Level 1 Flora and Fauna Assessment

Kondinin Wind Farm

OCTOBER 2017

Prepared for
Kondinin Energy Pty Ltd

Version control

Project number:	SW140
Project file path:	SW140 Kondinin wind farm BA report 20170918
Client:	Kondinin Energy Pty Ltd
Revision	v20171011
Date	11/10/17
Prepared by	Shane Priddle
Reviewed by	Bianca Heinze, Greg Harewood,
Approved by	Shane Priddle
Client review by	James Townsend
Status	Final

SW Environmental is a registered business name trading under SW Environmental Pty Ltd, ABN: 52 605 825 367

Acknowledgements:

Ecoedge (2017) was engaged by SW Environmental to prepare the flora and vegetation components (Level 1 flora survey) of this report. SW Environmental has relied on the accuracy and information supplied by Ecoedge directly in the preparation of the relevant (flora and vegetation) sections of the reports cited below.

- Ecoedge (2017) Report of a Level 1 Flora and Vegetation Survey at Kondinin. Unpublished report to SW Environmental.
- Ecoedge (2017) Targeted Rara Flora Survey – Proposed Wind farm, Kondinin. Unpublished report to SW Environmental.

po box 1037, dunsborough, wa 6281
t 0437 700 917 | admin@swenvironmental.com.au
www.swenvironmental.com.au

Contents

APPENDICES

FIGURES

TABLES

COMMON TERMS/ACRONYMS

BC Act	WA *Biodiversity Conservation Act 2016*
DBCA	WA Department of Biodiversity, Conservation and Attractions Parks and Wildlife Service, including the Parks and Wildlife Service
DotEE	Department of the Environment and Energy
EP Act	WA *Environmental Protection Act 1986*
EPBC Act	Federal *Environment Protection and Biodiversity Conservation Act 1999*
ESAs	Environmentally sensitive areas
IBAs	Important Bird Areas
OEPA	Office of the Environmental Protection Authority
project	The proposed wind farm development
project area	The study area, including the broader development area
project site	the proposed infrastructure footprint
PEC	Priority ecological community
PMST	EPBC Act Protected Matters Search Tool
TEC	threatened ecological community
WA	Western Australia
WC Act	WA *Wildlife Conservation Act 1950*

EXECUTIVE SUMMARY

Kondinin Energy Pty Ltd is proposing to develop a wind farm north of Kondinin, WA. A flora and fauna survey was required to support the development application for the project and guide the project design.

Surveys included a spring reconnaissance flora survey carried out in 2016 by Ecoedge, across the whole project area (circa 4740 ha at that time) and targeted surveys at proposed impact sites (three access points and the proposed circa one hectare transmission line easement). The substation lot and transmission line tie-in location were not included in the 2016 surveys. Follow-up targeted spring flora surveys were required in 2017, to address additional potential impact locations for access points. Note the project area was reduced to approximately 3237 ha for the 2017 surveys to focus surveys on the current project design. Level 1 fauna surveys were also carried out in spring 2017 with additional survey elements targeting fauna groups considered to be 'at risk' in relation to wind farms. The additional survey or 'targeted surveys' included:

- Hollow bearing tree (black cockatoo breeding) assessment at potential clearing (access and transmission line) locations,
- Additional survey effort for bats (bat call analysis), and a
- Bird and bat risk assessment.

Desktop and site surveys found the following values within the project area:

- Nineteen native vegetation units varying in condition from completely degraded to excellent condition, across >75 patches (the largest at 24 ha) totalling approximately 153 ha.
- Several structural fauna habitats occur at the site with poor to good fauna habitat value, including:
    - Tall woodland,
    - Mallee,
    - Shrubland,
    - Cropped land,
    - Farm dams (approximately 30),
    - Granite outcrops.
- Beard vegetation associations 1023 and 960 that are considered over-cleared (less than 30% remaining) and under-reserved (less than 10% reserved) (DAFWA 2016) occur across the project area.
- Priority flora (4 taxa) and fauna (1 taxa) were identified as occurring within the project area, an additional 46 flora and seven fauna of conservation significance may potentially occur at the site.
- One hundred and thirty vascular flora taxa were identified within the project area, of which three were introduced species (partial list only).
- Sixty-three fauna species were identified during the field visit; 44 of these were birds.
- The presence of 29.4 ha of federally-listed "Eucalypt Woodlands of the Western Australian Wheatbelt" (also P3) across the project area.

Clearing impacts proposed are summarised below:

- Clearing includes up to 0.15 ha at three locations (approximately 0.1% of the native vegetation within the project area).
- No flora of conservation significance will need to be impacted (proposed impacts are 20m away based on infrastructure locations provided).
- The TEC will require pruning based on current designs. It should be avoided if possible, as outlined below.

- Threatened fauna are unlikely to be significantly impacted by the clearing proposed. Based on Table 5-1 the proposal is not likely to trigger the need for federal referral for Carnaby's Black Cockatoo based on clearing (note collision impact risks below).
- The bird and bat risk assessment (Appendix A.5) identified:
    - A number of common and secure species as 'at risk' species, indicating that they have potential to suffer collision mortality at the proposed wind farm from time to time, should they occur on site.
    - Carnaby's Black Cockatoo and Rainbow Bee-eater as being 'at risk' conservation significant species. A qualitative risk assessment found Carnaby's Black Cockatoo to have a rare likelihood of collision as individuals would normally fly below the RSA height, but a moderate risk, mainly due to the endangered status of the population rather than the likelihood of collision. Rainbow Bee-eater was found to be low risk species.
    - Given that Carnaby's Black Cockatoo was found to be a moderate risk species for the wind farm based on bird and bat risk assessment, the proponent may wish to liaise further with Department of the Environment and Energy (DotEE) in relation to whether the project should be for referred for legal certainty.
    - The Kondinin Wind Farm presents an overall low risk to birds and bats as a potential wind farm site.

Clearing impacts proposed are likely to be very low in scale and nature if the recommendations below are incorporated. Recommendations to avoid and mitigate potential impacts of the proposal include:

- Minimise disturbance to remnant native vegetation.
- Minimise impact at the TEC locations where pruning of trees will currently be required, north of the substation (617362E 6408104S) and the existing entrance to Lot 16619 off Notting-Karlgarrin Road (621930E 6408104S). This should be possible by aligning the transmission line to avoid most of the large trees north of the substation, and by relocating the easement north by approximately 30m, away from the TEC along the Notting-Karlgarrin Road. If significant pruning is required within the TEC then an Assessment of Significance should be carried out to determine if a significant impact is likely, and therefore the need to refer to DotEE.
- Avoid disturbing mapped populations of Priority flora.
- Avoid paddock trees >30cm DBH that may support hollows. If any hollow bearing paddock trees do require clearing, schedule clearing outside of Black Cockatoo key breeding periods (August-February). Ensure an experienced and licensed fauna specialist is present during clearing of hollow trees to manage any displaced/injured wildlife.

1 INTRODUCTION

1.1 Background

Kondinin Energy Pty Ltd is proposing to develop a wind farm north of Kondinin, WA, herein referred to as the 'project'. A flora and fauna survey was required to support the development application for the project and guide the project design.

1.1.1 Project description

The project involves the development of a large scale wind farm, consisting of the following components:

- Compound batching plant x 2, at 3.0 and 2.8 ha footprint each (no clearing required),
- Solar farm, 131.5 ha footprint (possible clearing of <10 isolated paddock trees),
- Substations x 3 at 2.5, 4.1 and 4.2 ha footprint each (impacts associated with the 2.5 ha site adjacent to the existing substation are outside of the scope of this project),
- Forty-six turbines and associated hardstand areas (no clearing required):
    - Turbines will be 185m in height from the base to the tip, with a hub height of approximately 115m,
    - Blade diameter will be 140m, with a blade elevation of approximately 45m,
    - The overall footprint at each turbine, including hardstand is approximately 100m by 50m. Turbine sites have been selected so the footprints can be orientated to avoid vegetation clearing.
- Four met masts (no clearing required),
- Access tracks (construction access and service), approximately 33.8km by six metres wide (maximum clearing footprint of 20m wide will impact a total of approximately 0.15ha of native vegetation at three points),
- Transmission line with associated easement,
    - Easement will be 30m wide but will remain uncleared,
    - Minor pruning will be required within the easement for trees over five metres high.

The 'project site' includes the proposed infrastructure footprint, described above. Considerable effort has been taken by the proponent to avoid the need to clear native vegetation in the location of infrastructure.

1.1.2 Location

The project is situated in the Shire of Kondinin in the eastern-central wheatbelt, approximately 240 km east-southeast of Perth (Figure 1-1). It extends from 4.2 km north and east of the Kondinin town site to 13.6 km north east of the town, over an area of approximately 3237 ha. The infrastructure is shown in Figure 1-2.

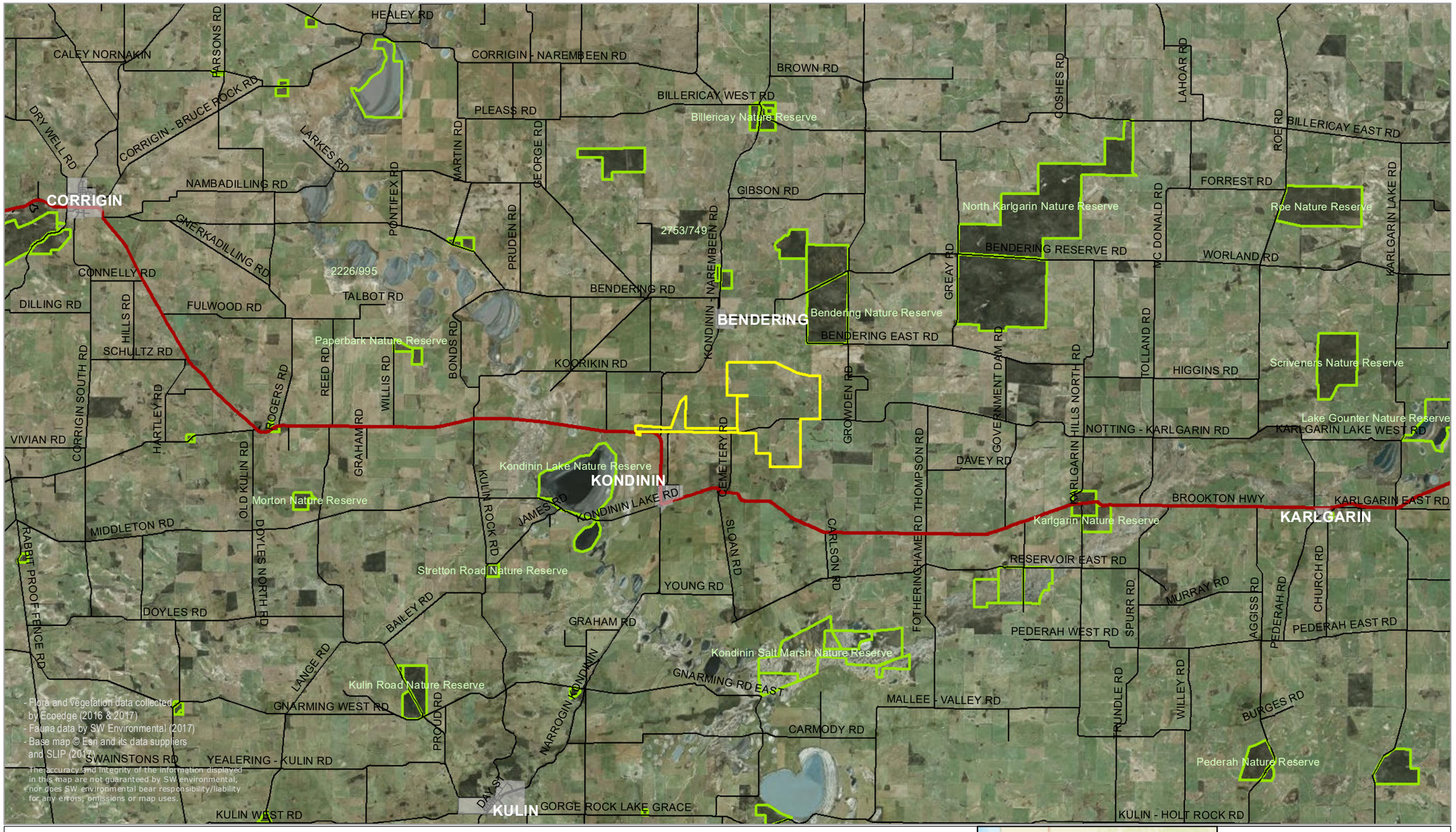


Figure 1-1 Project location

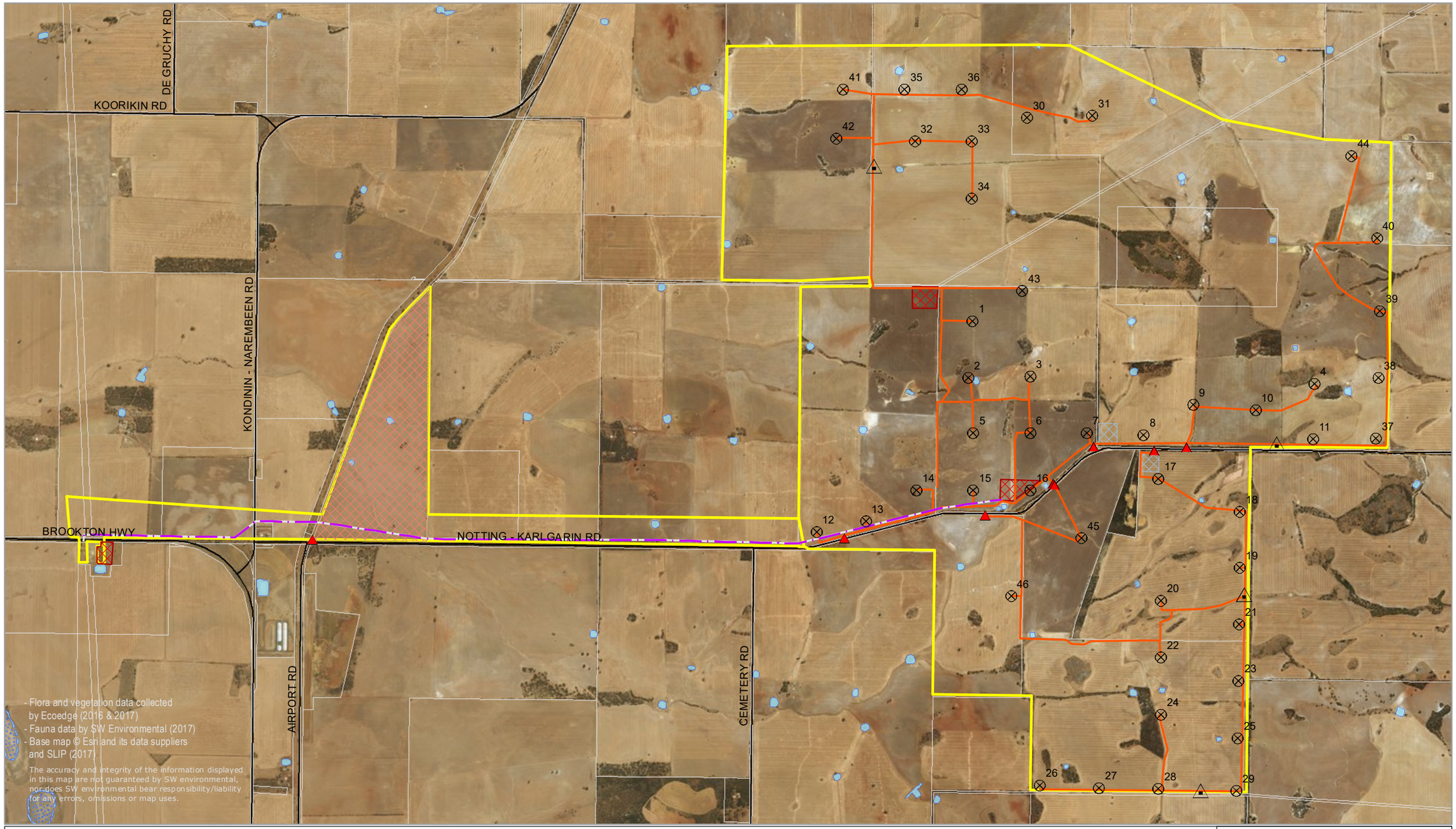


Figure 1-2 Project site showing remnant vegetation and proposed infrastructure

1.2 Scope of works

A Level 1 Flora and Fauna Assessment report was required for the proposed wind farm development. Due to the large scale of the project and the minimal clearing of native vegetation required, a combination of reconnaissance and targeted surveys were proposed in line with relevant EPA guidelines (refer to *Section 1.3.2*). Specifically, the survey scope included:

- 2016 Level 1 (reconnaissance and targeted) spring flora and vegetation surveys,
- 2017 Level 1 fauna survey and additional targeted spring flora surveys.

2016 Level 1 (reconnaissance and targeted) spring flora and vegetation surveys

A reconnaissance survey was carried out in 2016 by Ecoedge (contract botanists), across the whole project area (circa 4740 ha at that time) and targeted surveys at proposed impact sites (three access points and the proposed circa one hectare transmission line easement). The substation lot and transmission line tie-in location were not included in the 2016 surveys.

2017 Level 1 fauna survey and additional targeted spring flora surveys

A Level 1 fauna survey was required to supplement the flora report, and to be compiled into a single Level 1 Flora and Fauna Assessment report.

The Level 1 fauna survey contained additional survey elements targeting fauna groups considered to be 'at risk' in relation to wind farms. The additional survey or 'targeted surveys' included:

- Hollow bearing tree (black cockatoo breeding) assessment at potential clearing (access and transmission line) locations,
- Additional survey effort for bats (bat call analysis), and a
- Bird and bat risk assessment.

Follow-up targeted spring flora surveys were also required in 2017, to target additional potential impact locations associated with several access points. Note the project area was reduced to approximately 3237 ha for the 2017 surveys to focus surveys on the current project design.

1.3 Regulatory context

1.3.1 Legislative framework

The conservation status of flora, fauna and ecological communities in Western Australia (WA) is assessed under the WA administered *Wildlife Conservation Act 1950 (*WC Act*)* and federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) The new WA *Biodiversity Conservation Act 2016* (BC Act) is also partly in force which will eventually repeal the WC Act. The *Environmental Protection Act 1986* (EP Act) may also be relevant, in relation to clearing of native vegetation.

Species listed as threatened or migratory under the above legislation are referred to collectively in this document as being 'conservation significant' or 'target' species. These terms include species and communities listed under the former Department of Parks and Wildlife's Priority lists.

EP Act

Clearing of native vegetation in WA is primarily regulated under Part V of the EP Act, through the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and amendments. A Clearing Permit may be required for the clearing of native vegetation if the project is not required to be assessed by the EPA.

WC Act

The WC Act allows for the statutory protection of fauna or flora species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Threatened species are those published as Specially Protected under the WC Act, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (may also be referred to as Declared Rare Flora).

- S1 - Critically endangered species,
- S2 – Endangered species,
- S3 - Vulnerable species,
- S4 - Presumed extinct species,
- S5 - Specially Protected: Migratory birds protected under an international agreement,
- S6 - Conservation dependent fauna,
- S7 - Other specially protected fauna.

A full description of conservation codes is provided in Appendix A.6.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

BC Act

The former WA Department of Parks and Wildlife has been identifying and listing threatened ecological communities (TECs) since 1994 through a non-statutory process if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. Some TECs, or components of them, are also listed under the EPBC Act. Ecological communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened, are placed on the Priority list and referred to as priority ecological communities (PECs).

The BC Act 2016 will eventually fully replace the WC Act. On 2 December 2016, several parts of the new Act were proclaimed in the Government Gazette. These parts came into effect on 3 December 2016, and cover (amongst other things) coverage for flora and fauna as provided in the WC Act but also provides coverage of additional matters including habitats, communities (TECs), threatening processes, environmental pests and weeds.

EPBC Act

In accordance with Commonwealth legislation, the EPBC Act provides a list of matters of 'National Environmental Significance' (NES), which includes significant fauna, flora and communities. Under the EPBC Act flora, fauna or ecological community matters of NES may be listed in any one of the following categories as defined in *Section 179* of the Act:

- Extinct,
- *Extinct in the wild,
- *Critically endangered,
- *Endangered,
- *Vulnerable,
- Conservation dependent.

*Only these categories are matters of NES under the Act.

The EPBC Act also lists migratory species that are recognized under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals).

IUCN Red List

The IUCN Red List is an inventory of the global conservation status of species and used to assist DBCA and other agencies in attributing a given threatened species status. It does not have any statutory authority and is not considered in detail in this assessment.

1.3.2 Guidelines

This report was prepared in line with the requirements of a level 1 survey in:

- *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority, 2016)
- *Technical Guidance - Terrestrial Fauna Surveys for Environmental Impact Assessment* (Environmental Protection Authority, 2016)

The following were also generally considered:

- Commonwealth *Matters of National Environmental Significance – Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999, Department of the Environment, Water, Heritage and the Arts* (DEWHA)', (2009).
- Commonwealth *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable), Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso* (SEWPaC 2012).
- *Terrestrial Biological Surveys as an Element of Biodiversity Protection*. Position Statement No. 3, EPA (2002).

2 METHODS

The primary aim of the assessment was to determine the likelihood of any species of conservation significance occurring over the project and the likely impacts upon them. The desktop assessment reviewed available information on the habitat requirements of the species of conservation significance that may occur in the area. Field surveys identified the likelihood of target flora, fauna and communities occurring in the area and the significance of the area to them.

2.1 Flora and vegetation

2.1.1 Desktop assessment

Desktop assessments were carried out by Ecoedge in 2016. No flora or vegetation assessments had previously been carried out within the project area. However, surveys had been undertaken in the nearby Bendering and West Bendering Nature Reserves. Flora surveys, assessments and reviews have also been undertaken in nearby areas, although not all are publicly available and therefore could not be referenced. The most relevant and/or significant of those available that were referred to during the preparation of this report are listed below:

- Muir, B.G. (1979). *Some Nature Reserves of the Western Australian Wheatbelt. Part 20*. Kondinin Shire. Unpublished report prepared for the Department of Fisheries and Wildlife. Perth, Western Australia.
- Muir, B.G. (1977a). *Biological Survey of the Western Australian Wheatbelt. Part II. Vegetation and habitat of Bendering Reserve*. Records of the West Australian Museum, Supplement No. 3.
- Muir, B.G. (1977b). *Biological Survey of the Western Australian Wheatbelt. Part IV: Vegetation of West Bendering Nature Reserve.* Records of the West Australian Museum, Supplement No. 5.

Prior to the field survey, a desktop assessment was carried out by searching the DBCA and Western Australian Museum's Rare and Priority flora databases, and from Naturemap to produce a list of all flora (including rare flora) occurring within 10 km of the project. A Protected Matters Search Tool report (PMST) was also generated, detailing all species listed under the EPBC Act that may potentially occur or have habitat occurring within 20 km of the project. Database search results are provided in Appendices A.1 and A.2. Flora of conservation significance that may occur within the project area are provided in Appendix A.3.

2.1.2 Field survey

The initial field survey was carried out by Russell Smith (Senior Botanist, Ecoedge) over three days from 3rd – 5th October 2016 as per the requirements for a Level 1 flora and vegetation assessment (reconnaissance survey and targeted survey; EPA and DPaW Technical Guide, 2015). The targeted survey was limited to the transmission line easement and three of the proposed wind farm access points, shown in Figure 2-1. A distance of approximately 50m was surveyed either site of the road at each of the access point locations.

The field survey was guided by the desktop survey and preliminary viewing of the areas of remnant vegetation using Google Earth. Information was collected on the dominant vascular flora present and the condition of the vegetation at 65 survey points along roadsides and within more than 30 vegetation remnants within the project area. Photographs were also taken to record the variation within vegetation types.

Taxonomy and conservation status was checked against DPaW (2016e). Notes were taken on species not able to be identified in the field, and they were photographed for later identification.

Additional targeted surveys (EPA and DPaW Technical Guide, 2016) were carried out on 1st September, 2017, targeting the additional areas including the substation site and additional potential access (impact) areas shown in Figure 2-1.

Vegetation condition was assessed using the categories of the EPA and DPaW (2015), defined in Table 2-1.

Table 2-1 Vegetation condition scale (EPA and DPaW, 2015).

Vegetation Condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

2.1.3 Flora survey limitations

Potential limitations of the assessment are addressed in Table 2-2.

Table 2-2 Limitations of flora assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	Negligible	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements. As per a Level 1 survey, field work was targeted to detect conservation significant species and their habitat. Therefore, a comprehensive vegetation survey was not undertaken (i.e. a partial vegetation list for the site was produced)
Availability of contextual information	Moderate	A detailed regional vegetation survey (as exists for the Swan Coastal Plain, for instance) – has not been carried out for the Wheatbelt/Mallee region.
Completeness of the survey	Negligible	A Level 1 reconnaissance survey was carried out in all significant patches of remnant vegetation on private property, and roadside vegetation was sampled. Detailed surveys were conducted at all of the potential impact areas (transmission line easement, entrance points and proposed substation site).
Skill and knowledge of the botanists	Negligible	The senior field botanist (Russell Smith, Ecoedge) conducting the survey has had extensive experience in botanical survey in south west Australia over a period of 25 years.

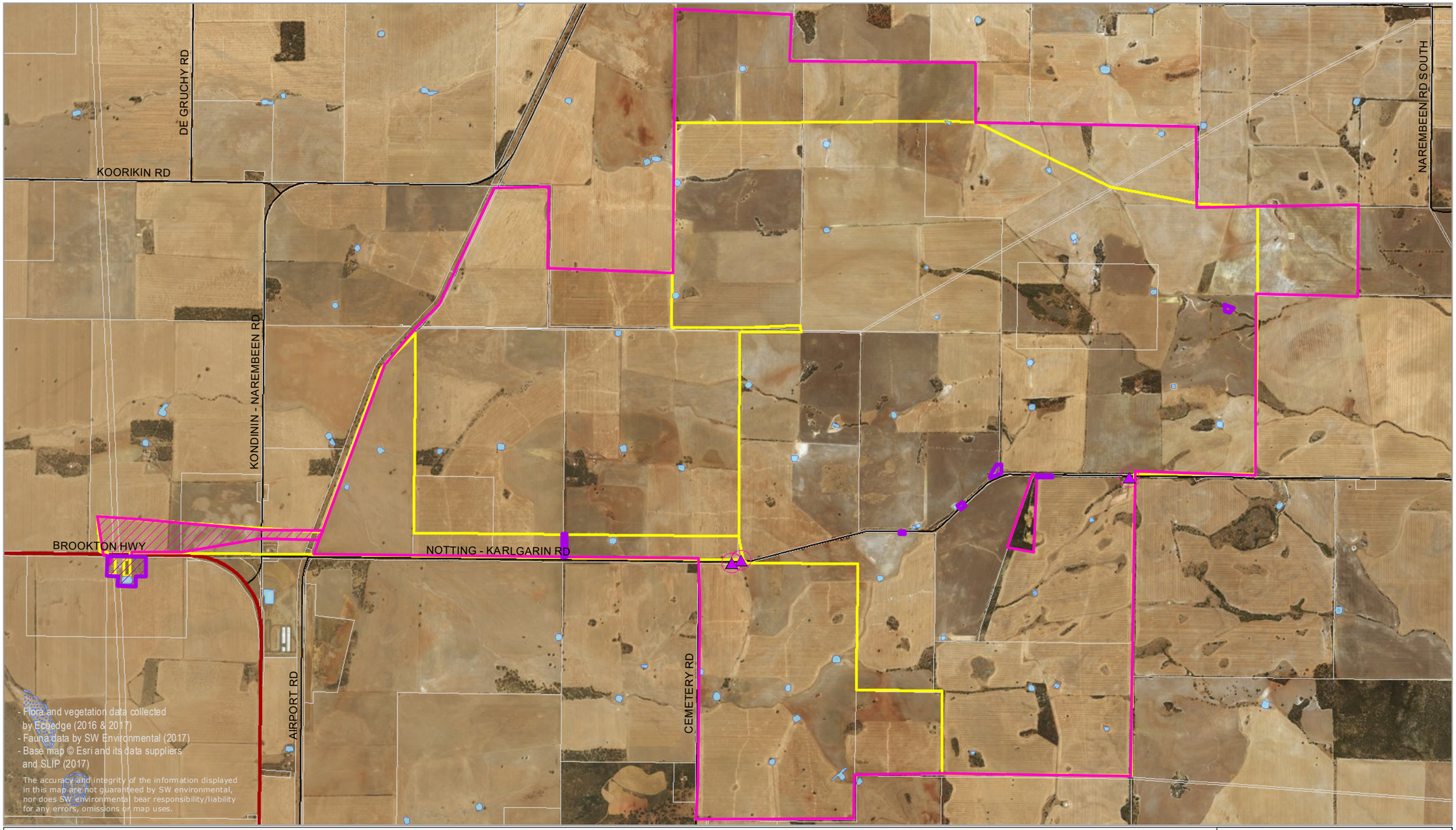


Figure 2-1 Flora survey areas

2.2 Fauna

2.2.1 Desktop assessment

Prior to field surveys, a desktop assessment was undertaken to develop an understanding of the ecological values of the project area and to assist in identifying the likelihood of target fauna species occurring. This involved a review of relevant databases, management plans, recovery plans, books, scientific journals and other publications, previous survey reports and consultation results.

Database search results within the locality were amalgamated from the Naturemap (20km) (DPaW 2017), Atlas of Living Australia (50km) (ALA) (2017) databases and PMST (20km) (DotEE 2017). The Naturemap and ALA database amalgamates records from sources including but not limited to WA Museum, Birdlife Australia, DBCA's threatened fauna and Fauna Survey Returns databases.

GIS datasets were also queried, including:

- Beard vegetation mapping dataset from the Department of Agriculture and Food WA (DAFWA) 'Native vegetation extent' dataset (current July 2013),
- Soils mapping datasets from DAFWA (2004),
- Aerial photography (ESRI and its data providers),
- GIS datasets (e.g. drainage lines and wetlands) sourced from the Shared Land Information Platform (SLIP) (2017).

A list of fauna species that may occur at the site is provided in Appendix B.1. Fauna of conservation significance that may occur locally are listed in Appendix A.4.

2.2.2 Publications

Publications consulted for general distribution of fauna included, but was not limited to:

- A Field Guide to the Mammals of Australia (Menkhorst and Knight, 2011),
- Field Companion to The Mammals of Australia (Van Dyck *et al.*, 2013),
- Field guide to frogs of Western Australia (Doughty and Tyler, 2009)
- Frogs of Western Australia (Thomson-Dans and Wardell-Johnson, 2002)
- Scats, Tracks and Other Traces: A field guide to Australian mammals (Triggs, 2008),
- Australian Bats (Churchill, 2008),
- The Field Guide to the Birds of Australia (Pizzey and Knight, 2012),
- The New Atlas of Australian Birds (Barrett *et al.,* 2003),
- Michael Morcombe's Birds of Australia eGuide, (Michael Morcombe, 2011),
- Handbook of Western Australian Birds (Volume 1 & 2)(Johnstone and Storr, 1998, 2004),
- A Complete Guide to Reptiles of Australia (Wilson and Swann, 2017),
- Reptiles and Frogs in the Bush: Southwestern Australia (Bush *et al.*, 2007),
- Reptiles and Amphibians of Australia (Cogger 2014),
- Tadpoles and Frogs of Australia (Anstis, 2013),
- Field guide to frogs of Western Australia (Doughty and Tyler, 2009),
- Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South Western Australia (Morgan *et al.* 2011),
- Waterbirds of South-west Wetlands (Thomson-Dans and Halse, 2001),
- Numerous online publications and other general species references (see *References* section).

2.2.3 Taxonomy and nomenclature

The taxonomy and nomenclature used in this report follows several sources, depending on the faunal group. It primarily follows the Naturemap database (DPaW 2017) but also the following:

- Amphibians: Bush *et al.* (2007),
- Aves: Pizzey and Knight (2007),
- Mammals: Menkhorst and Knight (2011),
- Reptiles: Bush *et al.* (2007).

2.2.4 Field survey

Fieldwork consisted of a site reconnaissance carried out over four days on 29-31st of August and 1st of September 2017, by experienced fauna and habitat surveyor Shane Priddle and senior zoologist Greg Harewood. The site reconnaissance included a mixture of general and targeted fauna surveys:

- Habitat assessment plots and desktop validation,
- Targeted surveys:
    - HBT mapping and black cockatoo surveys,
    - Diurnal bird surveys,
    - Acoustic bat recordings,
    - Motion sensing infrared cameras ("camera traps"),
    - Opportunistic surveys.

Weather conditions

The weather conditions were generally conducive for a Level 1 survey. The Corrigin weather station (about 30km west of the site, from Weatherzone, 2017) recorded minimum and maximum temperatures up to four degrees warmer than average at:

- 10-20°C on 29/08/2017 with no rain,
- 9-20°C on 30/08/2017 with no rain,
- 7-18°C on 31/08/2017 with intermittent rain on site in the afternoon,
- 6-16°C on 1/09/2017 with intermittent rain on site.

The cooler temperatures associated with later winter/early spring would have affected the activity of some fauna groups, such as reptiles, amphibians and bats, and therefore their ability to be detected. The abundance of farm dams and local water may also have spread water birds to lower densities on site, with the timing too early to have identified most migratory birds should they frequent local wetlands.

2.2.5 Habitat assessment

Vegetation units identified during the flora and vegetation survey (Appendix C.2: Ecoedge 2016) were used to define broad fauna habitat types across the site. Habitats identified during the desktop study were validated by walking over the study area and sampling for fauna habitat attributes (using 10x10m habitat assessment plots) within each structural fauna habitat type. Sampling included at least one plot within each broad structural habitat type. Specifically, the assessment included visiting 65 of the (approximately 70) vegetation patches mapped by Ecoedge (2016); see Figure 4-1. The remaining patches that were not assessed were unable to be easily accessed and deemed to be represented adequately by other plots. The results (Appendix C.3) are summarised in *Section 4-2*.

Micro habitat elements assessed included vegetation structure, habitat condition, ground cover, presence of rocky outcrops, ground litter, type of substrate, presence/absence of habitat trees, termite mounds, fallen logs and the presence or absence of ephemeral or permanent drainage

features. In particular, habitat attributes were considered with respect to species of conservation significance. Photos were taken and notes were made about the quality of habitat based on the descriptions in Table 2-3 below.

Fauna observations were recorded along with secondary evidence of fauna such as tracks, nests, scat, bones, diggings and characteristic feed signs.

Table 2-3 Fauna habitat quality categories and descriptions

Quality	Description
Good	• Native vegetation with habitat structure diverse and intact, with different vegetation age classes present at most stratum levels (ground, understorey, midstorey, canopy). • Forest/woodland: abundant hollow-bearing trees, including those with or likely to develop large hollows. Mature trees also produce more foraging resources for nectar and seed eating fauna. • Presence of shelter/refuges at ground level (dense understorey plants, tussock, rocky outcrop, hollow logs). • High habitat complexity (ecotones between vegetation types or areas forming a habitat mosaic). This increases the range of foraging and shelter opportunities within a habitat. • Presence of key foraging and microhabitat components for target species. • Little to no obvious weed invasion or evidence of grazing. • May be large patch and/or connected to other areas of native vegetation.
Moderate	• Native flora species dominant with moderate complexity of habitat structure appropriate to vegetation type. Ground litter layer intact or slightly disturbed. More than one age class present. • Forest/woodland: low to moderate abundance of hollow-bearing trees or trees likely to develop hollows. • Some shelter and refuge present for ground dwelling fauna. • Some habitat complexity (ecotones between vegetation types or areas forming a habitat mosaic). • Marginal presence of key microhabitat components for target species. • May be small or large in scale, and isolated or well connected.
Poor	• Habitat highly disturbed and simplified with very little structural complexity. Ground litter layer absent or highly modified. Complexity reduced by only one age class present. • Little or no shelter and refuge for ground dwelling fauna. • Forest/woodland: not likely to support hollow-bearing trees. • Lack of key foraging and microhabitat components for target species. • May have evidence of weed invasion or grazing. • May be narrow or small area and substantially influenced by edge effects, and isolated from other areas of native vegetation.

2.2.6 Targeted surveys

HBT mapping and black cockatoo surveys

Hollow bearing trees (HBT) may provide breeding habitat for a number of threatened species, including Carnaby's Black Cockatoo, or roosting sites for bats. HBT surveys were carried out within the targeted survey areas (the proposed substation and potential access sites). These surveys did not include targeted HBT surveys of paddock trees across the site.

HBT locations, hollow heights, sizes, and diameter at breast height (DBH) classes, for tree species that typically form hollows, were recorded where present. Presence or absence of black cockatoo forage habitat and roosting evidence was also noted.

Diurnal bird surveys

Four bird survey transects were carried out through remnant vegetation patches, shown below (refer to Figure 2-2 for transect locations). Species within the search area, flying overhead and outside the search area were recorded by sight and vocalisations along with estimated flight height in metres above the ground level. The survey effort (transect location, length, duration and date) is shown below:

- Transect 1: 600m, 50 mins, 30/08/2017,
- Transect 2: 600m, 50 mins, 30/08/2017,
- Transect 3: 180m, 20 mins, 30/08/2017,
- Transect 4: 600m, 30 mins, 31/08/2017.

Opportunistic observations of birds were also made during other phases of the fauna survey.

Acoustic bat recordings

Acoustic recordings were undertaken at three sites for one night each (see Table 2-4) using a Wildlife Acoustics SongMetre SM2BAT+ Ultrasonic Bat Detector (refer to Figure 2-2). The detector was located to target key habitat features such as large remnant vegetation patches, flight corridors, watering points, and set to record between sunset and sunrise. The detectors convert ultrasonic echolocation signals produced by bats into audible electronic signals that are then recorded. The recordings were later processed by Bat Call WA Pty Ltd (Bob Bullen) to determine the presence of specific species.

Table 2-4 Acoustic bat recording survey effort

Recording ID	mE	mN	Open	Closed	Nights	Comments
Bat 1	625836	6408549	29/08/2017	30/08/17	1	Road verge adjacent to farm dam; Mallee
Bat 2	626950	6410525	30/08/2017	31/08/17	1	Rocky outcrop; Shrubland
Bat 3	626621	6406772	31/08/2017	1/09/17	1	Remnant vegetation with farm dam; Mallee

Motion sensing infrared cameras

Four camera traps were deployed at five locations around the site (one camera trap was moved after the first night). Acorn brand LTL 5210A and 5310 model units were deployed and set to record three 12MP photographs in succession on each trigger event. Camera traps were baited with fish oil to target carnivorous mammals.

Table 2-5 Camera trap effort

Name	Open	Closed	mE	mN	Days
CAM1	29/08/2017	1/09/2017	626619	6408874	4
CAM2	30/08/2017	1/09/2017	626457	6410802	3
CAM3	29/08/2017	30/08/2017	626290	6408926	1
CAM4	29/08/2017	1/09/2017	627127	6408892	4
CAM5	29/08/2017	1/09/2017	623786	6408033	4

Opportunistic surveys

Non-systematic opportunistic observations of fauna species were made and recorded. Secondary evidence of fauna such as tracks, diggings and scats were also noted. Active searching was undertaken in specific areas to locate frog and reptile species. Searches generally included investigating burrows, investigating scats, tracks and other traces, turning fallen timber, roofing tin and rocks, etc.

Invertebrates and short range endemics

Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002). Invertebrate surveys were not part of the scope of work, however, the presence/absence of any invertebrates of conservation significance was noted.

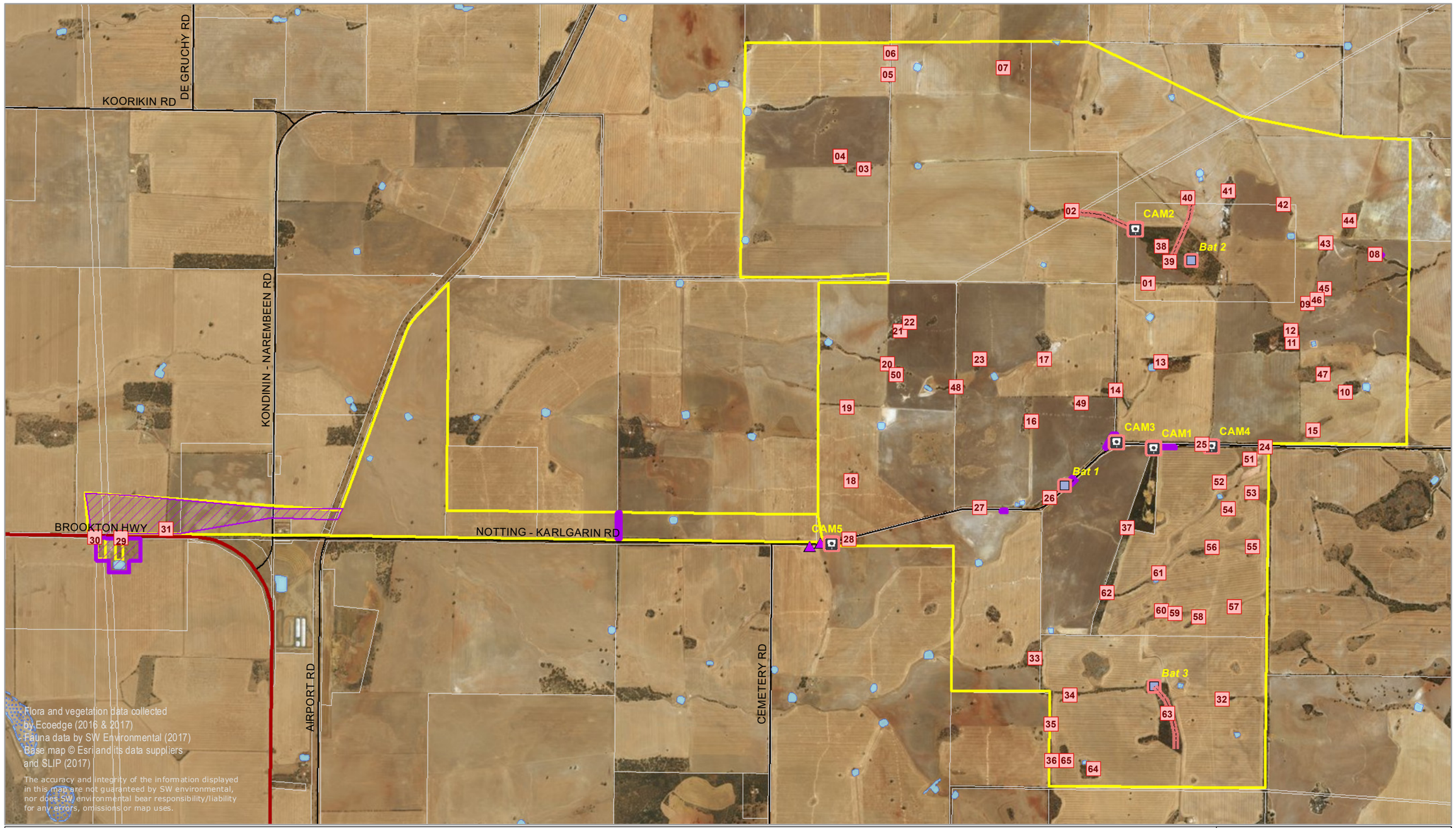


Figure 2-2 Fauna survey locations

2.2.7 Fauna survey limitations

Certain species may not have been detected during field investigations due to:

- seasonal inactivity during field survey (e.g. frogs and reptiles),
- species present within micro habitats not surveyed,
- cryptic species able to avoid detection, and
- transient wide-ranging species not present during survey period.

Some species may be present in the general area but may only use the study area itself on rare occasions or as vagrants. Any lack of observational data should not be taken as indicating that a species is absent from the site.

The habitat requirements and ecology of many of the species known to occur in the wider area are often not well understood or documented. It can therefore be difficult to include/exclude species from the potential list based on the apparent presence or absence of a specific habitats or microhabitats within the study area. A precautionary approach has been adopted for this survey. Any fauna species that would possibly occur within the study area (or immediately adjacent), as identified in the desktop assessment, has been assumed to potentially occur in the project area. The potential fauna list produced for this report (Appendix B.1) is likely an overestimation of those species that actually utilise the site.

In accordance with the EPA *Guidance Statement No. 56*, potential limitations of the fauna survey are identified below.

Table 2-6 Limitations of fauna assessment adequacy and accuracy

Aspect	Constraint	Comment
Competency	No	Suitably qualified individuals carried out the survey work: senior zoologist Greg Harewood and Shane Priddle (Certified Environmental Practitioner No.310).
Scope	Yes, negligible	A Level 1 fauna survey was undertaken and supplemented with desktop research, field survey and targeted surveys for fauna groups potentially at risk of wind farm development (birds and bats). Given that the clearing of native vegetation will be minimal the scope is considered adequate to have met the scale of works and budget.
Proportion of fauna identified, recorded and/or collected	No	Sixty-three fauna species were observed at the site; approximately one quarter of the species recorded locally, including two bats and one bird that were not previously identified locally from the desktop assessment. Additional survey effort may increase the total number of species found, but would be unlikely to identify any additional fauna of conservation significance given they have been considered through a precautionary approach.
Sources of information	Yes, negligible	The desktop assessment was based on Naturemap (20km) and ALA (50km) databases and PMST (20km) for target species. There may be additional surveys that have been carried out with results that were not provided submitted through DBCA Fauna Survey Returns, in the above datasets. The wide search ranges have been adopted in an attempt to address this limitation.
The proportion of the task achieved and further work	No	The field survey was completed adequately, with the survey carried out to a sufficient level with respect to required scope of works.
Timing/weather/season /cycle	Yes, negligible	Field surveys were undertaken in winter/spring and conditions considered suitable for a Level 1 assessment. The cool weather would have affected species counts for frogs and reptiles, however, given there are no locally occurring threatened

Aspect	Constraint	Comment
		species from these groups the survey is considered to have been adequate.
Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey	No	None observed.
Intensity (in retrospect, was the intensity adequate)	No	Based on the results the survey is considered adequate to meet the project scope.
Completeness (e.g. was relevant area fully surveyed);	No	Survey effort was considered adequate and of a higher intensity than typically required by a Level 1 survey.
Resources (e.g. degree of expertise available in animal identification to taxon level);	No	No unresolved problems/uncertainties arose with respect to identifying observed fauna species.
Remoteness and/or access problems;	No	Most of the study area was easily accessed by foot traverse or vehicle.
Availability of contextual (e.g. biogeographic) information on the region.	No	ALA and Naturemap databases which includes previous local fauna survey data, specialist books/publications and data were consulted.

3 DESKTOP REVIEW

3.1 Environmental context

3.1.1 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides for the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) National Reserve System, endorsed by all levels of government as a key tool for identifying land for conservation under Commonwealth's *Australia's Strategy for the National Reserve System 2009-2030* (DE, 2017).

The project is located in the Western Mallee (MAL2) sub region of the Mallee Bioregion, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (DE, 2017). The Mallee Bioregion is the south-eastern part of Yilgarn Craton. Its landscape is gently undulating, with partially occluded drainage, and is fragmented with particular surface-types almost completely cleared as wheatfields (Beecham and Danks, 2001).

3.1.2 Landform, geology, soils and climate

Beecham and Danks (2001) describe the Western Mallee (MAL2) sub region as having more relief than its eastern counterpart: main surface-types comprise clays and silts underlain by Kankar, exposed granite, sandplains and laterite pavements. It is characterised by salt lake systems on a granite basement and occluded drainage. Mallee communities occur on a variety of surfaces; *Eucalyptus* woodlands occur mainly on fine-textured soils, with scrub-heath on sands and laterite. The climate is warm Mediterranean and annual rainfall is 250-500 millimetres.

The project is in the South-eastern Zone of Ancient Drainage (SZAD) in the Avon Province. The SZAD extends from Corrigin east through Hyden to the edge of the intensive agricultural zone (clearing line), and south to the north-eastern part of the Shire of Gnowangerup (Verboom and Galloway, 2004). It is described by Schoknecht, *et al.* (2004) as a smooth to irregularly undulating plain dominated by salt lake chains in the main valleys. Duplex and lateritic soils on the uplands are characterised by Mallee vegetation (on duplex soils) and Proteaceous vegetation on gravels and sands (Schoknecht, *et al.* 2004). Within the SZAD, the project is situated on soils of the Corrigin East (250Ci) soil landscape system. A small section of the transmission line easement also crosses the Kondinin (250Ki) soil landscape system. These are described in Table 3-1.

Table 3-1 Soil Mapping Units occurring within the project area (Tille and Lantzke, 1990).

Soil Landscape	Description
250Co	Gently undulating rises to undulating low hills in the southern wheatbelt, with laterite, sandy & loamy gravels, duplexes & loamy earths & clays over mixed mafic rock. Heath & Mallee on lateritic uplands. Mallees on upper colluvial slopes, Salmon gum on lower colluvial slopes.
250Ki	Broad flat valleys of the southern Ancient drainage zone with fine textured alluvial soils derived mainly from mafic parent material. Mainly *Eucalyptus* woodlands, including *E. loxophleba, E. salmonophloia, E. capillosa, E. salubris* & halophytes.

3.1.3 Brief land use summary

The project, and broader Western Mallee sub region, fall within the wheatbelt and Intensive Land-use Zone (ILZ) (DAFWA, 2016). The ILZ has been mostly cleared and developed for intensive agriculture such as cropping and livestock production with only 31% of native vegetation remaining in the area. About 10% of the subregion is reserved for conservation, containing about 25% of the remaining vegetation (Shepherd et al, 2002). The project area itself is located within active agricultural land, primarily cleared but with narrow linear remnant vegetation strips still intact. Most of the site is cropped with canola or wheat. Fallow fields were grazed with sheep, many patches of remnant vegetation were not fenced and therefore also grazed.

3.1.4 Conservation lands

The nearest conservation lands include:

- Kondinin Lake Nature Reserve (~1700 ha); 8 km west from the closest proposed turbine, 2 km south west of the proposed substation;
- Bendering Nature Reserve (~1900 ha); 2 km north of the project site;
- Bendering West Nature Reserve (~100 ha); 4.5 km north of the project site;
- North Kalgarin Nature Reserve (~5800 ha); 9.2 km north east of the project site;
- Kondinin Salt Marsh Nature Reserve (~2200 ha); 9.5 km south of the project site;
- Kalgarin Nature Reserve and an unnamed reserve (~1400 ha); 14 km south east of the project site;

(SLIP 2017)

The Bendering and North Kalgarin Nature Reserves appear to be relatively intact from aerial photo interpretation and contain a number of threatened fauna records on Naturemap (2017). Given they are the largest contiguous patches of local native vegetation they are also likely to have best flora and fauna habitat values locally.

Kondinin Lake and Salt Marsh Nature Reserves are large seasonally inundated lakes that support a variety of wetland birds at certain times of the year. Kondinin Lake is used locally for water sports. They may provide habitat for the threatened Fairy Shrimp.

3.1.5 Important Bird Areas (IBA)

Important Bird Areas (IBAs) are areas identified by Birdlife International. IBAs are considered conservation priorities, sites able to be conserved in their entirety and are usually part of a protected-area network or recognised as having global bird conservation importance (Birdlife International, 2017).

No IBAs occur in the immediate vicinity of the subject site. The closest (Birdlife International, 2017) is the Dragon Rocks IBA, within the Dragon Rock Nature Reserve, situated approximately 75 kilometres east of the project.

The Dragon Rocks IBA supports the endangered Carnaby's Black-Cockatoo, the vulnerable Malleefowl, and four species restricted to the Mallee and the south-western biome: Western Rosella, Blue-breasted Fairy-wren, Purple-gaped Honeyeater and Western Yellow Robin.

The Holleton IBA, is the next closest at 77km north east of the site. It encompasses a number of nature reserves. The Holleton IBA supports important habitat for the vulnerable Malleefowl and four species restricted to the Mallee and the south-western biome: Rufous Treecreeper, Blue-breasted Fairy-wren, Purple-gaped Honeyeater and Western Yellow Robin.

3.1.6 Wetlands and migratory flyways

Irregular flooding and resource booms occur in many parts of Australia; this is particularly true for Australia's interior water bodies. There are 37 types of shorebirds that annually migrate to Australia to utilise waterbodies and shorelines along flyways. Flyways are broad corridors used by migrating birds. The East Asian-Australasian Flyway is one of eight identified around the world, extending from within the Arctic Circle, through East and South-east Asia, to Australia and New Zealand, stretching across 22 countries. The numbers of waders in the East Asian-Australasian Flyway are unknown but there are probably a minimum of two million migratory waders within Australia (Birdlife Australia, 2017). The flyway includes a number of staging sites as well as an indication of the regular routes used by thousands of migrating birds (Birdlife International 2017).

Little is known about the movement corridors and flyways used by migratory species within Australia (both international and endemic species) and that uncertainty adds to the risk posed by wind farms to migrating birds. Movement appears to vary species by species, with some showing high fidelity to certain sites and routes, and varies according to the boom-and-bust style of flooding and drying cycles of the Australian climate (Bianca Heinze *pers.comm*. with Rob Clemens, Shorebirds 2020, Bird Australia, 22/12/09).

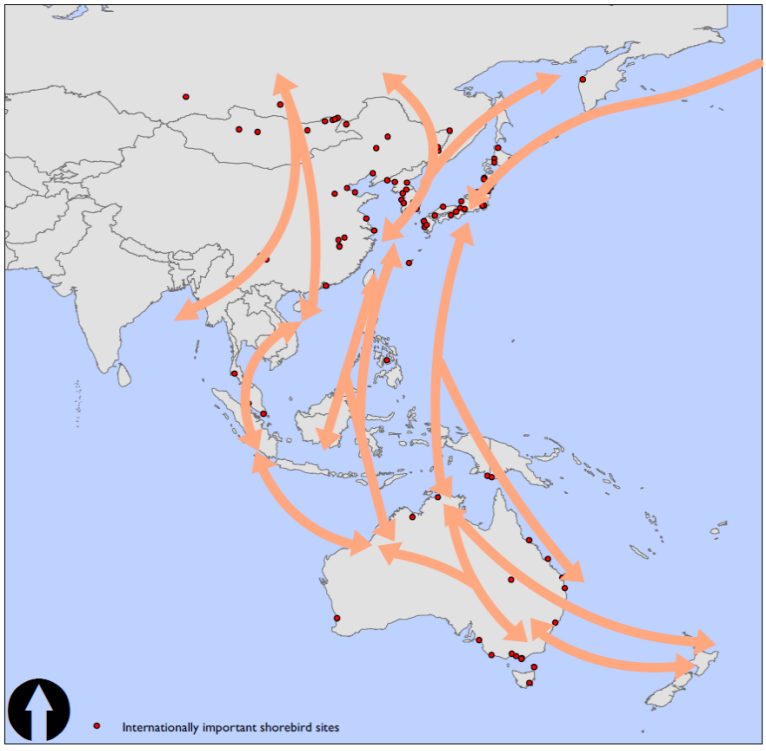


Figure 3-1 The East Asia / Australasia Flyway routes shown with arrows (Extract from: University of QLD, undated)

Wind farms have the potential to significantly increase bird mortalities where they are constructed along a major migratory bird flyway. Figure 3-1 shows the general location of routes used in the East Asia / Australasia Flyway; note that there is not a route near the site.

The Kondinin Wind Farm would be located in an area of mostly cleared agricultural land in the crook of the confluence of Lockhart River and Camm River. The closest wetlands to the project are the Kondinin Lake Nature Reserve which is part of a band of seasonal lakes; eight kilometres west from the closest proposed turbine, two kilometres south west of the proposed substation. It is not listed in the Directory of Important Wetlands in Australia (nor is it a RAMSAR site), which indicates that the local ephemeral lake system is unlikely to provide important habitat for nomadic or migratory waterbirds. The nearest RAMSAR site is Toolibin Lake about 80km southwest of the site.

The likely impact of the project on wetland birds is considered in more detail *Section 3.3.5*, and in the *General synopsis of operational impact upon birds and bat (risk assessment)* in Appendix A.5.

3.1.7 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are declared by the Minister for Environment under section 51B of the *Environmental Protection Act 1986* (EP Act). ESAs are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and are selected for their environmental values at state or national levels. They include;

- Defined wetlands and riparian vegetation within 50 m;
- Areas covered by Threatened Ecological Communities;
- Area of vegetation within 50 m of Declared Rare Flora;
- Bush Forever sites; and
- Declared World Heritage property sites.

According to the SLIP (2017), there are no known ESAs within the project area. The closest ESA is the Bendering Nature Reserve.

3.2 Flora and vegetation

3.2.1 Vegetation types

The project lies within the Roe district of the South-western Botanical Province (Beard, 1980). A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which generally described vegetation systems at a scale of 1: 250,000. Beard's vegetation maps attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent. The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd *et al.* (2002).

Beard vegetation associations have been described to a minimum standard of Level 3 'Broad Floristic Formation' for the National Vegetation Inventory System (NVIS) (state-wide to regional scale). Three vegetation associations are mapped as occurring within the project area, these are described in Table 3-2 and shown in Figure 3-2.

Table 3-2 Description of Beard Vegetation Associations mapped within the project area (Beard, 1972).

Vegetation Association	Description
1023	Medium woodland; York gum, wandoo & salmon gum (*E. salmonophloia*)
960	Shrublands; mallee scrub, redwood & black marlock
128	Bare areas; rock outcrops

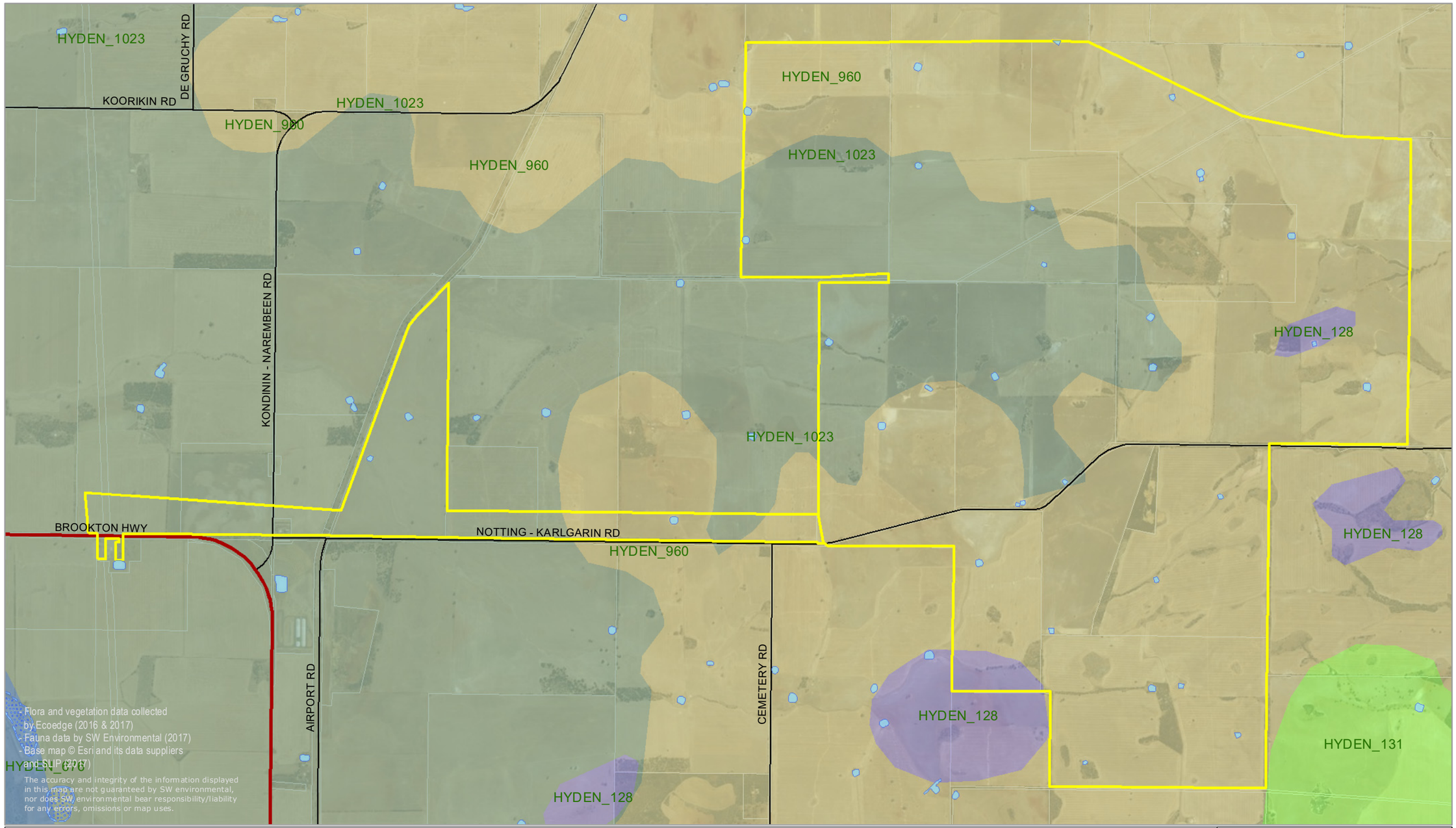


Figure 3-2 Beard Vegetation Associations mapped within the project area (Beard, 1972)

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30% or more of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia, 2001). This level of recognition is in keeping with the targets set in the EPA's Position Statement on the *Environmental protection of native vegetation in Western Australia: clearing of native vegetation, with particular reference to the agricultural area* (EPA, 2000). With regard to conservation status, the EPA has set a target of 15% of pre-European extent for each ecological community to be protected in a comprehensive, adequate and representative reserve system (EPA, 2006).

The Government of Western Australia, in its report on the *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis,* provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the Comprehensive, Adequate and Representative (CAR) reserve system for WA (Government of Western Australia, 2016). This system is also based on retention targets of 30% overall and 15% of pre-European native vegetation in reserves managed by DBCA under the *Conservation and Land Management Act 1984* (Government of Western Australia, 2016), in line with the Commonwealth and EPA targets detailed above. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the CAR Reserve Analysis. For this analysis, the Beard vegetation associations are used, as this is the only mapping dataset that covers the entire state. An assessment of the vegetation associations in the Project Area against the *Statewide Vegetation Statistics* is presented in Table 3-3.

Table 3-3 Beard Vegetation Associations of the project area assessed against the Statewide Vegetation Statistics (Government of Western Australia, 2016).

Beard Vegetation Association Code	% Remaining of pre-European extent	% of pre-European extent in all DPaW managed land
1023	10.84%	1.35%
960	13.78%	5.00%
128	87.54%	21.29%

3.2.2 Threatened ecological communities

Ecological communities are defined by DBCA as ...*naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services.* (DEC, 2010). The conservation status and protection of ecological communities are described in *Section 1.3.1* and Appendix A.6.

A PMST query for communities listed under the EPBC Act occurring within a 20 km radius of the project was undertaken (DotEE, 2016c), and the current DBCA TEC and PEC listings were consulted (DPaW 2016a; 2016b). Threatened or priority ecological communities known to occur or possibly occurring within 20 km of the project area are listed in Table 3-4.

Table 3-4 Threatened and Priority Ecological Communities known to occur within 20 km of the Project Area (DPaW 2016a; 2016b; DotEE, 2016c).

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
Eucalypt Woodlands of the Western Australian Wheatbelt	Eucalypt-dominated woodlands in the Western Australian Wheatbelt region as defined by the IBRA Avon Wheatbelt 1 and 2 and Western Mallee subregions.	P3	CE

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
	The community is defined by its woodland structure woodland with eucalypt trees in the canopy layer - most commonly salmon gum (*Eucalyptus salmonophloia*), York gum (*Eucalyptus loxophleba*), red morrell (*Eucalyptus longicornis*) or gimlet (*Eucalyptus salubris*). Several of the other emergent eucalypt species which may be present as characteristic species (e.g. Kondinin blackbutt (*E. kondinensis*), *E. myriadena*, salt river gum (E. *sargentii*), silver mallet (*E. ornata*) and mallet (*E. singularis*) are found only in the Western Australian Wheatbelt. The following are not included in the community description: woodlands and forests dominated by Jarrah (E. *marginata*) or Marri (*Corymbia calophylla*) where they occur without York Gum present; and non-woodland communities dominated by eucalypts, specifically those with a mallee growth form.		

3.2.3 Conservation significant flora

Thirteen threatened flora and 37 Priority flora may occur locally based on database searches within 20 km of the project (NatureMap and the PMST report) (Appendices A.1-A.2). These are listed in Table 3-5 below. Appendix A.3 includes an evaluation of the likelihood of these conservation significant species occurring at the site.

Based on an assessment of their known distributions and preferred habitats some of the species listed in Table 3-5 could potentially occur within the project area. The majority of species listed would have either been flowering at the time of survey or could be identified in the field without flowers.

Table 3-5 Threatened and Priority flora species known to occur within 20 km of the project area (DPaW 2016c; DotEE, 2016c).

Conservation status			
Threatened	**Priority**	**Priority** *(continued)*	**Priority** *(continued)*
Dasymalla axillaris T (CE)	*Acacia sclerophylla var. teretiuscula* P1	*Baeckea sp. Hyden (J.M. Brown 141)* P3	*Opercularia rubioides* P3
Duma horrida subsp. abdita T (CE)	*Chamelaucium sp. Parker Range (B.H. Smith 1255)* P1	*Banksia rufa subsp. obliquiloba* P3	*Oxymyrrhine plicata* P3
Guichenotia seorsiflora T (CE)	*Darwinia divisa* P1	*Banksia xylothemelia* P3	*Podotheca pritzelii* P3
Acacia lanuginophylla T (EN)	*Eucalyptus mimica subsp. continens* P1	*Calytrix nematoclada* P3	*Sarcocornia globosa* P3
Boronia capitata subsp. capitata T (EN)	*Melaleuca grieveana* P1	*Dielsiodoxa leucantha subsp. Leucantha* P3	*Stylidium sejunctum* P3
Eremophila verticillata T (EN)	*Pterostylis echinulata* P1	*Eucalyptus erythronema subsp. inornata* P3	*Synaphea constricta* P3
Grevillea dryandroides subsp. hirsuta T (EN)	*Acacia arcuatilis* P2	*Eucalyptus exigua* P3	*Thomasia tenuivestita* P3
Grevillea involucrata T (EN)	*Eremophila sargentii* P2	*Eucalyptus microschema* P3	*Thysanotus cymosus* P3
Grevillea scapigera T (EN)	*Millotia steetziana* P2	*Eucalyptus ornata* P3	*Diuris recurva* P4
Ptilotus fasciculatus T (EN)	*Acacia deflexa* P3	*Eucalyptus spathulata subsp. salina* P3	*Eremophila veneta* P4

Conservation status			
Threatened	**Priority**	**Priority** *(continued)*	**Priority** *(continued)*
Roycea pycnophylloides T (EN)	*Acacia inophloia* P3	*Frankenia drummondii* P3	*Grevillea asteriscosa* P4
Symonanthus bancroftii T (EN)	*Acacia undosa* P3	*Hibbertia glabriuscula* P3	
Verticordia staminosa var. cylindracea T (EN)	*Angianthus micropodioides* P3	*Lasiopetalum fitzgibbonii* P3	

3.3 Fauna

3.3.1 Fauna and habitats

General habitat

From the landscape scale Beard vegetation mapping (Table 3-3) key structural vegetation types of remnant vegetation include woodland, shrublands/mallee scrub and bare areas/rocky outcrops. From aerial photo interpretation, most of the site has been cleared and is cropped with canola and wheat with only narrow, mostly linear remnant vegetation strips still intact.

There are a number of ephemeral natural drainage features over the site, however they are all degraded and in most cases completely cleared of native vegetation. There are approximately 30 farm dams, varying in size from about 0.1-0.4 ha, located at various locations around the site. They are generally devoid of native vegetation along the banks. There are no other wetlands at the site.

Local records

Local records amalgamated from the Naturemap (20km) (DPaW 2017) and Atlas of Living Australia (50km) (ALA) (2017) databases, supplemented by species that may occur locally listed in the PMST report (2017), are provided in Appendix B.1. A total of 257 species have been recorded locally, with birds by far the most abundant class.

Class	Species
Amphibian	9
Bird	165
Mammal	30
Reptile	53
TOTAL	257

At least eight of the listed fauna are introduced species. Invertebrates, marine or aquatic dependant species (fish) are not included. Some near coastal or wetland taxa may be included in the list even though they do not use the site.

3.3.2 Conservation significant fauna

Of the 257 species that have been recorded locally (not necessarily at the site), 17 species are of conservation significance. Appendix A.3 provides an evaluation of the likelihood of relevant terrestrial conservation significant species occurring at the site. One Priority 4 invertebrate, Fairy Shrimp (*Parartemia contracta*) may also occur locally.

Class	Species
Bird	9
Mammal	9
Reptile	0
TOTAL	18

Table 3-6 Threatened and Priority fauna recorded, or that may occur, within 50 km of the project area (Naturemap 2017; ALA, 2017; PMST, 2017).

Group	Name	Vernacular	Conservation status (see Appendix A.6)
BIRDS	*Calidris ferruginea*	Curlew Sandpiper	WA (T)|EPBC Act (T) (IA)
	Calidris ruficollis	Red-necked Stint	EPBC Act (IA)
	Ardea (Bubulcus) ibis	Cattle Egret	IA
	Ardea (Casmerodius) modesta	Great Egret	IA
	Merops ornatus	Rainbow Bee-eater	IA
	Leipoa ocellata	Malleefowl	WA (T)|EPBC Act (T)
	Calyptorhynchus baudinii	Baudin's Black Cockatoo	WA (T)|EPBC Act (T)
	Calyptorhynchus latirostris	Carnaby's Black Cockatoo	WA (T)|EPBC Act (T)
	Pezoporus occidentalis	Night Parrot	WA (T)|EPBC Act (T)
MAMMALS	*Dasyurus geoffroii geoffroii*	Chuditch	WA (T)|EPBC Act (T)
	Phascogale calura	Red-tailed Phascogale	WA (S)|EPBC Act (T)
	Notamacropus irma	Western Brush Wallaby	WA (P4)
	Pseudomys occidentalis	Western Mouse	WA (P4)
	Myrmecobius fasciatus fasciatus	Numbat	WA (T)|EPBC Act (T)
	Bettongia penicillata penicillata	Brush-tailed Bettong	WA (T)|EPBC Act (T)
	Macrotis lagotis	Bilby	WA (T)|EPBC Act (T)
	Nyctophilus major tor	Greater Long-eared Bat	WA (P4)

3.4 Birds, bats and windfarm operations

Operational wind turbines present a risk to a range of birds and bats. The main risk is mortality through collision with moving turbine blades (blade-strike), although alienation (behavioural avoidance of suitable habitat near infrastructure) is also an important issue. A *General synopsis of operational impact upon birds and bats (risk assessment)* for the proposed wind farm is provided in Appendix A.5, based on the desktop considerations below.

Collision impacts

Fatality and injury may be caused by collision with the moving blades, or by being swept down by the wake behind a blade (Winkelman 1994) or for microbats, via barotrauma. Barotrauma is a *"traumatic [usually fatal] respiratory tract injury caused as a result of a sudden air pressure differential that may occur near moving wind turbine rotors"* (EPHC 2010 p136). In this report, barotrauma and blade-strike are referred to collectively as 'collision' impacts. Key factors when considering the potential rates of collision at a wind farm include the proposed configuration in

relation to habitat (such as good quality forest) and topographical features (such as steep slopes providing updraughts).

Birds and bats flying within or close to the rotor swept area (RSA) are at risk of collision impacts. The RSA is the area of air space defined by the rotation of the turbine blade. As well as direct collision with infrastructure, the rotating blades produce a wake which may draw animals into the blades; the wake is principally behind the turbine within the same plane (Sandersee 2009). The lateral extent of the wake is not well studied (Maalouf *et al.* 2009). In summary, the wind turbine primarily presents a collision risk to birds and bats that fly within or close to RSA *height*. Therefore, the ground clearance of the RSA relative to the flying height of bird and bat species is a key consideration.

The earliest large-scale wind farms, such as Altamont Pass in California, experienced high levels of avian collision mortality, mainly of migrating raptors. Turbine design and wind farm layouts have since progressed. While bird and bat fatalities continue to be recorded at modern wind farms, these are at substantially lower rates (EPHC 2010).

Alienation impacts

Operational wind turbines may cause changes in bird and bat behaviour. Where such behaviour includes avoiding nesting or foraging resources or diverging around the broad area where turbines are located, this is termed an 'alienation' or 'barrier' effect. The turbines, in these instances, act to 'sterilise' otherwise suitable areas of habitat or movement pathways. Alienation may affect local sedentary birds in their daily traverses for foraging, roosting and breeding sites or may cause migratory birds to shift migratory flyways. Birds and bats may be forced to change their flight behaviour to avoid collisions with turbines, subsequently impacting on their breeding and foraging success (Drewitt and Langston 2006). Alienation of hunting habitat for raptors such as Wedge-tailed Eagle may be of particular concern (Smales 2006) for local populations. The distance over which disturbance effects can extend from a wind farm varies considerably. A distance of 600 m is often reported as the zone of disturbance around turbines, however this ranges from 80 m (for a grassland songbird), to 800 m (for waterfowl) and four kilometres (for seabirds) (Sharp 2010). Barrier effects have been demonstrated at offshore wind farms in Europe, however there is little evidence at onshore farms (EPHC 2010, Hull 2013).

For both collision and alienation impacts, many species appear to habituate to the presence of turbines, after an initial acclimation period, reducing the effect of these impacts (Auswind 2006, Hull 2013, De Lucas *et al.* 2008).

3.4.2 Fauna factors

Birds

Generally speaking, birds at risk of collision are those that frequent the rotor sweep area (Hull 2013). Not all species of bird are at equal risk of collision with turbines. Generally, the identified groups at higher risk are (Kingsley and Whittam 2003, Kunz *et al.* 2007, Hull 2013):

- Raptors: Soaring birds use landform features such as elevation, ridges and slopes to cruise and take ascendance. Further, they are generally higher order species, meaning they are less abundant and therefore more susceptible to population level impacts.

- Passerines: Passerines have been among the most frequently reported fatalities at wind farms in Europe, America and Australia. Breeding birds in the vicinity of wind farms may be at greater collision risk if displaying aerial courtship. Migrating and nomadic passerines typically fly at altitudes of 150m or higher.

- Waterbirds: waterbird (i.e. grebes, cormorants, ducks, waders, cranes, rails, crakes, gulls, shorebirds) fatalities have been reported worldwide at wind farms close to staging, breeding and wintering areas.

In addition, wind farm sites may be frequented by scavenger species (e.g. crows, raptors), attracted by crops, livestock or carrion, resulting of collisions with turbines.

However, publicly available carcass monitoring data from Australian wind farms, which is restricted to several facilities in Tasmania, have found *no single foraging or taxonomic guild* to predominate amongst mortalities. Species colliding with wind farms include *carnivores, scavengers, nectivores and ground- and aerial-feeders* (Woehler and Belbin undated). In Victoria, the species most often discovered in mortality surveys are, in descending order, Australian Magpie, Brown Falcon and Nankeen Kestrel (Smales pers. comm. May 2016).

Australian carcass monitoring results reviewed by Hull (2013) suggest that approximately 20 percent of the bird assemblage present at the wind farm are involved in collisions; common species were found to be at most risk of colliding with turbines rather than rare or threatened species, based on their higher abundance. However De Lucas *et al.* (2008) found no clear relationship between species abundance and species mortality (overseas study).

Bats

Bats, specifically microbats, are also impacted by collision impacts at wind farms worldwide (Cryan and Brown 2007, Kunz *et al.* 2007). In terms of blade-strike, Australian species that appear to be most at risk are those that forage above canopy height (i.e. in open airspace) and move through their environment at high speeds, such as the White-striped Freetail Bat. These species are more likely to travel at blade-sweep height. Collisions result either where the individual fails to detect the moving blades or is unable to manoeuvre around them.

Another group of microbats that appears to be at high risk from wind farms, based on international studies, are those that migrate (Baerwald & Barclay 2009). Migrating bats are thought to travel high in the air column on 'auto-pilot'. That is they appear to rely less on echolocation when migrating, instead navigating using alternative spatial senses or orographic features such as mountain ranges (Baerwald & Barclay 2009). Consequently migrating bats may fail to detect wind turbines.

Based on the above, two groups of Australian bats can be identified as higher risk from blade-strike impacts:

- Non-migrating, high-flying microbats (e.g. Gould's Wattled Bat)
- Migrating, high-flying microbats (e.g. White-striped Freetail Bat), particularly those of conservation concern (e.g. threatened) (e.g. Eastern Bentwing Bat)

3.4.3 Site factors

Siting and configuration of turbines is the primary factor influencing alienation impacts; inappropriate layout (such as lines of turbines between important habitat features) can create a barrier effect, resulting in habitat loss or fragmentation (Brett Lane & Associates 2009). Turbines are generally placed to maximise wind values and to minimise turbulence from topographic features and other turbines. In practice, this means there are usually large and variable spaces between turbines (Smales 2006). Rows of turbines throughout the project area could in effect act as multiple barriers to the movement of birds and bats.

Within a wind farm design layout there is potential for some turbines to result in higher collision risk to bird and bat species due to proximity to:

- Steep topography: gully heads, ridge lines, deep valleys and escarpments. These areas can concentrate migrating birds along relatively narrow pathways. They also provide updraughts utilised by swifts, swallows, martins, gulls and raptors.

- Wetlands: marsh, pond, lake, stream, and/or river. Higher concentrations of birds and bats would be encountered near water sources. Water bodies may also provide staging areas for migrating waterbirds.
- Dense vegetation areas: woodland, forest, tree lines, tree clusters.
- Habitat resources such as hollow-bearing trees, caves (narrow flight corridors usually occur near cave entrances) or through gaps between habitat patches. Waterbird staging, wintering or breeding areas.

(Thelander 2004, Kunz *et al.* 2007, Hull 2013).

3.4.4 *Turbine parameter factors*

The parameters of the turbines under consideration for the proposed Kondinin Wind Farm are shown in Table 3-7. The key concerns for birds and bats are:

- Minimum lower rotor-swept area (RSA), (i.e. the ground clearance).
- The height profile of the RSA.

Table 3-7 Turbine parameters under consideration at the proposed Kondinin Wind Farm

Parameter	Approximate dimensions
Hub height	115 m
Blade diameter	140 m
Rotor-swept area (RSA) height profile	45 m – 185 m
Ground clearance (minimum lower RSA)	45 m
Number of turbines	46

RSA height profile

The RSA would occupy the airspace between 45 m and 185 m above the ground - at the lowest point in its arc, the moving blade would travel within approximately 45 m of the ground.

The flying heights of bird species vary considerably (Sharp 2010). While flight-height data collected in south-eastern Australia indicates that many bird taxa rarely fly above 25 metres (EPHC 2010), this is influenced by site and species specific factors. Most birds and bats fly within or just above vegetation canopy height (Smales, I. *pers.comm*, May 2016; *pers.obs.* B, Heinze, Churchill 2008).

The majority of birds and bats fly well below the minimum RSA height proposed. Species that regularly fly high while foraging would be most at risk from the turbine parameters under consideration. This includes common species such as Welcome Swallow and Wedge-tailed Eagle. This is considered further in Section 5.3.

4 RESULTS

4.1 Flora and vegetation results

4.1.1 Vegetation types

Nineteen vegetation units were recognised within the project area (Table 4-1). Their distribution is mapped in Figure 4-1 and a species list for and photograph of each of the vegetation units is provided in Appendix B.2. The structure of most of the vegetation units is Mallee, with some woodland units containing the trees *Eucalyptus salmonophloia* and *E. loxophleba* subsp. *lissophloia* and (rarely) *E. ornata*. There are several shrubland units and one unit (O), is comprised primarily of a lithic herbland complex over granite outcrops. A similar range of structural formations was found in the vegetation of West Bendering Reserve, immediately to the north of the Project Area, by Muir (1977b).

Several of the vegetation units within the Project Area fit the definition of the Federally-listed threatened ecological community "Eucalypt Woodlands of the Western Australian Wheatbelt". In particular, those patches of vegetation units A, E, I and P which fit the area and condition criteria as outlined in Commonwealth of Australia (2016) would likely qualify (Figure 4-4). There were no State-listed threatened ecological communities within the Project Area, however, the federally-listed "Eucalypt Woodlands of the Western Australian Wheatbelt" is also listed as a State-listed Priority 3 ecological community.

Table 4-1 Vegetation units within the Project Area. Units which qualify as WA Wheatbelt Woodlands TEC are marked with an asterisk*.

Code	Description	Simplified structural vegetation type
A.*	Open woodland of *Eucalyptus salmonophloia* and *E. loxophleba* subsp. *lissophloia*, with patches of Mallee on red-brown or yellow-brown loam.	Tall woodland
A.(vd)	Open woodland of *Eucalyptus salmonophloia* on yellow-grey sandy loam. (Very Degraded)	Tall woodland
B.	Mallee/tall shrubland of *Eucalyptus calycogona* subsp. *calycogona*, *E. loxophleba* subsp. *lissophloia* (mallee), *Allocasuarina acutivalvis*, *Callitris canescens* and *Santalum spicatum* on red-brown or yellow-brown loam with patches of granite outcrop.	Tall woodland
C.	Open Mallee of *Eucalyptus calycogona* subsp. *calycogona* below breakaways	Mallee
D.	Open Mallee of *Eucalyptus capillosa subsp. polyclada, E. cylindriflora, E. neutra, E. pluricaulis subsp. pluricaulis* and *E. tenera* on rocky yellow-brown loam.	Mallee
E.*	Open woodland/low woodland of *Eucalyptus capillosa* subsp. *polyclada* and *E. phaenophylla*, with occasional emergent *E. salmonophloia* on rocky/gravelly yellow-brown sandy loam.	Mallee
F.	Shrubland of *Acacia acanthoclada, A. dissona var. dissona, Allocasuarina acutivalvis, Banksia armata, Calytrix breviseta subsp. stipulosa* and various other species on yellow-grey loamy sand.	Shrubland
G.	Low Mallee of *Eucalyptus phaenophylla* on grey-brown sandy loam.	Mallee
H.	Very open Mallee of *Eucalyptus celastroides* subsp. *virella* on gravelly sandy loam.	Mallee
I.*	Woodland of *Eucalyptus ornata* and *E. salmonophloia* on yellow-brown loam.	Tall woodland
J.	Low Mallee of *Eucalyptus phaenophylla*, *E. phenax* and *E. tenera* on gritty yellow-brown sandy loam.	Mallee
K.	Open Mallee of *Eucalyptus platycorys* on yellow-brown sandy loam.	Mallee
L.	Tall shrubland of *Acacia acuminata* with emergent *Eucalyptus loxophleba* subsp. *lissophloia* on gritty brown sandy loam, associated with granite outcrops.	Shrubland

Code	Description	Simplified structural vegetation type
M.	Low Mallee of *Eucalyptus eremophila* and occasional *E. calycogona* subsp. *calycogona*, *E. capillosa* subsp. *polyclada*, *E. celastroides* subsp. *virella*, *E. sporadica* and *Callitris canescens* grey-brown gritty sandy clay with occasional sandstone outcrops.	Mallee
N.	Shrubland of *Allocasuarina acutivalvis, Gastrolobium spinosum, Hakea preissii, H. francisiana, Phebalium tuberculosum* and *Santalum spicatum* on lateritic breakaway.	Shrubland
O.	Tall shrubland of *Acacia acuminata* surrounding a lithic herbland complex on shallow gritty loam, associated with granite outcrops.	Shrubland
P.*	Open woodland of *Eucalyptus salmonophloia* on yellow-grey sandy loam.	Tall woodland
Q.	Open Mallee of *Eucalyptus gardneri* subsp. *gardneri* and *E. loxophleba* subsp. *lissophloia* on yellow-brown loamy sand.	Mallee
PL	Planted/Plantation	Mallee

As shown in Table 4-2, the site is dominated by completely degraded native vegetation, paddock trees and cropped areas (95.3% of the site). Mallee accounts for 3.2% of the site area, native shrubland for 1.2% and woodland occupies only 0.3% of the site.

Table 4-2 Vegetation areas of each simplified structural type within the project area.

Condition	Area (ha)	%
Tall woodland	11	0.3
Mallee	103	3.2%
Shrubland	38	1.2%
Unmapped (completely degraded native vegetation, paddock trees, cropped areas)	3085	95.3%
Total	*3237*	*100.0*

4.1.2 Vegetation condition

Most of the remnant native vegetation in the project area was rated as either Excellent (where it was protected from grazing by livestock) or Completely Degraded (where it was completely open to grazing by livestock) (Table 4-3) (EPA and DPaW 2015).

In the eastern part of the project, there are several substantial areas (> 5 ha) of remnant vegetation that have been fenced off from livestock since the land was first cleared and which show almost no signs of degradation. In contrast are the many small patches of completely degraded vegetation which consist almost entirely of mallee eucalypts and pasture grasses, which have been subject to livestock grazing probably since the land was first cleared. The completely degraded areas have not been mapped.

Table 4-3 Vegetation areas in each condition class within the project area.

Condition	Area (ha)	%
Excellent	52.08	0.24
Very Good	37.17	0.17
Good	33.42	0.16
Degraded	28.92	0.14
Completely Degraded	61.30	0.29
Total	*212.90*	*100.0*

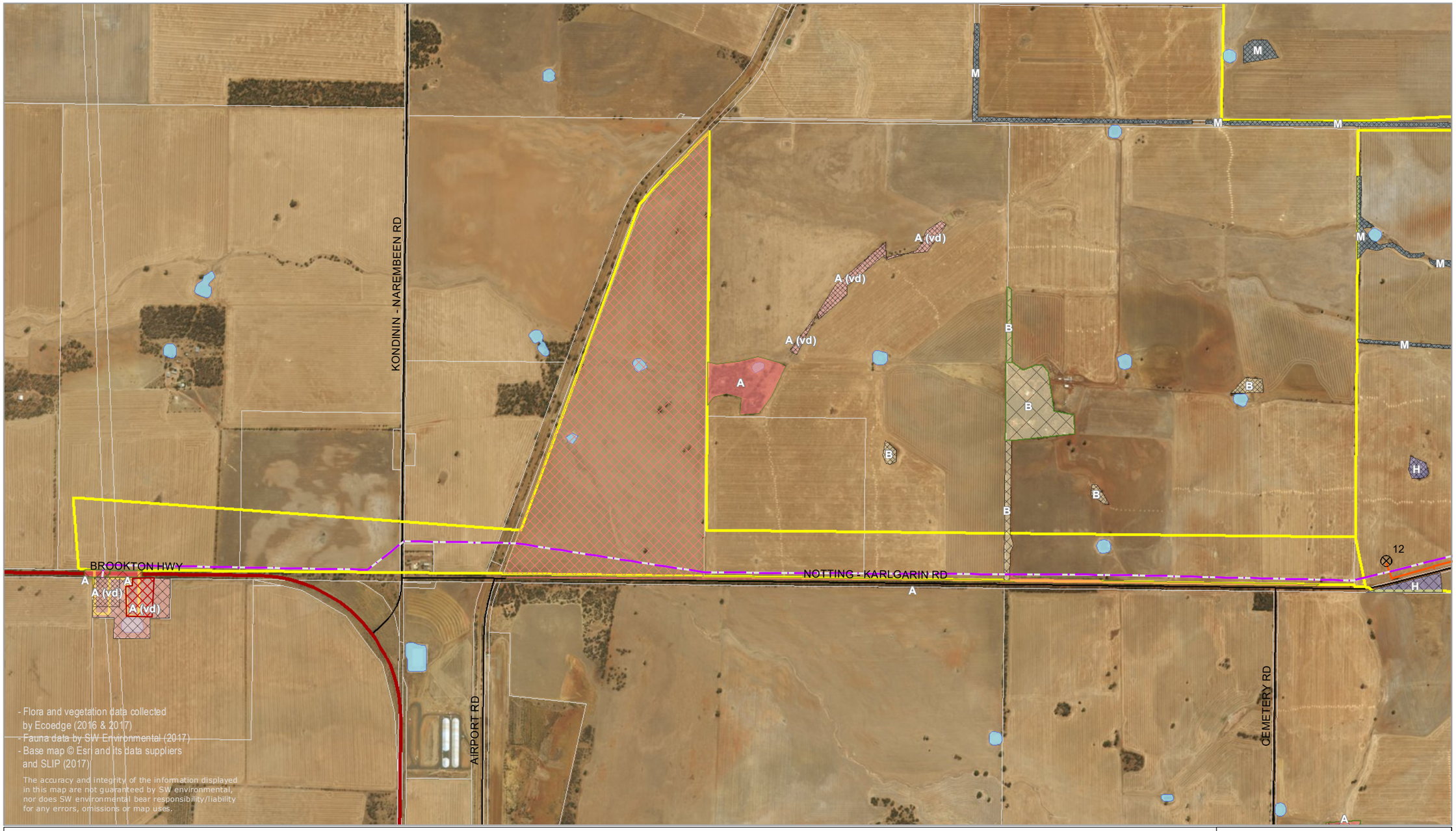


Figure 4-1 Vegetation types and condition mapped across the substation/transmission line section of the project area (adapted from Ecoedge, 2017)

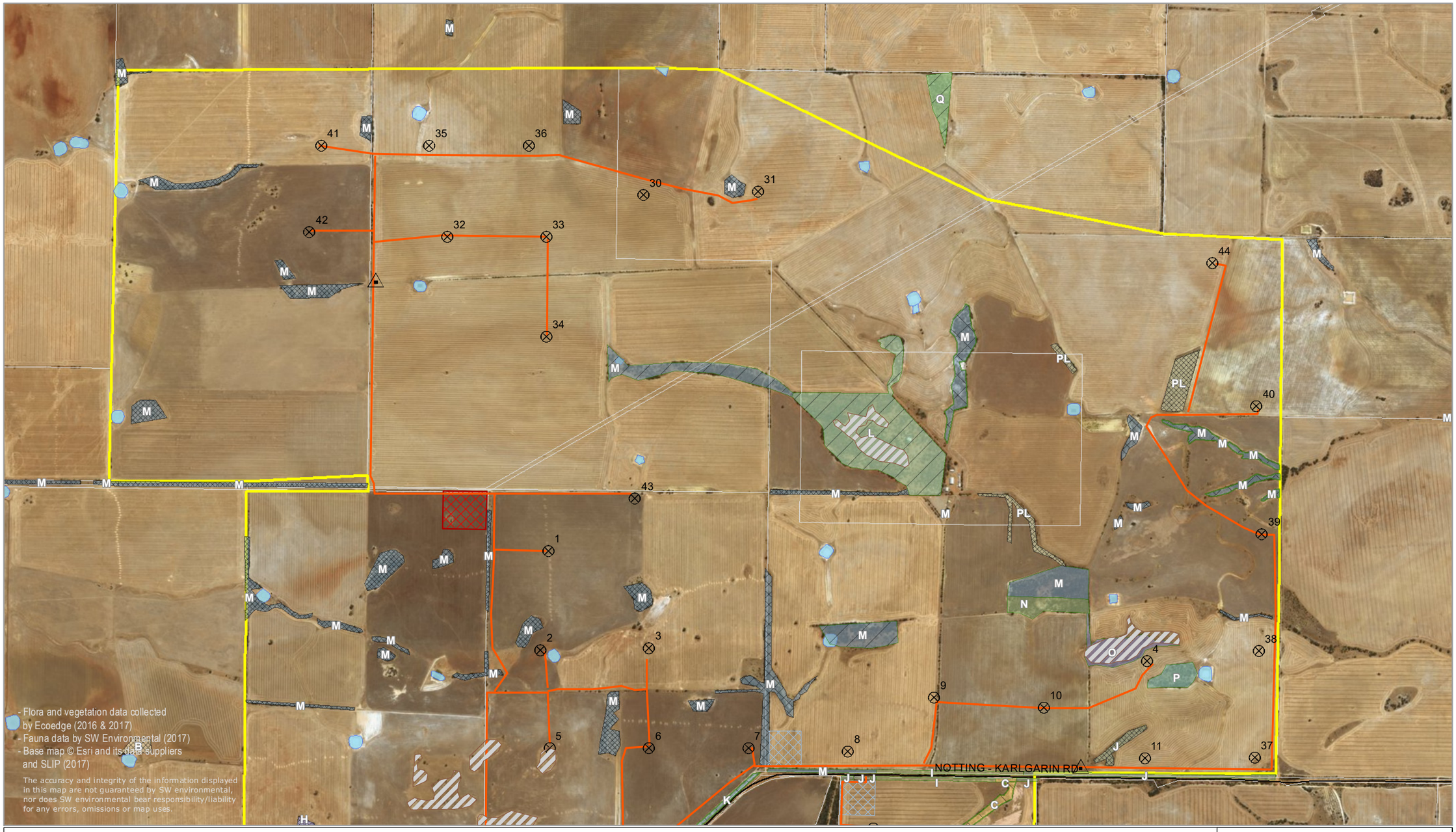


Figure 4-2 Vegetation types and condition mapped across the wind farm area – northern section (adapted from Ecoedge, 2017)

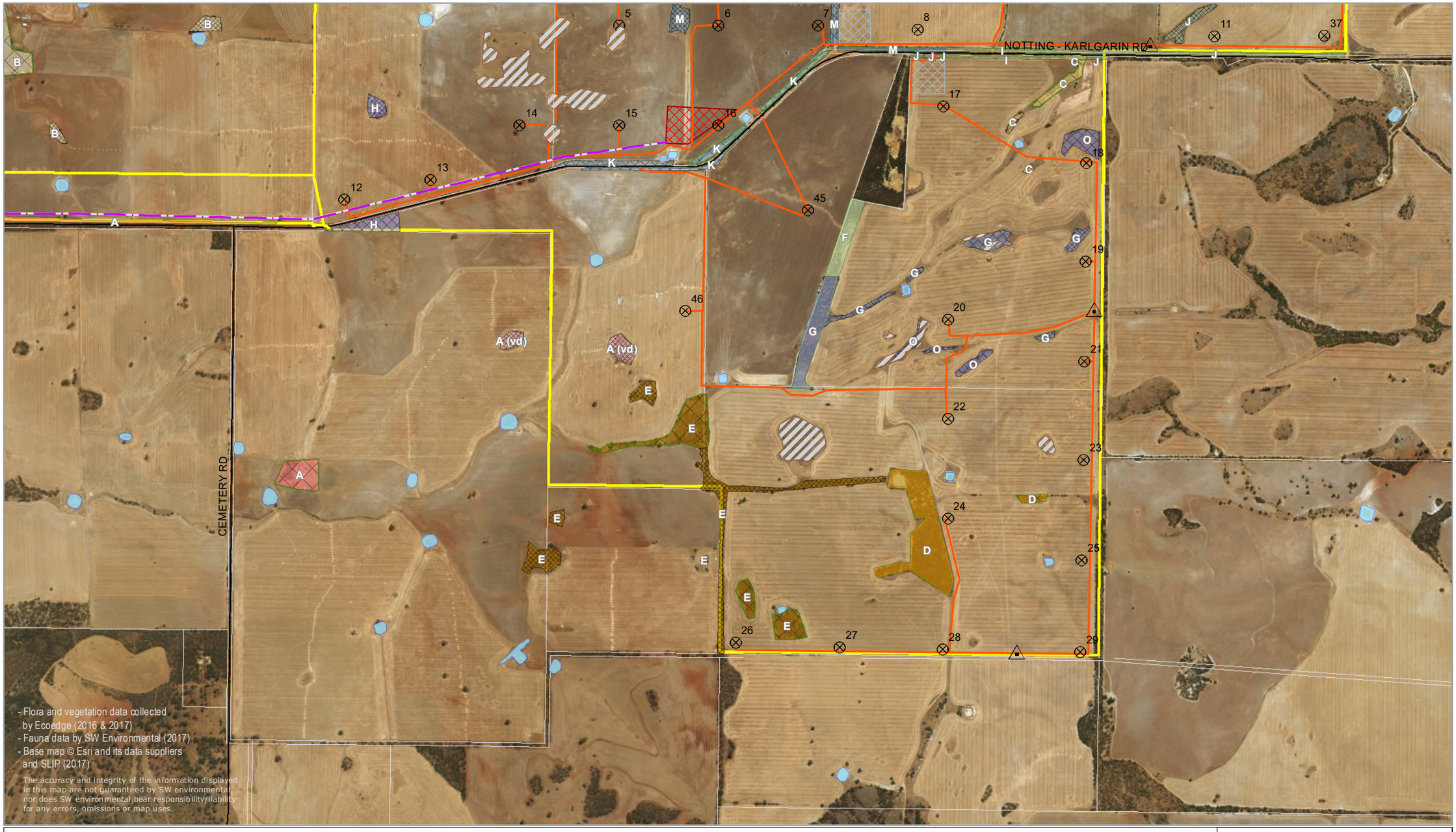


Figure 4-3 Vegetation types and condition mapped across the wind farm area – southern section (adapted from Ecoedge, 2017)

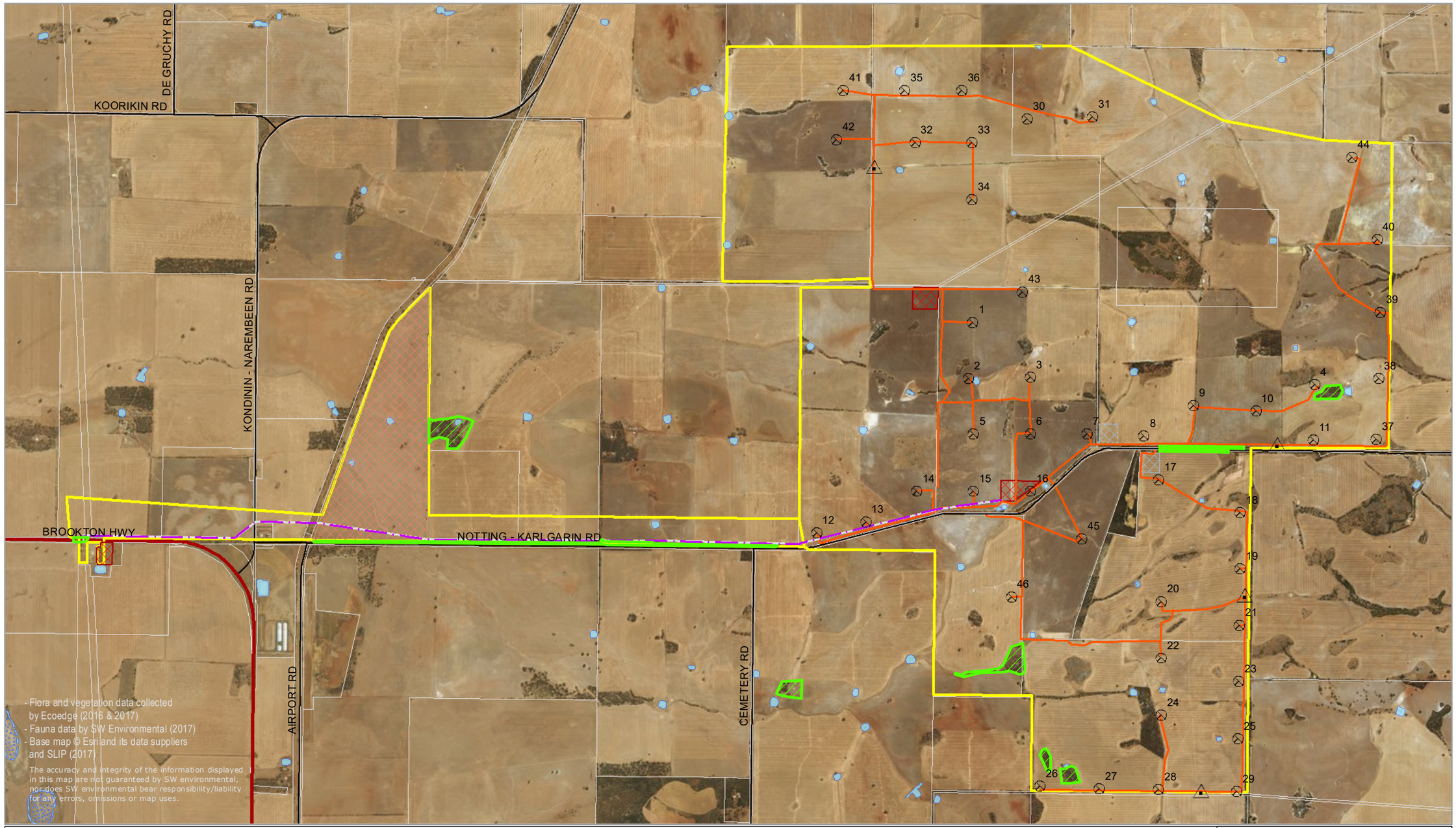


Figure 4-4 Threatened ecological community "Eucalypt Woodlands of the Western Australian Wheatbelt' extent across the site (adapted from Ecoedge, 2017)

4.1.3 Flora

One hundred and thirty vascular flora taxa were identified within the project area, of which three were introduced species (Appendix B.2). This list contains only a partial list of vascular flora within the project area; provision of a complete list of vascular flora was outside the scope of the Project (refer to Table 2-2 Limitations of flora assessment adequacy and accuracy. Table 2-2). A high proportion of the upper storey taxa were identified, but perhaps only 50% of the shrub and herbaceous layer species are listed. Only about one hectare of remnant vegetation was subjected to a comprehensive survey (impact locations at the proposed access points and proposed powerline easement) due to high potential for conservation significant species to occur there.

Photographs of vegetation typical of the access point survey areas are provided in Appendix C.1.

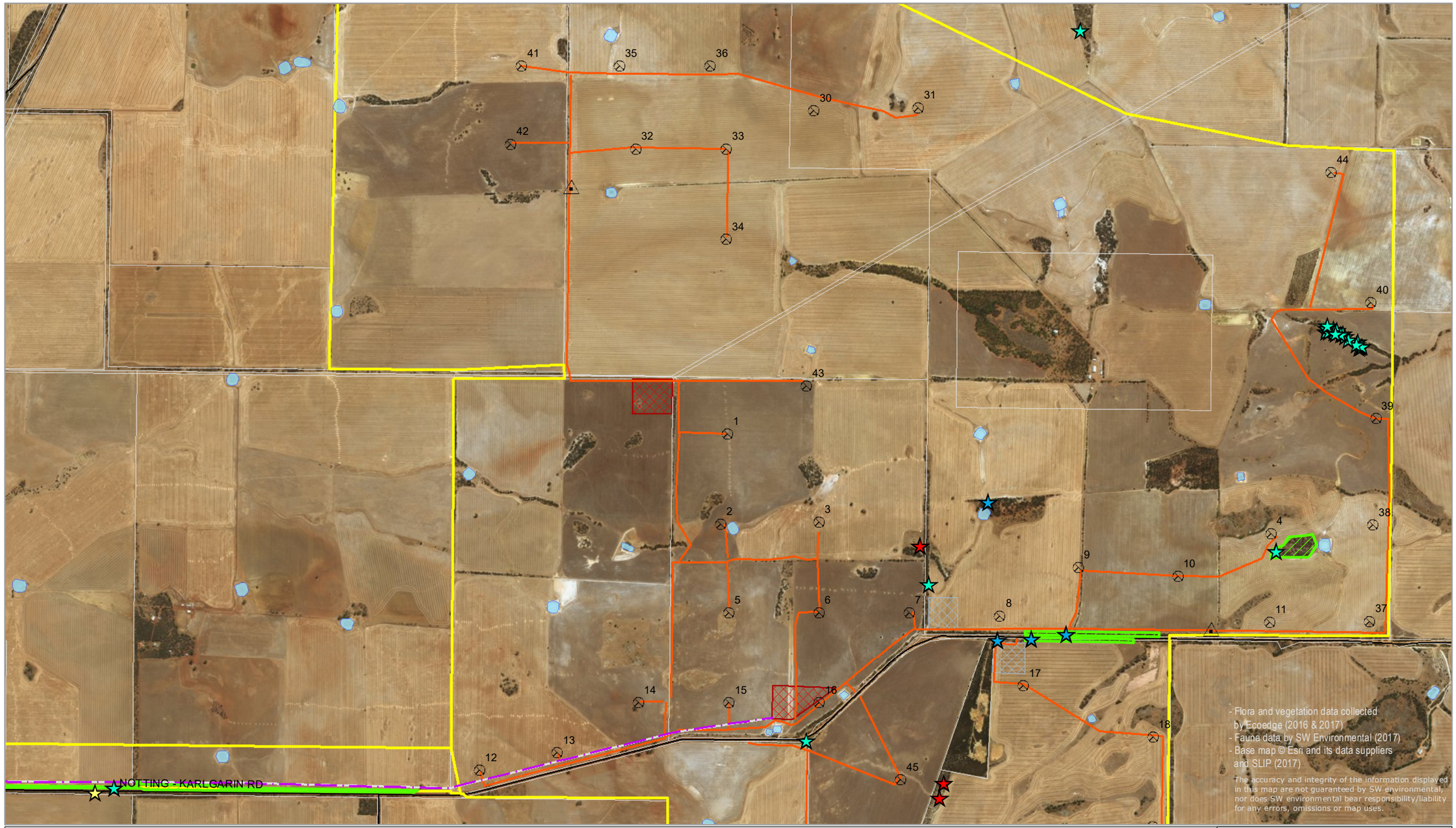
4.1.4 Conservation significant flora

Four Priority-listed taxa were found in the project area (Figure 4-5):

- *Eucalyptus erythronema* subsp. *inornata* (Priority 3),
- *E. ornata* (Priority 3),
- *Eremophila veneta* (Priority 4),
- *Grevillea asteriscosa* (Priority 4).

Other conservation significant vascular flora have potential to occur within remnant vegetation within the project area that are not proposed to be impacted (refer to Section 2 for methods).

In the areas subject to detailed vegetation survey in 2016 (i.e. entrance points and powerline easement), no threatened flora were found. In the areas subject to detailed survey in 2017, two priority species were found (included in the list above).



Eremophila veneta, P4
Eucalyptus erythronema subsp. inornata, P3
Eucalyptus ornata, P3
Grevillea asteriscosa, P4
Threatened ecological community "Eucalypt Woodlands of the Western Australian Wheatbelt'
Turbine (proposed)
Metmast (proposed)
Transmission line (proposed)
Road (proposed)
Substation (proposed)
Compound batching plant (proposed)
Farm dam
Project boundary
Road
Cadastre

0 0.25 0.5 1 Km
A3 @1:22000
Author: SP
Ref: SW140
NORTH

Figure 4-5 Location of Priority flora observed within the project area

Eremophila veneta (P4)

Eremophila veneta (Metallic-flowered Eremophila), Figure 4-6, a shrub with silvery to lilac flowers found in the southern wheatbelt from Corrigin to Gnowangerup, is represented by 74 records in DBCA databases. Six populations of *E. veneta* were found within the project area, two of them in Tall woodland on the verge of Notting-Karlgarin Road and four in remnant patches on farms and Tall woodland / Mallee.

Figure 4-6 *Eremophila veneta* (left); *Eucalyptus erythronema* subsp. *inornata* (right) (Ecoedge 2016).

Eucalyptus erythronema subsp. inornata (P3)

Eucalyptus erythronema subsp. *inornata* is a small mallee with creamy yellow flowers that is restricted to the central wheatbelt of Western Australia (Figure 4-6), where it is distributed in a crescent from south of Wyalkatchem southwards and then south-east to south of Kulin and Pingaring (Nicolle and French, 2012). It is represented by 36 records in DBCA databases. One population was found within the project area, in Tall woodland on the verge of Notting-Karlgarin Road.

Eucalyptus ornata (P3)

Eucalyptus ornata (Ornate Mallet) is a small tree, or mallet, to 6-10 m in height, sometimes with a slightly buttressed trunk, with smooth grey or silvery bark and white flowers (Figure 4-7). It is restricted to the southern wheatbelt, from east of Narembeen to east of Lake Grace, and is represented by 27 records in DBCA databases. It is found mainly on road verges, although there are several populations within Nature Reserves. Four populations were found within the project area high in the landscape,

- one a known occurrence (DBCA database) in Tall woodland,
- one on the verge of Notting-Karlgarin Road in Tall woodland,
- another within a private property remnant north of the roadside population in Mallee.
- An additional plant was found just east of the gravel pit entrance, near a proposed clearing area in Tall woodland.

Figure 4-7 *Eucalyptus ornata* beside Notting-Karlgarin Road.

Grevillea asteriscosa (P4)

Grevillea asteriscosa (Star-leaf Grevillea), is a shrub, 0.3 to 2 m in height, with red flowers (Figure 4-8), found in the central and southern wheatbelt from Merredin to Gnowangerup. It is represented by 50 records in DBCA databases. Two populations, both in private property remnants (in Mallee and Shrubland), were found within the project area.

Figure 4-8 *Grevillea asteriscosa*.

4.2 Fauna results

4.2.1 Habitat assessment

General habitat units

Fauna habitats are generally associated with the vegetation, type soils and other microhabitat features. Over the site they vary for different fauna groups but for the purposes of this assessment have been grouped into structural vegetation types adapted from Ecoedge (2017):

- Tall woodland,
- Mallee,
- Shrubland.

Additional habitats across the site include:

- Cropped land,
- Farm dams,
- Granite outcrops.

Habitat quality

The remnant vegetation patches (tall woodland, mallee and shrubland) provide the dominant fauna habitat at the site. Habitat quality varies across the site and is dependent on the size of the patch and the condition/diversity of vegetation. Typically, the narrow width and isolated nature of many of the remnant vegetation patches are unlikely to provide good habitat for larger species, particularly native mammals, due to a lack of cover and food resources, exposure to predators and edge effects affecting vegetation condition (sheep grazing, weeds). Fenced areas are typically less degraded and offer better fauna habitat opportunities, unfenced areas (most of the smaller patches) are of low habitat quality and likely to be used mostly by birds.

Cropped areas mostly provide habitat on the fringes between ecotones, primarily for foraging. Raptors may forage in these areas. Rocky outcrops (particularly where there is layering/crevices), rock piles and dead timber are found throughout the project area (naturally occurring some in better quality patches and as artificial piles in degraded patches). And provide essential habitat components (e.g. shelter) for a variety of fauna. The invertebrate, microbial and vertebrate species supported by decaying wood provides food for a number of other species. Intact islands of vegetation may still provide habitat for a range of birds, reptiles and bats.

There are a number of ephemeral natural drainage features over the site, however they are all degraded and in most cases completely cleared of native vegetation. They generally exist as washouts that would only contain pools or running water immediately during or after a rainfall event. As noted there are approximately 30 farm dams, varying in size from about 0.1-0.4 ha, scattered over the project area. The banks are typically cleared offering little opportunity for fauna refuge. They do however provide vital watering opportunities for native fauna and may concentrate fauna activity, particularly dams located within and adjacent to remnant vegetation.

Granite outcrops occur in the project area (mapped in Figure 4-1). Where they occur on site, they are often exposed massive bedrock, providing fairly homogenous habitat without variations such as fissures, boulders and layering that offer refuge for fauna. Weathering can form small crevices in some outcrops which provide refuge for small animals such as skinks, though these are fairly rare. Seeps have formed at the edges of some outcrops and these maybe used as water points or as habitat by frogs – small pools containing tadpoles were observed during the field survey. Figure 4-19 shows a typical granite outcrop in the project area.

Photos of representative habitat types are provided below, generally in order of abundance across the site (starting with the most common):

Figure 4-9 Cropped land

Figure 4-10 Mallee (poor habitat value)

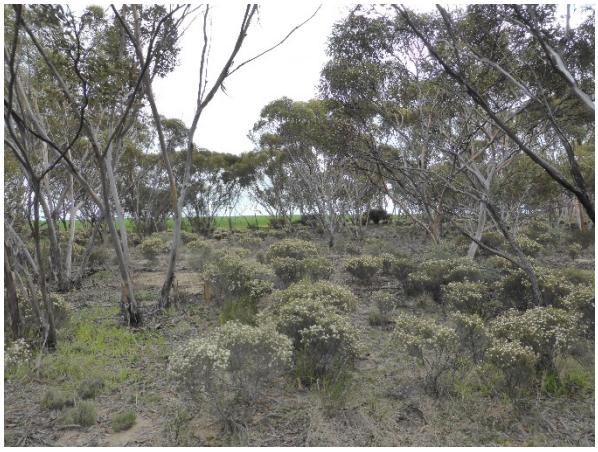


Figure 4-11 Mallee (good habitat value)

Figure 4-12 Shrubland (poor habitat value)

Figure 4-13 Shrubland (moderate to good habitat value)

Figure 4-14 Tall woodland (poor habitat value)

Figure 4-15 Tall woodland (good habitat value)

Figure 4-16 Planted vegetation

Figure 4-17 Farm dam

Figure 4-18 Drainage line

Figure 4-19 Granite outcrop

Potential habitat trees

Potential habitat trees are those that are hollow bearing or greater than 30 cm[1] at breast height that may develop large hollows in the future - not those that are multi-stemmed with small branches above breast height. Hollow bearing trees are critical elements for many fauna species; including some arboreal mammals (such as bats, phascogales and possums) and many bird species (such as owls and black cockatoos). Hollows take many years to form. For example, a study by Mawson *et al.* (1994) found that hollows utilised by the medium sized Long-billed Corella (which can utilise smaller hollows than black cockatoos) may take an average of 450 years to form in Marri and over 1000 years in Jarrah (as stags).

Numerous potential habitat trees, some with large hollows, occur throughout the site, particularly in the tall woodland areas or as paddock trees. There were no hollow bearing trees within the areas proposed to be cleared (access areas or transmission line easement). Most trees at these locations were in mallee form, or multi-stemmed at or above breast height, and not likely to develop large hollows.

4.2.2 *Species recorded*

Sixty-three fauna species were identified during the field visit; 44 of these were birds (refer to Table 4-4 and Appendix B.1). A species of note was the *Neophema splendida* (Scarlet-chested Parrot) with an individual was found in the woodland south of proposed Turbine 4. Scarlet-chested Parrot, whilst not conservation significant in WA or nationally (the species is Vulnerable in NSW, Least Concern: IUCN), it is highly nomadic, fairly uncommon and rarely seen locally. The proposal area is probably at the far west of its distribution (though there are a couple of records around Perth; ALA, 2017).

Class	Species
Amphibian	1
Bird	44
Mammal	13
Reptile	5
TOTAL	63

Table 4-4 Fauna observed within the project area

Class	Scientific Name	Vernacular Name
Frogs	*Limnodynastes dorsalis*	Western Banjo Frog
Birds	*Chenonetta jubata*	Australian Wood Duck
	Anas (Nettion) gracilis	Grey Teal
	Phaps chalcoptera	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
	Chrysococcyx basalis	Horsfield's Bronze-cuckoo
	Cacomantis (Vidgenia) pallidus	Pallid Cuckoo
	Elanus axillaris	Black-shouldered Kite

[1] Typically 50cm at DBH is the considered a potential habitat tree, except for Salmon Gum and Wandoo which may develop large hollows at 30 cm DBH. Therefore 30cm DBH was considered in this assessment, with trees (some larger than 30/50 cm at DBH but multi stemmed/mallee generally not considered potential habitat trees if based on the particular tree, were not considered likely to develop hollows.

Class	Scientific Name	Vernacular Name
	Falco longipennis	Australian Hobby
	Falco (Ieracidea) berigora	Brown Falcon
	Falco (Tinnunculus) cenchroides	Nankeen Kestrel
	Coturnix pectoralis	Stubble Quail
	Smicrornis brevirostris	Weebill
	Gerygone fusca	Western Gerygone
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Cracticus tibicen	Australian Magpie
	Artamus (Angroyan) cinereus	Black-faced Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Strepera (Neostrepera) versicolor	Grey Currawong
	Cracticus nigrogularis	Pied Butcherbird
	Lalage (Lalage) sueurii	Australian White-winged Triller
	Coracina (Coracina) novaehollandiae	Black-faced Cuckoo-shrike
	Corvus coronoides	Australian Raven
	Petrochelidon (Hylochelidon) nigricans	Tree Martin
	Hirundo neoxena	Welcome Swallow
	Cincloramphus cruralis	Brown Songlark
	Lichmera indistincta	Brown Honeyeater
	Melithreptus (Eidopsarus) brevirostris	Brown-headed Honeyeater
	Anthochaera carunculata	Red Wattlebird
	Gavicalis virescens	Singing Honeyeater
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater
	Epthianura albifrons	White-fronted Chat
	Manorina (Myzantha) flavigula	Yellow-throated Miner
	Grallina cyanoleuca	Magpie-lark
	Anthus (Anthus) novaeseelandiae	Australian Pipit
	Pachycephala (Alisterornis) rufiventris	Rufous Whistler
	Pardalotus striatus	Striated Pardalote
	Petroica goodenovii	Red-capped Robin
	Rhipidura albiscapa	Grey Fantail
	Rhipidura leucophrys	Willie Wagtail
	Eolophus roseicapillus	Galah
	Barnardius zonarius	Australian Ringneck
	Neophema splendida	Scarlet-chested Parrot
	Neophema (Neonanodes) elegans	Elegant Parrot
	Polytelis anthopeplus	Regent Parrot
	Coturnix pectoralis	Stubble Quail
Mammals	*Ovis aries*	Sheep
	Vulpes vulpes	Red Fox
	Felis catus	House Cat

Class	Scientific Name	Vernacular Name
	Oryctolagus cuniculus	European Rabbit
	Macropus fuliginosus	Western Grey Kangaroo
	Austronomus australis	White-striped Free-tailed Bat
	Tachyglossus aculeatus	Short-beaked Echidna
	Chalinolobus morio	Chocolate Wattled Bat
	Chalinolobus gouldii	Gould's Wattled Bat
	Nyctophilus geoffroyi	Lesser Long-eared bat
	Vespadelus regulus	Southern Forest Bat
	Nyctophilus major tor	Greater Long-eared Bat
	Mormopterus (Ozimops) kitcheneri	South-western Freetail Bat
Reptiles	*Gehyra variegata*	Variegated Dtella
	Delma australis	Marble-faced Delma
	Tiliqua rugosa	Bobtail
	Cryptoblepharus buchananii	Buchanans snake-eyed skink
	Tiliqua occipitalis	Western Bluetongue

As noted, microbats and raptors are identified as key risk groups for wind farms. The list includes four raptors: Black-shouldered Kite, Australian Hobby, Brown Falcon and Nankeen Kestrel. Other raptors may also use the site as part of a larger home range, e.g. Wedge-tailed Eagle.

In addition to the five bats identified within 50km of the site (ALA, 2017) (White-striped Free-tailed Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Lesser Long-eared bat, Southern Forest Bat) the field surveys identified Central Long-eared Bat (*Nyctophilus major tor*) (P4) and South-western Freetail Bat (*Mormopterus (Ozimops) kitcheneri*). Microbats are known to forage considerable distances from their roost sites (15 – 30 km; Churchill 2008), so it is unclear whether the recorded bats are roosting within the project area or are only foraging.

Figure 4-20 A group of passerine birds (Black-faced Woodswallow, White-fronted Chat and Horsfield's Bronze-cuckoo) perching on a farm fence

Reptiles were only found during active searches due to the cool climate at the time of the survey. It is likely that there are many more taxa occurring within the project area than the five observed, including snakes.

The mammalian fauna observed included Short-beaked Echidna, Western Grey Kangaroo, microbats and exotic species, including cats, foxes, rabbits and sheep. Cats and foxes pose a significant threat to a number of native animals including threatened species such as Malleefowl and Red-tailed Phascogale. Native populations persisting in narrow remnants are known to be particularly at risk of predation from species such as cats and foxes, due to edge effects.

Figure 4-21 Fox and Cat recorded by infrared camera traps

4.2.3 Conservation significant fauna

The only conservation significant fauna identified within the project area was the Central Long-eared Bat (P4). Based on the site survey and the threatened fauna evaluation table, five birds of conservation significance and two mammals have potential to occur within the project area. An extract of the threatened fauna evaluation table (Appendix A.4) is given below (Table 4-5).

Table 4-5 Fauna of conservation significance that may occur within the project area

Family Genus species	Vernacular	Status Federal	Stat. WA	Presence of habitat	Likelihood of occurrence
ARDEIDAE *Ardea ibis*	Cattle Egret	IA	IA	Marginal	Possible, infrequent visitor with abundant similar habitat locally
Ardea modesta	Great Egret	IA	IA		
CACATUIDAE Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN	Present	Possible, site located towards the eastern edge of known distribution
FALCONIDAE *Falco peregrinus*	Peregrine Falcon	-	OS	Present	Possible
MEROPIDAE *Merops ornatus*	Rainbow Bee-eater	IA	IA	Present	Possible
DASYURIDAE *Phascogale calura*	Red-tailed Phascogale	VU	CD	Present	Possible
MURIDAE *Pseudomys occidentalis*	Western Mouse	-	P4	Marginal	Possible, but dense native vegetation is generally rare over the site
VESPERTILIONIDAE *Nyctophilus major tor*	Central Long-eared Bat	-	P4	Present	Present

5 POTENTIAL IMPACTS

Impacts to flora, fauna and vegetation may be associated with construction and operation of the wind farm. Construction impacts may be both direct (e.g. clearing) and indirect (e.g. edge effects). Operational impacts would be mostly direct (e.g. bird and bat blade strike) although indirect impact may also occur (e.g. alienation). These are discussed below.

5.1 Clearing of native vegetation

Typical impacts potentially associated with clearing native vegetation include:

- Direct loss of habitat and mortality of individual plants and animals. Loss of nesting habitat has greater impacts during spring, the nesting period for most fauna.
- Loss of mature vegetation (which also provides more flowers, nectar, fruit, seeds, refuge for fauna).
- Loss of below ground biomass (such as seed banks).
- Changes to vegetation and fauna assemblages within affected vegetation patches.
- Fragmentation of habitat connectivity and populations.

The total clearing proposed is less than 0.15 of degraded vegetation, consisting of:

- Less than 0.15 ha of clearing of degraded vegetation at three locations, allowing for a 20 m wide 'worst case scenario' (actual access track will likely be four metres wide)
    - <0.07 ha of vegetation Unit K,
    - <0.04 ha of vegetation Unit M,
    - <0.04 ha of vegetation Unit J.
- Potential clearing of paddock trees where they cannot be avoided (e.g. less than 10 trees associated with the solar farm).
- Pruning of vegetation over five metres high within the proposed 30 m wide transmission line easement.

Considering the size of the project area, the clearing impact associated with the proposed wind farm development will be very low (less than 0.1% of vegetation across the project area). Photos of the proposed clearing locations are shown below. Habitat connectivity will not be impacted at either site or landscape scales by the clearing proposed.

Figure 5-1 Proposed substation site, showing highly disturbed, degraded vegetation of Type A(vd). Photo taken from Habitat Plot 29.

Figure 5-2 Degraded vegetation Type K that will require clearing at Crossing 1

Figure 5-3 Degraded vegetation Type M that will require clearing at Crossing 2

Figure 5-4 Degraded vegetation Type J that will require clearing at Crossing 3

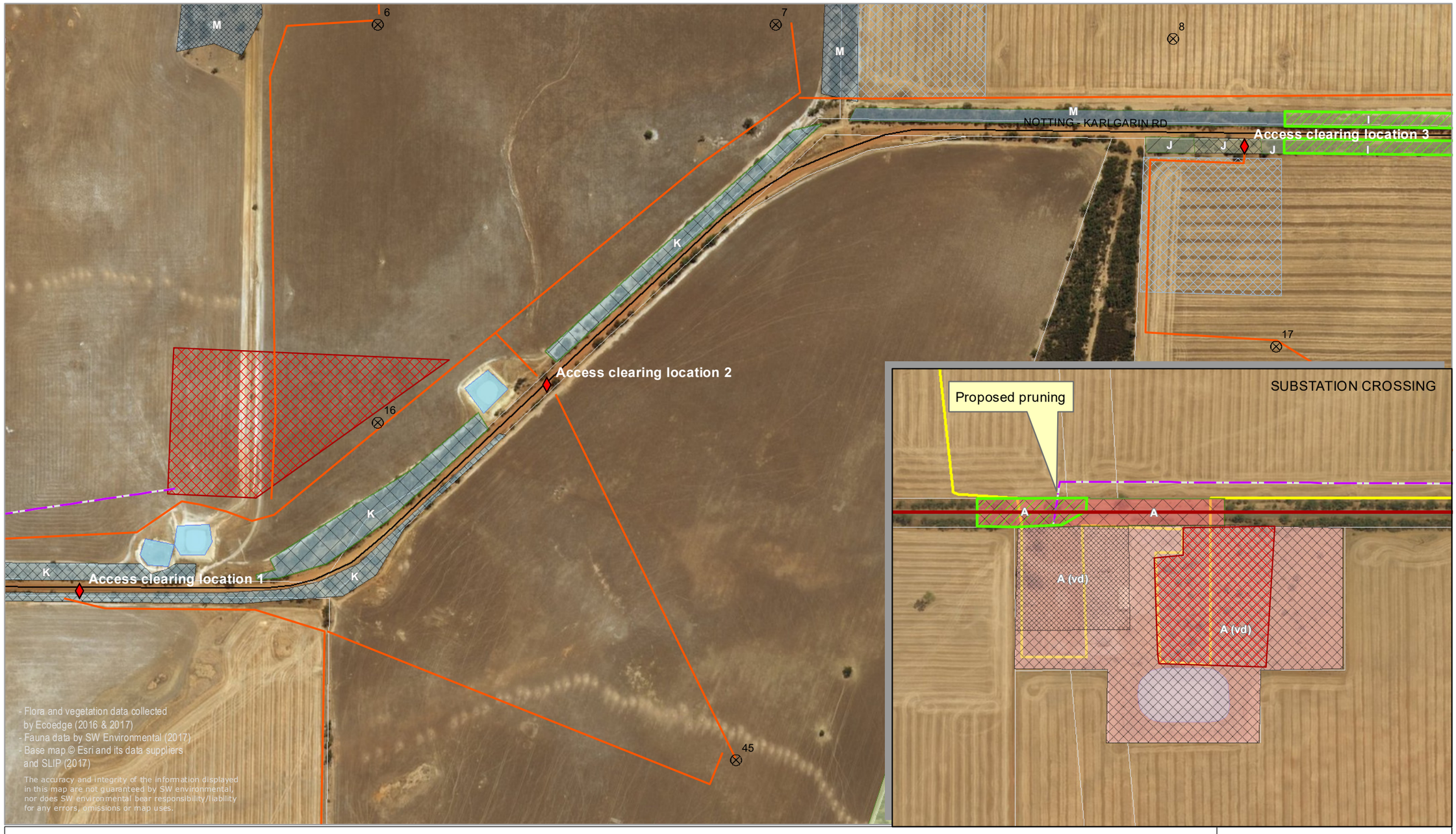


Figure 5-5 Proposed clearing locations

5.2 Indirect impacts / construction environment

Construction, including clearing, may lead to a number of indirect impacts. Indirect impacts may be associated with the construction period (short term) and cumulative impacts associated with ongoing land management (long term). Activities that are likely to cause indirect impacts include:

- Deliberate/accidental clearing or disturbance of native vegetation,
- Machinery access,
- Compaction of soils,
- Noise, dust and vibration, and
- Increased visitation and use of the site by humans and introduced species.

Indirect impacts include:

- Increased negative edge effects causing ingress of weeds, changes to microhabitat and increased access for invasive predators such as foxes and cats. Foxes, cats and rabbits already occur at the site and compete with native fauna, such as macropods, for feed resources; habitat degradation caused by rabbits is well documented (DEWHA 2008). Populations of small mammals and birds may be impacted further by foxes and cats. Domestic animals may also act as vectors for weeds.
- Disruptions to fauna breeding cycles. Birds disturbed from the nest (for example, from excessive noise or changes to light) may disrupt incubation or cease to feed their young (Webster 1999). Many marsupials display a strong fidelity to their territory (Rhind 2003), and therefore disturbance can cause stress. An example of a stress factor may include loss of foraging resources (such as through a high intensity burn or clearing), thereby necessitating an increase in foraging effort, potential for loss of physical condition and potential for neglect or ejection of young.

The indirect impacts of the proposal would be very low, considering:

- The minimal ground disturbance with existing tracks and cleared areas being utilised,
- The small scale of clearing restricted to degraded vegetation,
- Remnant native vegetation patches will largely be left intact.

Potential indirect impacts will be able to be mitigated through appropriate environmental management and implementing the recommendations made in Section 6.

5.3 Operational impacts: Bird and bat collision risk

5.3.1 Topography, wetlands, vegetation communities and habitat resources

The factors described in the *Bird and bat risk assessment (Section 3.3.3)*; topography, wetlands and habitat resources, are considered below specifically for the proposed site in relation to birds and bats.

Topography

The topography of the region is generally flat (DoW 2008). Site surveys found the land to be generally low undulating hills with few prominent topographical features.

Wetlands

At first glance, the siting (effectively surrounded by a wetland system; *Section 3.1.6*) suggests that the proposed wind farm could be established in an area frequented by wetland bird species, and that the proposal would represent a risk to such birds. However, looking more closely at the nature of the wetlands, it can be seen that the majority provide little in the way of habitat for nomadic and migratory species most of the time.

DoW (2008) describe the Lockhart River and salt-lake system as in generally degraded condition with the majority of the lakes in vicinity of the proposed wind farm being secondarily salinized. Secondary salinized wetlands are characterised by simplified ecological communities based on cyanobacteria. Most of the fringing vegetation is cleared or degraded, with the majority of the wetlands being open or dominated by *Samphire* spp. vegetation (DoW 2008).

While waterbirds are reported to frequent the local lakes (Central Wheatbelt Visitor Centre 2017), Halse *et al.* (1995) report that open wetlands are strongly avoided by most wetland species. Further, most waterbird species typical of naturally saline wetlands are rarely found at secondarily saline wetlands (Halse *et al.* 2004). In a survey of wetlands of south-western Western Australia, Halse *et al.* (1994) also found that the majority of breeding waterbirds surveyed showed strong preference for wetlands with more complex fringing vegetation communities rather than open wetlands or those with only samphire communities.

Several of the nearby lakes are protected areas, such as Lake Kondinin Nature Reserve and Kondinin Salt Marsh Nature Reserve. However, these areas appear to have more value for recreation than conservation and little information can be found as to their ecological significance. Lake Kondinin was inspected during the site survey. There was little fringing vegetation and the lake appeared to provide low quality waterbird habitat. Ducks and swans were observed utilising the wetland, but the simplicity of the habitat suggests that Lake Kondinin is unlikely to regularly support significant flocks of these species nor breeding flocks.

It would be expected that Lake Kondinin and other nearby wetlands have the capacity to support larger flocks or rare species from time to time in ideal conditions. However, given the degraded state of the river system, this is likely to be a rare occurrence. Therefore, it is considered that the surrounding wetlands do not present a significant site collision risk for the proposed Kondinin Wind Farm.

Vegetation communities and habitat resources

The region is heavily cleared and many of the vegetated corridors, such as those along the Lockhart River, are in poor condition and provide poor linkage between vegetation remnants (DoW 2008). Site surveys identified small to medium sized vegetation remnants of shrubland, mallee and tall woodland communities, in Completely degraded to Excellent condition (refer to *Section 4.1*). Hollow-bearing trees, locally significant corridors, caves and other important habitat resources for birds and bats were generally absent or in low abundance in the vicinity of the turbines. Isolated paddock trees with potential to contain hollows occur sporadically across the project area. The vegetation across the site is fairly typical of local landscape patterns. The proximity of important habitat resources is not considered a significant site collision risk factor for the proposal. Additionally, bird and bat species are unlikely to be alienated from an area of important habitat by the proposal.

Summary

The local and regional setting for the proposed wind farm do not appear to present significant operational impact risks on the basis of topography, wetlands or habitat resources.

5.3.2 RSA minimum heights

The RSA would occupy the airspace between 45 m and 185 m above the ground - at the lowest point in its arc, the moving blade would travel within approximately 45 m of the ground.

Shrubland and mallee vegetation is generally lower than 10 m high. Tall woodland areas grow up to approximately 25 m high at some locations and are arguably higher risk areas for birds and bats where it is in close proximity to turbines. Tall woodland, however, is mainly found in the transmission line and Notting-Karlgarin Road areas (Figure 5-6). Tall woodland areas mapped within the wind farm (turbine locations) are limited to the following:

- 1.37 ha completely degraded patch of A(vd), 315m southwest of Turbine 46.
- 2.4 ha lineal road verge patches of Unit I along Notting-Karlgarin Road in excellent condition, 165m south east of Turbine 8.

- 2.25 ha patch of excellent condition of Unit P remnant vegetation, 100 m from Turbine 4.

The blades pass by approximately 35 m above the main vegetation (Mallee) canopy height and there are no turbines *within* native vegetation patches. This is considered a sufficient vertical buffer to protect the majority of birds and bats that fly within or just above canopy height; the majority of species are unlikely to encounter the turbine blades during normal daily activities.

As noted in Section 3.4, the flying heights of bird species vary considerably but most birds and bats fly within or just above vegetation canopy height and well below the minimum RSA height proposed. Species that regularly fly high while foraging would be most at risk from the turbine parameters under consideration. This includes common species such as Welcome Swallow and Wedge-tailed Eagle.

5.3.3 Turbine layout factors

In terms of topography concentrating bird and bat movements, the proposed site and the proposed layout present little risk. The turbines in closer proximity to tall woodland patches may have a higher localised collision risk for birds or bats.

The turbine most likely to present a collision risk is Turbine 4, which is located within the <135 m wide cleared corridor between excellent condition tall woodland and shrubland. The main risk would be to birds and bats moving between vegetation patches. Although many small birds would avoid crossing such large open gaps, bats frequently forage around the edges of bushland and between patches (Churchill 2008). The siting of this particular turbine has some potential (more so than other turbines) to be problematic for high-flying microbats, such as White-striped Freetail Bats, and high-flying generalist birds such as cockatoos, raptors, Australian Magpie, ravens and crows passing between patches. However, given the generally low vegetation height (refer *Section 5.3.2*) the risk to most species is still considered low.

There are numerous farm dams within 100-300 m of turbines (see *Section 4.2.1*); aerial imagery and site inspection shows most of these to be generally devoid of fringing native vegetation. Turbines that are positioned between a dam and better quality remnants may present a higher risk for bats in particular. However, given the high level of existing clearing across the site, the positioning of turbines at least 20 m from vegetation and good clearance between average vegetation height and the minimum RSA (refer to *Section 5.3.2*), these risks should be minimised.

5.3.4 Summary

The results of the risk evaluation and assessment show that the Kondinin Wind Farm presents an overall low risk to birds and bats as a potential wind farm site. This is on account of:

- There is no significant or important bird or bat habitat nearby,
- The proposed turbine model includes a minimum RSA height which is well above the average height of vegetation,
- The proposed layout includes at least a 20 m buffer from vegetation remnants.

Figure 5-6 Tall woodland areas over the project area, in proximity to turbines

5.4 Potential impact to conservation significant species

5.4.1 Threatened Ecological Communities

The 'Eucalypt Woodlands of the Western Australian Wheatbelt' TEC occurs over approximately 29.4 ha of the survey area. It occurs in remnant native vegetation Types A, E, I and P, typically[2] in good or better condition. It occurs mostly along the Corrigan-Kondinin Road (Brookton Highway) and Notting-Karlgarrin Road reserves, but also as several discreet patches within paddock areas.

The project will not require the clearing of any TEC. There are however two points where the proposed transmission line easement (30m) may cross areas of mapped TEC and pruning of trees will be required at these locations:

1. At the north west entry to the substation (617362E 6408104S)
2. The entrance to Lot 16619 off Notting-Karlgarrin Road (621930E 6408104S).

It may be possible to minimise the impact (pruning) upon the TEC by micro-siting the easement between large trees near the existing substation and by moving the easement north by approximately 30m away from the TEC along the Notting-Karlgarrin Road. This is included as a recommendation in *Section 6*.

5.4.2 Flora

Based on the infrastructure locations proposed, no conservation significant flora will be directly impacted by clearing. Several populations of Priority flora were located across the site however none of these are within 20 m of the proposed infrastructure locations and all should be able to be avoided.

5.4.3 Fauna

Eight conservation significant fauna were identified (Appendix A.4) as potentially occurring or having suitable habitat within the project area:

- Red-tailed Phascogale (*Phascogale calura*) (VU, CD),
- Western Mouse (*Pseudomys occidentalis*) (P4),
- Greater Long-eared Bat Central Form (*Nyctophilus major tor*) (P4),
- Cattle Egret (*Ardea ibis*) (IA, IA),
- Great Egret (*Ardea modesta*) (IA, IA),
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (EN, EN),
- Peregrine Falcon (*Falco peregrinus*) (OS), and
- Rainbow Bee-eater (*Merops ornatus*) (IA, IA).

Clearing impacts are unlikely to impact the fauna above considering the small amount of clearing (total less than 0.15 ha of the 153 ha of mapped native vegetation) across the 3237 ha project area, within degraded patches. Red-tailed Phascogale and Western Mouse require good quality vegetation and/or large patches (not associated with the proposed impact areas). The birds and bats above are mobile species and unlikely to be impacted by the small scale and nature of clearing proposed.

A number of common and secure species have been identified as 'at risk' species, indicating that they have potential to suffer collision mortality at the proposed wind farm from time to time, should they occur on site.

[2] A section of Good condition Type A vegetation type north of the existing substation is not TEC due to species composition, however the adjacent section is still considered TEC.

- Birds and bats evaluated as 'at risk' are all common and secure species, apart from Carnaby's cockatoo which whilst being of moderate risk, is probably occurs only rarely at the site and likely would fly below the RSA height.

The risk assessment (Appendix A.5) on operational impacts of the wind farm on birds and bats using ecological and biological information about each species against risk factors, identified Carnaby's Black Cockatoo and Rainbow Bee-eater as being at 'at risk' conservation significant species. A qualitative risk assessment found Carnaby's Black Cockatoo to be a moderate risk species for collision, mainly due to the endangered status of the population rather than the likelihood of collision. The likelihood of collision was considered rare as individuals would fly below the RSA height. Rainbow Bee-eater was found to be low risk species.

Consideration against EPBC Act referral guidelines for Carnaby's Black Cockatoo

A proposal that is likely to result in a significant impact to Carnaby's Black Cockatoos will require referral to DotEE for assessment in accordance with the EPBC Act. An assessment against the EPBC significance criteria is outlined in Table 5-1.

Based on the Table 5-1 the proposal is not likely to trigger the need for referral based on clearing (if the recommendations included in Section 6 are adopted, including avoiding paddock trees where possible). However given that Carnaby's Black Cockatoo was found to be a moderate risk species for the wind farm based on the assessment criteria the proponent may wish to liaise further with DotEE and refer the project for legal certainty.

Table 5-1 EPBC Act significant impact trigger criteria from 'Referral guidelines for three species of Western Australian black cockatoos', SEWPAC 2012.

High risk of significant impacts: EPBC referral recommended	
Trigger	**Triggered?**
Clearing of any known nesting tree	Unlikely. No hollow bearing trees were identified in the proposed clearing areas (substation, transmission line and access points). Paddock trees may contain hollows however these should be able to be avoided over most of the project area. If individual trees are unable to be avoided then potential nesting trees would be managed as per the recommendations in Section 6.
Clearing or degradation of any part of a vegetation community known to contain breeding habitat.	Unlikely. As above, a recommendation has been made to avoid paddock trees.
Clearing of more than 1 ha of quality foraging habitat.	No. The 2.5 ha substation site, which may require some clearing but is outside of the scope of this report, contains *Eucalyptus kondinensis* and *E. salmonophloia* over *Acacia acuminata* over *Enchylaena tomentosa, Exocarpos sparteus* over grassland/herbland of pasture species in a very degraded condition. Most of this area is unlikely to be considered 'quality foraging habitat' with *E. salmonophloia* being the only potential feed species present (DEC, 2011) and only present as isolated trees. The 0.15 ha proposed to be cleared within this assessment is considered marginal foraging habitat and well under 1 ha in area.
Clearing or degradation (including pruning of top canopy) of a known roosting site.	No, no evidence of roost sites were identified during the surveys within the proposed clearing areas.

Creating a gap or greater than 4 km between patches of Black Cockatoo Habitat (breeding, foraging or roosting).	No, the clearing would not create habitat fragmentation at the landscape scale.
Uncertainty: Referral recommended or contact DotEE	
Trigger	**Triggered?**
Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.	No, clearing is addressed above. No additional degradation is anticipated.
Clearing or disturbance in areas surrounding Black Cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effect, hydrological changes, increase human visitation or fire.	No, clearing impacts will be minor in relation to Black Cockatoos.
Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.	No.
Actions with the potential to introduce known plant diseases such as Phytophthora spp. to an area where the pathogen was not previously known.	Unlikely given extensive areas of similar or better habitat are available locally.
Low Risk of significant impacts: referral may not be required but you may refer for legal certainty	
Trigger	**Triggered?**
Actions that do not affect black cockatoo habitat or individuals.	No.
Actions whose impacts occur outside the modelled distribution of the three Black Cockatoos.	No.

5.5 Proposed clearing against relevant guidelines

The project also falls within the agricultural area defined in *Position Statement No. 2* (EPA 2000). Guidelines that the proposal must be considered against to gain permission for clearing of native vegetation, include

- Four points for clearing remnant native vegetation in agricultural areas from *Position Statement No. 2* (EPA 2000),
- Eight points for clearing remnant native vegetation in WA generally from *Position Statement No. 2* (EPA 2000), and
- Ten clearing principles under the Environmental Protection Act 1986.

The federally-listed "Eucalypt Woodlands of the Western Australian Wheatbelt" (also P3) occurs within the project area. The Beard vegetation associations 1023 and 960 are considered over-cleared (less than 30% remaining) and under-reserved (less than 10% reserved) (DAFWA 2016). Priority flora (4 taxa) and fauna (1 taxa) were identified as occurring within the project area, an additional 49 flora and eight fauna of conservation significance may potentially occur at the site.

The proposal has been briefly considered against the above guidelines, and discussed below.

Clearing remnant native vegetation in agricultural areas

In principal, the EPA does not support any further clearing of remnant native vegetation in the agricultural area (EPA 2000). The following is a preliminary analysis of EPA requirements for clearing in the agriculture area from Section 4.2 of EPA (2000):

1. Alternative mechanisms are addressed to protect biodiversity (e.g. rehabilitation or offset),
2. Clearing area is relatively small over the area in consideration, including the extent of vegetation in the surrounding area,
3. Impacts of clearing are consistent with the requirements of Section 4.3 in the EPA (2000), and
4. Other processes of land degradation would not be exacerbated as a result of the proposal.

The level of clearing associated with the proposed wind farm development is very low, with the clearing of less than 0.15 ha of highly disturbed, degraded vegetation proposed. The total clearing accounts for approximately well under 1% of the remnant vegetation surveyed, with all areas of good or better quality vegetation to be avoided. The clearing proposed is not likely to conflict with the EPA values described above.

Clearing remnant native vegetation in WA

The following is a preliminary analysis of EPA requirements from Section 4.3 of EPA (2000):

1. A comparison of development scenarios, or options, to evaluate protection of biodiversity at the species and ecosystem levels, and demonstration that all reasonable steps have been taken to avoid disturbing native vegetation.
2. No known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable.
3. No association or community of indigenous plants or animals cease to exist as a result of the project.
4. There would be an expectation that a proposal would demonstrate the vegetation removal would not compromise any vegetation type by taking it below the 'threshold level' of 30% of the pre-clearing extent of the vegetation type.
5. Where a proposal would result in a reduction below the 30% level, the EPA would expect alternative mechanisms to be put forward to address the protection of biodiversity.
6. There is comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves.
7. If the project area is large (and what is meant by large will vary depending on where in the State) the project areas itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity is secure and protected.
8. The on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

The project will avoid the clearing of remnant native vegetation in good or better condition. A recommendation has been given to avoid the occurrences Priority flora and TEC. No flora or fauna are likely to become extinct as a result of the project. The Beard vegetation associations across the site are already in completely degraded and degraded condition. They are not considered to be representative of the Beard communities that have been mapped and addressed in the CAR reserve system. The clearing proposed is not likely to conflict with the EPA values described above.

Clearing principles

The following is a preliminary analysis the proposal against the clearing principles:

1. Native vegetation should not be cleared if it comprises a high level of biological diversity.

2. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.
3. Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.
4. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.
5. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
6. Native vegetation should not be cleared if it is growing in, or association with, an environment associated with a watercourse or wetland.
7. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
8. Native vegetation should not be cleared if the clearing of the vegetation is likely to an adverse impact on the environmental values of any adjacent or nearby conservation areas.
9. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.
10. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The proposal is unlikely to be at variance with any of these principles providing the Priority flora and TEC are avoided.

6 CONCLUSIONS AND RECOMMENDATIONS

A Level 1 flora and fauna assessment has been carried out for the proposed wind farm at Kondinin. Desktop and site surveys found the following values within the project area:

- Nineteen vegetation units varying in condition from Completely degraded to Excellent condition, across >75 patches (the largest at 24 ha).
- Several structural fauna habitats occur at the site with poor to good fauna habitat value, including:
    - Tall woodland
    - Mallee
    - Shrubland
    - Cropped land
    - Farm dams (approximately 30)
    - Granite outcrops
- Beard vegetation associations 1023 and 960 that are considered over-cleared (less than 30% remaining) and under-reserved (less than 10% reserved) (DAFWA 2016) occur in the project area.
- Priority flora (4 taxa) and fauna (1 taxa) were identified as occurring within the project area, an additional 46 flora and seven fauna of conservation significance may potentially occur at the site.
- One hundred and thirty vascular flora taxa were identified within the project area, of which three were introduced species (partial list only).
- Sixty-three fauna species were identified during the field visit; 44 of these were birds.
- The presence of 29.4 ha of federally-listed "Eucalypt Woodlands of the Western Australian Wheatbelt" TEC (also P3) in the project area.

Clearing impacts are summarised below:

- No flora of conservation significance will be impacted (proposed impacts are 20m away based on infrastructure locations provided).
- The TEC will require pruning based on current designs. It should be avoided if possible, as outlined below.
- Threatened fauna are unlikely to be significantly impacted by the clearing proposed. Based on the Table 5-1 the proposal is not likely to trigger the need for federal referral for Carnaby's Black Cockatoo based on clearing.
- The bird and bat risk assessment (Appendix A.5) identified:
    - A number of common and secure species have been identified as 'at risk' species, indicating that they have potential to suffer collision mortality at the proposed wind farm from time to time, should they occur on site.
    - Carnaby's Black Cockatoo and Rainbow Bee-eater as being 'at risk' conservation significant species. A qualitative risk assessment found Carnaby's Black Cockatoo to have a rare likelihood of collision as individuals would normally fly below the RSA height, but a moderate risk, mainly due to the endangered status of the population rather than the likelihood of collision. Rainbow Bee-eater was found to be low risk species.
    - Given that Carnaby's Black Cockatoo was found to be a moderate risk species for the wind farm based on bird and bat risk assessment, the proponent may wish to liaise further with Department of the Environment and Energy (DotEE) in relation to whether the project should be for referred for legal certainty.
    - The Kondinin Wind Farm presents an overall low collision risk to birds and bats as a potential wind farm site.

Clearing impacts proposed (0.15 ha of degraded vegetation) would be very minor in scale and nature, if the recommendations below are incorporated. Recommendations to avoid and mitigate potential impacts of the proposal include:

- Minimise disturbance to remnant native vegetation.
- Minimise impact at the TEC locations where pruning of trees will currently be required, north of the substation (617362E 6408104S) and the existing entrance to Lot 16619 off Notting-Karlgarrin Road (621930E 6408104S). This should be possible by aligning the transmission line to avoid most of the large trees north of the substation, and by relocating the easement north by approximately 30m, away from the TEC along the Notting-Karlgarrin Road. If significant pruning is required within the TEC then an Assessment of Significance should be carried out to determine if a significant impact is likely, and therefore the need to refer to DotEE.
- Avoid disturbing mapped populations of Priority flora.
- Avoid paddock trees >30cm DBH that may support hollows. If any hollow bearing paddock trees do require clearing, schedule clearing outside of Black Cockatoo key breeding periods (August-February). Ensure an experienced and licensed fauna specialist is present during clearing of hollow trees to manage any displaced/injured wildlife.

7 REFERENCES

Australian Government (2009) *Interim Biogeographic Regionalisation of Australia (IBRA) Version 6.1*, Department of the Environment, Water, Heritage and the Arts. Retrieved 26/07/2016 from http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html

Auswind (2006) Best Practice Guidelines for the implementation of Wind Energy Projects in Australia, Australian Wind Energy Association.

Baerwald, E.F. & Barclay, R.M.R. (2009) 'Geographic variation in activity and fatality of migratory bats at wind energy facilities' *Journal of Mammalogy*, 90: 6: 1341-1349

Birdlife International (2017) website http://datazone.birdlife.org/site/mapsearch accessed September 2017

Beard, J.S. (1972) *The vegetation of the Corrigin area, Western Australia* [cartographic material] : map and explanatory memoir, 1:250,000 series.

Beard, J.S. (1980) *A new phytogeographic map of Western Australia*. Western Australian Herbarium Research Notes 3: 45.

Beecham, B. and Danks, A. (2001) Mallee 2 (MAL2 - Western Mallee subregion) in *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Report to and for the Department of Conservation and Land Management.

Brett Lane and Associates. (2005) *Wind Farms and Birds: Interim standards for risk assessment, Australian Wind Energy Association Report*. AusWEA (Australian Wind Energy Association).

Brett Lane and Associates. (2009) Summary of investigation of Wedge-tailed Eagle breeding: Challicum Hills Wind Farm. Ecological Research and ManagementPopa-Lisseanu, A.G. & Voight, C.C. (2009) 'Bats on the move' *Journal of Mammalogy,* 90: 6: 1283-1289

Central Wheatbelt Visitor Centre (2017) *Salt Lakes of the Wheatbelt*, accessed online at file:///C:/Users/Bink/Sync/Work/SW%20Enviro/Kondinin%20Wind%20farm/References/Not%20useful/Salt%20lakes%20of%20the%20Wheatbelt%20-%20Central%20Wheatbelt%20Visitor%20Centre.htm in September 2017.

Churchill (2008) Australian Bats, 2nd edition Allen & Unwin, New South Wales, Australia

Commonwealth of Australia (2001) *National Objectives and Targets for Biodiversity Conservation 2001-2005.* Environment Australia, Department of Environment and Heritage, Canberra, Australian Capital Territory.

Commonwealth of Australia. (2016) Eucalypt Woodlands of the Western Australian Wheatbelt: a nationally protected ecological community.

Cryan, P.M. and Brown, A. C. (2007) 'Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines'. Biological Conservation

De Lucas, M., Janss, G.F.E., whitfield, D.P., Ferrer, M. (2008) 'Collision fatality of raptors in wind farms does not depend on raptor abundance', *Journal of Applied Ecology,* 45: 6: 1695–1703

Department of Agriculture and Food (DAFWA) (2007) *GIS Soil-landscape mapping in South-Western Australia.* Department of Agriculture and Food Western Australia, Perth.

Department of Environment, (DE), (2017) website, accessed September 2017 http://www.environment.gov.au/land/nrs/science/ibra

Department of Environment and Conservation (2010) *Definitions, categories and criteria for threatened and priority ecological communities.* Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (2011) *Plants Used by Carnaby's Black Cockatoo,* list prepared by Christine Groom, Department of Environment and Conservation 15 April 2011

Department of Environment, Water, Heritage and the Arts (1999) *Environment Protection and Biodiversity Conservation Act 1999*. Department of Environment, Water, Heritage and the Arts. Canberra, Australian Capital Territory

Department of Parks and Wildlife (2017). *Conservation Codes for Western Australian Flora and Fauna.* https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/conservation_code_definitions.pdf 3/05/2017

Department of Parks and Wildlife (2016a). *Threatened ecological communities endorsed by the Minister for the Environment* (October 2016). http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities

Department of Parks and Wildlife (2016b). *Priority ecological communities list* (June 2016). Department of Parks and Wildlife. http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities

Department of Parks and Wildlife (DPaW) (2016c). *Extract from the Department's Threatened (Declared Rare) Flora database and the Western Australian Herbarium*. DPaW Species and Communities Branch dated 22 October 2016.

Department of Parks and Wildlife (2016d). *Naturemap*, Western Australian Herbarium. http://naturemap.dec.wa.gov.au/default.aspx Report generated 30 September 2016

Department of Parks and Wildlife (2016e). *The WA Herbarium Census of WA Plants Database* (WACENSUS: 'Max' update 19/05/2016).

Department of Parks and Wildlife (2016f). *Florabase*, Western Australian Herbarium.

Department of the Environment and Energy (2016a). *Threatened ecological communities under the EPBC Act*. http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl

Department of the Environment and Energy (2016b). *Categories of Threatened Ecological Communities under the EPBC Act*. http://www.environment.gov.au/biodiversity/threatened/communities/about#howec

Department of the Environment and Energy (2016c). *Protected Matters Search Tool query*, generated 30 September 2016.

Department of the Environment and Energy (2016d). *Categories of Threatened species under the EPBC Act*. http://www.environment.gov.au/biodiversity/threatened/species.html Accessed 5 October 2016

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). *Background document for the threat abatement plan for competition and land degradation by rabbit*s, DEWHA, Canberra

DoW (2008) *Waterway assessment for the Lockhart River: Lake Kurrencutten to the Camm River confluence*, Department of Water, Western Australia. Accessed online at https://www.water.wa.gov.au/__data/assets/pdf_file/0008/3311/78113_part1.pdf in September 2017.

Drewitt A and Langston R (2006) Assessing the impacts of wind farms on birds, Ibis 148:29–42.

Environment Australia (2001) *National objectives and targets for biodiversity conservation 2001–2005. http://www.environment.gov.au/resource/national-objectives-and-targets-biodiversity-conservation-2001%E2%80%932005*

Environmental Protection Authority (2000). Environmental Protection of Native Vegetation in Western Australia. EPA Position Statement No. 2. EPA, Perth

Environmental Protection Authority of WA (2004). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 51. Environmental Protection Authority Perth, Western Australia.

Environmental Protection Authority (EPA) (2006) Level of Assessment for Proposals affecting Natural Area within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region. Guidance Statement No. 10, June 2006, Perth.

Environmental Protection Authority (2014) Environmentally Sensitive Areas GIS dataset. ESRI Shapefile. Accessed via https://www2.landgate.wa.gov.au/web/guest/downloader

Environmental Protection Authority and Department of Parks and Wildlife (2015) *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (eds. K Freeman, G Stack, S Thomas and N Woolfrey). Perth, Western Australia.

EPHC (2010). Draft National Wind Farm Development Guidelines. Environment Protection and Heritage Council, Australia.

Geographic Information Services, D. (DAFWA) (2016) Intensive land use zone of south west Western Australia. Department of Agriculture and Food, Western Australia, Perth. Map.

Government of Western Australia (1950) *Wildlife Conservation Act 1950*. Perth, Western Australia.

Government of Western Australia. (2016) 2016 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of October 2016. WA Department of Parks and Wildlife, Perth, https://www2.landgate.wa.gov.au/web/guest/downloader

Halse, S.A., Pearson, G.B., Vervest, R.M. and Yung, F.H. (1995) 'Annual waterfowl counts in south-west Western Australia – 1991/92' *CALMScience* 2: 1: 1-24

Halse, S.M., Lyons, M.N., Pinder, A.M. and Shiel, R.J, (2004) 'Biodiversity patterns and their conservation in wetlands of the Western Australian wheatbelt' *Records of the Western Australian Museum*, Supplement No 67: 337-364

Halse, S.M., Vervest, R.M., Pearson, G.B., Yung, F.H. and Fuller, P.J. (1994) 'Annual waterfowl counts in south-west Western Australia – 1990/91' *CALMScience* 1: 2: 107-129

Harvey, M. S. (2002) Endemism among the Australian fauna: some examples from nonmarine environments. *Invertebrate Systematics* **16**: 555–570.

Hull, C. (2013) *Bird and Bat Studies at Hydro Tasmania's Wind Farms*, presentation accessed online at http://www.kingisland.net.au/files/wind/Dr_Cindy_Hull_presentation_KI_20May2013.pdf

Kingsley, A. and Whittam, B. (2003) Wind Turbines and Birds - A Guidance Document for Environmental Assessment. Prepared for Canadian Wildlife Service Environment Canada Bird Studies Canada.

Kunz, T., Arnett,E., Cooper, B., Erickson, W., Larkin, R., Mabee, T., Morrison, M., Strickland, M. And Szewczak, J. (2007) 'Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document' Journal of Wildlife Management, vol 71: 8: 2449-2486

Landgate (2017) Shared Location Information Platform (SLIP)

Maalouf, B., Dobrev, I. And Massouh, F. (2009) 'Vortex structure in the wake of a wind turbine rotor' *19eme Congrès Français de Mécanique*, Marseille, 24-28 août 2009, accessed online at http://documents.irevues.inist.fr/bitstream/handle/2042/36813/993.pdf on 25 May 2016

Mawson, P and Long, J. L., (1994) Size and Age Parameters of Nest Trees Used by Four Species of Parrot and One Species of Cockatoo in South-west Australia, EMU Vol 94, 149-155

Muir, B.G. (1979) *Some Nature Reserves of the Western Australian Wheatbelt. Part 20. Kondinin Shire*. Unpublished report prepared for the Department of Fisheries and Wildlife. Perth, Western Australia.

Muir, B.G. (1977a) Biological Survey of the Western Australian Wheatbelt. Part II. Vegetation and habitat of Bendering Reserve. Records of the West Australian Museum, Supplement No. 3.

Muir, B.G. (1977b) Biological Survey of the Western Australian Wheatbelt. Part IV. Vegetation of West Bendering Reserve. Records of the West Australian Museum, Supplement No. 5.

Nicolle, D., and French, M.E. (2012) A review of *Eucalyptus erythronema* (Myrtaceae) from the wheatbelt of south-western Australia. *Nuytsia* 22(6): 455-463.

Rhind, S. (2003) 'Communal nesting in the usually solitary marsupial, *Phascogale tapotafa*', *J.Zool.Lond.* 261:345-351

Sandersee, B. (2009) *Aerodynamics of wind turbine wakes: literature review*, Energy Research Centre of the Netherlands, accessed online at http://www.ecn.nl/docs/library/report/2009/e09016.pdf on 25 May 2016

Schoknecht, N., Tille, P., Purdie, B. (2004) *Soil Landscape Mapping in South-Western Australia – Overview of Methodology and Outputs* – Resource Management Technical Report 280. Department of Agriculture, Government of Western Australia.

Sharp A. (2010) Briefing note on the effects of wind farms on bird and bat populations, Lower North Natural Resource Management Group, Department for Environment and Heritage, Government of South Australia

Smales, I. (2006) Impacts of avian collisions with wind power turbines: an overview of the modelling of cumulative risks posed by multiple wind farms, Biosis Research. Report prepared for Department of Environment & Heritage

Smales, I. (2015) 'Fauna collision with wind turbines: effects and ipacts, individuals and populations. What are we trying to assess?' in *Wind and Wildlife*, DOI 10.1007/978-94-017-9490-9_2

Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M., (2002) Native vegetation in Western Australia: Extent, Type and Status. Resource Management Technical Report No. 249. Department of Agriculture and Food, Government of Western Australia. Retrieved 2007-01-31

Thelander, C.G. (2004) 'Bird fatalities in the Altamont Pass Wind Resource Area: a case study, part 1 in Savitt Schwarz, S. [ed] Proceedings of the Wind Energy and Birds/Bat Workshop: understanding and resolving bird and bat impacts, 18-19 May 2004.

Thelander, C.G., Smalwood, K.S. and Rugge, L. (2003) *Bird risk behaviors and fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998 – December* 2000, BioResource Consultants Ojai, California December 2003 NREL/SR-500-33829

University of Queensland (undated) Fuller, R, Wilson H and Possingham, H, Map titled "Understanding and reversing the rapid declines in Australia's shorebirds" from the 'Fuller Lab' website https://www.fullerlab.org/2011/07/ in September 2017

Verboom, W H, Galloway, P D, National Landcare Program (Australia), and Natural Heritage Trust (Australia) (2004) *Corrigin Area Land Resources Survey.* Department of Agriculture and Food, Western Australia. Report 20.

Weatherzone (2017) http://www.weatherzone.com.au/station.jsp?lt=site&lc=10536&list=ds&of=of_a&ot=ot_a&mm=08&yyyy=2017&sub=go accessed 07/09/2017.

Webster, A. Cooke, R. Jameson, G. and Wallis, R. (1999) Diets, roost and breeding of Powerful Owls *Ninox strenua* in a disturbed, urban environment: a case for cannabalism? or a case of infanticide? EMU, Vol 99, Pt 1, 80-83

Winkelman, J.E. (1994) Bird/wind turbine investigations in Europe. Pages 43-48 in Proceedings of the National Avian - Wind Power Planning Meeting, Denver, CO, 20-21 July 1994. Proceeding prepared by LGL Ltd., environmental research associates, King City, Ontario

Woehler, E. and Belbin, L. (undated) *Wind, wind farms, birds and bats: insights and predictions from the Atlas of Living Australia*, accessed online at *http://www.ala.org.au/faq/spatial-portal/spatial-portal-case-studies/wind-wind-farms-birds-and-bats/* on 24 May 2016