Willatook Wind Farm

Flora and Fauna Assessment

Prepared for Willatook Wind Farm Pty Ltd

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Nature Advisory

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1. Executive Summary

Willatook Wind Farm Pty Ltd engaged Nature Advisory Pty Ltd to conduct a flora and fauna assessment of approximately 7,600 hectares of private and public land involved in or potentially affected by the development of the Willatook Wind Farm (WWF). The WWF Site is located approximately 25 kilometres north of Port Fairy within the Moyne Shire.

WWF proposes to install up to 59 wind turbines and a battery storage facility within the site boundary (the Site). Each wind turbine will comprise a tower, nacelle and blades with a maximum and minimum blade tip height of 250 metres and 40 metres respectively. The maximum and minimum parameters above have been adopted for this EES, allowing a 'worst case' assessment of environmental and social impacts. 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.

Additional infrastructure includes up to 60 kilometres of new access tracks within the Site to provide for construction and maintenance access. Each wind turbine would be connected to an onsite substation by approximately 112 km of underground cabling within 62 km of trenching. Three lattice tower wind monitoring masts are proposed, each up to 150 m high. Temporary infrastructure would include a construction compound with office facilities, associated parking and toilet facilities, temporary laydown areas for wind turbines and electrical equipment, concrete batching plants and an on-site quarry.

This report has been specifically prepared to accompany the Environment Effects Statement (EES) required for the project under the Victorian *Environment Effects Act 1978* (EE Act). It includes data from, and updates, the *Final Report Biodiversity Assessment: Willatook Wind Farm, Willatook, Victoria*, prepared for Wind Prospect (EHP 2018), to assess the final design of the wind farm development and to bring the contained information in line with gazetted changes to Victoria's native vegetation removal regulations and more recent fauna investigations.

The investigations undertaken are summarised below under the following headings:

- Vegetation and flora surveys (Section 5)
- Groundwater Dependent Ecosystems (Section 6)
- Fauna Overview (Section 7)
- Bat assessment (Section 8)
- Bird assessment (Section 9)
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- Matters of National Environmental Significance (Section 12).

The impacts of the project on the state-threatened Brolga have been assessed in accordance with the *Interim guidelines for the assessment, avoidance, mitigation and offsetting of potential wind farm impacts on the Victorian Brolga population 2011* (DSE 2012). The results of this work are presented in a stand-alone report (Nature Advisory 2022).

1.1. Vegetation and flora assessment

A total of 848 hectares of native vegetation in patches was mapped within the WWF study area, including DELWP mapped wetlands. This comprised nine Ecological Vegetation Classes (EVCs) and 684 habitat zones. The remainder of the site comprised introduced and planted vegetation, including crop, pasture and non-indigenous treed wind breaks.

An over-dimensional transport (OD) route was also assessed. Vegetation in the OD route study area (i.e. roadsides and intersections requiring upgrade) consisted of six EVCs and totalled an area of 0.72 hectares of native vegetation in patches, including DELWP mapped wetlands. The remainder of the OD route study area was dominated by introduced pasture grasses.

Native vegetation was surveyed in detail for threatened flora species. VBA records and the EPBC Protected Matters Search Tool indicated that within the search region there were records of, or there occurred potential suitable habitat for, 43 listed species, including 20 species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), 22 listed under the state *Flora and Fauna Guarantee Act 1988* (FFG Act), and 42 listed under the *Advisory List of Rare or Threatened Plants in Victoria* (DELWP 2014).

A likelihood of occurrence analysis indicated that 43 listed flora species were likely to occur or had the potential to occur within the wind farm study area based on regional status and presence of potentially suitable habitat. Targeted surveys within the project footprint in suitable habitat for each were undertaken at seasonally appropriate times (i.e. flowering seasons) to assess potential occurrence in 2018/19 and 2021 in areas planned to be impacted at that time. Due to further alteration to the development footprint since the 2021 targeted surveys, further targeted surveys will be required to determine the presence or otherwise of listed flora species within the current development footprint, where the impact footprint extends beyond the assessment area. These areas are identified in Figure 5.

Two flora species listed under the EPBC Act, Swamp Everlasting (*Xerochrysum palustre*) and Trailing Hop-bush (*Dodonaea procumbens*), have been recorded within the wind farm study area. Swamp Everlasting is also listed under the FFG Act. Two EPBC Act listed ecological communities, *Grassy Eucalypt Woodland of the Victorian Volcanic Plain*[1] (GEWVVP) and *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP) were recorded within the site.

The current footprint of the wind farm development will result in the removal of 4.567 hectares of native vegetation, including six large trees. This includes the loss of 4.132 hectares of native vegetation from patches, less than 0.5% of the native vegetation within the WWF site. Realignment of tracks and power cabling and micro-siting of infrastructure has been employed to avoid native vegetation. All Swamp Everlasting and Trailing Hop-bush individuals have been avoided and will therefore not be impacted.

An area of 0.486 hectares of the EPBC Act listed community *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP) will be impacted by the current project footprint. It has been determined that the Project will potentially have a significant impact on listed communities, but it is unlikely that it will have a significant impact on flora species.

Offsets required to compensate for the proposed removal of native vegetation under the Victorian *Guidelines for the removal, destruction and lopping of native vegetation* (DELWP 2017a) are documented below:

- 1.206 general habitat units and must include the following offset attribute requirements:
    - Minimum strategic biodiversity value (SBV) of 0.312
    - Occur within the Glenelg Hopkins CMA boundary or the Moyne municipal district.
    - Include protection of at least six large trees.

All offsets must be secured prior to the removal of native vegetation.

The OD route will result in impacts to 0.043 hectares of native vegetation.

Offsets required to compensate for the proposed removal of native vegetation from the OD route under the Victorian *Guidelines for the removal, destruction and lopping of native vegetation* (DELWP 2017a) are documented below:

- 0.014 general habitat units and must include the following offset attribute requirements:
    - Minimum strategic biodiversity value (SBV) of 0.683.
    - Occur within the Glenelg Hopkins CMA boundary or the Moyne or Glenelg municipal districts.

An Offset Broker has been engaged and has indicated that suitable offsets in the Glenelg Hopkins CMA can be provided.

[1] The Victorian Volcanic Plain bioregion was renamed the Southern Volcanic Plain bioregion in October 2021. The official name of this threatened community however has not yet been changed so it is referred to by its current name.

1.2. Fauna overview

The WWF is situated across a modified agricultural landscape, consisting primarily of cereal crops and grazing land. Assessment has identified seven potential fauna habitats across the site, ranging from low to moderate quality, including: modified native grassland, modified woodland and scattered trees, stony knolls, rivers and creeks, swamps and marshes, planted vegetation, artificial waterbodies, and exotic pastures and crops.

A review of existing information and online databases found that a total of 37 listed species under the EPBC Act and 48 species 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).

An analysis of the likelihood of occurrence of these species, given regional status and the habitat available, indicated that species listed under the EPBC Act likely to occur were:

- Ten migratory bird species: Common Greenshank, Curlew Sandpiper, Eastern Cattle Egret, Eastern Great Egret, Fork-tailed Swift, Glossy Ibis, Latham's Snipe, Red-necked Stint, Sharp-tailed Sandpiper and White-throated Needletail;
- Two listed threatened and migratory bird species: Curlew Sandpiper and White-throated Needletail;
- Two listed threatened bat species: Grey-headed Flying-Fox and Southern Bent-wing Bat;
- One listed threatened frog species: Growling Grass Frog; and
- Two listed threatened fish species: Little (Dwarf) Galaxias and Yarra Pygmy Perch.

Additionally, species likely to occur, listed as threatened in Victoria under the FFG Act, included:

- Eight bird species: Australasian Shoveler, Black Falcon, Blue-billed Duck, Brolga, Hardhead, Little Eagle, Musk Duck and Plumed Egret;
- One bat species: Yellow-bellied Sheathtail Bat; and
- One reptile species: Glossy Grass Skink.

Nature Advisory undertook assessments of these species and their habitat to confirm their status and the extent and condition of potential habitat on the WWF site, including; bat surveys, bird utilisation surveys (BUS), migratory bird surveys and Striped Legless Lizard surveys, as well as mapping of potentially suitable habitat for the Swamp Skink and Growling Grass Frog. These assessments are described below.

1.3. Bat assessment

Initial bat surveys using ultrasonic bat detectors to record species-specific calls were undertaken from October to March in 2009-2011 (EHP 2018) and again in 2018-2020 by Nature Advisory. One threatened species listed under the EPBC Act, Southern Bent-wing Bat (*Miniopterus schreibersii bassanii*) (SBWB), and one listed under the FFG Act, Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) (YBSB), were recorded during these surveys.

The majority of calls recorded across each survey were from common bat species, including: Gould's Wattled Bat, Chocolate Wattled Bat and Large Forest Bat.

In spring 2009, nine bat species and one species complex were recorded, including two threatened bat species: SBWB (28 calls, mostly calls from the species-complex that includes this species) and YBSB (39 calls). Greater numbers of SBWB were recorded during the targeted surveys in 2010-2011: 99, mostly species-complex calls.

In 2018 the spring survey recorded ten bat species and four species complexes. The SBWB was recorded with five confirmed calls from five different sites. In addition, eight calls from four sites with records from the species complex may be attributed to SBWB. The YBSB was recorded ten times, five calls at each of two different sites. No listed bat species were recorded from high-mounted recorder microphones on wind monitoring masts 45 metres above the ground (i.e. in the lower part of the lowest possible rotor swept area (RSA)).

In summer - autumn 2019, SBWB and YBSB were detected again. A total of 42 positively identified calls were recorded for the SBWB. These calls were generated from 13 of the 29 survey sites. In addition, there were 117 species complex calls. One call was recorded from the YTSB.

Further surveys were undertaken between May 2019 and May 2020 at 22 sites. SBWB were detected again at five sites (one call at each site) over 12 months.

The findings from this bat assessment indicate that:

- A comparatively low number of SBWB calls was recorded over all surveys conducted so far (totaling 4,691 bat detector nights) over five of the last 11 years;
- The sites with the highest numbers of calls lie 490 metres to the west and over 1,550 metres to the east of proposed turbines;
- During its nightly, routine movements it is unlikely to often fly high over farmland areas; and
- Suitable wetland and treed habitat for the species does not occur near proposed turbine sites.

Based on these findings, it is concluded that the species does not occur in significant numbers regularly over the wind farm site. Mitigation measures have been implemented, taking into consideration the bats behaviour at the site. To reduce the risk on this species mitigation measures include turbine dimensions – increasing the lower RSA height to 40 m above the ground and design layout – positioning turbines in areas cleared of treed vegetation. An adaptive management framework has also been developed including details of proposed operational monitoring and an impact trigger and response framework. For these reasons, the proposed wind farm is unlikely to cause a significant impact to this species as only a small fraction of their population is likely to occur in or around the wind farm site. It is unlikely that the risk of a collision by this species with turbines in the proposed wind farm will compromise its future survival and the impact of the project for the species is not considered significant.

The YBSB is a wide-ranging species through tropical and sub-tropical Australia. In Victoria, the species is a rare visitor in late summer and autumn. It is a high-flying species that usually flies fast and straight above tree canopy height, but flies lower over open spaces and at forest edges. It is thus potentially susceptible to collision with wind turbines in treed areas, however there are few treed areas on the WWF site where this species might fly at RSA height and given the low numbers likely to occur, it is unlikely there is a high risk of population impacts from collision with turbines at WWF.

The Grey-headed Flying-fox was considered as potential to occur due to the presence of suitable foraging habitat. There is limited foraging habitat at the wind farm site including planted Sugar Gum and fruit trees. The majority of the study area is treeless, very limited remnant trees and most planted trees are cypress which is not a food source for the flying-fox.

There are two flying-fox camps located in the surrounding region the closest being at Warrnambool which is located further than usual nightly flight distances travelled when foraging for food resources. The study area is not located between the two camps.

Due to the limited food resource available at the study area, the distance from the nearest camp and the study area not being located between any camps it is considered unlikely that the Grey-headed Flying-fox would visit the study area frequently. Turbine free buffers have been implemented from all treed habitats including any potential foraging trees. For these reasons it is unlikely that the Grey-headed Flying-fox would collide with turbines and the risk to the species population is considered to be low.

1.4. Bird Assessment

1.4.1. Overall birds

Bird utilisation surveys (BUS) were undertaken consistent with the requirements for a “Level Two” bird risk assessment in accordance with ‘Wind Farms and Birds - Interim Standards for Risk Assessment’ (AusWEA 2005) and the latest Clean Energy Council (2018) Best Practice Guidelines for wind farm development in Australia.

A total of 49 bird species were recorded during BUS in 2009, including a total of 978 individual movements of birds during 72 fixed–point counts. The most common species recorded included in order of abundance: Raven sp. (mostly Little Raven *Corvus mellori*), Australian Magpie (*Gymnorhina tibicen*), European Goldfinch (*Carduelis carduelis*), Australasian Pipit (*Anthus novaeseelandiae*) and Eurasian Skylark (*Alauda arvensis*). Most birds were found flying less than 40 metres above the ground and no threatened bird species were detected.

Two bird utilisation surveys (BUS) were undertaken in 2018-19: the first during spring 2018 and the second at the end of summer 2019. During these, the five most abundant species of birds at the survey sites were common resident species (Australian Magpie, Little Raven, Eurasian Skylark, Common Starling (*Sturnus vulgaris*), with Magpie–lark (*Grallina cyanoleuca*) and European Goldfinch equal fifth ranked), and overall, they formed over 75.1% in spring and 66.5% in summer of all birds recorded during the BUS. Most birds were recorded flying below RSA height.

Raptors and waterbirds were not found to be abundant. One listed species was recorded during the BUS: the Fork–tailed Swift (*Apus pacificus*) (EPBC Act: migratory).

Considering the bird assemblage present within the WWF site is not unique, consisting both common and well represented native and introduced species, the impact on the overall native bird populations was assessed to be negligible.

1.4.2. Brolga

The Brolga is listed as vulnerable under the FFG Act and has been recorded in the study area and is discussed in more detail in a stand-alone report. Appropriate turbine free buffers have been implemented around Brolga breeding wetlands to protect Brolga breeding habitat and breeding Brolga.

1.4.3. Fork-tailed Swift

The Fork-tailed Swift (listed as migratory under the EPBC Act) is an aerial bird species that forages on the wing. This species is a summer visitor to south-east Australia and is not considered to be a regular visitor to the study area each year. The Fork-tailed Swift often flies at rotor swept area heights. The Fork-tailed Swift population is unknown though is considered stable and likely to be over 100,000 (DAWE 2021b). It has been rarely recorded colliding with wind turbines. Given this, the impact on this species' population is likely to be negligible.

1.4.4. White-throated Needletail

While not recorded during field surveys for the project, the White-throated Needletail (listed as vulnerable and migratory under the EPBC Act and vulnerable under the FFG Act) has the potential to pass through the site based on its known range. The White-throated Needletail is an aerial species that forages on the wing, often at rotor swept area heights. The species occurs more frequently over forested areas in Australia. The lack or records from the study area and lack of forested vegetation or extensive planted treed areas indicates that the wind farm site does not support the preferred habitat for this species. Notwithstanding this, at wind farms elsewhere, the species has been recorded colliding with operating wind turbines in small numbers (Nature Advisory data). The numbers involved are unlikely to represent a significant impact on the population, which numbers at least ten thousand.

1.4.5. Raptors

The Nankeen Kestrel, Brown Falcon, and Wedge-tailed Eagle are the species most exposed to collision risk due to their flight behaviour, with juveniles and subadults being the most susceptible. Within the wind farm site, these species were recorded in low numbers (2 to 4% of all birds) with even lower numbers recorded above 40 metres. Based on monitoring of collisions at Macarthur Wind Farm and elsewhere, it is likely that there will be instances of collision with wind turbines of these species within the WWF). In terms of overall impacts to the local populations of these species, each of these species is distributed widely across Australia and is considered to be secure (i.e., not threatened). They also have strong dispersal abilities. As such, the overall effect of any collision related impacts on the population of these species is considered to be negligible.

Potential impacts to the Black Falcon and Little Eagle were assessed to be low.

1.4.6. Threatened ducks

The Australasian Shoveler and Hardhead are two duck species recorded in small numbers on wetlands outside the WWF site. The Blue-billed Duck and Musk Duck may also occur occasionally on deeper wetlands. None of these ducks were recorded on the site or are expected to occur in significant numbers given the limited extent of habitat. They are far more common on larger wetlands elsewhere in Victoria. Few ducks were observed flying at RSA heights, and the creation of the large turbine-free buffer area encompassing the Cockatoo Swamp wetland complex and other wetland buffers would considerably reduce the likelihood of collisions of these species with turbines. The likelihood of a significant impact on the populations of these species is considered very low.

1.4.7. Threatened egrets and Glossy Ibis

The Eastern Great Egret has been recorded from several wetlands in the search region and has the potential to occur at the wind farm site due to the presence of suitable wetland habitat. This species wades in shallow water, foraging for food. It is unlikely that this species occurs regularly or in significant numbers due to the limited extent and quality of wetland habitat within the wind farm site. Similarly the Eastern Cattle Egret (recorded in paddocks well to the south of the wind farm) and Plumed Egret may occur in small numbers when seasonal conditions suit, but their overall populations are unlikely to be affected by interactions with the operating wind farm. The Glossy Ibis is another large wading bird that is similarly likely to occur at least occasionally and was recorded from two wetlands outside the wind farm boundary. Aquatic habitats are not being significantly affected by the proposed development as turbines, tracks and other infrastructure are located at least 100 metres from almost all wetlands and waterways with the exception of a small number of creek crossings. Furthermore, most seasonal wetland areas will be avoided as a result of the creation of the large turbine free buffer area encompassing the Cockatoo Swamp wetland complex. The likelihood of a significant impact on the population of this species is therefore considered to be very low.

1.4.8. Migratory shorebird survey

Due to the presence of potentially suitable habitat at a range of waterbodies and tributaries located within the study area, five migratory shorebird species were considered potentially to occur within the proposed WWF site. Accordingly, a targeted survey was undertaken, consistent with the survey methods outlined in EPBC Act Policy Statement 3.21 (*Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*) (DoEE 2017).

Wetlands within the boundaries of the WWF were assessed in the field to determine their status, extent, habitat type and suitability for migratory shorebirds. Furthermore, all wetlands found to be potentially suitable, both within, and out to three kilometres from the wind farm site, were surveyed for migratory shorebirds four times in summer, as required in the foregoing policy statement.

Creek lines (i.e. Shaw River, Back Creek and Moyne River) were also inspected in the field for the presence of Latham's Snipe (*Gallinago hardwickii*), as this species was considered potentially to use these narrow corridors for foraging and roosting in nearby areas of dense vegetation.

Most wetlands were found to be ephemeral and too densely vegetated with Common Tussock Grass, introduced pasture grasses or sedges taller than 30 centimetres 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) and short grassy areas at night. Overall, suitable habitat for migratory shorebirds was found to be very limited in extent on and near the Willatook Wind Farm.

Three species of migratory shorebird were recorded in the study area during the current investigation: Common Greenshank (*Tringa nebularia*), Latham's Snipe and Sharp-tailed Sandpiper (*Calidris acuminata*). These species were found in small numbers, given the limited extent of suitable habitat, well below the important population threshold of 0.1% of the flyway population or in the case of the Latham's Snipe, habitats that support at least 18 individuals as specified in the relevant EPBC Act policy statement.

Given these findings, there was no important habitat for migratory shorebirds within the proposed WWF site and therefore migratory shorebirds will not be affected by the wind farm development. The lack of extensive habitat, and the small numbers of these species observed during the surveys indicate that the wetland areas concerned are highly unlikely to support an important population or habitat for any listed migratory species.

1.5. Reptile assessment

1.5.1. Striped Legless Lizard assessment

A review of existing information indicated potential for the Striped Legless Lizard (*Delma impar*) (SLL) to occur on the WWF site, based on existing records and habitat modelling. The VBA showed no records of the species within 20 kilometres of the wind farm site and only one record within 30 kilometres. Given the presence of potentially suitable habitat in areas of remnant native grassland, targeted surveys were undertaken in 2009-2011 and 2018. Areas of non-indigenous grassy vegetation lacked habitat features suitable for this species and were therefore not considered suitable habitat and were not subject to targeted surveys.

The surveys were undertaken using methods consistent with the DELWP Biodiversity Precinct Structure Planning Kit (DSE 2010) and the EPBC Act Referral guidelines (DSEWPAC 2011a) using a tile grid method. As a habitat assessment identified a very limited area of habitat likely to support SLL only a small number of three grids were deployed.

No SLL were found at any of the sites supporting potentially suitable habitat. Given these results, it is considered unlikely that a population of this species remains within the WWF site.

Impacts on the SLL resulting from the proposed wind farm are therefore considered to be negligible. If, during construction, a SLL is detected in areas physically affected by the wind farm, a salvage and translocation protocol within the Construction Environment Management Plan will be implemented to relocate affected lizards.

1.5.2. Swamp Skink assessment

Suitable habitat for the FFG Act listed species Swamp Skink (*Lissolepis coventryi*), in the form of vegetated areas prone to inundation, were initially identified within the WWF site. Targeted surveys were therefore undertaken in 2009-11, with further investigations in 2018. However the wind farm footprint has since been amended and reduced, and the suitable habitat now lies well outside the WWF boundary.

VBA data indicated that five records occurred within the wider search region within 20 kilometres of the study area. Based on historical records and the habitats observed on site, it was found that the area close to the Moyne River supported Swamp Skink on the WWF site.

Additionally, field assessment of habitat found that one wetland contiguous with the Moyne River, or its tributary, had potential to support Swamp Skink in addition to the Moyne River environs themselves.

All other wetlands and waterways assessed for habitat suitability across the WWF site were ephemeral in their hydrology, so were unlikely habitats for Swamp Skink. In addition, Kangaroo Creek and Back Creek were found to be subject to grazing that had removed most of the vegetation cover required by Swamp Skink. It is therefore unlikely Swamp Skink would occur in these ephemeral creeks.

The species is regarded as present along the Moyne River, which is located outside the wind farm boundary and no direct impacts on the species are anticipated, as construction works have avoided these areas and are expected to occur over four kilometres from areas of suitable habitat.

1.5.3. Glossy Grass Skink assessment

The FFG Act listed Glossy Grass Skink (*Pseudemoia rawlinsoni*) has been recorded within the search region on five occasions from 2003 to 2009. It was recorded along a road reserve during targeted reptile surveys. Habitat along this road reserve had a native grassland understorey and scattered Blackwood (*Acacia melanoxylon*) overstorey.

The native grassland habitat with Blackwood overstory is confined to road side reserves in the study area. This habitat type has been avoided in finalising the development layout and no impacts on this species are anticipated.

1.6. Frog assessment

One frog species listed on the EPBC Act and FFG Act is likely to occur on the proposed wind farm site, based on the presence there of suitable habitat at a range of waterbodies, was the Growling Grass Frog (*Litoria raniformis*). Targeted surveys were undertaken in 2009 and an assessment was undertaken within the proposed WWF site to identify waterbodies containing adequate cover of aquatic and emergent vegetation to support the GGF.

The VBA holds one record of GGF within the search region, dated 1976. Another record was obtained during surveys in 2009 (EHP 2018) of the species calling at or near a wetland south of Poynton's Road (state wetland no. 25816 Wild Dog Swamp, a wetland outside the WWF site, located in the Moyne River floodplain.) During spring 2018 Brolga surveys, GGF was heard along Back Creek within the WWF. During October and December in 2019 GGF was heard calling from Wild Dog Swamp.

Current information on habitat suitability indicates that they are unlikely to reside within the WWF site at locations other than along Back Creek, where the best habitat remains for them. Habitat elsewhere is unsuitable due to a lack of aquatic vegetation from stock grazing pressure and wetland drainage.

Impacts on the Growling Grass Frog were assessed against the significant impact criteria for Growling Grass Frog. The criteria state there are two impact pathways that need to be assessed; habitat degradation and fragmenting or isolating existing populations. Known sites for GGF are to be avoided and where possible, all wind farm infrastructure is to be placed at least 100 metres from waterways and wetlands. Where this is unavoidable, namely one crossing of Back Creek and to a lesser extent one crossing across Shaw River, construction planning will ensure that a minimal area of habitat is altered. These crossings represent a very small proportion of the potential habitat for this species and will not ultimately limit movement of the species within this habitat. Additionally, the hydrological and hydrogeological investigations for the project indicate that it will not lead to significant changes in flows and water quality in waterways and wetlands.

With the implementation of design and management measures, potential impacts to the Growling Grass Frog via physical disturbance of waterway crossings, were assessed to be low with any impacts likely to be localised at crossing points, following rehabilitation in these areas.

1.7. Aquatic fauna assessment

The Little Galaxias, Yarra Pygmy Perch and Hairy Burrowing Crayfish were assessed as these three aquatic species were initially assessed as having potential to occur within the study area. A summary of the findings are below.

1.7.1. Threatened fish

Habitat and targeted surveys for threatened fish species were undertaken in 2009 (EHP 2018). These surveys established that Little Galaxias (*Galaxiella toourtkoourt*) and Yarra Pygmy Perch (*Nannoperca obscura*) occur in the waterways on the WWF site. Surveys were undertaken using bait traps, dip nets and Fyke nets in locations with suitable habitat in Kangaroo Creek and the Moyne River to the east of the WWF site. A follow up habitat assessment in 2018 confirmed these results were still likely to be valid.

The EPBC Act listed Dwarf Galaxias (*Galaxiella pusilla)* has now been split into two species and does incorporate the FFG Act listed Little Galaxias (*G. toourtkoourt*). This and Yarra Pygmy Perch have been detected during the 2009 surveys and repeat surveys are not considered necessary given there has been no change in habitat conditions in the intervening period. It has been assumed that both species continue to inhabit those waterways.

Two impact pathways were assessed including degradation and loss of habitat and alteration to flow regime.

Disturbance is being avoided within a 100-metre buffer along the streams (Moyne River, Back Creek, Kangaroo Creek and Shaw River and their minor tributaries), with the exception of two creek crossings with temporary impacts. Construction of waterways crossings will result physical disturbance to creek beds and associated aquatic habitats at two crossing points and resulting reduction in water quality (primarily increased suspended sediment) at these points. However, based on the ecology of the Little Galaxias and the Yarra Pygmy Perch, and the availability of refuge habitats, these construction impacts are assessed to be localised and temporary.

The Hydrological Assessment report indicated that impacts on river, stream and wetland hydrology will not be significant on the basis that detailed designs will be informed by detailed hydrological modelling to ensure that hydrological connectivity maintained. With further design mitigation implemented through detailed design and robust construction management measures in place to minimise physical disturbance, the impacts on Little Galaxias and Yarra Pygmy Perch within the WWF site were assessed to be low during construction reducing to very low during operation.

1.7.2. Hairy Burrowing Crayfish

Mud chimneys, the entrances to burrowing crayfish burrows, were present in a section of the banks of the Moyne River and an adjacent partially drained wetland. The precautionary approach was adopted here and it was considered that the Hairy Burrowing Crayfish, listed as vulnerable under the FFG Act, resided in these areas where chimneys were present.

The area where the chimneys were observed were within the original wind farm project boundary. However, the boundary of the wind farm has contracted over time and the area the Hairy Burrowing Crayfish were recorded is no longer considered part of the wind farm project. No signs of Hairy Burrowing Crayfish were observed within the proposed wind farm boundary or development footprint. The closest turbine to areas where Hairy Burrowing Crayfish were recorded was approximately four kilometres to the south-west.

1.8. Matters of National Environmental Significance

EPBC Act listed species considered likely to occur or recorded on the WWF site were assessed against general or species-specific criteria for significant impacts.

Ecological communities, listed flora, Southern Bent-wing Bat, Striped Legless lizard, Growling Grass Frog, Little Galaxias, Yarra Pygmy Perch and Migratory Shorebirds were assessed. It was found that all listed 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.

A total of 0.486 hectares of the EPBC Act listed community *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP) will be impacted by the current project footprint. It was determined that the EPBC Act listed community *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP) may therefore be significantly impacted by the project.

2. Introduction

2.1. Background

Willatook Wind Farm Pty Ltd engaged Nature Advisory Pty Ltd to conduct a flora and fauna assessment of approximately 7,600 hectares of private and public land for the development of the Willatook Wind Farm (WWF) located approximately 25 kilometres north of Port Fairy within the Moyne Shire. The proposed wind farm is situated to the south of the Woolsthorpe-Heywood Road, between Penhurst-Warrnambool Road and Hamilton-Port Fairy Road. The proposed WWF site and associated transport route is referred to herein as the 'study area'.

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

The preliminary findings of the initial investigation identified that a referral was required under the Victorian *Environmental Effects Act 1978,* which was submitted by the proponent to the Department of Environment, Land, Water and Planning (DELWP) on 5th October 2018. On the 27th December 2018, the Minister for Planning determined that an Environment Effects Statement (EES) was required due to the potential for the Project to have significant effects on environmental values.

Additionally, preliminary findings of the initial investigation also identified that a referral was required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which was submitted by the proponent to the Department of Environment and Energy (now the Department of Agriculture, Water and the Environment (DAWE) (EPBC Ref: 2019/8439). A decision was made on 12th June 2019 that the proposed action is a controlled action and, as such, it requires assessment and approval under the EPBC Act.

As part of its referral decision, DAWE determined that the appropriate assessment pathway for matters protected under the EPBC Act would be via the Victoria Environment Effects Statement (EES) process under the approved bilateral agreement between the Commonwealth and the State of Victoria.

The *Scoping Requirements for Willatook Wind Farm Environment Effects Statement* (2019) were issued on behalf on the Minister for Planning and provided by the Victorian Government's DELWP. The purpose of the EES is to provide a detailed description of the Project, assess its potential effects on the environment and assess alternative Project layouts, designs and approaches to avoid and mitigate potential effects. The scoping requirements set out the specific matters to be investigated and documented in the EES and were informed by public comments on the draft version. This report addresses the EES scoping requirements relating to flora and fauna aspects (see section 3 below).

This report also provides the required information to address Victoria's native vegetation removal regulations and includes site-based information from the *Final Report Biodiversity Assessment: Willatook Wind Farm, Willatook, Victoria*, prepared by Ecology and Heritage Partners for Wind Prospect (EHP 2018), as well as information collated by Nature Advisory during its subsequent investigations.

2.2. Proposed development

2.2.1. Wind Farm site

WWF proposes to install up to 59 wind turbines and a battery storage facility within the site boundary (the WWF site). Each wind turbine will comprise a tower, nacelle and blades with a maximum and minimum blade tip height of 250 metres and 40 metres respectively (see Figure 1). The maximum and minimum parameters above have been adopted for this EES, allowing a 'worst case' assessment of environmental and social impacts. Note that if the minimum blade clearance of 40 metres is adopted, the maximum tip height will be 230 metres. If the maximum tip height of 250 metres is adopted, the ground clearance will be 60 metres or higher. 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.

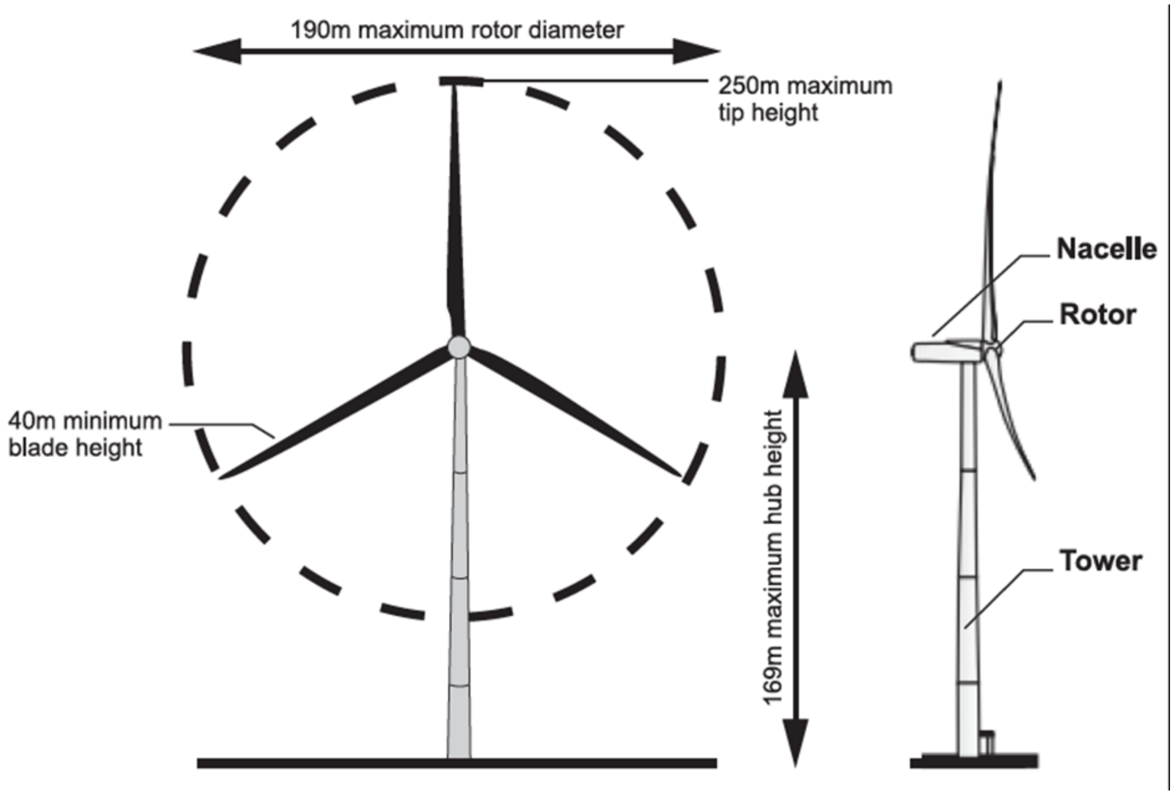

Figure 1: Wind turbine components

A total of 12 site access points from the Woolsthorpe-Heywood Road, Tarrone North Road, Riordan's Road and Old Dunmore Road will be required that connect to approximately 60 km internal access roads. The arrangement of the tracks has been designed to minimise the removal of native vegetation as well as minimise the length of access track required. The tracks would generally have a width of six metres, or up to 10 metres at the corners. Up to four staging areas of up to 100 metres in length would be constructed adjacent to the tracks, thereby doubling the width in those locations.

Approximately 112 km of 33 kV electricity cable network will be laid in underground in trenches with a total length of 62 km. This cabling (including fibre-optic cabling) connects the wind turbines to the on-site substation, located on the property to the north of the Tarrone Terminal Station, which links the existing 132 kV Macarthur Wind Farm high voltage transmission link to the 500 kV Moorabool to Heywood transmission line. Approximately 300 m overhead transmission line will connect the on-site substation to the Tarrone Terminal Station. The underground cabling and associated trenching would be up to 2 metres wide within a work area of 5 metres wide for the excavator to operate and for stockpiling of soil.

Other ancillary infrastructure is described below.

- An on-site quarry for basalt rock will be used to provide crushed rock for access tracks and hardstand areas. This is located in the western part of the WWF site. The proposed Work Authority area is approximately 30 hectares, with the extraction area being 10 hectares with a maximum depth of 14 metres.
- A single substation will be a single yard with a footprint of up to 80 metres by 80 metres and infrastructure with a height of up to five metres. The substation will consist of a series of electrical transformers, switchgear, a control room and switch room, amenity facilities, including a toilet, and fire services.
- A battery energy storage system (BESS) will be located immediately to the west of the substation. The BESS would consist of a series of batteries with transformers, high voltage AC (HVAC) coolers and other electrical plant. The BESS would be sited on a hardstand area of up to to five hectares.
- An operations and maintenance (O&M) facility will be sited in a central location. The perimeter would have an area one hectare (nominally 100m x 100m) and include an office and maintenance facility housed on a concrete base, with car parking adjacent to the facility.
- The temporary construction compound would be established during the enabling works and would be in the central part of the Project area. The compound would have an area of up to five hectares and consist of offices, maintenance and storage area, parking for vehicles and toilet facilities, as well as temporary laydown areas for wind turbines and electrical equipment and concrete batching plants,
- Three lattice tower wind monitoring masts are proposed around the edges of the site. Each mast would be up to 150 m high, in line with the proposed maximum wind turbine hub height.

The WWF site is currently used as rural farmland, and this would continue after construction. The proposed development footprint consists of 222 hectares (ha), which is 5.4% of the site. Once temporary construction areas have been rehabilitated, the operational footprint is estimated to be 99.5 ha, which represents 2.4% of the project 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.

Within 12 months of wind turbines permanently ceasing to generate electricity, the wind farm would be decommissioned. This would include removing all above ground equipment, restoration of all areas associated with the project, unless otherwise useful to the ongoing management of the land, and post-decommissioning revegetation with pasture or crop.

The main components of the project are detailed in Table 1 below with approximate dimensions listed (where applicable), and shown in Figure 2.

Table 1: Project summary

Infrastructure	Current Design (approximate dimensions)
▪ Turbine dimensions	▪ The turbine envelope proposed includes: ▪ Overall maximum tip height of up to 250 m; ▪ Rotor diameter is up to 190 m; and ▪ Minimum tip height 40 m.
▪ On-site quarry	▪ On-site quarry includes: ▪ Total area up to 30 ha; ▪ Quarry extraction area up to 10 ha; ▪ Rock crushing plant; ▪ Access tracks; and ▪ Office facilities and amenities.
▪ Onsite access tracks	▪ 60 km of gravel access track. A 12 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	▪ Three concrete batching plants (50 m x 100 m) ▪ Three construction compounds (200 m x 200 m) ▪ Storage/Laydown areas 300 m x 6 m
▪ Operations and maintenance facility	▪ 100 m x 100 m
▪ Collector Substation	▪ 80 m x 80 m
▪ Battery storage	▪ Up to 5 ha
▪ On-site cabling	▪ Approximately 62.1 km of underground cable trenches
▪ Wind Monitoring Masts	▪ Up to 3 wind monitoring masts, each up to 150 m high.

2.2.1. Over-dimensional (OD) route

The over-dimensional (OD) route will allow road transport of turbine components from the Port of Portland to the Willatook Wind Farm site. Five intersections may require upgrades to allow for the trucks carrying turbine components to turn. The OD route and intersections requiring upgrades are shown in Figure 3.

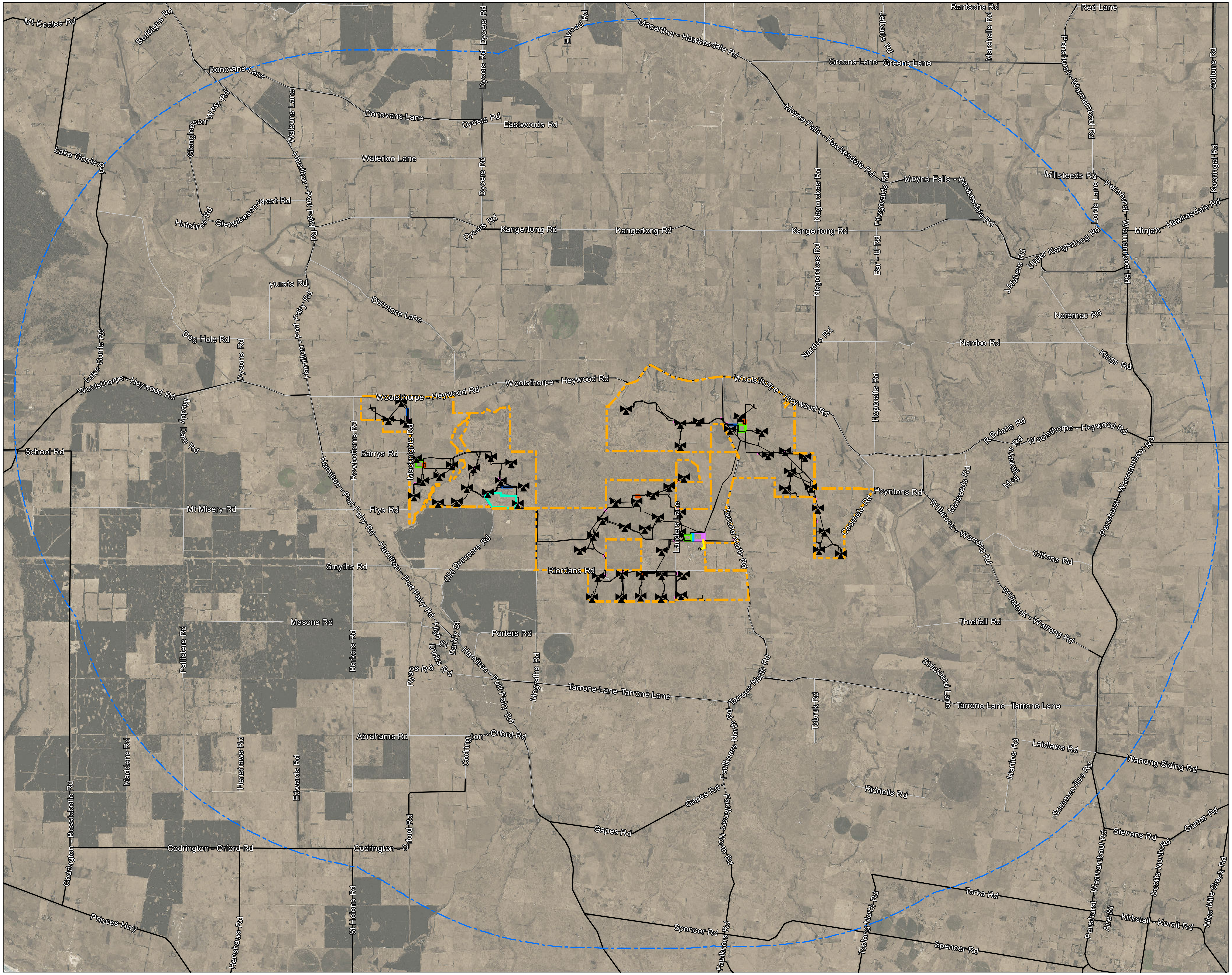

Figure 2: Willatook Wind Farm layout

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 28/04/2022

- Wind farm boundary
- 10km search region
- Construction footprint
- Overhead transmission line
- Quarry works area
- Wind turbine
- Concrete batch plant
- Construction compound
- Site office
- Staging areas
- Washdown facilities
- BES and Terminal station

N

Metres
0 1,000 2,000

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Figure 3: OD route and surveyed intersections

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 18/01/2022

Proposed Port to Site route

OD route surveyed intersections

N

Metres
0 2,400

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2.3. Scope of Work and Timeline of Surveys

The surveys completed for this assessment of the flora and fauna impacts of WWF are summarised in Table 2. This table excludes the Brolga investigations, which are documented in a separate report.

Table 2: Surveys completed (to December 2021)

Survey – field assessment	Date
Flora assessments	
Vegetation surveys – Wind Farm site	▪ 25 November 2009 ▪ 1-3 & 8-9 December 2009 ▪ 25 February and 3 March 2011 ▪ 25-27 July 2018 ▪ 19 March 2019 ▪ 18 June 2019 ▪ 1-3 March 2021 ▪ 6-8 October 2021 ▪ 4-5 November 2021 ▪ 7-8 December 2021
Flora survey – OD route	▪ 25-27 July 2018 ▪ 4-5 November 2021
Targeted surveys for threatened ecological communities and listed flora species	▪ 22-24 October 2018 ▪ 31 October 2018 ▪ 10-12 December 2018 ▪ 6 February 2019 ▪ 6-8 & 26 October 2021 ▪ 4-5 November 2021 ▪ 7-8 December 2021
Bird studies	
Bird utilisation surveys	▪ 4-6 & 16-20 November 2009 ▪ 15-20 October 2018 ▪ 25 February – 1 March 2019
Migratory shorebird habitat assessment and targeted surveys	▪ 4-7 November 2018 ▪ 11-13 December 2018 ▪ 11-12 January 2019 ▪ 23-24 January 2019 ▪ 28 February 2019
Targeted Striped Legless Lizard and Fat-tailed Dunnart surveys -	▪ 4 November 2009 - 19 February 2010
Targeted Striped Legless Lizard survey	▪ July – November 2019
Aquatic fauna studies	
Targeted Growling Grass Frog surveys	▪ 16-20 November 2009
Growling Grass Frog habitat & Swamp Skink habitat assessment	▪ 4-7 November 2018
Aquatic surveys (freshwater fish)	▪ 15—18 December 2009
Targeted Brown and Southern Toadlet survey	▪ 18 March 2009 ▪ 22 May 2009
Targeted Swamp Skink surveys (Trapping)	▪ 15-19 February 2010
Bat studies	
Bat surveys – general and targeted Southern Bent-wing Bat	▪ 4 November 2009—27 January 2010 ▪ 20 October —25 November 2010 ▪ 31 January—28 March 2011 ▪ 25 October – 14 December 2018

Survey – field assessment	Date
	▪ 26 March – 30 April 2019 ▪ May 2019 to May 2020

3. Regulatory context

This section presents the relevant Commonwealth, State and Local legislation, policy and guidelines relating to the protection of biodiversity, as summarised in the following sub-sections.

3.1. Commonwealth 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 matters of national environmental significance. Any impact on such matters that is considered significant requires the approval of the Commonwealth Minister for the Environment.

The proposed WWF was Referred to the Commonwealth Minister for the Environment (Ref EBPC 2019/8439). On 12th June 2019, the Minister determined that the WWF would be a Controlled Action that required assessment and approval under the EPBC Act before it can proceed. The relevant controlling provisions are listed threatened species and communities (Section 18 and 18A). Of particular concern were:

- Southern Bent-wing Bat;
- Seasonal Herbaceous (Freshwater) of the temperate Lowland Plains;
- Growling Grass Frog; and
- A range of listed plant species.

The Minister also decided that the EES will be the accredited process for assessment of the proposed WWF (the Controlled Action) under the EPBC Act.

A number of specific EPBC Act guidelines have been consulted and directions from these applied during surveys and in formulating the investigations of flora and fauna impacts described in this report. These include:

- Matters of National Environmental Significance - Significant Impact Guidelines 1.1 (DoE 2013);
- Department of the Environment and Energy (DoEE) 2017. *EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Department of the Environment and Energy, Canberra.
- Department of the Environment, Water, Heritage and The Arts (DEWHA) 2009b, Significant Impact Guidelines for the vulnerable growling grass frog (*Litoria raniformis*), EPBC Act Policy Statement 3.21, Department of Environment and Energy, Canberra; and
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) 2011, 'Environment Protection and Biodiversity Conservation Act referral guidelines for the vulnerable striped legless lizard, *Delma impar*', Department of Sustainability, Environment, Water, Population and Communities, Canberra.

3.2. State Legislation and Policy

3.2.1. *Planning and Environment Act 1987*

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:

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

Exemptions

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

Planted vegetation: 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 2018c).
- State-wide 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 impacts to native vegetation are 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. Environmental Effects Act 1978 (EE Act)

The *Environment Effects Act 1978* provides for assessment of proposed projects (works) that can have a significant effect on the environment. One or a combination of several criteria may trigger a requirement for a Referral to the Victorian Minister for Planning, who will determine if an Environmental Effects Statement (EES) is required according to the *Ministerial Guidelines for Assessment of Environmental Effects under the* Environment Effects Act 1978 (DSE 2006). An EES describes a project and its potential environmental effects, enabling stakeholders and decision-makers to understand how the project is proposed to be implemented and the likely environmental effects of doing so.

The proposed WWF was Referred to the Victorian Minister for Planning on 5th October 2018. On the 27th December 2018, the Minister for Planning decided that an Environment Effects Statement (EES) was required for WWF. The procedures and requirements for the EES assessment process are set out in the Minister's Statement of Decision, the Ministerial Guidelines and are further detailed in the scoping requirements.

This report addresses Section 4.1 (Biodiversity and habitat) and part of Section 4.2 (Catchment values and hydrology) of the EES scoping requirements, the evaluation objectives and key issues for which are provided below.

<u>Section 4.1 (Biodiversity and habitat)</u>

Draft evaluation objective:

To avoid or minimise potential adverse effects on biodiversity values within and near the site including native vegetation, listed threatened species and ecological communities, and habitat for these species. Where relevant, offset requirements are to be addressed consistent with state and Commonwealth policies.

Key issues:

- Direct loss or degradation of native vegetation and associated listed ecological communities, including those listed as threatened under the EPBC Act, the FFG Act and/or DELWP advisory lists.
- Direct loss or degradation of habitat for flora and fauna listed as threatened under the EPBC Act, the FFG Act and/or DELWP advisory lists.
- Disturbance and/or degradation of adjacent or nearby habitat that may support listed species or other protected flora, fauna or ecological communities.
- Disturbance and/or individual to population level loss of flora and fauna species listed as threatened under the EPBC Act, FFG Act and/or DELWP advisory lists.
- Indirect habitat loss or degradation resulting from other effects, such as edge effects, surface hydrological changes, groundwater drawdown, noise, vibration, light or the introduction of weeds/ pathogens.
- Disruption to the movement of fauna between areas of habitat across the broader landscape, including between roosting or breeding sites for the Southern Bent-wing Bat.

- The availability of suitable offsets for the loss of native vegetation and habitat for listed threatened species under the EPBC Act and FFG Act.
- Potential collision risk for protected bird and bat species with project infrastructure, including with wind turbine blades.
- Potential cumulative effects on relevant listed threatened species and communities of flora and/or fauna, in particular Brolga and Southern Bent-wing bat, from the project in combination with the construction and operations of other energy facilities.

Section 4.2 (Catchment values and hydrology)

Draft evaluation objective

To maintain the functions and values of aquatic environments, surface water and groundwater quality and stream flows and avoid adverse effects on protected beneficial uses.

Key issues (relevant to this assessment)

- Potential for the project to have significant impact on wetland systems, including, but not limited to, Seasonal Herbaceous Wetlands (EPBC Act listed community), and the ability for wetland systems to support habitat for flora species listed under the FFG Act and EPBC Act.

3.2.3. *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 on 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.

The EES process requires that impacts on FFG Act listed species be assessed, even on private land.

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.

3.2.5. Local laws and regulations

The proposed Wind Farm is located within the Moyne local government area. It is currently zoned Farm Zone (FZ) in the Moyne Planning Scheme.

The over-dimensional (OD) transport route includes intersection upgrades in both the Moyne and Glenelg local government areas. It is currently zoned Road Zone – Category 1 (RDZ1) in the Moyne and Glenelg Planning Schemes.

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

Local Planning Policies

Local Planning Policy 21.06 – Environment in the Moyne Planning Scheme is relevant to the current investigation. LPP 21.06 contains several objectives that broadly aim to:

- Significantly reduce the impact of pest plants and animals on the Shire's resources and production.
- Protect the region's soil resources for the long-term benefit of all users.
- Balance competing demands for water while maintaining and improving water quality through responsible waterway and drainage arrangements.
- Protect and enhance the region's indigenous genetic biodiversity by maintaining the extent and diversity of the various ecosystems.

The objectives of LPP 21.06 are implemented through overlays, discussed below.

Overlays

The Wind Farm site is subject to the following overlay in the Moyne Planning Scheme:

- **Environmental Significance Overlay – Schedule 4 (ESO 4)** – A permit is required to remove native vegetation under this overlay. Information required to address the decision guidelines of this overlay is provided in this report.
- **Environmental Significance Overlay – Schedule 5 (ESO 5)** – A permit is required to remove native vegetation under this overlay. Information required to address the decision guidelines of this overlay is provided in this report.

The OD transport route is subject to one overlay in the Glenelg Planning Scheme at the intersection of the Ettrick-Tyrendarra Road:

- **Environmental Significance Overlay – Schedule 3 (ESO 3)** – A permit is required to remove the following vegetation under this overlay:
    - Any dead hollow bearing Eucalyptus tree with a trunk diameter greater than 40 centimeters at 1.3 metres above ground level; or
    - A live hollow bearing eucalypt tree; or

- A live Brown Stringybark (*Eucalyptus baxteri*) or Desert Stringybark (*Eucalyptus arenacea*) tree with a trunk diameter of greater than 30 centimeters at 1.3 metre above ground level.

Information required to address the decision guidelines of this overlay is provided in this report.

3.3. 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)
- Interim Guidelines for the Assessment, Avoidance, Mitigation and Offsetting of Potential Wind Farm Impacts on the Victorian Brolga Population (DSE 2011)
- Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (CEC 2018)
- Policy and planning guidelines - Development of wind energy facilities in Victoria (DELWP March 2019).

4. Site description

4.1. Location and context

The location of the proposed wind farm is approximately 32 kilometres to the north-west of Warrnambool and extends across both sides of the Woolsthorpe-Heywood Road, between Penhurst-Warrnambool Road and Hamilton-Port Fairy Road. The proposed WWF site and associated transport route is referred to herein as the 'study area'. The study area is located in the Victorian Volcanic Plain bioregion of western Victoria.

Budj Bim National Park (formerly known as Mount Eccles National Park), recently added to the World Heritage list, and Mount Napier State Park are located approximately 12 kilometres and 20 kilometres north-west of the project site, respectively. Other reserves within 20 kilometres of the project include Yambuk Coastal Reserve, Woolsthorpe Nature Conservation Reserve, Yambuk Wetlands Nature Conservation Reserve, Tower Hill Wildlife Reserve, as well as other smaller bushland and flora reserves. Blue gum plantations are located south-west of the Project Site, approximately 400 metres from the nearest proposed turbine.

4.2. Geology

The geology of the WWF site is described in detail in the *Proposed Willatook Farm Geoheritage Assessment* (Environmental GeoSurveys Pty Ltd 2022), and is summarised below.

The WWF site falls on the southern margin of the Western Plains of Victoria. The Western Plains is a landscape developed mainly on volcanic rocks with enclaves of older sedimentary rocks. The geology across the WWF site is basaltic lava with a regolith of basalt stones, weathered basalt and a variable thickness of alluvial and swamp deposits. Over most of the areas of the younger lava flows, basalt is exposed at the surface as blocks, boulders and locally continuous outcrop.

The site is relatively flat, supporting soils of volcanic origin on a dissected landscape featuring many rocky outcrops and wet depressions.

4.3. Hydrology

The WWF site falls within the Shaw River catchment in the west, and the Moyne River catchment in the east. Major aquatic systems within the WWF site include the Moyne River at the eastern extremity, Back Creek (a tributary of the Moyne River) in the east of the site, the Shaw River in the north and west of the site, and the Cockatoo Swamp complex in the centre of the site. Several other smaller ephemeral drainages occur within the site. The site receives on average in excess of 700 mm rainfall annually (BoM 2021a). Much of the site is low lying and has a poorly defined drainage system, resulting in numerous small, ephemeral wetlands.

Characterisation of the existing hydrology of the site including modelling of peak flow events was conducted by Water Technology (2022).

4.4. Vegetation

The land use of the site and surrounds is agricultural (primarily livestock grazing), and widespread clearing of the study area and surrounds has resulted in native vegetation being largely restricted to roadside reserves. Vegetation within most private properties around the site consists of predominantly introduced vegetation. This includes areas of improved and unimproved pasture dominated by common, introduced pasture species.

The dominant landscape across the WWF site is rocky outcrops interspersed with lower depressions that hold water ephemerally. Some rocky outcrops support Stony Knoll Shrubland vegetation, with native grasses and Austral Bracken being the dominant native species, and higher-quality examples retaining shrubs such as Sweet Bursaria and Tree Violet. Many rocky outcrops no longer support native vegetation due to heavy grazing, and are now dominated by pasture grasses. Many landscape depressions support Plains Grassy Wetland, although much of this is species depauperate due to stock grazing. Plains Grassy Wetland was generally dominated by Common Tussock Grass, with higher quality examples supporting a greater diversity of graminoids and some aquatic herbs.

Some of the higher quality vegetation within the WWF site is associated with roadsides, and included Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland. Higher-rainfall Plains Grassy Woodland was also mapped in association with the Shaw River in the west of the site, while Tall Marsh was mapped along Back Creek in the east of the site.

4.5. Fauna habitats

Habitats across the site are highly modified and exist in an agricultural landscape. While some changes may have occurred to small scale habitats across the site, such as individual wetlands, field work on the site in 2018 and 2019 found that habitat types had not changed significantly since the assessments in 2009 and 2010. The fauna habitat descriptions summarised below are taken from the EHP (2018) report.

Modified Native Grassland

This habitat was described as of moderate quality for fauna species, being deficient in some key habitat components, such as a diversity of flora species and refuge sites, and being fragmented within the landscape. It is largely restricted to roadsides but these would act as 'stepping-stones' between habitats elsewhere.

Modified Woodland and scattered trees

Low to moderate quality for fauna, this habitat consists of stands of trees to 15 metres tall along roadsides and some patches in agricultural land, and scattered remnant trees. It is lacking the mid-storey and understorey components that many fauna species require and provides limited connectivity. Generally localised in roadside reserves and scattered in grazing land, where it completely lacks understorey, this provides remnant habitat in a highly modified agricultural landscape.

Rocky rise/stony knoll

Occurring over much of the southern section of the WWF site, this habitat provides shelter for some species of native ground dwelling fauna and is considered of low to moderate quality. Consisting of embedded rocks and typically some vegetation cover, the habitat primarily occurs in grazing land and has been impacted by farm stock grazing and weed invasion. Though lacking a diversity of indigenous plant species, the structure of rocky habitat provides important shelter for reptiles, such as skinks and lizards, and acts as 'stepping-stones' for some more mobile species of small mammals and snakes.

Rivers, creek and drainage lines

The waterways in the study area are of moderate quality for fauna. These habitats vary in form from permanent rivers to ephemeral drain lines. Many support terrestrial and aquatic vegetation. Some of these habitats hold water year-round and support vegetated habitat along edges to varying extents. Other areas were ephemeral and less vegetated and provide temporary habitat when they hold water.

Swamps and marsh

Much of the original wetland habitat in the study area has been modified or drained. The limited area of remaining wetland habitats is of moderate quality fauna habitat. Typically lacking floristic diversity, the wet areas of the habitat still support 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. The largest of these habitats is Cockatoo Swamp which is spread out across agricultural land with limited remnant indigenous vegetation cover.

Planted vegetation

Consisting mainly of young stands of planted exotic and native trees, usually in wind breaks, this habitat is of low quality for fauna. The habitat occasionally contains trees of up to 20 metres tall but lacks understorey and other habitat components, such as hollows.

Artificial waterbodies

Including farm dams and drains in drained wetlands, this habitat is of low to moderate quality for fauna. Several of these habitats exist within the study area, some supporting aquatic or fringing vegetation, typically surrounded by grazing and cropped land. Waterbirds and some bat species would be likely to use these habitats.

Exotic pasture and crops

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

4.6. Land-use history

The WWF site has been used for sheep and cattle farming for over 150 years. It comprises several properties owned by individuals and companies. The site has been subject to extensive removal of native vegetation in the past. Fertiliser has been extensively applied on the site and, in places, the site has been cultivated for pasture improvement.

5. Vegetation and Flora Survey

KEY FINDINGS

Wind Farm Site

Vegetation within the WWF site 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 684 habitat zones from nine Ecological Vegetation Classes (EVCs), totalling 848 hectares of native vegetation in patches. This area included 501.401 hectares of DELWP mapped wetlands which are treated as native vegetation according to the Guidelines. Over 6,000 hectares of the WWF site comprised introduced and planted vegetation, including crop, pasture and non-indigenous treed wind breaks.

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 October and December 2018 and October and December 2021. Targeted surveys were undertaken to coincide with the flowering time for the following listed species:

- Basalt Leek-orchid (FFG Act: critically endangered)
- Basalt Peppercress (EPBC Act: Endangered; FFG Act: endangered)
- Button Wrinklewort (EPBC Act: Endangered; FFG Act: endangered)
- Clover Glycine (EPBC Act: Vulnerable; FFG Act: vulnerable)
- Curly Sedge (FFG Act: endangered)
- Dense Leek-orchid (EPBC Act: Vulnerable; FFG Act: critically endangered)
- Gorae Leek-orchid (EPBC Act: Endangered; FFG Act: critically endangered)
- Lacey River Buttercup (FFG Act: critically endangered)
- Maroon Leek-orchid (EPBC Act: Endangered; FFG Act: endangered)
- Matted Flax-lily (EPBC Act: Endangered; FFG Act: critically endangered)
- Pale Swamp-everlasting (FFG Act: critically endangered)
- Pretty Leek-orchid (FFG Act: critically endangered)
- Purple Blown-grass (FFG: endangered)
- Slender Style-wort (FFG Act: endangered)
- Swamp Diuris (FFG Act: endangered)
- Swamp Everlasting (EPBC Act: Vulnerable; FFG Act: critically endangered)
- Swamp Fireweed (EPBC Act: Vulnerable)
- Swamp Flax-lily (FFG Act: endangered)
- Trailing Hop-bush (EPBC Act: Vulnerable)

During these surveys, one flora species listed under the EPBC Act and FFG Act – Swamp Everlasting – was recorded within this targeted survey area. Approximately 23 individuals were recorded in a single patch of Plains Grassy Wetland vegetation. In March 2021 one additional flora species listed under the EPBC Act – Trailing Hop-bush – was recorded during vegetation mapping, within vegetation on Old Dunmore Road. 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 that was surveyed. New development areas beyond those covered by targeted surveys to date, totalling 0.336

hectares of native vegetation removal, as shown in Figure 5, will be surveyed in October and December 2022 for completeness.

Native vegetation within the proposed development footprint was surveyed for threatened ecological communities in October and December 2018 and October and December 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. Two EPBC Act listed ecological communities – Grassy Eucalypt Woodland of the Victorian Volcanic Plain (GEWVVP) and Seasonal Herbaceous Wetland of the Temperate Lowland 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.

Over dimensional (OD) transport route

Vegetation in the OD route study area (i.e. roadsides and intersections requiring upgrade) consisted of six EVCs. 18 patches of native vegetation were identified in the OD route study area (including DELWP mapped wetlands). This totalled an area of 0.720 hectares of native vegetation in patches. The remainder of the OD route study area was dominated by introduced pasture grasses.

No ecological communities or flora species listed under the EPBC or FFG Acts were recorded within the OD route study area.

Impacts and implications

The proposed WWF development footprint will have the following impacts:

- The loss of 4.132 hectares of native vegetation from patches;
- The loss of seven scattered trees, including six large scattered trees;
- 0.486 hectares of EPBC Act listed community Seasonal Herbaceous Wetland of the Temperate Lowland Plain (SHWTLP).

The proposed OD route will have the following impacts:

- The loss of 0.043 hectares of native vegetation from patches.

An offset will be required to compensate for the proposed removal of native vegetation under the Guidelines. Under the Guidelines all offsets must be secured prior to the removal of native vegetation. Discussions have been initiated with an Offset Broker and they have indicated that a landowner within the Glenelg Hopkins Catchment Management Authority can provide the required offsets.

Impacts to SHWTLP 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, in particular along the OD Route, at the entrance point to the wind farm and from public road reserves:

- *Acacia mearnsii* (member of a genus *protected* under the FFG Act)
- *Acacia verticillata* (member of a genus *protected* under the FFG Act)
- *Melaleuca halmaturorum* (*threatened* species listed under the FFG Act)
- *Cassina aculeata* (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 native vegetation and targeted flora surveys was to identify areas of native vegetation within the WWF site and to ascertain the potential for any EPBC Act and FFG Act listed threatened flora species and ecological communities to be present within the development footprint. Additionally, the surveys aimed to determine the location, extent and impacts to any such values found to be present. The information from these surveys has been used to inform the proposed wind farm layout by applying the 'avoid' and 'minimise' principles of the Guidelines.

A native vegetation assessment in 2017-18 (EHP 2018) covered a survey area that sits within the WWF site (see Figure 2). Nature Advisory updated native vegetation assessments included proposed site entrances and other areas of the proposed footprint beyond those surveyed by EHP, as shown in Figure 2. In this manner, native vegetation assessments have been undertaken for the entirety of the proposed footprint.

Nature Advisory undertook native vegetation surveys of the OD route as shown in Figure 3. A larger study area than the expected actual footprint of the OD route was surveyed to allow for design adjustments and application of the 'avoid' and 'minimise' principles in accordance with the Guidelines.

An overview of native vegetation recorded in the study area is presented in Figure 4.

Targeted threatened flora surveys during the appropriate flowering seasons were undertaken in areas of suitable habitat which was based on a provisional footprint provided by Willatook Wind Farm Pty Ltd. Targeted surveys for spring-flowering threatened flora species were undertaken in areas of suitable habitat during October 2018 and 2021 (to coincide with the flowering time for these species). Targeted surveys for summer-flowering threatened species were undertaken in areas of suitable habitat during December 2018 and 2021 (to coincide with the flowering times for these species). New development areas beyond those covered by targeted surveys to date, totalling 0.336 hectares of native vegetation removal, as shown in Figure 5, are to be surveyed in October and December 2022 for completeness.

This section of the report presents the results of the native vegetation and targeted flora surveys to date. The methods used and sources of information are considered first. The native vegetation that lies within the WWF site (including additional development areas recently assessed for vegetation) and the OD route study area is then described, including vegetation mapping. The impacts on vegetation, listed communities and threatened species is then assessed. 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).

Table 3: Application requirements under the Guidelines

Application requirement		Response
1.	Information about the native vegetation to be removed	Please see Section 5.3 and Section 5.4.
2.	Topographic and land information relating to the native vegetation to be removed	Please see Section 5.3 and Section 5.4.
3.	Recent, dated photographs of the native vegetation to be removed	Please see 2.
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	Not applicable. It is understood that no native vegetation removal has occurred associated with the project in the last five years.
5.	An avoid and minimise statement	Please see Section 5.4.2.
6.	A copy of any Property Vegetation Plan contained within an agreement made pursuant to section 69 of the *Conservation, Forests and Lands Act 1987* that applies to the native vegetation to be removed	Not applicable. It is understood that no Property Vegetation Plan applies to the native vegetation proposed to be removed.
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.	Not applicable. The proposed native vegetation removal is not to create defendable space.

Application requirement		Response
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).	Not applicable. This application is being made under Clause 52.17, not 52.16.
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.	Please see Section 5.6.1.
Additional requirements for applications in the Detailed Assessment Pathway		
10.	A site assessment report of the native vegetation to be removed, including: ▪ A habitat hectare assessment of any patches of native vegetation, including the condition, extent (in hectares), Ecological Vegetation Class and bioregional conservation status. ▪ The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any large trees within patches ▪ The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any scattered trees, and whether each tree is small or large.	Please see Section 5.3.1., Appendix 3 and Appendix 4.
11.	Information about impacts on rare or threatened species habitat, including: ▪ The relevant section of the Habitat importance map for each rare or threatened species requiring a species offset. ▪ For each rare or threatened species that the native vegetation to be removed is habitat for, according to the Habitat importance maps: o the species' conservation status o the proportional impact of the removal of native vegetation on the total habitat for that species o whether their habitats are highly localised habitats, dispersed habitats, or important areas of habitat within a dispersed species habitat.	Please see Section 5.4.4. and Appendix 5 and Appendix 6.

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 study area was reviewed.

- Moyne Planning Scheme
- Glenelg Planning Scheme
- *Biodiversity Assessment: Willatook Wind Farm, Willatook, Victoria* (EHP 2018).

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 study 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 Plain bioregion[2] (DSE 2004a); and
- NatureKit (DELWP 2018a).

Listed matters

Existing flora and fauna 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 perimeter of the study area (coordinates: latitude 38˚ 07' 49" S and longitude 142˚ 09' 55" E for the Wind Farm site and Latitude 38° 19' 25.58" S Longitude 141° 35' 51.98" E, Latitude 38° 18' 06.45" S Longitude 141° 36' 02.11" E, Latitude 38° 16' 59.91" S Longitude 141° 39' 37.52" E, Latitude 38° 17' 47.90" S Longitude 141° 38' 32.20" E for the OD route).

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

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[2] 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).

The online EPBC Act Protected Matters Search Tool (DAWE 2021a) was consulted to determine whether nationally listed species or communities potentially occurred in the search regions based on habitat modelling based on a centrepoint within the wind farm of -38.15037 142.16408 and buffered to 15 kilometres.

5.2.2. Field methods

Native vegetation assessment

Initial native vegetation assessments were undertaken in November and December 2009, and February and March 2011 and June and July 2017 (EHP 2018). During the 2017 native vegetation assessment, all observed vascular plants were recorded, any significant records mapped and the overall condition of vegetation noted. Vegetation outside the survey area was not assessed. Remnant vegetation in the local area was reviewed to assist in determining the original vegetation within the study area (see EHP 2018).

The boundaries of each vegetation type were mapped through aerial photograph interpretation and using a hand-held GPS (accuracy ± 5 metres). A habitat hectare assessment was undertaken by a DELWP-certified native vegetation assessor in conjunction with the flora survey.

Additional native vegetation assessments were conducted by Nature Advisory on 25th – 27th July 2018 by a DELWP-certified native vegetation assessor. During this assessment, the OD route study area and areas within the WWF site beyond the earlier survey area proposed to be impacted were surveyed on foot.

Further areas within the WWF site beyond the earlier survey area where impacts were proposed were also assessed on foot for native vegetation on 19th March 2019, 18th June 2019,1st – 3rd March, 6th – 8th October, 4th and 5th November, and 7th and 8th December 2021.

During native vegetation surveys, sites found to support native vegetation or with potential to support listed matters were mapped through a combination of aerial photograph interpretation and ground-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, if found, were also mapped using the same method.

In addition, five patches of native vegetation within the earlier 2017 survey area were recorded during the later targeted flora surveys which had not yet been mapped. These patches were surveyed using the above-described methods.

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[3] where the drip line[4] 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[2] that does not form part of a patch.

Scattered trees are counted and mapped, the species identified and their circumference at 1.3 metres 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.

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

[3] 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.
[4] The drip line is the outermost boundary of a tree canopy (leaves and/or branches) where the water drips on to the ground.

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 human 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 likelihood of listed threatened ecological communities occurring in the WWF site and OD route study area was determined by checking general field observations against published descriptions of relevant listed ecological communities modelled to potentially occur in the study 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 initial native vegetation assessments, it was determined that 19 flora species listed under the EPBC Act and/or FFG Act had the potential to occur within areas of suitable habitat in the WWF site. These species are listed below.

- Basalt Leek-orchid (FFG Act: critically endangered)
- Basalt Peppercress (EPBC Act: Endangered; FFG Act: endangered)
- Button Wrinklewort (EPBC Act: Endangered; FFG Act: endangered)
- Clover Glycine (EPBC Act: Vulnerable; FFG Act: vulnerable)
- Curly Sedge (FFG Act: endangered)
- Dense Leek-orchid (EPBC Act: Vulnerable; FFG Act: critically endangered)
- Gorae Leek-orchid (EPBC Act: Endangered; FFG Act: critically endangered)
- Lacey River Buttercup (FFG Act: critically endangered)
- Maroon Leek-orchid (EPBC Act: Endangered; FFG Act: endangered)
- Matted Flax-lily (EPBC Act: Endangered; FFG Act: critically endangered)
- Pale Swamp-everlasting (FFG Act: critically endangered)
- Pretty Leek-orchid (FFG Act: critically endangered)
- Purple Blown-grass (FFG Act: endangered)
- Slender Style-wort (FFG Act: endangered)
- Swamp Diuris (FFG Act: endangered)

- Swamp Everlasting (EPBC Act: Vulnerable; FFG Act: critically endangered)
- Swamp Fireweed (EPBC Act: Vulnerable)
- Swamp Flax-lily (FFG Act: endangered)
- Trailing Hop-bush (EPBC Act: Vulnerable).

Targeted surveying was undertaken across four separate site surveys (October and December 2018 and October and December 2021) to coincide with the published regular flowering periods for the targeted species. Climate data (BOM 2021a) indicates that 2018 was a dry year, with annual rainfall, October and December rainfall, as well as the three months preceding all below average. By contrast, 2019 was closer to average and 2020 slightly higher than average. Spring-summer 2020-21 was wetter than average, but most of 2021 experienced average monthly rainfall. Targeted surveying for threatened flora was undertaken only where native vegetation supporting suitable habitat for those species occurred within the footprint provided by Willatook Wind Farm Pty Ltd. The surveys involved visual searching on foot by qualified and experienced botanists along transects spaced no more than five metres apart. Where any threatened flora species was observed, its location was recorded using a handheld GPS.

As most areas included in the targeted surveys were small/linear/narrow bands of habitat, this method allowed very thorough visual searching of these areas to be undertaken.

Combined with the timing of the surveys (within the published regular flowering periods of all species) this method was considered appropriate to determine whether the targeted species were present or absent in the impact areas.

Targeted surveys for threatened flora were conducted as described below.

- <u>October targeted flora survey</u> (targeting spring flowering species namely Basalt Leek-orchid, Button Wrinklewort, Clover Glycine, Curly Sedge, Dense Leek-orchid, Lacey River Buttercup, Maroon Leek-orchid, Pretty Leek-orchid, Purple Blown-grass, Slender Stylewort, Swamp Diuris and Swamp Flax-lily): 22nd to 24th October 2018, 6th-8th and 26th October and 4th and 5th November 2021.
- <u>December targeted flora survey</u> (targeting summer flowering species namely Basalt Peppercress, Gorae Leek-orchid, Matted Flax-lily, Pale Swamp Everlasting, Swamp Everlasting and Swamp Fireweed, Trailing Hop-bush): 10th to 12th December 2018 and 7th and 8th December 2021.

During all of these surveys, the following areas were surveyed:

- All areas of proposed removal of Higher Rainfall Plains Grassy Woodland (EVC 55_63);
- All areas of proposed removal of Plains Grassy Wetland (EVC 125);
- All areas of proposed removal of Heavier-soils Plains Grassland (EVC 132_61); and
- All areas of proposed removal of Basalt Shrubby Woodland (EVC 642).

Since the above surveys were undertaken, the proposed footprint of the wind farm development has undergone further alteration for a variety of reasons, including minimising impacts on mapped native vegetation. Areas of proposed impact outside of the 2018 and 2021 targeted survey study areas are required to undergo further surveys in 2022 as follows:

- October surveys in:
  - Plains Grassy Wetland (EVC 125) (0.314 hectares).
- December surveys in:
  - Plains Grassy Wetland (EVC 125) (0.314 hectares); and
  - Basalt Shrubby Woodland (EVC 642) (0.052 hectares).

These areas total 0.336 hectares of native vegetation removal, and are shown in Figure 5. Given that the outstanding areas requiring targeted survey are a small proportion (8%) of the proposed native vegetation removal, the survey effort to date and the commitment to undertake these targeted surveys prior to construction, it is considered that sufficient information is available for impact assessment purposes.

Over dimensional transport route

Based on the results of the native vegetation assessments, it was determined that five flora species listed under the EPBC Act and/or FFG Act had the potential to occur within areas of suitable habitat in the over-dimensional route. These species were:

- Clover Glycine (EPBC Act: Vulnerable; FFG Act: vulnerable);
- Gorae Leek-orchid (EPBC Act: Endangered; FFG Act: critically endangered);
- Maroon Leek-orchid (EPBC Act: Endangered; FFG Act: endangered);
- River Swamp-wallaby-grass (EPBC Act listed: Vulnerable); and
- Curly Sedge (FFG Act: endangered).

Targeted surveying was undertaken across two separate site surveys (October 2018 and December 2018) to coincide with the published regular flowering periods for the five target species. Climate data (BOM 2021a) indicates that 2018 was a dry year, with annual rainfall, October and December rainfall, as well as the three months preceding all below average. Targeted surveying for threatened flora was undertaken in all areas of suitable habitat within the over-dimensional route study area to allow for design flexibility. As these patches were small and often linear, very thorough visual searching of these areas was undertaken.

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

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

- October targeted flora survey (targeting spring flowering species, namely Clover Glycine and Curly Sedge): 31st October 2018.

  During this survey, the following EVCs were surveyed:

  - Herb-rich Foothill Forest (EVC 23); and
  - Aquatic Herbland (EVC 653).

- December targeted flora survey (targeting summer flowering species, namely River Swamp Wallaby-grass, Gorae Leek-orchid and Maroon Leek-orchid): 12th December 2018.

During this survey, the following EVCs were surveyed:

- Aquatic Herbland (EVC 653).

Limitations of native vegetation assessments

The short duration and seasonal timing of field assessments can result in some species not being detected when they may occur at other seasons. 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.

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

The results of vegetation mapping undertaken by Ecology and Heritage Partners (EHP 2018) have been used in this report, combined with further vegetation mapping undertaken by Nature Advisory, to determine the impacts to vegetation, flora and fauna.

5.3. Assessment results

5.3.1. Native vegetation

Patches of native vegetation

Wind Farm site

Vegetation in the Wind Farm site consisted of nine EVCs: Aquatic Herbland (EVC 653), Basalt Shrubby Woodland (EVC 642), Higher-rainfall Plains Grassy Woodland (EVC 55_63), Heavier-soils Plains Grassland (EVC 132_61), Plains Grassy Wetland (EVC 125), Stony Knoll Shrubland (EVC 649), Swamp Scrub (EVC 53), Swampy Riparian Woodland (EVC 83) and Tall Marsh (EVC 821).

Descriptions of these EVCs are provided within the EVC benchmarks in Appendix 7. Descriptions of habitat zones in the WWF site are provided in Table 4. The habitat hectare assessment results for these habitat zones are provided in Appendix 3.

In total 684 habitat zones comprising the abovementioned EVCs were identified in the WWF site (Table 4). This totalled an area of 847.637 hectares of native vegetation in patches. This area included 501.401 hectares of DELWP mapped wetlands, which are treated as native vegetation in accordance with the Guidelines.

The remainder of the WWF site comprised introduced and planted vegetation, present as crop, pasture and non-indigenous treed wind breaks.

Table 4: Description of habitat zones in the WWF site

Habitat Zones	EVC	Description	Total area (Ha)	Average condition score (/100)
XAO, XAP, XAR, XAS, XAT, XBI, XBM, XBO, XBQ, XBS, 72, PGWe1, PGWe2, PGWe3, PGWe4, PGWe5, PGWe6, CI, CD, CE, F, H, I, Q, X, Y, AA, AD, AE, AF, AG, AGG, G, J, AP, AJ, AK, AL, AN, AM, AR, AS, AT, AU, AV, AVV, AX, DB, DD, DC, DK, DP, DL, E, K, AQ, DR, DQ, DRR, AW, AZ, DA, CB, CC, DS, DT, DU, DV, ED, EE, EG, EI	Plains Grassy Wetland (EVC 125)	Plains Grassy Wetland was present throughout the Wind Farm site, occupying low lying areas between stony knolls and on the flats. Plains Grassy Wetland was typically dominated by Common Tussock Grass, with Rushes, Brown-back Wallaby-grass, Variable Willow-herb, and Common Spike-sedge also present. Numerous weed species were present including Yorkshire Fog, Sweet Vernal-grass, Toowoomba Canary Grass, Onion Grass and Flatweed. Much of the Plains Grassy Wetland was highly simplified as a result of grazing, and typically comprised a modified cover of Common Tussock Grass.	250.021	24
AAA, CG, CH, CX, CY, CZ, DI, DJ, DM, DN, DO, EA, EB, EC, EF, EH, EJ, EK, EL, EM, SKS1, SKS2, SKS3, SKS4, XBL, XBR, 14144A, 14144J, 14144K, 1DB	Stony Knoll Shrubland (EVC 649)	Stony Knoll Shrubland was present throughout the Wind Farm site on numerous rocky outcrops. The majority of rocky outcrops throughout the Wind Farm site are highly modified and have been subjected to extensive disturbance from agricultural activities (i.e. grazing, fertilizing), which has resulted in an extremely modified cover of opportunistic and primary colonising species such as Bristly Wallaby-grass and Austral Bracken and is not representative of the pre-1750 Stony Knoll Shrubland EVC. The vegetation cover typically included several indigenous grasses including Rough Spear-grass, Kangaroo Grass, Bristly Wallaby Grass, Weeping Grass, Grey Tussock Grass and Kidney Weed. Several patches also included a modified cover	51.343	25

Habitat Zones	EVC	Description	Total area (Ha)	Average condition score (/100)
		of Sweet Bursaria and Tree Violet, with Austral Bracken also generally present. Several weed species were commonly observed, including Yorkshire Fog, Sweet Vernal-grass, Toowoomba Canary Grass, Perennial Ryegrass, Flatweed, Variegated Thistle, Spear Thistle and Cape Weed.		
BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA1, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, DE, DF, DG, DG1, DG10, DG11, DG12, DG13, DG14, DG15, DG16, DG17, DG18, DG2, DG3, DG4, DG5, DG6, DG7, DG8, DG9, FA, FB, FC, FD, FE, PGW1, PGW10, PGW2, PGW3, PGW4, PGW6, PGW7, PGW8, PGW9, XBN, XBP, XBT, XBU	Higher-rainfall Plains Grassy Woodland (EVC 55_63)	Higher-rainfall Plains Grassy Woodland was identified within the road reserves of the Wind Farm site, and in the west of the Wind Farm site. This variant of Plains Grassy Woodland occupies areas receiving greater than 700 mm annual rainfall (DSE 2004a). Plains Grassy Woodland within the road reserve was mainly present as Acacia or Sheoak dominated woodland to eight metres tall. The understorey was generally highly modified and dominated by exotic grass species such as Toowoomba Canary Grass, Cocksfoot, Sweet Vernal-grass and Yorkshire Fog. The overstory was typically comprised a modified layer of mature and emergent Blackwood and Black Wattle. In the west of the Wind Farm site, Plains Grassy Woodland was mainly present as patches of Manna Gum and River Red Gum over a predominately exotic understorey.	16.833	21

Habitat Zones	EVC	Description	Total area (Ha)	Average condition score (/100)
1AL, 1AM, 1AN, 1AO, 1AQ, 1AR, 1AS, 1AT, 1AU, 1AV, 1AW, 1AX, 1AY, 1AZ, 1BB, 1BC, 1BD, 1BE, 1BF, 1BG, 1BH, 1BI, 1BJ, 1BK, 1BL, 1BM, 1BN, 1BO, 1BP, 1BQ, 1BR, 1BS, 1BT, 1BU, 1BV, 1BW, 1BX, 1BY, 1BZ, 1DC, 1DD, 1DE, 1DF, 1O, BSW1, BSW2, LA, LB, LC, LE, LF, LG, LI, LJ, LK, LL, LM, LO, XAA, XAB, XAD, XAE, XAF, XAG, XAH, XAI, XAJ, XAK, XAM, XAN, XAQ, XAU, XAV, XAW, XAX, XAY, XAZ, XBA, XBB, XBC, XBD, XBE, XBF, XBJ, XBK, XBV, XBW, XBX, XBY, XBZ, XCA, XCB, XCC	Basalt Shrubby Woodland (EVC 642)	Basalt Shrubby Woodland was largely confined to the road reserves within the Wind Farm site and was dominated by understory trees including Black Wattle and Blackwood. Understory shrubs included Prickly Tea-tree, Cherry Ballart and Prickly Moses. The ground layer of some patches included native graminoids such as Common Wallaby Grass, Kangaroo Grass, Common Tussock Grass, Black-anther Flax Lily and Wattle Mat-rush. Austral Bracken was also generally present. The ground-layer of these areas typically had a high cover of exotic grasses such as Cocksfoot and Toowoomba Canary Grass, with some patches not supporting any native species in the ground layer.	19.200	17
PG1, PG2, PG3, PG5, CA2, AY, CF	Heavier-soils Plains Grassland (EVC 132_61)	Plains Grassland was present within the Wind Farm site as a derived grassland community from Basalt Shrubby Woodland and Plains Grassy Woodland. It should be noted that this community does not meet the criteria for the EPBC Act listed Natural Temperate Grassland of the Victorian Volcanic Plain (TSSC 2008b), or the FFG Act listed Western (Basalt) Plains Grasslands Community.	3.133	23

Habitat Zones	EVC	Description	Total area (Ha)	Average condition score (/100)
		Plains Grassland was dominated by perennial grasses, including Kangaroo Grass, Common Wallaby Grass, Common Wheat-grass and Rough Spear-grass; along with native lilies and herbs such as Yellow Rush-lily, Sheep's Burr, Scaly Buttons, and Pink Bindweed. Weed species present in this area included Toowoomba Canary Grass, Bearded Oat, Onion Grass and Perennial Ryegrass.		
AO, GA, GB, TM1, XAL, XBH	Tall Marsh (EVC 821)	Within the Wind Farm site, remnants of Tall Marsh were found within Back Creek, which enters the study area from the north. Tall Marsh was dominated Common Reed with scattered occurrences of Broad-leaf Cumbungi.	2.947	27
AH1	Aquatic Herbland (EVC 653)	Aquatic Herbland was recorded on private land within the Wind Farm site. This EVC was dominated by Tall Spike-sedge, with scattered occurrences of Pacific Azolla and Duckweed and Variable Willow-herb.	0.040	39
HH	Swampy Riparian Woodland (EVC 83)	Swampy Riparian Woodland was recorded on private property along the Banks of the Shaw River.	0.066	10
1AP, 1BA	Swamp Scrub (EVC 53)	Two patches of Swamp Scrub occurred within the Wind Farm site along the Woolsthorpe-Heywood Road, near the intersection with Nagorckas Road. These lacked a woody vegetation layer and were species depauperate, being dominated by Narrow-leaf Cumbungi with scattered Black-anther Flax-lily and Glabrous Willow-herb around the edges. Weed cover was moderate and dominated by Phalaris.	0.006	26
Current Wetlands	DELWP 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	501.401	N/A

Habitat Zones	EVC	Description	Total area (Ha)	Average condition score (/100)
		the total perennial understory plant cover is native), but have been treated as native vegetation in accordance with the Guidelines. Areas of Mapped Wetlands have been assigned DELWP modelled scores in in accordance with the Guidelines.		
Unassessed	Unassessed	Areas which are yet to be assessed, and have therefore been assumed to support native vegetation, and the modelled condition score applied.	2.647	25 (modelled condition score)
TOTAL			847.637	21

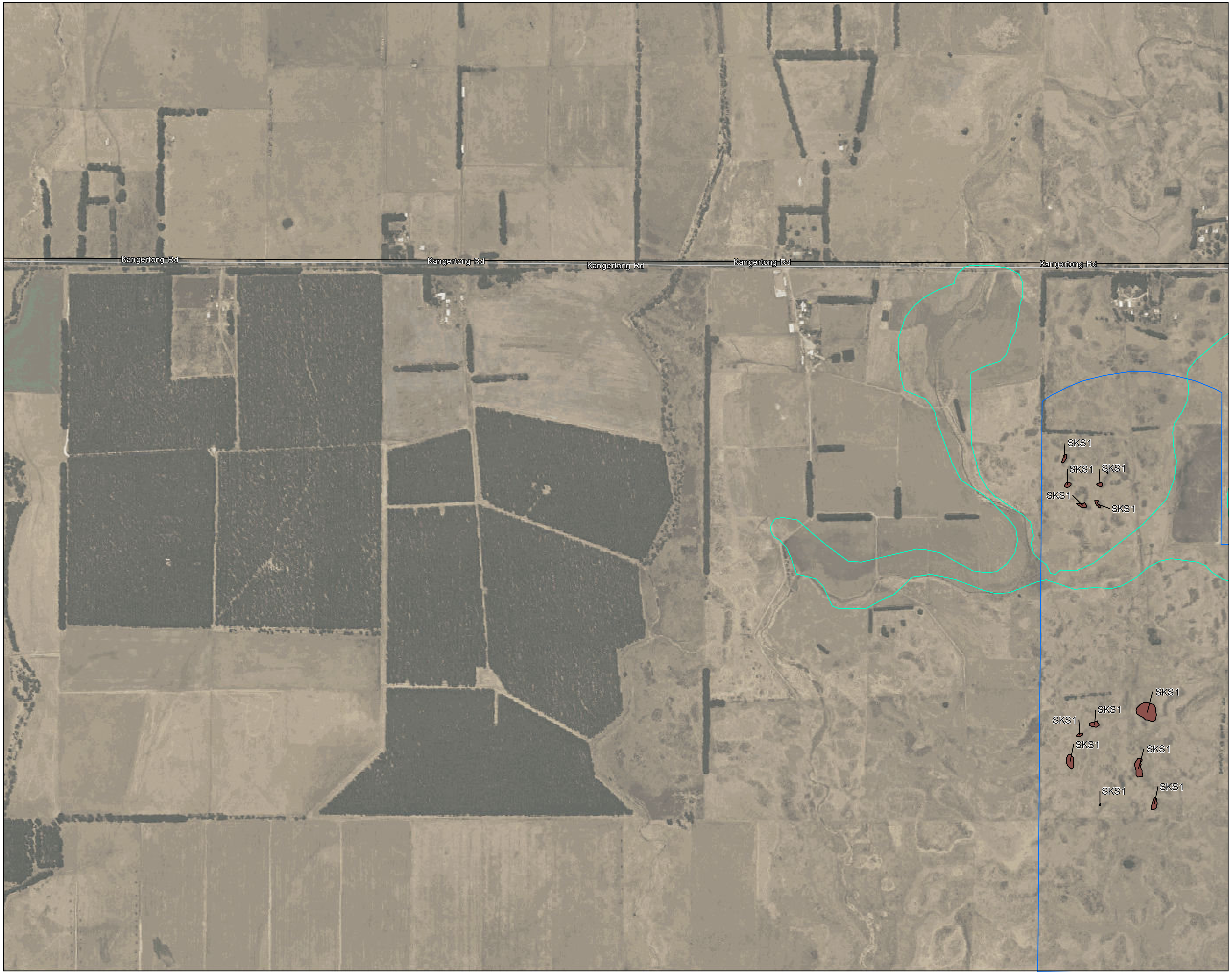
Figure 4-a: Study area and native vegetation

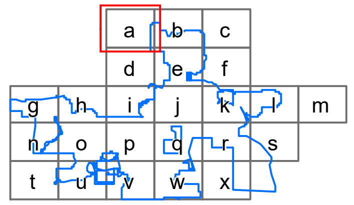
Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Study area

Native vegetation

Stony Knoll Shrubland





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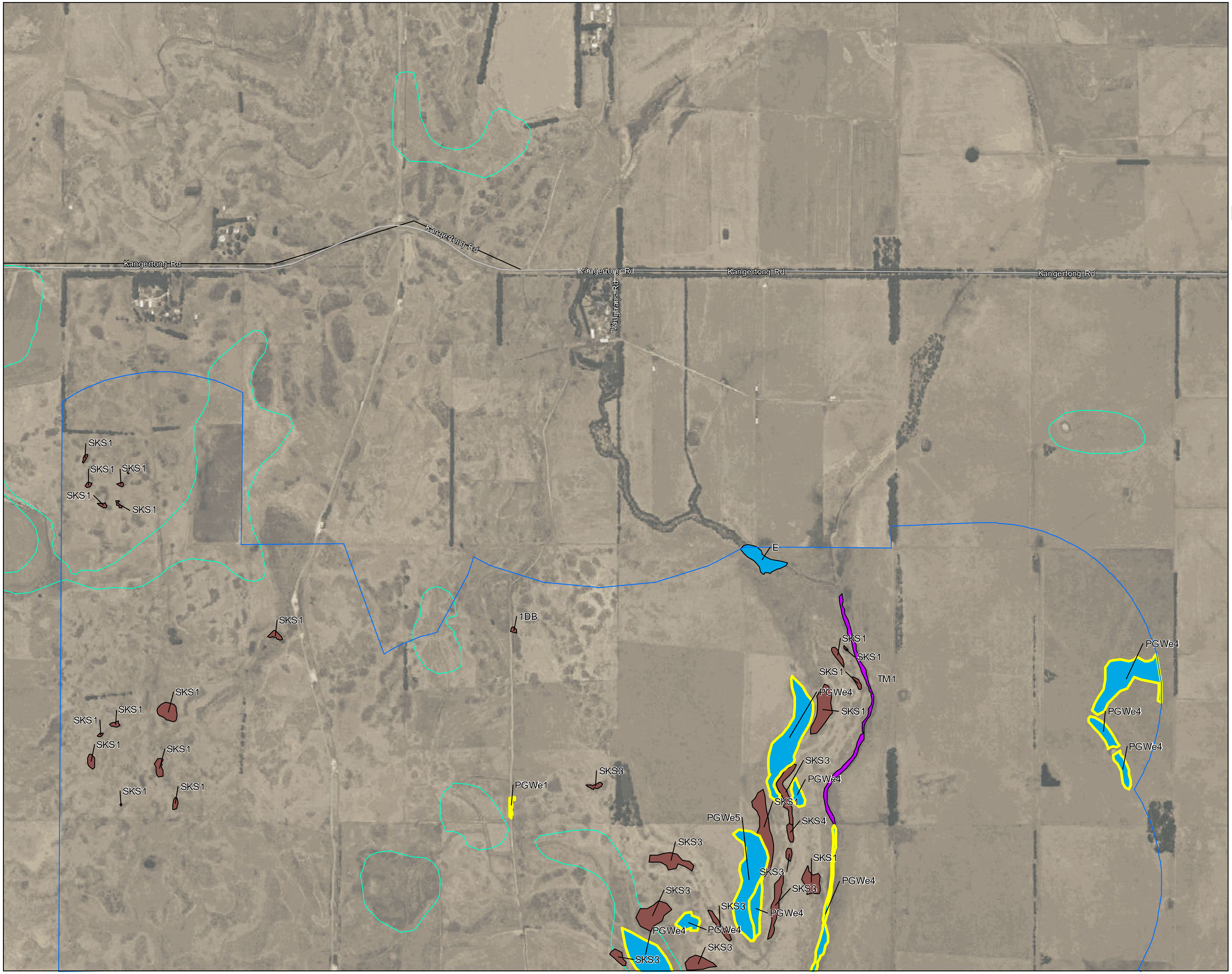

Figure 4-b: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Study area

Native vegetation

Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh

Listed communities

Potential SHWTLP

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Figure 4-c: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Study area

Native vegetation

Plains Grassy Wetland

Listed communities

Potential SHWTLP

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Figure 4-d: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Study area

Native vegetation

Higher Rainfall Plains Grassy Woodland
Stony Knoll Shrubland

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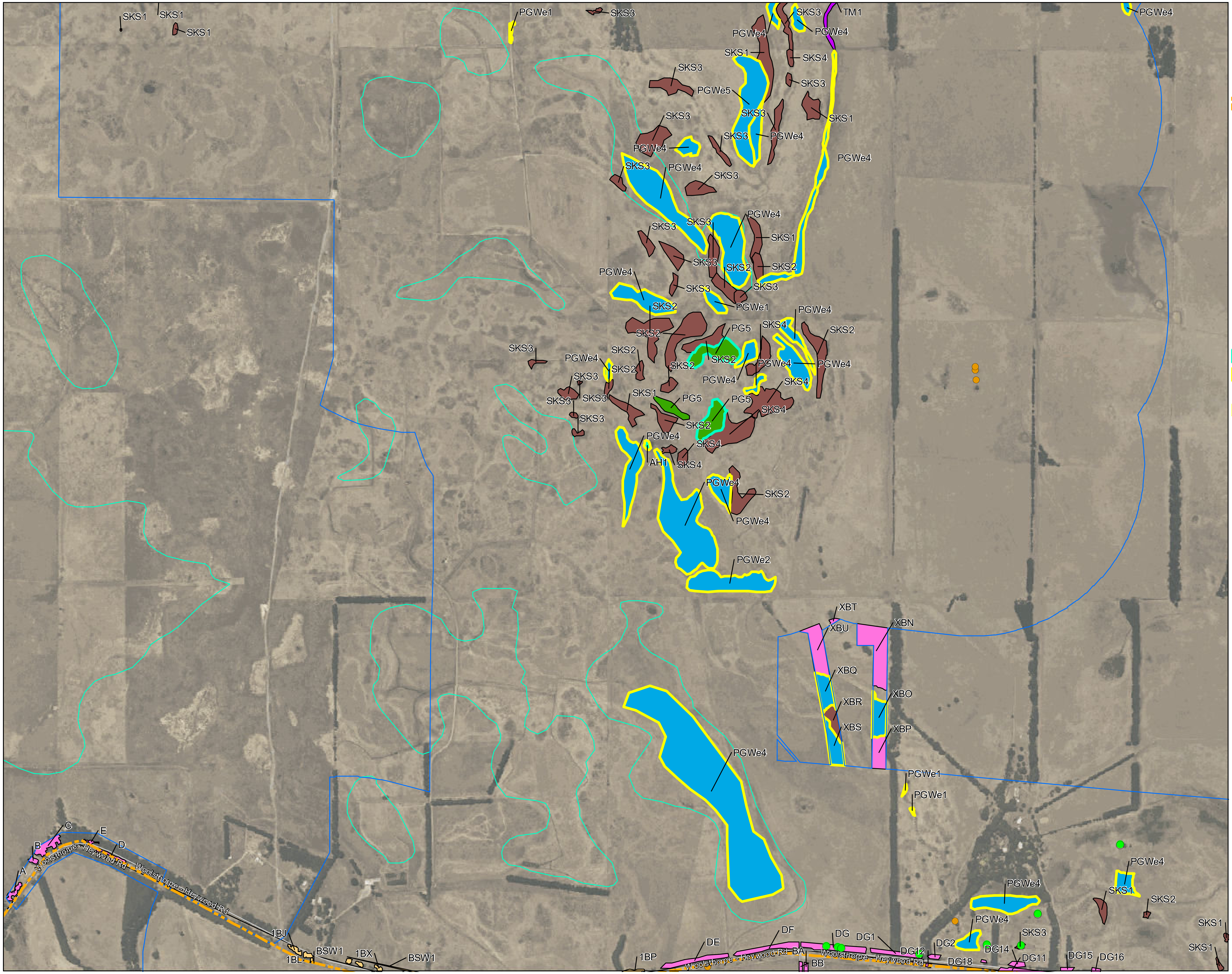

Figure 4-e: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Study area
Large Scattered Tree
Small Scattered Tree

Native vegetation

Aquatic Herbland
Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh

Listed communities

Potential GEWVVP
Potential SHWTLP

Targeted survey results

Confirmed SHWTLP

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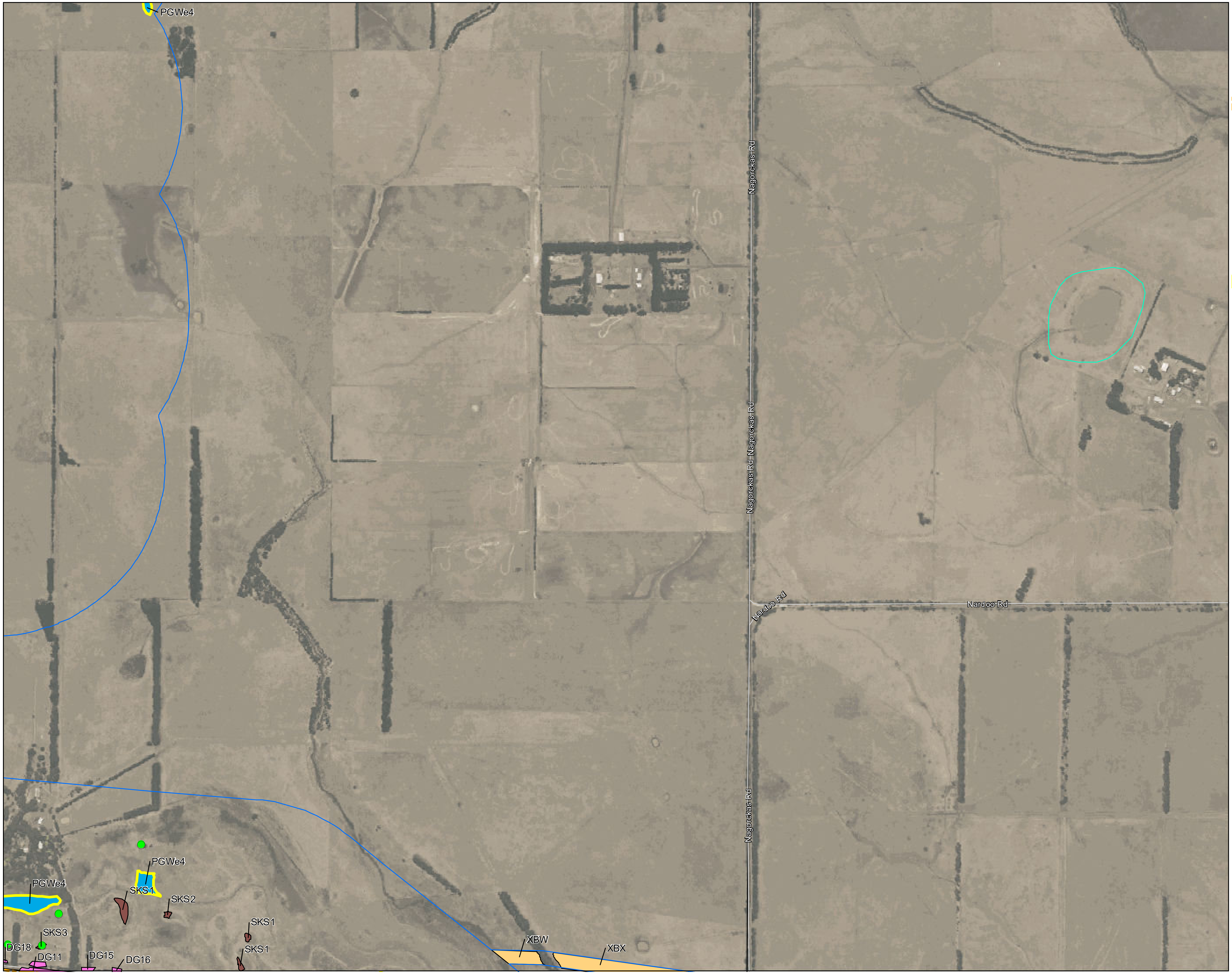


Figure 4-f: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

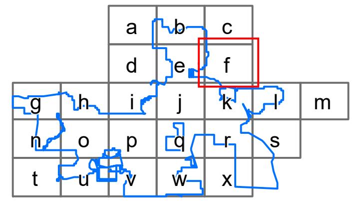
Wind farm boundary
Study area
Large Scattered Tree

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland

Listed communities

Potential SHWTLP



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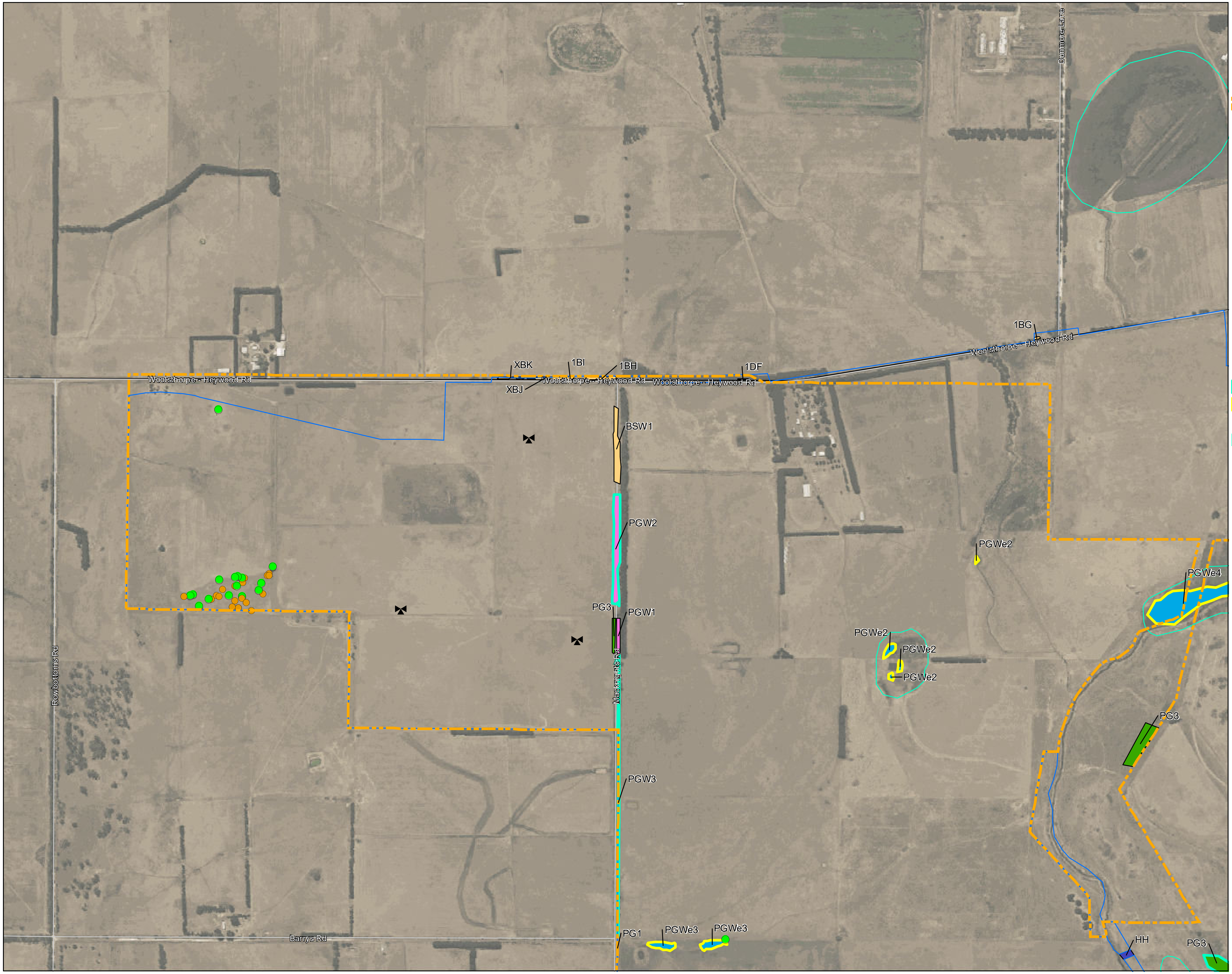

Figure 4-g: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Threatened Species
Matted Flax-lily

Native vegetation
Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Swampy Riparian Woodland

Listed communities
Potential GEWVVP
Potential SHWTLP

Targeted survey results
Confirmed GEWVVP

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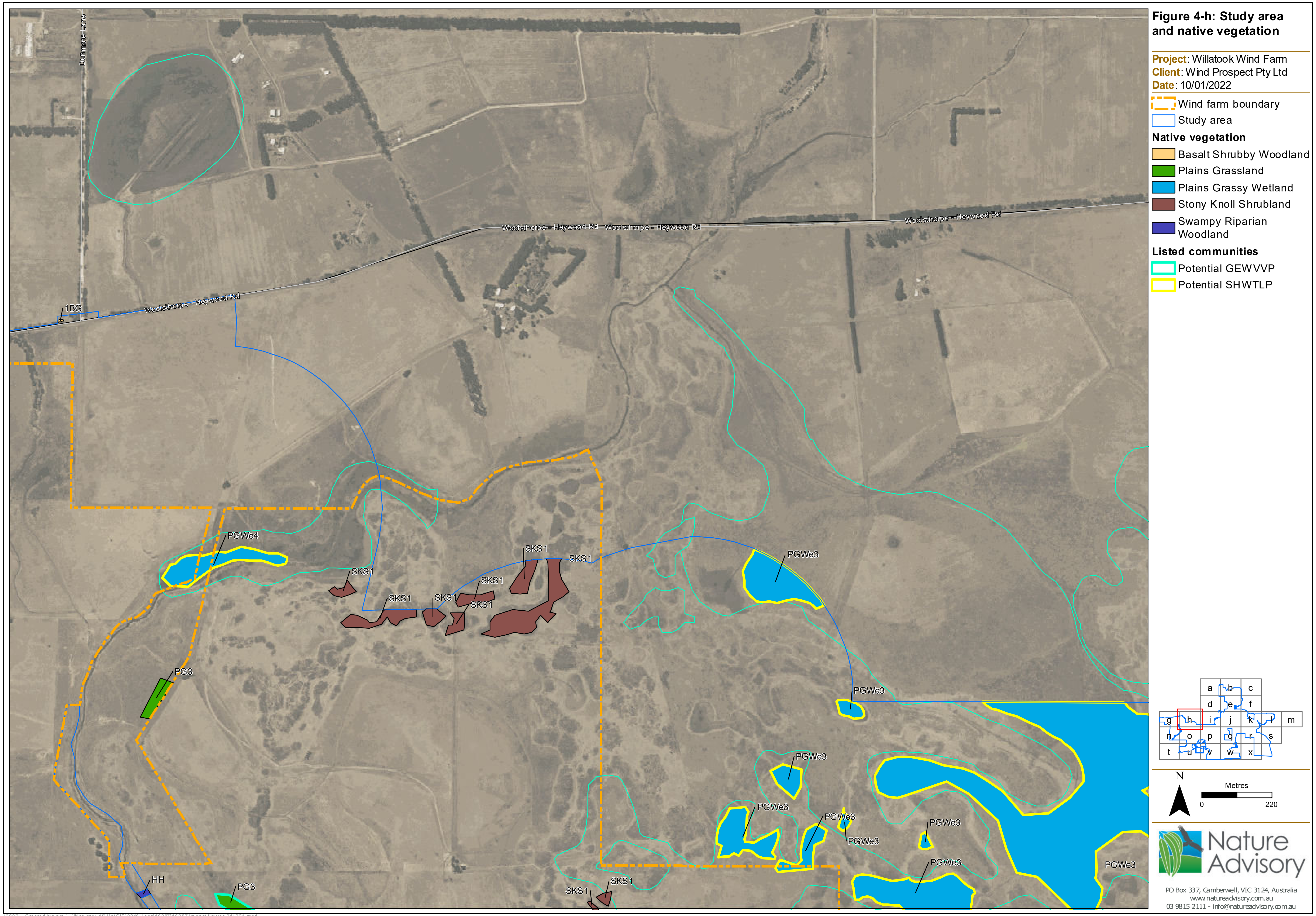

Figure 4-h: Study area and native vegetation
Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022
Wind farm boundary
Study area
Native vegetation
Basalt Shrubby Woodland
Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Swampy Riparian Woodland
Listed communities
Potential GEWVVP
Potential SHWTLP
Woolsthorpe - Heywood Rd
Dunmore Lane
1BG
PGWe4
PGWe3
SKS1
PG3
HH
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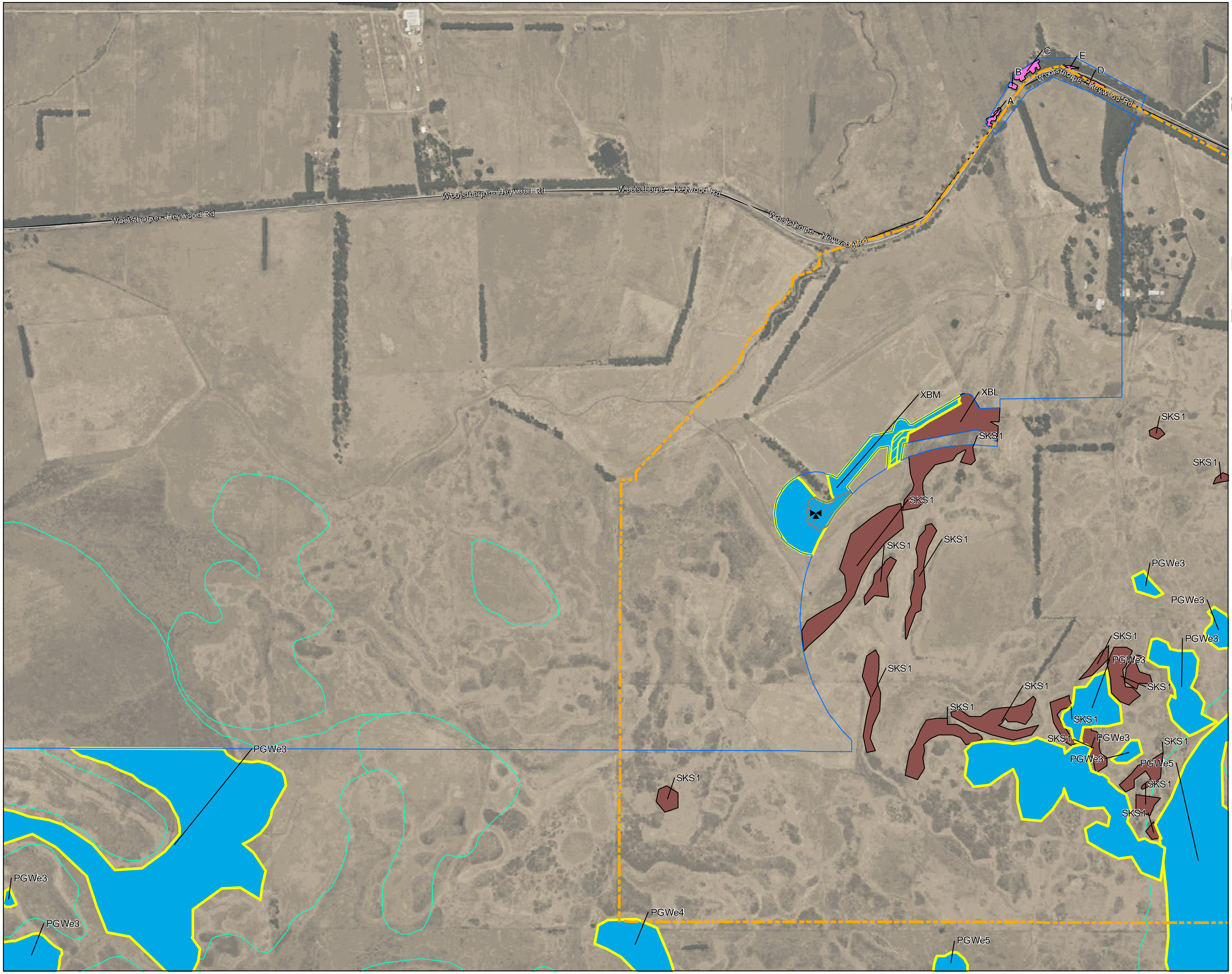

Figure 4-i: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area

Native vegetation

Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland

Listed communities

Potential SHWTLP

Targeted survey results

Confirmed SHWTLP
Not SHWTLP

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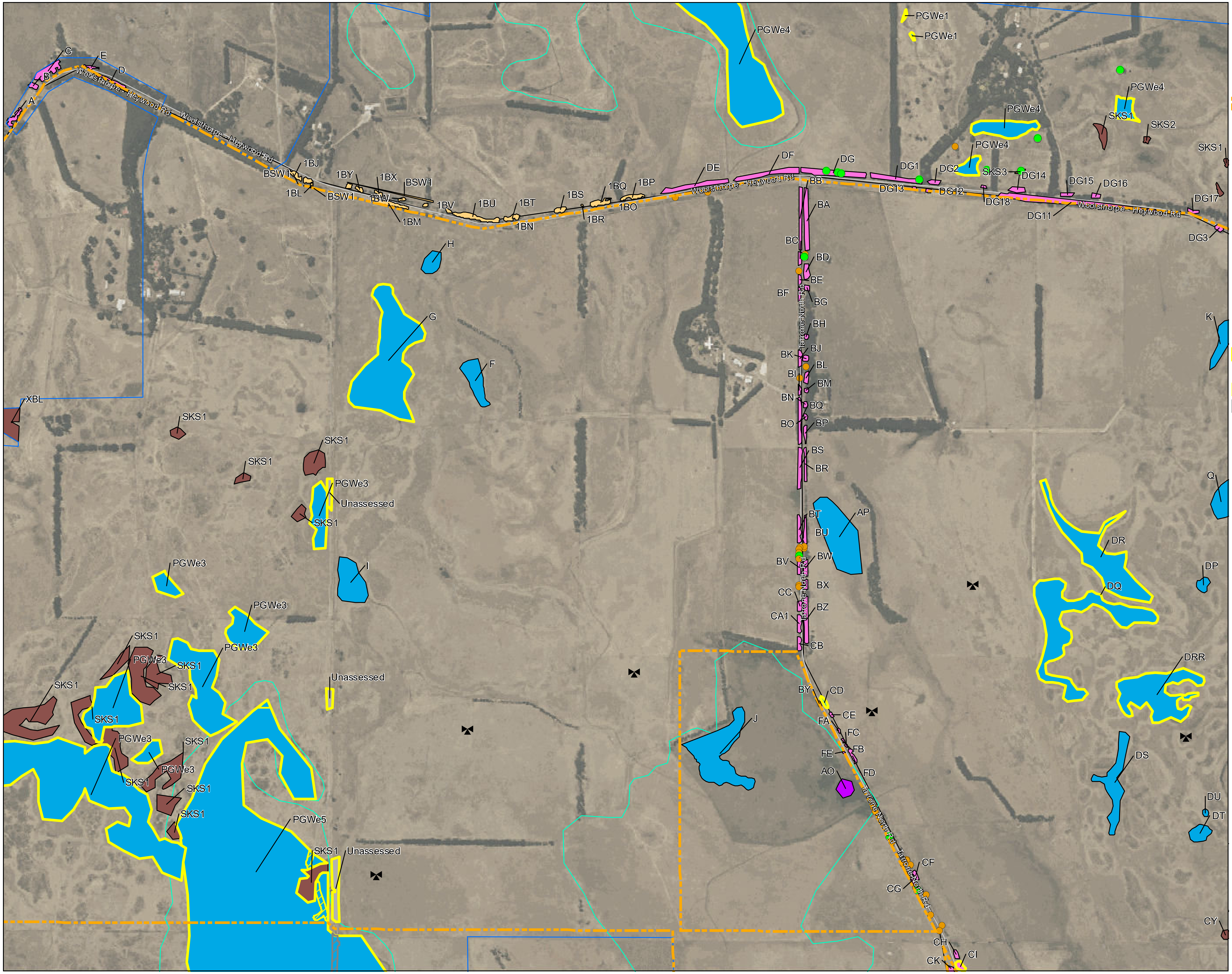

Figure 4-j: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh
Unassessed

Listed communities

Potential SHWTLP

Targeted survey results

Confirmed SHWTLP
Not SHWTLP

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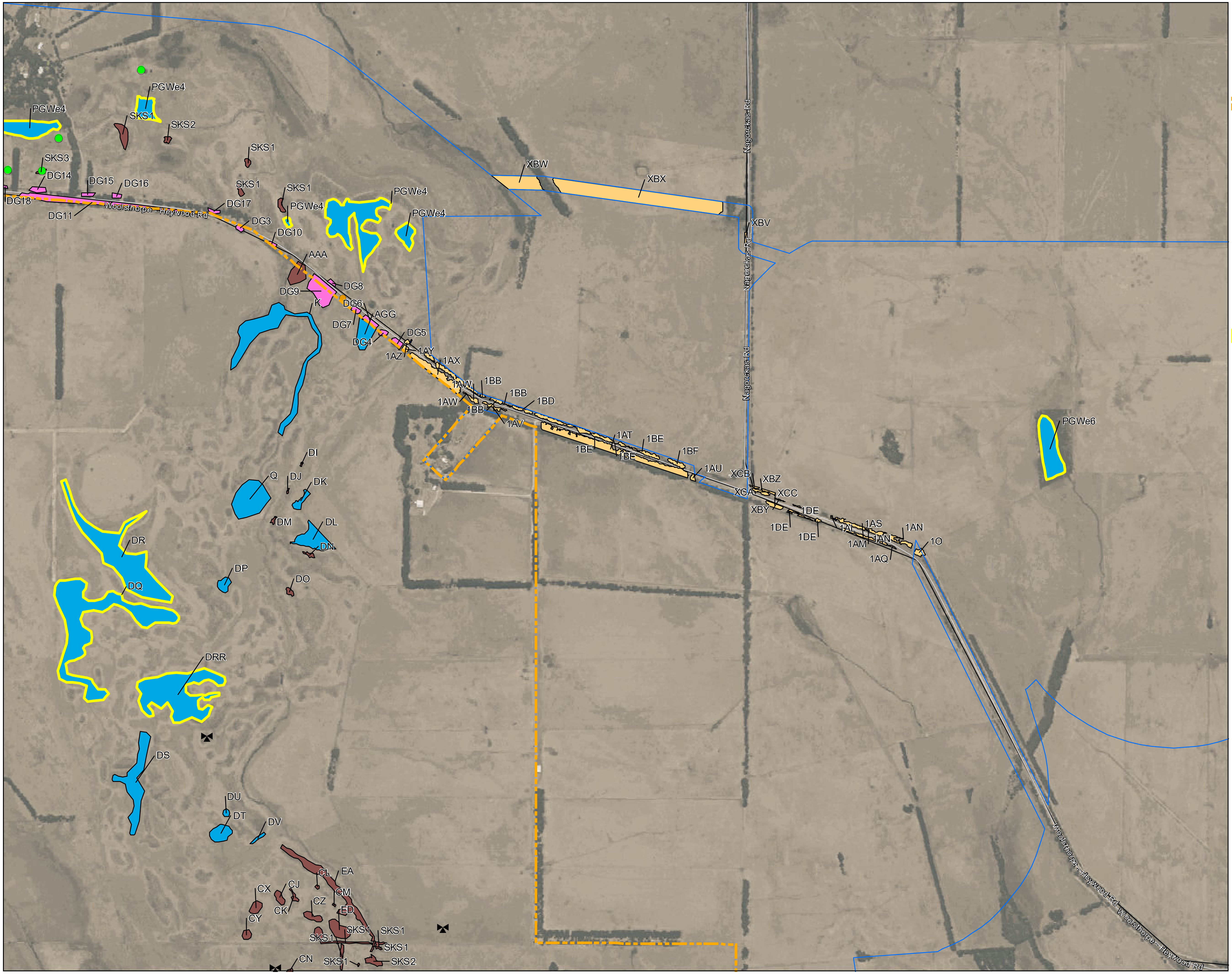

Figure 4-k: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
Swamp Scrub

Listed communities

Potential SHWTLP

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Figure 4-l: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Study area

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland

Listed communities

Potential SHWTLP

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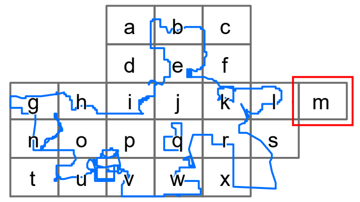
Figure 4-m: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022



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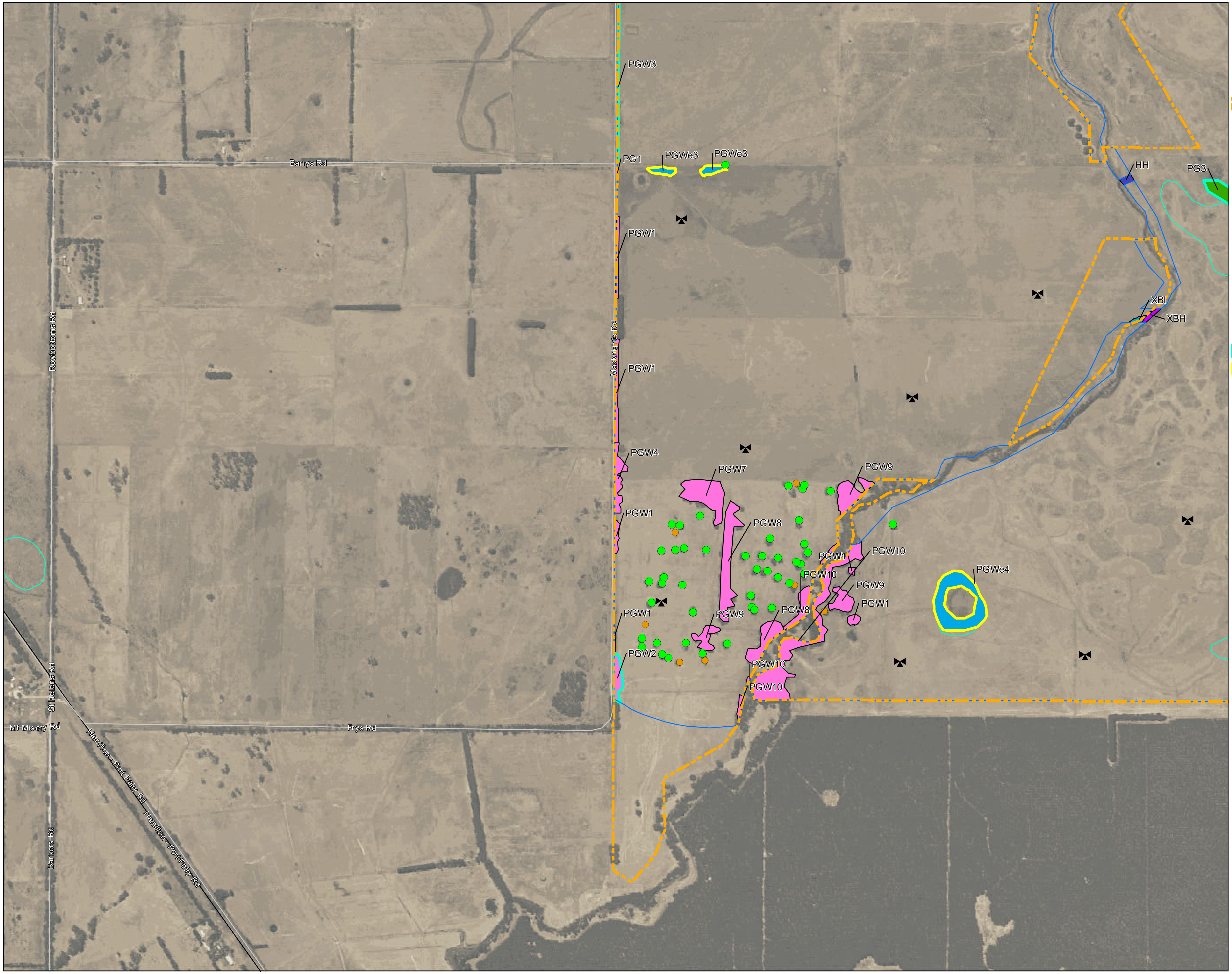


Figure 4-n: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

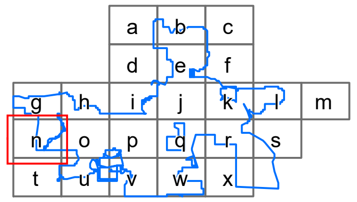
Wind farm boundary
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Native vegetation

Higher Rainfall Plains Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Swampy Riparian Woodland
Tall Marsh

Listed communities

Potential GEWVVP
Potential SHWTLP



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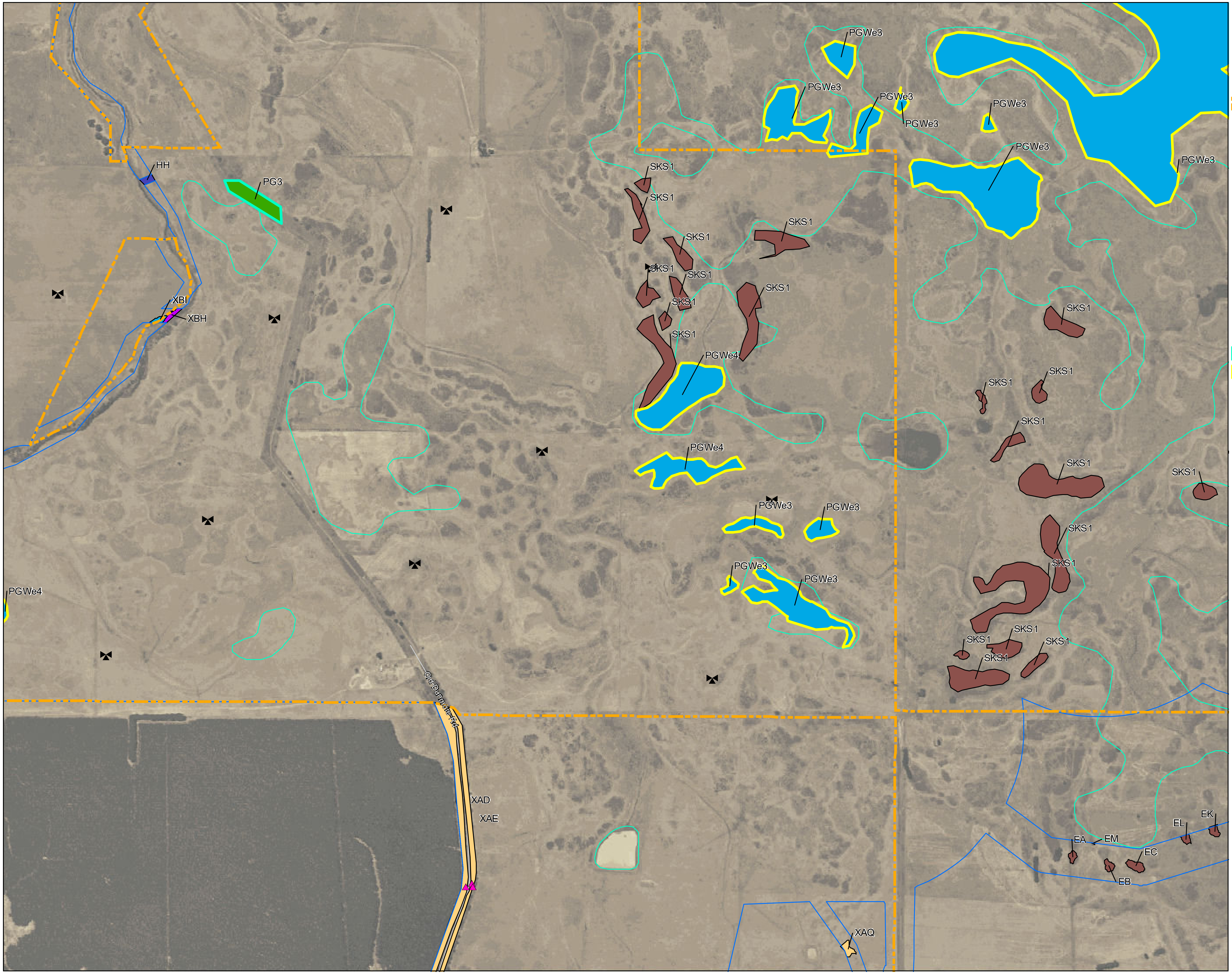

Figure 4-o: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area

Threatened Species
Trailing Hop Bush

Native vegetation
Basalt Shrubby Woodland
Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Swampy Riparian Woodland
Tall Marsh

Listed communities
Potential GEWVVP
Potential SHWTLP

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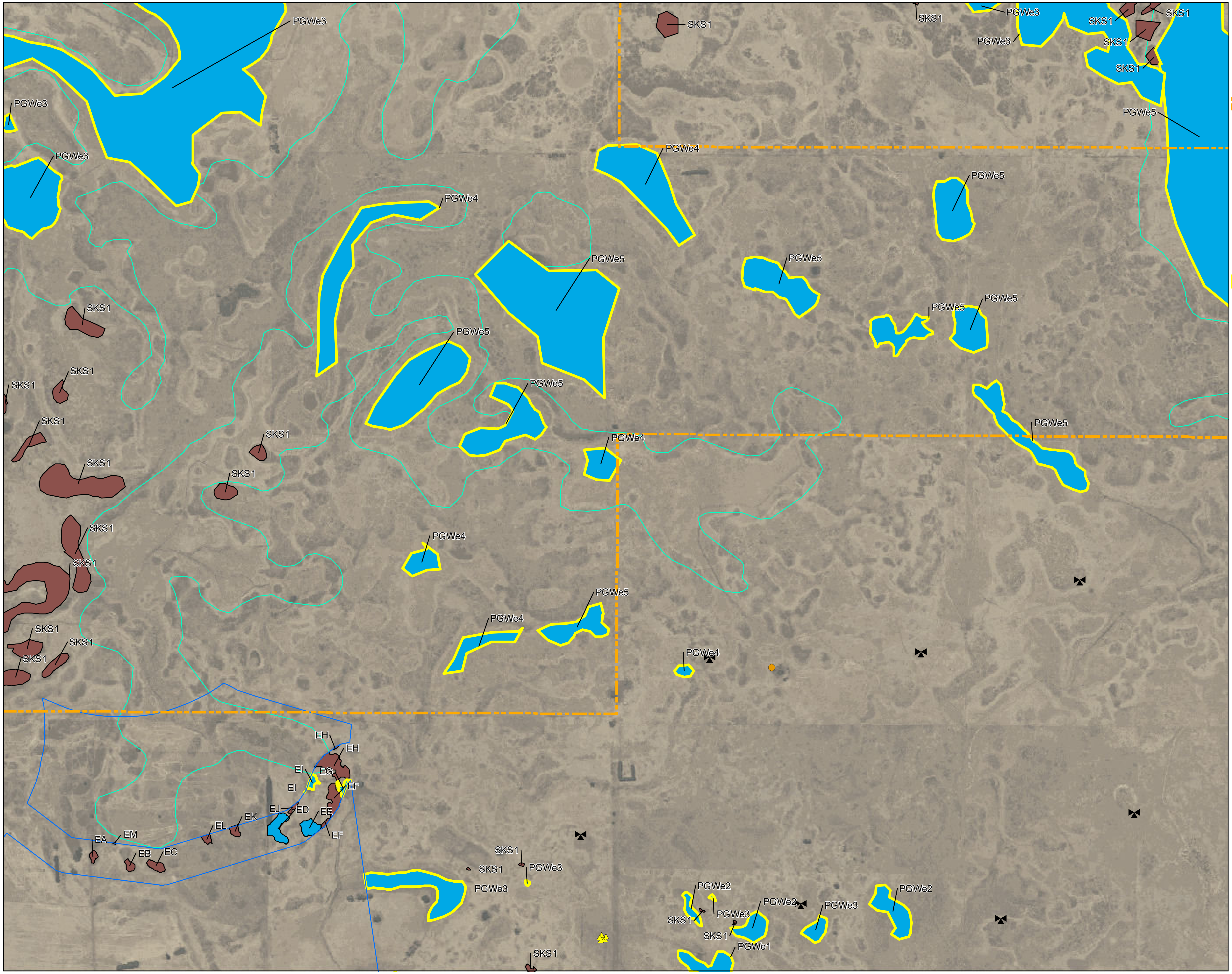

Figure 4-p: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area
Small Scattered Tree
Swamp Everlasting records

Native vegetation

Plains Grassy Wetland
Stony Knoll Shrubland

Listed communities

Potential SHWTLP

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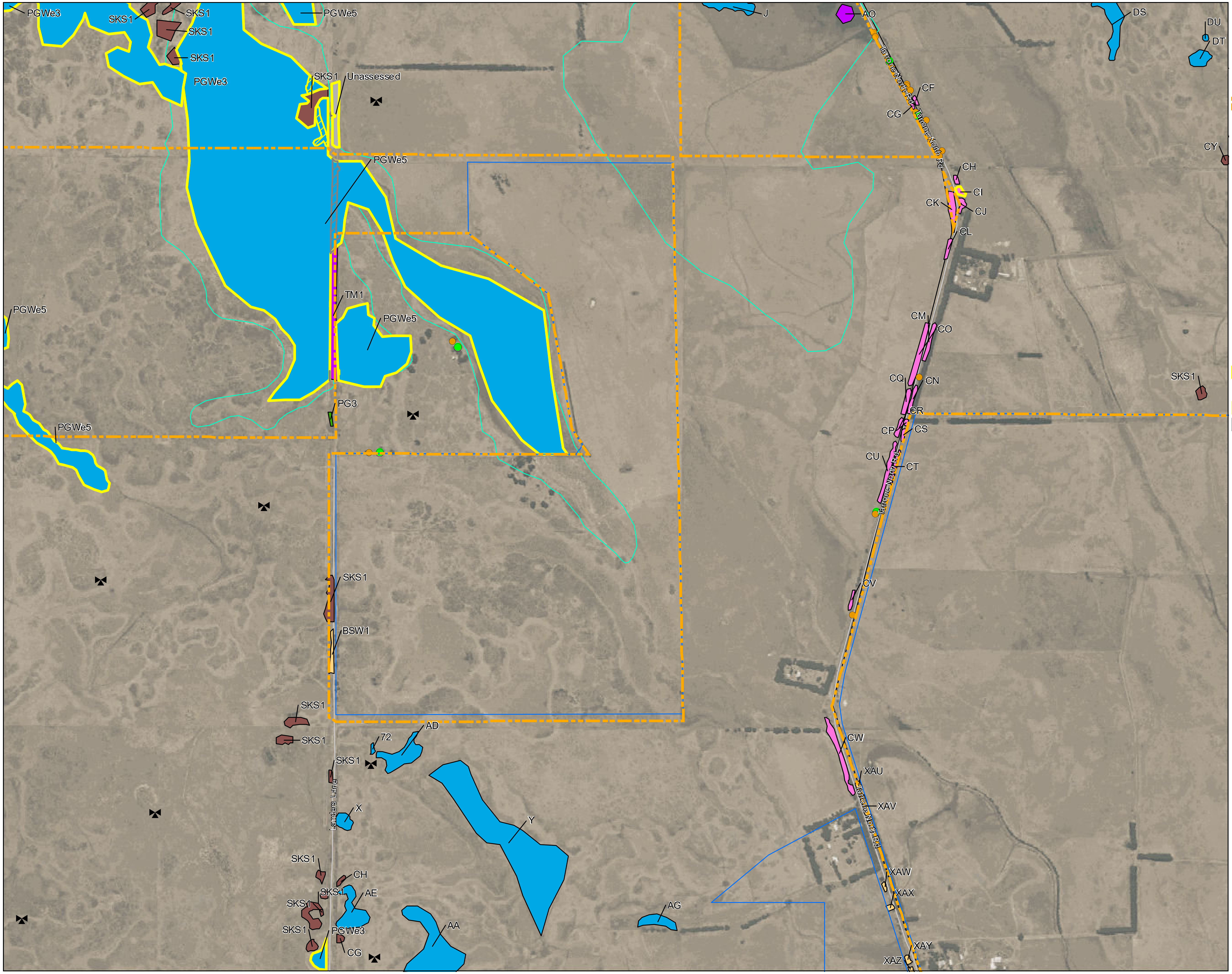

Figure 4-q: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh
Unassessed

Listed communities

Potential SHWTLP

Targeted survey results

Confirmed SHWTLP
Not SHWTLP

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Figure 4-r: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

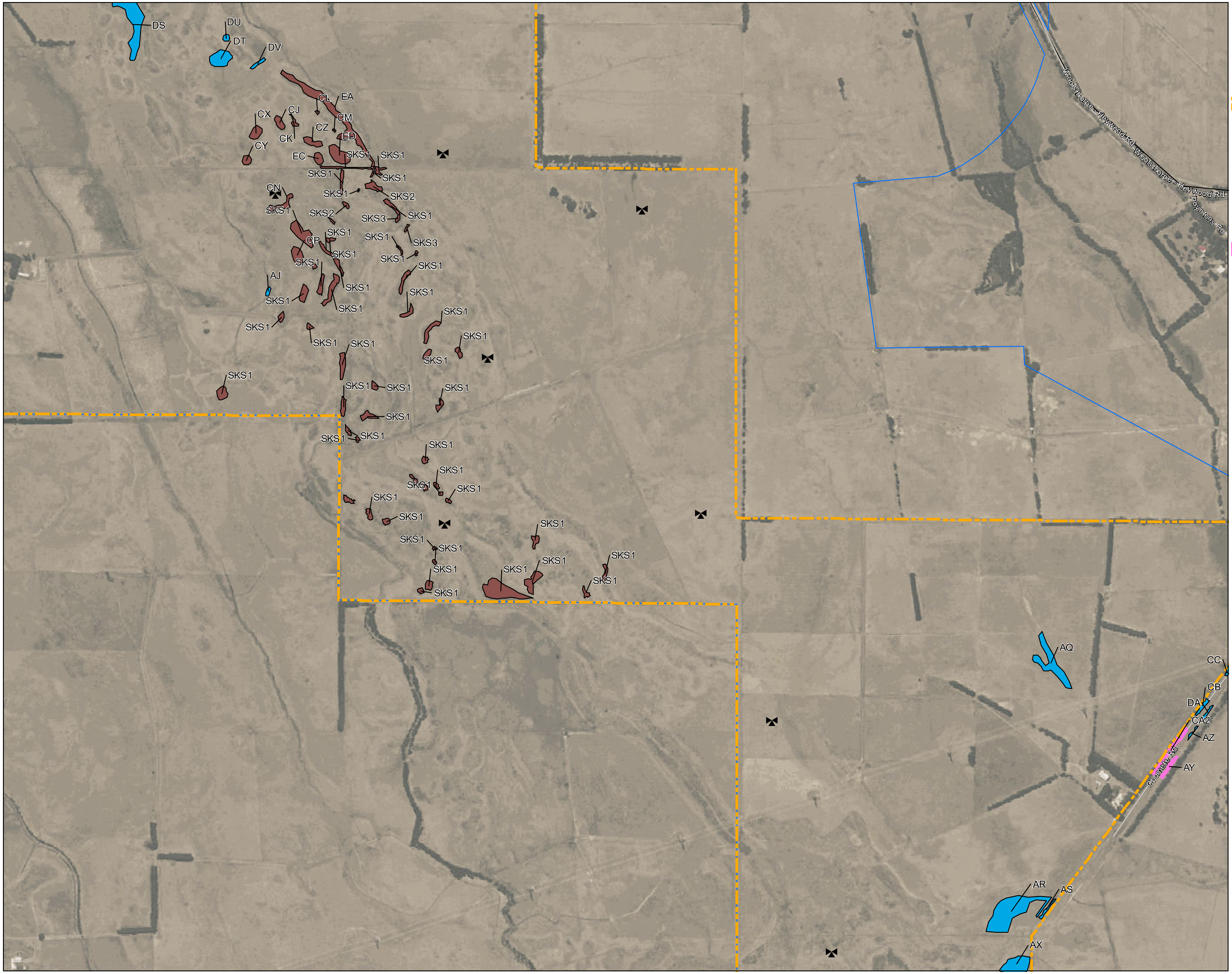
Wind farm boundary
Wind turbine
Study area

Native vegetation

Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland

Listed communities

NTGVVP



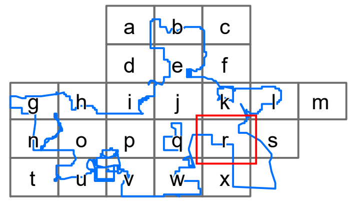


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Figure 4-s: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Study area

Native vegetation
Plains Grassland
Plains Grassy Wetland
Tall Marsh

Listed communities
Potential SHWTLP
NTGVVP

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Figure 4-t: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

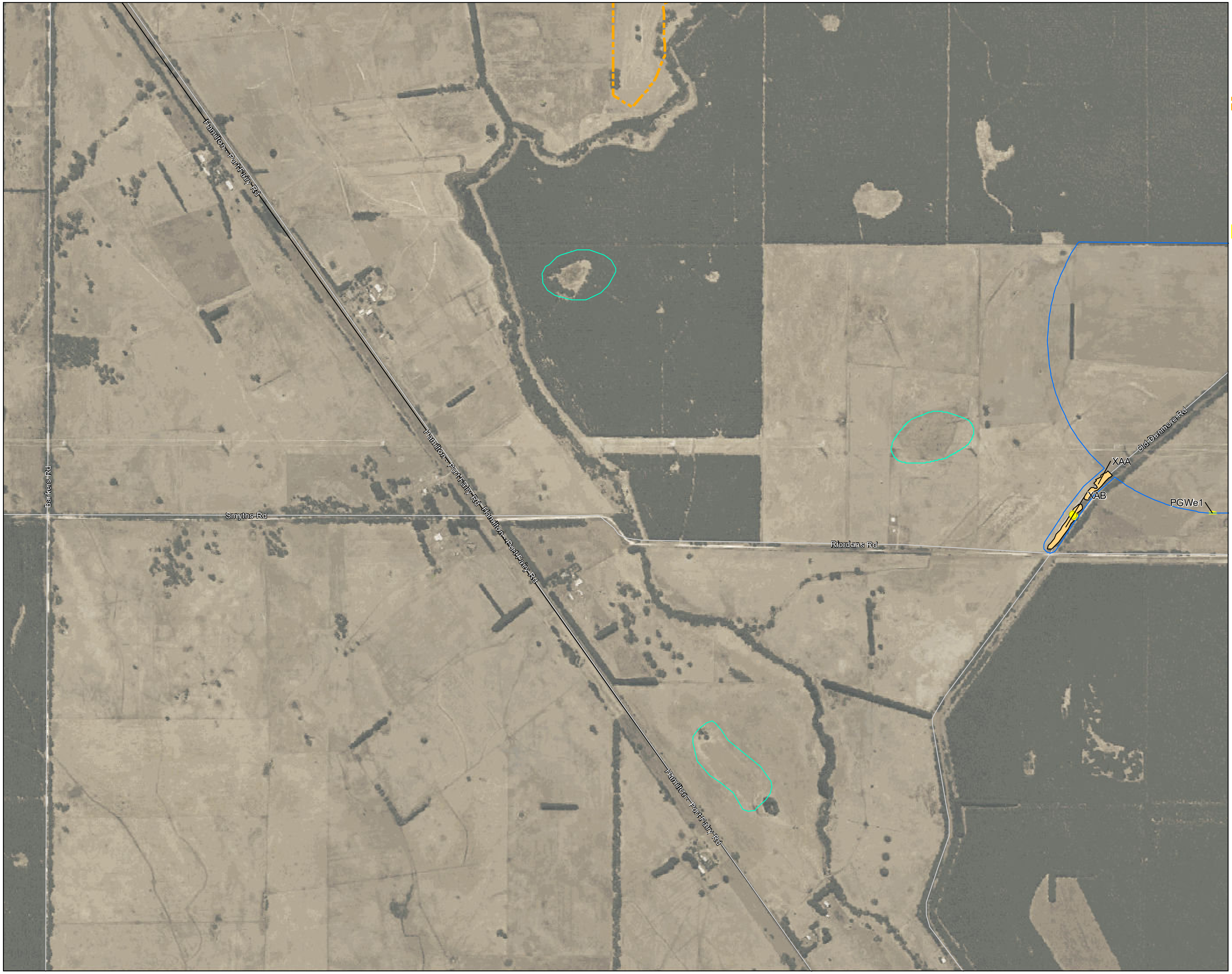
Wind farm boundary
Study area
Large Tree in Patch

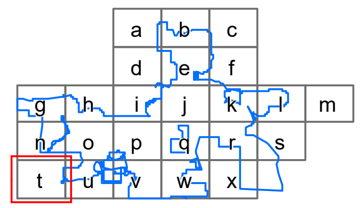
Native vegetation

Basalt Shrubby Woodland
Plains Grassy Wetland

Listed communities

Potential SHWTLP





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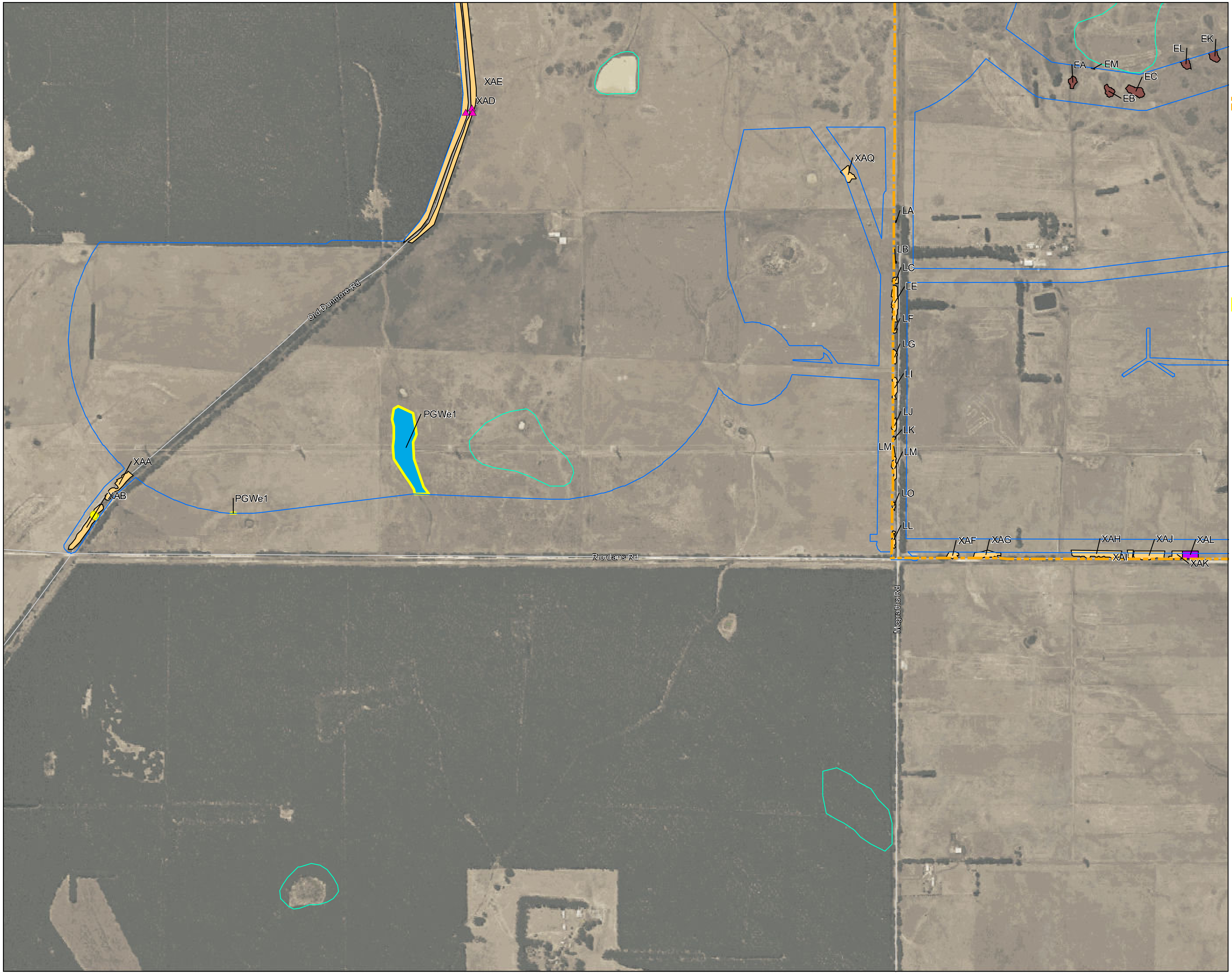

Figure 4-u: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Study area
Large Tree in Patch

Threatened Species

Trailing Hop Bush

Native vegetation

Basalt Shrubby Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh

Listed communities

Potential SHWTLP

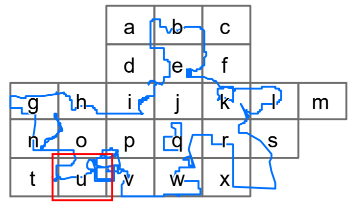

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Figure 4-v: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

- Wind farm boundary
- Wind turbine
- Study area
- Swamp Everlasting records

Native vegetation

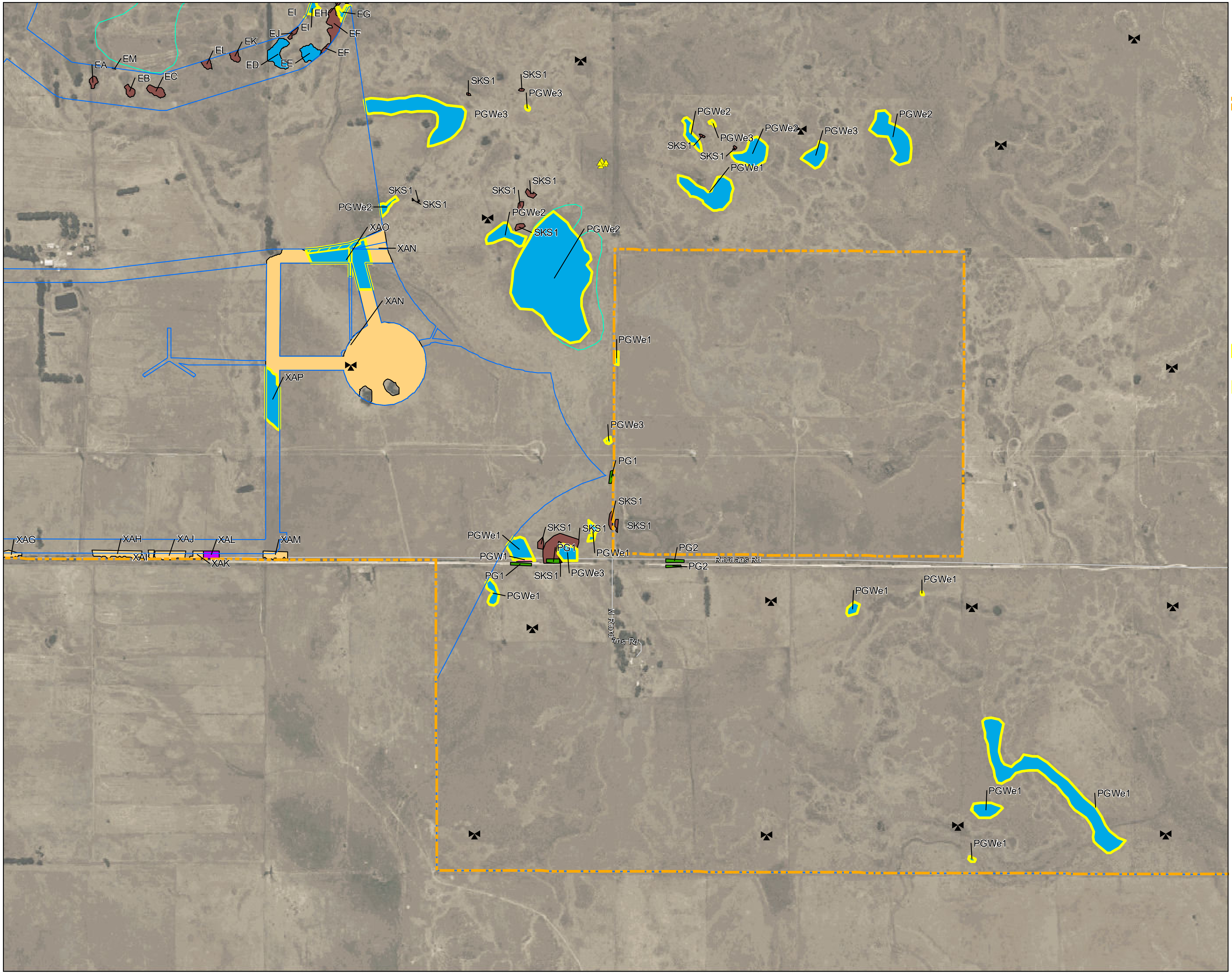
- Basalt Shrubby Woodland
- Higher Rainfall Plains Grassy Woodland
- Plains Grassland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Tall Marsh

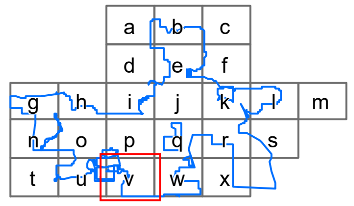
Listed communities

- Potential SHWTLP

Targeted survey results

- Confirmed SHWTLP





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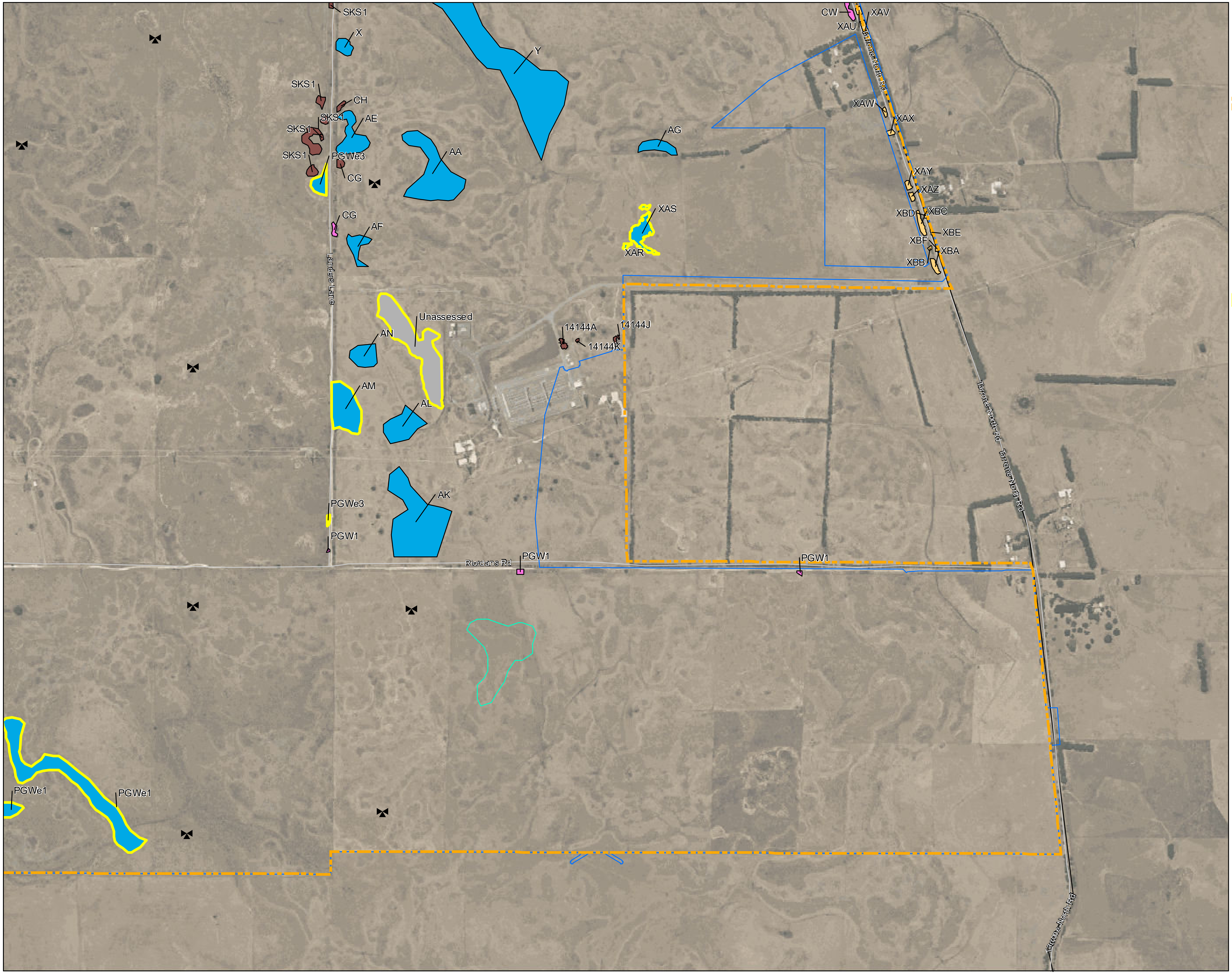

Figure 4-w: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

Wind farm boundary
Wind turbine
Study area

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
Unassessed

Listed communities

Potential SHWTLP

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Figure 4-x: Study area and native vegetation

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/01/2022

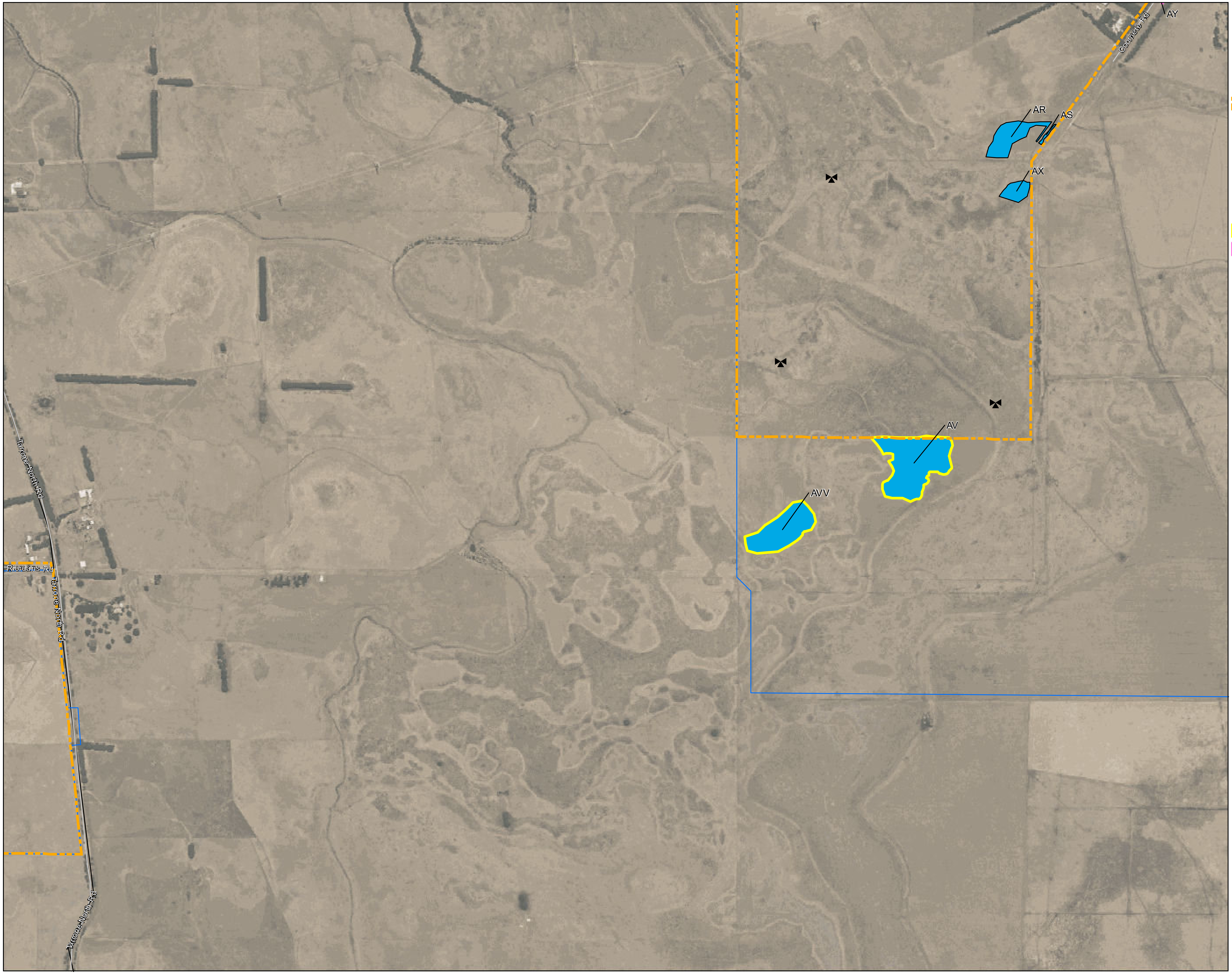

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Figure 5-a: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Study area

Native vegetation

Stony Knoll Shrubland

DELWP wetland

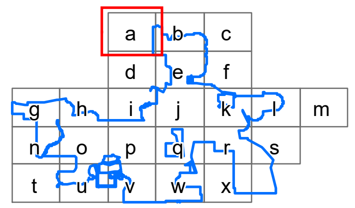

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Figure 5-b: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Study area

Native vegetation

Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh
DELWP wetland

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Figure 5-c: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Study area

Native vegetation

Plains Grassy Wetland

DELWP wetland

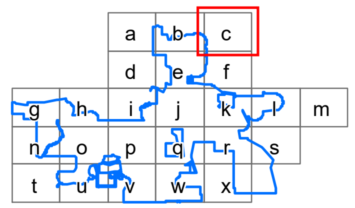

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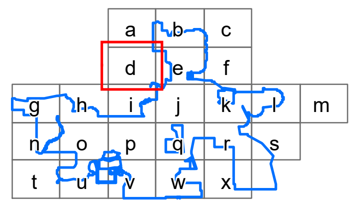
Figure 5-d: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Study area

Native vegetation

Higher Rainfall Plains Grassy Woodland
Stony Knoll Shrubland
DELWP wetland



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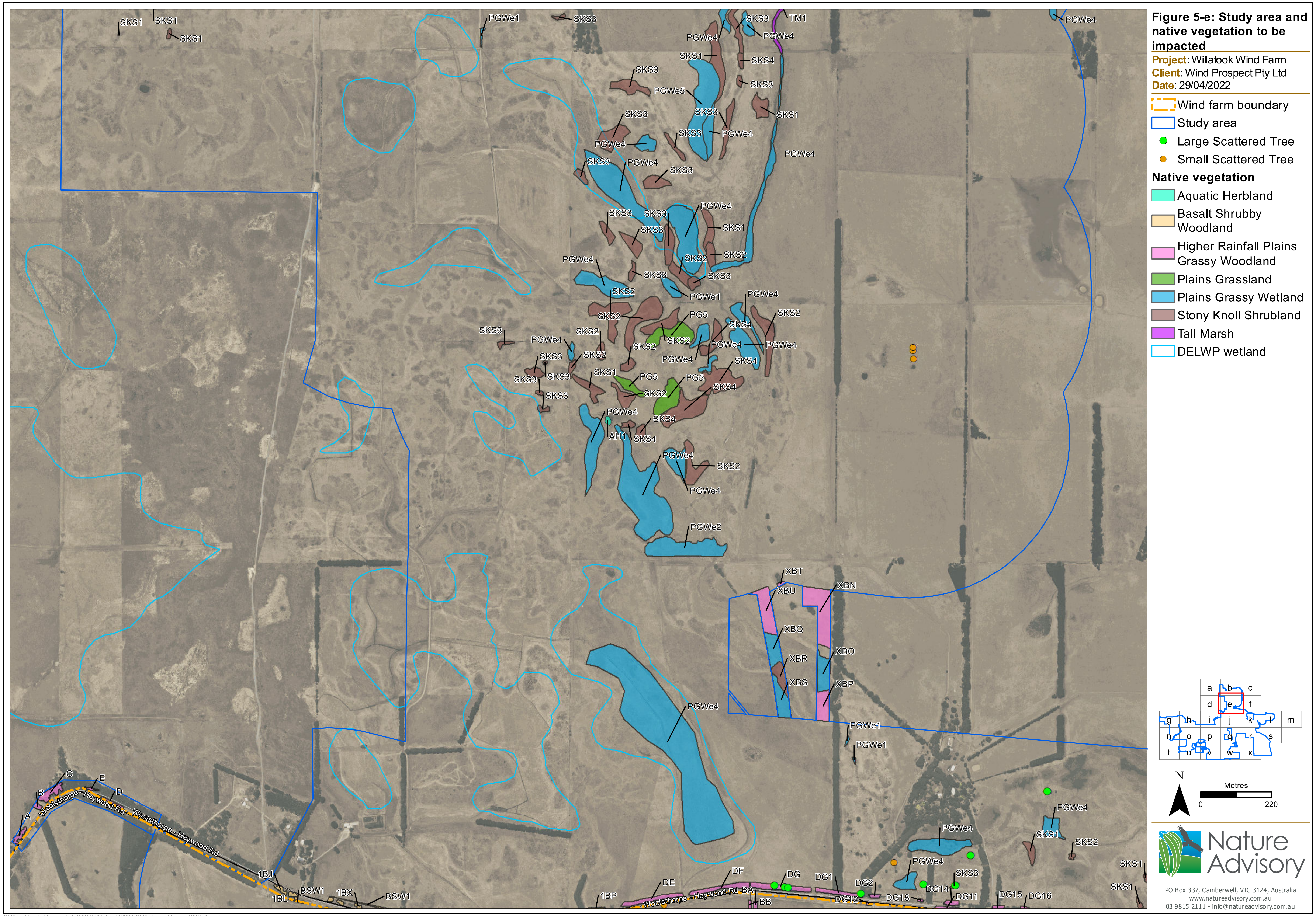
Figure 5-e: Study area and native vegetation to be impacted
Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022
Wind farm boundary
Study area
Large Scattered Tree
Small Scattered Tree
Native vegetation
Aquatic Herbland
Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh
DELWP wetland
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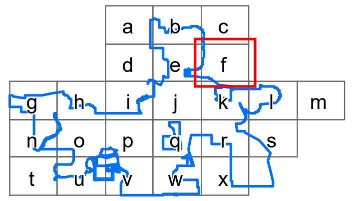
Figure 5-f: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Study area
Large Scattered Tree

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
DELWP wetland



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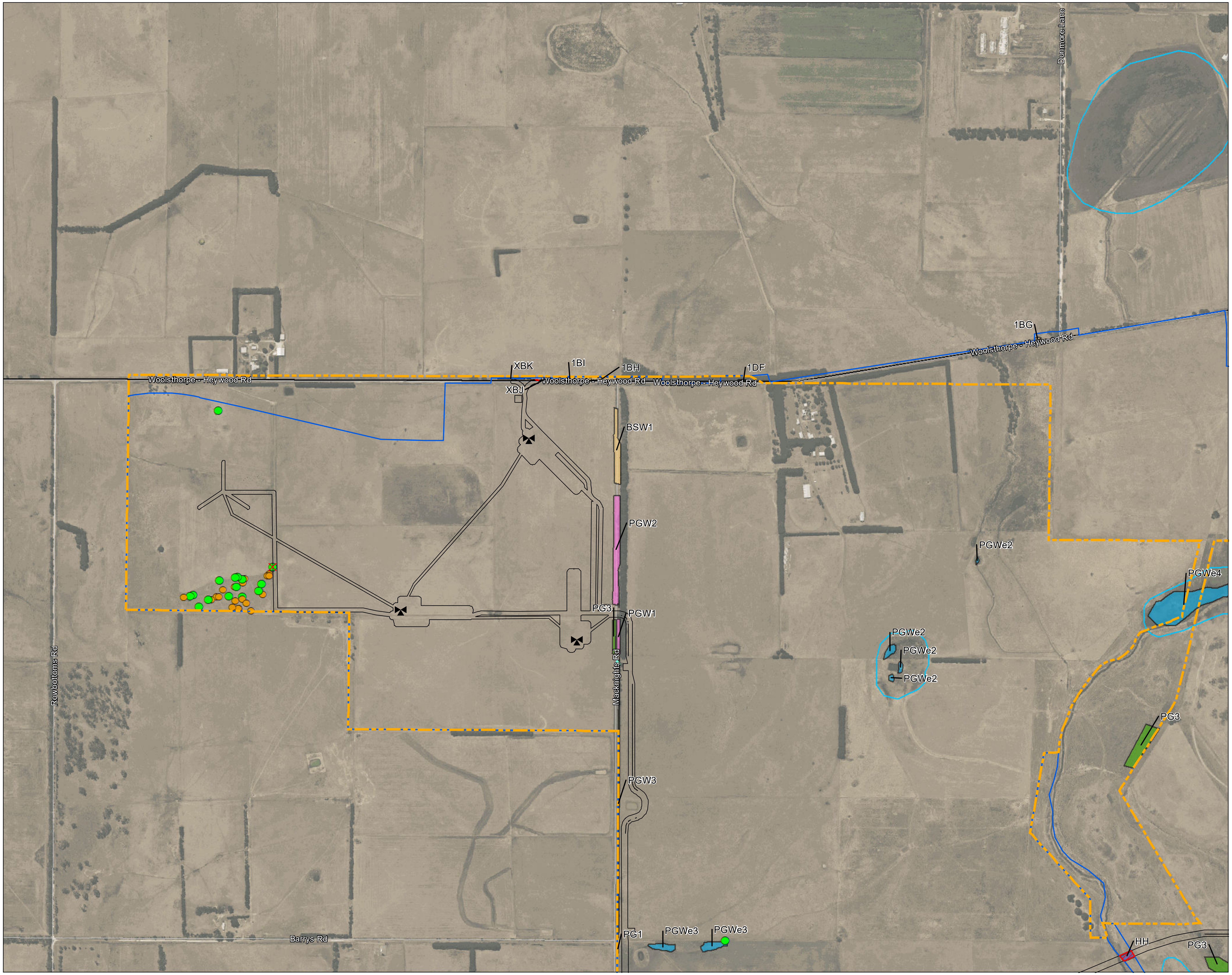

Figure 5-g: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Threatened Species

Matted Flax-lily

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Swampy Riparian Woodland
DELWP wetland
Native vegetation to be removed
Tree to be removed

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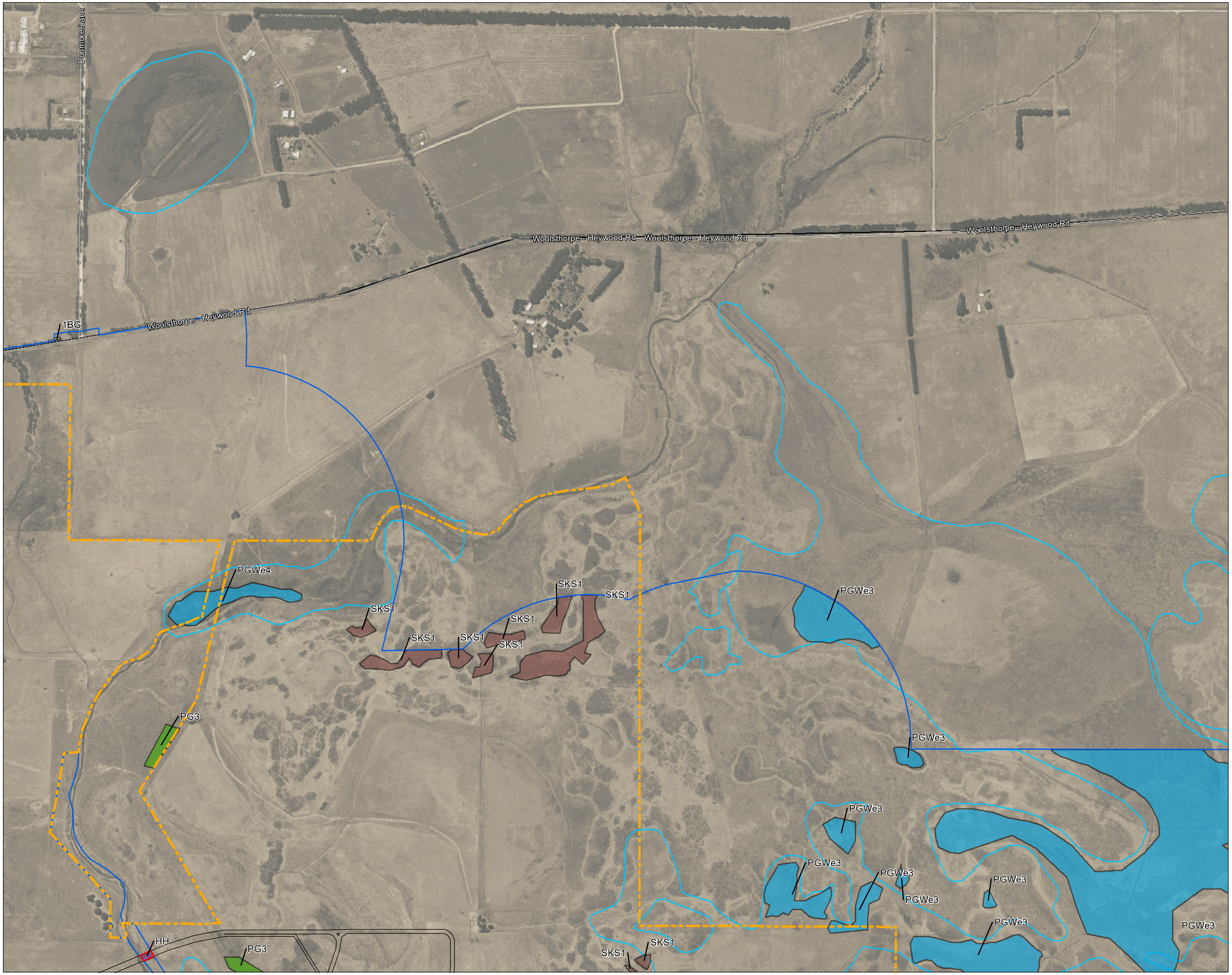
Figure 5-h: Study area and native vegetation to be impacted

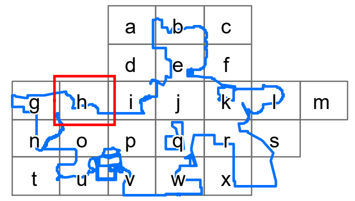
Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022



Wind farm boundary
Construction footprint
Study area

Native vegetation

Basalt Shrubby Woodland
Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Swampy Riparian Woodland
DELWP wetland
Native vegetation to be removed



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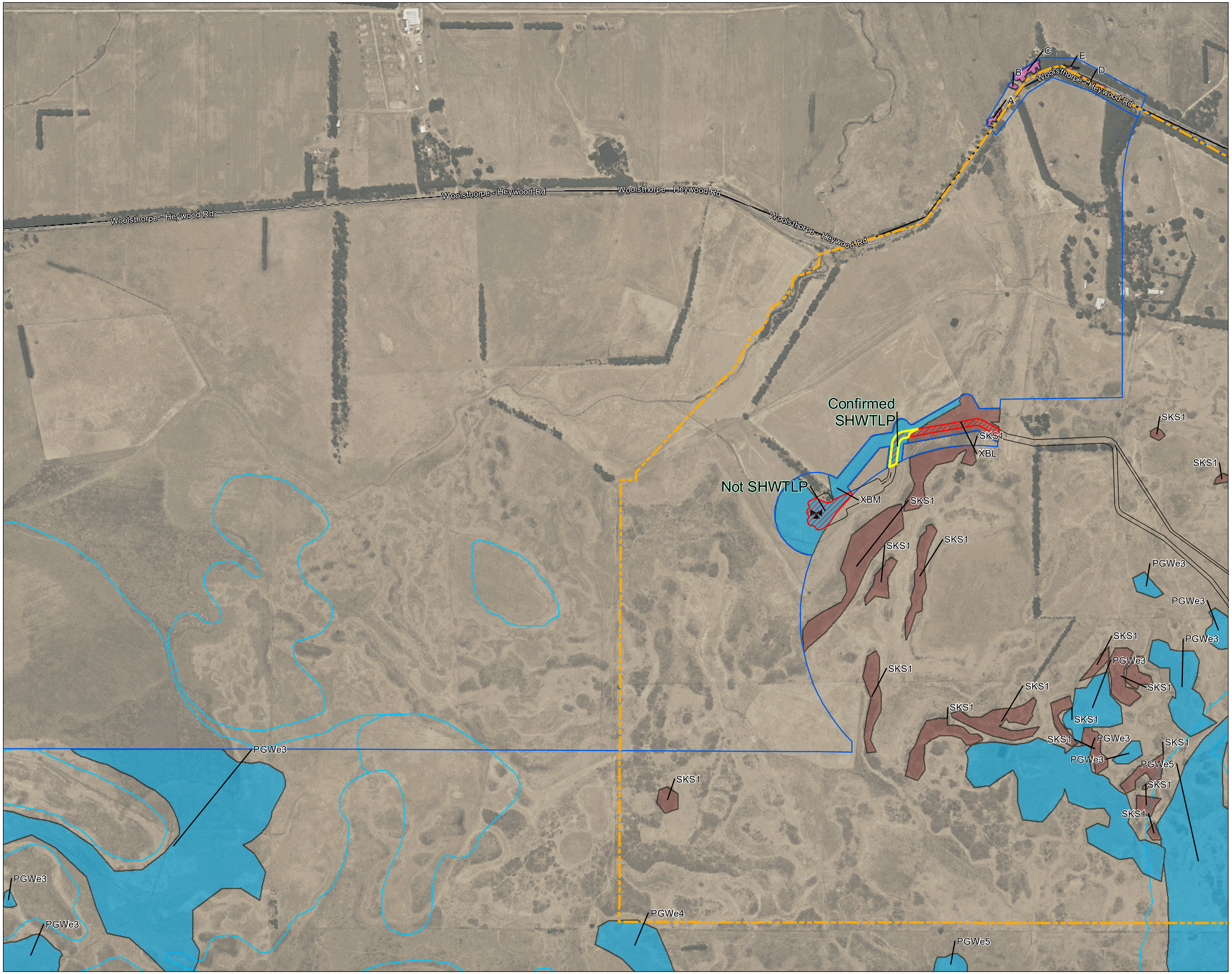

Figure 5-i: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Wind turbine
Study area

Native vegetation

Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
DELWP wetland
Native vegetation to be removed
Confirmed SHWTLP
Not listed community

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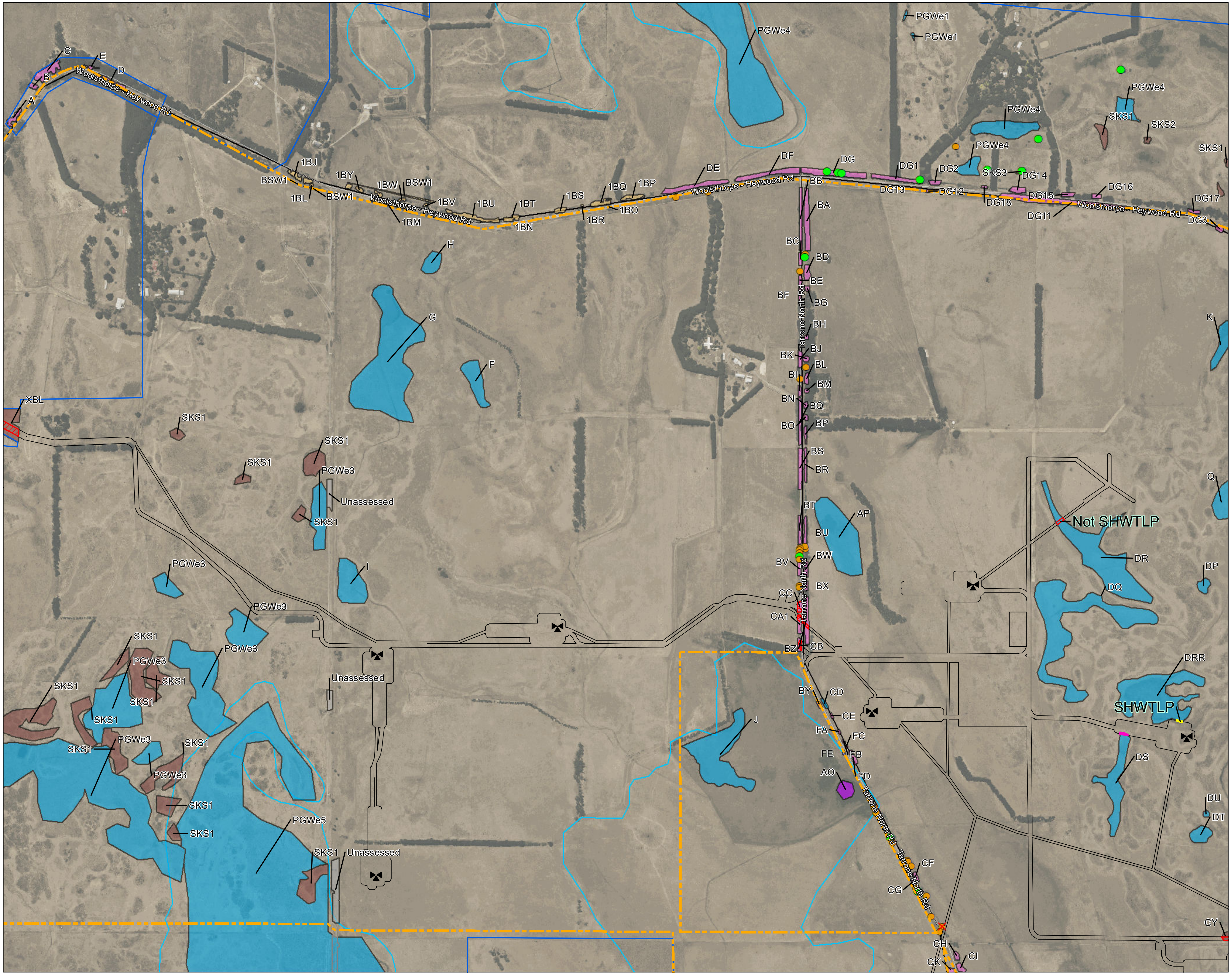

Figure 5-j: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

- Wind farm boundary
- Construction footprint
- Wind turbine
- Study area
- Large Scattered Tree
- Small Scattered Tree

Native vegetation

- Basalt Shrubby Woodland
- Higher Rainfall Plains Grassy Woodland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Tall Marsh
- Unassessed
- DELWP wetland
- Targeted survey not yet done
- Native vegetation to be removed
- Tree to be removed
- Confirmed SHWTLP
- Not listed community

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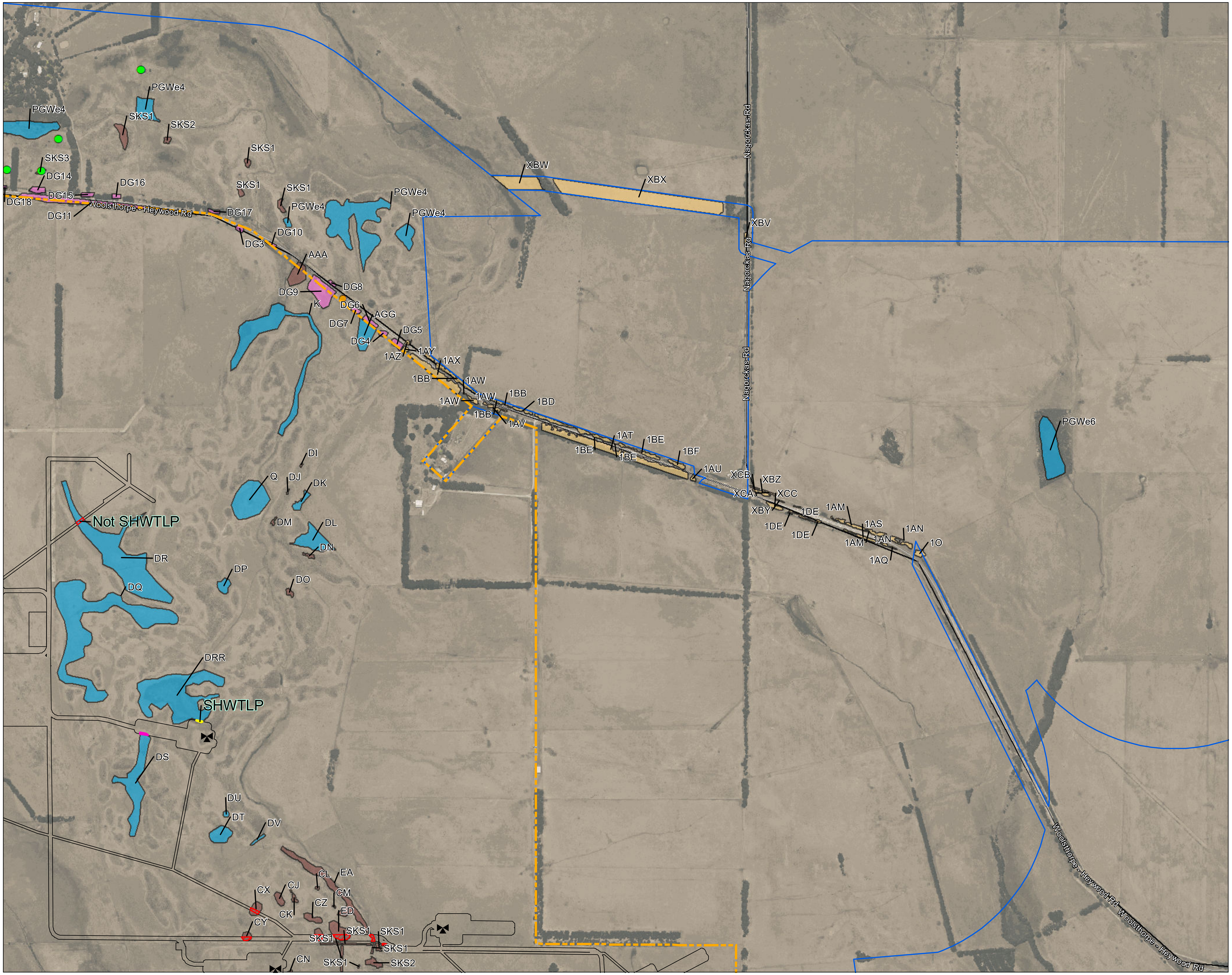

Figure 5-k: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Wind turbine
Study area
Large Scattered Tree
Small Scattered Tree

Native vegetation

Basalt Shrubby Woodland
Higher Rainfall Plains Grassy Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
Swamp Scrub
Targeted survey not yet done
Native vegetation to be removed
Confirmed SHWTLP

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Figure 5-l: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Study area

Native vegetation

Basalt Shrubby Woodland

Higher Rainfall Plains Grassy Woodland

Plains Grassy Wetland

DELWP wetland

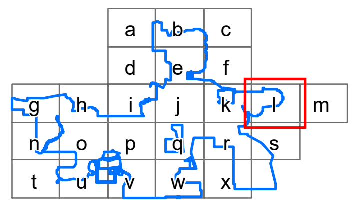

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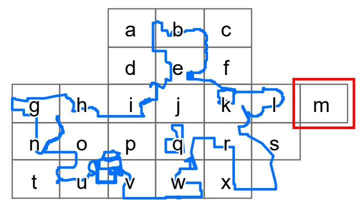
Figure 5-m: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

DELWP wetland



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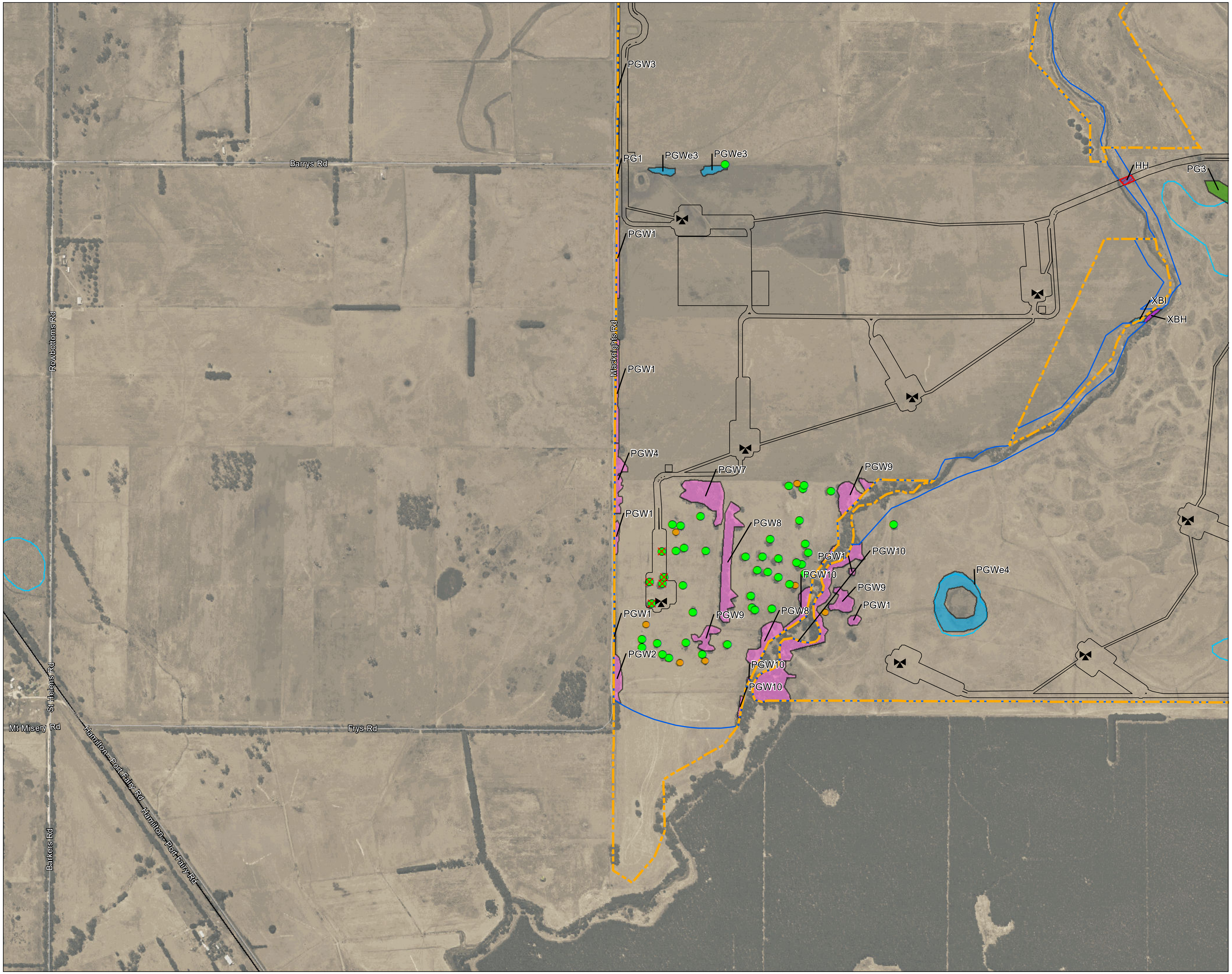

Figure 5-n: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

- Wind farm boundary
- Construction footprint
- Wind turbine
- Study area
- Large Scattered Tree
- Small Scattered Tree

Native vegetation

- Higher Rainfall Plains Grassy Woodland
- Plains Grassland
- Plains Grassy Wetland
- Swampy Riparian Woodland
- Tall Marsh
- DELWP wetland
- Native vegetation to be removed
- Tree to be removed

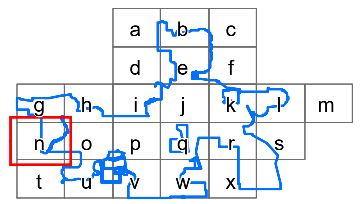

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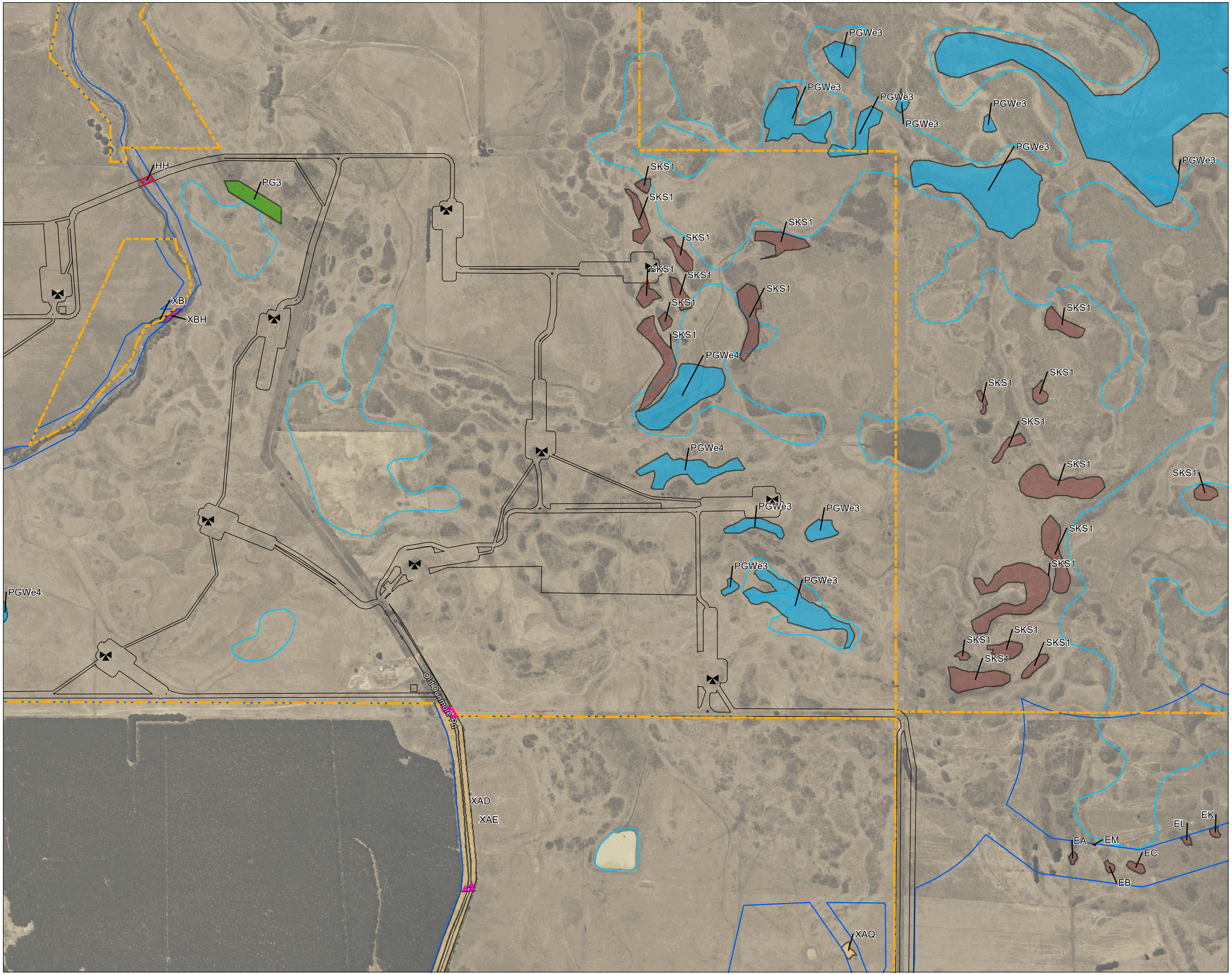
Figure 5-o: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022



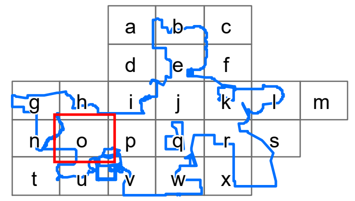
- Wind farm boundary
- Construction footprint
- Wind turbine
- Study area

Threatened Species

- Trailing Hop Bush

Native vegetation

- Basalt Shrubby Woodland
- Plains Grassland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Swampy Riparian Woodland
- Tall Marsh
- DELWP wetland
- Targeted survey not yet done
- Native vegetation to be removed



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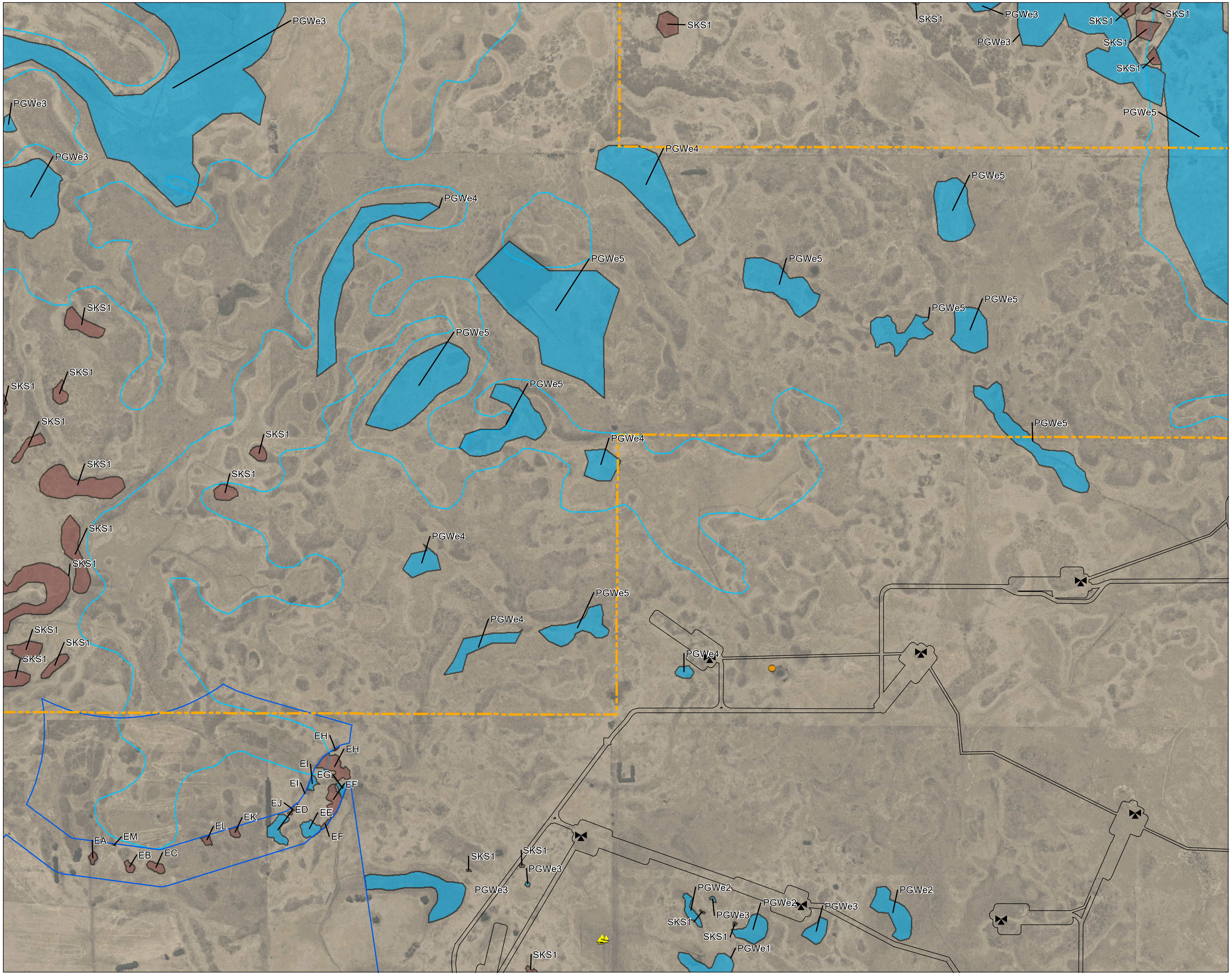


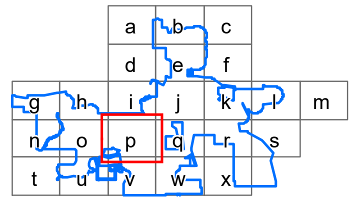
Figure 5-p: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Wind turbine
Study area
Small Scattered Tree
Swamp Everlasting records

Native vegetation

Plains Grassy Wetland
Stony Knoll Shrubland
DELWP wetland



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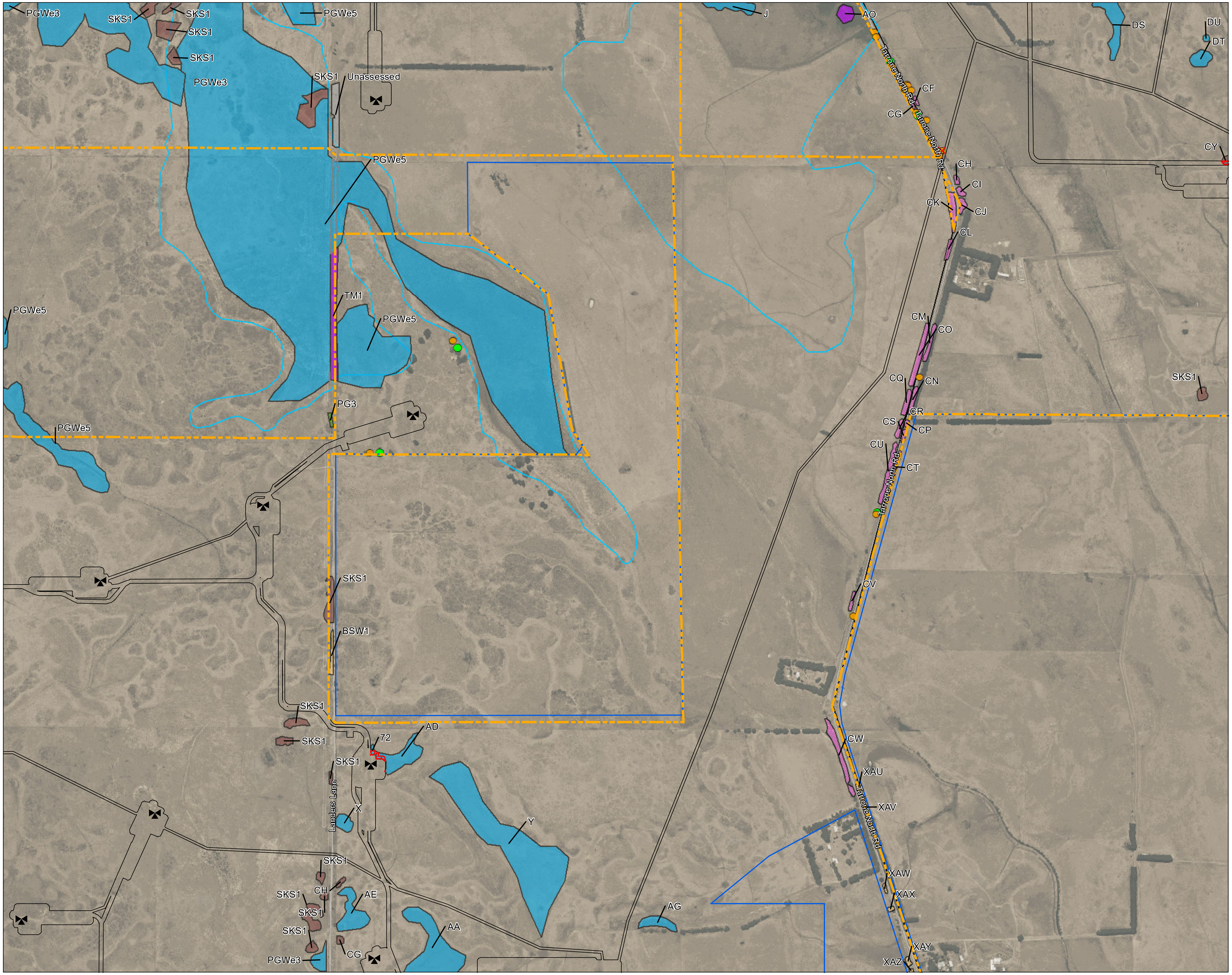

Figure 5-q: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

- Wind farm boundary
- Construction footprint
- Wind turbine
- Study area
- Large Scattered Tree
- Small Scattered Tree

Native vegetation

- Basalt Shrubby Woodland
- Higher Rainfall Plains Grassy Woodland
- Plains Grassland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Tall Marsh
- Unassessed
- DELWP wetland
- Native vegetation to be removed
- Tree to be removed
- Not listed community

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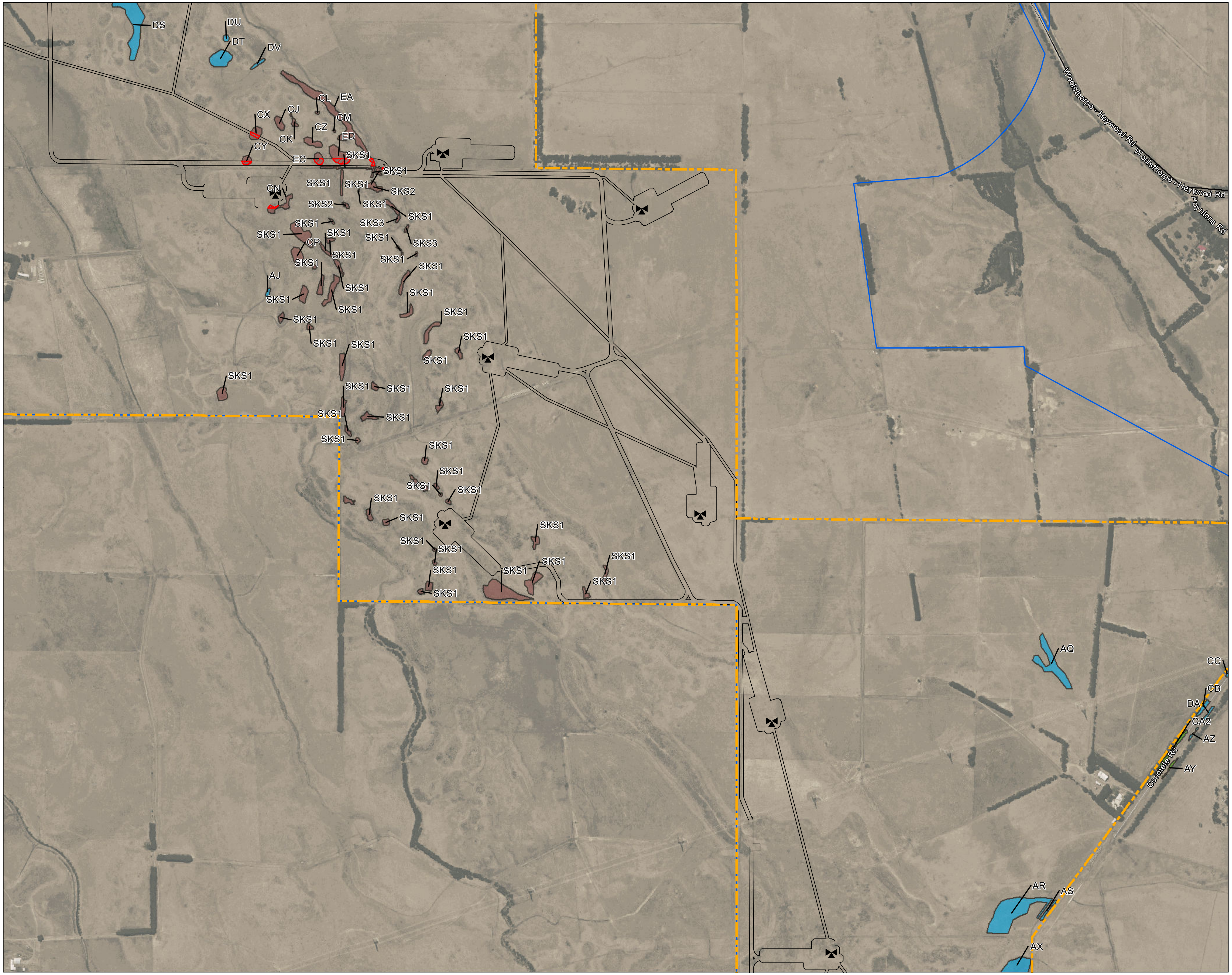

Figure 5-r: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Wind turbine
Study area

Native vegetation

Plains Grassland
Plains Grassy Wetland
Stony Knoll Shrubland
Native vegetation to be removed

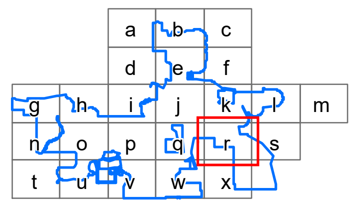

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Figure 5-s: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Study area

Native vegetation

Plains Grassland
Plains Grassy Wetland
Tall Marsh
DELWP wetland

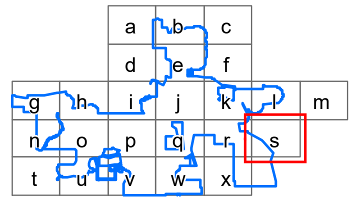

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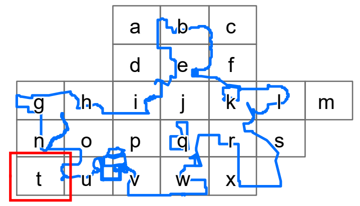
Figure 5-t: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Study area
Large Tree in Patch

Native vegetation

Basalt Shrubby Woodland
Plains Grassy Wetland
DELWP wetland



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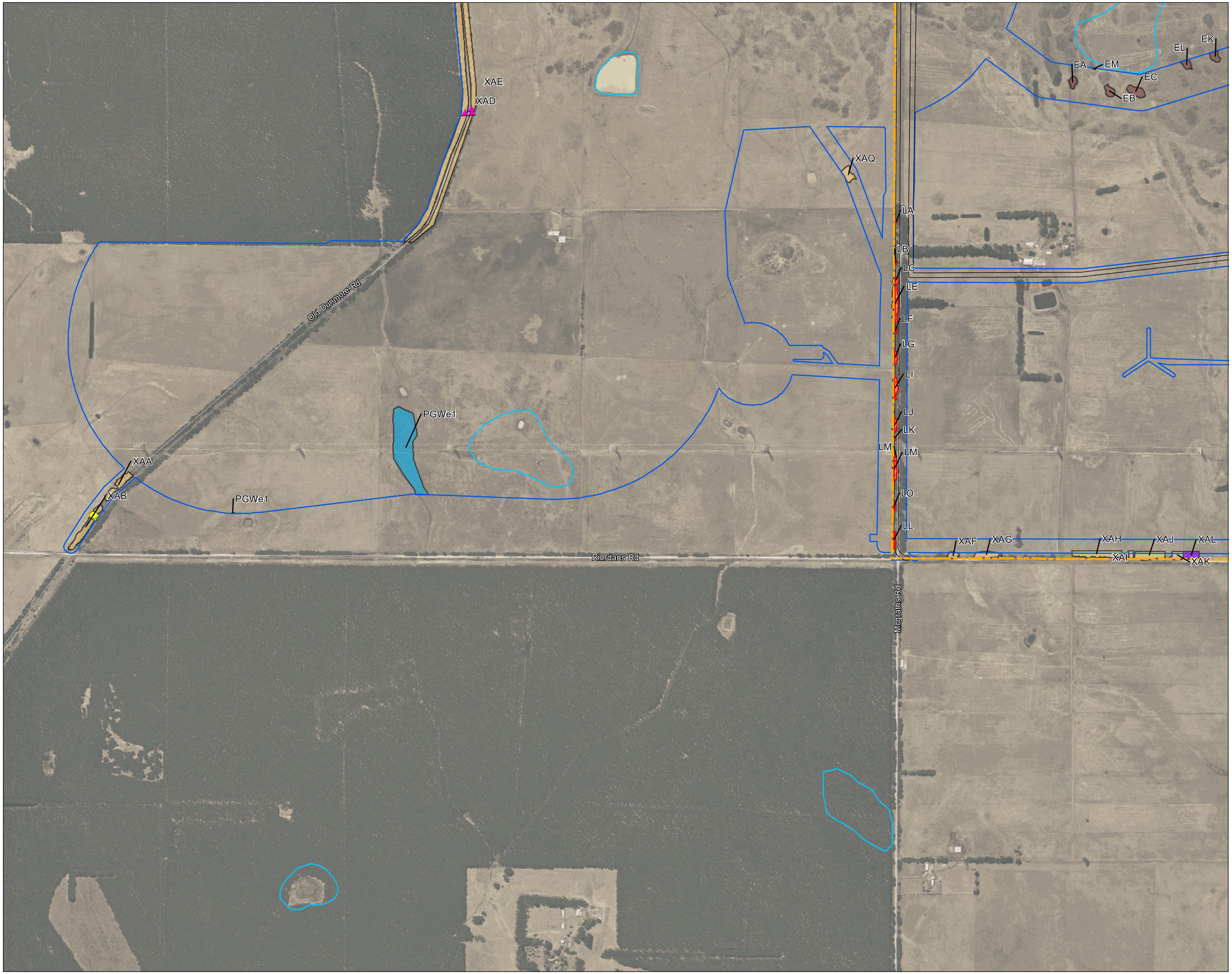

Figure 5-u: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Study area
Large Tree in Patch

Threatened Species

Trailing Hop Bush

Native vegetation

Basalt Shrubby Woodland
Plains Grassy Wetland
Stony Knoll Shrubland
Tall Marsh
DELWP wetland
Native vegetation to be removed

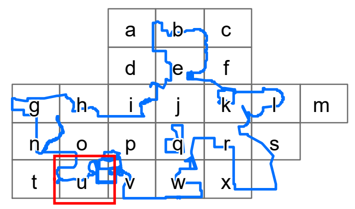

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Figure 5-v: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

- Wind farm boundary
- Construction footprint
- Wind turbine
- Study area
- Swamp Everlasting records

Native vegetation

- Basalt Shrubby Woodland
- Higher Rainfall Plains Grassy Woodland
- Plains Grassland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Tall Marsh
- DELWP wetland
- Targeted survey not yet done
- Native vegetation to be removed
- Confirmed SHWTLP

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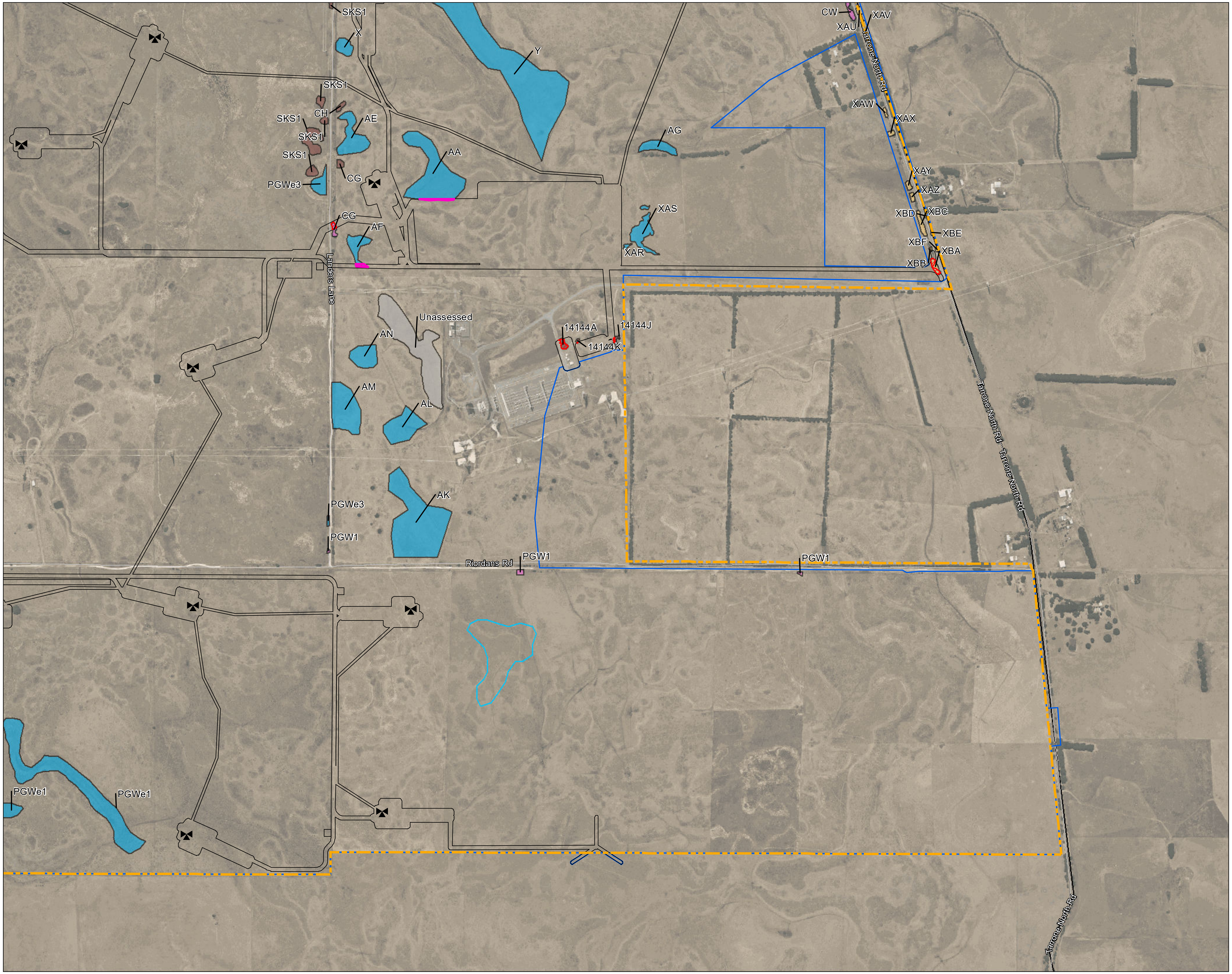

Figure 5-w: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

- Wind farm boundary
- Construction footprint
- Wind turbine
- Study area

Native vegetation

- Basalt Shrubby Woodland
- Higher Rainfall Plains Grassy Woodland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Unassessed
- DELWP wetland
- Targeted survey not yet done
- Native vegetation to be removed

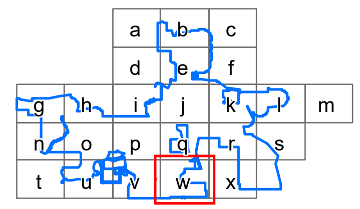

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Figure 5-x: Study area and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 29/04/2022

Wind farm boundary
Construction footprint
Wind turbine
Study area

Native vegetation

Plains Grassland
Plains Grassy Wetland

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OD route

Vegetation in the OD route study area consisted of six EVCs: Aquatic Herbland (EVC 653), Basalt Shrubby Woodland (EVC 642), Freshwater Meadow (EVC 680), Herb-rich Foothill Forest (EVC 23), Stony Rises Woodland (EVC 203) and Tall Marsh (EVC 821).

Descriptions of these EVCs are provided within the EVC benchmarks in Appendix 7. Descriptions of habitat zones in the OD Route study area are provided in Table 5. The habitat hectare assessment results for these habitat zones are provided in Appendix 3.

18 patches (referred to herein as habitat zones) comprising the abovementioned EVCs, were identified in the OD route study area (Table 5 and Figure 6), including DELWP mapped wetlands. This totalled an area of 0.720 hectares of native vegetation in patches and included no large trees.

The remainder of the OD route study area is dominated by pasture grasses.

Table 5: Description of habitat zones in the OD route study area

Habitat Zones	EVC	Description	Total area (Ha)	Average Condition Score (/100)
A, B, C, D, E	Higher-rainfall Plains Grassy Woodland (EVC 55_63)	Patches of Higher-rainfall Plains Grassy Woodland occurred within the OD route on a bend in the Woolsthorpe-Heywood Road.	0.393	15
1TrAA, 1TrAB, 1TrAC, 1TrAD, 1TrAE, 1TrAF, 1TrAG	Herb-rich Foothill Forest (EVC 23)	Patches of Herb-rich Foothill Forest occurred within the OD route at the intersections of the Henty Highway and New Street, and the Henty Highway and Princes Highway. The canopy included Manna Gum and Swamp-gum as well as planted, non-indigenous eucalypts such as Southern Mahogany. The understorey included planted natives including Drooping She-oak, Coast Wattle and the FFG Act listed Salt Paperbark. The high-threat woody weeds Mirror-bush, Italian Buck-thorn, Sweet Pittosporum, Gorse and Sweet Briar were also present in some patches. The ground-layer was dominated by exotic species including Kikuyu), Paspalum, Cocksfoot, with some patches supporting native species including Kangaroo grass.	0.129	17
1TrAH	Tall Marsh (EVC 821)	Within the OD route study area, Tall Marsh was recorded at the intersection of the Tyrendarra-Ettick Road and Woolsthorpe-Heywood Road. Tall Marsh was dominated by Broad-leaf Cumbungi, which had a very high cover. Other species included native Austral Bracken and Variable Willow-herb and the exotic pasture grass Toowoomba Canary-grass on the edge of the patch.	0.008	39
1TrAI	Aquatic Herbland (EVC 653)	Aquatic Herbland was recorded within the OD route study area at the intersection of the Tyrendarra-Ettick Road and Woolsthorpe-Heywood Road. This EVC was dominated by graminoids, including Common Tussock-grass, Australian Sweet-grass and Poong'ort, with scattered occurrences of and Variable Willow-herb.	0.018	42

Habitat Zones	EVC	Description	Total area (Ha)	Average Condition Score (/100)
1TrAJ	Stony Rises Woodland (EVC 203)	One patch of Stony Rises Woodland was mapped at the intersection of the Tyrendarra-Ettick Road and Woolsthorpe-Heywood Road. Stony Rises Woodland was dominated by Blackwood with a wholly exotic ground-layer including Toowoomba Canary-grass and Cleavers.	0.012	17
1TrAK	Basalt Shrubby Woodland (EVC 642)	Basalt Shrubby Woodland occurred within the OD route study area, at the intersection of the Woolsthorpe-Heywood Road and the Hamilton-Port Fairy Road. This patch was dominated by the understory trees Black Wattle and Blackwood. The ground layer of some patches included scattered native graminoids including Kangaroo Grass, Weeping Grass and Wattle Mat-rush. Austral Bracken was also present. The ground-layer had a high cover of the exotic grass Cocksfoot.	0.011	8
Current Wetlands	DELWP mapped Wetlands	Mapped Wetlands occurred 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 understory plant cover is native), but have been treated as native vegetation in accordance with the Guidelines. Areas of Mapped Wetlands have been assigned DELWP modelled scores in in accordance with the Guidelines.	0.150	-
TOTAL			**0.721**	**25**

Scattered trees

Wind Farm site

Scattered trees recorded in the study area would have once comprised the canopy component of Higher-rainfall Plains Grassy Woodland (EVC 55_63).

138 scattered trees occurred in the study area, comprising:

- 75 large scattered trees (≥ 70 cm DBH for Eucalypts and ≥ 40 cm DBH for Wattles); and
- 63 small scattered trees (< 70 cm DBH and < 40 cm DBH for Wattles).

Details of all scattered trees recorded are listed in Appendix 4 and shown in Figure 5.

Over-dimensional route

No scattered trees were recorded in the OD route study area.

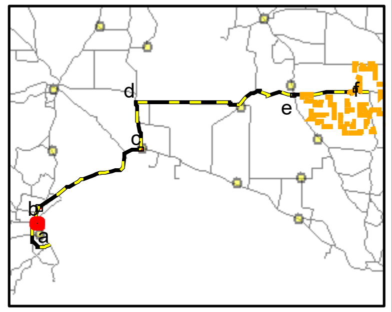
Figure 6a: OD route and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 5/05/2022

Proposed Port to Site route

Native vegetation

Herb-rich Foothill Forest



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Metres
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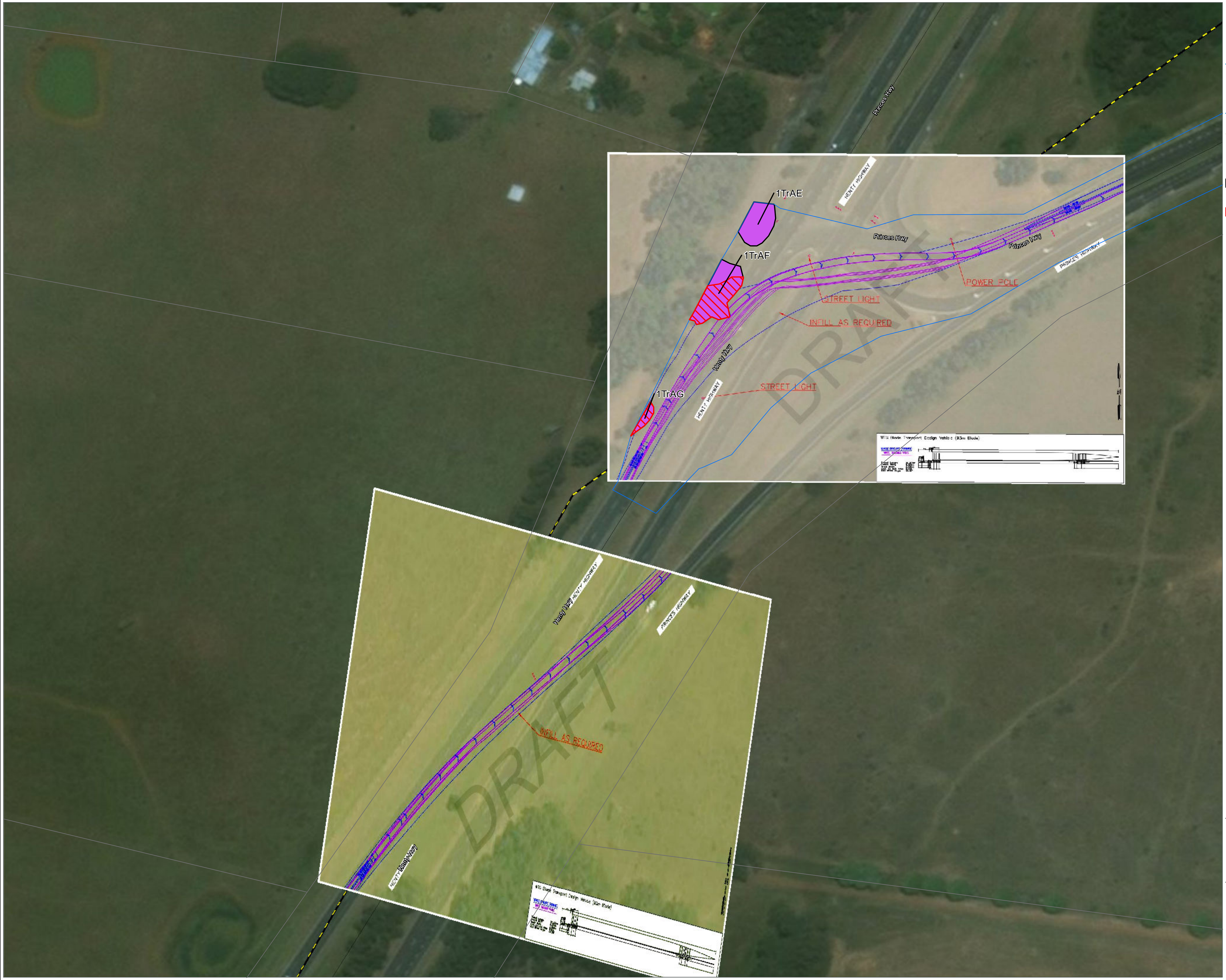

Figure 6b: OD route and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 5/05/2022

Proposed Port to Site route

Native vegetation

Herb-rich Foothill Forest

Native vegetation to be impacted

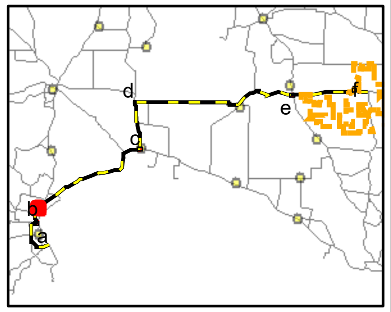

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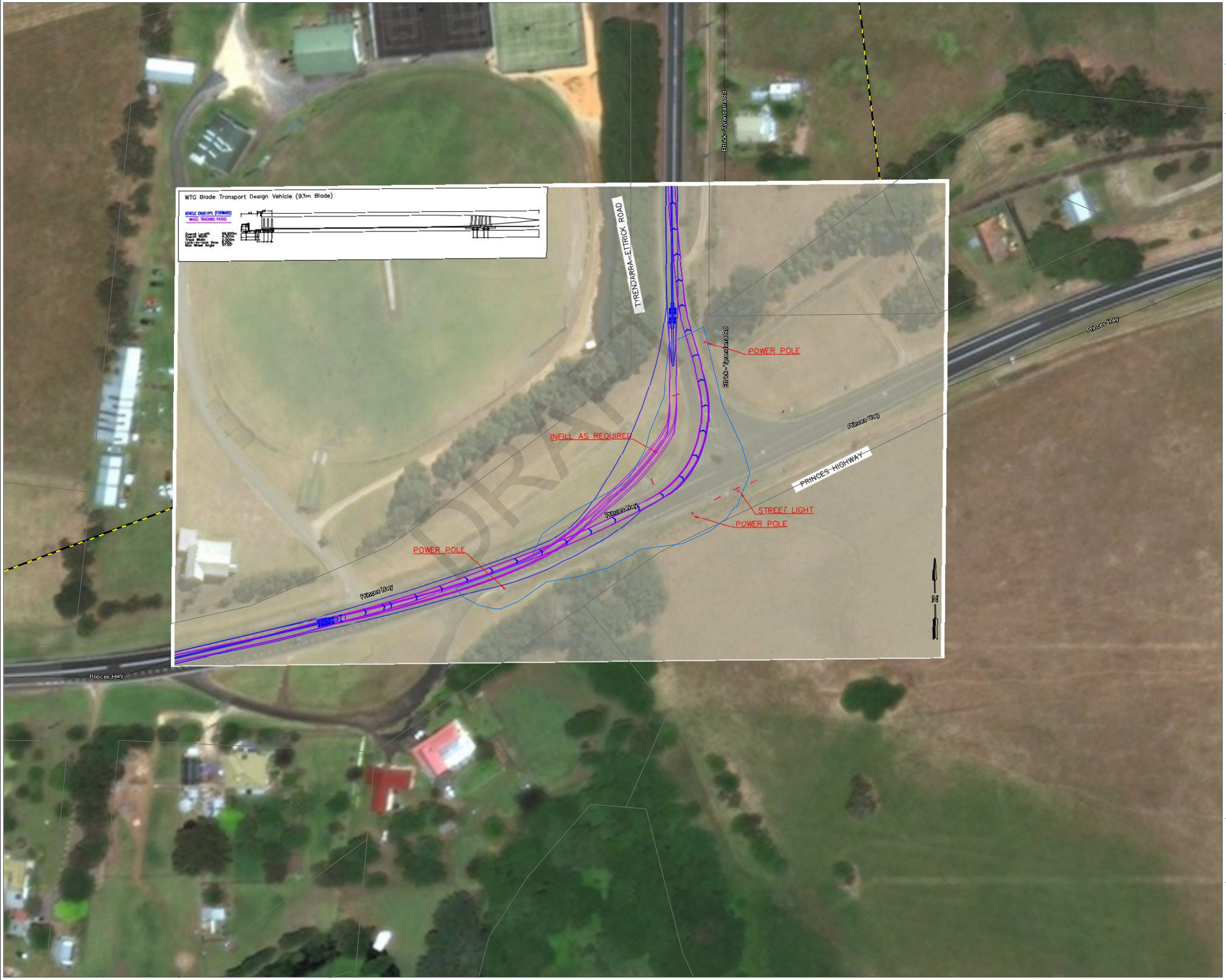
Figure 6c: OD route and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 5/05/2022

Proposed Port to Site route



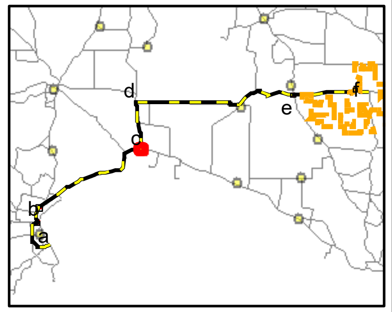


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Figure 6d: OD route and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 5/05/2022

Proposed Port to Site route

Native vegetation

Freshwater Meadow

Shallow Freshwater Marsh

Stony Rises Woodland

Native vegetation to be impacted

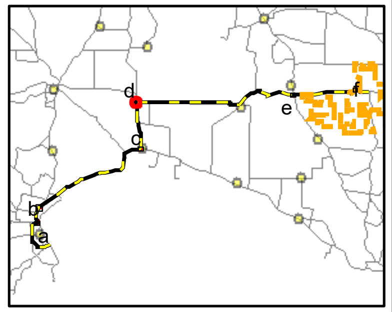

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Figure 6e: OD route and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 5/05/2022

Proposed Port to Site route

Native vegetation

Basalt Shrubby Woodland

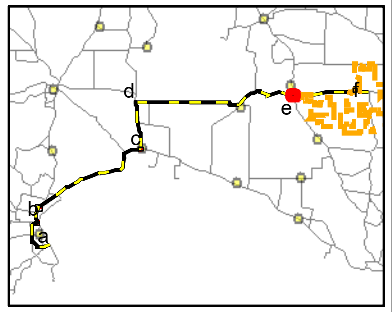

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Figure 6f: OD route and native vegetation to be impacted

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 5/05/2022

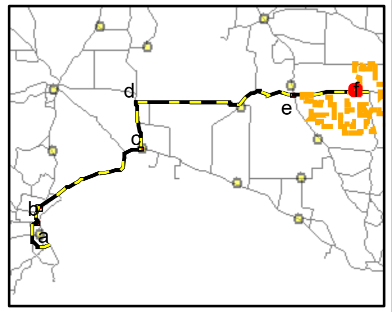
Wind farm boundary

Proposed Port to Site route

Native vegetation

Higher Rainfall Plains Grassy Woodland

Native vegetation to be impacted



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5.3.2. Flora species

Species recorded

During the field assessments, 208 plant species were recorded. Of these, 123 (59%) were indigenous and 85 (41%) were introduced or non-indigenous native in origin (Appendix 8).

Listed species

WWF site

VBA records (DELWP 2021) and the EPBC Protected Matters Search Tool (DAWE 2021a) indicated that within the search region there were records of, or there occurred potential suitable habitat for, 43 listed species, including 18 species listed under the Commonwealth EPBC Act and 35 listed under the state FFG Act. One flora species listed under the EPBC Act (Basalt Peppercress) was previously recorded in the survey area (EHP 2018); however precise records of the location of this species were not taken.

The likelihood of occurrence in the study area of species listed under the EPBC Act and FFG Act is addressed in Table 6. Species considered 'likely to occur' are those that have a very high chance of being in the study area based on numerous records in the search region and suitable habitat in the study area. Species considered to have the 'potential to occur' are those for which suitable habitat exists, but recent records are scarce.

This analysis indicated that 19 listed flora species were likely to occur or had the potential to occur. These species are listed below.

- Basalt Leek-orchid (*Prasophyllum viretrum*), FFG Act (critically endangered). Potential to occur in areas of *Heavier-soils* Plains Grassland (EVC 132_61). Not recorded during targeted surveys within surveyed areas of the footprint.
- Basalt Peppercress (*Lepidium hyssopifolium*), EPBC Act (Endangered), FFG Act (endangered). Likely to occur in areas of *Heavier-soils* Plains Grassland (EVC 132_61), *Higher-rainfall* Plains Grassy Woodland (EVC 55_63) and Basalt Shrubby Woodland (EVC 642). Not recorded during targeted surveys within surveyed areas of the footprint.
- Button Wrinklewort (*Rutidosis leptorhynchoides*) EPBC Act (Endangered), FFG Act (endangered) Potential to occur in areas of *Heavier-soils* Plains Grassland (EVC 132_61), *Higher-rainfall* Plains Grassy Woodland (EVC 55_63) and Basalt Shrubby Woodland (EVC 642). Not recorded during targeted surveys within surveyed areas of the footprint.
- Clover Glycine (*Glycine latrobeana*), EPBC Act (Vulnerable), FFG Act (vulnerable). Potential to occur in areas of *Heavier-soils* Plains Grassland (EVC 132_61) and *Higher-rainfall* Plains Grassy Woodland (EVC 55_63). Not recorded during targeted surveys within surveyed areas of the footprint.
- Curly Sedge (*Carex tasmanica*), FFG Act (endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Dense Leek-orchid (*Prasophyllum spicatum*), EPBC Act (Vulnerable), FFG Act (critically endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.

- Gorae Leek-orchid (*Prasophyllum diversiflorum*), EPBC Act (Endangered), FFG Act (critically endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Lacey River Buttercup (*Ranunculus amplus*), FFG Act (critically endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Maroon Leek-orchid (*Prasophyllum frenchii*), EPBC Act (Endangered), FFG Act (endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Matted Flax-lily (*Dianella amoena*), EPBC Act (Endangered), FFG Act (critically endangered). Potential to occur in areas of *Heavier-soils* Plains Grassland (EVC 132_61) and *Higher-rainfall* Plains Grassy Woodland (EVC 55_63). Not recorded during targeted surveys within surveyed areas of the footprint.
- Pale Swamp Everlasting (*Coronidium gunnianum*), FFG Act (critically endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Pretty Leek-orchid (*Prasophyllum anticum*), FFG Act (critically endangered). Potential to occur in areas of *Heavier-soils* Plains Grassland (EVC 132_61). Not recorded during targeted surveys within surveyed areas of the footprint.
- Purple Blown-grass (*Lachnagrostis punicea* subsp. *filifolia*), FFG Act (endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Slender Style-wort (*Levenhookia sonderi*), FFG Act (endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Swamp Diuris (*Diuris palustris*), FFG Act (endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Swamp Everlasting (*Xerochrysum palustre*), EPBC Act (Vulnerable), FFG Act (critically endangered). Potential to occur in other areas of Plains Grassy Wetland (EVC 125). Recorded during 2018 targeted surveys. Not recorded during targeted surveys within surveyed areas of the current proposed footprint.
- Swamp Fireweed (*Senecio psilocarpus*), EPBC Act-listed (Vulnerable). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Swamp Flax-lily (*Dianella callicarpa*), FFG Act (endangered). Potential to occur in areas of Plains Grassy Wetland (EVC 125). Not recorded during targeted surveys within surveyed areas of the footprint.
- Trailing Hop-bush (*Dodonaea procumbens*), EPBC Act-listed (Vulnerable). Potential to occur in areas of Heavier-soils Plains Grassland (EVC 132_61), Higher-rainfall Plains Grassy Woodland (EVC 55_63) and Basalt Shrubby Woodland (EVC 642). Three individuals recorded on Old Dunmore Road, within Habitat Zones XAD and XAE. Not recorded during targeted surveys within surveyed areas of the current proposed footprint.

Targeted surveys were conducted in the proposed development footprint as follows:

- October surveys in:
    - Higher Rainfall Plains Grassy Woodland (EVC 55_63);
    - Plains Grassy Wetland (EVC 125); and
    - *Heavier-soils* Plains Grassland (EVC 132_61).
- December surveys in:
    - Plains Grassy Woodland (EVC 55_63);
    - Plains Grassy Wetland (EVC 125);
    - *Heavier-soils* Plains Grassland (EVC 132_61); and
    - Basalt Shrubby Woodland (EVC 642).

These areas were inspected thoroughly along transects spaced no more than five metres apart. This transect spacing was chosen based on the lifeform of the targeted species and the visibility (i.e. density of vegetation cover at the time of the survey) within areas of suitable habitat. Since the above surveys were undertaken, the proposed footprint of the wind farm development has undergone further alteration for a variety of reasons, including minimising impacts on mapped native vegetation. Areas of proposed impact outside of the 2018 and 2021 targeted survey study areas are required to undergo further surveys in 2022 as follows:

- October surveys in:
    - Plains Grassy Wetland (EVC 125) (0.314 hectares).
- December surveys in:
    - Plains Grassy Wetland (EVC 125) (0.314 hectares); and
    - Basalt Shrubby Woodland (EVC 642) (0.052 hectares).

These areas are shown in Figure 5.

Two flora species listed under the EPBC Act – Swamp Everlasting and Trailing Hop-bush – were recorded in the wind farm site. Swamp Everlasting is also listed under the FFG Act.

<u>Swamp Everlasting</u> (EPBC Act (Vulnerable), FFG Act (critically endangered)) – Some 24 Swamp Everlasting plants were recorded during targeted surveys, all of which were recorded within habitat zone CA, a patch of Plains Grassy Wetland on private land (see Figure 5p and 5v). Swamp Everlasting plants recorded within the targeted survey area were large, well-established individuals that were in flower at the time of survey (see Photographs 1 and 2).

Photograph 1 and 2: Swamp Everlasting within Habitat Zone CA

Trailing Hop-bush (EPBC Act (Vulnerable)) – Three Trailing Hop-bush plants were recorded during vegetation mapping in March 2021, within Habitat Zones XAD and XAE, patches of Basalt Shrubby Woodland (EVC 642) on Old Dunmore Road (see Figure 5o and 5u).

The proposed footprint of the wind farm development has been changed to avoid these species, and both of these species locations no longer fall within the development footprint.

Table 6: FFG Act and EPBC Act listed flora species and likelihood of occurrence – Wind Farm site

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 (DAWE 2021b).	None	N/A	No suitable habitat. No records within 10 km. Unlikely to occur.
Basalt Leek-orchid	*Prasophyllum viretrum*		cr	Moist to wet grassland on dark basaltic loam (Jones & Rouse 2006).	164	13/11/2019	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Basalt Peppercress	*Lepidium hyssopifolium* s.s.	EN	en	Known to establish on open, bare ground with limited competition from other plants. Previously recorded from Eucalypt woodland with a grassy ground cover, low open Casuarina woodland with a grassy ground cover and tussock grassland. Now generally found amongst exotic pasture grasses and beneath exotic trees (DAWE 2021b).	3	25/11/2009	Previously recorded within the study area (EHP 2018). Likely to occur within the broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Blotched Sun-orchid	*Thelymitra benthamiana*		en	Found mostly in heathland, heathy woodlands and open forests on well-drained sand and clay loams (Weber & Entwisle 1994).	1	30/10/1992	No suitable habitat. Unlikely to occur.
Button Wrinklewort	*Rutidosis leptorhynchoides*	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 (RBGV 2021).	None	N/A	Suitable habitat. No records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
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 (DAWE 2021b).	11	13/11/2019	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Coast Dandelion	*Taraxacum cygnorum*	VU	cr	Woodland and scrub on limestone (Scarlett 1999).	None	N/A	No suitable habitat. No records within 10 km. Unlikely to occur.
Coast Ixodia	*Ixodia achillaeoides subsp. arenicola*	VU		Confined to coastal vegetation in the Cape Bridgewater-Portland area (Short 1999).	None	N/A	No suitable habitat. No records within 10 km. Unlikely to 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 2010). Known occurrences are localised around Heywood, Portland, Port Fairy, Karish (Lake Weeranganuk), Craigieburn, Kalkallo and Wollert (Victorian Biodiversity Atlas 2015).	2	3/04/2018	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Dense Leek-orchid	*Prasophyllum spicatum*	VU	cr	Occurs in coastal and near-coastal heathland and heathy woodland. Soils are generally sandy, with some sites seasonally waterlogged (Duncan 2010).	3	1/11/2000	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Flax-lily	*Dianella longifolia var. grandis*		cr	Grassland and grassy woodlands on better mallee soils and loams. Clay and clay loams (RBGV 2021).	3	13/11/2019	No suitable habitat. Unlikely to occur.

Common Name	Scientific name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Giant Honey-myrtle	*Melaleuca armillaris subsp. armillaris*		en	Near coastal sandy heaths. Widely planted (RBGV 2021).	4	29/11/2011	No suitable habitat. Unlikely to occur.
Golden Cowslips	*Diuris behrii*		en	Flat Grassy areas on heavy soils (Entwisle 1994).	1	1/11/2007	No suitable habitat. Unlikely to occur.
Gorae Leek-orchid	*Prasophyllum diversiflorum*	EN	cr	Wet grasslands or inundated swamps among tussocks (Jones 2006).	5	19/11/1998	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Green-striped Greenhood	*Pterostylis chlorogramma*	VU	en	Occurs in mixed Box-Stringybark forest with a shrubby understorey, often with Pteridium esculentum as a major component on sandy or clay loam soils (Duncan et al. 2009).	None	N/A	No suitable habitat. No records within 10 km. Unlikely to occur.
Lacey River Buttercup	*Ranunculus amplus*		cr	Scattered throughout southern Victoria, but most common in south-west. Grows in stream verges and swamps (RBGV 2021).	2	27/10/2015	Suitable habitat. Records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Lanky Buttons	*Leptorhynchos elongatus*		en	Dry open forest, mostly in Victoria's eastern uplands (e.g. Benambra, Omeo, Wulgulmerang and Corryong areas). There are also historical records from the southern mallee areas in western Victoria (Flann 1999).	1	1/11/1902	No suitable habitat. No recent records within 10 km. Unlikely to occur.
Leafy Greenhood	*Pterostylis cucullata*	VU		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. No records within 10 km. 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 (DAWE 2021b).	1	01/12/1893	Suitable habitat. No recent records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Matted Flax-lily	*Dianella amoena*	EN	cr	Lowland grassland and grassy woodlands on well-drained to seasonally waterlogged fertile sandy loams to heavy cracking soils derived from sedimentary or volcanic Geology. It is widely distributed from eastern to south-western Victoria (DAWE 2021b).	1	2/10/2016	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
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 (DAWE 2021b).	None	N/A	No suitable habitat. No records within 10 km. Unlikely to occur.
One-flower Early Nancy	*Wurmbea uniflora*		vu	An uncommon species, mostly from moist, heathy lowland sites (RBGV 2021).	1	26/02/2011	No suitable habitat. Unlikely to occur.
Pale Swamp Everlasting	*Coronidium gunnianum*		cr	Usually at low elevations (under c. 100 m) where mostly in grasslands and riverine Eucalyptus camaldulensis woodland on soils that are prone to inundation (RBGV 2021).	2	13/11/2019	Suitable habitat. Records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.

Common Name	Scientific name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Pale-flower Crane's-bill	*Geranium sp. 3*		en	Open, grassy areas of dry woodlands and forests (Smith 1999).	1	25/09/2019	No suitable habitat. Unlikely to occur.
Parsley Xanthosia	*Xanthosia leiophylla*		en	Known from sandy heathland and heathy woodland (RBGV 2021).	1	14/11/2011	No suitable habitat. Unlikely to occur.
Pretty Leek-orchid	*Prasophyllum anticum*		cr	Grassland on moist to wet black basaltic loam (Jeanes 2015).	13	23/10/2018	Suitable (but marginal) habitat. Recent records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Purple Blown-grass	*Lachnagrostis semibarbata var. filifolia*		en	Seasonally wet, heavy clay soils (Walsh 1994).	6	21/11/2011	Suitable (but marginal) habitat. Recent records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
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 (DAWE 2021b).	1	4/09/1973	No suitable habitat. No records within 10 km. Unlikely to occur.
Slender Stylewort	*Levenhookia sonderi*		en	Seasonally damp ground and drying swamps in lowland areas (RBGV 2021).	1	01/11/1899	Suitable habitat. No recent records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Small Sickle Greenhood	*Pterostylis lustra*		en	Apparently restricted to waterlogged black, peaty alkaline soils in closed, Woolly Tea-tree scrub within swamps and along watercourses. Vegetation considered to be suitable habitat provides a continuous canopy over a relatively open understorey with a herbaceous ground layer. Gahnia species, Viola hederacea, Lobelia species, Selliera radicans and Geranium molle are notable associated species (Duncan et al. 2009).	2	18/12/1900	No suitable habitat. No recent records within 10 km. Unlikely to occur.
Southern Blue-gum	*Eucalyptus globulus subsp. globulus*		en	Recent studies of variation in Southern Blue-gums suggest that populations of typical subsp. globulus occur in Victoria only in the area south of the Strzelecki Range, e.g. Port Franklin, Wilsons Promontory, and that other populations in south Gippsland and the Otway Ranges probably represent intergrades between subsp. globulus and subsp. pseudoglobulus (RBGV 2021).	1	26/02/2011	Not recorded during vegetation surveys. Unlikely to occur.
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).	None	N/A	No suitable habitat. No records within 10 km. Unlikely to occur.
Swamp Diuris	*Diuris palustris*		en	Scattered distribution throughout western Victoria. Usually in swampy depressions in grassland or open woodland (Entwisle 1994).	1	21/09/1903	Suitable habitat. No recent records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
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,	2	19/02/2009	Suitable habitat. Records within 10 km. Recorded during 2018

Common Name	Scientific name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
				Chorizandra, Craspedia, Eleocharis, Isolepis, Lachnagrostis, Lepidosperma, Myriophyllum, Phragmites australis, Themeda triandra and Villarsia (DAWE 2021b).			targeted surveys. Not recorded during targeted surveys within surveyed areas of the current proposed footprint.
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 2008).	13	13/11/2019	Suitable habitat. Recent records within 10 km. Likely to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
Swamp Flax-lily	*Dianella callicarpa*		en	Seasonally inundated, permanently moist or waterlogged basalt, and in remnant Leptospermum lanigerum scrub (RBGV 2021).	7	6/01/2016	Suitable habitat. Records within 10 km. Potential to occur within broader landscape. Not recorded during targeted surveys within surveyed areas of the development footprint.
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 (DAWE 2021b).	None	N/A	Three Trailing Hop-bush plants were recorded during vegetation mapping in March 2021. Not recorded during targeted surveys within surveyed areas of the development footprint.
Tuberous Bitter-cress	*Cardamine gunnii s.s.*		ex	Appears to have been a plant of lowland swamps. The species is probably extinct due to extensive habitat clearing for agriculture. One recent (1968) collection was from Mount Gambier in South Australia (Thompson 1996).	2	1/11/1903	Presumed extinct. No recent records. Unlikely to occur.
Wavy Swamp Wallaby-grass	*Amphibromus sinuatus*		en	Apparently confined to permanent swamps in cool, sometimes elevated sites (Walsh 1994).	2	13/11/2019	No suitable habitat. Unlikely to occur.
Western Peppermint	*Eucalyptus falciformis*		vu	Occurs on sandy soils in near-coastal heathy woodland from Anglesea area west to the SA border, sometimes adjacent to wetter vegetation. Also locally common in broadly similar vegetation in the Grampians (RBGV 2021).	5	4/02/1993	Not recorded during vegetation surveys. Unlikely to occur.

Notes:

EPBC = threatened species status under EPBC Act: CR = critically endangered; EN = endangered; VU = vulnerable.

FFG = threatened species status under the FFG Act: ex = presumed extinct; cr = critically endangered; en = endangered; vu = vulnerable.

OD Route

VBA records (DELWP 2018e) and the EPBC Protected Matters Search Tool (DEE 2019a) indicated that within the search region there were records of, or there occurred potential suitable habitat for, 19 species listed under the Commonwealth EPBC Act and 25 listed under the state FFG Act, including 14 listed under both Acts.

One species listed under the FFG Act – Salt Paperbark - was recorded within the OD route study area as a planted specimen. This species occurred in Habitat Zones 1TrAA, 1Tr AB, 1Tr AC and 1Tr AD. It is considered unlikely that this species would have naturally occurred in this area given its habitat requirements and the original modelled vegetation of these areas (DELWP 2018a) but has been included in roadside planting along with other native plants not indigenous to the locality.

The likelihood of occurrence in the OD route study area of species listed under the EPBC Act and FFG Act is addressed in Table 7. Species considered 'likely to occur' are those that have a very high chance of being in the study area based on numerous records in the search region and suitable habitat in the study area. Species considered to have the 'potential to occur' are those for which suitable habitat exists, but recent records are scarce.

This analysis indicates that five listed flora species were likely to occur or had the potential to occur. These species are listed below.

- River Swamp Wallaby-grass (*Amphibromus fluitans*), EPBC Act (Vulnerable) - not recorded during targeted surveys. Now considered unlikely to occur within the OD route study area.
- Curly Sedge (*Carex tasmanica*), FFG Act (endangered) – not recorded during targeted surveys. Now considered unlikely to occur within the OD route study area.
- Clover Glycine (*Glycine latrobeana*), EPBC Act (Vulnerable), FFG Act (vulnerable) – not recorded during targeted surveys. Now considered unlikely to occur within the OD route study area.
- Gorae Leek-orchid (*Prasophyllum diversiflorum*), EPBC Act (Endangered), FFG Act (critically endangered) – not recorded during targeted surveys. Now considered unlikely to occur within the OD route study area.
- Maroon Leek-orchid (*Prasophyllum frenchii*), EPBC Act (Endangered), FFG Act (endangered) – not recorded during targeted surveys. Now considered unlikely to occur within the OD route study area.

The targeted surveys for the above-listed flora species focussed on areas identified to support suitable habitat for them. These areas were inspected thoroughly along transects spaced no more than five metres apart. This transect spacing was chosen based on the lifeform of the targeted species and the visibility (i.e. density of ground cover) within areas of suitable habitat.

None of the above-listed threatened flora species were recorded in the October or December 2018 targeted flora surveys, and they are therefore now considered unlikely to occur in the OD route study area.

Table 7: FFG Act and EPBC Act listed flora species and likelihood of occurrence - OD route

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 (DAWE 2021b).	None	N/A	Suitable (but marginal) habitat. Potential to occur in EVC 653. Not recorded during targeted surveys. Now considered **unlikely to occur within the OD route survey area.**
Glistening Saltbush	*Atriplex billardierei*		ex	Sandy seashores, scattered from western to eastern extremities of Victoria, rarely collected (Walsh 1996).	1	1/01/1980	No suitable habitat. **Unlikely to occur.**
Limestone Spider-orchid	*Caladenia calcicola*	VU	cr	Well-drained limey sands in heathy forest on limestone ridges (Jones 2006).	111	1/10/2005	No suitable habitat. **Unlikely to occur.**
Scented Spider-orchid	*Caladenia fragrantissima*		cr	Moist to well-drained sandy loam soils in dense heathland and heathy forest (Jones 2006).	17	5/11/2009	No suitable habitat. **Unlikely to occur.**
Mellblom's Spider-orchid	*Caladenia hastata*	EN	cr	Well-drained sands in dense coastal heathland and heathy forest (Jones 2006).	55	9/10/2017	No suitable habitat. **Unlikely to occur.**
Ornate Pink-fingers	*Caladenia ornata*	VU	en	Heathy forest and among shrubs on seasonally moist sandy loams (Jones 2006).	None	N/A	No suitable habitat. **Unlikely to occur.**
Robust Spider-orchid	*Caladenia valida*		cr	Well-drained sands in coastal heathy forest and scrub (Jones 2006).	3	1/10/1940	No suitable habitat. **Unlikely to 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 2010). Known occurrences are localised around Heywood, Portland, Port Fairy, Karish (Lake Weeranganuk), Craigieburn, Kalkallo and Wollert (DELWP 2019).	11	12/11/2015	Suitable (but marginal) habitat. Potential to occur in EVC 653. Not recorded during targeted surveys. Now considered **unlikely to occur within the OD route survey area.**
Wrinkled Cassinia	*Cassinia rugata*	VU	cr	Found in damp, low open forest or dense heathy scrub. Open forest sites are generally dominated by Eucalyptus ovata (Swamp Gum) (Carter & Walsh 2006).	1	21/04/1962	No suitable habitat. **Unlikely to occur.**
Coast Helmet-orchid	*Corybas despectans*		en	Shrubby forest, coastal scrubs and mallee - on limey sand or on red soils over limestone (Jones 2006).	3	30/06/1986	No suitable habitat. **Unlikely to occur.**
Bell-flower Hyacinth-orchid	*Dipodium campanulatum*	EN	en	Typically found on deep grey sands or limestone in stringybark woodland with an understorey of bracken fern, Acacia species , cranberry heath and magenta storks bill (NRSE, 2014). These areas have wet winters and long dry mild summers.	None	N/A	No suitable habitat. **Unlikely to occur.**
Swamp Diuris	*Diuris palustris*		en	Scattered distribution throughout western Victoria. Usually in swampy depressions in grassland or open woodland (Entwisle 1994).	13	28/09/2006	No suitable habitat. **Unlikely to occur.**
Large-fruit Yellow-gum	*Eucalyptus leucoxylon subsp. megalocarpa*		cr	Undulating low hills of thin loam over limestone in coastal shrubland. Naturally restricted to far south-western Victoria, near the Glenelg River estuary south of Nelson, and south-eastern South Australia. Other occurrences comprise planted individuals (Nicolle 2006).	1	13/04/2012	No suitable habitat. **Unlikely to occur.**

Common Name	Scientific Name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
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 (DAWE 2021b).	1	1/01/1980	Suitable (but marginal) habitat. Potential to occur in EVC 23. Not recorded during targeted surveys. Now considered **unlikely to occur within the OD route survey area.**
Coast Ixodia	*Ixodia achillaeoides subsp. arenicola*	VU		Confined to coastal vegetation in the Cape Bridgewater-Portland area (Short 1999).	3	27/08/2008	No suitable habitat. **Unlikely to occur.**
Salt Paperbark	*Melaleuca halmaturorum*		en	Mostly fringing salt lakes or on saline soils near the coast (Spencer 1996).	1	13/04/2012	No suitable habitat. Unlikely to occur naturally. **Recorded as a planted specimen in habitat zones AA, AB, AC and AD.**
Gorae Leek-orchid	*Prasophyllum diversiflorum*	EN	cr	Wet grasslands or inundated swamps among tussocks (Jones 2006).	4	5/11/1949	Suitable (but marginal) habitat. Potential to occur in EVC 653. Not recorded during targeted surveys. Now considered **unlikely to occur within the OD route survey area.**
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 (DAWE 2021b).	2	9/10/1947	Suitable (but marginal) habitat. Potential to occur in EVC 653. Not recorded during targeted surveys. Now considered **unlikely to occur within the OD route survey area.**
Coastal Leek-orchid	*Prasophyllum litorale*		cr	Coastal scrub and heath on stabilised dunes and swales (Jones 2006).	7	14/12/2010	No suitable habitat. **Unlikely to occur.**
Marsh Leek-orchid	*Prasophyllum niphopedium*		en	Apparently confined to sub-alpine meadows and fertile montane woodland in the Mt Cobberas region of eastern Victoria (Bates 1994).	2	26/12/1983	No suitable habitat. **Unlikely to occur.**
Pale Leek-orchid	*Prasophyllum pallidum s.l.*	VU		Western Victoria, where it grows in forest with a jeathy-grassy understorey in gravelly loam (Bishop 2000)	1	1/01/1980	No suitable habitat. **Unlikely to occur.**
Dense Leek-orchid	*Prasophyllum spicatum*	VU	cr	Occurs in coastal and near-coastal heathland and heathy woodland. Soils are generally sandy, with some sites seasonally waterlogged (Duncan 2010).	1	10/11/1980	No suitable habitat. **Unlikely to occur.**
Green-striped Greenhood	*Pterostylis chlorogramma*	VU	en	Occurs in mixed Box-Stringybark forest with a shrubby understorey, often with Pteridium esculentum as a major component on sandy or clay loam soils (Duncan et al 2009).	4	10/07/2007	No suitable habitat. **Unlikely to occur.**
Leafy Greenhood	*Pterostylis cucullata subsp. cucullata*	VU	en	Coast Tea-tree (Leptospermum laevigatum) or Moonah (Melaleuca lanceolata) coastal scrubs on stabilized sand dunes, with an open understorey and grassy and herbaceous groundcover on seasonally damp but well drained humus rich sandy loams. Mt Eccles population occurs in Brown Stringybark (Eucalyptus baxteri) and Manna Gum (E. viminalis) forest with a grassy groundcover (Duncan 2010b).	3	24/10/1944	No suitable habitat. **Unlikely to occur.**
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	None	N/A	Suitable (but marginal) habitat. No records within 10km. **Unlikely to occur.**

Common Name	Scientific Name	EPBC	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
				Melbourne, and Honans Scrub in south-eastern South Australia (DEWHA 2008).			
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 (DAWE 2021b).	None	N/A	Suitable (but marginal) habitat. No records within 10km. **Unlikely to occur.**
Winter Sun-orchid	*Thelymitra hiemalis*		cr	Swamps and heaths on sandy soils near coast to low woodlands on skeletal soils inland, mostly in moist and poorly drained areas (Weber & Entwisle 1994). South-west Victoria near Portland and immediately east of Melbourne at Blackburn on Glenelg Plain and Gippsland Plain (DSEWPAC 2011)	2	30/06/2010	No suitable habitat. **Unlikely to occur.**
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).	None	N/A	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, Themea triandra and Villarsia (DAWE 2021b).	None	N/A	Suitable (but marginal) habitat. No records within 10km. **Unlikely to occur.**

Notes:

EPBC = threatened species status under EPBC Act: CR = critically endangered; EN = endangered; VU = vulnerable.

FFG = threatened species status under the FFG Act: ex = presumed extinct; cr = critically endangered; en = endangered; vu = vulnerable.

5.3.3. Listed ecological communities

Wind Farm Site

The EPBC Protected Matters Search Tool (DEE 2019a) indicated that four ecological communities listed under the EPBC Act had the potential to occur in the Wind Farm site (Appendix 9). Two of these were recorded in the Wind Farm site.

Table 8: EPBC Act listed ecological communities and likelihood of occurrence in Wind Farm site

Ecological Community	EPBC	Occurrence in the Wind Farm site
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	CR	**Recorded** within the Wind Farm site
Natural Temperate Grassland of the Victorian Volcanic Plain	CR	**Not recorded** within the Wind Farm site
Seasonal Herbaceous Wetland of the Temperate Lowland Plain	CR	**Recorded** within the Wind Farm site
White Box-Yellow-Box-Blakeley's Red Gum Grassy Woodland	CR	**Not recorded** within the Wind Farm site

Notes: EPBC = status under EPBC Act: CR = critically endangered.

Based on an assessment of native vegetation in the Wind Farm site against published descriptions and condition thresholds for these communities, the listed ecological communities discussed below were recorded in the Wind Farm site:

- **Grassy Eucalypt Woodland of the Victorian Volcanic Plain** – listed as Critically Endangered under the EPBC Act (PGW2)

  Two patches of Higher Rainfall Plains Grassy Woodland (EVC 55_63) within the Wind Farm site, denoted PGW2, were found to meet the condition thresholds for this community (EHP 2018), namely each patch is at least 0.5 hectares and 50% or more of the perennial ground layer vegetation comprises native species (TSSC 2008b). These patches total 0.836 hectares.

  2.172 hectares of Heavier-soils Plains Grassland (EVC 132_61) (identified as a derived grassland community from Basalt Shrubby Woodland and Plains Grassy Woodland (EHP 2018)) would potentially qualify as the listed community, as each patch is at least 0.5 hectares in area. No assessment of these patches against the condition thresholds for the community (TSSC 2008b) has been undertaken. These patches of potential GEWVVP are shown in Figure 4. None of this potential listed community will be removed by the wind farm footprint..

  All other patches of Higher Rainfall Plains Grassy Woodland (EVC 55_63), Basalt Shrubby Woodland (EVC 642) and Heavier-soils Plains Grassland (EVC 132_61) within the Wind Farm site were found not to meet the condition thresholds for this community, as they were either too small or because 50% or more of the perennial ground layer vegetation was not native species, and there were not more than ten native perennial species and at least three big trees per hectare (TSSC 2008b).

- **Seasonal Herbaceous Wetland of the Temperate Lowland Plain** – listed as Critically Endangered under the EPBC Act

  One EVC (Plains Grassy Wetland (EVC 125) which is associated with this community (TSSC 2012) was recorded within the study area. EHP (2018) determined that due to the modified condition of Plains Grassy Wetland patches it was unlikely that these would meet the thresholds for the community; however, they also recognised that the field assessments were not conducted during the optimal season to assess the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains ecological community (October – December) (TSSC 2012a).

  Patches of Plains Grassy Wetland that intersected with footprint have therefore assessed in October and December (during the optimal season) by Nature Advisory in 2018 and 2021 to determine whether they met the key diagnostic criteria and condition thresholds for this community (TSSC 2012a). These patches of Plains Grassy Wetland that met these criteria (TSSC 2012a), namely they were patches in which *50% or more of the total cover of plants in the ground layer of the wetland* was *dominated by native species characteristic of the Seasonal Herbaceous Wetlands ecological community, and the wetland was 0.5 ha or larger in size*, are shown in Figure 4.

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

- **Natural Temperate Grassland of the Victorian Volcanic Plain** – listed as Critically Endangered under the EPBC Act

  One EVC (Heavier-soils Plains Grassland (EVC 132_61)) that is associated with this community (TSSC 2008b) was recorded within the Wind Farm site; however, all patches of Heavier-soils Plains Grassland (EVC 132_61) mapped within the Wind Farm site are a derived grassland community from Basalt Shrubby Woodland (EVC 642) and would not meet the key diagnostic criteria for the listed community, which is described as a patch of remnant native vegetation on the Victorian Volcanic Plain where trees are (and were) absent or sparse such that the projective foliage cover of native trees in the patch is (and would have been) 5% or less (TSSC 2008b).

- **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 WWF site met the first key diagnostic criterion for this community (EHP 2018), namely that at least one of the most common overstorey species is/was White Box, Yellow Box or Blakely's Red Gum (TSSC 2006).

OD route

The EPBC Protected Matters Search Tool (DEE 2019a) indicated that seven ecological communities listed under the EPBC Act had the potential to occur in the OD route (Table 9). None of these were recorded in the OD route study area.

Table 9: EPBC Act listed ecological communities and likelihood of occurrence in the OD route study area

Ecological Community	EPBC	Occurrence in the OD route study area
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	EN	**Not recorded** within the OD route study area
Giant Kelp Marine Forests of South East Australia	EN	**Not recorded** within the OD route study area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	CR	**Not recorded** within the OD route study area
Natural Temperate Grassland of the Victorian Volcanic Plain	CR	**Not recorded** within the OD route study area
Seasonal Herbaceous Wetland of the Temperate Lowland Plain	CR	**Not recorded** within the OD route study area
Subtropical and Temperate Coastal Saltmarsh	VU	**Not recorded** within the OD route study area
White Box-Yellow-Box-Blakeley's Red Gum Grassy Woodland and Derived Native Grassland	CR	**Not recorded** within the OD route study area

Notes: EPBC = status under EPBC Act: CR = critically endangered; EN = endangered; VU = vulnerable.

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

- **Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community** – listed as Endangered under the EPBC Act

  No vegetation within the OD route study area met the description of this community, which occurs in estuaries (DEE 2018a).

- **Giant Kelp Marine Forests of South East Australia** – listed as Endangered under the EPBC Act

  No vegetation within the OD route study area met the key diagnostic criteria of this community, which occurs at or below sea level (TSSC 2012b).

- **Grassy Eucalypt Woodland of the Victorian Volcanic Plain** – listed as Critically Endangered under the EPBC Act

  Herb-rich Foothill Forest (EVC 23) and Higher-rainfall Plains Grassy Woodland (EVC 55_63) mapped within the OD route study area would potentially meet the key diagnostic criteria for this community (TSSC 2008a), 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 or associated eucalypts, including Swamp Gum and Manna Gum in areas receiving over 700 mm rainfall (as patches of Herb-rich Foothill Forest mapped within the OD route study area would (BoM 2021b)). Habitat Zones A, B, C, D, E, 1TrAB, 1TrAC, 1TrAD, 1TrAE, 1TrAF and 1TrAG do not meet the minimum patch size (0.5 hectares) for the listed ecological community (TSSC 2008a). Habitat zone 1TrAA does meet the minimum patch size, but does not meet the first condition threshold for the listed ecological community, because 50% or more of the perennial ground layer vegetation was not native species, and there were not more than ten native perennial species and at least three big trees per hectare (TSSC 2008a). Therefore, this community does not occur within the OD route.

- **Natural Temperate Grassland of the Victorian Volcanic Plain** – listed as Critically Endangered under the EPBC Act

  No vegetation within the OD route study area met the key diagnostic criteria of this community, which is described as a patch of remnant native vegetation on the Victorian Volcanic Plain where trees are (and were) absent or sparse such that the projective foliage cover of native trees in the patch is (and would have been) 5% or less (TSSC 2008b).

- **Seasonal Herbaceous Wetland of the Temperate Lowland Plain** – listed as Critically Endangered under the EPBC Act

  No EVCs associated with the listed ecological community (TSSC 2012a) were recorded within the OD route study area.

- **Subtropical and Temperate Coastal Saltmarsh** – listed as Vulnerable under the EPBC Act

  No vegetation within the OD route study area met the physical conditions of the listed community, which occurs in coastal areas under regular or intermittent tidal influence (DSEWPaC 2013).

- **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 OD route 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 proposed development

The current proposal will involve the construction and operation of the Willatook Wind Farm, as described above 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 5. This area has been referred to as the 'development footprint', which includes all temporary and permanent project components.

5.4.1. Impact pathways

Construction impact pathways are grouped into two types of impact pathways. These are:

- Direct vegetation and habitat loss from clearance, earthworks and physical disturbance.

- Habitat and vegetation degradation from direct and indirect pathway including introduction or spread of invasive species or pathogens, edge effects, barrier effects, surface hydrological changes, groundwater drawdown, deposition of eroded sediments or from contamination caused by accidental spills of hazardous materials.

The key activity during construction with the potential to impact on native vegetation and listed flora values is physical disturbance and earthworks. Physical disturbance includes vegetation clearance, excavation, trenching and earthworks such as stockpiling or cut-and-fill material movements required to construct Project infrastructure. The shape, size and duration of physical disturbance (i.e., temporary or permanent) influences the degree to which vegetation and listed flora may be impacted. Physical disturbance will primarily occur during construction, although a small amount of physical disturbance is expected during decommissioning of the Project.

In comparison to other large infrastructure developments, the construction of wind farms is characterised by comparatively small footprints at any one location, but those areas are spread out over a broad landscape, connected by tracks and cables. Wind farms are constructed progressively so construction activities in any location would be temporary over a number of weeks with the exception of the quarry and construction site compounds, which would be used for the entirety of the two-year construction period.

Physical disturbance for the construction of Project infrastructure will result in the clearance of some native vegetation, and this may cause direct mortality to individual plants during earthwork activities.

Clearing of native vegetation can result in habitat fragmentation, whereby previously contiguous areas of habitat are separated into smaller patches. A feature of wind farm developments is that physical disturbance is not concentrated in a single location, with turbines occupying a relatively small footprint. A large proportion of physical disturbance is contributed from accessways and cable trenches that provide vehicle access and enables electricity transmission.

Weeds and pathogens may be lodged and transported in construction plant and equipment and then driven through the project area. Plant and equipment used within the project site also can spread weeds and pathogens to other areas causing potential infestations further afield. Five declared noxious weed species (listed under the CALP Act) were recorded in the project including Blackberry, Gorse, Perennial Thistle, St John's Wort and Sweet Briar.

Where Project activities are close to watercourses or watercourses are downslope of earthworks and construction activities, sediment-laden runoff can enter watercourses because of erosion. As a result, water quality of watercourses can be reduced due to higher turbidity. Microhabitats within the watercourse may be smothered from the settling of sediment and there is also potential to influence riparian habitats.

Operation of the on-site quarry would result in groundwater dewatering. Construction of turbine foundations also has the potential to intercept shallow groundwater and require dewatering for a short period. These activities would reduce groundwater levels, potentially influencing groundwater availability at these locations.

5.4.2. 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 WWF to avoid and minimise impacts on threatened ecological communities and native vegetation. These include:

- A 100-metre buffer was placed around all mapped wetlands ('current wetlands' layer) on the Victorian Wetland Inventory 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 Shaw River, Back Creek and smaller drainages, were buffered by 100 metres (with the exception of several required track and cable crossings) 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 (with the exception of several required track and cable crossings) 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, including trucks from the quarry, 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 WWF site (Figure 5); and
- Re-alignment and micro-siting of infrastructure has avoided the majority of known and all potential SHWTLP within the WWF site (Figure 5).

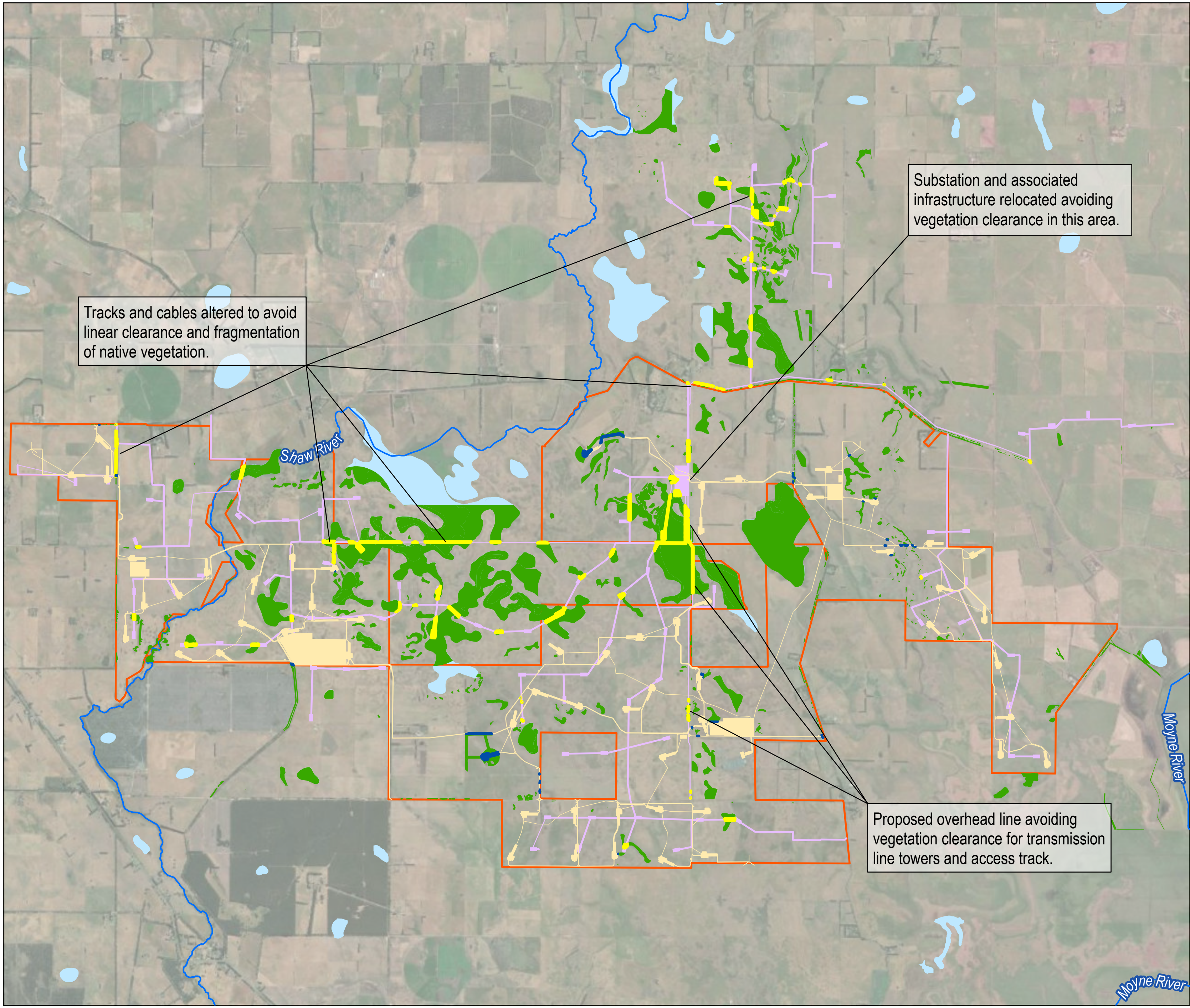
Native vegetation surveys have progressively refined the understanding of native vegetation coverage and habitat for threatened flora and fauna across the site. Throughout the design process there have been significant efforts made to avoid the clearance of native vegetation.

The initial project design as envisaged would have resulted in the need to remove at least 20 hectares of native vegetation. A range of design changes were made as part of the project concept design that was referred to the Victorian government in 2018 including:

- Re-routing on-site tracks;
- Re-routing underground cabling;
- Repositioning three wind turbines and associated hardstands; and
- Repositioning a further four hardstands.

Key measures to minimise the spread of weeds and pathogens has been including washdown stations at all entry points and gates. Construction works would also be subject to management requirements for weeds and pathogens such as vehicle hygiene protocols and soil management, which would be incorporated into the project CEMP

Further avoidance measures were implemented throughout the completion of EES supporting to arrive at the current project reference design.



LEGEND

- Watercourse
- Concept design construction footprint
- Current project construction footprint
- Areas of native vegetation (mapped EVCs)
- DELWP mapped wetlands
- Areas of avoided vegetation clearance
- Proposed areas of vegetation clearance
- Willatook Wind Farm boundary

SOURCE:
Willatook Wind Farm boundary, EVC and construction footprints from Wind Prospect.
Watercourses from Vicmap.
Wetlands from DELWP.
Imagery from ArcGIS Online (various capture dates).

0 1 km
SCALE 1:72,000
PAGE SIZE: A4
PROJECTION: GDA 1994 MGA Zone 54

WIND PROSPECT
WILLATOOK WIND FARM

FIGURE 7

Avoid and minimise process for native vegetation removal

DATE: 04.02.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F049B_GIS DOC REFERENCE: 287657_02_FIGS_E.APRX_V02

DISCLAIMER: THIS FIGURE HAS BEEN PRODUCED FOR INTERNAL REVIEW ONLY AND MAY CONTAIN INCONSISTENCIES OR OMISSIONS. IT IS NOT INTENDED FOR PUBLICATION.

Mitigation measures

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.

Efficacy of proposed mitigation

An Environmental Management Framework (EMF) has been developed to provide the project and stakeholders with a transparent and integrated framework for managing environmental risk and mitigating adverse effects. It contains the environmental management measures developed in collaboration with environmental specialists to address specific potential impacts identified through the impact assessment process.

The EMF, which contains mitigation measures outlined within this report, documents the processes to be followed in the preparation, review, approval and implementation of environmental management plans and procedures. It also provides for the regular review and updating of these plans and procedures as well as independent monitoring, auditing and reporting of compliance.

The project will implement a proactive monitoring regime to assess the ongoing environmental performance of the project and identify any instances of breaches against the performance criteria set out by legislation and the project's planning permit.

The project has sought to adopt best practice guidelines in the development of Environmental Management Measures. Examples include specific reference to EPA and DELWP guidelines where appropriate. It is anticipated that the EMF, including mitigation measures documented above, will effectively avoid any unanticipated, indirect impacts on native vegetation and habitat for listed species, given that:

- The project site is relatively uncomplicated from a constructability perspective with gentle slopes and reasonable access;
- The project will occur in an existing agricultural landscape that is largely cleared of native vegetation;
- Stringent protocols for the identification and protection of native vegetation to be retained will be implemented;
- No significant changes to the site's hydrology will arise as a result of the project;
- Best-practice guidelines will be used in the preparation of Environmental Management Plans; and

A comprehensive monitoring and audit schedule will be required under the EMF.

5.4.3. Native vegetation

The current proposal will result in the loss of a total extent of 4.574 hectares of native vegetation, including six large trees, from the WWF site as shown in Figure 5 and documented in the (NVR) report provided by DELWP (Appendix 5). This vegetation removal comprises:

- 4.131 hectares of native vegetation in patches (3.518ha on private land and 0.613ha on public land); and
- Seven scattered trees, including six large scattered trees all on private land.

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

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

Representative photographs of native vegetation proposed for removal are provided in Appendix 2.

OD route

The OD route footprint will result in the loss of a total extent of 0.043 hectares of native vegetation as shown in Figure 6 and documented in the *Native Vegetation Removal* (NVR) report provided by DELWP (Appendix 6). This vegetation removal comprises:

- 0.043 hectares of native vegetation in patches all on public land.

The native vegetation to be removed is not in an area mapped as an endangered Ecological Vegetation Class under Victorian Regulations.

Proposed native vegetation removal associated with the WWF site (see above) has been included as past removal for the OD route.

Representative photographs of native vegetation proposed for removal are provided in Appendix 2.

5.4.4. Modelled species important habitat

The current development footprint will not have a significant impact on any habitat for any rare or threatened species.

5.4.5. Listed flora species

The analysis of the likelihood of occurrence and targeted surveys of listed flora species presented in Section 5.3.2 identified that the following species could be impacted by development in the study area:

- Swamp Everlasting (EPBC Act: Vulnerable; FFG Act: critically endangered); and
- Trailing Hop-bush (EPBC Act: Vulnerable).

As shown in Figure 5, all Swamp Everlasting and Trailing Hop-bush individuals have been avoided by the current development footprint.

Further targeted surveys are required to determine the presence of listed flora species within the current development footprint, due to the alterations to the development footprint since the 2021 targeted surveys were undertaken.

Targeted flora surveys for threatened species were not completed in a small area (0.336 ha) of the proposed development footprint (222 ha). It is proposed that this area be surveyed in late 2022 for completeness. Considering the survey effort to date and the characterisation of the vegetation/habitat quality across the site, the assessment has assessed the potential impacts considering the affected/impacted potential habitat for these species. A commitment to undertake targeted flora surveys prior to construction has also been made. If a threatened flora species is recorded within these areas, specific measures to minimise impacts would be developed.

5.4.6. Threatened ecological communities

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

- 0.486 hectares of the EPBC Act listed community *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP).

5.5. Impact assessment

Following the application of avoid and minimise measures, an assessment of residual effects and impacts was completed describing the likely changes to vegetation, listed ecological communities, and changes to populations of flora brought about by the construction, operation and eventual decommissioning of the Project, and rating the significance of these effects (Table 10).

Table 10: Impact criteria for biodiversity impacts

Rating	Criteria
Very high	The effects on ecological values extend beyond the study area across its entire range. Major loss or alteration to ecological value and/or loss of a significant proportion of the known population or range of the value with the viability of the biological value reduced.
High	The effects on ecological values extend beyond the study area within the region. Loss or alteration to ecological value and/or loss of a proportion of the known population or range of the value with the viability of the biological value reduced. The effects are contained within the bioregion.
Moderate	Loss or alteration to ecological value that is readily detectible with respect to natural variability, and/or loss of a moderate proportion of the known population or range of the value with limited overall reduction in the viability of the value. The effects are contained within the project site.
Low	Minor effect from existing baseline conditions. Effects unlikely to reduce the overall viability of the ecological value. The effects contained within the Project disturbance area.
Very low	Effects likely to be very low or barely detectable and reduction in the viability of the ecological value is highly unlikely. The effects are limited to areas within the Project footprint

5.5.1. Native vegetation

The primary impact pathway resulting the direct loss and/or degradation of native vegetation is from vegetation clearance, earthworks and physical disturbance. The Project also has the potential to indirectly degrade native vegetation via introduction or spread of weeds and pathogens, changes to hydrology and deposition of eroded sediments.

The proposed development footprint consists of 222 hectares. As the development footprint has been derived in accordance with the 'avoid' and 'minimise' principles, the majority of the native vegetation has been avoided and will be retained.

The Project would result in the loss of a total extent of 4.567 hectares of native vegetation and six large trees. Most of this impact will occur in the Plains Grassy Wetland and Basalt Shrubby Woodland EVCs as presented in Table 11. As discussed in Section 5.3.1, average condition scores for the majority of mapped native vegetation were low (<35), a likely reflection of their location within an active agricultural landscape. Furthermore, the average condition score for zones to be impacted was 21, reflecting an effort to avoid impacts to higher-quality native vegetation.

Table 11: Native vegetation losses as a result of the Project

EVC	Mapped Area (ha)	Proposed clearance (ha)	Area to be retained (ha)	Proportion of loss within the study area
Plains Grassy Wetland (EVC 125)	250.021	1.314	248.707	0.53%
Stony Knoll Shrubland (EVC 649)	51.343	0.738	50.605	1.44%
Basalt Shrubby Woodland (EVC 642)	19.200	1.909	17.291	9.94%
Higher-rainfall Plains Grassy Woodland (EVC 55_63)	16.833	0.083	16.750	0.49%
Heavier-soils Plains Grassland (EVC 132_61)	3.133	0.022	3.111	0.70%
Swampy Riparian Woodland (EVC 83)	0.066	0.066	0.000	100%

A total of 4.132 hectares of native vegetation in patches is proposed to be removed, representing less than 0.5% of native vegetation mapped within the site.

Impacts to native vegetation have been assessed as **low**, given that:

- Less than 0.5% of native vegetation mapped within the site will be impacted;
- Direct and indirect impacts will be contained within the Project disturbance area; and
- The average condition score of native vegetation to be impacted is 21.

5.5.2. Listed communities

The primary impact pathway resulting the direct loss and/or degradation of listed ecological communities is from vegetation clearance, earthworks and physical disturbance. The Project also has the potential to indirectly degrade listed ecological communities via introduction or spread of weeds and pathogens, changes to hydrology and deposition of eroded sediments.

Seasonal Herbaceous Wetland of the Temperate Lowland Plain

A total of 19.601 hectares of *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP) has been mapped within the project site. Due to several limitations not all areas of potential Plains Grassy Wetland have been surveyed in accordance with national survey guidelines for *Seasonal Herbaceous Wetland of the Temperate Lowland Plain*. As such, a further 205 hectares of Plains Grassy Wetland beyond the proposed footprint is considered potential SHWTLP.

Avoidance has been the primary measure to mitigate potential impacts on *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* ecological community within the Site. By selectively placing infrastructure away from mapped Plains Grassy Wetland, more than 97% of the confirmed community, and 100% of the potential community will be retained (Table 12). The creation of the turbine free buffer around the Cockatoo Swamp complex ensures that most potential areas for the *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* are well beyond potential areas of disturbance.

Table 12: Proposed clearance of listed communities

Listed community	Mapped Area (ha)	Proposed clearance (ha)	Area to be retained (ha)	Proportion of loss within the study area
SHWTLP	19.586	0.486	19.100	2.48%
Potential SHWTLP	204.599	0	204.599	0%

The project will impact 0.486 hectares of confirmed SHWTLP. This clearance occurs within four separate patches of this ecological community as shown in Figure 5 and detailed below.

- PGWe1 0.002 hectares predicted to be impacted within the defined extent of the patch of 8 hectares
- DRR 0.003 hectares predicted to be impacted within the defined extent of the patch of 2.23 hectares
- XAO 0.25 hectares predicted to be impacted within the defined extent of the patch of 1.28 hectares
- XBM2 0.231 hectares predicted to be impacted within the defined extent of the patch of 4.51 hectares.

Overall, the predicted impact to SHWTLP have been assessed as **low**, given that:

- Only 2.48% of confirmed SHWTLP will be impacted (affecting between 0.3% and 19.5% of four separate defined patches);
- In each case, while a portion of the patch may be impacted these unlikely to affect the overall viability of each habitat patch with proposed management measures implemented.
- No areas of mapped 'potential SHWTLP' within the site will be impacted; and
- Direct and indirect impacts will be contained within the Project disturbance area.

An assessment of proposed impacts to SHWTLP against the EPBC Act significant impact guidelines is included in Section 12.1.1.

Grassy Eucalypt Woodland of the Victorian Volcanic Plain

0.836 hectares of *Grassy Eucalypt Woodland of the Victorian Volcanic Plain* (GEWVVP) has been mapped within the Site. This will not be impacted by the project.

A further 2.172 hectares of native vegetation within the site would potentially qualify as GEWVVP. No assessment of these patches against the condition thresholds for the community (TSSC 2008b) has been undertaken. None of this area will be impacted by the Project.

There will therefore be **no impacts** to GEWVVP (confirmed or potential).

5.5.3. Habitat for listed species

Two species of conservation significance were recorded in the Site. These are Swamp Everlasting (EPBC Act: Vulnerable; FFG Act: critically endangered) and Trailing Hop-bush (EPBC Act: Vulnerable). Another seventeen species of conservation significance were assessed as having the potential to occur based on recent records within 10 km and the presence of suitable habitat. These are listed below.

- Basalt Leek-orchid (FFG Act: critically endangered)
- Basalt Peppercress (EPBC Act: Endangered; FFG Act: endangered)

- Button Wrinklewort (EPBC Act: Endangered; FFG Act: endangered)
- Clover Glycine (EPBC Act: Vulnerable; FFG Act: vulnerable)
- Curly Sedge (FFG Act: endangered)
- Dense Leek-orchid (EPBC Act: Vulnerable; FFG Act: critically endangered)
- Gorae Leek-orchid (EPBC Act: Endangered; FFG Act: critically endangered)
- Lacey River Buttercup (FFG Act: critically endangered)
- Maroon Leek-orchid (EPBC Act: Endangered; FFG Act: endangered)
- Matted Flax-lily (EPBC Act: Endangered; FFG Act: critically endangered)
- Pale Swamp-everlasting (FFG Act: critically endangered)
- Pretty Leek-orchid (FFG Act: critically endangered)
- Purple Blown-grass (FFG: endangered)
- Slender Style-wort (FFG Act: endangered)
- Swamp Diuris (FFG Act: endangered)
- Swamp Fireweed (EPBC Act: Vulnerable)
- Swamp Flax-lily (FFG Act: endangered).

Swamp Everlasting

A total of 24 Swamp Everlasting plants were recorded within a single patch of Plains Grassy Wetland on private land during surveys for the Project. This patch has been avoided and will therefore not be impacted by the Project.

Swamp Everlasting grows in swamps and bogs typically within Plains Grassy Wetland within the Southern Volcanic Plain bioregion. Based on avoidance measures made during project design, 97% of Plains Grassy Wetland EVC will not be impacted by the Project. The majority of areas of Plains Grassy Wetland within the development footprint have been subject to targeted surveys at an appropriate time of year for Swamp Everlasting. These surveys did not detect this species. Areas of Plains Grassy Wetland within the development footprint that are yet to be surveyed for this species are shown in Figure 5. Prior to construction, surveys for Swamp Everlasting will be conducted in these areas and if located species-specific management measures developed that may include micro-siting or directional drilling. As such, the Project is predicted to have a **very low** impact on the species.

Trailing Hop-bush

Trailing Hop-bush was recorded two patches Basalt Shrubby Woodland along Old Dunmore Road, which will not be impacted by the Project.

This species grows in low-lying areas that are often wet in winter and are known to occur in Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland EVCs. Based on avoidance measures made during project design, approximately 95% of these EVCs within the Site will be retained. The majority of areas of Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland within the development footprint have been subject to targeted surveys at an appropriate time of year for Trailing Hop-bush. These surveys did not detect this species. Areas of Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland within the development footprint that are yet to be surveyed for this species are shown in Figure 5. Prior to construction, surveys for Trailing Hop-bush will be conducted in these areas and if located species-specific management measures developed that may include micro-siting or directional drilling. As such, the Project is predicted to have a **very low** impact on the species.

Other flora species of conservation significance

Basalt Leek-orchid, Basalt Peppercress, Button Wrinklewort, Clover Glycine, Matted Flax-lily, Pale Swamp Everlasting and Pretty Leek-orchid have similar habitat preferences, occurring on heavy clay soils associated with grassland or grassy woodland. The majority of areas of Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland within the development footprint have been subject to targeted surveys at an appropriate time of year for these species. These surveys did not detect these species. Areas of Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland within the development footprint that are yet to be surveyed for these species are shown in Figure 5. Based on avoidance measures made during project design, approximately 95% of these EVCs within the Site will be retained. Prior to construction, surveys for these species in potential habitats within the proposed construction footprint will be conducted in these areas and if located species-specific management measures developed that may include micro-siting or directional drilling. As such, the Project is predicted to have a **very low** impact on the species.

Curly Sedge, Dense Leek-orchid, Gorae Leek-orchid, Lacey River Buttercup, Maroon Leek-orchid, Purple Blown-grass, Slender Style-wort, Swamp Diuris, Swamp Fireweed and Swamp Flax-lily are known to occur in Plains Grassy Wetland EVC. The majority of areas of Plains Grassy Wetland within the development footprint have been subject to targeted surveys at an appropriate time of year for these species. These surveys did not detect these species. Areas of Plains Grassy Wetland within the development footprint that are yet to be surveyed for these species are shown in Figure 5. Based on avoidance measures made during project design, approximately 99.5% of this EVC within the Site will be retained. Prior to construction, surveys for these species in potential habitats within the proposed construction footprint will be conducted in these areas and if located species-specific management measures developed that may include micro-siting or directional drilling. As such, the Project is predicted to have a **very low** impact on the species.

5.6. Implications of the proposed development

5.6.1. Implications under the Guidelines

WWF site

Assessment pathway

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

- Location Category: Location 2; and
- Extent of native vegetation: 4.567 hectares of native vegetation.

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 study area are provided below.

- 1.206 general habitat units and must include the following offset attribute requirements:
  - Minimum strategic biodiversity value (SBV) of 0.312;
  - Occur within the Glenelg Hopkins CMA boundary or the Moyne municipal district; and
  - Include protection of at least six large trees.

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

OD route

Assessment pathway

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

- Location Category: Location 1; and
- Extent of native vegetation: 0.043 hectares of native vegetation.

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 study area are provided below.

- 0.014 general habitat units and must include the following offset attribute requirements:
  - Minimum strategic biodiversity value (SBV) of 0.683; and
  - Occur within the Glenelg Hopkins CMA boundary or the Moyne or Glenelg municipal districts.

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

Offset statement

General habitat units required for each local government area include the following.

- Moyne Shire 1.207 habitat units
- Glenelg Shire 0.013 habitat units.

Offsets will be secured through an accredited native vegetation offset broker. Discussions have been initiated with Vegetation Link and they have confirmed that they have a landowner located in the Glenelg Hopkins CMA that can provide the offsets.

5.6.2. 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.

The Referral Decision of the Commonwealth Minister for the Environment included rare flora as a basis for making the project a Controlled Action as at the time of the Referral, parts of the layout had not been surveyed at seasonally appropriate times for these species. While no listed flora species have been detected in the current footprint, areas that are yet to undergo targeted surveys (totalling 0.366 hectares) are shown in Figure 5. The presence (or otherwise) of listed flora species will need to be confirmed in these areas prior to construction.

SHWLTP was also part of the trigger for this decision in view of the lack of confirmation of the status of the community in areas designated as 'potential' SHWLTP due to unsuitable conditions prevailing before the Referral was submitted and the potential for changes in water regime in wetlands that support the community from construction and operational impacts. To resolve this, a detailed assessment of these areas has been undertaken in areas impacted by the layout. Additionally, a surface water impact assessment has been undertaken to understand hydrological impacts in areas where this community may occur.

As impacts to 0.486 hectares of *Seasonal Herbaceous Wetland (Freshwater) of the Temperate Lowland Plain* cannot be avoided or mitigated, an offset package in line with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy will need to be provided.

The package must include, but not be limited to, the following:

- Offset Strategy
    - A description of the offset site(s) including location, size, condition and environmental values.
    - Details of the surveys undertaken in accordance with the survey guidelines used to confirm the presence of the protected matter at the offset site.
    - Details of the quality of the offset site and habitat characteristics for the protected matter.
    - Details of on-going threats to the protected matter at the offset site.
    - A comparison of the environmental values as compared to the impact site.
    - Justification of how the offset package meets the EPBC Act Environmental Offsets Policy.
- Offset Management Plan
    - The specific environmental outcomes to be achieved.
    - Details on how the offset will be secured, managed and monitored to meet these environmental outcomes, including:
        - Mechanism to secure and timeframe, management actions, performance targets, monitoring methodology and review criteria.
        - Responsibility and timing for implementation of actions.

In all cases targets and criteria should be specific and measurable.

Discussions with an offset broker (Vegetation Link) have been initiated. They have a landowner located within the Glenelg Hopkins Catchment Management Authority that can supply the offsets on their property.

Offsets required by the State can contribute to offset obligations under the EPBC Act if those offsets also meet the requirements of the EPBC Act Environmental Offsets Policy. Seasonal Herbaceous Wetland offset sites are limited in Victoria. Discussions with landowner that has Seasonal Herbaceous Wetlands on their property are continuing. On approval more detailed surveys will be undertaken at the property and an offset strategy and management plan will be produced as outlined above.

5.6.3. FFG Act

The Victorian FFG Act lists threatened and protected species and ecological communities (DELWP 2017c, DELWP 2017d). 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 following FFG Act values listed as threatened or protected are susceptible to impacts from the proposed development on public land:

- *Acacia mearnsii (*member of a genus *protected* under the FFG Act);
- *Acacia verticillata (*member of a genus *protected* under the FFG Act);
- *Melaleuca halmaturorum (*species *listed* under the FFG Act); and
- *Cassina aculeata* (member of a genus *protected* under the FFG Act).

A Protected Flora Permit would be required from DELWP to remove the abovementioned plants taxa from public land. Application forms for Protected Flora Permits can be obtained from DELWP offices or from their customer service centre.

5.6.4. 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 study area, must be controlled.

- Blackberry
- Gorse
- Perennial Thistle
- St John's Wort
- 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. Groundwater dependent ecosystems

KEY FINDINGS

In the GDEs toolbox (SKM 2011), groundwater is defined as *subsurface water located in the zone of saturation in pores, fractures in rocks and cavities*. Groundwater dependent ecosystems (GDEs) are defined as *ecosystems that require access to groundwater to meet all or some of their water requirements to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide.*

The toolbox (SKM 2011) further divides GDEs into three types:

- **Aquifer and cave ecosystems (Type 1)** including karst aquifer systems, fractured rock, saturated sedimentary environments and the hyporheic zones of rivers, floodplains and coastal environments.
- **Ecosystems dependent on the surface expression of groundwater (Type 2)** include wetlands, lakes, seeps, springs, river baseflow, coastal areas and estuaries that constitute brackish water and marine ecosystems. In these cases, the groundwater extends above the earth surface, as a visible expression.
- **Ecosystems dependent on subsurface presence of groundwater (Type 3)** (via the capillary fringe) include terrestrial vegetation that depends on groundwater fully or on a seasonal or episodic basis to prevent water stress and generally avoid adverse impacts to their condition.

All three types of GDEs identified in the toolbox (SKM 2011) have the potential to occur within the WWF.

The hydrogeological and hydrological impact assessment for the project (Water Technology 2022) recognises the presence of aquifers (including the possibility of a perched aquifer) within WWF; however, no investigation of whether these subsurface aquifers support subterranean ecosystems has been undertaken. But the local groundwater environment was assessed and no subterranean GDEs have been identified in the study area.

The hydrogeological and hydrological impact assessment has notes that groundwater within the region is shallow across the project site, estimated to be between 1 and 12 metres below natural surface level. Localised areas of shallow groundwater (less than 3 metres below natural surface level) are likely to occur, particularly in topographic lows (Water Technology 2022). Groundwater levels were shown to vary markedly between seasons, with the highest levels occurring in late spring following recharge by winter rainfall and the lowest levels occurring in late summer. Water Technology (2022) note that groundwater may discharge into streams (as baseflow) where the streams are aligned with contacts between the stony rises and underlying units, such as along the Shaw River and a at the toes of stony rise outcrops.

The relatively high rainfall at the site, ephemeral nature of wetlands and smaller watercourses, and fluctuation of waterbodies with rainfall weighs against the presence of Type 2 and Type 3 GDEs. It is, however, recognised that wetland and terrestrial vegetation types may benefit from access to groundwater over summer and during drought if it is available at that time. Colvin et al. (2003) note that demonstration of groundwater use does not necessarily equate to groundwater dependence, while DPI (2010) note that defining the degree of dependency on the subsurface presence of groundwater is difficult, given that a species may use groundwater once every decade to survive or once each year. Furthermore, GDE dependence on groundwater is highly variable, ranging from partially and infrequently to continually and wholly dependent (DPI 2010).

By dependence it is meant that the ecosystem would be significantly altered and even irreversibly degraded if groundwater availability was altered beyond its 'normal' range of fluctuation (Colvin *et al*. 2003).

While there is a moderate to high likelihood that likely that terrestrial and aquatic ecosystems receive groundwater inflows Newer Volcanic Group basalts aquifer in addition to rainfall, Water Technology (2022) concluded that these effects as a result of the project were likely to be very low to low. The key potential impact related to groundwater drawdown as a result of developing an on-site quarry. Water Technology (2022) predicted that the likely drawdown from the quarry pit dewatering would extend out to 518 metres from the quarry. Within this area there is a small area of mapped aquatic GDE is on the edge of the 0-metre drawdown contour for the likely groundwater drawdown scenario. No material impact from the operation of the quarry to aquatic GDEs is predicted with a negligible reduction in groundwater levels predicted. As such quarry drawdown was assessed to be unlikely to impact surrounding potential terrestrial or aquatic GDEs.

With preventative measures in place, the risk of accidentally released, fuels and chemicals stored within the project site impacting GDEs was assessed by Water Technology (2022) to be low.

The hydrogeological and hydrological report (Water Technology 2022) includes an assessment of impacts to potential GDEs within the WWF. This assessment determined that the likely effects to GDEs arising from the project is low, with a range of management measures recommended (Water Technology 2022). The same report notes that the impervious land surface of the development would be approximately 2% of the total project area and impervious turbine foundations will be covered with soil which can absorb rainfall. Therefore, Water Technology (2022) consider the cumulative impact of the proposed impervious infrastructure on groundwater recharge to be insignificant.

As such, it is considered unlikely that the project would detrimentally impact any GDEs that may occur within the WWF site.

6.1. Introduction

This investigation was commissioned to provide information on the likelihood of occurrence of groundwater dependent ecosystems (GDEs) at WWF in accordance with the GDEs toolbox (SKM 2011).

The potential occurrence of GDEs at WWF is indicated in the Bureau of Meteorology's *Groundwater Dependent Ecosystems Atlas* (BoM 2019) and reported on in the hydrogeological and hydrological assessment for WWF (Water Technology 2022). DELWP have requested that potential impacts to GDEs arising from the development of WWF be considered. The aim of this assessment is to determine the likelihood that GDEs occur within the WWF site using existing vegetation, habitat and the hydrogeological assessment of Water Technology (2022) to assess the potential for impacts on them from the proposed WWF project.

Specifically, the scope of the investigation included:

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

6.2. Existing information and methods

6.2.1. Existing information

Existing information used for this investigation is described below.

- Groundwater Dependent Ecosystems Atlas (BoM 2019)
- Australian groundwater-dependent ecosystems toolbox part 1: assessment framework (SKM 2011)
- Mapping Terrestrial Groundwater Dependent Ecosystems: Method Development and Example Output (DPI 2010)
- Willatook Wind Farm Hydrogeological and Hydrological Assessment (Water Technology 2022).

6.2.2. Definitions

In accordance with the GDEs toolbox (SKM 2011), groundwater is defined as *subsurface water located in the zone of saturation in pores, fractures in rocks and cavities*. Groundwater dependent ecosystems (GDEs) are defined as *ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide.*

The toolbox (SKM 2011) further divides GDEs into three types:

- **Aquifer and cave ecosystems (Type 1)** typically include karst aquifer systems, fractured rock, saturated sedimentary environments and the hyporheic zones of rivers, floodplains and coastal environments. The deep subsurface groundwater environment provides relatively stable, lightless environmental conditions with restricted inputs of energy and low productivity which supports a particular suite of subsurface ecosystems.
- **Ecosystems dependent on the surface expression of groundwater (Type 2)** include wetlands, lakes, seeps, springs, river baseflow, coastal areas and estuaries that constitute brackish water and marine ecosystems. In these cases, the groundwater extends above the earth surface, as a visible expression. In these situations, groundwater provides water to support aquatic biodiversity by providing access to habitat (especially when surface runoff is low) and regulation of water chemistry and temperature.
- **Ecosystems dependent on subsurface presence of groundwater (Type 3)** (via the capillary fringe) include terrestrial vegetation that depends on groundwater fully or on a seasonal or episodic basis in order to prevent water stress and generally avoid adverse impacts to their condition. In these cases, and unlike the situation with Type 2 systems, groundwater is not visible from the earth surface. These ecosystems can exist wherever the water table is within the root zone of the plants, either permanently or episodically.

6.3. Methods

The native vegetation and aquatic habitats recorded within the WWF site have been assessed against relevant Stage 1 questions from Table 3-1 of the GDEs toolbox (SKM 2011) to determine the likelihood of occurrence of GDEs. The following questions were relevant to this assessment.

- Does a stream/river continue to flow all year, or a floodplain waterhole remain wet all year in dry periods?
- Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?

- Is the level of water in a wetland maintained during extended dry periods?
- Is groundwater discharged to the surface for significant periods of time each year at critical times during the lifetime of the dominant vegetation type?
- Is groundwater or the capillary fringe above the water table present within the rooting depth of any vegetation?
- Is the level of water in a wetland/swamp maintained during extended dry periods?

An affirmative answer to one or more of these questions indicates that potentially a GDE is present.

6.3.1. Limitations

This groundwater dependent ecosystems assessment has been undertaken on a desktop-only basis. Nature Advisory, and EHP before it, have undertaken several site assessments at Willatook Wind Farm of all native vegetation and fauna habitats on the site, some of which are potential GDEs. No field visit has been undertaken to ascertain whether the identified ecosystems on the site were groundwater dependent. The assessments of the likelihood of occurrence of GDEs and of the impacts of the project on them therefore rely on the accuracy of existing information (i.e. ground-truthed mapping of remnant ecosystems) and the findings of Water Technology (2022).

6.4. Assessment results

6.4.1. Potential GDE mapping

The *Groundwater Dependent Ecosystems Atlas* (BoM 2019) indicates that several potential aquatic and terrestrial GDEs occur within the WWF site, focussed in the Cockatoo Swamp complex and around major watercourses.

Potential aquatic GDEs mapped by the GDE Atlas consist of:

- Temporary freshwater marshes and meadows associated with the Cockatoo Swamp wetland complex and an area of the Shaw River, which were assigned a high probability that are likely to receive groundwater inflows in addition to rainfall based on regional studies;
- Smaller isolated temporary freshwater marshes and meadows assigned moderate probability to receive groundwater inflows in addition to rainfall based on regional studies; and
- Areas of ephemeral wetlands highly likely to receive groundwater inflows in addition to rainfall based on regional studies.

Terrestrial GDEs in the atlas within and near the project site include six terrestrial vegetation wetland, woodland, and shrubland communities typically in isolated fragments or along major watercourses. These areas have been based on broad-scale EVC modelling. Field investigations of native vegetation present within and near the project site (see Section 5) have been used to accurately describe the presence of potential terrestrial GDEs.

Hydrogeology and Hydrology

The hydrogeology and hydrology of the WWF has been described by Water Technology (2022), and is summarised below.

WWF is dominated by the weathered plains and stony rise basalts of the Newer Volcanic Group. In volcanic plain environments, the groundwater flow is strongly linked to the fractures in basalt where groundwater flow rates are highly variable in both regional and intermediate flow systems.

Depth to groundwater varies across the region. It also varies at different times of the year, influenced by seasonal rainfall and longer-term climatic changes. In general, groundwater is shallow across the project site, estimated to be between 1 and 12 metres below natural surface level. Localised areas of shallow groundwater (less than 3 metres below natural surface level) are likely to occur, particularly in topographic lows. Groundwater level measurements taken during May 2016 at six registered groundwater bores ranged from 1.0 to 11.7 metres below ground level. Additional measurements taken in February 2021 from five boreholes within the proposed quarry extraction site ranged from 2.1 to 5.2 metres below ground level.

Groundwater levels in this region are known to vary markedly between seasons, with the highest levels occurring in late spring after recharge by winter rainfall and the lowest levels occurring in late summer. Monitoring has shown that there is typically an annual fluctuation in groundwater depth of between 0.5 and 3.5 metres, depending on the location, between the beginning of spring when groundwater levels are highest and the end of summer when groundwater levels are at their lowest suggesting groundwater levels are influenced by rainfall.

Groundwater at WWF shows a low hydraulic gradient towards the south-southwest. Groundwater recharge appears to be principally from local rainfall.

Discharge from the Newer Volcanic Group basalt aquifer occurs through groundwater extraction from wells, as well as at the edge of formations and topographic lows where surface expressions of groundwater (e.g. springs and freshwater meadows) are common. Depletion also occurs through evapotranspiration.

One major waterway intersects the WWF site, the Shaw River. Kangaroo Creek and Carmichael Creek discharge to the Shaw River. To the east of the site the Moyne River flows from north to south. Several wetlands identified by the VWI are located within the site. Inundation can also be caused by direct rainfall within the site flowing along gullies and ephemeral waterways. The Shaw River is the most significant waterway within the development area.

Many shallow, ephemeral wetlands on the WWF site have been farmed for over a century for pasture and some cropping. In the course of agricultural development they have been drained permanently through the construction of drains that remove natural topographic features that naturally impede water flow out of wetland basins. Such altered wetlands remain dry most of the year, filling briefly then draining rapidly after large rainfall events. There is no evidence that these shallow systems either support remnant native vegetation (i.e. represent remnant ecosystems) or receive groundwater surface discharge.

Aquatic habitats

Assessment of aquatic habitats has been undertaken by Nature Advisory with a specific focus on flora and fauna species and communities listed on environmental legislation. These habitats are sporadic in the study area and vary in form from permanent rivers to ephemeral drain lines. Many supported terrestrial and aquatic vegetation.

Most seasonal wetlands within the WWF site were found to be ephemeral, with the exception of waterways contiguous with the Moyne River. Although typically lacking floristic diversity, the hydrology of wetlands within the WWF site still supports many fauna species. Characterised by sedges and rushes, the low-lying areas are typically inundated during the wetter months. These areas are generally grazed whenever possible. The largest of these habitats is Cockatoo Swamp which is spread out across agricultural land.

Most of the waterways, creeks and rivers, if not completely dry, are reduced to small ponds and pools in the dry season. These waterways would be habitat for aquatic fauna. Other watercourses were ephemeral (i.e. they dry out completely) and less vegetated would provide temporary aquatic habitat.

Native vegetation

Vegetation on the WWF site consisted of eight EVCs: Aquatic Herbland (EVC 653), Basalt Shrubby Woodland (EVC 642), Heavier-soils Plains Grassland (EVC 132_61), Plains Grassy Wetland (EVC 125), Higher-rainfall Plains Grassy Woodland (EVC 55_63), Stony Knoll Shrubland (EVC 649), Swamp Scrub (EVC 53) and Tall Marsh (EVC 821).

Assessment of native vegetation against GDEs criteria

Table 3-1 of the GDEs toolbox contains a series of questions that can be used to determine the likelihood of occurrence of GDEs. Native vegetation and habitat recorded within the WWF is assessed against relevant questions in Table 13.

6.4.2. Aquifer and cave ecosystems (Type 1)

Figure 2-7 of the toolkit identifies the Willatook Wind Farm site as a Volcano Karst area (SKM 2011); however, the hydrogeological assessment (Water Technology 2022) does not identify karst systems within the WWF site, nor have any cave systems been identified on-site during assessments undertaken by Nature Advisory.

The Geoscience assessment of the WWF site by Environmental GeoSurveys (Neville Rosengren) in 2022 reported the following findings: “Volcano-speleology is the recognition and exploration of caves formed in lava flows. Unlike caves developed in other lithologies (principally limestone) by dissolution and other weathering processes, caves in volcanic rocks are a consequence of the mechanisms of volcanic emplacement…. There is one recorded cave on the Mount Rouse lavas and a possible cave entrance on a property south of the Gerrigerrup – Minhamite Road. Both are outside the present study area. No caves are recorded for the area of the present wind farm on any database maintained by formal speleological societies. Given the relatively high intensity and long history of rural land use, and the high visibility and accessibility of the lava surfaces compared with the flows from Mount Eccles and Mount Napier where there are multiple caves, the likelihood of unknown cave entrances occurring is low.”

The hydrogeological assessment (Water Technology 2022) does identify aquifers within the WWF site, including the potential for a perched aquifer. DPI (2010) identifies that aquifers can support a diverse array of ecosystems, usually dominated by microbial and invertebrate species. No data on the occurrence of aquifer ecosystems within the WWF has been collected.

Therefore, it is considered unlikely that WWF supports cave GDEs, but possible that aquifer fed GDEs occur within the WWF site.

6.4.3. Ecosystems dependent on the surface expression of groundwater (Type 2)

Four vegetation types recorded within the WWF site are considered potentially to be Type 2 GDEs. These are:

- Plains Grassy Wetland (EVC 125);
- Tall Marsh (EVC 821);
- Aquatic Herbland (EVC 653); and

- Swamp Scrub (EVC 53).

In addition, Type 2 GDEs can include aquatic ecosystems such as in rivers and creeks with groundwater inflow that do not meet the definition of a patch of native vegetation.

Aquatic Herbland and most Plains Grassy Wetland at WWF occurs in wet depressions away from watercourses. These have been found to be ephemeral, with water level fluctuating seasonally according to rainfall. This suggests that although these vegetation types may interact with groundwater, it is not their primary water source.

Swamp Scrub in the region are often associated with spring fed systems. No such spring fed systems were recorded in the study area.

Tall Marsh, Swamp Scrub and a small area of Plains Grassy Wetland at WWF occur on watercourses. Some of these are permanent, while others are ephemeral. The water level of all watercourses at WWF fluctuates seasonally according to rainfall. This suggests that although these vegetation types may interact with groundwater, it is not the primary water source for these vegetation types and they are supported by seasonal high flows from watercourses and local catchment runoff.

6.4.4. Ecosystems dependent on subsurface presence of groundwater (Type 3)

Four vegetation types recorded within the WWF site are considered to potentially be Type 3 GDEs. These are:

- Stony Knoll Shrubland (EVC 649);
- Higher-rainfall Plains Grassy Woodland (EVC 55_63);
- Basalt Shrubby Woodland (EVC 642); and
- Heavier-soils Plains Grassland (EVC 132_61).

The degree of interaction (if any) of these vegetation types with groundwater cannot be determined from the currently available data. Given the relatively high annual rainfall of the site (BoM 2021a), it is considered likely that the primary source of water for terrestrial vegetation types is rainfall. Terrestrial vegetation types may benefit from access to groundwater over summer and during drought but current evidence makes this unlikely.

The low stature and generally shallow root systems of the plants that make up most of the terrestrial EVCs in the study area make it unlikely that this vegetation is dependent on groundwater for its survival (Table 13).

Table 13: Assessment of native vegetation at WWF against relevant GDEs likelihood of occurrence questions (from SKM 2011)

EVC	Ecosystems reliant on surface expressions of groundwater				Ecosystems reliant on the subsurface presence of groundwater	
	Does a stream/river continue to flow all year, or a floodplain waterhole remain wet all year in dry periods?	Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?	Is the level of water in a wetland maintained during extended dry periods?	Is groundwater discharged to the surface for significant periods of time each year at critical times during the lifetime of the dominant vegetation type?	Is groundwater or the capillary fringe above the watertable present within the rooting depth of any vegetation?	Is the level of water in a wetland/swamp maintained during extended dry periods?
Plains Grassy Wetland (EVC 125)	The majority of these wetlands do not occur on streams or rivers. For those that occur on streams or rivers, the flow fluctuates seasonally with rainfall.	The majority of these wetlands do not occur on streams or rivers. Unknown for those that occur on streams or rivers.	No. All but one wetland are ephemeral and dry out over summer. One wetland on the Moyne River relies on flooding for water but water level fluctuates seasonally.	Unknown, although the water level in this vegetation type appears to closely match rainfall.	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	No. All Plains Grassy Wetland are ephemeral and dry out over summer. One wetland on the Moyne River relies on flooding for water, but water level fluctuates seasonally.
Stony Knoll Shrubland (EVC 649)	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur within wetland	No. No groundwater discharge observed in this vegetation type.	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	N/A Vegetation type does not occur within wetland
Higher-rainfall Plains Grassy Woodland (EVC 55_63)	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur within wetland	No. No groundwater discharge observed in this vegetation type.	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	N/A Vegetation type does not occur within wetland

EVC	Ecosystems reliant on surface expressions of groundwater				Ecosystems reliant on the subsurface presence of groundwater	
	Does a stream/river continue to flow all year, or a floodplain waterhole remain wet all year in dry periods?	Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?	Is the level of water in a wetland maintained during extended dry periods?	Is groundwater discharged to the surface for significant periods of time each year at critical times during the lifetime of the dominant vegetation type?	Is groundwater or the capillary fringe above the watertable present within the rooting depth of any vegetation?	Is the level of water in a wetland/swamp maintained during extended dry periods?
Basalt Shrubby Woodland (EVC 642)	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur within wetland	No. No groundwater discharge observed in this vegetation type.	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	N/A Vegetation type does not occur within wetland
Heavier-soils Plains Grassland (EVC 132_61)	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur within wetland	No. No groundwater discharge observed in this vegetation type.	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	N/A Vegetation type does not occur within wetland
Tall Marsh (EVC 821)	Yes, although flow fluctuates seasonally with rainfall.	Unknown	Yes, although flow fluctuates seasonally with rainfall.	Unknown	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	Yes, although flow fluctuates seasonally with rainfall.
Aquatic Herbland (EVC 653)	N/A Vegetation type does not occur on streams or rivers	N/A Vegetation type does not occur on streams or rivers	No. Wetland is ephemeral and dries out over summer.	Unknown	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	No. Wetland is ephemeral and dries out over summer.

EVC	Ecosystems reliant on surface expressions of groundwater				Ecosystems reliant on the subsurface presence of groundwater	
	Does a stream/river continue to flow all year, or a floodplain waterhole remain wet all year in dry periods?	Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?	Is the level of water in a wetland maintained during extended dry periods?	Is groundwater discharged to the surface for significant periods of time each year at critical times during the lifetime of the dominant vegetation type?	Is groundwater or the capillary fringe above the watertable present within the rooting depth of any vegetation?	Is the level of water in a wetland/swamp maintained during extended dry periods?
Swamp Scrub (EVC 53)	No. Watercourse is ephemeral.	Unknown	No. Swamp is ephemeral and dries out over summer.	Unknown	Made up of shallow-rooted plants unlikely to depend on groundwater for their survival.	No. Swamp is ephemeral and dries out over summer.

6.5. Impact assessment

6.5.1. Impact pathways

Impact pathways to terrestrial GDEs include:

- Physical disturbance;
- Reduced groundwater availability through drawdown as a result of quarrying and a lesser extent from constructing wind turbine foundations; and
- Reduced groundwater quality due to spills of hazardous materials.

6.5.2. Mitigation measures

Avoidance of impacts by design has been central to the development of the project. The approach has been to firstly avoid potential impacts if feasible and practical, then to minimise the severity of the impact over space and time, followed by the application of targeted mitigation and management measures.

A 100-metre buffer was placed around all mapped wetlands on the Victorian Wetland Inventory (including areas that are mapped as being of high probability of groundwater inflow GDE systems) to exclude all project infrastructure. This buffer was selected as a means of avoiding physical disturbance to wetlands and their fringes, and limiting poor water quality reaching these wetlands from construction works zones.

A single, large buffer was placed around a series of wetlands that form the Cockatoo Swamp is response to the potential breeding habitat by Brolga. This results would ensure avoidance of most of mapped GDEs in the WWF site.

Impacts to potential GDEs have been avoided through the following measures:

- 100 m buffer applied to potential aquatic GDEs. In some instances, these areas were already buffered by large buffer areas (e.g., within the Brolga buffers) discussed above;
- Watercourses including the Shaw River, Back 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, including trucks from the quarry, 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 WWF site.

A range of management controls are proposed by Water Technology (2022) to manage the potential effects of groundwater drawdown and accidental spills of hazardous materials including the commitment to develop a Water Management Plan (WMP).

6.5.3. Residual effects

Groundwater extraction would be limited to locations where a perched or very shallow aquifer is encountered during construction. Excavation during construction would typically be to depths of less than 3.5 metres, except at the quarry site. If shallow groundwater is intercepted during construction, localised groundwater from the uppermost zones may seep into the excavated area. Under this scenario, groundwater abstraction via pumping (termed 'dewatering' of the excavation) may be required to create a safe work area. Dewatering may temporarily lower the water table until the concrete foundations are laid, however, as the construction period for turbine foundations is short (i.e., up to two weeks), impacts are unlikely materially to affect GDEs.

All three types of GDEs identified in the toolbox (SKM 2011) have the potential to occur within the WWF, and sufficient evidence does not exist to comprehensively establish their presence (or otherwise); however, based on the available evidence, it is considered likely that Type 2 and 3 GDEs are present, but unlikely that Type 1 GDEs occur at the WWF site. Based on the stature and likely root depth of the vegetation concerned however, groundwater dependence is unlikely to be widespread as the grasses and herbs that dominate the EVCs on the site have shallow roots and rely on surface water. The relatively high rainfall at the site, ephemeral nature of wetlands and smaller watercourses, and fluctuation of waterbodies with rainfall, as well as the predominance of herb-rich vegetation types weighs against the presence of Type 2 and Type 3 GDEs. It is, however, recognised that wetland and terrestrial vegetation types may benefit from access to groundwater inflow systems over summer and during drought. Colvin *et al.* (2003) note that demonstration of groundwater use does not necessarily equate to groundwater dependence, while DPI (2010) note that defining the degree of dependency on the subsurface presence of groundwater is difficult, given that a species may use groundwater once every decade to survive or once each year. Furthermore, GDE dependence on groundwater is highly variable, ranging from partially and infrequently to continually and wholly dependent (DPI 2010).

By dependence it is meant that the ecosystem would be significantly altered and even irreversibly degraded if groundwater availability was altered beyond its 'normal' range of fluctuation (Colvin *et al.* 2003). Given the relatively high rainfall of the WWF and the low stature and shallow roots of native vegetation in the study area, native vegetation and associated wetland ecosystems are unlikely to be highly dependent on groundwater.

All three GDE types identified in the toolbox (SKM 2011) have the potential to occur within the WWF site but sufficient evidence does not exist to comprehensively establish their presence (or otherwise). Confirmation of their presence (or otherwise) is likely to require a number of years of monitoring. Therefore, it is considered most practical to proceed with consideration of potential impacts and implications on the conservative assumption that GDEs occur within the WWF site, despite it being more likely that remnant ecosystems on the site are not dependent on groundwater.

Potential impacts of physical disturbance to native vegetation communities (which may also be defined as GDEs) is described in Section 5.5.

The hydrogeological and hydrological impact assessment (Water Technology 2022) includes an assessment of impacts to potential GDEs in the three different aquifers that may occur within the

WWF. The assessment on GDE's was undertaken using different impact pathways and a residual impact significance was concluded considering changes in drawdown and extent of groundwater. Water Technology (2022) concluded that the residual impact significance as a result of the project were likely to be very low to low.

The key potential impact related to groundwater drawdown as a result of developing an on-site quarry. Water Technology (2022) predicted that the likely drawdown from the quarry pit dewatering would extend from the quarry out to 518 metres for the base case scenario and up to 1,080 metres for the high hydraulic conductivity scenario. Under the base case scenario there is one aquatic GDE (ephemeral wetland) that may experience some drawdown predicted to be around two metres. This wetland represents 2% of the potential GDE's within the study area.

During turbine foundation construction, construction of infrastructure foundations and foundation excavations drawdown will depend on the time of year construction activities take place and is expected to be brief only occurring during winter and spring. Impacts to GDE's from these activities are considered to be very low.

With preventative measures in place, the risk of accidentally released, fuels and chemicals stored within the project site impacting GDEs was assessed by Water Technology (2022) to be low.

To minimise the potential for impacts on GDE's mitigation measures have been incorporated into the design of the project with buffers from aquatic and terrestrial systems. The quarry has been located away from sensitive receptors including groundwater bores. Management measures have also been proposed for the construction, operation and decommission phases of the project to further reduce impacts. Given these findings above and the implementation of mitigation measures, it is considered unlikely that the project would detrimentally impact GDEs if they were found to occur within the WWF site.

7. Fauna overview

KEY FINDINGS

Initial fauna assessments of the WWF site were done between 2009 and 2011 with additional targeted surveys for fauna in 2018, 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 (2018) described seven fauna habitats across the study area, including; modified grassland, woodland and scattered trees, stony rises, waterways, swamps, planted vegetation 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 2018, DELWP 2019, DAWE 2021a) found a total of 37 listed species under the EPBC Act and 49 species 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:

- Twenty-two bird species, including 17 listed as migratory;
- Seven mammal species, including two bats;
- One reptile species;
- One frog species;
- Three fish species; and
- Two invertebrate species.

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

- Thirty-three bird species;
- Seven mammal species;
- Two reptile species;
- Two frog species;
- Three fish species; and
- Two invertebrate species.

Of the listed species with potential to occur, a number were ruled out based on field and habitat assessments. Of the remaining species, those listed under the EPBC Act considered likely to occur included:

- Eight listed migratory bird species: Common Greenshank, Curlew Sandpiper, Fork-tailed Swift, Glossy Ibis, Latham's Snipe, Sharp-tailed Sandpiper, Red-necked Stint and White-throated Needletail;
- Two listed threatened bat species: Southern Bent-wing Bat and Grey-headed Flying-fox;
- One listed threatened frog species: Growling Grass Frog; and
- Two listed threatened fish species: Dwarf (Little) Galaxias, Yarra Pygmy Perch.

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

- Five bird species: Black Falcon, Blue-billed Duck, Brolga, Eastern Great Egret and Plumed Egret;
- One bat species: Yellow-bellied Sheathtail Bat; and

- One reptile species: Glossy Grass 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, Striped Legless Lizard surveys, aquatic habitat surveys, Swamp Skink surveys and habitat assessments, and Growling Grass Frog habitat assessments. The methods and results of these surveys are described in later sections of this report.

Assessment of potential impacts on Brolga are provided in a separate report (Nature Advisory 2022).

7.1. 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.

7.2. Existing information

Existing information used for this investigation is described below.

7.2.1. Existing reporting and documentation

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

- Final Report Biodiversity Assessment: Willatook Wind Farm, Willatook, Victoria, Prepared for Willatook Wind Farm Pty Ltd (EHP 2018)
- 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 (DoEE 2017)
- DSE's Biodiversity Precinct Structure 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).

7.2.2. Listed matters

Existing fauna 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 boundary of the proposed wind farm. In some circumstances the search region was expanded due to lack of previous records and this circumstance the search region was extended to a 40 kilometre radius from the centre point 38˚ 08' 46" S and 142˚ 08' 33" E and referred to as the 'wider search region'.

A list of the fauna species recorded in the search region was obtained from the Victorian Biodiversity Atlas (VBA), a database administered by DELWP (2019). A list of bird species was obtained from Birdata, a database administered by Birdlife Australia (2019). A list of fauna species recorded in the study area has been presented in Appendix 10.

The online EPBC Act Protected Matters Search Tool (DAWE 2021a) was consulted to determine whether nationally listed species or communities potentially occurred in the search region based on habitat modelling.

An initial desktop review was undertaken in the period 2009 to 2011 to determine the likelihood of listed species occurring on the WWF site (EHP 2018). 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

7.2.3. Field methods

Several fauna assessments have been undertaken at the proposed wind farm site. Early surveys were undertaken by Ecology Partners Pty Ltd from 2009 to 2011 then by Nature Advisory Pty Ltd from 2018 onwards. Fauna assessments undertaken at the WWF site are listed below with a summary of the methods used. More detail is provided in subsequent sections of this report.

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 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.

- 30th October – 22nd November 2009
- 20th October – 22nd November 2010
- 31st January – 28th March 2011
- 25th October – 14th December 2018
- 7th February – 29th April 2019
- 1st May 2019 – 1st May 2020.

Detectors were deployed across the WWF site to determine the spatial distribution of bats utilising the proposed wind farm site 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 proposed wind farm site 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 prescribed by DEWLP and followed by the proponent. A total of over 4,900 detector nights of survey were undertaken seasonally in six out of 11 years, significantly more than required for impact assessment at any other proposed wind farm site in Victoria. Full details are provided in Section 8 of this report.

Bird utilisation survey

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

- 4th – 6th and 16th – 20th November 2009
- 15th – 20th October 2018
- 25th February – 1st March 2019.

Full details of the bird utilisation surveys are provided in section 9of this report.

Migratory bird survey

Wetlands in the proposed wind farm site 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.

- 4th – 7th November 2018
- 11th – 13th December 2018
- 11th – 12th January 2019
- 23rd – 24th January 2019
- 28th February 2019.

Details of the methods and results of these surveys are presented in section 9 of this report.

Striped Legless Lizard survey

The tile grid method was used to determine the presence or absence of the Striped Legless Lizard. The deployment of tiles and tile grid numbers in 2018 were consistent with the EPBC Act survey guidelines for this species (DSEWPAC 2011); previous surveys pre-dated these standards. Searches of tile grids were undertaken during the following periods:

- 4th November 2009 – 19th February 2010
- 13th September – 22nd November 2018.

Full details of the survey methods and results are provided in section 10 of this report.

Swamp Skink

Searches of the Willatook Wind Farm site for habitats suitable for the Swamp Skink were undertaken during the following periods.

- 11th – 13th December 2018
- 11th – 12th January 2019
- 23rd – 24th January 2019.

Further details can be found in section 10 of this report.

Growling Grass Frog

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.

- 16th – 20th November 2009
- 4th – 7th November 2018
- 11th – 13th December 2018
- 11th – 12th January 2019.

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

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.

- 15th - 18th December 2009.

The methods and results of these surveys are detailed in section 11 of this report.

Brolga

Please note the Brolga matters are not included in this report but are considered in a separate report (Nature Advisory 2022).

7.3. Results

7.3.1. Review of existing information

Nature Advisory undertook additional investigations to provide updated information on listed fauna species. Initial desktop investigations indicated that a total of 37 listed species under the EPBC Act and 48 species under the FFG Act had been recorded 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.

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

- Twenty-three bird species, including 18 listed as migratory;
- Seven mammal species, including two bats;
- One reptile;
- One frog;
- Three fish; and
- Two invertebrates.

A total of 48 listed species under the FFG Act are considered likely to occur in the search region included:

- Twenty-five bird species;
- Nine mammal species;
- Five reptile species;
- Two frog species;
- Three fish species; and
- Four invertebrate species.

Table 6 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.

Species likely to occur are listed below, including additional listed migratory species also considered likely to occur in the more recent analysis.

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*)
- Eastern Cattle Egret (*Ardea coromandus*)

- Eastern Great Egret (*Ardea modesta*)
- Fork-tailed Swift (*Apus pacificus*)
- Glossy Ibis (*Plegadis falcinellus*)
- 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*).

Amphibians

- Growling Grass Frog (*Litoria raniformis*).

Fish

- Little (Dwarf) Galaxias (*Galaxiella toourtkoourt*, listed as *Galaxiella pusilla*)
- Yarra Pygmy Perch (*Nannoperca obscura*).

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*),
- Eastern Great Egret (*Ardea modesta),*
- Hardhead (*Aythya australis*),
- Little Eagle (*Hieraaetus morphnoides*)
- Musk Duck (*Biziura lobata*)
- Plumed Egret (*Ardea intermedia plumifera*).

Bats

- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).

Reptiles

- Glossy Grass Skink (*Pseudemoia rawlinsoni*).

7.3.2. Field surveys and habitat assessments

Targeted surveys and detailed habitat assessments for listed species were undertaken in the study area to determine their status and distribution on the wind farm site, including for migratory shorebird species, Southern Bent-wing Bat, Striped Legless Lizard, Glossy Grass Skink, Swamp Skink and Growling Grass Frog. FFG Act listed bird and bat species have generally been addressed by bird utilisation surveys and bat surveys. These species and groups are considered in latter sections of this report.

Table 14: Listed fauna species likelihood of occurrence

Common Name	Scientific name	EPBC-T	EPBC-M	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).	6	12/11/19	Paucity of suitable habitat. Unlikely to occur regularly.
Australasian Shoveler	*Anas rhynchotis*			v	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).	16	9/12/19	Habitat exists. Recorded on site.
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 (DAWE 2021bDAWE 2021b).	2	2/2/09	Little or no suitable habitat. Unlikely to occur regularly.
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).	1	22/9/81	This species is nomadic and may fly over the study area on occasion - potential to occur.
Blue-billed Duck	*Oxyura australis*			v	Terrestrial wetlands and prefers deep permanent, well vegetated water bodies (Marchant & Higgins 1990).	1	22/7/01	Some suitable habitat in wetlands - potential to occur.
Brolga	*Grus rubicunda*			e	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).	187	13/11/19	Confirmed as occurring in the study area: one pair has been regularly recorded breeding next to the wind farm project.
Common Greenshank	*Tringa nebularia*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))	e	Inhabits wide range of coastal or inland wetlands with varying levels of salinity; mainly muddy margins or rocky shores of wetlands (Higgins & Davies 1996).	None	N/A	Suitable wetland habitat. Recorded on site.
Common Sandpiper	*Actitis hypoleucos*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H)	v	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	No suitable habitat. Unlikely to occur.
Curlew Sandpiper	*Calidris ferruginea*	CR	M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))	cr	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	29/11/16	Suitable wetland habitat. Potential to occur.
Eastern Curlew	*Numenius madagascariensis*	CR	M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H)	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	No suitable habitat. Unlikely to occur.
Eastern Cattle Egret	*Ardea coromandus*		M (JAMBA, CAMBA)		Wet pastures in association with cattle; roosting and breeding at wetlands (Marchant and Higgins 1990).	4	22/10/00	Suitable wetland and pasture habitat. Potential to occur.
Eastern Great Egret	*Ardea modesta*			v	Occurs in a variety of wetlands including: permanent water bodies on flood plains; shallows of deep permanent lakes, either open or vegetated with shrubs or trees; semi-permanent swamps with tall emergent vegetation (e.g. bulrush) and herb dominated seasonal swamps with abundant aquatic flora (Marchant and Higgins 1990).	14	10/12/19	Suitable habitat in wetlands, has been recorded in the study area.
Eastern Ground Parrot	*Pezoporus wallicus*				Coastal heath, and in Tasmania, upland moors (Buttongrass plain) (Higgins 1999).	1	17/4/07	No suitable habitat. Unlikely to occur.
Fork-tailed Swift	*Apus pacificus*		M (JAMBA, CAMBA, ROKAMBA)		The species can occur over 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).	2	25/2/19	Suitable habitat. Recorded flying over the site.
Freckled Duck	*Stictonetta naevosa*			e	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 and Higgins 1990).	1	11/11/07	Paucity of suitable habitat. Unlikely to occur regularly.

Common Name	Scientific name	EPBC-T	EPBC-M	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Glossy Ibis	*Plegadis falcinellus*		M (CAMBA, Bonn (A2S))		Prefer freshwater inland wetlands, in particular, permanent or ephemeral water bodies and swamps with abundant vegetation (Marchant & Higgins 1990).	4	11/12/19	Small area of suitable habitat. Potential to occur.
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*			e	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).	3	24/6/07	Paucity of suitable habitat. Unlikely to occur regularly.
Hardhead	*Aythya australis*			v	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).	16	9/12/19	Suitable habitat on site - potential to occur.
Latham's Snipe	*Gallinago hardwickii*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H)		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).	6	29/10/19	Suitable habitat. Recorded on site.
Little Eagle	*Hieraaetus morphnoides*			v	Open wooded and forested country including arid areas (Marchant and Higgins 1993).	5	20/4/89	Suitable habitat on site - likely to occur.
Magpie Goose	*Anseranas semipalmata*			v	Terrestrial and aquatic habitats, but activities cantered on wetlands, mainly those on floodplains of rivers (Marchant & Higgins 1990).	2	11/11/19	Suitable habitat on site. Paucity of records suggest that it is unlikely to occur regularly.
Musk Duck	*Biziura lobata*			v	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).	9	11/11/00	Suitable habitat on site - potential to occur.
Orange-bellied Parrot	*Neophema chrysogaster*	CR	M (JAMBA)	cr	The Orange-bellied Parrot is endemic to south-eastern Australia. Its current non-breeding mainland distribution is from the mouth of the Murray River in South Australia, along the coast, to the east of Jack Smith Lake in South Gippsland, Victoria, covering approximately 1000 km of coastline. The most used sites in Victoria are around Port Phillip Bay and Bellarine Peninsula. In South Australia, Carpenter Rocks is the main site. During winter on the mainland, found mostly within 3 km of the coast. In Victoria, they mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries, or, rarely, saltworks. They are also found in low samphire herbland dominated by Beaded Glasswort (*Sarcocornia quinqueflora*), Sea Heath (*Frankenia pauciflora*) or Sea-blite (*Suaeda australis*), and in taller shrubland dominated by Shrubby Glasswort (*Sclerostegia arbuscula*). They are sometimes found in low samphire dominated by Grey Glasswort (*Halosarcia halocnemoides*) or in Chenopodiaceous herbfields. Breeds at Melaleuca in Tas during spring/summer months (DAWE 2021b).	None	N/A	No suitable habitat. Unlikely to occur.
Osprey	*Pandion cristatus*		M (Bonn (A2S))		Rare vagrant to Victoria (Marchant & Higgins 1993). Littoral and coastal habitats and terrestrial wetlands. They are mostly found in coastal areas but occasionally travel inland along major rivers (Johnstone & Storr 1998; Marchant & Higgins 1993; Olsen 1995). They require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993).	None	N/A	No suitable habitat. Unlikely to occur.
Painted Honeyeater	*Grantiella picta*	VU		v	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	No suitable habitat. Unlikely to occur.
Pectoral Sandpiper	*Calidris melanotos*		M (JAMBA, ROKAMBA, Bonn (A2H))		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	No suitable habitat. Unlikely to occur.
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	No suitable habitat. Unlikely to occur.
Plumed Egret	*Ardea intermedia plumifera*			cr	It mainly inhabits terrestrial wetlands; only occasionally visit coastal wetlands and forages amongst aquatic vegetation in shallow water and requires trees for roosting and nesting. It often occurs in wetlands that contain vegetation, including bulrush (Marchant and Higgins 1990).	1	1/11/11	Suitable habitat on site - potential to occur.
Powerful Owl	*Ninox strenua*			v	Open and tall wet sclerophyll forests with sheltered gullies and old growth forest with dense understorey. They are also found in dry forests with box and ironbark eucalypts and River Red Gum. Large old trees with hollows are required by this species for nesting. In Victoria, the Powerful Owl is widespread, having been recorded from most of the state. However, throughout its range it is uncommon and occurs in low densities. (Higgins 1999; Soderquist et al. 2002).	5	2/2/09	No suitable habitat in the study area - unlikely to occur.
Red Knot	*Calidris canutus*	EN	M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H)	e	In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and	None	N/A	No suitable habitat. Unlikely to occur.

Common Name	Scientific name	EPBC-T	EPBC-M	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
					pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (DAWE 2021b).			
Red-necked Stint	*Calidris ruficollis*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H)		In Australasia the Red-necked Stint mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches.	1	27/12/77	Small area of suitable habitat. 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).	4	1/1/69	Paucity of suitable habitat. Unlikely to occur regularly.
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	No suitable habitat. Unlikely to occur.
Sharp-tailed Sandpiper	*Calidris acuminata*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))		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).	3	2/11/09	Suitable wetland habitat. Recorded on site.
Swift Parrot	*Lathamus discolor*	CR		cr	Prefers a narrow range of eucalypts in Victoria, including White Box, Grey 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	No suitable habitat. Unlikely to occur.
White-throated Needletail	*Hirundapus caudacutus*		V, M (JAMBA, CAMBA, ROKAMBA)	v	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).	3	20/3/86	Suitable habitat exists. May pass through/fly over the study area. 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 (DAWE 2021b).	None	N/A	No suitable habitat. Unlikely to occur.
Mammals								
Grey-headed Flying-fox	*Pteropus poliocephalus*	VU		v	Brisbane, Newcastle, Sydney and Melbourne are occupied continuously. Elsewhere, during spring, they are uncommon south of Nowra and widespread in other areas of their range. 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 (DAWE 2021b).	None	N/A	Paucity of suitable habitat. Unlikely to occur regularly, but occasional Flying-fox may pass through.
Heath Mouse	*Pseudomys shortridgei*	EN		e	In eastern Australia, prefers recently burnt (preferably 7–10 years post fire), floral species-rich, treeless, dry heathlands in an area with 600 mm annual rainfall. The optimum situation for the species appears to be a mosaic of habitats of differing maturity, subject to the disturbance by fire. Some populations occur in Eucalypt forest with a heathy understorey (DAWE 2021b).	None	N/A	No suitable habitat. Unlikely to occur.
Eastern Bent-wing Bat	*Miniopterus orianae oceanensis*			cr	Rainforest, wet and dry sclerophyll forest, Melaleuca forests, open woodland and open grasslands (Churchill 2008).	1	7/10/09	At or beyond accepted known range. Unlikely to occur regularly.
Long-nosed Potoroo	*Potorous tridactylus tridactylus*	VU		v	In Victoria coastal heathy woodland; in Tasmania moist forest with dense shrub layer; in the north edge of rainforest (Menkhorst 1995).	None	N/A	No suitable habitat. Unlikely to occur.
Southern Bent-wing Bat	*Miniopterus orianae bassanii*	CR		cr	Roosts in caves during the day, dispersing over a range of habitats at night. Its feeding areas tend to be associated with major drainage systems (Menkhorst 1995).	1	7/10/09	Suitable habitat exists. Recorded in the study area.
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	EN		e	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 (DAWE 2021b).	6	17/12/12	No suitable habitat. Unlikely to occur.
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	EN		e	Rainforest, wet and dry forest, coastal heath and scrub and River Red-gum woodlands along inland rivers (Menkhorst 1995).	12	1/1/82	Suitable habitat exists, but no recent records. Unlikely to occur.
Swamp Antechinus	*Antechinus minimus maritimus*	VU		v	Dense wet heath, tussock grassland, sedgeland heathy woodland and coastal heath and scrub (Menkhorst 1995).	None	N/A	No suitable habitat. Unlikely to occur.

Common Name	Scientific name	EPBC-T	EPBC-M	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*			v	Known to occur from urban, agricultural semi-arid and tall wet forest habitats (Menkhorst 1995).	None	N/A	This species has been recorded in the study area.
Reptiles								
Glossy Grass Skink	*Pseudemoia rawlinsoni*			e	Swamps, lake edges, salt marsh, and boggy creeks with dense vegetation (Wilson & Swan 2003).	5	23/10/18	This species has been recorded in the study area along a road reserve.
Lace Monitor	*Varanus varius*			e	Well timbered areas from dry woodland to wet southern forests and rainforest (Wilson & Swan 2003).	1	2/2/09	No suitable habitat - unlikely to occur.
Swamp Skink	*Lissolepis coventryi*			e	Wetlands including swamp margins, lakes, rivers, creeks and even tidal salt marshes, often associated with tea-tree thickets (Wilson & Swan 2003).	5	2010	Recorded outside the study area along the Moyne River, considered unlikely to occur within the wind farm boundary.
Striped Legless Lizard	*Delma impar*	VU		e	Grassland specialist. Known to occur in some areas dominated by introduced species such as Phalaris aquatica, Serrated 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 ground 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 (DAWE 2021b).	None	N/A	Very little suitable habitat. Surveyed but not detected. Unlikely to occur.
Tussock Skink	*Pseudemoia pagenstecheri*			e	Tussock grasslands with few or no trees (Wilson & Swan (2003).	2	2/2/09	Suitable habitat is limited, was not recorded in targeted surveys using tile grids - unlikely to occur.
Frogs								
Brown Toadlet	*Pseudophryne bibronii*			e	Wet and dry forest, grassy areas besides small creeks, alpine grasslands and mossy bogs (Cogger 2000).	4	4/5/09	No suitable habitat - unlikely to occur.
Growling Grass Frog	*Litoria raniformis*	VU		v	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).	4	9/12/19	Suitable habitat. Recorded on site along the Back Creek.
Fish								
Australian Grayling	*Prototroctes maraena*	VU		e	Large and small coastal streams and rivers with cool, clear waters with a gravel substrate and altering pools and riffles (Cadwallader & Backhouse 1983).	None	N/A	No suitable habitat. Unlikely to occur.
Little Galaxias (Western Plains Galaxiella)	*Galaxiella toourtkoourt*	VU		e	Occurs in swamps, wetlands, shallow lakes, billabongs, small creeks and artificial earthen drains at low elevation. Inhabits mostly shallow areas with still to low water velocities (or often backwaters in faster flowing conditions) and partial shading (Coleman et al 2015). Species clarified in 2015 as a separate species to Dwarf Galaxias. Recorded in the Moyne River.	15	4/2/16	Suitable habitat. Likely to have been recorded on site.
Yarra Pygmy Perch	*Nannoperca obscura*	VU		v	Streams and small lakes, prefers flowing water with abundant aquatic vegetation (Allen et al. 2002).	18	4/2/16	Suitable habitat. Recorded on site.
Invertebrates								
Glenelg Spiny Crayfish	*Euastacus bispinosus*	EN		e	Glenelg Spiny Freshwater Crayfish is considered a specialist species with typically low tolerance to environmental conditions (namely dissolved oxygen concentrations), ensuring that species requires specific habitat requirements. As with other *Euastacus* species, Glenelg Spiny Freshwater Crayfish prefer permanently-flowing, cool (and shaded) and well-oxygenated water (Morgan 1986; Morgan 1997). Other habitat requirements vary across Victorian and South Australian populations.	None	N/A	No suitable habitat. Unlikely to occur.
Golden Sun Moth	*Synemon plana*	CR		v	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).	None	N/A	A total area of 3.1333ha of potential habitat (Plains Grassland) exist across the study area. Potential habitat are in small patches and are very limited, fragmented and considered low quality. The study area is outside current distribution of this species (27km SW of known distribution), Due to the study area being outside the known distribution combined with the current condition of areas of potential habitat this species was considered unlikely to occur.
Hairy Burrowing Crayfish	*Engaeus sericatus*			v	Occurs along the edges of rivers and streams.	2	1/1/08	The study area is outside its known distribution though chimneys of burrowing

Common Name	Scientific name	EPBC-T	EPBC-M	FFG	Habitat	Number of records	Date of last record	Likelihood of occurrence
								crayfish were present in a small section on the banks of the Moyne River and adjacent wetland. This species has been recorded outside the study area though is considered unlikely to occur within the study area.
NE Grampians Bush Yabby	*Geocharax falcata*			e	Seasonally dry wetlands (Johnston and Robson 2009).	2	26/1/11	The study area is outside its natural distribution - unlikely to occur.

Notes: EPBC-T = threatened species status under EPBC Act (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 - species listed explicitly; CAMBA - China- Australia Migratory Birds Agreement; JAMBA - Japan-Australia Migratory Birds Agreement; ROKAMBA - Republic of Korea Australia Migratory Birds Agreement); **FFG:** status under DELWP (2021) (cr = critically endangered; e = endangered; v = vulnerable).

7.4. Potential impacts

The construction and operation of the WWF may have the impacts on fauna species described below:

- Direct removal of fauna habitat;
- Indirect alteration to habitat from altered runoff quantity and quality 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 WWF site is 4,154 hectares (ha), and the proposed development footprint consists of 222.3 ha, which is 5.4% of the site. The assessment of native vegetation removal indicated that 4.5 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 residual impact on indigenous vegetation and habitat represents approximately 1.1% of the 600 hectares of native vegetation and DELWP-mapped wetland habitat on the site.

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.

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 temporarily. 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.

Noise from wind turbines is usually continuous and does not vary suddenly. Therefore, it is likely that fauna in adjacent habitats will not be significantly disturbed by this.

The occurrence of and potential impacts on key listed fauna species for which targeted species and habitat surveys were undertaken are discussed in later sections of this report. Other listed species are considered below.

7.5. Mitigation measures

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. Indirect impacts on remaining habitats can be avoided through the implementation of design and construction environmental management measures, as described below. More detailed, species-specific mitigation measures are described in relevant later sections of this report.

- With the exception of a small number of creek crossings, most wind farm infrastructure is located more than 100 metres from waterways and wetlands;
- 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 during construction of the wind farm, 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;
- 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
- As soil borne pathogens such as Cinnamon Fungus and livestock diseases can be easily transported by machinery, 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).

As is common for the development of wind farms, a bird and bat adaptive management plan (BBAMP) will be produced and implemented. The BBAMP will provide clear objectives and strategies to minimise bird and bat mortalities arising from the construction and operation of the wind farm development.

The overall aim of the BBAMP is to provide a program for monitoring the impact of operating turbines at the wind farm on birds and bats and responding in an adaptive manner to better mitigate and manage any impact in response to the findings of monitoring and related investigations and, ultimately, to reduce mortality of species of birds and bats of concern.

This is achieved by establishing monitoring and management procedures consistent with the methods outlined by the Australian Wind Energy Association (AusWEA 2005) and endorsed in the Clean Energy Council's Best Practice Guidelines (CEC 2018) and the onshore wind farms - Interim advice on bird and bat management (DAWE 2022a).

The specific objectives of the BBAMP are set out below.

- To implement a monitoring program to estimate the impact of the project on at-risk birds and/or bats that can reasonably be attributed to the operation of the project, as an indicator of population impact
- To directly record impacts on birds and bats through carcass searches
- To document an agreed decision-making framework that identifies impact triggers requiring a management response to reduce impacts and the management activities that will be considered; and
- To identify matters to be addressed in periodic reports on the outcomes of monitoring, the application of the decision-making framework, mitigation measures and their success.

Overall, the BBAMP is intended to maximise the likelihood that the local population of each threatened species remains at similar or greater levels during the operation of the project.

The strategies to be employed to ensure that any impact triggers are detected includes the following:

- Baseline and operational phases bird and bat utilisation surveys;

- Carcass searches under turbines;
- Statistical analysis of the results of carcass searches to derive estimates of mortality levels and rates; and
- Reporting.

The BBAMP will use an adaptive management approach where management measures are adapted to manage and mitigate impacts based on the findings of the monitoring program more effectively. It is intended that the results of the initial monitoring program will inform the requirements of the ongoing monitoring program, depending on detected bird and bat impacts, and identify additional targeted carcass searching and surveys to be carried out to inform ongoing management and mitigation strategies.

Strategies to detect, manage and mitigate potential impacts on birds and bats are outlined below.

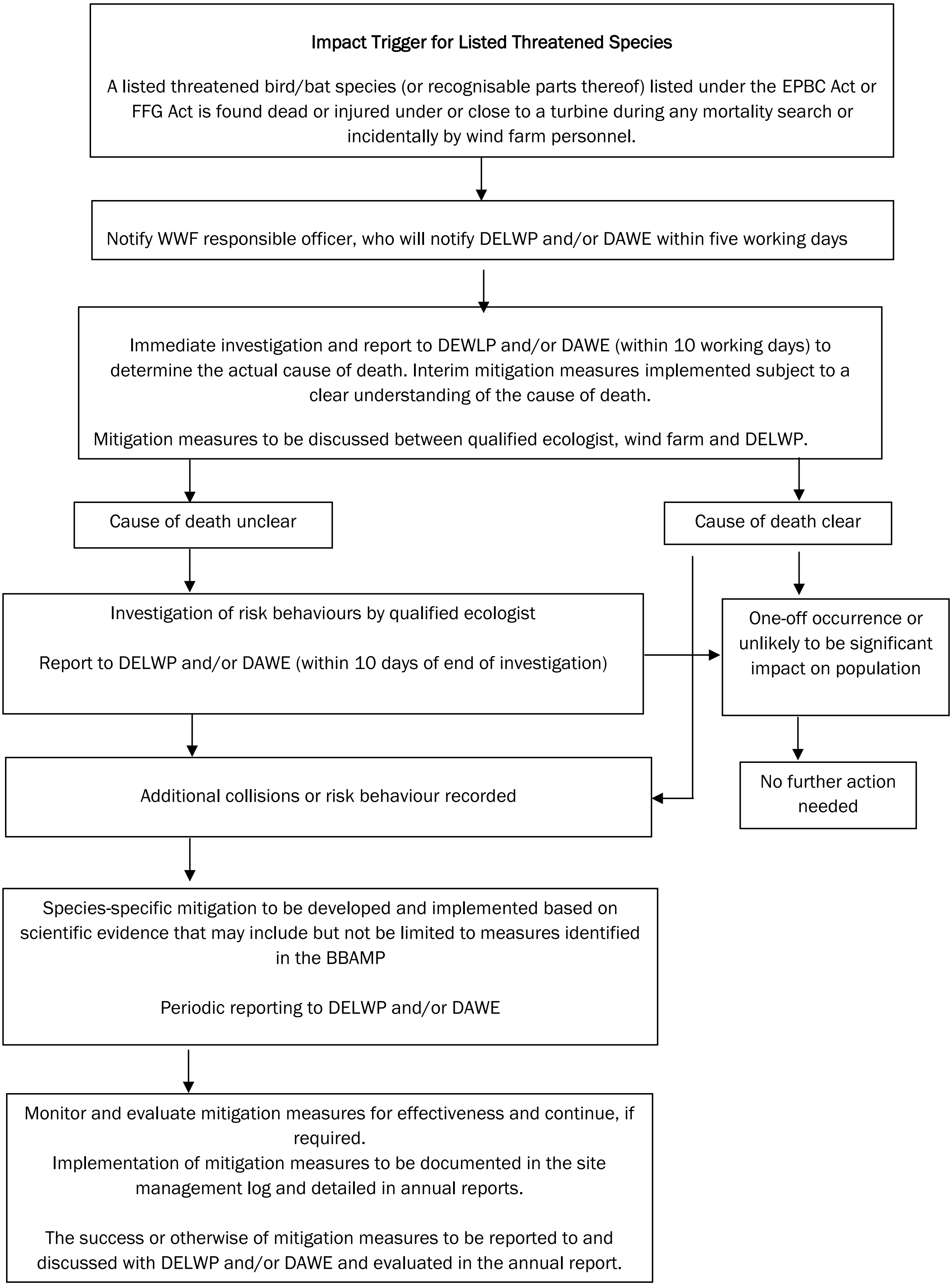
- Design and implement a mortality monitoring program
- Provide definitions of an impact
- Include appropriate response measures in the event of an impact
- Reporting requirements.

The design and implementation of the bird and bat mortality monitoring program will be comprehensive and science-based. It involves frequent monitoring of a sample of turbines for a minimum of three years duration, that begins when the first turbine is commissioned. A BBAMP will outline procedures for reporting mortalities of birds and bats to the responsible authority. A draft BBAMP framework has been developed for the project and is presented in Appendix 13.

Circumstances that will result in notification, further investigation and additional mitigation for both threatened and non-threatened birds and bats can be referred to as impact triggers. By way of definition, an **impact trigger** may be an unacceptable impact in itself or may lead to an unacceptable impact if it continues. The purpose of defining an impact trigger is that it results in a more detailed investigation of the project's impact on the species concerned with the specific objective of determining the scope and nature of mitigation measures.

Impact Trigger for Threatened Species occurs if a threatened bird or bat species (or recognisable parts thereof) listed under the EPBC Act or VIC FFG Act is found dead or injured within the search area under a turbine, or within 100 metres of it incidentally, either during any formal mortality search or incidentally by wind farm personnel. Once triggered an appropriate response is initiated and reporting requirements outlined in the decision making framework in Figure 8 below.

Figure 8: Decision making framework for identifying and mitigating impacts on threatened species



Mitigation measures will be implemented in the event that additional collisions of a threatened species occurs or risk behaviour of a threatened species is observed in close proximity to turbines. Mitigation responses will be species-specific depending on the circumstance based of scientific evidence.

It is not possible to identify every potential impact trigger and if there is a significant impact on the population of a listed species. Table 15 below provides possible mitigation actions to address a significant impact on the local population of a listed species. These are detailed as mitigation measures that will be considered for listed species with a significant risk of ongoing/adverse impacts.

Table 15: Mitigation measures in the event repeated collisions or risk behaviour by a threatened species

Hypothetical cause of impact	Possible Mitigation Measure[5]	Time to implementation
Foraging source identified that attracts threatened species and "at risk" species to impact areas (All species)	The use of acoustics (i.e. loud music/irregular noise) to discourage birds from foraging in this location where such noise would not impact neighbours.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
	Encourage species into alternative areas outside of the WWF boundary, where available, through the use of social attraction techniques offsite (decoys and audio playback systems), as well as supplementary feeding (e.g. grain) where practicable.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
Farming practice attracts threatened species to risky areas (e.g. grain feeding of stock, lambing) (All species)	Investigate whether farming practice is a contributing factor and if so, subject to landowner agreement relocate farming further from turbines to reduce risk. Determine if affected bird species is feeding on rabbits and control rabbits to reduce the attractiveness of turbine surrounds to the species.	Immediately.
Wind/rain/fog causing low visibility (All species)	Carcass searches will be repeated during periods of low visibility to measure mortality rates. Temporary shutdown of those turbines found to generate repeated impact triggers will be necessary during periods of extreme low visibility.	Immediately low visibility is identified as the cause of unacceptable impacts on threatened species.
Attraction to lights on the wind farm site (Night flying species)	Except where otherwise required by CASA, avoid high intensity lighting within the WWF site (e.g. use of light hoods) or switch off lighting temporarily while species is on or near the WWF site based on the surveys described in section 3. Additional measures include: • Synchronise any flashing lights; • Use red rather than white or yellow lights; or • Remove lights, where practicable. All other lights switched off except when needed for service work.	If lights can be switched off, this should occur immediately. Alternative measures should be implemented as soon as practicable after recording the impact trigger.

[5] Note that the mitigation measures in this table are examples of what may be possible. Ultimately, the chosen mitigation measure will be identified as part of the impact-trigger investigations shown in Figure 8 may not include any of these examples if they are not relevant. As wind turbine collision mitigation studies are ongoing throughout the world, as new knowledge is generated on the nature and effectiveness of mitigation it will be taken into consideration in finalising recommended mitigation measures for discussion with DELWP and DAWE.

Hypothetical cause of impact	Possible Mitigation Measure[5]	Time to implementation
Nest site close to turbine (All species)	Conduct an assessment by a qualified ecologist and depending upon species and the clear risk identified, develop options for mitigation measures for consultation with DELWP and DAWE. Agree on species-appropriate actions to discourage nesting close to turbines. Specific action to be agreed between DELWP, DAWE and WWF with advice from a qualified ecologist. For example if a raptor is observed nesting within 200 metres of a turbine, let the breeding attempt run its course, when raptors are no longer using nest in non-breeding season remove the tree to discourage nesting nearby.	Prior to breeding season.
Perching/foraging close to turbines (All species)	Minimise perching opportunities near turbines. Depending on species and "risk" arising from the utilisation of the perch, a decision may be made to discourage perching close to turbines in a manner agreed to between DELWP and WWF and consideration will be given to removing the perch. If the perch is not otherwise part of protected vegetation (e.g. part of a planted wind break) it can be removed immediately.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
On-going turbine collisions with threatened bat species with assessed significant impact on populations	Vary turbine cut in speed where turbines operate based on species and sites specific research and monitoring with demonstrated ability to decrease significant impact on populations.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
	Targeted turbine curtailment based on site- and species-specific understanding of risk behaviours with demonstrated ability to decrease significant impact on population.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
	Ultrasonic deterrents for threatened bat species that deter based on specific understanding of risk behaviours with demonstrated ability to decrease significant impact on population.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
On-going turbine collisions with threatened bird species with assessed significant impact on populations	Video and radar detection of bird activity and turbine curtailment for specific actions based on species and sites specific research and monitoring with demonstrated ability to decrease significant impact on populations.	Implement according "decision making framework for identifying and mitigating impact triggers" (Figure 8) to respond to a "risk", a decision may need to be implemented in a manner agreed to between DELWP, DAWE and WWF.
	Vary turbine cut in speed where turbines operate based on species and sites specific research and monitoring with demonstrated ability to decrease significant impact on populations.	
	Targeted turbine curtailment based on information site- and species-specific understanding of risk behaviours with demonstrated ability to decrease significant impact on populations.	

8. Bat assessment

KEY FINDINGS AND CONCLUSIONS

A total of 4,924 nights of bat call detection was undertaken at 100 unique sites on the proposed Willatook Wind Farm and its surrounds seasonally in six years between 2009 and 2020, including extensive recording at height from two wind monitoring masts.

Ten species of bats were recorded during these bat surveys.

Eight 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. Species within these complexes are not listed as threatened.

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, 150 were attributable to Southern Bent-wing Bat and 16 to Yellow-bellied Sheathtail Bat, indicating that these species occur at low activity levels at the proposed WWF site.

The majority (60%) of recorded attributable Southern Bent-wing Bat calls were from localities and in habitats away from proposed turbine locations: specifically, along the Shaw River and associated treed habitats to the south-west of the site; and in treed habitat to the east of the site. These areas lie 490 metres and 1,550 metres respectively from the nearest proposed wind turbines.

Away from the two areas with most Southern Bent-wing Bat calls, very few calls of this species were recorded and no relationship with habitat features could therefore be discerned, including from gradient studies with recorders placed increasing distances from forest plantation and permanent water bodies at the Shaw and Moyne Rivers.

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 Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat, Little Forest Bat and White-striped Freetail Bat were recorded at a height of 45 metres, but the Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat were not recorded at this height.

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. A Bird and Bat Adaptive Management Plan will be implemented which includes an impact monitoring protocol, management actions if an impact on a threatened species occurs and mitigation options to reduce impacts.

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 WWF on the Southern Bent-wing Bat or Yellow-bellied Sheathtail Bat populations.

8.1. Introduction

Since 2009, six targeted bat surveys have been undertaken at the proposed Willatook Wind Farm (WWF) over six of the last 11 years (to 2020) to determine the presence and activity levels of bat species, particularly threatened species, and inform the assessment of impacts of the wind farm on bat species. Surveys involved the deployment of ultrasonic bat detectors for several weeks at a time at 100 unique survey sites during both spring and late summer to early autumn; times when bat activity is maximal and dispersal of the EPBC Act listed critically endangered Southern Bent-wing Bat (*Miniopterus orianae bassanii*) occurs. Recordings were undertaken at ground level and also at heights of 45 metres on wind monitoring masts to detect species flying at height to provide data on what species may be at greater risk of collision with operating wind turbines, which at WWF will have a minimum rotor swept area height of 40 metres.

8.2. Methods

Ultrasonic detectors that detect and record echo-location calls emitted by micro-bat species were deployed to identify the species of bats present at the proposed WWF site. Due to the occurrence of Southern Bent-wing Bat an intensive survey effort was undertaken which, upon conclusion, totalled 4,924 detector nights. To date, this is the greatest bat survey effort of any proposed wind farm in Victoria.

The surveys for bats considered in this report were undertaken on and near the proposed WWF site during the following time periods.

- Spring 2009
- Spring 2010
- Summer/autumn 2011
- Spring 2018
- Summer/autumn of 2019
- From May 2019 to May 2020.

In the 2009–11 survey period, Anabat ultrasonic recorders were deployed. In the 2018-20 surveys, the more advanced Songmeter (SM4) ultrasonic recorders became commercially available and were deployed. The 2009-11 surveys were undertaken by EHP (2018) and 2018-20 surveys by Nature Advisory.

During surveys undertaken in summer 2009 and spring 2018, all bat calls were analysed to identify all species recorded in the study area. During the spring 2010, summer/autumn 2011, summer/autumn 2019 only the calls of threatened bat species were analysed and identified to species and species complex levels due to the volume of data collected. During the 2019-2020 surveys only Southern Bent-wing Bat and all the species in the Southern Bent-wing Bat/Chocolate Wattled Bat/Little Forest Bat/forest bat complex were analysed, This was considered the most suitable approach to assess impacts on threatened bat species. Species complexes comprise calls that cannot accurately be attributed to one species, because of similar call frequency range, so may be from one of several species. The capacity to distinguish bat species from the species complex depends on the quality of the call recording which, in turn depends on propagation of the call from varying distances or under different weather conditions.

8.2.1. Survey effort

An increased survey effort was undertaken in summer-autumn 2019 and from May 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 WWF site, including areas of relatively poor habitat where, nonetheless, turbines are proposed to be located.

Van Harten *et al*. (2020) has expressed concern that wind farm proponents may underestimate bat activity if pre-construction monitoring is undertaken only short-term or during summer when juveniles are still dependant on adult females at maternity caves. This study has been undertaken over many seasons with emphasis during spring and autumn when the species is considered to be actively flying across the landscape and less confined to maternity caves. A year long study was undertaken from May 2019 – May 2020 to capture seasonal variation.

Table 16 summarises the survey effort and includes the number of detector-nights (where available) for each surveying period. Figure 9 shows the locations of all survey points and the proposed WWF layout. Appendix 11 presents the detailed survey effort for each site.

Table 16: Survey effort at the proposed Willatook Wind Farm site

Survey Period	Min and max no. of recorder-nights/site	No. of sites (total)	Total detector nights
Spring 2009 30 Oct – 22 Nov	Undisclosed*	7	128
Spring 2010 20 Oct – 22 Nov	7–26	21	203
Summer/Autumn 2011 9 Feb – 31 Mar	7–59	16	341
Spring 2018 25 Oct – 14 Dec	5–50	34	361
Summer/Autumn 2019 27 Feb – 1 May	21–84	29	1824
Autumn – Autumn 2019-2020 2 May 2019 – 20 May 2020	21–295	22	2067
Total number of detector nights			**4,924**

Notes: * = Number of recorder nights not indicated in EHP (2018) Biodiversity Assessment

8.2.2. Deployment of bat detectors

Detectors were deployed across the study area and surrounds with a focus on where turbines were proposed to be located. Locations included a variety of habitats such as open paddocks, treed areas, adjacent to watercourses, wetlands and treed plantations.

Two microphones connected to recorders were suspended at height (45 metres above the ground) from two wind monitoring masts (Eastern Met Mast; Western Met Mast on Figure 9). The height of 45 metres above the ground is higher than some species of bat typically fly, however; importantly, it lies within the lower part of the rotor swept area (RSA). The detectors at height would be able to record calls up to 15-75 metres above the ground in suitable weather conditions. In windy or rainy conditions the detection area would decrease (see Section 8.2.5). At both sites, a second detector was deployed at ground level immediately below the recorder at height to record simultaneously for comparison. All remaining detectors were placed approximately one metre above the ground.

In 2019-20 "gradient surveys" were undertaken with the aim of understanding the level of bat activity at increasing distances from areas considered to be preferred foraging habitats. This was intended to provide data to support potential mitigation measures in the form of appropriate buffer areas between turbine locations and preferred foraging habitat on site, thus reducing the risk of bat interaction with turbines. The surveys involved five detectors positioned at 60 metre intervals in a straight line from a specific ecological feature, including a treed area and permanent water, habitats known to typically attract higher bat activity (Stratman 2005, Richards 2006, 2007, Mills and Pennay 2017, DELWP 2020). Gradient surveys were deployed at the following locations (Figure 9).

- A Blue Gum (*Eucalyptus globulus*) plantation (sites 47–51 in Table 17) in 2019 and 2020;
- A permanent pool along the Shaw River (sites 54–58 in Table 17) in summer- autumn 2019; and
- An inundated area at the Moyne River basin (sites 89–93 in Table 167) in summer -autumn 2019.

At WWF, wetlands and ephemeral wetlands were considered in discussions with DELWP to provide potential foraging habitat for Southern Bent-wing Bat. To determine the utilisation of these habitats, a detector was deployed next to a wetland and a detector was also placed at a control site located over 200 metres from the wetland. These paired wetland recorders were located in the following positions:

- Cockatoo Swamp (site 94)
- Wetland 25677 (site 96) and
- The permanent pool at the Shaw River (sites 53 and 54).

During the 2019-2020 surveys, water levels, or "fill" levels, were recorded at each of the wetlands above. These are summarised below:

- Cockatoo Swamp: April - 30%, May - 40%, June - 60%, July – 80%
- Wetland 25677: April - 0%, May - 20%, June - 30%, July 50% and
- Shaw River pool: April - 40%, May - 50%, June - 70%, July – 90%.

From August to December 2020 all wetlands were generally 100% full as it was an above average rainfall year. Water levels were not collected prior to this survey period.

8.2.3. Habitat descriptions where bat detectors were deployed

Table 17 presents the habitat descriptions for each of the 100 survey sites and the proximity of the site to treed habitats and permanent waterbodies. Treed habitats refer to Blue Gum plantations, planted row of trees and remnant vegetation (usually along road reserves or creeks and rivers). The vast majority of wetlands in the study area are ephemeral and only hold water for part of the year. Few permanent waterbodies occur across the landscape. During most of the surveys (done when bats are most active) surface water was limited to farm dams and parts of the Shaw River.

The majority of survey sites from 2018 onwards (after the initial surveys during 2009-11 established the presence of listed bat species) were placed where turbines are proposed and consisted of open paddocks, the dominant habitat of the study area, being an altered agricultural landscape that has been mostly cleared of native vegetation, primarily used for grazing sheep and cattle. Coordinates of all deployments are presented in Appendix 11.

Commonly used 'planted trees' in the study area include; Blue Gum, Sugar Gum and Monterey Cypress, usually along fence lines and around farm houses. Some Blue Gum plantations occur nearby but not within the proposed wind farm itself. Remnant indigenous trees, comprising eucalypt and acacia species occur along road reserves and along the banks of creeks and rivers in the study area.

Stoney rise areas are recent lava flows where surface basalt rocks remain. They are usually treeless though remnant vegetation occurs here, including bracken, and some native grasses and herbs, with a significant exotic grass component.

Table 17: Habitat descriptions of Songmeter/Anabat sites (2009-2020) in the study area

Site	Habitat description	Habitat category (within 30m radius)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
1	Planted pine trees, farm dam and open paddocks.	Open Paddock, planted trees, farm dam.	20	20
2	Remnant trees along a road reserve, open paddock.	Open paddock, remnant trees.	0	340
3	Open paddock, near the Shaw River and remnant trees.	Open paddock, remnant trees, creek.	20	30
4	Open paddock, Stony rise, some remnant wattle trees.	Open paddock, remnant wattles.	20	200
5	On the banks of the Kangaroo Creek, dry in warmer months, floodplain.	Open paddock, remnant trees, creek.	15	1180
6	Near planted pine trees and remnant trees, open paddock, near a wetland in wetter months.	Open paddock, planted pine trees and remnant trees.	5	1460
7	Stony rise, open paddock.	Open paddock, Stoney rise.	490	520
8	Along the banks of the Shaw River, Remnant vegetation, open paddocks.	Open paddock, remnant trees, creek.	10	30
8	River/Creek line, lightwood riparian vegetation.	River/creek side, lightwood riparian vegetation.	10	30
9	Open paddocks, planted and remnant trees.	Open paddock, planted and remnant trees.	0	270
10	Open paddock, with a row of planted pine trees and remnant trees along road reserve.	Open paddock, planted and remnant trees.	30	630
11	Remnant trees, planted trees and open paddocks.	Open paddock, planted and remnant trees.	0	140
12	Remnant trees, planted trees and open paddocks.	Open paddock, planted and remnant trees.	0	560
13	Remnant trees, planted trees and open paddocks.	Open paddock, planted and remnant trees.	30	480
14	At an ephemeral dam, two planted trees, open paddocks.	Open Paddock, planted trees, farm dam.	0	0
15	A tributary of the Black Creek, open paddock, planted trees.	Open paddock, ephemeral creek.	100	580
16	Remnant trees, open paddocks.	Open paddock, remnant trees.	0	290
17	Remnant trees, open paddocks.	Open paddock, remnant trees.	0	350
18	Remnant and planted trees, open paddocks.	Open paddock, planted and remnant trees.	0	500
19	Remnant and planted trees, open paddocks.	Open paddock, planted and remnant trees.	0	510
20	Open paddocks.	Open paddock.	60	230

Site	Habitat description	Habitat category (within 30m radius)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
21	Open paddocks along the banks of the Shaw River.	Open paddock, river.	50	670
22	Planted trees and open paddocks.	Open paddock, planted trees.	0	560
23	Open paddock, Stony rise, remnant vegetation.	Open paddock, Stoney rise, remnant vegetation.	15	290
24	Open paddock	Open paddock.	50	250
25	Open paddock, two remnant trees.	Open paddock, two remnant trees.	20	100
26	Remnant and planted trees, open paddocks.	Open paddock, planted and remnant trees.	10	590
27	Remnant and planted trees, open paddocks.	Open paddock, planted and remnant trees.	5	570
28	Planted trees, open paddocks.	Open paddock, planted trees.	10	630
29	Planted trees, open paddocks.	Open paddock, planted trees.	0	140
30	Remnant trees, open paddocks.	Open paddock, remnant wattle trees.	15	960
31	Planted trees, open paddocks.	Open paddock, planted trees.	0	700
32	Planted trees, open paddocks.	Open paddock, planted trees.	0	600
33	Open paddock.	Open paddock.	60	160
34	Remnant trees and open paddocks.	Open paddock, remnant wattle trees.	0	670
35	Open paddocks.	Open paddocks.	590	660
36	Open paddocks.	Open paddocks.	290	100
37	Ephemeral creekside comprising stands of acacia.	Ephemeral creek, remnant acacia trees, planted trees.	0	370
38	Roadside stands of acacia and radiata pine. Open paddocks.	Open paddocks, planted trees and shrubs.	0	510
39	Open, undulating paddocks with scattered rows of planted vegetation (native and exotic).	Open, undulating paddocks, planted trees.	0	200
40	Planted row of established radiata pine.	Open paddocks, planted trees.	0	340
41	Grazing pasture, in close proximity to treed habitat.	Open paddocks, planted trees.	30	240
42	Planted rows of eucalypts (small in size) and radiata pine nearby.	Open, undulating paddocks, planted trees.	0	380
43	Scattered paddock trees within grazing paddock.	Open undulating paddocks, planted trees, scattered remnant trees.	160	520
44	Small row of remnant acacia amongst Themeda grasses. Planted stand of established radiata pine. Open paddocks.	Open paddocks, remnant and planted trees.	0	240
45	Open paddocks.	Open paddocks.	430	90

Site	Habitat description	Habitat category (within 30m radius)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
46	Remnant Manna Gum in riparian zone (mounted amongst this veg). Situated along the Shaw River. Blue Gum plantation and open paddocks.	Open paddocks, river, plantation, remnant eucalypts.	0	30
47	Grazing pasture, situated adjacent to blue gum plantation.	Open paddock, planted trees.	10	850
48	Grazing pasture, situated adjacent to blue gum plantation.	Open paddock.	70	820
49	Grazing pasture, situated adjacent to blue gum plantation.	Open paddock.	130	750
50	Grazing pasture, situated adjacent to blue gum plantation.	Open paddock.	190	750
51	Grazing pasture, situated adjacent to blue gum plantation.	Open paddock, planted trees.	250	730
52	Open paddocks.	Open paddocks.	300	1340
53	Grazing pasture bordering the Shaw River, this was one of the very few permanent water bodies in the area at this time of year.	Open undulating paddocks, river.	220	30
54	Located at a permanent pool of water in the Shaw River, open paddocks surround.	Permanent water in the river, open paddocks.	380	0
55	Dry flood plain, grazing paddock, rock rise.	Open undulating paddock.	420	60
56	Dry flood plain, grazing paddock, rock rise.	Open undulating paddock.	480	120
57	Rock rise with herbs and bracken, grazed.	Open Stoney rise.	540	180
58	Rock rise with herbs and bracken, grazed.	High point in landscape, open Stoney rise.	600	240
59	Open paddocks, nearby stands of planted eucalypts and radiata pine rows.	Open paddocks, planted trees.	50	660
60	Open paddock, rock rise, some planted trees in the vicinity.	Open undulating paddock.	90	630
61	Open, undulating paddocks.	Open, undulating paddocks.	100	830
62	Open paddock close to a roadside with remnant acacia vegetation.	Open paddock, remnant trees.	200	170
63	Grazing pasture.	Open paddock.	265	390
64	Open paddocks and blue gum plantation adjoin the road, with predominantly acacia lining the roadside.	Open paddocks, blue gum plantation, remnant acacia patches.	0	470
65	Open paddock close to a roadside with remnant acacia vegetation.	Open paddock, remnant trees.	90	200
66	Open paddock, close to Blue Gum plantation and remnant roadside vegetation.	Open, undulating paddocks, planted trees, remnant vegetation.	190	110
67	Nearby planted stands of cypress pine and radiata pine.	Open paddocks, planted trees.	155	224
68	Planted row of eucalypts amongst grazing pasture.	Open, undulating paddocks, planted trees.	0	430
69	Open paddock with planted row of exotic pine trees.	Open undulating paddocks, planted trees.	0	900

Site	Habitat description	Habitat category (within 30m radius)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
70	Open paddocks, near rocky outcrops.	Open undulating paddocks.	280	560
71	Open paddocks. Low lying areas with ephemeral wetlands.	Open, undulating paddocks, ephemeral wetlands.	1090	470
72	Open paddocks. Low lying areas with ephemeral wetlands.	Open, undulating paddocks, ephemeral wetlands.	1300	680
73	Open paddocks.	Open paddocks.	130	120
74	Open paddocks.	Open paddocks.	240	400
75	Lone patch of acacia. Open paddocks.	Open paddocks, small patch of acacia.	740	240
76	Open paddocks. Acacias and other planted native shrub and tree species line the roadside nearby.	Open paddocks, planted trees and shrubs.	120	540
77	Planted stands of acacia and other native trees and shrubs. Open paddocks.	Open paddocks, planted trees and shrubs.	0	460
78	Roadside native vegetation (small in extent). Open paddocks.	Open paddocks, small patches of roadside remnant vegetation.	0	380
79	Roadside strip of acacia and radiata pines. Open paddocks.	Open paddock, roadside trees.	0	435
79	Roadside strip of acacia and radiata pines. Open paddocks.	Open paddock, roadside trees.	0	435
80	Open, undulating paddocks, with nearby dam.	Open, undulating paddocks, dam nearby.	340	170
81	Grazing pasture.	Open paddocks.	520	770
82	Open paddocks comprising rocky outcrops and a nearby creek.	Open undulating paddocks, ephemeral creek.	670	600
83	Open paddocks, near rocky outcrops.	Open, undulating paddocks.	240	350
84	Planted row of eucalypts amongst a great matrix of grazing pasture.	Open paddocks, planted trees.	0	190
85	Planted patch of exotic trees within a grazing paddock.	Open paddocks, planted trees.	0	800
86	Patches of acacia, open paddocks.	Open paddocks, with sparse planted rows of treed vegetation.	0	960
87	Planted row of eucalypts within grazing pasture.	Open paddocks, planted trees.	0	1,340
88	Patches of acacia. Undulating, open paddocks.	Open paddocks, with sparse planted rows of treed vegetation.	370	1090
89	At an inundated area of the Moyne River, open grazed paddocks.	Wetland, open paddock.	660	0
90	Dry flood plain, grazed paddock.	Open paddock.	600	60
91	Dry flood plain, grazed paddock.	Open paddock.	540	120
92	Dry flood plain, grazed paddock.	Open paddock.	480	180
93	Dry flood plain, grazed paddock.	Open paddock.	420	240

Site	Habitat description	Habitat category (within 30m radius)	Proximity to nearest treed habitat (metres)	Proximity to nearest permanent waterbody (metres)
94	Wetland, grazed paddock.	Wetland, open paddock.	390	0
95	Dry floodplain, grazed paddock.	Open paddock.	620	260
96	Wetland, grazed paddock.	Wetland, open paddock.	525	0
97	Dry floodplain, grazed paddock.	Open paddock.	360	0
98	Planted row of native trees within a grazing paddock.	Open paddocks, with sparse planted rows of treed vegetation.	0	710
Eastern Met Mast	Open paddocks.	Open paddocks.	230	500
Western Met Mast	Open paddocks.	Open paddocks.	450	450

8.2.4. Bat call analysis

Calls from the detectors 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 spectrogram 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 the recorded change in frequency patterns over time. For confidence, 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. Mr Gration provided the information below on call analysis.

Southern Bent-wing Bat call analysis

The analysis of Southern Bent-wing Bat calls was guided by the parameters below.

Call sequences required a minimum of five pulses.

Key call identification characters used were: long characteristic section, frequency range of 46-50 kHz based on Conole (2000) (refer to the call shape in Spectrogram 1 below). A series of continuous pulses that formed the majority of pulses in the call sequence (refer to Spectrogram 2 below).

Filters used include those described below.

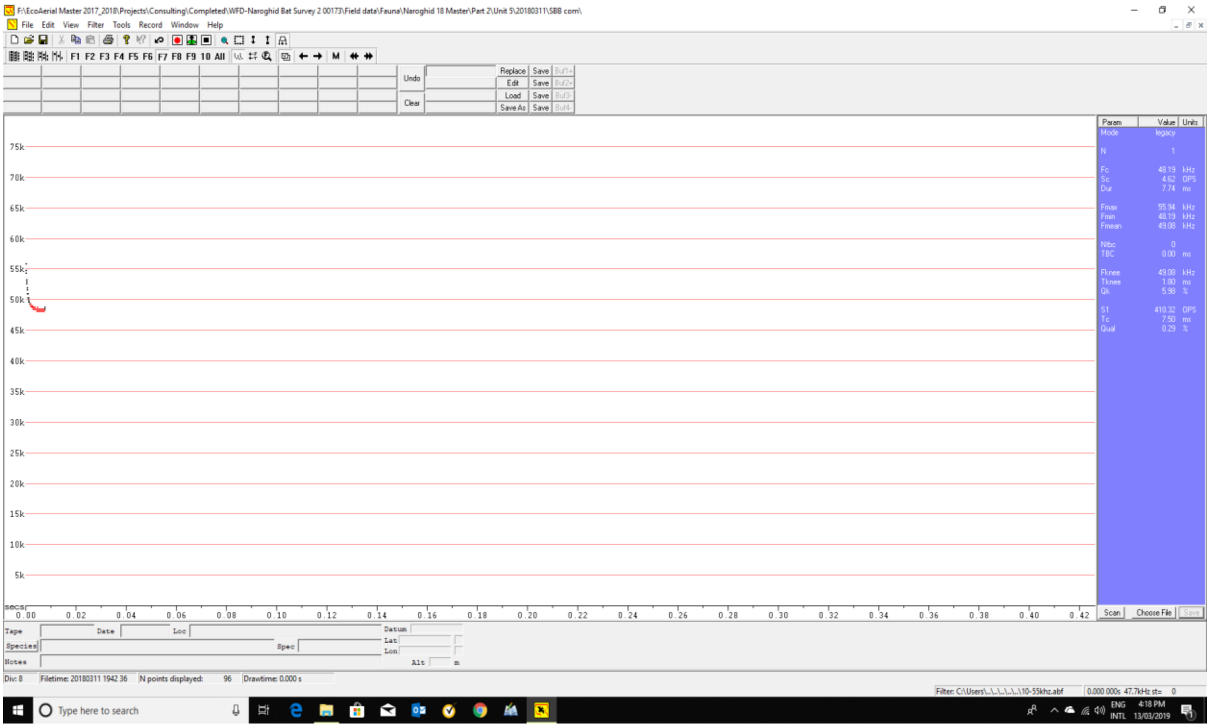
- If SBWB only is required to be analysed, the following filter is applied; frequency range 45~55kHz. This filter was developed by Chris Corben & Terry Reardon. It also incorporates the Little Forest Bat, Chocolate Wattled Bat and Southern Bent-wing Bat call complex
- For Willatook, a 10-55 kHz filter was used as the presence of all species was requested.

The reference call used for the Southern Bent-wing Bat was of the species exiting Panmure Cave recorded by Rob Gration.

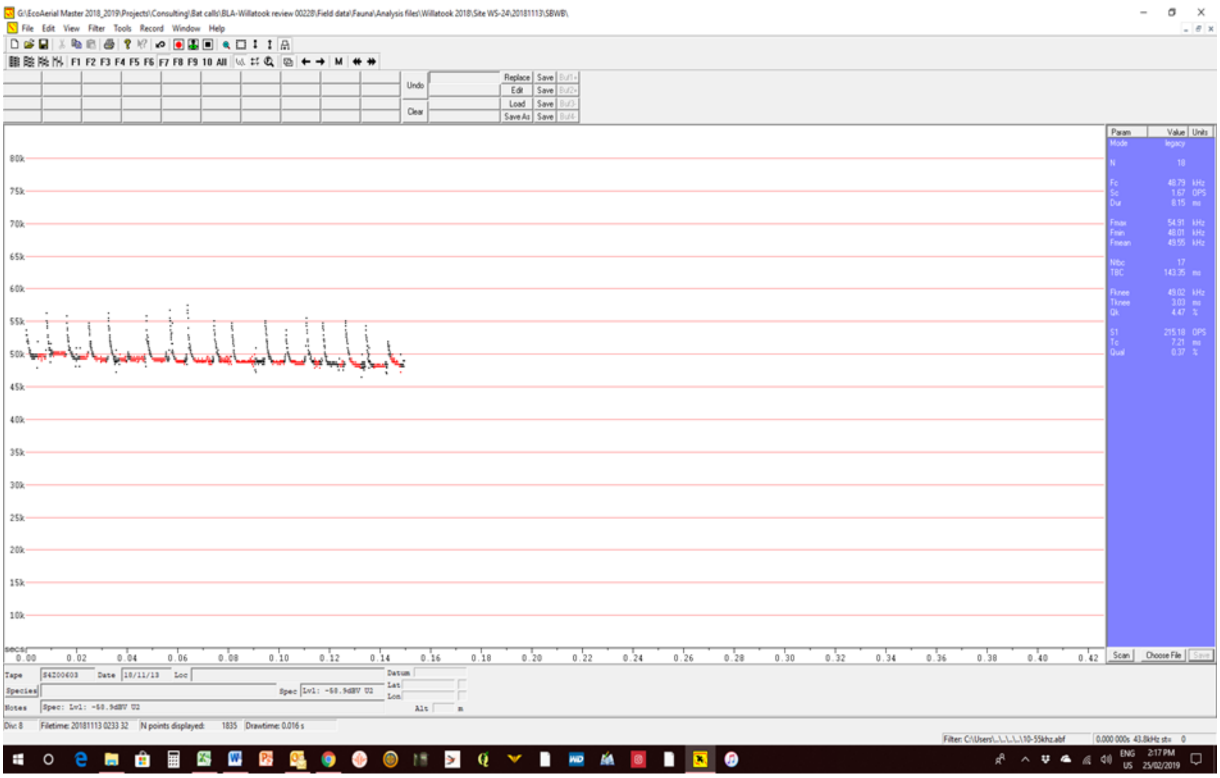
The threshold for assigning to a call complex included: a call sequence consisting of a range of call shapes that could be attributed to Little Forest Bat, Chocolate Wattled Bat and Southern Bent-wing Bat; no one call shape dominated and a consistent pulse sequence was lacking (refer to Spectrogram 3 below).

Data were provided to Nature Advisory (as per ECOAERIAL's standard approach since the Australian Bat Society reporting standards were published) in the following ways:

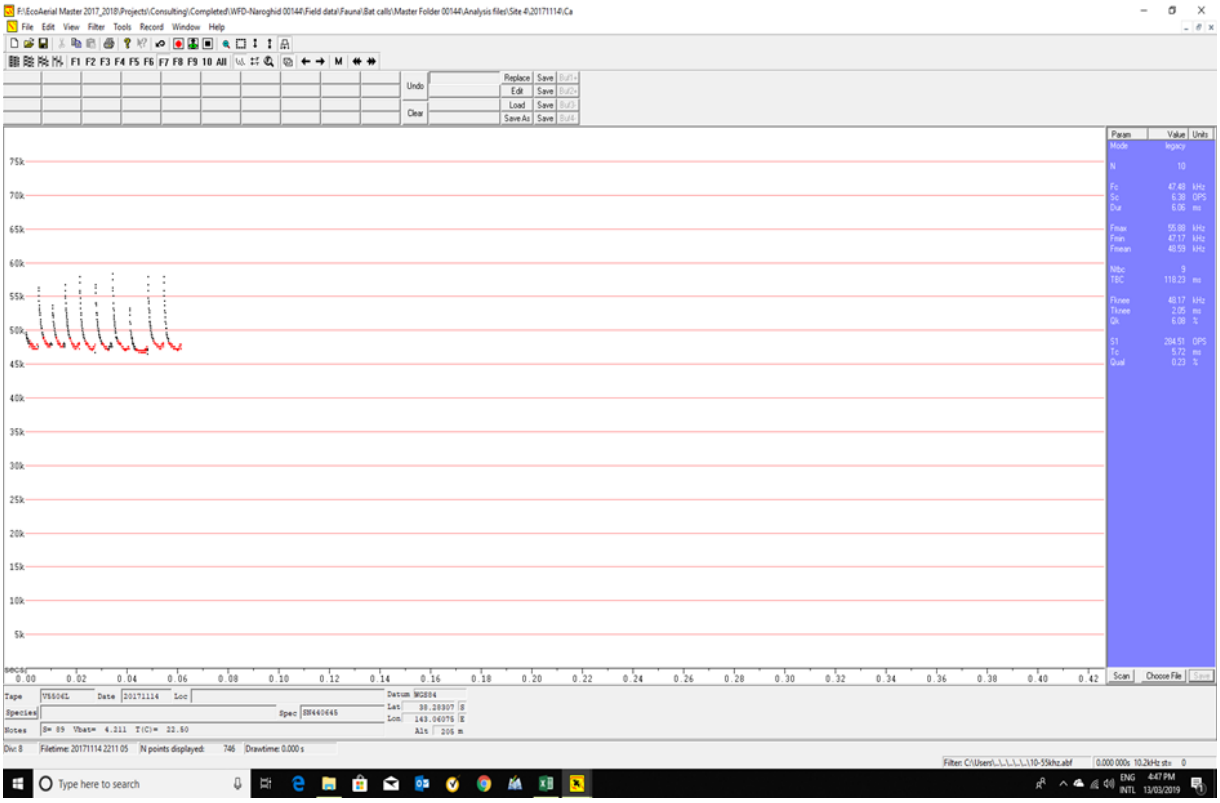
- Detailed numbers of calls attributed to Southern Bent-wing Bat and Southern Bent-wing Bat call complex were provided in a spreadsheet for each site and the relevant date. Call images for each call attributed to Southern Bent-wing Bat were also provided.
- Where required, comments were provided in relation to the bat call image.



Spectrogram 1: Southern Bent-wing Bat call pulse characteristics used for identification



Spectrogram 2: Example of call sequence attributed to Southern Bent-wing Bat



Spectrogram 3: Southern Bent-wing Bat call complex example. Call sequence consisting of a number of pulses that could be attributed to either Little Forest Bat or Southern Bent-wing Bat

The call characteristic graphs and identification for the two threatened species were provided to Greg Ford – Director and Principal Consultant at Balance! Environmental - to peer review for confirmation of the identification to species and/or complexes. Greg Ford has over 25 years' experience in ecological research, impact assessment, biodiversity monitoring and land use planning throughout eastern Australia. He is a recognised expert on bats, with specialist expertise in acoustic analysis of bat echolocation calls for species identification. Greg is active member of the Australasian Bat Society since 1996, having served in the past as President and Vice-president and received the highly esteemed award of Life Membership of the Society in April 2018. The peer review is presented in Appendix 12.

The peer review concluded that the identification of threatened bats, including the Southern Bent-wing Bat and the Yellow-bellied Sheathtail Bat was conservative (Appendix 12).

The peer review noted that one of the bat calls that was identified as Southern Bent-wing Bat, comprised components of both the Southern Bent-wing Bat and Little Forest Bat. In the opinion of the reviewer, the call more closely resembled that of the Little Forest Bat. Similarly, three of the bat calls identified as Yellow-bellied Sheathtail were considered by the reviewer as atypical suggesting that they may be possible alternatives including part of a clutter, a foraging sequence or second harmonic of White-striped Freetail Bat or could be an aberrant social call of Gould's Wattle Bat.

The peer review undertaken by Greg Ford agreed with all other bat call identifications for the SBWB from the 2018-20 surveys.

8.2.5. Assessment of potential roosting sites

The results of detailed landholder surveys were completed to assess potential roosting sites. A key element of the surveys was to identify the presence of any caves on their properties.

Interviews using a community questionnaire were held with landholders within the wind farm from 10 kilometres from the wind farm site from 3rd to 7th December 2018. All landowners, including absent landowners, and dwelling owners within 10 kilometres of the boundary of the wind farm were contacted by letter and invited to take part. Where possible and if information was available follow up calls were made with all landowners within 10 kilometres. If the phone numbers were not available, it was not possible to contact these additional landholders.

Interviews were undertaken with landholders at the Willatook Community Hall from 3rd to 7th December 2018. During the interviews, each participant was questioned for a period of up to 30 minutes. Additional consultations were held by telephone on the 4th and 6th February 2019 with landowners. A total of 37 landholders participated in the community questionnaire.

Further information on the occurrence of Southern Bent-wing Bat non-breeding caves in the Southern Volcanic Plains region was sought from Nicholas White from the Victorian Speleologist Association and from Amanda Bush who is an insectivorous bat specialist from the Arthur Rylah Institute on the 8th and 11th of May 2020. The Geoscience assessment by Neville Rosengren (Environmental GeoSurveys, 2022) also undertook an assessment on lava tunnels in the study area. 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 or detailed activity levels. It does however provide the presence / absence of the species on the site and an indicative, qualitative level of activity.

Occasionally bat detectors such as those used in the survey experience technical difficulties. As a result of these technical difficulties, periods during surveys may not have been recorded and total hours of recording varied between the different recorders/sites.

In calm conditions the detectors will record calls farther away than in windy conditions. The bat detectors used during this survey sampled a limited airspace to a distance of approximately 20 to 30 metres, depending on weather variables. This may also be influence by the call intensity of bats. These limitations are summarised by Gration (2011).

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
- 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 can be challenging and often key, salient call characters may not feature prominently in all recordings to allow for a confirmed identification or confirmed exclusion of this species. Such calls were attributed to the Southern Bent-wing Bat/Forest Bats/Chocolate Wattled Bat complex as it is sometimes not possible to distinguish the call as belonging to any of these species, which have calls within the same frequency range.

An analysis was done on the data that was collected from 2019 and 2020. Each time the Southern Bent-wing Bat/Forest Bats/Chocolate Wattled Bat complex was reported from a site the other potential species within the complex were noted if they were recorded at the same site and night. The results from the analysis are presented below in Table 18. This showed that each time the Southern Bent-wing Bat/Forest Bats/Chocolate Wattled Bat complex was recorded there were no confirmed Southern Bent-wing Bat calls at the same site on the same night. There were many occasions when Chocolate Wattled Bat, Little Forest Bat and the forest bat complex were reported at the same site and night as the Southern Bent-wing Bat/Forest Bats/Chocolate Wattled Bat complex was recorded. This strongly suggests that complex calls could be attributed mostly to the other three species and that they do not provide a representative picture of the occurrence and activity of the Southern Bent-wing Bat.

Table 18: Southern Bent-wing Bat complex

Date	Site	Southern Bent-wing Bat/Forest Bats/Chocolate Wattled Bat complex	Southern Bent-wing Bat	Chocolate Wattle Bat	Little Forest Bat	Forest bat complex
21/02/2020	54	2		×	×	×
26/02/2020	54	3		×	×	×
28/02/2020	54	2		×	×	×
18/03/2020	54	3		×	×	×
18/03/2020	54	3		×	×	×
31/03/2020	54	2				×
4/05/2020	54	1				×
5/05/2020	54	1				×
10/05/2020	54	1				×
17/05/2020	54	2		×	×	×
18/05/2020	54	4		×	×	×
7/03/2019	Met mast east height	1		×		×
27/03/2020	57	1		×	×	
30/03/2020	57	1		×		×
15/05/2020	58	1				
17/05/2020	58	1		×		
19/05/2020	58	1				

Notes: x = confirmed at same site and night.

Given the combined survey effort (4,924 recorder nights) undertaken across the site over six survey periods, and the number of sites with confirmed Southern Bent-wing Bat calls recorded (150 calls across 29 sites), it was considered appropriate to only consider confirmed calls in the following analysis of the species' usage and occurrence across the site. The species complex call recordings of the Southern Bent-wing Bat/Forest Bats/Chocolate Wattled Bat complex contain calls from these three species that cannot be differentiated from one another.

In the 2010 and 2011 surveys, the Chocolate Wattle Bat was recorded from 26 of the 45 sites compared with the Southern Bent-wing Bat from eight sites. During the intensive and widespread spring 2018 survey the Chocolate Wattled Bat was recorded from 20 out of 36 sites compared with Southern Bent-wing Bat from four sites. During the Summer/Autumn 2019 – Autumn 2020 surveys the Chocolate Wattle Bat was recorded from 21 of the 22 sites whereas Southern Bent-wing Bat was recorded from five sites. Given the exceptional survey effort, the detection of confirmed Southern Bent-wing Bat calls, and the potential strong biasing of findings by assuming species complex calls belong to the Southern Bent-wing Bat exclusively, the Southern Bent-wing/Forest Bats/Chocolate Wattled Bat complex was excluded from any further analysis. This rationale makes the reasonable assumption that there is an equal likelihood that a call belonging to a species in the complex is recorded in a manner that does or does not enable confirmed species identification.

While it cannot be completely ruled out that complex calls did not originate from Southern Bent-wing Bat, it is highly likely that most of the species complex calls belonged to those bat species more frequently occurring on the site, namely the Forest Bats and/or Chocolate Wattled Bat. Given the total effort of 4,924 recorder nights, it is considered that the peer reviewed, Southern Bent-wing Bat calls, collected and collated across 2009-2020, provide an acceptable representation of the species occurrence at and comparative usage of different parts of the site, and therefore, a more accurate insight into the risks posed to the species from wind farm construction and operation.

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 Willatook Wind Farm 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 forest bat species complex for the purposes of analysis. None of these species are 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 were grouped together in the analysis. None of these species are threatened.

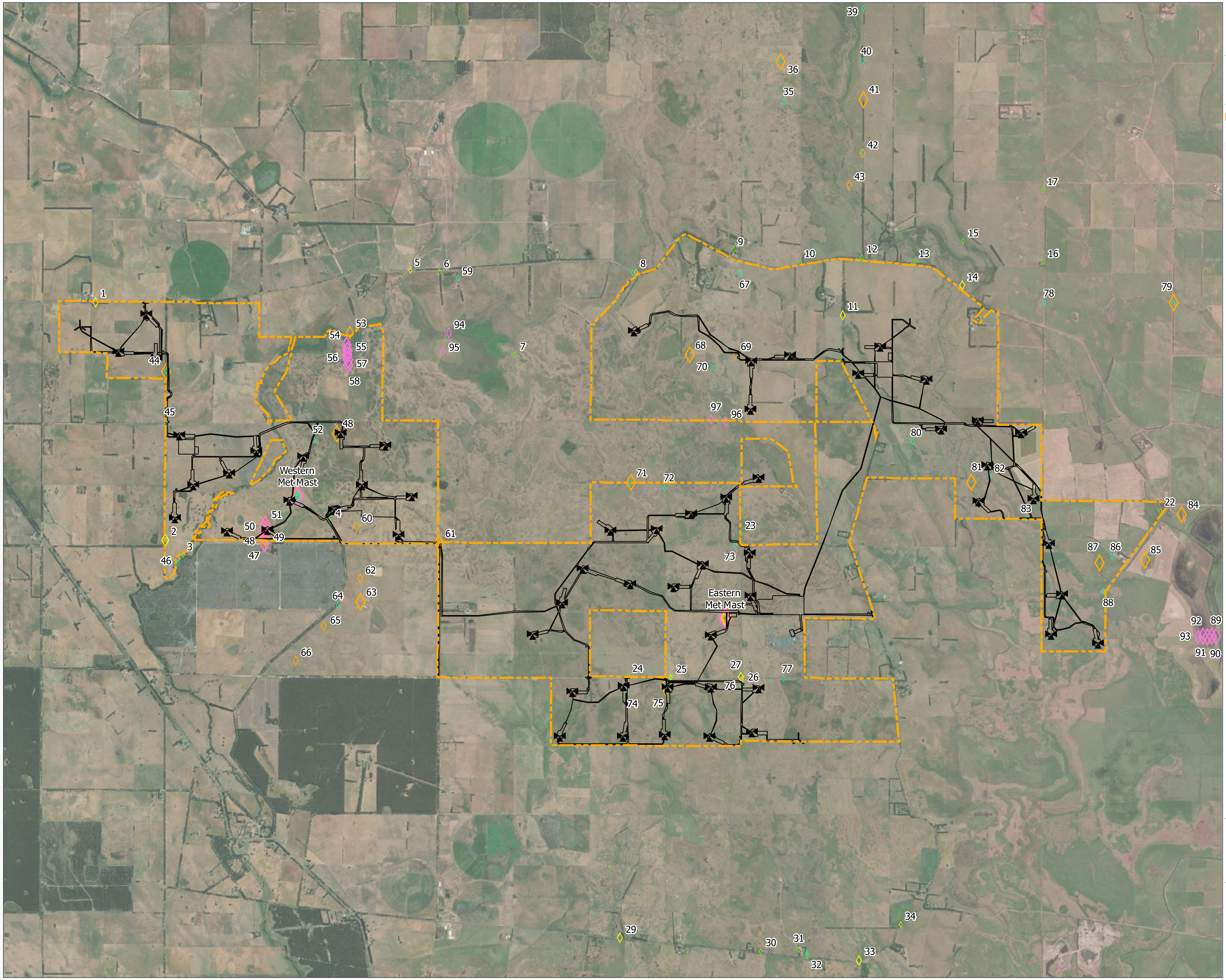


Figure 9: Bat site locations and survey effort

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 3/03/2022

Wind farm boundary
Wind turbine
Construction footprint

Spring 2010
- 6 - 12 nights (19 sites)
- 13 - 26 nights (1 sites)
- 27 - 50 nights (0 sites)
- 51 - 91 nights (0 sites)
- 92 - 295 nights (0 sites)

Autumn 2011
- 6 - 12 nights (5 sites)
- 13 - 26 nights (6 sites)
- 27 - 50 nights (3 sites)
- 51 - 91 nights (0 sites)
- 92 - 295 nights (0 sites)

Spring 2018
- 6 - 12 nights (30 sites)
- 13 - 26 nights (0 sites)
- 27 - 50 nights (4 sites)
- 51 - 91 nights (0 sites)
- 92 - 295 nights (0 sites)

Summer/Autumn 2019
- 6 - 12 nights (0 sites)
- 13 - 26 nights (7 sites)
- 27 - 50 nights (1 sites)
- 51 - 91 nights (23 sites)
- 92 - 295 nights (0 sites)

May 2019 to May 2020
- 6 - 12 nights (0 sites)
- 13 - 26 nights (4 sites)
- 27 - 50 nights (1 sites)
- 51 - 91 nights (13 sites)
- 92 - 295 nights (4 sites)

N

Metres
0 600

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8.3. Results of the bat surveys

This sub-section presents a summary of results of the bat studies undertaken at the proposed WWF.

The bat studies at WWF identified ten species of bat and four species complex in the study area. They have been listed below.

- Chocolate Wattled Bat (*Chalinolobus morio*)
- Eastern Falsistrelle (*Falsistrellus tasmaniensis*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)
- Inland Forest Bat (*Vespadelus baverstocki*)
- Large Forest Bat (*Vespadelus darlingtonia*)
- Little Forest Bat (*Vespadelus vulturnus*)
- ***Southern Bent-wing Bat (Critically endangered – EPBC Act& FFG Act)***
- Southern Freetail Bat (*Ozimops planiceps*)
- White-striped Freetail Bat (*Austronomus australis*)
- ***Yellow-bellied Sheathtail Bat (Vulnerable - FFG Act.***
- Long-eared Bat species complex
- Freetail Bat species complex
- Southern Bent-wing Bat/Chocolate Wattled Bat/Forest bat complex
- Forest Bat species complex.

Of the species above, two are listed as threatened: the Southern Bent-wing Bat and Yellow-bellied Sheathtail Bat and these are discussed in more detail later.

While not recorded during surveys for the project, the Grey-headed Flying-Fox has the potential to occasionally fly over the wind farm site based on the distance of the known roosting camp at Warrnambool.

8.3.1. Height distribution of bats

Five species of bat were recorded at height (45 metres above the ground) from the two met masts, including the following.

- Chocolate Wattled Bat
- Gould's Wattled Bat
- Large Forest Bat
- Little Forest Bat and
- White-striped Freetail Bat.

Bat activity 45 metres above the ground was much lower compared with bat activity at the base of the met masts, indicating that most species occurring on site fly relatively close to the ground, and generally below RSA height, with the typical exception of the above higher-flying species.

The Southern Bent-wing Bat was recorded on one occasion at ground level at each of the Eastern and Western Met Masts. This species was not recorded at height (45 metres above the ground) at these two locations.

8.3.2. Threatened bat species recorded in the study area

There were two threatened bat species recorded in the study area. Southern Bent-wing Bat was positively recorded from 29 sites during the studies (Table 19 and Figure 10), and Yellow-bellied Sheathtail Bat was recorded from nine sites (Figure 10). These are discussed further below.

Southern Bent-wing Bat

The Southern Bent-wing Bat was listed as critically endangered under the EPBC Act from December 2007. It was previously listed as conservation dependent under the EPBC Act.

The Southern Bent-wing Bat has a restricted distribution occurring only in south-eastern South Australia (from Robe, Naracoorte and Port MacDonnell) to south-western Victoria (east to Lorne and Pomboneit). There are two major maternity caves used by the Southern Bent-wing Bat one at Naracoorte Cave in South Australia and the other near Warrnambool in Victoria. Recently a third maternity cave has been discovered near Portland in Victoria (TSSC 2021). The two major maternity caves are separated by 220 kilometres and migrations between them are thought to be rare (Dwyer 1969).

The species utilises many other caves throughout the year, referred to as non-breeding caves. There are 52 known non-breeding caves in South Australia (Mott & Aslin 2000, Bourne 2010, Lear 2012). In Victoria there are 18 known non-breeding caves (DELWP 2020). Most of the significant caves used by Southern Bent-wing Bat are likely to be known, though it is possible that some undiscovered sea caves on rugged coastlines are used as roosts by the species (TSSC 2021).

Recent studies have shown that a very high proportion of Southern Bent-wing Bats return to their natal cave each year during the breeding season and suggest that it is likely that discrete populations may be operating at some level (TSSC 2021). As there are many non-breeding caves that are located between the three maternity caves, it is possible that individuals from both populations share some non-breeding caves.

Current population estimates at Naracoorte in November 2019 were 30,700 individuals and 17,000 – 18,000 at Warrnambool (TSSC 2021). The Portland maternity cave is expected to have a smaller population than the two major maternity caves.

The Southern Bent-wing Bat is an insectivorous cave dwelling bat. At night the species disperses over a range of habitats. In Victoria, it usually forages over forested areas, remnant native vegetation, non-native shelter belts, volcanic plains, wetlands, coastal vegetation (including beaches) and urban areas (Grant 2004, DAWE 2021b).

The Warrnambool and Portland maternity caves are located approximately 40 and 50 kilometres away from the WWF site respectively. Given that it is now known that the species can travel up to 70-85 kilometres in a just a few hours, it is possible that individuals may visit the Willatook area, potentially while travelling to roosting sites at Byaduk or Mt Eccles.

The Naracoorte maternity cave is located over 160 kilometres from the proposed WWF and it is not considered that bats from this cave would frequent the WWF site.

The Southern Bent-wing Bat was recorded from 29 of the 100 sites across the study area from 2010 to 2020 (see Table 19). Figure 10 maps the survey results for the Southern Bent-wing Bat at all survey sites from 2010 to 2020. A single record of the species in spring 2009 was not given a location (EHP 2013).

Southern Bent-wing Bats were not recorded in most sites surveyed across the wind farm site (71 sites). It was recorded at an unknown location in spring 2009, in four locations during spring 2010, at three locations during autumn 2011, at five locations during spring 2018, 13 locations in summer-autumn 2019 and at five locations from May 2019–May 2020. It is noted that the survey efforts were substantially higher in 2019 and 2020.

The Southern Bent- wing Bat has undergone serious population decline since the 1960s (DELWP 2020). Survival rates assessed by van Harten (2020) in 2016– 2019 show lowered seasonal survival during summer (December–February) and autumn for juveniles and lactating females, with the lowest survival rates coinciding with drought in early 2016. Population modelling predicts a continued population decline (van Harten 2020), the cause of which remains uncertain, though resource limitation due to loss of foraging habitat and drought is suspected as a primary cause (DELWP 2020; van Harten 2020). Of the total 150 confirmed calls recorded for the project, 99 were during the 2010-2011 surveys (Table 19) (68 in the Spring of 2010 and 31 from Autumn of 2011). In Spring of 2018, there were substantially fewer calls of the Southern Bent-wing Bat compared with the period between 2010 and 2011. More calls were recorded in the Autumn of 2019, but still significantly lower compared to 2010 and 2011. From this point until Autumn 2020 only single calls were recorded.

The site with the highest number of calls was site 3 which had an average of 2.92 Southern Bent-wing Bat calls per survey night. Site 3 was located along the Shaw River where remnant vegetation occurs along the river bank. This site lies approximately 490 metres from proposed wind turbines at the south-western edge of the proposed wind farm. This area supported good quality riparian habitat and a larger area of Blue Gum plantation that provided good foraging habitat compared with elsewhere, either on the WWF site, which is largely cleared for agricultural purposes, or in the surrounding area. This plantation has since been logged and replanted.

Site 22 had an average of 2.5 Southern Bent-wing Bat calls per night over a 12-night recording period. This site was located to the east of the wind farm site with surrounding planted trees. The closest proposed turbine to this site is approximately 1,550 metres to the west. The planted trees at this site are likely to provide good foraging opportunities for the bat.

One further site (site 2, not far from site 3) was found to have 0.9 Southern Bent-wing Bat calls/night. Site 2 is over 300 metres from the nearest proposed turbine. It was located along a treed road reserve in habitat not characteristic of the WWF site. All other sites recorded less Southern Bent-wing Bat activity than this. A few other locations that had smaller numbers of confirmed calls comprised treed areas in road reserves, planted trees along fence lines and some in open areas.

Usage of the study area by Southern Bent-wing Bat was infrequent with an overall average of 0.03 calls per detector night when averaging the 150 confirmed calls in the study area (see Table 19 below).

Table 19: Southern Bent-wing Bat recorded in the study area

Survey period	Site	No. of calls	No. of nights surveyed	Average calls per night
Spring 2010	3	35	12	2.92
	22	30	12	2.5
	24	2	7	0.29
	32	1	7	0.14
Autumn 2011	2	26	29	0.9
	34	1	7	0.14
	1	4	14	0.29
Spring 2018	45	1	7	0.14
	61	1	7	0.14
	78	1	8	0.13
	86	1	8	0.13
	64	1	10	0.1
Autumn 2019	84	8	81	0.1
	87	7	81	0.09
	49	7	62	0.11
	85	5	81	0.06
	53	4	34	0.12
	69	4	20	0.2
	Western Met Mast ground	1	82	0.01
	68	1	61	0.02
	48	1	62	0.02
	81	1	81	0.01
	62	1	20	0.05
	50	7	62	0.11
	51	1	62	0.02
May 2019 - May 2020	Eastern Met mast Ground	1	295	0.003
	49	1	69	0.01
	54	1	91	0.01
	56	1	70	0.01
	95	1	21	0.05
Totals		**150**	**4,691**	**0.03**

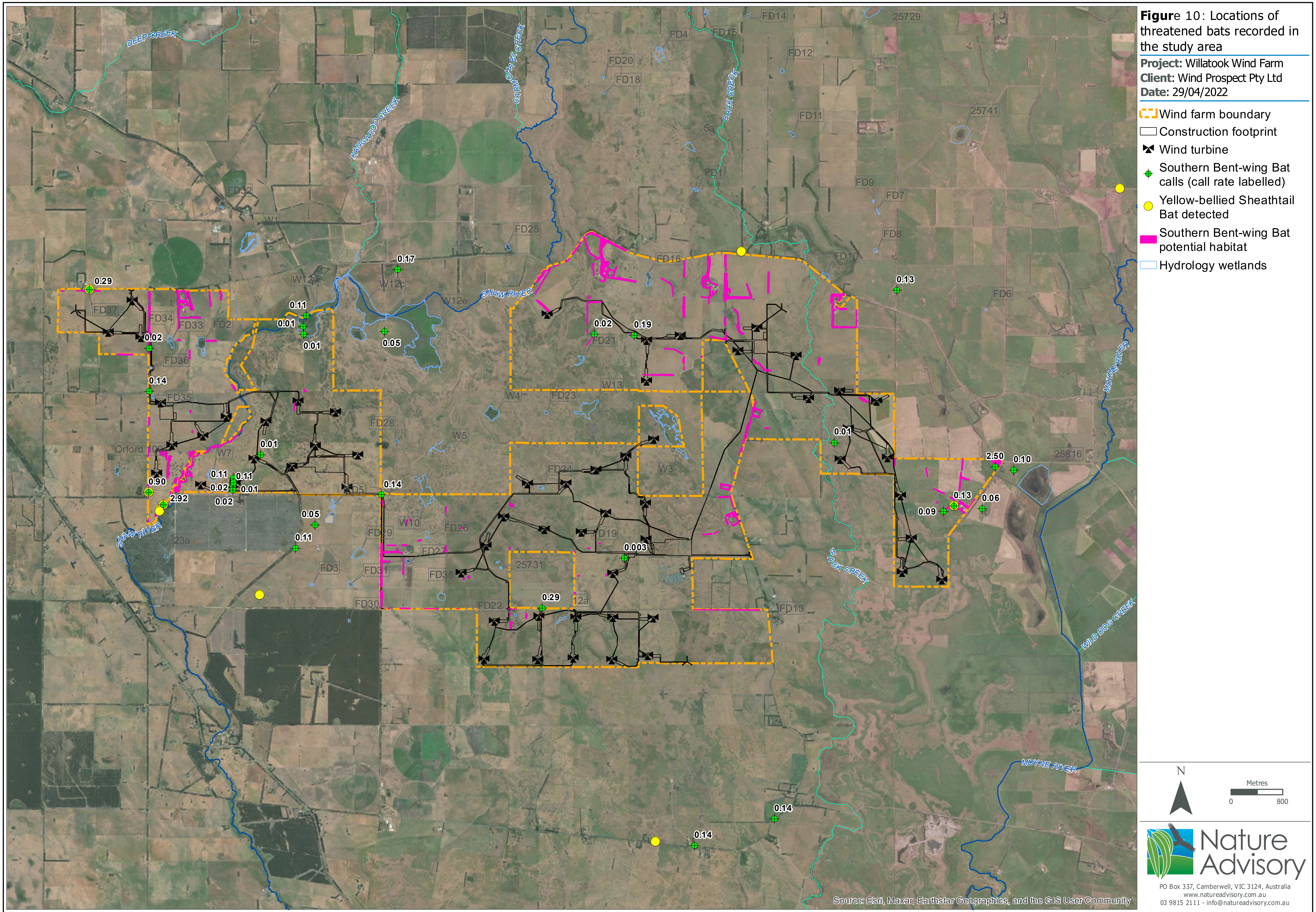

Figure 10: Locations of threatened bats recorded in the study area

Habitat usage and behaviour of the Southern Bent-wing Bat

The Southern Bent-wing Bat prefers forested and treed areas to forage as outlined below. Many studies reveal that the Southern Bent-wing Bat prefers foraging in or adjacent to treed areas compared with open areas. Below are some examples of studies that have been undertaken.

Richards (2006, 2007) suggests a strong preference for areas of treed (both native and non-native) habitat with the bulk of the Southern Bent-wing Bat calls recorded 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 Large (Eastern) Bent-wing Bat. In their study, Bent-wing Bat activity was almost seven times greater at forested sites.

In a recent study of the movements of the Southern Bent-wing Bat, Bush *et al.* (2022) tracked the nightly foraging flights of individuals using miniature GPS/VHF units (~1.4 g) in a highly modified agricultural landscape in south-west Victoria. To investigate the importance of treed vegetation to the bats' flight paths they measured the distance of each GPS fix to the nearest tree and compared this to the distance to trees of randomly generated points. Preliminary analysis revealed that bat locations were closer to trees than would be expected from random movement alone. This included both native and exotic paddock trees, and planted linear strips.

Southern Bent-wing Bat also show a preference for seasonally inundated swamps with terrestrial vegetation around the fringes (Stratman 2005). DELWP (2020) state that wetlands are used extensively, with individuals recorded flying considerable distances to reach these foraging areas. Though there was no correlation between wetlands and Southern Bent-wing Bat activity at the study area.

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 of all bat species 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 preferred habitat for bats. Calls recorded 120 metres away from remnant treed vegetation were 5% of calls recorded from remnant treed vegetation. Calls recorded 120 metres away from wetlands were 7% of calls recorded at wetlands. Similarly, 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 the 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 disperse *en-masse* from the maternity cave but disperse gradually in small groups. Monitored dispersal in 2007 was over a much longer period than previously described, where dispersal from the maternity cave was mid to late summer (Duncan *et al* 1999). Dispersal appeared to be continuing when the study had finished in April 2007.

At the proposed WWF site, the gradient studies undertaken have not shown any trends in Southern Bent-wing Bat activity levels. An average of 72% of Southern Bent-wing Bat calls at the Blue Gum plantation were within 130 metres of the plantation (Table 20). Only two Southern Bent-wing Bat calls were recorded at the Shaw River gradient site and none at the Moyne River gradient site. With very few calls of Southern Bent-wing Bat recorded it is difficult to come to any meaningful quantitative conclusions on activity levels at increasing distances from potential foraging habitats such as treed areas and waterways.

Table 20: Results of the gradient studies

Survey period	Plantation /wetland	Site	Distance from Plantation/ wetland	No. of SBWB calls	No. of nights surveyed	Average calls per night
Summer/ Autumn 2019	Plantation	48	70	1	63	0.02
Summer/ Autumn 2019	Plantation	49	130	7	63	0.11
Summer/ Autumn 2019	Plantation	50	190	1	63	0.02
Summer/ Autumn 2019	Plantation	51	250	1	63	0.02
Summer/ Autumn 2020	Plantation	47	10	0	69	0
Summer/ Autumn 2020	Plantation	49	70	1	69	0.01
Summer/ Autumn 2020	Plantation	50	190	0	69	0
Summer/ Autumn 2020	Plantation	51	250	0	69	0
Summer/ Autumn 2020	Shaw River	54	0	1	91	0.01
Summer/ Autumn 2020	Shaw River	55	60	0	70	0
Summer/ Autumn 2020	Shaw River	56	120	1	70	0.01
Summer/ Autumn 2020	Shaw River	57	180	0	70	0
Summer/ Autumn 2020	Shaw River	58	240	0	91	0
Summer/ Autumn 2020	Moyne River	89	0	0	68	0
Summer/ Autumn 2020	Moyne River	90	60	0	68	0
Summer/ Autumn 2020	Moyne River	91	120	0	68	0
Summer/ Autumn 2020	Moyne River	92	180	0	68	0

Survey period	Plantation /wetland	Site	Distance from Plantation/ wetland	No. of SBWB calls	No. of nights surveyed	Average calls per night
Summer/ Autumn 2020	Moyne River	93	240	0	33	0

Sites within 30 metres of watercourses or wetlands did not show higher levels of Southern Bent-wing Bat activity. Table 21 below presents the results of the bat studies undertaken at watercourses or wetlands in the study area. The site with the highest number of calls and most activity was Site 3, a site located along the Shaw River that also had remnant vegetation along its banks. Overall, low activity levels of Southern Bent-wing Bat were recorded near most watercourses, farm dams and ephemeral wetlands on the WWF site, with the majority of such sites recording no Southern Bent-wing Bat activity at all.

Table 21: Results of wetland studies

Site	Waterbody	Survey period	No. of SBWB calls	No. of nights surveyed	Average calls per night
1	Farm dam	Autumn 2011	4	14	0.29
3	Shaw River	Spring 2010	35	12	2.92
5	Kangaroo Creek	Autumn 2011	-	7	
8	Shaw River	Autumn 2011	-	8	
		Spring 2018	-	7	
14	Farm dam	Autumn 2011	-	21	
15	Black Creek	Spring 2010	-	12	
21	Moyne River	Autumn 2011	-	14	
37	Black Creek	Spring 2018	-	8	
46	Shaw River	Spring 2018	-	6	
53	Shaw River	Summer/Autumn 2019	-	35	
54	Shaw River	May 2019 – May 2020	1	91	0.01
71	Ephemeral wetland	Spring 2018	-	8	
		Summer/Autumn 2019	-	62	
72	Ephemeral wetland	Spring 2018	-	6	
82	Black Creek	Spring 2018	-	7	
89	Moyne River	May 2019 – May 2020	-	68	
94	Ephemeral wetland	May 2019 – May 2020	-	21	
96	Ephemeral wetland	May 2019 – May 2020	-	22	

The results above suggest that the wetland and waterway habitat across the site is not consistently or regularly utilised by this species. As available studies suggest, Southern Bent-wing Bat prefers remnant vegetation for foraging and dispersing across the landscape as opposed to the treeless habitat and unvegetated farm dams and wetlands, which are more prevalent at the proposed WWF.

These findings indicate that although the species may occasionally fly across the site, there is no habitat within the site that is consistently favoured by the species. With sporadic arrival times to the WWF site, routine utilisation is unlikely; strongly suggesting it is not a core habitat of significance for the species.

Flight heights of the Southern Bent-wing Bat

The Southern Bent-wing Bat has a fast, direct flight pattern and typically forages in open spaces (Dwyer 1965). Where there are trees it typically forages above the canopy, but can fly closer to the ground in more open areas (DELWP 2020).

Studies have been undertaken at numerous wind farm sites by Nature Advisory to determine the flight height of the Southern Bent-wing Bat. Flight heights are determined by hoisting the microphone of bat detectors up on the met masts and recording calls at 45 metres above the ground (with a range from 15 - 75 metres in good weather conditions) and simultaneously at ground level. Nature Advisory has not recorded Southern Bent-wing Bat calls at these heights at proposed or operating wind farm sites. It is noted that there are a number of limitations with collected acoustic data at high heights such as increased noise from higher wind speeds and the particular characteristics of the SBWB's echolocation call which is more difficult to detect in these conditions (see Section 8.2.6). A study in Europe found that bat flight height monitored from wind masts can predict mortality risk at wind farms (Roemer *et al.* 2017). Bat detectors were installed on 23 wind masts to record bat activity on the vertical axis. A collision susceptibility index was calculated for each bat species recorded. The correlation between the activity of bats recorded at height and bat fatalities at wind farm sites strongly supports that activity estimates from wind masts are appropriate for wind turbine impact assessments. However, it is acknowledged that there are some specific limitations relating to positive identification of SBWB's echolocation call at height. Recent height studies associated with the Kentbruck Wind Farm placed recorders at 1.5, 28, 56 and 84 metres above the ground (Biosis 2020). Each height class was surveyed at the same time and an equal amount of time of 54 nights. The purpose of collecting results at multiple heights at the same location during the same time period was to present stratification of bat call data at height. At this height trial four Southern Bent-wing Bat calls were recorded, all four were recorded at 1.5 metres above ground and none recorded at 28 metres 56 metres and 84 metres above the ground.

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. The surveys have been undertaken between 2007 to 2019 and used best practice guidelines and technology available at the time. All surveys were conducted during the Southern Bent-wing Bat non-breeding season when bats are dispersing and recorded calls were analysed and peer reviewed by bat call experts.

All but two wind farms on the extreme edge of the species range were surveyed between two and four dispersal periods, often with earlier surveys being repeated to ensure best practice and up to date ecological data. Ten windfarm bat surveys included at least one recorder at height (45 to 50 metres) paired with another at ground level which was limited by the availability of met masts and the ability to install bat recorders on them. The survey effort varied at each wind farm site. There were more recorders placed at ground level compared with mounted at height on met mast at each site. It is therefore expected that there would be more activity recorded at ground level when comparing to at height data.

Most of these sites were found to have relatively low Southern Bent-wing Bat activity compared with other bat species and at two wind farms, no Southern Bent-wing Bat activity was recorded. These two sites were at the very edge of the species' predicted range. The remaining nine had at least one call confirmed as Southern Bent-wing Bat. Two sites had comparatively high Southern Bent-wing Bat activity relative to other bat species.

At all surveyed wind farms, Southern Bent-wing Bat calls were recorded only once above 45 metres, even when there was activity recorded at ground level simultaneously. It is acknowledged survey effort was greater at ground level and is expected to have a higher activity level at ground level due to this. Additionally, 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). Recent work closer to the limestone cave systems of south-western Victoria (Kentbruck near Nelson - Biosis 2020) recorded about 2% of Southern Bent-wing Bat calls at heights above the ground level detection height.

A recent report by Symbolix (2020) on post-construction bird and bat monitoring of wind farms in Victoria states there have been eight mortality records of Southern Bent-wing Bat from less than three wind farms, based on data sourced from 10 wind farms from 2014 - 2019. Evidently there is a risk posed to the species by operating turbines, however it is not stated where these mortalities have occurred, what the turbine heights were or what habitats were on the site.

Two of these collisions have been confirmed to occur at the Macarthur Wind Farm located approximately seven kilometres to the north of the Willatook Wind Farm, although the exact location of the turbine where the strike was recorded was not disclosed. The minimum RSA height there is 28 metres above the ground and the highest blade tip is 140 metres above the ground. This compares with the proposed RSA at Willatook Wind Farm, which is 40 to 250 metres above the ground. Given the information summarised above from available studies and unpublished data from Nature Advisory's extensive bat survey work in western Victoria, it is apparent that Southern Bent-wing Bat activity is likely to be much more common at ground level than at heights 45 metres or above. Collision risk with turbines is likely to be less the higher the minimum blade tip height is from ground level.

Southern Bent-wing Bat have been reported flying 250 metres above the ground when departing their maternity cave (Reardon pers. comm., 2018, cited in Thompson 2018). 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 the ground in open areas (Churchill 2008). The Southern Bent-wing Bat has only been recorded flying at these heights when departing maternity caves or above treed areas.

While acknowledging that there are uncertainties regarding the typical foraging flight heigh of the Southern Bent-wing Bat , it is likely that while Southern Bent-wing Bat are capable of undertaking flight at height when departing their caves or flying above treed areas, their typical behaviour in open areas is to fly closer to the ground. As there is little treed habitat across the WWF site, and given the results of the field studies reported here from a number of Victorian wind farm sites, Southern Bent-wing Bat are unlikely to occur regularly or fly often at turbine RSA height at the proposed WWF site where turbines are proposed to be located. The proposed turbine blade lower tip height is to be a minimum of 40 metres above the ground. This higher minimum RSA height will reduce the risk of collisions with most bat species, including the Southern Bent-wing Bat.

Flight distances of the Southern Bent-wing Bat

The Southern Bent-wing Bat are known to fly long distances between caves, particularly when dispersing from maternity caves compared with their nightly foraging expeditions from maternity or non-breeding roosting caves.

Recent tracking of the nightly foraging flights of individuals using miniature GPS/VHF units (~1.4 g) in a highly modified agricultural landscape in south-west Victoria showed that the bats generally foraged northeast of cave roosts, but overall foraging direction ranged from the north to the east. The minimum furthest straight-line distance travelled from the individuals' day roosting cave averaged 35 kilometres (with a range of 3 - 85 kilometres) (Bush *et al*. 2022).

In another recent study, van Harten *et al.* (2022) tagged a total of 2966 Southern Bent-wing Bats with passive integrated transponder (PIT) tags. Antennas were used to detect bats in flight at a major maternity cave and a key non-breeding cave in south-east South Australia. They showed that direct movements between the two monitored caves occurred throughout the year, in all seasons. Individuals were able to fly the 72 kilometres between caves in a single night in a time frame as little as 3.3 hours. The nightly occurrence of detecting such ‘direct flights’ peaked during the early autumn, autumn–winter and winter–spring population movements. The proportion of bats making this flight was typically below 0.5% of the tagged population, but several spikes were recorded that extended 2% of the tagged population. Movements by some individuals were recorded back and forth between the caves on successive nights.

When foraging, lactating females were recorded repeatedly returning to areas 23–25 kilometres from the Naracoorte maternity cave in a night (Grant 2004; Bourne 2010) and one radio tracked male was recorded 35 kilometres from the roost site (Bourne 2010). Grant (2004) recorded individuals radio tracked from the Naracoorte maternity cave predominantly foraging along a forested ridgeline within three to four kilometres of the cave.

A study by Wilson (2000) indicated that the average distances moved between maternity caves and non-breeding roost caves was between 15.5 kilometres for males and 43.8 kilometres for females.

Roosting cave assessment of the Southern Bent-wing Bat

The Southern Bent-wing Bat is a cave-dwelling bat with a restricted distribution, occurring only in south-east South Australia and south-west Victoria (DELWP 2020). Its local distribution is largely determined by the availability of caves or tunnels. In Victoria, it is usually recorded over forested areas but also occurs widely in lower densities on the sparsely-treed Southern Volcanic Plain (Menkhorst 1995, Richards 2006, Churchill 2008).

Recent research has provided some new insights into the seasonal movement patterns of the Southern Bent-wing Bat. van Harten *et al.* (2022) showed that mass birthing occurred in November in the Naracoorte maternity cave and presence of individuals at the maternity cave remained high among all age and sex classes over the subsequent summer months. Juveniles began flying in January. Lactation rates decreased in early February (van Harten 2020), suggesting the bats are being weaned at this time. Following juveniles becoming independent, a movement event occurred in autumn months each year, which peaked in mid-March, with bats moving away from the maternity cave and then returning in April and May.

During the non-breeding season, in autumn and winter, after the young are weaned, the bats disperse throughout the region roosting in a larger number of caves and rock crevices (Churchill 2008, DELWP 2020). Most known Southern Bent-wing Bat roost locations are in limestone caves but some also occur in lava tubes in the Southern Volcanic Plain and coastal cliff rock crevices and man-made tunnels (DELWP 2020). Small numbers have also been recorded roosting during the day in inland and coastal cliff caves (Menkhorst 1995, Duncan *et al*. 1999). Different caves are used seasonally according to required microclimatic conditions (DELWP 2020).

Previously, the southern bent-winged bat was thought to entering periods of torpor over winter months from mid-May to mid-September, including deeper hibernation from June to mid-August. van Harten *et al.* (2022) found that while the encounter probability was significantly reduced from mid-June through July, there were bats active during this period.

In spring, the return of individuals to the maternity cave was gradual van Harten *et al.* (2022). Adult males returned first, then adult females, and finally juveniles from the previous breeding season. By October, daily encounter probability approached similar levels to that observed before winter dispersal.

In late spring and summer, this species congregates in "maternity caves" where the females give birth to and raise their young. Conservation and protection of the maternity caves is vital for this species. In autumn and winter, after the young are weaned, these bats disperse over a large region. Southern Bent-wing Bat is believed to move into more widely dispersed, smaller non-breeding caves for winter (Churchill, 2008).

The Southern Bent-wing Bat recovery plan (DELWP 2020) outlines there are at least 48 non-breeding sites across southeast South Australia. There are 18 known and important non-breeding caves in Victoria. Many of these are not listed publicly and exist on private land and while a number of Southern Bent-wing Bat roost sites are known from Victoria's southwest, a knowledge gap exists around the characteristics and number of caves that are critical to the subspecies lifecycle and survival (Thompson 2018, DELWP 2020).

Further information on the occurrence of Southern Bent-wing Bat non-breeding caves in the Southern Volcanic Plains region was sought from Nicholas White from the Victorian Speleologist Association and from Amanda Bush who is an insectivorous bat survey specialist from the Arthur Rylah Institute on the 8th and 11th of May 2020 respectively who indicate that they are unaware of other major caves used by this species in the Southern Volcanic Plain bioregion apart from those already known and identified in Table 22 below. This was confirmed in the Geoscience assessment by Neville Rosengren (Environmental GeoSurveys, 2021) who stated there were no lava tunnels in the study area. Furthermore local landholders were consulted and no caves were acknowledged though the consultation period. There may be smaller roosting caves or crevices that could support smaller numbers of Southern Bent-wing Bat in the region but these would be extremely difficult to identify and assess.

Reardon (2019) states that populations within wintering caves fluctuate and that the species undergoes torpor for weeks at a time, during which they are partly active. Individuals will move between non-breeding caves during winter when most of the population is in torpor and shut down their bodies in the colder months of the year (Reardon 2019, TSSC 2021).

Four of the known non-breeding caves listed are located within 35 kilometres of the proposed wind farm (Table 22) which is the average straight-line distance travelled by GPS tracked Southern Bent-wing Bat individuals' day roosting cave (Bush *et al*. 2022). These caves are located at Byaduk and Mt. Napier, Mt Eccles, Yambuk/Deen Mar/Codrington and Grassmere non-breeding caves. Several other roosting and maternity caves are located within 85 kilometres of the proposed wind farm (Table 22) which is within the greatest straight-line distance travelled from the individuals' day roosting cave (Bush *et al*. 2022).

The Warrnambool maternity cave (Figure 11) is located 41 kilometres from the proposed wind farm site. The WWF project area is unlikely to be on route of a flyway between the maternity site and non-breeding caves. Table 22 lists publicly known and important Southern Bent-wing Bat roosting locations throughout Victoria and Figure 11 shows their location in relation to the proposed Willatook Wind Farm.

Table 22: Publicly known and important Southern Bent-wing Bat maternity and non-breeding caves

Location	Approx. distance from Willatook WF	Description
Mt Eccles National Park	15.6 kms West-Northwest	Situated within the Mt Eccles National Park and an important non-breeding site (Richards 2006, ACCIONA Energy 2009).
Yambuk	16 kms Southwest	Known non-breeding caves (ACCIONA Energy 2009). SBWB detected near a cave here by Rob Gration in 2019 (personal communication 2019). A number of caves on the coast near Yambuk including Codrington.
Byaduk	25.5 kms West	A series of caves and a well-known non-breeding site (Lumsden and Jemison 2015).
Grassmere	26.8 kms Southeast	Cave on private property (Rob Gration personal communication 2019, DELWP 2020). Known to support large non-breeding SWBW numbers (ACCIONA Energy 2009).
Warrnambool	41 kms southeast	One of the major maternity caves with recent population estimates of up to 18,000 bats (TSSC 2021).
Panmure	47 kms Southeast	Known non-breeding 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	50 kms Southeast	Known non-breeding 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).
Bats Ridge	55 kms Southwest	A series of caves and a known non-breeding location near Portland (Lumsden and Jemison 2015, Rob Gration personal communication 2019).
Portland	60 kms Southwest	Coastal sea cave with reasonable numbers (ACCIONA Energy 2009) recently discovered that a small number of Southern Bent-wing Bat breed here (TSSC 2021).
Porndon	97 kms Southeast	Used as an important non-breeding roost (ACCIONA Energy 2009)
Cape Volney	117 kms Southeast	A series of sea cliff caves in the western end of the Otways used as an important non-breeding roost (ACCIONA Energy 2009). Signs of bat activity but not confirmed as SBWB in 2019 (Rob Gration personal communication 2019).
Lower Glenelg	138 kms West	Reasonable numbers of SBWB (ACCIONA Energy 2009).

Location	Approx. distance from Willatook WF	Description
National Park		
Lorne	155 kms Southeast	Used as an important non-breeding roost (ACCIONA Energy 2009)
Cape Patton	155 kms Southeast	Used as an important non-breeding 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).

Examining at what time Southern Bent-wing Bat are recorded within the study area can reveal possible nearby roosting locations. From the most recent survey periods spring 2018 – Autumn 2020, only one Southern Bent-wing Bat was recorded within an hour of sunset (Table 23). All other recordings were substantially later in the night. The almost complete lack of call recordings early in the night suggests strongly that the Southern Bent-wing Bat is commuting some distance to the study area and an undetected nearby roost is unlikely.

Table 23: Detection times of Southern Bent-wing Bats

Survey Season	Site	Date	Time	Minutes after sunset
Spring 2018	61	13/11/2018	2:33	375
Spring 2018	64	24/11/2018	22:40	130
Spring 2018	86	28/11/2018	4:25	474
Spring 2018	78	13/12/2018	0:09	231
Autumn 2019	84	7/02/2019	unknown	-
Autumn 2019	84	8/02/2019	unknown	-
Autumn 2019	84	8/02/2019	unknown	-
Autumn 2019	48	10/02/2019	22:49	133
Autumn 2019	84	14/02/2019	22:08	97
Autumn 2019	85	18/02/2019	22:55	149
Autumn 2019	68	24/02/2019	21:56	98
Autumn 2019	68	24/02/2019	23:43	205
Autumn 2019	68	24/02/2019	23:42	204
Autumn 2019	68	24/02/2019	unknown	-
Autumn 2019	84	26/02/2019	unknown	-
Autumn 2019	84	26/02/2019	unknown	-
Autumn 2019	49	28/02/2019	4:56	523
Autumn 2019	84	28/02/2019	1:00	287
Autumn 2019	85	28/02/2019	unknown	-
Autumn 2019	50	7/03/2019	20:52	49
Autumn 2019	87	10/03/2019	4:44	526
Autumn 2019	87	10/03/2019	unknown	-
Autumn 2019	87	10/03/2019	unknown	-
Autumn 2019	87	10/03/2019	unknown	-
Autumn 2019	87	11/03/2019	unknown	-
Autumn 2019	87	11/03/2019	unknown	-

Survey Season	Site	Date	Time	Minutes after sunset
Autumn 2019	49	14/03/2019	21:54	122
Autumn 2019	Western met mast ground	16/03/2019	21:43	104
Autumn 2019	85	18/03/2019	21:45	119
Autumn 2019	68	20/03/2019	unknown	
Autumn 2019	85	22/03/2019	1:59	379
Autumn 2019	84	23/03/2019	unknown	-
Autumn 2020	Eastern met mast ground	23/02/2020	unknown	-
Autumn 2020	WP3	3/03/2020	5:26	559
Autumn 2020	56	3/03/2020	unknown	
Autumn 2020	54	9/03/2020	0:44	287
Autumn 2020	95	29/04/2020	19:35	110

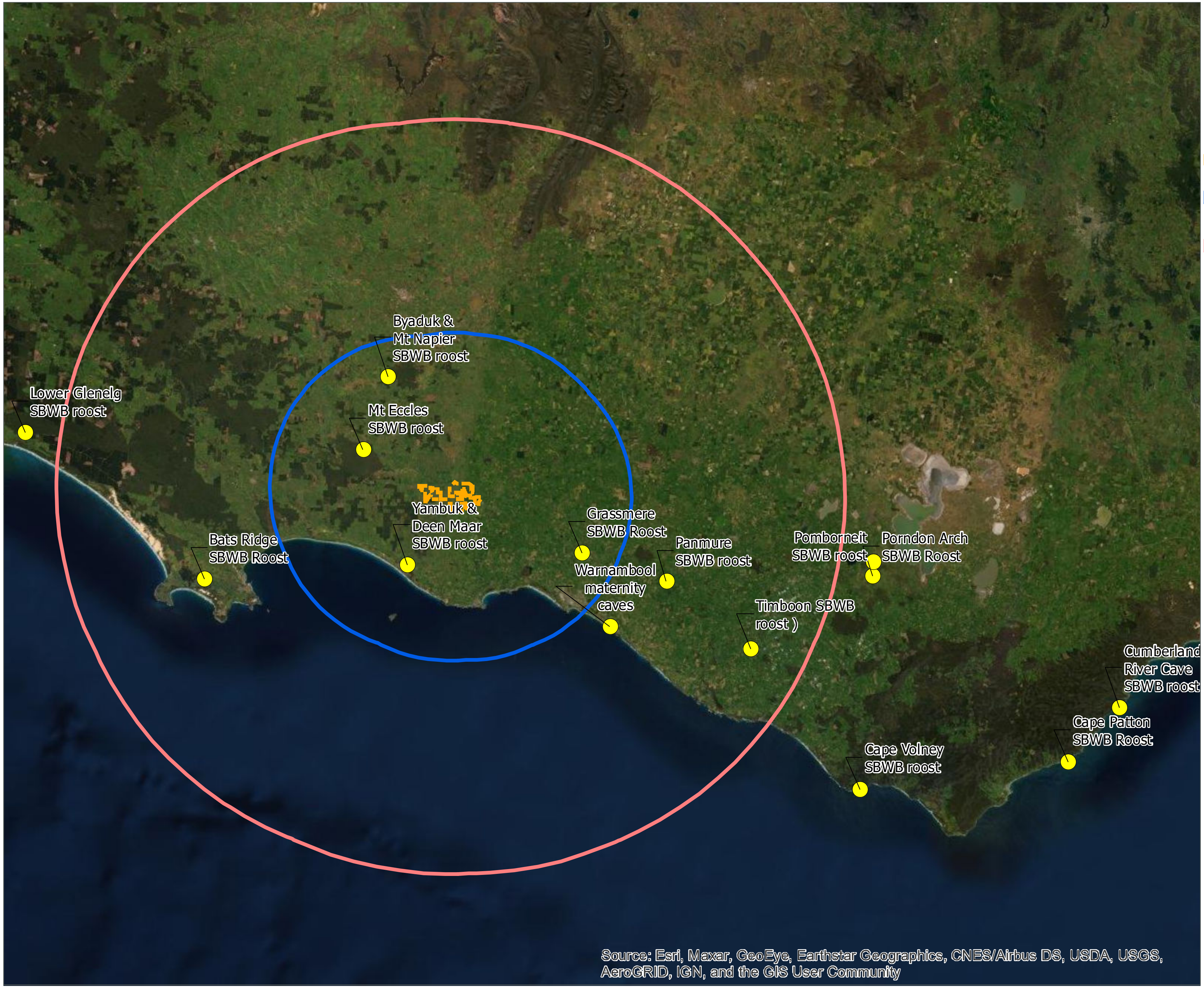

Figure 11: Southern Bent-wing Bat roosts and maternity caves

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 10/05/2022

Wind farm boundary
Average nightly distance travelled (35km)
Maximum nightly distance travelled (85km)
SBWB caves

N

Metres
0 19,000

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Comparison of average calls per night of Southern Bent-wing Bat at other wind farms in SW Victoria

In order to provide adequate context to the activity of Southern Bent-wing Bat at the WWF site the number of Southern Bent-wing Bat calls per detector night were compared against other bat studies in the region.

Ten wind farms within the Victorian range of the Southern Bent-wing Bat which had publicly available information on their bat survey results were collated. From this the number of positively identified Southern Bent-wing Bat calls were divided by the number of detector nights to determine the average number of calls per detector night (Figure 12).

The highest activity levels from the ten examined wind farms was from the approved Hawkesdale Wind Farm approximately 20 kilometres to the east of Willatook. This study which lasted 105 detector nights found an average of 4.25 Southern Bent-wing Bat calls per detector night of surveying. While the operational Macarthur Wind Farm located three kilometres to the north was surveyed for 800 detector nights and had an average of 2.15 Southern Bent-wing Bat calls per detector night.

The lowest activity levels were recorded at the Naroghid wind farm approximately 80 kilometres east of Willatook. No positively identified Southern Bent-wing Bat were recorded during this study over 210 detector nights.

The WWF site ranked six out of ten for bat activity with an average of 0.031 Southern Bent-wing Bat calls per detector night with the highest survey effort of 4,924 detector nights. Despite the highest survey effort being undertake at Willatook it had some of the lowest levels of Southern Bent-wing Bat activity.

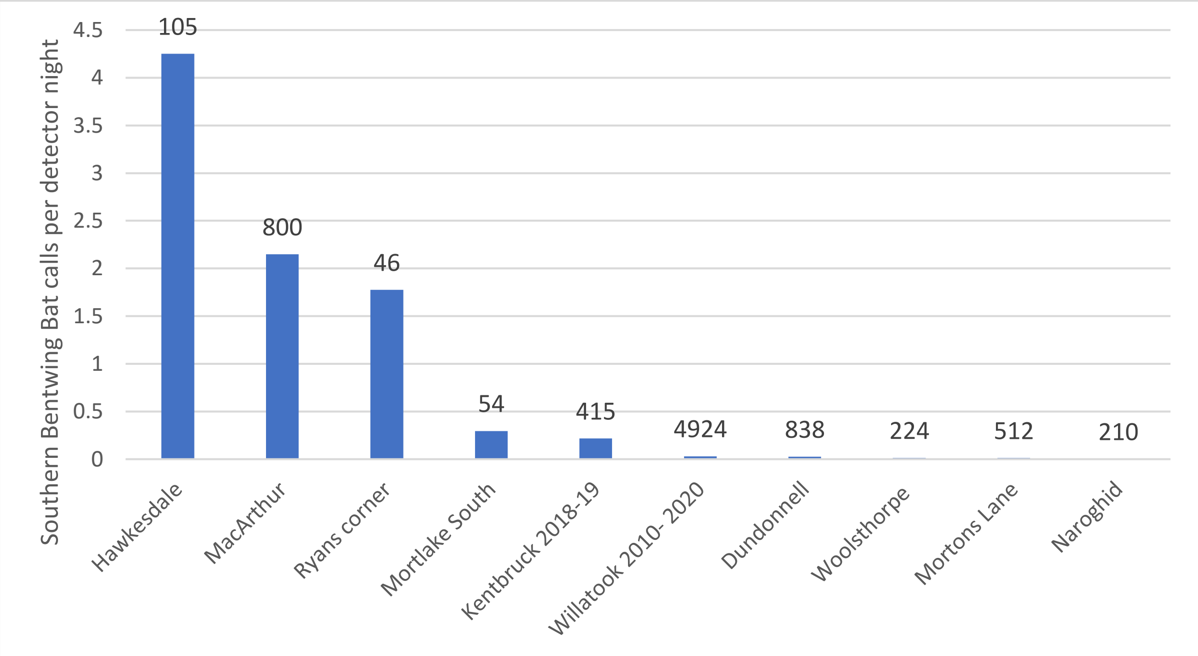

Figure 12: Comparison of SBWB calls per detector night at the proposed Willatook Wind Farm to other approved or constructed wind farms in south west Victoria (number of detector nights shown above)

Yellow-bellied Sheath-tailed Bat

Calls were analysed for Yellow-bellied Sheathtail bat from studies from 2009 to April 2019 from a total of 2,857 detector nights (frequency rate of 0.003). Due to the low number of calls recorded during initial surveys the data post April 2019 was not analysed as the survey effort was considered sufficient to determine that the species is not a frequent visitor to the site. The Yellow-bellied Sheathtail Bat was recorded from nine sites across the study area, summarised in Table 24 below and shown on Figure 9.

Table 24: Yellow-bellied Sheathtail Bat recorded in the study area

Survey period	Site	Recorded
Spring 2010	3	X
	12	X
	20	X
	30	X
Autumn 2011	1	X
	2	X
Spring 2018	46	X
	86	X
Autumn 2019	66	X

The Yellow-bellied Sheathtail Bat was recorded in areas generally outside where turbines are proposed, notwithstanding the considerable survey effort within the proposed wind farm layout. This reflects the lack of suitable habitat for high levels of bat activity within the area affected by the proposed wind farm.

8.4. Impact assessment

8.4.1. Impact pathways

Extensive bat surveys have been conducted over more than a decade at 100 survey sites in both spring and late summer to early autumn and have recorded ten species of bats. Eight are common species, considered secure in their conservation status. 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). In addition, there is the possibility that the Grey-headed Flying Fox may fly over the site.

Both direct and indirect impacts on bats can arise from three impact pathways listed below.

- Physical disturbance effects that remove or degrade foraging habitat for bats
- Direct collision[6] with operating wind turbine blades or towers

[6] Collision in this case includes ‘barotrauma’, a hypothetical but unlikely mechanism related to air pressure changes near operating turbine blades claimed to cause bat fatalities, the injuries from

- Alterations in landscapes, which have the potential to disrupt movements and behaviour.

8.4.2. Mitigation measures

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

- It is recommended that turbines are located at least 215 metres away (inclusive of 95m blade) from remnant and planted treed vegetation. These habitats are more favoured by the species at the proposed Willatook Wind Farm site 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. The 215 metre buffer was derived using the 120 metre plus an additional 95 metre blade length
- 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 bird and bat adaptive management plan (BBAMP) will be implemented for the WWF. An overview of the mortality program is provided in Section 7.5 and Table 25. The proposed bat monitoring program is outlined in Appendix 13 and the implications and mitigation response in the circumstance of a threatened bat carcass being found under a turbine is described below.

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which resemble those of blunt trauma from direct collision (Rollins *et al*. 2012; Lawson *et al*. 2020).

Table 25: Overview of management actions for the BBAMP implementation

Management action	Description
Operational bat monitoring	Ultrasonic bat surveys would be undertaken in spring and summer/autumn in the first two years of operation. Songmeter ultrasonic bat detectors will be used to monitor bat activity at height (on nacelle or meteorological masts) paired with a bat detector up to one metre off the ground. The Songmeters would operate between sunset and sunrise over a six-week period, in November and February/March when Southern Bent-wing bat are most active.
	Further details of the monitoring protocol are presented in Appendix 13.
Mortality (carcass) monitoring	A mortality monitoring program would be conducted either using searches on foot along pre-determined transects by an adequately trained ecologist; or searches by a trained scent dog.
	Monitoring would consist of searches of 20 randomly selected turbines out to a distance of 120 metres once per month for a period of two years. A second follow-up search, a 'pulse search' will be undertaken to 60 metres during the warmer months (September to April) when microbats are more active.
	Further detail on the proposed search protocol, site selection, and analysis and reporting are presented in Appendix 13.
Scavenger trial	A scavenger trial will be implemented to ascertain the rate at which carcasses are removed by scavengers. The trials will be conducted twice over the two year monitoring period. Carcasses (in three size groups) will be randomly placed under selected turbines with motion sensor cameras will be used to monitor scavenger activity taking place.
	Further detail on the proposed scavenger trial methods are presented in Appendix 13.
Detectability (Observer) trial	Detectability trials conducted to test the rate at which the trained searchers, or scent detection dog, detect carcasses under wind turbines
	Further detail on the proposed design of the detectability (Observer) trial are presented in Appendix 13.

Impact triggers

This section identifies the circumstances that will result in notification, further investigation and additional mitigation for threatened bats ('impact triggers'). If an impact trigger is met, there must be an investigation into the cause of the impact, immediate stepped-up carcass monitoring to determine if the impact is ongoing and the development of mitigation measures informed by scientific studies.

The procedure to respond adaptively to impact triggers documented in this section will be implemented at any time an impact trigger is detected for the life of the project, from the commencement of operations until decommissioning. The aim is to understand how the impact happened or may have happened, and to identify and design targeted mitigation measures. If scientific uncertainty results in an incomplete understanding of whether an unacceptable impact is occurring this will not prevent the implementation of mitigation measures.

Ultimately, the WWF approval holder will be responsible for implementation of the BBAMP and the decision-making that goes with it, with technical support provided by the approved expert. Importantly, a clear basis for informing and consulting with DELWP and DAWE is documented and will be followed.

Decision making framework

Triggers and responses are determined by the conservation status of the affected species. If a threatened species impact trigger occurs, further investigation will immediately be triggered, and the decision-making framework outlined below and in Figure 8 will be followed.

- An impact trigger will be immediately reported to WWF's responsible manager, who will report it to DELWP and DAWE within five business days of it being recorded
- Carcass searching will be immediately expanded to cover all 59 turbines fortnightly in the subsequent six weeks to determine if the species concerned is colliding more than once
- Bat monitoring using Songmeters will be initiated at the turbine both at height (on top of the nacelle) and below at one metre off the ground, if currently not already undertaken, in accordance with Appendix 13
- Within 10 days, an appropriately qualified ecologist will determine, if possible, the circumstances that lead to the death or injury. If the cause of death is considered to be due to turbine collision, an investigation will be undertaken to identify any circumstances that could have led to the collision and the likelihood of further occurrences will be evaluated
- The rapid investigation will aim to provide a clear understanding of the cause of the impact, informed by on-site investigations of the occurrence of the species on the WWF site and any risk behaviour it is displaying
- This will identify the most effective available mitigation measures to be implemented with those measures to be implemented as soon as practicable based on the information collected during the investigation (increased mortality searches and bat monitoring using Songmeters)

- If the cause of the impact trigger is not clear and definition of effective mitigation measures is not feasible, further investigation of the species' behaviour will be required over the following six weeks (in parallel with the stepped-up carcass searches). This investigation will also consider the following
    - Any recent data/information on the species e.g. academic literature, EPBC policy statements
    - Information from implementation and monitoring from other wind farms
    - A review of the effectiveness of management measures
- If these investigations suggest that the impact was not continuing (e.g. the species had left the site) then no further action would be necessary. This decision will be determined in consultation with DELWP and DAWE, based on the collected evidence and adopting the most effective of the mitigation measures indicated in Appendix 13
- If the onsite investigation suggests that the impact trigger indicates the potential for an unacceptable impact, species-specific monitoring *and* mitigation will be required. During species-specific monitoring and mitigation, periodic reports will be provided to DELWP and DAWE, and, additionally, fully evaluated for their ongoing effectiveness in annual reports
- Examples of mitigation measures that will be evaluated include but are not limited to those outlined in Appendix 13. As wind turbine collision mitigation studies are ongoing throughout the world, as new knowledge is generated on the nature and effectiveness of mitigation it will be included in this evaluation

Based on these investigations, a report will be prepared and provided to DAWE and DELWP. This report will consider any cumulative impact of WWF on threatened species to date, including previous strikes of threatened species which may have occurred throughout the operating period of WWF. This report will identify mitigation measures based on the investigations described above as well as their effectiveness where they can be implemented immediately (e.g, where it is obvious why additional collisions are occurring). Any mitigation measures proposed in the report must be to the satisfaction of DELWP.

Mitigating an ongoing impact

Mitigation measures will be implemented in consultation with DELWP and DAWE if the investigation of an impact trigger concludes there is potential for an ongoing impact. The purpose of mitigation measures will be to prevent the impact from continuing to occur at a scale that leads to an unacceptable impact. Specific mitigation measures will be implemented depending on the nature, cause and significance of any impact recorded and in response to the results of investigations of the event and of the species concerned on the WWF site.

The following is recommended if Southern Bent-wing Bat collision mortality is recorded:

- Immediate investigation to determine if the impact was a one-off event or potential to be ongoing
- Increase carcass searching will be immediately expanded to cover all 59 turbines once a fortnight in the subsequent six weeks to determine if the species concerned is colliding was a one-off event or potential ongoing event

- Bat monitoring using Songmeters will be initiated at the turbine of collision both at height and at one metre off the ground, if currently not already undertaken, in accordance with Appendix 13
- Investigation report to be provided to DELWP and the responsible authority.

Depending on the findings of the incident report, further mitigation may be implemented for any turbines deemed to be at-risk including.

- Vary turbine cut in speed to 4 m/s where turbines operate based on species and sites specific research and monitoring with demonstrated ability to decrease significant impact on populations
- Targeted turbine curtailment based on site and species-specific understanding of risk behaviour with demonstrated ability to decrease significant impact on population, likely to be wind speeds between 0-4 metres per second
- Investigate potential deterrents or evolving technologies that may include the following.
    - Avoid or limit the use of artificial lights on or near turbines
    - Ultrasonic deterrents that deter bats based on specific understanding of risk behaviour with demonstrated ability to decrease significant impact on population. Trials to be initiated sampling two thirds of turbines leaving one third as a control.

Mitigation measures such as varied cut in speed and low speed curtailment may be implemented on a temporary basis for an agreed period of time depending on the outcomes of the investigations.

Turbine shutdown will be considered as a last resort once all alternative mitigation options are found in post-trigger investigations to be ineffective. Information needed to inform consideration of turbine shutdown will include but not be limited to the following.

- Additional collisions by threatened species, including the level of risk to the species' population
- The findings of detailed investigations undertaken in response to the impact trigger, focusing on the species' use of the immediate area around the turbine where the collision occurred
- Clear scope for on-going monitoring to identify triggers for turbine shut-down.

8.4.3. Residual effects

Overall bat assemblage

During construction, project activities have the potential to result in temporary disturbance of local bat populations, and remove foraging, as well as behaviour disturbance as a result of human presence, and construction noise. During construction, the loss of up to 4.5 ha of native vegetation and six large trees. The loss in native vegetation is unlikely to have a material effect on the availability of foraging habitat for bat populations. Through the design process 99% of native vegetation was avoided.

Direct collisions with operating wind turbine blades or towers is the most likely effect on bats as a result of the project.

Results of post-construction bird mortality from the Macarthur Wind Farm provide a direct analogy to predict the likely impact to bat mortality from turbine collisions. Wood (2017) assessed post-construction bat mortality at Macarthur Wind Farm over a 11-month period. Annual bat mortality was estimated at 3.08 ± 1.68 bats per turbine. Bat mortality was greatest in autumn and at relatively lower levels in spring and summer. The White-striped Freetail Bat was the most common bat fatality found (80% of fatalities).

Post construction monitoring of bat deaths from turbine collisions at 15 Victorian wind farms between 2003 to 2018 recorded 13 species. Three bat species accounted for 83% of all recorded deaths with the majority of bat deaths were the White-striped Freetail Bat (67%), which typically flies higher above the ground than most other species of Victorian bats. Symbolix (2020) used post construction monitoring results to model collision mortality. Overall they predicted, between 7 and 10.8 bat mortalities occur per turbine per year in Western Victoria. Median annual per turbine mortality for individual species was 4.7-5.0 for White-striped Freetail Bat, 1.6-1.8 for Gould's Wattled Bat, and 0.5-0.8 for Eastern False Pipistrelle.

If the project was approved and constructed there would be expected to be some bat deaths from collisions with wind turbines, as would other operating wind farms in the region. As bat activity in the project site is comparatively lower than for other wind farm sites in the region, the cumulative impact to the bat community generally from the project is assessed as low.

As noted in Section 8.3, results of paired bat recording (at ground level and 45 metres) showed that most calls were from the ground-based detector indicating bats in these areas typically fly around ground level. Species recorded at a height of 45 metres were Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat, Little Forest Bat and the White-striped Freetail Bat.

A key element of the project design has been to selectively place wind turbines in areas of treeless agricultural land. This selective placement will minimise the likelihood of collisions with turbines since there is known to be a strong relationship with treed areas and bat abundance. For example, Lumsden and Bennett (2005) surveyed bat assemblages at 30 sites in south-eastern Australia, in five habitat categories representing a range of tree densities from remnant woodland blocks (>35 trees/ha) to sparsely scattered trees (<1 tree/ha), and open paddocks devoid of trees. They found that overall activity in open paddocks was significantly lower compared to the forested categories. While all species were recorded in open paddocks, for eight of the ten species this represented <7% of their total activity recorded across all habitat categories.

Based on both on-site recording and considering the results of post construction monitoring of bat deaths (Symbolix 2020), it is likely that White-striped Freetail Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat and Little Forest Bat will collide with operating wind turbines. Each of these species are common and widely distributed and considered to be secure (i.e., not threatened). Based on Symbolix (2020), White-striped Freetail Bat and Gould's Wattled Bat will be the most impacted. This is likely related to the species' foraging habits, which take them high above the tree canopy and open ground while feeding on flying insects, bringing them into turbine RSA heights frequently, and the fact that they are among the most common and widespread species of micro-bat in Australia. The higher RSA height of 40 metres proposed for WWF is expected to lessen these impacts compared with some Victorian wind farms described in Symbolix (2020) that have lower minimum RSA heights.

Considering that a) bat activity in the wind farm site is lower compared to other areas, b) placement of wind turbines has avoided treed and forested areas and c) that the minimum blade tip is higher than most operating wind farms in Victoria, the overall impact of the proposed WWF on bats is considered to be lower than impacts at other operating wind farms in western Victoria.

Southern Bent-wing Bat

As the Southern Bent-wing Bat has been recorded on the WWF site there is a risk that it may collide with operating turbines. The risk of Southern Bent-wing Bat colliding with turbines has been assessed and it has been deduced that the impact on this species is low, as explained below.

The Recovery Plan for the Southern Bent-wing Bat states that the impacts from wind farms on the population is unclear at this stage (DELWP 2020) though is possible if a wind farm is built close to a roosting site it may have a major impact on that population. The risk increases the closer the wind farm is to a maternity cave or dispersal route and potential impacts include cave destruction during construction, mortalities due to collision with turbines and altered access to foraging areas (DELWP 2020). Individuals from the Warrnambool maternity cave population are the most likely to occur at the proposed wind farm site. Current estimates for the Warrnambool maternity population are 17,000 to 18,000 individuals.

As the wind farm is located greater than 15 kilometres from any known non-breeding cave and more than 41 kilometres from a maternity cave, impacts due to construction activities and destruction of caves is considered highly unlikely.

Despite an extensive surveying effort of 4,924 detector nights, activity levels of the Southern Bent-wing Bat were low across the study area. The overall average number of calls in the study area was 0.03 calls per detector night. Southern Bent-wing Bat was only recorded from 29 out of 100 sites in the study area.

No areas with repeated Southern Bent-wing Bat activity were located near proposed turbines. Throughout the studies only two surveying sites (sites 3 & 22) showed signs of higher activity with an average of 2.5–2.92 calls per night respectively. Site 3 was located along the Shaw River where there were remnant acacia trees lining the river bank continuous with a Blue Gum plantation located in the south-west of the study area approximately 490 metres from the nearest proposed turbine. Site 22 was in the far eastern part of the study area and had planted trees in a grove surrounding the site. The nearest proposed turbine to this site is approximately 1.55 kilometres to the west.

Habitats where higher activity has been recorded in the study area (remnant acacia along a river bank and planted tree grove) are not characteristic of the wider wind farm site, which is largely cleared for agricultural purposes. Studies undertaken at the Dundonnell Wind Farm indicated that bat activity was considerably lower 120 metres from treed areas compared with at the treed habitat. As the habitat on the majority of the site is non preferred and the preferred treed habitat is located at least 215 metres away from proposed turbines, it is unlikely that flights will be undertaken regularly near turbines.

Movement between the two sites of highest activity and areas of suitable habitat is a possibility and this may take individuals directly over turbine locations. Given the evidence provided in the preceding sections regarding flight heights in open areas, where turbines are proposed to be situated, the infrequency with which Southern Bent-wing Bat calls were recorded and the proposed RSA minimum blade tip height of 40 metres, it is considered there is a low risk of turbine collision if the species were to traverse the site.

The closest known non-breeding caves are Yambuk, approximately 15-20 kilometres south-west of the site and Byaduk, approximately 25-30 kilometres north west of the site. These sites are within the known nightly flight ranges of the species.

Additionally, WWF is located between several non-breeding caves between which Southern Bent-wing Bat may undertake occasional, longer-distance movements of up to 70 kilometres. It is possible that bats may travel to the proposed wind farm site from these caves though the majority of movements will be closer to non-breeding caves. Given this, it is unlikely that high numbers of individuals would be on site regularly or for extended periods and likely that they won't be flying as high as the lower RSA height of turbines (i.e. 40+ metres). The times of Southern Bent-wing Bat calls were typically well after sunset (average approximately four hours) indicating roosting sites are unlikely to be close by.

The nearest major maternity cave is the Warrnambool maternity cave, so bats breeding there are not predicted to routinely visit the WWF site. The wind farm is located between the maternity cave and Byaduk caves, between which some movements is expected. Flight routes are likely to follow large patches of vegetation located to the south-east of the site in areas with Blue Gum plantation, a habitat not characteristic of the proposed wind farm site. Additionally, the areas of highest activity, corresponding with remnant acacia along creek line and planted groves of trees, were located at a minimum of 490 metres from proposed turbines. The lack of records where the WWF is to be located during all surveys, including repeated surveys at a high survey effort during the species' dispersal period, indicate that it does not regularly use the WWF site during these times in autumn, winter and early spring.

Activity levels were generally thought to be lower for most of the non-breeding season (April through to September), when the Southern Bent-wing Bat is at non-breeding caves. New information has shown that SBWBs are significantly more active in winter than previously thought, which can include frequent (e.g., over successive nights) inter-cave movements of as far as 70km (van Harten 2020, TSSC 2021). Some bats roost in clusters, whilst others roost individually at this time.

There is no evidence that the Southern Bent-wing Bat were attracted to wetlands in the study area, given the lack of vegetated wetland habitat, notwithstanding the presence of significant water in the landscape from 2018 to 2020. Other than Site 3, which was located close to treed vegetation near the Shaw River which recedes into small pools in the summer time and is vegetated with remnant acacia trees, survey results showed there was little to no activity by the species at wetlands in the study area. Although the species may occasionally fly across the site, there is no habitat within the site that is consistently favoured by the species, strongly suggesting it is not core habitat of significance.

Monitoring of impacts on the Southern Bent-wing Bat has been outlined in the proposed BBAMP bat monitoring program presented in Appendix 13

Potential cumulative impacts on the Southern Bent-wing Bat population

It is difficult to determine the cumulative impacts on the Southern Bent-wing Bat without a central registry of operational monitoring data of wind farms in Victoria. Most mortality data from Victorian wind farms is not publicly available. The Arthur Rylah Institute are developing a Population Viability Analysis for the Southern Bent-wing Bat that may be able to predict the cumulative impacts of any proposed wind farm.

The Threatened Species Scientific Committee has undertaken a Population Viability Analysis on the combined South Australian and Victorian population of Southern Bent-wing Bat. Two models were used to calculate the number of mature adults predicted to be alive in 2056 and it revealed an overall population decline of 84% - 97% (TSSC 2021).

An analysis was undertaken by Symbolix (2020) to produce cumulative statistics and quantify the collision rates of different bird and bat species at wind farms in Victoria. Some of their findings are summarised below.

- Between 7 – 10.8 bat mortalities occur per turbine per year in Western Victoria
- The two most common bat species found to collide with turbines are the White-striped Freetail Bat and Gould's Wattled Bat
- Mortalities are higher for White-striped Freetail Bat than any other bird or bat
- A total of eight Southern Bent-wing Bat collisions are known to have occurred at two wind farms.

The cumulative statistics analysis undertaken by Symbolix (2020) was done for species found at more than two wind farms so Southern Bent-wing Bat did not qualify for the analysis.

The scale of overall impact on the Southern Bent-wing Bat is low compared with other species. The median annual per-turbine estimates for White-striped Freetail Bat and Gould's Wattled Bat at the Willatook Wind Farm is 4.7 and 1.8 mortalities respectively (Symbolix 2020).

Utilisation rates of Southern Bent-wing Bat are far lower than other approved wind farms (Figure 12) and minimum RSA is higher than the Macarthur Wind Farm (known wind farm where Southern Bent-wing Bat collision has occurred), which suggests that the cumulative impact will be less than for other approved wind farm projects.

Given the low activity levels of Southern Bent-wing Bat and the lack of suitable foraging habitat where turbines are proposed (see above), the proposed WWF is considered to represent a low impact on the species. There is a very low likelihood of a collision by this species with turbines in the proposed wind farm over the life of the project though a small number may be affected by interactions with turbines, it is considered unlikely that this will lead to a long-term decrease in the size of the population. The extent of impact is unlikely to compromise its future survival and the impact rating (Table 10) is considered to be low. Significant impacts on the Warrnambool maternity cave population estimated at 17,000 to 18,000 individuals are considered highly unlikely from the construction and operation of the WWF. The impact assessment is presented later in this report in Section 12.3.1.

Yellow-bellied Sheathtail Bat

The Yellow-bellied Sheathtail Bat is a wide-ranging species through tropical and sub-tropical Australia. In Victoria, the species is considered to be a rare visitor in late summer and autumn (NSW Office of Environment & Heritage 2021).

Many of the Victorian specimens have been found in exposed situations in an exhausted condition (e.g. hanging from the outside wall of buildings in broad daylight), which might suggest that they have been unintentionally driven south by adverse wind conditions. The species occurs in a wide range of habitats from wet and dry sclerophyll forests to open woodlands. It usually roosts in large tree hollows but sometimes uses buildings (Menkhorst 1995, Churchill 2008, NSW Office of Environment & Heritage 2021).

There is no information on the number of Yellow-bellied Sheathtail Bats that visit Victoria as it has only been recorded rarely and irregularly. The number of individuals that occur in Victoria are not known but the low numbers recorded in the WWF bat survey area, compared with other, more common bat species, indicates that the Victorian population would be small and unlikely to represent a highly significant part of the overall, larger, national population.

The Yellow-bellied Sheathtail Bat is a high-flying species that usually flies fast and straight above the canopy, but flies lower over open spaces and at the forest edge (Churchill 2008). It is thus potentially susceptible to collision with wind turbines in treed areas, where the tree height may force it to fly higher. The species has been recorded colliding with wind turbines interstate, further north in its range where it is more abundant (Nature Advisory data), indicating that it is vulnerable to turbine collision.

Calls were analysed for Yellow-bellied Sheathtail bat from studies from 2009 to April 2019. From a total of 2,857 detector nights the species was recorded at nine sites with an average call frequency rate of 0.003 per detector night. The Yellow-bellied Sheathtail Bat was recorded in areas generally outside where turbines are proposed. This reflects the lack of suitable habitat for high levels of bat activity within the area affected by the proposed wind farm.

Given the very small number of calls recorded, despite considerable survey effort, and the fact that most calls were from habitat outside the proposed wind farm layout, it is considered unlikely that the proposed wind farm will lead to regular mortality of this species and, therefore, a very low impact on the Yellow-bellied Sheathtail Bat is predicted.

Grey-headed Flying-fox

Grey-headed Flying-fox has the potential to occasionally fly over the wind farm site which may put it at risk of collision with turbines.

The closest known roost of this species is located at Warrnambool and is greater than 30 kilometres from the closest proposed turbine. The Warrnambool camp has had up to 2,500 - 10,000 individuals recorded at the camp. The usual numbers at the camp are between 1 and 2,499 individuals (DAWE 2022b).

In the past two years a temporary camp has established itself at a pine plantation northwest of Mortlake and is greater than 45 kilometres from the closest proposed turbine. Numbers at this camp are estimated between 2,500 and 9,999 (DAWE 2022b).

There were no records of Grey-headed Flying-fox within the 10 kilometre search region. The closest record of Grey-headed Flying-fox from the VBA was recorded in 2020 located at Kirkstall approximately 15 kilometres from the closest proposed turbine and an old record from Koroit (DELWP 2021). Several VBA records from the township of Warrnambool.

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 kilometres of its roost in search of food each night (Tideman 1998) though they have been reported moving out to 50 kilometres (DAWE 2021b). The study area is outside the usual nightly movements and is not located between the two closest camps.

There are limited food resources at the proposed WWF that would attract the flying-fox to the area. Food resources at the WWF include blossoms of remnant eucalypts and planted rows of Sugar Gum (*Eucalyptus cladocalyx*) and the fruit of any planted fruit trees that may be around farm houses. The Blue Gum plantations which are adjacent to the wind farm are not a favoured food source of the Grey-headed Flying-fox.

Turbine free buffers of 215 metres have been recommended from all treed areas. This includes any potential foraging areas of the Grey-headed Flying-fox.

It is considered unlikely that the Grey-headed Flying-fox would visit the proposed WWF regularly. Consequently, it is considered unlikely that the proposed wind farm will lead to regular mortality of this species and, therefore, it is unlikely to cause a significant impact on it. Overall the impact rating (Table 10) is considered to be very low for this species.

9. Bird assessment

9.1. Overview

The bird community present at the proposed wind farm site was investigated by completing a review of desktop information, conducting bird utilisation surveys using a fixed-point bird count method (AusWEA 2005), habitat assessments and roaming surveys. In addition, a migratory shorebird survey was undertaken of seasonal wetlands in spring and summer, in accordance with the EPBC Act survey guidelines for migratory species (DoEE 2017). The following sections describe the findings of these assessments before a consolidated assessment of impacts is provided.

9.2. Bird Utilisation Survey

KEY FINDINGS

- From 2009 to the current date, 96 bird species, have been recorded on the WWF site either during formal point based bird counts or incidentally.
- Species diversity was slightly higher during spring (Spring 45; Summer 41), while bird abundance was slightly higher in summer (Spring 914; Summer 1094).
- During point counts, most bird sightings (95%) occurred below rotor swept area (RSA) height (40 metres above the ground) during the two surveys. No birds were observed during surveys flying above RSA height (i.e. more than 250 metres above the ground).
- The Fork-tailed Swift, listed as migratory under the EPBC Act, was recorded. It occurs in the region occasionally, so the frequency of turbine collisions will likely be low, with no significant implications for its population, which numbers more than 100,000 individuals.
- Six raptor species were recorded during the two seasonal point-based surveys, with Brown Falcon and Nankeen Kestrel being the most recorded species. Wedge-tailed Eagle activity on the site was comparatively low.
- The most common species recorded across all sites during the two seasons were (in order of utilisation): Little Raven, Australian Magpie, Eurasian Skylark, Common Starling, and Magpie-lark and Long-billed Corella equal fifth.

9.2.1. 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) endorsed by the latest Best Practice Guidelines for wind farms in Australia (Clean Energy Council 2018).

Two BUS were undertaken, the first during spring 2018 and the second at the end of summer 2019.

9.2.2. Previous studies

A BUS (EHP 2018) was undertaken in late spring (4th – 6th and 16th – 20th November) 2009. The survey was undertaken assuming RSA heights of 41–220 metres and bird flight heights were recorded in accordance with these heights.

The 2009 study followed the *Fixed-Point Bird Count* method which was undertaken utilising nine points (seven within the wind farm and two reference sites at least 500 metres from the project area). The search radius used was 100 metres for small birds and 800 metres for large birds. Points were surveyed eight times with the exception of survey points 7, 8 & 9, which were surveyed seven times each. Each point was surveyed at a different time of the day and bird height was recorded in intervals of ten metres for each observation.

The survey used a different approach so the results could not be combined with the more recent BUS conducted by Nature Advisory. However, general findings, such as species abundance and species flying at RSA height were comparable. The same RSA heights were ultimately relevant for both surveys.

A complete bird species list from the 2009 BUS is presented in Appendix 14, which shows the heights each bird was recorded. A total of 49 bird species were recorded from 793 individual movements of birds during 69 fixed–point counts. The most common species recorded included, in order of utilisation: Raven sp. (Little Raven), Australian Magpie, European Goldfinch, Australian Pipit and Eurasian Skylark.

The majority of birds were found flying below RSA heights (71.1% of birds below, 28.7 % at and 0.1% above RSA heights). Birds recorded flying at RSA were usually Little Raven, with 43% of observations at RSA heights being this species. Other birds observed at RSA heights included Yellow–tailed Black–Cockatoo, raptors and other common birds associated with agricultural environments.

No threatened or listed bird species were recorded during the 2009 BUS.

9.2.3. Methods

Updated bird utilisation surveys were undertaken in 2018 and 2019. This sub-section describes the methods and results of these most recent surveys.

Timing of the surveys

Two pre–construction bird utilisation surveys (BUS) were undertaken by Nature Advisory on the Willatook Wind Farm site on the dates listed below.

- Spring 2018: 15th – 20th October 2018
- Summer 2019: 24th – 28th February 2019.

These surveys cover the main seasonal changes in abundance and use of the wind farm site between the spring breeding period and the late summer, non-breeding, flocking period.

During the surveys, eight counts were made at each of the eight survey points (Figure 13). Table 26 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.

Table 26: Times when each fixed-point was surveyed

Day/time	Time of day							
	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30
Day 1								
Day 2	2	1	3	4	5	6	7	8
Day 3	3	4	5	6	7	8	2	1
Day 4	5	6	7	8	2	1	3	4
Day 5	7	8	2	1	3	4	5	6
	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00
Day 1			2	1	3	4	5	6
Day 2	2	1	3	4	5	6	7	8
Day 3	3	4	5	6	7	8	2	1
Day 4	5	6	7	8	2	1	3	4
Day 5	7	8						

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. 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.

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 (Nature Advisory 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.

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 250 metres (at the upper level of the rotors) with a diameter of the turbine blades of 200 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 metre intervals between 0 and 60 metres and at 20 metre intervals thereafter. This allowed for a more precise description of bird flight heights.

Locations of survey point

Eight fixed survey points were established during both of the spring and summer surveys. Survey points were located near 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). Survey points were distributed as evenly as possible (subject to access constraints) across the wind farm site to maximise coverage in areas where wind turbines would be located (Figure 13).

Table 27 below provides a description of the habitats associated with each survey point.

Table 27: Habitat associated with each survey point

Site Number	Site description
1	Open pasture grazed by sheep and cattle. Planted gum trees and one pine tree in the site. The Sugar Gums were flowering during the February visit.
2	Open pasture dominated by introduced pasture grasses, little rocky areas, grazed by cattle and treeless.
3	Open pasture, rocky rise area, large transmission line running through the site. A large pine tree present, otherwise treeless. A low-lying area with Tussock Grass in the site, though dry in summer.
4	Open pasture grazed by cattle dominated by introduced pasture grasses, with some *Themeda*, *Austrostipa* and bracken present. Several Black Wattle trees and a large pine tree present in the site. Rocky rise areas in parts and a low-lying area with Tussock Grass.
5	Open pasture grazed by cattle dominated by introduced pasture grasses. Some rocky rise areas with bracken and some low-lying areas with Tussock Grass. Planted pine and Sugar Gum also present.
6	Open pasture, grazed by sheep and cattle. Some rocky rise areas with bracken and a low-lying area with Tussock Grass that was dry in summer.
7	Open pasture grazed by cattle with rocky rise areas with some bracken and small shrubs. A creek runs through the site that was dry in summer.
8	Open pasture grazed by sheep. A road runs through the site that has remnant Black Wattle in road reserve and planted eucalypt, casuarina, wattles and introduced pine along the fence line.

Incidental observations

In addition to observations during formalised fixed-point counts, observations of threatened species and raptors made incidentally while moving across the wind farm site 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 Willatook Wind Farm footprint. Observations were also made close to sunrise and sunset to ascertain if any large-scale movements of roosting birds were occurring across the WWF site.

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 north-westerly winds and little or no rain. Similar weather was encountered in summer but with some hot days and southerly and northerly winds. 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 wind farm site by birds.

The purpose of the surveys was to collect data on usage of the site by resident and migratory birds at the two key parts of their annual cycle when behaviour differs most – breeding and non-breeding seasons. For example, during late summer, birds such as magpies, starlings and ravens gather in larger feeding flocks. In spring, birds are breeding as isolated pairs in territories. Abundance in particular areas differs substantially between these two times.

For these reasons, the utilisation rates and species relative abundance recorded during the current surveys, are representative of the site, with time of year and time of day biases accounted for in the combined data.

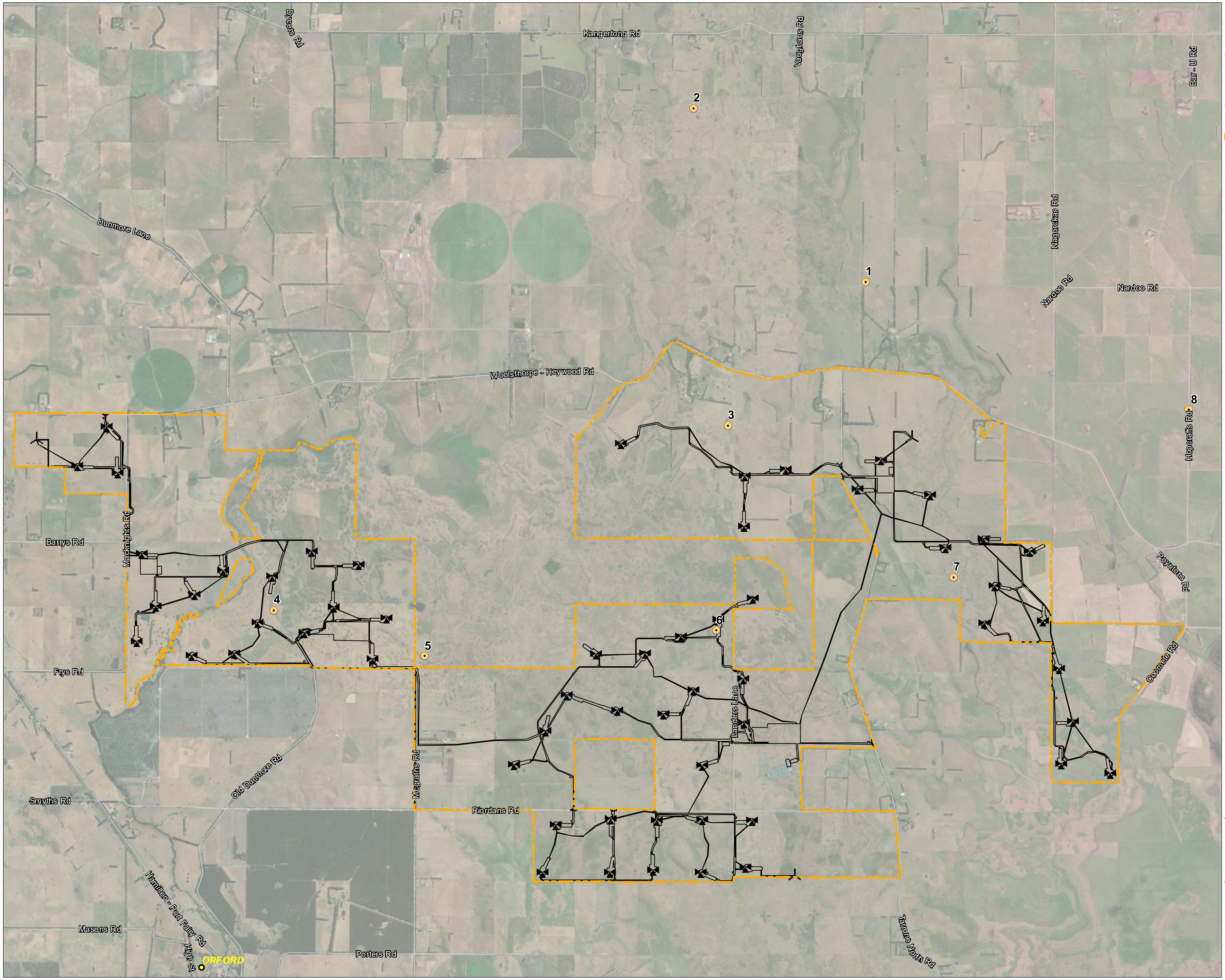

Figure 13: Willatook Wind farm showing location of BUS points

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 3/03/2022

Legend

- Wind farm boundary
- Wind turbine
- Construction footprint
- BUS points

N

Metres
0 500

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9.2.4. Results

Survey Suitability

The cumulative number of species recorded from the consecutive fixed-point bird counts conducted at the observation points during the spring and summer surveys are shown in Figure 14.

In spring, the number of species recorded was higher than during the summer survey. The number of new species observed during spring surveys almost levelled off after approximately 30 counts, after which the occasional new species was found. Over 80% of species were found after 30 counts. Similarly, the summer survey results showed that new species observed almost levelled off after 28 counts.

The combined results strongly suggested that the two surveys collectively provided a representative picture of the diversity of bird species flying over the wind farm site during the spring and summer survey periods.

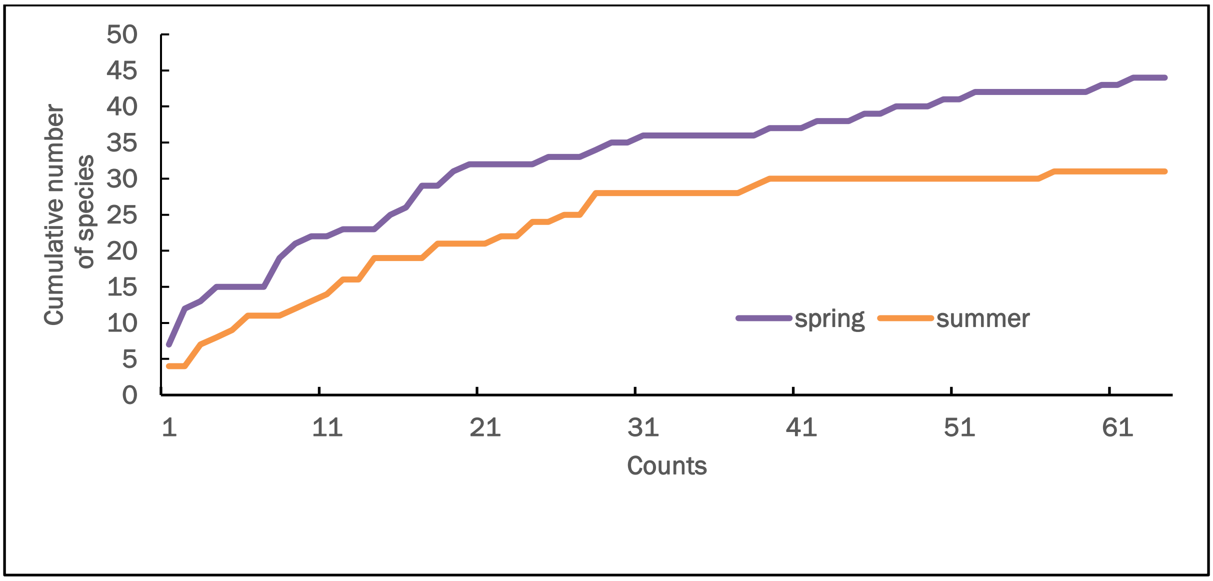

Figure 14: The cumulative number of bird species recorded during consecutive counts at survey points during the spring and summer surveys

Findings

A total of 57 bird species were recorded utilising the wind farm site during both the two BUS surveys and incidentally in 2018-19. This number represents approximately 42% percent of the 137 species of birds reported by the *Victorian Biodiversity Atlas* for the search region (an area of 10 km radius from the boundary of the wind farm site).

The actual number recorded in each of the two seasons during the formal BUS counts was 45 species during spring and 41 during summer or 56 species combined (one additional incidental species was found). The number of species was higher during spring but bird numbers (abundance) were higher during summer (see below).

The species observed utilising the impact points, their abundance and height distribution are detailed in Appendix 15. This 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] RSA height). A summary of the two-seasons' data is presented in Table 28.

The abundance of birds varied between the two seasons 914 individuals were counted in spring and 1094 in summer. This reflects the presence of juvenile birds after the spring breeding season and for some species, such as ravens, magpies, starlings and cockatoos, post-breeding flocking and communal feeding.

The five most abundant species of birds at the survey points are shown in Table 29. The common resident species (Little Raven most abundant over both seasons; Common Starling; Australian Magpie) dominated in both seasons. Overall, the five most common species formed over 75% in spring and 66% in summer of all birds recorded during the BUS. Little Ravens dominated overall, forming 26.8% (spring) and 25.8% (summer) of total abundance.

The order of dominance, however, differed between the two seasons, in spring the common resident species dominated together with Eurasian Skylark, and Long-billed Corella and Magpie-lark (equal 5th most abundant). The last two species were recorded in low numbers in summer. Superb Fairy-wren and European Goldfinch were amongst the most abundant species in summer.

The relative abundance of birds at the impact points varied within seasons depending mainly on the habitat at the observation point. Those points with more mature native trees and close to or within remnant trees attracted more birds and more species, including those that inhabit only tree cover, than those in open grazing paddocks or at points adjacent to rows of planted pine trees (windbreaks).

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Table 28: Summary of the number and height distribution of bird at the survey points during two seasons

Season	Observation Point	Below RSA	RSA	Above RSA	Total	%
Spring	1	126	6		132	14.44
	2	75	7		82	8.97
	3	147	7		154	16.85
	4	98	5		103	11.27
	5	101	12		113	12.36
	6	82	9		91	9.96
	7	107	13		120	13.13
	8	114	5		119	13.02
	Season Totals	850	64	0	914	100
Summer	1	248	1		249	22.76
	2	40	8		48	4.39
	3	96	7		103	9.41
	4	92	2		94	8.59
	5	121	1		122	11.15
	6	211	1		212	19.38
	7	140	16		156	14.26
	8	110	0		110	10.05
	Season Totals	1058	36	0	1094	100
Both seasons	1	374	7		381	18.97
	2	115	15		130	6.47
	3	243	14		257	12.8
	4	190	7		197	9.81
	5	222	13		235	11.7
	6	293	10		303	15.09
	7	247	29		276	13.75
	8	224	5		229	11.4
	Grand Total	1908	100	0	2008	100

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

Table 29: The five most abundant species at the survey points

Spring 2018		Summer 2019		Both seasons	
Species	%	species	%	species	%
Little Raven	26.81	Little Raven	25.78	Little Raven	26.25
Eurasian Skylark	23.74	Australian Magpie	20.57	Australian Magpie	16.43
Australian Magpie	11.49	Common Starling	10.51	Eurasian Skylark	11.90
Common Starling	5.80	Superb Fairywren	5.12	Common Starling	8.37
Magpie-lark / Long-billed Corella	3.61	European Goldfinch	4.48	European Goldfinch / Magpie-lark	3.49
Total percentage	75.05		66.45		69.92

Flight heights

Bird heights were classified as below (< 40 metres above the ground), at (40–250 metres), and above (> 250 metres) RSA height. The numbers of birds recorded during the two seasonal surveys at these flight heights are presented in Table 27.

Most 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**: 93% (below), 7% (at), none (above RSA height);
- **Summer 2019**: 97% (below), 3% (at), none (above RSA height);
- **Both seasons combined**: 95% (below), 5% (at), none (above RSA height).

The detailed height distribution of birds over the wind farm site is shown in Figure 15. The height distribution confirms that most birds flew below RSA height, or were either on the ground or in trees (from 1 to 19 metres height).

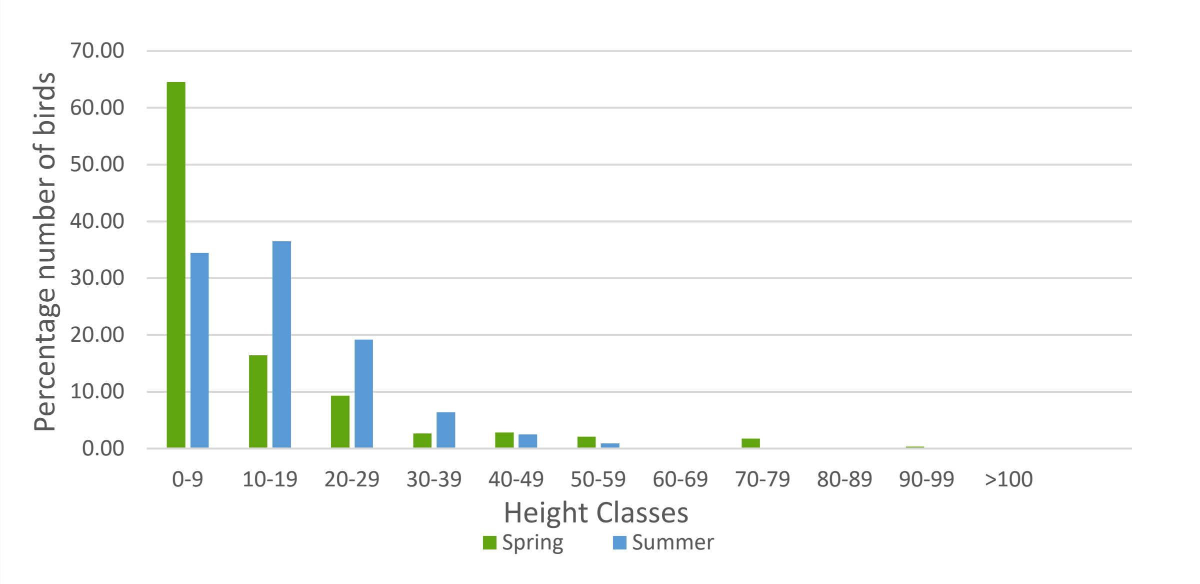

Figure 15: The height distribution of birds observed at the survey points

Species recorded at RSA height

Table 30 summarises the species of birds found flying at RSA heights during the two seasons of BUS. Generally, such birds were larger and included mostly Little Raven, Long-billed Corella, Australian Magpie 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. Fork-tailed Swift, which live predominantly on the wing, and Blue-winged Parrot, which also ascends to RSA height on occasions, were also observed flying high.

The number of birds recorded flying at RSA heights varied between the two seasons, with 7.11 percent of all birds in spring, 3.38 percent in summer, and five percent for the combined seasons. Four species of birds were recorded at RSA heights in spring, six species in summer, and a total of nine species for the combined seasons. The most common bird to fly regularly at RSA heights in spring was the Eurasian Skylark. Other birds regularly flying at RSA heights included Sulphur-crested Cockatoo, Little Raven and raptors. In summer, Australian Magpie was the most common bird flying at RSA heights. Other birds included Little Raven, Fork-tailed Swift and raptors. Among raptors there were three sightings of the Wedge-tailed Eagle, of which two were at RSA heights.

Table 30: Species flying at rotor swept height (RSA) at the survey points during BUS

Season	Species at RSA	Birds at RSA	All birds	% of birds at RSA	% RSA of all birds at RSA	% RSA of flights of all birds
Spring	Eurasian Skylark	58	217	26.73	89.23	2.89
	Long-billed Corella	5	33	15.15	7.69	0.25
	Blue-winged Parrot	1	1	100	1.54	0.05
	Brown Falcon	1	8	12.50	1.54	0.05

Season	Species at RSA	Birds at RSA	All birds	% of birds at RSA	% RSA of all birds at RSA	% RSA of flights of all birds
	Grand Total	65	914	7.11	100	3.24
Summer	Australian Magpie	13	225	5.78	35.14	0.65
	Little Raven	13	282	4.61	35.14	0.65
	Fork-tailed Swift	4	4	100	10.81	0.2
	Brown Falcon	3	16	18.75	8.11	0.15
	Nankeen Kestrel	2	10	20	5.41	0.1
	Wedge-tailed Eagle	2	3	66.67	5.41	0.1
	Grand Total	37	1094	3.38	100	1.84
Both Seasons	Eurasian Skylark	58	239	24.27	56.86	2.89
	Australian Magpie	13	330	3.94	12.75	0.65
	Little Raven	13	527	2.47	12.75	0.65
	Long-billed Corella	5	33	15.15	4.9	0.25
	Brown Falcon	4	24	16.67	3.92	0.2
	Fork-tailed Swift	4	4	100	3.92	0.2
	Nankeen Kestrel	2	15	13.33	1.96	0.1
	Wedge-tailed Eagle	2	3	66.67	1.96	0.1
	Blue-winged Parrot	1	35	2.86	0.98	0.05
	Grand Total	**102**	**2008**	5.08	100	5.08

Notes: RSA height (40 -250 m), All birds = all birds counted at all heights in the survey.

Birds of concern

Raptors and waterbirds

Six raptor species were recorded during the two seasonal BUS (Table 30). The Brown Falcon was by far the most abundant raptor as the prevailing habitat of open grasslands and scattered mature large trees for roosting attracted this species. The Nankeen Kestrel was the second most abundant species flying at RSA heights. The Wedge-tailed Eagle, a raptor of concern due to its soaring habits and susceptibility of collision with operating turbines, was recorded on few occasions: no birds in spring and three in summer. The Wedge-tailed Eagle utilisation rate was less than 0.007 birds per hectare per hour, considered a low activity level compared with a rate range of 0.001–0.44 eagle per hectare per hour recorded in other wind farms in south eastern Australia (Nature Advisory data). Raptors in general constituted a small fraction of the total birds utilising the site (Table 30). Based on the low utilisation rate by raptor species, risks to these species are low.

A total of seven species of waterbirds were recorded during BUS (seven species in spring and one in summer) (Table 30) and an additional three waterbirds from the 2009 BUS. The Pacific Black Duck, White-faced Heron, and Australian Shelduck dominated the number of waterbirds. Most were recorded flying close to the ground and would avoid collision with operating turbines.

Other less abundant waterbirds observed were the Australian White and Straw–necked Ibises, White–necked Heron and Grey Teal. These species were seen foraging occasionally in open paddocks or near farm dams, and usually fly close to the ground between farm dams but may occasionally fly at RSA heights.

The 2009 BUS recorded Australian Wood Duck, Black–tailed Native–hen and Masked Lapwing. Australian White Ibis, Straw-necked Ibis, White–faced Heron, Australian Shelduck and Pacific Black Duck were recorded at RSA heights.

Table 31: Raptors and waterbirds recorded at the survey points during the two seasonal BUS surveys

Raptors	Spring	Summer	Both Seasons	% of raptors	% of all birds
Brown Falcon	8	16	24	52.17	1.2
Brown Goshawk		2	2	4.35	0.1
Nankeen Kestrel	5	10	15	32.61	0.75
Spotted Harrier	1		1	2.17	0.05
Swamp Harrier	1		1	2.17	0.05
Wedge-tailed Eagle		3	3	6.52	0.15
Total raptors	15	31	46	100	2.29
Waterbirds	**Spring**	**Summer**	**Both Seasons**	**% of wetland birds**	**% of all birds**
Australian Shelduck	12		12	25	0.6
Australian White ibis	2		2	4.17	0.1
Grey Teal	2		2	4.17	0.1
Pacific Black Duck	13		13	27.08	0.65
Straw-necked Ibis	1		1	2.08	0.05
White-faced Heron	4	9	13	27.08	0.65
White-necked Heron	5		5	10.42	0.25
Total waterbirds	39	9	48	100	2.39
Total raptor and waterbirds	**54**	**40**	**94**	**100**	**4.68**

Threatened species

Most birds found to utilise the wind farm site were common birds. Of the species recorded during the BUS at the Willatook Wind Farm, one listed species was observed: Fork-tailed Swift, listed as migratory under the EPBC Act. This species was recorded in low numbers at the wind farm site, however it does fly at RSA height, where it is at risk of collision. Due to its secure population (100,000+, DoE 2015) and low abundance in the WWF site, it is considered unlikely that the proposed wind farm will have a significant impact on its population.

Conclusions

The conclusions from the BUS of the Willatook Wind Farm are presented below.

- The study area consists largely of open, grassy paddocks grazed by cattle and sheep, linear windbreaks of planted native and introduced trees supporting mostly common, widespread farmland and some woodland birds.
- Two seasonal surveys were undertaken, the first in spring (15th – 20th October 2018), and the second in summer (24th – 28th February 2019).
- A total of 57 species of bird were recorded utilising the wind farm site during the most recent two BUS (2018-19), including incidental recordings away from the fixed survey points. The total number of birds recorded on site from 2009 to the current date is 96 species.
- Of the species recorded at the survey sites during BUS, 45 species were recorded during spring and 41 species during summer surveys.
- Bird abundance and diversity was generally similar between the eight surveyed impact points.
- The four most abundant species of birds at the impact sites were common resident species (Little Raven, Australian Magpie, Eurasian Skylark, Common Starling) with Magpie–lark and Long-billed Corella ranked equal fifth. These species comprised 69% of all birds recorded during both seasons. A similar set of birds were also reported as dominant species during 2009 BUS with the addition of Australian Pipit and European Goldfinch (EHP 2018) indicating that little change has occurred in bird species composition over the years.
- Most birds were recorded flying below RSA heights, with an overall percentage over the two (2018-19) seasonal surveys of 95% below 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 (Nature Advisory data). A total of 4.2 percent of all birds in spring and 0.9 percent in summer were found to fly at RSA heights.
- The list of birds recorded flying at RSA heights was similar between observation points. Common species such as the Eurasian Skylark, Little Raven, Australian Magpie, Long-billed Corella and some raptors made up most of the birds flying at RSA heights.
- Raptors were comparatively less abundant at the site with only six individuals being recorded across both seasons. The Wedge-tailed Eagle was recorded three times during the 2018-19 BUS, much less than the number in the 2009 surveys (EHP 2018) and only recorded on one occasion flying at RSA height.
- Waterbirds were more abundant during spring when wetlands held water and were mostly restricted in their use of the wind farm site to wetlands. Few were observed flying at RSA heights.
- One listed species was recorded throughout all the BUS surveys in 2018: Fork–tailed Swift, listed as migratory under the EPBC Act. A small flock of four individuals was observed flying over the wind farm during the summer 2018 survey. The species was observed flying at RSA height (it was at 40 metres height), although it regularly does so and is potentially vulnerable to collision with wind turbines.

9.3. Migratory shorebird assessment

KEY FINDINGS AND CONCLUSIONS
Three EPBC Act-listed migratory shorebird species (Sharp-tailed Sandpiper, Common Greenshank and Latham's Snipe) were detected on the WWF site during targeted surveys conducted by Nature Advisory in 2018. None of the three species of listed migratory shorebird (Sharp-tailed Sandpiper, Common Greenshank and Latham's Snipe) 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). Two other listed migratory waterbirds may also occur occasionally on wetlands in the WWF site: Curlew Sandpiper and Red-necked Stint. These may be expected to occur in small numbers occasionally, given the limited extent of suitable habitat on the WWF site. Such numbers would not exceed significance levels of a threshold of 0.1% of flyway population (DoEE 2017). Suitable habitat for listed migratory shorebirds was scarce, limited in extent and scattered. Far more extensive habitat that supports much higher numbers of all the recorded or likely species of shorebird occur coastward from the wind farm search region. Based on these findings, it was concluded that there will be no significant impacts on migratory shorebirds from the WWF development. 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 WWF site are unlikely to exceed 0.1 percent of the population and no wetland is likely to support at least 18 individuals (DoEE 2017).

9.3.1. Introduction

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

The aim of this survey was to identify areas of suitable wetland foraging habitat that may support any one of these EPBC Act listed shorebird species within the proposed WWF 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.

9.3.2. Species biology

Australia is party to several international treaties to protect migratory bird species that occur along the East Asian – Australasian flyway. 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). In Australia, the EPBC Act provides for the implementation of these treaty obligations.

Key species protected by these agreements are the migratory shorebirds, which comprise 37 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 (DoEE 2017).

The 37 listed migratory shorebirds are shown in Table 32below.

Table 32: Listed migratory shorebirds species or species habitat recorded in the search region

Common name		Scientific name
Sandpipers and related birds		Scolopacidae
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*
Plovers		Charadriidae
30	Pacific Golden Plover	*Pluvialis fulva*
31	Grey Plover	*Pluvialis squatarola*
32	Little Ringed Plover	*Charadrius dubius*
33	Double-banded Plover	*Charadrius bicinctus*
34	Lesser Sand Plover	*Charadrius mongolus*

	Common name	Scientific name
35	Greater Sand Plover	*Charadrius leschenaultii*
36	Oriental Plover	*Charadrius veredus*
	Pratincoles	Glareolidae
37	Oriental Pratincole	*Glareola maldivarum*

Most of the listed species are birds of coastal mudflats and intertidal zones, or of grassland habitats in northern Australia. They have various body sizes, leg lengths, and in particular, variation in bill lengths and shapes that are adaptations to various food types and foraging niches within their habitat.

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

Of the 37 listed species, five were considered likely to occur regularly on the inland wetlands of the Willatook region (see Section 10.1), on the basis of habitat suitability and existing records from the wind farm and search region.

9.3.3. Sources of information

Existing information

Existing information on the status of migratory shorebirds was obtained from the Victorian Biodiversity Atlas (VBA), a public database held by the Department of Environment Land Water and Planning (DELWP 2019). These records were obtained from a wider area, termed the 'search region' defined for this assessment as an area bounded by co-ordinates 38˚ 01' to 38˚ 16' S and 141˚ 57 to 142˚ 25' E. This encompasses the area from Macarthur to Codrington, to just north-east of Koroit and then to halfway between Hawkesdale and Caramut. That is, falling just short of coastal habitats that are known to support larger numbers of some species of shorebirds (i.e. Tower Hill, Port Fairy, Belfast Lough, Moyne River estuary and nearby beaches).

The likelihood of suitable habitat in the study area for listed migratory species was also ascertained through a search of the online EPBC Act Protected Matters Search Tool (DAWE 2021a) using the same search region.

Habitat assessment and selection

The aquatic habitat assessment considered the characteristics of wetlands and waterways and whether they met the habitat requirements of the targeted species.

The following process was undertaken:

- The DELWP mapped wetlands and other aquatic habitats were identified on the WWF site; and
- Any habitat within three kilometers of the planned development was identified.

All habitat within this shorebird surveys area was subject to targeted migratory shorebird surveys.

Field methodology

The method for targeted migratory shorebird field surveys is contained in Appendix 16. Four surveys were completed in summer, in accordance with EPBC Act migratory shorebird survey guidelines (DoEE 2017): one in December 2018, two in January 2019 and one in February 2019. Each survey ran for up to four days in the field. The Nature Advisory team has also been visiting and assessing wetlands as part of the Brolga breeding season surveys from July to December 2018, 2019 and 2020. The outputs of this wetland assessment (particularly in relation to water regime) also informed the current assessment.

Habitat for the potential species was searched for by visiting mapped wetlands from the Victorian Wetland Inventory (VWI) a mapping database administered by DELWP, 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. Shaw River, Back Creek and Moyne River) 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.

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.

9.3.4. Results

Existing information

Existing records of migratory shorebird species listed under the EPBC Act in the search region are presented in Appendix 17. Four species were previously recorded within the search region listed below.

- Curlew Sandpiper
- Latham's Snipe
- Red-necked Stint
- Sharp-tailed Sandpiper.

The review of the VBA from the search region found that there were six records of Latham's Snipe from 1980 to 2009, three records of Sharp-tailed Sandpiper from 1980 to 2009 and one record each of Curlew Sandpiper and Red-necked Stint in 1977.

The highest numbers of Latham's Snipe officially reported in the search region in VBA was three. One landowner reporting up to "ten or a dozen" birds observed over a period of years (not observed within any one-year period), on his property (same property as the only sighting during this targeted survey). Previous records of Latham's Snipe are mostly scattered outside the boundary of the wind farm to the west and south, with one record within the boundaries of the WWF site. An expanded search of VBA taking in the coast from Yambuk to Warrnambool, found over 1,000 records of Latham's Snipe, indicating that it is likely to occur more regularly in more coastward wetlands in the region.

During the community consultation it was noted that there were Latham's Snipe scattered across the search region in small numbers. Furthermore, when the water recedes and mud flats are exposed along the floodplains along the Moyne River to the south-east of the study area there were small congregations of Sharp-tailed Sandpiper reported by a local landholder.

Areas beyond the site therefore support higher numbers of these species than the WWF site and its immediate surrounds (to 3 km). This is likely to be related to the year-round inundation of many of the coastal wetlands in which Latham's Snipe and other migratory shorebirds occur, as opposed to the ephemeral nature of wetlands on the WWF site, where Latham's Snipe would occur in very small numbers for a limited period prior to the drying of the swamps.

Survey results

Three species of migratory shorebird were recorded within the study area during the current investigation. Each species was recorded in the eastern section of the study area to the east of Tarrone North Road on a shallow depression that has been partly modified into a dam (mapped as Wetland 6 in Figure 16.

Migratory shorebirds of three species were recorded during spring-early summer 2018 at Willatook Wind Farm.

- **Sharp-tailed Sandpiper**: Seven on 15th November, 11 on 20th November and 24 on 5th December 2018
- **Common Greenshank**: One on 5th December 2018
- **Latham's Snipe**: One on 1st November 2018. The record of Latham's Snipe was close to the previous record documented in the VBA.

Most wetlands were found to be ephemeral and too densely vegetated with Common Tussock Grass, introduced pasture grasses or sedges taller than 30 centimetres 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. Suitable habitat for Latham's Snipe occurs along Back Creek and nearby drains in the eastern part of WWF, as well as along the Shaw River and some deeper, more heavily vegetated wetlands within the stony rise mosaic that retain water through much of spring. Moreover, many of the wetlands are ephemeral and were already dry by December 2018 but may provide habitat in spring for small numbers of this species (Appendix 17). Some additional wetlands and creek lines met the requirements for potential Latham's Snipe habitat; these wetlands were considered to be of moderate or high quality.

It is unlikely that significant numbers of listed migratory shorebirds would occur at the WWF site. Figure 16 shows surveyed wetlands and wetlands that could potentially provide habitat for migratory shorebird species and shows the records of Latham's Snipe recorded during the targeted surveys and during Brolga breeding season wetland surveys. The impact rating (Table 10) for migratory shorebirds is considered to be very low.

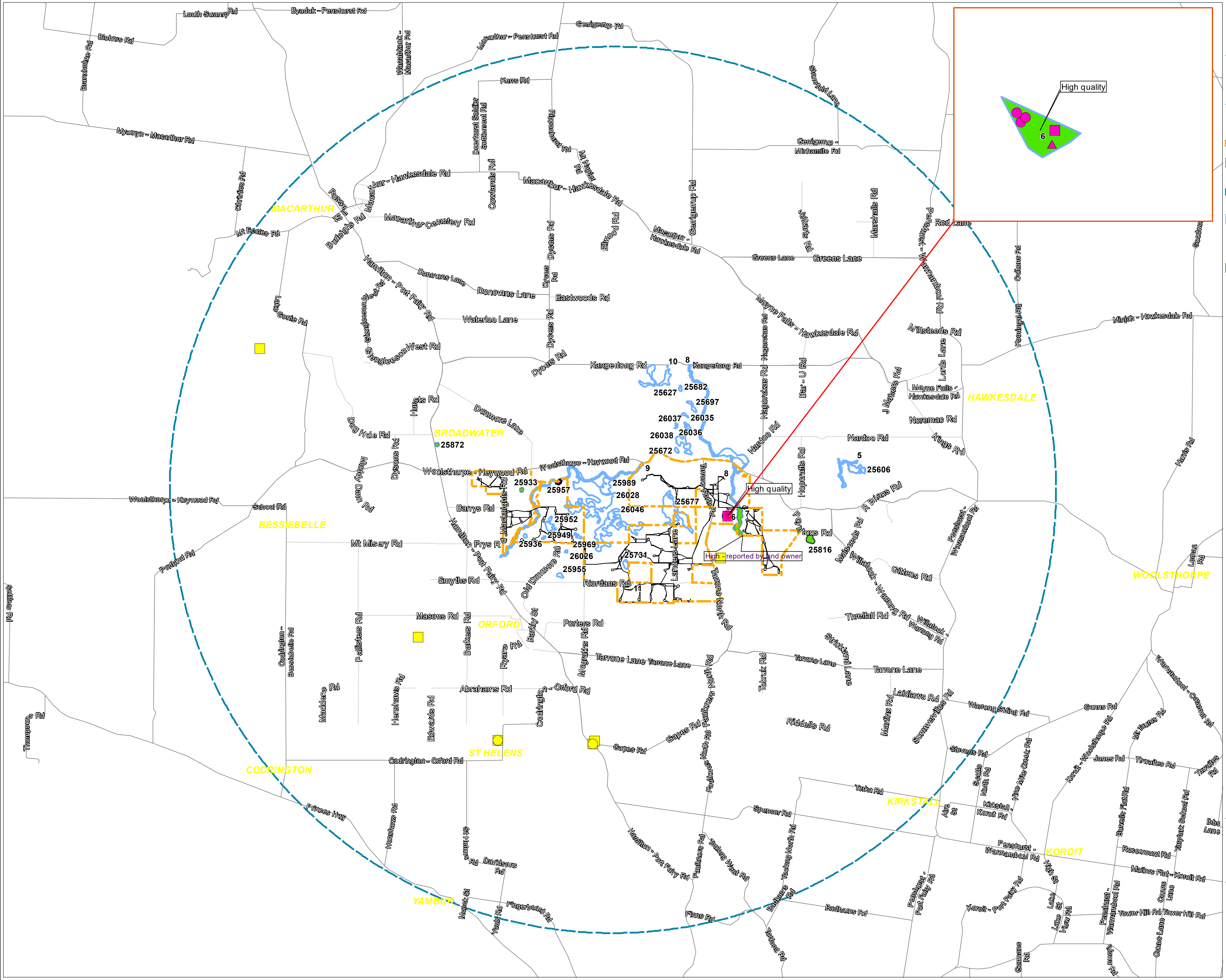

Figure 16: Map of previous records and potential habitat for Migratory Shorebirds

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 12/05/2022

Legend

- Wind farm boundary
- Construction footprint
- Wider search region 20km radius
- Surveyed wetlands
- Potential Migratory shorebird habitat

NA records

- Common Greenshank
- Latham's Snipe
- Sharp-tailed Sandpiper

VBA records

- Curlew Sandpiper
- Latham's Snipe
- Red-necked Stint
- Sharp-tailed Sandpiper

N

Metres
0 1,500 3,000

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9.4. Impact assessment

9.4.1. Impact pathways

As described in Section 7.4, development of the project has the potential to impact the existing bird community through a number of pathways.

During construction, there is the potential for direct habitat loss from vegetation clearance and physical disturbance associated with construction earthworks, as well as habitat degradation from indirect effects such as the introduction or spread of invasive species, edge effects, barrier effects, hydrological changes etc. During construction there would also be increased noise, vibration and lighting that has the potential to disrupting the behaviour of birds and potentially reducing reproductive success.

Once operating, wind farm impacts on birds mostly relate to the interaction with wind turbine infrastructure. The most likely impact is due to death or injury of birds via collision with turning blades. Some birds are particularly sensitive to collision with turbines based on their flight behaviour, for example, high flying species or those that are less manoeuvrable, such as eagles. In addition to direct collision risk, some birds may modify their behaviour and/or use of habitat in response to the presence of wind turbines and associated human activity.

9.4.2. Mitigation measures

Avoidance or minimisation of impacts by design has been central to the development of the project. Ecological considerations have been built into the project GIS as constraints that influence the siting of project infrastructure. Avoidance measures have focussed on those on areas that are important to birds, particularly those areas that support threatened or migratory species.

A study was undertaken by Lilleyman *et al* 2016 looking at disturbance to shorebirds. It was found that the mean flight-initiation distance due to human disturbance was 56 metres and recommended a 100 metre disturbance buffer to shorebird roosting sites. This 100 metre buffer has been implanted at the proposed Willatook Wind Farm.

Design measures that have been implemented include the following.

- Applying a 100-metre buffer around all mapped wetlands on the Victorian Wetland Inventory (i.e., 'current wetland' layer) to exclude all project infrastructure.
- Applying a 100-metre buffer around waterways to exclude all project infrastructure with the exception of watercourse crossings required for access tracks and electrical cables
- Committing to a minimum blade tip height of 40 metres above the ground (i.e., all wind turbine blades will be at least 40 metres from ground level).

The design was also refined to incorporate a turbine free buffer zone around the Cockatoo Swamp wetland complex to limit potential impacts to Brolga.

Other management measures that have been committed to minimise potential impacts to bird species include the following.

- Avoid siting wind turbines and associated hard stands, within 100 metres of confirmed habitat of listed migratory shorebirds

- Avoid disturbance of banks, channels and vegetation in wetlands and nearby areas (within 30 meters of center line of streams or within 30 meters from the edge of wetlands) identified as potential habitat of listed migratory shorebirds in Figure 16
- Where essential wind farm infrastructure (e.g. access tracks) crosses a creek, measures for avoiding and minimising impacts should be documented in the Construction Environmental Management Plan (CEMP) including avoiding permanent disturbance of banks, channels and nearby vegetation and restoring temporarily disturbed creek banks and vegetation to at least their pre-construction condition
- Install sediment fencing during construction to protect riparian zones if works are to be undertaken within 30 metres of creeks
- A bat and avifauna adaptive management plan (BAMP) will be prepared for the WWF 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.

9.4.3. Residual effects

During construction, project activities have the potential to result in temporary disturbance of local bird populations, and to remove foraging and nesting habitat, as well as to cause disturbance as a result of human presence, and construction noise. The extent of habitat loss from native vegetation removal is minor and, given the fragmented nature of vegetation on the site, birds present are adapted to a highly altered landscape and are unlikely to be affected. Construction disturbance is likely to have a temporary effect on a small number of individuals at any one point in time so the impact of project construction on birds on the site assessed considered to be very low.

Research of the potential impacts on bird populations as a result of operating wind farms has demonstrated there are two main impacts described below.

- Direct bird mortality from collisions with wind turbines
- Indirect impacts from habitat disruption and displacement due to the presence of wind turbines.

These impacts are influenced by both the location and design of the wind farm, but also the behaviour of the bird species. This assessment will first consider the bird community in general before focussing on birds of concern.

As described be Section 9.2.4, a total of 96 species of bird have been recorded at the wind farm site. Of the species recorded at the survey sites, the four most abundant species of birds were common resident species (Little Raven, Australian Magpie, Eurasian Skylark, Common Starling) with Magpie–lark and Long-billed Corella ranked equal fifth. Most birds (95%) were recorded flying below RSA heights. Birds recorded flying at RSA heights was similar between observation points. Common species such as the Eurasian Skylark, Little Raven, Australian Magpie, Long-billed Corella and some raptors made up most of the birds flying at RSA heights. Raptors were comparatively less abundant at the site with only six individuals being recorded across both seasons and only on one occasion recorded at RSA height.

Assessment of the impacts on birds due to collisions with turbines is routinely undertaken at operating wind farms, and this includes post-construction mortality monitoring. Bird carcasses that are found are documented to estimate the total numbers of mortalities that are likely to have occurred on a wind farm. These data enable predictions regarding the likely impact to birds as a result of the project, by comparing operating wind farms in similar contexts.

Results of post-construction bird mortality from the Macarthur Wind Farm provide a direct comparison to predict the likely impact to bird mortality from turbine collisions. Macarthur Wind Farm is approximately 7.5 kilometres north of the project in a similar environment and bird assemblage. Australian Ecological Research Services (2017) assessed post-construction bird mortality at Macarthur Wind Farm over a 11-month period. Introduced species accounted for 42% of bird fatalities. The Eurasian Skylark was the most common fatality found (36.8% of fatalities), followed by the Nankeen Kestrel (14.5%), and Australian Magpie (10.5%). Wedge-tailed Eagle was recorded twice during formal searches representing 2.6% of all records and an additional seven Wedge-tailed Eagle were reported incidentally outside of the official monitoring program. No mortality of a threatened bird species was recorded.

Similar findings were made by Malony *et al*. (2019) who reviewed mortality records of birds and bats at 15 Victorian wind farms between February 2003 to February 2018. They recorded at least 58 species of birds that had been killed by turbine collisions. The most frequently recorded bird species of pooled results across all wind farms was the Australian Magpie (*Cracticus tibicen*) (20% of records), the Wedge-tailed Eagle (*Aquila audax*) (10% of records), followed by the Nankeen Kestrel (9.5%), Brown Falcon (8.5%), and Eurasian Skylark (7.4%).

Symbolix 2020, found a clear difference in the expected mortality of birds across different turbine classes (small versus large). The larger the swept area, the larger the loss. For large turbines, mortality was predicted to range from 5 to 6.7 birds per turbine per year.

Bird mortality from collisions with turbines is predicted to reduce the local abundance of a number of species within the wind farm site such as Eurasian Skylark, Australian Magpie, Little Raven, Long-billed Corella and Magpie–lark. It is predicted that small birds will experience the highest rates of mortality, while larger birds will have the lowest rate of mortality, based on monitoring of other operating wind farms.

If the project was constructed there would be expected to be some bird deaths from collisions with wind turbines, as would other operating wind farms in the region. While each wind farm would be expected to have an impact on the local bird population, given distances between wind farms the cumulative impact is predicted to be low.

Considering the bird assemblage present within the WWF site is not unique, consisting both common and well represented native and introduced species, the impact on the overall native bird populations was assessed to be very low.

Birds of concern

The Brolga is listed as vulnerable under the FFG Act and has been recorded in the study area and is discussed in more detail in a stand-alone report (Nature Advisory 2022).

Based on bird utilisation surveys, one species (Fork–tailed Swift) listed as migratory under the EPBC Act – was recorded. Six raptor species were recorded, with Brown Falcon and Nankeen Kestrel being the most abundant species. Wedge-tailed Eagle activity on the site was comparatively low. A number of waterbirds including Australasian Shoveler, Hardhead, Eastern Great Egret, Eastern Cattle Egret, Plumed Egret, and the Glossy Ibis were recorded or considered likely to occur at the wind farm site during spring when ephemeral wetlands hold water. Three species of migratory shorebird were recorded during targeted surveys. These were the Common Greenshank (*Tringa nebularia*), Latham's Snipe and Sharp-tailed Sandpiper (*Calidris acuminata*), all found in small numbers, given the limited extent of suitable habitat,

The Fork-tailed Swift (listed as migratory under the EPBC Act) is an aerial bird species that forages on the wing. This species is a summer visitor to south-east Australia and is not considered to be a regular visitor to the study area each year. The Fork-tailed Swift often flies at rotor swept area heights. The Fork-tailed Swift population is unknown though is considered stable and likely to be over 100,000 (DAWE 2021b). It has been rarely recorded colliding with wind turbines (Nature Advisory data). Given this, the impact on this species' population is likely to be negligible and the impact rating (Table 10) is considered to be very low.

While not recorded during field surveys for the project, the White-throated Needletail (listed as vulnerable and migratory under the EPBC Act and vulnerable under the FFG Act) has the potential to pass through the site based on its known range. The White-throated Needletail is an aerial species that forages on the wing, often at rotor swept area heights. 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 in summer and early autumn, a time when their activity over Victoria is 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). The lack of forested vegetation or extensive planted treed areas indicates that the wind farm site does not support the preferred habitat for this species. Notwithstanding this, at wind farms elsewhere, the species has been recorded colliding with operating wind turbines in small numbers (Nature Advisory data). The numbers involved are unlikely to represent a significant impact on the population, which numbers at least ten thousand (Higgins 1999) and the impact rating (Table 10) is considered to be low. An assessment against the Commonwealth Significant Impact Guidelines (DoE 2013, DoE 2015), is provided in Section 12.

The Black Falcon and Little Eagle (listed under the FFG Act as critically endangered and vulnerable respectively) have the potential to occur occasionally at the study area though these species were not recorded during field surveys. The Black Falcon has a wide distribution extending across northern, eastern, southern and central Australia where it occurs along tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas, though is also known to occur over grasslands in south-eastern Australia. It is a highly mobile species, moving in response to food availability and seasonal conditions. There are very few records of the species in the region. If an individual were to fly across the project site there is potential to collide with a turbine due to its flight behaviour and collisions with this species is known to occur at other wind farms in south-eastern Australia. The Little Eagle occurs in a variety of habitats though shows a preference for woodland habitats. The species is known to fly at RSA heights which puts it at risk of collision though due to the low abundance present at the study area this is considered to be low. In the unlikely event there were to be a collision(s) of individuals of these species while moving through the landscap, it was not predicted to have a material impact on the population and a such a low impact rating (Table 10) is predicted.

the Nankeen Kestrel, Brown Falcon, and Wedge-tailed Eagle are the species most exposed to collision risk due to their flight behaviour, with juveniles and subadults being the most susceptible. Within the wind farm site, these species were recorded in low numbers (2 to 4% of all birds) with even lower numbers recorded above 40 metres. Based on monitoring of collisions at Macarthur Wind Farm and elsewhere, it is likely that there will be instances of collision with wind turbines of these species within the WWF). In terms of overall impacts to the local populations of these species, each of these species is distributed widely across Australia and is considered to be secure (i.e., not threatened). They also have strong dispersal abilities. As such, the overall effect of any collision related impacts on the population of these species is considered to be negligible and have a impact rating (Table 10) of low impact predicted.

The Australasian Shoveler and Hardhead are two duck species recorded in small numbers on wetlands outside the WWF site. The Blue-billed Duck and Musk Duck may also occur occasionally on deeper wetlands. None of these ducks were recorded on the site or are expected to occur in significant numbers given the limited extent of habitat.. They are far more common on larger wetlands elsewhere in Victoria (Marchant and Higgins 1990). Few ducks were observed flying at RSA heights, and the creation of the large turbine-free buffer area encompassing the Cockatoo Swamp wetland complex and other wetland buffers would considerably reduce the likelihood of collisions of these species with turbines,. The likelihood of a significant impact on the populations of these species is considered very low.

The Eastern Great Egret has been recorded from several wetlands in the search region and has the potential to occur at the wind farm site due to the presence of suitable wetland habitat. This species wades in shallow water, foraging for food. It is unlikely that this species occurs regularly or in significant numbers due to the limited extent and quality of wetland habitat within the wind farm site. Similarly the Eastern Cattle Egret (recorded in paddocks well to the south of the wind farm) and Plumed Egret may occur in small numbers when seasonal conditions suit, but their overall populations are unlikely to be affected by interactions with the operating wind farm. The Glossy Ibis is another large wading bird that is similarly likely to occur at least occasionally and was recorded from two wetlands outside the wind farm boundary. Aquatic habitats are not being significantly affected by the proposed development as turbines, tracks and other infrastructure are located at least 100 metres from almost all wetlands and waterways with the exception of a small number of creek crossings. Furthermore, most seasonal wetland areas will be avoided as a result of the creation of the large turbine free buffer area encompassing the Cockatoo Swamp wetland complex. The likelihood of a significant impact on the population of this species is therefore considered to be very low.

Migratory shorebirds listed under the EPBC Act were detected at one site on the wind farm during the 2018 surveys. The three species of migratory shorebirds present on and/or near the WWF site (Sharp-tailed Sandpiper, Common Greenshank and Latham's Snipe) occurred in small numbers that did not meet the important habitat threshold of 0.1% of the flyway population or at least 18 individuals of Latham's Snipe, as specified in relevant EPBC Act guidelines (DoEE 2017). The migratory Curlew Sandpiper and Red-necked Stint inhabit similar habitat to the preceding species and therefore may also be expected to occur in small numbers occasionally. Such numbers would not exceed significance levels of a threshold of 0.1% of flyway population (DoEE 2017).

It was determined that there is little suitable habitat within the wind farm footprint for most migratory shorebirds, largely due to the highly ephemeral nature of most waterbodies in the study area, and limited extent of open water or exposed muddy shorelines. The lack of extensive habitat, and the small numbers of these species observed during the surveys indicate that the wetland areas concerned are unlikely to support important habitat of any of these species. The creation of the large turbine free buffer area encompassing the Cockatoo Swamp wetland complex and other wetland and waterway buffers would further reduce the likelihood of collisions of these species with turbines. Listed migratory shorebirds will therefore not be significantly impacted by the wind farm development and are considered to have an impact rating (Table 10) of very low.

10. Reptile and amphibian assessment

10.1. Striped Legless Lizard and Glossy Grass Skink

KEY FINDINGS AND CONCLUSIONS

The EPBC Act and FFG Act-listed Striped Legless Lizard (*Delma impar*) (SLL) was not detected on the proposed wind farm during tile grid surveys in 2009-10 or 2018.

The site is dominated by exotic pastures with remnant native grassland representing potential habitat for this species confined to a very small proportion of the site in areas unaffected by the proposed development.

As this listed threatened species was considered unlikely to be present in the wind farm development area based on these surveys, impacts on it from the project are considered unlikely.

The FFG Act listed Glossy Grass Skink (*Pseudemoia rawlinsoni*) has been recorded within the search region on five occasions between 2003 and 2009 along a road reserve during targeted reptile surveys. Habitat along this road reserve had a native grassland understorey and scattered Blackwood (*Acacia melanoxylon*) overstorey. The native grassland habitat with Blackwood overstorey is confined to road side reserves in the study area. This habitat type has been avoided in finalising the development layout and no impacts on this species are anticipated.

10.1.1. Introduction

Reptiles and frogs present at the proposed wind farm site were investigated by completing a review of desktop information, habitat assessments, conducting surveys using tile grid method and incidental sightings while completing roaming surveys. The following sections focus on the assessments of Striped Legless Lizard, Glossy Grass Skink, Swamp Skink and Growling Grass Frog before a consolidated assessment of impacts is completed. Striped Legless Lizard and Glossy Grass Skink assessment

Due to the presence of potentially suitable habitat in areas of remnant native grassland, it was concluded from existing information that there was potential for the SLL to occur within the proposed WWF site. Accordingly, a targeted survey was undertaken in 2018. This was additional to similar targeted surveys undertaken in 2009-10 (EHP 2018).

The aim of this survey was to identify areas of native and non-native vegetation with potential to support the EPBC Act listed SLL within the proposed WWF site. A targeted survey using the tile grid method was then undertaken in identified potential habitat to try and detect this 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.

10.1.2. Species biology - Striped Legless Lizard

Description

The SLL is a member of the family *Pygopodidae*, the legless or flap footed lizards (Cogger 2000). The key distinguishing features of this species include the following.

- Visible ear openings
- A rounded tongue and
- Presence of scaly hind limb flaps.

While it shows considerable variation in colour and pattern, this species of legless lizard is usually pale grey-brown above and cream on the ventral surface, with a series of longitudinal dark brown or black stripes along the length of the body that breaks into rows of spots on the tail (Cogger 2000). It is slightly thicker than a pencil and grows up to approximately 30 centimetres in length (Webster *et al*. 1992).

Habitat

The Striped Legless Lizard inhabits dense native grasslands, often with rocky rises, that were once extensive on the volcanic plains of south western Victoria (Webster *et al.* 1992). It utilises rocks, soil cracks, burrows and grass tussocks for sheltering (Smith and Robertson 1999). Work on the species has found that it can also occur in grasslands dominated by introduced species, in secondary grasslands (Dorrough and Ash 1999, Koehler 2004, O'Shea 2004) and in habitats where rocks are absent but deep cracking clay soil is present (Coulson 1990).

Little is known about the movements of Striped Legless Lizard; however, studies have shown that the species can move approximately 20 metres in one day (Smith and Robertson 1999).

Distribution

The species is primarily found in Victoria with some populations being present in eastern South Australia and southern New South Wales.

Threats

The main threats to the species are habitat loss, degradation and fragmentation. In particular agricultural practices, such as cultivation and cropping, have resulted in a significant population decline and, in some cases, local extinctions.

The Striped Legless Lizard is listed as vulnerable under the EPBC Act and is listed as endangered under the FFG Act.

10.1.3. Species biology – Glossy Grass Skink

Description

The Glossy Grass Skink grows up to 65 millimetres from snout to vent and is yellowish-brown to olive-brown above and has no contrasting flecks or spots. It has distinct stripes, with a dark brown vertebral line and occasionally narrow paravertebral lines (Photograph 3). The characteristic cream dorso-lateral stripe is centred along the third scale row (Roberson and Coventry 2019).

Habitat

The Glossy Grass Skink inhabits dense vegetation near wetlands and swamps (Roberson and Coventry 2019).

Photograph 3: Glossy Grass Skink

Distribution

The Glossy Grass Skink is patchily distributed across southern and eastern Victoria. It occurs in eastern Melbourne, along parts of the Victorian coast and in the highlands (Roberson and Coventry 2019).

Threats

The main threats to this species includes removal of habitat, drainage of wetlands, alteration to hydrological regime and alteration to water quality.

10.1.4. Methods

Existing Information

For Striped Legless Lizard, the search region was extended to 40km due to the paucity of records within the initial 10km search region to evaluate the likelihood of the species occurring in the study area. The approximate centre point of the study area of the wider search region is latitude 38˚ 08' 46" S and longitude 142˚ 08' 33" E.

A list of the Striped Legless Lizard records in the region was obtained from the Victorian Biodiversity Atlas (VBA), a database administered by DELWP (DELWP 2019).

The previous report on the biodiversity of the study area (EHP 2018) was reviewed as part of this investigation. This included targeted tile surveys using the tile grid method in areas of potential habitat to detect the presence of the Striped Legless Lizard.

Habitat Assessment

The targeted survey was undertaken in sites identified as being potentially suitable Striped Legless Lizard habitat, with a good cover of basaltic surface rock, cracking soils and dense tussock-forming grasses, where available.

Three habitat quality categories were used and described below.

High: Habitat components listed below are usually all present.

- High-density native tussock grassland present (e.g. Kangaroo Grass - *Themeda triandra,* wallaby grass - *Rytidosperma* spp. and spear grass - *Austrostipa*)
- Large, extensive and continuous areas of native tussock grassland
- High cover of surface and embedded rocks, and cracking soil
- 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.

- Some native tussock grassland present
- Large, extensive and continuous areas of mixed native and exotic grassland
- Some surface and embedded rocks, and cracking soil
- Some connectivity.

Low: Many habitat elements have been lost and habitat fragmented.

- Low density and small areas of native tussock grassland present
- Native tussock grassland species may be absent
- Surface and embedded rocks are often absent
- Isolated and little to no connectivity
- Showing signs of disturbance (such as soil erosion and compaction and/or grazing pressures).

Field Methodology

The 2018 SLL survey was undertaken using methods consistent with the DELWP Biodiversity Precinct Planning Kit (DSE 2010) and the EPBC Act Referral guidelines (DSEWPAC 2011b), including using the tile grid method, previously used successfully to survey for Striped Legless Lizard in the basalt plains grasslands of Melbourne (O'Shea 2004).

In addition, according to the current EPBC Act survey guidelines for the species, areas greater than 30 hectares in size require a minimum of ten tile survey grids (DSEWPC 2011b). In the case of WWF site, an initial assessment was conducted of the extent of Plains Grasslands, Plains Grassy Woodland and Stony Knoll Shrubland within the WWF boundary. The majority of the wind farm was vegetated with introduced pasture grasses, was intensively grazed by cattle and/or sheep and was therefore unsuitable for Striped Legless Lizard. Areas of potential habitat for Striped Legless lizard were disturbed, isolated and fragmented.

This assessment identified there was a very limited area of potential habitat likely to support Striped Legless Lizard so a small number of grids (three) was deployed (Figure 17). Better quality habitats were selected to place the tile grids. Grid 2 was placed at a road reserve with higher quality habitat than surrounding areas. Grids 1 and 3 were placed in areas of Stony Knoll Shrubland.

In each grid, 50 grooved, terracotta roof tiles were placed in a 20 x 45 metre grid configuration, with tiles spaced five metres apart. The north-west corner of the grid was recorded using a handheld GPS.

Three tile grids were laid out on 30th-31st July 2018 and monitored in spring and early summer at fortnightly intervals. Survey guidelines for Striped Legless Lizard in Victoria (DSE 2010) state to survey between September and December is this the period with the highest success rate. The lizards are not very active prior to September and after December the lizards are unlikely to use the tiles as harbour as they get too hot. The first monitoring took place on 13th September 2018, with the last check on 22nd November 2018. A final check was completed upon decommissioning of the tiles on 7th December 2018. Each grid was checked a total of seven times, including decommissioning.

The grids were checked between approximately 9am and 1pm. The time of grid checking was randomised, to eliminate time-of-day differences between grids in detection. The weather conditions during the checks ranged from cool to warm and varied from overcast to clear skies. These conditions were considered suitable for detecting the SLL using the tile grid method.

Limitations of field assessment

The timing of the survey, its duration and the weather conditions were considered suitable for detecting the species. The tiles, which were used as the main method for detecting this species in the study area, do not trap the animals. Hence, it is important to time the monitoring to maximise the chances of detecting this species while the animals are utilising the tiles. Every effort was made during the current survey to ensure that monitoring took place under suitable conditions in the morning to detect the species. Later in the day after the tile has warmed up can result in animals no longer resting under the tile as it is too hot.

The overall survey effort (888 tiles checked) was considered sufficient to detect significant populations of SLL in the study area based on experience in areas known to support such populations.

Figure 17: Location of Striped Legless Lizard tile surveys in the study area

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 28/04/2022

Legend

- Wind farm boundary
- Striped Legless Lizard tile grid
- Potential SLL habitat

N

Metres
0 500

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10.1.5. Results

Existing information

The VBA shows no records of SLL within 20 kilometres of the wind farm site and only one record (at 'Byaduk Hamilton' in 1904) within 30 kilometres (DELWP 2019). This old record is located 9.5 kilometres north-west of Macarthur and at least 24 kilometres from the northern edge of the Willatook Wind Farm (see Table 33).

Table 33: VBA records of Striped Legless Lizard in the search region (30km radius from central point of Willatook Wind Farm)

Common Name	Scientific Name	Survey Start Date	Survey End Date	Site Location Description	Latitude GDA94	Longitude GDA94
Striped Legless Lizard	*Delma impar*	14/10/1904	14/10/1904	Byaduk Hamilton	-37.95686	141.9597

The WWF site is situated south of the main concentration of records of Striped Legless Lizard (Figure 18) on the Southern Volcanic Plain (DELWP 2019). The study area is not continuous with areas of suitable habitat near the previous record.

The SLL was not recorded in initial biodiversity assessments (EHP 2018).

Site selection

The study area has been used for grazing and other agriculture purposes over a long period and contains a predominance of introduced pasture grasses and some native grass species. Habitats with native tussock grasses, rocks and cracking soils were chosen for this targeted survey. However, most areas of the site lacked key habitat features, hence the small number of survey grids.

Habitat condition at each tile grid is described in detail below (Table 34). It is notable that the best habitats that could be found for the species on the WWF site were all low to moderate quality, reflecting the long history of agricultural use of the land and the impacts of this on habitat conditions. Figure 17 shows the location of tile grids within the study area.

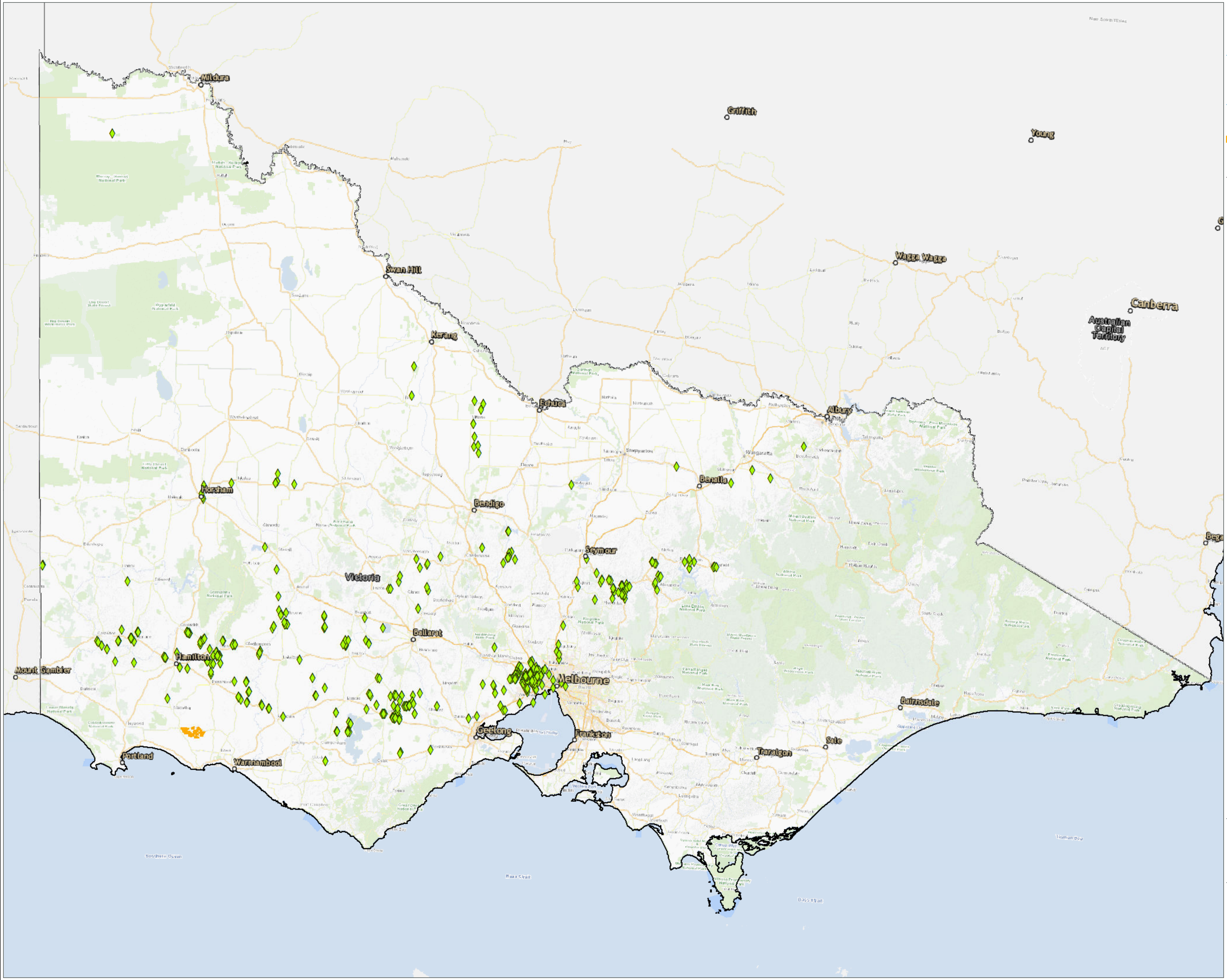

Figure 18: Distribution of Striped Legless Lizard in Victoria (Source: VBA 2022)

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 12/05/2022

Legend

Wind farm boundary
VBA SLL records
Victoria boundary

N

Metres
0 26,000 52,000

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Table 34: Tile grid habitat assessment

Grid number	Quality	Site description	Public/ Private tenure
1	Low to moderate	Located in paddock grazed by sheep, on a stony knoll dominated by Austral Bracken and exotic pasture grasses, next to a Tussock Grass swamp. Limited connectivity.	Private
2	Low	Located in a road reserve, dominated by Kangaroo Grass *Themeda triandra*, cracking soils, no rocks, overstory of Acacia on eastern side of road (Black Wattle and Blackwood). Introduced grasses and bulbs also present. Connectivity to other areas of suitable habitat is poor.	Public
3	Low	Located between two remnant patches of stony knoll shrubland. Dominated by exotic pasture grass; stony knoll areas have Austral Bracken and herbs.	Private

Survey results

No SLL were detected during the spring 2018 tile grid survey at WWF. Tile surveys by EHP between 2009 and 2011 also failed to record the species.

Tiles were checked while ambient temperatures ranged between 10°C and 22°C and between 54% and 84% relative humidity.

A number of other reptile species were recorded under the tiles during the 2018 survey listed below.

- Eastern Three-lined Skink (*Acritoscincus duperreyi*)
- Glossy Grass Skink (*Pseudemoia rawlinsoni*) (FFG Act: endangered in Victoria)
- Little Whip Snake (*Parasuta flagellum*)
- Lowland Copperhead (*Austrelaps superbus*)
- Southern Grass Skink (*Pseudemoia entrecasteauxii*)
- Tiger Snake (*Notechis scutatus*)
- White-lipped Snake (*Drysdalia coronoides*)
- White's Skink (*Liopholis whitii*).

Due to the lack of historical records in and around the study area, the degraded, isolated and fragmented state of potential habitat in the study area and the results of the targeted survey failing to record any Striped Legless Lizard, it is considered unlikely that the Striped Legless Lizard occurs within the study area.

10.2. Swamp Skink assessment

KEY FINDINGS AND CONCLUSIONS
The FFG Act-listed Swamp Skink was detected outside of the proposed wind farm site during targeted surveys conducted by EHP in 2009-10 (EHP, 2018). The species was also detected during wetland assessments conducted by Nature Advisory in 2018 along the same catchment as EHP recorded the species previously. The WWF project boundary has since been reduced and the area where the Swamp Skink was observed now lies outside the boundary of the WWF. Suitable on-site riparian habitats for this species were reported outside the WWF boundary, in areas unaffected by the development. The Swamp Skink assessment has concluded that this species is unlikely to occur within the wind farm development footprint, therefore no significant impacts are anticipated on local populations.

10.2.1. Introduction

Due to the presence of potentially suitable habitat in the form of well-vegetated areas prone to inundation and the presence of the species nearby (EHP 2018), the FFG Act listed Swamp Skink (*Lissolepis coventryi*) was initially considered likely to occur within the proposed WWF site. Accordingly, a detailed habitat assessment was undertaken by Nature Advisory in 2018.

The aim of this survey was to identify areas of well-vegetated riparian habitat with the potential to support the Swamp Skink within the proposed WWF site and, if found, undertake targeted Swamp Skink surveys to confirm their status in affected areas then to determine if the project would impact those habitats.

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

10.2.2. Species biology

Description

The Swamp Skink is a medium sized lizard growing to 250 millimetres total length. It is shiny, pale yellow-brown to olive above with two broad dark brown to black stripes along the dorsal surface, and dark sides with numerous small pale spots. The head is characterised by large scales (Robertson and Clemann 2015).

Distribution

The species occurs in south-eastern Australia, from Mt Gambier in South Australia across the southern parts of Victoria, extending marginally into New South Wales on the far south coast. Relatively few inland populations have been reported, although records exist for localities including the Grampians Ranges National Park, Enfield State Forest south of Ballarat, the eastern suburbs of Melbourne, Yellingbo and East Gippsland. It has been studied intensively at several localities on the Mornington Peninsula (Clemann 2001, Robertson and Clemann 2015).

Habitat

This species inhabits dense, low vegetation in or adjacent to wetlands and water bodies, and a dense overstorey is likely to preclude this species by denying or limiting sunny basking sites. Preferred wetlands include low-lying marshes and lagoon margins, paperbark swamps, sedge and tea-tree (*Melaleuca*) swamps, rivers, lakes, reedy habitats near these water bodies, and tidal salt-marshes. It can occur in wooded areas where there is a break in the surrounding canopy. It shelters in burrows including those of crustaceans (Wilson and Knowles 1988, Cogger 2000, Wilson and Swan 2003, Robertson and Clemann 2015, Robertson and Coventry 2019).

On the Mornington Peninsula, habitat preference has been documented for two populations. In the first site, the species occupies habitats dominated by dense Swamp Paperbark *Melaleuca ericifolia*, Woolly Tea-tree *Leptospermum lanigerum* and sedges *Gahnia* spp. on black soils, but is absent in adjacent vegetation on sandy dunes. At the second site, the species occurs in dense saltmarsh and tussock habitats dominated by Shrubby Glasswort *Tecticornia arbuscula,* Beaded Glasswort *Sarcocornia quinqueflora*, Chaffy Saw-sedge *Gahnia filum* and Prickly Spear-grass *Austrostipa stipoides*, as well as Swamp Paperbark scrub where these plants do not form a dense canopy (Clemann 2001).

Breeding and behaviour

Swamp Skink is usually diurnal, active from September to April. Mating occurs in November and one to six live young are born in late January to February. Swamp Skink basks in sunny areas to thermoregulate. The species is territorial and has a home range of about 10 metres from its burrow based on mark-recapture studies. Juveniles disperse up to 200 metres (Robertson 1980). It occupies burrows it digs itself but it also uses yabby, crab and freshwater crayfish burrows, where available. Rocks, logs and artificial debris are utilised as sheltering and basking sites (Robertson and Clemann 2015).

Threats

Threats to the Swamp Skink population include (after Robertson and Clemann 2015) the following.

- Loss and fragmentation of habitat
- Clearance for agriculture
- Drainage of wetlands
- Changed water regimes or rivers and wetlands
- Pollution of waterbodies
- Degradation of waterside vegetation
- Pollution of marine and coastal areas resulting in changes in vegetation
- Weed invasion
- Recreational pressures including trampling of vegetation, construction of footpaths

- Spread of Cinnamon fungus (*Phytophthera cinnamomea*) resulting in degradation of vegetation
- Grazing and trampling of habitat by stock
- Industrial and urban development
- Infrastructure effects – e.g. road widening, path construction may cause increased access for predators
- Introduced predators – foxes, cats, dogs, rats
- Loss of genetic diversity in small fragmented populations – small isolated populations are inherently at risk of extinction.

This species is listed as endangered in Victoria under the Victorian FFG Act.

10.2.3. Methods

Existing Information

For Swamp Skink, the search region was extended to 20km due to the paucity of records within the initial 10km search region, to evaluate the likelihood of the species occurring in the wider region. The approximate centre point of the study area and the wider search region is 38˚ 08' 46" S and 142˚ 08' 33" E.

In addition to the updated database search, EHP (2018) completed targeted Swamp Skink surveys. This included setting forty Elliott traps (A type) in two locations. One site was located along a tributary of the Moyne River and the other along the Shaw River. Traps were placed approximately five metres apart underneath suitable vegetation and adjacent to potential shelter sites (e.g., logs). Traps were baited with dough made from sardines and flour. The traps were checked twice every day at dawn and dusk and left in place for four days.

Two sets of traps were placed in areas of potentially suitable habitat to the west side adjacent to the Moyne River. Traps were set for a total of 160 trap days.

Habitat Assessment

Potential habitat for Swamp Skink was assessed for its suitability. Habitat components, including vegetation type, structure, proximity to waterways and basking opportunities, were examined and mapped.

Areas considered to be suitable habitat for Swamp Skink included the following habitat characteristics.

- Dense ground layer vegetation up to two metres high, with little or no overstorey
- Wet and boggy habitats with ground debris
- Presence of burrowing crayfish (e.g. *Geocharax* sp.)
- Connectivity with other areas of suitable habitat
- Little to no signs of disturbance (grazing pressures, drainage of wetlands, etc.).

Field Methodology

Wetlands within 100 metres of proposed infrastructure of the WWF were assessed in the field to determine their extent, habitat type and habitat suitability for Swamp Skink.

The following process was undertaken:

- The Victorian Wetland Inventory and other aquatic habitats were identified within the boundary of WWF;
- The WWF infrastructure layout was examined and any habitat within 100 metres of the planned development was identified;
- Field surveys were undertaken to identify and map any suitable habitat within 100 metres of infrastructure. This assessment was based on:
    - Type of vegetation present; and
    - Amount and quality of water (permanent and temporary).

The wetland and habitat assessment field work were carried out over four occasions from December 2018 to February 2019, the period of maximum cover of wetland vegetation after spring wetland filling and vegetation growth.

The assessment enabled the location of suitable habitat potentially affected by the project (i.e. within 100 metres of wind farm infrastructure) to be identified. Adopting a precautionary approach, any such habitat was then avoided where possible in finalising the wind farm layout.

10.2.4. Results

Existing Information

The VBA holds five records of Swamp Skink in the wider search region (within 20 kilometre), dating from 1965 to 2018 (Appendix 17). All these records are from the immediate vicinity of Warrnambool, including three from Lake Pertobe (Figure 19).

EHP (2018) recorded Swamp Skink during their targeted survey of the study area in a wetland close to the Moyne River in the eastern part of the WWF site, in February 2010. EHP also mentioned another reported Swamp Skink in 2003 (not in the VBA) some 10 kilometres south of this record, also along the Moyne River, but gave no other details. The Moyne River is considered to provide suitable habitat and provide a habitat link for this species.

Targeted surveys

One Swamp Skink was trapped during the targeted survey by EHP (2018). Active searching at the location of the two trap sites did not reveal any additional Swamp Skinks.

Habitat assessment

Detailed results of the habitat assessment are presented in Appendix 18.

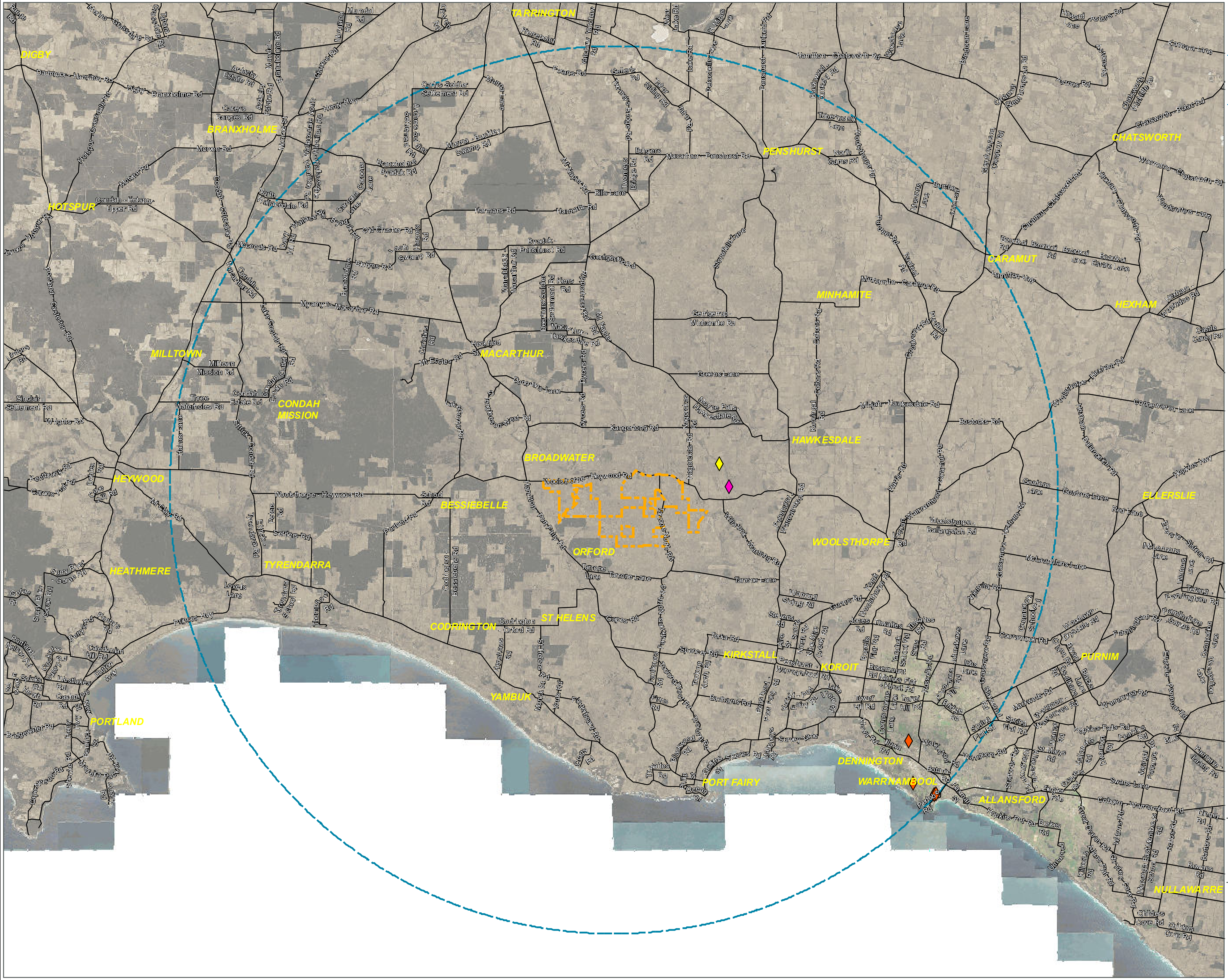
Field observations found that the Moyne River and Wetland 25606 contiguous with the Moyne River and its tributary had potential to support Swamp Skink. Habitat at the Moyne River site (mapped as wetland 5, Figure 20) included dense in-stream Bulrush *(Typha sp.),* Woolly Tea-tree (*Leptospermum lanigerum*) and Water Ribbon (*Triglochin procera*). Along the banks were some basalt surface rocks (for basking) and freshwater crayfish burrows.

A nearby wetland (No. 25606) that was contiguous with the Moyne River was found to support freshwater crayfish burrows, which could be used by Swamp Skink, as well as being densely vegetated with Common Tussock-grass (*Poa labillardierei*) and Poong-ort (*Carex tereticaulis*) vegetation, suggesting it has potential to support Swamp Skink, particularly in areas close to the bend of the Moyne River where there are scattered stands of Woolly Tea-tree.

The Shaw River, running through the western part of the WWF, was assessed for habitat suitability. While the channel of this river contained dense Bulrush, the bank in the southern reaches of the river on the WWF had scattered Black Wattle (*Acacia mearnsii*) and Blackwood (*Acacia melanoxylon*). This assessment found habitat here to be sub-optimal for Swamp Skink, with streamside vegetation too sparse to support a population. Furthermore, this site also lacked the freshwater crayfish burrows present at the Moyne River site. The Shaw River on the WWF site is unlikely to support Swamp Skink.

Figure 19: Previous recods of Swamp Skinkin the wider search region

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 12/01/2022



Legend

- Wind farm boundary
- Wider search region 40km radius
- EHP records
- NA records
- VBA records

N

Metres
0 3,000 6,000

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16087 - Created by: nm - \\Nat-haw-dt04\e\GIS\2016 Jobs\16087\16087 FIG 19 Swamp Skink record and Habitat 211222.mxd

All other wetlands surveyed lacked dense ground layer vegetation up to two metres tall, were ephemeral in their hydrology, lacked any noticeable freshwater crayfish burrows and showed signs of disturbance from domestic stock. More specifically, Kangaroo Creek and Back Creek were subject to grazing that had removed most of the vegetation cover required by Swamp Skink. It is considered unlikely that Swamp Skink would occur in these minor, ephemeral creeks. These and remaining wetlands and waterways that lacked suitable habitat were not considered to have the potential to support Swamp Skink.

Survey Results

During the assessment, an incidental record was obtained of one Swamp Skink basking on a rock along the Moyne River bank within the WWF site on 5th December 2018 (mapped as wetland 5, Figure 20). This is in the same area as the EHP (2018) record, which was "*at a wetland close to Moyne River*".

The Moyne River is likely to act as a habitat link for the Swamp Skink and areas of suitable habitat located along the river may support this species.

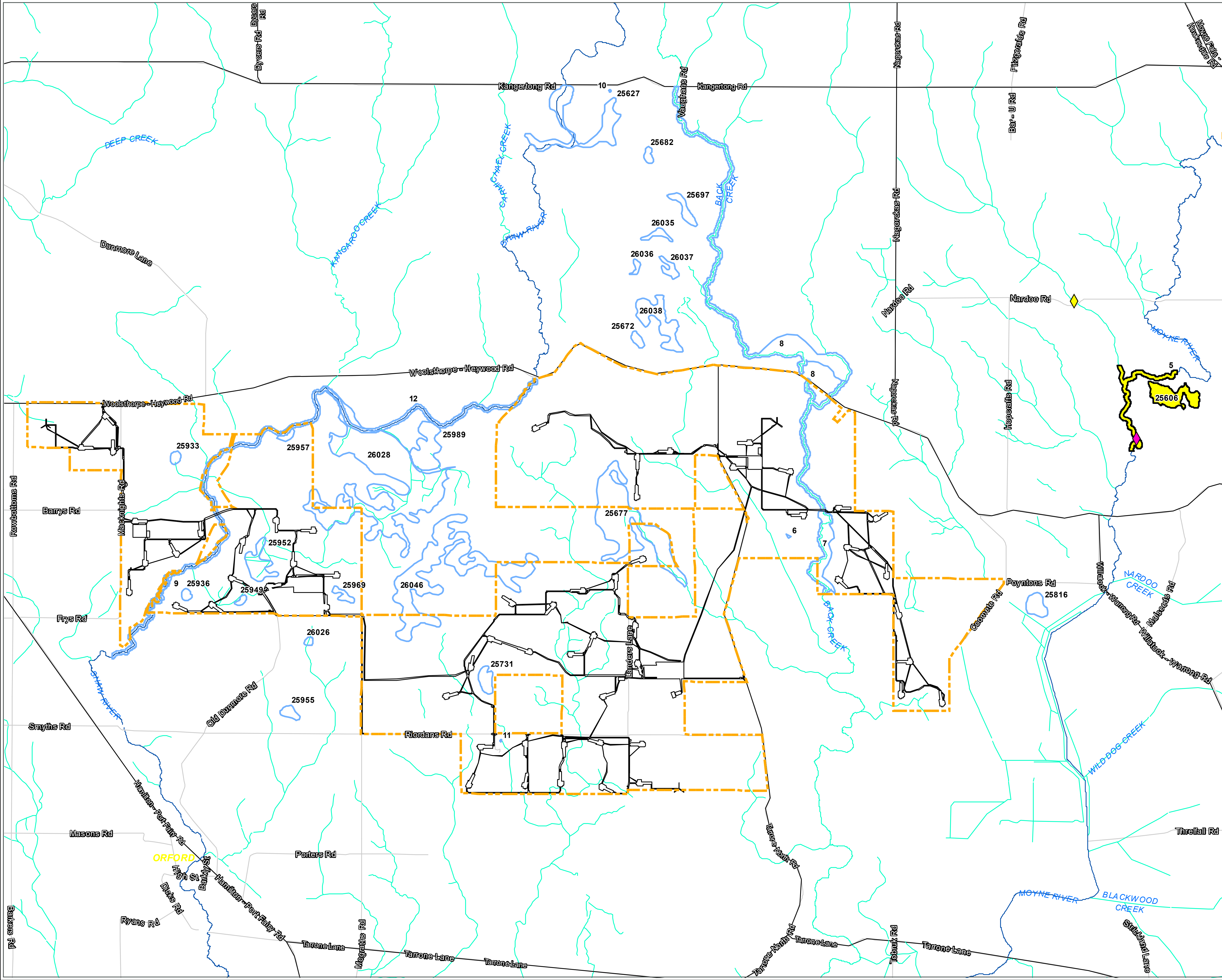
Most other wetlands and waterways were found to be ephemeral and lacking any kind of dense ground layer vegetation close to water, had no signs of burrows and showed signs of disturbance by domestic stock and were therefore considered unlikely to be occupied by Swamp Skink (Figure 20).

Figure 20: Potential habitat for Swamp Skink

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 24/12/2021

Legend

- Wind farm boundary
- Construction footprint
- Surveyed wetlands
- Potential Swamp Skink habitat
- EHP records
- NA records



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10.3. Growling Grass Frog assessment

KEY FINDINGS

The EPBC Act and FFG Act-listed Growling Grass Frog (*Litoria raniformis*) (GGF) was not detected on the WWF site initially during targeted surveys in 2009-10 undertaken in accordance with Commonwealth and Victorian surveying guidelines (DEWHA 2009b, DSE 2010) conducted by EHP, but one individual was heard calling from the Moyne River, a short distance beyond the proposed study area (EHP, 2018).

One GGF was opportunistically detected on the WWF site, heard calling along Back Creek, on 23rd October 2018 during surveys conducted by Nature Advisory.

Additionally, GGF were heard calling from Wetland 25816 (Wild Dog Swamp) in October and December 2019. This wetland is outside the wind farm boundary along the Moyne River floodplain.

Suitable on-site aquatic habitats for this species are confined to a small proportion of the wind farm site, primarily along Moyne River and Back Creek in the eastern part of the WWF site. Shaw River has been assessed as potentially providing habitat for GGF but it was not found here or in any wetlands in or around the Cockatoo Swamp during site fieldwork.

Back Creek initially had seven waterway crossings, this was minimised to one that will remove approximately 0.14 hectares of potential GGF habitat along the creek, most of which will be temporarily removed and rehabilitated.

All turbines and associated access tracks (apart from crossings) are located greater than 100 metres from the GGF habitat along Back Creek.

Impacts on GGF habitat from the WWF along Back 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 WWF 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 considered unlikely.

10.3.1. Introduction

Due to the presence of potentially suitable habitat in a range of wetland and waterways within the WWF site, the GGF was considered potentially to occur. Accordingly, a detailed habitat assessment and mapping exercise was undertaken by Nature Advisory in 2018 of largely permanent waterbodies containing adequate coverage of aquatic floating and emergent vegetation that could support the Growling Grass Frog to inform the design of the wind farm layout to avoid and minimise impacts on potential habitat areas.

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

10.3.2. Species biology

Description

The GGF is a large species of frog growing to a size of 85 millimetres. It is dull green to bright emerald green with blotches of brown or rich golden bronze, 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 blue-green (Cogger 2000, Pyke 2002).

Distribution

The 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 New South Wales and the Australian Capital Territory, through most of Victoria (excluding mallee and alpine areas) and into south-eastern South Australia 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 New South Wales and the Australian Capital Territory, from much of central Victoria and from parts of Tasmania and South Australia. With human assistance there has been some expansion within and near its natural range, and it has long been established as an introduced species in New Zealand (Pyke 2002).

Habitat

The GGF inhabits areas of permanent water occurring commonly around reservoirs, farm dams and swamps, especially those with emergent, fringing and floating aquatic vegetation. It is found in cool temperate grasslands near these aquatic habitats and can be found up to 200 metres from wetlands in such adjacent terrestrial habitats. The species often hides by day under debris (Turner 2004). A minimum of a 100-metre wide corridor (i.e. 50 metres either side of a waterway) is recommended by DEWHA (2009) to facilitate movement of the GGF along waterways.

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 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 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 (Nature Advisory staff, pers. obs.). Tadpoles have been observed from September to April, and immature frogs from January to April (Pyke 2002). Over 1500 eggs are usually laid by a female 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 the surface with their head upwards.

GGF are generally more active and more often seen at night but will often call during the day from September to December (Nature Advisory staff, pers. obs.). The frog is not a frequent climber of plants and is 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; they are also reported to feed on other vertebrates, including snakes, lizards and small fish as well as on invertebrates (DAWE 2021b).

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, increased predation of tadpoles by the introduced Mosquito Fish (*Gambusia* spp.) and global climate 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).

The species is listed as vulnerable under the EPBC Act and FFG Act.

10.3.3. Methods

Existing information

For Growling Grass Frog, the search region was extended to 40km due to the paucity of records within the initial 10km search region, to evaluate the likelihood of the species occurring in the study area. The approximate centre point of the study area of the wider search region is 38° 08' 46" S and 142° 08' 33" E.

The likelihood of suitable habitat on the WWF site for nationally threatened fauna species was ascertained through a search of the online EPBC Act Protected Matters Search Tool (DAWE 2021a) using the 10km search region.

The relevant results of the previous biodiversity assessment of the WWF site (EHP 2018) were reviewed prior to the current site assessment.

Habitat assessment

Aquatic habitats on 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; and
- 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 (e.g. 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; and
- 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); and
- Thick ground cover vegetation or rocks absent.

Field methodology

A habitat assessment of wetlands within the boundaries of the WWF was undertaken by Nature Advisory to determine the condition and status of existing wetlands and related habitats.

The following process was undertaken:

- The VWI mapped wetlands and other aquatic habitats were identified within the boundaries of WWF;
- The WWF infrastructure layout was examined and any habitat within 100 metres of the planned development was identified;
- Field surveys were undertaken to identify and map any suitable habitat. This assessment was based on:
    - Type of vegetation present;
    - Amount and quality of water (permanent and temporary); and
    - Assessment of aquatic fauna in the area.

The wetland and aquatic habitat assessments were carried out over four occasions from December 2018 to February 2019.

10.3.4. Results

Existing information

The VBA holds one record of Growling Grass Frog within the search region, dated 1976 (Appendix 19). The VBA has 22 records from the wider search region (extending to Warrnambool in the southeast and beyond Yambuk in the west, north to Hamilton) excluding duplicates – see Appendix 19. Many of these outlying records are historical (pre-2000), or come from the Hexham – Mortlake area, coastal wetlands such as Tower Hill, and west of Port Fairy (Figure 21), i.e. well beyond the wind farm boundaries (DELWP 2019).

EHP (2018) documented a record of the species calling at or near a wetland south of Poynton's Road (near Wild Dog Swamp) at the beginning of their field work in 2009 in the WWF region, but the species was not subsequently recorded in the VBA at the time.

It is possible that the paucity of records of GGF in WWF and its immediate surrounds may be due to lack of survey effort but it is more likely due to a paucity of suitable waterbodies with the appropriate connectivity, permanent or semi-permanent water and specific vegetation characteristics required by the species given the long history of wetland drainage and land use for agriculture.

Assessment results

Wetlands were found to be ephemeral and lacked sufficient fringing, floating or emergent vegetation of the type favoured by GGF. All wetlands within the WWF boundary were considered low habitat quality or unsuitable for GGF (see Appendix 18). The Back Creek within the study area was considered to provide breeding habitat and act as a dispersal corridor to other habitats up and downstream and considered to be high quality habitat for Growling Grass Frog. The Shaw River has been considered as suitable habitat to a lesser extent using the precautionary principal and is considered to be low quality habitat for Growling Grass Frog.

Some wetlands and waterways outside the wind farm boundary did meet the requirements for potential Growling Grass Frog habitat; including Moyne River and Back Creek, serving as movement corridors and wetlands that supported vegetation favoured by the species. These wetlands are listed as moderate or high quality and include Wetlands 25816 and 25872 (Appendix 18). Locations of these waterways and wetlands are presented in Figure 22.

During habitat assessments, one Growling Grass Frog was recorded incidentally, heard along Back Creek on 23rd October 2018 (mapped as wetland 7 in Figure 22). Growling Grass Frog was also heard calling in October and December 2019 from Wild Dog Swamp during Brolga breeding wetland assessments. This would suggest that both Back Creek and Moyne River are used as movement corridors by the species.

Growling Grass Frog is known to breed in wetlands including Seasonal Herbaceous Wetlands. Breeding wetlands are usually located within 200 metres of a waterway which the frogs use a wildlife corridor (Hamer and Organ 2008). Robertson *et al.* (2002) and Heard *et al*. (2004) have proven that that waterbodies distant from occupied waterbodies has a low probability of occupancy. As the Seasonal Herbaceus Wetlands identified within the development footprint are well beyond 200 metres from the Back Creek and Moyne River movement corridors, Growling Grass Frog are considered unlikely to occur in these wetlands.

GGF was not confirmed to occur along the Shaw River or associated Cockatoo Swamp during wetland assessments. It is considered unlikely that GGF occurs in this waterway though it has been identified as potential habitat using the precautionary principal.

Figure 22 shows areas of known and potential habitat for GGF within the wind farm site, much of which represents a movement corridor along Back Creek and Moyne River. In addition to Back Creek and Moyne River, it is also possible GGF may use the Shaw River as a movement corridor during and after heavy rainfall events to access other wetlands, although habitat along the Shaw River is considered low quality habitat for the species.

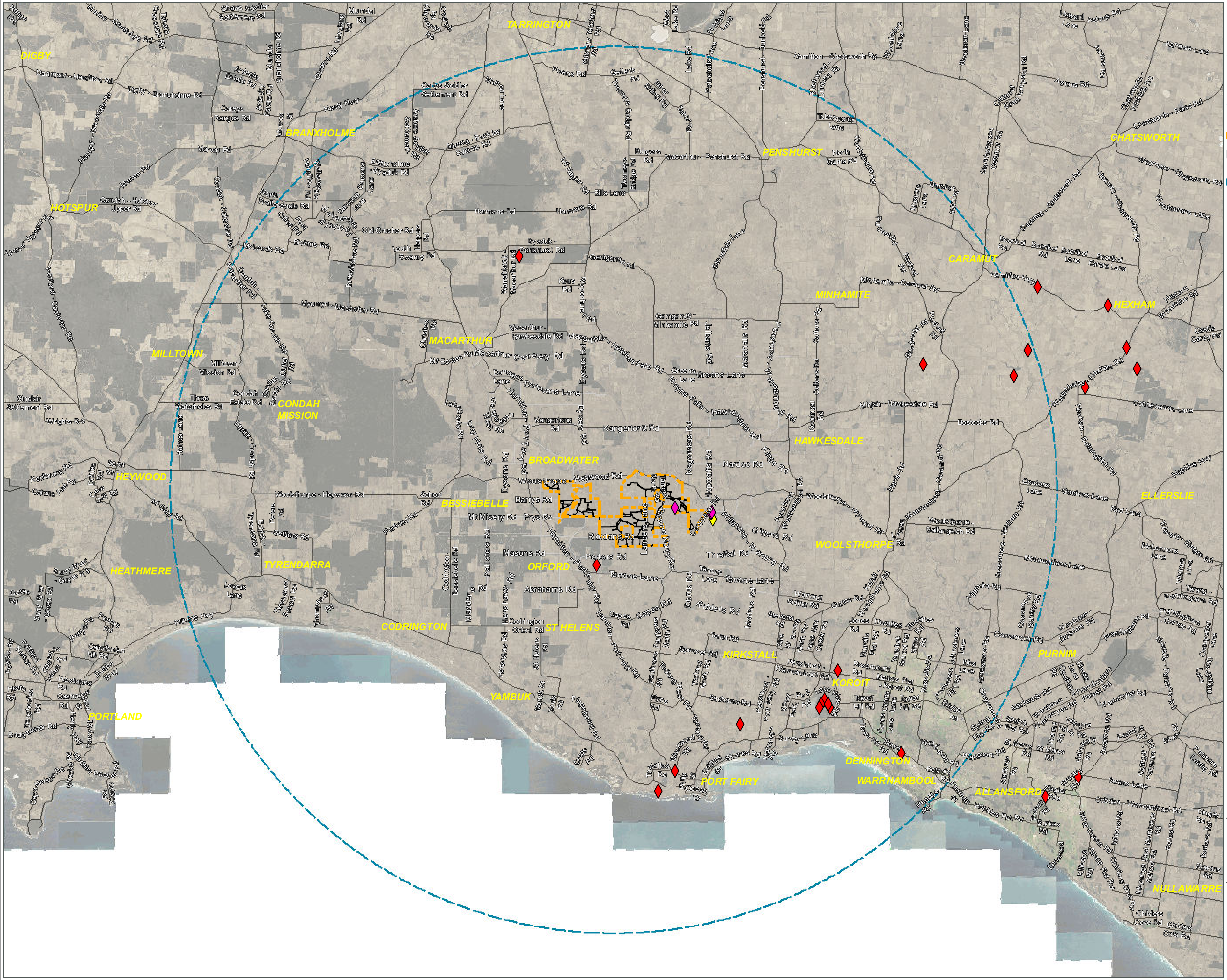

Figure 21: Previous records of Growling Grass Frog in the wider search region

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 12/01/2022

Legend

- Wind farm boundary
- Construction footprint
- Wider search region 40km radius
- EHP records
- NA records
- VBA records

N

Metres
0 3,000 6,000

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16087 - Created by: nm - \\Nat-haw-dt04\e\GIS\2016 Jobs\16087\16087 FIG 19 GGF record and Habitat 211222.mxd

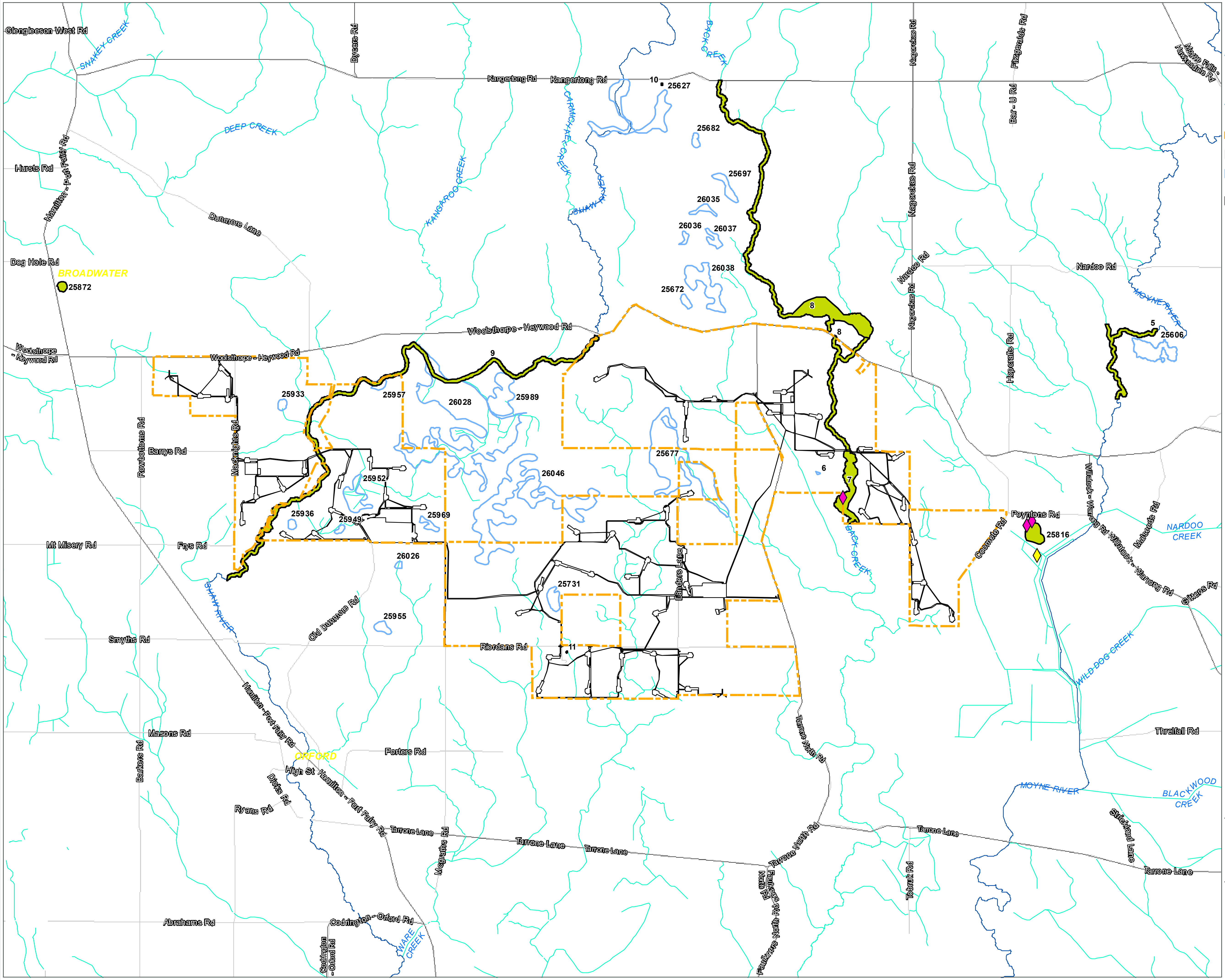

Figure 22: Potential habitat for Growling Grass Frog

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 3/03/2022

Legend

- Wind farm boundary
- Construction footprint
- Surveyed wetlands
- Potential Growling Grass Frog habitat
- EHP records
- NA records

N

Metres
0 500 1,000

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10.4. Impact assessment

10.4.1. Impact pathways

Potential impact pathways to reptiles and frogs within the wind farm site include:

- Changes to available habitat due to habitat loss and degradation resulting from vegetation clearance, earthworks and physical disturbance, or indirectly due to hydrology changes and/or reduced water quality.
- Injury, death or displacement of individuals from vegetation clearing and earthworks, entrapments in trenches or collision with vehicles.

10.4.2. Mitigation measures

Through the implementation of design avoidance measures primarily through micrositing infrastructure, most native vegetation has been avoided and will not be directly impacted by the project. Most of this clearance, will occur in the Basalt Shrubby Woodland and Plains Grassy Wetland EVCs.

Design measures have also included creation of buffers along watercourses and riparian zones, which are likely to have a higher abundance of amphibian and reptile species. With the exception of access track and cable crossings, wind farm infrastructure have been located more than 100 metres from potential GGF habitat, as identified within this report.

The WWF project design initially had seven waterway crossings Back Creek in the concept design layout. The revised layout minimised the creek crossings to one that will remove approximately 0.14ha of GGF habitat along the Back Creek and to a lesser extent 0.12ha of low quality habitat at the Shaw River crossing.

Management measures that have been committed to minimise potential impacts to the SLL if the species is discovered in or close to works areas during construction include:

- All workers on the site will be inducted to recognise this species and alert the site manager when found
- In the event that a Striped Legless Lizard is found during construction works, a salvage and translocation protocol will be prepared.
- Where possible, surface and embedded rocks will not be removed from the site and where possible these will be reintroduced where they are removed temporarily.

Management measures that have been committed to minimise potential impacts to the Growling Grass Frog include:

- Prepare and implement a Growling Grass Frog Management Plan.
- Minimise disturbance of banks, channels and vegetation in waterways (i.e. movement corridors) identified as potential habitat for Growling Grass Frog, where possible;
- Where essential wind farm infrastructure (e.g. access roads, underground cabling trenches) intersects an area identified as potential habitat for Growling Grass Frog, specific action will be undertaken as outlined in the Construction Environmental Management Plan (CEMP). The

CEMP will describe appropriate disturbance mitigation measures in relation to sensitive habitat areas such as waterway banks, channels and nearby vegetation. Actions will include:

- A salvage and translocation protocol will be prepared. This plan will be implemented in the event that a Growling Grass Frog is found during construction works
- Pre-construction surveys of affected habitats should be undertaken and frogs found translocated to nearby sections of waterways;
- Install temporary frog exclusion fencing either side of construction areas to prevent frogs from moving into works areas while construction is underway;
- All workers on the site will be inducted to recognise this species and alert the site manager when found
- All crossings of waterways will have a reduced width of track and trench;
- Construction of crossings will ideally be undertaken outside the frogs breeding season when conditions are dry;
- Adopt the culvert design standards (from DELWP 2017f) that facilitate passage of GGF;
- Adopt precautions to avoid altering the hydrology of Back Creek as described in the Surface Water Impact Assessment (Water Technology, 2022);
- The restoration or enhancement of affected areas of waterway to at least their pre-construction condition is recommended;
- Implement measures (from Murray *et al.* 2011) to reduce the introduction and spread of the pathogen Chytrid Fungus, which causes the disease Chytridiomycosis in GGF, leading to mortality. Ensure on-site hygiene to minimise the transfer of diseases from personnel, footwear, clothing, equipment and vehicles/machinery by undertaking the following:
    - Hand, arms, etc. to be washed and cleaned before moving to wetland site
    - Footwear/clothing to be thoroughly cleaned and disinfected before working in a wetland/creek and before moving between different wetland/creek sites
    - Equipment that is used at one wetland/creek site must be cleaned and disinfected before re-use at another site
    - If vehicles/machinery are used to traverse potential habitat for Growling Grass Frog and could result in mud or water being transferred to other water bodies, then wheels/tyres should be cleaned and disinfected.

10.4.3. Residual effects

With the implementation of mitigation measures outlined above, impacts to the overall reptile and frog communities (excluding threatened species) was assessed to be low.

Striped Legless Lizard

The Stiped Legless Lizard was not observed during the current assessment, there was very limited and fragmented habitat for the species in the study area, the limited habitat present on site was considered to be low-moderate habitat quality and there was no habitat connectivity to the previous record from 1904 located more than 20 kilometres from the study area. The species was considered unlikely to occur and therefore it is unlikely that an important population resides at the WWF site.

In the event that a Striped Legless Lizard is found during construction works, a salvage and translocation protocol will be implemented. The potential impact on the Striped Legless Lizard as a result of the proposed WWF is therefore considered to be very low.

Glossy Grass Skink

The Glossy Grass Skink was found in one location during the tile grid survey, along a roadside reserve at the Willatook Wind Farm. This species is likely to be found only in remnant native grassland and nearby areas that have not been markedly degraded by cropping or stock grazing. These habitats are very limited in extent across the wind farm footprint. Provided these areas are avoided by infrastructure of the wind farm, as planned, there should be negligible impact on this species arising from construction and operation of the wind farm.

Swamp Skink

The only habitat found to be suitable for the Swamp Skink was along the Moyne River, approximately four kilometres east of the WWF development footprint. One skink was recorded in this habitat during the current assessment. The area the suitable habitat was confirmed, is now well outside the updated wind farm boundary. No other suitable habitat was found on the site and the development footprint for the project would not affect any habitat suitable for the Swamp Skink. Therefore, no direct impacts on the species are anticipated, as the project is approximately four kilometres from areas of suitable habitat.

Hydrological changes along the Moyne River as an indirect impact on Swamp Skink from project construction is not considered as a credible impact pathway due to this habitat being upstream of the project.

Based on the review of existing information and the current survey results, it is considered that the current proposal will not impact on the Swamp Skink population.

Growling Grass Frog

Back Creek within the wind farm boundary and Wetland 25816 (Wild Dog Swamp) to the east of the WWF was confirmed to support GGF. The main area of potential habitat within the WWF site was Back Creek. Back Creek, a tributary of the Moyne River, is a narrow and relatively shallow and meandering ephemeral flowing waterway that passes through the central area of the WWF site. During wetter periods, adjacent swamps and low-lying areas can become inundated, but dry during summer.

The EPBC Act significant impact guidelines (DEWHA 2009) state that there are two significant impact thresholds for the species including the following:

- Habitat degradation in an area supporting an important population
- Isolation and fragmentation of populations.

Habitat degradation

The waterways at the WWF are considered to provide suitable habitat for Growling Grass Frog. They are likely to provide key ecological functions including foraging, breeding, dispersal and shelter opportunities. Any action that results in degradation of habitat such that recruitment, survival or dispersal rates of an important population are lowered, may have a significant impact on the species (*sensu* DEWHA 2009).

Any viable population of Growling Grass Frog is considered to be important population for the persistence and recovery of the species. For Growling Grass Frog, a viable population is one which is not isolated from other populations or water bodies, such that it has the opportunity to interact with nearby populations or has the ability to establish new populations when water bodies fill and become available. Interactions with nearby populations occur when the frogs disperse over areas of suitable movement habitat including creeks and rivers and terrestrial habitat within 200 metres of these corridors (DEWHA 2009).

Much of GGF habitat has been degraded, isolated or fragmented, restricting the opportunity for important population processes such as dispersal and colonisation. Therefore any viable population is considered to be an important population for the persistence and recovery of the species (DEPI 2013). Given this, the GGF population that occurs along the Back Creek is considered to be an important population and impacts will need to be avoided where possible. While the proposed design footprint generally excludes GGF habitat there are two instances where unavoidable access tracks cross Back Creek and to a lesser extent the Shaw River are required. Crossings of the Moyne River have been avoided.

The initial development footprint had seven crossings across Back Creek and one of the Shaw River. In the current proposed layout the proponent has reduced the crossings of Back Creek to one and the one crossing of the Shaw River remains.

Isolation and fragmentation

The Back Creek is a potential movement corridor providing connectivity to other habitats up and down stream. Any isolation of waterbodies, through destruction of habitat or creation of physical barriers can lead to a significant impact on the species (DEWHA 2009).

As described above, the project design initially had seven waterway crossings Back Creek in the concept design layout. The revised layout minimised the creek crossings to two that will remove approximately 0.14ha of GGF habitat along the Back Creek and to a lesser extent 0.12ha of low quality habitat at the Shaw River crossing.

The crossing of Back Creek will be built to ensure that GGF will be able to easily move along the creeks and rivers. The Victorian government have produced culvert design standards that facilitate GGF passage under roads (DELWP 2017f).

Impacts on the GGF habitat from the WWF along Back Creek will be minimised at both the detailed design and construction phases of the project by implementing the mitigation measures described below. These will be incorporated into a Construction Environmental Management Plan (CEMP) and Growling Grass Frog Management Plan.

Provided the known sites for GGF are avoided and there is minimal physical disturbance of potential habitat during the construction of the wind farm, it is considered that there will be minimal impact on this species within the WWF site.

With the implementation of design and management measures, potential impacts to the Growling Grass Frog via physical disturbance of waterway crossings, were assessed to be low with any impacts likely to be localised at crossing points, following rehabilitation of crossing points.

11. Aquatic fauna assessment

KEY FINDINGS

Fish surveys were undertaken by EHP in December 2009 (EHP 2018) to determine the status of native freshwater fish species within the study area.

Two listed threatened species were recorded at WWF, with the Yarra Pygmy Perch present in the Moyne River, and Little Galaxias present in Kangaroo Creek (EHP, 2018).

Recent field inspection of those sites and other streams (Shaw River and Back Creek) on the wind farm confirmed the current persistence of suitable habitat for Yarra Pygmy Perch and Little Galaxias as recorded by EHP (2018).

Disturbance should be avoided where feasible within a 30-metre buffer along the streams (Moyne River, Back Creek, Kangaroo Creek and Shaw River and their tributaries), and all requirements for limiting sediment run-off into waterways during construction implemented. This would result in a low likelihood of any impacts on these listed freshwater fish species.

The Hairy Burrowing Crayfish was recorded well outside the study area along the banks of the Moyne River and an adjacent wetland. This species was not recorded within the current development footprint or within the project boundary and is considered unlikely to occur.

11.1. Introduction

The project is situated in both the Shaw River and Moyne River catchments. Both cover large rural areas and are comprised largely of agricultural land dominated by dryland sheep and cattle grazing. Tributaries to the Shaw and Moyne rivers include the Kangaroo Creek and Carmichael Creek, which feed the Shaw River upstream of the WWF site, and Back Creek, which is a tributary of the Moyne River. Smaller drainages of both catchments also occur across the site.

Due to the presence of potentially suitable habitat at a range of waterbodies and tributaries located within the study area, it was considered that there was potential for threatened fish to occur within the proposed WWF site. Accordingly, a targeted fish survey was undertaken by Ecology and Heritage Partners (EHP 2018).

The aim of this survey was to identify areas of suitable habitat to support threatened fish within the proposed WWF site. Such areas were identified so that the wind farm layout could be designed to avoid, wherever possible, impacts on these areas.

An assessment on the Hairy Burrowing Crayfish was undertaken given that burrowing crayfish chimneys, the entrance to the burrows, were present at a section on the banks of the Moyne River.

This section of the report presents information on the methods and results of the surveys and assessments, followed by a discussion of the proposed impacts of the project and recommended mitigation measures.

11.2. Species biology

11.2.1. Little Galaxias

Description

The Little Galaxias is a tiny, slender, elongated, freshwater fish that averages 30-40 millimetres in length (DAWE 2021b). The species is sexually dimorphic, with males being smaller and more slender than females, having three longitudinal black stripes along each side of the trunk, and a distinct orange stripe between the mid and lowest black stripe. The black stripes are less distinct or absent in females (Cadwallader & Backhouse 1983, McDowell 1996).

Distribution

Is now known to occur from the upper Barwon Downs, Victoria, west to Cortina Lakes, near the Coorong, South Australia (SWIFFT 2021)

Habitat

The Little Galaxias typically occurs in slow flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often but not always containing dense aquatic macrophytes and emergent plants (Cadwallader & Backhouse 1983, McDowall 1996). Some wetlands where it occurs may partially or completely dry up during summer (Humphries 1986). It is also found to be associated with burrowing freshwater crayfish (*Engaeus* spp.), with their burrows providing a dry season refuge (McDowell 1996). Other critical habitat often utilised in dry conditions include areas that naturally connect wetlands to a river or creek (Saddlier *et al*. 2010).

Threats

Threats to the Little Galaxias populations includes the following (Saddlier *et al*. 2010):

- Degradation and loss of habitat throughout its range, caused by wetland drainage, wetland inundation, fouling by livestock, ploughing, concreting of waterways, chemical pollution and Carp (*Cyprinus carpio*)
- Alteration to waterway flow regime
- Climate change increasing drying and reducing suitable habitat and connectivity throughout its range
- Introduced fish species resulting in increased competition and predation
- Illegal collection leading to localized depletion.

In 2015 a new fish species was described covering populations of the Dwarf Galaxias west of Melbourne, that are now considered distinct at the species level from those east of Melbourne. This new species is the Little Galaxias (*Galaxiella toourtkoourt*), listed as endangered under the FFG Act. Under the EPBC Act, populations inhabiting western Victoria and south-east South Australia are as of September 2021 still listed as Eastern Dwarf Galaxias (*Galaxiella pusilla*) a species considered to be vulnerable under the EPBC Act. As the Eastern Dwarf Galaxias and the Little Galaxias are referring to the same species the Little Galaxias is also considered to be vulnerable under the EPBC Act.

11.2.2. Yarra Pygmy Perch

Description

The Yarra Pygmy Perch is a small perch-like freshwater fish that can reach 75 millimetres in length. The body is often grey-brown ranging through to gold and olive green (Cadwallader & Backhouse 1983). The fins are transparent or translucent, with faint golden to black colouring (SWIFFT 2021).

Distribution

The Yarra Pygmy Perch is distributed from Bunyip River basin in west Gippsland east through southern Victoria and in south-eastern South Australia, as far west as Lake Alexandria and the Finniss River, near the mouth of the Murray River (Saddlier & Hammer 2010).

Habitat

The Yarra Pygmy Perch typically occurs in slow-flowing or still waters that support large amounts of aquatic vegetation (particularly emergent vegetation) such as lakes, ponds, wetlands and the stiller reaches of rivers (Saddlier & Hammer 2010).

Threats

Threats to the Yarra Pygmy Perch populations includes the following (Saddlier & Hammer 2010):

- Degradation and loss of habitat throughout its range, cause by wetland drainage to agriculture, urban and industrial development, wetland inundation and fouling by livestock and Carp
- Alteration to waterway flow regime
- Climate change increasing drying and reducing suitable habitat and connectivity throughout its range
- Introduced fish species increasing competition and predation
- Illegal collection leading to localized depletion.

The Yarra Pygmy Perch (*Nannoperca obscura*) is listed as vulnerable under the EPBC Act and FFG Act.

11.2.3. Hairy Burrowing Crayfish

Description

The Hairy Burrowing Crayfish (*Engaeus sericatus*) is brown in colour and ranges from 8 – 15cm in size with a hard outer shell with two large claws used for foraging, building their burrows and defending themselves. Compared to its body and claw size, has a relatively small tail in comparison.

Distribution

It is a short-ranged endemic species found in Western Victoria, namely in the north-west corner of the state and along the west coast from Portland to the Otway Ranges and north toward Ballarat (Horwitz 1990; March and Robson 2006).

Habitat

The species are semiterrestrial and while requiring a permanent water source, ideally riparian zones that are well vegetated and floodplains, they also engage in terrestrial activity during rain events or at night either to forage or mate (March and Robson 2006; Linton *et al.* 2009). The species constructs large tunnels that reach the underground water table and have chimneys at the surface to block water from flooding their burrow.

Threats

Since European settlement and man-made modifications to the landscape, the species habitat and population are under threat. This is particularly evident in agricultural areas in south-western Victoria where vegetation removal, cattle grazing, soil compaction, bank erosion and increased salinisation, to name a few, have threated population numbers (O'Brien 2007).

11.3. Methods

11.3.1. Existing information

Existing aquatic fauna 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 boundary of the proposed wind farm. A list of the aquatic fauna species recorded in the search region was obtained from the VBA (DELWP 2019).

A review of existing documentation relating to the study area was reviewed. The Shaw River Power Station EES Report (McRobert *et al*. 2010) included information on previous aquatic surveys that have been undertaken in the Shaw River.

11.3.2. Field methodology

The suitability of waterways on and near the WWF site for Little Galaxias and Yarra Pygmy Perch was assessed through a site inspection that considered previous records and assessments (EHP 2018), and any known habitat characteristics. Habitat components, including proximity to waterways and the character of instream and adjacent vegetation were assessed.

Fish surveys were undertaken by EHP from 15th to 18th December 2009 (EHP 2018) to determine the status of native freshwater fish species within the study area. During these surveys, ten bait traps with light sticks designed to lure native fish species were deployed in suitable habitat at three locations along Kangaroo Creek (drains into the Shaw River) in the north of the WWF site and the Moyne River to the east of the site. Furthermore, dip netting was undertaken across multiple sites, with an additional two Fyke nets set at dusk in another two locations for two nights. Details can be found in EHP (2018).

While undertaking habitat assessments and Brolga surveys in the study area, surveyors recorded any signs of burrowing crayfish. Burrowing crayfish produce chimneys of bally mud at the entrance of their burrows. This is an indication that they reside on the area.

11.4. Results

11.4.1. Existing Information

The review of the VBA found three threatened fish species occur within the search region. Of these two species (Yarra Pygmy Perch and Little Galxias) were considered likely to occur within the study area (Section 7.3.1) as there were previous records of these two species in the Shaw River and Back Creek. The Australian Grayling was considered unlikely to occur in the study area due to a lack of suitable habitat.

The aquatic fauna studies undertaken for the Shaw River Power Plant and supporting water pipeline found that there were previous records of Yarra Pygmy Perch and Little Galaxias (EHP 2009, McRobert *et al*. 2010) within the Shaw River, Back Creek and Moyne River. Aquatic ecological surveys undertaken for this project confirmed the presence of Yarra Pygmy Perch and Little Galaxias within the Shaw River and Back Creek (EHP 2009), McRobert *et al*. 2010). The Australian Grayling was not confirmed and was thought to reside in the nearby Hopkins River (McRobert *et al*. 2010).

The Hairy Burrowing Crayfish and NE Grampians Bush Yabby have been previously recorded in the search region. These two species were considered unlikely to occur in the study area due to their distribution being outside the study area. EHP (2018) considered crayfish unlikely to occur due to the lack of historical records. Correspondence with DELWP representatives have indicated that the Hairy Burrowing Crayfish has been recorded in a Moyne River tributary six kilometres east of Willatook (Schultz *et al*. 2008) which is well outside its previously known distribution.

11.4.2. Field assessment

Aquatic ecology field surveys for the project recorded between nine and 23 macroinvertebrate families in the Moyne River, Back Creek and Shaw River. All sites surveyed in these watercourses had a signal pollution rating of 'Severe Pollution' at the time of the surveys.

Six fish species were recorded during field surveys (Table 35). Two EPBC Act and FFG Act listed freshwater native fish species were recorded in the region in 2009, with the Yarra Pygmy Perch present in the Moyne River, and Little Galaxias in Kangaroo Creek (EHP 2018).

Recent field inspections of those sites and other streams (Shaw River and Back Creek) on the WWF site confirmed the persistence of suitable habitat (Figure 23) as recorded by EHP 10 years previously (2018).

Table 35: Fish recorded during aquatic surveys

Name	Status	Occurrence
Short Finned Eel (*Anguilla australis*)		Back Creek
Southern Pygmy Perch (*Nannoperca australis*)		Moyne River
Yarra Pygmy Perch (*Nannoperca obscura*)	(VU, vu)	Moyne River, Back Creek, Shaw River,
Tupong (*Pseudaphritis urvillii*)		Moyne River
Common Galaxias (*Galaxias maculatus*)		Moyne River, Back Creek, Shaw River
Mountain Galaxias *(Galaxias olidus*)		Moyne River
Little Galaxias (*Galaxiella toourtkoourt)* (recorded as Dwarf Galaxias (*Galaxiella pusilla*))	(Vu, en)	Shaw River, Back Creek, Kangaroo Creek

Notes: EPBC Act status: VU = vulnerable, FFG Act status: en = endangered, vu = vulnerable.

Chimneys from burrowing Crayfish were observed in one section along the Moyne River and adjacent wetland 25606 (Photograph 4, Figure 23). Two species of burrowing crayfish occur in south-west Victoria that are the Portland Burrowing Crayfish and Hairy Burrowing Crayfish, both listed under the FFG Act. The study area is well outside the known distribution for both species, a DELWP representative made it known that the Hairy Burrowing Crayfish has recently been reported in a tributary along the Moyne River (Schultz *et al*. 2008). Due to the presence of chimneys and the recent report of Hairy Burrowing Crayfish occurring in the catchment of the Moyne River it was concluded that the Hairy Burrowing Crayfish occurs in Moyne River catchment.

No signs of Hairy Burrowing Crayfish were observed within the proposed wind farm boundary or development footprint. The closest turbine to areas where Hairy Burrowing Crayfish were recorded was approximately four kilometres to the south-west.

Photograph 4: Chimney of the Hairy Burrowing Crayfish

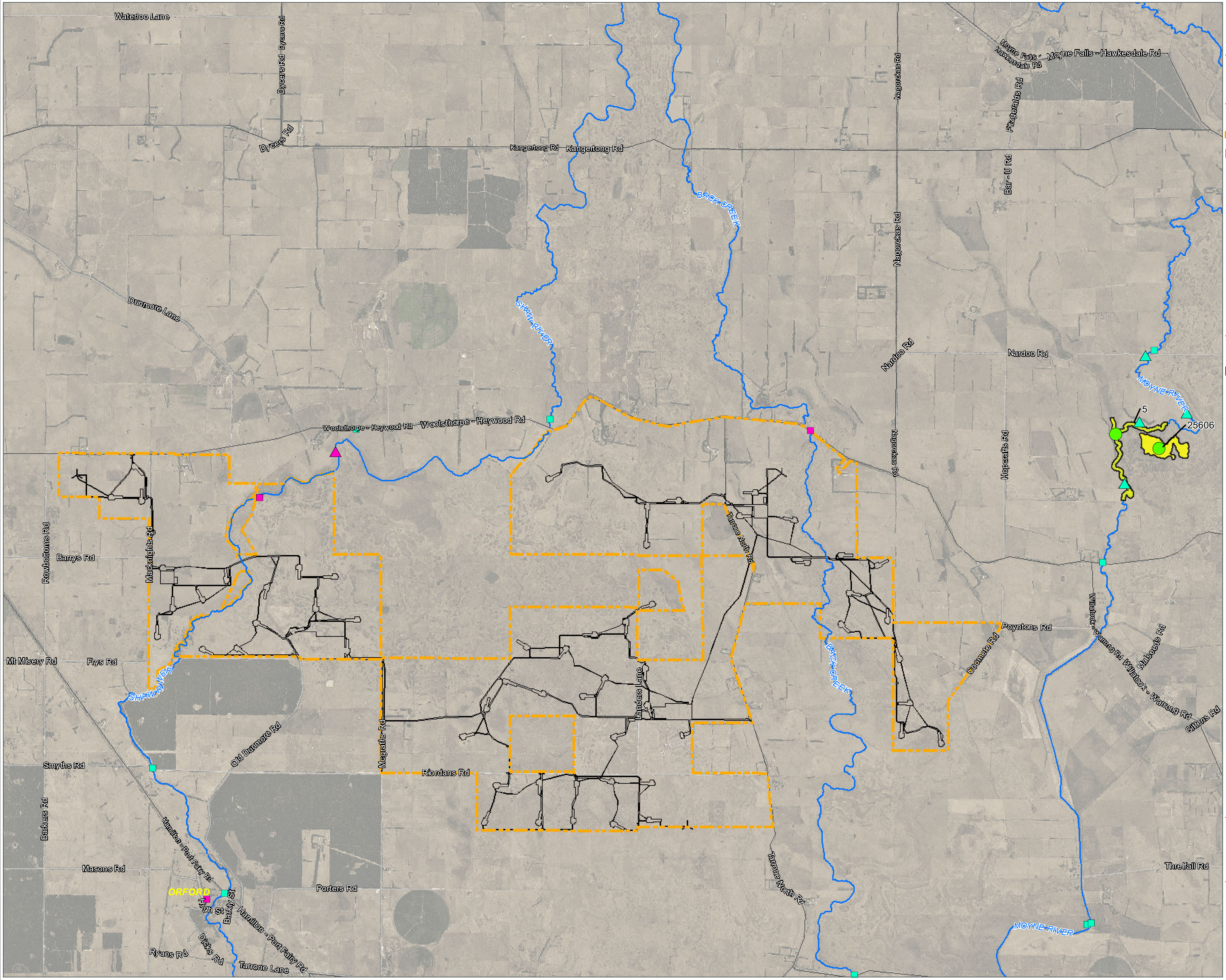

Figure 23: Aquatic fauna habitat

Project: Willatook Wind Farm
Client: Wind Prospect Pty Ltd
Date: 24/02/2022

Wind farm boundary
Construction footprint
EHP records (2018)
Little Galaxias
Yarra Pygmy Perch
VBA 2022
Little Galaxias
Yarra Pygmy Perch
NA records
Hairy Burrowing Crayfish
Habitat for threatened fish
Hairy Burrowing Crayfish habitat

N
Metres
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16087 - Created by: nm - \\Nat-haw-dt04\e\GIS\2016 Jobs\16087\16087 FIG 22 Threatened fish 220218.mxd

11.5. Impact assessment

11.5.1. Impact pathways

There were previous records of Little Galaxias and Yarra Pygmy Perch within the Shaw River. The Moyne River and Kangaroo Creek were confirmed to support Little Galaxias and Yarra Pygmy Perch. Back Creek and Shaw River were also considered to provide potential habitat for Little Galaxias and Yarra Pygmy Perch and a range of other non threatened fish species.

The national recovery plans for both the Little Galaxias and Yarra Pygmy Perch list several threats to the species (Section11.2). The two potential threats that may occur as a result of the construction and operation of the WWF include the following.

- Degradation and loss of habitat
- Alteration to flow regime

The Hairy Burrowing Crayfish was recorded from the Moyne River and an adjacent wetland. These areas are located approximately four kilometers from the closest proposed turbine. The proposed development is unlikely to pose an impact to this population of Burrowing Crayfish.

11.5.2. Mitigation Measures

A number of design measures were implemented to minimise potential impacts to aquatic ecological values. With the exception of access track and cable crossings, wind farm infrastructure has been located more than 100 metres of waterways and ephemeral wetlands, and 30 metres from drainage lines.

The WWF project concept design had seven waterway crossings over Back Creek and one over Shaw River. Potential impacts to these waterways were minimised with the removal of six waterway crossings.

As noted in Section 5.4.2, during the design process a 100-metre buffer was placed around all mapped wetlands on the DELWP Victorian Wetland Inventory. This was the primary measure used to limit potential impacts to areas that become seasonally inundated and provide ephemeral wetland habitats within and around the project site.

A single, larger buffer was placed around a series of wetlands that form the Cockatoo Swamp complex in response to the potential breeding of Brolga. The total buffered area around the Cockatoo Swamp complex is 2,658 hectares and maintains connectivity between wetlands. A detailed explanation of the buffering methodology and rationale can be found in Nature Advisory (2022). While designed to avoid potential impacts to Brolga, these buffers also further reduce potential impacts to these ephemeral wetland areas and habitats they provide. Management measures that have been committed to minimise potential impacts to the aquatic fauna include:

- The adoption of a 100 metre buffer between waterways and wind farm infrastructure, with the exception of track and cable crossings.
- Where essential wind farm infrastructure (e.g. access tracks and underground cabling trenches) crosses a waterway, measures for avoiding and minimising impacts should 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 their pre-construction condition.

- Micrositing has occurred to avoid deeper pools of water for waterway crossings.
- At waterway crossings the width of the track and trench should be reduced.
- Install sediment fencing during construction to protect riparian zones if works are to be undertaken within 30 metres of waterways.
- Access tracks throughout the site should be designed with culverts to divert flow paths beneath the roads.
- Infrastructure unavoidably sited in identified flow paths should be relocated to reduce risk of erosion, sediment transfer, affected access and inundation of infrastructure.
- Infrastructure should be designed to consider resilient design for flooding, including mitigation measures such as culverts beneath access roads and building threshold levels relative to anticipated water levels.
- Underground cabling trenches should be refilled with material of the same permeability to mitigate land salinisation and induced groundwater flows.

Water Technology (2022) completed an assessment of impacts to surface water features within the project site. This assessment provides further detail regarding recommended design and management measures to minimise potential impacts to surface waters and environmental values they support.

11.5.3. Residual effects

The main impact pathway for aquatic ecology, primarily in the Shaw River and Back Creek systems would be physical disturbance to the creek bed and associated aquatic habitats at two crossing points for accessways and cables. These crossings would be expected temporary increase in sedimentation from construction at the watercourse crossing locations, and to a lesser extent other upstream construction works areas. The second potential impact pathway is the disruption of hydrology and flow, altering migration or feeding patterns of fish.

These potential impacts are assessed in detail in the surface water impact assessment (Water Technology 2022). Potential impacts to aquatic fauna largely reflect the predicted changes to surface water systems. Therefore, this assessment focusses on the implications of these changes to aquatic fauna.

Degradation and loss of habitat

The waterways provide key ecological functions including spawning, short term refuge and long-term refuge for the two threatened fish species that they support. Any action that results in degradation and loss of habitat may have a significant impact on the species.

To minimise potential environmental impacts, these waterway crossings have been minimised from eight to two crossings. Crossing structures have been designed to maintain appropriate flow capacity, and to minimise the extent of disturbance and vegetation removal within the waterway and the duration over which construction activities take place. Appropriate sediment control structure will also be used to capture suspended solids and stream banks would be promptly rehabilitated.

Construction of waterways crossings will result physical disturbance to creek beds and associated aquatic habitats at four crossing points and resulting reduction in water quality (primarily increased suspended sediment) at these points. However, based on the ecology of the Little Galaxias and the Yarra Pygmy Perch, and the availability of refuge habitats, these construction impacts are assessed to be localised and temporary.

Given that Little Galaxias and the Yarra Pygmy Perch are known to occur within wetland habitats, the clearance of 1.3 hectares of Plains Grassy Wetland could potentially degrade a portion of available habitat. However, avoidance measures made during project design would ensure that 99.5% of Plains Grassy Wetland EVC within the site would be retained. As such the potential degradation of this area at least on a seasonal basis is predicted to have a negligible effect on the local populations of these species.

Alteration to flow regime

Appropriate hydrological conditions that regularly replenish the shallow freshwater habitats are essential for the survival of the Little Galaxias. The natural degree of wetland connectivity to a more permanent waterbody such as rivers or creeks are also vital to their long term survival particularly during extended dry conditions (Saddlier *et al*. 2010).

The Hydrological Assessment report (Water Technology 2022) indicated that impacts on river, stream and wetland hydrology will not be significant on the basis that detailed designs will be informed by detailed hydrological modelling to ensure that hydrological connectivity maintained.

With further design mitigation implemented through detailed design and robust construction management measures in place to minimise physical disturbance, the impacts on Little Galaxias and Yarra Pygmy Perch within the WWF site were assessed to be low during construction reducing to very low during operation.

12. Matters of National Environmental Significance

This section of the report assesses the impacts of the proposed wind farm and OD route and associated infrastructure on the listed communities and species either recorded or initially assessed as potentially occurring on the WWF site. This comprises a series of tables addressing the EPBC Act significant impact criteria (DoE 2013).

12.1. Ecological communities

12.1.1. Wind Farm site

Two EPBC Act listed ecological communities were recorded within the WWF site.

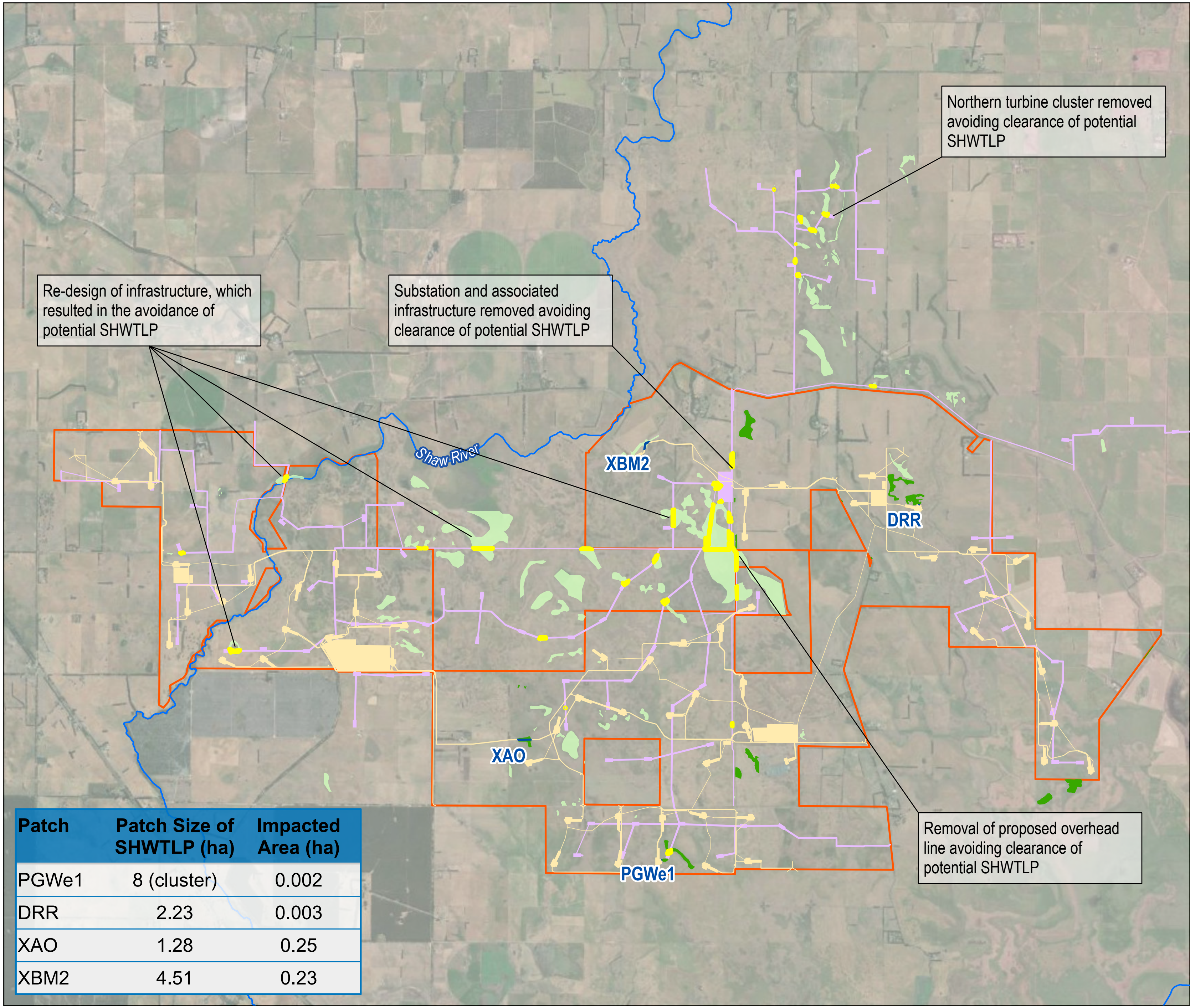
Avoidance has been the primary measure to mitigate potential impacts on listed ecological communities within the site. *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* ecological community within the Site. By selectively placing infrastructure away from mapped Plains Grassy Wetland, more than 97% of the confirmed *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* ecological community, and 100% of the potential community will be retained (Table 12).

Figure 24 shows the key changes in the project design that demonstrate where measures were taken that avoid areas of potential *Seasonal Herbaceous Wetland of the Temperate Lowland Plain.* The creation of the turbine free buffer around the Cockatoo Swamp wetland complex ensures that most potential areas for the *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* are well beyond potential areas of disturbance (Figure 24). As a result of this design change, most of the Cockatoo Swamp wetland complex is now excluded from the project site boundary.

Other key design changes that minimised the likelihood of clearance of *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* was the relocation of the proposed substation and associated overhead transmission line (see Figure 24) and also removal of a proposed cluster of turbines to the north of Woolsthorpe-Heywood Road (see Figure 24).

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

- 0.486 hectares of EPBC Act listed community *Seasonal Herbaceous Wetland of the Temperate Lowland Plain* (SHWTLP).



Patch	Patch Size of SHWTLP (ha)	Impacted Area (ha)
PGWe1	8 (cluster)	0.002
DRR	2.23	0.003
XAO	1.28	0.25
XBM2	4.51	0.23

LEGEND

- Current project construction footprint
- Concept design construction footprint
- Watercourse
- Willatook Wind Farm boundary

Seasonal Herbaceous Wetland of the Temperate Lowland Plain (SHWTLP)

- Areas of potential SHWTLP
- Areas of confirmed SHWTLP
- Avoided clearance of SHWTLP areas
- Proposed clearance of SHWTLP areas

SOURCE:
Willatook Wind Farm boundary, EVC and construction footprints from Wind Prospect.
Watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

0 1 2 km
SCALE 1:72,000
PAGE SIZE: A4
PROJECTION: GDA 1994 MGA Zone 54

WIND PROSPECT
WILLATOOK WIND FARM
FIGURE 24
Proposed and avoided clearance of Seasonal Herbaceous Wetland of the Temperate Lowland Plain

DATE: 05.05.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F076_GIS DOC REFERENCE: 287657_02_FIGS_H.APRX_V03

The impacts of the proposed WWF on SHWTLP are considered below in Table 36against the EPBC Act Significant Impact Guidelines for critically endangered and endangered ecological communities (DoE 2013).

Table 36: Impact assessment of listed ecological communities

Criterion*	Assessment	Significant impact likelihood
Reduce the extent of an ecological community	The Project will reduce the extent of SHWTLP by 0.486 hectares. This is spread across four separate patches within the project footprint (Figure 7). This would affect 0.3% to 19.5% of the defined areas of these patches. Overall, this represents 2.48% of confirmed SHWTLP with the study area, and none of potential SHWTLP within the wind farm site.	Potential
Fragment or increase fragmentation of an ecological community	The occurrence of SHWTLP within the Wind Farm site is already fragmented through landscape features such as rocky outcrops, and by existing tracks and loss of vegetation from past agricultural development. In most cases, the Project will not further fragment SHWTLP.	Unlikely
Adversely affect habitat critical to the survival of an ecological community	As the Project may permanently alter four patches of SHWTLP, the available habitat will be adversely affected on a local scale. This represents 2.48% of confirmed SHWTLP with the study area. Given the large number of wetlands within and surrounding the Wind Farm site, it is considered unlikely that the Project would adversely affect habitat critical to the survival of an ecological community on the Wind Farm site, or at a larger scale.	Unlikely
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Alteration of existing hydrological drainage patterns or natural seasonal filling regime has the potential to adversely impact abiotic factors necessary for an ecological community's survival. Recognising this potential impact, substantial efforts have been made to avoid ephemeral wetland areas by creating buffers around mapped wetlands. Hydrological flood modelling was also used to inform the placement of turbine locations and other infrastructure, and would be used to develop detailed designs of project infrastructure. With the implementation of these measures, it is considered unlikely that the project would adversely modify hydrological patterns necessary for the community's survival. Reduction in groundwater levels is predicted to occur around the proposed on-site quarry; however, there are no areas of SHWTLP mapped in proximity of this drawdown.	Unlikely

Criterion*	Assessment	Significant impact likelihood
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	SHWTLP that will be impacted by the Project has been subject to stock grazing, and is therefore already relatively species poor and dominated by exotic species. While the Project will impact 0.486 hectares of SHWTLP, it is considered unlikely that it would cause a substantial change in the species composition of an occurrence of the ecological community given the small area of removal in each instance, and the area remaining across the Wind Farm site.	Unlikely
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	The Project will be constructed and operated in accordance with a detailed environmental management plan that will include monitoring and adaptive control of weed and pest animal infestations, and strict controls for the management of chemicals and pollutants. It will therefore not cause a substantial reduction in the quality or integrity of an occurrence of an ecological community.	Unlikely
Interfere with the recovery of an ecological community	Given the large number of wetlands within and surrounding the Wind Farm site, it is considered unlikely that the Project would interfere with the recovery of SHWTLP. Ample opportunities will remain in currently modified wetland basins on the site and in the wider region to restore this community, should the opportunity arise.	Unlikely
Overall assessment of likelihood of significant impact		Potential

This potential significant impact will require offsetting under the EPBC Act Environmental Offsets Policy. An appropriate offset has been located in consultation facilitated by an Offset Broker. If approved an offset strategy would be developed see Section 5.6.2.

12.1.2. OD route

No EPBC Act listed ecological communities were recorded within the OD route.

Therefore, no EPBC Act listed ecological communities will be impacted by the current OD route footprint.

12.2. Flora

12.2.1. Wind Farm site

The analysis of the likelihood of occurrence of listed flora species (Table 6) identified that ten EPBC Act listed species could occur in remnant native vegetation within the Wind Farm site.

Two EPBC Act listed flora species, Swamp Everlasting and Trailing Hop-bush, have been recorded within the broader wind farm site.

The Project has been re-designed to avoid all Swamp Everlasting and Trailing Hop-bush individuals recorded. Consequently, no impacts are expected provided the populations are clearly temporarily marked and signed as a no-go area in the project construction and operational environmental management plan (CEMP and OEMP).

Targeted surveys for EPBC Act listed flora species have been undertaken based on a series of layouts between October 2018 and December 2021. Since the December 2021 surveys were undertaken the layout has been modified slightly in response to ongoing design requirements and to reduce impacts on the listed TEC - Seasonal Herbaceous Wetlands. Seasonally appropriate surveys (October and December) will be undertaken of the modified layout where the layout impacts on native vegetation for EPBC Act listed species that are yet to be surveyed, totalling an area of 0.366 hectares (see Figure 5). It is considered that most EPBC Act listed flora species are unlikely to occur as they have not been recorded to date in the 2018 and 2021 targeted surveys described above. However, should an EPBC Act listed species be recorded in the remaining footprint that is yet to be surveyed, the relocation of infrastructure will occur to eliminate the potential for impact on these species (as demonstrated by the relocation of infrastructure away from the Swamp Everlasting and Trailing Hop-bush described above).

Proposed management measures are outlined in Section Therefore, the proposed WWF will not have a significant impact on threatened flora species.

12.2.2. OD route

No EPBC Act listed flora species were recorded within the OD route.

Therefore, no EPBC Act listed flora species will be impacted by the current OD route footprint.

12.3. Fauna

This assessment found that 13 EPBC Act listed fauna species were 'likely to occur' or have 'potential to occur' or were recorded during surveys at the WWF (Table 14), including:

- Eight listed migratory bird species: Common Greenshank, Curlew Sandpiper, Fork-tailed Swift, Glossy Ibis, Latham's Snipe, Sharp-tailed Sandpiper, Red-necked Stint and White-throated Needletail (the last also listed as vulnerable under the Act);
- Two listed threatened bat species: Southern Bent-wing Bat and Grey-headed Flying-Fox;
- One listed threatened frog species: Growling Grass Frog; and
- Two listed threatened fish species: Dwarf (Little) Galaxias, Yarra Pygmy Perch.

These are considered further below.

12.3.1. Southern Bent-wing Bat (SBWB)

SBWB were subject to the most comprehensive bat detector survey of any wind farm assessed in Victoria. A total of 4,691 detector-nights of survey were undertaken over five of the eleven years between 2009 and 2020 at more than 100 separate recording sites. A total of 150 confirmed calls were recorded over the five years, amounting to an average of one call per month of detector-nights. Although more unconfirmed calls were recorded, evidence shows few of these would have belonged to SBWB. Most calls were from 2010 and 2011. From May 2019 to May 2020 there were single calls recorded from five sites from a total of 546 recording nights (or frequency rate of 0.009 calls per recording night).

SBWB activity was primarily associated with native riparian vegetation and a eucalypt plantation adjacent to the Shaw River to the west of the WWF and at a planted grove of trees to the east of the site, indicating these are the main foraging habitats for this species within the study area. These habitats are not characteristic of the wider wind farm site, which is mostly cleared for agricultural purposes. The locations of records are respectively 490 metres from and 1.55 kilometres west of the nearest turbines. A few other locations that yielded one or two confirmed and/or complex calls indicating that SBWB may occasionally utilise roadside and wind break vegetation and farm dams on the site but this would be infrequent, given the low-quality habitat and low SBWB activity levels. A low level of activity by this species on the site was consistently observed over a number of years' of recording on the site. This observation was made notwithstanding the presence of one non-breeding cave within 23 kilometres of the site and three others between 20 and 35 kilometres away.

Given the low activity levels of Southern Bent-wing Bat, mostly at survey points away from the WWF site, and the lack of suitable foraging habitat where turbines are proposed (see above), the proposed WWF is considered to represent a very low risk to this species. There is a very low likelihood of a collision by this species with turbines in the proposed wind farm, so over the life of the project, a very small number is expected to be affected by interactions with turbines. The extent of impact is unlikely to compromise its future survival. Significant impacts on the population and the species' recovery are considered highly unlikely.

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 bat collisions with the SBWB, which is not known to fly at height in open areas, with few calls being recorded more than 25 metres above the ground (Nature Advisory data).

The WWF will operate under a comprehensive Bat and Avifauna Management Plan that will require the wind farm operator to monitor and manage impacts on bats and avifauna, including SBWB. In the unlikely event of an SBWB collision with turbines, further monitoring and mitigation measures will be designed and implemented with the aim of avoiding significant impacts to this species (see Section 7.5).

The impacts of the proposed WWF on the SBWB are considered in Table 37below against the EPBC Act Significant Impact Guidelines for critically endangered and endangered species (DoE 2013).

Table 37: Southern Bent-wing Bat significant impact assessment

Significant impact criterion	Assessment	Significant impact likelihood
Lead to a long-term decrease in the size of a population	The population of SBWB migrating from the Warrnambool maternity cave is estimated to be approximately 17,000-18,000 individuals (TSSC 2021). The total species' population is estimated to be approximately 48,700 overall (TSSC 2021). While electronic bat recordings cannot give an accurate representation of numbers of individuals in an area, the low numbers of confirmed SBWB calls recorded in the survey indicates that it is unlikely that a significant proportion of SBWB individuals migrate through or utilise the area regularly. No preferred habitats occur on the proposed WWF site, as it has mostly been cleared for agricultural purposes and most wetlands have been drained, are grazed and lack native vegetation. At most bat survey sites where turbines will be located, SBWBs were not detected and, where they were, very few calls were recorded. Therefore, SBWB are not likely to use the WWF site frequently or in high numbers. The low number of SBWB calls consistently detected over five years, and the lack of suitable habitat on the proposed wind farm site, indicate that the chance of collisions with turbines by SBWB is considered very low. No impact on the population of a scale that would lead to a long-term decrease in numbers is expected from the project. The minimum lower rotor swept area of the turbines will be 40 metres above the ground. This is one of the highest minimum RSAs of turbines at a wind farm in south-western Victoria. As SBWB are not known to fly regularly at this height, it is highly unlikely that interactions between the turbines and SBWB will occur.	Unlikely
Reduce the area of occupancy of the species	The proposed wind farm site supports mostly highly modified habitat that surveys show SBWB use very infrequently or not at all. The proposed turbine locations and associated infrastructure do not affect the areas with the highest numbers of calls. Any habitat being removed during construction is unlikely to be key habitat for SBWB and therefore the project will not reduce the area of occupancy of the species.	Unlikely
Fragment an existing population into two or more populations	The project will not fragment the population. When infrequently flying across the site, bats will be able to pass between turbines.	Unlikely
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the species is primarily the two major breeding caves located in South Australia and Warrnambool, both a considerable distance from the site. Other habitat critical to the species are non-breeding caves, the closest known of these are Yambuk, approximately 16 kilometres from the site and Mt Eccles National Park approximately 15 kilometres from the site. There are no other known caves closer to the site and no caves are to be impacted by the construction of the WWF. Foraging habitat in proximity to the above-mentioned caves is also critical habitat to the species. None of this critical habitat occurs on or near the proposed wind farm site.	Unlikely
Disrupt the breeding cycle of a population	The wind farm lies 41 km from the nearest maternity cave (near Warrnambool). The project is not predicted to disrupt the breeding cycle of this species.	Unlikely
Modify, destroy, remove, isolate or decrease the	For the reasons outlined above, the site does not support habitat of importance to the species. For this reason, the advent of the proposed	Unlikely

Significant impact criterion	Assessment	Significant impact likelihood
availability or quality of habitat to the extent that the species is likely to decline	wind farm will not decrease the availability or quality of any suitable habitat. The species will therefore not decline as a result.	
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	The Project will be constructed and operated in accordance with a detailed environmental management plan that will include monitoring and adaptive control of weed and pest animal infestations and agricultural and plant diseases. It will therefore not result in an outbreak of any invasive species or diseases on the site.	Unlikely
Introduce disease that may cause the species to decline	See previous comment.	Unlikely
Interfere with the recovery of the species	The site is not considered prime habitat for the recovery of this species. It will continue to be used for farming, including grazing and will not be available for revegetation that might increase the area of suitable habitat within the species' range.	Unlikely
Overall assessment of likelihood of significant impact		*Unlikely*

On this basis, the WWF will not have a significant impact on the Southern Bent-wing Bat.

12.3.2. Striped Legless Lizard

EHP conducted targeted tile grid surveys for Striped Legless Lizard in three locations outside the impact zone (EHP 2018). These were adjacent to the proposed WWF. No Striped Legless Lizards were recorded.

Further targeted investigations within the proposed development zone were undertaken in the small areas of suitable habitat within the WWF site to determine whether the species is present on and near the proposed development footprint. No Striped Legless Lizards were recorded.

In the unlikely event that this species is recorded during construction, suitable mitigation measures will be put in place via the project construction environmental management plan to avoid or, if necessary, minimise impacts.

Impacts on the Striped Legless Lizard resulting from the proposed wind farm are therefore considered to be negligible and a further, more detailed impact assessment is unwarranted. However, this species is to be considered in the CEMP and mitigation measures proposed if it is recorded.

12.3.3. Growling Grass Frog

One Growling Grass Frog was detected inside the wind farm boundary, with one heard calling along Back Creek on 23rd October 2018. Growling Grass Frog was also heard in an area outside of the wind farm boundary, near the Moyne River (EHP 2018) at Wetland 25816 – Wild Dog Swamp during October and December 2019. It is likely that Growling Grass Frog use both Back Creek and

Moyne River as movement corridors and may also use Shaw River during and after heavy rainfall events to access other seasonally inundated wetlands that dry out over summer, but current habitat conditions indicate they are unlikely to reside in the wind farm other than along the Back Creek.

Management measures to reduce any potential impacts on the Growing Grass Frog are outlined in Section 10.4.2. To ensure protection and enable connectivity between populations, a buffer is to be applied along each waterway and its associated terrestrial habitats of at least 100 metres, wherever practicable. The wind farm layout includes four creek crossings along Back Creek and one crossing of Shaw River, for which careful construction environmental management measures, including pre-construction surveys and, if required, salvage, translocation and temporary frog fencing of construction areas would be set out in a Construction Environmental Management Plan (CEMP) to preclude short-term, temporary impacts from having any enduring consequences for the local Growling Grass Frog population.

Constructing crossings through habitat can create barriers that pose a risk to connectivity with nearby populations. Crossings will be designed and built to ensure that Growling Grass Frog will be able to move easily along the creeks and rivers. The Victorian government have produced culvert design standards that facilitate Growling Grass Frog passage under roads (DELWP 2017f). Furthermore, as the hydrological and hydrogeological investigations have concluded that there will be no impacts on the existing hydrological regime or water quality of aquatic habitats from construction and operation of the proposed wind farm, significant ongoing impacts on this species from the project are not expected.

Criteria for significant impacts on the Growling Grass Frog are set out in EPBC Act Policy Statement 3.14 (DEWHA 2009). Table 38provides an assessment of impacts on Growling Grass Frog against MNES Impact Criteria for Vulnerable species.

Table 38: Significant impact assessment for Growling Grass Frog

Significant impact criterion	Assessment	Significant impact likelihood
Lead to a long-term decrease in the size of an important population of a species.	The proposed wind farm construction will not lead to a long-term decrease in the population size of Growling Grass Frogs as most infrastructure is set back 100 metres from the potential habitat. Any creek crossings will be completed without impacts on flows or water quality and there will be no impacts on aquatic habitats from construction and operation of the proposed wind farm. Strong construction environmental management measures aimed at detecting and mitigating impacts on Growling Grass Frog will be implemented. Significant impacts on this species are not expected.	Unlikely
Reduce the area of occupancy of an important population.	The proposed works associated with the wind farm will not reduce the area of occupancy of an important population as most infrastructure is set back 100 metres from potential habitat and the creek crossings will be temporary disruptions completed in a sensitive manner. Works undertaken for trenched cables will be temporary and rehabilitated. The width of access tracks will be reduced. There will be no impacts on flows or water quality on	Unlikely

Significant impact criterion	Assessment	Significant impact likelihood
	aquatic habitats from construction and operation of the proposed wind farm. Given these findings, the project will not lead to a reduction in the area of occupancy of an important population.	
Fragment an existing important population into two or more populations.	The proposed works associate with the wind farm will not fragment important populations as the mapped habitat is mainly contiguous along creeks and streams and infrastructure is set back 100 metres from the potential habitat with the exception of creek crossings, which will be completed without impacts on hydraulic or habitat connectivity for this comparatively mobile frog species.	Unlikely
Adversely affect habitat critical to the survival of a species.	The proposed works will not adversely affect habitat critical to the survival of the species as impacts on Back Creek from crossings will be carefully managed.	Unlikely
Disrupt the breeding cycle of a population.	The proposed works will not disrupt the breeding cycle of an important population as infrastructure is set back 100 metres from the potential habitat and creek crossings will be completed without impacts on connectivity.	Unlikely
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	While the project layout has minimised the number of creek crossings, approximately 0.14ha of GGF habitat along the Back Creek and 0.12ha of low quality habitat at the Shaw River crossing will be temporarily impacted by the construction of watercourse crossings. With the implementation of proposed design and control measures, potential impacts to Back Creek (and to a lesser extent Shaw River) via physical disturbance of watercourse crossings and generation of poor water quality runoff was assessed to be localised (at crossing points), for a short duration (expected to be over several weeks). These were assessed to be unlikely to adversely affect habitat critical to the survival of Growling Grass Frog.	Unlikely
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	Invasive species that are a threat to Growling Grass Frog include species such as *Gambusia* (Mosquito Fish), which predate on tadpoles. The proposed development does not represent a risk of introducing a new invasive species that would affect Growling Grass Frogs, as mitigation measures during construction will be implemented and monitored as stated in the CEMP.	Unlikely
Introduce disease that may cause the species to decline.	The Growling Grass Frog is susceptible to a highly infectious disease caused by the amphibian chytrid fungus *Batrachochytrium dendrobatidi*. Management measures will be enforced consistent with Murray et al (2011) to prevent such harmful diseases from being introduced. These mitigation measures will be implemented during the construction phase to control the spread of disease between waterbodies and adjacent waterways.	Unlikely

Significant impact criterion	Assessment	Significant impact likelihood
Interfere substantially with the recovery of the species.	The proposed development will not interfere substantially with the recovery of the species as infrastructure is set back 100 metres from the potential habitat and creek crossings will be completed without impacts on habitat or connectivity.	Unlikely
Overall assessment of likelihood of significant impact		*Unlikely*

In conclusion the WWF will not lead to a significant impact on the Growling Grass Frog.

12.3.4. Little (Dwarf) Galaxias and Yarra Pygmy Perch

The Little Galaxias and Yarra Pygmy Perch are assumed to be present in Shaw River (and upstream tributary of the Kangaroo Creek), Back Creek and Moyne River. Both species occur in well vegetated slow flowing, freshwater habitats including swamps, ponds and backwaters of streams and creeks. Given their assumed presence in the project site, an assessment of the likelihood of a significant impact was completed in accordance with criteria outlined in the Significant Impact Guidelines (Department of the Environment, 2013a) (Table 39).

Management measures to reduce any potential impacts to listed fish are presented in Section 11.5.2.

Table 39: Significant impact assessment for Little Galaxias and Yarra Pygmy Perch

Significant impact criterion	Assessment	Significant impact likelihood
Lead to a long-term decrease in the size of an important population	Physical disturbance to watercourses and associated aquatic habitats at crossing points over Back Creek and to a lesser extent Shaw River for access tracks and cables have the potential to impact Little Galaxias and Yarra Pygmy Perch. These crossings would be expected temporary increase in sedimentation from construction at the watercourse crossing locations. A range of design measures and management controls have been proposed to limit the potential impacts of watercourse crossings to these species, including using fish friendly culverts to ensure natural flows are maintained, micro-siting access tracks and cable crossings to avoid deeper pools of water, limiting the construction workspace for these watercourse crossings, and rehabilitating crossings. Both the Yarra Pygmy Perch and Little Galaxias are known to occur in a range of environmental conditions and can persist in watercourses of reduced water quality. This would indicate they have a degree of tolerance to temporary changes in water quality. Based on the predicted level of impact, it is unlikely the project would lead to a long-term decrease in the size of an important population of these species	Unlikely
Reduce the area of occupancy of the species	The project is not expected to reduce the area of occupancy of Little Galaxias or Yarra Pygmy Perch. Construction activities would result in physical disturbance to creek beds and associated aquatic habitats at two crossing points and resulting reduction in water quality (primarily increased suspended sediment) at these points in Shaw River and Back Creek.	Unlikely

Significant impact criterion	Assessment	Significant impact likelihood
	It is proposed that the project would use fish friendly culverts to maintain natural flows and deeper pools that have the potential to provide refuge habitat within these watercourses would be avoided during detailed design.	
Fragment an existing important population into two or more populations	As noted above, the project would use fish friendly culverts to maintain natural flows and connectivity for Yarra Pygmy Perch and Little Galaxias. As such, the project is not predicted to fragment an existing important population of these species.	Unlikely
Adversely affect habitat critical to the survival of a species	As noted above, the main impact pathway to both Yarra Pygmy Perch and Little Galaxias would be physical disturbance of Back Creek and Shaw River for watercourse crossings, which would result in physical habitat disturbance and localised and temporary reduction of water quality. A range of design measures and management controls are proposed to limit the potential impacts of watercourse crossings including using fish friendly culverts, micro-siting crossings to avoid deeper pools of water, restricting the construction workspace for these watercourse crossings, and rehabilitating crossings. With these measures in place, and noting that both species are predicted to have some tolerance to altered water quality, the project was assessed to be unlikely to adversely affect habitat critical to the survival of Yarra Pygmy Perch and Little Galaxias.	Unlikely
Disrupt the breeding cycle of a population	The proposed works would not disrupt the breeding cycle of an important population of Yarra Pygmy Perch and Little Galaxias for the reasons outlined above.	Unlikely
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	As noted above, there would be physical disturbance of Back Creek and Shaw River for watercourse crossings, which would result in physical habitat disturbance and localised and temporary reduction of water quality. Temporary disturbance is only expected to be temporary during construction. With the design measures and management controls proposed to limit the potential impacts of watercourse crossings, these impacts would be unlikely to result in the decline of these species. During operations, the main potential impact pathway would be altered hydrological connectivity and drainage. However, this is not predicted to occur (Water Technology 2022) on the basis that detailed designs would be informed by detailed hydrological modelling with hydrological connectivity maintained. As such, this is unlikely to cause a decline in the species due to reduced habitat quality or availability.	Unlikely
Overall assessment of likelihood of significant impact		*Unlikely*

Suitable aquatic habitat exists within the study area, particularly in tributaries of the Moyne River. These two listed fish species were detected along the Moyne River and Kangaroo Creek during surveys conducted in 2009 (EHP 2018).

Provided there are no impacts on flows or water quality on these two watercourses from construction and operation of the proposed wind farm then impacts are not expected on these species. A buffer of at least 100 metres has been provided between wind farm infrastructure and these waterways, wherever possible. Where this is not possible a minimum 30 metre separation between the development footprint (i.e. turbines, access tracks and power cabling) and the Shaw River, Back Creek and any significant tributaries on the site together with best practice sediment and erosion control measures will prevent significant impacts on these fish species.

12.3.5. Golden Sun Moth

There are no previous records of Golden Sun Moth from database searches undertaken within the wind farm site search region. Potential habitat of Plains Grassland and Stony Knoll Shrubland were small, fragmented and limited across the wind farm site. EHP (2018) considered that this species has a moderate likelihood of occurrence within the wind farm site. However, during the assessments in 2019 it was considered that due to the lack of recent or regular records, the study area being outside it's known distribution and the lack of availability of suitable habitat in the wind farm site supporting significant cover of either indigenous or exotic food plant species, it was considered unlikely that Golden Sun Moth occurred on the wind farm site. Therefore, the likelihood of an important population or the species' population being affected by the proposed wind farm was considered very low.

12.3.6. Migratory shorebirds

Five listed migratory species are likely to occur on the WWF site: Latham's Snipe, Curlew Sandpiper, Red-necked Stint, Common Greenshank and Sharp-tailed Sandpiper.

Management measures aimed and mitigating any potential impacts to migratory shorebirds are outlined in Section 9.4.2.

Impacts of the project on migratory shorebirds were assessed against EPBC Act Policy Statement 3.21 *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE 2017)*.

Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. The widely accepted approach at identifying internationally important shorebird habitat throughout the world has been through criteria adopted under the Ramsar Convention on Wetlands.

According to this approach, wetland habitat should be considered internationally important if it regularly supports (DoEE 2017):

- 1% of the individuals in a population of one species or subspecies of waterbird; or
- A total abundance of at least 20,000 waterbirds.

Nationally important habitat for migratory shorebirds is similarly defined if it regularly supports (DoEE 2017):

- 0.1% of the flyway population of a single species of migratory shorebird; or
- A minimum of 2,000 migratory shorebirds; or
- A minimum of 15 migratory shorebird species.

Wetlands at the WWF are not already identified as internationally important habitats (RAMSAR wetland). The wetlands also do not meet the above criteria for internationally or national important habitat for migratory shorebirds.

The Latham's Snipe is treated a little differently to the other migratory shorebirds as it does not regularly aggregate in large flocks or use the same habitats as many other migratory shorebird species. Consequently, important habitat for Latham's Snipe uses a different criteria. Important habitat for Latham's Snipe is described as (DoEE 2017):

- Areas that have previously been identified as internationally important for the species; or
- Areas that support at least 18 individuals of the species.

Areas at the WWF have not been previously identified as internationally important for Latham's Snipe and have not recorded at least 18 individuals in any particular area. Therefore, it is considered unlikely that any areas at the proposed WWF contain important habitat for the Latham's Snipe.

As there is no important habitat for any migratory shorebirds at the proposed WWF site the project is unlikely to lead to a significant impact on any migratory shorebirds.

12.3.7. White-throated Needletail and Fork-tailed Swift

White-throated Needletail and Fork-tailed Swift are aerial foragers, spending most of their time flying in search of aerial insect prey and rarely roosting (Higgins 1999). They usually occur in Victoria in summer or early autumn and may be expected to forage over the study area on several days each year.

They move large distances in a short time and their use of the site is transitory and brief when moving these long distances.

These migratory species were found to have the potential to occur over the proposed wind farm and the Fork-tailed Swift (EPBC-Migratory) was recorded during the 2019 survey. There are few regional records to date. This low level of historical occurrence, coupled with the suboptimal habitat on the site (primarily farmland with few forested areas), suggests the frequency of occurrence of these species over the site is likely to be low.

Observations at operating wind farms in south eastern Australia indicate that these species may occasionally collide with wind turbines (Nature Advisory data). Collisions at WWF are expected to be low in number (one or two per year), based on experience at wind farms elsewhere in its range. Both species remain common and widespread throughout eastern Australia during summer and early autumn according to DAWE (2021b). The population of White-throated Needletail numbers 10,000 or more (Higgins 1999), so the loss of the occasional individual is expected to have negligible consequences for the species' population. While the population of Fork-tailed Swift is unknown in Australia, it is believed to be stable and the species is listed as least concern by the IUCN (DAWE 2021b).

Table 40 provides an assessment of potential impacts to White-throated Needletail and Fork-tailed Swift against the MNES significant impact criteria for species listed as Migratory under the EPBC Act.

Table 41 provides an assessment of potential impacts to White-throated Needletail against the MNES significant impact guidelines for species listed as Vulnerable under the EPBC Act.

Table 40: Assessment of White-throated Needletail and Fork-tailed Swift against MNES Impact Criteria for migratory species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	Analysis of proposed impact
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	The proposed works will not impact important habitat for these species as they are predominately aerial and roost in forested habitats. Their breeding habitat occurs in the Northern Hemisphere.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	As these species are almost exclusively aerial (Higgins 1999), the proposed works will not result in any invasive species that is harmful to these species becoming established in an area of important habitat. The temporary and short-term nature of the species' occurrence on the site means any infestations of invasive species would have a negligible impact on them. That said, the adoption of best practice construction environmental management measures will ensure monitoring and adaptive control of any infestation of an invasive plant or animal species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	These species don't breed in Australia and the wind farm site does not represent important non-breeding habitat. Therefore, the proposed works will not seriously disrupt the life-cycle of the White-throated Needletail.

The EPBC Act listed migratory White-throated Needletail and Fork-tailed Swift are therefore not considered to be impacted significantly by the proposed wind farm development.

Table 41: Assessment of White-throated Needletail against MNES Impact Criteria for vulnerable species

Significant impact criterion	Assessment	Significant impact likelihood
Lead to a long-term decrease in the size of an important population	The population of White-throated Needletail numbers 10,000 or more (Higgins 1999), so the loss of the occasional individual due to collision is expected to have negligible consequences for the species' population.	Unlikely
Reduce the area of occupancy of an important population	The proposed wind farm site supports highly modified habitat that is not the preferred habitat for the species and it is expected to visit the WWF site infrequently. The project will therefore not reduce the extent of the species range.	Unlikely
Fragment an existing population into two or more populations	The project will not fragment the population. Even if flying across the site, birds will be able to pass over or between turbines.	Unlikely
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the species are breeding grounds in Asia and some forested habitats with high reporting rates. These will not be impacted by the proposed WWF.	Unlikely
Disrupt the breeding cycle of an important population	Breeding grounds are located in Asia. The proposed WWF will not disrupt the breeding cycle.	Unlikely

Significant impact criterion	Assessment	Significant impact likelihood
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	For the reasons outlined above, the site does not support habitat of importance to the species. For this reason, the advent of the WWF will not decrease the availability or quality of any suitable habitat. The species will therefore not decline as a result.	Unlikely
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Project will be constructed and operated in accordance with a detailed environmental management plan that will include monitoring and adaptive control of weed and pest animal infestations and agricultural and plant diseases. It will therefore not result in an outbreak of any invasive species or diseases on the site.	Unlikely
Introduce disease that may cause the species to decline	See previous comment.	Unlikely
Interfere substantially with the recovery of the species	The site is not considered prime habitat for the recovery of this species. It will continue to be used for intensive grazing.	Unlikely
Overall assessment of likelihood of significant impact		*Unlikely*

The EPBC Act listed vulnerable White-throated Needletail is therefore not considered to be impacted significantly by the proposed wind farm development.

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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:
  - Location 1 – shown in light blue on the *Location* Map, and occurring over most of Victoria.
  - Location 2 – shown in dark blue on the *Location* Map, and includes areas mapped as endangered EVCs and/or sensitive wetlands and coastal areas.
  - Location 3 – 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:
  - Patch – The area of the patch in hectares
  - Scattered Tree – 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 H*abitat importance map.*

These factors are then used as follows to determine the biodiversity value of a site:

General habitat score = habitat hectares x general landscape factor

Species habitat score = habitat hectares x species landscape factor

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: Representative photographs of native vegetation proposed for removal

Plains Grassy Wetland (EVC 125) Photo Nature Advisory taken 23/10/2018

Basalt Shrubby Woodland (EVC 642) Photo Nature Advisory taken 27/07/2018

Stony Knoll Shrubland (EVC 649) Photo Nature Advisory taken 23/10/2018

Higher Rainfall Plains Grassy Woodland (EVC 55_63) Photo EHP (2018) taken 28/06/2017

Tall Marsh (EVC 821) Photo EHP (2018) taken 28/06/2017

Heavier-soils Plains Grassland (EVC 132_61) Photo EHP (2018) taken 26/06/2017

Appendix 3: Detailed habitat hectare assessment results

Habitat Zone			1AL	1AM	1AN	1AO	1AP	1AQ	1AR	1AS	1AT	1AU	1AV	1AW	1AX
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			642	642	642	642	53	642	642	642	642	642	642	642	642
Total area of Habitat Zone (ha)			0.004	0.115	0.064	0.000	0.002	0.007	0.010	0.062	0.785	0.020	0.048	0.037	0.329
Site Condition	Large Old Trees	/10	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	2	2	0	0	0
	Lack of Weeds	/15	0	4	4	4	7	4	0	4	0	0	0	0	0
	Understorey	/25	5	10	10	10	10	10	5	5	15	15	5	5	5
	Recruitment	/10	0	10	5	5	0	5	0	5	10	10	5	5	5
	Organic Matter	/5	3	5	4	4	5	4	3	5	2	2	2	2	2
	Logs	/5	0	0	0	0	N/A	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
	Site Condition subtotal		*8*	*29*	*23*	*23*	*22*	*23*	*8*	*19*	*29*	*29*	*12*	*12*	*12*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	1	1	1
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**9**	**30**	**24**	**24**	**23**	**24**	**9**	**20**	**30**	**30**	**14**	**14**	**14**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			1AY	1AZ	1BA	1BB	1BC	1BD	1BE	1BF	1BG	1BH	1BI	1BJ	1BK
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			642	642	53	642	642	642	642	642	642	642	642	642	642
Total area of Habitat Zone (ha)			0.027	0.015	0.004	0.184	0.032	0.047	0.286	0.054	0.012	0.082	0.021	0.053	0.034
Site Condition	Large Old Trees	/10	0	0	N/A	0	0	0	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	0	0	0	3	0	0	0	0	0	0	0	0	0
	Lack of Weeds	/15	0	0	7	0	0	0	0	0	0	0	0	0	0
	Understorey	/25	5	5	10	10	5	5	5	5	5	5	5	5	5
	Recruitment	/10	0	5	0	6	3	0	5	0	0	6	6	5	3
	Organic Matter	/5	3	2	5	2	2	2	2	2	2	2	2	2	2
	Logs	/5	0	0	N/A	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition subtotal		*8*	*12*	*28*	*21*	*10*	*7*	*12*	*7*	*7*	*13*	*13*	*12*	*10*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	1	0	0	1	1	1	1	1	0	0	1	1
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**9**	**14**	**29**	**22**	**12**	**9**	**14**	**9**	**9**	**14**	**14**	**14**	**12**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			1BL	1BM	1BN	1BO	1BP	1BQ	1BR	1BS	1BT	1BU	1BV	1BW	1BX
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			642	642	642	642	642	642	642	642	642	642	642	642	642
Total area of Habitat Zone (ha)			0.008	0.114	0.001	0.002	0.073	0.085	0.005	0.047	0.064	0.177	0.012	0.018	0.026
Site Condition	Large Old Trees	/10	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
	Lack of Weeds	/15	0	0	0	4	0	0	0	0	0	0	0	0	0
	Understorey	/25	5	5	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	5	0	0	0	0	3	0	0	6	0	0	0	0
	Organic Matter	/5	2	2	2	2	2	2	3	2	2	2	2	2	2
	Logs	/5	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
	Site Condition subtotal		*12*	*7*	*7*	*11*	*7*	*10*	*8*	*7*	*13*	*7*	*7*	*7*	*7*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	1	0	1	0	1	1	0	1	0	1	1	1	1
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**14**	**8**	**9**	**12**	**9**	**12**	**9**	**9**	**14**	**9**	**9**	**9**	**9**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			1BY	1BZ	1DB	1DC	1DD	1DE	1DF	XAA	XAB	XAD	XAE	XAN	XAO
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			642	642	649	642	642	642	642	642	642	642	642	642	125
Total area of Habitat Zone (ha)			0.024	0.021	0.018	0.007	0.012	0.030	0.007	0.172	0.265	1.634	1.226	7.600	1.283
Site Condition	Large Old Trees	/10	0	0	N/A	0	0	0	0	0	5	0	0	0	0
	Tree Canopy Cover	/5	0	0	N/A	0	0	0	0	0	0	0	0	0	0
	Lack of Weeds	/15	0	0	2	4	6	2	0	4	4	4	4	4	9
	Understorey	/25	5	5	10	10	15	5	5	10	15	10	10	5	20
	Recruitment	/10	0	0	0	5	10	6	5	10	6	10	6	0	0
	Organic Matter	/5	2	2	4	4	5	2	2	4	2	3	3	3	5
	Logs	/5	0	0	N/A	0	0	0	0	2	4	0	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36
	Site Condition subtotal		*7*	*7*	*22*	*23*	*36*	*15*	*12*	*30*	*36*	*27*	*23*	*12*	*46*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	6	6
	Neighbourhood	/10	1	1	1	1	1	1	1	0	0	0	0	3	3
	Distance to Core	/5	0	0	1	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**9**	**9**	**25**	**25**	**38**	**17**	**14**	**31**	**37**	**28**	**24**	**21**	**55**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			XAP	XAQ	XAR	XAS	XAT	XAU	XAV	XAW	XAX	XAY	XAZ	XBA	XBB
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	642	125	125	125	642	642	642	642	642	642	642	642
Total area of Habitat Zone (ha)			0.583	0.101	0.023	0.393	0.025	0.033	0.087	0.024	0.029	0.038	0.033	0.063	0.009
Site Condition	Large Old Trees	/10	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
	Lack of Weeds	/15	4	0	6	6	4	0	0	0	0	0	0	0	0
	Understorey	/25	10	5	10	10	5	5	5	5	5	5	5	5	5
	Recruitment	/10	0	0	0	0	0	5	0	0	5	5	5	5	5
	Organic Matter	/5	0	5	3	3	4	4	2	2	4	4	4	2	2
	Logs	/5	0	0	0	0	0	0	2	4	0	0	0	4	4
	Site condition standardising multiplier*		1.36	1.00	1.36	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition subtotal		*19*	*10*	*26*	*26*	*18*	*14*	*9*	*11*	*14*	*14*	*14*	*16*	*16*
Landscape Context	Patch Size	/10	6	6	1	1	1	6	1	1	1	6	1	1	1
	Neighbourhood	/10	3	3	0	0	0	3	0	0	0	3	0	0	0
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**28**	**19**	**27**	**27**	**19**	**23**	**10**	**12**	**15**	**23**	**15**	**17**	**17**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			XBC	XBD	XBE	XBF	XBH	XBI	XBJ	XBK	XBL	XBM	XBN	XBO	XBP
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			642	642	642	642	821	125	642	642	649	125	55_63	125	55_63
Total area of Habitat Zone (ha)			0.092	0.013	0.013	0.011	0.067	0.062	0.053	0.027	1.831	4.514	0.991	0.430	0.372
Site Condition	Large Old Trees	/10	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
	Lack of Weeds	/15	0	4	4	4	11	11	4	7	7	7	4	4	4
	Understorey	/25	5	5	5	5	15	5	15	5	5	10	5	5	5
	Recruitment	/10	5	5	0	0	0	0	5	0	0	3	0	0	0
	Organic Matter	/5	2	4	4	4	3	3	5	5	5	5	5	5	5
	Logs	/5	5	0	0	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.36	1.36	1.00	1.00	1.00	1.36	1.00	1.36	1.00
	Site Condition subtotal		*17*	*18*	*13*	*13*	*39*	*26*	*29*	*17*	*17*	*34*	*14*	*19*	*14*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	2	2	6	6	6
	Neighbourhood	/10	0	0	0	0	0	0	0	0	1	1	2	2	2
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**18**	**19**	**14**	**14**	**40**	**27**	**30**	**18**	**20**	**37**	**22**	**27**	**22**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

	Habitat Zone		XBQ	XBR	XBS	XBT	XBU	XBV	XBW	XBX	XBY	XBZ	XCA	XCB	XCC
	Bioregion		VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
	EVC Number		125	649	125	55_63	55_63	642	642	642	642	642	642	642	642
	Total area of Habitat Zone (ha)		0.393	0.266	0.416	0.031	0.600	0.024	0.457	1.905	0.005	0.041	0.017	0.010	0.050
Site Condition	Large Old Trees	/10	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
	Lack of Weeds	/15	4	9	4	4	4	0	6	6	4	4	4	4	4
	Understorey	/25	5	10	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	0	0	0	0	0	5	0	0	0	5	5	5	5
	Organic Matter	/5	5	5	5	3	3	4	5	5	5	5	4	5	5
	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
	Site condition standardising multiplier*		1.36	1.00	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition subtotal		*19*	*24*	*19*	*12*	*12*	*14*	*16*	*16*	*14*	*19*	*18*	*19*	*19*
Landscape Context	Patch Size	/10	6	6	6	6	6	1	6	6	6	6	6	6	6
	Neighbourhood	/10	2	2	2	2	2	0	4	4	4	4	4	4	4
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**27**	**32**	**27**	**20**	**20**	**15**	**26**	**26**	**24**	**29**	**28**	**29**	**29**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			LA	LB	LC	LE	LF	LG	LI	LJ	LK	LL	LM	LO	72
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			642	642	642	642	642	642	642	642	642	642	642	642	125
Total area of Habitat Zone (ha)			0.002	0.003	0.027	0.156	0.011	0.040	0.074	0.037	0.006	0.036	0.066	0.015	0.028
Site Condition	Large Old Trees	/10	0	0	0	0	0	0	0	0	0	0	0	0	NA
	Tree Canopy Cover	/5	0	0	0	0	0	0	0	0	0	0	0	0	NA
	Lack of Weeds	/15	0	0	0	0	0	0	0	0	0	0	0	0	0
	Understorey	/25	5	5	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	5	5	5	5	5	5	5	5	5	5	5	5	0
	Organic Matter	/5	2	2	2	2	2	2	2	2	2	2	2	2	2
	Logs	/5	0	0	0	0	0	0	0	0	0	0	0	0	NA
	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	1.36
	Site Condition subtotal		*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*10*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	2
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	3
Total Condition Score		**/100**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**16**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			PGWe1	PGWe2	PGWe3	PGWe4	PGWe5	PGWe6	SKS1	SKS2	SKS3	SKS4	PG1	PG2	PG3
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	125	125	125	125	125	649	649	649	649	132_61	132_61	132_61
Total area of Habitat Zone (ha)			6.086	9.273	56.082	42.736	80.394	0.836	36.774	3.890	3.324	2.117	0.125	0.078	1.315
Site Condition	Large Old Trees	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lack of Weeds	/15	0	6	2	2	4	9	2	4	4	2	4	9	0
	Understorey	/25	5	10	5	5	10	10	5	15	10	10	5	5	5
	Recruitment	/10	3	6	3	3	3	6	3	3	3	3	3	3	3
	Organic Matter	/5	2	5	2	4	5	5	2	5	5	5	3	3	3
	Logs	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	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
	Site Condition subtotal		*14*	*37*	*16*	*19*	*30*	*41*	*16*	*37*	*30*	*27*	*20*	*27*	*15*
Landscape Context	Patch Size	/10	4	4	4	4	4	4	4	4	4	4	4	4	4
	Neighbourhood	/10													
	Distance to Core	/5													
Total Condition Score		**/100**	**18**	**41**	**20**	**23**	**34**	**45**	**20**	**41**	**34**	**31**	**24**	**31**	**19**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			PG5	BSW1	BSW2	PGW1	PGW2	PGW3	PGW4	PGW6	PGW7	PGW8	PGW9	PGW10	TM1	AH1
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			132_61	642	642	55_63^	55_63^	55_63^	55_63^	55_63^	55_63^	55_63^	55_63^	55_63^	821	653
Total area of Habitat Zone (ha)			1.462	0.547	0.128	0.925	0.836	0.232	0.374	0.036	0.920	1.587	1.151	2.392	1.365	0.040
Site Condition	Large Old Trees	/10	N/A	0	0	0	8	3	2	0	7	4	10	9	N/A	N/A
	Tree Canopy Cover	/5	N/A	0	0	0	5	3	5	4	4	4	5	5	N/A	N/A
	Lack of Weeds	/15	4	0	4	0	9	9	9	4	2	2	0	2	4	6
	Understorey	/25	5	15	5	5	15	15	15	5	5	5	5	10	5	15
	Recruitment	/10	3	1	1	0	6	3	3	0	1	1	0	3	0	3
	Organic Matter	/5	4	5	5	3	5	5	5	5	5	5	4	5	3	2
	Logs	/5	N/A	2	0	0	5	0	5	0	5	3	0	3	N/A	N/A
	Site condition standardising multiplier*		1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.36
	Site Condition subtotal		*22*	*23*	*15*	*8*	*53*	*38*	*44*	*18*	*29*	*24*	*24*	*37*	*16*	*35*
Landscape Context	Patch Size	/10	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Neighbourhood	/10														
	Distance to Core	/5														
Total Condition Score		**/100**	**26**	**27**	**19**	**12**	**57**	**42**	**48**	**22**	**33**	**28**	**28**	**41**	**20**	**39**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

^ These zones were listed as Plains Grassy Woodland (EVC 55_61) in the habitat hectare tables of EHP 2018, but were described in the text of this same report as Higher Rainfall Plains Grassy Woodland (EVC 55_63). They have been changed to Higher Rainfall Plains Grassy Woodland (EVC 55_63), which occurs in areas receiving areas receiving greater than 700 mm annual rainfall (DSE 2004a), based on the description in the text, and the average annual rainfall at the nearest weather station (Hawkesdale), which is 702 mm (BoM 2021a).

Habitat Zone			CI	CD	CE	F	H	I	Q	X	Y	AA	AD	AE	AF
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	125	125	125	125	125	125	125	125	125	125	125	125
Total area of Habitat Zone (ha)			0.048	0.282	0.052	0.539	0.278	0.866	0.873	0.192	5.127	1.768	0.616	0.613	0.302
Site Condition	Large Old Trees	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lack of Weeds	/15	9	4	4	2	2	2	2	2	2	2	2	2	2
	Understorey	/25	15	10	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	0	0	0	0	0	0	0	0	0	0	0	0	0
	Organic Matter	/5	0	5	3	3	3	3	3	3	3	3	3	3	3
	Logs	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	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
	Site Condition subtotal		*33*	*26*	*16*	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*	*14*
Landscape Context	Patch Size	/10	8	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	4	0	0	0	0	0	0	0	0	0	0	0	0
	Distance to Core	/5	1	3	3	1	1	1	1	1	1	1	1	1	1
Total Condition Score		/100	46	30	20	16	16	16	16	16	16	16	16	16	16

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			AG	AGG	G	J	AP	AJ	AK	AL	AN	AM	AR	AS	AT
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	125	125	125	125	125	125	125	125	125	125	125	125
Total area of Habitat Zone (ha)			0.295	0.323	4.249	1.978	1.816	0.024	2.752	0.756	0.441	1.015	0.891	0.044	0.221
Site Condition	Large Old Trees	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lack of Weeds	/15	2	2	9	6	6	2	0	0	0	4	2	6	9
	Understorey	/25	5	5	10	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	0	0	0	0	0	0	0	0	0	0	0	3	0
	Organic Matter	/5	3	3	3	0	0	2	2	2	2	2	3	0	2
	Logs	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	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
	Site Condition subtotal		*14*	*14*	*30*	*15*	*15*	*12*	*10*	*10*	*10*	*15*	*14*	*19*	*22*
Landscape Context	Patch Size	/10	1	1	2	1	1	1	2	1	1	1	1	1	1
	Neighbourhood	/10	0	0	1	1	1	0	1	1	1	1	0	0	0
	Distance to Core	/5	1	1	0	0	0	0	1	1	1	1	0	0	0
Total Condition Score		**/100**	**16**	**16**	**33**	**17**	**17**	**13**	**14**	**13**	**13**	**18**	**15**	**20**	**23**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			AU	AV	AVV	AX	DB	DD	DC	DK	DP	DL	E	K	AAA
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	125	125	125	125	125	125	125	125	125	125	125	649
Total area of Habitat Zone (ha)			0.907	2.813	1.691	0.362	0.106	0.025	0.750	0.104	0.122	0.464	0.462	1.502	0.244
Site Condition	Large Old Trees	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
	Lack of Weeds	/15	4	6	6	2	4	4	9	2	2	4	6	6	6
	Understorey	/25	15	5	5	10	10	10	15	5	5	10	15	10	5
	Recruitment	/10	0	0	0	0	3	3	6	3	3	6	0	0	0
	Organic Matter	/5	5	0	0	0	5	5	3	2	2	2	3	2	0
	Logs	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	1.15
	Site Condition subtotal		*33*	*15*	*15*	*16*	*30*	*30*	*45*	*16*	*16*	*30*	*33*	*24*	*13*
Landscape Context	Patch Size	/10	1	2	2	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	1	1
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		/100	34	17	17	17	31	31	46	17	17	31	34	26	15

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			AO	AQ	DI	DJ	EA	CG	CH	DR	DQ	DRR	AW	CA2	AY
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			821	125	649	649	649	649	649	125	125	125	125	132_61	132_61
Total area of Habitat Zone (ha)			0.194	0.443	0.006	0.006	0.720	0.102	0.072	2.376	3.196	2.229	0.528	0.108	0.031
Site Condition	Large Old Trees	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Lack of Weeds	/15	9	2	4	4	9	6	6	4	4	4	7	6	4
	Understorey	/25	5	5	5	5	5	5	5	10	10	10	5	5	5
	Recruitment	/10	0	0	5	5	6	0	0	3	3	3	3	0	6
	Organic Matter	/5	0	2	2	2	0	2	2	3	3	3	0	2	2
	Logs	/5	N/A	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
	Site condition standardising multiplier*		1.36	1.36	1.36	1.36	1.15	1.15	1.15	1.36	1.36	1.36	1.36	1.36	1.36
	Site Condition subtotal		*19*	*12*	*22*	*22*	*23*	*15*	*15*	*27*	*27*	*27*	*20*	*18*	*23*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	2	2	2	1	1	1
	Neighbourhood	/10	0	0	0	0	1	1	1	1	1	1	0	1	1
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	3	1	1
Total Condition Score		**/100**	**20**	**13**	**23**	**23**	**25**	**17**	**17**	**30**	**30**	**30**	**24**	**21**	**26**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			AZ	DA	CB	CC	CF	DE	DF	BA	BB	BC	BE	BF	BG
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	125	125	125	132_61	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.018	0.027	0.094	0.099	0.039	0.256	0.253	0.245	0.159	0.035	0.025	0.026	0.022
Site Condition	Large Old Trees	/10	N/A	N/A	N/A	N/A	N/A	0	0	9	9	9	9	9	9
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	N/A	2	2	4	N/A	N/A	N/A	N/A	N/A
	Lack of Weeds	/15	0	0	0	0	2	0	0	0	0	0	0	0	0
	Understorey	/25	5	5	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	3	3	3	3	0	0	0	3	3	3	3	3	3
	Organic Matter	/5	3	3	4	4	4	4	4	2	3	3	3	3	3
	Logs	/5	N/A	N/A	N/A	N/A	N/A	0	0	5	5	0	0	0	0
	Site condition standardising multiplier*		1.36	1.36	1.36	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition subtotal		*15*	*15*	*16*	*16*	*15*	*11*	*11*	*28*	*25*	*20*	*20*	*20*	*20*
Landscape Context	Patch Size	/10	1	1	2	2	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	1	1	0	1	1	0	0	0	0	0	0
	Distance to Core	/5	0	0	1	1	1	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**16**	**16**	**20**	**20**	**17**	**13**	**13**	**29**	**26**	**21**	**21**	**21**	**21**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Nature Advisory

Habitat Zone			BI	BJ	BL	BQ	BD	BH	BK	BM	BN	BO	BP	BR	BS
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.025	0.055	0.038	0.121	0.069	0.017	0.027	0.016	0.020	0.017	0.041	0.066	0.133
Site Condition	Large Old Trees	/10	0	9	0	5	9	0	0	0	0	0	10	9	9
	Tree Canopy Cover	/5	N/A	N/A	N/A	N/A	0	0	0	0	0	3	5	2	2
	Lack of Weeds	/15	0	0	0	0	0	0	0	0	4	4	7	0	0
	Understorey	/25	5	5	5	5	5	5	5	5	5	0	5	5	5
	Recruitment	/10	3	3	3	3	3	5	5	5	0	0	0	5	5
	Organic Matter	/5	3	3	3	3	2	2	2	2	2	2	3	2	2
	Logs	/5	0	0	0	5	0	0	0	0	0	0	4	4	5
	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
	Site Condition subtotal		*11*	*20*	*11*	*21*	*19*	*12*	*12*	*12*	*11*	*9*	*34*	*27*	*28*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**12**	**21**	**12**	**22**	**20**	**13**	**13**	**13**	**12**	**10**	**35**	**28**	**29**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			BV	BY	CF	CG	CD	CE	BT	BU	BW	BX	CA1	CC	CL
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.041	0.020	0.039	0.102	0.282	0.052	0.076	0.058	0.057	0.036	0.063	0.099	0.088
Site Condition	Large Old Trees	/10	9	0	0	0	0	0	0	9	9	9	9	9	0
	Tree Canopy Cover	/5	2	2	2	2	0	0	2	2	2	2	0	0	0
	Lack of Weeds	/15	0	0	0	0	0	0	0	0	0	0	0	0	0
	Understorey	/25	5	5	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	5	5	5	5	5	5	3	3	3	3	3	3	3
	Organic Matter	/5	2	2	2	2	2	2	2	2	2	2	2	2	2
	Logs	/5	4	0	0	0	0	0	4	5	5	0	2	4	2
	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
	Site Condition subtotal		*27*	*14*	*14*	*14*	*12*	*12*	*16*	*26*	*26*	*21*	*21*	*23*	*12*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**28**	**15**	**15**	**15**	**13**	**13**	**17**	**27**	**27**	**22**	**22**	**24**	**13**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			CK	CH	CI	CJ	CM	CN	CO	CR	CS	CB	BZ	CP	CT
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.224	0.072	0.048	0.143	0.121	0.197	0.291	0.076	0.039	0.094	0.180	0.154	0.094
Site Condition	Large Old Trees	/10	3	0	0	0	0	0	4	0	0	9	7	0	10
	Tree Canopy Cover	/5	2	0	0	0	0	2	3	2	2	3	3	0	5
	Lack of Weeds	/15	0	0	0	0	0	0	0	0	0	0	0	7	0
	Understorey	/25	5	5	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	3	3	3	3	3	3	3	3	3	3	3	3	3
	Organic Matter	/5	2	2	2	2	2	2	2	2	2	2	2	3	2
	Logs	/5	5	0	0	2	4	0	2	2	0	4	2	0	2
	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
	Site Condition subtotal		*20*	*10*	*10*	*12*	*14*	*12*	*19*	*14*	*12*	*26*	*22*	*18*	*27*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	0	0	0	0	0	0	0	0
	Distance to Core	/5	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Condition Score		**/100**	**21**	**11**	**11**	**13**	**15**	**13**	**20**	**15**	**13**	**27**	**23**	**19**	**28**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			CU	CV	CW	14144A	14144J	14144K	10	CQ	CX	CY	CZ	DG	DG1
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	55_63	649	649	649	642	55_63	649	649	649	55_63	55_63
Total area of Habitat Zone (ha)			0.226	0.053	0.327	0.041	0.022	0.008	0.050	0.101	0.099	0.057	0.090	0.308	0.177
Site Condition	Large Old Trees	/10	10	0	8	N/A	N/A	N/A							
	Tree Canopy Cover	/5	5	0	5	N/A	N/A	N/A							
	Lack of Weeds	/15	0	0	0	4	4	4							
	Understorey	/25	5	5	5	5	5	5							
	Recruitment	/10	3	3	10	3	3	3							
	Organic Matter	/5	2	2	2	5	5	5				Not Available			
	Logs	/5	2	0	0	N/A	N/A	N/A							
	Site condition standardising multiplier*		1.00	1.00	1.00	1.36	1.36	1.36							
	Site Condition subtotal		*27*	*10*	*30*	*23*	*23*	*23*							
Landscape Context	Patch Size	/10	1	1	1	1	1	1							
	Neighbourhood	/10	0	0	0	0	0	0							
	Distance to Core	/5	0	0	0	1	1	1							
Total Condition Score		**/100**	**28**	**11**	**31**	**25**	**25**	**25**				**25**		**13**	**13**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			DG10	DG11	DG12	DG13	DG14	DG15	DG16	DG17	DG18	DG2	DG3	DG4	DG5
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.025	0.615	0.018	0.011	0.068	0.041	0.035	0.032	0.014	0.041	0.038	0.037	0.067
Site Condition	Large Old Trees	/10													
	Tree Canopy Cover	/5													
	Lack of Weeds	/15													
	Understorey	/25													
	Recruitment	/10													
	Organic Matter	/5							Not available						
	Logs	/5													
	Site condition standardising multiplier*														
	Site Condition subtotal														
Landscape Context	Patch Size	/10													
	Neighbourhood	/10													
	Distance to Core	/5													
Total Condition Score		**/100**		13											

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			DG6	DG7	DG8	DG9	DM	DN	DO	DS	DT	DU	DV	EB	EC
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	55_63	55_63	649	649	649	125	125	125	125	649	649
Total area of Habitat Zone (ha)			0.065	0.039	0.024	0.421	0.018	0.029	0.034	0.953	0.240	0.030	0.039	0.070	0.189
Site Condition	Large Old Trees	/10	Not available												
	Tree Canopy Cover	/5													
	Lack of Weeds	/15													
	Understorey	/25													
	Recruitment	/10													
	Organic Matter	/5													
	Logs	/5													
	Site condition standardising multiplier*														
	Site Condition subtotal														
Landscape Context	Patch Size	/10													
	Neighbourhood	/10													
	Distance to Core	/5													
Total Condition Score		**/100**								30					25

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			ED	EE	EF	EG	EH	EI	EJ	EK	EL	EM	FA	FB	FC
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			125	125	649	125	649	125	649	649	649	649	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.529	0.207	0.276	0.071	0.394	0.078	0.036	0.070	0.058	0.002	0.009	0.006	0.006
Site Condition	Large Old Trees	/10	Not available												
	Tree Canopy Cover	/5													
	Lack of Weeds	/15													
	Understorey	/25													
	Recruitment	/10													
	Organic Matter	/5													
	Logs	/5													
	Site condition standardising multiplier*														
	Site Condition subtotal														
Landscape Context	Patch Size	/10													
	Neighbourhood	/10													
	Distance to Core	/5													
Total Condition Score		**/100**	**25**												

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Habitat Zone			FD	FE	GA	GB	HH	XAF	XAG	XAH	XAI	XAJ	XAK	XAL	XAM
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			55_63	55_63	821	821	83	642	642	642	642	642	642	821	642
Total area of Habitat Zone (ha)			0.043	0.010	0.256	0.965	0.066	0.053	0.126	0.272	0.031	0.204	0.077	0.101	0.150
Site Condition	Large Old Trees	/10	Not available												
	Tree Canopy Cover	/5													
	Lack of Weeds	/15													
	Understorey	/25													
	Recruitment	/10													
	Organic Matter	/5													
	Logs	/5													
	Site condition standardising multiplier*														
	Site Condition subtotal														
Landscape Context	Patch Size	/10													
	Neighbourhood	/10													
	Distance to Core	/5													
Total Condition Score		**/100**					10								

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Over-dimensional (OD) route

Habitat Zone			1TrAA	1TrAB	1TrAC	1TrAD	1TrAE	1TrAF	1TrAG	1TrAH	1TrAI	1TrAJ	1TrAK	A	B	C	D	E
Bioregion			VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP
EVC Number			23	23	23	23	23	23	23	821	653	203	642	55_63	55_63	55_63	55_63	55_63
Total area of Habitat Zone (ha)			0.032	0.014	0.018	0.010	0.016	0.026	0.003	0.008	0.018	0.012	0.011	0.078	0.037	0.188	0.065	0.025
Site Condition	Large Old Trees	/10	0	0	0	0	0	0	0	N/A	N/A	0	0	0	0	0	0	0
	Tree Canopy Cover	/5	2	0	0	0	0	3	0	N/A	N/A	0	0	0	0	0	0	0
	Lack of Weeds	/15	0	4	0	0	0	0	0	7	7	0	0	0	0	0	0	0
	Understorey	/25	5	5	5	5	5	5	15	15	15	5	5	5	5	5	5	5
	Recruitment	/10	0	0	0	0	5	5	6	0	0	5	0	0	0	0	0	0
	Organic Matter	/5	5	5	5	5	2	5	5	3	5	2	2	4	4	4	4	4
	Logs	/5	0	0	0	0	0	0	0	N/A	N/A	0	0	5	5	5	5	5
	Site condition standardising multiplier*		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Site Condition subtotal		*12*	*14*	*10*	*10*	*12*	*18*	*26*	*34*	*37*	*12*	*7*	*14*	*14*	*14*	*14*	*14*
Landscape Context	Patch Size	/10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Neighbourhood	/10	0	0	0	0	0	1	1	3	3	3	0	0	0	0	0	0
	Distance to Core	/5	1	1	1	1	1	3	3	1	1	1	0	0	0	0	0	0
Total Condition Score		**/100**	**14**	**16**	**12**	**12**	**14**	**23**	**31**	**39**	**42**	**17**	**8**	**15**	**15**	**15**	**15**	**15**

* Modified approach to habitat scoring - refer to Table 14 of DELWP's Vegetation Quality Assessment Manual (DSE, 2004)

Appendix 4: Scattered trees recorded in the study area (some data derived from EHP 2018)

Tree No.	Common Name	Scientific Name	DBH (cm)	Habitat Category	Radius of TPZ (m)
1	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	61	Small scattered tree	7.32
2	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	70	Large scattered tree	8.4
3	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	85	Large scattered tree	10.2
4	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	75	Large scattered tree	9
5	Stag	*Eucalyptus* sp.	50	Small scattered tree	6
6	Stag	*Eucalyptus* sp.	50	Small scattered tree	6
7	Stag	*Eucalyptus* sp.	55	Small scattered tree	6.6
8	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	75	Large scattered tree	9
9	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	115	Large scattered tree	13.8
10	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	100	Large scattered tree	12
11	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	50	Small scattered tree	6
12	Stag	*Eucalyptus* sp.	43	Small scattered tree	5.16
13	Stag	*Eucalyptus* sp.	45	Small scattered tree	5.4
14	Stag	*Eucalyptus* sp.	110	Large scattered tree	13.2
15	Stag	*Eucalyptus* sp.	49	Small scattered tree	5.88
16	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	80	Large scattered tree	9.6
17	Stag	*Eucalyptus* sp.	42	Small scattered tree	5.04
18	Stag	*Eucalyptus* sp.	55	Small scattered tree	6.6
19	Stag	*Eucalyptus* sp.	98	Large scattered tree	11.76
20	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	80	Large scattered tree	9.6
21	Stag	*Eucalyptus* sp.	70	Large scattered tree	8.4
22	Stag	*Eucalyptus* sp.	67	Small scattered tree	8.04
23	Stag	*Eucalyptus* sp.	80	Large scattered tree	9.6
24	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	92	Large scattered tree	11.04
25	Stag	*Eucalyptus* sp.	47	Small scattered tree	5.64
26	Stag	*Eucalyptus* sp.	66	Small scattered tree	7.92
27	Stag	*Eucalyptus* sp.	58	Small scattered tree	6.96
28	Stag	*Eucalyptus* sp.	42	Small scattered tree	5.04
29	Stag	*Eucalyptus* sp.	43	Small scattered tree	5.16
30	Stag	*Eucalyptus* sp.	50	Small scattered tree	6
31	Stag	*Eucalyptus* sp.	46	Small scattered tree	5.52
32	Stag	*Eucalyptus* sp.	110	Large scattered tree	13.2
33	Stag	*Eucalyptus* sp.	60	Small scattered tree	7.2

Tree No.	Common Name	Scientific Name	DBH (cm)	Habitat Category	Radius of TPZ (m)
34	Stag	*Eucalyptus* sp.	80	Large scattered tree	9.6
35	Stag	*Eucalyptus* sp.	66	Small scattered tree	7.92
36	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	65	Small scattered tree	7.8
37	Stag	*Eucalyptus* sp.	51	Small scattered tree	6.12
38	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	72	Large scattered tree	8.64
39	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	85	Large scattered tree	10.2
40	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	77	Large scattered tree	9.24
41	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	80	Large scattered tree	9.6
42	Stag	*Eucalyptus* sp.	50	Small scattered tree	6
43	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	110	Large scattered tree	13.2
44	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	140	Large scattered tree	15
45	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	130	Large scattered tree	15
46	Stag	*Eucalyptus* sp.	50	Small scattered tree	6
47	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	80	Large scattered tree	9.6
48	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	70	Large scattered tree	8.4
49	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	90	Large scattered tree	10.8
50	Stag	*Eucalyptus* sp.	60	Small scattered tree	7.2
51	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	170	Large scattered tree	15
52	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	120	Large scattered tree	14.4
53	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	90	Large scattered tree	10.8
54	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	87	Large scattered tree	10.44
55	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	76	Large scattered tree	9.12
56	Stag	*Eucalyptus* sp.	70	Large scattered tree	8.4
57	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	100	Large scattered tree	12
58	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	79	Large scattered tree	9.48
59	Stag	*Eucalyptus* sp.	68	Small scattered tree	8.16
60	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	120	Large scattered tree	14.4
61	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	88	Large scattered tree	10.56
62	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	90	Large scattered tree	10.8
63	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	70	Large scattered tree	8.4
64	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	95	Large scattered tree	11.4
65	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	125	Large scattered tree	15
66	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	69	Small scattered tree	8.28
67	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	76	Large scattered tree	9.12

Tree No.	Common Name	Scientific Name	DBH (cm)	Habitat Category	Radius of TPZ (m)
68	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	130	Large scattered tree	15
69	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	89	Large scattered tree	10.68
70	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	120	Large scattered tree	14.4
71	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	89	Large scattered tree	10.68
72	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	100	Large scattered tree	12
73	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	110	Large scattered tree	13.2
74	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	90	Large scattered tree	10.8
75	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	87	Large scattered tree	10.44
76	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	77	Large scattered tree	9.24
77	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	113	Large scattered tree	13.56
78	Stag	*Eucalyptus* sp.	70	Large scattered tree	8.4
79	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	105	Large scattered tree	12.6
80	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	68	Small scattered tree	8.16
81	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	70	Large scattered tree	8.4
82	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	120	Large scattered tree	14.4
83	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	187	Large scattered tree	15
84	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	90	Large scattered tree	10.8
85	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	90	Large scattered tree	10.8
86	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	77	Large scattered tree	9.24
87	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	75	Large scattered tree	9
88	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	80	Large scattered tree	9.6
89	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	69	Small scattered tree	8.28
90	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	80	Large scattered tree	9.6
91	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	95	Large scattered tree	11.4
92	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	98	Large scattered tree	11.76
93	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	68	Small scattered tree	8.16
94	Manna Gum	*Eucalyptus viminalis* subsp. *viminalis*	78	Large scattered tree	9.36
95	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	70	Large scattered tree	8.4
96	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	58	Small scattered tree	6.96
97	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	76	Large scattered tree	9.12
98	River red-gum	*Eucalyptus camaldulensis* subsp. *camaldulensis*	56	Small scattered tree	6.72
99	Bog Gum	*Eucalyptus kitsoniana*	62	Small scattered tree	7.44
100	Swamp Gum	*Eucalyptus ovata* subsp. *ovata*	88	Large tree in patch	10.56
101	Swamp Gum	*Eucalyptus ovata* subsp. *ovata*	88	Large tree in patch	10.56

Tree No.	Common Name	Scientific Name	DBH (cm)	Habitat Category	Radius of TPZ (m)
102	Blackwood	*Acacia melanoxylon*	37	Small scattered tree	4.44
103	Blackwood	*Acacia melanoxylon*	69	Large scattered tree	8.28
104	Blackwood	*Acacia melanoxylon*	27	Small scattered tree	3.24
105	Blackwood	*Acacia melanoxylon*	30	Small scattered tree	3.6
106	Blackwood	*Acacia melanoxylon*	15	Small scattered tree	2
107	Blackwood	*Acacia melanoxylon*	25	Small scattered tree	3
108	Blackwood	*Acacia melanoxylon*	23	Small scattered tree	2.76
109	Blackwood	*Acacia melanoxylon*	38	Small scattered tree	4.56
110	Blackwood	*Acacia melanoxylon*	20	Small scattered tree	2.4
111	Blackwood	*Acacia melanoxylon*	12	Small scattered tree	2
112	Blackwood	*Acacia melanoxylon*	43	Large scattered tree	5.16
113	Blackwood	*Acacia melanoxylon*	35	Small scattered tree	4.2
114	Blackwood	*Acacia melanoxylon*	25	Small scattered tree	3
115	Blackwood	*Acacia melanoxylon*	15	Small scattered tree	2
116	Blackwood	*Acacia melanoxylon*	60	Large scattered tree	7.2
117	Blackwood	*Acacia melanoxylon*	27	Small scattered tree	3.24
118	Blackwood	*Acacia melanoxylon*	30	Small scattered tree	3.6
119	Blackwood	*Acacia melanoxylon*	25	Small scattered tree	3
120	Blackwood	*Acacia melanoxylon*	35	Small scattered tree	4.2
121	Blackwood	*Acacia melanoxylon*	23	Small scattered tree	2.76
122	Blackwood	*Acacia melanoxylon*	13	Small scattered tree	2
123	Blackwood	*Acacia melanoxylon*	15	Small scattered tree	2
124	Blackwood	*Acacia melanoxylon*	23	Small scattered tree	2.76
125	Blackwood	*Acacia melanoxylon*	45	Large scattered tree	5.4
126	Blackwood	*Acacia melanoxylon*	20	Small scattered tree	2.4
127	Blackwood	*Acacia melanoxylon*	20	Small scattered tree	2.4
128	Blackwood	*Acacia melanoxylon*	30	Small scattered tree	3.6
129	Blackwood	*Acacia melanoxylon*	23	Small scattered tree	2.76
130	Blackwood	*Acacia melanoxylon*	18	Small scattered tree	2.16
131	Blackwood	*Acacia melanoxylon*	40	Large scattered tree	4.8
132	Blackwood	*Acacia melanoxylon*	25	Small scattered tree	3
133	Blackwood	*Acacia melanoxylon*	38	Small scattered tree	4.56
134	Blackwood	*Acacia melanoxylon*	35	Small scattered tree	4.2
135	Blackwood	*Acacia melanoxylon*	15	Small scattered tree	2

Tree No.	Common Name	Scientific Name	DBH (cm)	Habitat Category	Radius of TPZ (m)
136	Blackwood	*Acacia melanoxylon*	45	Large scattered tree	5.4
137	Blackwood	*Acacia melanoxylon*	50	Large scattered tree	6
138	Blackwood	*Acacia melanoxylon*	60	Large scattered tree	7.2
139	Blackwood	*Acacia melanoxylon*	50	Large scattered tree	6
140	Blackwood	*Acacia melanoxylon*	30	Small scattered tree	3.6

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;

Directional drilling within its TRZ occurs at less than 600 millimeters below the surface, or is not confirmed to be appropriate (including considerations concerning bore hole width) by a qualified arborist; or

Lopping removes more than 1/3 of its crown.

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

Appendix 5: Native vegetation removal report (NVR – Moyne Shire)

Native vegetation removal 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: 26/04/2022
Time of issue: 8:40 am

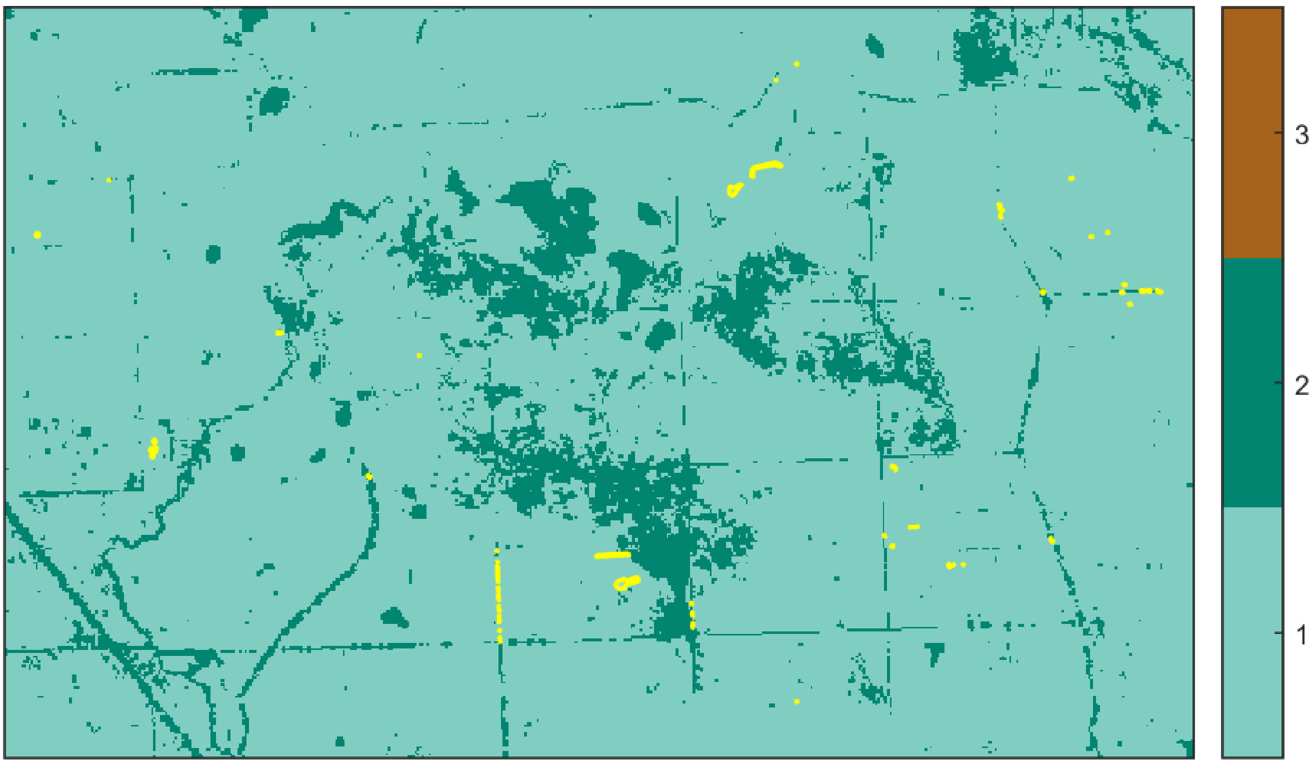
Report ID: NAA_2022_061

Project ID	16087_Willatook_Wind_Farm_Impact_and_ODRoute_v80_001_Moyne_220421

Assessment pathway

Assessment pathway	**Detailed Assessment Pathway**
Extent including past and proposed	4.572 ha
Extent of past removal	0.000 ha
Extent of proposed removal	4.572 ha
No. Large trees proposed to be removed	6
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[1]	1.207 general habitat units
Vicinity	Glenelg Hopkins Catchment Management Authority (CMA) or Moyne Shire Council
Minimum strategic biodiversity value score[2]	0.312
Large trees	6 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

1 The general offset amount required is the sum of all general habitat units in Appendix 1.

2 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
- 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.

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							Information calculated by EnSym					
Zone	Type	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-PGWe1	Patch	vvp_0125	Endangered	0	no	0.180	0.002	0.002	0.430		0.000	General
1-PGWe3	Patch	vvp_0125	Endangered	0	no	0.180	0.015	0.015	0.630		0.003	General
1-PG1	Patch	vvp_0132_61	Endangered	0	no	0.240	0.022	0.022	0.630		0.006	General
1-SKS1a	Patch	vvp_0649	Endangered	0	no	0.200	0.032	0.032	0.639		0.008	General
1-SKS1b	Patch	vvp_0649	Endangered	0	no	0.200	0.003	0.003	0.450		0.001	General

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	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-SKS 1c	Patch	vvp_0649	Endangered	0	no	0.200	0.004	0.004	0.290		0.001	General
1-AA	Patch	vvp_0125	Endangered	0	no	0.160	0.031	0.031	0.410		0.005	General
1-AF	Patch	vvp_0125	Endangered	0	no	0.160	0.024	0.024	0.730		0.005	General
1-BZ	Patch	vvp_0055_63	Endangered	0	no	0.230	0.012	0.012	0.300		0.003	General
1-CA1	Patch	vvp_0055_63	Endangered	0	no	0.220	0.020	0.020	0.300		0.004	General
1-CB	Patch	vvp_0055_63	Endangered	0	no	0.200	0.014	0.014	0.320		0.003	General
1-CG	Patch	vvp_0055_63	Endangered	0	no	0.170	0.020	0.020	0.410		0.004	General
1-DR	Patch	vvp_0125	Endangered	0	no	0.300	0.017	0.017	0.270		0.005	General
1-CN	Patch	vvp_0649	Endangered	0	no	0.130	0.010	0.010	0.280		0.001	General
1-DS	Patch	vvp_0125	Endangered	0	no	0.300	0.006	0.006	0.317		0.002	General
1-CX	Patch	vvp_0649	Endangered	0	no	0.250	0.019	0.019	0.300		0.005	General
1-CY	Patch	vvp_0649	Endangered	0	no	0.250	0.023	0.023	0.300		0.006	General
1-EC	Patch	vvp_0649	Endangered	0	no	0.250	0.034	0.034	0.330		0.008	General
1-EA	Patch	vvp_0649	Endangered	0	no	0.250	0.016	0.016	0.290		0.004	General
1-ED	Patch	vvp_0649	Endangered	0	no	0.250	0.054	0.054	0.330		0.013	General
1-DRR	Patch	vvp_0125	Endangered	0	no	0.300	0.003	0.003	0.360		0.001	General
1-XAO	Patch	vvp_0125	Endangered	0	no	0.550	0.250	0.250	0.458		0.150	General
1-XBJ	Patch	vvp_0642	Endangered	0	no	0.300	0.001	0.001	0.320		0.000	General

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	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-XBL	Patch	vvp_0649	Endangered	0	no	0.200	0.497	0.497	0.353		0.101	General
1-XAD	Patch	vvp_0642	Endangered	0	no	0.280	0.024	0.024	0.120		0.006	General
1-XAE	Patch	vvp_0642	Endangered	0	no	0.240	0.028	0.028	0.120		0.006	General
1-XAN1	Patch	vvp_0642	Endangered	0	no	0.210	0.080	0.080	0.530		0.019	General
1-HH	Patch	vvp_0083	Endangered	0	no	0.100	0.066	0.066	0.440		0.007	General
1-LA	Patch	vvp_0642	Endangered	0	no	0.130	0.002	0.002	0.450		0.000	General
1-LB	Patch	vvp_0642	Endangered	0	no	0.130	0.002	0.002	0.410		0.000	General
1-LC	Patch	vvp_0642	Endangered	0	no	0.130	0.016	0.016	0.410		0.002	General
1-LE	Patch	vvp_0642	Endangered	0	no	0.130	0.076	0.076	0.410		0.010	General
1-LF	Patch	vvp_0642	Endangered	0	no	0.130	0.005	0.005	0.439		0.001	General
1-LG	Patch	vvp_0642	Endangered	0	no	0.130	0.022	0.022	0.440		0.003	General
1-LI	Patch	vvp_0642	Endangered	0	no	0.130	0.042	0.042	0.440		0.006	General
1-LJ	Patch	vvp_0642	Endangered	0	no	0.130	0.022	0.022	0.420		0.003	General
1-LK	Patch	vvp_0642	Endangered	0	no	0.130	0.003	0.003	0.420		0.000	General
1-LO	Patch	vvp_0642	Endangered	0	no	0.130	0.008	0.008	0.390		0.001	General
1-LL	Patch	vvp_0642	Endangered	0	no	0.130	0.020	0.020	0.390		0.003	General
1-72	Patch	vvp_0125	Endangered	0	no	0.160	0.012	0.012	0.450		0.002	General
1-14144A	Patch	vvp_0649	Endangered	0	no	0.250	0.040	0.040	0.390		0.010	General

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	BioEVC	BioEVC conservation status	Large tree(s)	Partial removal	Condition score	Polygon Extent	Extent without overlap	SBV score	HI score	Habitat units	Offset type
1-1414 4J	Patch	vvp_0649	Endangered	0	no	0.250	0.005	0.005	0.200		0.001	General
1-LM	Patch	vvp_0642	Endangered	0	no	0.130	0.042	0.042	0.420		0.006	General
1-XBM 2	Patch	vvp_0125	Endangered	0	no	0.370	0.231	0.231	0.326		0.085	General
1-XBM 1	Patch	vvp_0125	Endangered	0	no	0.370	0.693	0.693	0.350		0.260	General
1-XAN 2	Patch	vvp_0642	Endangered	0	no	0.210	1.347	1.347	0.439		0.305	General
1-XAN 3	Patch	vvp_0642	Endangered	0	no	0.210	0.131	0.131	0.410		0.029	General
1-1414 4K1	Patch	vvp_0649	Endangered	0	no	0.250	0.000	0.000	0.390		0.000	General
1-1414 4K2	Patch	vvp_0649	Endangered	0	no	0.250	0.000	0.000	0.390		0.000	General
1-XBA 2	Patch	vvp_0642	Endangered	0	no	0.170	0.019	0.019	0.370		0.003	General
1-XBA 1	Patch	vvp_0642	Endangered	0	no	0.170	0.019	0.019	0.370		0.003	General
1-CC2	Patch	vvp_0055_63	Endangered	0	no	0.200	0.002	0.002	0.300		0.000	General
1-CC1	Patch	vvp_0055_63	Endangered	0	no	0.200	0.015	0.015	0.300		0.003	General

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	Type	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-AD2	Patch	vvp_0125	Endangered	0	no	0.160	0.030	0.030	0.450		0.005	General
1-AD1	Patch	vvp_0125	Endangered	0	no	0.160	0.000	0.000	0.450		0.000	General
1-E	Patch	vvp_0055_61	Endangered	0	no	0.150	0.005	0.005	0.470		0.001	General
1-A	Patch	vvp_0055_61	Endangered	0	no	0.150	0.001	0.001	0.260		0.000	General
1-132	Scattered Tree	vvp_0055_63	Endangered	1	no	0.200	0.070	0.070	0.321		0.014	General
1-137	Scattered Tree	vvp_0055_63	Endangered	1	no	0.200	0.070	0.070	0.280		0.014	General
1-138	Scattered Tree	vvp_0055_63	Endangered	1	no	0.200	0.070	0.070	0.280		0.014	General
1-139	Scattered Tree	vvp_0055_63	Endangered	1	no	0.200	0.070	0.062	0.280		0.012	General
1-140	Scattered Tree	vvp_0055_63	Endangered	1	no	0.200	0.070	0.062	0.280		0.012	General
1-142	Scattered Tree	vvp_0055_63	Endangered	1	no	0.200	0.070	0.070	0.280		0.014	General
1-170	Scattered Tree	vvp_0055_63	Endangered	0	no	0.200	0.031	0.031	0.430		0.007	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	0.0001
Lacey River Buttercup	*Ranunculus amplus*	505019	Rare	Dispersed	Habitat importance map	0.0001
Showy Lobelia	*Lobelia beaugleholei*	502733	Rare	Dispersed	Habitat importance map	0.0000
Squat Picris	*Picris squarrosa*	504827	Rare	Dispersed	Habitat importance map	0.0000
Swamp Everlasting	*Xerochrysum palustre*	503763	Vulnerable	Dispersed	Habitat importance map	0.0000
Wavy Swamp Wallaby-grass	*Amphibromus sinuatus*	503625	Vulnerable	Dispersed	Habitat importance map	0.0000
Plains Yam-daisy	*Microseris scapigera s.s.*	504657	Vulnerable	Dispersed	Habitat importance map	0.0000
Bog Gum	*Eucalyptus kitsoniana*	501290	Rare	Dispersed	Habitat importance map	0.0000
Dense Leek-orchid	*Prasophyllum spicatum*	504506	Endangered	Dispersed	Habitat importance map	0.0000
Small Sickle Greenhood	*Pterostylis lustra*	504876	Endangered	Dispersed	Habitat importance map	0.0000
Swamp Flax-lily	*Dianella callicarpa*	505086	Rare	Dispersed	Habitat importance map	0.0000
Purple Blown-grass	*Lachnagrostis punicea subsp. punicea*	504206	Rare	Dispersed	Habitat importance map	0.0000
Blotched Sun-orchid	*Thelymitra benthamiana*	503369	Vulnerable	Dispersed	Habitat importance map	0.0000
Leafy Twig-sedge	*Cladium procerum*	500786	Rare	Dispersed	Habitat importance map	0.0000
Swamp Fireweed	*Senecio psilocarpus*	504659	Vulnerable	Dispersed	Habitat importance map	0.0000
Parsley Xanthosia	*Xanthosia leiophylla*	504562	Rare	Dispersed	Habitat importance map	0.0000
Western Peppermint	*Eucalyptus falciformis*	505358	Rare	Dispersed	Habitat importance map	0.0000
Purple Blown-grass	*Lachnagrostis punicea subsp. filifolia*	504222	Rare	Dispersed	Habitat importance map	0.0000
Western Golden-tip	*Goodia medicaginea*	501518	Rare	Dispersed	Habitat importance map	0.0000

Pale Swamp Everlasting	*Coronidium gunnianum*	504655	Vulnerable	Dispersed	Habitat importance map	0.0000
One-flower Early Nancy	*Wurmbea uniflora*	503583	Rare	Dispersed	Habitat importance map	0.0000
Dwarf Brooklime	*Gratiola pumilo*	503753	Rare	Dispersed	Habitat importance map	0.0000
Golden Cowslips	*Diuris behrii*	501061	Vulnerable	Dispersed	Habitat importance map	0.0000
Clover Glycine	*Glycine latrobeana*	501456	Vulnerable	Dispersed	Habitat importance map	0.0000
Southern Bent-wing Bat	*Miniopterus schreibersii bassanii*	61343	Critically endangered	Dispersed	Habitat importance map	0.0000
Black Falcon	*Falco subniger*	10238	Vulnerable	Dispersed	Habitat importance map	0.0000
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*	10220	Vulnerable	Dispersed	Habitat importance map	0.0000

Habitat group

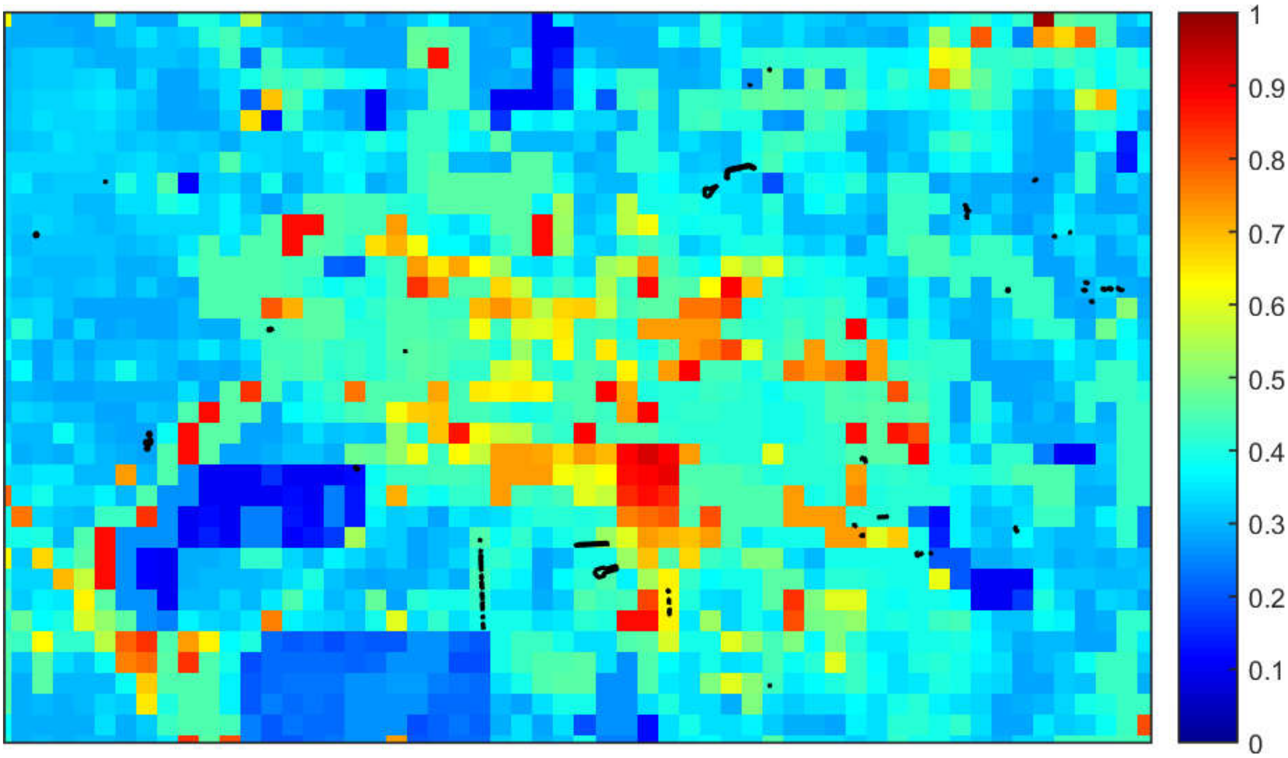
- Highly localised habitat means there is 2000 hectares or less mapped habitat for the species
- Dispersed habitat means there is more than 2000 hectares of mapped habitat for the species

Habitat impacted

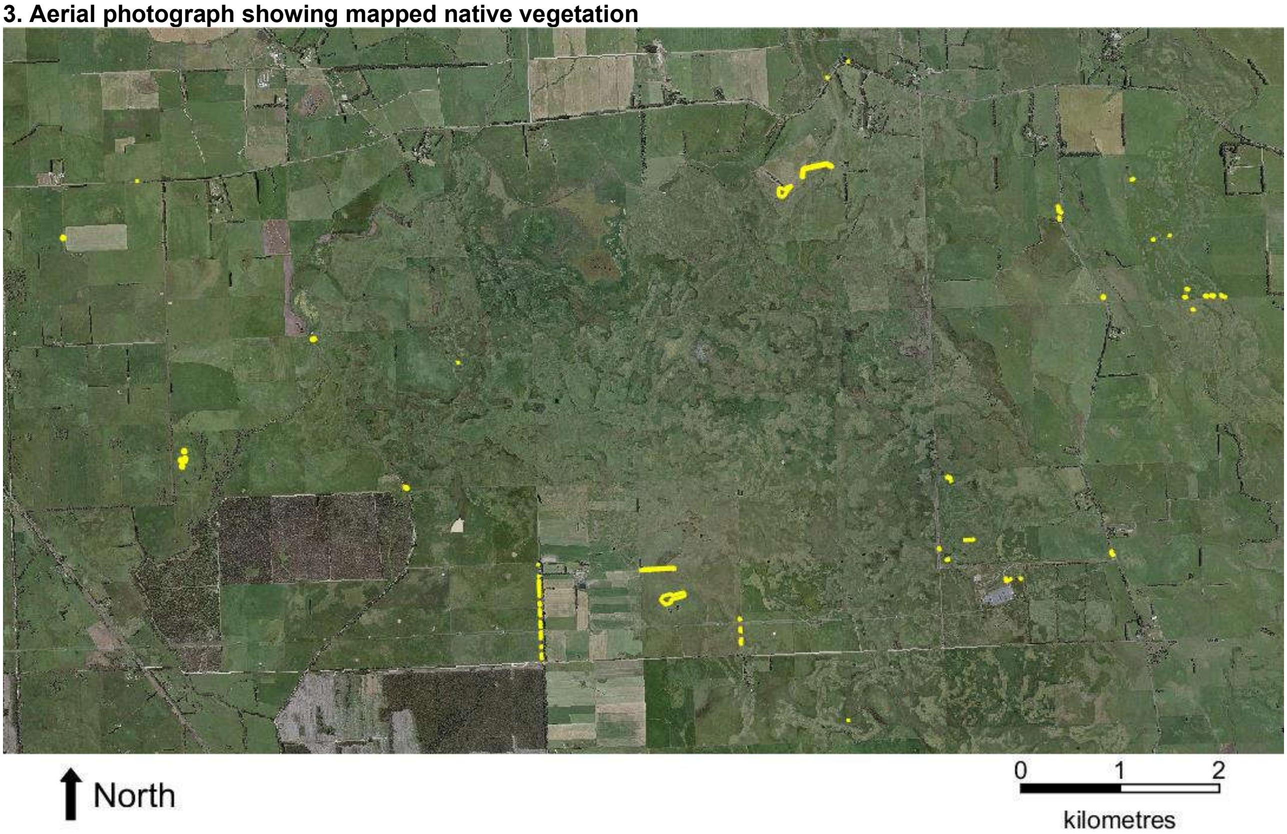
- Habitat importance maps are the maps defined in the Guidelines that include all the mapped habitat for a rare or threatened species
- Top ranking maps are the maps defined in the Guidelines that depict the important areas of a dispersed species habitat, developed from the highest habitat importance 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

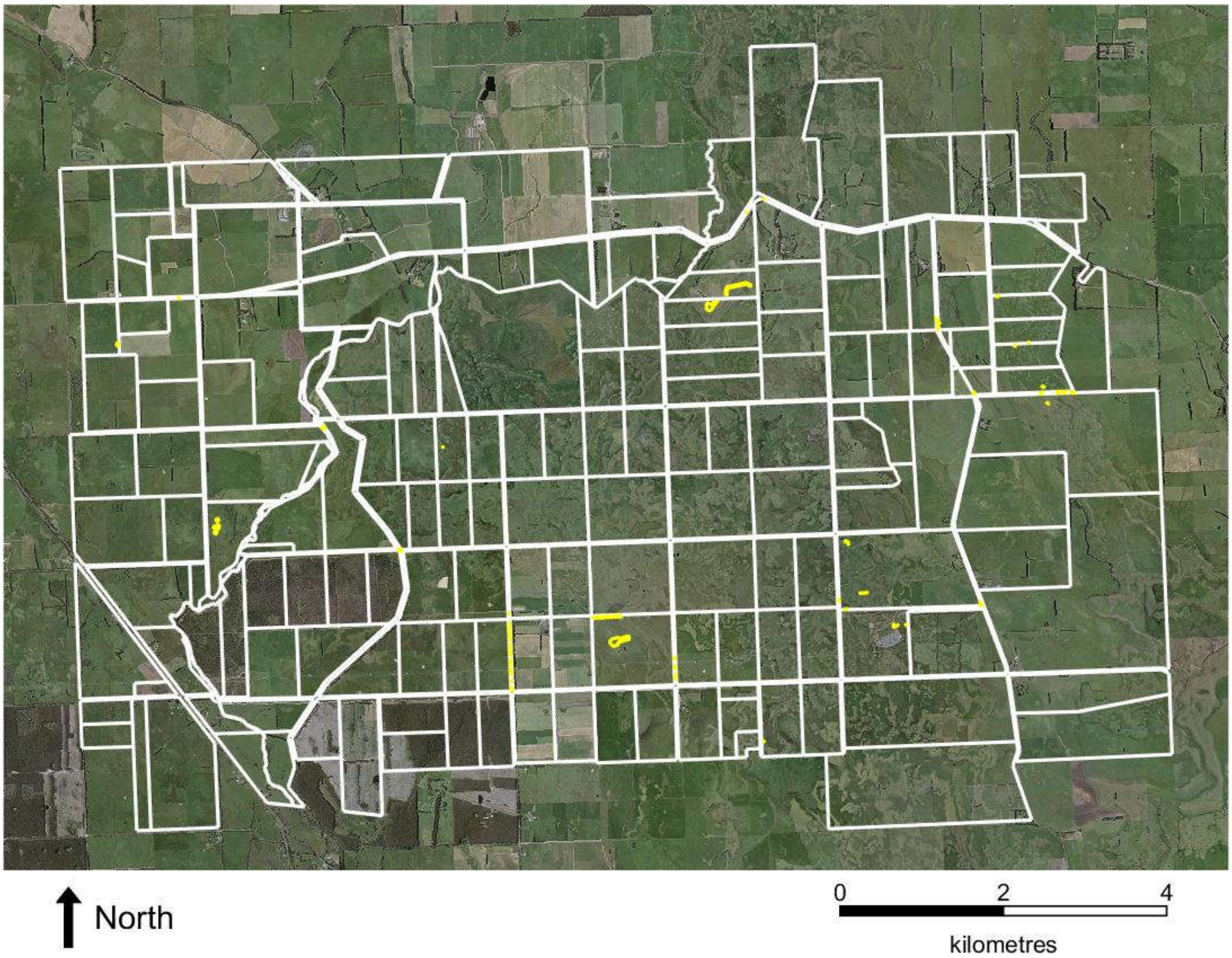
2. Strategic biodiversity values map



3. Aerial photograph showing mapped native vegetation



4. Map of the property in context



Yellow boundaries denote areas of proposed native vegetation removal.

Appendix 6: Native vegetation removal report (NVR – OD route – Glenelg Shire)

Native vegetation removal 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.

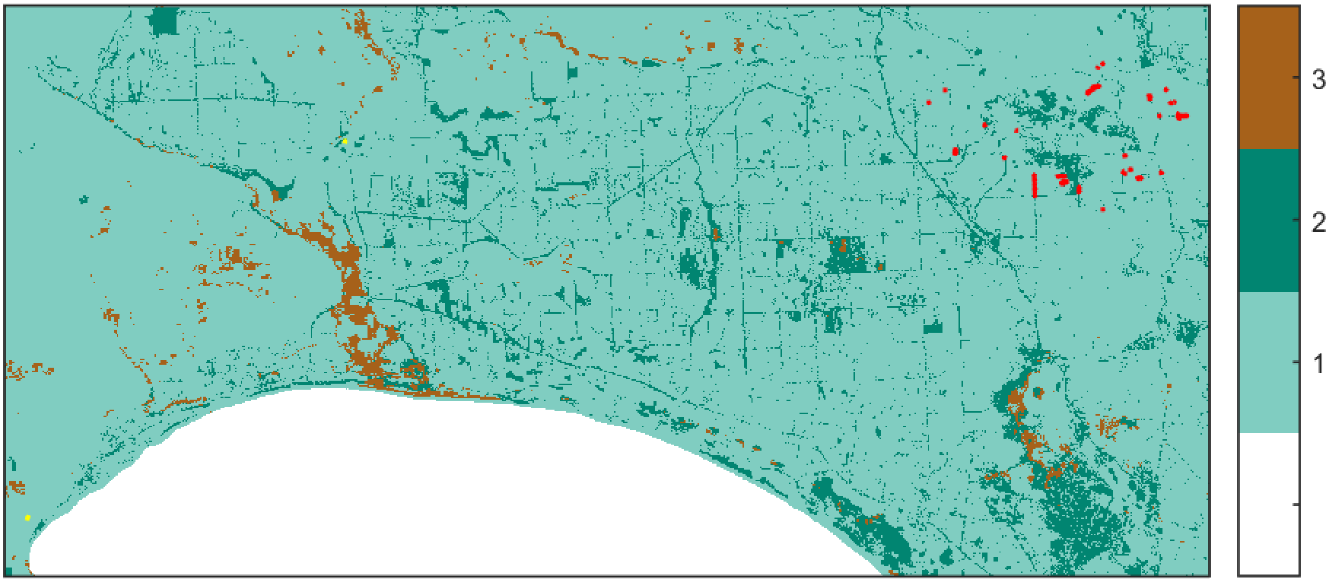
Date of issue: **26/04/2022** **Report ID: NAA_2022_062**
Time of issue: **9:26 am**

Project ID	16087_Willatook_Impact_ODRoute_v80_001_Glenelg_220421

Assessment pathway

Assessment pathway	**Detailed Assessment Pathway**
Extent including past and proposed	4.609 ha
Extent of past removal	4.572 ha
Extent of proposed removal	0.037 ha
No. Large trees proposed to be removed	0
Location category of proposed removal	Location 1 The native vegetation is not in an area mapped as an endangered Ecological Vegetation Class (as per the statewide EVC map), sensitive wetland or coastal area. Removal of less than 0.5 hectares 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[1]	0.013 general habitat units
Vicinity	Glenelg Hopkins Catchment Management Authority (CMA) or Glenelg Shire Council
Minimum strategic biodiversity value score[2]	0.734
Large trees	0 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

1 The general offset amount required is the sum of all general habitat units in Appendix 1.

2 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
- 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.

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							Information calculated by EnSym					
Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
1-1TrAI	Patch	vvp_0203	Vulnerable	0	no	0.420	0.005	0.005	0.960		0.003	General
1-1TrAJ	Patch	vvp_0200	Endangered	0	no	0.170	0.010	0.010	0.960		0.002	General
1-1TrAG	Patch	vvp_0023	Vulnerable	0	no	0.310	0.003	0.003	0.599		0.001	General
1-1TrAF	Patch	vvp_0023	Vulnerable	0	no	0.230	0.019	0.019	0.940		0.006	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	0.0001
Lacey River Buttercup	*Ranunculus amplus*	505019	Rare	Dispersed	Habitat importance map	0.0001
Showy Lobelia	*Lobelia beaugleholei*	502733	Rare	Dispersed	Habitat importance map	0.0000
Squat Picris	*Picris squarrosa*	504827	Rare	Dispersed	Habitat importance map	0.0000
Swamp Everlasting	*Xerochrysum palustre*	503763	Vulnerable	Dispersed	Habitat importance map	0.0000
Dense Leek-orchid	*Prasophyllum spicatum*	504506	Endangered	Dispersed	Habitat importance map	0.0000
Wavy Swamp Wallaby-grass	*Amphibromus sinuatus*	503625	Vulnerable	Dispersed	Habitat importance map	0.0000
Plains Yam-daisy	*Microseris scapigera s.s.*	504657	Vulnerable	Dispersed	Habitat importance map	0.0000
Bog Gum	*Eucalyptus kitsoniana*	501290	Rare	Dispersed	Habitat importance map	0.0000
Small Sickle Greenhood	*Pterostylis lustra*	504876	Endangered	Dispersed	Habitat importance map	0.0000
Swamp Flax-lily	*Dianella callicarpa*	505086	Rare	Dispersed	Habitat importance map	0.0000
Blotched Sun-orchid	*Thelymitra benthamiana*	503369	Vulnerable	Dispersed	Habitat importance map	0.0000
Leafy Twig-sedge	*Cladium procerum*	500786	Rare	Dispersed	Habitat importance map	0.0000
Purple Blown-grass	*Lachnagrostis punicea subsp. punicea*	504206	Rare	Dispersed	Habitat importance map	0.0000
Swamp Fireweed	*Senecio psilocarpus*	504659	Vulnerable	Dispersed	Habitat importance map	0.0000
Parsley Xanthosia	*Xanthosia leiophylla*	504562	Rare	Dispersed	Habitat importance map	0.0000
Western Peppermint	*Eucalyptus falciformis*	505358	Rare	Dispersed	Habitat importance map	0.0000
Purple Blown-grass	*Lachnagrostis punicea subsp. filifolia*	504222	Rare	Dispersed	Habitat importance map	0.0000
Lime Fern	*Pneumatopteris pennigera*	502578	Endangered	Dispersed	Habitat importance map	0.0000

Western Golden-tip	*Goodia medicaginea*	501518	Rare	Dispersed	Habitat importance map	0.0000
Pale Swamp Everlasting	*Coronidium gunnianum*	504655	Vulnerable	Dispersed	Habitat importance map	0.0000
One-flower Early Nancy	*Wurmbea uniflora*	503583	Rare	Dispersed	Habitat importance map	0.0000
Coast Helmet-orchid	*Corybas despectans*	500836	Vulnerable	Dispersed	Habitat importance map	0.0000
Dwarf Brooklime	*Gratiola pumilo*	503753	Rare	Dispersed	Habitat importance map	0.0000
Coast Ground-berry	*Acrotriche cordata*	500119	Rare	Dispersed	Habitat importance map	0.0000
Spotted Hyacinth-orchid	*Dipodium pardalinum*	500324	Rare	Dispersed	Habitat importance map	0.0000
Clover Glycine	*Glycine latrobeana*	501456	Vulnerable	Dispersed	Habitat importance map	0.0000
Swamp Greenhood	*Pterostylis tenuissima*	502819	Vulnerable	Dispersed	Habitat importance map	0.0000
Southern Bent-wing Bat	*Miniopterus schreibersii bassanii*	61343	Critically endangered	Dispersed	Habitat importance map	0.0000
Lax Twig-sedge	*Baumea laxa*	500378	Rare	Dispersed	Habitat importance map	0.0000
Swamp Onion-orchid	*Hydrorchis orbicularis*	502186	Vulnerable	Dispersed	Habitat importance map	0.0000
Leafy Greenhood	*Pterostylis cucullata subsp. cucullata*	505911	Endangered	Dispersed	Habitat importance map	0.0000
Swamp Diuris	*Diuris palustris*	501082	Vulnerable	Dispersed	Habitat importance map	0.0000
Winter Sun-orchid	*Thelymitra hiemalis*	505006	Endangered	Dispersed	Habitat importance map	0.0000
Southern Xanthosia	*Xanthosia tasmanica*	504088	Rare	Dispersed	Habitat importance map	0.0000
Swamp Skink	*Lissolepis coventryi*	12407	Vulnerable	Dispersed	Habitat importance map	0.0000
Salt Blown-grass	*Lachnagrostis robusta*	504223	Rare	Dispersed	Habitat importance map	0.0000
Hoary Rapier-sedge	*Lepidosperma canescens*	501915	Rare	Dispersed	Habitat importance map	0.0000
Salt Paperbark	*Melaleuca halmaturorum*	502149	Vulnerable	Dispersed	Habitat importance map	0.0000
Mauve-tuft Sun-orchid	*Thelymitra malvina*	503374	Vulnerable	Dispersed	Habitat importance map	0.0000
Slender Pink-fingers	*Caladenia vulgaris*	504449	Rare	Dispersed	Habitat importance map	0.0000
Rough Daisy-bush	*Olearia asterotricha*	502300	Rare	Dispersed	Habitat importance map	0.0000
Metallic Sun-orchid	*Thelymitra epipactoides*	503367	Endangered	Dispersed	Habitat importance map	0.0000

Maroon Leek-orchid	*Prasophyllum frenchii*	502709	Endangered	Dispersed	Habitat importance map	0.0000
Forest Bitter-cress	*Cardamine papillata*	505034	Vulnerable	Dispersed	Habitat importance map	0.0000
Southern Toadlet	*Pseudophryne semimarmorata*	13125	Vulnerable	Dispersed	Habitat importance map	0.0000
Lewin's Rail	*Lewinia pectoralis pectoralis*	10045	Vulnerable	Dispersed	Habitat importance map	0.0000
Delicate Crane's-bill	*Geranium sp. 6*	505347	Vulnerable	Dispersed	Habitat importance map	0.0000
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*	10220	Vulnerable	Dispersed	Habitat importance map	0.0000
Neat Spear-grass	*Austrostipa mundula*	503281	Rare	Dispersed	Habitat importance map	0.0000
Rough Blown-grass	*Lachnagrostis rudis subsp. rudis*	500159	Endangered	Dispersed	Habitat importance map	0.0000
Masked Owl	*Tyto novaehollandiae novaehollandiae*	10250	Endangered	Dispersed	Habitat importance map	0.0000
Wiry Bog-sedge	*Schoenus carsei*	503043	Rare	Dispersed	Habitat importance map	0.0000
White-throated Needletail	*Hirundapus caudacutus*	10334	Vulnerable	Dispersed	Habitat importance map	0.0000

Habitat group

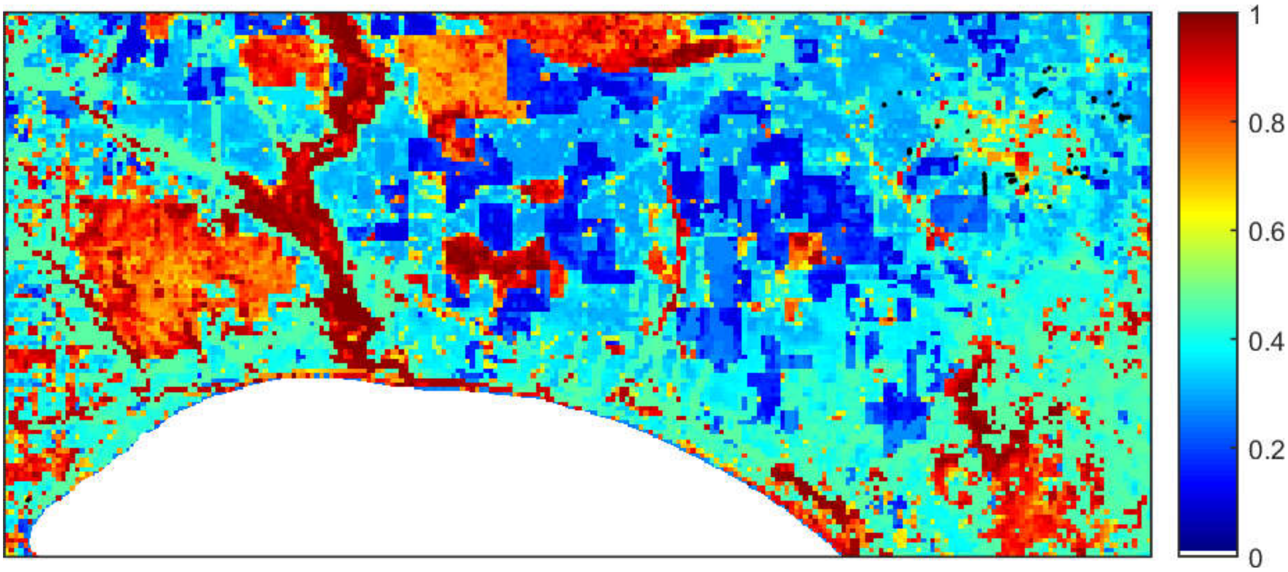
- Highly localised habitat means there is 2000 hectares or less mapped habitat for the species
- Dispersed habitat means there is more than 2000 hectares of mapped habitat for the species

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.

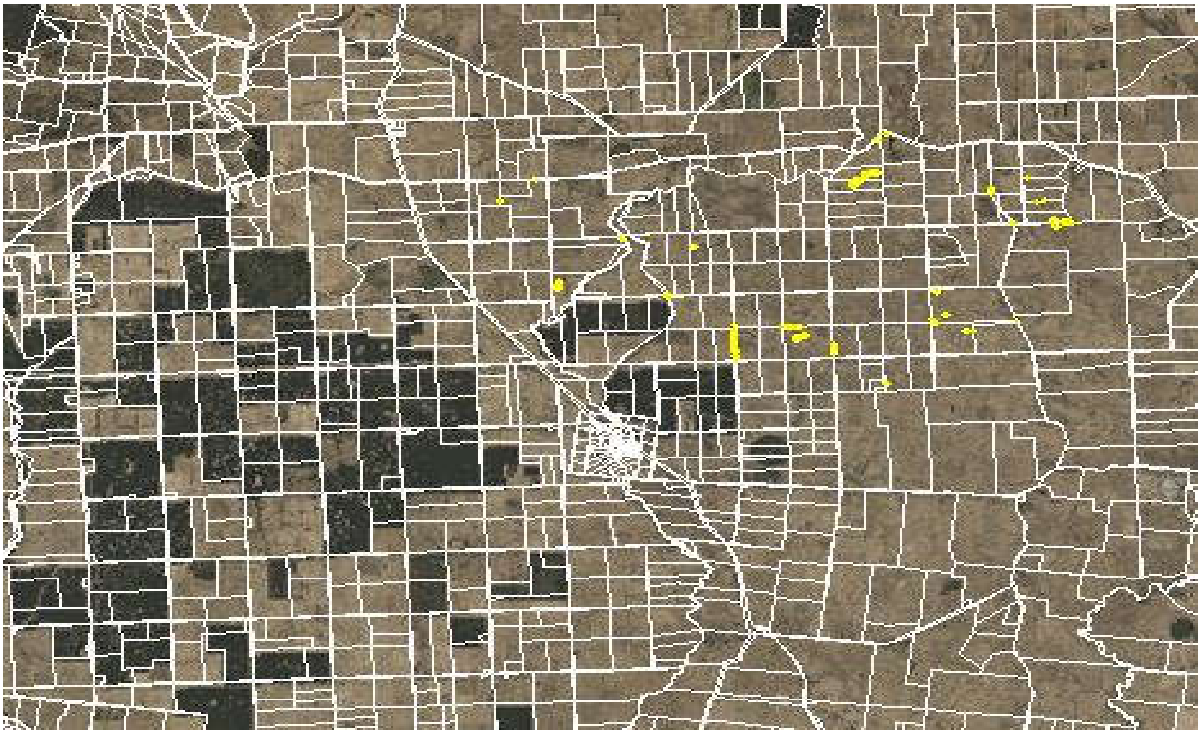
Appendix 3 – Images of mapped native vegetation

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.

Red boundaries denote areas of past removal.

Appendix 7: EVC benchmarks

Southern Volcanic Plain:

- Herb-rich Foothill Forest (EVC 23)
- Higher-rainfall Plains Grassy Woodland (EVC 55_63)
- Plains Grassy Wetland (EVC 125)
- Heavier-soils Plains Grassland (EVC 132_61)
- Stony Rises Woodland (EVC 203)
- Basalt Shrubby Woodland (EVC 642)
- Stony Knoll Shrubland (EVC 649)
- Aquatic Herbland (EVC 653)
- Tall Marsh (EVC 821)

Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 23: Herb-rich Foothill Forest

Description:

Occurs on relatively fertile, moderately well-drained soils on an extremely wide range of geological types and in areas of moderate to high rainfall. Occupies easterly and southerly aspects mainly on lower slopes and in gullies. A medium to tall open forest or woodland to 25 m tall with a small tree layer over a sparse to dense shrub layer. A high cover and diversity of herbs and grasses in the ground layer characterise this EVC.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	20 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
40%	*Eucalyptus ovata*	Swamp Gum
	Eucalyptus obliqua	Messmate Stringybark
	Eucalyptus viminalis ssp. *viminalis*	Manna Gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	2	10%	T
Medium Shrub	3	20%	MS
Small Shrub	1	1%	SS
Large Herb	2	5%	LH
Medium Herb	6	15%	MH
Small or Prostrate Herb	3	5%	SH
Large Tufted Graminoid	3	20%	LTG
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	5	10%	MTG
Medium to Tiny Non-tufted Graminoid	2	10%	MNG
Ground Fern	1	5%	GF
Scrambler/Climber	2	5%	SC
Bryophytes/Lichens	na	20%	BL

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EVC 23: Herb-rich Foothill Forest - Victorian Volcanic Plain bioregion

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia melanoxylon*	Blackwood
MS	*Leptospermum continentale*	Prickly Tea-tree
MS	*Acacia verticillata*	Prickly Moses
MS	*Ozothamnus ferrugineus*	Tree Everlasting
MS	*Bursaria spinosa*	Sweet Bursaria
SS	*Pimelea humilis*	Common Rice-flower
SS	*Hibbertia riparia*	Erect Guinea-flower
PS	*Bossiaea prostrata*	Creeping Bossiaea
PS	*Acrotriche serrulata*	Honey-pots
LH	*Senecio tenuiflorus*	Slender Fireweed
LH	*Pterostylis longifolia* s.l.	Tall Greenhood
MH	*Euchiton collinus* s.s.	Creeping Cudweed
MH	*Hypericum gramineum*	Small St John's Wort
MH	*Gonocarpus tetragynus*	Common Raspwort
MH	*Viola hederacea* sensu Willis (1972)	Ivy-leaf Violet
SH	*Hydrocotyle laxiflora*	Stinking Pennywort
LTG	*Juncus procerus*	Tall Rush
LTG	*Lepidosperma laterale* var. *majus*	Variable Sword-sedge
LTG	*Deyeuxia quadriseta*	Reed Bent-grass
LNG	*Lepidosperma longitudinale*	Pithy Sword-sedge
MTG	*Lomandra filiformis*	Wattle Mat-rush
MTG	*Lomandra sororia*	Small Mat-rush
MTG	*Lepidosperma laterale* var. *laterale*	Variable Sword-sedge
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass
MNG	*Poa tenera*	Slender Tussock-grass
GF	*Pteridium esculentum*	Austral Bracken
SC	*Clematis aristata*	Mountain Clematis
SC	*Billardiera scandens*	Common Apple-berry

Recruitment:
Continuous

Organic Litter:
40 % cover

Logs:
20 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Centaurium erythraea*	Common Centaury	high	low
MNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Anthoxanthum odoratum*	Sweet Vernal-grass	high	high

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 55_63: Higher Rainfall Plains Grassy Woodland

Description:
An open, eucalypt woodland to 15 m tall or acacia/sheoak woodland to 10 m tall. Occupies poorly drained, fertile soils on flat or gently undulating plains at low elevations. The understorey consists of a few sparse shrubs over a species-rich grassy and herbaceous ground layer. This variant occupies areas receiving greater than 700 mm annual rainfall.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha
Acacia melanoxylon	40 cm	
Allocasuarina verticillata	40 cm	

Tree Canopy Cover:

%cover	Character Species	Common Name
20%	*Eucalyptus ovata*	Swamp Gum
	Eucalyptus viminalis	Manna Gum
	Acacia melanoxylon	Blackwood
	Allocasuarina verticillata	Drooping Sheoak

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	5%	T
Medium Shrub	3	10%	MS
Small Shrub	2	1%	SS
Prostrate Shrub	1	1%	PS
Large Herb	3	5%	LH
Medium Herb	8	15%	MH
Small or Prostrate Herb	3	5%	SH
Large Tufted Graminoid	2	5%	LTG
Medium to Small Tufted Graminoid	12	45%	MTG
Medium to Tiny Non-tufted Graminoid	2	5%	MNG
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	10%	S/C

LF Code	Species typical of at least part of EVC range	Common Name
MS	*Acacia pycnantha*	Golden Wattle
MS	*Acacia paradoxa*	Hedge Wattle
SS	*Pimelea humilis*	Common Rice-flower
PS	*Astroloma humifusum*	Cranberry Heath
PS	*Bossiaea prostrata*	Creeping Bossiaea
MH	*Leptorhynchos squamatus*	Scaly Buttons
MH	*Chysocephalum apiculatum*	Common Everlasting
MH	*Gonocarpus tetragynus*	Common Raspwort
MH	*Acaena echinata*	Sheep's Burr
SH	*Dichondra repens*	Kidney-weed
SH	*Hydrocotyle laxiflora*	Stinking Pennywort
LTG	*Austrostipa mollis*	Supple Spear-grass
LTG	*Austrostipa bigeniculata*	Kneed Spear-grass
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Poa morrisii*	Soft Tussock-grass
MTG	*Austrodanthonia setacea*	Bristly Wallaby-grass
MTG	*Austrodanthonia racemosa* var. *racemosa*	Stiped Wallaby-grass
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass

Recruitment:
Continuous

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EVC 55_63: Higher Rainfall Plains Grassy Woodland - Victorian Volcanic Plain bioregion

Organic Litter:
10 % cover

Logs:
10 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
MS	*Lycium ferocissimum*	African Box-thorn	high	high
LH	*Cirsium vulgare*	Spear Thistle	high	high
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Plantago lanceolata*	Ribwort	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Romulea rosea*	Onion Grass	high	low
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MTG	*Briza maxima*	Large Quaking-grass	high	low

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For more information contact: Customer Service Centre, 136 186

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 125: Plains Grassy Wetland

Description:

This EVC is usually treeless, but in some instances can include sparse River Red Gum *Eucalyptus camaldulensis* or Swamp Gum *Eucalyptus ovata*. A sparse shrub component may also be present. The characteristic ground cover is dominated by grasses and small sedges and herbs. The vegetation is typically species-rich on the outer verges but is usually species-poor in the wetter central areas.

Life Forms:

Life form	#Spp	%Cover	LF code
Large Herb	5	5%	LH
Medium Herb	6	10%	MH
Small or Prostrate Herb	3	10%	SH
Large Tufted Graminoid	3	15%	LTG
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	8	30%	MTG
Medium to Tiny Non-tufted Graminoid	2	10%	MNG
Bryophytes/Lichens	na	10%	BL

LF Code	Species typical of at least part of EVC range	Common Name
LH	*Epilobium billardierianum*	Variable Willow-herb
LH	*Villarsia reniformis*	Running Marsh-flower
LH	*Epilobium billardierianum ssp. cinereum*	Grey Willow-herb
MH	*Potamogeton tricarinatus s.l.*	Floating Pondweed
MH	*Lilaeopsis polyantha*	Australian Lilaeopsis
MH	*Utricularia dichotoma s.l.*	Fairies' Aprons
SH	*Eryngium vesiculosum*	Prickfoot
SH	*Neopaxia australasica*	White Purslane
SH	*Lobelia pratioides*	Poison Lobelia
LTG	*Juncus flavidus*	Gold Rush
LTG	*Deyeuxia quadriseta*	Reed Bent-grass
LTG	*Amphibromus nervosus*	Common Swamp Wallaby-grass
LTG	*Poa labillardierei*	Common Tussock-grass
MTG	*Triglochin procerum s.l.*	Water Ribbons
MTG	*Glyceria australis*	Australian Sweet-grass
MTG	*Juncus holoschoenus*	Joint-leaf Rush
MTG	*Austrodanthonia duttoniana*	Brown-back Wallaby-grass
MNG	*Eleocharis acuta*	Common Spike-sedge
MNG	*Eleocharis pusilla*	Small Spike-sedge

Recruitment:

Episodic/Flood. Desirable period between disturbances is 5 years.

Organic Litter:

20% cover

Logs:

5 m/0.1 ha.(where trees are overhanging the wetland)

EVC 125: Plains Grassy Wetland - Victorian Volcanic Plain bioregion

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Cirsium vulgare*	Spear Thistle	high	high
MH	*Leontodon taraxacoides ssp. taraxacoides*	Hairy Hawkbit	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
LTG	*Phalaris aquatica*	Toowoomba Canary-grass	high	high
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MTG	*Romulea rosea*	Onion Grass	high	low
TTG	*Cyperus tenellus*	Tiny Flat-sedge	high	low

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For more information contact: Customer Service Centre, 136 186

Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 132_61: *Heavier-soils* Plains Grassland

Description:
Treeless vegetation mostly less than 1 m tall dominated by largely graminoid and herb life forms. Occupies fertile cracking basalt soils prone to seasonal waterlogging in areas receiving at least 500 mm annual rainfall.

Life Forms:

Life form	#Spp	%Cover	LF code
Large Herb	2	5%	LH
Medium Herb	12	20%	MH
Small or Prostrate Herb	4	5%	SH
Large Tufted Graminoid	1	5%	LTG
Medium to Small Tufted Graminoid	13	40%	MTG
Medium to Tiny Non-tufted Graminoid	4	5%	MNG
Bryophytes/Lichens and Soil Crust*	na	20%	BL

* Note: treat as one life form in this EVC

LF Code	Species typical of at least part of EVC range	Common Name
SS	*Pimelea humilis*	Common Rice-flower
LH	*Rumex dumosus*	Wiry Dock
MH	*Calocephalus citreus*	Lemon Beauty-heads
MH	*Acaena echinata*	Sheep's Burr
MH	*Leptorhynchos squamatus*	Scaly Buttons
MH	*Eryngium ovinum*	Blue Devil
SH	*Solenogyne dominii*	Smooth Solenogyne
SH	*Lobelia pratioides*	Poison Lobelia
LTG	*Austrostipa bigeniculata*	Kneed Spear-grass
LTG	*Dichelachne crinita*	Long-hair Plume-grass
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Austrodanthonia caespitosa*	Common Wallaby-grass
MTG	*Elymus scaber* var. *scaber*	Common Wheat-grass
MTG	*Schoenus apogon*	Common Bog-sedge
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass
MNG	*Thelymitra pauciflora* s.l.	Slender Sun-orchid
MNG	*Microtis unifolia*	Common Onion-orchid
SC	*Convolvulus erubescens*	Pink Bindweed

Recruitment:
Episodic/Fire or Grazing. Desirable period between disturbances is 5 years.

Organic Litter:
10% cover

EVC 132_61: *Heavier-soils* Plains Grassland - Victorian Volcanic Plain bioregion

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Plantago lanceolata*	Ribwort	high	low
LH	*Cirsium vulgare*	Spear Thistle	high	high
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Leontodon taraxacoides* ssp. *taraxacoides*	Hairy Hawkbit	high	low
MH	*Trifolium subterraneum*	Subterranean Clover	high	low
MH	*Plantago coronopus*	Buck's-horn Plantain	high	low
MH	*Trifolium striatum*	Knotted Clover	high	low
MH	*Trifolium dubium*	Suckling Clover	high	low
LTG	*Phalaris aquatica*	Toowoomba Canary-grass	high	high
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Romulea rosea*	Onion Grass	high	low
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MTG	*Bromus hordeaceus* ssp. *hordeaceus*	Soft Brome	high	low
MTG	*Briza maxima*	Large Quaking-grass	high	low
MTG	*Lolium rigidum*	Wimmera Rye-grass	high	low
MTG	*Lolium perenne*	Perennial Rye-grass	high	low
MTG	*Nassella neesiana*	Chilean Needle-grass	high	high
MNG	*Cynosurus echinatus*	Rough Dog's-tail	high	low
MNG	*Juncus capitatus*	Capitate Rush	high	low

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Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 203: Stony Rises Woodland

Description:
Eucalypt woodland to 15 m tall on stony rises (highly irregular terrain on recent basalt flows). Soils are fertile and well-drained but shallow or skeletal. Limited soil development outside of rock-cracks and dry summers promote annuals and deep-rooted perennials.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
15%	*Eucalyptus viminalis* ssp. *viminalis*	Manna Gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	10%	T
Medium Shrub	1	5%	MS
Small Shrub	1	5%	SS
Large Herb	3	5%	LH
Medium Herb	8	15%	MH
Small or Prostrate Herb	4	10%	SH
Large Tufted Graminoid	1	5%	LTG
Medium to Small Tufted Graminoid	4	20%	MTG
Medium to Tiny Non-tufted Graminoid	1	5%	MNG
Ground Fern	2	20%	GF
Scrambler or Climber	1	1%	SC
Bryophytes/Lichens	na	10%	BL

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia melanoxylon*	Blackwood
MS	*Cassinia longifolia*	Shiny Cassinia
SS	*Rubus parvifolius*	Small-leaf Bramble
LH	*Epilobium billardierianum* ssp. *cinereum*	Grey Willow-herb
LH	*Senecio pinnatifolius*	Variable Groundsel
LH	*Rumex brownii*	Slender Dock
MH	*Acaena novae-zelandiae*	Bidgee-widgee
MH	*Geranium solanderi* s.l.	Austral Cranesbill
MH	*Ranunculus sessiliflorus*	Annual Buttercup
MH	*Parietaria debilis* s.l.	Shade Pellitory
SH	*Oxalis exilis*	Shady Wood-sorrel
SH	*Crassula sieberiana*	Sieber Crassula
SH	*Dichondra repens*	Kidney-weed
MTG	*Austrodanthonia racemosa* var. *racemosa*	Stiped Wallaby-grass
MTG	*Dichelachne rara*	Common Plume-grass
MTG	*Poa ensiformis*	Sword Tussock-grass
GF	*Pteridium esculentum*	Austral Bracken
GF	*Asplenium flabellifolium*	Necklace Fern
GF	*Cheilanthes austrotenuifolia*	Green Rock Fern
SC	*Clematis microphylla*	Small-leaved Clematis

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EVC 203: Stony Rises Woodland - Victorian Volcanic Plain bioregion

Recruitment:
Continuous

Organic Litter:
20 % cover

Logs:
15 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Carduus pycnocephalus*	Slender Thistle	high	high
LH	*Sonchus asper* s.l.	Rough Sow-thistle	high	low
LH	*Cirsium vulgare*	Spear Thistle	high	high
LH	*Solanum nigrum* sensu Willis (1972)	Black Nightshade	high	low
MH	*Cerastium glomeratum* s.l.	Common Mouse-ear Chickweed	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Veronica persica*	Persian Speedwell	high	low
MH	*Trifolium subterraneum*	Subterranean Clover	high	low
MH	*Trifolium dubium*	Suckling Clover	high	low
MH	*Acetosella vulgaris*	Sheep Sorrel	high	high
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Anthoxanthum odoratum*	Sweet Vernal-grass	high	high
MTG	*Bromus diandrus*	Great Brome	high	low

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Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 642: Basalt Shrubby Woodland

Description:
Eucalypt-dominated woodland to 15 m tall with an understorey of shrubs and grasses, presumed originally quite species-rich. Occurs on well-drained to seasonally damp fertile soils in higher rainfall areas of volcanic plain.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
15%	*Eucalyptus ovata*	Swamp Gum
	Eucalyptus viminalis	Manna Gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	2	10%	T
Medium Shrub	2	5%	MS
Prostrate Shrub	2	1%	PS
Large Herb	2	1%	LH
Medium Herb	10	15%	MH
Small or Prostrate Herb	5	10%	SH
Large Tufted Graminoid	3	5%	LTG
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	10	25%	MTG
Medium to Tiny Non-tufted Graminoid	3	10%	MNG
Ground Fern	1	15%	GF
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	10%	S/C

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia melanoxylon*	Blackwood
T	*Acacia mearnsii*	Black Wattle
MS	*Leptospermum continentale*	Prickly Tea-tree
MS	*Acacia verticillata*	Prickly Moses
PS	*Bossiaea prostrata*	Creeping Bossiaea
PS	*Astroloma humifusum*	Cranberry Heath
LH	*Senecio glomeratus*	Annual Fireweed
MH	*Drosera peltata ssp. auriculata*	Tall Sundew
MH	*Lagenophora stipitata*	Common Bottle-daisy
SH	*Oxalis exilis*	Shady Wood-sorrel
SH	*Kennedia prostrata*	Running Postman
SH	*Lobelia pedunculata s.l.*	Matted Pratia
SH	*Leptostigma reptans*	Dwarf Nertera
LTG	*Austrostipa pubinodis*	Tall Spear-grass
LTG	*Lepidosperma elatius*	Tall Sword-sedge
LTG	*Deyeuxia quadriseta*	Reed Bent-grass
MTG	*Dichelachne rara*	Common Plume-grass
MTG	*Lomandra filiformis ssp. filiformis*	Wattle Mat-rush
MTG	*Dichelachne crinita*	Long-hair Plume-grass
MTG	*Austrodanthonia pilosa*	Velvet Wallaby-grass
MNG	*Poa tenera*	Slender Tussock-grass
MNG	*Microlaena stipoides var. stipoides*	Weeping Grass
GF	*Pteridium esculentum*	Austral Bracken

EVC 642: Basalt Shrubby Woodland - Victorian Volcanic Plain bioregion

Recruitment:
Continuous

Organic Litter:
20 % cover

Logs:
15 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
T	*Pinus radiata*	Radiata Pine	high	high
LH	*Centaurium tenuiflorum*	Slender Centaury	high	low
LH	*Plantago lanceolata*	Ribwort	high	low
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Cirsium vulgare*	Spear Thistle	high	high
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Centaurium erythraea*	Common Centaury	high	low
MH	*Gamochaeta purpurea s.s.*	Spiked Cudweed	high	low
MH	*Leontodon taraxacoides ssp. taraxacoides*	Hairy Hawkbit	high	low
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MTG	*Briza maxima*	Large Quaking-grass	high	low
MTG	*Anthoxanthum odoratum*	Sweet Vernal-grass	high	high
MNG	*Aira elegantissima*	Delicate Hair-grass	high	low
MNG	*Cynosurus echinatus*	Rough Dog's-tail	high	low
SNG	*Sisyrinchium iridifolium*	Blue Pigroot	high	low

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Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 649: Stony Knoll Shrubland

Description:
Stony Knoll Shrubland is a shrubland to 3 m tall or low non-eucalypt woodland to 8 m tall with a grassy understorey. It occurs on low stony rises on basalt flows. The soils are fertile and well drained but shallow with out cropping rock, causing severe summer dryness.

+ woodland only components (ignore when assessing treeless areas and standardise final score as appropriate)

Canopy Cover+:

%cover	Character Species	Common Name
15%	*Allocasuarina verticillata*	Drooping Sheoak
	Bursaria spinosa	Sweet Bursaria

Understorey:

Life form	#Spp	%Cover	LF code
Medium Shrub	3	10%	MS
Prostrate Shrub	1	1%	PS
Large Herb	2	1%	LH
Medium Herb	11	10%	MH
Small or Prostrate Herb	4	5%	SH
Medium to Small Tufted Graminoid	10	25%	MTG
Tiny Tufted Graminoid	2	5%	TTG
Medium to Tiny Non-tufted Graminoid	2	5%	MNG
Ground Fern	2	5%	GF
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	10%	S/C
Total understorey projective foliage cover		**85%**	

LF Code	Species typical of at least part of EVC range	Common Name
MS	*Hymenanthera dentata* s.l.	Tree Violet
MS	*Acacia paradoxa*	Hedge Wattle
PS	*Kennedia prostrata*	Running Postman
LH	*Senecio quadridentatus*	Cotton Fireweed
LH	*Senecio glomeratus*	Annual Fireweed
MH	*Oxalis perennans*	Grassland Wood-sorrel
MH	*Rumex brownii*	Slender Dock
MH	*Hypericum gramineum*	Small St John's Wort
MH	*Acaena ovina*	Australian Sheep's Burr
SH	*Dichondra repens*	Kidneyweed
SH	*Hydrocotyle laxiflora*	Stinking Pennywort
SH	*Crassula sieberiana*	Sieber Crassula
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Poa sieberiana*	Grey Tussock-grass
MTG	*Austrodanthonia caespitosa*	Common Wallaby-grass
MTG	*Austrodanthonia setacea*	Bristly Wallaby-grass
TTG	*Carex breviculmis*	Short-stem Sedge
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass
GF	*Pteridium esculentum*	Austral Bracken
GF	*Adiantum aethiopicum*	Common Maidenhair
SC	*Convolvulus erubescens* spp. agg.	Pink Bindweed

Recruitment:
Continuous

Organic Litter:
20 % cover

EVC 649: Stony Knoll Shrubland - Victorian Volcanic Plain bioregion

Logs^{+}:

5 m/0.1 ha. (note: large log class does not apply)

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
T	*Schinus molle*	Pepper Tree	high	high
MS	*Lycium ferocissimum*	African Box-thorn	high	high
MS	*Genista monspessulana*	Montpellier Broom	high	high
SS	*Marrubium vulgare*	Horehound	high	high
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Helminthotheca echioides*	Ox-tongue	high	low
LH	*Lactuca serriola*	Prickly Lettuce	high	low
LH	*Sisymbrium officinale*	Hedge Mustard	high	low
LH	*Sonchus asper* s.l.	Rough Sow-thistle	high	low
LH	*Verbascum thapsus* ssp. *thapsus*	Great Mullein	high	high
LH	*Echium plantagineum*	Paterson's Curse	high	high
LH	*Centaurium tenuiflorum*	Slender Centaury	high	low
LH	*Foeniculum vulgare*	Fennel	high	high
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Trifolium arvense* var. *arvense*	Hare's-foot Clover	high	low
MH	*Trifolium subterraneum*	Subterranean Clover	high	low
MH	*Trifolium campestre* var. *campestre*	Hop Clover	high	low
MH	*Trifolium angustifolium* var. *angustifolium*	Narrow-leaf Clover	high	low
MH	*Lotus suaveolens*	Hairy Bird's-foot Trefoil	high	low
MH	*Cerastium glomeratum* s.l.	Common Mouse-ear Chickweed	high	low
SH	*Medicago polymorpha*	Burr Medic	high	low
SH	*Trifolium glomeratum*	Cluster Clover	high	low
SH	*Modiola caroliniana*	Red-flower Mallow	high	low
SH	*Aptenia cordifolia*	Heart-leaf Ice-plant	high	high
LTG	*Phalaris aquatica*	Toowoomba Canary-grass	high	high
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
LNG	*Avena fatua*	Wild Oat	high	low
MTG	*Nassella trichotoma*	Serrated Tussock	high	high
MTG	*Ehrharta longiflora*	Annual Veldt-grass	high	low
MTG	*Briza maxima*	Large Quaking-grass	high	low
MTG	*Bromus hordeaceus* ssp. *hordeaceus*	Soft Brome	high	low
MTG	*Sporobolus africanus*	Rat-tail Grass	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Romulea rosea*	Onion Grass	high	low
MTG	*Pentaschistis airoides* ssp. *airoides*	False Hair-grass	high	low
MTG	*Lolium perenne*	Perennial Rye-grass	high	low
MTG	*Dactylis glomerata*	Cocksfoot	high	high
MTG	*Vulpia myuros*	Rat's-tail Fescue	high	low
MTG	*Bromus rubens*	Red Brome	high	low
MTG	*Avena barbata*	Bearded Oat	high	low
MTG	*Aira caryophyllea*	Silvery Hair-grass	high	low
SC	*Vicia sativa* ssp. *sativa*	Common Vetch	low	low

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Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 653: Aquatic Herbland

Description:
Herbland of permanent to semi-permanent wetlands, dominated by sedges (especially on shallower verges) and/or aquatic herbs. Occurs on fertile paludal soils, typically heavy clays beneath organic accumulations.

Life Forms:

Life form	#Spp	%Cover	LF code
Medium Shrub	1	1%	MS
Small Shrub	1	1%	SS
Large Herb	2	10%	LH
Medium Herb	5	40%	MH
Small or Prostrate Herb	2	10%	SH
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	4	10%	MTG
Medium to Tiny Non-tufted Graminoid	2	10%	MNG
Total understorey projective foliage cover		**85%**	

LF Code	Species typical of at least part of EVC range	Common Name
LH	*Villarsia reniformis*	Running Marsh-flower
MH	*Myriophyllum simulans*	Amphibious Water-milfoil
MH	*Potamogeton tricarinatus s.l.*	Floating Pondweed
MH	*Potamogeton pectinatus*	Fennel Pondweed
MH	*Marsilea drummondii*	Common Nardoo
SH	*Azolla filiculoides*	Pacific Azolla
SH	*Lobelia pratioides*	Poison Lobelia
SH	*Lemna disperma*	Duckweed
LNG	*Eleocharis sphacelata*	Tall Spike-sedge
MTG	*Triglochin procerum s.l.*	Water Ribbons
MTG	*Lachnagrostis filiformis*	Common Blown-grass
MTG	*Glyceria australis*	Australian Sweet-grass
MTG	*Austrodanthonia duttoniana*	Brown-back Wallaby-grass
MNG	*Eleocharis pusilla*	Small Spike-sedge
MNG	*Eleocharis acuta*	Common Spike-sedge

Recruitment:
Episodic/Flood. Desirable period between disturbances is 5 years.

Organic Litter:
10% cover

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Aster subulatus*	Aster-weed	high	low
LH	*Rumex crispus*	Curled Dock	high	low
MH	*Plantago coronopus*	Buck's-horn Plantain	high	high
MH	*Cotula coronopifolia*	Water Buttons	high	high
MTG	*Lolium rigidum*	Wimmera Rye-grass	high	low
MTG	*Romulea rosea*	Onion Grass	high	low

EVC 653: Aquatic Herbland - Victorian Volcanic Plain bioregion

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For more information contact: Customer Service Centre, 136 186

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 821: Tall Marsh

Description:
Closed to open grassland/sedgeland to 3 m tall, dominated by Common Reed and Cumbungi. Small aquatic and semi-aquatic species occur amongst the reeds. Occurs on Quaternary sedimentary geology of mainly estuarine sands, soils are peaty, silty clays, and average annual rainfall is approximately 600 mm. It requires shallow water (to 1 m deep) and low current-scour, and can only tolerate very low levels of salinity.

Life Forms:

Life form	#Spp	%Cover	LF code
Large Herb	3	10%	LH
Medium Herb	2	5%	MH
Small or Prostrate Herb	6	10%	SH
Large Tufted Graminoid	1	5%	LTG
Large Non-tufted Graminoid	2	40%	LNG
Medium to Tiny Non-tufted Graminoid	1	1%	MNG
Total understorey projective foliage cover		**70%**	

LF Code	Species typical of at least part of EVC range	Common Name
LH	*Myriophyllum verrucosum*	Red Water-milfoil
LH	*Myriophyllum salsugineum*	Lake Water-milfoil
LH	*Villarsia reniformis*	Running Marsh-flower
MH	*Rumex bidens*	Mud Dock
MH	*Lilaeopsis polyantha*	Australian Lilaeopsis
MH	*Lepilaena bilocularis*	Small-fruit Water-mat
SH	*Lemna disperma*	Common Duckweed
SH	*Azolla filiculoides*	Pacific Azolla
SH	*Wolffia australiana*	Tiny Duckweed
SH	*Mimulus repens*	Creeping Monkey-flower
LTG	*Triglochin procerum s.l.*	Water Ribbons
LTG	*Juncus ingens*	Giant Rush
LNG	*Schoenoplectus tabernaemontani*	River Club-sedge
LNG	*Phragmites australis*	Common Reed
LNG	*Typha domingensis*	Cumbungi
LNG	*Typha orientalis*	Broad-leaf Cumbungi
MNG	*Lepilaena cylindrocarpa*	Long-fruit Water-mat
MNG	*Eleocharis acuta*	Common Spike-sedge

Recruitment:
Episodic/Flood: desirable period of disturbance is every five years

Organic Litter:
10% cover

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
MH	*Cotula coronopifolia*	Water Buttons	high	high
MNG	*Paspalum distichum*	Water Couch	high	high

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EVC 821: Tall Marsh - Victorian Volcanic Plain bioregion

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Appendix 8: Flora species recorded in the study area

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	CaLP Act
#	Sallow Wattle	*Acacia longifolia* subsp. *longifolia*			p	
#	Coast Wattle	*Acacia longifolia* subsp. *sophorae*			p	
	Black Wattle	*Acacia mearnsii*			p	
	Blackwood	*Acacia melanoxylon*				
	Hedge Wattle	*Acacia paradoxa*				
	Golden Wattle	*Acacia pycnantha*			p	
	Hop Wattle	*Acacia stricta*			p	
	Prickly Moses	*Acacia verticillata*			p	
	Sheep's Burr	*Acaena echinata*				
	Bidgee-widgee	*Acaena novae-zelandiae*				
*	Sheep Sorrel	*Acetosella vulgaris*				
	Honey-pots	*Acrotriche serrulata*			p	
	Common Maidenhair	*Adiantum aethiopicum*			p	
*	Brown-top Bent	*Agrostis capillaris*				
*	Creeping Bent	*Agrostis stolonifera*				
*	Silvery Hair-grass	*Aira caryophyllea subsp. caryophyllea*				
*	Quicksilver Grass	*Aira cupaniana*				
*	Delicate Hair-grass	*Aira elegantissima*				
	Drooping Sheoak	*Allocasuarina verticillata*				
	Broom Spurge	*Amperea xiphoclada var. xiphoclada*				
	Common Wheat-grass	*Anthosachne scabra s.l.*				
*	Sweet Vernal-grass	*Anthoxanthum odoratum*				
	Sea Celery	*Apium prostratum subsp. prostratum*				
*	Cape weed	*Arctotheca calendula*				
	Pale Vanilla-lily	*Arthropodium milleflorum s.l.*				
	Chocolate Lily	*Arthropodium strictum s.l.*				
*	Bridal Creeper	*Asparagus asparagoides*				R
	Common Woodruff	*Asperula conferta*				
	Water Woodruff	*Asperula subsimplex*				
	Kneed Spear-grass	*Austrostipa bigeniculata*				
	Tall Spear-grass	*Austrostipa pubinodis*				
	Silver Banksia	*Banksia marginata*				
*	Twiggy Turnip	*Brassica fruticulosa*				
*	Large Quaking-grass	*Briza maxima*				
*	Prairie Grass	*Bromus catharticus var. catharticus*				
*	Great Brome	*Bromus diandrus*				
*	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*				
	Milkmaids	*Burchardia umbellata*				
	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*				
	Western Water-starwort	*Callitriche cyclocarpa*		L	p	
*	Common Water-starwort	*Callitriche stagnalis*				

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	CaLP Act
	Milky Beauty-heads	*Calocephalus lacteus*			p	
	Bitter Cress	*Cardamine spp.*				
*	Slender Thistle	*Carduus pycnocephalus*				R
	Tall Sedge	*Carex appressa*				
	Common Grass-sedge	*Carex breviculmis*				
	Knob Sedge	*Carex inversa*				
	Poong'ort	*Carex tereticaulis*				
	Shiny Cassinia	*Cassinia longifolia*			p	
*	Kikuyu	*Cenchrus clandestinus*				
*	Common Centaury	*Centaurium erythraea*				
	Centella	*Centella cordifolia*				
	Hairy Centrolepis	*Centrolepis strigosa subsp. strigosa*				
*	Common Mouse-ear Chickweed	*Cerastium glomeratum s.l.*				
	Blue Stars	*Chamaescilla corymbosa var. corymbosa*				
*	Perennial Thistle	*Cirsium arvense*				C
*	Spear Thistle	*Cirsium vulgare*				R
*	Hemlock	*Conium maculatum*				R
	Pink Bindweed	*Convolvulus erubescens s.l.*				
	Prickly Currant-bush	*Coprosma quadrifida*				
*	Mirror Bush	*Coprosma repens*				
	Pale Swamp Everlasting	*Coronidium gunnianum*		cr	p	
	Button Everlasting	*Coronidium scorpioides s.s.*			p	
	Bloodwood	*Corymbia spp.*				
*	Cotoneaster	*Cotoneaster spp.*				
	Common Cotula	*Cotula australis*			p	
	Swamp Billy-buttons	*Craspedia paludicola*			p	
	Swamp Crassula	*Crassula helmsii*				
*	Rough Dog's-tail	*Cynosurus echinatus*				
*	Drain Flat-sedge	*Cyperus eragrostis*				
*	Cocksfoot	*Dactylis glomerata*				
*	Carrot	*Daucus carota*				
	Reed Bent-grass	*Deyeuxia quadriseta*				
	Black-anther Flax-lily	*Dianella revoluta var. revoluta s.l.*				
	Common Plume-grass	*Dichelachne rara*				
	Kidney-weed	*Dichondra repens*				
	Pale Sundew	*Drosera peltata subsp. peltata spp. agg.*				
*	Panic Veldt-grass	*Ehrharta erecta var. erecta*				
	Common Spike-sedge	*Eleocharis acuta*				
	Common Heath	*Epacris impressa*			p	
	Variable Willow-herb	*Epilobium billardierianum*				
*	Flaxleaf Fleabane	*Erigeron bonariensisConyza bonariensis*				
	Prickfoot	*Eryngium vesiculosum*				

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	CaLP Act
#	Southern Mahogany	*Eucalyptus botryoides*				
	River Red-gum	*Eucalyptus camaldulensis*				
	Bog Gum	*Eucalyptus kitsoniana*		cr		
	Yellow Gum	*Eucalyptus leucoxylon subsp. leucoxylon*				
	Swamp Gum	*Eucalyptus ovata*				
*	Moort	*Eucalyptus platypus subsp. platypus*				
	Manna Gum	*Eucalyptus viminalis*				
	Annual Cudweed	*Euchiton sphaericus*			p	
	Cherry Ballart	*Exocarpos cupressiformis*				
*	Bastard's Fumitory	*Fumaria bastardii*				
	Thatch Saw-sedge	*Gahnia radula*				
	Saw Sedge	*Gahnia spp.*				
*	Cleavers	*Galium aparine*				
*	Montpellier Broom	*Genista monspessulana*				R
	Austral Crane's-bill	*Geranium solanderi s.l.*				
	Australian Sweet-grass	*Glyceria australis*				
	Common Raspwort	*Gonocarpus tetragynus*				
	Bent Goodenia	*Goodenia geniculata*				
	Austral Brooklime	*Gratiola peruviana*				
*	Ox-tongue	*Helminthotheca echioides*				
*	Monterey Cypress	*Hesperocyparis macrocarpa Cupressus macrocarpa*				
	Erect Guinea-flower	*Hibbertia riparia*				
*	Yorkshire Fog	*Holcus lanatus*				
	Stinking Pennywort	*Hydrocotyle laxiflora*				
	Small St John's Wort	*Hypericum gramineum spp. agg.*				
*	St John's Wort	*Hypericum perforatum subsp. veronense*				C
*	Smooth Cat's-ear	*Hypochaeris glabra*				
*	Flatweed	*Hypochaeris radicata*				
	Swamp Club-sedge	*Isolepis inundata*				
	Green Rush	*Juncus gregiflorus*				
	Joint-leaf Rush	*Juncus holoschoenus*				
	Tall Rush	*Juncus procerus*				
	Finger Rush	*Juncus subsecundus*				
*	Hare's-tail Grass	*Lagurus ovatus*				
*	Hairy Hawkbit	*Leontodon saxatilis subsp. saxatilisLeontodon taraxacoides subsp. taraxacoides*				
*	Common Peppercress	*Lepidium africanum*				
	Basalt Peppercress	*Lepidium hyssopifolium s.s.*	EN	en	p	
	Tall Sword-sedge	*Lepidosperma elatius*				
	Variable Sword-sedge	*Lepidosperma laterale*				
	Pithy Sword-sedge	*Lepidosperma longitudinale*				
	Wiry Buttons	*Leptorhynchos tenuifolius*			p	
	Prickly Tea-tree	*Leptospermum continentale*				
*	Ox-eye Daisy	*Leucanthemum vulgare*				R

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	CaLP Act
	Matted Pratia	*Lobelia pedunculata s.l.*				
	Poison Lobelia	*Lobelia pratioides*				
*	Perennial Rye-grass	*Lolium perenne*				
	Wattle Mat-rush	*Lomandra filiformis*				
	Dwarf Mat-rush	*Lomandra nana*				
	Common Woodrush	*Luzula meridionalis var. flaccida*				
*	Pimpernel	*Lysimachia arvensis*				
	Small Loosestrife	*Lythrum hyssopifolia*				
	Jointed Fine Twig-sedge	*Machaerina arthrophylla Baumea articulata*				
*	Black Medic	*Medicago lupulina*				
*	Burr Medic	*Medicago polymorpha*				
*	Lucerne	*Medicago sativa subsp. sativa*				
#	Swamp Paperbark	*Melaleuca ericifolia*				
	Salt Paperbark	*Melaleuca halmaturorum*		en	p	
	Tree Violet	*Melicytus dentatus s.l.*				
	Slender Mint	*Mentha diemenica*				
*	Pennyroyal	*Mentha pulegium*				
	Weeping Grass	*Microlaena stipoides var. stipoides*				
	Upright Water-milfoil	*Myriophyllum crispatum*				
*	Chilean Needle-grass	*Nassella neesiana*				R
	Grassland Wood-sorrel	*Oxalis perennans*				
*	Paspalum	*Paspalum dilatatum*				
	Short Purple-flag	*Patersonia fragilis*				
	Five-awned Spear-grass	*Pentapogon quadrifidus var. quadrifidus*				
*	Toowoomba Canary-grass	*Phalaris aquatica*				
*	Timothy Grass	*Phleum pratense*				
	Common Reed	*Phragmites australis*				
	Common Rice-flower	*Pimelea humilis*				
#	Sweet Pittosporum	*Pittosporum undulatum*				
*	Ribwort	*Plantago lanceolata*				
*	Annual Meadow-grass	*Poa annua s.s.*				
	Common Tussock-grass	*Poa labillardierei*				
	Soft Tussock-grass	*Poa morrisii*				
	Grey Tussock-grass	*Poa sieberiana var. sieberiana*				
	Slender Tussock-grass	*Poa tenera*				
	Austral Bracken	*Pteridium esculentum subsp. esculentum*				
	Buttercup	*Ranunculus spp.*				
*	Italian Buckthorn	*Rhamnus alaternus*				
*	Onion Grass	*Romulea rosea*				

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	CaLP Act
*	Sweet Briar	*Rosa rubiginosa*				C
*	Blackberry	*Rubus fruticosus spp. agg.*				C
	Slender Dock	*Rumex brownii*				
*	Curled Dock	*Rumex crispus*				
	Wiry Dock	*Rumex dumosus*				
*	Dock (naturalised)	*Rumex spp. (naturalised)*				
	Common Wallaby-grass	*Rytidosperma caespitosum*				
	Brown-back Wallaby-grass	*Rytidosperma duttonianum*				
	Smooth Wallaby-grass	*Rytidosperma laeve*				
	Slender Wallaby-grass	*Rytidosperma racemosum var. racemosum*				
	Bristly Wallaby-grass	*Rytidosperma setaceum*				
	Common Bog-sedge	*Schoenus apogon*				
*	Golden Thistle	*Scolymus hispanicus*				P
	Groundsel	*Senecio spp.*			p	
*	Slender Pigeon Grass	*Setaria parviflora*				
*	Variegated Thistle	*Silybum marianum*				R
*	Rough Sow-thistle	*Sonchus asper s.l.*				
*	Common Sow-thistle	*Sonchus oleraceus*				
*	Rat-tail Grass	*Sporobolus africanus*				
	Cranberry Heath	*Styphelia humifusa Astroloma humifusum*			p	
*	Garden Dandelion	*Taraxacum officinale spp. agg.*				
	Kangaroo Grass	*Themeda triandra*				
*	Sea Wheat-grass	*Thinopyrum junceiforme*				
	Twining Fringe-lily	*Thysanotus patersonii*			p	
	Yellow Rush-lily	*Tricoryne elatior*				
*	Narrow-leaf Clover	*Trifolium angustifolium var. angustifolium*				
*	Strawberry Clover	*Trifolium fragiferum var. fragiferum*				
*	White Clover	*Trifolium repens var. repens*				
*	Clover	*Trifolium spp.*				
*	Knotted Clover	*Trifolium striatum*				
	Dwarf Arrowgrass	*Triglochin nana*				
	Narrow-leaf Cumbungi	*Typha domingensis*				
	Broad-leaf Cumbungi	*Typha orientalis*				
*	Gorse	*Ulex europaeus*				C
*	Common Vetch	*Vicia sativa*				
*	Squirrel-tail Fescue	*Vulpia bromoides*				
*	Fox-tail Fescue	*Vulpia myuros f. megalura*				
	Sprawling Bluebell	*Wahlenbergia gracilis*				
	Naked Bluebell	*Wahlenbergia gymnoclada*				
*	Bulbil Watsonia	*Watsonia meriana var. bulbillifera*				R

Origin	Common name	Scientific name	EPBC	FFG-T	FFG-P	CaLP Act
	Common Early Nancy	*Wurmbea dioica*				
	Small Grass-tree	*Xanthorrhoea minor subsp. lutea*			p	
	Swamp Everlasting	*Xerochrysum palustre*	VU	cr	p	

Notes:

EPBC = threatened species status under EPBC Act: CR = critically endangered; EN = endangered; VU = vulnerable;

FFG-T = threatened species status under the FFG Act: cr = critically endangered; en = endangered

FFG-P = protected species status under the FFG Act: p = listed as protected;

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)

* = introduced to Victoria

= Victorian native taxa occurring outside their natural range

Appendix 9: EPBC Act Protected Matters Search

Australian Government

Department of Agriculture, Water and the Environment

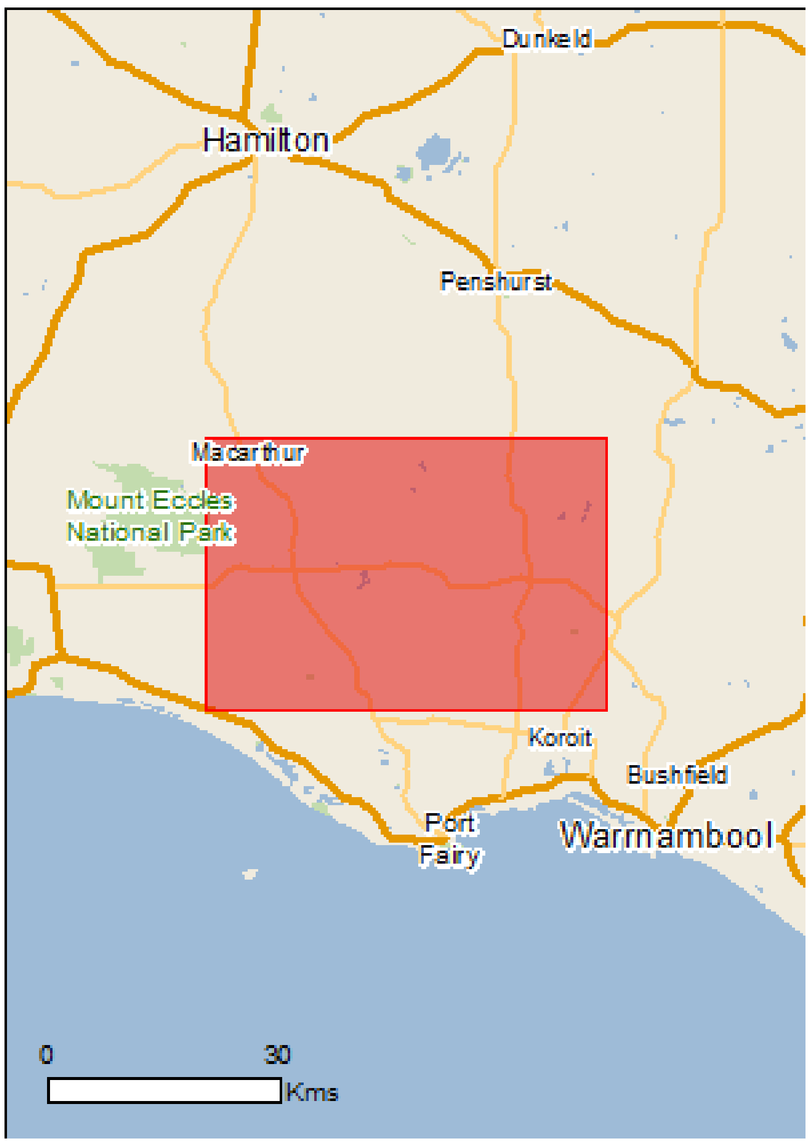
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

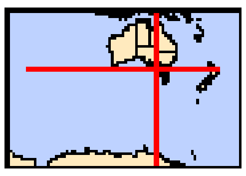
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/02/21 12:45:08



Coordinates

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	44
Listed Migratory Species:	14

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	30
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties		[Resource Information]
Name	State	Status
Budj Bim Cultural Landscape	VIC	Declared property

National Heritage Properties		[Resource Information]
Name	State	Status
Indigenous		
Budj Bim National Heritage Landscape - Mt Eccles Lake Condah Area	VIC	Listed place

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Falco hypoleucos		
Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor		
Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Neophema chrysogaster		
Orange-bellied Parrot [747]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Thinornis cucullatus cucullatus Hooded Plover (eastern), Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat may occur within area
Crustaceans		
Euastacus bispinosus Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat likely to occur within area
Fish		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat known to occur within area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat likely to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat likely to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Species or species habitat likely to occur within area
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Amphibromus fluitans		
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area
Dianella amoena		
Matted Flax-lily [64886]	Endangered	Species or species habitat known to occur within area
Dodonaea procumbens		
Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area
Glycine latrobeana		
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Ixodia achillaeoides subsp. arenicola		
Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat may occur within area
Lachnagrostis adamsonii		
Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area
Lepidium hyssopifolium		
Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area
Prasophyllum diversiflorum		
Gorae Leek-orchid [13210]	Endangered	Species or species habitat known to occur within area
Prasophyllum frenchii		
Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat likely to occur within area
Prasophyllum spicatum		
Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Pterostylis chlorogramma		
Green-striped Greenhood [56510]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cucullata		
Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area
Rutidosis leptorhynchoides		
Button Wrinklewort [67251]	Endangered	Species or species habitat may occur within area
Senecio psilocarpus		
Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area
Taraxacum cygnorum		
Coast Dandelion [2508]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra epipactoides		
Metallic Sun-orchid [11896]	Endangered	Species or species habitat may occur within area
Thelymitra matthewsii		
Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Xerochrysum palustre		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Broadwater I90 B.R.	VIC
Broadwater I91 B.R.	VIC
Budj Bim	VIC
Pretty Hill F.R	VIC
St Helens F.R	VIC
Unnamed P0059	VIC
Woolsthorpe N.C.R.	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
West Victoria RFA	Victoria

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.01667 141.95,-38.01667 142.41667,-38.26667 142.41667,-38.26667 141.95,-38.01667 141.95

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 10: Fauna species recorded or considered potential to occur at the proposed Willatook Wind Farm

Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Australasian Grebe	*Tachybaptus novaehollandiae*				X
Australasian Pipit	*Anthus novaeseelandiae*				X
Australasian Shoveler	*Anas rhynchotis*			vu	X
Australian Hobby	*Falco longipennis*				
Australian Magpie	*Gymnorhina tibicen*				X
Australian Pelican	*Pelecanus conspicillatus*				
Australian Raven	*Corvus coronoides*				X
Australian Reed-Warbler	*Acrocephalus australis*				X
Australian Shelduck	*Tadorna tadornoides*				X
Australian White Ibis	*Threskiornis molucca*				X
Australian Wood Duck	*Chenonetta jubata*				X
Baillon's Crake	*Porzana pusilla palustris*				
Banded Lapwing	*Vanellus tricolor*				X
Black Falcon	*Falco subniger*			cr	
Black Kite	*Milvus migrans*				
Black Swan	*Cygnus atratus*				X
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*				X
Black-fronted Dotterel	*Elseyornis melanops*				
Black-shouldered Kite	*Elanus axillaris*				X
Black-tailed Native-hen	*Tribonyx ventralis*				X
Black-winged Stilt	*Himantopus leucocephalus*				X
Blue-winged Parrot	*Neophema chrysostoma*				X
Brolga	*Grus rubicunda*			en	X
Brown Falcon	*Falco berigora*				X
Brown Goshawk	*Accipiter fasciatus*				X
Brown Quail	*Coturnix ypsilophora australis*				
Brown Songlark	*Cincloramphus cruralis*				X
Brown Thornbill	*Acanthiza pusilla*				X
Brown-headed Honeyeater	*Melithreptus brevirostris*				
Buff-banded Rail	*Gallirallus philippensis*				
Buff-rumped Thornbill	*Acanthiza reguloides*				
Cattle Egret	*Ardea ibis*		M (JAMBA, CAMBA)		
Chestnut Teal	*Anas castanea*				
Collared Sparrowhawk	*Accipiter cirrhocephalus*				
Common Blackbird	*Turdus merula*			*	X
Common Bronzewing	*Phaps chalcoptera*				X

Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Common Greenshank	*Tringa nebularia*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))	en	X
Common Starling	*Sturnus vulgaris*			*	X
Crested Pigeon	*Ocyphaps lophotes*				X
Crimson Rosella	*Platycercus elegans*				X
Dusky Moorhen	*Gallinula tenebrosa*				
Dusky Woodswallow	*Artamus cyanopterus*				
Eastern Great Egret	*Ardea modesta*			vu	X
Eastern Rosella	*Platycercus eximius*				X
Eastern Spinebill	*Acanthorhynchus tenuirostris*				
Emu	*Dromaius novaehollandiae*				
Eurasian Coot	*Fulica atra*				X
European Goldfinch	*Carduelis carduelis*				X
European Greenfinch	*Chloris chloris*			*	X
Eurasian Skylark	*Alauda arvensis*			*	X
Fairy Martin	*Petrochelidon ariel*				X
Fan-tailed Cuckoo	*Cacomantis flabelliformis*				
Flame Robin	*Petroica phoenicea*				X
Forest Raven	*Corvus tasmanicus*				X
Fork-tailed Swift	*Apus pacificus*		M (JAMBA, CAMBA, ROKAMBA)		X
Galah	*Eolophus roseicapilla*				X
Glossy Ibis	*Plegadis falcinellus*			vu	
Golden Whistler	*Pachycephala pectoralis*				
Golden-headed Cisticola	*Cisticola exilis*				X
Great Cormorant	*Phalacrocorax carbo*				
Grey Butcherbird	*Cracticus torquatus*				
Grey Currawong	*Strepera versicolor*				X
Grey Fantail	*Rhipidura albiscapa*				X
Grey Shrike-thrush	*Colluricincla harmonica*				X
Grey Teal	*Anas gracilis*				X
Hardhead	*Aythya australis*			vu	
Hoary-headed Grebe	*Poliocephalus poliocephalus*				X
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*				X
House Sparrow	*Passer domesticus*			*	X
Latham's Snipe	*Gallinago hardwickii*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H)		X
Laughing Kookaburra	*Dacelo novaeguineae*				X
Little Black Cormorant	*Phalacrocorax sulcirostris*				
Little Corella	*Cacatua sanguinea*				X

Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Little Eagle	*Hieraaetus morphnoides*			vu	
Little Grassbird	*Megalurus gramineus*				X
Little Pied Cormorant	*Microcarbo melanoleucos*				X
Little Raven	*Corvus mellori*				X
Long-billed Corella	*Cacatua tenuirostris*				X
Magpie-lark	*Grallina cyanoleuca*				X
Masked Lapwing	*Vanellus miles*				X
Masked Woodswallow	*Artamus personatus*				
Mistletoebird	*Dicaeum hirundinaceum*				
Musk Lorikeet	*Glossopsitta concinna*				
Nankeen Kestrel	*Falco cenchroides*				X
Nankeen Night Heron	*Nycticorax caledonicus hillii*				
New Holland Honeyeater	*Phylidonyris novaehollandiae*				X
Noisy Miner	*Manorina melanocephala*				X
Pacific Barn Owl	*Tyto javanica*				
Pacific Black Duck	*Anas superciliosa*				X
Pallid Cuckoo	*Cacomantis pallidus*				X
Peregrine Falcon	*Falco peregrinus*				X
Pied Currawong	*Strepera graculina*				X
Pink-eared Duck	*Malacorhynchus membranaceus*				X
Plumed Egret	*Ardea intermedia*			cr	
Purple Swamphen	*Porphyrio porphyrio*				X
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*				
Rainbow Lorikeet	*Trichoglossus haematodus*				
Red Wattlebird	*Anthochaera carunculata*				X
Red-browed Finch	*Neochmia temporalis*				X
Red-necked Stint	*Calidris ruficollis*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))		
Red-rumped Parrot	*Psephotus haematonotus*				X
Restless Flycatcher	*Myiagra inquieta*				
Royal Spoonbill	*Platalea regia*				X
Rufous Songlark	*Cincloramphus mathewsi*				X
Rufous Whistler	*Pachycephala rufiventris*				
Sacred Kingfisher	*Todiramphus sanctus*				
Sharp-tailed Sandpiper	*Calidris acuminata*		M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))		X
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*				X
Silver Gull	*Chroicocephalus novaehollandiae*				

Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Silvereye	*Zosterops lateralis*				X
Spotted Harrier	*Circus assimilis*				X
Southern Boobook	*Ninox novaeseelandiae*				
Spotless Crake	*Porzana tabuensis*				
Spotted Dove	*Streptopelia chinensis*				
Spotted Pardalote	*Pardalotus punctatus punctatus*				
Straw-necked Ibis	*Threskiornis spinicollis*				X
Striated Fieldwren	*Calamanthus fuliginosus*				X
Striated Pardalote	*Pardalotus striatus*				
Striated Thornbill	*Acanthiza lineata*				X
Stubble Quail	*Coturnix pectoralis*				X
Sulphur-crested Cockatoo	*Cacatua galerita*				X
Superb Fairy-wren	*Malurus cyaneus*				X
Swamp Harrier	*Circus approximans*				X
Tawny Frogmouth	*Podargus strigoides*				
Tree Martin	*Petrochelidon nigricans*				
Wedge-tailed Eagle	*Aquila audax*				X
Weebill	*Smicrornis brevirostris*				
Welcome Swallow	*Hirundo neoxena*				X
Whiskered Tern	*Chlidonias hybridus javanicus*				X
Whistling Kite	*Haliastur sphenurus*				X
White-browed Scrubwren	*Sericornis frontalis*				X
White-browed Woodswallow	*Artamus superciliosus*				
White-eared Honeyeater	*Lichenostomus leucotis*				X
White-faced Heron	*Egretta novaehollandiae*				X
White-fronted Chat	*Epthianura albifrons*				X
White-naped Honeyeater	*Melithreptus lunatus*				
White-necked Heron	*Ardea pacifica*				X
White-plumed Honeyeater	*Lichenostomus penicillatus*				X
White-throated Needletail	*Hirundapus caudacutus*	VU	M (JAMBA, CAMBA, ROKAMBA)	vu	
White-throated Treecreeper	*Cormobates leucophaeus*				
White-winged Chough	*Corcorax melanorhamphos*				X
White-winged Triller	*Lalage sueurii*				X
Willie Wagtail	*Rhipidura leucophrys*				X
Yellow Thornbill	*Acanthiza nana*				X
Yellow-billed Spoonbill	*Platalea flavipes*				X

Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Yellow-faced Honeyeater	*Lichenostomus chrysops*				X
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				X
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*				X
Black Rat	*Rattus rattus*			*	
Black Wallaby	*Wallabia bicolor*				X
Cat	*Felis catus*			*	X
Chocolate Wattled Bat	*Chalinolobus morio*				X
Common Brush-tailed Possum	*Trichosurus vulpecula*				
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*			cr	X
Eastern Falsistrelle	*Falsistrellus tasmaniensis*				X
Eastern Freetail Bat	*Mormopterus norfolkensis*				X
Eastern Grey Kangaroo	*Macropus giganteus*				X
Eastern Ring-tailed Possum	*Pseudocheirus peregrinus*				
European Hare	*Lepus europeaus*			*	X
European Rabbit	*Oryctolagus cuniculus*			*	X
Gould's Wattled Bat	*Chalinolobus gouldii*				X
House Mouse	*Mus musculus*			*	X
Inland Forest Bat	*Vespadelus baverstocki*				X
Koala	*Phascolarctos cinereus*				X
Large Forest Bat	*Vespadelus darlingtoni*				X
Lesser Long-eared Bat	*Nyctophilus geoffroyi*				X
Little Forest Bat	*Vespadelus vulturnus*				X
Red Fox	*Vulpes vulpes*				X
Red-necked Wallaby	*Macropus rufogriseus*				
Short-beaked Echidna	*Tachyglossus aculeatus*				X
Southern Bent-wing Bat	*Miniopterus orianae bassanii*			cr	X
Southern Forest Bat	*Vespadelus regulus*				
Southern Freetail Bat	*Ozimops planiceps*				X
Sugar Glider	*Petaurus breviceps*				
Swamp Rat	*Rattus lutreolus*				X
White-striped Freetail Bat	*Tadarida australis*				X
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*			dd	X
Blotched Blue-tongued Lizard	*Tiliqua nigrolutea*				X
Common Blue-tongued Lizard	*Tiliqua scincoides*				
Eastern Brown Snake	*Pseudonaja textilis*				X
Eastern Three-lined Skink	*Acritoscincus duperreyi*				X
Garden Skink	*Lampropholis guichenoti*				

Common name	Scientific name	EPBC-T	EPBC-M	FFG	Recorded
Glossy Grass Skink	*Pseudemoia rawlinsoni*			en	X
Lowland Copperhead	*Austrelaps superbus*				X
Southern Grass Skink	*Pseudemoia entrecasteauxii*				X
Southern Water Skink	*Eulamprus tympanum tympanum*				
Tiger Snake	*Notechis scutatus*				X
Tussock Skink	*Pseudemoia pagenstecheri*			en	
White-lipped Snake	*Drysdalia coronoides*				X
White's Skink	*Liopholis whitii GROUP*				X
Common Froglet	*Crinia signifera*				X
Common Spadefoot Toad	*Neobatrachus sudellae*				
Growling Grass Frog	*Litoria raniformis*	VU		vu	X
Southern Brown Tree Frog	*Litoria ewingii*				X
Southern Bullfrog	*Limnodynastes dumerilii*				X
Southern Smooth Froglet	*Geocrinia laevis*				
Spotted Marsh Frog	*Limnodynastes tasmaniensis*				X
Striped Marsh Frog	*Limnodynastes peronii*				X
Bluespot Goby	*Pseudogobius olorum*				
Brown Trout	*Salmo trutta*				
Common Galaxias	*Galaxias maculatus*				
Congolli	*Pseudaphritis urvillii*				
Little Galaxias	*Galaxiella toourtkoourt*	VU		en	X
Flathead Gudgeon	*Philypnodon grandiceps*				
Macquarie Perch	*Macquaria australasica*				
Mountain Galaxias	*Galaxias olidus*				
River Blackfish	*Gadopsis marmoratus*				
Southern Pygmy Perch	*Nannoperca australis*				
Southern Shortfin Eel	*Anguilla australis*				X
Spotted Galaxias	*Galaxias truttaceus*				
Tupong	*Pseudaphritis urvillii*				
Yarra Pygmy Perch	*Nannoperca obscura*	VU		vu	X

Notes: EPBC-T = threatened species status under EPBC Act (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 - species listed explicitly; CAMBA - China- Australia Migratory Birds Agreement; JAMBA - Japan-Australia Migratory Birds Agreement; ROKAMBA - Republic of Korea Australia Migratory Birds Agreement); **FFG** = status under FFG Act (cr = critically endangered; en = endangered; vu = vulnerable); * = introduced to Victoria.

Appendix 11: Detailed bat survey effort for each monitoring site

Org	Site	Start date	End date	Survey period	Nights	latitude	longitude
EHP	1	24/02/2011	10/03/2011	Autumn 2011	14	-38.1393	142.075354
EHP	2	16/02/2011	31/03/2011	Autumn 2011	29	-38.1678	142.086444
EHP	3	10/11/2010	22/11/2010	Spring 2010	12	-38.1696	142.089082
EHP	4	10/11/2010	22/11/2010	Spring 2010	12	-38.1653	142.111554
EHP	5	9/02/2011	16/02/2011	Autumn 2011	7	-38.135	142.123164
EHP	6	27/10/2010	3/11/2010	Spring 2010	7	-38.1352	142.127694
EHP	7	20/10/2010	27/10/2010	Spring 2010	7	-38.145	142.139364
EHP	8	16/02/2011	24/02/2011	Autumn 2011	8	-38.1349	142.157544
BL&A	8	1/11/2018	8/11/2018	Spring 2018	7	-38.1349	142.15702
EHP	9	20/10/2010	27/10/2010	Spring 2010	7	-38.1321	142.172364
EHP	10	27/10/2010	3/11/2010	Spring 2010	7	-38.1334	142.182544
EHP	11	24/02/2011	10/03/2011	Autumn 2011	14	-38.1398	142.189113
EHP	12	3/11/2010	10/11/2010	Spring 2010	7	-38.1327	142.191954
EHP	13	3/11/2010	10/11/2010	Spring 2010	7	-38.1332	142.199963
EHP	14	10/03/2011	31/03/2011	Autumn 2011	21	-38.136	142.207283
EHP	15	10/11/2010	22/11/2010	Spring 2010	12	-38.1307	142.207353
EHP	16	27/10/2010	3/11/2010	Spring 2010	7	-38.133	142.219543
EHP	17	3/11/2010	10/11/2010	Spring 2010	7	-38.1244	142.219373
EHP	18	16/02/2011	24/02/2011	Autumn 2011	8	-38.0949	142.191654
EHP	19	20/10/2010	27/10/2010	Spring 2010	7	-38.0952	142.191643
EHP	20	9/02/2011	24/02/2011	Autumn 2011	15	-38.1232	142.259453
EHP	21	24/02/2011	10/03/2011	Autumn 2011	14	-38.1234	142.264443
EHP	22	10/11/2010	22/11/2010	Spring 2010	12	-38.1627	142.237843
EHP	23	10/11/2010	22/11/2010	Spring 2010	12	-38.1662	142.174004
EHP	24	20/10/2010	27/10/2010	Spring 2010	7	-38.1836	142.157104
EHP	25	16/02/2011	24/02/2011	Autumn 2011	8	-38.1836	142.163634
EHP	25	27/10/2010	3/11/2010	Spring 2010	7	-38.1835	142.163724
EHP	26	9/02/2011	16/02/2011	Autumn 2011	7	-38.1837	142.174404
EHP	27	10/03/2011	31/03/2011	Autumn 2011	21	-38.1835	142.174384
EHP	28	9/02/2011	16/02/2011	Autumn 2011	7	-38.1376	142.023794
EHP	29	24/02/2011	10/03/2011	Autumn 2011	14	-38.215	142.156434
EHP	30	27/10/2010	3/11/2010	Spring 2010	7	-38.2163	142.177934
EHP	31	20/10/2010	27/10/2010	Spring 2010	7	-38.2161	142.183704
BL&A	32	8/11/2018	15/11/2018	Spring 2018	7	-38.2166	142.1773
EHP	32	3/11/2010	10/11/2010	Spring 2010	7	-38.2168	142.184903
EHP	33	16/02/2011	31/03/2011	Autumn 2011	29	-38.2173	142.192914
EHP	34	9/02/2011	16/02/2011	Autumn 2011	7	-38.2129	142.199153
BL&A	35	29/11/2018	5/12/2018	Spring 2018	6	-38.1142	142.179837
BL&A	36	27/02/2019	30/04/2019	Summer/Autumn 2019	62	-38.1094	142.179159
BL&A	36	29/11/2018	5/12/2018	Spring 2018	6	-38.1091	142.179081

Org	Site	Start date	End date	Survey period	Nights	latitude	longitude
BL&A	37	21/11/2018	29/11/2018	Spring 2018	8	-38.0975	142.181184
BL&A	38	1/11/2018	8/11/2018	Spring 2018	7	-38.095	142.190902
BL&A	39	5/12/2018	13/12/2018	Spring 2018	8	-38.1027	142.191727
BL&A	40	20/11/2018	29/11/2018	Spring 2018	9	-38.1092	142.191651
BL&A	41	7/02/2019	30/04/2019	Summer/Autumn 2019	82	-38.1138	142.19181
BL&A	42	28/02/2019	27/03/2019	Summer/Autumn 2019	27	-38.1203	142.191893
BL&A	42	15/11/2018	20/11/2018	Spring 2018	5	-38.1202	142.191849
BL&A	43	7/02/2019	28/02/2019	Summer/Autumn 2019	21	-38.1242	142.189944
BL&A	44	27/02/2019	30/04/2019	Summer/Autumn 2019	62	-38.1475	142.086224
BL&A	44	31/10/2018	7/11/2018	Spring 2018	7	-38.1474	142.086213
BL&A	45	8/11/2018	15/11/2018	Spring 2018	7	-38.1535	142.086326
BL&A	46	1/11/2018	7/11/2018	Spring 2018	6	-38.1705	142.088393
BL&A	47	27/02/2019	1/05/2019	Summer/Autumn 2019	63	-38.168	142.101557
Nature Advisory	47	19/02/2020	28/04/2020	Autumn 2019 - Autumn 2020	69	-38.168	142.10154
BL&A	48	27/02/2019	1/05/2019	Summer/Autumn 2019	63	-38.1674	142.101552
BL&A	49	27/02/2019	1/05/2019	Summer/Autumn 2019	63	-38.1669	142.10156
Nature Advisory	49	19/02/2020	28/04/2020	Autumn 2019 - Autumn 2020	69	-38.1669	142.10154
BL&A	50	27/02/2019	1/05/2019	Summer/Autumn 2019	63	-38.1663	142.101553
Nature Advisory	50	19/02/2020	28/04/2020	Autumn 2019 - Autumn 2020	69	-38.1664	142.10156
BL&A	51	27/02/2019	1/05/2019	Summer/Autumn 2019	63	-38.1657	142.101559
Nature Advisory	51	19/02/2020	28/04/2020	Autumn 2019 - Autumn 2020	69	-38.1659	142.10153
BL&A	52	15/11/2018	20/11/2018	Spring 2018	5	-38.1555	142.108904
BL&A	53	27/03/2019	1/05/2019	Summer/Autumn 2019	35	-38.1426	142.114225
Nature Advisory	54	19/02/2020	20/05/2020	Autumn 2019 - Autumn 2020	91	-38.1441	142.1137
Nature Advisory	55	19/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	70	-38.1447	142.113737
Nature Advisory	56	19/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	70	-38.1453	142.113796
Nature Advisory	57	19/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	70	-38.1458	142.113878
Nature Advisory	58	19/02/2020	20/05/2020	Autumn 2019 - Autumn 2020	91	-38.1464	142.113874
BL&A	59	1/11/2018	7/11/2018	Spring 2018	6	-38.1359	142.130517
BL&A	60	6/02/2019	27/02/2019	Summer/Autumn 2019	21	-38.1659	142.115547
BL&A	61	28/02/2019	30/04/2019	Summer/Autumn 2019	61	-38.1678	142.128117
BL&A	61	8/11/2018	15/11/2018	Spring 2018	7	-38.1678	142.128074

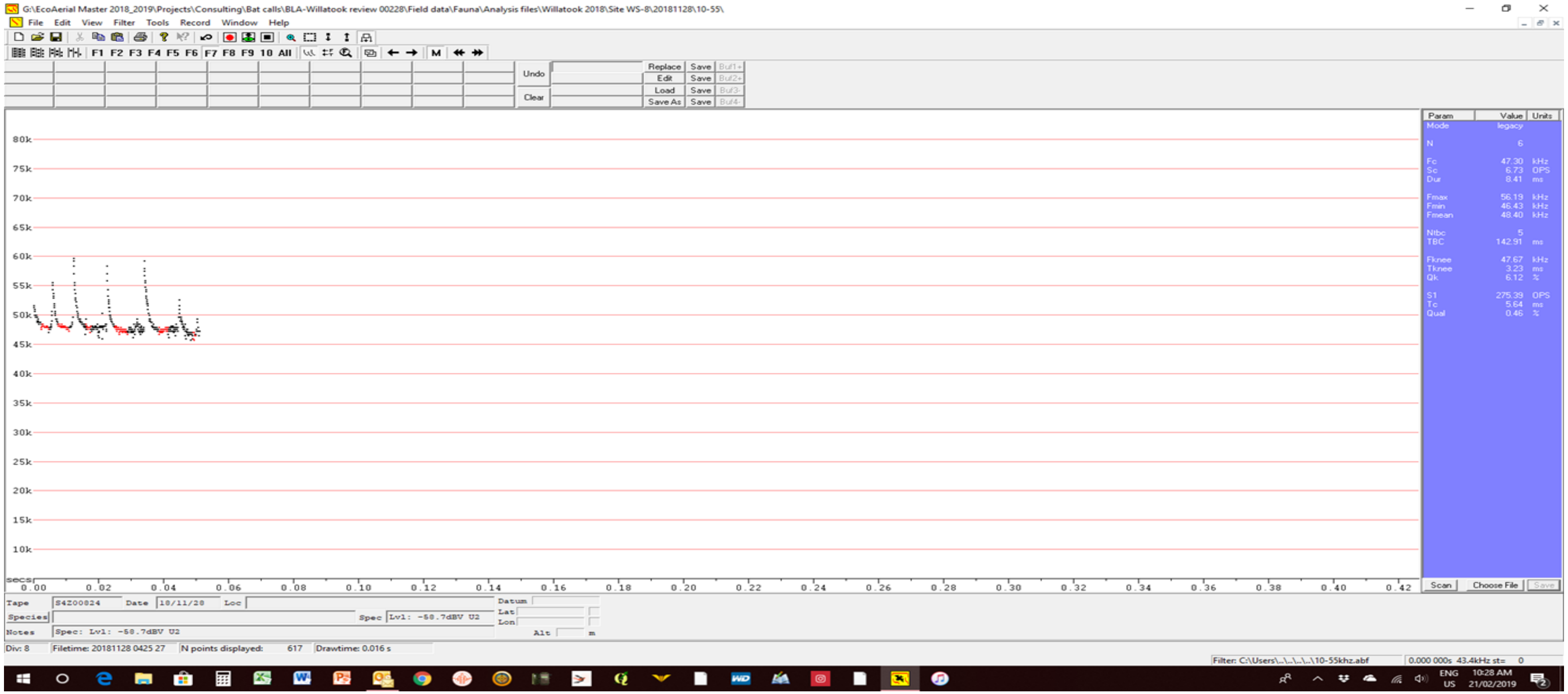
Org	Site	Start date	End date	Survey period	Nights	latitude	longitude
BL&A	62	6/02/2019	27/02/2019	Summer/Autumn 2019	21	-38.1722	142.116246
BL&A	63	27/02/2019	30/04/2019	Summer/Autumn 2019	62	-38.1749	142.116198
BL&A	64	20/11/2018	29/11/2018	Spring 2018	9	-38.1755	142.112775
BL&A	65	6/02/2019	27/02/2019	Summer/Autumn 2019	21	-38.178	142.110747
BL&A	66	6/02/2019	28/02/2019	Summer/Autumn 2019	22	-38.1822	142.106505
BL&A	67	25/10/2018	1/11/2018	Spring 2018	7	-38.1348	142.17342
BL&A	68	28/02/2019	1/05/2019	Summer/Autumn 2019	62	-38.1447	142.165852
BL&A	69	7/02/2019	28/02/2019	Summer/Autumn 2019	21	-38.1448	142.17297
BL&A	70	25/10/2018	1/11/2018	Spring 2018	7	-38.1463	142.169614
BL&A	71	28/02/2019	1/05/2019	Summer/Autumn 2019	62	-38.1602	142.157192
BL&A	71	5/12/2018	13/12/2018	Spring 2018	8	-38.1602	142.157192
BL&A	72	28/11/2018	4/12/2018	Spring 2018	6	-38.1608	142.162403
BL&A	73	25/10/2018	1/11/2018	Spring 2018	7	-38.1676	142.173131
BL&A	74	25/10/2018	1/11/2018	Spring 2018	7	-38.1855	142.157079
BL&A	75	7/02/2019	30/04/2019	Summer/Autumn 2019	82	-38.1847	142.162815
BL&A	75	25/10/2018	1/11/2018	Spring 2018	7	-38.1846	142.162759
BL&A	76	24/10/2018	31/10/2018	Spring 2018	7	-38.1847	142.174481
BL&A	77	5/12/2018	13/12/2018	Spring 2018	8	-38.1836	142.180811
BL&A	78	5/12/2018	13/12/2018	Spring 2018	8	-38.138	142.219822
BL&A	79	27/02/2019	30/04/2019	Summer/Autumn 2019	62	-38.1377	142.239429
BL&A	79	15/11/2018	21/11/2018	Spring 2018	6	-38.1377	142.239443
BL&A	80	1/11/2018	8/11/2018	Spring 2018	7	-38.1549	142.199999
BL&A	81	7/02/2019	30/04/2019	Summer/Autumn 2019	82	-38.1596	142.209
BL&A	82	8/11/2018	15/11/2018	Spring 2018	7	-38.1588	142.211931
BL&A	83	15/11/2018	21/11/2018	Spring 2018	6	-38.164	142.217501
BL&A	84	7/02/2019	30/04/2019	Summer/Autumn 2019	82	-38.1632	142.241171
BL&A	85	7/02/2019	30/04/2019	Summer/Autumn 2019	82	-38.1687	142.235634
BL&A	86	21/11/2018	29/11/2018	Spring 2018	8	-38.1683	142.230563
BL&A	87	7/02/2019	30/04/2019	Summer/Autumn 2019	82	-38.1691	142.2287
BL&A	88	29/11/2018	5/12/2018	Spring 2018	6	-38.1725	142.229356
Nature Advisory	89	20/02/2020	26/10/2020	Autumn 2019 - Autumn 2020	68	-38.1778	142.24663
Nature Advisory	90	20/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	68	-38.1778	142.24597
Nature Advisory	91	20/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	68	-38.1778	142.24528
Nature Advisory	92	20/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	68	-38.1778	142.24455

Org	Site	Start date	End date	Survey period	Nights	latitude	longitude
Nature Advisory	93	20/02/2020	29/04/2020	Autumn 2019 - Autumn 2020	33	38.17784	142.24389
Nature Advisory	94	29/04/2020	20/05/2020	Autumn 2019 - Autumn 2020	21	-38.1425	142.129284
Nature Advisory	95	29/04/2020	20/05/2020	Autumn 2019 - Autumn 2020	21	-38.1447	142.128302
Nature Advisory	96	20/05/2020	1/09/2020	Autumn 2019 - Autumn 2020	22	-38.1528	142.171632
Nature Advisory	97	20/05/2020	1/09/2020	Autumn 2019 - Autumn 2020	22	-38.1526	142.169246
BL&A	98	28/02/2019	30/04/2019	Summer/Autumn 2019	61	-38.1548	142.112346
EHP	Eastern Met Mast ground	9/02/2011	31/03/2011	Autumn 2011	59	-38.1764	142.17172
BL&A	Eastern Met Mast ground	6/02/2019	1/05/2019	Summer/Autumn 2019	84	-38.1763	142.17209
BL&A	Eastern Met Mast ground	25/10/2018	14/12/2018	Spring 2018	50	-38.1764	142.17172
EHP	Eastern Met Mast ground	20/10/2010	22/11/2010	Spring 2010	19	-38.1763	142.17172
Nature Advisory	Eastern Met Mast height	19/02/2020	25/07/2020	Autumn 2019 - Autumn 2020	295	-38.1763	142.17172
Nature Advisory	Eastern Met Mast height	25/07/2020	26/10/2020	Autumn 2019 - Autumn 2020	295	-38.1764	142.171772
EHP	Eastern Met Mast height	9/02/2011	31/03/2011	Autumn 2011	59	-38.1764	142.17172
BL&A	Eastern Met Mast height	6/02/2019	1/05/2019	Summer/Autumn 2019	84	-38.1763	142.17209
BL&A	Eastern Met Mast height	8/11/2018	3/12/2018	Spring 2018	25	-38.1764	142.171772
EHP	Eastern Met Mast height	19/10/2010	26/10/2010	Spring 2010	26	-38.1763	142.17172
BL&A	Western Met Mast ground	6/02/2019	30/04/2019	Summer/Autumn 2019	83	-38.1624	142.106408
Nature Advisory	Western Met Mast ground	19/02/2020	25/07/2020	Autumn 2019 - Autumn 2020	200	-38.1624	142.106386
BL&A	Western Met Mast ground	8/11/2018	7/12/2018	Spring 2018	29	-38.1625	142.106642
BL&A	Western Met Mast height	6/02/2019	30/04/2019	Summer/Autumn 2019	83	-38.1624	142.106408
Nature Advisory	Western Met Mast height	25/07/2020	26/10/2020	Autumn 2019 - Autumn 2020	218	-38.1624	142.106386

Org	Site	Start date	End date	Survey period	Nights	latitude	longitude
BL&A	Western Met Mast height	8/11/2018	13/12/2018	Spring 2018	35	-38.1624	142.106386

Appendix 12: Results from bat call peer review

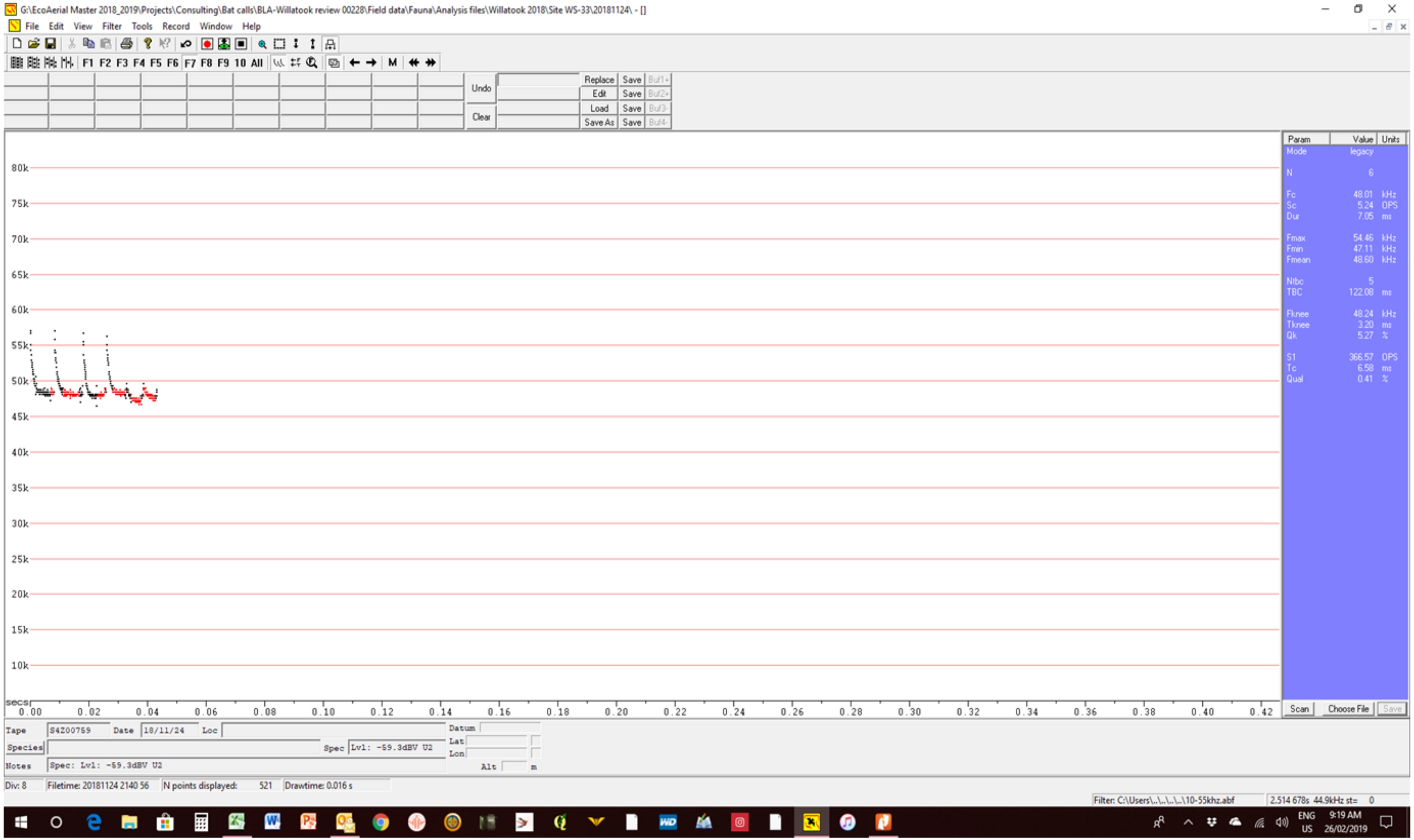
Initial identification undertaken by Rob Gration from EcoAerial, peer review by Greg Ford (GF) from Balance Environmental.



Southern Bent-wing Bat

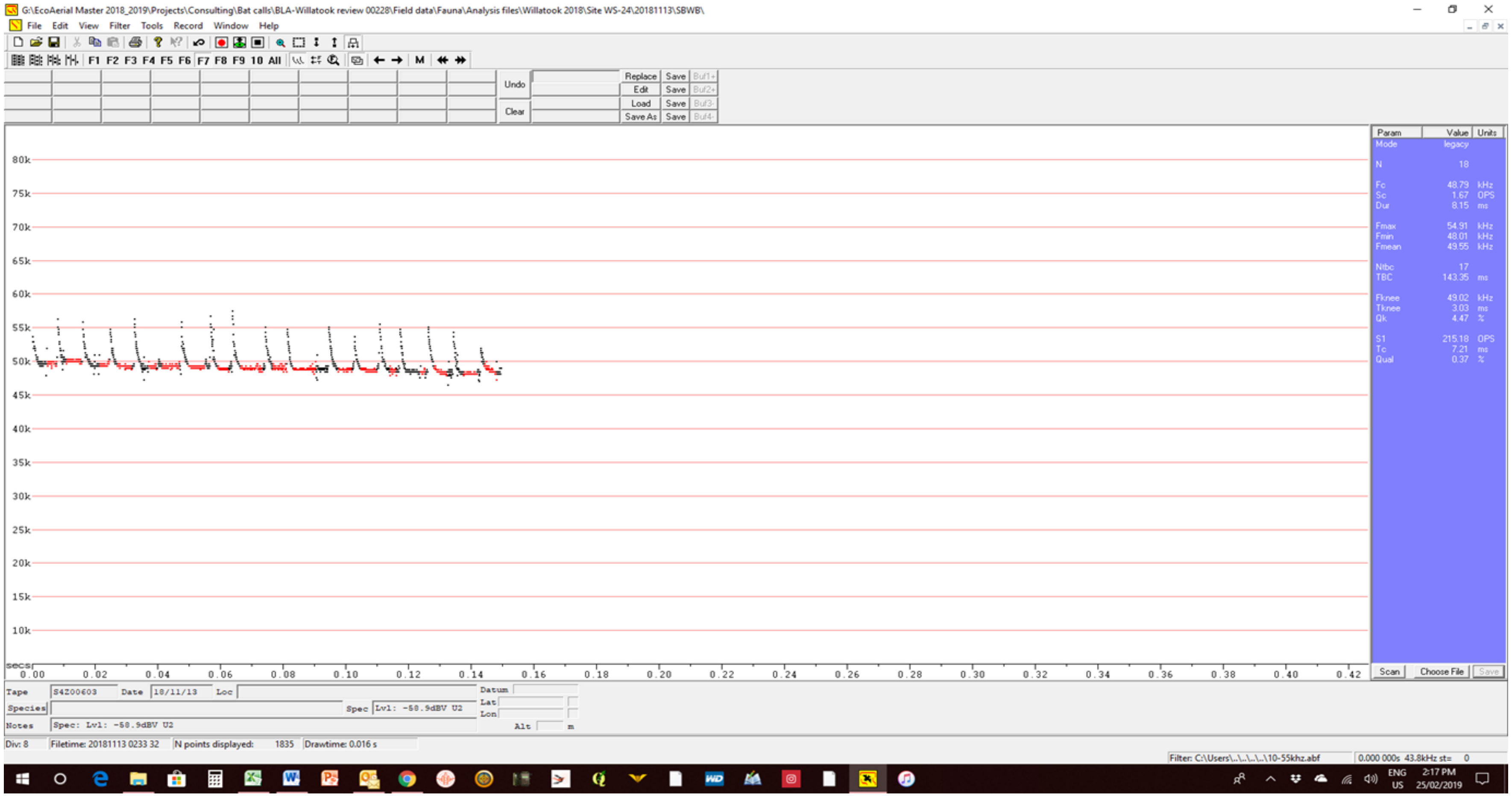
GF – agree

This set of SBWB calls have similar pulse shapes to the calls of Little Forest Bat (LFB), but on average the total pulse duration (Dur) is greater and the pulse body duration (difference between time to characteristic frequency Tc and time to knee Tk) constitutes a considerably greater proportion of the total duration of each pulse (>0.44 SBWB *cf.* <0.31 LFB in the calls presented herein). However, see comments below the 5th SBWB call in this set.



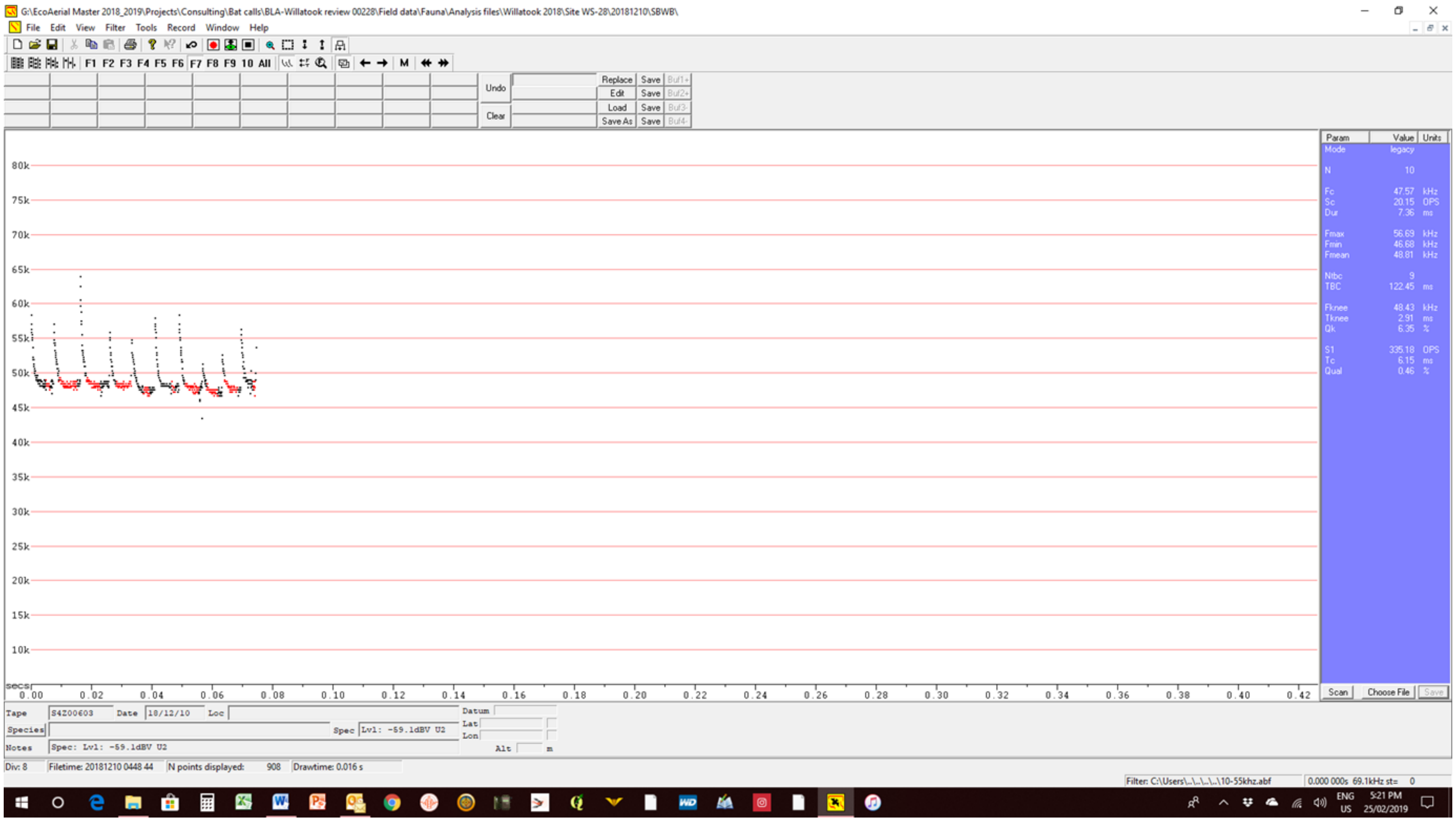
Southern Bent-wing Bat

GF – agree



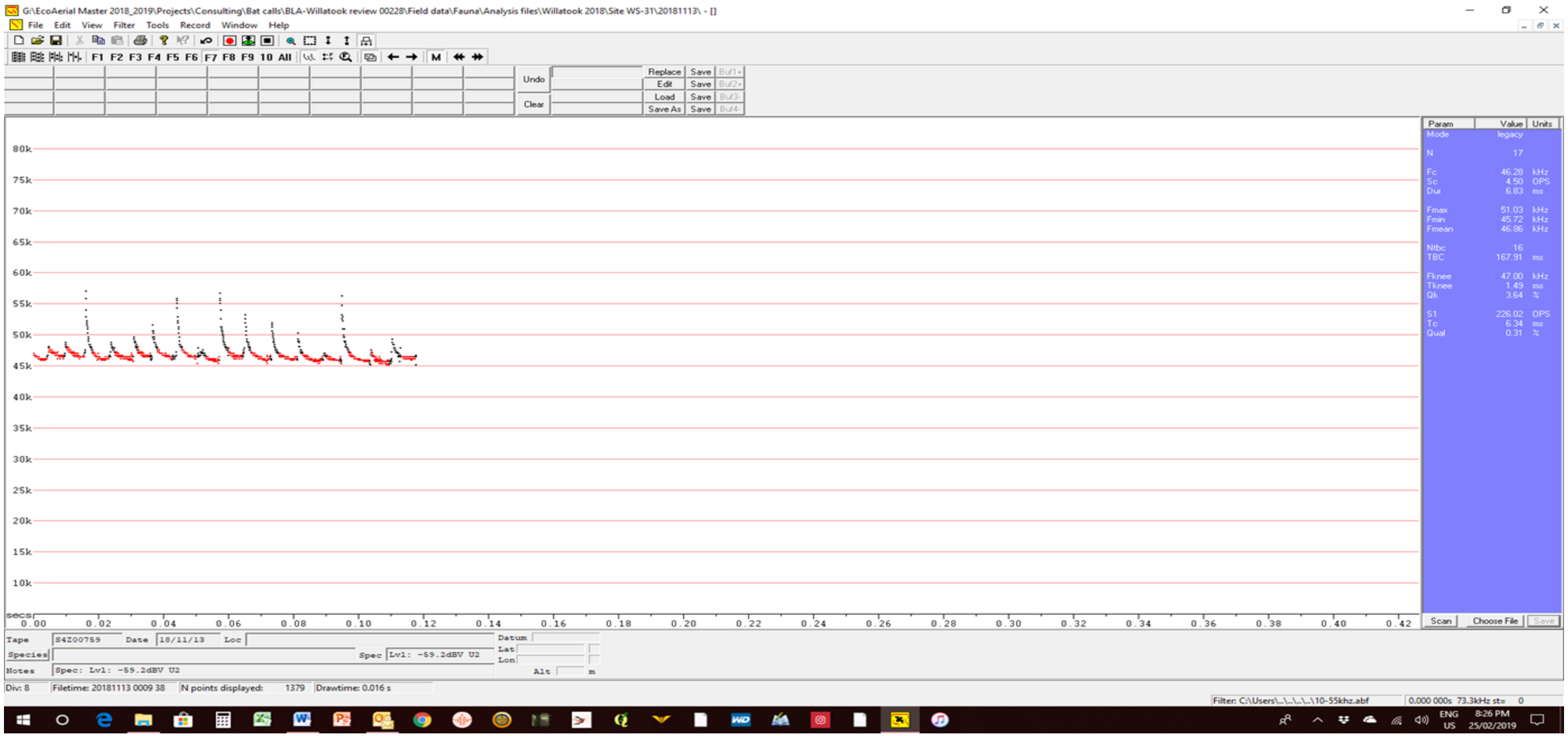
Southern Bent-wing Bat

GF – agree



Southern Bent-wing Bat

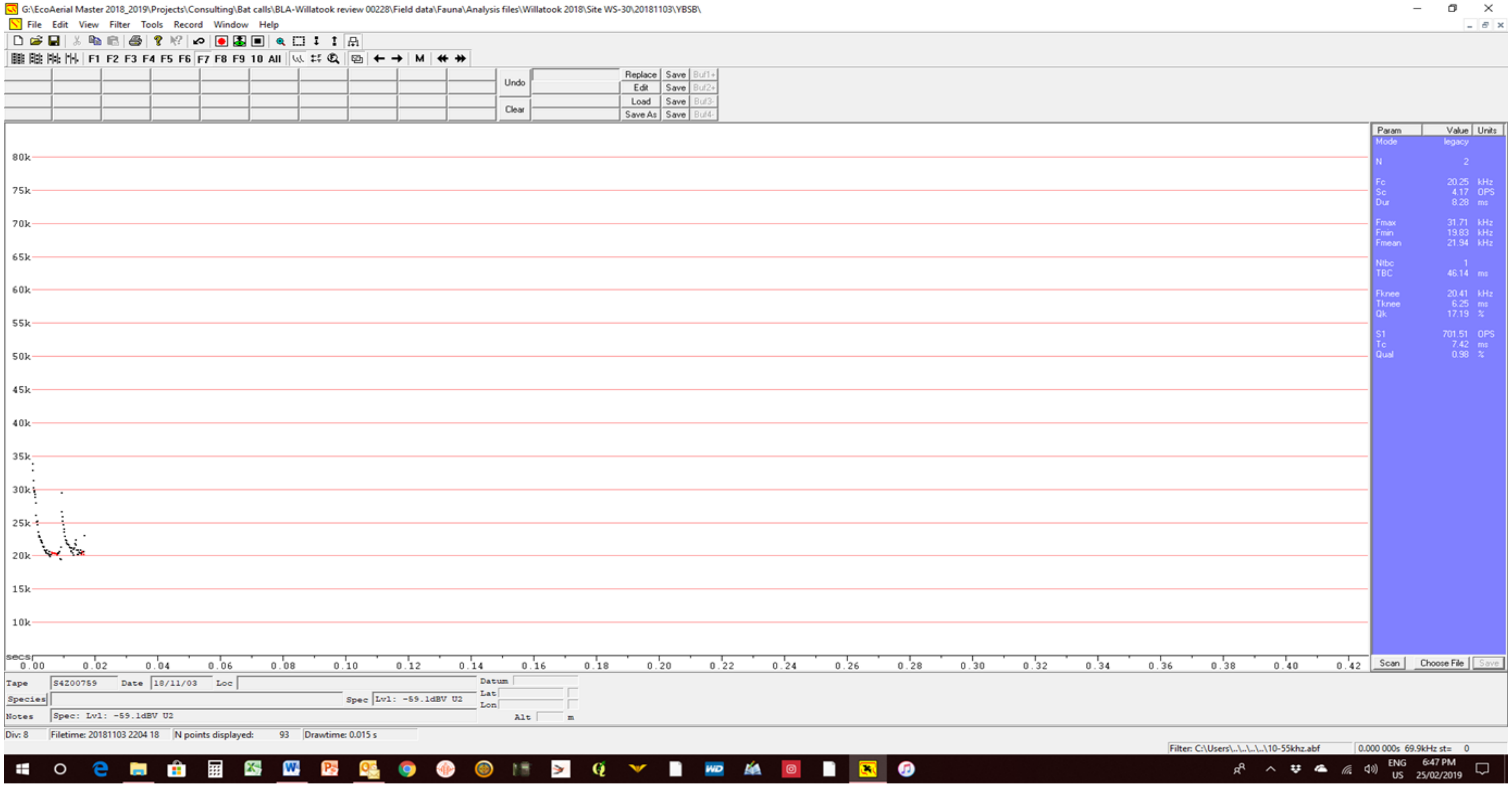
GF – agree



Southern Bent-wing Bat

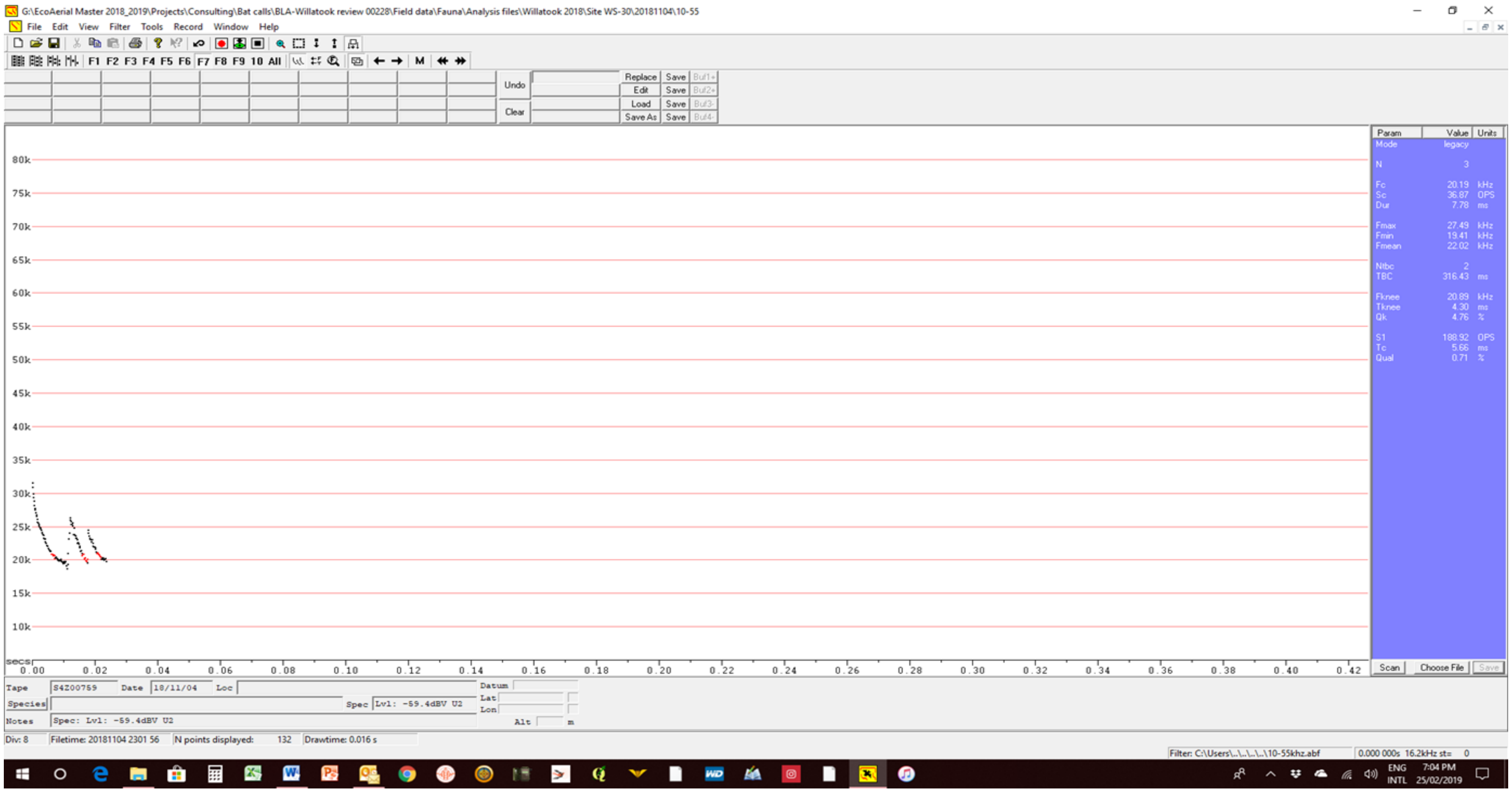
GF – agree

There appears to be an error in calculation of the Dur metric (pulse duration); the pulses appear to be of similar duration to the other bentwing calls displayed above, but the Dur is apparently 6.83ms (*cf.* 7.05-8.41 ms in above spectrograms). This measured value is closer to the Dur of little forest bat (see below), which has physical appearance of much shorter pulses than those in the above spectrogram and measures at Dur=6.13ms



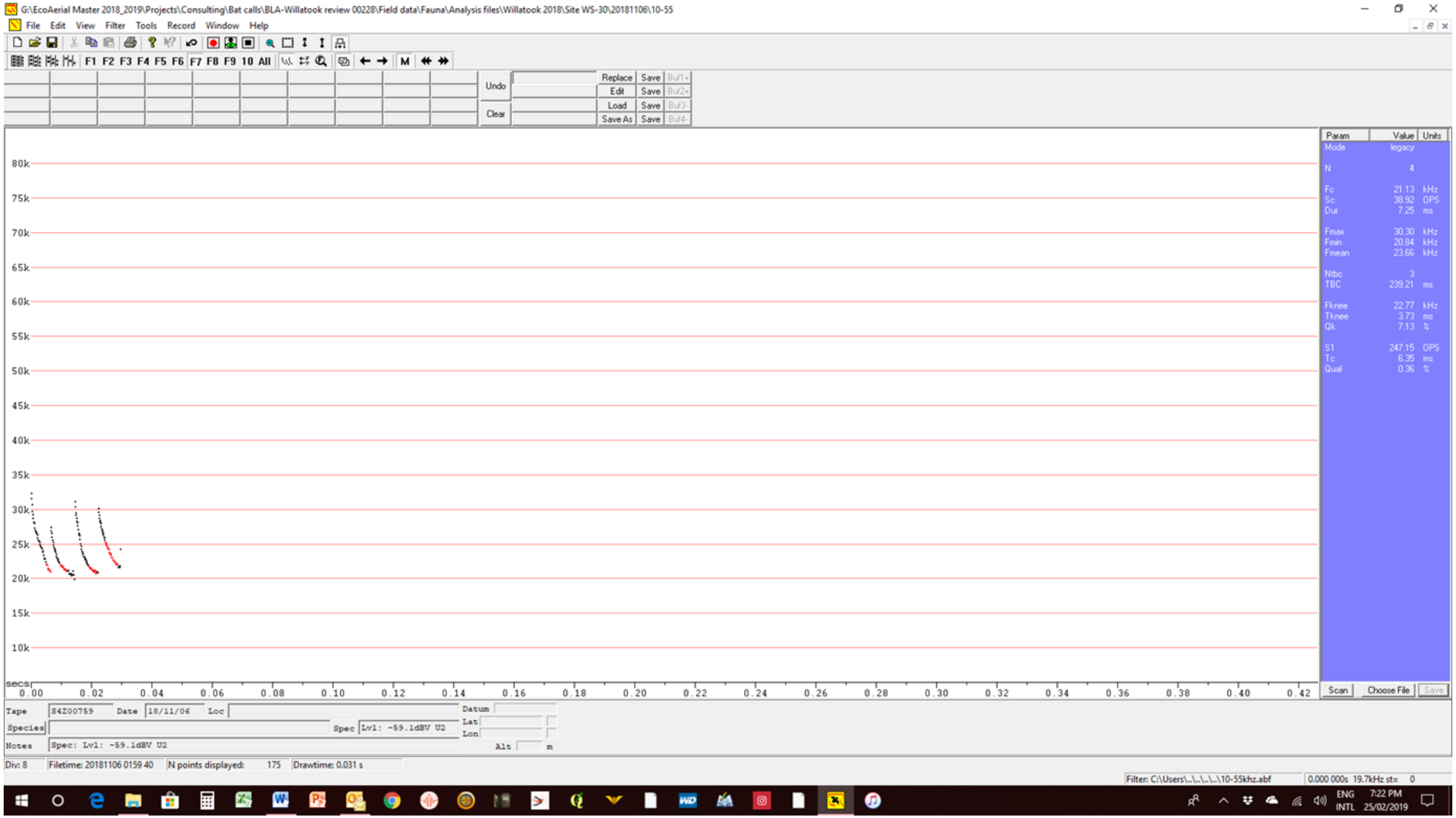
Yellow-bellied Sheathtatil Bat ; *__potentially__*. (The call shape doesn't match what I normally associate with YBSB however; the frequency of the call at 20kHz meets YBSB criteria. There are no other Victorian bats that call at this frequency).

GF – agree with tentative ID and reasoning – pulse shape definitely atypical and (perhaps remotely) possible that it is part of a social call or abberrant frequency emission by Gould's Wattled Bat



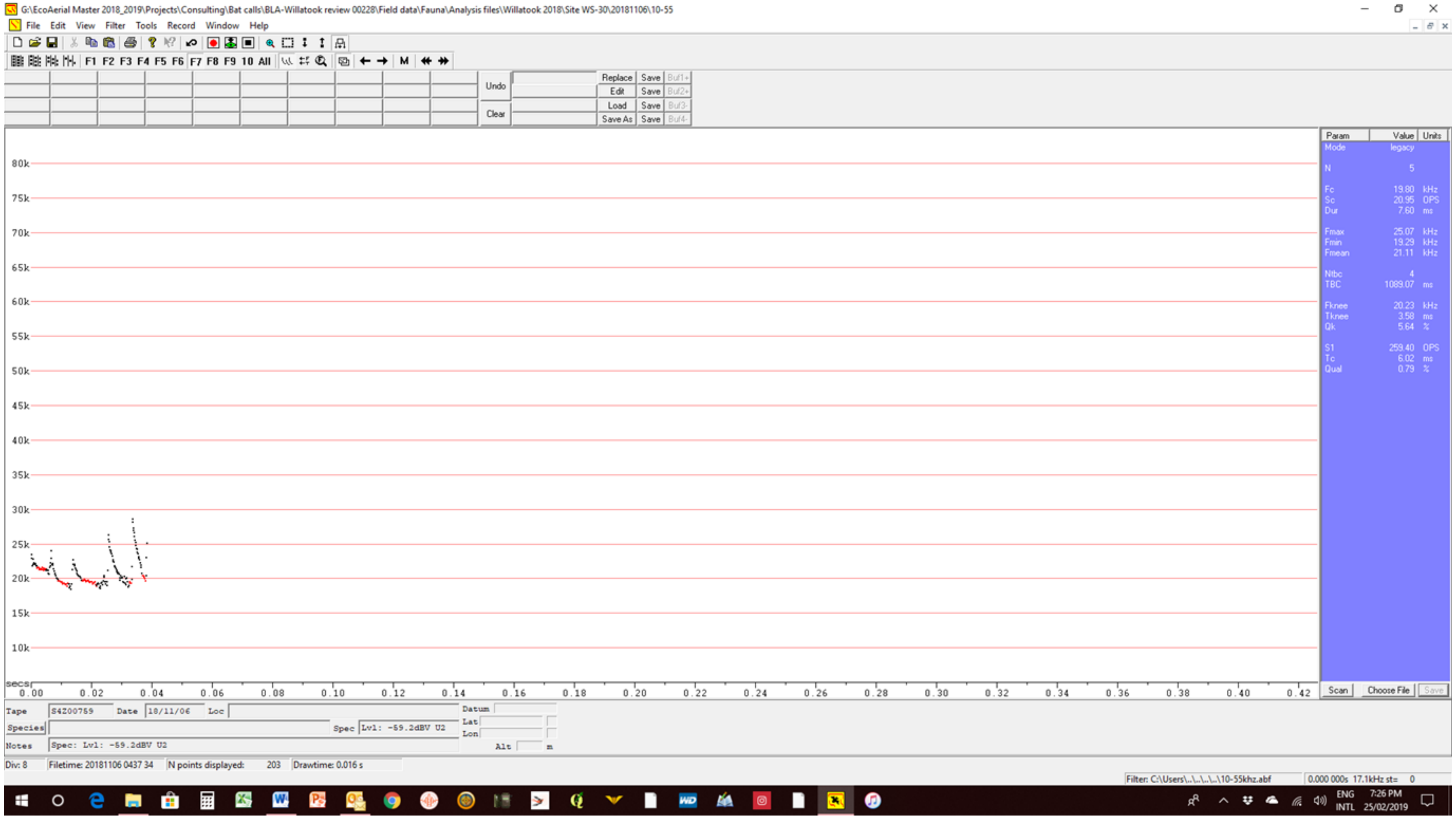
Yellow-bellied Sheathtatil Bat ; _potentially_. (The call shape doesn't match what I normally associate with YBSB however; the frequency of the call at 20kHz meets YBSB criteria. There are no other Victorian bats that call at this frequency).

GF – agree with tentative ID – pulse slope and erratic shape suggests possible alternative is that it is part of a clutter/foraging sequence by White-striped Freetial Bat – could be second harmonic of that species being rendered by ZCA rather than the more typical rendering of 1st harmonic at *ca.* 10 kHz



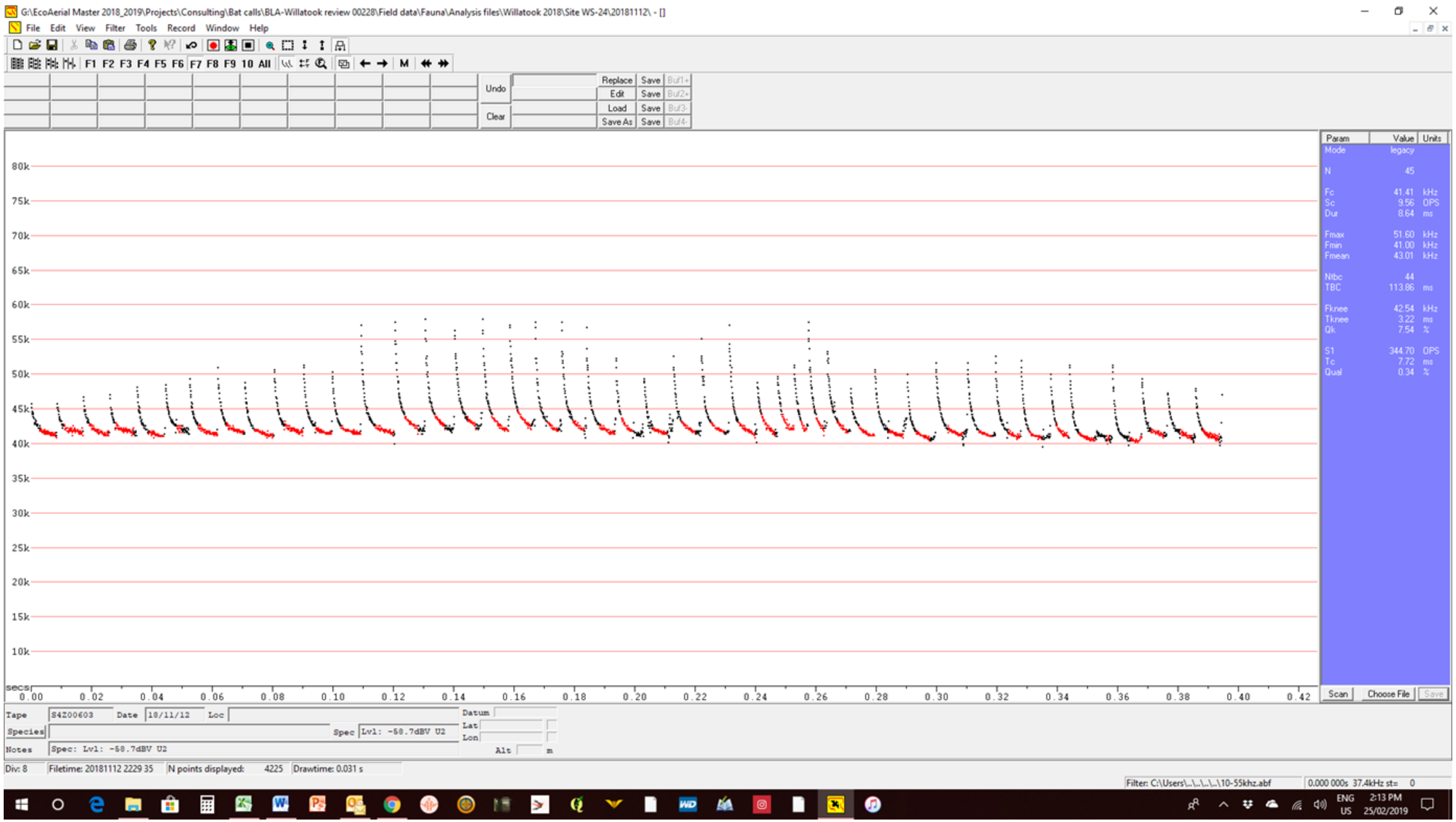
Yellow-bellied Sheathtatil Bat ; *potentially*. (The call shape doesn't match what I normally associate with YBSB however; the frequency of the call at 20kHz meets YBSB criteria. There are no other Victorian bats that call at this frequency).

GF – comments as per previous call



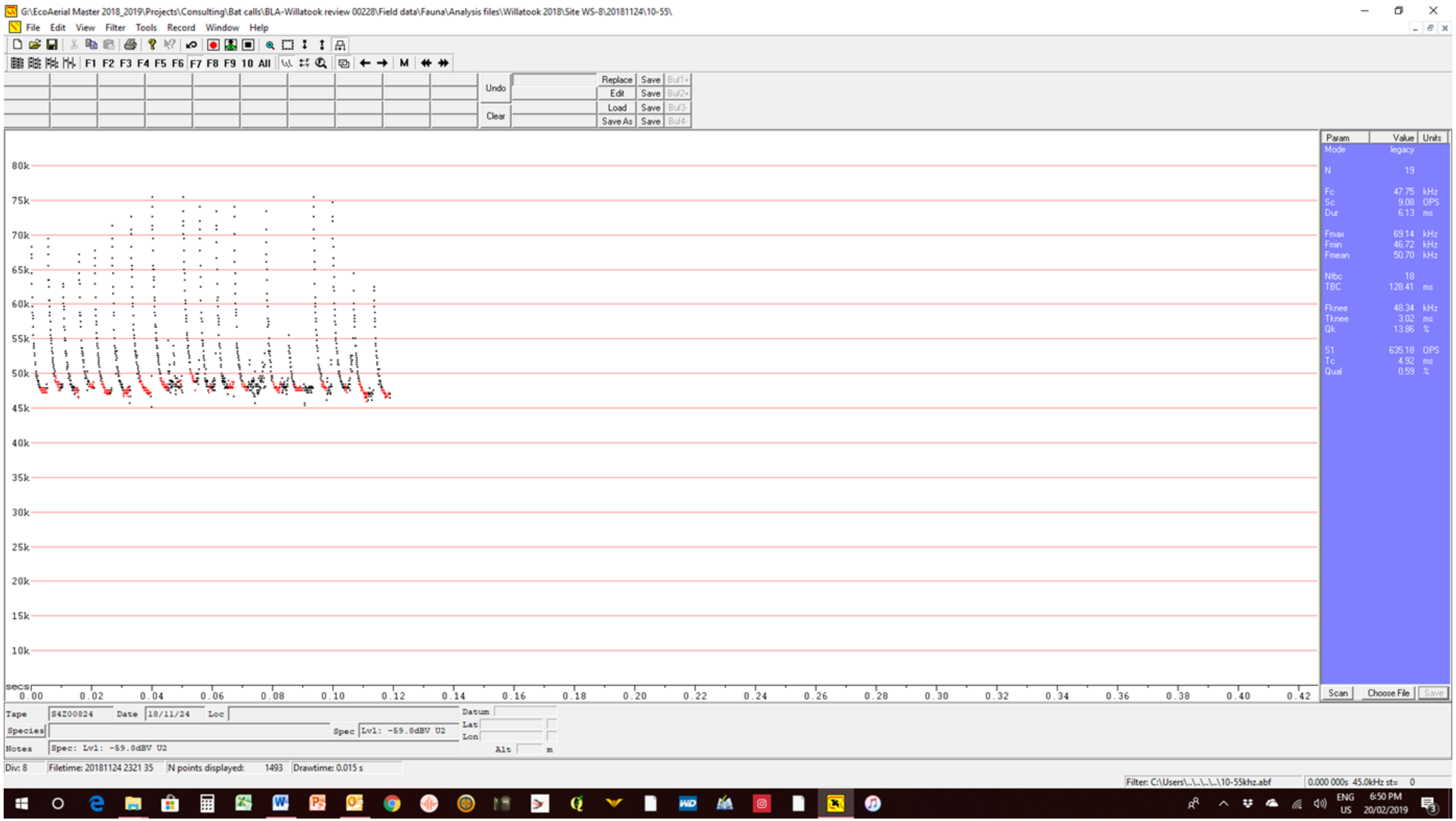
Yellow-bellied Sheathtatil Bat ; _potentially_. (The call shape doesn't match what I normally associate with YBSB however; the frequency of the call at 20kHz meets YBSB criteria. There are no other Victorian bats that call at this frequency).

GF – atypical pulses – again, could represent 2nd harmonic of White-striped freetail or aberrant/social call by Gould's Wattled

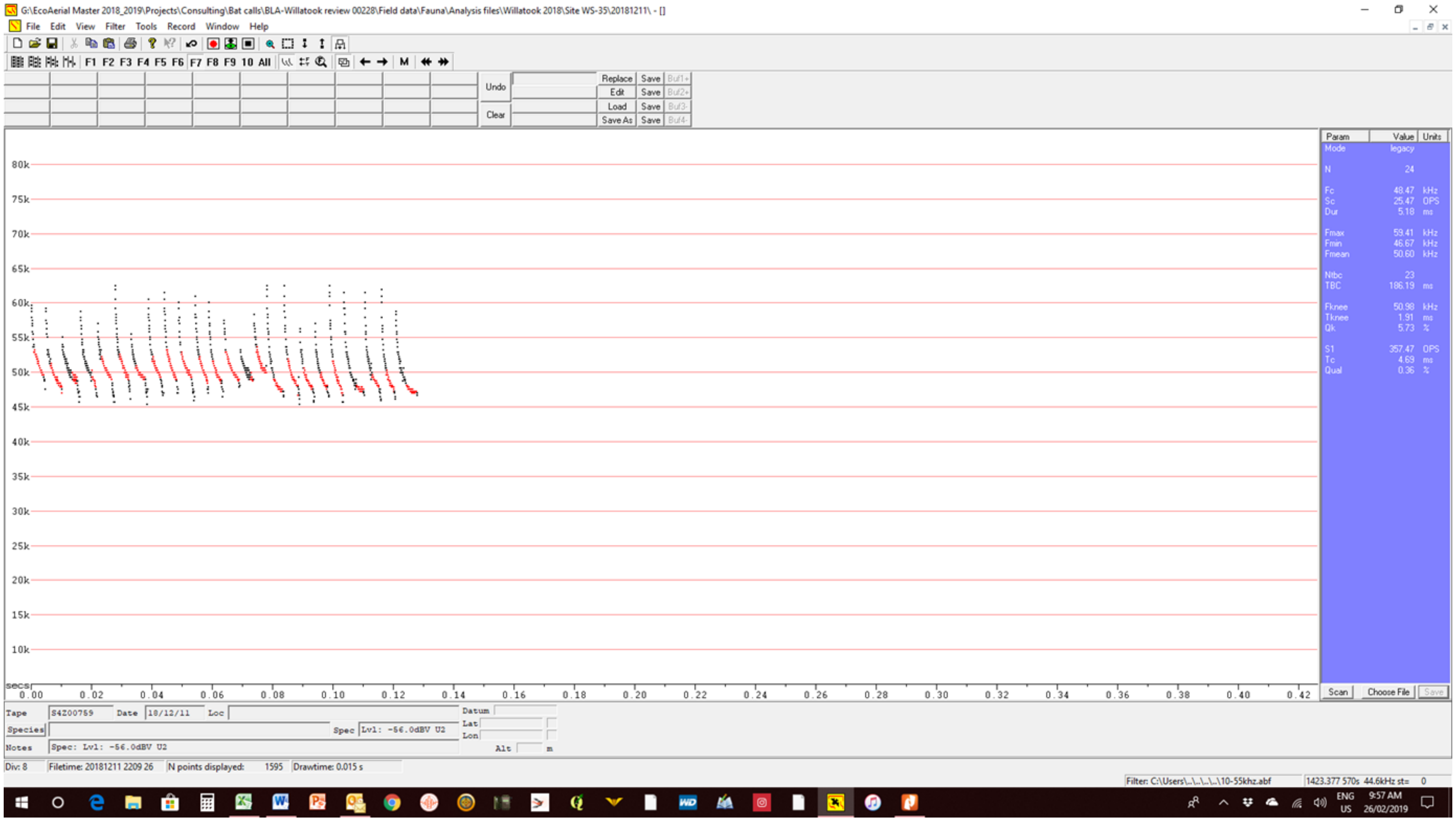


Large Forest Bat

GF - agree

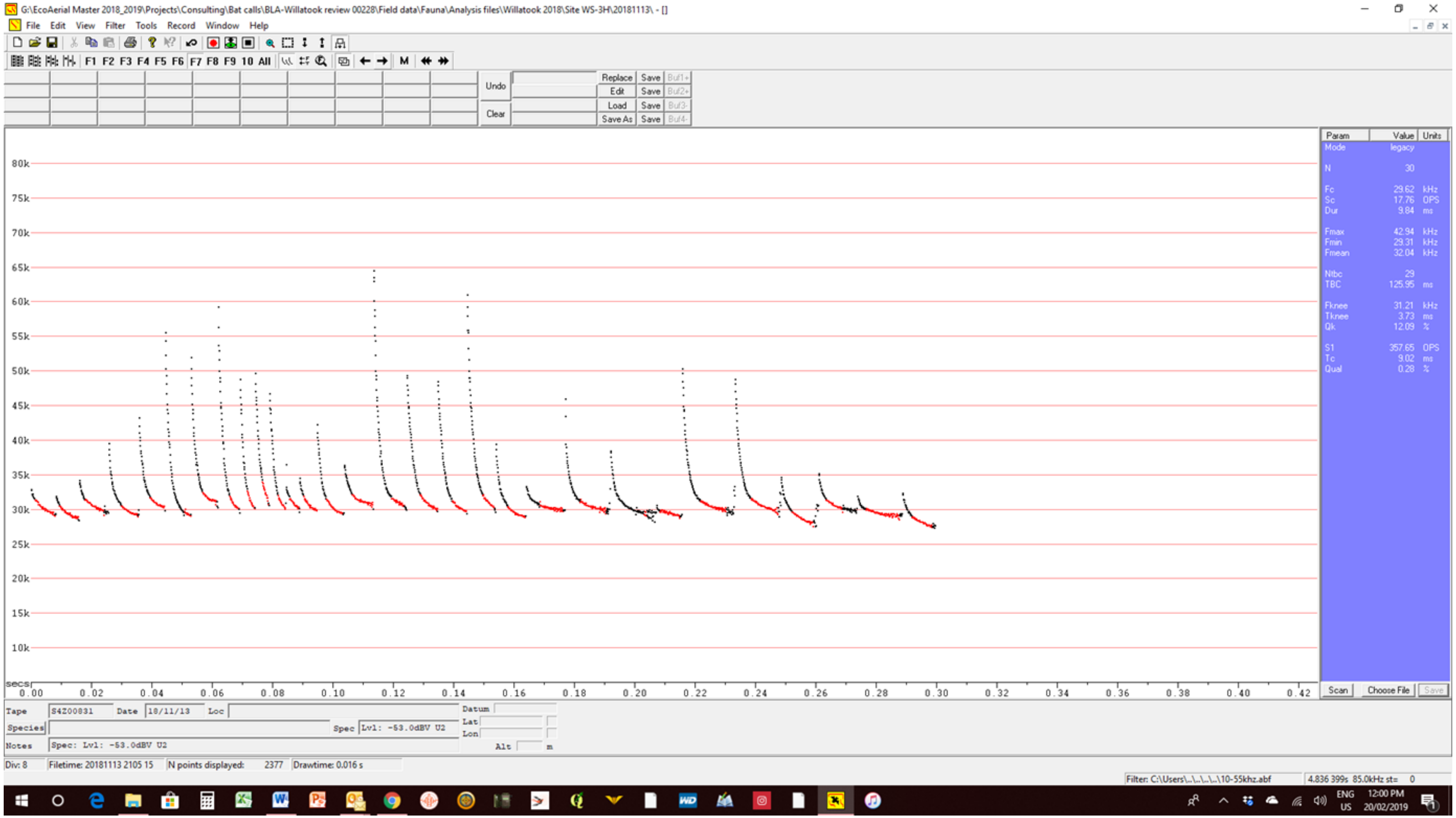


Little Forest Bat



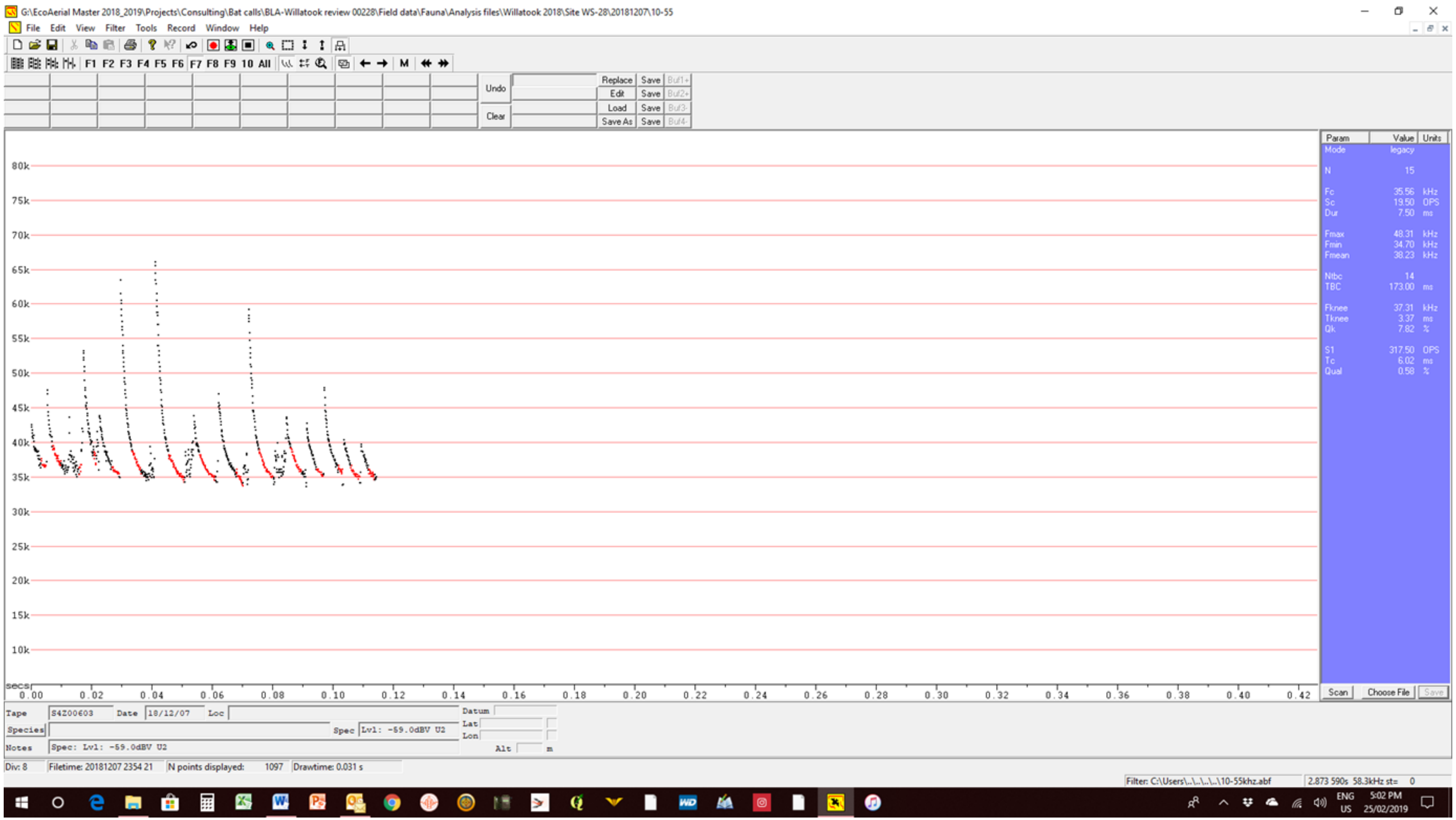
Chocolate Wattled Bat

GF – probably correct ID; however, pulses at right are getting a little low in frequency, so could be Southern Bentwing Bat flying in clutter



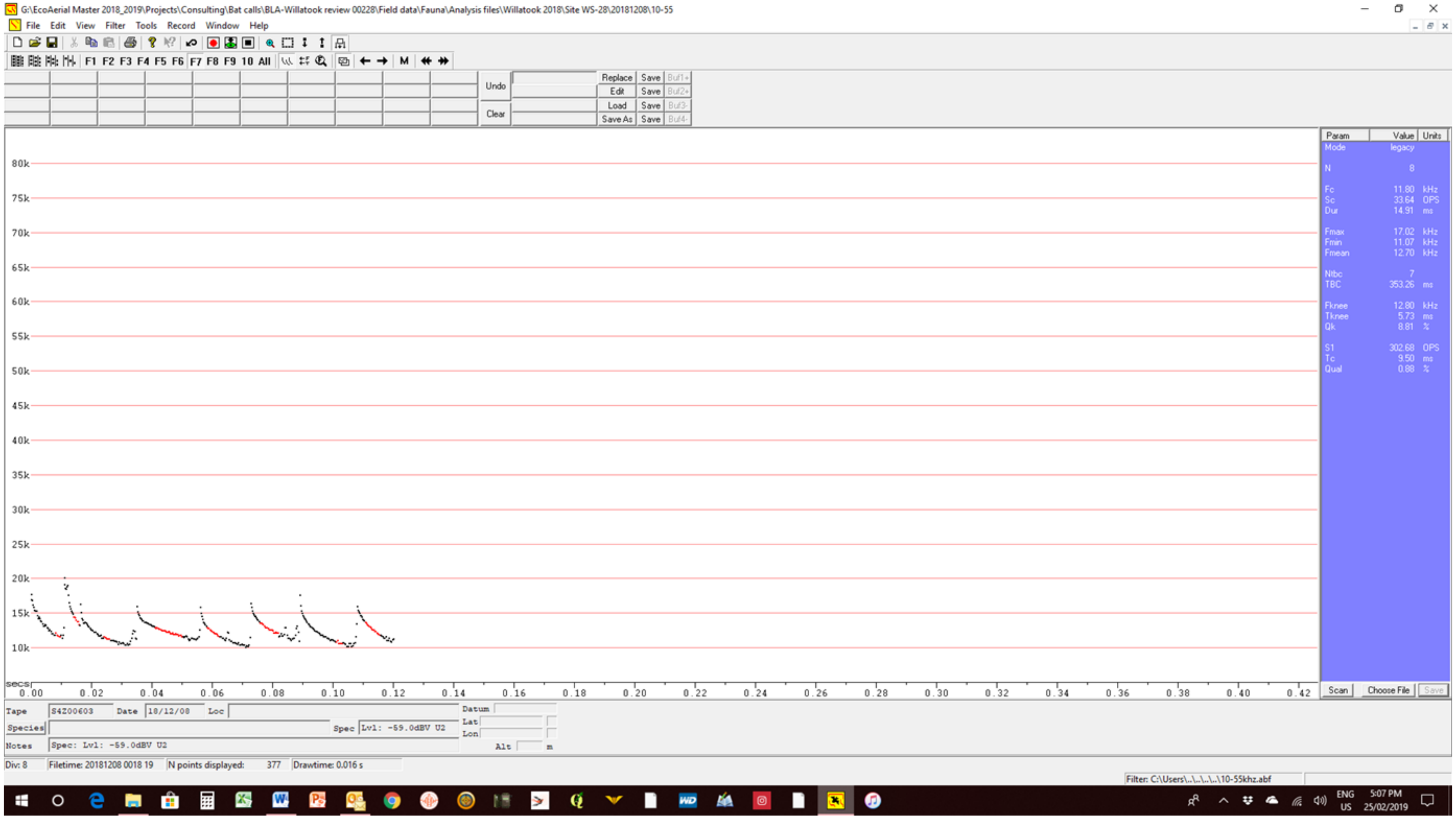
Gould's Wattled Bat

GF - agree



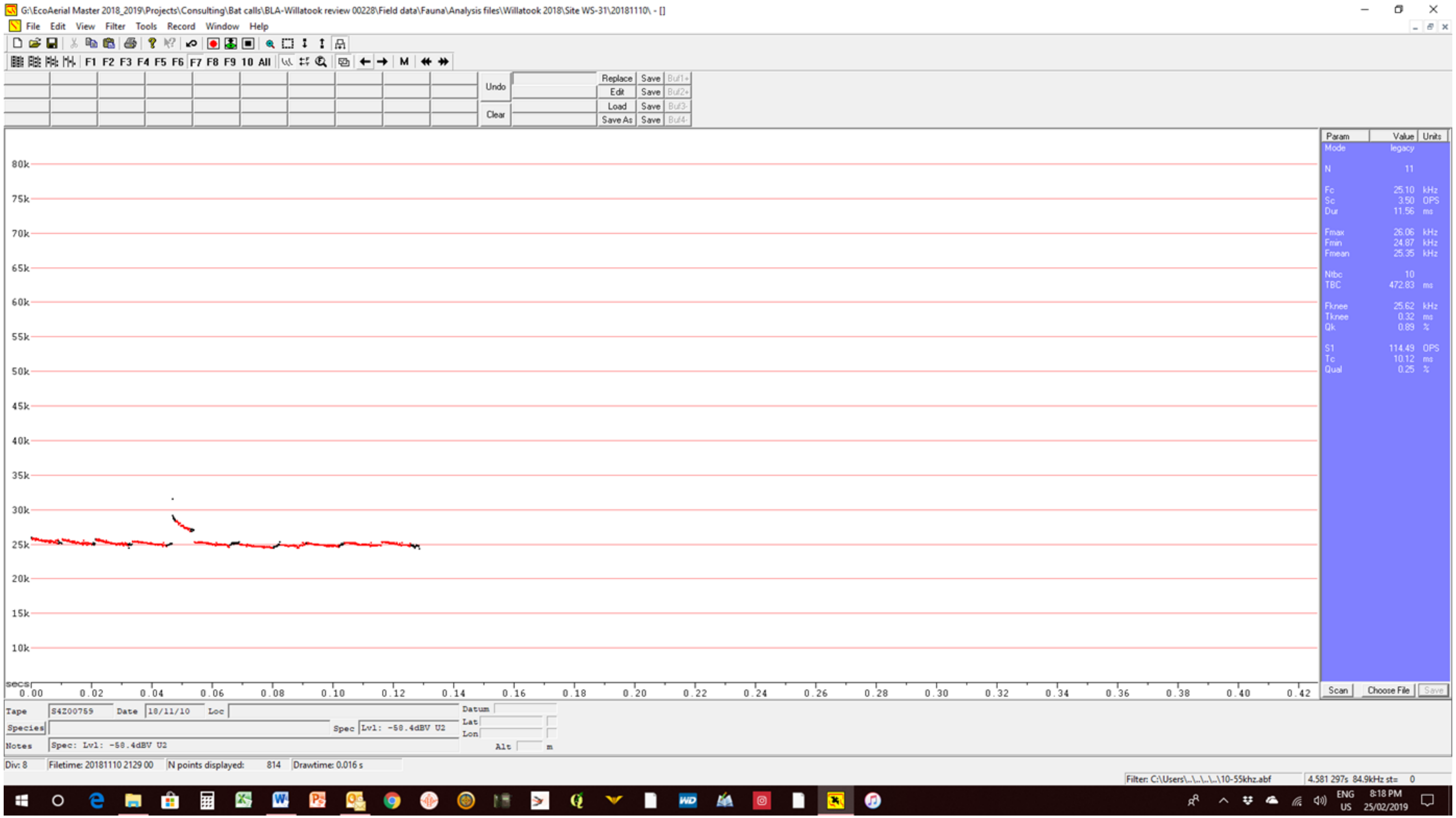
Eastern Falsistrelle

GF - agree



White-striped freetail bat

GF - agree



Southern Freetail Bat

GF - agree

Appendix 13: BBAMP bat monitoring program

The Bird and Bat Adaptive Management Plan (BBAMP) will be implemented for Willatook Wind Farm (WWF) detailing a monitoring program to understand the impact of the wind farm on bids and bats and describe an adaptive bird and bat management framework for responding to impacts of concern. In summary, the program includes targeted bird and bat utilisation surveys over a two-year period and an initial two years of monthly carcass searches under a fixed random sub-set of turbines. The results of this initial program will inform the requirements for subsequent surveys and carcass searches for the remainder of the operation of the WWF and associated trials, providing direction for any re-focussed or species-specific investigation and mitigation.

Bat monitoring programs are outlined below with a specific focus on detecting and responding to impacts on the Southern Bent-winged Bat. This species is listed under both the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the state *Flora and Fauna Guarantee Act* 1988 (FFG Act).

1.1 Baseline monitoring

Baseline bat monitoring (bat detector surveys) has occurred during the planning stage and commenced in 2009. Bat monitoring at the WWF has gathered baseline data to inform the assessment of impacts and any required strategies for further monitoring and mitigation. Small numbers of Southern Bent-wing Bat calls have been recorded in baseline monitoring which occurred over five years between 2009 and 2021, totalling almost 5,000 detector-nights, the most comprehensive baseline bat survey for any Victorian wind farm. Future monitoring of bats at the WWF have a specific focus on identifying and responding to impacts on the Southern Bent-wing Bat. This is detailed below.

1.2 Operational phase monitoring

Operational phase monitoring sits within an adaptive management framework. Should a significant impact be detected (see later) then contingency mitigation measures will be adopted, thereby ensuring a rapid response to an urgent issue, should it arise. Thereafter, monitored impacts, if considered significant, will be mitigated based on focussed investigations to understand risk behaviour and its cause, and associated targeted mitigation measures. To achieve this, two broad approaches have been adopted in this BBAMP:

- Investigations to monitor bat activity (deploying bat detectors) and ongoing bat mortality (carcass searches) that aim to monitor impacts (displacement, collisions) occurring in the initial two years of project operation; and
- Specific responses to impact triggers involving stepped up carcass searching, contingency mitigation measures, if required, investigation of risk behaviours and development of targeted mitigation strategies and methods.

Section 1.2.1 describes the survey methods to be implemented once WWF becomes operational. Section 1.2.2 describe the ongoing mortality monitoring methods, including correction factor trials (scavenging and detection rates).

Specific responses to impact triggers, such as impacts on listed species, are an ongoing requirement for the life of the project and the scope and scale of the monitoring, as well as the nature of any mitigation measures will be governed by the decision-making framework set out in Section 8.4.2 of the Flora and Fauna report.

1.2.1 Bat monitoring

Ultrasonic bat surveys will be undertaken in spring and summer/autumn (when Southern Bent-wing Bat are more mobile and more likely to be present) and repeated in the first two years of operation.

Songmeter ultrasonic bat detectors will be used to monitor bat activity at height (on nacelle and/or meteorological masts) paired with a bat detector up to one metre off the ground. The Songmeters will be attached to a turbine at eight sites evenly distributed across the wind farm. The Songmeters will be programmed to operate between sunset and sunrise over a six-week period, over two survey periods, during (1) spring and (2) late summer/early autumn (September/October and February/March) when Southern Bent-wing bat are most likely to be moving larger distances across the landscape, as indicated through knowledge of Southern Bent-wing Bat activity patterns and results of the pre-construction survey. The two Songmeters at each of the eight sites will operate at the exact same time to allow direct comparison.

Reporting of bat results to be provided to the Responsible Authority and DELWP.

1.2.2 Mortality monitoring

The purpose of mortality monitoring is to estimate the annual number of fatal turbine collisions of birds and bats. Mortality rates can be estimated for all bird species combined, and all bat species combined. If threatened species are found underneath a turbine, the mortality rate for that species may also be estimated, subject to sufficient data being available.

Mortality is defined as any dead bat detected under a wind turbine and within a distance of the turbine in which carcasses could potentially fall if struck. Detection can be either during the formal carcass searches (designed to generate an estimate in accordance with a statistically rigorous sampling design) or at other times (incidental observation, often by operational staff). A protocol is triggered whenever a carcass is found, either within the formal searches or incidentally to collect consistent and useful data on the fatality event.

Collision by bats with wind turbines will be monitored through a statistically rigorous carcass-search program for a minimum period of two years. This will involve systematic, monthly searches for dead bat carcasses under a random selection of turbines. This will ensure statistically useable and robust results are generated from the carcass monitoring program that include an estimate of both bat mortality rates, together with an estimate of sampling precision.

It will be assumed that any intact dead bat, detected beneath a turbine has died as a result of collision or interaction with a turbine, unless there are obvious signs of another cause of death (e.g. caught in a fence etc.).

Ongoing monitoring of mortality from blade strike at operating WWF typically serves to (i) provide data that can inform adaptive management of the collision risk (i.e. patterns of mortality related to seasonal changes or local conditions); and (ii) detect mortality of threatened and non-threatened bird and bat species, which can be used to understand actual bird and bat impacts.

The search protocol (see Section 1.2.2.2) has been designed to optimise detection of species and groups of concern that have a higher than negligible risk of impact, as well as any other species that have fatally collided with turbines. The consistent application of this protocol will ensure that statistically robust, and spatially and temporally consistent data are collected on bat mortality.

Once two years of results are available, the precision of mortality estimates can be calculated and considered in determining requirements for further monitoring. Notwithstanding this, records of mortality of threatened species would trigger immediate investigation, reporting and management intervention.

A number of factors, such as carcass scavenging and carcass detectability, can affect mortality rate estimates and must be measured and incorporated into any estimate of overall mortality rates. A scavenged carcass may increase the variability in mortality rate estimates and thus carcasses will be assessed for possible scavenging and rates will be estimated from experimental trials (Section 1.2.2.2). Detectability of carcasses is also a potential confounding variable and protocols have been developed to control for this factor in the final mortality estimates.

The practical considerations that have informed the design of the carcass search program and associated trials are:

- Very few carcasses are found under turbines in Australia compared with Northern Hemisphere wind farms (i.e. on average, less than half the number in the Northern Hemisphere based on Nature Advisory data across seventeen wind farms) due to the much smaller number of night-migrating songbird species (which make up 50% of carcasses at Northern Hemisphere wind farms) and bird numbers due to the lack of land in the Southern Hemisphere at latitudes where severe winter has led to the evolution of widespread, long-distance migration;
- Carcasses of a suitable range of sizes for scavenger and detectability trials are difficult to source and usually involve a combination of carcasses found under turbines and those found along roads and other legal sources. It is illegal to source un-cleaned carcasses from poultry producers;
- For statistical reasons, it is likely to be very difficult to determine more than the grossest of differences in scavenging rate or detectability across the year and there is no evidence in the literature for significant differences between seasons in scavenger activity. Therefore, annual scavenger and detectability correction factors will be generated and applied;
- It is known that detectability will be easier in short grass at the dry time of the year compared with in longer grass at the wet time of the year, and detectability trials have been scheduled accordingly (see Section 1.2.2.2).

At the completion of the two-year initial operational-phase monthly carcass search program, the results of the mortality monitoring and any impact trigger investigations will be reviewed to guide ongoing operational-phase monitoring activities in the following years of BBAMP implementation.

The following sections outline:

- **Turbine selection for searches**: how the turbines will be selected for the search;
- **Carcass search protocol**: the search area and how frequently to undertake searches;
- **Incidental search protocol:** outlining the procedure to be adopted in the event of an incidental carcass find by WWF personnel outside the formal carcass-searches; and
- **Analysis and mortality estimation**: general outline of how the data will be analysed to gain estimates of bat mortality.

Section 1.2.2.2 describes the methods, including the following:

- **Search protocol**: the size of area beneath turbines to be searched and how this area will be searched systematically and results recorded;
- **Scavenger rates and trials**: definition of scavenging and how experimental trials will be conducted; and
- **Detectability and trials**: definition of detectability and the experimental trial methodology.

1.2.2.1 Turbine selection

Overall, 20 turbines (33% of the proposed 59 turbines) will be searched each month. This will ensure the calculation of accurate and precise mortality rate estimates. Turbine section is to be random. Once randomly chosen, these 20 turbines will be searched every month during the carcass monitoring period.

1.2.2.2 Carcass search protocol

The same 20 randomly selected turbines will be searched out to 120 metres once per month. A second follow-up search, a 'pulse search' will be undertaken to 60 metres during the warmer months (September to April) when microbats are more active. This pulse search will be conducted once a month within several days of the first search to detect additional mortality of bats. The order of turbines searched will be randomized between searches.

The search method will involve either:

- Searches on foot along pre-determined transects by an adequately trained ecologist; or
- Searches by a trained scent dog.

Searches by a trained searcher

The search area beneath each turbine has been determined to best detect bats and medium to large bird carcasses, based on the turbine dimensions (Hull & Muir 2010). Based on the Hull and Muir model (2010) the fall area for a turbine with hub height 120m and blade length 72m, the following is noted from the model:

- Bats – 100% and 83% of carcasses should fall within circles 120 metres and 60 metres from the turbines respectively;
- Medium birds - 97% and 49% should fall within circles 120 metres and 60 metres from the turbines respectively; and
- Large birds – 83% and 36% should fall within circles 120 metres and 60 metres from the turbines respectively.

Given this evidence, inner and outer circular search zones have been designated. The inner zone targets the detection of carcasses of bats and small to medium and large sized birds. In the inner zone, a circle is formed with a 60-metre radius from the turbine and transects are spaced every six metres across this circle (**Error! Reference source not found.**).

The outer zone will comprise the zone between the 60-metre and 120-metre radius circles. Although they are still recorded in the inner zone, the outer zone will ensure the adequate detection of carcasses of medium to larger sized birds, which can fall further away from turbines. Search transects in the outer zone are spaced at 12 metres and carried out from the edge of the inner zone out to the edge of the outer zone (see Figure 1). Given that the defined transect spacing and total search area are based on experience and evidence from previous studies (e.g. Arnett *et al*. 2005, Hull and Muir 2010) they are considered to be ample to detect bats and the bird species of concern arising out of the risk assessment.

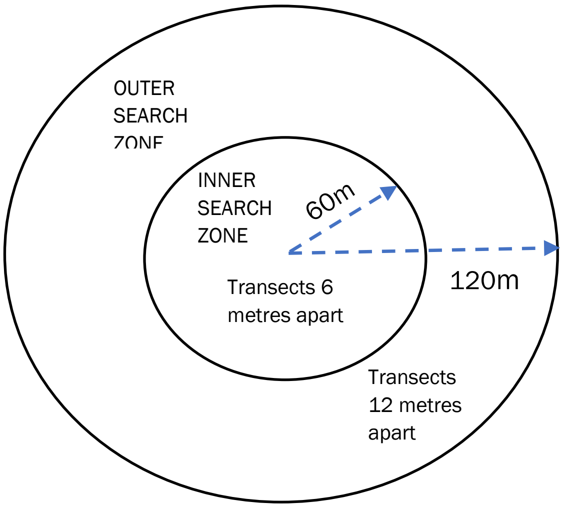


Figure 1: Inner and outer carcass search zones underneath the turbines

During searches, turbines will be searched out to 120 metres once per month. A second follow-up search, a 'pulse search' will be undertaken to 60 metres during the warmer months (October to April) when microbats are more active, once a month within several days of the first search to detect additional mortality of bats and birds. The order of turbines searched will be randomized between searches.

All searchers will operate under the supervision of a qualified ecologist experienced in wind farm bird and bat monitoring, who will ensure adequate training in the monitoring methods and reporting requirements.

Searches by a trained scent dog

Scent dogs can be trained to locate a variety of targets. The same search area will be targeted out to 120 metres. The dog does not 'look' for carcasses but finds them via scent. Therefore, it does not need to cover as much ground as if were looking with its eyes but only needs to cover enough ground to encounter all possible 'scent cones' within the search radius. The scent cone is the area downwind of the target, in this case a carcass, in which the scent will drift with the wind. So, if the wind is strong; the scent will drift further but in a narrower scent cone, and if the wind is light; the scent cone will be wider but will not drift as far. In the case of strong wind, then transects will need to be narrow to ensure scent cone areas will be encountered. Transects of approximately 30 metres wide will be adequate to cover an area in moderate wind conditions.

The handler can start down wind of the turbine and walk across the direction of the wind allowing the dog to freely zig zag across the searcher's transects, using whistle commands to control how far the dog moves to each side of the transect (i.e. 30 metres). This will ensure all scent cone areas will be encountered (Figure 2). As represented in Figure 2 the search pattern walking across the wind any carcasses scent cone will be encountered several times, or for a long duration, allowing the dog to easily detect and track down the carcass.

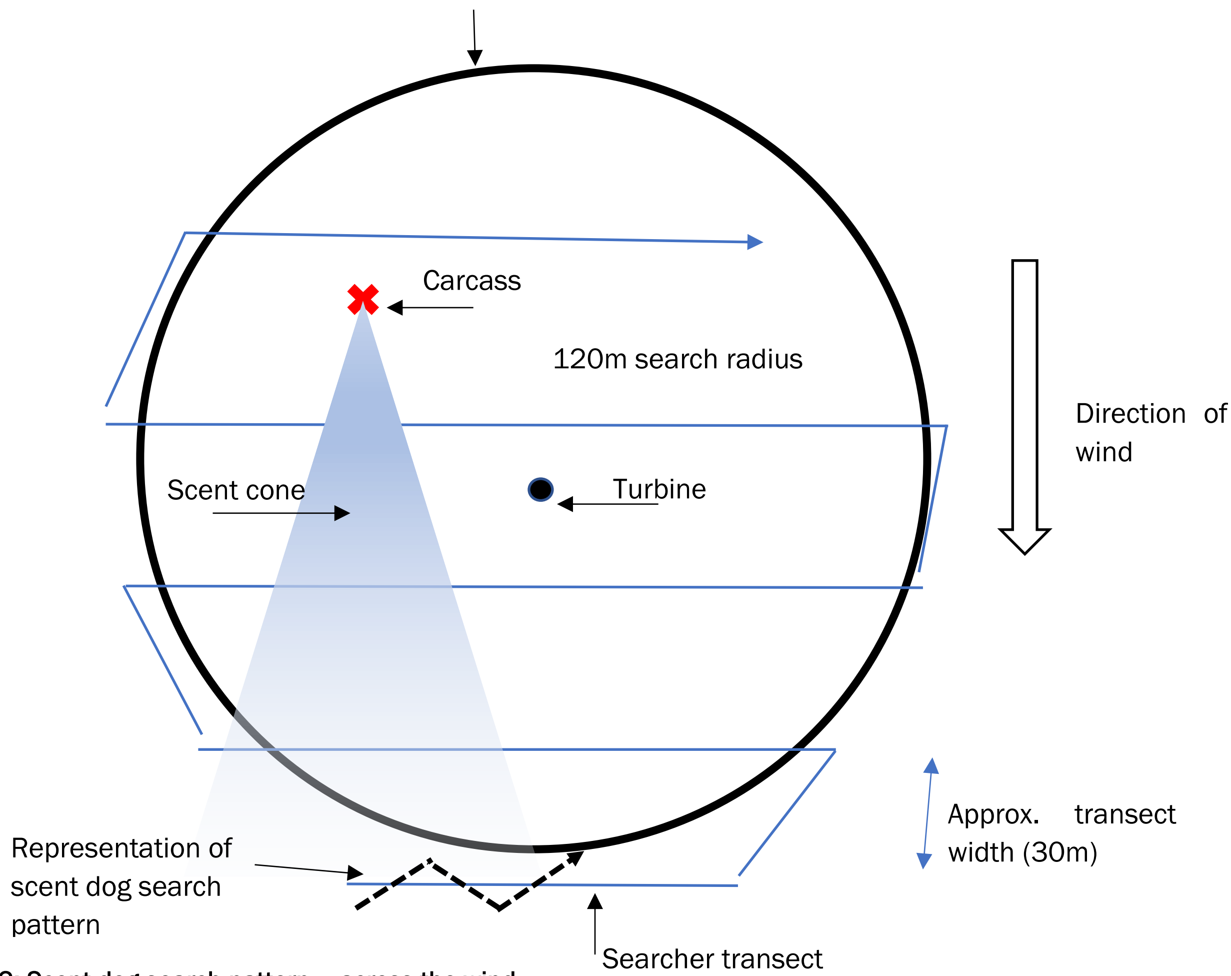


Figure 2: Scent dog search pattern – across the wind

Carcass detection protocol

If a carcass is detected (a 'find') the following variables will be recorded in the carcass search data sheet (see Figure 3):

- GPS position, distance in metres and compass bearing of the carcass from the base of the wind turbine tower;
- Substrate and vegetation, particularly if it was found on a track or hard-stand area without vegetation as this may assist in quantifying the number of carcasses not found in areas where ground cover makes carcasses less visible;
- Species, age, number, sex (if possible) signs of injury and estimated date of strike;
- Weather (including recent extreme weather events, if any), visibility, maintenance to the turbine and any other factors that may affect carcass discovery; and
- If the species is not able to be immediately identified because there is not a qualified ecologist on-site (i.e. an incidental find), photographs will be provided to the qualified ecologist within 2 business days of the find for identification and the ecologist must reply within 5 business days for the possible reporting to DELWP and DAWE of an impact on a threatened species within 2 business days of confirmation.

The carcass will be handled according to standard procedures, as follows:

- The carcass will be removed from the site to avoid re-counting;

- The carcass will be handled by personnel wearing rubber gloves, packed into a plastic bag, then wrapped in a sheet of newspaper then in a second plastic bag;
- The carcass will be clearly labelled with a reference number linked to its completed carcass search data sheet in the second plastic bag to ensure that its origin can be traced at a later date, if required; and
- The double-bagged and wrapped carcass will be transferred to a freezer at the site office for storage so a second opinion on the species identity may be sought, if necessary, and for use in later scavenger and detectability trials.

The handling and storage of native wildlife (including dead wildlife) as part of the monitoring program has been approved as part of the approval of the project based on advice provided by DELWP.

Scavenger rates and trials

It will be important to ascertain the rate at which carcasses are removed by scavengers. This can be used to develop a 'correction factor' that informs the estimate of wind farm impacts on birds and bats (mortality rate). Scavengers can include ground-based animals, such as foxes and rats (more likely to detect carcasses by scent), as well as aerial scavengers such as birds of prey and ravens (more likely to detect them visually). The scavenger trial described below is designed to ascertain the scavenging rate, usually expressed as average carcass duration in the field.

An intact carcass will be defined as a carcass that does not appear to have been scavenged by a vertebrate scavenger. A partially eaten carcass will be any skeletal or flesh remains found. Feather spots will be defined by their presence and the absence of any other remains (a feather spot being a cluster of five or more feathers). Intact or partial carcasses and feather spots will all be recorded as a 'find'. However, the scavenger correction factor will not be applied to feather spots as these are most likely to represent the remains of carcasses after they have been scavenged.

Scavenger trials will be undertaken twice over the initial two year of operational phase monitoring. The objective of having two trials is to account for different vegetation conditions, so one will be held when the grass is long and one when the grass is short. The two periods for scavenger trials are shown in the Table 1, below.

Table 1: Timing for scavenger trials

Vegetation condition	Likely time period	Weather	Stocking
Short grass	Winter (August-July)	Cold weather	Heavy stock levels
Long grass	Spring (September - November)	Follow rain and higher temperatures	Light stock levels

After the scavenger trials conducted over the first two years, the need and frequency of further scavenger and detectability trials will be reviewed and discussed with DELWP.

Provided enough carcasses have been collected and are available, the scavenger trial will be stratified into the turbine classes indicated below. If species carcasses cannot be sourced, comparable substitute carrion species will be used (e.g. brown mice as bat substitutes, birds from control programs including Common Myna and Common Starling etc).

Scavenger Trials

Scavenger Trials will be undertaken by a trained person to determine the rate of loss by scavengers, and the nature of removal by scavengers. Carcasses for scavenger trial purposes will be deployed within the inner search zone of turbines of randomly selected turbines monitored as part of the monthly monitoring program.

To identify potentially different scavenging rates, three categories of carcass will be used (Table 2). Based on current mortality estimation software requirements, every endeavour will be made to find all carcasses of each category. Improvements on this method would require an impractical and unlikely availability of required carcass numbers, and do not lead to a commensurate improvement in the statistical power of estimates. In addition, large birds (raptor size) may be substituted with data from previous grouped studies with approval from DELWP and DAWE.

Table 2: Number of replicates for each scavenger trial

Trial period	Micro-bat – small bird	Medium sized birds	Large birds (large raptor size)
Winter	7	7	Data will be used from previous studies
Spring	7	7	

A total of 14 carcasses will be randomly placed under different turbines for each trial period and motion sensor cameras will be used to monitor scavenger activity taking place. All carcasses will not be placed at once, but rather a number of carcasses will be placed during monthly searches that occur during each trial period until all 14 carcasses have been deployed. This will more accurately reflect numbers of mortalities on the ground each month and be less likely to attract additional scavengers to turbines. It will also allow for additional carcasses to be deployed in the event any cameras do not record sufficient information (through technical difficulties, stock interfering with cameras, etc.)

A 1.5 metre star picket will be driven into the ground approximately 3-4 metres away from each randomly placed carcass and a camera attached using cable ties. The camera will record any scavenging activity on a 16gb SD card. The placement of the carcass will be reviewed at each deployment to ensure that the carcass is appropriately in frame of the camera before being left in the field. The carcass will then be left for a period of 30 days after which the camera and SD card will be collected and scavenging activity reviewed. If the carcass remains after this time, it is assumed that the carcass will not be scavenged. The information recorded will capture the exact time and date and provide a photograph of which scavenger, if any, has taken the carcass.

This method eliminates the need for scavenger trial carcasses to be monitored regularly.

Additional information on scavenger trials includes:

- A mix of small and medium to large carcasses (if available) will be obtained for use in the scavenger trial. Where carcasses of the species of concern cannot be found, a similar-sized and coloured substitute, e.g. mice for bats will be used to reduce bias by visual predators;
- Birds bred for consumption must not be used as substitute for detectability or scavenger trials;
- Carcases may come from on-site, road kill or feral animal control programs (e.g. Common Myna);
- Latex gloves will be worn at all times while handling carcasses to minimise contact with human scent, which may alter predator responses around carrion and to minimise disease risk to the handler;

- At each trial site, one carcass (or more) will be placed randomly within the 60-metre search area. Carcasses will be thrown in the air and allowed to land on the ground to simulate at least some of the fall and allow for ruffling of fur or feathers;
- Carcasses used in the trial will have their coordinates recorded;
- Notes will be taken on evidence remaining at sites where carcasses have been scavenged (e.g. scavenger scats, bones, feathers, animal parts and type of scavenging) if visible, such as tearing, pecking, complete removal of carcass, partial removal of carcass, bird or mammal predator evidence); and
- Notes will be taken on the state of remaining carcasses.

Conducting two scavenger trials at seasonally different times is designed to account for occasional winter/spring increase in carrion use by some scavenger species. Previous studies have found that Red Foxes are reliant on rabbits and carrion in agricultural and forested areas (e.g. Brunner *et al*. 1975, Catling 1988, Molsher *et al.* 2000). Feral cats show little but uniform use of carrion throughout the year, whereas fox prey type is dependent on availability (Catling 1988). Catling (1988) found that foxes ate more carrion in winter/spring compared with summer/autumn, when they fed on adult rabbits. However, Molsher *et al*. (2000) found that there was no overall significant difference between seasons for carrion use. Seasonal differences only occurred in other prey types (not carrion), such as lambs, invertebrates and reptiles, as these are only available at certain times of the year.

Scavenger trials for large raptors will only be conducted once in either winter or spring due to lack of availability of suitable carcasses for a technically sound trial. Experience from other wind farms indicates a low level of scavenging of these carcases and a high level of detectability that is consistent across the year (Nature Advisory, unpubl. data).

The number of carcasses per animal and size category is based on obtaining a reasonable level of statistical confidence in the estimate of average carcass duration, as reflected in software requirements for current mortality estimation processes, whilst seeking to minimise the number of carcasses used, as they can be difficult to source. Large numbers of carcasses (e.g. on-site, road-kill) are difficult to obtain and it may be very complicated to find alternative sources (e.g. farmed and culled animals). It is also possible that large numbers of carcasses, more size categories and more replicates may attract more scavengers to the area. Previous studies (e.g. Molsher *et al*. 2000) have shown that fox prey use is related to availability and therefore more foxes may be attracted to the area if more carcasses are used, thereby biasing the resulting correction factor. In addition, raptors are potentially more susceptible to collision when preying on carrion beneath turbines. However, it is necessary to conduct these trials under turbines as some scavengers may alter their behaviour in response to the turbines. The final scavenger trial design is therefore a necessary compromise between high numbers of trials and practicality whilst ensuring a statistically-valid trial design without altering either the behaviour of scavengers or the number of birds that may collide with turbines.

Detectability (Observer) trials

Detectability trials are conducted to test the rate at which the trained searchers, or scent detection dog, detect carcasses under wind turbines. This enables a correction factor to be applied in calculating the rate at which turbines strike birds and bats.

As outlined above, the trial will be supervised by a qualified ecologist and undertaken by trained ecologists or personnel trained by the ecologist.

To account for searcher variability in detecting carcasses, only personnel who have carried out monthly searches at WWF will be involved in the detectability trials. Detection efficiency (percentage of carcasses detected) will then be incorporated into later analyses that derive mortality estimates (i.e. how many carcasses are potentially not found each monitoring period). The number of carcasses to be employed in each trial is detailed in Table 3 and explained below.

The number of turbines used in the detectability trials will be based on how many turbines searches the person undertaking monthly monitoring can do in one day. For example, if the searcher completes seven turbines on average a day then the 14 carcasses required for a trial will be deployed in random amounts, but less than five, per turbine.

A carcass controller (a person not involved in monthly carcass searches) will throw each carcass into the air and allow it to land on the ground to simulate at least some of the fall and the potential ruffling of fur and feathers. The carcass controller will note the placement of carcasses (via GPS) which will be placed at random under each turbine, however all bats should be located within the inner search zone.

The searcher will then undertake turbine searches as usual (see above) and record and mark with GPS coordinates any carcasses they find during the search. This will be reviewed by the carcass controller upon completion of the trial to determine their detectability rate.

All carcasses should be collected during or on completion of the trial and returned to the on-site freezer for use in scavenger trials.

Table 3: Number of replicates per season for detectability trials, given two factors of size and visibility

<table>
<tr><th>Season</th><th>Micro-bat</th><th>Medium sized birds</th><th>Large birds
(large raptor size)</th></tr>
<tr><td>Winter</td><td>7</td><td>7</td><td rowspan="2">5</td></tr>
<tr><td>Spring</td><td>7</td><td>7</td></tr>
</table>

Previous analysis indicates that there is a large confidence interval on the estimate of searcher efficiency, even for a high number of trials (plus or minus ten percent even with 50 replicates). This means that only relatively large seasonal changes in detection (~20 - 30% or more) will be resolvable from normal background variation. Sampling will be undertaken during the two periods that represent the greatest change in vegetation cover (therefore visibility), using a number of carcasses that is logistically manageable and aligned with the number and timing of scavenger trials. Statistical confidence analysis indicates that this will result in a reasonably precise detectability estimate after one year, and optimal precision after two, although as second year of trials is not currently planned.

Any substitute carcasses for these trials will be of both similar size, colour and form to the species being represented or species of concern (i.e. brown mice rather than birds should be substituted for bats as birds do not have the same body shape, colour and appearance).

If sufficient carcasses cannot be obtained, then stuffed, realistic-looking artificial substitutes may be used. As humans are entirely visual searchers, it is not essential to use real carcasses as long as the substitutes appear similar once on the ground. It is considered to be more time efficient and cost effective to undertake scavenger and detectability (observer) trials concurrently.

1.2.2.3 Ongoing incidental carcass protocol

Personnel at the WWF may from time to time find carcasses during day-to-day operations and maintenance activities. In this case, the carcass will be handled according to the carcass detection protocol outlined in Section 1.2.2.2. All WWF personnel will be made aware of the carcass handling protocol as part of their training and induction. If a carcass find is made within five days prior to a scheduled carcass search, the carcass will be left *in situ* but photographed and its position recorded (GPS). A carcass search data sheet (Figure 3) will be completed for each incidental carcass found (whether removed or not).

This incidental carcass protocol is valid for the life of the WWF project.

1.2.2.4 Analysis of results and mortality estimation

The results of the carcass searches will be analysed in order to provide information on:

- The species, number, age and sex (if possible) of bats being struck by the turbines;
- Separate estimated annual mortality rates for all bats (and for particular species, if required) including an estimate of the number of carcasses per turbine per year; and
- Any detected spatial or temporal variation in the number of bat strikes.

The search results will be detailed in the first annual report and the detailed analysis and estimates in the second annual report. The latter will identify if further detailed investigations or mitigation measures are required.

Statistically robust projections of bat mortality for the entire WWF site will be presented, based on the data collected from mortality searches. It is acknowledged that this is a current and dynamic aspect of research and that the outcomes from such programs may be equally dynamic. The current program is designed to provide an acceptably accurate and precise estimate of WWF-related bat mortality within two years, so the full analysis and estimate will be provided in the second annual report, together with recommendations on the scope of future monitoring, if required.

All data will be analysed to provide the average estimated mortality of birds and bats, their standard error (variability) and ranges for the WWF. The mortality rate of each species (if estimates for individual species are possible) and size class detected will be calculated after two years. If possible, the standard error and range of these estimates will be reported. Note that it may not be possible to provide this due to the likely low number of carcasses detected. Where this is an issue, it will be reported. Mortality estimates will also take into consideration the actual operational time of the turbines (obtained from the project operator).

WILLATOOK WIND FARM - BIRD AND BAT MORTALITY MONITORING PROGRAM CARCASS SEARCH DATA-SHEET*				
Please fill out all details above the heavy line for each site searched All details below the line are required if a carcass is found Do not move a carcass until the details below have been completed				
Willatook WF				
Date:				
Start Time:				
Finish Time:				
Turbine Number:				
Wind direction and strength in preceding 24 hours:				
Any unusual weather conditions in last 48 hours?				
Distance of Carcass from Tower(m):				
Bearing of Carcass from Tower (deg):				
Preliminary Species Identification:				
Photo Taken**	Yes / No			
Signs of injury:				
How old is carcass estimated to be (tick category):	<24 hrs	1-3 days	> 3 days	Other
Other Notes (ie. sex/age of bird, substrate and vegetation at site of find):				
Post Find Actions: Place carcass in sealable plastic bag then wrap it in newspaper then in a second plastic bag with a copy of this data-sheet and take to freezer at site office.				
* One form should be completed for each carcass found				
** Please attach photo to this form				

Figure 3: Carcass Search Data Sheet

1.3 References

Arnett EB, Erickson WP, Kerns J and Horn J 2005. *Relationships between bats and wind turbines in Pennsylvania and West Virginia: An assessment of fatality search protocols, patterns of fatality, and behavioural interactions with wind turbines*. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Brunner, H, Loyd, JW and Coman, BJ 1975. Fox scat analysis in a forest park in south-eastern Australia, *Australian Wildlife Research*, 2: 147-154.

Catling, PC 1988. Similarities and contrasts in the diets of foxes, *Vulpes vulpes*, and cats, *Felis catus*, relative to fluctuating prey populations and drought, *Australian Wildlife Research*, 15: 307-317.

Hull, CL and Muir, Stuart 2010. Search areas for monitoring bird and bat carcasses at wind farms using a Monte-Carlo model. *Australasian Journal of Environmental Management* Vol 17, No. 2, Pages 77—87, Publisher is Taylor & Francis.

Molsher RL, Gifford EJ, McIlroy JC 2000, Temporal, spatial and individual variation in the diet of red foxes (Vulpes vulpes) in central New South Wales. *Wildlife Research* 27, 593–601.

Appendix 14: Bird data collected in 2009 showing the number of instances of bird species recorded in Point Count Surveys classified according the height at which they were detected (EHP 2018)

Species	Ground	Below RSA	At RSA	Above RSA	Heard Only	Total
Australasian Pipit	11	20	6	0	28	55
Australian Magpie	37	61	8	0	12	118
Australian Raven	6	9	7	0	5	27
Australian Shelduck	0	2	1	0	0	3
Australian White Ibis	1	8	5	0	0	16
Australian Wood Duck	1	0	0	0	0	1
Banded Lapwing	0	0	1	0	0	1
Black-tailed Native-hen	1	0	0	0	0	1
Brown Falcon	0	8	5	0	0	13
Brown Goshawk	0	2	0	0	0	2
Brown Songlark	0	9	0	0	6	15
Brown Thornbill	0	3	0	0	1	4
Australian Reed Warbler	0	2	0	0	4	6
Common Starling	1	25	7	0	3	36
Crimson Rosella	0	1	0	0	0	1
European Goldfinch	1	49	11	0	1	66
Eurasian Skylark	0	5	0	0	45	50
Fairy Martin	0	2	0	0	1	3
Galah	0	2	2	0	0	4
Golden-headed Cisticola	0	6	3	0	2	11
Grey Shrike Thrush	0	0	0	0	3	3
Horsfield's Bronze-Cuckoo	0	1	0	0	1	2
House Sparrow	0	1	0	0	1	2
Laughing Kookaburra	0	0	0	0	2	2
Little Raven	10	41	18	0	2	71
Long-billed Corella	3	5	5	0	2	15
Magpie-lark	0	6	0	0	10	16
Masked Lapwing	2	0	0	0	0	2
Nankeen Kestrel	0	4	4	0	0	8
New Holland Honeyeater	0	1	0	0	0	1
Pacific Black Duck	0	3	1	0	0	4
Raven Spp.	11	82	100	0	1	194
Red Wattlebird	0	4	1	0	3	8
Red-rumped Parrot	0	1	0	0	0	1
Rufous Songlark	0	1	0	0	2	3
Straw-necked Ibis	4	11	17	1	0	33
Stubble Quail	0	1	0	0	22	23
Sulphur-crested Cockatoo	0	1	0	0	0	1
Superb Fairy-wren	1	24	0	0	17	42
Wedge-tailed Eagle	0	2	7	0	0	9
Welcome Swallow	0	17	4	0	0	21
White-browed Scrubwren	0	1	0	0	0	1
White-faced Heron	0	12	4	0	0	16
White-fronted Chat	0	18	2	0	0	20
White-necked Heron	0	2	2	0	0	8
Willie Wagtail	0	9	0	0	6	15
Yellow-faced Honeyeater	0	3	0	0	1	4
Yellow-rumped Thornbill	2	5	0	0	4	11
Yellow-tailed Black Cockatoo	0	2	7	0	0	9
Total number of records	92	472	228	1	185	978

Notes: Please note that the RSA referred to this table is from the original RSA height of below RSA = 1–40m; RSA = 41–220m; Above RSA = >220m above the ground

Appendix 15: Bird species, flight height and relative abundance – Spring 2018 and Summer 2019

Spring 2018																	
Impact point	1		2		3		4		5		6		7		8		
Species	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Total
Australasian Pipit	11						4								1		16
Australian Magpie	5		15		25		4		18		7		15		16		105
Australian Shelduck													3		9		12
Australian White ibis					2												2
Blue-winged Parrot														1			1
Brown Falcon		1	4		1		1						1				8
Brown Songlark							1										1
Brown Thornbill															2		2
Common Blackbird					1												1
Common Starling	12		1		23		2		1		13				1		53
Crested Pigeon	3																3
European Goldfinch					13				2		2				4		21
European Greenfinch	3																3
Eurasian Skylark	27	4	7	7	6	7	25	5	16	8	40	9	30	12	9	5	217
Fairy Martin	4												10				14
Forest Raven	1		2														3
Galah							1										1
Golden-headed Cisticola							1										1
Grey Fantail															1		1
Grey Shrike-thrush															1		1
Grey Teal													2				2
Horsfield's Bronze-Cuckoo	1		1														2
House Sparrow											5						5
Little Raven	19		16		61		27		37		9		32		44		245
Long-billed Corella	4	1			2		3		17	4			2				33
Magpie-lark	4		4		2		10		4						9		33
Nankeen Kestrel	1						1		2		1						5
New Holland Honeyeater	1														5		6
Pacific Black Duck					1		9						3				13
Red Wattlebird	3		2												1		6
Shining Bronze-Cuckoo	1																1
Spotted Harrier													1				1
Straw-necked Ibis							1										1
Striated Fieldwren			2		1		3				1		3				10
Stubble Quail			4														4
Sulphur-crested Cockatoo					6												6
Superb Fairy-wren			3								3				7		13
Swamp Harrier									1								1
Welcome Swallow	16		10						2				4				32
White-faced Heron					1		2				1						4
White-necked Heron					2		2						1				5
White-plumed Honeyeater	7																7
Willie Wagtail	3		4						1						4		12
Yellow-faced Honeyeater							1										1

Spring 2018																	
Impact point	1		2		3		4		5		6		7		8		
Species	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Below RSA	RSA	Total
Grand Total	**126**	**6**	**75**	**7**	**147**	**7**	**98**	**5**	**101**	**12**	**82**	**9**	**107**	**13**	**114**	**5**	**914**
Summer 2019																	
Australasian Pipit	2										8						10
Australian Magpie	29	1	12	4	43	3	23		52		23		13	4	18		225
Black-faced Cuckoo-shrike							11		2								13
Blue-winged Parrot											32		2				34
Brown Falcon	4		1		3	1			2		2	1	1	1			16
Brown Goshawk									2								2
Brown Thornbill	6														16		22
Common Starling	63				8						44						115
Crested Pigeon	7		5		15										1		28
European Goldfinch	3										42		4				49
Eurasian Skylark											3		19				22
Fork-tailed Swift														4			4
Galah	7				2								2				11
Grey Shrike-thrush	1														1		2
House Sparrow											28						28
Little Raven	74		22	4	11	2	22	2	21		5		75	5	39		282
Magpie-lark	6				12		7		4				2		6		37
Nankeen Kestrel					1	1					4		3	1			10
New Holland Honeyeater	2														1		3
Red Wattlebird	15						1		10								26
Red-rumped Parrot											4						4
Striated Fieldwren									1		4		7				12
Superb Fairy-wren							9		8		1		12		26		56
Wedge-tailed Eagle										1	1			1			3
Welcome Swallow	10																10
White-faced Heron											9						9
White-plumed Honeyeater	6																6
White-winged Chough	4																4
Willie Wagtail	9				1		18		19		1						48
Yellow Thornbill															2		2
Yellow-rumped Thornbill							1										1
Grand Total	**248**	**1**	**40**	**8**	**96**	**7**	**92**	**2**	**121**	**1**	**211**	**1**	**140**	**16**	**110**	**0**	**1094**

Notes: Below RSA = <40 metres; RSA = 40–250 metres above the ground.

Appendix 16: Survey method for listed migratory bird species

Important habitat is the key element in assessing likely impacts from a proposed action on migratory shorebirds. Surveys for migratory shorebirds must be conducted in potential shorebird areas where either:

- no suitable survey records exist
- records are too old to be considered reliable
- characteristics of the area have changed.

Where suitable data are lacking, surveys are needed to establish the presence and number of migratory shorebirds, as well as to record some habitat characteristics (for example, type, quality, size and availability). An important consideration is the context of the area within the local region, including the existing level of cumulative habitat loss.

Survey coverage - At a minimum survey coverage should include:

- all of the habitat thought to be used by the same population of shorebirds
- the entire area of contiguous habitat where shorebirds may occur

This will require consideration of the regional context of the wetland and may include multiple discrete roosts and feeding areas.

Survey timing

Surveys should be conducted during:

- the months when the majority of migratory shorebirds are present in the area

Numbers of shorebirds may vary during these months, particularly in the north of the country, due to presence of additional shorebirds during inbound and outbound migration at the beginning and end of the non-breeding season. Local knowledge should be sought to determine optimum survey times.

- the northern hemisphere breeding season (mid-April to mid-August) to obtain data on nonbreeding, non-migrating populations of immature migratory shorebirds and double-banded plover populations (March to August).

Surveys should not be undertaken during periods of high rainfall or strong winds.

Surveys should not be undertaken when activities are taking place which cause shorebird disturbance.

Survey effort

Ideally, survey effort should be comprised of a minimum of:

four surveys for roosting shorebirds during the period when the majority of shorebirds are present in the area

Replicate surveys over this period are important to measure population variability.

Some areas will meet the importance criteria only during the migration periods when many birds are temporarily stopping over. In most cases, ***one survey in December, two surveys in January, and one survey in February will be adequate***.

– one survey during the northern hemisphere breeding season to capture data on birds that remain in Australia during the breeding season, as well as the double-banded plover (March to August).

For large areas or for areas where many birds are expected, it is recommended that at least two people undertake the counts and agree on the number of birds and the number of species present. It is acknowledged that in such circumstances it is often difficult or impossible to achieve more than one complete survey of shorebird populations, in which case it is most important to adhere to optimum timing and survey coverage requirements.

Minimum data requirements

The following should be included in the survey report:

- Shorebird statistics relating to roosting areas:
  - total abundance (total number of birds present across all species)
  - species richness (number of species observed)
  - species abundance (number of birds of each species present).
- Shorebird behaviour:
  - activity (roosting, foraging)
  - foraging location (spatial data of the area used by shorebirds for feeding to enable mapping of foraging habitat).
- Survey conditions:
  - date, time of day
  - tide height
  - weather conditions (temperature, precipitation, wind speed & direction).
- Number of observers and experience level.
- Method used to conduct the survey.
- The following habitat characteristics may also be useful:
  - dominant landform type
  - hydrology
  - dominant terrestrial and aquatic vegetation types
  - intertidal substrate characteristics
  - invasive species
  - current disturbance regime (see below)
  - presence of suitable nocturnal roosting areas (see below).

Non-tidal areas

Survey timing

Surveys should be conducted during:

- the period when the majority of migratory shorebirds are present in the area to obtain data on the total population

This period will vary across Australia. In the north of the country key staging areas are often used by additional shorebirds during inbound and outbound migration, and therefore should also be surveyed at the beginning or end of the non-breeding season. Local knowledge should be sought to determine the appropriate time period.

- the northern hemisphere breeding season (mid-April to mid-August) to obtain data on nonbreeding, non-migrating immature populations, as well as double-banded plover.
- Surveys should be conducted when habitat conditions are suitable for migratory shorebirds. Typically, this will be when water is present with a minimally vegetated, exposed margin.
- Surveys should not be undertaken during periods of high rainfall or strong winds.
- Surveys should not be undertaken when activities are taking place which cause disturbance to the birds

Appendix 17: Historical records of migratory shorebirds from Willatook WF search region

Common Name	Scientific Name	Total Count	Survey Start Date	Survey End Date	Site Location Description	Latitude GDA94	Longitude GDA94	Accuracy (m)
Curlew Sandpiper	*Calidris ferruginea*		25/12/1977	27/12/1977	ST HELENS	-38.24853	142.0847	9000
Latham's Snipe	*Gallinago hardwickii*	1	29/10/2008		Tarrone	-38.17323	142.19848	100
Latham's Snipe	*Gallinago hardwickii*		1/01/1984		Bluebottle	-38.0902	141.9597	900
Latham's Snipe	*Gallinago hardwickii*	3	26/08/1985	27/08/1985	5' BLOCK CONTAINING ST HELENS	-38.20686	142.04303	4500
Latham's Snipe	*Gallinago hardwickii*	1	2/11/2009		Hamilton-Port Fairy Rd/Grapes Rd Intersection	-38.2494	142.13382	100
Latham's Snipe	*Gallinago hardwickii*		19/12/1980	25/01/1981	ST HELENS	-38.24853	142.0847	9000
Latham's Snipe	*Gallinago hardwickii*	1	15/10/2003		Gapes Rd Orford	-38.24832	142.13453	100
Red-necked Stint	*Calidris ruficollis*		25/12/1977	27/12/1977	ST HELENS	-38.24853	142.0847	9000
Sharp-tailed Sandpiper	*Calidris acuminata*	1	2/11/2009		Hamilton-Port Fairy Rd/Grapes Rd Intersection	-38.2494	142.13382	100
Sharp-tailed Sandpiper	*Calidris acuminata*		1/12/1978	28/02/1979	ST HELENS	-38.24853	142.0847	9000
Sharp-tailed Sandpiper	*Calidris acuminata*		25/12/1977	27/12/1977	ST HELENS	-38.24853	142.0847	9000

Appendix 18: Aquatic Species Wetland Assessment – Willatook Wind Farm, December 2018

Wetland Number / Water body Description	Habitat quality - migratory shorebirds	Habitat Quality - Latham's Snipe	Habitat Quality - Growling Grass Frog	Habitat suitability - Swamp Skink	Wetland Description
5 (Moyne River)	Low	Low	Moderate potential (as movement corridor)	High Suitable - recorded 5/12/2018	In stream / streamside veg. of Bulrush, Woolly Tea-tree, Prickly Tea-tree, some Water Ribbon. Along reveg. corridor - Swamp Gum, Manna Gum, Prickly Moses, Blackwood, Black Wattle, Coast Wattle, Drooping She-oak, Sweet Bursaria, Dogwood (all planted); some remnant Austral Bracken, Sheep's Burr, Weeping grass and Tree Violet; introduced grasses such as Rough Dog's Tail, widespread. Many freshwater crayfish burrows evident along banks.
6	High - two species present 5/12/18	High - recorded by Nature Advisory November 2018 (B. Meney)	Low	Unsuitable	Open water wetland /dam <1 ha - very small and shallow with broad muddy margins. Previously (spring) held ducks and herons. Grazed - cattle, which probably maintain open muddy structure. Vegetated section (Dock, *Rumex* spp.) close to farm road reportedly good for snipe in late spring.
7 (Back Creek south)	Low	High - reported by land owner	High - recorded by Nature Advisory 23/10/18	Unsuitable	A few soaks and pools of water remained in Dec. but mostly dry. Evidence of wetland vegetation e.g. Water Ribbon. Snipe may roost in nearby bracken or Tree Violet.
8	Low	Low-moderate	Moderate, likely to use as movement corridor	Unsuitable	Dense wetland vegetation in stream course dominated by Bulrush and some Giant Spike-rush. Grazed by cattle throughout, minimising suitability for Swamp Skink and GGF. Burrows of freshwater crayfish not observed.
9 (Shaw River)	Low	Low - Moderate	Low	Unsuitable	Dense wetland vegetation in stream course dominated by Bulrush, Common Reed and some Giant Spike-rush. Upper banks lack significant rocks, dense shrubby vegetation and bracken although small areas of patchy shrubbery occur on stony rise to the west, minimising suitability for Swamp Skink and GGF. Some Black Wattle and Blackwood line the downstream section. Burrows of freshwater crayfish not observed.
10	Low	Low	Moderate	Unsuitable	Farm dam <1ha. Permanent water. Extensive fringing cover of Giant Spike-rush and *Myriophyllum* spp. Could support GGF.
11	Low	Low	Moderate	Unsuitable	Small permanent dam fed by bore. Open water and extensive Bulrush and floating vegetation. Looked suitable for GGF (but connectivity poor?)
25606	Low	Low	Low	Unsuitable	Ephemeral meadow close to Moyne River. Dominant vegetation is Common Tussock-grass. Some rushes *Juncus* spp. and sedges *Carex* spp. and much pasture grass. Scattered cover of Woolly Tea-tree along the river and presence of freshwater crayfish burrows suggest Swamp Skink is likely to occur. Unlikely to retain water for long after winter.
25627	Low	Low	Low	Unsuitable	Dry. Introduced pasture grasses dominant: Ryegrass, Mediterranean Wheat-grass, Yorkshire Fog etc. Some native Common Tussock-grass. Higher ground supports scattered Bracken and Tree Violet. This wetland would rarely hold water.
25672	Low	Low - Moderate	Low	Unsuitable	Overflow from slurry pond downstream of dairy. Flooded meadow with lush grass growth.
25677	Low	Low-moderate	Low	Unsuitable	Ephemeral, currently dry. Extensive wetland among stony rises. Vegetation included Common Reed, sedges including Tall Sedge (*Carex* spp.), Common Tussock-grass, occasional Blackwood saplings.
25682	Low	Low	Low	Unsuitable	Dry. Introduced pasture grasses dominant: Ryegrass, Yorkshire Fog etc. This wetland would rarely hold water.
25697	Low	Low	Low	Unsuitable	Dry. Vegetated with Common Tussock-grass and Tall Sedge. Large basalt boulders and bracken; Tree Violet clumps around edge.
25731	Low	Low-moderate	Low	Unsuitable	Ephemeral marsh. Currently dry. Grazed by cattle. Common Tussock-grass is dominant. Also some sedges (Carex spp.)
25816 (Wild Dog Swamp)	Moderate	High	Moderate - recorded by Nature Advisory in October and December 2019	Unsuitable	Visible south of Poyntons Road. Outside wind farm boundary. Large freshwater marsh supporting many large waterbirds (herons, stilts, ducks etc.). Still well inundated in early December 2018. Not checked in detail but well vegetated with areas of open water which is likely to support shorebirds in spring or summer when drying. Considered suitable for GGF: recorded there by EHP (2018) and Nature Advisory in October and December 2019.
25872	Low	Moderate - High	Moderate - High	Unsuitable	At Broadwater 1.2km N of Woolsthorpe - Heywood Road along Port Fairy - Hamilton Road. Outside wind farm boundary. Large farm dam with extensive open water and emergent vegetation (Water Ribbons). Visible from road but not accessed in December.

Wetland Number / Water body Description	Habitat quality - migratory shorebirds	Habitat Quality - Latham's Snipe	Habitat Quality - Growling Grass Frog	Habitat suitability - Swamp Skink	Wetland Description
25933	Low	Moderate	Low	Unsuitable	Farm dam surrounded by marshy depression. Drains to Shaw River. Extensive cover of Common Spike-rush and Water Buttons *Cotula australis*. Small area of *Potomogeton* spp. and Water Ribbons. Could support snipe spring/summer when water level and soil condition suits. Grazed by sheep.
25936	Low	Low	Low	Unsuitable	Ephemeral marsh. Currently dry. In depression, fills by rainwater. Some wetland vegetation - Common Spike-rush and low herbs. Clearly some degree of open water when wet. Surrounded by pasture grasses such as Ryegrass, Soft Brome and Mediterranean Wheat-grass.
25949	Low	Low	Low	Unsuitable	Ephemeral marsh. Currently dry. Some wetland vegetation - Common Tussock-grass. Not extensive evidence of open water although an old swans nest seen from earlier in year. Surrounded by pasture grasses such as Ryegrass, Soft Brome and Mediterranean Wheat-grass.
25952	Low	Low - Moderate	Low	Unsuitable	Dry. Dominated by introduced pasture grasses. Some Common Tussock-grass especially north of fence line; Common Spike Rush and low herb cover. Grazed by cattle; no bare open water/mud.
25955	Low	Low	Low	Unsuitable	Ephemeral wet meadow. Dry except for small farm dam - open water, earth banks. Dam had no vegetation. Rest vegetated with pasture grasses and rushes *Juncus* spp. A few clumps of Common Tussock-grass and Dock *Rumex* spp. Grazed by cattle.
25957	Low-moderate	Low-moderate	Low	Unsuitable	Shaw River overflow, some of which visible from main road. Access closed during December visit. Vegetated with Common Reed, some bare mud along the river banks. Many waterbirds on earlier visit in late winter. Likely visited by snipe in spring; open mud may attract a few shorebirds.
25969	Low	Low-moderate	Low	Unsuitable	Ephemeral marsh among stony rises. Currently dry. Vegetated with sedges (Carex spp.) Few/no areas of open mud or water likely. Grazed.
25989	Low	Low	Low	Unsuitable	Ephemeral marsh close to Cockatoo Swamp. Common Tussock-grass dominant. Bounded on south side by stony rise - probably swamp has similar characteristics to Cockatoo Swamp WL 26026.
26026	Low	Low	Low	Unsuitable	Dam surrounded by raised levee. Banks steep, mostly bare earth, a few rocks. A few clumps of fringing/emergent rushes. Small boggy area at north end of poor quality - heavily grazed by cattle.
26028 (Cockatoo Swamp)	Low (but Sharp-tailed Sandpiper may occur at times)	Low - Moderate	Low	Unsuitable	Currently dry. Vegetation comprised *Myriophyllum* spp., Common Spike-rush, Common Tussock-grass, Rushes *Juncus* spp. Bounded to south by stony rises with patchy cover of Bracken and Tree Violet. Pasture grasses to north. Grazed by cattle.
26035	Low	Low - Moderate	Low	Unsuitable	Dry. Areas of bare mud. Little wetland vegetation except tiny area of *Myriophyllum* spp. and Common Spike-rush. Surrounded by pasture grasses e.g. Ryegrass; on higher ground some larger basalt boulders with bracken clumps & Tree Violet.
26036	Low	Low	Low	Unsuitable	Dry. Introduced pasture grasses dominant; small area of rushes *Juncus* spp. Part of this wetland would hold water in winter.
26037	Low	Low	Low	Unsuitable	Dry. Introduced pasture grasses dominant; small area of rushes *Juncus* spp. Part of this wetland would hold water in winter. Part of mapped wetland is actually stony rise.
26038	Low	Low - Moderate	Low	Unsuitable	Dry. Introduced pasture grasses dominant; little or no wetland vegetation visible. Part of this wetland would hold water in winter.
26046	Low	Low-moderate	Low	Unsuitable	Depression among stony rises. Ephemeral. Drains intersect this wetland - therefore unlikely to hold water long after winter rains. Vegetation comprised pasture grasses (Ryegrass, Yorkshire Fog, Soft Brome etc.), Common Tussock-grass, sedges (*Carex* sp.), Dock *Rumex* sp.

Appendix 19: Historical records from the VBA of Swamp Skink and Growling Grass Frog from the wider search region (20km buffer)

Common Name	Scientific Name	Total Count	Survey Start Date	Survey End Date	Site Location Description	Latitude GDA94	Longitude GDA94	Accuracy (m)
Growling Grass Frog	*Litoria raniformis*		01/01/1788	31/12/1982	5' BLOCK CONTAINING LOVEL	-38.04019	142.45969	4500
Growling Grass Frog	*Litoria raniformis*		01/01/1788	31/12/1982	5' BLOCK CONTAINING BLACKFELLOWS BRIDGE	-37.95686	142.04303	4500
Growling Grass Frog	*Litoria raniformis*	10	25/12/1999		Tower Hill	-38.33518	142.27661	100
Growling Grass Frog	*Litoria raniformis*		01/01/1788	31/12/1982	5' BLOCK CONTAINING ILLOWA	-38.29019	142.37637	4500
Growling Grass Frog	*Litoria raniformis*		18/11/1992		Tower Hill State Game Reserve	-38.31438	142.36318	100
Growling Grass Frog	*Litoria raniformis*		18/11/2004		Hamilton HWY: Adjacent to Ti-Tree Creek	-37.97557	142.57548	100
Growling Grass Frog	*Litoria raniformis*	1	1/11/1979		ROUGHLY 2 KM N OF CONNEWARREN BRIDGE	-38.05686	142.62636	900
Growling Grass Frog	*Litoria raniformis*	1	20/10/2010		Mustons Creek, Hexham	-38.048	142.55312	100
Growling Grass Frog	*Litoria raniformis*	1	20/10/2010		Hamilton Hwy, 2.5km west of Hexham town centre	-37.99	142.64856	100
Growling Grass Frog	*Litoria raniformis*	1	20/10/2010		Mustons Creek, Hexham	-38.0272	142.56657	100
Growling Grass Frog	*Litoria raniformis*		28/11/2011		Hexham VIC	-38.0409	142.6797	60
Growling Grass Frog	*Litoria raniformis*	1	20/10/2010		Woolsthorpe-Hexham Rd, 5km Sth Hamilton Hwy	-38.0242	142.66838	100

Common Name	Scientific Name	Total Count	Survey Start Date	Survey End Date	Site Location Description	Latitude GDA94	Longitude GDA94	Accuracy (m)
Growling Grass Frog	*Litoria raniformis*	1	28/05/1976		5' BLOCK CONTAINING RYAN CORNER	-38.20686	142.12637	4500
Growling Grass Frog	*Litoria raniformis*		01/01/1788	31/12/1982	5' BLOCK CONTAINING GRIFFITHS ISLAND	-38.37353	142.2097	4500
Growling Grass Frog	*Litoria raniformis*		6/01/1962		Several miles W. of Port Fairy	-38.3902	142.19304	900
Growling Grass Frog	*Litoria raniformis*	15	26/09/2000		Wagon Bay Tower Hill SGR	-38.31802	142.35982	100
Growling Grass Frog	*Litoria raniformis*	100	10/03/1993		Tower Hill	-38.32075	142.35758	100
Growling Grass Frog	*Litoria raniformis*	1	3/02/1993		Tower Hill State Game Reserve	-38.32062	142.36902	100
Growling Grass Frog	*Litoria raniformis*		1/12/1993		Tower Hill State Game Reserve	-38.31794	142.36668	100
Growling Grass Frog	*Litoria raniformis*		13/12/1961		156 M.P. on the Princes Highway	-38.35686	142.44303	900
Growling Grass Frog	*Litoria raniformis*		1/03/1972		8 km E. of Warrnambool	-38.39019	142.59303	900
Growling Grass Frog	*Litoria raniformis*		01/01/1788	31/12/1982	5' BLOCK CONTAINING MEPUNGA WEST	-38.37352	142.62636	4500
Swamp Skink	*Lissolepis coventryi*		13/01/1965		Dennington Warrnambool	-38.34668	142.44961	900
Swamp Skink	*Lissolepis coventryi*	1	8/09/2003		Merri River: Northcote Drive Warrnambool	-38.38086	142.45487	100
Swamp Skink	*Lissolepis coventryi*	6	31/01/2018		Lake Pertobe: Pertobe Rd Warrnambool	-38.3896	142.4768	100
Swamp Skink	*Lissolepis coventryi*	16	8/09/2003		Lake Pertobe: Pertobe Rd Warrnambool	-38.3896	142.4768	100
Swamp Skink	*Lissolepis coventryi*		1/04/1981		Lake Pertobe: Warrnambool	-38.38867	142.47907	900