposed were undertaken from 8<sup>th</sup> to 11<sup>th</sup> November 2021. During these assessments, the investigation area was surveyed initially by vehicle and areas supporting native vegetation were inspected in more detail on foot.

Sites in the investigation area found to support native vegetation or with potential to support listed matters were mapped through a combination of aerial photograph interpretation and ground-

<sup>&</sup>lt;sup>1</sup> A bioregion is defined as "a geographic region that captures the patterns of ecological characteristics in the landscape, providing a natural framework for recognising and responding to biodiversity values". In general bioregions reflect underlying environmental features of the landscape (DNRE 1997).



truthing using a hand-held GPS (accurate to approximately five metres). Species and ecological communities listed as threatened under the EPBC Act or FFG Act (where they occurred on public land) were also mapped using the same method.

#### Native vegetation

Native vegetation is currently defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'. The Guidelines (DELWP 2017a) further classify native vegetation as belonging to two categories:

- Patch; or
- Scattered tree.

The definitions of these categories are provided below, along with the prescribed DELWP methods to assess them. Further details on definitions of patches and scattered trees are provided in Appendix 1.

#### Patch

A patch of native vegetation is either:

- An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native; or
- Any area with three or more native canopy trees<sup>2</sup> where the drip line<sup>3</sup> of each tree touches the drip line of at least one other tree, forming a continuous canopy; or
- Any mapped wetland included in the *Current wetlands map*, available in DELWP systems and tools.

Patch condition is assessed using the habitat hectare method (Parkes *et al.* 2003; DSE 2004b) whereby components of the patch (e.g. tree canopy, understorey and ground cover) are assessed against an EVC benchmark. The score effectively measures the percentage resemblance of the vegetation to its original condition.

The Native Vegetation Information Management (NVIM) system (DELWP 2018b) provides modelled condition scores for native vegetation to be used in certain circumstances.

#### Scattered tree

A scattered tree is:

• A native canopy tree<sup>2</sup> that does not form part of a patch.

Scattered trees are counted and mapped, the species identified and their circumference at 1.3 m above the ground is recorded.

#### Flora species and habitats

Records of flora species were made in conjunction with sampling methods used to undertake habitat hectare assessments of native vegetation described above. Specimens requiring identification using laboratory techniques were collected.

<sup>&</sup>lt;sup>3</sup> The drip line is the outermost boundary of a tree canopy (leaves and/or branches) where the water drips on to the ground.



<sup>&</sup>lt;sup>2</sup> A native canopy tree is a mature tree (i.e. it is able to flower) that is greater than 3 metres in height and is normally found in the upper layer of the relevant vegetation type.

Species protected under the FFG Act were determined by crosschecking against the FFG Act Protected Flora List (DELWP 2017b).

The potential for habitats to support listed flora species was assessed based on the criteria outlined below:

- The presence of suitable habitat for flora species such as soil type, floristic associations and landscape context; and
- The level of disturbance of suitable habitats by anthropogenic disturbances and invasions by pest plants and animals.

Wherever appropriate, a precautionary approach was adopted in determining the likelihood of occurrence or flora listed under the EPBC Act and/or FFG Act. That is, where insufficient evidence was available on the potential occurrence of a listed species, it is assumed that it could be in an area of suitable habitat.

#### Threatened ecological communities

The investigation area was assessed against published descriptions of relevant listed ecological communities modelled to potentially occur in the investigation area.

Reviewed ecological community descriptions comprised identification criteria and condition thresholds from listing advice for EPBC Act communities as well as FFG Act listed community descriptions (SAC 2015).

#### Targeted flora survey

Based on the results of the vegetation assessments, it was determined that 10 flora species listed under the EPBC Act or FFG Act had the potential to occur within areas of suitable habitat in the wind farm footprint. These species were:

- Adamson's Blown-grass (Lachnagrostis adamsonii) EPBC Act: endangered, FFG Act: endangered
- Basalt Sun-orchid (Thelymitra gregaria), FFG Act: protected
- Clover Glycine (Glycine latrobeana), EPBC Act: vulnerable, FFG Act: vulnerable
- Curly Sedge (Carex tasmanica), FFG Act: endangered
- Cut-leaf Burr-daisy (Calotis anthemoides), FFG Act: protected
- Hairy Tails (Ptilotus erubescens), FFG Act: critically endangered
- Purple Blown-grass (Lachnagrostis punicea subsp. filifolia), FFG Act: endangered
- Small Milkwort (Comesperma polygaloides), FFG Act: critically endangered
- Trailing Hop-bush (Dodonaea procumbens), EPBC Act: vulnerable
- White Sunray (Leucochrysum albicans subsp. tricolor), EPBC Act: endangered, FFG Act: endangered

Targeted surveying for these 10 threatened flora species was undertaken across three separate site surveys (November 2018, January 2019 and November 2021) to coincide with the published flowering times for the target species. Targeted surveying for threatened flora was undertaken only in parts of the investigation area where native vegetation supporting suitable habitat for those species was proposed to be removed (i.e. where native vegetation supporting suitable habitat intersected with the proposed development footprint). As such, most areas included in the targeted



surveys were small/linear/narrow bands of habitat, allowing very thorough visual searching of these areas to be undertaken.

This method, combined with the timing of the surveys (within the published flowering times of all species) was considered appropriate to determine whether the targeted species were present or absent in the impact areas.

Table 5 of this report outlines the areas of habitat assessed during each of the three targeted flora surveys.

These targeted surveys for threatened flora were conducted as described below.

- November targeted flora surveys (targeting spring flowering species namely Adamson's Blowngrass, Basalt Sun-orchid, Clover Glycine, Curly Sedge, Cut-leaf Burr-daisy, Hairy Tails, Purple Blown-grass, Small Milkwort and White Sunray): 28<sup>th</sup> to 30<sup>th</sup> November 2018 and 22<sup>nd</sup> to 25<sup>th</sup> November 2021. During these assessments, the following areas were surveyed:
  - All areas of proposed removal of Plains Grassy Wetland (EVC 125);
  - All areas of proposed removal of Plains Grassy Woodland (EVC 55\_61 and 55\_63) that supported a native ground layer; and
  - All areas of proposed removal of *Heavier-soils* Plains Grassland (EVC 132\_61).
- January targeted flora survey (targeting Trailing Hop-bush): 10<sup>th</sup> and 11<sup>th</sup> January 2019. During this assessment, the following areas were surveyed:
  - Areas of proposed removal of Plains Grassy Woodland (EVC 55\_61 and EVC 55\_63) that supported a native ground layer; and
  - Areas of proposed removal of *Heavier-soils* Plains Grassland (EVC 132\_61) with sufficient species and structural diversity to support Trailing Hop-bush.

All the above detailed targeted surveying for threatened flora involved visual searching on foot by qualified and experienced botanists along transects spaced 5 metres apart. Where any threatened flora species was observed, its location was recorded using a handheld GPS.

#### Limitations of native vegetation assessment

The site assessment was carried out in late spring. The short duration and seasonal timing of field assessments can result in some species not being detected when they may occur at other times. Additionally, some flora species and life-forms may be undetectable at the time of the survey or unidentifiable due to a lack of flowers or fruit.

The timing of the survey and condition of vegetation was otherwise considered suitable to ascertain the extent and condition of native vegetation.

These limitations were not considered to compromise the validity of the current investigation, which was designed to address the relevant policies and decision guidelines.

Identification of EVCs considers vegetation types which would have naturally occupied the landscape prior to European impacts. Significant past alteration of the investigation area's hydrology as well as past vegetation clearance has resulted in the emergence of the establishment of vegetation in some areas that is likely to be notably different to what would have naturally occupied the investigation area. Identification of EVCs in altered areas was therefore based upon consideration of:

- Modelled EVC mapping (DELWP 2018a);
- Observations of adjacent landforms that had not been significantly altered;



- Observations of nearby natural vegetation;
- Any observed indigenous flora species that are useful for determining EVCs; and
- Relevant published EVC benchmark descriptions.

If the above information was not sufficient to allow for a reasonable conclusion to be made on which EVC would have naturally occurred and the observed vegetation resembled an EVC which is likely to have naturally occurred in the region, EVC identification was based upon the structure and floristic composition of current observed vegetation.

#### 5.3. Assessment results

#### 5.3.1. Patches of native vegetation

Pre-European EVC mapping (DELWP 2018a) indicated that the investigation area and surrounds would have supported Plains Grassy Woodland (EVC 55), Plains Grassy Wetland (EVC 125), Plains Grassland (EVC 132), Creekline Grassy Woodland (EVC 68), Swampy Riparian Woodland (EVC 83), Riparian Woodland (EVC 641) and Plains Swampy Woodland (EVC 651) prior to European settlement based on modelling of factors including rainfall, aspect, soils and remaining vegetation.

Evidence on site, including floristic composition and soil characteristics, suggested that Plains Grassy Woodland (EVC 55\_61), Higher Rainfall Plains Grassy Woodland (EVC 55\_63), Floodplain Riparian Woodland (EVC 56), Plains Grassy Wetland (EVC 125), *Heavier-soils* Plains Grassland (EVC 132\_61), Creekline Grassy Woodland (EVC 68), Riparian Woodland (EVC 641) and Tall Marsh (EVC 821) were present within the investigation area (Table 4). Descriptions of these EVCs are provided within the EVC benchmarks in Appendix 6.

257 patches (referred to herein as habitat zones) comprising the abovementioned EVCs, were identified in the investigation area (Table 4). This totalled an area of 49.067 hectares of native vegetation in patches and included 18 large trees in patches (Appendix 3).

In addition, 14.456 hectares of DELWP mapped wetlands occurred within the investigation area. While these areas did not meet the definition of native vegetation during the native vegetation assessment, they have been treated here as patches of native vegetation in accordance with the Guidelines.

Therefore, the total area of native vegetation (patches and DELWP mapped wetlands) that has been recorded within the investigation area was 62.525 hectares.

The investigation area includes the area of the latest construction footprint but also earlier surveys that were undertaken on previous layout options by Nature Advisory. Some areas have been assessed, but due to layout changes are not part of the construction footprint anymore in order to avoid impacts on native vegetation and fauna habitat, for example areas in the east close to Hopkins River.



# Table 4: Description of EVCs in the investigation area

EVC	Description within investigation area	Area (ha) within investigation area
Plains Grassy Woodland (EVC 55_61) - endangered	Plains Grassy Woodland occurred as patches along roadsides and within wind-breaks on private property in the north and east of the site, which receive between 500 mm and 700 mm rainfall annually (BoM 2018a,b). It generally lacked a canopy and large trees, but where these occurred, they were River Red-gums. The understorey tree layer (where present) was Black Wattle, Silver Wattle and Blackwood. In most patches the ground layer was species depauperate and dominated by exotic grasses. Native species in the ground layer (where they occurred) included spear grasses, wallaby grasses and Sheep's Burr. The most common weeds were pasture grasses including Phalaris, Barley-grass, Cocksfoot and Yorkshire Fog. Seven patches along the Hexham-Balangich Road, totaling 8.42 hectares, qualified as the EPBC Act listed Grassy Eucalypt Woodland of the Victorian Volcanic Plain (GEWVVP).	24.828
Heavier-soils Plains Grassland (EVC 132_61) - endangered	Plains Grassland occurred as species and structurally depauperate patches along farm tracks on private property, and as species and structurally rich patches along roadsides. Patches on private land were dominated by wallaby grasses, while patches along roadsides also supported Kangaroo Grass, spear grasses and Common Wheat-grass as well as Blue Devils, Sheep's Burr, Woodland Sorrell and Wiry Dock. The most common weeds were pasture grasses including Phalaris, Barley-grass, Cocksfoot and Yorkshire Fog. 13 patches along numerous roadsides, totaling 3.608 hectares, qualified as the EPBC Act listed Natural Temperate Grassland of the Victorian Volcanic Plain.	6.080


EVC	Description within investigation area	Area (ha) within investigation area
Plains Grassy Wetland (EVC 125) - endangered	Plains Grassy Wetland occurred along watercourses on roadsides and public land, ranging from ephemeral to permanent. Patches included native grasses such as Common Tussock-grass, Australian Sweet-grass and Common Blown-grass and native herbs including Poison Lobelia, Swamp Starwort and Creeping Monkey-flower. The most common weeds were moisture-loving grasses including Phalaris, Yorkshire Fog and Annual Beard-grass. One patch in pasture land south of Immigrants Lane totaling 0.527 hectares qualified as the EPBC Act listed Natural Temperate Grassland of the Victorian Volcanic Plain. One patch in pasture land east of Gilberts Road totaling 0.084 hectares qualified as the EPBC Act listed Seasonal Herbaceous Wetland of the Temperate Lowland Plain.	14.616
Higher Rainfall Plains Grassy Woodland (EVC 55_63) - endangered	Higher Rainfall Plains Grassy Woodland occurred on private land as windbreaks and along the roadsides of the Grassmere-Hexham Road and Gordons Lane in the south-west of the site (district of Woolsthorpe), which receives an average of over 700 mm rainfall per year (BoM 2018c). Patches of Higher Rainfall Plains Grassy Woodland supported a canopy of wither River Red-gum or Blackwood (or a combination of these species), with the ground-layer being dominated by weedy species, including pasture grasses such as Phalaris, Yourkshire Fog and Cocksfoot.	0.309



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EVC	Description within investigation area	Area (ha) within investigation area		
	Riparian Woodland occurred as three patches along Mustons Creek and one on an unnamed creek on private land.			
Riparian Woodland (EVC 641) - endangered	All patches lacked a canopy layer and were dominated by aquatic native graminoids and herbs such as Common Reed, Spike-rushes, Marsh Club- sedge. Water Ribbons, Poison Lobelia, Creeping Monkey-flower and Swamp Starwort.	0.862		
	Weed cover was moderate and dominated by moisture-loving pasture grasses including Phalaris and Yorkshire Fog, as well as Common Chamomile.			
	Slow-moving water was observed within the creekline of Mustons Creek at the time of survey.			
Creekline Grassy Woodland (EVC 68) - endangered	Creekline Grassy Woodland occurred as three patches along an unnamed creek on private land and one patch on an unnamed creek along the Hexham-Ballangeich Road.	0.281		
	All patches lacked a canopy, and were dominated by aquatic natives including Cumbungi, Common Reed and Water Ribbons.			
	Slow-moving water was observed within the creekline of all patches of Creekline Grassy Woodland at the time of survey.			
	Floodplain Riparian Woodland was observed as three patches along the Hopkins River, where New Bridge Road crosses it.			
Floodplain Riparian Woodland (EVC 56) - endangered	River Red-gums occurred in all three patches, either as a canopy, or as immature trees.			
	Terrestrial areas supported Common Wallaby-grass, Kangaroo Grass and Common Tussock-grass as well as Sheep's Burr.	0.098		
	The Hopkins River was flowing at the time of survey. Within the watercourse, the Hopkins River supported Common Reed, Rushes, Water Ribbons and Marsh Club-sedge.			
	Weed cover was high but restricted to terrestrial areas of the patches. Dominant weeds included pasture grasses such as Phalaris, Sweet Vernal- grass and Yorkshire Fog.			



EVC	Description within investigation area	Area (ha) within investigation area		
	Tall Marsh occurred as one patch in a dam on private property.			
Tall Marsh (EVC 821)	It was dominated by native aquatic graminoids including Spike-rushes and Australian Sweet-grass, and native aquatic herbs such as Thin Pondweed and Water-milfoil.	0.178		
	Weed cover was low and included Willows and pasture grasses.			
	The dam held standing water at the time of survey.			
	Aquatic Herbland occurred throughout the study area as aquatic vegetation in creeks and large drainage lines with flowing water.			
Aquatic Herbland (EVC 653) - endangered	It was dominated by Water Ribbons and Grey Spike- rush, with variable covers of Common Duckweed, Azolla and Swamp Wallaby-grass.	0.244		
	Weed cover in the water was very low, although fringing vegetation tended to be heavily invaded by Toowoomba Canary Grass and other pasture grasses.			
	Brackish Wetland occurred in one patch in pasture land east of Gilberts Road.			
Brackish Wetland (EVC 656) - endangered	A single patch of Brackish Wetland vegetation was recorded on private land. It was associated with an ephemeral creekline and was dry at the time of the assessment. This vegetation was characterized by a moderate cover of grasses and sedges and a lower cover of salt tolerant herbs. Common indigenous species included Common Tussock-grass, Rigid Panic, Club-sedge, Centrolepis, Creeping Brookweed, Buttercup and Monkey-flower. Weed cover was high, with common weeds including Common Cotula, Buck's-horn Plantain, Spear Thistle and Soft Brome.	0.579		
	This patch, totaling 0.579 hectares, qualified as the EPBC Act listed Seasonal Herbaceous Wetland of the Temperate Lowland Plain.			



EVC	Description within investigation area	Area (ha) within investigation area		
	Creekline Tussock Grassland occurred in two patches adjacent to Mustons Creek.			
Creekline Tussock Grassland (EVC 654) - endangered	Vegetation was dominated by Common Tussock- grass with a diverse herbaceous understory including River Buttercup, Bluebells, Kidney Weed and Crane's Bill.	0.347		
	Weed cover was low, and consisted largely of Ribwort, Brad-leaf Dock and Yorkshire Fog.			
	Both patches, totaling 0.347 hectares, qualified as the EPBC Act listed Natural Temperate Grassland of the Victorian Volcanic Plain.			
Plains Sedgy Wetland (EVC 647) - endangered	Plains Sedgy Wetland occurred throughout the study area in roadside depressions, low-lying pasture land and ephemeral drainage lines and ponds.			
	Vegetation was often species-poor, consisting of Common Spike-rush, Swamp Wallaby-grass, Short- stem Sedge and Knob Sedge.	0.645		
	Weed cover was often high and consisted of pasture grasses and Club-rush.			
Mapped Wetlands	Mapped Wetlands occurred on private property, in areas that did not meet the threshold for a patch of native vegetation during the field survey (i.e. 25 per cent of the total perennial understorey plant cover is native), but have been treated as native vegetation in accordance with the Guidelines.	14.456		
	Areas of Mapped Wetlands have been given the modelled score in in accordance with the Guidelines.			
	TOTAL	63.525		

The habitat hectare assessment results for these habitat zones are provided Appendix 2. Details of large trees in patches are provided in Appendix 3.





Figure 1: Study area and native vegetation

Project: Hexham Wind Farm Client: Wind Prospect Pty Ltd Date: 10/12/2021

Wind farm boundary **IIInvestigation area** 

- Turbines
- Large tree in patch
- Large scattered tree
- Small scattered tree

#### Native vegetation

- 🔼 Aquatic Herbland
- Creekline Grassy Woodland
- Creekline Tussock Grassland
- 🔼 Plains Grassland
- Plains Grassy Wetland
- Floodplain Riparian Woodland
- Plains Grassy Woodland
- 🔼 Riparian Woodland
- Plains Sedgy Wetland
- 🔽 Tall Marsh
- DELWP wetland



#### 5.3.2. Scattered trees

Scattered trees recorded in the investigation area would have once comprised the canopy component of Plains Grassy Woodland (EVC 55\_61) and High-rainfall Plains Grassy Woodland (EVC 55\_63).

29 scattered trees occurred in the investigation area (Appendix 3), including:

- 18 large scattered trees ( $\geq$  80 cm DBH in EVC 55\_61,  $\geq$  70 cm DBH for River Red-gum and  $\geq$  40 cm DBH for Blackwood in EVC 55\_63); and
- 11 small scattered trees (< 80 cm DBH in EVC 55\_61, < 70 cm DBH for River Red-gum and < 40 cm DBH for Blackwood in EVC 55\_63).</li>

Details of all scattered trees recorded are listed in Appendix 3.

#### 5.3.3. Flora species

#### Species recorded

During the field assessment 145 plant species were recorded. Of these, 90 (62%) were indigenous and 55 (38%) were introduced or non-indigenous native in origin (Appendix 4).

#### Listed species

VBA records (DELWP 2018c) and the EPBC Protected Matters Search Tool (DoEE 2015) indicated that within the search region there were records of, or there occurred potential suitable habitat for, 18 species listed under the Commonwealth EPBC Act and 23 listed under the state FFG Act, including 15 listed under both Acts. No flora species listed under the EPBC Act were recorded during the field survey.

The likelihood of occurrence in the investigation area of species listed under the EPBC Act and FFG Act is addressed in Table 5. Species considered 'likely to occur' are those that have a very high chance of being in the investigation area based on numerous records in the search region and suitable habitat in the investigation area. Species considered to have the 'potential to occur' are those where suitable habitat exists, but recent records are scarce.

This analysis indicates that the following ten listed flora species were considered likely to occur or considered to have the potential to occur.

- Adamson's Blown-grass (Lachnagrostis adamsonii) EPBC Act: endangered, FFG Act: endangered
- Basalt Sun-orchid (Thelymitra gregaria), FFG Act: protected
- Clover Glycine (Glycine latrobeana), EPBC Act: vulnerable, FFG Act: vulnerable
- Curly Sedge (Carex tasmanica), FFG Act: endangered
- Cut-leaf Burr-daisy (Calotis anthemoides), FFG Act: protected
- Hairy Tails (Ptilotus erubescens), FFG Act: critically endangered
- Purple Blown-grass (Lachnagrostis punicea subsp. filifolia), FFG Act: endangered
- Small Milkwort (Comesperma polygaloides), FFG Act: critically endangered
- Trailing Hop-bush (Dodonaea procumbens), EPBC Act: vulnerable
- White Sunray (Leucochrysum albicans subsp. tricolor), EPBC Act: endangered, FFG Act: endangered



A targeted survey for nine of the above-listed flora species (with the exception of Trailing Hop-bush) was undertaken between 28<sup>th</sup> and 30<sup>th</sup> November 2018. A targeted survey for Trailing Hop-bush was undertaken on the 10<sup>th</sup> and 11<sup>th</sup> January 2019. Surveys for additional areas beyond the initial investigation area were undertaken from 22<sup>nd</sup> to 25<sup>th</sup> November 2021. During these surveys, areas identified to support suitable habitat for these species were inspected thoroughly along transects spaced five metres apart. This transect spacing was chosen based on the lifeform of the targeted species and the visibility within areas of suitable habitat.

The specific area investigated, referred to herein as the 'investigation area', comprised suitable habitat within the proposed infrastructure layout plus the following buffers:

- 25 metres each side of the centreline provided by Hexham Wind Farm for vehicle tracks;
- 15 metres each side of the centreline provided by Hexham Wind Farm for cables; and
- 100 metres from the centre point provided by Hexham Wind Farm for Turbines.

#### Results

The only species recorded was Purple Blown-grass (Lachnagrostis punicea subsp. filifolia), endangered under the FFG Act, which was recorded during targeted surveys in November 2021 in habitat zones IH and II, two small patches within road reserves of Woolsthorpe-Hexham Road (see Figure 2-11).

None of the other species surveyed for were recorded during targeted surveys, and they are therefore now considered unlikely to occur in the impact area.



#### Table 5: FFG Act and EPBC Act listed flora species and likelihood of occurrence

Common Name	Scientific Name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
River Swamp Wallaby- grass	Amphibromus fluitans	VU		River Swamp Wallaby-grass grows mostly in permanent swamps and also lagoons, billabongs, dams and roadside ditches. The species requires moderately fertile soils with some bare ground; conditions that are caused by seasonally- fluctuating water levels (DoEE 2018).	None	N/A	Suitable (but sub-optimal) habitat along watercourses. No records within 10 km. <b>Unlikely to occur.</b>
Cut-leaf Burr-daisy	Calotis anthemoides		CR	Scattered north and west of Melbourne (e.g. Sunshine, Camperdown, Moyston, Dunkeld, Numurkah regions) on heavy soils prone to waterlogging, but now rather rare due to habitat depletion (Walsh 1999). Wet depressions in Plains Grassland, Plains Grassy Wetland and Plains Grassy Woodland (Bull 2014).	3	21/10/2010	Suitable habitat in EVCs 132_61 and 55. Potential to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> occur.
Curly Sedge	Carex tasmanica		EN	Occurs in seasonally wet, fertile, heavy basalt clay soils, usually around the margins of slightly saline drainage lines or freshwater swamps. The dominant vegetation type varies, but is often grassy/sedgy and generally lacks trees (Carter 2010a).	1	8/12/2005	Suitable habitat along drainage lines. Potential to occur in EVCs 125, 641 and 821. Not recorded during targeted surveys, and therefore now considered <b>unlikely to occur.</b>
Small Milkwort	Comesperma polygaloides		CR	Found in remnant native grasslands and grassy woodlands on heavy soils (Walsh 1999) on the Western Basalt Plains, dominated by Kangaroo Grass, Silver Tussock and, less commonly, wallaby grasses and spear grasses (DSE 1999)	2	21/10/1991	Suitable habitat in EVCs 132_61 and 55. Potential to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> occur.
Bell-flower Hyacinth-orchid	Dipodium campanulatum	EN	EN	Reported from only a few scattered localities west of Melbourne to Portland (Entwisle 1994). Typically found on deep grey sands or limestone in stringybark (Eucalyptus baxteri /arenacea) woodland with an understorey of bracken fern, Acacia species (Bates, 2011), cranberry heath and magenta storks bill. It is also found in South Australian blue gum (E. leucoxylon) and pink gum association woodlands. These areas have wet winters and long dry mild summers (DoE 2018).	None	N/A	No suitable habitat. Unlikely to occur.
Clumping Golden Moths	Diuris gregaria		CR	Grassland dominated by Kangaroo Grass and among rocks on basalt outcrops in red-brown to blackish loams. Highly localised in Derrinallum-Chatsworth area (Jones 2006).	5	21/10/2010	No suitable habitat. Unlikely to occur.
Trailing Hop-bush	Dodonaea procumbens	VU		Grows in low lying, often winter wet areas in woodland, low open-forest heathland and grasslands on sands and clays. Largely confined to SW of Victoria (DoEE 2018).	None	N/A	Suitable habitat within EVCs 132_61 and 55. No records within 10 km. Potential to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> <b>occur.</b>
Clover Glycine	Glycine latrobeana	VU	VU	Found across south-eastern Australia in native grasslands, dry sclerophyll forests, woodlands and low open woodlands with a grassy ground layer. In Victoria, populations occur in lowland grasslands, grassy woodlands and sometimes in grassy heath (DoEE 2018).	11	17/12/1998	Suitable habitat in EVCs 132_61 and 55. Potential to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> occur.



Common Name	Scientific Name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Adamson's Blown-grass	Lachnagrostis adamsonii	EN	EN	Confined to slow moving creeks, swamps, flats, depressions or drainage lines that are seasonally inundated or waterlogged and usually moderately to highly saline. Appear to favour sites that have some shelter from the wind (DoEE 2018).	4	9/06/2001	Suitable habitat along drainage lines. Potential to occur in EVCs 125, 641 and 821. Not recorded during targeted surveys, and therefore now considered <b>unlikely to occur.</b>
Purple Blown-grass	Lachnagrostis punicea subsp. filifolia		EN	Seasonally wet, heavy clay soils (Walsh 1994).	1	15/12/1995	Suitable habitat along drainage lines. Potential to occur in EVCs 125, 641 and 821. Recorded during targeted surveys in habitat zone IH and II, <b>does occur.</b>
Spiny Peppercress	Lepidium aschersonii	VU	EN	The Spiny Peppercress occurs in periodically wet sites such as gilgai depressions and the margins of freshwater and saline marshes and shallow lakes, usually on heavy clay soil. Almost all sites receive some degree of soil waterlogging or seasonal flooding (Carter 2010b).	3	1/06/1983	No suitable habitat. Unlikely to occur.
White Sunray	Leucochrysum albicans subsp. tricolor	EN	EN	Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. Plants can be found in natural or semi-natural vegetation and grazed or ungrazed habitat. Bare ground is required for germination. The unpalatability of this species is likely to protect it in heavily grazed areas where patches of bare ground are likely to develop, favouring recruitment (DoEE 2018).	3	11/11/2008	Suitable habitat in EVCs 132_61 and 55. Potential to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> occur.
Spiny Rice-flower	Pimelea spinescens subsp. spinescens	CR	CR	Occurs in grassland or open shrubland on basalt derived soils, usually comprising black or grey clays. Plants from more northerly populations occur on red clay complexes, while plants from southern populations occur on heavy grey-black clay loams. Topography is generally flat but populations may occur on slight rises or in slightly wettish depressions (Carter & Walsh 2006).	None	N/A	Suitable (but sub-optimal) habitat in EVC 132_61. No records within 10 km. <b>Unlikely to occur.</b>
Salt-lake Tussock-grass	Poa sallacustris	VU	CR	Margins of brackish to salt lakes (Walsh 1994).	None	N/A	No suitable habitat. Unlikely to occur.
Maroon Leek-orchid	Prasophyllum frenchii	EN	EN	Grows mainly in open sedge swampland or in wet grassland and wet heathland generally bordering swampy regions. Sites are generally low altitude, flat and moist. Soils are generally moderately rich damp sandy or black clay loams. Climate is mild, with an annual rainfall of 600–1100 mm, occurring predominantly in winter and spring (DoEE 2018).	None	N/A	Suitable (but sub-optimal) habitat along watercourses. No records within 10 km. <b>Unlikely to occur.</b>
Fragrant Leek-orchid	Prasophyllum suaveolens	EN	CR	Occurs in open, species rich native grassland dominated by Themeda triandra with perennial herbs and lilies on poorly drained red-brown soil derived from basalt (DSE 2003).	2	21/10/2010	No suitable habitat. Unlikely to occur.
Basalt Leek-orchid	Prasophyllum viretrum		CR	Moist to wet grassland on dark basaltic loam (Jones & Rouse 2006).	5	13/12/2013	No suitable habitat. Unlikely to occur.
Leafy Greenhood	Pterostylis cucullata	VU	EN	Tea-tree scrubs on tall sandy and calcareous dunes, in moist, open or even deep shaded locations (Jones 1994).	None	N/A	No suitable habitat. Unlikely to occur.
Hairy Tails	Ptilotus erubescens		CR	Fertile soils with grassland and woodland communities (Walsh 1996).	25	14/12/2004	Suitable habitat in EVCs 132_61 and 55. Likely to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> occur.



Common Name	Scientific Name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Button Wrinklewort	Rutidosis Ieptorhynchoides	EN	EN	In Victoria restricted to open stands of plains grassland and grassy woodlands, on fertile clays to clay loams, usually in areas where the grass cover is more open, either as a result of recurrent fires or grazing by native macropods or stock. It also occurs on low rises with shallow, stony soils at less than 100 m above sea level (NSW 0EH 2012).	None	N/A	Suitable (but sub-optimal) habitat in EVC 132_61. No records within 10 km. <b>Unlikely to occur.</b>
Swamp Fireweed	Senecio psilocarpus	VU		Herb-rich winter-wet swamps on volcanic clays or peaty soils (Walsh 1999). Known from approximately 10 sites between Wallan, about 45 km north of Melbourne, and Honans Scrub in south-eastern South Australia (TSSC 2008a).	None	N/A	No suitable habitat. Unlikely to occur.
Coast Dandelion	Taraxacum cygnorum	VU	CR	Woodland and scrub on limestone (Scarlett 1999).	None	N/A	No suitable habitat. Unlikely to occur.
Metallic Sun-orchid	Thelymitra epipactoides	EN	EN	Grows primarily in mesic coastal heathlands, grasslands and woodlands, but is also found in drier inland heathlands, open forests and woodlands. Substrates may be moist or dry sandy loams or loamy sands. Critical habitat has not been determined but the species is likely to require open conditions, which may be created by soil disturbance or fire, for recruitment (DoEE 2018).	None	N/A	Suitable (but sub-optimal) habitat in EVCs 132_61 and 55. No records within 10 km. <b>Unlikely to occur.</b>
Basalt Sun-orchid	Thelymitra gregaria		CR	Tussock grasslands on rich, water-retentive red-brown soils derived from basalt (Backhouse & Jeanes 1995, Jones 2006 in DSEWPC 2003).	5	21/10/2010	Suitable habitat in EVC 132_61. Potential to occur. Not recorded during targeted surveys, and therefore now considered <b>unlikely to</b> <b>occur.</b>
Spiral Sun-orchid	Thelymitra matthewsii	VU	EN	Slightly elevated sites to 300m in well-drained soils (sandy loams to gravelly limestone soils) in light to dense forest; sometimes in coastal sandy flats (Weber & Entwisle 1994).	1	29/08/1998	No suitable habitat. Unlikely to occur.
Swamp Everlasting	Xerochrysum palustre	VU	CR	Grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils. Commonly associated genera include Amphibromus, Baumea, Carex, Chorizandra, Craspedia, Eleocharis, Isolepis, Lachnagrostis, Lepidosperma, Myriophyllum, Phragmites australis, Themeda triandra and Villarsia (DoEE 2018).	None	N/A	Suitable (but sub-optimal) habitat along watercourses. No records within 10 km. <b>Unlikely to occur.</b>

Notes:

**EPBC** = threatened species status under EPBC Act

FFG = threatened species status under the FFG Act

CR = critically endangered; EN = endangered; VU = vulnerable



#### 5.3.4. Listed Ecological Communities

The EPBC Protected Matters Search Tool (DoEE 2015) indicated that five ecological communities listed under the EPBC Act had the potential to occur in the investigation area (Table 6). Two of these ecological communities were found to occur within the study area.

Table 6: EPBC Act listed ecological communities and likelihood of occurrence in the investigation area

Ecological Community	EPBC	Occurrence in the investigation area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	CR	Potential to occur in areas of Plains Grassy Woodland (EVC 55_61) and High Rainfall Plains Grassy Woodland (EVC 55_63). Occurs in the investigation area along the Hexham- Ballangeich Road. Habitat zones DA, DI, DK, DM, DP, DR and DV. <b>8.57 hectares</b> in total.
Natural Temperate Grassland of the Victorian Volcanic Plain	CR	Potential to occur in areas of <i>Heavier-soils</i> Plains Grassland (EVC 132_61). Occurs in the investigation area along the Woolsthorpe- Hexham Road, the Warrnambool-Caramut Road, the Hexham-Ballangeich Road, Cooramook Lane and the Hamilton Highway. Habitat zones BE, CE, DC, DE, DG, EU, EV, FA, GB, GE, HI, II, XAD, XAF, XAU and XAV. <b>4.34 hectares</b> in total.
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	CR	Potential to occur in areas of Plains Grassy Wetland (EVC 125). Occurs in the investigation area along the proposed transmission line north and east of proposed turbine T37. Habitat Zones XBS and XBT. <b>0.662 hectares</b> in total.
Grey Box ( <i>Eucalyptus microcarpa</i> ) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EN	Does not occur in the investigation area.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CR	Does not occur in the investigation area.

**Notes: EPBC** = status under EPBC Act: EN = Endangered; CR = critically endangered.

Based on an assessment of native vegetation in the investigation area against published descriptions and condition thresholds for these communities, the following listed ecological communities were recorded in the investigation area:

 Grassy Eucalypt Woodland of the Victorian Volcanic Plain – listed as Critically Endangered under the EPBC Act (DA, DI, DK, DM, DP, DR and DV)

Plains Grassy Woodland (EVC 55\_61) and High Rainfall Plains Grassy Woodland (EVC 55\_63) mapped within the investigation area would potentially meet the key diagnostic criteria for this



community (TSSC 2008b), namely remnant native vegetation within the Victorian Volcanic Plain where trees are present such that the projective foliage cover of native trees is more than 5% and the tree canopy is generally dominated by River Red Gum (Eucalyptus camaldulensis) or associated eucalypts. Seven patches of Plains Grassy Woodland (EVC 55\_61) within the study area, along the Hexham-Balangeich Road, were found to meet the condition thresholds for this community (TSSC 2008b). These were Habitat Zones DA, DI, DK, DM, DP, DR and DV, all of which were patches bigger than or equal to 0.5 hectares in which 50% or more of the perennial ground layer vegetation comprises native species (TSSC 2008b). All patches of High Rainfall Plains Grassy Woodland (EVC 55\_63), and all other patches of Plains Grassy Woodland (EVC 55\_61) within the investigation area were found not to meet the condition thresholds for this community, either as they were too small, because 50% or more of the perennial ground layer vegetation was not native species or because there were not more than ten native perennial species and at least three big trees per hectare (TSSC 2008b).

 Natural Temperate Grassland of the Victorian Volcanic Plain – listed as Critically Endangered under the EPBC Act (BE, CE, DC, DE, DG, EU, EV, FA, GB, G, HI, II, XAD, XAF, XAU and XAV).

Patches of Heavier-soils Plains Grassland (EVC 132\_61) within the investigation area would potentially meet the key diagnostic criteria for this community (TSSC 2008b), namely remnant native vegetation within the Victorian Volcanic Plain where trees are absent or sparse such that the projective foliage cover of native trees is less than 5% and the ground vegetation layer is dominated by native grasses and/or other native herbs. 11 patches of Heavier-soils Plains Grassland (EVC 132\_61) within the investigation area, along the Woolsthorpe-Hexham Road, the Warrnambool-Caramut Road, the Hexham-Ballangeich Road, Cooramook Lane and the Hamilton Highway, were found to meet the condition thresholds for this community (TSSC 2008c). These were Habitat Zones BE, CE, DC, DE, DG, EU, EV, FA, GB, GE, HI, II, XAD, XAF, XAU and XAV, all of which were patches bigger than or equal to 0.05 hectares in which the dominant native species represented at least 50% of the native species and the perennial tussock cover (TSSC 2008c). All other patches of Heavier-soils Plains Grassland (EVC 132\_61) within the investigation area were found not to meet the condition thresholds for this community, either as they were too small or because the dominant native species did not represent at least 50% of the native species and the perennial tussock cover (TSSC 2008c).

 Seasonal Herbaceous Wetland of the Temperate Lowland Plain – listed as Critically Endangered under the EPBC Act (XBS and XBT)

Patches of Plains Grassy Wetland (EVC 125) within the investigation area would potentially meet the key diagnostic criteria for this community, this being one of the EVCs that correlate with the listed community (TSSC 2012). The listed community occurs in the investigation area along the proposed transmission line north and east of proposed turbine T37. Habitat Zone XBS and XBT, met the key diagnostic of having more than 50% of the total cover of plants in the ground layer of the wetland dominated by native species characteristic of the Seasonal Herbaceous Wetlands ecological community (TSSC 2012).

Based on an assessment of native vegetation in the investigation area against published descriptions and condition thresholds, the following communities were found not to occur in the investigation area based on the factors described below.

• Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of Southeastern Australia – listed as Endangered under the EPBC Act (habitat zone/location).

No vegetation within the study area met the third key diagnostic criterion for this community, namely that at least one of the most common overstorey species is/was Grey Box (TSSC 2010).



 White Box-Yellow-Box-Blakeley's Red Gum Grassy Woodland and Derived Native Grassland – listed as Critically Endangered under the EPBC Act

No vegetation within the study area met the first key diagnostic criterion for this community, namely that at least one of the most common overstorey species is/was White Box, Yellow Box or Blakely's Red Gum (TSSC 2006).

#### 5.4. Impacts of the proposed development

The current proposal will involve the construction and operation of the HWF, as described in Section 2.2.

The extent of the area of impact for the current proposal was considered to include the outer-most boundaries of the proposed development layout presented in Figure 2. This area has been referred to as the 'development footprint'.

#### 5.4.1. Native vegetation

The current footprint will result in the loss of a total extent of 5.202 hectares of native vegetation (0.84 ha Plains Grassy Woodland, 0.93 ha Plains Grassland, 2.93 ha Plains Grassy Wetland, and 0.52 ha other EVCs) as represented in Figure 1 and documented in the Native Vegetation Removal (NVR) report provided by DELWP (Appendix 7).

This comprised of:

- 4.977 ha of patch native vegetation (no large trees in patches); and
- 4 scattered trees (namely 3 large scattered trees and 1 small scattered tree), equating to an area loss of 0.225 ha.

The native vegetation to be removed is in an area mapped as an endangered Ecological Vegetation Class.

It is understood that no native vegetation has been approved for removal on the property within the last five years.

Photographs of native vegetation proposed for removal are provided in Appendix 5.

#### 5.4.2. Modelled species important habitat

The current proposal footprint will not have a significant impact on any habitat for any rare or threatened species as determined in Appendix 7.

#### 5.4.3. Listed flora species

The analysis of the likelihood of occurrence of listed flora species presented in Section 5.3.3 identified that the following species could be impacted by any development in the investigation area:

 Purple Blown-grass (Lachnagrostis punicea subsp. filifolia), FFG Act endangered – recorded during targeted surveys in habitat zones IH and II.

Three individual plants of this species will be impacted just east of habitat zone XAJ.

#### 5.4.4. Threatened ecological communities

The proposed development footprint will result in the following losses:

- 1.591 hectares of Natural Temperate Grassland of the Victorian Volcanic Plains.
- 0.662 hectares of potential Natural Temperate Grassland of the Victorian Volcanic Plains.



#### 5.4.5. Avoid and minimise statement

In accordance with the Guidelines, all applications to remove native vegetation must provide an avoid and minimise statement which details any efforts undertaken to avoid the removal of, and minimise the impacts on biodiversity and other values of native vegetation, and how these efforts focussed on areas of native vegetation that have the most value. Efforts to avoid and minimise impacts to native vegetation in the current application are presented below.

#### Design response to avoid and minimise impacts on flora and fauna

A number of measures have been incorporated into the design of the HWF to avoid and minimise impacts on threatened ecological communities and native vegetation. These include:

- A 100-metre buffer was placed around all mapped wetlands to exclude all Project infrastructure. This area was selected as a means of avoiding:
  - Physical disturbance to wetlands and their fringes; and
  - Limit surface water runoff, and entrained sediment loads reaching these ephemeral wetlands from construction works zones.
- Watercourses including the Mustons Creek, Drysdale Creek and smaller drainages, were buffered by 100 metres to prevent:
  - Unnecessary disturbance to the watercourses or their banks; and
  - Limit potential downstream effects from construction activities such as sedimentation of water.
- Ephemeral drainage lines were buffered by 30 metres to:
  - Limit physical disturbance to the drainage line; and
  - Limit surface water runoff and entrained sediment loads reaching these ephemeral drainages from construction work zones.
- Watercourse crossings have been minimised through the siting of the accessways. The proposed crossings are necessary to provide access to infrastructure and will prevent vehicles being diverted onto public roads. Other key design measures for watercourse crossings include:
  - Permanent surface structures designed to maintain existing overland flow paths and not cause increased upstream flood levels; and
  - Waterway crossings will be designed to accommodate a 1 in 10 ARI design criteria.
- Re-alignment and micro-siting of infrastructure has avoided most of the native vegetation within the HWF site; and
- Re-alignment and micro-siting of infrastructure has avoided the majority of NTGVVP and SHWTLP within the HWF site.

Native vegetation surveys have progressively refined the understanding of native vegetation coverage and habitat for threatened flora and fauna across the site. Throughout the design process there have been significant efforts made to avoid the clearance of native vegetation.

#### Mitigation of indirect impacts

Commitments to mitigate indirect impacts to vegetation and habitat during construction are provided below:

- Appropriate vegetation protection zones will be established around areas of native vegetation to be retained prior to works.
- Appropriate tree protection zones will be established around scattered native trees to be retained prior to works.



- All construction personnel will be appropriately briefed prior to works, and no construction personnel, machinery or equipment will be placed inside vegetation/tree protection zones.
- Where essential wind farm infrastructure (e.g. access tracks) crosses a waterway, measures for avoiding and minimising impacts will be documented in the Construction Environmental Management Plan (CEMP) including avoiding permanent disturbance of banks, channels and nearby vegetation and restoring temporarily disturbed waterway banks and vegetation to at least its pre-construction condition.
- Bridges and culverts will be designed to allow flow beneath the roads along their natural flow paths. The watercourse crossings construction method will be dependent on the site conditions of the crossing location. All waterway crossings and culvert and bridge designs would conform to relevant local Council, Glenelg Hopkins Catchment Management Authority and DELWP guidelines.
- Sediment fencing will be installed during construction to protect riparian zones if works are to be undertaken within 30 metres of waterways.
- Access tracks throughout the site will be designed with culverts to divert flow paths beneath the roads.
- Underground cabling trenches will be refilled with material of the same permeability to mitigate land salinisation and induced groundwater flows.
- A CEMP will be prepared for the project, which includes:
  - Designated entry and exit points from each property;
  - Biosecurity signage, with clear instructions and contact details at all entry points;
  - Defined routed for entry and exit of all machinery;
  - A site induction for all employees and visitors;
  - Decontamination bays at all site entries and between properties, where necessary to prevent the spread of weeds across the site;
  - Decontamination procedures, including record keeping of all decontaminations undertaken; and
  - Measures to ensure any materials imported to the site are free from biosecurity risks, including record keeping of all materials.



Figure 2: Native vegetation and proposed impacts within the investigation area





### Figure 2-1: Native vegetation to be impacted

**Project**: Hexham Wind Farm **Client**: Wind Prospect Pty Ltd **Date**: 14/01/2022

Wind farm boundary Development footprint

- Turbines
- Native vegetation
- Z Plains Grassy Woodland
- Plains Grassland
- DELWP wetland
- Native vegetation to be removed



Metres 0 200



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#### Figure 2-3: Native vegetation to be impacted

Project: Hexham Wind Farm Client: Wind Prospect Pty Ltd Date: 14/01/2022

Wind farm boundary Investigation area Development footprint

- Turbines
- EPBC Act listed community

#### Native vegetation

- Plains Grassy Woodland
- N Plains Grassland
- Plains Grassy Wetland
- Plains Sedgy Wetland
- DELWP wetland
- Native vegetation to be removed



Metres





**Figure 2-4:** Native vegetation to be impacted

**Project**: Hexham Wind Farm **Client**: Wind Prospect Pty Ltd **Date**: 14/01/2022

Wind farm boundary Investigation area Development footprint

- Turbines
- Native vegetation

Plains Grassy Woodland DELWP wetland



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# Figure 2-10: Native vegetation to be impacted

**Project:** Hexham Wind Farm **Client:** Wind Prospect Pty Ltd **Date:** 14/01/2022

Wind farm boundary Investigation area Development footprint • Turbines Large scattered tree • Small scattered tree Tree Protection Zone (TPZ) EPBC Act listed community Native vegetation Z Plains Grassy Woodland Aquatic Herbland Creekline Tussock Grassland Plains Grassy Wetland 🔼 Riparian Woodland DELWP wetland Remove × Tree to be removed Native vegetation to be removed



Metres 0 200





### Figure 2-11: Native vegetation to be impacted

Project: Hexham Wind Farm Client: Wind Prospect Pty Ltd Date: 14/01/2022

Wind farm boundary Investigation area Development footprint

- Turbines
- Large tree in patch
- Large scattered tree
- Small scattered tree

Tree Protection Zone (TPZ)

Threatened and protected species

- 🔺 Buloke
- Purple Blown-grass
- ▲ Common Onion-orchid
- Sun Orchid

EPBC Act listed community

- GEWVVP

Native vegetation

Plains Grassy Woodland

- Aquatic Herbland
- Creekline Tussock Grassland
- **Plains** Grassland
- Plains Grassy Wetland
- 🔼 Riparian Woodland
- DELWP wetland

#### Remove

× Tree to be removed Native vegetation to be removed



Ν

Metres 0 200



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# Figure 2-14: Native vegetation to be impacted

**Project**: Hexham Wind Farm **Client**: Wind Prospect Pty Ltd **Date**: 14/01/2022

Wind farm boundary

- Development footprintTurbines
- Large scattered tree

EPBC Act listed community

- Native vegetation
- Z Plains Grassy Woodland
- Nains Grassland
- DELWP wetland











#### 5.5. Implications of the proposed development

#### 5.5.1. Implications under the Guidelines

#### Assessment pathway

The assessment pathway is determined by the location category and the extent of native vegetation as detailed for the investigation area as follows:

- Location Category: Location 2
- Extent of native vegetation: A total of 5.202 ha of native vegetation (including 3 large trees).

Based on these details, the Guidelines stipulate that the proposal is to be assessed under the **Detailed** assessment pathway.

This proposal would trigger a referral to DELWP based on the criteria specified in Section 3.2.1

#### Offset requirements

Offsets required to compensate for the proposed removal of native vegetation from the investigation area are provided below.

- 1.523 general habitat units and must include the following offset attribute requirements:
  - Minimum strategic biodiversity value (SBV) of 0.306
  - Occur within the Glenelg Hopkins CMA boundary or the Moyne Shire Council municipal district.
  - Include protection of at least 3 large trees.

Under the Guidelines all offsets must be secured prior to the removal of native vegetation.

#### Offset statement

The offset requirements for the proposal will be met via purchase of a third-party offset through DELWP's Native Vegetation Credit Register (NVCR). Evidence that the required offset is currently available through the NVCR is provided in Appendix 8.

#### 5.5.2. EPBC Act

The EPBC Act protects a number of threatened species and ecological communities that are considered to be of national conservation significance. Any significant impacts on these species require the approval of the Australian Minister for the Environment.

If there is a possibility of a significant impact on nationally threatened species or communities or listed migratory species, a Referral under the EPBC Act should be considered. The Minister will decide after 20 business days whether the project will be a 'controlled action' under the EPBC Act, in which case it cannot be undertaken without the approval of the Minister. This approval depends on a further assessment and approval process (lasting between three and nine months, depending on the level of assessment).

Based on the relevant guidelines, the proposed development is likely to result in a significant impact on EPBC Act listed values presented below.

Natural Temperate Grassland of the Victorian Volcanic Plains

A Referral under the EPBC Act will be required for the above-listed values, including any values found to be potentially significantly impacted upon.



#### 5.5.3. FFG Act

The Victorian FFG Act lists threatened and protected species and ecological communities (DELWP 2017b, DELWP 2017c). Any removal of threatened flora species or communities (or protected flora) listed under the FFG Act from public land requires a Protected Flora Permit under the Act, obtained from DELWP.

The FFG Act only applies to private land in relation to the commercial collection of grasstrees, treeferns and sphagnum moss.

The following FFG Act values listed as protected are susceptible to impacts from the proposed development on public land:

- Buloke
- Black Wattle
- Sun Orchid
- Common Onion-orchid

A Protected Flora Permit would be required from DELWP to remove the plant taxa comprising the abovementioned listed threatened community, listed threatened flora species or otherwise protected values from public land. Application forms for Protected Flora Permits can be obtained from DELWP offices or from their customer service centre.

#### 5.5.4. CaLP Act

The Catchment and Land Protection Act 1994 (CaLP Act) requires that land owners (or a third party to whom responsibilities have been legally transferred) must prevent the growth and spread of regionally controlled weeds.

In accordance with the *Catchment and Land Protection Act* 1994, the noxious weed species listed below, which were recorded in the investigation area, must be controlled.

- African Box-thorn
- Blackberry
- Sweet Briar

Precision control methods that minimise off-target kills (e.g. spot spraying) should be used in environmentally sensitive areas (e.g. within or near native vegetation, waterways, etc.).



### 6. Fauna Overview

#### **KEY FINDINGS**

Initial fauna assessments of the HWF site were done between 2011 and 2012 with additional targeted surveys for fauna in 2018 and 2019, focussing on species likely or with potential to occur based on desktop review of recent information.

The study site is highly modified and dominated by grazing and cropping land. EHP (2014) described seven fauna habitats across the study area, including; modified grassland, woodland and scattered trees, planted vegetation, rivers, creeks and drainage lines, swamps and marshes and artificial waterbodies. These were all found to be low, low-moderate or moderate in habitat quality.

The current review of existing information and online databases (EHP 2014, DELWP 2019, DAWE 2021a) found a total of 12 listed species under the EPBC Act and 10 additional species listed under the FFG Act were recorded, or their habitat was predicted to occur, in the search region (an area that extends 10km from the wind farm boundary). These totals exclude marine species and species that occur in strictly coastal habitats.

Listed fauna under the EPBC Act assessed as having the potential to occur within the search region included:

- Eight bird species listed as migratory, one of which is also critically endangered;
- Two bat species;
- One reptile; and
- One frog.

Listed fauna species under the FFG Act assessed as having the potential to occur within the search region included:

- Seven bird species;
- One bat species;
- One reptile species; and
- One invertebrate species.

Species listed under the EPBC Act considered likely to occur included:

- Migratory bird species: Common Greenshank, Curlew Sandpiper, Double-banded Plover, Fork-tailed Swift, Latham's Snipe, Red-necked Stint, Sharp-tailed Sandpiper and White-throated Needletail;
- Two listed threatened bat species: Grey-headed Flying-Fox and Southern Bent-wing Bat;
- One listed threatened reptile species: Striped Legless Lizard; and
- One listed threatened frog species: Growling Grass Frog.

Additional threatened fauna species listed only under the FFG Act considered likely to occur on the site included:

- Seven bird species: Australasian Shoveler, Black Falcon, Blue-billed Duck, Brolga, Freckled Duck, Hardhead and Musk Duck;
- One bat species: Yellow-bellied Sheathtail Bat;
- One reptile species: Tussock Skink; and
- One invertebrate species: Hairy Burrowing Crayfish.

Targeted surveys have been undertaken to determine the occurrence and current extent of listed species at the wind farm, including Bird Utilisation Surveys, migratory bird surveys, bat surveys,


Golden Sun Moth surveys and Growling Grass Frog habitat assessments. The methods and results of these surveys are described in later sections of this report.

Brolga impacts are considered in a separate report (Nature Advisory 2022).

# 6.1. Introduction

A combination of reviewing existing information and field assessments was undertaken to assess the potential impacts the proposed development may have on fauna species listed under the Commonwealth EPBC Act and Victorian FFG Act.

# 6.2. Existing information

Existing information used for this investigation is described below.

# 6.2.1. Existing reporting and documentation

The existing documentation below, relating to the study area was reviewed.

- Hexham Wind Farm Detailed Flora and Fauna Investigations. Prepared for Hexham Wind Farm Pty Ltd (EHP 2014).
- Best Practice Guidelines for Wind Energy Developments in Australia (CEC 2018)
- Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DEE 2017)
- DSE's Biodiversity Precinct Planning Kit (DSE 2010)
- EPBC Act survey guidelines for listed threatened fauna and various significant impact guidelines for listed species under the EPBC Act (DSEWPAC 2011a).

# 6.2.2. Listed Matters

The potential for occurrence in the study area and on the affected site access points of nationally threatened fauna species was obtained from the *EPBC Act* Protected Matters Search Tool (DAWE 2020). Records of fauna species for the area were obtained from the Victorian Biodiversity Atlas (VBA, DELWP 2020) along with bird species observations from BirdLife Australia's online data base; Birdata (BirdLife 2019). Records from previous surveys conducted by EHP (2014) were reviewed. Appendix 9 outlines species previously recorded within the radius of investigation. This report follows the VBA Fauna taxonomy and nomenclature, unless stated otherwise.

Existing information has been obtained from a wider area, termed the 'radius of investigation' defined for this assessment as the study area plus a 10-kilometre buffer area beyond its boundary.

An initial desktop review was undertaken in the period 2011 to 2012 to determine the likelihood of listed species occurring on the HWF site (EHP 2014). Databases searched included the Atlas of Victorian Wildlife (AVW – now the Victorian Biodiversity Atlas) and Birds Australia Atlas data. This initial analysis was considered and included in this up-to-date assessment

# 6.3. Field Assessment Methods

Several fauna assessments have been undertaken in the study area. Early surveys were undertaken by Ecology & Heritage Partners Pty Ltd (EHP 2014) from 2011 to 2012 then by Nature Advisory Pty Ltd from 2018 onwards. Fauna assessments undertaken at the HWF site are listed



below with a summary of the methods used. More detail is provided in subsequent sections of this report.

## 6.3.1. Bird utilisation survey

Bird utilisation surveys were undertaken across the study area using a fixed-point bird count method to characterise the use of the study area by the region's avifauna. Habitat assessments and roaming surveys were also undertaken across the study area. These surveys were undertaken on the dates listed below.

- 28<sup>th</sup> November 2<sup>nd</sup> December 2011
- 20<sup>th</sup> 22<sup>nd</sup> February 2012
- 29<sup>th</sup> October 2<sup>nd</sup> November 2018
- 4<sup>th</sup> March 8<sup>th</sup> March 2019

Full details of the bird utilisation surveys are provided in Section 7 of this report.

#### 6.3.2. Migratory bird survey

Wetlands in the study area and surrounding areas were visited during spring and summer, and wetlands were assessed for suitable foraging habitat for migratory shorebirds in accordance with the EPBC Act survey guidelines for migratory species (DoEE 2015). Surveys were undertaken on the dates listed below.

- 18<sup>th</sup> 20<sup>th</sup> December 2018
- 9<sup>th</sup> 11<sup>th</sup> January 2019
- 30<sup>th</sup> 31<sup>st</sup> January 2019
- 26<sup>th</sup> 28<sup>th</sup> February 2019
- 27<sup>th</sup> 29<sup>th</sup> February 2019.

Details of the methods and results of these surveys are presented in Section 8 of this report.

#### 6.3.3. Bat survey

Bat surveys were undertaken using ultrasonic bat detectors deployed remotely and recording the calls of bats that passed by them. Surveys were undertaken across the study area and immediately adjacent areas in a range of habitat types representative of the study area. The aim was to determine the location and levels of activity of the threatened bat species, such as the Southern Bent-wing Bat, listed as Critically Endangered under the EPBC Act and FFG Act and the Yellow-bellied Sheath-tail Bat, listed as vulnerable in Victoria under the FFG Act. Surveys were undertaken during the periods listed below.

- 21<sup>st</sup> October 23<sup>rd</sup> November 2010
- 10<sup>th</sup> February 31<sup>st</sup> March 2011
- 25<sup>th</sup> October 18<sup>th</sup> December 2018
- 5<sup>th</sup> February 25<sup>th</sup> April 2019
- 18<sup>th</sup> February 2020 1<sup>st</sup> May 2020.

Detectors were deployed across the HWF site to determine the spatial distribution of bats utilising the study area and specifically to detect movements of Southern Bent-wing Bat across the site. The surveys were intended to provide data on the composition of the general microbat community within the study area as well as resolving the status and distribution of the Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat on and near the site. The survey effort in 2019 was developed in consultation with DEWLP and implemented by the proponent. A total of over 3,776 detector nights



of survey were undertaken seasonally in five out of 11 years, significantly more than required for impact assessment at any other proposed wind farm site in Victoria.

In addition, targeted surveys were undertaken in February 2022 for the Grey-Headed Flying Fox. A zoologist undertook two dawn and dusk surveys to determine the presence, number and flight direction of Grey-headed Flying Foxes observed flying and feeding between the 14<sup>th</sup> and 16<sup>th</sup> February 2022.

While undertaking the dawn and dusk surveys, the observer scanned the sky looking for and listening for Grey-headed Flying Fox. The observer undertook visual searches of the area with their eyes, binoculars and when it became too dark to see GHFF with these, used thermal binoculars. Searches consisted of the observer scanning the sky from the horizon vertically and horizontally in all directions.

Full details are provided in Section 9 of this report.

# 6.3.4. Growling Grass Frog habitat

A survey to map suitable habitat for the Growling Grass Frog was undertaken across the study areas, checking all wetlands and waterways. Habitat mapping was used to inform the layout of the wind farm to ensure suitable habitats were avoided wherever possible. Habitat assessments were undertaken on the dates listed below.

- 21<sup>st</sup> 24<sup>th</sup> November 2011
- 13<sup>th</sup> 28<sup>th</sup> November 2018

Full details of this work are presented in Section 10 of this report.

6.3.5. Other fauna surveys

#### Fish survey

Native freshwater fish surveys were undertaken using fyke nets, dip netting, and collapsible bait traps. No electrofishing was used due to high water salinity at all survey sites. The aquatic survey was undertaken during the following dates.

21<sup>st</sup> – 24<sup>th</sup> November 2011.

# Golden Sun Moth habitat surveys

Golden Sun Moth habitat surveys were undertaken during the following dates.

- 16<sup>th</sup> and 19<sup>th</sup> December 2011
- 6<sup>th</sup> January 2012.

# 6.4. Results

# 6.4.1. Review of existing information

The review of existing information (including VBA records and the results of the EPBC Protected Matters Search Tool) indicated that within the search region there were records of, or there occurred potential suitable habitat for 22 fauna species listed under the Commonwealth EPBC Act and/or the state FFG Act. The likelihood of occurrence of these species in the investigation area was assessed and the results are presented in Table 7.

This analysis of potential occurrence of listed fauna species excludes:

Marine fauna given that the investigation area is inland



 Migratory oceanic bird species (such as albatrosses and petrels) and migratory shorebirds given that the investigation area is inland.

Species considered 'likely to occur' are those that have a very high chance of being in the investigation area given the existence of numerous records in the search region and suitable habitat in the investigation area. Using the precautionary approach, species considered to have the 'potential to occur' are those where suitable habitats exists, but recent records are scarce. Nature Advisory undertook additional investigations to provide updated information on listed fauna species. Initial desktop investigations indicated that a total of 25 listed species under the EPBC Act and/or under the FFG Act had been recorded historically or had suitable habitat modelled in the search region. These totals exclude marine species and species that occur in strictly coastal habitats. The list under consideration also excluded FFG Act-listed species that were not recorded in the search region since January 1980.

#### 6.4.2. Fauna Species

#### Species recorded

During this and previous field assessments (EHP 2014); a combined 121 fauna species were recorded in total. This included 101 bird (five introduced), two mammals (none introduced), one reptile, four frog and three invertebrate species (Appendix 9). These numbers include targeted surveys and incidental records.

#### Listed fauna species

This analysis indicates that 12 listed fauna species listed under the EPBC Act are likely to occur or have the potential to occur.

Listed fauna under the EPBC Act that are considered to have potential or are likely to occur in the search region included:

- Eight bird species listed as migratory, one of which is also critically endangered;
- Two bat species;
- One reptile; and
- One frog.

An additional 10 species listed (only) under the FFG Act are considered to have potential or are likely to occur in the search region included:

- Seven bird species;
- One bat species;
- One reptile species; and
- One invertebrate species.

Table 7 presents the likelihood of occurrence of listed species with the potential to occur within the study area. This assessment considers the suitability of habitat on site and recent records of each species in the search region.

#### EPBC Act listed species

Species listed under the EPBC Act assessed as having the potential to occur are listed below.

#### Migratory Birds

Common Greenshank (*Tringa nebularia*)



- Curlew Sandpiper (*Calidris ferruginea*)
- Double-banded Plover (Charadrius bicinctus)
- Fork-tailed Swift (Apus pacificus)
- Latham's Snipe (Gallinago hardwickii)
- Red-necked Stint (*Calidris ruficollis*)
- Sharp-tailed Sandpiper (Calidris acuminata)
- White-throated Needletail (*Hirundapus caudacutus*).

#### Bats

- Grey-headed Flying-Fox (*Pteropus poliocephalus*)
- Southern Bent-wing Bat (Miniopterus orianae bassanii).

#### Reptiles

• Striped Legless Lizard (Delma impar)

#### Amphibians

• Growling Grass Frog (Litoria raniformis).

#### FFG Act listed species

Additional to those listed under the EPBC Act above, species listed under the FFG Act assessed as having the potential to occur are listed below.

#### Birds

- Australasian Shoveler (Anas rhynchotis),
- Black Falcon (Falco subniger),
- Blue-billed Duck (Oxyura australis),
- Brolga (Grus rubicunda),
- Freckled Duck (Stictonetta naevosa)
- Hardhead (Aythya australis)
- Musk Duck (Biziura lobata)

#### Bats

Yellow-bellied Sheathtail Bat (Saccolaimus flaviventris)

#### Reptiles

Tussock Skink (Pseudemoia pagenstecheri)

#### Invertebrates

Hairy Burrowing Crayfish (Engaeus sericatus)

#### **DELWP** listed species

An additional seven species having the potential to occur are listed under the DEWLP advisory list:

- Emu (Dromaius novaehollandiae)
- Nankeen Night-heron (Nycticorax caledonicus)
- Royal Spoonbill (Platalea regia)
- Spotted Harrier (*Circus assimilis*)
- Whiskered Tern (Chlidonias hybridus)
- Fat-tailed Dunnart (Sminthopsis crassicaudata)



Eastern Snake-necked Turtle (Chelodina longicollis)



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# Table 7: Listed fauna species from the search region and likelihood of occurrence in the investigation area

Common Name	Scientific Name	EPBC-thrt	EPBC-mig	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
					Birds			
Australasian Bittern	Botaurus poiciloptilus	EN		CR	Terrestrial wetlands, including a range of wetland types but prefers permanent water bodies with tall dense vegetation, particularly those dominated by sedges, rush, reeds or cutting grass (Marchant & Higgins 1990).	None	N/A	Unsuitable habitat, lack of records - <b>Unlikely to occur</b>
Australasian Shoveler	Spatula rhynchotis			VU	Large and deep permanent bodies of water and aquatic flora abundant. Also occurs on billabongs, watercourses and flood waters on alluvial plains, freshwater meadows, shallow swamps, reed swamps, wooded lakes, sewage farms and farm dams (Marchant and Higgins 1990).	45	23/11/2018	Recorded in study area during surveys - Likely to occur
Australian Bustard	Ardeotis australis			CR	Inhabits mainly grasslands, low shrublands and lightly timbered open woodlands (Marchant & Higgins 1993).	1	23/06/1876	Regionally extinct - Unlikely to occur
Australian Painted-snipe	Rostratula australis	EN		CR	Generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass or sometimes tea-tree (Melaleuca). Sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (DoEE 2019).	None	N/A	Most suitable habitat present in the study area has been drained - <b>unlikely to occur</b>
Black Falcon	Falco subniger			CR	Woodlands, open country and terrestrial wetlands; in arid and semi-arid zones; mainly over open plains and undulating land with large tracts of low vegetation. It is more commonly found in north-western Victoria and is only occasionally found in southern Victoria. It is a highly mobile species, moving in response to food availability and seasonal conditions. (Marchant and Higgins 1993).	2	28/11/2011	Recorded during EHP (2014) surveys - <b>Likely to occur</b>
Blue-billed Duck	Oxyura australis			VU	Terrestrial wetlands and prefers deep permanent, well vegetated water bodies (Marchant & Higgins 1990).	7	22/11/2018	Recorded in study area during BL&A surveys - Likely to occur
Brolga	Grus rubicunda			EN	Wetlands that include permanent open water and deep freshwater marsh. Between 500 and 700 Brolgas are known to occur in southwestern Victoria. (Marchant & Higgins 1993).	75	31/10/2018	Recorded in study area during BL&A surveys - Likely to occur
Common Greenshank	Tringa nebularia		M (Bonn A2H, ROKAMBA, JAMBA, CAMBA)	EN	Inhabits wide range of coastal or inland wetlands with varying levels of salinity; mainly muddy margins or rocky shores of wetlands (Higgins & Davies 1996).	6	2/10/2018	Recorded incidentally during surveys - Likely to occur
Common Sandpiper	Actitis hypoleucos		M (Bonn A2H, JAMBA, CAMBA)	VU	Inhabits a wide range of coastal or inland wetlands with varying levels of salinity; mainly muddy margins or rocky shores of wetlands. In Vic. Mostly found Westernport and Port Phillip Bay. (Higgins & Davies 1996).	None	N/A	Unsuitable habitat - Unlikely to occur



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Common Name	Scientific Name	EPBC-thrt	EPBC-mig	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Curlew Sandpiper	Calidris ferruginea	CR	M (Bonn A2H, ROKAMBA, JAMBA, CAMBA)	CE	Inhabits wide range of coastal or inland wetlands with varying levels of salinity; mainly muddy margins or rocky shores of wetlands (Higgins & Davies 1996).	2	5/02/1988	Suitable habitat in wetlands - Potential to occur
Double-banded Plover	Charadrius bicinctus		M (Bonn A2H)		Inhabits wide range of coastal or inland wetlands with varying levels of salinity; mainly muddy margins or rocky shores of wetlands (Marchant & Higgins 1993).	2	2/10/2018	Recorded incidentally during BL&A surveys - Likely to occur
Eastern Curlew	Numenius madagascariensis	CR	M (Bonn A1, ROKAMBA, JAMBA, CAMBA)	CR	Inhabits sheltered coasts, especially estuaries, embayment, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats, often with beds of sea grass (Higgins & Davies 1996).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
Fork-tailed Swift	Apus pacificus		M (CAMBA, ROKAMBA, JAMBA)		The species can occur in wet sclerophyll forest but mainly prefers open forest or plains. It is almost exclusively aerial and feeds up to hundreds on metres above the ground, but can feed among open forest canopy. The species breeds internationally and seldom roosts in trees (Higgins et al 2006b).	None	N/A	Potential to fly over site - Potential to occur
Freckled Duck	Stictonetta naevosa			EN	Terrestrial wetlands; prefer fresh, densely vegetated waters, particularly floodwater swamps and creeks vegetated with lignum or cane grass. During dry seasons or droughts, move off ephemeral breeding swamps and occupy large permanent waters (Marchant & Higgins 1990).	5	8/5/2019	Suitable habitat in wetlands - Potential to occur
Grey Falcon	Falco hypoleucos	VU		VU	Inhabits arid and semi-arid zones; mainly on sandy and stony plains of inland drainage systems, lightly timbered with acacia. Hunt far into open areas, over spinifex, tussock grasslands and low shrublands. In Victoria, few records mostly in north and northwestern regions (Marchant & Higgins 1993).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
Grey Goshawk	Accipiter novaehollandiae			EN	Inhabit rainforests, open forests, swamp forests, woodlands and plantations; most abundant where forest or woodland provide cover for hunting from perches. in Vic., most common in Otway ranges. (Marchant & Higgins 1993).	1	14/09/1994	Unsuitable habitat - <b>Unlikely to occur</b>
Hardhead	Aythya australis			VU	Inhabits large, deep waters where vegetation is abundant; particularly deep swamps and lakes, pools and creeks. Also occur on freshwater meadows, seasonal swamps with abundant aquatic flora, reed swamps, wooded lakes and swamps, rice fields, and sewage ponds (Marchant and Higgins 1990).	53	5/1/2019	Recorded in study area during surveys - <b>Likely to occur</b>



Common Name	Scientific Name	EPBC-thrt	EPBC-mig	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Latham's Snipe	Gallinago hardwickii		M (Bonn A2H, ROKAMBA, JAMBA, CAMBA)		Occurs in wide variety of permanent and ephemeral wetlands; it prefers open freshwater wetlands with dense cover nearby, such as the edges of rivers and creeks, bogs, swamps, waterholes. The species is wide spread in southeast Australia and most of its population occurs in Vic. Except in the northwest of the state. (Naarding 1983; Higgins and Davies 1996).	2	2/10/2018	Recorded incidentally during surveys - Likely to occur
Magpie Goose	Anseranas semipalmata			VU	Terrestrial and aquatic habitats, but activities centered on wetlands, mainly those on floodplains of rivers (Marchant & Higgins 1990).	1	14/09/1988	Unsuitable habitat, few records - Unlikely to occur
Musk Duck	Biziura lobata			VU	It inhabits terrestrial wetlands, estuarine habitats and sheltered inland waters. Almost entirely aquatic; preferring deep water of large swamps, lakes and estuaries, where conditions are stable and aquatic flora abundant (Marchant & Higgins 1990).	14	25/10/2018	Recorded in study area during surveys - Likely to occur
Osprey	Pandion cristatus		M (Bonn A2S)		<ul> <li>Rare vagrant to Victoria (Marchant &amp; Higgins 1993). Littoral and coastal habitats and terrestrial wetlands. They are mostly found in coastal areas but occasionally travel inland along major rivers (Johnstone &amp; Storr 1998; Marchant &amp; Higgins 1993; Olsen 1995). They require extensive areas of open fresh, brackish or saline water for foraging (Marchant &amp; Higgins 1993).</li> </ul>	None	N/A	Unsuitable habitat, coastal, no records - <b>Unlikely to occur</b>
Painted Honeyeater	Grantiella picta	VU		VU	Inhabits box-ironbark forests and woodlands and mainly feeds on the fruits of mistletoe. Strongly associated with mistletoe around the margins of open forests and woodlands. Occurs at few localities. Uncommon breeding migrant from further north, arriving in October and leaving in February. (Higgins et al. 2001; Tzaros 2005).	None	N/A	Unsuitable habitat, no records - <b>Unlikely to occur</b>
Pectoral Sandpiper	Calidris melanotos		M (Bonn A2H, ROKAMBA, JAMBA)		Inhabit shallow fresh to saline wetlands, usually coastal to near-coastal, but occasionally farther inland. Wetlands often have open fringing mudflats and low emergent or fringing vegetation (Higgins & Davies 1996).	None	N/A	Unsuitable habitat, no records - <b>Unlikely to occur</b>
Plains-wanderer	Pedionomus torquatus	CR		CR	This species inhabits native grasslands with sparse cover, preferring grasslands that include wallaby grass and spear grass species (Marchant & Higgins 1993).	None	N/A	Unsuitable habitat - Unlikely to occur
Red-necked Stint	Calidris ruficollis		M (Bonn A2H, ROKAMBA, JAMBA, CAMBA)		Inhabit shallow fresh to saline wetlands, usually coastal to near-coastal, but occasionally farther inland. Wetlands often have open fringing mudflats and low emergent or fringing vegetation (Higgins & Davies 1996).	2	28/11/2011	Suitable habitat in wetlands - Potential to occur
Rufous Fantail	Rhipidura rufifrons		M (Bonn A2H)		In east and south-east Australia, mainly inhabits tall wet sclerophyll forests, often in gullies. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, as well as parks and gardens (Higgins et al. 2006).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
Satin Flycatcher	Myiagra cyanoleuca		M (Bonn A2H)		Tall forests and woodlands in wetter habitats but not in rainforest (Higgins et al. 2006)	None	N/A	Unsuitable habitat - Unlikely to occur
Sharp-tailed Sandpiper	Calidris acuminata		M (Bonn A2H, ROKAMBA, JAMBA, CAMBA)		Inhabit shallow fresh to saline wetlands, usually coastal to near-coastal, but occasionally farther inland. Wetlands often have open fringing mudflats and low emergent or fringing vegetation (Higgins & Davies 1996).	50	24/10/2018	Recorded in study area during surveys - Likely to occur



Common Name	Scientific Name	EPBC-thrt	EPBC-mig	FFG	Habitat	Number of	Date of last record	Likelihood of occurrence
Swift Parrot	Lathamus discolor	CR		CR	Prefers a narrow range of eucalypts in Victoria, including White Box, Red Ironbark and Yellow Gum as well as River Red Gum when this species supports abundant 'lerp'. Breeds in Tasmania and migrates to the mainland of Australia for the autumn, winter and early spring months. It lives mostly north of the Great Dividing Range, passing through two areas of Victoria on migration: the Port Phillip district and Gippsland. (Emison et al. 1987; Higgins 1999; Kennedy and Tzaros 2005).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
White-throated Needletail	Hirundapus caudacutus		M (CAMBA, ROKAMBA, JAMBA)	VU	Aerial, over all habitats, but probably more over wooded areas, including open forest and rainforest. Often over heathland and less often above treeless areas such as grassland and swamps or farmland (Higgins 1999).	None	N/A	Potential to fly over site - Potential to occur
Yellow Wagtail	Motacilla flava		M (JAMBA, CAMBA, ROKAMBA)		Extremely uncommon migrant. Few sightings in Victoria. Mostly occurs in well- watered open grasslands on the fringes of wetlands. Roosts in mangroves and other dense vegetation (DoEE 201X).	None	N/A	Rare vagrant <b>Unlikely to occur</b>
					Mammals			
Eastern Barred Bandicoot	Perameles gunnii	EN		EN	The habitat of the Eastern Barred Bandicoot (mainland) is perennial tussock grassland and eucalypt woodland with a grassy ground layer (Dufty 1994b; Seebeck 1995a, 2001). Drainage lines and areas of high vegetative cover have been identified as prime habitat. The key determining factor for persistence of this species appears to be high structural complexity and heterogeneity within the environment, reflected in its absence from agricultural areas but persistence in rubbish dumps and other variable habitats	5	14/08/1997	Regionally extinct - <b>Unlikely to occur</b>
Long-nosed Potoroo	Potorous tridactylus trisulcatus	VU		VU	in Victoria coastal heathy woodland; in Tasmania moist forest with dense shrub layer; in the north edge of rainforest (Menkhorst 1995).	None	N/A	Unsuitable habitat - Unlikely to occur
Southern Brown Bandicoot	lsoodon obesulus obesulus	EN		EN	Species experts define suitable habitat for Southern Brown Bandicoots (eastern) to be any patches of native or exotic vegetation, within their distribution, which contains understorey vegetation structure with 50–80% average foliage density in the 0.2–1 m height range. In areas where native habitats have been degraded or diminished, exotic vegetation, such as Blackberry (Rubus spp.), can and often does, provide important habitat (DoEE 2020).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
Spot-tailed Quoll	Dasyurus maculatus maculatus	EN		EN	Rainforest, wet and dry forest, coastal heath and scrub and River Red-gum woodlands along inland rivers (Menkhorst 1995).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
Swamp Antechinus	Antechinus minimus maritimus	VU		VU	Dense wet heath, tussock grassland, sedgeland heathy woodland and coastal heath and scrub (Menkhorst 1995).	None	N/A	Unsuitable habitat - Unlikely to occur
Southern Bent-wing Bat	Pseudophryne semimarmorata	CR		CR	Damp areas in forests and woodlands (Cogger 2000).	13	26/04/1979	Recorded during bat surveys - does occur
Grey-headed Flying- fox	Pteropus poliocephalus	EN		EN	Roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast. Roost vegetation includes rainforest patches, stands of Melaleuca, mangroves and riparian vegetation, but colonies also use highly modified vegetation in urban and suburban areas (DoEE 2019). A 'satellite camp' (small temporary roosting colony) was	1	27/2/2019	Recent records in the region and recorded - <b>does occur</b>



Common Name	Scientific Name	EPBC-thrt	EPBC-mig	FFG	Habitat		Date of last record	Likelihood of occurrence
					observed in the region on private property near Cobra Kullic reserve in 2018 (Nature Advisory unpub. data).	records		
Yellow-bellied Sheathtail Bat	Saccolaimus flaviventris			VU	Known to occur from urban, agricultural semi-arid and tall wet forest habitats (Menkhorst 1995).	24	17/12/2018	Recorded during bat surveys – <b>does occur</b>
					Reptiles			
Corangamite Water Skink	Eulamprus tympanum marnieae	EN		EN	Found in grassy open woodland and cleared pastures dotted with ephemeral swamps and lakes, on rocky basaltic soils. The preferred habitat is a geographically peculiar landform comprising basalt ridges and boulder heaps resulting from the collapse of lava tunnels (DoEE 201X).	None	N/A	Unsuitable habitat - <b>Unlikely to occur</b>
Striped Legless Lizard	Delma impar	VU		EN	Grassland specialist. Known to occur in some areas dominated by introduced species such as Phalaris aquatica, Serated Tussock (Nasella trichotoma) and Hypocharis radicata and at sites with a history of grazing and pasture improvement. Shelter in grass tussocks, thick ground cover, soil cracks, under rocks, spider burrows, and under debris such as timber. The majority of sites in Victoria and NSW occur on cracking clay soils with some surface rock which provide shelter for the species (DoEE 2020).	58	15/11/2013	Some suitable habitat may occur, specifically in road reserves - <b>Potential to occur</b>
Tussock Skink	Pseudemoia pagenstecheri			EN	Tussock grasslands with few or no trees (Wilson & Swan 2003).	67	18/11/2010	Some suitable habitat may occur, specifically in road reserves - <b>Potential to occur</b>
					Fish			
Australian Grayling	Prototroctes maraena	VU		EN	Large and small coastal streams and rivers with cool, clear waters with a gravel substrate and altering pools and riffles (Cadwallader & Backhouse 1983).	1	1/01/1981	Some suitable habitat but not detected during targeted surveys - <b>Unlikely to occur</b>
Dwarf Galaxis	Galaxiella pusilla	VU		EN	Barwon River to Mitchell River. Vegetated margins of still water, ditches, swamps and backwaters of creeks, both ephemeral and permanent (Allen et al. 2002).	None	N/A	Some suitable habitat but not detected during targeted surveys - <b>Unlikely to occur</b>
Little Galaxias	Galaxiella toourtkoourt			EN	Occurs in clear pool of small, flowing streams around rocks or logs (Allen et al. 2002).	6	12/06/2008	Some suitable habitat but not detected during targeted surveys - <b>Unlikely to occur</b>
Macquarie Perch	Macquaria australasica	EN		EN	Cool, clear water of rivers and lakes. Favours slower moving water (Allen et al. 2002).	3	1/12/1920	Some suitable habitat but not detected during targeted surveys - Unlikely to occur
Murray Cod	Maccullochella peelii	VU		EN	Slow flowing turbid water of rivers and streams of low elevation; also fast flowing clear upland streams (Allen et al. 2002).	None	N/A	Unsuitable habitat - Unlikely to occur



Common Name	Scientific Name	EPBC-thrt	EPBC-mig	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Yarra Pygmy Perch	Nannoperca obscura	VU		VU	Streams and small lakes, prefers flowing water with abundant aquatic vegetation (Allen et al. 2002).	10	15/11/2007	Some suitable habitat but not detected during targeted surveys - <b>Unlikely to occur</b>
					Amphibians			
Brown Toadlet	Pseudophryne bibronii			EN	Wet and dry forest, grassy areas besides small creeks, alpine grasslands and mossy bogs (Cogger 2000).	3	18/05/1962	Unsuitable habitat - <b>Unlikely to occur</b>
Growling Grass Frog	Litoria raniformis	VU		VU	Permanent, still or slow flowing water with fringing and emergent vegetation in streams, swamps, lagoons and artificial wetlands such as farm dams and abandoned quarries (Clemann & Gillespie 2004).	14	19/11/2018	Heard calling in study area during surveys - <b>Likely to occur</b>
Southern Toadlet	Pseudophryne semimarmorata			EN	Damp areas in forests and woodlands (Cogger 2000).	13	26/04/1979	Unsuitable habitat - <b>Unlikely to occur</b>
					Invertebrates			
Hairy Burrowing Crayfish	Engaeus sericatus			VU	Banks of creeks, rivers and roadside drains. Can be found in low lying pastoral areas and flood plains. Presence can be detected by small chimney structures along these habitats (NatureGelelgtrust 2019)	7	1/01/2008	Suitable habitat present - Potential to occur
Golden Sun Moth	Synemon plana	CR		VU	Areas that are, or have been native grasslands or grassy woodlands. It is known to inhabit degraded grasslands with introduced grasses being dominant, with a preference for the native wallaby grass being present (DEWHA 2009).	6	21/12/2009	Suitable habitat occurs, Not detected during EHP (2014) targeted surveys - Unlikely to occur

Notes:

**EPBC-T** = threatened species status under EPBC Act; EX = presumed extinct in the wild; CR = critically endangered; EN = endangered; VU = vulnerable;

**EPBC-M** = migratory status under the EPBC Act; M = listed migratory taxa; Bonn Convention (A2H) - Convention on the Conservation of Migratory Species of Wild Animals – listed as a member of a family; Bonn Convention (A2S) - Convention on the Conservation of Migratory Species of Wild Animals – listed as a member of a family; Bonn Convention (A2S) - Convention on the Conservation of Migratory Species of Wild Animals – listed as a member of a family; Bonn Convention (A2S) - Convention on the Conservation of Migratory Species of Wild Animals – species listed explicitly; CAMBA - China- Australia Migratory Birds Agreement; JAMBA - Japan-Australia Migratory Birds Agreement; Brfg = threatened species status under the FFG Act; ; CR = critically endangered; EN = endangered; VU = vulnerable



# 6.5. Impacts and Implications

This section investigates any potential risks to listed fauna species posed by the construction and operation of the Hexham Wind Farm.

6.5.1. Potential impacts on fauna

The construction and operation of the Hexham Wind Farm may have the following impacts on fauna species:

- Direct removal of fauna habitat;
- Indirect alteration to habitat from runoff from construction areas into adjacent habitat;
- Indirect disturbance to fauna inhabiting the site during construction and operations;
- Direct mortality due to collision with construction traffic and/or construction activities; and
- Direct mortality of birds and bats due to collision with operating turbines.

The total area of the HWF site is 16,104 hectares, and the proposed development footprint consists of 421.54 hectares (ha), which is 2.6% of the Site. The assessment of native vegetation removal indicated that 4.977 hectares of native vegetation would be removed. As the development footprint has been derived in accordance with the 'avoid' and 'minimise' principles, the bulk of the best grassland and wetland habitat remaining on the site for native fauna has been avoided and will be retained.

The impact on the local population on any grassland-dependent fauna is therefore likely to be limited and these populations will persist in the remaining areas of grassland habitat.

Construction activities have the potential to degrade the quality of adjacent grassland habitat, as well as contribute sediment-laden runoff to nearby wetlands and/or waterways if not properly managed.

During construction, vehicle movements, human activity and noise will increase significantly. This has the potential to disturb native fauna. As most activity will occur during daylight hours, nocturnal fauna are not expected to be disrupted significantly near works areas. During daylight hours, a small proportion of grassland habitat on the site will experience indirect disturbance and some mobile fauna species may be deterred from using these areas. Once construction is complete, the lower level of vehicle traffic and human activity associated with operating the completed wind farm is considered unlikely to disturb fauna in adjacent habitats persistently. As construction is temporary and intermittent (estimated to last for short periods at any one works site within the longer project construction period), and operational activity is at a very low level, long-term exclusion of fauna from these disturbed areas is not anticipated.

Disturbance and behavioural changes in fauna can come about through increased light and noise permeating into ecosystems (Gaston *et. al.* 2015). The latter can result in a wide range of behavioural changes in fauna, which can in turn effect breeding and foraging success (Jakob-Hoff *et. al.* 2019, Shannon *et. al.* 2016). Typically, animals will habituate to regular noise. Compared with chronic background or repetitive noise, unpredictable noise can provoke distress responses in animals (Broucek 2014). Noise from wind turbines is usually continuous and does not vary suddenly. Habituation may occur within individuals and reduce physiological responses to environmental stress over time (Iskasson 2015). Unfortunately, members of species that are less adaptable or naturally timid in temperament are likely to be disadvantaged in high-disturbance



environments (Lowry *et. al.* 2013). Therefore, it is likely that fauna in adjacent habitats will not be significantly disturbed by this.

Collision with turbines poses a risk to many bird and bat species at operating wind farms and should be assessed and mitigated for any species considered at risk

Impacts to listed fauna considered as having the potential to occur in the study area are discussed below.

#### Birds

Five listed non-migratory bird species are considered to have the potential to occur in the investigation area. The susceptibility of these species to possible impacts from any development in the investigation area is discussed below.

• Australasian Shoveler (FFG Act vulnerable)

This species was recorded by Nature Advisory as occurring on site. It prefers large and deep permanent bodies of water and with abundant aquatic flora, but can also occur on billabongs, watercourses and flood waters on alluvial plains, freshwater meadows, shallow swamps, reed swamps, wooded lakes, sewage farms and farm dams. This species could be impacted through habitat loss.

Black Falcon (FFG Act critically endangered)

This species is an uncommon visitor to parts of southern Victoria and its occurrence on site is expected to be very infrequent. Impacts to this species are considered as unlikely from any source, with the exception of the potential for collision with turbine blades once the wind farm is operational. Collisions of Black Falcon have occurred at wind farms within the species range in NSW (Nature Advisory unpub. data).

The foraging behaviour of raptor species puts them at risk with collision above other bird groups. However, as this species is considered to occur in the area only irregularly collisions would be expected to be highly infrequent.

Blue-billed Duck (FFG Act vulnerable)

This species was recorded by Nature Advisory as occurring on site. It prefers well vegetated and deep-water wetland habitats and is almost entirely aquatic, rarely appearing on land. This species may be impacted through changes to, or loss of wetland habitat, disturbance and operation of turbines.

Brolga (FFG Act endangered)

Brolga were recorded in the study area during previous and recent survey. They may be susceptible to impacts from loss of habitat, habitat alterations, disturbance and direct mortality pre and post construction.

Analysis of these impacts and associated mitigation measures and other recommendations are considered in a separate dedicated report focussing on Brolgas in relation to Hexham Wind Farm.

Freckled Duck (FFG Act endangered)

This species prefers heavily vegetated wetlands containing species such as Cumbungi. Such habitat was not observed in the study area and so it is not expected to utilise habitat for breeding or foraging, but recent records indicate that they may occasionally utilise the area.

Impacts from wind farm related activities may arise from changes to, or loss of wetland habitat, disturbance and operation of turbines.



#### • Hardhead (FFG Act vulnerable)

Hardhead has been recorded in the radius of investigation and has the potential to occur in the study area due to the presence of suitable wetland habitat. This species inhabits large, deep waters where vegetation is abundant; particularly deep swamps and lakes, pools and creeks. It is unlikely that this species occurs regularly or in significant numbers due to the limited extent and quality of wetland habitats within the study area.

Impacts from wind farm related activities may arise from changes to, or loss of wetland habitat, disturbance and operation of turbines.

Musk Duck (FFG Act vulnerable)

The Musk Duck has been recorded in the radius of investigation and has the potential to occur in the study area. It inhabits terrestrial wetlands, estuarine habitats and sheltered inland waters. It is almost entirely aquatic and prefers deep water of large swamps, lakes and estuaries, where conditions are stable and aquatic flora abundant.

Impacts from wind farm related activities may arise from changes to, or loss of wetland habitat, disturbance and operation of turbines.

#### Migratory Birds

Eight listed migratory bird species (excluding oceanic species and shorebirds) have the potential to occur in the investigation area. The susceptibility of these species to possible impacts from any development in the investigation area is discussed below.

White-throated Needletail (Vulnerable, Migratory – EPBC Act)

The White-throated Needletail is an aerial bird species that spends most of its life on the wing. This species is often observed in south-eastern Australia in the summer, flying ahead of storm fronts, feeding on flying insects. No needletails were observed during Bird Utilisation Surveys (BUS) in summer and early autumn, a time when activity over Victoria is thought to be at its peak, indicating that the habitat on the site is unlikely to represent important habitat for a significant proportion of the population for any length of time. The species occurs more frequently over forested areas in Australia (Higgins 1999) and the lack of forested vegetation or extensive planted treed areas indicates that the habitat is not the preferred type for this species. Therefore, impacts from disturbance, habitat loss or changes are not expected.

Notwithstanding this, at wind farms elsewhere (Nature Advisory unpub. data) the species has been repeatedly recorded colliding with operating wind turbines in small numbers and the operation of Hexham Wind Farm will pose a risk of collision with turbines to the species.

Fork-tailed Swift (Migratory – EPBC Act)

An aerial bird species that spends most of its life on the wing. Therefore, impacts from disturbance, habitat loss or changes are not expected. The Fork-tailed Swift often flies at rotor swept area heights and as such may be at risk of collision with operating turbines. Fork-tailed Swift is a more abundant and widespread bird than the White-throated Needletail and its population numbers as high as 100,000 (DoEE 2015) and is rarely recorded colliding with wind turbines (Nature Advisory, unpub. data).

Migratory wetland species listed below are discussed separately in Section 8.

- Common Greenshank (Migratory EPBC Act)
- Curlew Sandpiper (Critically endangered, Migratory EPBC Act)
- Double-banded Plover (Migratory EPBC Act)



- Latham's Snipe (Migratory EPBC Act)
- Red-necked Stint (Migratory EPBC Act)
- Sharp-tailed Sandpiper (Migratory EPBC Act)

#### Frogs

One listed frog species is considered to have the potential to occur in the investigation area. The susceptibility of these species to possible impacts from any development in the investigation area is discussed below.

Growling Grass Frog (Vulnerable – EPBC Act, FFG Act vulnerable)

The Growling Grass Frog is a nocturnal ambush predator and is unlikely to forage more than 100 metres from the waterline of wetlands (Heard et al. 2008). It was recorded as calling during surveys and it may occur in a variety of the aquatic habitats throughout the study area.

Possible impacts on the Growling Grass Frog from the proposed wind farm may arise through, aquatic habitat changes or loss, disturbance and direct mortality.

This species and any impacts are explored further in Section 10.

#### Bats

Three listed bat species are considered to have the potential to occur in the investigation area. The susceptibility of these species to possible impacts from any development in the investigation area is discussed below.

Southern Bent-wing Bat (Critically endangered – EPBC Act, FFG Act critically endangered)

This species was recorded on site during bat utilisation surveys (Section 9) and is an obligate cave dweller occurring across south western Victoria and eastern South Australia. It is unlikely to be impacted by habitat loss or change or disturbance but recent mortalities have been recorded through collision with operating turbines in Victoria and so is at some risk of collision.

This species and associated impacts are explored further in Section 9.4.

• Grey Headed Flying-fox (endangered – EPBC Act, FFG Act endangered)

There are very few records of this species in the region and the nearest confirmed permanent roost is situated in the Warrnambool Botanic Gardens, approximately 35 km south. The colony hosts around 500 individuals on average which leave to forage in the surrounding region, though the proposed wind farm area is likely beyond their nightly foraging range. The species are considered to be capable of long-distance movements to new colonies throughout the entirety of their range, which extends from Victoria to Queensland. The habitat of the study area is generally not considered preferable to the species so they would be unlikely to occur regularly, however Nature Advisory identified a small temporary camp while undertaking investigations for another wind farm in the region in 2018. These camps form when temporary foraging resources in an area become available, such as the blossoming of Eucalyptus trees which would provide nectar for the species to feed on. The species will move in and 'camp' temporarily while the resources are available and then move on when they are depleted. Such a temporary camp was located south of the Cobra Kulic reserve approximately 17 kilometres north-east of the proposed wind farm.

Grey-headed Flying Fox have been recorded in small numbers (5-10 individuals) during targeted surveys in February 2022. This survey was undertaken after DELWP indicated a camp with a large number of Flying Foxes may be located within 2km of the wind farm site.



This survey confirms the presence of this species and the location of a camp is assumed within a plantation to the east of the proposed wind farm site, south of Hamilton Highway. Further studies will be undertaken in March 2022, when the majority of Flying Foxes are expected to arrive at the site based on information of a local resident.

Impacts from disturbance are unlikely but may arise from habitat loss through the removal of foraging resources such as large numbers of flowering trees. Grey Headed Flying-foxes may collide with turbines if passing through or utilising habitat in the area and the wind farm might pose such a risk, if further temporary camps were to occur in the region regularly. Mitigation measures will be developed based on the results of further investigations.

• Yellow-bellied Sheathtail Bat (FFG Act vulnerable)

Inhabiting a range of habitats across a large area of occurrence, this species was confirmed in the study area during surveys. Thought to be partially migratory within Australia with its range contracts to warmer, northern areas of northern NSW and Queensland during the colder months, its appearance in the area is likely to be limited to the warmer months in Victoria. It is unlikely to be impacted by disturbance, however the species utilises hollows and any removal of hollow bearing trees may impact the species. The species is known to collide with turbines (Nature Advisory unpub. data) at wind farms in south-eastern Australia and collision is a risk for this species.

This species and associated impacts are explored further in Section 9.4.

#### Reptiles

• Striped Legless Lizard (vulnerable – EPBC Act, FFG Act endangered)

Suitable habitat for this species was recorded socially within patches of Plains Grassland within road sides of Woolsthorpe-Hexham Road and Hexham-Ballangeigh Road. No targeted surveys have been undertaken based on early advice from the Department of Environment and Primary Industry (DEPI) to assume presence within suitable habitat (EHP 2014).

Impacts to this species could occur though the removal of suitable grassland habitat within road reserves due to required road widening in some areas.

Tussock Skink (FFG Act endangered)

Suitable habitat for this species may occur within tussock grasslands of road reserves.

Impacts to this species could occur though the removal of suitable grassland habitat within road reserves due to required road widening in some areas.

#### Fish

- Australian Grayling (vulnerable EPBC Act, FFG Act endangered)
- Yarra Pygmy Perch (vulnerable EPBC Act, FFG Act vulnerable)
- Dwarf Galaxias (vulnerable EPBC Act, FFG Act endangered)

Targeted surveys for these species were undertaken by EHP from 21 to 24 November 2011 using bait traps and fyke nets set overnight as well as active searches through dip netting within suitable habitat (EHP 2014). None of these species were recorded.

#### Invertebrates

• Golden Sun Moth (vulnerable – EPBC Act, FFG Act vulnerable)

EHP undertook targeted Golden Sun Moth surveys in December 2011 and January 2012 at the request of the Department of the Environment and Primary Industries (DEPI) although preliminary



fauna surveys determined that there was a low likelihood of occurrence due to low number of records in the local area and lack of high quality suitable habitat (EHP 2014). No Golden Sun Moth were observed during the surveys, although they were observed flying at reference sites outside the study area on the survey dates.

Hairy Burrowing Crayfish (FFG Act vulnerable)

There is little information available regarding this cryptic species however, as with many other species of burrowing crayfish, its habitat preferences are associated with waterways and wetland habitat. It can be identified by mud chimney structures around margins of aquatic habitats and can be found some distance from water itself on flood plains and wet areas.

This species is exposed to risks from habitat loss and destruction through construction occurring in or around waterways.

#### DELWP advisory species

• Wetland bird species - Nankeen Night-heron, Royal Spoonbill, Whiskered Tern.

The above three wetland bird species listed under the DELWP Advisory list have been grouped together here as they generally are exposed to the same risks. Though each exhibit different behaviour and habitat preference, all are wetland habitat specialists that have either been recorded as occurring in the study area or are likely to utilise habitat within it. Risks to this general group may occur through disturbance, habitat change or loss in wetlands and collision with turbines.

Emu

The emu is an uncommon species in the west Victoria Volcanic Plains with only one record existing in the study area. The species prefers areas of open water for foraging, which occur in the study area, but is more associated with coastal or semi-arid habitats in Victoria.

There is unlikely to be any risks posed to the species through the construction and operation of Hexham Wind Farm.

Spotted Harrier

This species typically prefers arid and semi-arid areas and nests in remnant woodlands however, recent records indicate that the species may occasionally utilise habitat within the study area. It is unlikely to be impacted by disturbance or habitat changes within the study area. The species typically flight characteristics are to forage low grassland habitat but it is capable of flying at height. It may, therefore be at some risk of collision with turbines.

Fat-tailed Dunnart

This species inhabits similar habitat than the Striped Legless Lizard and is susceptible to impacts on grasslands within road reserves.

• Eastern Snake-necked Turtle

This species is primarily aquatic but may rarely travel overland in search of new habitat. It is at risk from alteration to waterways and aquatic habitat during construction through run off and any loss of habitat.

#### 6.5.2. Recommendations and mitigation measures

Impacts on fauna through removal of fauna habitat can be avoided and minimised by avoiding fauna habitat such as woodlands, grasslands and wetlands and siting infrastructure away from



these areas where possible. Section 5.4.5 outlines measures that have been taken in design response to facilitate this mitigation measure. The proper implementation of habitat avoidance should eliminate any significant impacts to fauna through the development.

Indirect impacts on fauna through alteration to habitats, disturbance and direct mortality during construction activities can be avoided through the implementation of best practice construction environmental management measures through the creation and implementation of an approved environmental management plan during construction. Measures will include, but not be limited to;

- Development works are sited at least 30 metres from wetlands and waterways where possible (with the exception of a small number of creek crossings, infrastructure is located mostly more than 100 metres from waterways and wetlands);
- Avoid impacts on native grassland habitat within road reserves where possible;
- Significant alterations to the site's hydrology from construction works in areas that support
  native vegetation will be avoided by minimising changes in topography that result in surface
  runoff changes;
- Retained native vegetation adjacent to construction areas will be temporarily fenced or marked with bunting, and appropriately signposted as 'no go' zones;
- Machinery, earthworks, lay down areas and stockpiles will be located in areas that do not support native vegetation, wherever practicable;
- All machinery will enter and exit works sites along defined routes that do not impact on native vegetation or cause soil disturbance and weed spread; and
- All machinery brought onto the site will be weed and pathogen free and will be washed down between farming properties (this is important for environmental and agricultural protection: soil borne pathogens such as Cinnamon Fungus and livestock diseases can be easily transported by machinery).

The proper implementation of environmental management measures should be outlined within a relevant management plan. Adherence to such a management plan will avoid any significant impacts resulting from the development.

Wind Farms in Australia are typically required as part of permit conditions to develop and implement management plans specifically targeted for bird and bat fauna. These include a risk analysis and recommendations and management actions for reducing such risks. The section below address whether there may be a risk but is not in itself a risk assessment. Whether a species may be susceptible to collision risk and if so what the significance of the risk may be should be considered further in any aforementioned management plans.



# 7. Bird Utilisation Surveys

## **KEY FINDINGS**

- From 2011 to the current date, 97 bird species, were recorded on the HWF site.
- A total of 68 species of birds were recorded on the HWF site during bird utilisation surveys (BUS) undertaken in 2018-19. This included incidental records away from the fixed survey points.
- Species diversity was higher during spring (Spring 58; Summer 45), while bird abundance was much higher in summer (Spring 1,818; Summer 2,911). This was due to the common resident birds, such as ravens, starlings and cockatoos collecting in large flocks while foraging, flowering of Sugar Gum which attracted large number of nectar-feeding birds and the natural build-up of population numbers following recruitment.
- Most bird sightings (94.4%) occurred below rotor swept area (RSA) height (<40m) during the two surveys. No birds were observed during surveys flying above RSA height (>250m).
- The only threatened species observed during the BUS was the FFG Act listed Brolga. One pair was seen foraging in open paddock. The Brolga was studied in more detail by undertaking breeding and flocking surveys in and around Hexham Wind Farm. Results of the Brolga studies are presented in a separate report. Other protected species were recorded incidentally within the study area including Hardhead, Latham's Snipe, Blue-billed Duck, Australasian Shoveler and Sharp-tailed Sandpiper. EHP (2014) reported five threatened species including Brolga, Hardhead, Great Egret, Black Falcon and Royal Spoonbill.
- Eight raptor species were recorded during the two seasonal BUS with Brown Falcon, Nankeen Kestrel and Whistling Kite being the most recorded species. Wedge-tailed Eagle activity on the site was very low with two birds observed in Spring and again in Summer.

The most common species recorded across all sites during the two seasons were (in order of utilisation): Australian Magpie, Little Raven and Common Starling.

# 7.1. Introduction

The bird utilisation survey (BUS) was undertaken consistent with the requirements for a "Level Two" bird risk assessment in accordance with 'Wind Farms and Birds - Interim Standards for Risk Assessment' issued by the Australian Wind Energy Association (AusWEA 2005). This approach has been endorsed in the Association's latest Best Practice Guidelines (Clean Energy Council 2018).

# 7.2. Methods

This section outlines the methods undertaken to implement BUS at Hexham WF.

# 7.2.1. Timing of the surveys

Two pre-construction BUS have been undertaken within the study area:

- Spring 2018: 29th October 2nd November 2018
- Late Summer early Autumn 2019: 4th 8th March 2019

The timing of these surveys covers a suitable period for surveying birds during their annual cycle, capturing the main seasonal changes in abundance and use of the study area.



During the surveys, eight counts were made at each of the eight-survey point (Figure 3). Table 8 indicates when each point was counted on each survey day. This schedule ensured that all points were visited at all times of day so that no time-of-day bird activity biases affected the pooled count data.

Davs	Time of Day													
Dayo	8:00	8:45	9:30	10:15	11:00	11:45	12:30							
Day 1	1	2	3	4	5	6	7							
Day 2	3	4	5	6	7	8	1							
Day 3	5	6	7	8	1	2	3							
Day 4	7	8	1	2	3	4	5							
Day 5	2	1	7	8	4	3	6							
Days	13:15	14:00	14:45	15:30	16:15	17:00								
Day 1	8	1	2	3	4	5								
Day 2	2	3	4	5	6	7								
Day 3	4	5	6	7	8	1								
Day 4	6	7	8	1	2	3								
Day 5	5	2	8	6		4								

Table 8: Times when points were counted for each fixed-point count survey day

Note: See Figure 3 for survey point locations.

# 7.2.2. Fixed-point bird count method

The fixed-point bird count method used to collect bird utilisation data involved an observer stationed at a survey point for 15 minutes. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (BL&A, unpublished data). This showed that 82 to 100 percent (average 88 percent) of species actually seen in one hour of surveying were seen in the initial 15 minutes of observation.

During this period, all birds observed within 200 metres were recorded. The species, the number of birds and the height of the bird when first observed were documented.

For the purpose of this report, flight height relative to the rotor swept area (RSA) height is presented as described below. These heights were based on an assumed turbine height of up to 250 metres with a diameter of the turbine blades of 150 metres.

- A = Below RSA (< 40 metres above ground)
- **B** = At RSA (40 250 metres above ground)
- **C** = Above RSA (> 250 metres above ground)

During the BUS, heights were measured at 10 metres intervals between 0 and 60 metres and at 20 metres intervals between 60 and 100 metres and above 100 metres for those flying over the latter height. This allowed for a more precise description of bird flight heights.

# 7.2.3. Locations of survey points

Eight fixed survey points were established during both of the spring and summer surveys. Impact points were located near and between proposed turbine locations.



The survey points were selected to ensure the sites were suitable (i.e. impact points were positioned on elevated ground where possible, allowing a clear view in all directions). Impact points were distributed as evenly as possible (subject to access constraints) across the study area to maximise coverage in areas where wind turbines would be located (Figure 3).

# 7.2.4. Incidental observations

In addition to the observations during formalised fixed-point counts, observations (if any) of threatened species and raptors made incidentally while moving across the study area were also recorded (observations outside the formal BUS count). Emphasis was placed on observing birds that were moving through the site at RSA height or those crossing the Hexham Wind Farm footprint.

# 7.2.5. Limitations

The bird utilisation surveys covered two seasons, representing key stages in the annual cycle of all birds. In spring, the weather was mostly fine with warm and sunny conditions prevailing, with moderate to light wind and little or no rain. Similar weather was encountered in summer but with some hot days. Almost all of the possible types of birds including residents, summer visitors and transient migratory species were present reflecting the seasonal variations in the use of the study area by birds.

The purpose of the surveys was to collect a range of data, including usage of the site by resident and migratory birds that may only occur at certain times of the year. For example, during late summer and autumn, birds such as magpies, starlings and ravens would be post-breeding, and could collect in larger feeding flocks at that time while such flocks disperse at other times of the year, especially during the breeding season.

For these reasons, the utilisation rates and species relative abundances recorded during the current surveys, once completed are considered to be representative of the site during the seasons and taking into consideration time-of-day variation in bird activity and species occurrence. They are therefore considered to provide a sound baseline with which to compare the bird impacts associated with the Hexham Wind Farm.





# 7.3. Results

# 7.3.1. Previous studies

Ecology & Heritage Partners undertook a detailed flora and fauna investigations of Hexham Wind Farm, including a BUS (EHP 2014). The survey was undertaken consistent with the requirements for bird risk assessment in accordance with 'Wind Farms and Birds - Interim Standards for Risk Assessment' issued by the Australian Wind Energy Association (AusWEA 2005).

The survey was undertaken in late Spring/early summer (28 November-2 December, 2011) and late summer (20-22 February, 2012), assuming RSA heights of 30-188 metres.

The 2014 study followed the *Fixed-Point Bird Count* method which was undertaken utilising 12 points, 10 of these were located within the wind farm footprint and two reference points located close to the site. The search radius used was 100 metres for small birds and 800 metres for large birds. Points were counted 13 times over the course of the two surveys (7 times in spring and 6 times in summer). Each point was surveyed at different time of the day and bird height was recorded for each observation.

Data collected were amalgamated for the seasons and summarised in Table 9 of the report (EHP 2014). There were 2,983 observations (called also in the report as instances) of 11,428 individuals from 97 species of birds during 153 fixed-point counts. The most common species recorded included in order of importance: Australian Magpie, Little Raven, Eurasian Skylark, Stubble Quail and Long-billed Corella.

The majority of birds were found flying below RSA heights (84% of birds below, 16% at and 0.1% above RSA heights). This figure was different when the report considered instances (number of times one or more birds were seen). Bird recorded flying at RSA included, mainly cockatoos, corellas, magpies and several other raptors and many other passerines.

The study identified five threatened species including Brolga, Great Egret, Black Falcon, Hardhead and Royal Spoonbill.

The methods used in this study, although based on the same source (AusWEA 2005), were different to that used in the Nature Advisory survey. EHP surveyed ten impact sites, of which five points were outside the current wind farm boundary, used different turbine dimensions and consequently different RSA heights, and used different approach for data analysis. It is therefore difficult, to make meaningful comparison of the results from the earlier survey to that of the current survey and results, However, general findings of bird life within the study area, such as common species utilising the site, species dominated the activity in terms their abundance, and species found at risk were comparable to those reported in the current study.

# 7.3.2. Survey Suitability

The cumulative number of species recorded from the 2018 and 2019 fixed-point bird counts conducted at the observation points during the spring and summer surveys are shown in Figure 4.

The number of new species observed during summer surveys almost levelled off after approximately 30 counts, after which the occasional new species was found. Over 70% of species were found after less than 50% of the surveys.

In spring, the number of species recorded was higher than those recorded during the summer survey, but both seasons showed a clear asymptote. The combined results strongly suggested that



the two surveys collectively provided a representative picture of the diversity of bird species flying over the study area during the spring and summer survey periods.





# 7.3.3. Species composition

Ninety bird species were recorded utilising the study area during the two seasonal BUS surveys, including incidental recordings away from the fixed survey points. This number represents approximately 75% percent of the 120 species of birds reported by the *Victorian Biodiversity Atlas* for an area of 10 km radius from the centre of the study area (Appendix 10).

The actual number recorded in each of the two seasons during the formal BUS counts were 58 species during spring and 45 during summer count. The combined number of species seen at both season during the formal BUS count amounted to 68 species. The number of species was higher during spring than that of summer. However, bird numbers (abundance) were much higher during the summer survey.

The species diversity compared well with other wind farms in the area (e.g. Dundonnell and Mortlake South Wind Farms) with the birds utilising the site comprising a combination of birds of open grasslands and stock grazing paddocks and woodland birds inhabiting fragmented woodland remnants.

Notwithstanding differences in number of species between spring (58 species) and summer (44 species), species diversity was not significantly different between the two seasons (Single factor ANOVA; F = 1.38, DF = 15, P < 0.5). The difference in species number was a reflection of the presence of several species of passage migrants which passed through the study area during spring together with the dominant resident species. Since diversity measurements are the product of both species numbers and their relative abundance, such relationship resulted in diversity not being significantly different between the two seasons. The smaller number of species in summer was compensated for by its increased relative abundance.

The data also suggested that the changes in diversity from the arrival of the transient migrants during spring does not significantly alter the composition of species diversity in the study area.



# 7.3.4. Species abundance

The species observed utilising the impact observation points, their relative abundance and height distribution are detailed in Appendix 10. The appendix includes a list of the species observed during the two seasonal BUS at each of the observation points, as well as the number of individuals per species recorded at each of the three height zones (below [<40 m], at [40–250 m] and above [>250 m] Rotor Swept Area [RSA] height). A summary of the two-season data is presented below in Table 9.

The abundance of birds varied between the two seasons, while the total number of birds counted during the formal counting time was 1818 individuals in spring; it increased to 2911 birds in summer.

The above differences in abundance of bird between the two seasons was significant (Single factor ANOVA; F = 9.852; DF 15; P < 0.001) and could be explained as resulting from one or more of the followings:

- In spring, most species of birds were engaged in their breeding behaviour. They were less active and more secretive than during other seasons;
- Numbers were significantly higher during summer and autumn when the populations naturally increase following the breeding recruitment;
- Some species, such as ravens, magpies, starlings and cockatoos were found to collect and feed communally in larger flocks;
- And finally, the Sugar Gum were flowering during the period when the survey was conducted. Such flowering take place almost annually between January and March and attract large numbers of nectar feeding birds such as lorikeets, wattlebirds and other honeyeaters.

The five most abundant species of birds at the impact sites are shown in Table 10. The common resident species (Australian Magpie; Raven [mainly Little Raven]; Common Starling), were the leading species and dominated over the two seasons. Overall, they formed over 46% in spring and 59.9% in summer of all birds recorded during the BUS.

The order of dominance, however, differed between the two seasons, in spring the common resident species dominated together with skylarks and corellas. The latter two species were not common in summer and recorded in low numbers. On the other hand, lorikeets dominated the bird numbers during summer together with the common resident species. As mentioned above, the abundance of Lorikeets and Red-rumped Parrot was due to the flowering of Sugar Gum. Lorikeets were a mixture of three species, mainly Purple-crowned Lorikeet, followed (in order of abundance) by Musk Lorikeet and then Little Lorikeet. They were treated in the report simply as Lorikeets to avoid miss-identification.

Table 9 shows the distribution of bird numbers (relative abundance) and their height distribution among the survey points at each of the two seasons of the BUS. The table also provides details of the abundance and/or density of birds (number birds/ha/hour) utilising the observation points and their seasonal differences.

The relative abundance of birds at the impact points varied within seasons depending mainly on the habitat of the observation point. Those points with more mature native trees, that are located close to or within a remnant woodland attracted more birds than those in open grazing paddocks or at points adjacent to lines of pines (windbreaks).

The mix of bird species recorded at each survey point also reflected the habitat in the count area. At points with patches of native vegetation, such as remnant woodlands, more woodland birds



were encountered compared with points in mostly open grazing paddocks and few or no trees. Similarly, the interface between woodlands and open grassy paddocks also attracted species that utilise both habitats.

The number of birds was also influenced by the time of year (season); abundance was significantly higher during summer compared to spring. Numbers in summer reflected post-breeding presence of young birds and increased activity compared with spring when birds were engaged in breeding and were more secretive in their movements. In the current survey, numbers were also influenced by the seasonal flowering of Sugar Gum which attracted large number of nectar feeding species (lorikeets, wattlebirds, Red-rumped Parrot). However, the variation in relative abundance (density/ha/hr) between the observation points and between seasons are shown in Figure 5. The figure demonstrates the characteristics described below.

- The difference in relative abundance (density/ha/hr) between the observation points varied between the seasons. In spring, there was no significant difference in relative abundance between the observation points (overlap of two standard errors). In contrast, the relative abundance differed significantly between the observation points during summer, as points (no. 1, 2, 3) with flowing Sugar Gum attracted more individuals than points without or very few trees within the survey area (No. 5, 6, 7, 8). Point 4 represented an intermediate position with both small remnant woodland and large grazing paddock within its survey area
- The collection of some of the resident bird species in large flocks (starlings, ravens) while foraging has also influenced bird numbers and added to the difference between seasons; however, these foraging flocks are accidental and only occasionally pass through the counting area.
- On seasonal basis, the above picture persisted, hover, when numbers of the nectar feeding birds were removed from the count, the seasonal differences would be damped and no longer significant differences between season can be detected.
- In conclusion, bird abundance was related to the complexity of the habitat at the survey point, prevailing seasonal conditions, such as food abundance, stage in breeding cycle and recruitment of new generations.



Species		Sp	ring		Summer				Totals				%
Species	A	В	С	Tot.	A	В	С	Tot.	Α	В	С	Tot.	Import.
Lorikeet spp.	0	0	0	0	563	20	0	583	563	20	0	583	12.3
Raven	198	12	0	210	271	44	0	315	469	56	0	525	11.1
Common Starling	175	0	0	175	341	0	0	341	516	0	0	516	10.9
Australian Magpie	227	4	0	231	248	8	0	256	475	12	0	487	10.3
Red-rumped Parrot	19	3	0	22	250	0	0	250	269	3	0	272	5.8
Red Wattlebird	45		0	45	149	0	0	149	194	0	0	194	4.1
Eurasian Skylark	148	12	0	160	2	0	0	2	150	12	0	162	3.4
White-plumed Honeyeater	64	0	0	64	94	0	0	94	158	0	0	158	3.3
Australian Wood Duck	6	0	0	6	145	0	0	145	151	0	0	151	3.2
Noisy Miner	21	0	0	21	105	0	0	105	126	0	0	126	2.7
Willie Wagtail	68	0	0	68	44	0	0	44	112	0	0	112	2.4
Magpie-lark	46	0	0	46	63	0	0	63	109	0	0	109	2.3
Long-billed Corella	25	45	0	70	19	12	0	31	44	57	0	101	2.1
European Goldfinch	55	0	0	55	41	0	0	41	96	0	0	96	2.0
Superb Fairy-wren	49	0	0	49	79	0	0	79	128	0	0	79	2.7
Fairy Martin	39	20	0	59	19	0	0	19	58	20	0	78	1.6
Welcome Swallow	23	4	0	27	39	6	0	45	62	10	0	72	1.5
House Sparrow	64	0	0	64	3	0	0	3	67	0	0	67	1.4
Galah	43	8	0	51	12	0	0	12	55	8	0	63	1.3
White-browed Woodswallow	60	0	0	60	0	0	0	0	60	0	0	60	1.3
Crested Pigeon	30	0	0	30	30	0	0	30	60	0	0	60	1.3
Yellow-rumped Thornbill	15	0	0	15	33	0	0	33	48	0	0	48	1.0
Australian Shelduck	2	0	0	2	43	0	0	43	45	0	0	45	1.0
New Holland Honeyeater	0	0	0	0	44	0	0	44	44	0	0	44	0.9

# Table 9: Summary of the number and height distribution of bird at the impact survey points recorded during two seasons at Hexham Wind Farm



<b>O</b> mosion		Sp	ring		Summer				Totals				%
Species	А	В	С	Tot.	А	В	С	Tot.	Α	В	С	Tot.	Import.
Sulphur-crested Cockatoo	18	19	0	37	0	0	0	0	18	19	0	37	0.8
Brown Songlark	34	2	0	36	0	0	0	0	34	2	0	36	0.8
Pacific Black Duck	12	0	0	12	22	0	0	22	34	0	0	34	0.7
Sulphur-crested Cockatoo	0	0	0	0	27	4	0	31	27	4	0	31	0.7
Brown Thornbill	10	0	0	10	20	0	0	20	30	0	0	30	0.6
Australasian Pipit	20	0	0	20	6	0	0	6	26	0	0	26	0.5
Grey Shrike-thrush	14	0	0	14	7	0	0	7	21	0	0	21	0.4
Australian Reed-Warbler	18	0	0	18	0	0	0		18	0	0	18	0.4
Grey Teal	10	0	0	10	8	0	0	8	18	0	0	18	0.4
White-faced Heron	9	0	0	9	6	2	0	8	15	2	0	17	0.4
Brown Falcon	8	1	0	9	6	1	0	7	14	2	0	16	0.3
Banded Lapwing	0	0	0	0	16	0	0	16	16	0	0	16	0.3
Yellow-faced Honeyeater	14	0	0	14	0	0	0		14	0	0	14	0.3
Restless Flycatcher	11	0	0	11	2	0	0	2	13	0	0	13	0.3
Australian White Ibis	0	0	0	0	0	13	0	13	0	13	0	13	0.3
White-fronted Chat	11	0	0	11	0	0	0	0	11	0	0	11	0.2
White-necked Heron	2	0	0	2	8	1	0	9	10	1	0	11	0.2
Striated Pardalote	8	0	0	8	0	0	0	0	8	0	0	8	0.2
Whistling Kite	1	3	0	4	1	3	0	4	2	6	0	8	0.2
Nankeen kestrel	1	1	0	2	4	2	0	6	5	3	0	8	0.2
Rufous Songlark	7	0	0	7	0	0	0	0	7	0	0	7	0.1
Rufous Whistler	7	0	0	7	0	0	0	0	7	0	0	7	0.1
Little Grassbird	6	0	0	6	0	0	0	0	6	0	0	6	0.1
Little Pied Cormorant	0	1	0	1	5	0	0	5	5	1	0	6	0.1
Straw-necked Ibis	0	0	0	0	0	6	0	6	0	6	0	6	0.1



Species		Sp	ring		Summer				Totals				%
Species	A	В	С	Tot.	A	В	С	Tot.	Α	В	С	Tot.	Import.
Striated Thornbill	0	0	0	0	6	0	0	6	6	0	0	6	0.1
Golden-headed Cisticola	4	0	0	4	0	0	0	0	4	0	0	4	0.1
Little Black Cormorant	4	0	0	4	0	0	0	0	4	0	0	4	0.1
Masked Lapwing	4	0	0	4	0	0	0	0	4	0	0	4	0.1
Silvereye	4	0	0	4	0	0	0	0	4	0	0	4	0.1
Wedge-tailed Eagle	2	0	0	2	1	1	0	2	3	1	0	4	0.1
Black-shouldered Kite	0	0	0	0	4	0	0	4	4	0	0	4	0.1
Crimson Rosella	3	0	0	3	0	0	0	0	3	0	0	3	0.1
Black Swan	0	2	0	2	0	0	0	0	0	2	0	2	0.0
Black-faced Cuckoo-shrike	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Brolga	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Grey Fantail	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Purple Swamphen	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Silver Gull	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Swamp Harrier	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Yellow-tailed Black-Cockatoo	2	0	0	2	0	0	0	0	2	0	0	2	0.0
Brown Goshawk	0	0	0	0	0	2	0	2	0	2	0	2	0.0
Great Egret	1	0	0	1	0	0	0	0	1	0	0	1	0.0
Little Eagle	0	0	0	1	0	0	0	0	0	0	0	1	0.0
Shining Bronze-Cuckoo	1	0	0	1	0	0	0	0	1	0	0	1	0.0
Grand Total	1680	138	0	1818	2786	125	0	2911	4466	263	0	4729	100

Notes: A = Below (<40 metres); B = At (40–250 metres); C = above RSA heights (250 metres). Note that no bird was recorded flying over 250 m in this survey.



Spring 2018		Summer 2019		Both seasonns			
Species	% Importance	species	% Importance	species	% Importance		
Australian Magpie	12.7	Lorikeet spp.	20.0	Lorikeet spp.	12.3		
Raven	11.6	Common Starling	11.7	Raven	11.1		
Common Starling	9.6	Raven	10.8	Common Starling	10.9		
Eurasian Skylark	8.8	Australian Magpie	8.8	Australian Magpie	10.3		
Long-billed Corella	3.5	Red-rumped Parrot	8.6	Red-rumped Parrot	5.8		
Total importance of all birds	46.2		59.9		50.4		

## Table 10: The five most abundant species at the impact observation points

# Table 11: Summary of the number and height distribution of bird at the impact and reference points during four seasons

Season	Observation points	A	В	С	Total	% Importance	% at RSA	Density Birds/ha/hr
	1	166	12	0	178	9.8	7.2	7.1
	2	150	0	0	150	8.3	0.0	6.0
	3	271	11	0	282	15.5	4.1	11.2
	4	244	52	0	296	16.3	21.3	11.8
Spring	5	227	28	0	255	14.0	12.3	10.1
	6	210	19	0	229	12.6	9.0	9.1
	7	281	8	0	289	15.9	2.8	11.5
	8	131	8	0	139	7.6	6.1	5.5
	Season totals	1680	138	0	1818	100.0	8.2	72.3
	1	543	29	0	572	19.6	5.3	22.8
	2	651	2	0	653	22.4	0.3	26.0
Summer	3	574	37	0	611	21.0	6.4	24.3
	4	348	12	0	360	12.4	3.4	14.3
	5	160	6	0	166	5.7	3.8	6.6



Season	Observation points	А	В	С	Total	% Importance	% at RSA	Density Birds/ha/hr
	6	140	15	0	155	5.3	10.7	6.2
	7	131	0	0	131	4.5	0.0	5.2
	8	239	24	0	263	9.0	10.0	10.5
	Season totals	2786	125	0	2911	100.0	4.5	115.8
Both	1	709	41	0	750	15.9	5.8	29.8
	2	801	2	0	803	17.0	0.2	31.9
	3	845	48	0	893	18.9	5.7	35.5
	4	592	64	0	656	13.9	10.8	26.1
	5	387	34	0	421	8.9	8.8	16.7
	6	350	34	0	384	8.1	9.7	15.3
	7	412	8	0	420	8.9	1.9	16.7
	8	370	32	0	402	8.5	8.6	16.0
	Grand totals.	4466	263	0	4729	100.0	5.9	188.1





#### Figure 5: Comparison of bird density (birds/ha/hour) at the observation points between the two seasons (bars are Standard errors)



# 7.3.5. Flight heights

Bird heights were classified as below (< 40 metres), at (40–250 metres), and above (> 250 metres) RSA height. The number of birds recorded during the two seasonal surveys at these flight heights are presented in Table 12.

The majority of birds were recorded flying below RSA heights. The percentage of birds recorded flying below, at, and above RSA heights at the impact sites were as follows:

Spring 2018: 92.4% below, 7.6% at and none above RSA heights;

Summer 2019: 95.7% below, 4.3% at and none above RSA heights;

Both seasons combined: 94.4% below, 5.6% at and none above RSA heights.

The detailed height distribution of birds over the study area is shown in Figure 6. The height distribution confirms that most birds flew below RSA height, or were either on the ground or in trees (from 1 to 20 metres in height), therefore reducing collision risks between birds and operational wind turbines.





# 7.3.6. Species recorded at the RSA height

Table 12 summarises the species of birds found flying at RSA heights during the two seasons of BUS. Generally, such birds were large sized and included mostly cockatoos and corellas, large waterbirds and raptors. Occasionally, small passerines were also found at RSA heights, including those that exhibit behaviour that takes them to heights above 100 metres above ground, such as Eurasian Skylark, which perform courtship and territory defence flights at this height. Also, Fairy Martin and Welcome Swallow, when feeding on the wing will sometimes ascend to RSA heights.

The number of birds recorded flying at RSA heights varied between the two seasons, mostly reflecting the seasonal abundance of these bird species and the pattern of their use of the study area. The species found flying at RSA height constituted 7.6 percent of all birds utilising the survey points in spring, 4.3 percent in summer, and overall percentage of 5.6 percent for the combined seasons.



The most common bird to fly regularly at RSA heights in spring was the Long-billed Corella. Despite their relatively large numbers at RSA, only a few of them have fatally collided with operating turbines in the past at other wind farm sites (BL&A; unpubl. data). Other birds regularly flying at RSA heights include Sulphur-crested Cockatoo, ravens and raptors.

In summer, ravens were the most common birds flying at RSA heights. Other birds included large waterbirds (such as ibises, and herons), cockatoos, corellas, and lorikeets together with raptors. Among raptors there were 2 sightings of the Wedge-tailed Eagle, of which one was at RSA heights.

In general, there were 15 species of birds recorded at RSA heights in spring, 15 species in summer, or a total of 23 species for the combined seasons.



Season	Species at RSA	Birds At RSA	All birds	% of RSA birds	% RSA Of all Birds at RSA	% RSA of Flights of All birds
Spring 2018	Long-billed Corella	45	70	64.3	32.6	2.5
	Fairy Martin	20	59	33.9	14.5	1.1
	Sulphur-crested Cockatoo	19	37	51.4	13.8	1
	Raven	12	210	5.7	8.7	0.7
	Eurasian Skylark	12	160	7.5	8.7	0.7
	Galah	8	51	15.7	5.8	0.4
	Australian Magpie	4	231	1.7	2.9	0.2
	Welcome Swallow	4	27	14.8	2.9	0.2
	Red-rumped Parrot	3	22	13.6	2.2	0.2
	Whistling Kite	3	4	75	2.2	0.2
	Brown Songlark	2	36	5.6	1.4	0.1
	Black Swan	2	2	100	1.4	0.1
	Brown Falcon	1	9	11.1	0.7	0.1
	Nankeen Kestrel	1	2	50	0.7	0.1
	Little-pied Cormorant	1	1	100	0.7	0.1
	Grand Total	138	1818	7.6	100.0	7.6
Summer 2019	Raven	44	315	14	35.2	1.5
	Lorikeet spp.	20	583	3.4	16	0.7
	Australian White Ibis	13	13	100	10.4	0.4
	Long-billed Corella	12	31	38.7	9.6	0.4
	Australian Magpie	8	256	3.1	6.4	0.3

# Table 12: Species flying at rotor swept (RSA) heights at the survey sites during BUS


Season	Species at RSA	Birds At RSA	All birds	% of RSA birds	% RSA Of all Birds at RSA	% RSA of Flights of All birds
	Welcome Swallow	6	45	13.3	4.8	0.2
	Straw-necked Ibis	6	6	100	4.8	0.2
	Sulphur-crested Cockatoo	4	31	12.9	3.2	0.1
	Whistling Kite	3	4	75.0	2.4	0.1
	White-faced Heron	2	8	25	1.6	0.1
	Nankeen Kestrel	2	6	33.3	1.6	0.1
	Brown Goshawk	2	2	100	1.6	0.1
	Brown Falcon	1	7	14.3	0.8	0
	White-necked Heron	1	9	11.1	0.8	0
	Wedge-tailed Eagle	1	2	50	0.8	0
	Grand Total	125	2911	4.3	100	4.3
	Long-billed Corella	57	101	56.4	21.7	1.2
	Raven	56	525	10.7	21.3	1.2
	Lorikeet spp.	20	583	3.4	7.6	0.4
	Fairy Martin	20	78	25.6	7.6	0.4
	Sulphur-crested Cockatoo	19	37	51.4	7.2	0.4
Both	Australian White Ibis	13	13	100	4.9	0.3
seasons	Australian Magpie	12	487	2.5	4.6	0.3
	Eurasian Skylark	12	162	7.4	4.6	0.3
	Welcome Swallow	10	72	13.9	3.8	0.2
	Galah	8	63	12.7	3	0.2
	Whistling Kite	6	8	75	2.3	0.1
	Straw-necked Ibis	6	6	100	2.3	0.1



Season	Species at RSA	Birds At RSA	All birds	% of RSA birds	% RSA Of all Birds at RSA	% RSA of Flights of All birds
	Sulphur-crested Cockatoo	4	31	12.9	1.5	0.1
	Red-rumped Parrot	3	272	1.1	1.1	0.1
	Nankeen Kestrel	3	8	37.5	1.1	0.1
	Brown Songlark	2	36	5.6	0.8	0
	White-faced Heron	2	17	11.8	0.8	0
	Brown Falcon	2	16	12.5	0.8	0
	Brown Goshawk	2	2	100	0.8	0
	Black Swan	2	2	100	0.8	0
	White-necked Heron	1	11	9.1	0.4	0
	Little-pied Cormorant	1	6	16.7	0.4	0
	Wedge-tailed Eagle	1	4	25	0.4	0
	Grand Total	263	4729	5.6	100	5.6

RSA height (40 -220 m)

All birds = all birds counted at all heights in the survey.



### 7.3.7. Birds of concern

#### Raptors and waterbirds

Eight raptor species were recorded during the two seasonal BUS surveys (Table 13). The Brown Falcon was by far the most abundant raptor as the prevailing habitat of open grasslands and mature large trees for roosting attracted this species. The Nankeen Kestrel and Whistling Kite were the second most abundant species within the study area. The Wedge-tailed Eagle, a raptor of special importance due to its soaring habits and susceptibility of collision with operating turbines, was recorded on few occasions; two birds in spring and another two in summer. The eagles' utilisation rate was less than 0.08 birds per hectare per hour in both seasons and considered as low activity level compared to a rate range of 0.001–0.44 eagle per hectare per hour recorded in other wind farms in south eastern Australia (BL&A, unpubl. data). Raptors in general constituted a small fraction of the total birds utilising the site (Table 13). Based on the low utilisation rate by raptor species at the survey points, risks to these species are considered to be low.

Rantors	Spring	Summer	Both	% of	% of
huptoro	Total	Total	seasons	raptors	All birds
Brown Falcon	9	7	16	35.6	0.3
Nankeen kestrel	2	6	8	17.8	0.2
Whistling Kite	4	4	8	17.8	0.2
Black-shouldered Kite	0	4	4	8.9	0.1
Wedge-tailed Eagle	2	2	4	8.9	0.1
Brown Goshawk	0	2	2	4.4	0.0
Swamp Harrier	2	0	2	4.4	0.0
Little Eagle	1	0	1	2.2	0.0
Total raptors	20	25	45	100.0	1.0
Waterbirde	Spring	Summer	Both	% of	% of
Waterbilds	Total	Total	seasons	raptors	All birds
Australian Wood Duck	6	145	151	50.3	3.2
Australian Shelduck	2	43	45	15.0	1.0
Pacific Black Duck	12	22	34	11.3	0.7
White-faced Heron	9	8	17	5.7	0.4
Australian White Ibis	0	13	13	4.3	0.3
White-necked Heron	2	9	11	3.7	0.2
Straw-necked Ibis	0	6	6	2.0	0.1
Little Pied Cormorant	1	5	6	2.0	0.1
Little Black Cormorant	4	0	4	1.3	0.1
Masked Lapwing	4	0	4	1.3	0.1
Black Swan	2	0	2	0.7	0.0
Brolga	2	0	2	0.7	0.0
Purple Swamphen	2	0	2	0.7	0.0
Silver Gull	2	0	2	0.7	0.0
Great Egret	1	0	1	0.3	0.0
Total waterbirds	49	251	300	100.0	6.3
Grand Total	1818	2911	4729		100.0

# Table 13: Raptors and waterbirds recorded at the impact survey points during the two seasonal BUS surveys



A total of 15 species of waterbirds were recorded during BUS (13 species in spring and eight in summer). The common species of ducks, particularly Australian Wood Duck, dominated the number of waterbirds. The presence and abundance of ducks is strongly related to the number and size of farm dams in the study area. Most were recorded flying close to the ground and would avoid collision with operating turbines (Table 9).

Other less abundant waterbirds observed were the Ibises and herons; both were seen occasionally foraging in open paddocks or near the farm dams, and usually fly close to the ground between farm dams but may occasionally fly at RSA heights.

The remaining waterbirds were less common and some of them, were only seen occasionally in the study area.

Among the less common species, a pair of Brolga were seen foraging in an open paddock in spring, but none seen in summer. The Brolga is considered as a threatened species in Victoria and protected under the state FFG Act.

### Threatened species

Most birds found to utilise the study area were common birds. Of the bird species recorded during field work at the Hexham Wind Farm, the Brolga was the only species listed as vulnerable in Victoria under the *Advisory list of Threatened Vertebrates Fauna in Victoria* (DSE 2013) and was also protected under the state *Flora and Fauna Guarantee Act* 1988.

As mentioned above, one pair was sighted foraging in open paddock. The Brolga was studied in more detail by undertaking breeding and flocking surveys in and around Hexham Wind Farm. Results of the brolga studies are presented in a separate report.

### 7.3.8. Conclusions

The conclusions from the BUS of the HWF are presented below.

- The study area consists largely of open, mostly flat, grassy paddocks and cultivated farmland intercepted with small to medium-sized remnant eucalypt woodlands, linear windbreaks of native trees and introduced pines and supporting a variety of common, predominantly farmland and woodland birds.
- Two seasonal surveys were undertaken, the first in spring (29<sup>th</sup> October to 2<sup>nd</sup> November 2018), and the second in late summer (4<sup>th</sup> to 8<sup>th</sup> March 2019).
- Sixty-eight species of bird were recorded in 2018/2019 utilising the study area, including incidental recordings away from the fixed survey points.
- Of the recorded species, 58, species were recorded at the impact sites during spring and 45 species during summer survey.
- Abundance and diversity of species utilising the study area was similar to that recorded at most south-eastern Australian wind farms (BL&A, unpubl. data), with large sized native farmland and bushland birds generally dominating the avifauna.
- Bird abundance and diversity was generally similar between the eight survey points, although points surrounded by remnant woodlands or scattered trees displayed higher abundance compared with sites within open grazing paddocks lacking trees.
- Diversity (number of species recorded) was similar between the two seasons of surveys, however, species numbers were slightly higher during spring compared to summer season (difference between the two seasons was not statistically significant).
- Bird abundance was significantly different between the two seasons. The high number of individuals in summer was due to first; the common resident birds, such as ravens,



starlings and cockatoos in this season collect in large flock while foraging; second, flowering of Sugar Gum which attracted large number of nectar-feeding birds; and third, the natural build-up of population numbers following recruitment.

- The five most abundant species of birds at the impact sites were common resident species (Australian Magpie; Little Raven; Common Starling), and overall, they formed over 46% in spring and 59.9% in summer of all birds recorded during the BUS. A similar set of birds were also reported as dominant species during 2014 BUS indicating that little change has occurred in bird species structure over the years (EHP 2014).
- The majority of birds were recorded flying below RSA heights, with an overall percentage over the two seasonal surveys of 95.7% below, 5.6% at, and none above RSA heights. These values are well within the average of 90–98% of birds found flying below RSA heights calculated from 10 other wind farms in south-eastern Australia (BL&A; unpublished). In terms of abundance, 7.6% in spring 2018, and 4.3% of all birds utilising the study area were found to fly at RSA heights. Surprisingly, EHP (2014) recorded a much higher number of birds at RSA (16%), this was due to the lower minimum RSA height of 30 metres that was assumed in the analysis.
- The list of birds recorded flying at RSA heights was similar between the survey points and between seasons. Large common species such as the corellas, ravens, large waterbirds and raptors formed most of the birds flying at RSA heights.
- Raptors were not common with only few birds being recorded at RSA heights. The Wedge-tailed Eagle was recorded on only few occasions, two at each season with an overall utilisation rate of 0.08 birds per hectare per hour. The abundance of eagles, however, was much less than the value given in 2014 surveys by EHP.
- Waterbirds, apart from The Australian Wood Duck were not common, and were mostly restricted in their use of the study area to wetlands.
- The study area supports one threatened species, the Brolga and only one pair was recorded during the formal BUS count. Other protected species were recorded incidentally within the study area including Hardhead, Latham's Snipe and Sharp-tailed Sandpiper. EHP (2014) reported five threatened species including Brolga, Hardhead, Great Egret, Black Falcon and Royal Spoonbill.



# 8. Migratory Birds

### **KEY FINDINGS AND CONCLUSIONS**

- Three EPBC Act-listed migratory shorebird species (Sharp-tailed Sandpiper, Latham's Snipe and Double-banded Plover) were detected on the HWF site during targeted surveys conducted by Nature Advisory in 2018/19.
- None of the three species of listed migratory shorebird recorded were in numbers that would be above the threshold significance levels of 0.1% of flyway population (i.e. a population of national importance) or in the instance of the Latham's Snipe a wetland that supports at least 18 individuals (DoEE 2017).
- Most wetlands were found to be ephemeral and too well vegetated with dense growth
  of reed, rush, sage, and introduced grasses on the edges and dense growth of water
  ribbon and emergent and submerged vegetation, particularly the sections that are
  expansions of the Muston Creek. In most cases vegetation was taller than 30 cm and
  as such were unsuitable for most migratory shorebirds, which require more open
  shorelines and shallow open water or mud in which to forage.
- Latham's Snipe may occur in a wider variety of sites than other migratory shorebirds, even though it has only been confirmed at one site on the proposed wind farm. Due to the limited extent of suitable habitat, numbers on the HWF site are unlikely to exceed 0.1 percent of the population and no wetland is likely to support at least 18 individuals (DoEE 2017).
- Based on these findings, it was concluded that there will be no significant impacts on migratory shorebirds from the HWF development.

# 8.1. Introduction

Habitat surveys and a review of previous assessments was undertaken for migratory shorebirds at the proposed HWF. The investigation provides updated information on the likelihood of occurrence of migratory shorebird species listed under the EPBC Act.

The investigation included:

- Wetland and aquatic fauna habitat assessment, and
- Targeted surveys.

Five species of migratory shorebirds listed under the Commonwealth EPBC Act had the potential to occur in wetlands on the HWF site: Common Greenshank, Curlew Sandpiper, Double-banded Plover, Latham's Snipe, Red-necked Stint and Sharp-tailed Sandpiper. Accordingly, targeted surveys were undertaken in the summer of 2018/2019.

The aim of these surveys was to identify areas of suitable wetland foraging habitat that may support any one of these EPBC Act listed shorebird species within the proposed HWF site and survey them for the potential shorebird species.

This section of the report presents information on the species' biology then the methods and results of this survey, followed by a discussion of the implications of the findings for the project.



# 8.1.1. Background

Australia is party to several international treaties which serve to protect a suite of migratory bird species that occur along the East Asia – Australasia flyway. The Convention on Wetlands of International Importance (or Ramsar Convention) was the earliest such agreement (1971); it protects wetlands of international significance. The Convention on Conservation of Species of Wild Animals (or Bonn Convention) also protects migratory animals including birds.

Additionally, three bilateral treaties that provide protection for migratory birds are the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA).

Key species protected by these agreements are the migratory shorebirds, which comprises 36 species that breed in the northern hemisphere (i.e. mostly in Siberia, China, Mongolia, Japan and the Korean Peninsula) and migrate to Australia and New Zealand during their non-breeding season (DEWHA 2009) are shown in Table 14 below.

	Common name	Scientific name
	Scolopacidae	Sandpipers and related birds
1	Latham's Snipe	Gallinago hardwickii
2	Pin-tailed Snipe	Gallinago stenura
3	Swinhoe's Snipe	Gallinago megala
4	Black-tailed Godwit	Limosa limosa
5	Bar-tailed Godwit	Limosa lapponica
6	Little Curlew	Numenius minutus
7	Whimbrel	Numenius phaeopus
8	Eastern Curlew	Numenius madagascariensis
9	Common Redshank	Tringa totanus
10	Marsh Sandpiper	Tringa stagnatilis
11	Common Greenshank	Tringa nebularia
12	Wood Sandpiper	Tringa glareola
13	Terek Sandpiper	Xenus cinereus
14	Common Sandpiper	Actitis hypoleucos
15	Grey-tailed Tattler	Tringa brevipes
16	Wandering Tattler	Tringa incana
17	Ruddy Turnstone	Arenaria interpres
18	Asian Dowitcher	Limnodromus semipalmatus
19	Great Knot	Calidris tenuirostris
20	Red Knot	Calidris canutus
21	Sanderling	Calidris alba
22	Red-necked Stint	Calidris ruficollis
23	Long-toed Stint	Calidris subminuta
24	Pectoral Sandpiper	Calidris melanotos
25	Sharp-tailed Sandpiper	Calidris acuminata
26	Curlew Sandpiper	Calidris ferruginea
27	Broad-billed Sandpiper	Limicola falcinellus
28	Ruff	Philomachus pugnax
29	Red-necked Phalarope	Phalaropus lobatus

### Table 14: The listed Migratory Shorebirds



	Common name	Scientific name
	Charadriidae	Plovers and Lapwings
30	Pacific Golden Plover	Pluvialis fulva
31	Grey Plover	Pluvialis squatarola
32	Double-banded Plover	Charadrius bicinctus
33	Lesser Sand Plover	Charadrius mongolus
34	Greater Sand Plover	Charadrius leschenaultii
35	Oriental Plover	Charadrius veredus
	Glareolidae	Pratincoles
36	Oriental Pratincole	Glareola maldivarum

Most of the listed species are birds of the coastal mudflats and intertidal zones, but some preferentially forage in freshwater habitats, including the Wood Sandpiper and Latham's Snipe. Others may occur in fresh, brackish and saline waters both inland and coastal (e.g. Sharp-tailed Sandpiper). One species, the Double-banded Plover migrates between Australia and New Zealand and occurs on ocean, estuarine and inland lake shorelines in Victoria.

# 8.1.2. Legislative protection

The 36 shorebird species are listed as 'migratory' under the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 and therefore considered to be of national conservation significance (DEWHA 2009). In Victoria, some species are also listed under the *Flora and Fauna Guarantee Act* 1988 as threatened (Table 15).

common name	Conservation status – Commonwealth (EPBC Act 1999)	Status under FFG Act 1988
Bar-tailed Godwit	VU	VU
Common Greenshank		VU
Common Sandpiper		VU
Curlew Sandpiper	CR	CR
Eastern Curlew	CR	CR
Great Knot	CR	CR
Greater Sand Plover	VU	VU
Grey Plover		VU
Grey-tailed Tattler		CR
Lesser Sand Plover	EN	EN
Pacific Golden Plover		VU
Red Knot	EN	EN
Ruddy Turnstone		EN
Terek Sandpiper		EN
Whimbrel		EN
Wood Sandpiper		EN

### Table 15: Status of migratory listed shorebirds

Note: CE = critically endangered; EN = endangered; VU = vulnerable.



Migratory shorebird surveys were undertaken based on guidelines from *EPBC* Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on *EPBC* Act listed migratory shorebird species (Dept. of Environment and Energy 2017).

# 8.2. Existing Information

Existing information on the status of the migratory shorebirds were obtained from the Victorian Biodiversity Atlas (VBA), a public database held by the Department of Environment Land Water and Planning (DELWP 2018). These records were obtained from a wider area, termed the 'search region' defined for this assessment as an area of 10 kilometres radius centred on a point of the study area (38° 02' 15" S and longitude 142° 34' 46" E).

The likelihood of suitable habitat in the study area for nationally threatened fauna species was ascertained through a search of the online *Environment Protection and Biodiversity Conservation Act* 1999 Protected Matters Search Tool (DoEE 2018) using the same search region.

Previous work on the study area undertaken by EHP (2014) was reviewed prior to the current investigations.

# 8.1. Methodology

# 8.1.1. Habitat Assessment and selection of survey sites

An aquatic fauna habitat assessment was undertaken to assess the location and extent of suitable habitat for migratory species. The habitat assessment considered the characteristics of wetlands and waterways and whether they meet the habitat requirements. Wetlands within three kilometres of the HWF boundary (the study area) were assessed to determine the status of their habitats and values.

Wetlands assessed were DELWP mapped and other wetlands and waterways identified in the study area. At each wetland site, the vegetation type, structure and habitat quality, and amount and quality of water (temporary or permanent) were examined.

Habitat for the potential species was searched for by visiting mapped wetlands from the DELWP database mapping layer, and then looking for:

- Habitat for most of these shorebird species, which is characterised by open, shallow wetlands (fresh or saline) with banks with shallow gradients and with no vegetation and open shorelines, or at most a shallow cover of aquatic herbs; or
- Habitat for Latham's Snipe, which comprises more heavily-vegetated, freshwater wetlands (e.g. comprising Water Ribbons *Triglochin procera*, Dock *Rumex* spp., Water Buttons *Cotula* sp., sedges and rushes), usually with soft muddy substrate and nearby dense vegetation (can include Austral Bracken *Pteridium esculentum* or dense heath, e.g. *Melaleuca* spp. or *Leptospermum* spp.)

Creek lines (i.e. Mustons Creek and Drysdale Creek) were also inspected for the presence of Latham's Snipe, as this species may use these narrow corridors for foraging, roosting in nearby areas of dense vegetation.

Wetlands assessed and surveyed are described in Appendix 12 and shown in Figure 7.





# 8.1.2. Field methodology

Surveys were undertaken by examining all possible and suitable wetland within and outside the wind farm boundary up to a 3 km buffer (Figure 1).

Whenever habitat was visited, a detailed search was made using 10x binoculars and 20-60x telescope for migratory shorebirds. All listed migratory birds encountered were identified and the number of individuals was counted.

Based on above guidelines, five surveys of the migratory shorebirds were undertaken on the following times (Table 16).

### Table 16: Migratory bird survey dates

Survey	Date
Survey 1	December 18th-20th 2018
Survey 2	January 9 <sup>th</sup> -11 <sup>th</sup> 2019
Survey 3	January 30 <sup>th</sup> -31 <sup>st</sup> 2019
Survey 4	February 26 <sup>th</sup> -28 <sup>th</sup> 2019
Survey 5	March 27th-29th 2019

Each survey was for a duration of two days. Each wetland was visited at least once, and those suspected of or found to support migratory birds were visited more than once.

# 8.2. Results

# 8.2.1. Existing Information

Existing records of migratory shorebird species listed under the EPBC Act in the search region and are expected to be found utilising the study area are presented in Table 17.

Similarly, the VBA data base was reviewed for species previously recorded within a 10 km radius of the centre of the study area, and species recorded to occur in or around the study area proper are listed in Table 17.

Furthermore, data from the EHP (2014) fauna targeted surveys were reviewed and species recorded to occur during their surveys were noted.

The EPBC Protected Listed Matters Search Tool expected that nine migratory species are likely to occur, in or near the study area, based on habitat presence and preferences. The VBA provided records for six of these species within the 10 km radius of the study area. Three species of these records were actually sighted during the current surveys (Table 17).

Records of the migratory shorebirds, either in the VBA or sighted during the surveys were of insignificant number of birds. No significant impacts on their populations are expected from the proposed wind farm.



Species	EPBC Act	FFG Act	VBA record	Recorded 2018/2019
Sharp-tailed Sandpiper	М		Recorded	Recorded
Curlew Sandpiper	CR	CR	Recorded	
Little Sandpiper	М		Not recorded	
Eastern Curlew	CR	CR	Not recorded	
Common Greenshank	М	VU	Recorded	
Latham's Snipe	М		Recorded	Recorded
Double-banded Plover	М		Recorded	Recorded
Common Sandpiper	М	VU	Not recorded	
Red-necked Stint	М		Recorded	

#### Table 17: Nationally and state listed shorebirds likely to occur in Hexham Wind Farm

EPBC Act, listed under the Environment Protection and Biodiversity Conservation Act FFG Act, listed under Flora and Fauna Guarantee Act CR - critically endangered; EN - Endangered; VU - Vulnerable; M – Migratory

# 8.2.2. Survey Results

Five surveys of the wetlands likely to provide habitat and refuge to migratory birds at Hexham Wind Farm were conducted throughout the season when such migratory birds are present in Australia.

During these assessments, mapped wetlands and creek and river frontages were visited throughout the footprint of Hexham Wind Farm (Figure 7). Most wetlands were found to be ephemeral and too well vegetated with dense growth of reed, rush, sage, and introduced grasses on the edges and dense growth of water ribbon and emergent and submerged vegetation, particularly the sections that are expansions of the Muston Creek. In most cases vegetation was taller than 30 cm and as such were unsuitable for most migratory shorebirds, which require more open shorelines and shallow open water or mud in which to forage.

One exception to this rule is the Latham's Snipe which hides in dense vegetation near water by day and mostly forages in more open wetlands with soft substrates (e.g. mud) at night. Moreover, many of the ephemeral wetlands were already dry by December 2018.

A total of three species of migratory shorebird were recorded within the study area during the current investigation Table 18.



Survey	Wetland	Observation
Survey 1	29405 (Site 3a)	A small group of 7 $-8$ <b>Sharp-tailed Sandpiper</b> were observed foraging at edge of the northern section of the large lake
Survey 2	111 (Site 17)	Two Latham's Snipe were observed at Mustons Creek at site 17 hiding among vegetation. Also, another small group of possible Sharp-tailed Sandpipers were seen, but were too far to be positively identified.
Survey 3	N/A	No migratory shorebirds were seen during this survey.
Survey 4	29405 (Site 3b)	A pair of <b>Double-banded Plover</b> sighted on the central section of the large lake
Survey 5	N/A	No migratory shorebirds were seen during this survey.

### Table 18: Migratory shorebird survey results

In addition to the above wetlands visited during the formal five surveys; other historical wetlands and sections of the Muston Creek were also visited particularly during Brolga breeding and flocking surveys (see separate Brolga report), but no additional shorebirds were sighted.

EHP (2014), recorded two species, namely, Red-necked Stint (8 birds) and Latham's Snipe (3 birds) during their fauna targeted surveys in 2014.

A number of species recorded to occur in or near the study area in the VBA data base shown (Table 17) were not recorded in the current surveys, such as Common Greenshank, Curlew Sandpiper and Red-necked Stint.

# 8.3. Conclusions and recommendations

Three migratory shorebird species listed under the EPBC Act were detected at two sites on the wind farm during the 2018/19 surveys:

**Sharp-tailed Sandpiper**: Seven-eight on 18<sup>th</sup> December, 2018 on the northern end of the large wetland (Wetland 3a);

Latham's Snipe: Two on 9th January 2019 on the Mustons Creek k (Wetland 17); and

**Double-banded Plover:** a pair on 26<sup>th</sup> February, 2019 on the muddy shores of the large lake (Wetland 3b).

It was determined that there is very little suitable habitat within the wind farm footprint for most species of migratory shorebird owing to the ephemeral nature of the majority of waterbodies, and the lack of muddy shoreline. Most shorebirds would therefore not be affected by the wind farm development.

The Latham's Snipe is an exception among the migratory shorebirds as it requires dense cover for daytime roosting and can tolerate plant cover when feeding at night. Its main requirement is soft substrate (usually mud) in which it can probe with its long bill to extract its prey from beneath the surface. This habitat is provided along the Mustons Creek and some of the muddy margins of the large lake (un-named) and large dams. the highest numbers of Latham's Snipe reported in this survey was a pair roosting among vegetation on the shore of Mustons Creek. The number of the snipe recorded fail to reach significant levels defined as 1% of the population in this case 18 individuals. It is therefore considered that there is unlikely to be an impact of the wind farm on Latham's Snipe or their habitat.



Based on the current survey results, it is considered that migratory shorebirds would only be present in small numbers that do not meet significant population thresholds of 1% of flyway population) for any species found at Hexham Wind Farm.

# 8.4. Mitigation Recommendations

To maximise the effectiveness of mitigation measures to avoid impact on migratory species, the following should be considered:

- Avoid siting wind turbines and associated hard stands, within 100 metres of confirmed habitat, as identified in this report.
- Avoid disturbance of banks, channels and vegetation in nearby areas (within 30 meters of centre line of streams or within 30 meters from the edge of wetlands) identified as potential habitat (i.e. marked as 'moderate quality'), as identified in this report (Appendix 12, Figure 7).
- Where essential wind farm infrastructure (e.g. access road) crosses a creek line or wetland identified as potential habitat of a listed aquatic fauna species, disturbance of banks, channels and nearby vegetation shall be kept to a minimum and if feasible, restored or enhanced to at least its pre-construction condition.
- Install sediment fencing during construction to protect riparian zones if works are to be undertaken (within 30 metres of) near creek crossings.



# 9. Bat Assessment

### **KEY FINDINGS**

- A total of 3,776 nights of bat call detection was undertaken at over 80 unique sites on the proposed Hexham Wind Farm and its surrounds seasonally in five years between 2010 and 2020, including extensive recording at height from two wind monitoring masts.
- Calls from nine species of bats were recorded during these bat surveys.
- Seven of the species recorded were common species, considered secure in their conservation status (i.e., not listed as threatened) being common and widely distributed.
- Two species recorded were listed threatened bats, namely the Southern Bent-wing Bat (EPBC Act Critically endangered, FFG Act Critically endangered) and Yellow-bellied Sheathtail Bat (FFG Act Vulnerable).
- A further four multi-species complexes were recorded, including the long-eared bat complex.
- The vast majority of bat activity was attributable with a high level of confidence to common and widespread species.
- Out of tens of thousands of recorded bat calls from all surveys, 168 were attributable to Southern Bent-wing Bat with 76 calls recorded in Spring 2010 and 72 calls in Summer/Autumn 2019. 610 Yellow-bellied Sheathtail Bat calls were recorded, 561 of these were recorded in Spring 2010 with lower numbers in Spring 2018 (4 calls) and Summer/Autumn 2019 (10 calls).
- The majority of recorded attributable Southern Bent-wing Bat calls were from treed and wetland habitats: specifically, along the Muston's Creek and its treed habitats.
- The Gould's Wattled Bat, White-striped Freetail Bat and Yellow-bellied Sheathtail Bat were recorded at heights of 42 to 50 metres. The Southern Bent-wing Bat was not recorded at this height.
- The Grey-headed Flying Fox (EPBC Act Vulnerable, FFG Act Vulnerable) has been recorded in small numbers during targeted surveys in February 2022.
- Bat activity was consistently greater closer to the ground than at height for most species. Where simultaneous paired ground and at-height recording occurred, the vast majority of bat calls were recorded from the ground-based detector, indicating that for most of the time, these species forage below Rotor Swept Area (RSA).
- The proposed wind farm has a minimum turbine blade tip height of 40 metres above the ground.
- At a minimum turbine blade tip height of 40 metres the risk of interactions between bats and rotating turbine blades is considered to be lower than at operating wind farms in western Victoria which have minimum rotor tip heights lower than this.

Having regard to the foregoing findings, collision risk for threatened micro-bat species is considered very low and no significant impact is expected from the proposed HWF on the Southern Bent-wing Bat or Yellow-bellied Sheathtail Bat populations. Further investigations are underway regarding the Flying Foxes. Mitigation measures will be developed based on this information.



# 9.1. Introduction

Numerous bat utilisation surveys have been undertaken since 2010 to inform the assessment of the potential impacts the construction and operation of the proposed Hexham Wind Farm may have on microbat species.

To determine the presence of micro-bat species utilising the study area, particularly that of EPBC Act and FFG Act listed bat species, ultrasonic bat detectors were deployed for several weeks at a time, in a wide variety of locations.

Surveys have been undertaken on or near the proposed HWF site during spring 2010, summer-autumn 2011, spring 2018 and summer-autumn 2019. Recordings were undertaken at ground level and also at heights of 50 metres on a wind monitoring mast to detect species flying at height to provide data on what species may be at greater risk of collision with operating wind turbines.

Targeted surveys were undertaken for the Grey-headed Flying Fox in February 2022 after DELWP raised the possibility of a camp being present close to the wind farm site (see Section 9.4.3).

The following section outlines methods, results and conclusions of all surveys to date at Hexham Wind Farm.

# 9.2. Methods

Best-practice survey techniques were deployed in an effort to detect which bat species occur across the study area. Ultrasonic detectors that detect and record echo-location calls emitted by micro-bat species were deployed to identify, through expert opinion, the species of bats occurring at the proposed site.

During the 2010–2011 survey period, Anabat detector units were deployed and in the 2018-2019 surveys, more advanced SongMeter (SM4 and SM2) detectors were deployed which had since become available. During the spring 2010 and the spring 2018 surveys all bat call data were analysed to determine every species present on site. During the summer/autumn 2011 and summer/autumn 2019, due to the volume of information collected and to provide a focus on species more likely to be significantly impacted, only the calls of threatened bat species and species complexes call were analysed in detail. Species complexes comprise calls that cannot accurately be attributed to one species and may be from one of a number of species, because of similar call frequency range.

# 9.2.1. Survey effort

An increased survey effort was undertaken in summer-autumn 2019 and from February 2019 – May 2020 in response to recommendations from DELWP (Barwon, SW). This reflected current and evolving best practice survey methodology to build upon the previous survey efforts undertaken a decade prior. The recent surveys also sought to target a wider range of areas and habitats across the site, as opposed to only suitable habitats where, for example, threatened species may occur. This approach aimed to gain a complete understanding of bat usage across the proposed HWF site, including areas of relatively poor habitat where, nonetheless, turbines are proposed to be located.

The survey effort and timeframes are described below (Table 19).



Survey Period	No. of nights	No. of sites	Total detector nights
Spring 2010 21 Oct – 23 Nov	33	31	382
Summer/Autumn 2011 10 Feb – 31 Mar	49	18	413
Spring 2018 25 Oct – 18 Dec	54	19	385
Summer/Autumn 2019 5 Feb – 25 Apr	79	19	1,560
Summer/Autumn 2020 18 Feb – 1 May	74	14	1,036
Total			3,776

#### Table 19: Date ranges, number of days and sites for each survey period

# 9.2.2. Deployment of bat detectors

The 2010-2011 surveys were undertaken at the proposed wind farm by Ecology and Heritage Partners (EHP) during October–November (spring) 2010 and February–March (autumn) 2011 (EHP 2014). Records were made from 32 locations (sites) in the spring and from 15 locations during the autumn survey using Anabat detectors. These locations were based on an older project boundary. The timing of the surveys was chosen to coincide with migration period of the threatened Southern Bent-wing Bat. For a detailed methodology and survey locations, refer to the EHP (2014) report and Figure 8.

The detectors used during 2018-2020 surveys undertaken by Nature Advisory were SongMeter 4 (SM4BAT ZC), except for four detectors which were SongMeter 2 (SM2<sup>+</sup>). Detectors were programmed to commence operation approximately 30 minutes before dusk, and to cease approximately 30 minutes after dawn. Each SongMeter unit used a 64GB SDHC card that recorded bat echolocation calls, along with the date and time of each call. Batteries and storage cards were changed in each unit at approximate monthly intervals to maintain consistent recordings.

A habitat description was noted at each site where each SongMeter was deployed for all Nature Advisory survey. Table 20 and Table 21 below present the habitat descriptions and the proximity of the SongMeters to treed habitat and permanent waterbodies for the spring 2018 and summer/autumn 2019 survey periods. Locations of surveys sites are sown in Figure 9 and Figure 10.

Summer/autumn 2020 surveys entailed a more specific approach to understanding threatened species present on site's habitat preferences and usage. Survey aims and methods are described in more in detail separately in Section 9.3.4 (height analysis) and Section 9.5 (wetland gradients).



Site	General habitat description (within 30 metres)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
HX1	Open paddocks, scattered planted trees, farm dam	30	40
HX2	Scattered remnant and scattered trees, open paddocks	230	1100
НХЗ	Wind row (sugar gums), open paddocks	40	1100
HX4	Open paddocks, small patch of acacia.	150	620
HX5	Pine windrow, open paddocks	65	750
HX6	Muston's Creek line, riparian woodland, open paddocks	10	370
HX7-air	Open paddocks	500	500
HX7-ground	Open paddocks	500	500
HX8	Eucalypt windrow, open paddocks	0	380
HX9	Eucalypt woodland, open paddocks	0	340
HX10	Eucalypt windrow, open paddocks	0	450
HX11	Small Eucalypt windrow, open paddocks	0	580
HX12	Large dry wetland/creek line, wind row, open paddocks	10	1100
HX13	Open woodland, farm dam, open paddocks	0	90
HX14	Dry creek, open woodland, open paddocks	10	2000
HX15	Open paddocks	80	1200
HX16	Scattered trees, open paddocks	10	320
HX17	Eucalypt windrow, open paddocks	10	650
HX18	Eucalypt windrow, open paddocks	10	540
HX19	Open paddocks, scattered trees	120	390

# Table 20: Habitat descriptions of SongMeter sites during Spring 2018



Site	General habitat description (within 30 metres)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
HS1	Open paddock, scattered trees, creek line w/large pools	160	25
HS2	Very large dam, scattered trees, open paddock	60	45
HS4	Farm dam, treed habitat, open paddock	0	30
HS5	Farm dam, open paddocks	320	5
HS6	Scattered remnant and scattered trees, open paddocks	230	1100
HS7 - ground	Open paddocks	500	500
HS7 - air	Open paddocks	500	500
HS8	Large old tree, open paddocks	75	75
HS9	Large dry wetland/creek line, wind row, open paddocks	10	1100
HS10	Wind row, open paddocks	10	1300
HS11	Dry creek, open woodland, open paddocks	10	2000
HS12	Scattered trees, open paddocks	10	320
HS13	Large old tree, open paddocks	300	910
HS14	Wind row (sugar gums), open paddocks	0	1100
HS15	Open paddocks, small patch of acacia.	130	620
HS16	Pine and acacia windrow, open paddocks	0	250
HS17	Acacia wind row, open paddocks	0	1200
HS18	Open paddocks	315	720
HS19	Open woodland, farm dam, open paddocks	0	90
*HG1-4	On a fence running parallel to northern section of large lake	60	60

### Table 21: Habitat descriptions of Songmeter sites during Autumn 2019

\*four recorders were placed in 60m intervals perpendicular from a lake in a preliminary test of a gradient study (see section 9.5)

Calls from the units were downloaded and sent to Rob Gration (ECOAERIAL Ecological Services, Newport, Victoria) for identification. The files from the recording sites were viewed in Kaleidoscope® software (Wildlife Acoustics, USA), which provides a sonogram display of frequency versus time. Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded from Victoria.



Identification is largely based on changes to frequency patterns over time, especially as the characteristic frequency changes. Only those recordings that contained at least two definite and discrete calls were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently. The call characteristic graphs and identification was then provided to a second reviewer for confirmation of the assignation into species and/or complexes.

During Spring 2018 as well as Summer-Autumn 2019 surveys, the presence-absence of bats were used to evaluate the presence, and activity of the common bats in the study area. The actual number of calls of each bat species was only taken for the threatened species.

# 9.2.3. Limitations

Using ultrasonic bat detectors, it is not possible to census bat numbers. For example, 10 calls of a particular species may be recorded but it is not known if this represents 10 individuals of that species or one individual of that species flying past the bat recorder 10 times. Therefore, it is not possible to determine utilisation rates, only activity levels.

Occasionally, recording devices such as those used in the survey experience technical difficulties. As a result, short periods of time may not be recorded and total hours of recording varies between the different recorders. The bat detectors used during this survey sample a limited airspace to a distance of approximately 20-30 metres.

Two Songmeters were placed at height (50 metres) which was above minimum RSA height (met masts). All remaining detectors were placed at ground level.

Bat activity levels vary in response to weather variables such as air temperature, relative humidity, barometric pressure, wind speed, direction & gusts, rain and moonlight. Typically, bats are found to be less active during the following circumstances:

- During periods of full moon, and when the moon is high in the sky;
- At wind speeds of over 10 metres per second; and
- During moderate to heavy rainfall.

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific; however, not all species can be consistently or reliably identified using this technique. The identification of Southern Bent-wing Bat calls using ultrasonic bat detectors is difficult and often key, salient call characters may not feature prominently in all recordings. Such calls were attributed to the Southern Bent-wing/Forest Bats/Chocolate Wattled Bat complex as it was not possible to distinguish the call as belonging to any of these species, which have calls within the same frequency range.

The ultrasonic calls of Long-eared bats (*Nyctophilus* spp.) are difficult to distinguish at a species level, and hence are grouped under their generic name as a species complex. The species that are likely to occur at HWF are *Nyctophilus* geoffroyi and *N. gouldi*. These species are not listed as threatened.

Similarly, calls of species of Forest Bats (*Vespadelus* spp.) can be difficult to differentiate and therefore some of their calls have been combined into the species complex for the purposes of analysis. None of these species are threatened.



Gould's Wattled Bat and forest bats also have similar calls and have been attributed to a species complex. None of these species are listed as threatened.

Although several species belonging to the Freetail Bat (*Ozimops* spp.) have recently been identified (Reardon *et al.* 2014), their calls are still difficult to identify; hence they are grouped together in the analysis. None of these species are threatened.



Figure 8: Bat survey sites 2010 – 2011 (EHP 2014)



### Legend

	BUS Point Count Locations
×	Anabat Survey Locations (Autumn 2011)
×	Anabat Survey Locations (Spring 2010)
	Golden Sun Moth Survey Locations
-	Study Area





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# 9.3. Results of the surveys

The following section outlines all bat utilisation surveys undertaken to date at the proposed Hexham WF.

# 9.3.1. Spring 2010 and Autumn 2011

The EHP (2014) surveys identified 9 species of bats and five species complexes (Table 22). Two threatened species were observed, the EPBC Act listed Southern Bent-wing Bat (Miniopterus orianae bassanii, SBB) and the FFG Act listed Yellow-bellied Sheathtail Bat (Saccolaimus flaviventris, YBSB).

			Total no. of calls		
Common name	Scientific name	Conservation status	Spring 2010	Autumn 2011	
Yellow-bellied Sheathtail Bat	Saccolaimus flaviventris	Vulnerable, FFG Act	561	35	
Southern Bent-wing Bat	Miniopterus orianae bassanii	Critically Endangered, EPBC and FFG Act	78	15	
Chocolate Wattled Bat	Chalinolobus morio	Common, secure	86	2	
Eastern Falsistrelle	Falsistrellus tasmaniensis	Common, secure	27	1	
Gould's Wattled Bat	Chalinolobus gouldii	Common, secure	528	16	
Large Forest Bat	Vespadelus darlingtoni	Common, secure	1286	46	
Little Forest Bat	Vespadelus vulturnus	Common, secure	61	0	
Southern Freetail Bat	Ozimops planiceps	Common, secure	3	0	
White-striped Freetail Bat	Austronomus australis	Common, secure	240	33	
Forest Bat sp.	Vespadelus darlingtoni/V. regulus/V. vulturnus	(species complex)	196	32	
Goulds Wattled Bat/Freetail Bat sp.	Chalinlobus gouldi/Mormopterus planiceps & ridei	(species complex)	24	0	
Little Forest Bat/Southern Bent-wing Bat/Chocolate Wattled Bat	Vespadelus vulturnus/Miniopterus schreibersii bassanii/Cahlinolobus morio	(species complex)	210	0	
Long-eared Bat sp.	Nyctophilus sp	(species complex)	173	1	
Freetail Bat sp.	Mormopterus planiceps & ridei	(species complex)	1	0	

Table 23 shows details of threatened species and complexes potentially attributable to threatened species recordings from the HWF observed in 2010 and 2011.

The SBB was recorded from seven locations during spring 2010 with a total of 77 calls; and two locations during autumn 2011 surveys with a total of 15 calls. The spring calls were mainly from one location (69 calls) located together with the remaining calls in the north-eastern section of the initial study area between Boonerah Estate Road and Woolthorpe-Hexham Road around the Hopkins River and its tributaries. These locations held River Red Gum trees which typically provide ideal foraging opportunities for SBB and are no longer a part of the proposed wind farm site.



Calls attributable to SBB made during Autumn were made in the western area of the wind farm, around a farm dam and on Muston's Creek. Waterbodies such as this may also provide good foraging opportunities for the species.

Call complexes that could possibly be attributed to SBB, but contain also more common species, occurred at 14 other locations.

The YBSB was detected during both the spring 2010 and autumn 2011 from unusually large number of calls (c. over 590 calls) at 16 locations in the former and 7 locations from the latter surveys. These locations were widely distributed throughout with some clustering around the southern sections of the study area.

Season	Survey dates	Survey location	Southern Bent-wing Bat	Yellow-bellied Sheathtail Bat	Call complex
		HS1	1		71
		HS2			301
		HS3	1		157
	21/10/10-28/10/10	HS6			2
	21/10/10-20/10/10	HS8		105	
		HS9		19	
		HS12		1	
		HS13		48	
		HS1-2	69		273
	28/10/10-4/11/10	HS2-2	3		145
		HS3-2	1	3	118
		HS6-2			3
		HS7-2			25
Spring		HS10-2		6	
		HS11-2		22	
		HS12-2		3	
		HS13-2		109	2
		HS1-3	1		27
		HS7-3			8
	1/11/10 /11/11/10	HS9-3		32	
	4/11/10-/11/11/10	HS10-3		4	59
		HS12-3			25
		HS13-3		17	
		HS1-4	1		258
	11/11/10-18/11/10	HS2-4			
		HS9-4		100	
		HS10-4		27	



Season	Survey dates	Survey location	Southern Bent-wing Bat	Yellow-bellied Sheathtail Bat	Call complex
		HS7-3			
		HS1-4			
		HS10-4			
	18/11/10-23/11/10	HS8-4		10	
		HS12-4		3	
		HS13-4		52	
	10/2/11 17/2/11	HA5			59
	10/2/11-1//2/11	HA6			25
	17/2/11-25/2/11	HA8		26	
		HA10		4	
		HA11			8
		HA12	2		49
		HA13	4		65
		HA7			
Autumn		Tower low			2
	25/1/11-4/3/11	HA3			
		HA12			53
		HA11			
	4/3/11-11/3/11	HA21			
		HA22			21
		Tower high			
	11/3/11-31/3/11	HA21		5	
		HA13	9		
	Total		92	596	1756

# 9.3.2. Spring 2018

Eight species of bats were recorded during Spring 2018 survey (Table 24); six of these species were common, widespread and secure and usually occur in farmland and other habitats throughout south-eastern Australia and two confirmed threatened species; SBB and YBSB.

SBB was detected in the central and north-eastern sections of the wind farm with five calls across five different sites, while YBSB was detected with four calls across two sites in the south eastern corner and central areas of the wind farm (see Figure 9).

In addition to the above positively identified species, four multi-species complexes were also identified (Table 24). Results are displayed by presence at each site given the low numbers of threatened species calls recorded. Three of the species complexes involved common species and the fourth included the threatened SBB.



Common name	Scientific name	Conservation status	Sites of recorded
Southern Bent-wing Bat (5 calls)	Miniopterus orianae bassanii	Critically Endangered EPBC Act and FFG Act	HX7-ground, HX11, HX13, HX15, HX17
Yellow-bellied Sheathtail Bat (4 calls)	Saccolaimus flaviventris	Vulnerable FFG Act	HX3, HX11
White-striped Freetail Bat	Austronomus australis	Common, secure	HX1, HX2, HX3, HX7-air, HX7-ground, HX11, HX14, HX15, HX16
Southern Freetail Bat	Ozimops planiceps	Common, secure	HX7-ground, HX11, HX13, HX15, HX17
Gould's Wattled Bat	Chalinolobus gouldii	Common, secure	HX1, HX2, HX3, HX4, HX5, HX6, hX7-air, HX7-ground, HX8, HX9, HX11, HX12, HX13, HX14, HX15, HX16, HX17, HX18
Chocolate Wattled Bat	Chalinolobus morio	Common, secure	HX1, HX2, HX3, HX7-ground, HX8, HX9, HX10, HX11, HX12, HX13, HX14, HX15, HX16, HX17, HX19
Eastern Falsistrelle	Falsistrellus tasmaniensis	Common, secure	HX1, HX3, HX9, HX17
Large Forest Bat	Vespadelus darlingtoni	Common, secure	HX1, HX2, HX3, HX4, HX5, HX6, HX7- ground, HX8, HX9, HX10, HX11, HX12, HX13, HX14, HX15, HX16, HX17, HX19
Little Forest Bat	Vespadelus vulturnus	Common, secure	HX1, HX3, HX7-ground, HX9, HX11, HX12, HX13, HX14, HX16, HX17, HX19
Species Complexes	s		
Southern Bent- wing Bat / Chocolate Wattle Bat / Little Forest Bat	Vespedelus vulturnus / Miniopterus orianae bassanii / Chalinolobus morio	(species complex)	HX7-ground, HX8, HX9, HX11, HX12, HX13, HX14, HX15, HX16, HX17
Mormopterus sp	Mormopterus planiceps & ridei	(species complex)	HX1, HX2, HX3, HX5, HX7-ground, HX10, HX11, HX13, HX14, HX15, HX16
Long-eared Bat species complex	Nyctophilus spp.	(species complex)	HX1, HX3, HX7-ground, HX11, HX13, HX14, HX15, HX16, HX19
Forest Bat species complex	Vespadelus spp.	(species complex)	HX1, HX2, HX3, HX4, HX5, HX6, HX7- ground, HX8, HX10, HX11, HX12, HX13, HX14, HX15, HX16, HX17, HX19

# Table 24: Bat occurrence at the proposed Hexham Wind Farm during the spring 2018 surveys



# 9.3.3. Summer – Autumn 2019

During the Summer to Autumn 2019 survey; two species of threatened bats, namely, the SBB and the YBSB were recorded in the study area. In addition, a small number of SBB were also recorded as a part of three species complex involving the common Chocolate Wattled and Forest Bats.

A total of 72 calls were positively identified as calls of the SBB. These calls were recorded at 11 sites. 10 calls of YBSB were recorded from four out of the 24 sites and the SBB/Chocolate Wattled Bat/Forest Bat species complex recorded 254 calls from 17 sites (Table 25).

	Total	Southern Bent-wing Bat		Species	complex*	Yellow-bellied Sheathtail Bat		
Site	recording nights	Total calls per site	Average calls per night	Total calls per site	Average calls per night	Total calls per site	Average calls per night	
HG1	58	1	0.02	5	0.09	1	0.02	
HG2	58	1	0.02	17	0.29	0	0	
HG3	58	1	0.02	0	0	0	0	
HG4	58	0	0	0	0	0	0	
HS1	79	0	0	3	0.04	0	0	
HS2	79	0	0	1	0.01	0	0	
HS3	79	6	0.08	26	0.33	0	0	
HS4	78	0	0	6	0.08	0	0	
HS5	79	1	0.01	1	0.01	1	0.01	
HS6	78	1	0.01	2	0.03	0	0	
HS7-ground	76	1	0.01	0	0	0	0	
HS7- 50m	76	0	0	0	0	0	0	
HS8	59	25	0.42	18	0.31	0	0	
HS9	58	0	0	0	0	0	0	
HS10	58	0	0	0	0	0	0	
HS11	58	0	0	1	0.02	0	0	
HS12	58	22	0.38	47	0.81	6	0.1	
HS13	59	0	0	3	0.05	0	0	
HS14	59	10	0.17	82	1.39	2	0.03	
HS15	59	0	0	3	0.05	0	0	
HS16	59	3	0.05	35	0.59	0	0	
HS17	59	0	0	3	0.05	0	0	
HS18	59	0	0	1	0.02	0	0	
HS19	59	0	0	0	0	0	0	
Totals	1560	72	0.05	254	0.16	10	0.01	

Table 25: Th	reatened bat species	recorded at the study are	ea during the summer/autumn	2019 surveys
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\* Species complex - Southern Bent-wing Bat/Chocolate Wattled Bat/Little Forest Bat



# 9.3.4. Height distribution of bats

Records were taken at height during each survey period. The height distribution of bats was studied by placing the recorder microphones at two different heights utilising the first wind mast for this purpose during the 2010/2011 and 2018/2019 surveys. In 2020 a second wind mast was included in the surveys. Microphones were placed at the following heights:

- 42 metre height (Tower high) (EHP survey)
- At 50 metres above ground (Nature Advisory surveys), and
- On the ground beneath each met mast.

Recordings were made concurrently at ground and at height over each period although it was not clear from EHP report whether concurrent recordings were made during Spring 2010.

The distribution of the frequency of bat calls and heights at which they were recorded are shown in Table 26. As previously mentioned, all species were analysed in Spring 2018 while only threatened species were taken into account in Summer-Autumn 2019 and Summer-Autumn 2020.

Calls recorded at the ground level were of mostly common species such as Gould's Wattled Bat and White-striped Freetail Bat during 2018 and SBB had a single call identified in both seasons. In addition, all species complexes were also recorded with the Forest Bat complex being the most frequently recorded during spring. The bat call complex including Southern Bent-wing Bat was recorded only at ground level with 2 calls in Autumn 2011, 1 call in Spring 2018 and one call in Summer/Autumn 2020.

At 50 metres above ground, only Gould's Wattled Bat and White-striped Freetail Bat were recorded during Spring 2018. These two species of bats, are known as high flying bats, particularly the second species and been regularly recorded at heights in other wind farms in similar settings (BL&A, Unpubl. Reports). No threatened species or associated complexes were recorded at height.



Species	Autum	n 2011	Spring	2018	Summer-A	utumn 2019		Summer-/	Autumn 2020	
	Tower 42m (35 nights)	Tower ground (35 nights)	HX7 50m (41 nights)	HX7 ground (40 nights)	HS7 50m (76 nights)	HS7 ground (76 nights)	North ground (69 nights)	North 50m (31 nights)	South ground (69 nights)	South 50m (31 nights)
Chocolate Wattled Bat							Х		Х	
Gould's Wattled Bat		2	11	11						
Large Forest Bat		1		2						
Little Forest Bat				1						
Southern Bent-wing Bat				1		1				
Yellow-bellied Sheathtail Bat	х									
White-striped Freetail Bat		14	7	3						
				Identified	to call comple	ЭX				
Freetail Bat complex				5						
SBB/Little Forest Bat/Chocolate Wattled Bat complex		2		1					1	
Long-eared Bat complex				5						
Forest Bat complex				15			Х	Х	Х	

# Table 26: Bat diversity at ground & 50m height at Hexham Wind Farm

X - Denotes presence (numbers not provided in EHP report and 2020 bat call analysis)



### 9.4. Overview of threatened bat species recorded across the study area

Two threatened species; SBB (confirmed and species complex) and YBSB were confirmed as occurring on site during each survey. Their occurrence across the study area and related implications are discussed in the following section.

### 9.4.1. Southern Bent-wing Bat

Southern Bent-wing Bat occurs between Robe and Naracoorte in south-east South Australia and has been recorded at Heywood, Portland, Hamilton and Warrnambool in western Victoria. Bentwing bats are insectivorous cave dwelling bats, and the Southern Bent-wing Bat's population is centred around the limestone cave system at Naracoorte, South Australia. At night the species disperses over a range of habitats. In Victoria, it usually forages over forested areas, volcanic plains, wetlands, coastal vegetation (including beaches) (DAWE 2020). It is likely that the species is associated with threatened EVCs, including wetlands of the Temperate Lowland Plains, which are listed as Critically Endangered.

In late spring and summer, this species congregates in "maternity caves" where the females give birth to and raise their young. In autumn and winter, after the young are weaned, these bats disperse over a large region. Only two known large maternity caves of the Southern Bent-wing Bat are known: Bat Cave at Naracoorte in South Australia and Starlight Cave at Warrnambool in Victoria. Southern Bent-wing Bats move into more widely dispersed, smaller caves for winter (Churchill, 2008).

SBB was recorded from 24 different sites across the study area from 2010 to 2019 (Table 27). Spring 2010 had the highest number of positively identified calls with 77 calls, 69 (89%) of these were recorded at a single site. Autumn 2019 had the next highest with 72 calls which were less concentrated than the Spring 2010 calls, but primarily distributed across three sites. Interestingly, during the 2010-2011 and 2018-2019 survey periods covering the SBB migration periods, only one season had high numbers of calls with the other season yielding comparatively low numbers of calls. For 2010-2011 it was Autumn and in 2018-2019 it was Spring. This may indicate that while SBB occasionally migrates through the study area, they likely take different paths with each migration.

The areas with the highest activity of SBB was at site HS13 during Spring 2010 with 89% (69 calls) of calls recorded, located in the southern section of the wind farm (Figure 13). This location was off Cooramook Lane approximately 700 metres from a large farm dam with small patches of treed wind breaks nearby.

During Autumn 2011; site HA13 recorded 86.7% (13 calls) of calls and was located approximately 300 metres south of a large farm dam towards the centre of the wind farm (Figure 13). There were also patches of linear treed wind breaks in the vicinity.

Five sites held one SBB call during Spring 2018 and were all generally located in the centre (within a few kilometres of large farm dam or Mustons Creek) or north east of the wind farm near where Limestone Creek runs and several small to medium farm dams are located (Figure 11).

HS8 had 34.7% (25 calls) of calls during Autumn 2019 and is located in the north east section of the wind farm approximately 100 metres from a farm dam and treed wind breaks. HS 12 also had a comparatively high number of calls (30.6%, 22 calls) and was located in a small patch of trees approximately 300 metres from a medium farm dam in the north east portion of the wind farm (Figure 12).



Table 27 shows the results for the Southern Bent-wing Bat at all survey sites from Spring 2010 to Autumn 2019. Locations of Southern Bent-wing Bat call records are shown in Figures 11 to 13.

Table 27: Numbers and average per	r night of Southern Bent-wing	Bat calls (2010-2019) by site
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Site	No. of nights	No. calls	Ave. calls per night
	Spring	2010	
HS1	8	1	0.13
HS3	8	1	0.13
HS1-2	8	69	8.63
HS2-2	8	3	0.38
HS3-2	8	1	0.13
HS1-3	8	1	0.13
Total	382	76	0.20
	Autumi	n 2011	
HA13	29	13	0.45
HA12	9	2	0.22
Total	413	15	0.04
	Spring	2018	
HX7-ground	53	1	0.02
HX11	21	1	0.05
HX13	21	1	0.05
HX15	20	1	0.05
HX17	20	1	0.05
Total	385	5	0.01
	Summer/Au	ıtumn 2019	
HS8	59	25	0.42
HS12	58	22	0.38
HS14	59	10	0.17
HS3	79	6	0.08
HS16	59	3	0.05
HG1	58	1	0.02
HG2	58	1	0.02
HG3	58	1	0.02
HS5	79	1	0.01
HS6	78	1	0.01
HS7-ground	76	1	0.01
Total	1560	72	0.05

The 2018 and 2019 Southern Bent-wing Bat calls were peer reviewed by Greg Ford (Principal Ecologist of Balance Environmental, QLD) and confirmed as such via email (21/7/2020).





- Southern Bent-wing Bat calls (number of calls recorded)
- Brolga turbine free buffer (incl 95m blade buffer)






#### Habitat usage and behaviour of the Southern Bent-wing Bat

Richards (2006, 2007) suggests a strong preference for areas of treed habitat with the bulk of the calls recorded of Southern Bent-wing Bat during a study of migratory routes and comparative habitat usage, being from sites that contained old and mature trees, particularly old pines, and only few calls were recorded from open treeless sites. Mills and Pennay (2017) concluded that there was a distinct difference in the average level of activity between usage of forested and cleared sites by the closely related sub-species Eastern Bent-wing Bat (or Large Bent-wing Bat) (*Miniopterus orianae oceanensis*). In their study, Bent-wing-bat activity was almost seven times greater at forested sites.

Southern Bent-wing Bat also show a preference for seasonally inundated swamps with terrestrial vegetation around the fringes (Stratman 2005). Lumsden and Jamieson (2015) state that wetlands are used extensively, with individuals recorded flying considerable distances to reach these foraging areas.

The published reports for the Dundonnell Wind Farm EES (BL&A 2015) included the results of bat detector recording adjacent to and 120 metres from remnant treed vegetation and from a wetland. In both cases, the numbers of calls detected (for the same recording effort) 120 metres from these two habitat types were much lower than adjacent to these habitat types and comparable with call numbers in open agricultural paddocks with no suitable habitat for bats. The work of Wood and Radford (2015) showed that bat activity at the Macarthur Wind Farm was an order of magnitude higher in treed habitats than in open pasture or near wetlands.

Richards (2007) also found that bats likely migrate at different times during the different years or do not necessarily pass through same site each year, and instead select alternative routes and appeared to usually follow large patches of remnant vegetation in their movements. In addition; bats do not migrate *en-masse* from the maternity cave, but dispersed gradually in small groups. Monitored dispersal in 2007 from was over a much longer period than previously described, where dispersal from the breeding cave was considered to be mid to late summer (Duncan *et al* 1999). Dispersal appeared to still be continuing when the study was closed by April 2007.

The discussion above reflects the results of the Hexham Wind Farm bat utilisation study which suggests that the species preferred the wetland and treed areas. It is likely that Southern Bentwing Bat will preference foraging and migrating through these areas as opposed to the treeless habitat and unvegetated farm dams where the majority of turbines are proposed to be located.

#### Flight height of the Southern Bent-wing Bat

Southern Bent-wing Bat are thought to fly up to and many times above the canopy height in treed areas but drop to approximately six metres above ground level in open areas (Churchill 1998, 2008).

A recent report by Moloney et. al. (2019) on post-construction surveys of wind farms in Victoria states there have been eight mortality records of Southern Bent-wing Bat, based on available data up to February 2018. Evidently there is risk posed to the species by operational turbines, however it is not stated what areas of Victoria these mortalities have occurred, what turbine dimensions have been utilised or what the habitats of the sites consist of.

Nature Advisory has undertaken pre and post construction bat utilisation surveys at 11 proposed and constructed wind farms within and on the very edge of the predicted Southern Bent-wing Bat range (Nature Advisory unpublished data). All surveys were undertaken by experienced zoologists from Nature Advisory or subcontracted experienced bat ecology experts. The surveys have been



undertaken between 2007 to 2019 and used best available guidelines and technology available at the time. All surveys were conducted during the Southern Bent-wing Bat migratory periods and recorded calls were analysed by bat call experts. All surveys were subject to the same limitations outlined in section 9.2.3.

All wind farms were surveyed between two and four migratory periods, often with earlier surveys being repeated to ensure best practice and up to date ecological data. Two wind farms were only survey over one period due to being on the very edge of the species range and recording no confirmed calls or complexes. Ten survey sites contained at least one recorder at height paired with another at ground level which was limited by the availability of met masts and the ability to install recorders on them. The recorder heights were at least 50 metres above the ground for the majority of wind farms and one wind farm had four paired recorders at 85 metres above the ground.

The majority of these sites contained relatively low activity compared with other bat species and two wind farms recorded no Southern Bent-wing Bat activity however, these were at the very edge of the species predicted range. The remaining nine had at least one call confirmed as Southern Bent-wing Bat and typically more calls identifiable to a species complex potentially attributable to the species. Two sites had relatively high activity recorded relative to other bat species.

At all surveyed wind farms, none recorded confirmed or complex Southern Bent-wind Bat calls at 50 metres or above, even when there was activity recorded at ground level simultaneously. One call was recorded on a complex at 20 metres, which is below typical RSA heights. An additional three publicly available wind farm bat utilisation reports; Hepburn Community, MacArthur and Mt Fyans Wind Farms also recorded no calls at heights (Richards 2011, Wood and Radford 2015, Biosis 2018).

While the above data suggests that Southern Bent-wing Bat do not typically fly at heights of 50 metres or greater, Mills and Pennay (2017) found that the closely related subspecies; Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) was recorded flying at 100 metres above the ground near the maternity cave of Wee Jasper in NSW. They also found they were 9.3 times more likely to be recorded at ground level. Further away from the cave, the concentration of Bentwing-bat activity was much lower and not detected flying at 100 metres above the ground at the same sites where they were detected at ground level. Similarly, Reardon (pers. comm., 2018, cited in Thompson 2018) states that Southern Bent-winged Bats fly up to heights of 250 metres above ground level, based on a study conducted using radar, when leaving caves. This information would suggest that Bent-wing Bats fly at great height when departing the maternity cave but then fly closer to the ground when moving further away.

Based on the above, it is likely that while Southern Bent-wing Bat are capable of undertaking flight at great height, their typical behaviour is to fly closer to the ground. As there is little treed habitat across the Hexham Wind Farm, Southern Bent-wing Bat are unlikely to fly at turbine rotor swept area (RSA) height frequently in areas proposed for turbines. The proposed turbine blade lower tip height is to be a minimum of 40 metres above the ground, which is higher than most wind turbine RSAs currently installed in Australia. This higher minimum RSA height will reduce the risks of collisions.

#### Flight distances of the Southern Bent-wing Bat

The Southern Bent-wing Bat can travel long distances from caves, with lactating females recorded repeatedly returning to areas 23 to 25 kilometres from the Naracoorte maternity cave (Grant 2004; Bourne 2010). One radio tracked male was recorded 35 km from the roost site (Bourne 2010). A study by Wilson (2000) indicated that the average distances moved between banding sites was



between 15.5 kilometres for males and 43.8 kilometres for females. Grant (2004) recorded individuals radio tracked from the Naracoorte maternity site predominantly foraging along a forested ridgeline within three to four kilometres of the cave. More recent studies have shown that movements between caves detected individuals moving repeatedly between Naracoorte and Glencoe caves which are approximately 70 kilometres distance apart in a time frame as little as 3.3 hours (Mills and Pennay 2017, van Harten et. al. 2018, unpub data).

The above information suggests that regular flights from caves are of distances between three kilometres and up to 35 kilometres. While movements between caves occur between 15.5 kilometres to 70 kilometres.

#### Wintering caves of the Southern Bent-wing Bat

The Southern Bent-wing Bat is an obligate cave-dwelling bat with a restricted distribution, occurring only in south-east South Australia and south-west Victoria (Lumsden and Jamieson 2015). Its local distribution is largely determined by the availability of caves, mine shafts or tunnels. In Victoria, it is usually recorded over forested areas but also occurs widely in lower densities on the sparsely-treed Volcanic Plain (Churchill 2008, Menkhorst 1995; Richards 2006).

Migration occurs in Autumn and Spring between maternity caves and caves used for overwintering roosting. In late Spring and Summer, this species congregates in maternity caves, using transition caves along the way, where the females give birth to and raise their young. Breeding females, and a proportion of the males and non-breeding females, congregate in the maternity caves (Churchill 2008, Lumsden and Jamieson 2015). Bats remain at the maternity cave and start dispersing in late January and February (P. Gray, pers. comm., Richards 2007) and continue through April.

During the non-breeding season, in Autumn and Winter, after the young are weaned, the bats disperse throughout the region roosting in a large number of caves and rock crevices (Churchill 2008, Lumsden and Jamieson 2015). Small numbers have also been recorded roosting during the day in inland and coastal cliff caves, as well as disused mine shafts (Duncan *et al.* 1999; Menkhorst 1995).

Most known Southern Bent-wing Bat roost locations are in limestone caves but also occur in lava tubes, coastal cliff rock crevices and man-made tunnels. Different caves are used seasonally according to required microclimatic conditions (Lumsden and Jamieson 2015).

The Southern Bent-wing Bat draft recovery plan (Lumsden and Jemison 2015) outlines that at least 50 roost sites are known across the species range. Many of these are not listed publicly and exist on private land and while there are a large number of known Southern Bent-wing Bat roost sites throughout Victoria's southeast, a knowledge gap exists surrounding the characteristics and number of caves that are critical to the subspecies lifecycle and survival (Thompson 2018).

Further information on the occurrence of Southern Bent-wing Bat roosting caves in the VVP region was sought from Nicholas White from the Victorian Speleologist Association and from Amanda Bush a Fauna Ecology, Threatened Species, Insectivorous Bat Surveys specialist from the Arthur Rylah Institute on the 8<sup>th</sup> and 11<sup>th</sup> of May 2020 respectively whom indicate that there are no other major known caves used by this species in the surrounding region.

Reardon (2019) states that populations within wintering caves fluctuate and that the species does not torpor for up to weeks at a time, during which they are active. He suggests that large proportions of the population will occasionally move between overwintering caves between the migration periods.



#### Known Roosting Caves

Lava tubes and other volcanic caves are scattered across the VVP, the majority of them in the western area where they are associated with two of the younger eruptions in the region from Mt Eccles and Mt Napier (Grimes 2007). Many of these provide potential roosting habitat for Southern Bent-wing Bat.

Lava tubes form in basaltic lava flows by two main processes; by roofing forming over surface lava channels and by molten material draining from beneath the solidified crust of a flow (Grimes 2007). These processes generally develop in association with volcanic vents and scoria cones which can form prominent features on the landscape, such as Mt Hamilton and Mt Napier and as smaller features such as Mt Fyans. Lava caves can also develop as a result of partial collapse of lava tubes on the flanks of slopes (Biosis 2018). Many lava tubes present may not be exposed to the surface at all.

Most known SBWB roost locations are in limestone caves but also occur in lava tubes, coastal cliff rock crevices and man-made tunnels. Different caves are used seasonally according to required microclimatic conditions (Lumsden and Jamieson 2015). Thomas (2018, cited in Biosis 2018) noted that all major SBWB roosts are located in lava tubes and none have yet been identified in scoria cone formations.

The microclimate within a cave is a key factor in determining its usage for both roosting and breeding activity. During winter bats select cool roost sites that facilitate entry into torpor, where they lower their body temperature to reduce energy expenditure (Hall 1982). While maternity caves have specific structural characteristics that allow heat and humidity to build up (Dwyer 1965). High temperatures and humidity levels have been recorded within the maternity cave at Naracoorte suggesting that the heat produced by the bats themselves increases the temperature (Baudinette *et al.* 1994).

The Southern Bent-wing Bat draft recovery plan (Lumsden and Jemison 2015) outlines that at least 50 roost sites are known across the species range. Many of these are not listed publicly and exist on private land and while there are a large number of known SBWB roost sites throughout Victoria's southeast, a knowledge gap exists surrounding the characteristics and number of caves that are critical to the subspecies lifecycle and survival (Thompson 2018).

Table 28 lists publicly known and important SBWB roosting locations throughout Victoria and Figure 14 shows their location in relation to Hexham Wind Farm.

Panmure and Grasmere roost sites, along with the Warrnambool maternity cave, are the only SBWB caves identified within 30 kilometres of Hexham Wind Farm.



Location	Cave	Approx. distance from Hexham Wind Farm	Description
Byaduk	Church Cave	56kms west northwest	A series of caves and a well-known roosting site (Lumsden and Jemison 2015).
Mt Eccles National Park	Unnamed cave	60 kms west	Situated within the Mt Eccles National Park and an important roost site (Richards 2006, ACCIONA Energy 2009).
Panmure	Panmure cave	30 kms south southeast	Known roosting lava tube cave on private property (Lumsden and Jemison 2015, Biosis 2018). Large numbers of bats use this as a roost (ACCIONA Energy 2009).
Pomborneit	Pomborneit cave	63 kms east southeast	known roosting cave (Lumsden and Jemison 2015, Rob Gration personal communication 2019). Can have up to 3000-4000 SBWB individuals which fluctuates over the winter period as bats move around (Reardon 2019). Was formerly mined for guano but recently disturbance to the cave is limited (Biosis 2018).
Grasmere	Grasmere (W5) cave	25kms south southwest	Cave on private property (Lumsden and Jemison 2015, Rob Gration personal communication 2019). Known to support large roosting SWBW numbers (ACCIONA Energy 2009).
Bats Ridge	Tom-the- cheap Cave	100kms west southwest	A series of caves and a known roosting location near Portland (Lumsden and Jemison 2015, Rob Gration personal communication 2019).
Yambuk	Yambuk Cave & Deen Maar cave	55km south west	Known roosting caves (ACCIONA Energy 2009). SBWB detected near a cave here by Rob Gration in 2019 (personal communication 2019). A number of caves in an Indigenous Protection Area on the coast near Yambuk.
Portland	Cape Bridgewater Sea Cave	100kms west southwest	Coastal sea cave with reasonable numbers (ACCIONA Energy 2009)
Lower Glenelg National Park	Unnamed cave	140 kms west	Reasonable numbers of SBWB (ACCIONA Energy 2009).
Cape Volney	Unnamed cave	97 kms south east	A series of sea cliff caves in the western end of the Otways used as an important roost (ACCIONA Energy 2009). Signs of bat activity but not confirmed as SBWB in 2019 (Rob Gration personal communication 2019).
Porndon	Porndon Arch	63 kms east southeast	Used as an important roost (ACCIONA Energy 2009)
Cape Patton	Unnamed cave	130 kms south east	Used as an important roost (ACCIONA Energy 2009). Sea cliff caves exposed to the ocean between Lorne and Apollo Bay. No signs of SBWB in 2019 (Rob Gration personal communication 2019).
Lorne	Cumberland River Cave	130 kms south east	Used as an important roost (ACCIONA Energy 2009)

#### Table 28: Numbers and average per night of Southern Bent-wing Bat calls (2010-2019) by site





#### Potential Roosting Caves

Further information on the occurrence of SBWB roosting caves in the VVP region was sought from Nicholas White from the Victorian Speleologist Association and from Amanda Bush Fauna Ecology, Threatened Species, Insectivorous Bat Surveys specialist from the Arthur Rylah Institute on the 8<sup>th</sup> and 11<sup>th</sup> of May 2020 respectively. Both confirmed that the important SBWB roost locations listed above are current extent of publicly available and confirmed SBWB roosting locations in the VVP region and surrounds.

Smaller caves may occur throughout the region in areas of volcanic activity, particularly around volcanoes, recent lava flows and lava extrusion points, as outlined in the sections above, and provide potential SBWB habitat. However, many of these formations are small and very difficult to identify, requiring on ground surveys by geological and SBWB ecology experts.

Roost investigations, mostly desktop based, have been undertaken at a number of proposed and developed wind farms in the VVP region, the ecological investigations for some of which are publicly available. Few actual roost searches have been done as part of these investigations or are at least not publicly available.

Biosis (2018) undertook a detailed on-ground SBWB investigation for major roosts (described as being of 10s of SBWB individuals roosting over multiple years (Thomas 2018)) in the Mt Fyans area, including of a scoria cone referred to as Flat Top and another referred to as Mondibili Cone on private land. These areas, along with Mt Hamilton and Mt Fyans were determined to be the most likely SBWB major roost areas based on extensive SBWB ecological and speleological knowledge of the researchers involved. No further SBWB roosting activity was identified. This investigation shows that any on-ground SBWB roost survey should focus of areas of recent volcanic activity or volcanic extrusion points in the vicinity to developments and in consultation with geological and speleological experts.

Two caves, Panmure and Grasmere, which are known to support roosting SBWB occur within 30 kilometre of Hexham Wind Farm. These caves lie to the south of the wind farm, closer to the Warrnambool maternity caves. The investigation identified another six important roosting sites within the 70-kilometre radius of the wind farm site and four more outside the 70m radius.

There is potential for additional SBWB roost sites to occur in the VVP region and these are likely to occur in association with caves formed by recent volcanic activity. Some caves may be small and unidentified.

SBWB usage of caves is dependent of climactic conditions and their usage of a cave may vary between seasons.

#### 9.4.2. Yellow-bellied Sheathtail Bat

This Yellow-bellied Sheathtail Bat (YbSB) is widespread over much of Australia, except for southern Western Australia and western South Australia assessed for the Red List by K Armstrong & L Lumsden. It is recorded rarely in south-eastern Australia, and it is still unknown if these records represent occasional summer-autumn visitors (Richards 2008), vagrants (Lumsden and Menkhorst 1995) or small resident populations with specific habitat requirements (Richards 2008). In Papua New Guinea it is known from two specimens collected in Central Province and the National Capital District (Armstrong et al (2017) noted from Flannery 1995, Bonaccorso 1998, and Richards 2008), but has not been captured since.



The species occurs in most environments from wet forests to open woodland to deserts (Menkhorst and Knight 2011). Seasonal migration movement patterns are poorly understood however, there is speculation about a migration to southern Australia in late summer and autumn (OEH 2020a). The species has been observed to fly fast and straight, usually above the canopy when foraging for insects, but lower in more open country (Churchill 2008). Armstrong et al (2017) propose that this species has an upper elevation limit (metres) of 600 metres.

Overall population numbers of this species in Victoria are unknown and the lack of records in the region may be related to lack of survey effort than a reflection of the population.

Nature Advisory (unpublished data) has recorded few individual records of this species at proposed wind farm sites from Queensland through to south western Victoria. Typically, acoustic recordings indicate low levels of activity and are of few calls (1-5) over one to two nights at different locations across a site.

EHP (2014) recorded unusually high numbers of YbSB calls at various sites across the study area in 2011 in both seasons indicating very high activity levels at recording locations and no specific habitat preference within the study area (Table 29). This further suggests that there may be a resident population at the proposed wind farm that does not migrate north during spring, as the available literature suggests. Nature Advisory is conducting on-going monitoring at Met mast locations on site which may provide further data on the species occurrence during different seasons.

The 2018 and 2019 surveys indicated much lower levels of activity than previously recorded and at much fewer locations (Table 29), but as discussed in the limitations section of this chapter, this does not translate to population census and rather only confirms the species continued presence on site. The species was recorded at windrows, wetlands, a farm dam and roadside vegetation.

Locations of Anabat/Songmeter recorders between surveys differed also but distances between those sites were not significant and all surveys targeted general potential habitat of micro-bat species such as windrows, roadside vegetation, waterways, dams and open paddocks. Therefore, the reason for differences in detected activity levels between years is unclear.

Survey location	Recorder nights	Yellow-bellied Sheathtail Bat	Ave. calls per night							
Spring 2010										
HS8	8	105	13.13							
HS9	8	19	2.38							
HS12	8	1	0.13							
HS13	8	48	6.00							
HS3-2	8	3	0.38							
HS10-2	8	6	0.75							
HS11-2	8	22	2.75							
HS12-2	8	3	0.38							
HS13-2	8	109	13.63							
HS9-3	8	32	4.00							
HS10-3	8	4	0.50							
HS13-3	8	17	2.13							
HS9-4	8	100	12.50							

#### Table 29: Numbers of Yellow-bellied Sheathtail Bat calls (2010-2019) by site



Survey location	Recorder nights	Yellow-bellied Sheathtail Bat	Ave. calls per night								
HS10-4	8	27	3.38								
HS8-4	6	10	1.67								
HS12-4	6	3	0.50								
HS13-4	6	52	8.67								
Total	382	561	1.47								
	Autumn 2011										
HA8	9	26	2.89								
HA10	9	4	0.44								
HA21	21	5	0.24								
Total	413	35	0.08								
		Spring 2018									
HX3	21	2	0.10								
HX11	21	2	0.10								
Total	385	4	0.01								
	S	ummer/Autumn 2019									
HG1	58	1	0.02								
HS5	79	1	0.01								
HS12	58	6	0.10								
HS14	59	2	0.03								
Total	1560	10	0.01								

#### Habitat usage and behaviour

YbSB is believed to forage across a wide variety of habitats, including eucalypt forests, woodlands and open habitats. It can be relatively abundant in some tall forests of northern Australia, likely ranging several tens of kilometres each night (K.N. Armstrong unpublished data as cited in IUCN 2018), and its use of large trees in riparian areas probably help it to expand its range into woodlands with relatively low tree height. It roosts in tree hollows, usually singly but sometimes in groups of up to 10, though breeding colonies may exceed 100 individuals. It may make migratory movements in the south-eastern portion of its range during autumn. Seasonal movements might also occur in the mid-coastal Western Australian range (N. McKenzie pers. comm as cited in IUCN 2018).

Breeding has been recorded from December to mid-March when some single young are born. They roost singly or in small groups of six in tree burrows. In treeless areas, they have been known to utilise mammal burrows (Menkhorst and Knight 2011).

The species diet consists of invertebrates, predominately beetles. They are also known to forage on grasshoppers, leafhoppers, shield bugs, crickets, wasps and a few flying ants (Churchill 2008).

Richards (2007, 2008) suggests the Yellow-bellied Sheathtail Bat is a species that flies high and fast above the canopy of dense forest and woodlands. An extensive study of habitat utilization by the Yellow-bellied Sheathtail Bat in the Cadia Valley (Orange district) NSW was conducted by Richards (2008) in November 2004. In this study, ten woodland/open forest remnants ranging in size from 20-1700 ha were monitored for this species Regression analysis of the number of calls recorded was highly correlated (R2 = 0.9459) with the approximate size of the remnants studied.



There appeared to be a threshold of at least 500 ha before high levels of activity and relative abundance were observed.

#### Flight heights

The species was recorded flying at a height of 45 metres during the 2011 surveys, confirming that the species can fly at least at this height. Nature Advisory has not recorded the species flying at height in the study area during the 2018 – 2019 surveys.

Nature Advisory (unpublished data) have identified at least two individuals as mortalities under turbines at other wind farms within the species range at wind farms in NSW. This comes from current and past monitoring of 15 wind farms within the species range which would indicate that collisions, while evidently known to occur with turbines, is not a common occurrence for this species.

#### Threats

This species is reported to have the highest prevalence of Australian bat Lyssavirus in Australian echolocating bats, though the implications for the species are not known (Armstrong, et al 2017). Feral European honeybees commonly take over tree hollows in arid Australia and displace many fauna species, including YbSB. Habitat clearance and modification in eastern Australia are likely causes of a reduction in area of occupancy, as is the replacement of perennial species in riparian zones of arid areas (N.L. McKenzie pers. Comm as cited in Armstrong et al 2017).

The likely causes of population decline are attributed to:

- Disturbance to roosting and summer breeding sites.
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions.
- Loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat.

Use of pesticides and herbicides which may reduce the availability of insects and can result in the accumulation of toxic residues in individuals' fat stores.

The Yellow-bellied Sheathtail Bat is listed under the FFG Act and is not listed as threatened under EPBC Act. It listed as "least Concern" on IUCN's Red List of Endangered Species (IUCN 2018).

The IUCN Red list states; "this bat is listed as Least Concern given its wide distribution, use of a broad range of habitats, large population size, occurrence in protected areas, and the absence of significant key threats or evidence for a decline. Acoustic surveys in northern Australia often encounter this species, especially those employing full spectrum detectors that allow harmonic profiles to be observed, suggesting that it can be relatively common. It is recorded rarely in south-eastern Australia, and it is still unknown if these records represent occasional summer-autumn visitors (Richards 2008), vagrants (Lumsden and Menkhorst 1995) or small resident populations."

It is present in many protected areas throughout Australia. Targeted surveys in Papua New Guinea are needed to more clearly define extent of occurrence and habitat association. Further ecological research is needed to investigate its status in the southern parts of its range as well as its basic ecology and roosting habits (Armstrong, et al 2017).



#### 9.4.3. Grey-headed Flying Fox

The Grey-headed Flying Fox has been recorded in small numbers (5-10 individuals) during targeted surveys in February 2022. This survey was undertaken after DELWP indicated a camp with a large number of Flying Foxes may be located within 2km of the wind farm site.

This survey confirms the presence of this species and the location of a camp is assumed within a plantation to the east of the proposed wind farm site, south of Hamilton Highway. Further studies will be undertaken in March 2022, when the majority of Flying Foxes are expected to arrive at the site based on information of a local resident.

There are limited food resources at the proposed HWF that would attract the Flying Fox to the area. Food resources at the HWF include blossoms of remnant eucalypts and planted Sugar Gum (*Eucalyptus cladocalyx*) and the fruit of any planted fruit trees that may be around farm houses.

The closest confirmed roost of this species is located at Warrnambool and is more than 30 kilometers from the closest proposed turbine. Each night the Flying Foxes leave their roost and spread out across the landscape in search of food resources which include fruit and nectar from blossoms. They will usually travel within 15 kilometers of its roost in search of food each night (Tideman 1998) though they have been reported moving out to 50 kilometers (DAWE 2021b).

Further investigations are underway to determine the number of Flying Foxes using the assumed camp east of the wind farm site, their flight directions and possible food sources within and beyond the wind farm site. Mitigation measures will be developed based on this information.

#### 9.5. Gradient studies from a permanent water source

In 2020 "Gradient surveys" were undertaken with the aim of determining buffer distances from turbine blade tips and areas of higher bat activity. These gradient surveys involved five detectors positioned at 60 metre intervals in a straight line from a specific ecological feature, specifically focusing on the activity levels of SBWB.

#### 9.5.1. Methods

Five detectors were deployed adjacent to a large dam on private property which would have flowed in Muston's Creek labelled as sites MC1 – MC5. The dam is located on the north western side of the proposed development and is situated in primarily cleared agricultural land with some scattered shrubs and trees. The dam generally follows the line of the creek forming a linear shape rather than a circular dam. Recorders were arranged in a line running east from the north end of the dam.

Another five detectors were placed at another large dam on private property closer to the western boundary of the proposed wind farm labelled W1 - W5. This dam would also have flowed into Muston's Creek and features a narrow band of planted riparian habitat surrounded by cleared agricultural lands. Recorders were placed starting from the edge of the southern arm of the dam running south.

Figure 15 shows the locations of the gradient study recorders.

'MC' site recorders were placed on the 20<sup>th</sup> February 2020 and retrieved on 22<sup>nd</sup> June 2020 whereas 'W' sites were placed 18<sup>th</sup> June 2020 and retrieved on 22<sup>nd</sup> June 2020.

The total number of bat calls from each recorder was analysed, as was the number of calls of threatened bat species and species complexes as per section 9.2 methods. Limitations outlines in that section also apply here.





#### 9.5.2. Results

The gradient study did not yield sufficient data to indicate a trend in habitat preference at either site for SBWB. No confirmed calls were recorded from the MC sites and eight calls were recorded from the W sites (Table 30). These numbers of calls per site are insufficient to provide a robust statistical analysis of significance and provide a meaningful quantitative conclusion. More calls were recorded from the complex however this cannot be directly attributed to SBWB and cannot reliably be used to confirm behaviour.

Site	Recorder nights	Distance from wetland (m)	Call complex calls	SBWB calls
MC1	94	0	15	0
MC2	94	60	0	0
MC3	94	120	0	0
MC4	94	180	0	0
MC5	94	240	0	0
Total	470		15	0
W1	92	0	0	0
W2	92	60	7	2
W3	92	120	9	6
W4	92	180	3	0
W5	92	240	0	0
Total	460		35	8

#### Table 30: Result of gradient study

To provide further insight into habitat preference of SBWB Table 31 below shows all confirmed SBWB calls recorded during each survey period, the habitat in which they were located and the general distance to the nearest waterbody (waterway, dam, creek).

The results show that SBWB was recorded in a variety of habitats not necessarily adjacent to water sources. Indeed, higher numbers tended to be more frequently recorded at treed habitat, occasionally hundreds of metres from water.

Survey location	Distance to water (km)	Habitat (within 30m)	Confirmed SBWB Calls							
	Spring 2010									
HS1-4	0	Mature red gums adjacent large dam	1							
HS1	0	Mature red gums adjacent large dam	1							
HS3	0.3	Pine windrow	1							
HS1-3	1.4	Scattered red gums	1							
HS3-2	1.7	Pine windrow	1							
HS2-2	0.5	Eucalyptus windrow	3							
HS1-2	0.9	Scattered Red Gums	69							
	Autumn 2011									
HA12	0	Muston's Creek	2							
HA13	0	Dam on Muston's Creek	13							

#### Table 31: Confirmed SBWB calls and associated habitat



Survey location	Distance to water (km)	Habitat (within 30m)	Confirmed SBWB Calls
Spring 2018			
HX13	0.1	Open woodland, farm dam, open paddocks	1
HX7-ground	0.5	Open paddocks	1
HX11	0.6	Small Eucalypt windrow, open paddocks	1
HX17	0.6	Eucalypt windrow, open paddocks	1
HX15	1.2	Open paddocks	1
		Autumn 2019	
HS5	0.0	Scattered trees, open paddocks	1
HS7-ground	0.5	Open paddocks	1
HS6	1.1	Scattered remnant and scattered trees, open paddocks	1
HS16	0.3	Pine and acacia windrow, open paddocks	3
HS3	0.0	Pine windrow, dry creek bed, open paddocks	6
HS14	1.1	Eucalyptus windrow, open paddocks	10
HS12	0.3	Scattered trees, open paddocks	22
HS8	0.1	Large old tree, open paddocks	25

#### 9.5.3. Mitigation measures

Mortalities due to collision and altered access to foraging areas are possible and mitigation measures to prevent these impacts are described below.

- Turbines being positioned at least 215 metres away (inclusive of blade) from remnant and planted treed vegetation. These habitats are more favoured by the species in the study area and studies at Dundonnell wind farm showed the activity levels of bats dropped considerably at 120 metres from treed areas compared with the treed area itself
- Turbines having a minimum height of 40 metres above the ground, a height at and above which the species is unlikely to fly on a regular basis.

A bat and avifauna adaptive management plan (BAMP) will be prepared for the HWF once a planning permit is approved. This will outline monitoring responsibilities, trigger responses in the event that a listed species is impacted by the wind farm and reporting requirements. Adaptive management measures to reduce impacts would be considered as part of such a plan, if required. Measures could include turbine curtailment at low wind speeds when bats are most active and acoustic bat deterrent devices fitted to turbines.



## 10. Growling Grass Frog

#### **KEY FINDINGS**

- The EPBC Act and FFG Act-listed Growling Grass Frog (*Litoria raniformis*) (GGF) was not detected on the HWF site during targeted surveys conducted by EHP in 2009-10 but was recorded in a number of locations across the study area during preliminary ecological assessments in 2011 following widespread, prolonged rainfall.
- GGF was detected on the HWF site, heard calling three separate sections of Mustons Creek by Nature Advisory.
- It is therefore assumed that the GGF may use the Mustons Creek for most parts of the year utilising the sections that retain sizable water pools. Mustons Creek connects to the Hopkins River to the east of the study area and therefore provide continuous habitat for the GGF.
- Several other smaller tributaries of the Mustons Creek within the study area could possibly
  provide habitat for the frog during the wet season and form a continuous network of wetland
  habitats for this threatened species.
- Most farm dams lack proper habitat, are usually trampled by livestock and are of low value for the frogs.
- All turbines and associated access tracks (apart from crossings) are located greater than 100 metres from the GGF habitat along Mustons Creek.
- Impacts on GGF habitat from the HWF along Mustons Creek will be minimised at both the detailed design and construction phases of the project by implementing the mitigation measures at the end of this section.
- Provided those measures can be implemented, then the impacts on the species from the HWF will be minor and temporary, affecting only a small proportion of its potential habitat permanently. These impacts will not result in the loss of the species from the creek and, therefore, population scale impacts are not considered likely.

#### 10.1. Introduction

A habitat survey and review of previous assessments was undertaken primarily for Growling Grass Frog (GGF) (*Litoria raniformis*), listed as Vulnerable under the EPBC Act, but also considered Swamp Skink (*Lissolepis coventryi*), listed as Endangered under the FFG Act, at the proposed Hexham WF site. This investigation provided updated information on the likelihood of occurrence of these threatened aquatic species.

The scope of the investigation included:

• Wetland and aquatic fauna habitat assessment.

#### 10.2. Background

#### Description

The Growling Grass Frog has several other common names including the Southern Bell Frog (NSW), Golden Bell Frog (SA), Green and Gold Frog (Tasmania) and Warty Swamp Frog.

It is a large species of frog growing to a size of 85mm. It is dull green to bright emerald green with blotches of brown or rich golden bronze and numerous large warts above and whitish below. It has



a narrow blackish stripe from the nostrils along each side to the groin, which is bright blue or bluegreen (Cogger 2000; Pyke 2002).

#### Distribution

GGF was originally widespread across south-eastern Australia, Bass Strait Islands and northern and eastern Tasmania. Previously the mainland distribution extended from the southern tablelands and Riverina of NSW and the ACT, through most of Victoria (excluding Mallee and alpine areas) and into south-eastern SA near the mouth of the Murray River.

The natural distribution of the frog has contracted, most noticeably since 1990. Since then it has disappeared from the slopes and southern Tablelands of NSW and ACT, from much of central Victoria and from parts of Tasmania and South Australia.

#### Habitat

The Growling Grass Frog is found in cool temperate grasslands near permanent water; inhabits areas of permanent water occurring commonly around reservoirs, farm dams and swamps, especially those with bulrushes. The species often hides by day under debris (Turner 2004).

It is usually associated with water bodies supporting large areas of fringing and aquatic vegetation such as Common Reed (*Phragmites australis*), Bulrush (*Typha spp.*) and Water Ribbon (*Triglochin procera*) (Organ 2002). The species has generally been reported to occur in or around water that is shallow and still or slowly moving, often with emergent aquatic vegetation, but a broad variety of waterbodies are occupied (Pyke 2002).

Near Melbourne, there has been found to be a negative association of Growling Grass Frog occurrence with the length of roads within 1000 metres of a site and a positive association with water-bodies with a high proportion of submerged or floating vegetation and the permanence of the water-body (Heard *et al.* 2004).

#### Breeding and behaviour

In Victoria GGF courtship advertisement calling begins in September or October and continues to about December or January (BL&A, pers. obs.). Tadpoles been observed from September to April, and immature frogs from January to April (Pyke 2002). Over 1500 eggs usually laid in a cluster in spring, summer or autumn following heavy rain resulting in local floods. Eggs hatch within 2 – 4 days of being laid; within four weeks tadpoles may reach metamorphosis. Tadpoles prefer warmer water and feed near surface with head upwards; may reach over 100 mm in length (Turner 2004).

GGF are generally more active and more often seen at night but will often call during the day from September to December (BL&A, pers. obs.). The frog is not a frequent climber of plants and usually found in water, on floating vegetation or nearby at ground level.

Little is known about diet and foraging. GGF are reported to be a 'sit-and-wait' predator, foraging during the day and at night. It may feed on tadpoles and other frogs, including members of the same and other species; also reported to feed on other vertebrates, including snakes, lizards and small fish and on invertebrates (DoEE 2018)

#### Threats

Threats to GGF are believed to include habitat loss and fragmentation through land clearing for agricultural and urban development, drought, disease (e.g. chytrid fungus), drainage and degradation of wetlands, increasing salinity and water pollution, and increased predation of tadpoles by the introduced Mosquito Fish (*Gambusia* spp.) and global climatic change (Heard et



al. 2004; Flora and Fauna Guarantee – Scientific Advisory Committee 1999). Mosquito Fish are widespread and abundant throughout much of Victoria and south-eastern Australia (Allen et. al. 2002).

#### Legislative protection

The species is listed as nationally 'vulnerable' under the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999. In Victoria, it is listed under the *Flora and Fauna Guarantee Act* 1988 as threatened; and endangered under the *Advisory List of Threatened Vertebrate Fauna* (DSE 2013). Overall, this species is considered to be of national conservation significance.

#### 10.3. Methods

The detailed GGF surveys based on DSE's *Biodiversity Precinct Planning Kit* and DSEWPC guidelines (2011) was not undertaken in the current investigation. Instead, Surveys were based on the presence or absence of suitable habitats within or near the wind farm, and records of the species from previous studies and the VBA data base.

Aquatic habitats in and near the proposed wind farm were assessed for their suitability for the Growling Grass Frog using the following criteria:

High: Habitat components listed below are usually all present.

- Permanent, or largely permanent, still water body;
- Slow-flowing stream with dense in-stream vegetation;
- Water body with large areas of fringing and aquatic vegetation (e.g. Common Reed, Bulrush, Sedges, Rushes (*Juncus* spp.) and Water Ribbon;
- Thick ground cover vegetation, or rocks, for shelter;
- Connectivity with other areas of suitable habitat.

**Moderate:** Some fauna habitat components are often missing although linkages with other remnant habitats in the landscape are usually intact.

- Water body likely to hold water for most of the year (i.e. permanent, or largely permanent);
- Water body with some fringing and aquatic vegetation (e.g. Common Reed, Bulrush, Sedges, Rushes (*Juncus* spp.) and Water Ribbon;
- Some ground cover vegetation, or rocks;
- Some connectivity with other areas of suitable habitat.
- Water body shows some signs of disturbance (such as erosion, access to stock, feral predators and pets)

Low: Many habitat elements have been lost. Aquatic habitats that are:

- Likely to be ephemeral (only hold water for part of the year);
- Little or no fringing or in-stream aquatic vegetation;
- Isolated (little or no connectivity);
- Showing signs of disturbance (such as erosion, access to stock);
- Thick ground cover vegetation or rocks absent.



The assessment of each of the wetlands is included in Appendix 12. The examination of wetlands for the presence of GGF was carried out during the five migratory shorebirds surveys and during Brolga surveys and incidentally while surveying for bird fauna. In few cases, the frogs were calling during the day confirming their utilization of certain wetlands.

#### Existing Information

Existing information on the status of the GGF were obtained from the VBA (DELWP 2018). These records were obtained from a wider area, termed the 'search region' defined for this assessment as an area of 10 kilometres radius centred on a point of the study area (38° 02' 15" S and longitude 142° 34' 46" E).

EHP did not record the species during targeted surveys in 2012, but recorded GGF in a number of locations across the study area during preliminary ecological assessments in 2011 following widespread, prolonged rainfall (EHP 2014).

The likelihood of suitable habitat in the study area for nationally threatened fauna species was ascertained through a search of the online *Environment Protection and Biodiversity Conservation Act* 1999 Protected Matters Search Tool (DoEE 2018) using the same search region.

Previous work on the study area undertaken by Ecology and Heritage Partners (2014) was reviewed prior to the current investigations.

#### 10.4. Results

GGF was heard calling during the assessment. There were three such records from three separate sections of Mustons Creek (Wetland 111 (17), Wetland 28248 (14) and wetland J (2) – see Figure 16).

It is therefore assumed that the GGF may use the Mustons Creek for most parts of the year utilising the sections that retain sizable water pools. Mustons Creek connects to the Hopkins River to the east of the study area and therefore provide continuous habitat for the GGF. Several other smaller tributaries of the Mustons Creek within the study area could possibly provide habitat for the frog during the wet season and form a continuous network of wetland habitats for this threatened species. In addition, the large lake (wetland 29405) and associated dams could possibly play part in the GGF distribution within the study area, but most dams lack proper habitat, are usually trampled by livestock and are of low value for the frogs (see Appendix 12 and Figure 16).

It is considered that, provided the known sites for GGF are avoided and minimal habitat is altered at creek crossing points during the construction and operation of the wind farm, there should be minimal impact on the local population of GGF.

#### 10.5. Conclusions and recommendations

GGF was heard along Mustons Creek on 10<sup>th</sup> January 2019 on Wetland 17, and also previously heard at two more sections of the Mustons Creek during December 2018 within the study area. It could also move along the small tributaries of the Mustons Creek or occupy a small number of dams and ephemeral wetlands during periods of inundation.

Provided appropriate avoidance and minimal removal of its wetland habitat can be achieved (e.g. at crossing road points of watercourses), there is no reason to expect that the frog would be adversely affected in the long term by the HWF development.

No other listed threatened species were recorded at any other locations on HWF, including all mapped wetlands visited.



### 10.6. Mitigation Recommendations

To maximise the effectiveness of mitigation measures to avoid impact on GGF, the following should be considered:

- Avoid siting wind turbines and associated hard stands, within 100 metres of confirmed habitat, as identified in this report;
- Avoid disturbance of banks, channels and vegetation in nearby areas (within 30 meters of centre line of streams or within 30 meters from the edge of wetlands) identified as potential habitat (i.e. marked as 'moderate quality'), as identified in this report (Appendix 12, Figure 16).
- Where essential wind farm infrastructure (e.g. access road) crosses a creek line or wetland identified as potential habitat of a listed aquatic fauna species, disturbance of banks, channels and nearby vegetation shall be kept to a minimum and if feasible, restored or enhanced to at least its pre-construction condition;
- Install sediment fencing during construction to protect riparian zones if works are to be undertaken (within 30 metres of) near creek crossings.





### **11.** Matters of National Environmental Significance

This section of the report assesses the potential impacts of the proposed wind farm on the listed communities and species either recorded or initially assessed as potentially occurring on the HWF site.

#### 11.1. Ecological communities

Two EPBC Act listed ecological communities were recorded within the HWF site (Figure 17).

The proposed current development footprint will result in the following losses:

- 1.591 hectares of Natural Temperate Grassland of the Victorian Volcanic Plains.
- 0.662 hectares of potential Natural Temperate Grassland of the Victorian Volcanic Plains.

#### **11.2.** Flora Species

The analysis of the likelihood of occurrence of listed flora species (Table 5) identified that four EPBC Act listed species could occur in remnant native vegetation within the Study area:

- Adamson's Blown-grass (Lachnagrostis adamsonii)
- Clover Glycine (Glycine latrobeana)
- Trailing Hop-bush (Dodonaea procumbens)
- White Sunray (Leucochrysum albicans subsp. tricolor)

Targeted surveys were undertaken between 28<sup>th</sup> and 30<sup>th</sup> November 2018, on the 10<sup>th</sup> and 11<sup>th</sup> January 2019 as well as from 22<sup>nd</sup> to 25<sup>th</sup> November 2021. During these surveys, areas within the proposed wind farm footprint that were identified to support suitable habitat for these species were inspected thoroughly along transects spaced five metres apart.

None of these EPBC Act listed flora species were recorded within the targeted survey area.

#### 11.3. Fauna Species

This assessment found that 12 EPBC Act listed fauna species were 'likely to occur' or were recorded during surveys at the HWF (Table 7), including:

- Migratory bird species: Common Greenshank, Curlew Sandpiper, Double-banded Plover, Fork-tailed Swift, Latham's Snipe, Red-necked Stint, Sharp-tailed Sandpiper and Whitethroated Needletail;
- Two listed threatened bat species: Grey-headed Flying Fox and Southern Bent-wing Bat;
- One listed threatened reptile species: Striped Legless Lizard; and
- One listed threatened frog species: Growling Grass Frog.

Potential Impacts on these matters of national environmental significance are considered in Table 32.





Table 32: Matters of National Environmental	Significance (MNES)
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N	MNES		Level of	Statue of MNES		Proposed	Likely significant	Relevant
Common name	Scientific name	status	assessment for MNES	in the study area	Relevant Significant Impact Criteria	mitigation measures	impact on MNES (Yes/No)	report section
				Flo	ora species			
Adamson's Blown-grass	Lachnagrostis adamsonii	EN	Habitat mapping and targeted surveys	Not recorded during targeted surveys - <b>unlikely</b> <b>to occur</b>	<ul> <li>Long-term decrease of population size</li> <li>reduction of area of occupance</li> <li>fragmentation of populations</li> <li>affect habitat critical for survival of species</li> </ul>	Not necessary	No, this species is unlikely to occur.	Section 5.3.3
Clover Glycine	Glycine Iatrobeana	VU	Habitat mapping and targeted surveys	Not recorded during targeted surveys - <b>unlikely</b> <b>to occur</b>	<ul> <li>Long-term decrease of size of an important population</li> <li>reduction of area of occupance of an important population</li> <li>fragmentation of important populations</li> <li>affect habitat critical for survival of species</li> </ul>	Not necessary	No, this species is unlikely to occur.	Section 5.3.3
Trailing Hop-bush	Dodonaea procumbens	VU	Habitat mapping and targeted surveys	Not recorded during targeted surveys - <b>unlikely</b> <b>to occur</b>	<ul> <li>Long-term decrease of size of an important population</li> <li>reduction of area of occupance of an important population</li> <li>fragmentation of important populations</li> <li>affect habitat critical for survival of species</li> </ul>	Roadsides with species present have been avoided	No, this species is unlikely to occur.	Section 5.3.3
White Sunray	Leucochrysum albicans var. tricolor	EN	Habitat mapping and targeted surveys	Not recorded during targeted surveys - <b>unlikely</b> <b>to occur</b>	<ul> <li>Long-term decrease of population size</li> <li>reduction of area of occupance</li> <li>fragmentation of populations</li> <li>affect habitat critical for survival of species</li> </ul>	Not necessary	No, this species is unlikely to occur.	Section 5.3.3



N	INES	EDBC Act	Level of	Statue of MNES		Proposed	Likely significant	Relevant				
Common name	Scientific name	status	assessment for MNES	in the study area	Relevant Significant Impact Criteria	mitigation measures	impact on MNES (Yes/No)	report section				
Listed Ecological Communities												
Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP)	N/A	CR	Detailed vegetation assessment and mapping	Present – mostly within road reserves	<ul> <li>reduce the extent of an ecological community</li> <li>fragment or increase fragmentation of an ecological community</li> </ul>	Impacts on remnant native vegetation have been avoided and minimised	Yes – 1.591 ha removed	Section 5.3.4				
Seasonal Herbaceous Wetlands (Freshwater ) of the Temperate Lowland Plains (SHWTLP)	N/A	CR	Detailed vegetation assessment and mapping	Present – limited areas	<ul> <li>reduce the extent of an ecological community</li> <li>fragment or increase fragmentation of an ecological community</li> </ul>	Impacts on remnant native vegetation have been avoided and minimised	Yes – 0.662 ha removed	Section 5.3.4				
Grassy Eucalypt Woodland of the Victorian Volcanic Plain (GEWVVP)	N/A	CR	Detailed vegetation assessment and mapping	Present – mostly within road reserves	<ul> <li>reduce the extent of an ecological community</li> <li>fragment or increase fragmentation of an ecological community</li> </ul>	Impacts on remnant native vegetation have been avoided	No, no removal proposed	Section 5.3.4				



Ν	INES	EDBC Act	Level of	Statue of MNES		Proposed	Likely significant	Relevant			
Common	Scientific name	status	assessment	in the study area	Relevant Significant Impact Criteria	mitigation	impact on MNES	report			
Fauna species											
Common Greenshank Curlew Sandpiper Double- banded Plover Red-necked Stint Sharp-tailed Sandpiper	Tringa nebulari Calidris ferruginea Charadrius bicinctus Calidris ruficollis Calidris acuminata	Migra- tory	Habitat assessment and fauna survey, bird utilisation survey	Not recorded during surveys – <b>potential to occur</b>	<ul> <li>Substantially modify destroy or isolate an area of important habitat for a migratory species;</li> <li>Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species (0.1% of flyway population)</li> </ul>	Turbines are well separated from wetlands, in most cases at least 700m from wetland edges.	No, unlikely to occur in significant numbers and habitat avoided. Unlikely to fly at RSA height and unlikely to collide with turbines.	Section 8			
Latham's Snipe	Gallinago hardwickii	M (JAMBA, ROKAMB A, Bonn)	Habitat assessment and fauna survey, bird utilisation surveys	Recorded in small numbers (i.e. not an important population)	<ul> <li>Impacts on important habitat:</li> <li>areas that support at least 18 individuals of this species</li> <li>naturally occurring open freshwater wetland with vegetation cover nearby</li> </ul>	Turbines are well separated from wetlands, in most cases at least 700m from wetland edges and 100 m from all major waterways.	No, unlikely to occur in significant numbers and habitat avoided. Unlikely to fly at RSA height and unlikely to collide with turbines.	Section 8			



N	MNES		Level of	Statue of MNES		Proposed	Likely significant	Relevant
Common name	Scientific name	status	assessment for MNES	in the study area	Relevant Significant Impact Criteria	mitigation measures	impact on MNES (Yes/No)	report section
White- throated Needletail Fork-tailed Swift	Hirundapus caudacutus Apus pacificus	M (CAMBA, JAMBA, ROKAMB A)	Bird Utilisation Survey	None recorded but likely to occur occasionally in summer	<ul> <li>Substantially modify destroy or isolate an area of important habitat for a migratory species;</li> <li>Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species (0.1% of flyway population = 10 birds)</li> </ul>	None	No, flies at RSA height, but less than 10 individuals expected to be affected in a year based on results from carcass searches at other wind farms.	Sections 7 and 8
Southern Bent-wing Bat	Pseudophryne semimarmorata	CR	Habitat assessment and targeted survey	recorded	<ul> <li>Long-term decrease of population size</li> <li>reduction of area of occupancy</li> <li>fragmentation of populations</li> <li>affect habitat critical for survival of species</li> </ul>	Turbines located 215m away from remnant and planted trees	No, unlikely to occur in significant numbers and unlikely to fly at RSA height and to collide with turbines.	Section 9
Grey- headed Flying Fox	Pteropus poliocephalus	EN	Habitat assessment and targeted survey	recorded	<ul> <li>Long-term decrease of population size</li> <li>reduction of area of occupancy</li> <li>fragmentation of populations</li> <li>affect habitat critical for survival of species</li> </ul>	Turbines located 215m away from remnant and planted trees	TBC based on studies planned for March 2022	Section 9
Striped Legless Lizard	Delma impar	VU	Habitat assessment and targeted survey	Suitable habitat within road reserves	<ul> <li>Long-term decrease of size of an important population</li> <li>reduction of area of occupance of an important population</li> <li>fragmentation of important populations</li> <li>affect habitat critical for survival of species</li> </ul>	Impacts on remnant native vegetation have been avoided and minimised. Salvage and translocation.	Yes – some areas within road reserves to be removed	Section 6



N	MNES		Level of	Statue of MNES		Proposed	Likely significant	Relevant
Common	Scientific name	status	assessment	in the study area	Relevant Significant Impact Criteria	mitigation	impact on MNES	report
name		Status	for MNES			measures	(Yes/No)	section
Growling Grass Frog	Litoria raniformis	VU	Habitat assessment and fauna survey	Recorded on the wind farm	<ul> <li>Long-term decrease of size of an important population</li> <li>reduction of area of occupance of an important population</li> <li>fragmentation of important populations</li> <li>affect habitat critical for survival of species</li> </ul>	Turbines are separated from wetlands, in most cases at least 700m from wetland edges and 100m from all major waterways	No impacts on habitat.	Section 10



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# Appendix 1: Details of the assessment process in accordance with the Guidelines for the removal, destruction or lopping of native vegetation (DELWP 2017a)

#### Purpose and objective

Policies and strategies relating to the protection and management of native vegetation in Victoria are defined in the State Planning Policy Framework (SPPF). The objective identified in Clause 12.01 of all Victorian Planning Schemes is 'To ensure that there is no net loss to biodiversity as a result of the removal, destruction or lopping of native vegetation'.

This is to be achieved through the following three-step approach, as detailed in the Guidelines:

- 1. Avoid the removal, destruction or lopping of native vegetation.
- 2. Minimise impacts from the removal, destruction or lopping of native vegetation that cannot be avoided.
- 3. Provide an offset to compensate for the biodiversity impact from the removal, destruction or lopping of native vegetation.

**Note:** While a planning permit may still be required, if native vegetation does not meet the definition of either a patch or a scattered tree, an offset under the Guidelines is not required.

#### Assessment pathways

The first step in determining the type of assessment required for any site in Victoria is to determine the assessment pathway for the proposed native vegetation removal. The three possible assessment pathways for applications to remove native vegetation in Victoria are:

- Basic;
- Intermediate; or
- Detailed.

This assessment pathway is determined by two factors:

- Location Category As determined using the states Location Map, the location category indicates the potential risk to biodiversity from removing a small amount of native vegetation. The three location categories are defined as:
  - <u>Location 1</u> shown in light blue on the *Location* Map, and occurring over most of Victoria.
  - <u>Location 2</u> shown in dark blue on the *Location* Map, and includes areas mapped as endangered EVCs and/or sensitive wetlands and coastal areas.
  - <u>Location 3</u> shown in orange on the *Location* Map, and includes areas where the removal of less than 0.5 ha of native vegetation could have a significant impact on habitat for rare and threatened species.
- Extent of native vegetation The extent of any patches and scattered trees proposed to be removed (as well as the extent of any past native vegetation removal), with consideration as to whether the proposed removal includes any large trees. Extent of native vegetation is determined as follows:
  - <u>Patch</u> The area of the patch in hectares
  - <u>Scattered Tree</u> The extent of a scattered tree is dependent on whether the scattered tree is small or large. A tree is considered to be a large tree if it is greater or equal to the large tree benchmark diameter at breast height (DBH) for the relevant bioregional EVC. Any scattered tree that is not a large tree is a small scattered tree. The extent of large and small scattered trees is determined as follows:



- Large scattered tree The area of a circle with a 15 metre radius, with the trunk of the tree at the centre.
- Small scattered tree The area of a circle with a 10 metre radius, with the trunk of the tree at the centre.

The assessment pathway for assessing an application to remove native vegetation is then determined as detailed in the following matrix table:

Extent of native vegetation	Location Category		
	Location 1	Location 2	Location 3
< 0.5 hectares and not including any large trees	Basic	Intermediate	Detailed
< 0.5 hectares and including one or more large trees	Intermediate	Intermediate	Detailed
≥ 0.5 hectares	Detailed	Detailed	Detailed

Note: If the native vegetation to be removed includes more than one location category, the higher location category is used to determine the assessment pathway.

#### Landscape scale information - Strategic biodiversity value

The strategic biodiversity value (SBV) is a measure of a location's importance to Victoria's biodiversity, relative to other locations across the state. It is represented as a score between 0 and 1 and determined from the *Strategic biodiversity value map*, available from NVIM.

#### Landscape scale information - Habitat for rare or threatened species

Habitat importance for rare or threatened species is a measure of the importance of a location in the landscape as habitat for a particular rare or threatened species, in relation to other habitat available for that species. It is represented as a score between 0 and 1 and is determined from the *Habitat importance maps*, administered by DELWP.

This includes two groups of habitat:

- *Highly localised habitats* limited in area and considered to be equally important, therefore having the same habitat importance score.
- Dispersed habitats less limited in are and based on habitat distribution models.

Habitat for rare or threatened species is used to determine the type of offset required in the detailed assessment pathway.

#### **Biodiversity value**

A combination of site-based and landscape scale information is used to calculate the biodiversity value of native vegetation to be removed. Biodiversity value is represented by a general or species habitat score, detailed as follows.

Firstly, the extent and condition of native vegetation to be removed are combined to determine the habitat hectares as follows:

Habitat hectares = extent of native vegetation x condition score


Secondly, the habitat hectare score is combined with a landscape factor to obtain an overall measure of biodiversity value. Two landscape factors exist as follows:

- General landscape factor determined using an adjusted strategic biodiversity score, and relevant when no habitat importance scores are applicable;
- Species landscape factor determined using an adjusted habitat importance score for each rare or threatened species habitat mapped at a site in the Habitat importance map.

These factors are then used as follows to determine the biodiversity value of a site:



#### Offset requirements

A native vegetation offset is required for the approved removal of native vegetation. Offsets conform to one of two types and each type incorporates a multiplier to address the risk of offset:

• A General offset is required when the removal of native vegetation does not have a significant impact on any habitat for rare or threatened species (i.e. the proportional impact is below the species offset threshold). In this case a multiplier of 1.5 applies to determine the general offset amount.

General offset (amount of general habitat units) = general habitat score x 1.5

 A Species offset is required when the removal of native vegetation has a significant impact on habitat for a rare or threatened species (i.e. the proportional impact is above the species offset threshold). In this case a multiplier of 2 applies to determine the species offset amount.

Species offset (amount of species habitat units) = Species habitat score x 2

**Note:** if native vegetation does not meet the definition of either a patch or scattered tree an offset is not required.

#### Offset attributes

Offsets must meet the following attribute requirements, as relevant:

- General offsets
  - Offset amount: General offset = general habitat score x 1.5
  - Strategic biodiversity value (SBV): The offset has at least 80% of the SBV of the native vegetation removed
  - Vicinity: The offset is in the same CMA boundary or municipal district as the native vegetation removed
  - Habitat for rare and threatened species: N/A
  - Large trees: The offset include the protection of at least one large tree for every large tree to be removed
- Species offsets



- Offset amount: Species offset = species habitat score x 2
- Strategic biodiversity value (SBV): N/A
- Vicinity: N/A
- Habitat for rare and threatened species: The offset comprises mapped habitat according to the Habitat importance map for the relevant species
- *Large trees:* The offset include the protection of at least one large tree for every large tree to be removed



### Appendix 2: Detailed habitat hectare assessment results

\* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habi	tat Zone		AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
Biore	egion		VVP														
EVC	Number		55_61	125	125	125	125	125	125	125	55_63	55_63	821	125	125	125	55_61
Total	area of Habitat Zor	ne (ha)	0.406	0.357	0.183	0.192	0.202	0.121	0.051	0.426	0.681	0.151	0.038	0.957	0.117	0.083	0.101
	Large Old Trees	/10	3	NA	0	9	NA	NA	NA	NA	9						
	Tree Canopy Cover	/5	4	NA	0	5	NA	NA	NA	NA	5						
R	Lack of Weeds	/15	0	6	0	0	0	0	0	0	0	0	9	0	0	0	7
ditic	Understorey	/25	5	15	5	5	5	5	10	5	5	5	15	5	5	5	5
Son (	Recruitment	/10	3	3	3	3	3	3	3	0	6	5	3	3	3	3	0
e l	Organic Matter	/5	3	2	5	4	5	5	4	2	3	2	5	4	4	4	5
Si	Logs	/5	5	NA	2	4	NA	NA	NA	NA	4						
	Site condition standardising mult	tiplier*	1.00	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.00	1.00	1.36	1.36	1.36	1.36	1.00
	Site Condition sub	total	23	35	18	16	18	18	23	10	16	30	44	16	16	16	35
e t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	Condition Score	/100	24	36	19	17	19	19	24	11	17	31	45	17	17	17	36
EPB( com	CAct listed ecologica munities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG . com	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD
Biore	gion		VVP														
EVC I	Number		125	125	125	125	641	55_61	55_61	55_61	55_61	55_61	55_61	125	641	125	125
Total	area of Habitat Zon	e (ha)	0.023	0.259	0.167	0.027	0.425	0.014	0.043	0.037	0.041	0.058	0.021	0.653	0.110	0.017	0.050
	Large Old Trees	/10	NA	NA	NA	NA	0	0	0	0	0	0	0	NA	0	NA	NA
	Tree Canopy Cover	/5	NA	NA	NA	NA	0	0	0	0	0	0	0	NA	0	NA	NA
5	Lack of Weeds	/15	7	0	0	0	4	0	0	0	0	0	0	2	7	9	7
ditio	Understorey	/25	15	5	5	5	15	5	5	5	5	5	5	10	5	15	15
ŏ	Recruitment	/10	3	3	3	3	0	5	5	5	5	5	5	3	0	0	3
te O	Organic Matter	/5	3	4	4	4	5	2	2	2	2	2	2	4	4	З	5
Sit	Logs	/5	NA	NA	NA	NA	0	0	0	0	0	0	0	NA	0	NA	NA
	Site condition standardising mult	tiplier*	1.36	1.36	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.00	1.36	1.36
	Site Condition sub	total	38	16	16	16	24	12	12	12	12	12	12	26	16	37	41
e +	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	39	17	17	17	25	13	13	13	13	13	13	27	17	38	42
EPBC comr	Act listed ecologica nunities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG / comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Hab	itat Zone		BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS
Bior	egion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC	Number		132_61	55_61	55_61	132_61	132_61	641	132_61	132_61	132_61	132_61	132_61	132_61	132_61	132_61	132_61
Tota (ha)	l area of Habitat	Zone	0.281	0.069	0.295	0.084	0.024	0.074	0.040	0.055	0.037	0.036	0.041	0.074	0.053	0.107	0.043
	Large Old Trees	/10	NA	0	0	NA	NA	0	NA								
	Tree Canopy Cover	/5	NA	0	0	NA	NA	0	NA								
_	Lack of Weeds	/15	6	0	0	0	0	7	0	0	0	0	0	0	0	0	0
tior	Understorey	/25	15	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ndi	Recruitment Organic Matter		0	5	3	0	0	0	0	0	0	0	0	0	0	0	0
ပိ	Organic Matter		2	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Site	Logs	/5	NA	0	0	NA	NA	0	NA								
	Site condition standardising multiplier*		1.36	1.00	1.00	1.36	1.36	1.00	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
	Site Condition subtotal		31	12	10	11	11	15	11	11	11	11	11	11	11	11	11
8.	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lano	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota Scoi	Total Condition		32	13	11	12	12	16	12	12	12	12	12	12	12	12	12
EPB com	C Act listed ecolo munities	gical	NTGVVP	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG com	Act listed ecologi munities	ical	-	-	-	-	_	-	-	-	-	-	-	-	-	-	-



Habi	at Zone		BT	BU	BV	BW	BX	BY	BZ	CA	СВ	CC	CD	CE	CF	CG	СН
Biore	gion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC I	Number		132_61	132_61	125	68	68	68	132_61	125	132_61	132_61	125	132_61	132_61	132_61	132_61
Total	area of Habitat Zon	e (ha)	0.134	0.025	0.023	0.070	0.082	0.116	0.116	0.041	0.031	0.022	0.021	0.461	0.161	0.097	0.023
	Large Old Trees	/10	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Tree Canopy Cover	/5	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
_	Lack of Weeds	/15	0	0	0	9	9	7	0	0	0	0	0	7	0	0	0
tion	Understorey	/25	5	5	10	5	5	5	5	10	5	5	10	10	5	5	5
ndi	Recruitment	/10	0	0	3	0	0	0	0	3	0	0	3	0	0	0	0
8	Organic Matter	/5	3	3	4	0	0	3	3	4	3	3	4	3	3	3	3
Site	Logs	/5	NA	NA	NA	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Site condition standardising multiplier*		1.36	1.36	1.36	1.00	1.00	1.00	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
	Site Condition sub	total	11	11	23	14	14	15	11	23	11	11	23	27	11	11	11
e t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	12	12	24	15	15	16	12	24	12	12	24	28	12	12	12
EPBC comr	Act listed ecologicanunities	al	-	-	-	-	-	-	-	-	-	-	-	NTGVVP	-	-	-
FFG / comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		Cl	CJ	CK	CL	СМ	CN	CO	СР	CQ	CR	CS	СТ	CU	CV	CW
Biore	egion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC	Number		132_61	55_61	641	132_61	132_61	55_61	125	132_61	55_61	55_61	55_61	55_61	55_61	56	56
Tota (ha)	area of Habitat Zo	one	0.042	0.835	0.253	0.308	0.130	0.537	0.284	0.020	0.020	0.075	0.022	0.014	0.080	0.033	0.053
	Large Old Trees	/10	NA	0	0	NA	NA	9	NA	NA	0	0	0	0	0	0	9
	Tree Canopy Cover	/5	NA	0	0	NA	NA	3	NA	NA	0	0	0	0	0	0	4
_	Lack of Weeds	/15	0	0	9	6	6	0	4	6	0	0	0	0	0	0	0
tior	Understorey	/25	5	5	5	5	5	5	15	5	5	5	5	5	5	15	10
ndi	Recruitment	/10	0	3	0	0	0	0	3	0	5	5	5	5	5	5	5
ပိ	Organic Matter	/5	3	2	0	4	4	2	4	4	2	2	2	3	3	0	4
Site	Logs	/5	NA	0	0	NA	NA	4	NA	NA	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.36	1.00	1.00	1.36	1.36	1.00	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition su	btotal	11	10	14	20	20	23	35	20	12	12	12	13	13	20	32
æ.,	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	Condition Score	/100	12	11	15	21	21	24	36	21	13	13	13	14	14	21	33
EPB( com	C Act listed ecologi munities	cal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG com	Act listed ecologica munities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habit	at Zone		CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL
Biore	gion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC I	Number		56	55_61	132_61	55_61	55_61	132_61	132_61	132_61	55_61	132_61	55_61	55_61	55_61	55_61	125
Total	area of Habitat Zor	ie (ha)	0.011	0.080	0.075	2.025	0.138	0.127	0.013	0.053	0.235	0.131	0.100	0.710	0.022	1.122	0.029
	Large Old Trees	/10	0	0	NA	0	0	NA	NA	NA	0	NA	0	0	0	0	NA
	Tree Canopy Cover	/5	0	0	NA	0	0	NA	NA	NA	0	NA	0	0	0	0	NA
_	Lack of Weeds	/15	7	4	7	7	4	4	4	4	0	4	4	7	0	0	9
tion	Understorey	/25	5	5	10	15	15	15	15	15	5	15	15	15	5	5	15
ndi	Recruitment	/10	0	0	3	2	5	0	0	0	5	0	5	5	5	5	0
8	Organic Matter	/5	3	4	3	3	3	3	3	3	2	3	4	2	2	2	5
Site	Logs	/5	0	0	NA	0	0	NA	NA	NA	0	NA	0	0	0	0	NA
	Site condition standardising multiplier*		1.00	1.00	1.36	1.00	1.00	1.36	1.36	1.36	1.00	1.36	1.00	1.00	1.00	1.00	1.36
	Site Condition sub	total	15	13	31	27	27	30	30	30	12	30	28	29	12	12	39
ed t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	16	14	32	28	28	31	31	31	13	31	29	30	13	13	40
EPBC comr	Act listed ecologicanunities	al	-	-	-	GEWVVP	-	NTGVVP	-	NTGVVP	-	NTGVVP	-	GEWVVP	-	GEWVVP	-
FFG A	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habit	at Zone		DM	DN	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA
Biore	gion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC [	Number		55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	68	55_61
Total	area of Habitat Zor	ie (ha)	0.864	0.259	0.134	0.869	0.197	0.930	0.137	0.209	0.170	1.900	0.250	0.304	0.026	0.013	0.478
	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
_	Lack of Weeds	/15	0	0	0	7	4	4	4	4	4	7	4	4	4	4	7
tion	Understorey	/25	5	5	5	15	15	15	15	15	15	15	15	15	15	5	15
ndi	Recruitment	/10	3	3	3	2	5	5	5	5	5	2	5	5	5	0	5
රි	Organic Matter	/5	2	2	2	3	3	3	3	3	3	3	4	4	4	3	3
Site	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition sub	total	10	10	10	27	27	27	27	27	27	27	28	28	28	12	30
e t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	11	11	11	28	28	28	28	28	28	28	29	29	29	13	31
EPBC comr	Act listed ecologicanulities	al	GEWVVP	-	-	GEWVVP	-	GEWVVP	-	-	-	GEWVVP	-	-	-	-	-
FFG A comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habit	at Zone		EB	EC	ED	EE	EF	EG	EH	El	EJ	EK	EL	EM	EN	EO	EP
Biore	gion		VVP														
EVC I	Number		55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61
Total	area of Habitat Zon	ie (ha)	0.394	0.081	0.150	0.023	0.009	0.018	0.022	0.071	0.019	0.005	0.016	0.004	0.004	0.006	0.019
	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
_	Lack of Weeds	/15	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tion	Understorey	/25	15	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ndi	Recruitment	/10	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5
8	Organic Matter	/5	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Site	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition sub	total	27	12	12	12	12	12	12	12	12	12	12	12	12	12	12
ed t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	28	13	13	13	13	13	13	13	13	13	13	13	13	13	13
EPBC comr	Act listed ecologicanunities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG A comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habit	tat Zone		EQ	ER	ES	ET	EU	EV	EW	EX	EY	EZ	FA	FB	FC	FD	FE
Biore	gion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC I	Number		55_61	55_61	55_61	55_61	132_61	132_61	55_61	55_61	55_61	55_61	132_61	55_61	55_61	55_61	55_61
Total	area of Habitat Zor	ie (ha)	0.003	0.013	0.010	0.024	0.604	0.512	0.022	0.031	0.007	0.052	0.325	0.181	0.015	0.039	0.030
	Large Old Trees	/10	0	0	0	0	NA	NA	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	0	0	0	0	NA	NA	0	0	0	0	NA	0	0	0	0
_	Lack of Weeds	/15	0	0	0	0	6	6	0	0	0	0	7	4	4	0	4
tior	Understorey	/25	5	5	5	5	15	15	5	5	5	5	10	15	5	10	5
ndi	Recruitment	/10	5	5	5	5	0	0	5	5	5	5	0	5	5	5	5
පී	Organic Matter	/5	2	2	2	2	3	3	2	2	2	2	3	3	4	5	4
Site	Logs	/5	0	0	0	0	NA	NA	0	0	0	0	NA	2	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.36	1.36	1.00	1.00	1.00	1.00	1.36	1.00	1.00	1.00	1.00
	Site Condition sub	total	12	12	12	12	33	33	12	12	12	12	27	29	18	20	18
ed t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	13	13	13	13	34	34	13	13	13	13	28	30	19	21	19
EPBC comr	Act listed ecologica nunities	al	-	-	-	-	NTGVVP	NTGVVP	-	-	-	-	NTGVVP	-	-	-	-
FFG A comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		FF	FG	FH	FI	FJ	FK	FM	FN	FO	FP	FQ	FR	FS	FT	FU
Biore	gion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC	Number		55_61	55_61	132_61	125	125	125	125	125	132_61	125	132_61	132_61	132_61	125	125
Total	area of Habitat Zor	ie (ha)	0.036	0.015	0.106	0.016	0.021	0.015	0.024	0.017	0.033	0.016	0.269	0.114	0.125	0.004	0.040
	Large Old Trees	/10	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Tree Canopy Cover	/5	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
_	Lack of Weeds	/15	4	4	0	0	0	0	0	0	4	0	4	4	4	0	4
tion	Understorey	/25	10	5	5	10	10	10	10	10	10	10	10	10	10	10	10
ndi	Recruitment	/10	5	5	0	3	3	3	3	3	0	3	0	0	0	3	0
8	Organic Matter	/5	5	4	2	4	4	4	4	4	3	4	3	3	3	4	5
Site	Logs	/5	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Site condition standardising multiplier*		1.00	1.00	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
	Site Condition sub	total	24	18	10	23	23	23	23	23	23	23	23	23	23	23	26
e t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	25	19	11	24	24	24	24	24	24	24	24	24	24	24	27
EPBC comr	Act listed ecologica nunities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG / comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		FV	FW	FX	FY	FZ	GA	GB	GD	GE	GF	GG	GH	GI	GJ	GK
Biore	gion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP						
EVC I	Number		55_61	55_61	55_61	55_61	55_61	55_61	132_61	55_61	132_61	55_61	55_61	125	125	55_63	55_63
Total	area of Habitat Zor	ie (ha)	0.126	0.206	0.060	0.071	0.066	0.086	0.188	0.193	0.108	0.131	0.200	0.038	0.019	0.050	0.041
	Large Old Trees	/10	0	0	0	0	0	0	NA	0	0	0	0	NA	NA	9	9
	Tree Canopy Cover	/5	0	0	0	0	0	0	NA	0	0	0	0	NA	NA	4	4
_	Lack of Weeds	/15	0	0	4	4	4	4	4	4	4	4	4	4	4	4	7
tion	Understorey	/25	10	15	5	5	5	5	5	5	5	10	5	10	10	5	5
ndi	Recruitment	/10	5	0	0	0	0	0	0	0	0	5	5	0	0	0	0
ပိ	Organic Matter	/5	4	4	4	4	4	4	3	4	3	5	5	3	5	3	3
Site	Logs	/5	0	0	0	0	0	0	NA	0	NA	0	0	NA	NA	0	0
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.00	1.36	1.00	1.00	1.36	1.36	1.00	1.00
	Site Condition sub	total	19	19	13	13	13	13	16	13	16	24	19	23	26	25	28
e t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	20	20	14	14	14	14	17	14	17	25	20	24	27	26	29
EPBC comr	Act listed ecologicanunities	al	-	-	-	-	-	-	NTGVVP	-	NTGVVP	-	-	-	-	-	-
FFG / comr	Act listed ecological nunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		GL	GM	GN	GO	GP	GQ	HA	HB	HC	HD	HE	HF	HG	HH	HI
Biore	gion		VVP														
EVC	Number		55_63	55_63	55_63	55_63	55_63	125	55_61	55_61	55_61	55_61	55_61	55_61	55_61	55_61	132_61
Total (ha)	area of Habitat Zo	one	0.028	0.022	0.008	0.044	0.116	0.014	0.033	0.033	0.040	0.008	0.016	0.034	0.029	0.027	0.421
	Large Old Trees	/10	0	0	0	9	0	NA	0	0	0	0	0	0	0	0	NA
	Tree Canopy Cover	/5	4	0	0	2	4	NA	0	0	0	0	0	0	0	0	NA
-	Lack of Weeds	/15	4	0	0	4	4	7	0	0	0	0	0	4	0	0	7
tior	Understorey	/25	5	5	5	15	15	10	5	5	5	5	5	5	5	5	20
ndi	Recruitment	/10	0	5	0	5	10	0	5	5	5	5	5	0	5	5	6
ပိ	Organic Matter	/5	3	3	3	3	3	5	2	2	2	2	2	5	2	2	5
Site	Logs	/5	0	0	0	0	0	NA	0	0	0	0	0	0	0	0	NA
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.00	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36
	Site Condition sul	btotal	16	13	8	38	36	30	12	12	12	12	12	14	12	12	52
8.	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	Condition Score	/100	17	14	9	39	37	31	13	13	13	13	13	15	13	13	53
EPB( com	PBC Act listed ecological ommunities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	NTGVVP
FFG . com	Act listed ecologica nunities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		IA	IB	IC	ID	IE	IF	IG	28359	28207	28223	28224	28414	28235
Biore	egion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
										DELWP	DELWP	DELWP	DELWP	DELWP	DELWP
EVC	Number		132_61	132_61	125	132_61	132_61	132_61	132_61	Mapped	Mapped	Mapped	Mapped	Mapped	Mapped
	-									Wetland	Wetland	Wetland	Wetland	Wetland	Wetland
Tota	area of Habitat Zo	ne (ha)	0.039	0.036	0.043	0.090	0.092	0.067	0.087	0.050	4.160	0.158	8.519	1.090	0.479
	Large Old Trees	/10	NA	NA	NA	NA	NA	NA	NA						
	Tree Canopy Cover	/5	NA	NA	NA	NA	NA	NA	NA						
Б	Lack of Weeds	/15	7	7	0	7	7	7	7						
ditio	Understorey	/25	10	10	5	10	10	10	10						
, Sol	Recruitment	/10	3	3	3	3	3	3	3						
te O	Organic Matter	/5	3	3	5	3	3	3	3						
Si	Logs	/5	NA	NA	NA	NA	NA	NA	NA						
	Site condition standardising mul	tiplier*	1.36	1.36	1.36	1.36	1.36	1.36	1.36						
	Site Condition sub	ototal	31	31	18	31	31	31	31						
e t	Patch Size	/10	1	1	1	1	1	1	1						
dsca	Neighbourhood	/10	0	0	0	0	0	0	0						
ر Lan	Distance to Core	/5	0	0	0	0	0	0	0						
Tota	Condition Score	/100	32	32	19	32	32	32	32	21^	20^	20^	24^	20^	21^
EPB( com	EPBC Act listed ecological communities		-	-	-	-	-	-	-	-	-	-	-	-	-
FFG com	FG Act listed ecological ommunities		-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		XBA	XBB	XBC	XBD	XBE	XBF	XBG	XBH	XBI	XBJ	XBK	XBL	XBM	XBN	XBO
Biore	egion		VVP														
EVC	Number		125	125	647	647	125	647	125	647	647	647	647	647	647	647	647
Total (ha)	area of Habitat Zo	one	0.078	0.031	0.010	0.008	0.123	0.011	0.168	0.011	0.099	0.004	0.006	0.023	0.009	0.042	0.050
	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
_	Lack of Weeds	/15	7	7	7	7	7	4	0	4	4	4	4	4	4	4	7
tion	Understorey	/25	15	15	15	15	15	5	5	5	5	5	5	5	5	5	5
ndi	Recruitment	/10	0	0	0	0	0	0	0	3	3	3	3	3	3	3	0
Site Cor	Organic Matter	/5	5	5	0	0	5	5	5	0	0	0	0	0	0	0	5
	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
	Site Condition sul	btotal	37	37	30	30	37	19	14	16	16	16	16	16	16	16	23
a +	Patch Size	/10	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	Condition Score	/100	38	38	31	31	38	20	15	18	18	18	18	17	17	17	24
EPB( com	EPBC Act listed ecological communities		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FFG . com	FG Act listed ecological		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Hab	tat Zone		XBP	XBQ	XBR	XBS	XBT	XBU	XBV	XBW	XBY	XBZ	XDA	XDB	XDC	XDE	XDF
Bior	egion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC	Number		55_63	55_63	656	125	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	653	125
Tota (ha)	l area of Habitat Zo	one	0.012	0.167	0.579	0.084	0.382	0.025	0.161	0.148	0.574	0.335	0.302	0.126	0.559	0.042	
	Large Old Trees	/10	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	3	0	0	0	0	0	0	0	5	0	0	0	0	0	0
	Lack of Weeds	/15	4	4	4	4	4	4	4	4	0	4	4	4	4	9	7
tior	Understorey	/25	5	5	5	10	5	5	5	5	5	5	5	5	5	9	10
ndi	Recruitment	/10	5	3	0	0	3	3	3	3	0	3	3	3	3	5	0
ပိ	Organic Matter	/5	3	5	5	5	5	5	5	5	3	3	3	3	3	5	5
Site (	Logs	/5	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.36
	Site Condition su	btotal	29	17	19	26	17	17	17	17	15	15	15	15	15	38	30
be t	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	I Condition Score	/100	30	18	20	27	18	18	18	18	16	16	16	16	16	40	31
EPB com	EPBC Act listed ecological communities		-	-	-	SHWTLP	SHWTLP	-	-	-	-	-	-	-	-	-	-
FFG com	Act listed ecologica munities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Hab	itat Zone		XDG	XDI	XDJ	XDK	XDL	XDM	IH	Ш	XAA	XAB	XAC	XAD	XAE	XAF	XAG
Bior	egion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP						
EVC	Number		55_63	125	55_63	125	125	125	132_61	132_61	647	125	132_61	55_61	125	125	125
Tota (ha)	l area of Habitat Zo	one	0.100	0.012	0.019	0.155	0.222	0.208	0.142	0.030	0.017	0.013	0.255	0.313	0.527	2.298	0.030
	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lack of Weeds	/15	4	4	4	4	7	7	6	2	0	6	9	9	6	4	4
tion	Understorey	/25	5	10	5	10	10	10	10	5	15	15	20	15	5	5	5
ndi	Recruitment	/10	6	3	3	3	3	3	6	6	3	3	3	5	3	3	3
Site Cor	Organic Matter	/5	5	3	3	5	3	3	3	5	4	2	3	3	5	5	5
	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
	Site condition standardising multiplier*		1.00	1.36	1.00	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.00	1.36	1.36	1.36
	Site Condition su	btotal	20	27	15	30	31	31	34	24	30	35	48	34	26	23	23
8.	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1
dsca	Neighbourhood	/10	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0
Lan	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	I Condition Score	/100	21	28	16	32	33	33	35	25	31	36	49	35	27	26	25
EPB com	EPBC Act listed ecological communities		-	-	-	-	-	-	-	NTGVVP	-	-	-	NTGVVP	-	NTGVVP	-
FFG com	Act listed ecologica munities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Hab	Habitat Zone		XAH	XAI	XAJ	XAK	XAL	XAM	XAN	XAO	XAP	XAQ	XAR	XAS	XAT	XAU	XAV
Bior	egion		VVP	VVP													
EVC	Number		125	125	125	55_61	55_61	55_61	55_61	125	125	55_61	125	653	653	654	654
Tota (ha)	l area of Habitat Zo	one	5.710	0.008	0.008	0.125	0.720	0.339	0.547	0.029	0.110	0.452	0.015	0.078	0.050	0.177	0.170
	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5					3										
_	Lack of Weeds	/15	6	6	4	0	6	0	6	9	0	6	9	15	11	9	9
tior	Understorey	/25	10	5	10	5	5	5	5	5	5	5	10	5	15	10	10
lpd	Recruitment	/10	3	3	6	6	6	6	6	6	0	6	6	0	0	10	10
Site Col	Organic Matter	/5	5	2	4	4	5	4	5	3	4	5	4	5	5	5	5
	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.36	1.36	1.36	1.00	1.00	1.00	1.00	1.36	1.36	1.00	1.36	1.36	1.36	1.36	1.36
	Site Condition su	btotal	33	22	33	15	25	15	22	31	12	22	39	34	42	46	46
Be -	Patch Size	/10	4	1	1	1	1	1	1	1	1	1	1	2	2	2	2
dsca	Neighbourhood	/10	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lan	Distance to Core	/5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tota	I Condition Score	/100	38	24	35	16	26	16	23	32	13	23	40	36	44	48	48
EPB com	EPBC Act listed ecological communities		-	-	-	-	-	-	-	-	-	-	-	-	-	NTGVVP	NTGVVP
FFG com	Act listed ecologica munities	al	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Habi	tat Zone		XAW	XAX	XAY	XAZ	XCA	XCB	XCC	XCD	XCE	XCF
Biore	gion		VVP									
EVC	Number		653	653	653	125	55_61	647	125	125	821	55_61
Total (ha)	area of Habitat Zo	one	0.059	0.026	0.031	0.049	0.208	0.308	0.021	0.022	0.140	0.060
	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5										
_	Lack of Weeds	/15	15	15	15	4	0	9	9	9	9	9
tior	Understorey	/25	15	15	15	10	5	15	5	5	15	5
ndi	Recruitment	/10	0	0	0	0	3	6	3	3	6	5
ပိ	Organic Matter	/5	5	5	5	4	5	5	3	3	5	3
Site	Logs	/5	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.36	1.36	1.36	1.36	1.00	1.36	1.36	1.36	1.36	1.00
	Site Condition su	btotal	48	48	48	24	13	48	27	27	48	22
e t	Patch Size	/10	2	2	2	1	1	1	1	1	1	1
dsca	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	1
Lar	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0
Total	Condition Score	/100	50	50	50	25	14	49	28	28	49	24
EPBC comr	EPBC Act listed ecological communities			-	-	-	-	-	-	-	-	-
FFG / comr	Act listed ecologica nunities	al	-	-	-	-	-	-	-	-	-	-



# Appendix 3: Large Trees in Patches and Scattered trees recorded in the investigation area

Tree No.	Common name	Scientific Name	DBH (cm)	Circum- ference	Tree Status and Size	Radius of TRZ (m)	Remove/ Retain	Notes
1	River Red-gum	Eucalyptus camaldulensis	274	861	Large Scattered Tree	15	Retain	
2	River Red-gum	Eucalyptus camaldulensis	155	487	Large Scattered Tree	15	Retain	
3	River Red-gum	Eucalyptus camaldulensis	40	126	Small Scattered Tree	4.8	Retain	DBH estimated due to presence of tree guard
4	River Red-gum	Eucalyptus camaldulensis	113	355	Large Scattered Tree	13.56	Retain	
5	River Red-gum	Eucalyptus camaldulensis	67	210	Small Scattered Tree	8.04	Retain	
6	River Red-gum	Eucalyptus camaldulensis	50	157	Small Scattered Tree	6	Retain	
7	River Red-gum	Eucalyptus camaldulensis	48	151	Small Scattered Tree	5.76	Retain	
8	River Red-gum	Eucalyptus camaldulensis	68	214	Small Scattered Tree	8.16	Retain	
9	River Red-gum	Eucalyptus camaldulensis	35	110	Small Scattered Tree	4.2	Retain	
10	Blackwood	Acacia melanoxylon	40	126	Large Scattered Tree	4.8	Retain	
11	Blackwood	Acacia melanoxylon	14	44	Small Scattered Tree	2	Retain	
12	Blackwood	Acacia melanoxylon	80	251	Large Tree in HZ GK	9.6	Retain	
13	Blackwood	Acacia melanoxylon	55	173	Large Tree in HZ GJ	6.6	Retain	
14	Blackwood	Acacia melanoxylon	54	170	Large Tree in HZ GJ	6.48	Retain	
15	River Red-gum	Eucalyptus camaldulensis	83	261	Large Tree in HZ AA	9.96	Retain	
16	Blackwood	Acacia melanoxylon	66	207	Large Tree in HZ AJ	7.92	Retain	
17	Blackwood	Acacia melanoxylon	63	198	Large Tree in HZ AJ	7.56	Retain	



Tree No.	Common name	Scientific Name	DBH (cm)	Circum- ference	Tree Status and Size	Radius of TRZ (m)	Remove/ Retain	Notes
18	Blackwood	Acacia melanoxylon	79	248	Large Tree in HZ AJ	9.48	Retain	
19	Blackwood	Acacia melanoxylon	53	167	Large Tree in HZ AJ	6.36	Retain	
20	Blackwood	Acacia melanoxylon	53	167	Large Tree in HZ AJ	6.36	Retain	
21	River Red-gum	Eucalyptus camaldulensis	83	261	Large Tree in HZ AO	9.96	Retain	
22	River Red-gum	Eucalyptus camaldulensis	106	333	Large Scattered Tree	12.72	Retain	
23	River Red-gum	Eucalyptus camaldulensis	94	295	Large Tree in HZ CN	11.28	Retain	
24	River Red-gum	Eucalyptus camaldulensis	94	295	Large Tree in HZ CN	11.28	Retain	
25	River Red-gum	Eucalyptus camaldulensis	102	320	Large Tree in HZ CN	12.24	Retain	
26	River Red-gum	Eucalyptus camaldulensis	83	261	Large Tree in HZ CN	9.96	Retain	
27	River Red-gum	Eucalyptus camaldulensis	108	339	Large Tree in HZ CN	12.96	Retain	
28	River Red-gum	Eucalyptus camaldulensis	87	273	Large Tree in HZ CN	10.44	Retain	
29	River Red-gum	Eucalyptus camaldulensis	117	368	Large Tree in HZ CW	14.04	Retain	
30	River Red-gum	Eucalyptus camaldulensis	115	361	Large Scattered Tree	13.8	Retain	
31	River Red-gum	Eucalyptus camaldulensis	185	581	Large Scattered Tree	15	Retain	
32	River Red-gum	Eucalyptus camaldulensis	130	408	Large Scattered Tree	15	Retain	
33	River Red-gum	Eucalyptus camaldulensis	52	163	Large Scattered Tree	6.24	Retain	
34	River Red-gum	Eucalyptus camaldulensis	47	148	Large Scattered Tree	5.64	Retain	
35	River Red-gum	Eucalyptus camaldulensis	47	148	Large Scattered Tree	5.64	Retain	
36	River Red-gum	Eucalyptus cameldulensis	148	465	Large Scattered Tree	17.76	Retain	



Tree No.	Common name	Scientific Name	DBH (cm)	Circum- ference	Tree Status and Size	Radius of TRZ (m)	Remove/ Retain	Notes
37	River Red-gum	Eucalyptus cameldulensis	134	421	Large Scattered Tree	16.08	Remove	
38	River Red-gum	Eucalyptus cameldulensis	190	597	Large Scattered Tree	22.8	Retain	
39	Eucalypt	Eucalyptus spp.	100	314	Large Scattered Tree	12	Retain	
40	River Red-gum	Eucalyptus cameldulensis	85	267	Large Scattered Tree	10.2	Remove	
41	River Red-gum	Eucalyptus cameldulensis	87	273	Large Scattered Tree	10.44	Remove	
42	River Red-gum	Eucalyptus cameldulensis	111	349	Large Scattered Tree	13.32	Retain	
43	Blackwood	Acacia melanoxylon	40	126	Large Tree in Patch	4.8	Retain	
44	River Red-gum	Eucalyptus cameldulensis	40	126	Small Scattered Tree	4.8	Retain	
45	River Red-gum	Eucalyptus cameldulensis	35	110	Small Scattered Tree	4.2	Retain	
46	River Red-gum	Eucalyptus cameldulensis	30	94	Small Scattered Tree	3.6	Remove	
47	River Red-gum	Eucalyptus cameldulensis	40	126	Small Scattered Tree	4.8	Retain	

#### Notes:

**DBH** = Diameter at breast height (130 cm from the ground); **TRZ** = Tree Retention Zone (see below)

DELWP guidelines (DSE 2010) provide definitions regarding tree losses. These are outlined below, and it is considered that they should be applied to scattered trees and edges of treed remnant patches when determining the proximity of development to retained native vegetation.

#### Any tree is deemed lost when:

- Earthworks encroach on more than 10% of its Tree Retention Zone (TRZ) during construction activities. Tree Retention Zones are defined as the area from the respective tree within a radius of 12 times the DBH of the respective tree, including the area above and below ground, notwithstanding it can be a minimum of two metres and a maximum of 15 metres radius around the respective tree
- Directional drilling within its TRZ occurs at less than 600 millimetres below the surface, or is not confirmed to be appropriate (including considerations concerning bore hole width) by a qualified arborist
- Lopping removes more than 1/3 of its crown



# Appendix 4: Flora species recorded in the investigation area

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	DELWP	CaLP Act
	Silver Wattle	Acacia dealbata					
	Black Wattle	Acacia mearnsii			р		
	Blackwood	Acacia melanoxylon					
	Golden Wattle	Acacia pycnantha			р		
	Sheep's Burr	Acaena echinata					
	Bidgee-widgee	Acaena novae-zelandiae					
*	Sheep Sorrel	Acetosella vulgaris					
*	Brown-top Bent	Agrostis capillaris					
*	Hair Grass	Aira spp.					
	Common Swamp Wallaby-grass	Amphibromus nervosus					
	Common Wheat-grass	Anthosachne scabra s.l.					
*	Sweet Vernal-grass	Anthoxanthum odoratum					
*	Cape weed	Arctotheca calendula					
	Chocolate Lily	Arthropodium strictum s.l.					
	Common Woodruff	Asperula conferta					
*	Hastate Orache	Atriplex prostrata					
	Fine-head Spear-grass	Austrostipa oligostachya					
	Tall Spear-grass	Austrostipa pubinodis					
	Rough Spear-grass	Austrostipa scabra subsp. falcata					
	Spear Grass	Austrostipa spp.					
*	Oat	Avena spp.					
	Marsh Club-sedge	Bolboschoenus medianus					
*	Great Brome	Bromus diandrus					
*	Soft Brome	Bromus hordeaceus					
	Blue Grass-lily	Caesia calliantha					
	Lemon Beauty-heads	Calocephalus citreus			р		
	Milky Beauty-heads	Calocephalus lacteus			р		
	Tall Sedge	Carex appressa					



Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	DELWP	CaLP Act
	Sedge	Carex spp.					
	Common Cassinia	Cassinia aculeata subsp. aculeata			р		
*	Common Centaury	Centaurium erythraea					
	Common Sneezeweed	Centipeda cunninghamii			р		
*	Common Mouse-ear Chickweed	Cerastium glomeratum s.l.					
*	Common Chamomile	Chamaemelum nobile					
*	Spear Thistle	Cirsium vulgare					R
	Pink Bindweed	Convolvulus erubescens s.l.					
*	Mirror Bush	Coprosma repens					
*	Water Buttons	Cotula coronopifolia					
	Common Water-ribbons	Cycnogeton procerum s.s.					
*	Rough Dog's-tail	Cynosurus echinatus					
*	Cocksfoot	Dactylis glomerata					
	Long-hair Plume-grass	Dichelachne crinita					
*	South African Orchid	Disa bracteata					
	Australian Salt-grass	Distichlis distichophylla					
	Sundew	Drosera spp.					
	Nodding Saltbush	Einadia nutans					
	Common Spike-sedge	Eleocharis acuta					
	Tall Spike-sedge	Eleocharis sphacelata					
	Hairy Willow-herb	Epilobium hirtigerum					
	Blue Devil	Eryngium ovinum					
	Prickfoot	Eryngium vesiculosum					
	River Red-gum	Eucalyptus camaldulensis					
*	Sugar Gum	Eucalyptus cladocalyx					
	Bog Gum	Eucalyptus kitsoniana				r	
	Swamp Gum	Eucalyptus ovata subsp. ovata					
	Star Cudweed	Euchiton involucratus s.s.			р		
*	Tall Fescue	Festuca arundinacea					
	Knobby Club-sedge	Ficinia nodosa					



Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	DELWP	CaLP Act
*	Desert Ash	Fraxinus angustifolia					
*	Cleavers	Galium aparine					
	Australian Sweet-grass	Glyceria australis					
	Varied Raspwort	Haloragis heterophylla					
*	Ox-tongue	Helminthotheca echioides					
*	Yorkshire Fog	Holcus lanatus					
*	Barley Grass	Hordeum spp.					
	Pennywort	Hydrocotyle spp.					
*	Flatweed	Hypochaeris radicata					
	Nodding Club-sedge	Isolepis cernua var. cernua					
	Club Sedge	Isolepis spp.					
	Toad Rush	Juncus bufonius					
	Gold Rush	Juncus flavidus					
	Joint-leaf Rush	Juncus holoschoenus					
	Pale Rush	Juncus pallidus					
	Rush	Juncus spp.					
	Running Postman	Kennedia prostrata					
	Common Blown-grass	Lachnagrostis filiformis s.l.					
	Common Duckweed	Lemna disperma					
	Variable Sword-sedge	Lepidosperma laterale					
	Scaly Buttons	Leptorhynchos squamatus			р		
	Salt Pratia	Lobelia irrigua					
	Poison Lobelia	Lobelia pratioides					
*	Rye Grass	Lolium spp.					
	Wattle Mat-rush	Lomandra filiformis					
*	Tall Wheat-grass	Lophopyrum ponticum					
*	African Box-thorn	Lycium ferocissimum					С
*	Pimpernel	Lysimachia arvensis					
	Small Loosestrife	Lythrum hyssopifolia					
*	Burr Medic	Medicago polymorpha					



Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	DELWP	CaLP Act
#	Giant Honey-myrtle	Melaleuca armillaris subsp. armillaris				r	
	Moonah	Melaleuca lanceolata					
	Common Onion-orchid	Microtis unifolia			р		
	Upright Water-milfoil	Myriophyllum crispatum					
	Grassland Wood-sorrel	Oxalis perennans					
*	Paspalum	Paspalum dilatatum					
	Five-awned Spear-grass	Pentapogon quadrifidus var. quadrifidus					
*	Toowoomba Canary-grass	Phalaris aquatica					
*	Lesser Canary-grass	Phalaris minor					
	Common Reed	Phragmites australis					
*	Radiata Pine	Pinus radiata					
*	Rice Millet	Piptatherum miliaceum					
*	Buck's-horn Plantain	Plantago coronopus					
	Narrow Plantain	Plantago gaudichaudii					
*	Ribwort	Plantago lanceolata					
*	Annual Meadow-grass	Poa annua s.l.					
-	Common Tussock-grass	Poa labillardierei					
-	Common Tussock-grass	Poa labillardierei var. labillardierei					
	Grey Tussock-grass	Poa sieberiana					
*	Annual Beard-grass	Polypogon monspeliensis					
	Common Purslane	Portulaca oleracea					
	Thin Pondweed	Potamogeton australiensis				k	
	Austral Bracken	Pteridium esculentum subsp. esculentum			р		
	Buttercup	Ranunculus spp.					
*	Onion Grass	Romulea rosea					
*	Sweet Briar	Rosa rubiginosa					С
*	Blackberry	Rubus fruticosus spp. agg.					С
*	Clustered Dock	Rumex conglomeratus					
*	Curled Dock	Rumex crispus					
	Wiry Dock	Rumex dumosus					



Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	DELWP	CaLP Act
	Common Wallaby-grass	Rytidosperma caespitosum					
	Short Wallaby-grass	Rytidosperma carphoides					
	Brown-back Wallaby-grass	Rytidosperma duttonianum					
	Bristly Wallaby-grass	Rytidosperma setaceum var. setaceum					
	Wallaby Grass	Rytidosperma spp.					
*	Willow	Salix spp.					Р
	Creeping Brookweed	Samolus repens var. repens					
	Shiny Swamp-mat	Selliera radicans					
	Large Kangaroo Apple	Solanum laciniatum					
*	Black Nightshade	Solanum nigrum s.l.					
	Smooth Solenogyne	Solenogyne dominii			р		
*	Common Sow-thistle	Sonchus oleraceus					
	Lesser Sea-spurrey	Spergularia marina s.s.					
	Swamp Starwort	Stellaria angustifolia subsp. angustifolia					
	Sun Orchid	Thelymitra spp.			р		
	Kangaroo Grass	Themeda triandra					
	Creeping Monkey-flower	Thyridia repens					
	Yellow Rush-lily	Tricoryne elatior					
*	Strawberry Clover	Trifolium fragiferum var. fragiferum					
*	White Clover	Trifolium repens var. repens					
*	Clover	Trifolium spp.					
	Narrow-leaf Cumbungi	Typha domingensis					
*	Small Nettle	Urtica urens					
	Slender Speedwell	Veronica gracilis					
*	Common Vetch	Vicia sativa					
*	Squirrel-tail Fescue	Vulpia bromoides					
	Sprawling Bluebell	Wahlenbergia gracilis					

Notes: EPBC = threatened species status under EPBC Act: CR = critically endangered; EN = endangered; VU = vulnerable;

**FFG-T** = threatened species status under the FFG Act: L = listed as threatened under the FFG Act;



**FFG-P** = protected species status under the FFG Act: p = listed as protected;

**DELWP** = status under DELWP's Advisory List (DEPI 2014); cr = critically endangered; e = endangered; v = vulnerable; r = rare; k = insufficiently known;

**CaLP Act** = declared noxious weeds status under the CaLP Act; S = State Prohibited Weeds (any infestations are to be reported to DELWP. DELWP is responsible for control of State Prohibited Weeds); P = Regionally Prohibited Weeds (Land owners must take all reasonable steps to eradicate regionally prohibited weeds on their land); C = Regionally Controlled Weeds (Land owners have the responsibility to take all reasonable steps to prevent the growth and spread of Regionally controlled weeds on their land); R = Restricted Weeds (Trade in these weeds and their propagules, either as plants, seeds or contaminants in other materials is prohibited); **WONS** = Weeds of National Significance

\* = introduced to Victoria

*#* = Victorian native taxa occurring outside their natural range





Appendix 5: Photographs of vegetation within the Hexham WF site





Nature Advisory





## Appendix 6: EVC benchmarks

#### Victorian Volcanic Plain bioregion

- Plains Grassy Woodland (EVC 55\_61)
- Higher Rainfall Plains Grassy Woodland (EVC 55\_63)
- Floodplain Riparian Woodland (EVC 56)
- Plains Grassy Wetland (EVC 125)
- Heavier-soils Plains Grassland (EVC 132\_61)
- Creekline Grassy Woodland (EVC 68)
- Riparian Woodland (EVC 641)
- Plains Sedgy Wetland (EVC 647)
- Aquatic Herbland (EVC 653)
- Creekline Tussock Grassland (EVC 654)
- Brackish Wetland (EVC 656)
- Tall Marsh (EVC 821)



Appendix 7: Native Vegetation Removal (NVR) report





This report provides information to support an application to remove, destroy or lop native vegetation in accordance with the *Guidelines for the removal, destruction or lopping of native vegetation*. The report **is not an assessment by DELWP** of the proposed native vegetation removal. Native vegetation information and offset requirements have been determined using spatial data provided by the applicant or their consultant.

Date of issue: Time of issue:	24/01/2022 10:51 pm		Report ID: NAA_2022_004
Project ID		18088(3)_HXM_Removal_v139_3_211209	

# Assessment pathway

Assessment pathway	Detailed Assessment Pathway			
Extent including past and proposed	5.202 ha			
Extent of past removal	0.000 ha			
Extent of proposed removal	5.202 ha			
No. Large trees proposed to be removed	3			
Location category of proposed removal	Location 2 The native vegetation is in an area mapped as an endangered Ecological Vegetation Class (as per the statewide EVC map). Removal of less than 0.5 hectares of native vegetation in this location will not have a significant impact on any habitat for a rare or threatened species.			

#### 1. Location map







# Offset requirements if a permit is granted

Any approval granted will include a condition to obtain an offset that meets the following requirements:

General offset amount <sup>1</sup>	1.523 general habitat units
Vicinity	Glenelg Hopkins Catchment Management Authority (CMA) or Moyne Shire Council
Minimum strategic biodiversity value score <sup>2</sup>	0.306
Large trees	3 large trees

NB: values within tables in this document may not add to the totals shown above due to rounding

Appendix 1 includes information about the native vegetation to be removed

Appendix 2 includes information about the rare or threatened species mapped at the site.

Appendix 3 includes maps showing native vegetation to be removed and extracts of relevant species habitat importance maps

<sup>1</sup> The general offset amount required is the sum of all general habitat units in Appendix 1.

<sup>2</sup> Minimum strategic biodiversity score is 80 per cent of the weighted average score across habitat zones where a general offset is required
# Next steps

Any proposal to remove native vegetation must meet the application requirements of the Detailed Assessment Pathway and it will be assessed under the Detailed Assessment Pathway.

If you wish to remove the mapped native vegetation you are required to apply for a permit from your local council. Council will refer your application to DELWP for assessment, as required. **This report is not a referral assessment by DELWP.** 

This *Native vegetation removal report* must be submitted with your application for a permit to remove, destroy or lop native vegetation.

Refer to the *Guidelines for the removal, destruction or lopping of native* vegetation (the Guidelines) for a full list of application requirements This report provides information that meets the following application requirements:

- The assessment pathway and reason for the assessment pathway
- A description of the native vegetation to be removed (partly met)
- Maps showing the native vegetation and property (partly met)
- Information about the impacts on rare or threatened species.
- The offset requirements determined in accordance with section 5 of the Guidelines that apply if approval is granted to remove native vegetation.

Additional application requirements must be met including:

- Topographical and land information
- Recent dated photographs
- Details of past native vegetation removal
- An avoid and minimise statement
- A copy of any Property Vegetation Plan that applies
- A defendable space statement as applicable
- A statement about the Native Vegetation Precinct Plan as applicable

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- A site assessment report including a habitat hectare assessment of any patches of native vegetation and details of trees
- An offset statement that explains that an offset has been identified and how it will be secured.

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Obtaining this publication does not guarantee that an application will meet the requirements of Clauses 52.16 or 52.17 of the Victoria Planning Provisions and Victorian planning schemes or that a permit to remove native vegetation will be granted.

Notwithstanding anything else contained in this publication, you must ensure that you comply with all relevant laws, legislation, awards or orders and that you obtain and comply with all permits, approvals and the like that affect, are applicable or are necessary to undertake any action to remove, lop or destroy or otherwise deal with any native vegetation or that apply to matters within the scope of Clauses 52.16 or 52.17 of the Victoria Planning Provisions and Victorian planning schemes.

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# Appendix 1: Description of native vegetation to be removed

The species-general offset test was applied to your proposal. This test determines if the proposed removal of native vegetation has a proportional impact on any rare or threatened species habitats above the species offset threshold. The threshold is set at 0.005 per cent of the mapped habitat value for a species. When the proportional impact is above the species offset threshold a species offset is required. This test is done for all species mapped at the site. Multiple species offsets will be required if the species offset threshold is exceeded for multiple species.

Where a zone requires species offset(s), the species habitat units for each species in that zone is calculated by the following equation in accordance with the Guidelines:

Species habitat units = extent x condition x species landscape factor x 2, where the species landscape factor = 0.5 + (habitat importance score/2)

The species offset amount(s) required is the sum of all species habitat units per zone

Where a zone does not require a species offset, the general habitat units in that zone is calculated by the following equation in accordance with the Guidelines:

General habitat units = extent x condition x general landscape factor x 1.5, where the general landscape factor = 0.5 + (strategic biodiversity value score/2)

The general offset amount required is the sum of all general habitat units per zone.

#### Native vegetation to be removed

	Information provided by or on behalf of the applicant in a GIS file BioEVC							Information calculated by EnSym					
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type	
1-AL	Patch	vvp_0125	Endangered	0	no	0.170	0.079	0.079	0.400		0.014	General	
1-AM	Patch	vvp_0125	Endangered	0	no	0.170	0.040	0.040	0.400		0.007	General	
1-BA	Patch	vvp_0125	Endangered	0	no	0.270	0.000	0.000	0.370		0.000	General	
1-BE	Patch	vvp_0132_61	Endangered	0	no	0.320	0.007	0.007	0.320		0.002	General	
1-BV	Patch	vvp_0125	Endangered	0	no	0.240	0.001	0.001	0.280		0.000	General	
1-BW	Patch	vvp_0068	Endangered	0	no	0.150	0.001	0.001	0.320		0.000	General	
1-BX	Patch	vvp_0068	Endangered	0	no	0.150	0.004	0.004	0.320		0.001	General	
1-BZ	Patch	vvp_0132_61	Endangered	0	no	0.120	0.063	0.063	0.270		0.007	General	
1-CG	Patch	vvp_0132_61	Endangered	0	no	0.120	0.080	0.080	0.270		0.009	General	
1-CI	Patch	vvp_0132_61	Endangered	0	no	0.120	0.034	0.034	0.280		0.004	General	
1-CK	Patch	vvp_0641	Endangered	0	no	0.150	0.028	0.028	0.440		0.005	General	

	Informa	tion provided by	or on behalf of th	ne applica	nt in a GIS f	ile	Information calculated by EnSym					
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1-CL	Patch	vvp_0132_61	Endangered	0	no	0.210	0.184	0.184	0.270		0.037	General
1-FA	Patch	vvp_0132_61	Endangered	0	no	0.280	0.017	0.017	0.325		0.005	General
1-BF	Patch	vvp_0055_61	Endangered	0	no	0.130	0.035	0.035	0.334		0.004	General
1-FI	Patch	vvp_0125	Endangered	0	no	0.240	0.013	0.013	0.290		0.003	General
1-FJ	Patch	vvp_0125	Endangered	0	no	0.240	0.001	0.001	0.290		0.000	General
1-FK	Patch	vvp_0125	Endangered	0	no	0.240	0.011	0.011	0.298		0.003	General
1-FM	Patch	vvp_0125	Endangered	0	no	0.240	0.024	0.024	0.300		0.006	General
1-FN	Patch	vvp_0125	Endangered	0	no	0.240	0.017	0.017	0.290		0.004	General
1-CB	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1-BT	Patch	vvp_0132_61	Endangered	0	no	0.120	0.082	0.082	0.270		0.009	General
1-FH	Patch	vvp_0132_61	Endangered	0	no	0.110	0.105	0.105	0.307		0.011	General
1-FO	Patch	vvp_0132_61	Endangered	0	no	0.240	0.030	0.030	0.300		0.007	General
1-FR	Patch	vvp_0132_61	Endangered	0	no	0.240	0.071	0.071	0.300		0.017	General
1-FF	Patch	vvp_0055_61	Endangered	0	no	0.250	0.015	0.015	0.320		0.004	General
1-FE	Patch	vvp_0055_61	Endangered	0	no	0.190	0.010	0.010	0.320		0.002	General
1-FD	Patch	vvp_0055_61	Endangered	0	no	0.210	0.038	0.038	0.320		0.008	General
1-FC	Patch	vvp_0055_61	Endangered	0	no	0.190	0.010	0.010	0.320		0.002	General
1-FG	Patch	vvp_0055_61	Endangered	0	no	0.190	0.008	0.008	0.320		0.001	General
1-AJ	Patch	vvp_0055_63	Endangered	0	no	0.310	0.001	0.001	0.450		0.000	General
1-BR	Patch	vvp_0132_61	Endangered	0	no	0.120	0.077	0.077	0.270		0.009	General
1-FS	Patch	vvp_0132_61	Endangered	0	no	0.240	0.125	0.125	0.300		0.029	General

	Informa	tion provided by	or on behalf of th	nt in a GIS fi	ile	Information calculated by EnSym					lated by EnSym	
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- XAB	Patch	vvp_0125	Endangered	0	no	0.360	0.003	0.003	0.340		0.001	General
1- XBA	Patch	vvp_0125	Endangered	0	no	0.380	0.008	0.008	0.314		0.003	General
1- XBD	Patch	vvp_0647	Endangered	0	no	0.310	0.008	0.008	0.390		0.003	General
1- XBF	Patch	vvp_0125	Endangered	0	no	0.200	0.001	0.001	0.340		0.000	General
1- XBG	Patch	vvp_0125	Endangered	0	no	0.150	0.079	0.079	0.351		0.012	General
1- XAE	Patch	vvp_0125	Endangered	0	no	0.270	0.107	0.107	0.280		0.028	General
1- XAG	Patch	vvp_0125	Endangered	0	no	0.250	0.007	0.007	0.460		0.002	General
1- XBH	Patch	vvp_0647	Endangered	0	no	0.180	0.009	0.009	0.290		0.001	General
1-XBI	Patch	vvp_0647	Endangered	0	no	0.180	0.014	0.014	0.290		0.002	General
1- XBM	Patch	vvp_0647	Endangered	0	no	0.170	0.002	0.002	0.290		0.000	General
1- XBL	Patch	vvp_0647	Endangered	0	no	0.170	0.003	0.003	0.290		0.000	General
1- XBN	Patch	vvp_0647	Endangered	0	no	0.170	0.006	0.006	0.290		0.001	General
1-XAI	Patch	vvp_0125	Endangered	0	no	0.240	0.002	0.002	0.270		0.001	General
1- XAK	Patch	vvp_0055_61	Endangered	0	no	0.160	0.014	0.014	0.281		0.002	General
1- XAN	Patch	vvp_0055_61	Endangered	0	no	0.230	0.063	0.063	0.280		0.014	General

	Informa	tion provided by	or on behalf of th	nt in a GIS fi	ile				Informa	ation calcu	lated by EnSym	
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- XAP	Patch	vvp_0125	Endangered	0	no	0.130	0.035	0.035	0.495		0.005	General
1- XBS	Patch	vvp_0125	Endangered	0	no	0.270	0.045	0.045	0.420		0.013	General
1- XBT	Patch	vvp_0055_61	Endangered	0	no	0.180	0.178	0.178	0.280		0.031	General
1- XAQ	Patch	vvp_0055_61	Endangered	0	no	0.230	0.034	0.034	0.270		0.007	General
1- XBV	Patch	vvp_0055_61	Endangered	0	no	0.180	0.039	0.039	0.290		0.007	General
1- XBW	Patch	vvp_0055_61	Endangered	0	no	0.180	0.022	0.022	0.300		0.004	General
1- XAT	Patch	vvp_0653	Endangered	0	no	0.440	0.012	0.012	0.450		0.006	General
1- XAS	Patch	vvp_0653	Endangered	0	no	0.360	0.028	0.028	0.460		0.011	General
1- XAU	Patch	vvp_0654	Endangered	0	no	0.480	0.019	0.019	0.850		0.013	General
1- XAV	Patch	vvp_0654	Endangered	0	no	0.480	0.025	0.025	0.850		0.017	General
1- XAW	Patch	vvp_0653	Endangered	0	no	0.500	0.007	0.007	0.850		0.005	General
1- XAX	Patch	vvp_0653	Endangered	0	no	0.500	0.002	0.002	0.440		0.001	General
1- XAY	Patch	vvp_0653	Endangered	0	no	0.500	0.002	0.002	0.440		0.001	General
1- XDE	Patch	vvp_0647	Endangered	0	no	0.400	0.008	0.008	0.440		0.004	General
1- XAZ	Patch	vvp_0125	Endangered	0	no	0.250	0.007	0.007	0.280		0.002	General

	Informat	ion provided by	or on behalf of th	nt in a GIS f	ile	Information calculated by EnSym					lated by EnSym	
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- XDH	Patch	vvp_0125	Endangered	0	no	0.360	0.016	0.016	0.430		0.006	General
1- XDK	Patch	vvp_0125	Endangered	0	no	0.320	0.016	0.016	0.439		0.006	General
1- XDL	Patch	vvp_0125	Endangered	0	no	0.330	0.035	0.035	0.440		0.013	General
1- XDM	Patch	vvp_0125	Endangered	0	no	0.330	0.025	0.025	0.420		0.009	General
1- XCB	Patch	vvp_0647	Endangered	0	no	0.490	0.116	0.116	0.282		0.055	General
1- XCC	Patch	vvp_0125	Endangered	0	no	0.280	0.001	0.001	0.280		0.000	General
1- XCE	Patch	vvp_0821	Endangered	0	no	0.490	0.018	0.018	0.300		0.009	General
1-20	Scattered Tree	vvp_0055_61	Endangered	0	no	0.200	0.031	0.031	0.460		0.007	General
1-8	Scattered Tree	vvp_0055_61	Endangered	1	no	0.200	0.070	0.070	0.450		0.015	General
1-12	Scattered Tree	vvp_0055_61	Endangered	1	no	0.200	0.070	0.062	0.411		0.013	General
1-11	Scattered Tree	vvp_0055_61	Endangered	1	no	0.200	0.070	0.062	0.401		0.013	General
1- XBR 1	Patch	vvp_0656	Endangered	0	no	0.200	0.005	0.005	0.420		0.001	General
1- XBR 2	Patch	vvp_0656	Endangered	0	no	0.200	0.008	0.008	0.420		0.002	General
1- XBR 3	Patch	vvp_0656	Endangered	0	no	0.200	0.167	0.167	0.420		0.035	General

	Informa	tion provided by	or on behalf of th	nt in a GIS fi	ile	Information calculated by EnSym					lated by EnSym	
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- XAL1	Patch	vvp_0055_61	Endangered	0	no	0.260	0.025	0.025	0.522		0.007	General
1- XAL2	Patch	vvp_0055_61	Endangered	0	no	0.260	0.006	0.006	0.490		0.002	General
1- XAL3	Patch	vvp_0055_61	Endangered	0	no	0.260	0.046	0.046	0.491		0.013	General
1- XBO 1	Patch	vvp_0647	Endangered	0	no	0.240	0.015	0.015	0.350		0.004	General
1- XBO 2	Patch	vvp_0647	Endangered	0	no	0.240	0.009	0.009	0.350		0.002	General
1- XAH 1	Patch	vvp_0125	Endangered	0	no	0.380	1.445	1.445	0.447		0.596	General
1- XAH 2	Patch	vvp_0125	Endangered	0	no	0.380	0.080	0.080	0.390		0.032	General
1- XAH 3	Patch	vvp_0125	Endangered	0	no	0.380	0.080	0.080	0.460		0.033	General
1- XAF1	Patch	vvp_0125	Endangered	0	no	0.260	0.095	0.095	0.457		0.027	General
1- XAF2	Patch	vvp_0125	Endangered	0	no	0.260	0.009	0.009	0.440		0.002	General
1- XAF3	Patch	vvp_0125	Endangered	0	no	0.260	0.020	0.020	0.440		0.006	General
1- XAF4	Patch	vvp_0125	Endangered	0	no	0.260	0.014	0.014	0.440		0.004	General
1- XAF5	Patch	vvp_0125	Endangered	0	no	0.260	0.500	0.500	0.391		0.136	General

	Informat	tion provided by	or on behalf of th	nt in a GIS f	ile	Information calculated by EnSym					lated by EnSym	
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- XBE 1	Patch	vvp_0125	Endangered	0	no	0.380	0.000	0.000	0.310		0.000	General
1- XBE 2	Patch	vvp_0125	Endangered	0	no	0.380	0.114	0.114	0.323		0.043	General
1- XBE 3	Patch	vvp_0125	Endangered	0	no	0.380	0.000	0.000	0.390		0.000	General
1- XAC 1	Patch	vvp_0132_61	Endangered	0	no	0.490	0.000	0.000	0.340		0.000	General
1- XAC 2	Patch	vvp_0132_61	Endangered	0	no	0.490	0.002	0.002	0.340		0.001	General
1- XAA 1	Patch	vvp_0647	Endangered	0	no	0.310	0.000	0.000	0.340		0.000	General
1- XAA 2	Patch	vvp_0647	Endangered	0	no	0.310	0.002	0.002	0.340		0.001	General
1- BH1	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General
1- BH2	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General
1- BH3	Patch	vvp_0132_61	Endangered	0	no	0.120	0.003	0.003	0.280		0.000	General
1- BH4	Patch	vvp_0132_61	Endangered	0	no	0.120	0.002	0.002	0.296		0.000	General
1- BH5	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.300		0.000	General

	Informat	tion provided by	ile	Information calculated by EnSym					lated by EnSym			
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- BH6	Patch	vvp_0132_61	Endangered	0	no	0.120	0.014	0.014	0.300		0.002	General
1- FB1	Patch	vvp_0055_61	Endangered	0	no	0.300	0.054	0.054	0.320		0.016	General
1- FB2	Patch	vvp_0055_61	Endangered	0	no	0.300	0.001	0.001	0.320		0.000	General
1- FB3	Patch	vvp_0055_61	Endangered	0	no	0.300	0.001	0.001	0.320		0.000	General
1- FQ1	Patch	vvp_0132_61	Endangered	0	no	0.240	0.004	0.004	0.300		0.001	General
1- FQ2	Patch	vvp_0132_61	Endangered	0	no	0.240	0.007	0.007	0.300		0.002	General
1- CH1	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General
1- CH2	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General
1- CH3	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General
1- CH4	Patch	vvp_0132_61	Endangered	0	no	0.120	0.001	0.001	0.280		0.000	General
1- CH5	Patch	vvp_0132_61	Endangered	0	no	0.120	0.001	0.001	0.278		0.000	General
1- CA1	Patch	vvp_0125	Endangered	0	no	0.240	0.002	0.002	0.270		0.000	General
1- CA2	Patch	vvp_0125	Endangered	0	no	0.240	0.001	0.001	0.270		0.000	General
1- CF1	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- CF2	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General

	Informat	tion provided by	or on behalf of th	ne applica	nt in a GIS f	ile				Informa	ation calcu	lated by EnSym
Zone	Туре	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1- CF3	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- CF4	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- CF5	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- CF6	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- BU1	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- BU2	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.270		0.000	General
1- BU3	Patch	vvp_0132_61	Endangered	0	no	0.120	0.011	0.011	0.270		0.001	General
1- BS1	Patch	vvp_0132_61	Endangered	0	no	0.120	0.001	0.001	0.270		0.000	General
1- BS2	Patch	vvp_0132_61	Endangered	0	no	0.120	0.002	0.002	0.270		0.000	General
1-BI1	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General
1-BI2	Patch	vvp_0132_61	Endangered	0	no	0.120	0.000	0.000	0.280		0.000	General

# Appendix 2: Information about impacts to rare or threatened species' habitats on site

This table lists all rare or threatened species' habitats mapped at the site.

Species common name	Species scientific name	Species number	Conservation status	Group	Habitat impacted	% habitat value affected
Curly Sedge	Carex tasmanica	500650	Vulnerable	Dispersed	Habitat importance map	0.0005
Salt Blown-grass	Lachnagrostis robusta	504223	Rare	Dispersed	Habitat importance map	0.0002
Yarra Pygmy Perch	Nannoperca obscura	4882	Vulnerable	Dispersed	Habitat importance map	0.0001
Salt Paperbark	Melaleuca halmaturorum	502149	Vulnerable	Dispersed	Habitat importance map	0.0001
Wavy Swamp Wallaby- grass	Amphibromus sinuatus	503625	Vulnerable	Dispersed	Habitat importance map	0.0001
Purple Blown-grass	Lachnagrostis punicea subsp. punicea	504206	Rare	Dispersed	Habitat importance map	0.0001
Striped Legless Lizard	Delma impar	12159	Endangered	Dispersed	Habitat importance map	0.0001
Leafy Twig-sedge	Cladium procerum	500786	Rare	Dispersed	Habitat importance map	0.0001
Purple Blown-grass	Lachnagrostis punicea subsp. filifolia	504222	Rare	Dispersed	Habitat importance map	0.0001
Pale Swamp Everlasting	Coronidium gunnianum	504655	Vulnerable	Dispersed	Habitat importance map	0.0001
Swamp Fireweed	Senecio psilocarpus	504659	Vulnerable	Dispersed	Habitat importance map	0.0001
Growling Grass Frog	Litoria raniformis	13207	Endangered	Dispersed	Habitat importance map	0.0000
Fragrant Leek-orchid	Prasophyllum suaveolens	504567	Endangered	Dispersed	Habitat importance map	0.0000
Brolga	Grus rubicunda	10177	Vulnerable	Dispersed	Habitat importance map	0.0000
Lewin's Rail	Lewinia pectoralis pectoralis	10045	Vulnerable	Dispersed	Habitat importance map	0.0000
Plump Swamp Wallaby- grass	Amphibromus pithogastrus	503624	Endangered	Dispersed	Habitat importance map	0.0000
Clumping Golden Moths	Diuris gregaria	504887	Endangered	Dispersed	Habitat importance map	0.0000
Button Wrinklewort	Rutidosis leptorhynchoides	502982	Endangered	Dispersed	Habitat importance map	0.0000

Dwarf Brooklime	Gratiola pumilo	503753	Rare	Dispersed	Habitat importance map	0.0000
Large-headed Fireweed	Senecio macrocarpus	503116	Endangered	Dispersed	Habitat importance map	0.0000
Brackish Plains Buttercup	Ranunculus diminutus	504314	Rare	Dispersed	Habitat importance map	0.0000
Melbourne Yellow-gum	Eucalyptus leucoxylon subsp. connata	504484	Vulnerable	Dispersed	Habitat importance map	0.0000
Snowy Mint-bush	Prostanthera nivea var. nivea	502746	Rare	Dispersed	Habitat importance map	0.0000
Creeping Rush	Juncus revolutus	501839	Rare	Dispersed	Habitat importance map	0.0000
Plains Yam-daisy	Microseris scapigera s.s.	504657	Vulnerable	Dispersed	Habitat importance map	0.0000
Pale-flower Crane's-bill	Geranium sp. 3	505344	Rare	Dispersed	Habitat importance map	0.0000
Matted Flax-lily	Dianella amoena	505084	Endangered	Dispersed	Habitat importance map	0.0000
Showy Lobelia	Lobelia beaugleholei	502733	Rare	Dispersed	Habitat importance map	0.0000
Swamp Flax-lily	Dianella callicarpa	505086	Rare	Dispersed	Habitat importance map	0.0000
Trailing Hop-bush	Dodonaea procumbens	501090	Vulnerable	Dispersed	Habitat importance map	0.0000
Golden Cowslips	Diuris behrii	501061	Vulnerable	Dispersed	Habitat importance map	0.0000
Purple Diuris	Diuris punctata	501084	Vulnerable	Dispersed	Habitat importance map	0.0000
Arching Flax-lily	Dianella sp. aff. longifolia (Benambra)	505560	Vulnerable	Dispersed	Habitat importance map	0.0000
Clover Glycine	Glycine latrobeana	501456	Vulnerable	Dispersed	Habitat importance map	0.0000
Hairy Tails	Ptilotus erubescens	502825	Vulnerable	Dispersed	Habitat importance map	0.0000
Black Falcon	Falco subniger	10238	Vulnerable	Dispersed	Habitat importance map	0.0000
Small Milkwort	Comesperma polygaloides	500798	Vulnerable	Dispersed	Habitat importance map	0.0000
Swamp Everlasting	Xerochrysum palustre	503763	Vulnerable	Dispersed	Habitat importance map	0.0000
Branching Groundsel	Senecio cunninghamii var. cunninghamii	503104	Rare	Dispersed	Habitat importance map	0.0000
Australasian Bittern	Botaurus poiciloptilus	10197	Endangered	Dispersed	Habitat importance map	0.0000
Little Egret	Egretta garzetta nigripes	10185	Endangered	Dispersed	Habitat importance map	0.0000

Fine-hairy Spear-grass	Austrostipa puberula	503988	Rare	Dispersed	Habitat importance map	0.0000
Blue-billed Duck	Oxyura australis	10216	Endangered	Dispersed	Habitat importance map	0.0000
Freckled Duck	Stictonetta naevosa	10214	Endangered	Dispersed	Habitat importance map	0.0000
White-bellied Sea-Eagle	Haliaeetus leucogaster	10226	Vulnerable	Dispersed	Habitat importance map	0.0000
Small-flower Mat-rush	Lomandra micrantha subsp. tuberculata	504711	Rare	Dispersed	Habitat importance map	0.0000
Southern Bent-wing Bat	Miniopterus schreibersii bassanii	61343	Critically endangered	Dispersed	Habitat importance map	0.0000
Small Scurf-pea	Cullen parvum	502773	Endangered	Dispersed	Habitat importance map	0.0000
Eastern Great Egret	Ardea modesta	10187	Vulnerable	Dispersed	Habitat importance map	0.0000
Large White Spider-orchid	Caladenia venusta	500533	Rare	Dispersed	Habitat importance map	0.0000
Bog Gum	Eucalyptus kitsoniana	501290	Rare	Dispersed	Habitat importance map	0.0000
Black-tailed Godwit	Limosa limosa	528553	Vulnerable	Dispersed	Habitat importance map	0.0000
Intermediate Egret	Ardea intermedia	10186	Endangered	Dispersed	Habitat importance map	0.0000
Musk Duck	Biziura lobata	10217	Vulnerable	Dispersed	Habitat importance map	0.0000
Wind-blown Tussock- grass	Poa physoclina	507791	Endangered	Dispersed	Habitat importance map	0.0000
Baillon's Crake	Porzana pusilla palustris	10050	Vulnerable	Dispersed	Habitat importance map	0.0000
Hardhead	Aythya australis	10215	Vulnerable	Dispersed	Habitat importance map	0.0000
Australasian Shoveler	Anas rhynchotis	10212	Vulnerable	Dispersed	Habitat importance map	0.0000
Golden Sun Moth	Synemon plana	15021	Critically endangered	Dispersed	Habitat importance map	0.0000
Yarra Gum	Eucalyptus yarraensis	501326	Rare	Dispersed	Habitat importance map	0.0000
Gull-billed Tern	Gelochelidon nilotica macrotarsa	10111	Endangered	Dispersed	Habitat importance map	0.0000
Blotched Sun-orchid	Thelymitra benthamiana	503369	Vulnerable	Dispersed	Habitat importance map	0.0000
Tough Scurf-pea	Cullen tenax	502776	Endangered	Dispersed	Habitat importance map	0.0000
Flat Bluebell	Wahlenbergia planiflora subsp. planiflora	504064	Vulnerable	Dispersed	Habitat importance map	0.0000

Common Pipewort	Eriocaulon scariosum	501218	Rare	Dispersed	Habitat importance map	0.0000
Elegant Parrot	Neophema elegans	10307	Vulnerable	Dispersed	Habitat importance map	0.0000
Grey Goshawk	Accipiter novaehollandiae novaehollandiae	10220	Vulnerable	Dispersed	Habitat importance map	0.0000
Spiny Rice-flower	Pimelea spinescens subsp. spinescens	504823	Endangered	Dispersed	Habitat importance map	0.0000
Button Immortelle	Leptorhynchos waitzia	501949	Vulnerable	Dispersed	Habitat importance map	0.0000
White Sunray	Leucochrysum albicans subsp. tricolor	504581	Endangered	Dispersed	Habitat importance map	0.0000
Southern Swainson-pea	Swainsona behriana	504944	Rare	Dispersed	Habitat importance map	0.0000
Grey Billy-buttons	Craspedia canens	504643	Endangered	Dispersed	Habitat importance map	0.0000

#### Habitat group

- Highly localised habitat means there is 2000 hectares or less mapped habitat for the species
- Dispersed habitat means there is more than 2000 hectares of mapped habitat for the species

#### Habitat impacted

- Habitat importance maps are the maps defined in the Guidelines that include all the mapped habitat for a rare or threatened species
- Top ranking maps are the maps defined in the Guidelines that depict the important areas of a dispersed species habitat, developed from the highest habitat importance scores in dispersed species habitat maps and selected VBA records
- Selected VBA record is an area in Victoria that represents a large population, roosting or breeding site etc.

# Appendix 3 – Images of mapped native vegetation 2. Strategic biodiversity values map



3. Aerial photograph showing mapped native vegetation



# 4. Map of the property in context



Yellow boundaries denote areas of proposed native vegetation removal.

Appendix 8: Evidence that native vegetation offsets are available





This report lists native vegetation credits available to purchase through the Native Vegetation Credit Register.

This report is **not evidence** that an offset has been secured. An offset is only secured when the units have been purchased and allocated to a permit or other approval and an allocated credit extract is provided by the Native Vegetation Credit Register.

#### Date and time: 16/12/2021 11:28

Report ID: 12269

### What was searched for?

#### General offset

General habitat units	Strategic biodiversity value	Large trees	Vicinity (0	Catchment Management Authority or Municipal district)
1.523	0.306	3	CMA	Glenelg Hopkins
			or LGA	Moyne Shire

# Details of available native vegetation credits on 16 December 2021 11:28

Credit Site ID	GHU	LT	СМА	LGA	Land owner	Trader	Fixed price	Broker(s)
BBA-2467	3.017	40	Glenelg Hopkins	Glenelg Shire	Yes	Yes	No	VegLink
BBA-3027	2.518	267	Glenelg Hopkins	Pyrenees Shire	Yes	Yes	No	VegLink
BBA-3041	4.144	283	Glenelg Hopkins	Moyne Shire	Yes	Yes	No	VegLink
VC_CFL- 3693_01	4.058	686	Glenelg Hopkins	Ararat Rural City	Yes	Yes	No	VegLink
VC_TFN- C2046_01	10.596	1459	Glenelg Hopkins	Southern Grampians Shire	Yes	Yes	No	Ecocentric, Ethos, VegLink

#### These sites meet your requirements for general offsets.

#### These sites meet your requirements using alternative arrangements for general offsets.

Credit Site ID	GHU	LT CN	МА	LGA	Land	Trader	Fixed	Broker(s)
					owner		price	

There are no sites listed in the Native Vegetation Credit Register that meet your offset requirements when applying the alternative arrangements as listed in section 11.2 of the Guidelines for the removal, destruction or lopping of native vegetation.

# These potential sites are not yet available, land owners may finalise them once a buyer is confirmed.

Credit Site ID	GHU	LT	СМА	LGA	Land	Trader	Fixed	Broker(s)
					owner		price	

There are no potential sites listed in the Native Vegetation Credit Register that meet your offset requirements.

LT - Large Trees

CMA - Catchment Management Authority

LGA - Municipal District or Local Government Authority

# **Next steps**

#### If applying for approval to remove native vegetation

Attach this report to an application to remove native vegetation as evidence that your offset requirement is currently available.

#### If you have approval to remove native vegetation

Below are the contact details for all brokers. Contact the broker(s) listed for the credit site(s) that meet your offset requirements. These are shown in the above tables. If more than one broker or site is listed, you should get more than one quote before deciding which offset to secure.

# **Broker contact details**

Broker Abbreviation	Broker Name	Phone	Email	Website
Abezco	Abzeco Pty. Ltd.	(03) 9431 5444	offsets@abzeco.com.au	www.abzeco.com.au
Baw Baw SC	Baw Baw Shire Council	(03) 5624 2411	bawbaw@bawbawshire.vic.gov.au	www.bawbawshire.vic.gov.au
Bio Offsets	Biodiversity Offsets Victoria	0452 161 013	info@offsetsvictoria.com.au	www.offsetsvictoria.com.au
Contact NVOR	Native Vegetation Offset Register	136 186	nativevegetation.offsetregister@d elwp.vic.gov.au	www.environment.vic.gov.au/nativ e-vegetation
Ecocentric	Ecocentric Environmental Consulting	0410 564 139	ecocentric@me.com	Not avaliable
Ethos	Ethos NRM Pty Ltd	(03) 5153 0037	offsets@ethosnrm.com.au	www.ethosnrm.com.au
Nillumbik SC	Nillumbik Shire Council	(03) 9433 3316	offsets@nillumbik.vic.gov.au	www.nillumbik.vic.gov.au
TFN	Trust for Nature	8631 5888	offsets@tfn.org.au	www.trustfornature.org.au
VegLink	Vegetation Link Pty Ltd	(03) 8578 4250 or 1300 834 546	offsets@vegetationlink.com.au	www.vegetationlink.com.au
Yarra Ranges SC	Yarra Ranges Shire Council	1300 368 333	biodiversityoffsets@yarraranges.vi c.gov.au	www.yarraranges.vic.gov.au

 ${\small \circledcirc}$  The State of Victoria Department of Environment, Land, Water and Planning 2021



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For more information contact the DELWP Customer Service Centre 136 186 or the Native Vegetation Credit Register at nativevegetation.offsetregister@delwp.vic.gov.au

#### Disclaimer

This publication may be of assistance to you but the State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

Obtaining this publication does not guarantee that the credits shown will be available in the Native Vegetation Credit Register either now or at a later time when a purchase of native vegetation credits is planned.

Notwithstanding anything else contained in this publication, you must ensure that you comply with all relevant laws, legislation, awards or orders and that you obtain and comply with all permits, approvals and the like that affect, are applicable or are necessary to undertake any action to remove, lop or destroy or otherwise deal with any native vegetation or that apply to matters within the scope of Clauses 52.16 or 52.17 of the Victoria Planning Provisions and Victorian planning schemes

Common name	Scientific name	EPBC-1	EPBC-M	FFG	Recorded
	Birds	-			
Australasian Bittern	Botaurus poiciloptilus	EN		CR	
Australasian Grebe	Tachybaptus novaehollandiae				Х
Australasian Pipit	Anthus novaeseelandiae				Х
Australasian Shoveler	Spatula rhynchotis			VU	Х
Australian Bustard	Ardeotis australis			CR	
Australian Hobby	Falco longipennis				
Australian Magpie	Cracticus tibicen				Х
Australian Painted-snipe	Rostratula australis	EN		CR	
Australian Pelican	Pelecanus conspicillatus				Х
Australian Raven	Corvus coronoides				Х
Australian Reed Warbler	Acrocephalus australis				Х
Australian Shelduck	Tadorna tadornoides				Х
Australian Spotted Crake	Porzana fluminea				
Australian White Ibis	Threskiornis molucca				Х
Australian Wood Duck	Chenonetta jubata				Х
Banded Lapwing	Vanellus tricolor				Х
Banded Stilt	Cladorhynchus leucocephalus				
Barn Owl	Tyto alba				
Black Falcon	Falco subniger			CR	
Black Kite	Milvus migrans			-	
Black Swan	Cvgnus atratus				Х
Black-faced Cuckoo-					
shrike	Coracina novaehollandiae				Х
Black-fronted Dotterel	Elseyornis melanops				Х
Black-shouldered Kite	Elanus axillaris				
Black-tailed Native-hen	Tribonyx ventralis				
Blue-billed Duck	Oxyura australis			VU	
Blue-winged Parrot	Neophema chrysostoma				
Brolga	Grus rubicunda			EN	Х
Brown Falcon	Falco berigora				Х
Brown Goshawk	Accipiter fasciatus				Х
Brown Songlark	Cincloramphus cruralis				Х
Brown Thornbill	Acanthiza pusilla				Х
Brown-headed					
Honeyeater	Melithreptus brevirostris				
Chestnut Teal	Anas castanea				Х
Collared Sparrowhawk	Accipiter cirrhocephalus				
Common Blackbird	Turdus merula				Х
Common Bronzewing	Phaps chalcoptera				
			M (Bonn		
			A2H,		
Common Greenshank	Tringa nebularia		ROKAMB	EN	Х
			A, JAMBA,		
			CAIVIBA) M (Ropp		
Common Sandpiper	Actitis hypoleucos		A2H	VU	
		1			

# Appendix 9: Terrestrial vertebrate fauna species recorded and species that have the potential to occur in the investigation area



Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
			JAMBA, CAMBA)		
Common Starling	Sturnus vulgaris				Х
Crested Pigeon	Ocyphaps lophotes				Х
Crimson Rosella	Platycercus elegans				
Curlew Sandpiper	Calidris ferruginea	CR	M (Bonn A2H, ROKAMB A, JAMBA, CAMBA)	CR	
Double-banded Plover	Charadrius bicinctus		M (Bonn A2H)		Х
Dusky Moorhen	Gallinula tenebrosa		,		Х
Dusky Woodswallow	Artamus cvanopterus				
Eastern Cattle Egret	Bubulcus coromandus				
Eastern Curlew	Numenius madagascariensis	CR	M (Bonn A1, ROKAMB A, JAMBA, CAMBA)	CR	
Eastern Rosella	Platycercus eximius				
Eastern Spinebill	Acanthorhynchus tenuirostris				
Eastern Yellow Robin	Eopsaltria australis				
Emu	Dromaius novaehollandiae				
Eurasian Coot	Fulica atra				Х
European Goldfinch	Carduelis carduelis				Х
European Greenfinch	Chloris chloris				
European Skylark	Alauda arvensis				Х
Fairy Martin	Petrochelidon ariel				Х
Flame Robin	Petroica phoenicea				
Forest Raven	Corvus tasmanicus				
Fork-tailed Swift	Apus pacificus		M (CAMBA, ROKAMB A, JAMBA)		
Galah	Eolophus roseicapilla				Х
Gang-gang Cockatoo	Callocephalon fimbriatum				
Golden Whistler	Pachycephala pectoralis				Х
Golden-headed Cisticola	Cisticola exilis				Х
Great Cormorant	Phalacrocorax carbo				
Great Crested Grebe	Podiceps cristatus				
Great Egret	Ardea alba			VU	Х
Grey Butcherbird	Cracticus torquatus				
Grey Fantail	Rhipidura albiscapa				
Grey Goshawk	Accipiter novaehollandiae			EN	
Grey Shrike-thrush	Colluricincla harmonica				Х
Grey Teal	Anas gracilis				X
Hardhead	Aythya australis			VU	X
Hoary-headed Grebe	Poliocephalus poliocephalus				Х
Horsfield's Bronze- Cuckoo	Chrysococcyx basalis				
Horsfield's Bushlark	Mirafra javanica				



Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
House Sparrow	Passer domesticus				Х
Jacky Winter	Microeca fascinans				
			M (Bonn		
Latham's Snipe	Gallinago hardwickii		A2H,		х
			ROKAMB		
	Decela neuro fuine es		A, JAMBA)		Y
	Dacelo novaeguineae				X
Lewin's Honeyealer					V
Little Black Cormorant	Phalacrocorax sulcirostris				X
				1/11	V
Little Eagle	Fieraaetus morphhoides				X
Little Egret				EN	V
	Poodytes gramineus				X
Little Lorikeet					V
Little Pied Cormorant					X
Little Raven					
Little Stint					
Little Wattlebird	Anthochaera chrysoptera				N N
Long-billed Corella	Cacatua tenuirostris				X
Magpie Goose	Anseranas semipalmata			VU	N N
Мадріе-Іагк	Grallina cyanoleuca				X
Masked Lapwing	Vanellus miles				X
Musk Duck	Biziura lobata			VU	
Musk Lorikeet	Glossopsitta concinna				
Nankeen Kestrel	Falco cenchroides				X
Nankeen Night Heron	Nycticorax caledonicus				
New Holland Honeyeater	Phylidonyris novaehollandiae				X
Noisy Miner	Manorina melanocephala				Х
Osprey	Pandion cristatus		M (Bonn A2S)		
Pacific Black Duck	Anas superciliosa				Х
Painted Honeyeater	Grantiella picta	VU		VU	
			M (Bonn A2H		
Pectoral Sandpiper	Calidris melanotos		ROKAMB		
			A, JAMBA)		
Peregrine Falcon	Falco peregrinus				
Pied Cormorant	Phalacrocorax varius				
Pied Stilt	Himantopus leucocephalus				
Pink-eared Duck	Malacorhynchus				x
	membranaceus				~
Plains-wanderer	Pedionomus torquatus	CR		CR	
Plumed Whistling-Duck	Dendrocygna eytoni				
Purple Swamphen	Porphyrio porphyrio				Х
Purple-crowned Lorikeet	Glossopsitta porphyrocephala				
Red Wattlebird	Anthochaera carunculata				Х
Red-browed Finch	Neochmia temporalis				
Red-capped Plover	Charadrius ruficapillus				X
Red-kneed Dotterel	Erythrogonys cinctus				X
Red-necked Avocet	Recurvirostra novaehollandiae				



Red-necked Stint   Calidris ruficollis   M (Bonn A2H, A2H, B ROKAMB A, JAMBA, CAMBA)     Red-necked Stint   Psephotus haematonotus   X     Restless Flycatcher   Mylagra inquieta   X     Rock Dove   Columba livia   X     Royal Spoonbill   Platalea regia   X     Rufous Fantail   Rhipidura ruffrons   M (Bonn A2H)     Rufous Songlark   Cincloramphus mathewsi   X     Rufous Songlark   Cincloramphus mathewsi   X     Rufous Whistler   Pachycephala rufiventris   X     Sacred Kingfisher   Todiramphus sanctus   X     Satin Flycatcher   Mylagra cyanoleuca   A2H, A2H, A2H, A2H, A2H, A2H, A2H, A2H,	Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Red-necked StintCalidris ruficoilisACAH ROKAMB A, JAMBA, CAMBDXRed-rumped ParrotPsephotus haematonotusXRestless FlycatcherMylagra inquietaXRock DoveColumba liviaXRock DoveColumba liviaXRock DoveColumba liviaXRock DovePatalea regiaXRufous FantallRhipidura rufifronsM(Born A2H)XRufous SonglarkCincloramphus mathewsiXRufous WhistlerPachycophala rufiventrisSacred KingfisherTodiramphus sanctusSatin FlycatcherMylagra cyanoleucaM (Born A2H)Sharp-tailed SandpiperCalidris acuminataM (Born A2H)XShining Bronze-CuckooChrysococcyx lucidusXSilver GullChroicocephalaratinaM (Born A2H)XSouthern BoobookNinox boobookXSouthern BobookNinox boobookXStriated PardalotePardalotus punctatus punctatusXStriated PardalotePardalotus punctatus punctatusXStriated PardalotePardalotus striatusXStriated PardalotePardalotus striatusXStriated PardalotePardalotus striatusX<				M (Bonn		
Red-necked StintCalidris rufficollisROKAMB A, JAMBA, CAMBA)Red-rumped ParrotPsephotus haematonotusXRestless FlycatcherMylagra inquietaXRock DoveColumba liviaXRoyal SpoonbillPlatalea regiaXRufous SonglarkCinoloramphus mathewsiXRufous SonglarkCinoloramphus mathewsiXRufous SonglarkCinoloramphus mathewsiXSatin FlycatcherMylagra oyanoleucaM (Bonn A2H)XSatin FlycatcherMylagra oyanoleucaM (Bonn A2H)XSatin FlycatcherMylagra oyanoleucaM (Bonn A2H)XSharp-tailed SandpiperCalidris acuminataROKAMB R, JAMBA, CAMBA)XShining Bronze-CuckooChrysococcyx lucidusXSilver GullChroicocephalus novaehollandiaeXSouten BoobookNinox boobookXSouten BoobookCurcus assimilisXSpotted PardalotePardalotus punctatus punctatusXXStriated PardalotePardalotus striatusXSububle QualCoturnix pectoralisXSububle QualCoturnix pectoralisXStriated PardalotePardalotus striatusXSububle QualCoturnix pectoralisXSububle QualCoturnix pectoralis </td <td></td> <td></td> <td></td> <td>A2H,</td> <td></td> <td></td>				A2H,		
Red-rumped ParrotPsephotus haematonotusA, JAMBA, CAMBA)Red-rumped ParrotPsephotus haematonotusXRestless FlycatcherMyiagra inquietaXRock DoveColumba iivaXRoyal SpoonbillPlatalea regiaXRufous SonglarkCincloramphus mathewsiXRufous SonglarkCincloramphus mathewsiXRufous SonglarkCincloramphus sanctusXSacred KingfisherTodiramphus sanctusXSacred KingfisherTodiramphus sanctusXSacred KingfisherTodiramphus sanctusXSacred KingfisherTodiramphus sanctusXSacred KingfisherTodiramphus sanctusXSacred KingfisherTodiramphus sanctusXSatin FlycatcherMyiagra cyanoleucaM(Bonn A2H)Sharp-tailed SandpiperCalidris acuminataM Bonn A2H, ROKAMBSilver GullChroicocephalus novaehollandiaeXSilver GullChroicocephalus novaehollandiaeXSilver GullNinox bobookIISpotted HarrierCircus assimilisIXStriated PardalotePardalotus punctatus punctatusIXStriated PardalotePardalotus striatusIXStriated PardalotePardalotus striatusIXStriated PardaloteCaurus agaleritaIXStriated PardaloteCaurus agaleritaIXStriated PardaloteCaurus agaleritaIX<	Red-necked Stint	Calidris ruficollis		ROKAMB		
Red-rumped ParrotPsephotus haematonotusCAMBA)Restless FlycatcherMylagra inquietaXRock DoveColumba liviaXRoyal SpoonbillPlatalea regiaRufous SonglarkChicloramphus mathewsiXRufous SonglarkChicloramphus mathewsiXRufous SonglarkChicloramphus mathewsiXRufous SonglarkChicloramphus mathewsiXRufous SonglarkChicloramphus sanctusSacred KingfisherTodiramphus sanctusSatin FlycatcherMylagra cyanoleucaM (Bonn A2H)Sharp-tailed SandpiperCalidris acuminataM (Bonn A2H)Sharp-tailed SandpiperCalidris acuminataM (Bonn A2H)XSilver GullChroicocephalus novaehollandiaeXSilvergeZosterops lateralisXSouthern BoobookNinox boobookXSpotted HarrierCircus assimilisStriated PardalotePardalotus pructatus punctatusXSulpur-trested CockatooCalagrins spinicollisXSulpur-trested CockatooCalagrins spinicollisXStraited PardalotePardalotus pructatus punctatusXSulpure rest CockatooChroicocephalus rovaestratusXSitiated PardalotePardalotus pructatus punctatusXStriated PardalotePardalotus pructat				A, JAMBA,		
Red-numped Parrot   Psephotus haematonotus   X     Restiess Flycatcher   Mylagra inquieta   X     Royal Spoonbill   Platalea regia   X     Rufous Songlark   Cincloramphus mathewsi   X     Rufous Songlark   Cincloramphus mathewsi   X     Rufous Whistler   Pachycephala rufiventris   X     Sacred Kingfisher   Todiramphus sanctus   X     Satin Flycatcher   Mylagra cyanoleuca   M (Bonn A2H)   X     Satin Flycatcher   Mylagra cyanoleuca   M (Bonn A2H)   X     Sharp-tailed Sandpiper   Calidris acuminata   ROKAMB A, JAMBA,   X     Shining Bronze-Cuckoo   Chroicocephalus novaehollandiae   X   X     Silver Gull   Chroicocephalus novaehollandiae   X   X     Southern Boobook   Ninox boobook   X   X     Spotted Pardalote Pardalotus punctatus   X   X   X     Strataet Pardalote   Pardalotus granitau   X   X     Strated Pardalote   Pardalotus granitau   X   X     Strated Pardalote   Pardalotus granitau   X   X     Strated Paralaote <td></td> <td></td> <td></td> <td>CAMBA)</td> <td></td> <td></td>				CAMBA)		
Restless Flycatcher   Mylagra inquieta   X     Rock Dove   Columba livia   Image: Columba livia   Image: Columba livia     Rufous Fantail   Rhipidura rufifrons   M (Bonn A2H)   X     Rufous Songlark   Cincloramphus mathewsi   Image: Columba livia   X     Rufous Songlark   Cincloramphus mathewsi   Image: Columba livia   X     Rufous Whistler   Pachycephala rufiventris   Image: Columba livia   X     Sacred Kingfisher   Todiramphus sanctus   Image: Columba livia   X     Satin Flycatcher   Mylagra cyanoleuca   M (Bonn A2H)   X     Sharp-tailed Sandpiper   Calidris acuminata   ROKAMB   X     Shining Bronze-Cuckoo   Chrysococcyx lucidus   Image: Columba livia   X     Silvere Gull   Chroicocephalus   Image: Columba livia   X     Solter Bobook   Ninox boobook   Image: Columba livia   X     Southern Boobook   Ninox boobook   Image: Columba livia   X     Spotted Pardalote   Pardalotus punctatus   Image: Columba livia   X     Striated Pardalote   Pardalotus striatus   Image: Columba livia   X	Red-rumped Parrot	Psephotus haematonotus				Х
Rock Dove   Columba livia   Image: Columba livia     Royal Spoonbill   Platalea regia   Image: Columba livia     Rufous Songlark   Cincloramphus mathewsi   Image: Columba livia     Rufous Songlark   Cincloramphus mathewsi   Image: Columba livia     Sacred Kingfisher   Todiramphus sanctus   Image: Columba livia     Sacred Kingfisher   Todiramphus sanctus   Image: Columba livia     Satin Flycatcher   Mylagra cyanoleuca   M. (Bonn A2H)     Satin Flycatcher   Mylagra cyanoleuca   M. (Bonn A2H)     Sharp-tailed Sandpiper   Calidris acuminata   M (Bonn A2H)     Shining Bronze-Cuckoo   Chrysococcyx lucidus   Image: Columba livia   X     Silver Gull   Chroicocoephalus novaehollandiae   X   X     Southern Bobook   Ninox bobook   Image: Columba livia   X     Spotted Harrier   Circus assimilis   Image: Columba livia   X     Striated Pardalote   Pardalotus punctatus   X   X     Striated Pardalote   Pardalotus striatus   Image: X   X     Striated Thornbill   Acanthiza lineata   Image: X   X     Sububble Quail   C	Restless Flycatcher	Myiagra inquieta				Х
Royal SpoonbillPlatalea regiaMeanRufous FantailRhipidura rufifronsM (Born A2H)XRufous SonglarkCincloramphus mathewsiXXRufous SonglarkTodiramphus sanctusMXSacred KingfisherTodiramphus sanctusMXSatin FlycatcherMylagra cyanoleucaM (Born A2H)XScarlet RobinPetroica boodangMCScarlet RobinPetroica boodangMXSharp-tailed SandpiperCalidris acuminataNQKAMB A, JAMBA, CMRDANBXShining Bronze-CuckooChrysococcyx lucidusXXSilver GullChroicocephalus novaehollandiaeXXSilver GullCircus assimilisZXSouthern BoobookNinox boobookIISpotted HarrierCircus assimilisIXStraw-necked IbisThreskionis spinicollisIXStrated PardalotePardalotus striatusIXStrated TornbillAcanthiza lineataIXStuber Fainy-wrenMalurus cyaneusIXStuber GuilaCournix pectoralisIXStrated TornbillAcanthiza lineataIXStrated PardalotePardalotus striatusIXStubble QuailCournix pectoralisIXStubble QuailCournix pectoralisIXStriated PardalotePardalotus striatusIXStriated PardalotePardalo	Rock Dove	Columba livia				
Rufous FantailRhipidura rufifronsM (Bonn A2H)Rufous SonglarkCincloramphus mathewsiXRufous WhistlerPachycephala rufiventrisXSacred KingfisherTodiramphus sanctusM (Bonn A2H)Satin FlycatcherMylágra cyanoleucaM (Bonn A2H)Scarlet RobinPetroica boodangM (Bonn 	Royal Spoonbill	Platalea regia				
Rufous SonglarkCincloramphus mathewsiXRufous WhistlerPachycephala rufiventrisSacred KingfisherTodiramphus sanctusSatin FlycatcherMylagra cyanoleuca $A_{2H}$ KScarlet RobinPetroica boodangSharp-tailed SandpiperCalidris acuminataM (Bonn A2H, CAMMBXSharp-tailed SandpiperCalidris acuminataM (Bonn A2H, CAMMBXXSilver GullChroicocephalus novaehollandiaeXSilver GullChroicocephalus novaehollandiaeXSouthern BoobookNinox boobookXSpotted PardalotePardalotus punctatus punctatusXStriated PardalotePardalotus spinicollisXXStriated PardalotePardalotus spinicollisXXStriated PardaloteCoturnik pectoralisXSubphur-crested CockatooCacatua galeritaXSubphur-crested CockatooCacatua galeritaXSught ParotLathamus discolorCRXSught ParotLathamus discolorCRXSubpher Crested CockatooCacatus galeritaXSubphur-crested CockatooCacatus galeritaXSubpher TearryMaluus cyaneusXSubphariterCir	Rufous Fantail	Rhipidura rufifrons		M (Bonn A2H)		
Rufous WhistlerPachycephala rufiventrisImage: Constraint of the second se	Rufous Songlark	Cincloramphus mathewsi				Х
Sacred KingfisherTodiramphus sanctusMMSatin FlycatcherMylägra cyanoleucaM (Bonn A2H)MScarlet RobinPetroica boodangMMSharp-tailed SandpiperCalidris acuminataM (Bonn A2H, ROKAMB 	Rufous Whistler	Pachycephala rufiventris				
Satin FlycatcherMyiagra cyanoleucaM (Bonn A2H)Scarlet RobinPetroica boodangSharp-tailed SandpiperCalidris acuminataM (Bonn A2H, ROKAMB A, JAMBA, CAMBA)XSharp-tailed SandpiperCalidris acuminataM (Bonn A2H, ROKAMB novaehollandiaeXSilver GullChroicocephalus novaehollandiaeXSilvergeZosterops lateralisXSouthern BoobookSpotted HarrierCircus assimilisStriated PardalotePardalotus punctatus punctatusXStriated PardalotePardalotus striatusXStriated PardaloteCournix pectoralisXStriated ThornbillAcanthiza lineataXStupher Crested CockatooCaeata galeritaXSuperb Fairy-wrenMalurus cyaneusXSwift ParrotLathamus discolarCRXSwift ParrotLathamus discolarCRXWeidge-tailed EagleAquila audaxXWhite-backed SwallowHirundo neoxenaXWhite-backed SwallowCheramoeaa leucosternusXWhite-backed SwallowAramus supercillosusXWhite-forced ChatEgrita novaeholaladiaeXWhite-forced HeronEgretta novaeholaladiaeXWhite-forced SwallowHirundo neoxenaXWhite-forced HeronEgretta novaeholaladiae	Sacred Kingfisher	Todiramphus sanctus				
Scarlet RobinPetroica boodangM (Bonn A2H, ROKAMB A,JAMBA, CAMBA)XSharp-tailed SandpiperCalidris acuminataM (Bonn A2H, ROKAMB A,JAMBA, CAMBA)XShining Bronze-CuckooChrysococcyx lucidusXSilver GullChroicocephalus novaehollandiaeXSilvereyeZosterops lateralitsXSouthern BoobookNinox boobookXSpotted HarrierCircus assimilisXSpotted PardalotePardalotus punctatus punctatusXStriated PardalotePardalotus striatusXStriated PardalotePardalotus striatusXStubble QuailCoturnix pectoralisXSuperb Fairy-wrenMalurus cyaneusXSwift ParrotLatamus discolorCRVaried SittellaDaphoenositta chrysopteraXWelcome SwallowHirundo neoxenaXWhite-backed SwallowCheramoeca leucosternusXWhite-browed ScrubwerSericornis frontalisXWhite-fronted ChatEgretta novaehollandiaeXWhite-fronted ChatEgretta novae	Satin Flycatcher	Myiagra cyanoleuca		M (Bonn A2H)		
Sharp-tailed SandpiperCalidris acuminataM (Bonn A2H, ROKAMB A, JAMBA, 	Scarlet Robin	Petroica boodang		,		
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Striated ThornbillAcanthiza lineataXStubble QuailCoturnix pectoralisXSulphur-crested CockatooCacatua galeritaXSuperb Fairy-wrenMalurus cyaneusXSwamp HarrierCircus approximansXSwift ParrotLathamus discolorCRTree MartinPetrochelidon nigricansXVaried SittellaDaphoenositta chrysopteraXWedge-tailed EagleAquila audaxXWhiskered TernChildonias hybridusXWhistling KiteHaliastur sphenurusXWhite-browed WoodswallowArtamus superciliosusXWhite-fronted ChatEgretta novaehollandiaeXWhite-naped HoneyeaterMelithreptus lunatusX	Striated Pardalote	Pardalotus striatus				Х
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Swamp HarrierCircus approximansXSwift ParrotLathamus discolorCRCRTree MartinPetrochelidon nigricansXVaried SittellaDaphoenositta chrysopteraXWedge-tailed EagleAquila audaxXWelcome SwallowHirundo neoxenaXWhiskered TernChlidonias hybridusXWhistling KiteHaliastur sphenurusXWhite-backed SwallowCheramoeca leucosternusXWhite-browedSericornis frontalisXWhite-browedArtamus superciliosusXWhite-fronted ChatEpthianura albifronsXWhite-naped HoneveaterMelithreptus lunatusX	Superb Fairy-wren	Malurus cvaneus				Х
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Tree MartinPetrochelidon nigricansOrOrVaried SittellaDaphoenositta chrysopteraXWedge-tailed EagleAquila audaxXXWelcome SwallowHirundo neoxenaXXWhiskered TernChlidonias hybridusXXWhistling KiteHaliastur sphenurusXXWhite-backed SwallowCheramoeca leucosternusXXWhite-browed ScrubwrenSericornis frontalisXWhite-browedArtamus superciliosusXXWhite-faced HeronEgretta novaehollandiaeXXWhite-fonted ChatEpthianura albifronsXX	Swift Parrot	Lathamus discolor	CR		CR	
Varied SittellaDaphoenositta chrysopteraImage: Chromosofta chrysopteraWedge-tailed EagleAquila audaxXWelcome SwallowHirundo neoxenaXWhiskered TernChlidonias hybridusXWhistling KiteHaliastur sphenurusXWhite-backed SwallowCheramoeca leucosternusXWhite-browed ScrubwrenSericornis frontalisImage: Chromosofta chrysopteraWhite-browed MoodswallowArtamus superciliosusXWhite-faced HeronEgretta novaehollandiaeXWhite-fornted ChatEpthianura albifronsX	Tree Martin	Petrochelidon nigricans				Х
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Welcome Swallow   Hirundo neoxena   X     Whiskered Tern   Chlidonias hybridus   X     Whistling Kite   Haliastur sphenurus   X     White-backed Swallow   Cheramoeca leucosternus   X     White-browed Scrubwren   Sericornis frontalis   X     White-browed   Artamus superciliosus   X     White-faced Heron   Egretta novaehollandiae   X     White-fonted Chat   Epthianura albifrons   X	Wedge-tailed Fagle	Aquila audax				Х
Whiskered Tern   Chlidonias hybridus   X     Whiskered Tern   Chlidonias hybridus   X     Whistling Kite   Haliastur sphenurus   X     White-backed Swallow   Cheramoeca leucosternus   X     White-browed Scrubwren   Sericornis frontalis   X     White-browed   Artamus superciliosus   X     White-faced Heron   Egretta novaehollandiae   X     White-fronted Chat   Epthianura albifrons   X	Welcome Swallow	Hirundo neoxena				X
Whileleou fermion formula information information   Image: Second Seco	Whiskered Tern	Chlidonias hybridus				X
White-backed Swallow   Cheramoeca leucosternus   Image: Cheramoeca leucosternus     White-browed Scrubwren   Sericornis frontalis   Image: Cheramoeca leucosternus     White-browed Scrubwren   Sericornis frontalis   Image: Cheramoeca leucosternus     White-browed   Artamus superciliosus   Image: Cheramoeca leucosternus     White-browed   Artamus superciliosus   Image: Cheramoeca leucosternus     White-faced Heron   Egretta novaehollandiae   Image: Cheramoeca leucosternus     White-fronted Chat   Epthianura albifrons   Image: Cheramoeca leucosternus     White-naped Honeyeater   Melithreptus lunatus   Image: Cheramoeca leucosternus	Whistling Kite	Haliastur sphenurus				X
White-browed Scrubwren Sericornis frontalis   White-browed Artamus superciliosus   Woodswallow Artamus superciliosus   White-faced Heron Egretta novaehollandiae   White-fronted Chat Epthianura albifrons   White-naped Honeyeater Melithreptus lunatus	White-backed Swallow	Cheramoeca leucosternus				~
White-browed   Artamus superciliosus   X     White-faced Heron   Egretta novaehollandiae   X     White-fronted Chat   Epthianura albifrons   X     White-naped Honeyeater   Melithreptus lunatus   X	White-browed Scrubwren	Sericornis frontalis				
Winte-faced Heron Artamus superciliosus X   White-faced Heron Egretta novaehollandiae X   White-fronted Chat Epthianura albifrons X   White-naped Honeyeater Melithreptus lunatus X	White-browed					
White-faced Heron Egretta novaehollandiae X   White-fronted Chat Epthianura albifrons X   White-naped Honeyeater Melithreptus lunatus X	Woodswallow	Artamus superciliosus				Х
White-fronted Chat Epthianura albifrons X   White-naped Honeyeater Melithreptus lunatus X	White-faced Heron	Egretta novaehollandiae				Х
White-naped Honeveater Melithreptus lunatus	White-fronted Chat	Enthianura albifrons				X
	White-naped Honeveater	Melithreptus lunatus				~~~~



Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
White-necked Heron	Ardea pacifica				Х
White-plumed Honeyeater	Ptilotula penicillatus				
White-throated Needletail	Hirundapus caudacutus		M (CAMBA, ROKAMB A, JAMBA)	VU	
White-winged Triller	Lalage sueurii				
Willie Wagtail	Rhipidura leucophrys				
Yellow Thornbill	Acanthiza nana				
Yellow Wagtail	Motacilla flava		M (JAMBA, CAMBA, ROKAMB A)		
Yellow-billed Spoonbill	Platalea flavipes				
Yellow-faced Honeyeater	Caligavis chrysops				Х
Yellow-rumped Thornbill	Acanthiza chrysorrhoa				Х
Yellow-tailed Black- Cockatoo	Calyptorhynchus funereus				Х
	Mammals	I	I	I	
Bare-nosed Wombat	Vombatus ursinus				
Black-tailed Wallaby	Wallabia bicolor				
Brown Rat	Rattus norvegicus				
Common Bent-wing Bat	Miniopterus schreibersii				
(southern ssp.)	bassanii	CR		CR	
Common Brush-tailed Possum	Trichosurus vulpecula				
Eastern Barred Bandicoot	Perameles gunnii	EN		EN	
Eastern Grey Kangaroo	Macropus giganteus				
Eastern Ring-tailed Possum	Pseudocheirus peregrinus				
European Brown Hare	Lepus europeaus				
Fat-tailed Dunnart	Sminthopsis crassicaudata				
Grey-headed Flying Fox	Pteropus poliocephalus	VU		VU	Х
House Mouse	Mus musculus				
Koala	Phascolarctos cinereus				
Large Forest Bat	Vespadelus darlingtoni				
Lesser Long-eared Bat	Nyctophilus geoffroyi				
Long-nosed Potoroo	Potorous tridactylus trisulcatus	VU		VU	
Platypus	Omithorhynchus anatinus			VU	Х
Red Fox	Vulpes vulpes				
	Notamacropus rufogriseus				
Red-necked Wallaby	banksianus				
Short-beaked Echidna	Tachyglossus aculeatus				
Southern Brown					
Bandicoot	isoodon obesulus obesulus	EN		EN	
Southern Forest Bat	Vespadelus regulus				
Or et taile 1.0	Dasyurus maculatus				
Spot-tailed Quoll	maculatus	EN		ΕN	
Swamp Antechinus	Antechinus minimus maritimus	VU		VU	



Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Yellow-bellied Sheathtail	Sagalaimus flavivantris			VII	
Bat	Saccolainius naviventins			vu	
	Reptiles				
Blotched Blue-tongued Lizard	Tiliqua nigrolutea				
Corangamite Water Skink	Eulamprus tympanum marnieae	EN		EN	
Eastern Brown Snake	Pseudonaja textilis				
Eastern Snake-necked Turtle	Chelodina longicollis				Х
Eastern Three-lined Skink	Acritoscincus duperreyi				
Little Whip Snake	Parasuta flagellum				
Lowland Copperhead	Austrelaps superbus				
Southern Grass Skink	Pseudemoia entrecasteauxii				
Striped Legless Lizard	Delma impar	VU		EN	
Tussock Skink	Pseudemoia pagenstecheri			EN	
White's Skink	Liopholis whitii GROUP				
	Reptiles				
Brown Toadlet	Pseudophryne bibronii			EN	
Common Froglet	Crinia signifera				
Growling Grass Frog	Litoria raniformis	VU		VU	Х
Southern Brown Tree	Litaria awingii				
Frog	Litona ewingi				
Southern Bullfrog (ssp.	Limpodupostos dupostilii				
unknown)	Linnodynastes dumenin				
Southern Toadlet	Pseudophryne semimarmorata			VU	
Spotted Marsh Frog	Limnodynastes tasmaniensis				
Striped Marsh Frog	Limnodynastes peronii				
	Fish				
Australian Grayling	Prototroctes maraena	VU		EN	
Australian Smelt	Retropinna semoni				Х
Brown Trout	Salmo trutta				
Carp Gudgeon	Hypseleotris spp.				Х
Common Galaxias	Galaxias maculatus				Х
Congolli	Pseudaphritis urvillii				
Dwarf Galaxis	Galaxiella pusilla	VU		EN	
Eastern Gambusia	Gambusia holbrooki				Х
Flathead Gudgeon	Philypnodon grandiceps				Х
Goldfish	Carassius auratus				
Little Galaxias	Galaxiella toourtkoourt			EN	
Macquarie Perch	Macquaria australasica	EN		EN	
Murray Cod	Maccullochella peelii	VU		EN	
Obscure Galaxias	Galaxias oliros				
Rainbow Trout	Oncorhynchus mykiss				
Redfin	Perca fluviatilis				Х
River Blackfish	Gadopsis marmoratus				
Southern Pygmy Perch	Nannoperca australis			-	Х
Southern Shortfin Eel	Anguilla australis				Х
Tench	Tinca tinca				Х
Yarra Pygmy Perch	Nannoperca obscura	VU		VU	



Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded						
	Invertebrates										
Golden Sun Moth	Synemon plana	CR		VU							
Mussels, decopod crustacea											
Hairy Burrowing Crayfish	Engaeus sericatus			VU							
Freshwater Crab	Hymenostomatidae spp.				Х						
Yabby	Charax destructor				Х						
Freshwater Shrimp	Paratya australiensis				Х						

#### Notes:

**EPBC-T** = threatened species status under EPBC Act;

**EPBC-M** = migratory status under the EPBC Act; M = listed migratory taxa; Bonn Convention (A2H) -Convention on the Conservation of Migratory Species of Wild Animals – listed as a member of a family;

Bonn Convention (A2S) - Convention on the Conservation of Migratory Species of Wild Animals - species listed explicitly; CAMBA - China- Australia Migratory Birds Agreement; JAMBA - Japan-Australia Migratory Birds Agreement; ROKAMBA - Republic of Korea Australia Migratory Birds Agreement;

**FFG** = threatened species status under the FFG Act: listed as threatened under the FFG Act.

EX = presumed extinct in the wild; CE = critically endangered; EN = endangered; VU = vulnerable



# Appendix 10: List of birds recorded in or close to Hexham WF

Common name	Scientific Name	VBA List <sup>1</sup>	Birdata list <sup>2</sup>	BUS List <sup>4</sup>	Incidental List <sup>5</sup>
Australasian Grebe	Tachybaptus novaehollandiae	Х	Х	Х	Х
Australasian Pipit	Anthus novaeseelandiae	Х	Х	Х	
Australasian Shoveler	Spatula rhynchotis	Х	Х		Х
Australasian Swamphen	Porphyrio melanotus	Х		Х	
Australian Bustard	Ardeotis australis	Х			
Australian Hobby	Falco longipennis	Х			
Australian Magpie	Cracticus tibicen	Х	Х	Х	
Australian Pelican	Pelecanus conspicillatus	Х	Х		Х
Australian Raven	Corvus coronoides	Х	Х	Х	
Australian Reed Warbler	Acrocephalus australis	Х	Х	Х	
Australian Shelduck	Tadorna tadornoides	Х	Х	Х	
Australian Spotted Crake	Porzana fluminea		Х		
Australian White Ibis	Threskiornis molucca	Х	Х	Х	
Australian Wood Duck	Chenonetta jubata	Х	Х	Х	
Banded Lapwing	Vanellus tricolor	Х		Х	
Banded Stilit	Cladorhynchus leucocephalus		Х		
Black Kite	Milvus migrans		Х		
Black Swan	Cygnus atratus	Х	Х	Х	
Black-faced Cuckoo-shrike	Coracina novaehollandiae	Х	Х	Х	
Black-fronted Dotterel	Elseyornis melanops	Х	Х		Х
Black-shouldered Kite	Elanus axillaris	Х	Х	Х	
Black-tailed Native-hen	Tribonyx ventralis	Х			
Black-winged Stilt	Himantopus leucocephalus		Х		
Blue-billed Duck	Oxyura australis	Х	Х		
Brolga	Grus rubicunda	Х	Х	Х	
Brown Falcon	Falco berigora	Х	Х	Х	
Brown Goshawk	Accipiter fasciatus	X	Х	Х	
Brown Songlark	Cincloramphus cruralis	Х	Х	Х	
Brown Thornbill	Acanthiza pusilla	Х	Х	Х	
Brown-headed Honeyeater	Melithreptus brevirostris		Х		
Cattle Egret	Bubulcus ibis	Х	Х		
Chestnut Teal	Anas castanea	X	Х		Х
Collared Sparrowhawk	Accipiter cirrhocephalus	Х			
Common Blackbird	Turdus merula	Х	Х		Х
Common Greenshank	Tringa nebularia	X	Х		Х
Common Starling	Sturnus vulgaris	Х	Х	Х	
Crested Pigeon	Ocyphaps lophotes	Х	Х	Х	
Crimson Rosella	Platycercus elegans	Х	Х		
Curlew Sandpiper	Calidris ferruginea		Х		



Common name	Scientific Name	VBA List <sup>1</sup>	Birdata list <sup>2</sup>	BUS List <sup>4</sup>	Incidental List <sup>5</sup>
Double-banded Plover	Charadrius bicinctus	Х	Х		Х
Dusky Moorhen	Gallinula tenebrosa	Х	Х		Х
Dusky Woodswallow	Artamus cyanopterus	Х	Х		
Eastern Rosella	Platycercus eximius	Х	Х		
Eastern Spinebill	Acanthorhynchus tenuirostris		Х		
Eastern Yellow Robin	Eopsaltria australis		Х		
Emu	Dromaius novaehollandiae		Х		
Eurasian Coot	Fulica atra	Х	Х		Х
European Greenfinch	Chloris chloris	Х			
European Goldfinch	Carduelis carduelis		Х	Х	
Eurasian Skylark	Alauda arvensis	Х	Х	Х	
Fairy Martin	Petrochelidon ariel	Х		Х	
Flame Robin	Petroica phoenicea	Х			
Forest Raven	Corvus tasmanicus		Х		
Galah	Eolophus roseicapilla	Х	Х	Х	
Golden Whistler	Pachycephala pectoralis	Х	Х		Х
Golden-headed Cisticola	Cisticola exilis	Х	Х	Х	
Great Cormorant	Phalacrocorax carbo	Х			
Great Crested Grebe	Podiceps cristatus	Х	Х		
Great Egret	Ardea alba	Х	Х	Х	
Grey Butcherbird	Cracticus torquatus	Х			
Grey Fantail	Rhipidura albiscapa	Х	Х	Х	
Grey Shrike-thrush	Colluricincla harmonica	Х	Х	Х	
Grey Teal	Anas gracilis	Х	Х	Х	
Hardhead	Aythya australis	Х	Х		Х
Hoary-headed Grebe	Poliocephalus poliocephalus	Х	Х		Х
Horsfield's Bushlark	Mirafra javanica	Х	Х		
House Sparrow	Passer domesticus	Х	Х	Х	
Latham's Snipe	Gallinago hardwickii	Х	Х		Х
Laughing Kookaburra	Dacelo novaeguineae	Х	Х		Х
Little Black Cormorant	Phalacrocorax sulcirostris	Х		Х	
Little Corella	Cacatua sanguinea	Х	Х		
Little Eagle	Hieraaetus morphnoides	Х	Х	Х	
Little Grassbird	Poodytes gramineus	Х	Х	Х	
Little Lorikeet	Glossopsitta pusilla	Х	Х	Х	
Little Pied Cormorant	Microcarbo melanoleucus		Х	Х	
Little Egret	Egretta garzetta		Х	Х	
Little Raven	Corvus mellori	Х	Х	Х	
Long-billed Corella	Cacatua tenuirostris	Х	Х	Х	
Magpie Goose	Anseranas semipalmata	X			



Common name	Scientific Name	VBA List <sup>1</sup>	Birdata list <sup>2</sup>	BUS List⁴	Incidental List <sup>5</sup>
Magpie-lark	Grallina cyanoleuca	Х	Х	Х	
Masked Lapwing	Vanellus miles	Х	Х	Х	
Musk Duck	Biziura lobata	Х	Х		
Musk Lorikeet	Glossopsitta concinna	Х	Х	Х	
Nankeen Kestrel	Falco cenchroides	Х	Х	Х	
Nankeen Night-Heron	Nycticorax caledonicus		Х		
New Holland Honeyeater	Phylidonyris novaehollandiae	Х	Х	Х	
Noisy Miner	Manorina melanocephala	Х	Х	Х	
Pacific Black Duck	Anas superciliosa	Х	Х	Х	
Peregrine Falcon	Falco peregrinus	Х			
Pied Cormorant	Phalacrocorax varius	Х	Х		
Pink-eared Duck	Malacorhynchus membranaceus	Х	Х		Х
Plumed Whistling-Duck	Dendrocygna eytoni	Х			
Purple-crowned Lorikeet	Glossopsitta porphyrocephala	Х	Х	Х	
Purple Swamphen	Porphyrio porphyrio		Х		
Red Wattlebird	Anthochaera carunculata	Х	Х	Х	
Red-browed Finch	Neochmia temporalis	Х	Х		
Red-capped Plover	Charadrius ruficapillus	Х			Х
Red-kneed Dotterel	Erythrogonys cinctus	Х	Х		Х
Red-necked Avocet	Recurvirostra novaehollandiae	Х			
Red-necked Stint	Calidris ruficollis	Х	Х		
Red-rumped Parrot	Psephotus haematonotus	Х	Х	Х	
Restless Flycatcher	Myiagra inquieta	Х	Х	Х	
Royal Spoonbill	Platalea regia	Х			
Rufous Songlark	Cincloramphus mathewsi	Х	Х	Х	
Rufous Whistler	Pachycephala rufiventris	Х	Х	Х	
Sacred Kingfisher	Todiramphus sanctus	Х			
Scarlet Robin	Petroica boodang	Х	Х		
Sharp-tailed Sandpiper	Calidris acuminata	Х	Х		Х
Shining Bronze-Cuckoo	Chrysococcyx lucidus	Х	Х	Х	
Silver Gull	Chroicocephalus novaehollandiae	Х	Х	Х	
Silvereye	Zosterops lateralis	Х	Х	Х	
Southern Boobook	Ninox boobook	Х	Х		
Spotted Harrier	Circus assimilis	Х	Х		
Spotted Pardalote	Pardalotus punctatus		Х		
Straw-necked Ibis	Threskiornis spinicollis	Х	Х	Х	
Striated Pardalote	Pardalotus striatus	Х	Х	Х	
Stubble Quail	Coturnix pectoralis	Х	Х		Х
Striated Thornbill	Acanthiza lineata		Х	Х	
Sulphur-crested Cockatoo	Cacatua galerita	Х	Х	Х	



Common name	Scientific Name	VBA List <sup>1</sup>	Birdata list <sup>2</sup>	BUS List <sup>4</sup>	Incidental List <sup>5</sup>
Superb Fairy-wren	Malurus cyaneus	Х	Х	Х	
Swamp Harrier	Circus approximans	Х	Х		Х
Tree Martin	Petrochelidon nigricans	Х	Х		Х
Wedge-tailed Eagle	Aquila audax	Х		Х	
Welcome Swallow	Hirundo neoxena	Х	Х	Х	
Whiskered Tern	Chlidonias hybridus	Х	Х		
Whistling Kite	Haliastur sphenurus	Х	Х	Х	
White-browed Scrubwren	Sericornis frontalis		Х		
White-browed Woodswallow	Artamus superciliosus		Х	Х	
White-faced Heron	Egretta novaehollandiae	Х	Х	Х	
White-fronted Chat	Epthianura albifrons	Х	Х	Х	
White-naped Honeyeater	Melithreptus lunatus	Х	Х		
White-necked Heron	Ardea pacifica	Х	Х	Х	
White-plumed Honeyeater	Ptilotula penicillatus	Х	Х	Х	
White-winged Triller	Lalage tricolor		Х		
Willie Wagtail	Rhipidura leucophrys	Х	Х	Х	
Yellow Thornbill	Acanthiza nana		Х		
Yellow-faced Honeyeater	Calicavis chrysops	Х	Х	Х	
Yellow-billed Spoonbill	Platalea flavipes	Х	Х		
Yellow-rumped Thornbill	Acanthiza chrysorrhoa	Х	Х	Х	
Yellow-tailed Black-Cockatoo	Calyptorhynchus funereus	Х	Х	Х	

1. List of bird recorded on the Victorian Biodiversity Atlas

2. List of bird records from Birdata (BirdLife Australia 2019)

3. List of birds recorded during two seasons of BUS

4. List of birds recorded incidentally while roaming within the study area and outside BUS formal recording times.



#### Appendix 11: Number and height distribution of bird recorded during the formal count of the spring 2018 and summer 2019 BUS surveys

Notes: A = Below RSA height (<40 metres); B = At RSA height (40–250 metres); C (>250 metres). Note that no bird was recorded flying over 190 m in this survey.

#### 1- Impact points – Spring 2017

	Obs. p	point 1	Obs. p	point 2	Obs. p	point 3	Obs. p	point 4	Obs. p	oint 5	Obs. p	oint 6	Obs. p	oint 7	Obs. p	oint 8		All poi	nts
Species	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	G. Total
Australian Magpie	26		34		19	4	25		41		26		35		21		227	4	231
Australasian Pipit			6		6								2		6		20	0	20
Australian Reed-Warbler	18																18	0	18
Australian Shelduck	2																2	0	2
Australian Wood Duck							6										6	0	6
Black Swan								2									0	2	2
Black-faced Cuckoo-shrike									1		1						2	0	2
Brolga									2								2	0	2
Brown Falcon							1		6	1			1				8	1	9
Brown Songlark	2		11		1				2				6		12	2	34	2	36
Brown Thornbill													10				10	0	10
Common Starling	6				68		20		9		36		36				175	0	175
Crested Pigeon	6		2				6		12		4						30	0	30
Crimson Rosella													3				3	0	3
Eurasian Skylark	14	1	22		20	1	12		24	2	10		20	2	26	6	148	12	160
European Goldfinch							6		6		18		14		11		55	0	55
Fairy Martin							37	20			2						39	20	59
Galah		2	2		5	4			4	2	20		8		4		43	8	51
Golden-headed Cisticola					3						1						4	0	4
Great Egret													1				1	0	1
Grey Fantail													2				2	0	2
Grey Shrike-thrush	4				2				3		4		1				14	0	14



	Obs. p	point 1	Obs.	point 2	Obs.	point 3	Obs.	point 4	Obs. p	point 5	Obs. p	oint 6	Obs. p	point 7	Obs.	point 8		All poi	nts
Species	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	G. Total
Grey Teal							6						4				10	0	10
House Sparrow					54				10								64	0	64
Little Black Cormorant							4										4	0	4
Little Eagle								1									0	1	1
Little Grassbird	6																6	0	6
Little-pied Cormorant		1															0	1	1
Long-billed Corella					12			27		5	9	13	4				25	45	70
Magpie-lark			8		4				16		10		2		6		46	0	46
Masked Lapwing													4				4	0	4
Nankeen Kestrel	1	1															1	1	2
Noisy Miner			16								3				2		21	0	21
Pacific Black Duck	1						7								4		12	0	12
Raven spp.	23	5	16		25		45	2	25	2	20		23	3	21		198	12	210
Red Wattlebird	12				10		12						4		7		45	0	45
Red-rumped Parrot					6		2				2	3	9				19	3	22
Restless Flycatcher											11						11	0	11
Rufous Songlark	4						3										7	0	7
Rufous Whistler													7				7	0	7
Shining Bronze-Cuckoo													1				1	0	1
Silver Gull							2										2	0	2
Silvereye													4				4	0	4
Striated Pardalote							2				2		4				8	0	8
Sulphur-crested Cockatoo							4		6	16	2	3	6				18	19	37
Superb Fairywren	19								8				22				49	0	49
Wedge-tailed eagle											2						2	0	2
Welcome Swallow		2	2		10	2	9								2		23	4	27



	Obs. p	oint 1	Obs. p	point 2	Obs. p	oint 3	Obs. p	point 4	Obs. p	oint 5	Obs. p	oint 6	Obs. p	oint 7	Obs. p	oint 8		All poi	nts
Species	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	G. Total
Whistling Kite							1							3			1	3	4
White-browed Woodswallow			30				30										60	0	60
White-faced Heron	2				2		1		1				3				9	0	9
White-fronted Chat													11				11	0	11
White-necked Heron													2				2	0	2
White-plumed Honeyeater	2				12				38		12						64	0	64
Willie Wagtail	14		1		11		3		12		15		3		9		68	0	68
Yellow-faced Honeyeater													14				14	0	14
Yellow-rumped Thornbill													15				15	0	15
Yellow-tailed Black Cockatoo	2																2	0	2
Grand Total	166	12	150		271	11	244	52	227	28	210	19	281	8	131	8	1680	138	1818

### 2-Impact points- Summer 2018

	Obs. p	point 1	Obs. p	point 2	Obs. p	point 3	Obs. p	oint 4	Obs. p	oint 5	Obs. p	oint 6	Obs. p	oint 7	Obs. p	oint 8		All poi	nts
Species	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	G. Total
Australasian Pipit	2		2												2		6	0	6
Australian Magpie	33		26		30		36		29		31	8	36		27		248	8	256
Australian Shelduck							43										43	0	43
Australian White Ibis																13	0	13	13
Australian Wood Duck					20		125										145	0	145
Banded Lapwing													2		14		16	0	16
Black-shouldered Kite					1		3										4	0	4
Brown Falcon							1		2			1	1		2		6	1	7
Brown Goshawk		2															0	2	2
Brown Thornbill	6								4		4		6				20	0	20
Common Starling			74		212								5		50		341	0	341
Crested Pigeon	4		4		2		7		5				8				30	0	30



	Obs. p	point 1	Obs.	point 2	Obs. p	point 3	Obs. p	oint 4	Obs. p	oint 5	Obs. p	point 6	Obs. p	ooint 7	Obs. p	ooint 8		All poi	nts
Species	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	G. Total
Eurasian Skylark															2		2	0	2
European Goldfinch	5				3		33										41	0	41
Fairy Martin	19																19	0	19
Galah							2				10						12	0	12
Grey Shrike-thrush	2								5								7	0	6
Grey Teal							8										8	0	8
House Sparrow	3																3	0	3
Little Pied Cormorant					2		3										5	0	5
Long-billed Corella					15	2			4			6				4	19	12	31
Lorikeet spp.	259	20	304														563	20	583
Magpie-lark	8		8		17		4		16		2		6		2		63	0	63
Nankeen kestrel					3					2			1				4	2	6
New Holland Honeyeater	44																44	0	44
Noisy Miner			63		16						2				24		105	0	105
Pacific Black Duck					22												22	0	22
Raven	6	4	33	2	102	32	26	6	37		8		20		39		271	44	315
Red Wattlebird	28		4		46		1		6		60				4		149	0	149
Red-rumped Parrot	34		121		16						7				72		250	0	250
Restless Flycatcher	2																2	0	2
Straw-necked Ibis																6	0	6	6
Striated Thornbill											6						6	0	6
Sulphur-crested Cockatoo					16		4	4	4		3						27	4	31
Superb Fairywren	22						26		15				16				79	0	79
Wedge-tailed Eagle									1	1							1	1	2
Welcome Swallow	18	2	6		4	2		2	11								39	6	45
Whistling Kite	1	1								1						1	1	3	4
White-faced Heron	T						4		2	2							6	2	8



	Obs. p	point 1	Obs. p	point 2	Obs. p	oint 3	Obs. p	oint 4	Obs. p	oint 5	Obs. p	oint 6	Obs. p	oint 7	Obs. p	oint 8		All poir	nts
Species	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	G. Total
White-necked Heron					1	1	7										8	1	9
White-plumed Honeyeater	38		2		34				16		4						94	0	94
Willie Wagtail	9		4		12		7		3		3		5		1		44	0	44
Yellow-rumped Thornbill							8						25				33	0	33
Grand Total	543	29	651	2	574	37	348	12	160	6	140	15	131		239	24	2786	125	2911

Notes: A = Below RSA height (<40 metres); B = At RSA height (40-250 metres); C (>250 metres). Note that no bird was recorded flying over 190 m in this survey.

No bird was recorded above RSA heights.



# Appendix 12: Wetland habitat quality assessment for surveys of listed fauna at Hexham WF

Wetland Number	Habitat quality- Migratory birds	Habitat quality- Latham's Snipe	Habitat quality- GGF	Description
DELWP Wetland 30275 (Wetland 15) Entry of Mustons Creek into WF- NW	medium	medium	medium	Deep valley creek with water, currently standing or very slow flow. Creek bed covered with dense growth of reed, sedge, rush (mainly <i>Caryx</i> spp.) and introduced grasses, mainly <i>Filaris</i> spp. The creek also expands forming open water pools with water ribbons, submerged, and emergent vegetations
DELWP Wetland 30816 (Wetland 16) part of Mustons creek and a very large dam	medium	high	medium-high	Creek as above, heavily over grown by reed ( <i>Phragmites austalis</i> ), rush, sedge and other aquatic vegetation including water ribbon, emergent and sub-merged. Edges covered by trees such as eucalypts, wattle, tee trees, native pines and large shrubs.
DELWP Wetland 30312 (Dam on 16)	medium-high	high	medium-high	Open dam > 1 ha. Fenced with edges a combination of open muddy areas and low introduced grasses with small patches of aquatic vegetation within the body of the dam. Edges not tramped by cattle. A large selection of waterbirds with possible 3 Freckled Ducks.
Wetland 111 (Wetland 17)	medium-high	high- recorded	high	Open expansions of the Mustons Creek forming large water pools- water standing but was freely flowing last month, flow seems to depend on rainfall. Water pools with dense growth of reed, rush, sage, and introduced grasses on the edges and dense growth of water ribbon and emergent and submerged vegetation. Fauna seen: 1- A pair of Latham's Snipe; 2. Growling Grass Frog; aural record during the day; 3. Many water birds including ducks, ibises, teals, swan, coot and others; 4. few hardheads.


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Wetland Number	Habitat quality- Migratory birds	Habitat quality- Latham's Snipe	Habitat quality- GGF	Description
DELWP Wetland 29405 (Wetland 3) Permanent large unnamed lake				Large lake at the central west section of WF. Lake is fenced with deep water and the edges densely covered with various types of aquatic vegetation and trees; parts of the edges were bare mud. A large selection of waterbirds and resident shorebirds was found utilizing the lake.
DELWP Wetland 29405 (Wetland 3a) North end of lake	medium-high	medium-high	medium	North end of large permanent Lake with dense vegetation cover at this section including very dense growth of reed, sedges concealing the open water species as in the body of the lake, part of this section is cut off from lake by a fence and trampled by cattle as it has open muddy shores and surrounded by grazing paddock. Few Red-kneed Dotterel were seen on the muddy shores. A small group of Sharp- tailed Sandpaper were seen during last month survey. The remaining north end and connecting creek at this north end is currently dry.
DELWP Wetland 29405 (Wetland 3b) Central section of lake	medium-high	High	medium-high	Deep permanent water- edges well covered by dense vegetation (reed, rush, sedges, introduced grass) with few sections of bare mud and low grasses. Edges are not subjected to cattle grazing and mostly shaded by various species of trees. A small flock (7 or 8 birds) were seen but were far to be identified, but most probably S.T. Sandpipers.
DELWP Wetland 29405 (Wetland 3c) Southern end of lake	medium	medium-high	Medium-high	Very similar to the northern section. Brolgas were seen there earlier in October but not again in either December or the current survey.
DELWP Wetland 28236 (Wetland 18)	Low	Low	Low	A fair-sized dam >1 ha, and accompanying creek. Dam fenced but open for cattle drinking, bare muddy edges with little aquatic veg. The creek very dry.



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Wetland Number	Habitat quality- Migratory birds	Habitat quality- Latham's Snipe	Habitat quality- GGF	Description
DELWP Wetlands 28252 and 28248 (Wetlands 13 and 14)	medium	High	high	Sections of the Mustons Ck at the eastern section of the WF. Habitat similar to other parts of the creek with dense vegetation and expanded pools of water. Water seemed standing and not flowing as in last month. Aural record during the day at W 14.
Wetland J (Wetland 2)	medium	High	high	Another section of the Mustons Creek with similar vegetation, at this section parts of the creek was fully dry and water stream is interrupted. Aural record during the day.
Wetland 5b	Low	Medium-high	medium-high	A section of one of the Mustons Creek tributaries, part dry and part still retain some shallow water pools with dense aquatic veg, similar to other parts of the Mustons Rivers.

