Waroona Solar Farm

Native Vegetation Clearing Permit Application

Waroona Solar Farm

Native Vegetation Clearing Permit Application

Client: SE Waroona Development Pty Ltd (South Energy)

ABN: 64 628 948 993

Prepared by

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Reviewed by	

Revision History

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			Name/Position	Signature
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Executive Summary

South Energy on behalf of SE Waroona Development Pty Ltd (the Applicant) proposes to construct and operate a solar farm (Waroona Solar Farm, or the project) at a site approximately 8 km west of Wagerup, in the Shire of Waroona (the site).

Clearing up to 19.0 ha of native vegetation is required for the project. All clearing in Western Australia must be completed under an approved native vegetation clearing permit (NVCP), unless an exemption applied under the *Environmental Protection (Clearing of native Vegetation) Regulations 2004*. As there are no NVCP exemptions that apply to this proposal, a NVCP is required.

This application was prepared to support an application for a NVCP (area permit) for development of the Waroona Solar Farm.

Assessment Against the 10 clearing Principles

Assessment against the 10 clearing principles identified that proposed clearing is not likely to be at variance with eight of the clearing principles. Proposed clearing may be at variance with principles b and e, which relate to the clearing of fauna habitat and significant remnants of native vegetation in areas that have been extensively cleared.

Principle b – Fauna Habitat

The proposal may be at variance with principle b because the proposed clearing includes removal of 4.39 ha of potential Black Cockatoo foraging habitat and up to 201 potential black cockatoo breeding trees. Of the 201 potential breeding trees proposed for clearing, 22 are potential breeding trees with hollows that may be suitable for nesting by black cockatoos. Twenty-one of the trees with potentially suitable hollows are dead trees with no vegetation cover nearby. Use of these trees by Black Cockatoos is considered limited.

To minimise potential impacts to Black Cockatoo species South Energy intends to investigate options to reinstate habitat. Planting areas onsite with Black Cockatoo foraging habitat and erecting Black Cockatoo nesting boxes are options for offsetting the clearing of Black Cockatoo breeding and foraging habitat.

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A high level, preliminary assessment of the concept layout has identified areas that South Energy propose to intentionally reserve for partial offset of clearing. These areas are at least approximately 7 ha of land suitable for planting of foraging species and an additional approximately 3.7 ha could potentially be planted with foraging species. Further investigation would be required to assess the suitability of this land due to its potential for flooding and heavy clay composition.

Principle e – Remnant Vegetation

The proposal may be at variance with principle e because it requires removal of 19.0 ha of a vegetation association that has been already been cleared below the national target and objective for biodiversity conservation, which is retention of 30% or more of the pre-clearing extent of each ecological community.

According to the Government of Western Australia (2018) 27.8% of vegetation association 1000 remains intact. Although this vegetation association is already below the 30% target, the proposed clearing comprises a series of small patches of degraded vegetation that have limited conservation value as an ecological community and are likely to continue to decline from impacts caused by farming practices.

1.0 Introduction

South Energy on behalf of SE Waroona Development Pty Ltd (the Applicant) proposes to construct and operate a solar farm (the project) at a site approximately 8 km west of Wagerup, in the Shire of Waroona (the site).

The site is located on two lots approximately 105 kilometres (km) south of Perth, in the Shire of Waroona (Figure 1). This site comprises a 308 hectare (ha) parcel of pastoral land that includes Lot 24 and 25 on Plan 59266 (Figure 2).

Clearing up to 19.0 ha of native vegetation is required for the project. All clearing in Western Australia must be completed under an approved native vegetation clearing permit (NVCP), unless an exemption applied under the *Environmental Protection (Clearing of native Vegetation) Regulations 2004*. As there are no NVCP exemptions that apply to this proposal, a NVCP is required.

1.1 Purpose and Scope

This application was prepared to support an application for a NVCP (area permit) for development of the Waroona Solar Farm. The applicant seeks approval to clear up to 19 ha of native vegetation.

1.2 Applicant and Owner Details

The proponent for this vegetation clearing application is:

The land on which this clearing is being proposed is owned by:

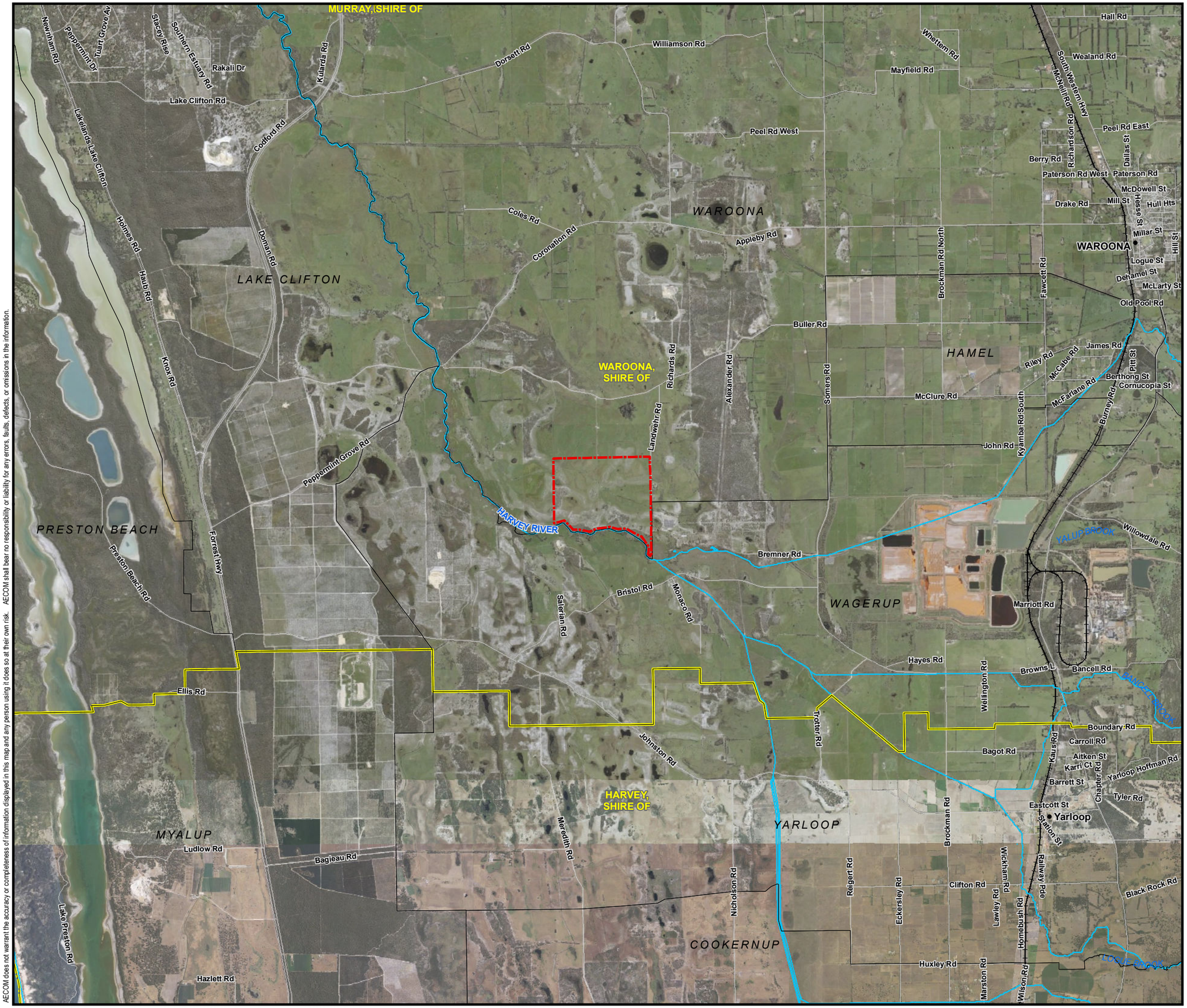
South Energy have been authorised by the land holder to use the land for the purposes of this proposal. Third party authorisation documentation is attached in Appendix A.

1.3 Site Details

Details of the site are outlined in Table 1 and shown on Figure 2.

Table 1 Site details

Property	Description
Land description	Lot 24 on Plan 59266 – Land ID 3800596 Lot 25 on Plan 59266 – Land ID 3800597
Property Area	308 ha
Clearing Permit Application Area	276.5 ha
Zoning	Rural 1 – General Farming Zone
Owner	



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APPROVED BY	C.Bennison
LAST MODIFIED	31 OCT 2019

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Kilometers

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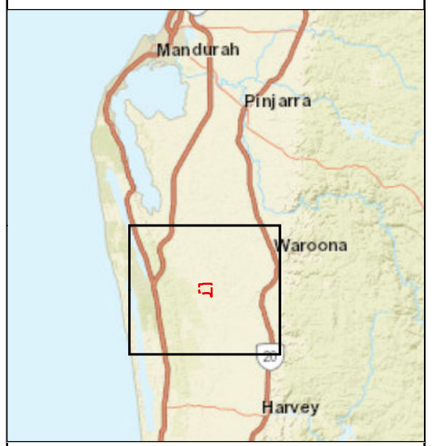
LEGEND

- Project Property Boundary
- Local Government Area Boundary
- Suburb Boundary



Data sources: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Project Location

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NATIVE VEGETATION CLEARING PERMIT APPLICATION

Figure 1

Map Document: (G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\07_60605068_ClearingPermitApplication\G60605068_Fig1_ProjectLocation_A3L.mxd) Plotted by: WyattK2 on 31/10/2019 9:19:33 AM

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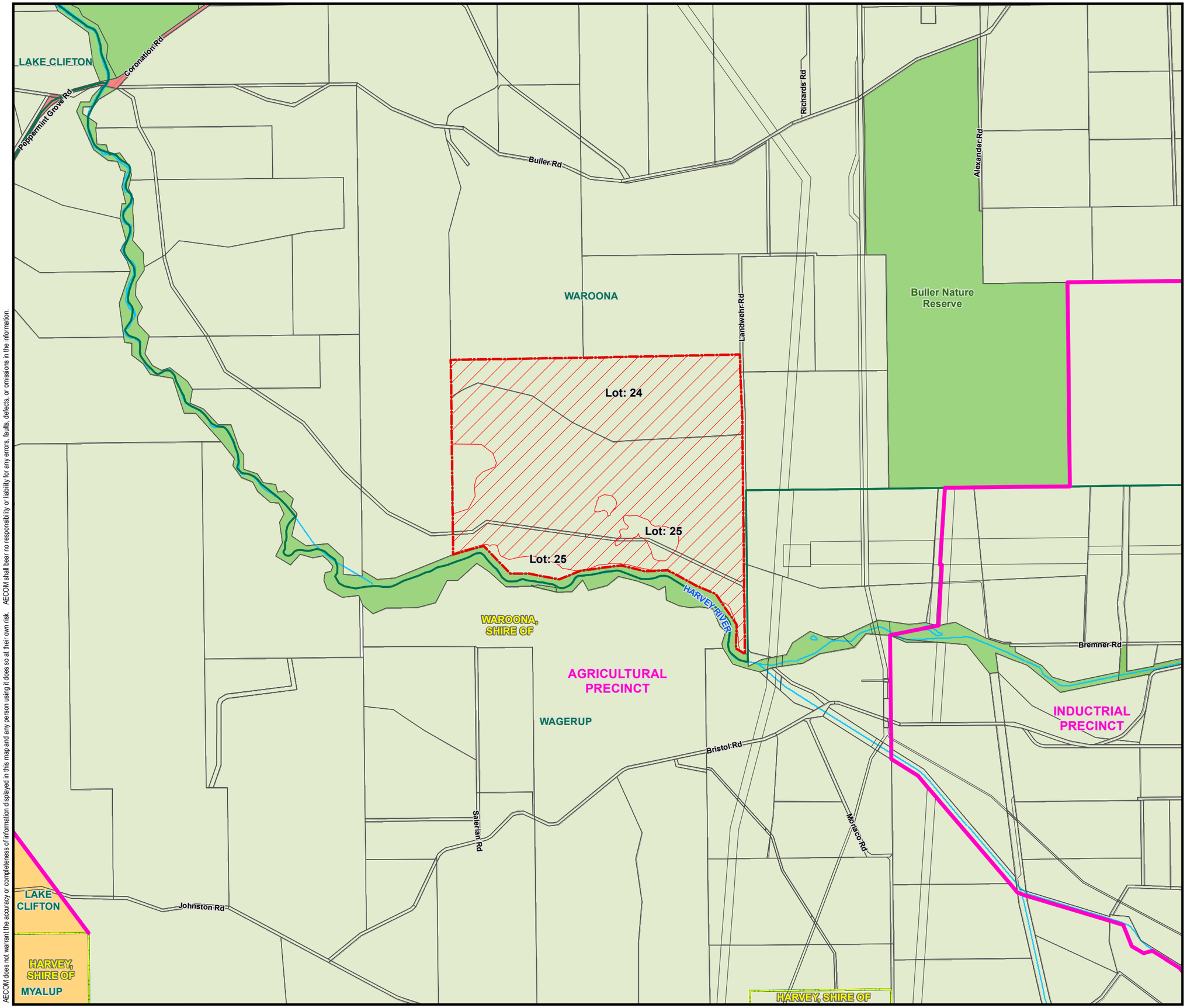

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Meters

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LEGEND

- Project Property Boundary
- Clearing Permit Application Area
- Local Government Area Boundary
- Locality Boundary
- Cadastral Boundary
- Precinct Boundaries

Region Scheme Reserves (PRS)

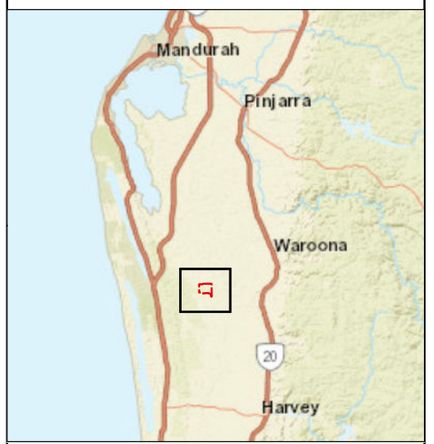
- State Forests
- Regional Open Space

Local Scheme Reserves

- Major Road

Local Scheme Zones

- General agriculture



Data sources: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community Department of Planning, Lands and Heritage (Local Planning Scheme No.7 - 31/08/2018)

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Zoning and Property Boundaries

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Figure 2

1.4 Environmental Assessments

Environmental assessment completed to support approvals are summarised in Table 2.

Table 2 Environmental assessments completed for the project

Title	Date	Purpose
Waroona Solar Farm Ecology Assessment (AECOM, 2019a)	August 2019	Identify potential conservation significant vegetation, flora and fauna at the site.
Waroona Solar Farm Preliminary Due Diligence Report: Planning and Environment (AECOM, 2019b)	January 2019	Identify and describe potential environmental constraints on development of the project.

1.5 Other Environmental and Planning Approvals

To obtain planning approval for the project, a development application was submitted to the Shire of Wanneroo in August 2019 (AECOM, 2019d).

The proposal is not expected to require referral under Part IV of the *Environmental Protection Act 1986* (EP Act). However, the project may require clearing potential habitat trees for black cockatoo species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The proponent intends to refer the project to the Department of Environment and Energy (DoEE) for assessment under the EPBC Act.

2.0 Existing Environment

2.1 Topography

Relief at the site is low, with elevations ranging from approximately 9 metres Australian Height Datum (mAHD) to 15 mAHD (AECOM, 2019c).

2.2 Geology

Three geology types have been mapped within the site (GSWA, 1982):

- S8 – eolian sand, white to pale grey at surface, yellow at depth, fine to medium grained, moderately sorted, subangular to sub-rounded minor heavy minerals.
- S10 – eolian sand (S8) over sandy clay to clayey sand of the Guildford formation.
- Ms2 – alluvial sandy silt, strong brown to mid-grey, mottled, blocky, disseminated fine sand, hard when dry.

2.3 Soils

Two land systems have been mapped at the site (Purdie *et al*. 2004):

- Bassendean System (212Bs) - sand dunes and sandplains with pale deep sand, semi-wet and wet soil. This covers most of the site.
- Pinjarra System (213Pj) - Poorly drained coastal plain with variable alluvial and aeolian soils. This system presents the alluvial plain of the Harvey River located along the southern margin of the site, as well as a small depression in the north eastern corner of the site.

2.3.1 Acid Sulfate Soils

Acid Sulfate Soils (ASS) risk at the site has been mapped by the Department of Water and Environmental Regulation (DWER) as moderate to low risk of ASS occurring within 3 m of natural soil surface, but high to moderate risk of ASS beyond 3 m of natural soil surface (DWER, 2016).

2.3.2 Salinity

The site lies within an area mapped as having a low risk of salinity (DAFWA, 2014).

2.4 Water

2.4.1 Groundwater

The site lies within the Murray groundwater area and Waroona groundwater sub-area. The Murray groundwater area is proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

There are two main aquifers that characterise the region: the Superficial Aquifer and the Leederville Aquifer (DoW, 2009). These may be hydraulically linked.

The Superficial Aquifer is typically 20 m to 40 m deep and consists of clay and sand in the Guildford formation. Groundwater at site flows toward the Harvey Main Drain. Salinity increases towards the Harvey River and ranges fresh to saline, with concentration reported at 500 m/L to 3000 mg/L.

The DWER Water Information Reporting database shows approximately 38 groundwater bores at the site (DWER, 2019a). It is unknown if any of these bores still exist. Given the catchment has previously been subject to impacts from eutrophication and the site is downgradient from a PRS priority agriculture area, it is likely that these bores were used to monitor nutrient discharge to the Harvey River caused by upgradient agricultural land use. Historical monitoring data indicates that groundwater levels range from approximately 7 mAHD to 10 mAHD.

2.4.2 Surface Water

No Public Drinking Water Source Areas intersect the site. Surface water allocation areas are used by DWER as an administrative tool to manage the availability and use of surface water resources. The site lies within the Harvey Surface Water Allocation Area and the Upper Harvey Main Drain Surface Water Allocation Sub-area.

Watercourses and man-made drains are common in the region. Several agricultural dams and drains have been built at the site and two drainage lines about the northern and southern boundaries of the site. The most significant of these is the Harvey Main Drain, which runs along the southern boundary and forms the main channel of the Harvey River. Along the northern boundary of the site is the Domain Main Drain, which discharges into the Harvey River approximately two kilometres northwest of the site.

The Harvey River discharges to the Harvey Estuary approximately 15 km northwest of the site.

Low relief at the Project indicates that drainage in the site is poor. Surface water collects in low lying basins and poorly draining soils associated with wetlands. In the north and south of the site water is expected to drain away from the site towards the Domain Main drain and Harvey River Main Drain.

2.4.3 Wetlands

Almost half of the site has been mapped by the Department of Biodiversity Conservation and Attractions as geomorphic wetlands of the Swan Coastal Plain. These wetlands are generally aligned with low lying areas or poorly draining sands, clays or duplex soils. Most of the wetland area is palusplain or dampland, flat plains with poor drainage that become seasonally waterlogged. Where low lying depressions occur sumplands exist. These are small basins that become seasonally inundated and create seasonal pools of water. At the southern boundary of the site is the Harvey River. The foreshore of the river is characterised by poorly draining clays and the associated alluvial plain would be prone to flooding.

No nationally significant wetlands listed in *A Directory of Important Wetlands in Australia* or Ramsar wetlands protected under international agreements occur within the site.

In Western Australia, wetlands can be classified in one of three management categories. The DBCA has mapped 14 wetlands at the site. These are classified as:

- One Conservation wetland
- One Resource Enhancement wetland
- 12 Multiple Use wetlands.

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APPROVED BY CBennison
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LEGEND

- Project Property Boundary
- Clearing Permit Application Area
- Road
- Watercourse(GA)

Management Category (DBCA)

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed
- Not Applicable

Data sources: GWSCP - Department of Biodiversity, Conservation and Attractions(DBCA);ESA - Department of Water and Environmental Regulation (DWER);

Base Data: Geoscience Australia (GA); (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Wetland Mapping

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NATIVE VEGETATION CLEARING PERMIT APPLICATION

Figure 3

Map Document: \\auper1gis01\geo\GIS_Projects\WaroonaSolarFarm\02_MXDs\07_60605068_ClearingPermitApplication\G60605068_Fig3_Wetlands_A4P.mxd (WyattK2)

A4 size

2.5 Vegetation, Flora and Fauna

Vegetation, flora and fauna at the site were surveyed by AECOM (Appendix B). The Ecology Assessment included:

- a desktop review to identify potential for Threatened or Priority flora, fauna or ecological communities to occur within, or near the proposed site.
- a flora, vegetation and fauna reconnaissance survey conducted in January 2019 to verify desktop review results, note evidence of conservation significant biota and investigate the presence (or likely presence) of specific Commonwealth and State-listed threatened flora and fauna species and communities.
- a detailed flora and vegetation assessment and targeted Black Cockatoo assessment conducted in June 2019.

2.5.1 Vegetation

2.5.1.1 Vegetation Associations

Beard (1974) mapped one pre-European vegetation association at the site (Table 3). Most of the pre-European vegetation at the site has been cleared for agriculture.

Heddle *et al.* (1980) conducted vegetation complex mapping for the Swan Coastal Plain at a scale of 1:250,000. The mapping shows three vegetation types (Table 4) including Serpentine River, Cannington and Southern River complex.

Table 3 Pre-European Vegetation Associations (Beard, 1974)

Vegetation Association	Description
1000	Low forest or woodland. Mosaic: medium forest; jarrah-marri / low woodland; banksia / Low forest; teatree (*Melaleuca* spp.).

Table 4 Vegetation complex mapping (Heddle *et al.* 1980)

Landform Unit	Complex	Description
Pinjarra Plain	35 Serpentine River Complex	Closed scrub of Melaleuca species and fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along streams.
Combination Bassendean Dunes and Pinjarra Plain	40 Cannington Complex	Mosaic of vegetation from adjacent vegetation complexes of Bassendean, Karrakatta, Southern River and Vasse.
	42 Southern River Complex	Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds.

The significance and value of the native vegetation within the Clearing Permit Application Area was assessed using the 2018 Statewide Vegetation Statistics (Government of Western Australia, 2018). Table 5 shows the current extent remaining of pre-European vegetation remaining in the region.

According to the Government of Western Australia (2018) 27.81% of vegetation association 1000 remains intact. This is below the recommended target of retaining 30% of vegetation at a local level.

Table 5 Vegetation Representation

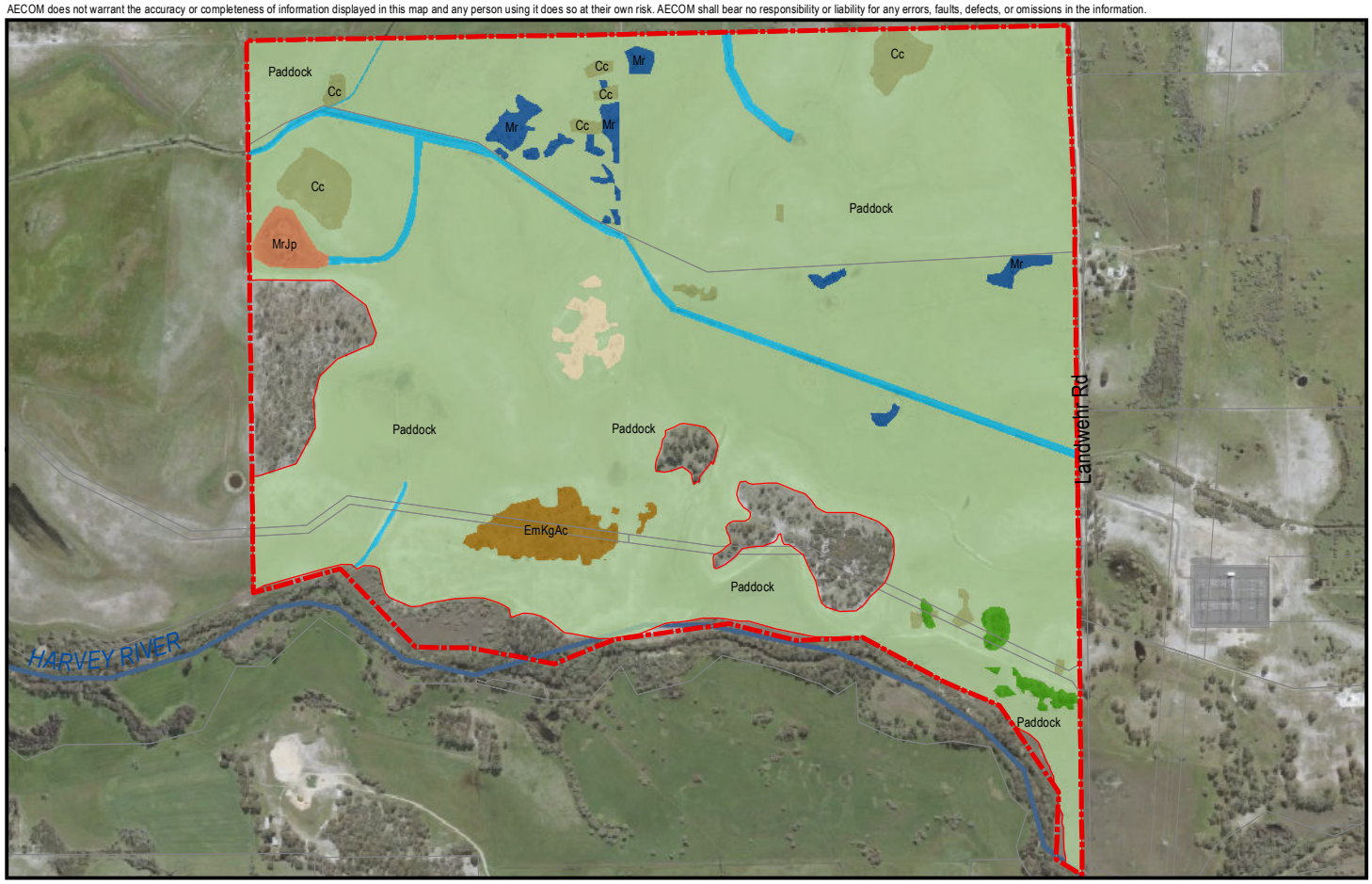
District	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining Statewide (%)	% Current Extent in DBCA Managed Land (proportion of Pre-European Extent)
Statewide	99,835.86	27,768.84	27.81	5.19
Shire of Waroona	15,226.94	2,289.14	14.99	2.79

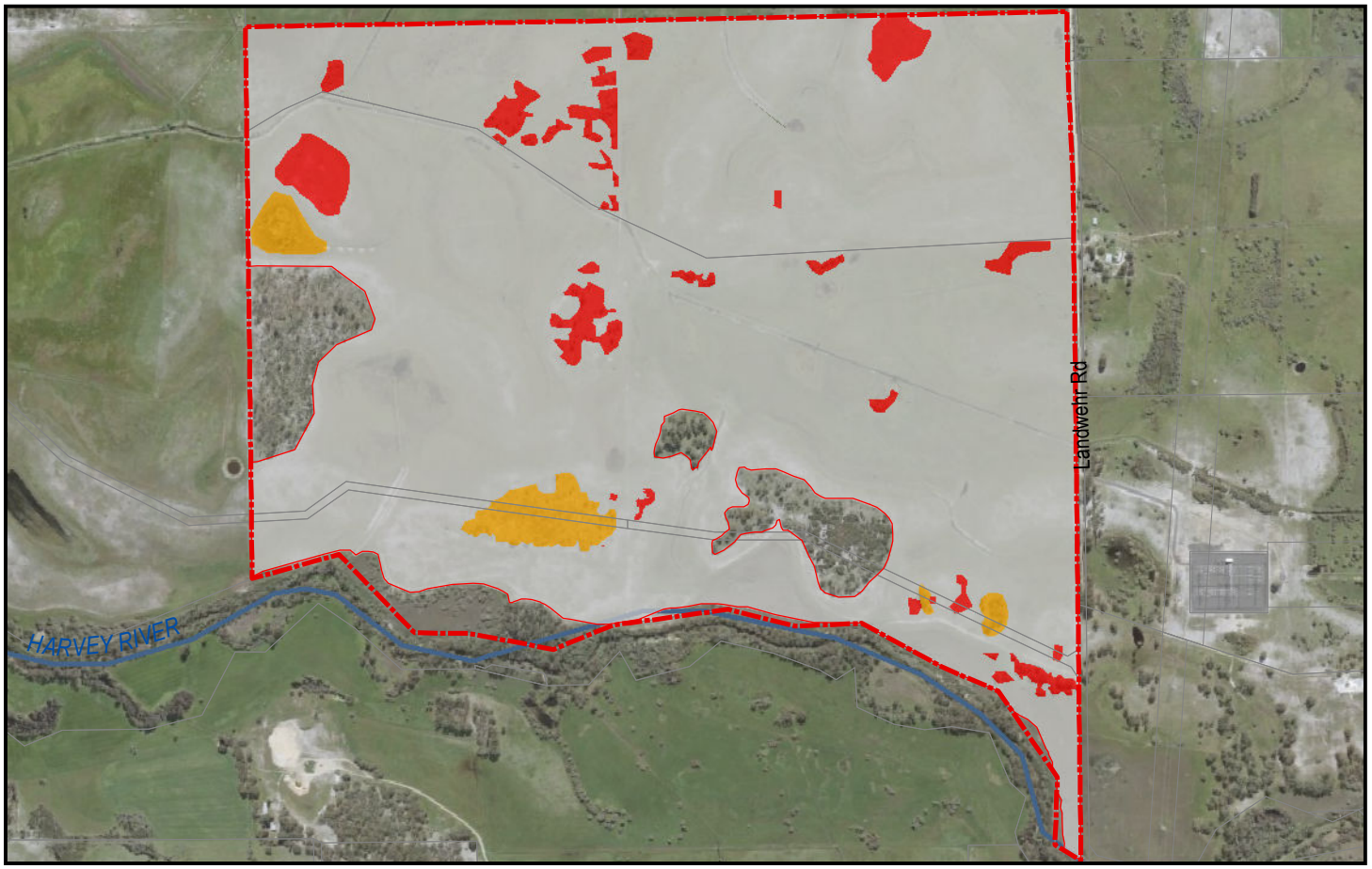
2.5.1.2 Vegetation Communities

AECOM (2019a) mapped six vegetation communities at the site (Table 6 and Figure 4). These vegetation communities cover an area of 19 ha. The remainder of the site comprises 257.5 ha of cleared paddocks and 31.5 ha of native vegetation that was not surveyed and will not be cleared.

Table 6 Vegetation communities mapped at the site

Code	Description	Details
Cc	*Corymbia calophylla* medium open woodland over pasture weeds and grasses.	Survey effort: N/A. Survey Area: 5.72 ha Condition: Completely Degraded
CcApAc	*Corymbia calophylla* and *Banksia ilicifolia* low to mid open woodland with *Acacia pulchella* low sparse shrubland over **Arctotheca calendula and *Hypochaeris glabra* low closed forbland.	Survey effort: one traverse (Waroona 02). Survey Area: 1.87 ha. Condition: Completely Degraded – Degraded
CcJp	*Corymbia calophylla* and *Melaleuca rhaphiophylla* tall open trees over *Juncus preissianus and Xanthorrhea preissii* low closed mixed sedge and shrubland.	Survey effort: one traverse (Waroona 05). Survey Area: 1.54 ha Condition: Completely Degraded – Degraded
EmKgAc	*Eucalyptus marginata* and *Banksia ilicifolia* low to mid open woodland with *Kunzea glabrescens and Acacia pulchella low* sparse shrubland over **Arctotheca calendula, *Ehrharta sp. and *Romula rosea* low closed mixed forb and grassland.	Survey effort: one traverse (Waroona 03). Survey Area: 4.42 ha Condition: Completely Degraded – Degraded
Mr	*Melaleuca rhaphiophylla* low open woodland over pasture weeds and grasses.	Survey effort: one traverse (Waroona 01). Survey Area: 3.55 ha Condition: Completely Degraded
MrJp	*Melaleuca rhaphiophylla* low open woodland with *Juncus preissianus* and *Solanum nigrun* low sparse shrubland over **Arctotheca calendula, ?Xanthosia huegelii,* and *Oxalis pes-caprae* low closed forbland.	Survey effort: one traverse (Waroona 04). Survey Area: 1.86 ha Condition: Degraded
Paddock	Cleared paddock comprising common pasture weeds.	Survey Area: 257.5 ha Condition: Cleared





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DATUM GDA 1994, PROJECTION MGA ZONE 50

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metres

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LEGEND

Project Property Boundary
Clearing Permit Application Area
Cadastre

Vegetation Condition
Completely Degraded
Degraded
Cleared

Vegetation Communities
Cc
CcApAc
CcJp
Drainage
EmKgAc
Mr
MrJp
Paddock

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Vegetation Communities and Condition

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NATIVE VEGETATION CLEARING PERMIT APPLICATION

Figure 4

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\07_60605068_ClearingPermitApplication\G60605068_Fig4_VegCommunitiesCondition_A4P.mxd (WyattK2)

A4 size

2.5.1.3 Vegetation Condition

Vegetation condition was mapped by AECOM (2019a) as Completely Degraded to Degraded (Table 7 and Figure 4). The condition reflects the current land use for agriculture. Areas of remnant native vegetation have not been fenced, therefore cattle grazing has contributed to the ongoing decline of vegetation condition. Altered hydrology may be affecting stands of trees, as noted by the numerous dead trees present. At this stage we are unable to exclude dieback as a contributing factor to vegetation decline.

Table 7 Vegetation condition mapped in the site

Condition Scale	Area (ha)
Cleared	263.8
Completely Degraded	12.13
Degraded	6.85

2.5.1.4 Threatened and Priority Ecological Communities

Desktop searches identified one Threatened Ecological Community (TEC) and one Priority Ecological Community (PEC) with potential to occur in the site. These include:

- Banksia Woodlands of the Swan Coastal Plain - listed as an Endangered TEC under the EPBC Act
- Claypans of the Swan Coastal Plain - listed as a Critically Endangered TEC under the EPBC Act and a Priority 1 PEC by the DBCA

Field surveys confirmed vegetation present does not represent either of these ecological communities.

2.5.2 Flora

A total of 39 Threatened and Priority flora species were identified during the desktop review as potentially occurring within the site. Eight species of these species were considered to have potential to occur within the site (Table 8). However, the field survey determined that the site generally lacks suitable habitat to support these species and none were recorded at the site. Consequently, most of these species are unlikely to occur.

Table 8 Threatened and Priority flora species with potential to occur at the site

Taxon	State BC Act / DBCA	Federal EPBC Act	Likelihood
Andersonia gracilis	Vulnerable	Endangered	Unlikely to occur
Diuris micrantha	Vulnerable	Vulnerable	May occur
Diuris purdiei	Endangered	Endangered	Unlikely to occur
Drakaea elastica	Critically Endangered	Endangered	Unlikely to occur
Drakaea micrantha	Endangered	Vulnerable	Unlikely to occur
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Critically Endangered	Unlikely to occur
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Endangered	Endangered	Unlikely to occur
Synaphea stenoloba	Critically Endangered	Endangered	Unlikely to occur

2.5.3 Fauna

The desktop review identified 26 conservation significant fauna species that could potentially occur at the site (AECOM, 2019a). Ten of these species have potential to use the site (Table 9), but only Baudin's Cockatoo (*Calyptorhynchus baudinii*) was recorded during the field survey.

Table 9 Conservation significant fauna species with potential to use the site

Species	State BC Act / DBCA	Federal EPBC Act
Calidris ferruginea Curlew Sandpiper	Critically Endangered	Migratory
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	Vulnerable	Vulnerable
Calyptorhynchus baudinii Baudin's Cockatoo	Endangered	Vulnerable
Calyptorhynchus latirostris Carnaby's Cockatoo	Endangered	Endangered
Falco peregrinus Peregrine Falcon	Other specially protected fauna	-
Plegadis falcinellus Glossy Ibis	Migratory	Migratory
Tringa nebularia Common greenshank	Migratory	Migratory
Notamacropus Irma Western Brush Wallaby	Priority 4	-
Phascogale tapoatafa subsp. *wambenger* South-western Brush-tailed Phascogale	Species of special conservation interest	Vulnerable
Pseudocheirus occidentalis Western Ringtail Possum	Critically Endangered	Critically Endangered

2.5.3.1 Fauna habitat

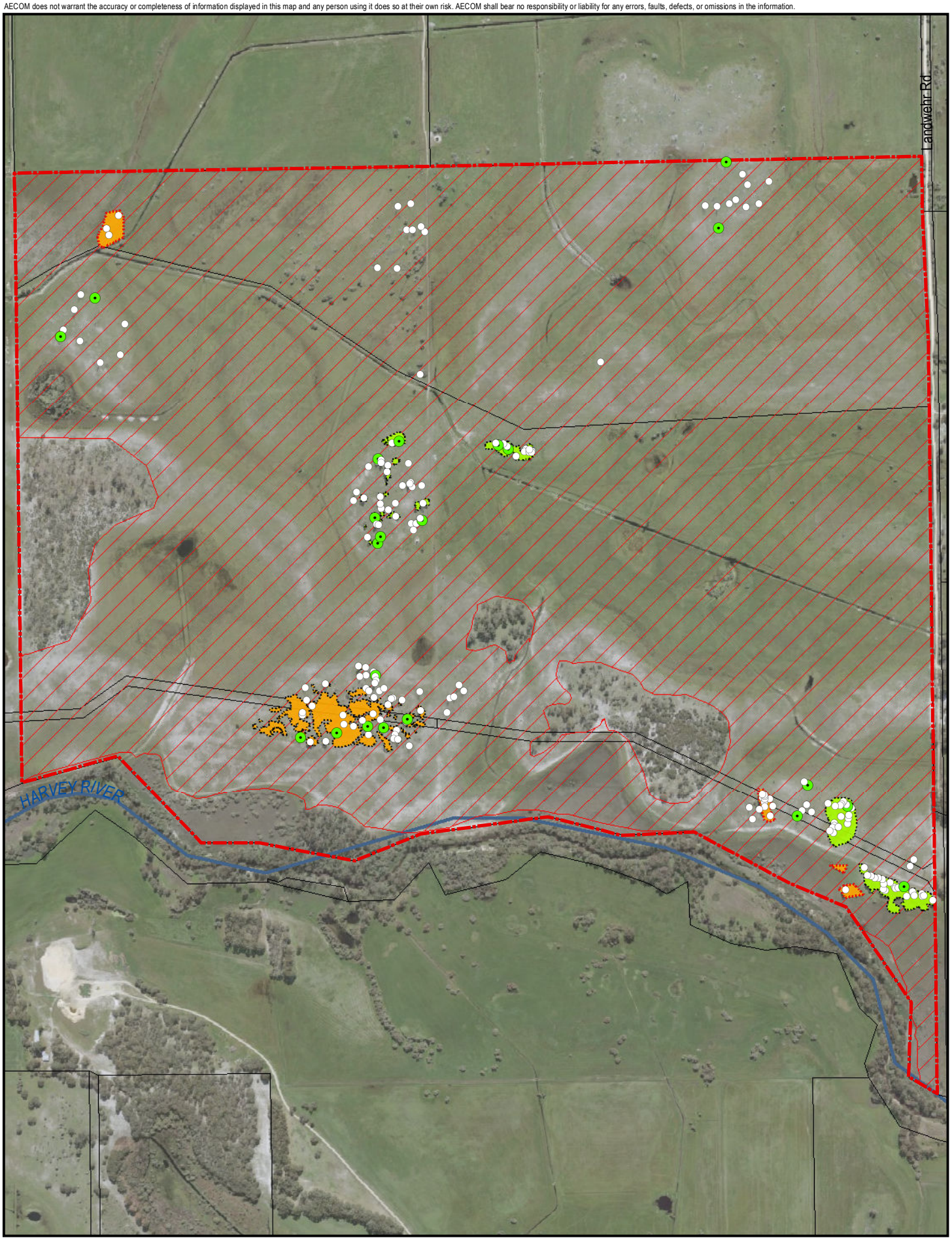
Four broad fauna habitats have been mapped at the site (Figure 5). Fauna habitats present and conservation significant fauna with potential to use them are described in Table 10.

Conservation significant fauna with potential to use the site include:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris)*
- Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)*
- Baudin's Cockatoo *(Calyptorhynchus baudinii)*

Marginal, generally poor quality and highly modified habitat also exists for:

- Peregrine Falcon (*Falco peregrinus*) may utilise the larger eucalypts
- Western Brush Wallaby (*Notamacropus Irma*) which may utilise the areas of mixed trees and adjacent paddocks
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) and the Western Ringtail Possum (*Pseudocheirus occidentalis*) which may utilise the areas of mixed trees, though these are generally smaller patches that are very isolated and of poor quality.
- wetland bird species including the Glossy Ibis *(Plegadis falcinellus),* Curlew Sandpiper (*Calidris ferruginea),* Common Greenshank *(Tringa nebularia),* Some of these species may utilise the poor quality drainage and wetland habitats, and areas within the paddocks which are highly modified but likely to flood over winter.



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metres

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LEGEND

- Project Property Boundary
- Native Vegetation Clearing Permit

Black Cockatoo Breeding Trees
- Hollows
- No Hollows

Baudin's Black Cockatoo / Carnaby's Black Cockatoo Foraging Quality
- High Quality
- Quality

Forest Red-Tailed Black Cockatoo Foraging Quality
- Quality
- Low Quality

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Fauna Habitat

SE WAROONA DEVELOPMENT PTY LTD

WAROONA SOLAR FARM
NATIVE VEGETATION CLEARING PERMIT APPLICATION

Figure 5

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\07_60605068_ClearingPermitApplication\G60605068_Fig5_FaunaHabitat.mxd (WyattK2)

A4 size

Table 10 Fauna Habitat Types in the Project Area

Habitat Type	Description	Area (ha)	Conservation Significant Species Potentially Utilising Habitat
Paddock with Scattered Trees and Drainage Areas	Cleared paddocks with scattered individual or clumps of large mature eucalypts (and other vegetation). Contains a mosaic of drainage lines and lower lying drainage areas of varying sizes. Some of the large eucalypts contain hollows and may represent significant fauna habitat such as black cockatoo breeding and potential breeding trees.	235.04	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise the mature eucalypts for foraging, roosting and / or breeding habitat • Mammals including the South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*) and Western Ringtail Possum (*Pseudocheirus occidentalis*) may utilise the mature eucalypts and *Agonis flexuosa* • Western Brush Wallaby (*Notamacropus Irma)* may utilise the habitat • Waterbird species may also utilise aspects of this habitat when damp or flooded.
River and Riparian Vegetation, Dams and Drainage	Riverine habitat comprising mature Flooded Gums and Paperbarks, generally with an understorey degraded by weeds and introduced fauna such as feral pigs. Contains drainage lines and lower lying drainage areas of varying sizes. A floodplain with cracking clays exists in the southeast area of the Project Area, directly north of Harvey River.	31.32	• Mammals including the Western Brush Wallaby (*Notamacropus Irma)* may utilise the riverine habitat • Waterbird species may also utilise aspects of this habitat.
Mixed Trees	Stands of mature Jarrah (*Eucalyptus marginata)* and Marri (*Corymbia calophylla*) over a degraded and mostly cleared understorey. Proteaceous species and *Agonis flexuosa* were observed in several stands. These areas generally contain light grey sandy soils.	10.81	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise the mature eucalypts and proteaceous species within this habitat for foraging, roosting and / or breeding habitat • Mammals including the South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*), Western Ringtail Possum (*Pseudocheirus occidentalis*), and Western Brush Wallaby (*Notamacropus Irma)* may utilise this habitat depending on understorey and species present.
Stags	Mostly mature dead trees (stags) with no understorey.	5.31	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise these stags as breeding habitat.

2.5.3.2 Black Cockatoo Species

A Black Cockatoo survey (AECOM, 2019a) was undertaken to assess the vegetation (roosting trees, foraging habitat, breeding and potential breeding trees) for over a survey area covering the extent of Lot 24 and Lot 25 (Table 1). The project development area is a subset of the survey area.

Roosting Trees

No roosting trees were identified within the site.

Foraging Habitat

Black Cockatoo foraging habitat at the site predominantly comprises isolated patches of Marri trees within paddocks. Significant dead trees were recorded in these patches and this has reduced the foraging quality of several patches. Foraging habitat and evidence of foraging recorded at the site is summarised in Table 11 and shown on Figure 5.

Table 11 Black Cockatoo foraging habitat at the site

Species	Habitat Quality			Foraging Evidence Recorded
	Low Quality	Quality	High Quality	
Carnaby's Cockatoo (*Calyptorhynchus latirostris)*	0.00	2.59	1.80	No foraging evidence was recorded in the site. Evidence recorded nearby.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)*	0.64	3.75	0.00	No foraging evidence was recorded in the site.
Baudin's Cockatoo (*Calyptorhynchus baudinii)*	0.00	2.59	1.80	Potential foraging evidence recorded under a Marri tree during January 2019 survey.

Breeding and Potential Breeding Trees

The site contains 201 potential Black Cockatoo breeding trees of suitable DBH, of which 22 contain hollows potentially suitable for use by Black Cockatoos (Table 12 and Figure 5). Of these, 21 trees were dead old trees with no vegetation cover nearby, therefore use by Black Cockatoos is considered limited. A comprehensive list of all potential Black Cockatoo breeding trees is provided in Appendix B.

Table 12 Trees with potentially suitable Black Cockatoo hollows within the Survey Area

ID	Longitude	Latitude	Species	Height (m)	DBH (cm)	Number of suitable hollows
5	115.4829	-32.5310	Stag	15	124	1
19	115.4844	-32.5420	Stag	16	85	1
34	115.4839	-32.5356	Stag	18	83	1
42	115.4836	-32.5355	Stag	8	92	1
56	115.4732	-32.5319	Stag	15	97	2
63	115.4758	-32.5350	Stag	25	180	2
75	115.4755	-32.5351	Jarrah	22	128	1
79	115.4752	-32.5351	Stag	30	113	1
87	115.4759	-32.5335	Stag	15	124	1
91	115.4759	-32.5337	Stag	18	101	2
92	115.4759	-32.5336	Stag	10	113	1

ID	Longitude	Latitude	Species	Height (m)	DBH (cm)	Number of suitable hollows
97	115.4830	-32.5335	Stag	15	125	1
112	115.4829	-32.5314	Stag	24	76	2
114	115.4810	-32.5330	Stag	25	66	1
118	115.4890	-32.5330	Stag	12	98	1
141	1151.4835	-32.5357	Stag	30	222	3
152	115.4732	-32.5322	Stag	15	108	3
158	115.4759	-32.5346	Stag	8	105	1
170	115.4759	-32.5350	Stag	18	110	1
177	115.4810	-32.5350	Stag	10	87	3
190	115.4759	-32.5331	Stag	15	105	1
197	115.4810	-32.5329	Marri (*Corymbia calophylla)*	25	102	1

2.6 Environmentally Sensitive Areas and Conservation Areas

One DWER Environmentally Sensitive Area (ESA) intersects the site (Figure 6). This lies in the southern extent of the site and is aligned with the Harvey River foreshore, which is a Conservation Category Wetland.

There are no other conservation areas within the site. The nearest conservation reserves are:

- Buller Nature Reserve (R 22199) – 1 km east
- Myalup State Forest (F16) – 3 km west
- Yalgorup National Park (R 11710) – 7 km west.

2.7 Cultural heritage

2.7.1 Aboriginal Heritage

A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System (AHIS) indicated that there are no Registered Aboriginal Heritage Sites or Other Heritage Places within the site. The nearest Register Aboriginal Heritage Site is Buller Road Camp (ID 3547), located approximately 3.5 km northeast of the site. This site is registered for its historical value as a camp site.

2.7.2 European Heritage

There are no World Heritage Properties or National Heritage Places within 10 km of the site.

No heritage sites listed in the State Register or Municipal Inventory intersect the site. The nearest heritage sites listed in the State Register and Municipal Inventory are detailed in Table 13.

Table 13 State listed Heritage Places near the site

Site Name	Place ID	Listing	Distance from Site
Fouracres Cottage	3093	State Register	8.5 km west
Wagerup Post Office	3083	State Register	8.5 km east
Waroona – Lake Clifton Railway	23523	State Register	8.0 km north
Thrombolites, Lake Clifton	17171	Municipal Inventory	7.2 km west
Hamel Nursery	3084	Municipal Inventory	9.7 km north east

PROJECT ID	60605068
CREATED BY	KW
APPROVED BY	C.Bennison
LAST MODIFIED	31 OCT 2019

AECOM
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N

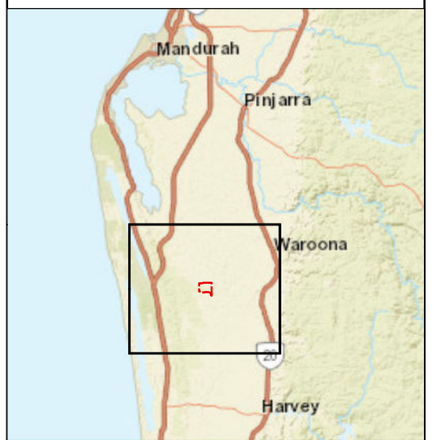
DATUM GDA 1994, PROJECTION MGA ZONE 50

0 1 2 3 4
Kilometers

1:75,000 (when printed at A3)

LEGEND

- Project Property Boundary
- Local Government Area Boundary
- Forestry Reserve
- Nature Conservation Reserve
- Reserves
- Environmentally Sensitive Areas



Environmentally Sensitive Areas and Conservation Reserves

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WAROONA SOLAR FARM
NATIVE VEGETATION CLEARING PERMIT APPLICATION

Figure 6

Map Document: (G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\07_60605068_ClearingPermitApplication\G60605068_Fig6_ESA_Reserves_A3L.mxd) Plotted by: WyattK2 on 31/10/2019 10:44:51 AM

A3 size

3.0 Proposed Clearing

3.1 Schedule

The applicant intends to commence clearing in Q3/Q4 2020. Construction of the project is expected to be completed by the end of 2022. Timing of clearing and other construction activities will not commence until relevant approvals are obtained.

3.2 Clearing Area

This application seeks approval to clear up to 19.0 ha of native vegetation for construction and operation of the Waroona Solar Farm. Clearing proposed is summarised in Table 14. This clearing area is based on clearing the vegetated areas in Figure 4 that are not in the reserved areas; that is all the red and orange in the vegetation condition figure. It should be noted that more than half of this area has been designated completely degraded in the ecological report. The concept layout to show the project configuration is show in Appendix C.

Table 14 Proposal characteristics

Aspect	Proposal Characteristics
Description	Mechanical clearing native vegetation for the development of a solar farm.
Project Area	308 ha
Application Area	276.50 ha
Clearing Area	19.0 ha of native vegetation
Life of project	30 years

3.3 Clearing Method

Vegetation will be removed using mechanical clearing with heavy earth moving machinery.

4.0 Assessment Against the 10 Clearing Principles

Proposed clearing has been assessed against the 10 Clearing Principles in accordance with *A Guide to the Assessment of Applications to Clear Native Vegetation* (DER, 2014).

Assessment categories used were:

- Not at variance – there is enough data to provide certainty
- Not likely to be at variance – there is an element of uncertainty
- May be at variance – there is insufficient data available to fully assess the impacts
- At variance – there are known impacts or significant risk of impact
- Seriously at variance – clearing will result in an impact so significant it is likely to be irreversible.

The results of the clearing assessment are presented in Table 15.

Table 15 Assessment against 10 Clearing Principles

Assessment Results	Source/ Tools for Assessment	Conclusion
Principle (a) - Native vegetation should not be cleared if it comprises a high level of biological diversity.		
The site does not occur in any biodiversity hotspots identified by the Threatened Species Scientific Committee (DoEE, 2019). Vegetation at the site does not represent any Priority Ecological Communities (PECs) or Threatened Ecological Communities (TECs). No Threatened or Priority flora species have been recorded at the site during the ecological survey. None of the flora recorded represented range extensions for the species. Ten conservation significant fauna species have potential to use the site. Only one of these species has been recorded at the site. Proposed clearing is unlikely to be at variance with this principle on the basis that vegetation present is degraded and contains assemblages of species that are common and widespread throughout the region.	Appendix B	Not likely to be at variance with this principle
Principle (b) - 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		
Ten conservation significant fauna species have potential to utilise habitat proposed for clearing. Habitat suitable for these species is generally marginal, highly modified and poor in quality. The exception to this is the three Black Cockatoo species. Up to 4.39 ha of Black Cockatoo foraging habitat is proposed for clearing, comprising: • 1.80 ha of High Quality Carnaby's and Baudin's Cockatoo foraging habitat • 2.59 ha of Quality habitat Carnaby's and Baudin's Cockatoo foraging habitat. • 3.75 ha of Quality Forest Red-tailed Black Cockatoo foraging habitat • 0.64 ha of Low Quality Forest Red-tailed Black Cockatoo foraging habitat	Appendix B	May be at variance with this principle

Assessment Results	Source/ Tools for Assessment	Conclusion
Two hundred and one potential breeding trees are proposed for clearing, including 22 potential breeding trees with hollows potentially suitable for nesting by Black Cockatoos. Twenty-one of the trees with potentially suitable hollows were dead trees with no vegetation cover nearby. Use of these trees by Black Cockatoos is considered limited. To minimise potential impacts to Black Cockatoo species South Energy intends to investigate options to reinstate habitat. Planting areas onsite with Black Cockatoo foraging habitat and erecting Black Cockatoo nesting boxes are options for offsetting the clearing of Black Cockatoo breeding and foraging habitat. A high level, preliminary assessment of the concept layout has determined that approximately 7 ha of land is potentially available and suitable for planting of foraging species and an additional approximately 3.7 ha could potentially be planted with foraging species, but further investigation would be required to assess the suitability of this land due to its potential for flooding and heavy clay composition (AECOM 2019a). Proposed clearing is at variance with this principle on the basis that clearing will require the removal of Black Cockatoo foraging and breeding habitat.		
Principle (c) - Native vegetation should not be cleared if it includes or is necessary for the continued existence of, rare flora.		
No conservation significant flora has been recorded within the proposed clearing area. The proposal will not require clearing of rare flora species and is therefore not at variance with this principle.	Appendix B	Not at variance with this principle.
Principle (d) - 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.		
No TECs or PECs (or their buffers) have been recorded within the proposed clearing area. The proposal will not require clearing of TECs or PECs and is therefore not at variance with this principle.	Appendix B	Not at variance with this principle
Principle (e) - Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been significantly cleared.		
The National Objectives and Targets for Biodiversity Conservation 2001-2005 (Commonwealth of Australia, 2001) recognised that the retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biodiversity is to be protected. According to the Government of Western Australia (2018) 27.8% of vegetation association 1000 remains intact. This is below the recommended target of retaining 30% of vegetation at a local level. The proposed clearing may be at variance with this principle because it requires clearing below the national target and objective for biodiversity conservation. Although this vegetation association is already below the 30% target, the proposed clearing comprises a series of small patches of degraded vegetation that have limited conservation value as an ecological community and are likely to continue to decline from impacts caused by farming practices.	Appendix B	May be at variance with this principle

Assessment Results	Source/ Tools for Assessment	Conclusion
Principle (f) - Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or a wetland		
Proposed clearing includes: • Part of Multiple Use wetlands - palusplain UFI 15231. and floodplain UFI 13300. • A small 0.3 ha Resource Enhancement wetland UFI 4347. This is a sumpland characterised by a patch of Melaleuca over common pasture weeds and grasses, which is in completely degraded condition. No conservation significant wetland vegetation is proposed for clearing and the Project has been designed to avoid clearing of conservation category wetlands such as the Harvey River foreshore. Clearing is not expected to have a significant impact on any important wetlands or watercourses. This proposal is therefore not at variance with this principle.	Appendix B	Not at variance with this principle
Principle (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.		
Clearing proposed involves removal of small, isolated patches of native vegetation scattered throughout an extensively cleared landscape. The small amount of clearing is not likely to result in significant changes to soil erosion, soil acidity or salinity. The clearing of vegetation is therefore not likely to cause appreciable land degradation and not likely to be at variance to this principle.	DWER, 2019b	Not likely to be at variance with this principle
Principle (h) - Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.		
The nearest conservation area is Buller Nature Reserve (R 22199), which is located approximately 1 km east of the site. The separation distance between Buller Nature Reserve and the site is considered sufficient to prevent significant adverse impacts. Riparian vegetation along the Harvey River is likely to provide an ecological linkage for local fauna. This area is protected as an ESA. No clearing is proposed within the ESA. Given the nature and scale of clearing proposed it is unlikely this proposal would result in significant impacts to offsite receptors such as nearby conservation areas. The proposal is therefore not likely to be at variance with this principle.	Appendix B	Not likely to be at variance with this principle
Principle (i) 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.		
Given that vegetation proposed for clearing generally lacks an understorey and poorly draining soils limit infiltration to groundwater, it is unlikely that proposed clearing would result in significant changes to surface water runoff or groundwater recharge. No soils prone to salinity or erosion are known to exist at the site.	Appendix B	Not likely to be at variance with this principle

Assessment Results	Source/ Tools for Assessment	Conclusion
Due to the history of eutrophication of the Peel-Harvey inlet, potential for clearing to increase nutrient loading in the Harvey River has been considered. Potential for the clearing to cause significant changes to downstream water quality is low. Although the area is used for crop and livestock farming and may be subject to seasonal fertilisation, drainage within the site is generally poor and soils types present are not prone to erosion. Clearing proposed is therefore not likely to cause significant changes to nutrient loads discharged to Harvey River is low. Other water quality parameters considered include potential for acidification from disturbance of ASS. Only shallow disturbance of soil in a small area with a low to moderate risk of ASS. Consequently, potential for disturbance from ASS is considered unlikely. No significant changes to the hydrological regime (including water quality) are expected to result from the proposed clearing. This proposal is therefore not likely to be at variance to this principle.		
Principle (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause or exacerbate the incidence or intensity of flooding.		
A small patch of degraded vegetation is proposed within the Harvey River floodplain. This floodplain is already extensively cleared, no widening of the river is proposed, and no riparian vegetation is proposed for clearing. Given the nature and scale of clearing proposed, it is unlikely the proposal would exacerbate the incidence or intensity of flooding.	Appendix B	Not likely to be at variance with this principle

5.0 Conclusions

South Energy proposed to clear 19.0 ha of native vegetation for development of the Waroona Solar Farm.

Assessment against the 10 clearing principles identified that proposed clearing is not likely to be at variance with eight of the clearing principles. Proposed clearing may be at variance with principles b and e, which relate to the clearing of fauna habitat and significant remnants of native vegetation in areas that have been extensively cleared.

5.1 Principle b – Fauna Habitat

The proposal may be at variance with principle b because the proposed clearing includes removal of 4.39 ha of potential Black Cockatoo foraging habitat and up to 201 potential black cockatoo breeding trees. Of the 201 potential breeding trees proposed for clearing, 22 are potential breeding trees with hollows that may be suitable for nesting by black cockatoos. Twenty-one of the trees with potentially suitable hollows are dead trees with no vegetation cover nearby. Use of these trees by Black Cockatoos is considered limited and the clearing will not have a significant impact on the species.

To minimise potential impacts to Black Cockatoo species South Energy intends to investigate options to reinstate habitat. Planting areas onsite with Black Cockatoo foraging habitat and erecting Black Cockatoo nesting boxes are options for offsetting the clearing of Black Cockatoo breeding and foraging habitat.

To minimise potential impacts to Black Cockatoo species South Energy intends to investigate options to reinstate habitat. Planting areas onsite with Black Cockatoo foraging habitat and erecting Black Cockatoo nesting boxes are options for offsetting the clearing of Black Cockatoo breeding and foraging habitat.

A high level, preliminary assessment of the concept layout has identified areas that South Energy propose to intentionally reserve for partial offset of clearing. These areas are at least approximately 7 ha of land suitable for planting of foraging species and an additional approximately 3.7 ha could potentially be planted with foraging species. Further investigation would be required to assess the suitability of this land due to its potential for flooding and heavy clay composition (AECOM 2019a).

5.2 Principle e – Remnant Vegetation

The proposal may be at variance with principle e because it requires removal of 19.0 ha of a vegetation association that has been already been cleared below the national target and objective for biodiversity conservation, which is retention of 30% or more of the pre-clearing extent of each ecological community.

According to the Government of Western Australia (2018) 27.8% of vegetation association 1000 remains intact. Although this vegetation association is already below the 30% target, the proposed clearing comprises a series of small patches of degraded vegetation that have limited conservation value as an ecological community and are likely to continue to decline from impacts caused by farming practices.

6.0 References

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Appendix A

Third Party Authorisation

Appendix A Third Party Authorisation

APPLICATION FOR PLANNING CONSENT (P1)

SHIRE OF WAROONA SEA TO SCARP

Office Use Only:	**Fees Paid**
TP No: _____ Assess No. A _____	Amount: $ _____
Lot area: _____ Zone: _____	Date Received: _____

Use Class: _____ Use Table Symbol: _____ Receipt No: _____

1. Full Name of Owner(s): Richard John Caratti and Aldo Joseph Caratti
   Address: 187 McNeill Road, Waroona, Western Australia, 6125
   PO Box 40, Waroona, Western Australia, 6215 Telephone: 0407770284
2. Full Name of Applicant: SE Waroona Development Pty Ltd
   Address: Lv 27, 150 Lonsdale Street, Melbourne, Victoria, 3000
   Tel: 0402653914 Fax: _____
3. Address for Correspondence: Applicant Contact Person: Baifulaqi Du
   Email: baifulaqi.du@southenergy.com.au
4. Locality of Proposed Development (Lot & Street No, Street, Locality): _____
   Lot 24 (known as 981 Buller Road, Waroona, WA), and Lot 25 (known as Landwehr Road, Waroona, WA)
5. Certificate of Title: Vol: 2700 Fol: 487 (Lot 24), 488 (Lot 25) Diagram/Plan: 59266
6. Purpose for which Applicant desires to use the land: Development application for the construction and operation of a 165 MW solar farm in Waroona, Shire of Waroona.
7. Nature of existing buildings and other improvements on the land: None
8. Nature of buildings and other improvements proposed to be constructed on the land: Site infrastructure will include photovoltaic modules, power conversion units (containing switchgear, inverters, transformers), substation, operations and maintenance facility, site office, laydown areas, internal access tracks, battery storage, security fencing.
9. Estimated time of Commencement: Construction 2020 (Q4); Operations 2022 Completion: Project Life ~30 years
10. No. of employees (if applicable): ~300 jobs during construction. ~6 permanent jobs during operations.
11. Approximate cost $ (**EX GST**): $250 million

Signature of Applicant: 百富拉齐 Date: 19/08/2019

Signature of Owner(s): RJ Caratti Aldo Caratti Date: 19/8/2019

Forms and Plans to be returned to:

Chief Executive Officer
Shire of Waroona
PO Box 20
WAROONA WA 6215

SEE NOTES ON REVERSE

Appendix B

Ecology Assessment

Appendix B Ecology Assessment

AECOM Imagine it. Delivered.

SE Waroona Development Pty Ltd (South Energy)
14-Aug-2019

Waroona Solar Farm

Ecology Assessment

Waroona Solar Farm

Ecology Assessment

Client: SE Waroona Development Pty Ltd (South Energy)

ABN: 64 628 948 993

Prepared by

AECOM Australia Pty Ltd
3 Forrest Place, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia
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ABN 20 093 846 925

14-Aug-2019

Job No.: 60590394

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document	Waroona Solar Farm
Ref	60590394
Date	14-Aug-2019
Prepared by	L Fisher
Reviewed by	L Kirchner

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	31-Jul-2019	Issued	Linda Kirchner Associate Director - Environment	
1	09-Aug-2019	Issued	Linda Kirchner Associate Director - Environment	
2	14-Aug-2019	Issued	Jared Leigh Principal Environmental Scientist - Ecologist	

Table of Contents

Figures

Tables

Executive Summary

An Ecological and targeted Black Cockatoo survey was undertaken for South Energy on behalf of SE Waroona Development Pty Ltd to determine the environmental constraints for a proposed Solar Farm (referred to as Waroona Solar Farm Project [the Project]). The Waroona Solar Farm Project includes a Project Area of 308 ha, located approximately eight kilometres west of Wagerup in the Shire of Waroona.

A preliminary site investigation including desktop assessment was undertaken by Ecologists Jared Leigh and Laura Fisher on 31 January 2019. This survey determined that no Threatened or Priority flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act), or listed by DBCA were likely to occur and no Threatened Ecological Communities occurred in the Project Area. Potential breeding and foraging habitat for three Black Cockatoo species (including Baudin's Cockatoo *Calyptorhynchus baudinii*, Carnaby's Cockatoo *Calyptorhynchus latirostris,* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso)* listed under the EPBC Act was mapped, and these species have the potential to utilise the Survey Area. Seven other threatened fauna species may potentially utilise the habitats within Survey Area, though the habitats present are generally poor quality, limited, isolated and highly modified.

A flora and vegetation assessment and targeted Black Cockatoo survey was undertaken by Ecologists Floora de Wit and Laura Fisher on 20 June 2019. At this time large patches of native vegetation were proposed to be retained and were excluded from the field survey. Traverses were walked through native vegetation to record general characteristics of the patch to inform the vegetation community and condition mapping. All potential Black Cockatoo breeding trees within the Survey Area were assessed and mapped and foraging quality was determined for discreet patches of native vegetation.

Six vegetation communities were recorded and mapped within the Survey Area largely comprising native trees over common pasture weeds surrounded by paddock. Of the 18.98 ha of native vegetation, 6.85 ha was mapped as Degraded and 12.13 ha was mapped as Completely Degraded. Vegetation condition reflects the current agriculture land use. Fauna habitats mapped included Paddock, Riparian and Drainage, Stags, and Mixed Trees. These habitats have the potential to be utilised by ten threatened fauna species, although they are generally poor quality, isolated and highly modified.

The Survey Area contains 201 potential Black Cockatoo breeding trees (i.e. DBH >500mm), of which 22 contain hollows potentially suitable for use by Black Cockatoos. Of these, 21 trees were dead old trees with no vegetation cover nearby, therefore their utilisation by Black Cockatoos is considered limited. The Black Cockatoo foraging assessment determined the presence of a total of:

- 1.80 ha of High Quality and 2.59 ha of Quality Carnaby's Cockatoo and Baudin's Cockatoo foraging habitat
- 3.75 ha of Quality and 0.64 ha of Low Quality Forest Red-tailed Black Cockatoo foraging habitat.

The potential presence of seven other threatened fauna species (apart from the three Black Cockatoo species), though habitat for these species is generally limited, of poor quality and highly modified.

The Survey Area is considered to have low biodiversity. Remnant patches of native vegetation are significantly altered and almost completely devoid of native understorey species. A large proportion of native trees were dead which may be a reflection of one or more factors including dieback, altered groundwater conditions, altered fire regimes, and salinity. It is likely that remaining living trees play an important role in hydrological function and therefore clearing of living native trees should be avoided where possible. Taking this into account, the following is recommended:

- Retain native vegetation, Quality and High Quality Black Cockatoo foraging habitat and Black Cockatoo breeding and potential breeding trees where possible.
- Areas supporting both hollow bearing Black Cockatoo breeding trees and good quality foraging habitat for Black Cockatoos should be prioritised. These generally include vegetation communities CcApAc, EmKgAc and CcJp, which also aids in local flood mitigation of the Harvey River.

- Native Vegetation Clearing Permit under Section 51E of the *Environmental Protection Act 1986* (EP Act)
- Hold a pre-referral meeting with the Department of the Environment and Energy (DoEE) to confirm whether referral under the *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act*)* is required, due to potential impacts to the three threatened Black Cockatoo species if clearing of habitat is unavoidable.

1.0 Introduction

1.1 Context

South Energy on behalf of SE Waroona Development Pty Ltd is considering the potential for development of a solar farm (referred to as the Waroona Solar Farm Project [the Project]), at a site near Waroona in the southwest of Western Australia. The Project is located approximately 105 kilometres (km) south of Perth and eight kilometres west of Wagerup, in the Shire of Waroona (Figure 1). The Project site is bordered by Landwehr Road and the Harvey River and is located on a parcel of pastoral land 308 hectares (ha).

South Energy is in the site selection phase of this Project and detailed design information is not yet available. A Survey Area was defined using cadastral boundaries which was further refined to exclude several patches of remnant vegetation identified as environmental values to be retained by South Energy. The total Survey Area is 282.5 ha.

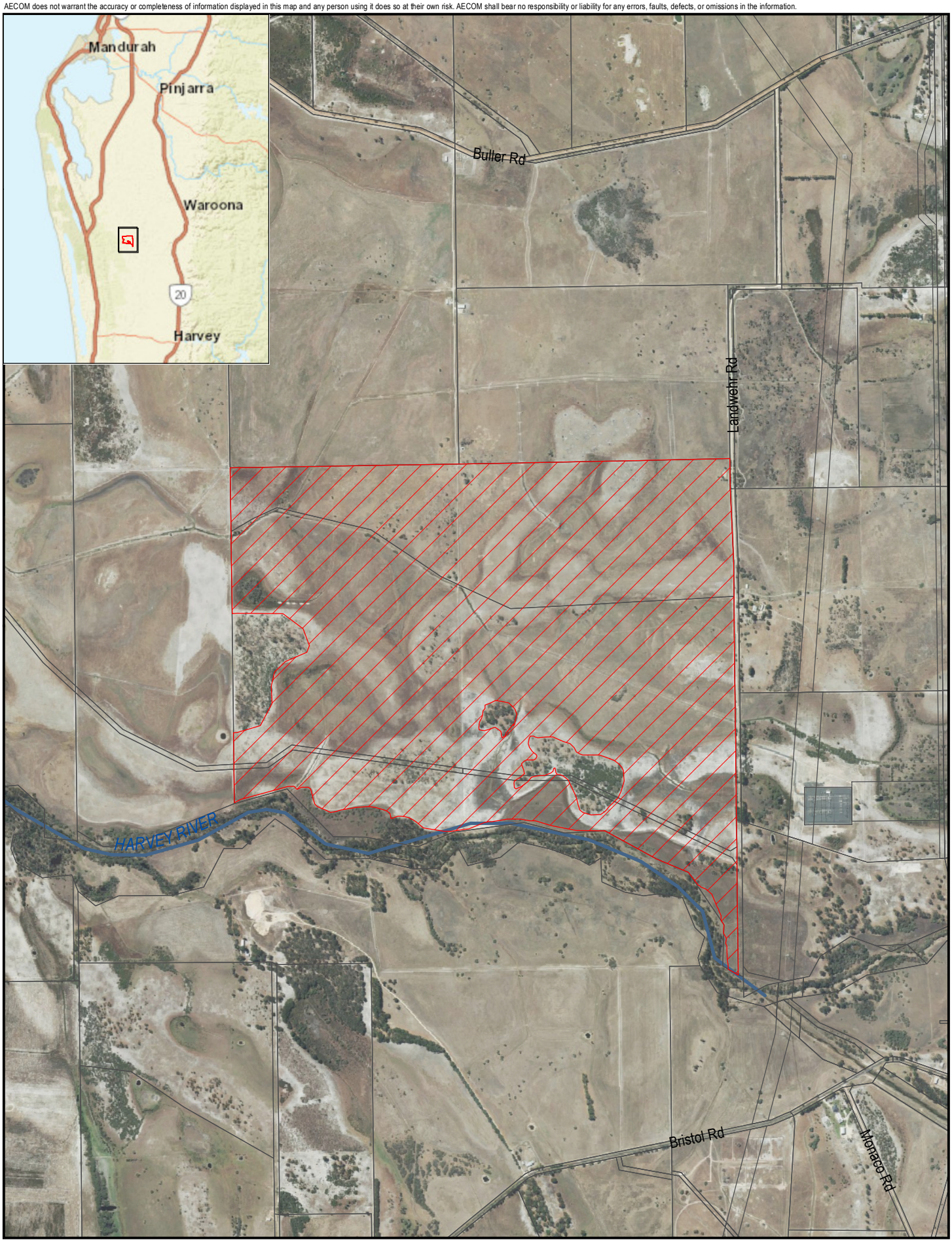
To inform the first stage of the planning and approvals process, AECOM was engaged by South Energy to undertake ecological surveys for the Project to define the environmental values of the Survey Area. A preliminary site investigation and detailed desktop review was undertaken for the Project in January 2019. This determined that Black Cockatoo potential breeding and foraging habitat was present and required a targeted survey to assess and quantify these values. This Targeted Black Cockatoo survey was completed in June 2019.

1.2 Purpose and Scope

The purpose of this report is to examine the existing environment within the Survey Area and identify the extent of any environmental values that may constrain the suitability of the site for solar farm development. Potential constraints assessed include conservation significant fauna habitat, flora species, and vegetation communities.

The scope of works for the ecological survey was to:

- Complete a desktop review to identify Threatened or Priority flora, fauna or ecological communities that may potentially occur within, or in close proximity to the Survey Area
- Undertake a field survey to:
    - verify the results of the desktop review
    - note evidence of any conservation significant biota that were not identified by the desktop review
    - investigate the presence (or likely presence) of specific Commonwealth and State-listed threatened flora and fauna species and communities
    - map and describe the flora and vegetation values including mapping vegetation communities and condition
    - identify and map potential Black Cockatoo breeding trees and foraging habitat within the Survey Area.
- Produce a technical report that includes the January and June 2019 assessments including methods, results and potential environmental constraints of the Survey Area.



PROJECT ID 60605068
CREATED BY KW
APPROVED BY L.Fisher
LAST MODIFIED 11 JUL 2019

AECOM
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Survey Area
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Location of the Project and the Survey Area Extent

SOUTH ENERGY

WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure
1

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2.0 Legislative Framework

Table 1 summarises the key legislation and guidance governing the protection and management of Western Australia's conservation significant flora, fauna and communities.

Table 1 Relevant Legislation, Regulations and Guidance

Legislation	Purpose
Commonwealth of Australia	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity.
EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species, (DSEWPAC, 2012)	These guidelines are intended to assist proponents in determining whether an action needs to be referred to the Australian Government. Definitions of habitat are provided as are criteria used to judge significant impact for these Black Cockatoo species.
Revised Draft Referral Guideline for Three Threatened Black Cockatoo Species (2017).	This guideline outlines important information and requirements for proponents, particularly on habitat quality, survey expectations, standards for mitigating impacts and significant impacts.
Western Australia	
Wildlife Conservation Act 1950 (WC Act) to be superseded by the *Biodiversity Conservation Act 2016* in January 2019.	Provides for the conservation and protection of Western Australia's wildlife.
Biodiversity Conservation Act 2016 (BC Act)	This Act will replace both the WC Act and the *Sandalwood Act 1929*. On 3 December 2016, several parts of the new Act were proclaimed by the State Governor in the Government Gazette. Provisions that replace those existing under the WC Act and *Sandalwood Act 1929* (including threatened species listings and controls over the taking and keeping of native species) and their associated Regulations have come into effect on 1 January 2019.
Environmental Protection Act 1986 (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.
Biosecurity and Agriculture Management Act 2007 (BAM Act)	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally.
EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a)	Provides guidance to ensure adequate flora and vegetation data of an appropriate standard are obtained and used in EIA.
EPA Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016b)	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial fauna.
EPA Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna, (EPA, 2016c)	Provides advice on fauna sampling techniques and methodologies for different regions of the State and the analysis, interpretation and reporting requirements for EIA.

2.1 Federal Legislation – *Environment Protection and Biodiversity Conservation Act 1999*

2.1.1 Matters of National Environmental Significant

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the main piece of Federal legislation protecting biodiversity in Australia. All Matters of National Environmental Significance (MNES) are listed under the EPBC Act. These include:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- world Heritage properties
- national Heritage places
- Great Barrier Reef Marine Park
- a water resource, in relation to coal seam gas development and large coal mining development
- nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

2.1.2 Flora and Fauna

Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 2.

Table 2 Categories of Species Listed under Schedule 179 of the EPBC Act

Conservation	Code Category
Ex	**Extinct Taxa** which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Conservation	Code Category
CD	**Conservation Dependent** Taxa which at a particular time if, at that time: the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered the following subparagraphs are satisfied: - the species is a species of fish - the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised the plan of management is in force under a law of the Commonwealth or of a State or Territory cessation of the plan of management would adversely affect the conservation status of the species.

2.1.3 Vegetation Communities

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia's ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of federally listed TECs are described in Table 3.

Table 3 Categories of TECs that are listed under the EPBC Act

Code	Category
CE	Critically Endangered If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

2.2 Western Australian Legislation

2.2.1 Flora and Fauna

Plants and animals that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the WC Act. These categories are defined in Table 4.

Table 4 Conservation codes for WA flora and fauna listed under the *Wildlife Conservation Act 1950* updated November 2015

Code	Category
CR	**Critically Endangered Species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered Species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora
VU	**Vulnerable Species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed Extinct Species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	**Migratory birds protected under an international agreement** Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	Special conservation
OS	Special protection for reasons other than those already mentioned

Species that have not yet been adequately surveyed to warrant being listed under the WC Act, or are otherwise data deficient, are added to a Priority Lists under Priorities 1, 2 or 3 by the State Minister for Environment. 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. Categories and definitions of Priority Flora and Fauna species are provided in Table 5.

Table 5 Conservation codes for WA flora and fauna as listed by DPaW and endorsed by the Minister for Environment

Code	Category
P1	**Priority One – Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	**Priority Four – Rare, Near Threatened and other species in need of monitoring** a. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

2.2.2 Biosecurity and Agriculture Management Act 2007

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment and community. Biosecurity is managed under the BAM Act which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth. Each organism listed under the Bam Act comes with certain legal / import requirements:

- Declared Pest, Prohibited - s12. Prohibited organisms are declared pests by virtue of section 22(1), and may only be imported and kept subject to permits.
- Permitted - s11. Permitted organisms may be subject to an import permit if they are potential carriers of high-risk organisms.
- Declared Pest - s22(2). Declared pests may be subject to an import permit if they are potential carriers of high-risk organisms, and may also be subject to control and keeping requirements once within Western Australia.
- Permitted, Requires Permit - r73. Regulation 73 permitted organisms may only be imported subject to an import permit.

Declared pests can be assigned to a C1, C2 or C3 control category under the Biosecurity and Agriculture Management Regulations 2013:

- C1 Exclusion - Organisms which should be excluded from part or all of Western Australia.
- C2 Eradication - Organisms which should be eradicated from part or all of Western Australia.
- C3 Management - Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
- Unassigned - Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the BAM Act.

2.2.3 Communities of Local, Regional and National Significance

Significant flora and vegetation units need to take into account a number of other features other than statutory listings in accordance with the Flora and Vegetation Environmental Factor Guideline (EPA, 2016a). These include the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- A role as a refuge
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

3.0 Existing Environment

3.1 Climate

The Survey Area is situated in southwest WA which has a Mediterranean type climate. A Mediterranean climate is characterised by warm to hot dry summers and mild to cool wet winters. The Mediterranean climate in Australia is a result of the Indian Ocean High, a high pressure cell that shifts towards the poles in summer and the equator in winter, playing a major role in the formation of the deserts of Western Australia. Precipitation occurs during winter months, with the possibility of some summer storms.

The nearest Bureau of Meteorology (BoM) weather station is Wagerup Refinery (Station ID 009538) located 7 km south of the Survey Area. Rainfall in the months leading up to both the January and June 2019 surveys were lower than the mean (Figure 2). The variation in rainfall in the months preceding the survey is not considered to have affected the survey results.

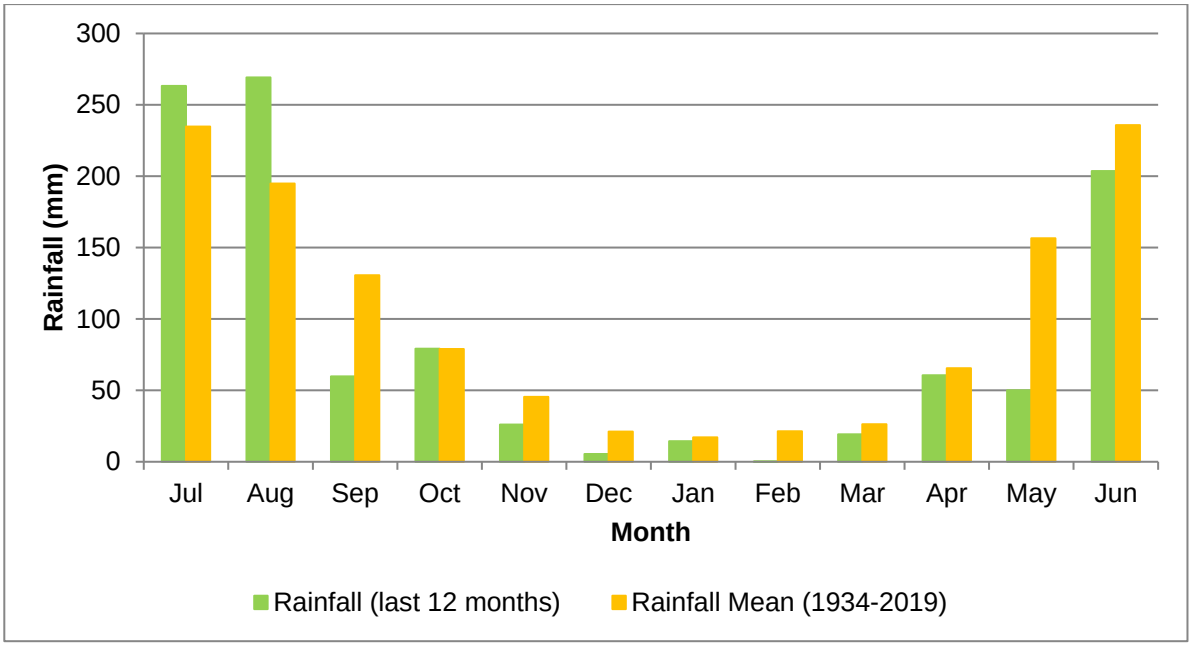


Figure 2 Rainfall recorded at the Wagerup Refinery (Station 009538)

3.2 IBRA Region

The Swan Coastal Plain bioregion, described in CALM (2002), includes Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age (Gibson et al 1994). A complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands are included in the bioregion. Younger sandy areas and limestone are dominated by heath and/or tuart woodlands, while *Banksia* and jarrah-*Banksia* woodlands are found on the older dune systems. The outwash plains at the foot of the Darling Escarpment were once dominated by *Casuarina obesa*-marri woodlands and Melaleuca shrublands. Extensive clearing has occurred on the Swan Coastal Plain for urban and agricultural development. The region is divided into the Dandaragan Plateau and the Swan Coastal Plain subregions.

The Swan Coastal Plain subregion, described by Mitchell et al. (2002), is a low-lying coastal plain covered with woodlands dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottnest, Carnac and Garden Islands. Land use is predominantly cultivation, Conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of rare and threatened species and ecological communities.

3.3 Soils and Geology

Purdie *et al*. (2004) broadly mapped two land systems within the Survey Area:

- Bassendean System (212Bs) - sand dunes and sandplains with pale deep sand, semi-wet and wet soil. This covers most of the Survey Area.
- Pinjarra System (213Pj) - Poorly drained coastal plain with variable alluvial and aeolian soils. This system presents the alluvial plain of the Harvey River located along the southern margin of the Survey Area, as well as a small depression in the north eastern corner of the Survey Area.

Land systems in the Survey Area can be broken down further into nine sub-systems that form a mosaic of sandplains, low dunes and depressions with varying drainage (In some places depressions may create poorly defined streams. Where the Pinjarra System is present, clays and duplex soils are more prevalent. These form a defined channel and banks at the Harvey River.

3.4 Vegetation

Pre-European vegetation mapping has been undertaken by Beard (1974). This mapping shows one vegetation association within the Survey Area, described as Association 1000 Low forest or woodland. Mosaic: medium forest; Jarrah-Marri / low woodland; *Banksia* / Low forest; Teatree (*Melaleuca* spp.).

Heddle *et al.* (1980) conducted vegetation complex mapping for the Swan Coastal Plain at a scale of 1:250,000. The mapping shows three vegetation types (Table 6) including Serpentine River, Cannington and Southern River complex.

Table 6 Vegetation complex mapping in the Survey Area completed by Heddle *et al.* (1980)

Landform Unit	Complex	Description
Pinjarra Plain	35 Serpentine River Complex	Closed scrub of Melaleuca species and fringing woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) along streams.
Combination Bassendean Dunes and Pinjarra Plain	40 Cannington Complex	Mosaic of vegetation from adjacent vegetation complexes of Bassendean, Karrakatta, Southern River and Vasse.
	42 Southern River Complex	Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds.

4.0 Methods

The ecological assessment builds on work completed in January 2019. This section describes all the survey effort conducted to-date including the desktop review and the two field surveys.

4.1 Desktop Review

A detailed desktop review was undertaken to define the existing environment and identify potential matters of conservation significance to target during the field survey.

The desktop review was informed by publicly available government databases including Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Museum's NatureMap (115° 48' 11" E, 32° 53' 40" S) and EPBC Act Protected Matters Search Tool (PMST). A buffer distance of 10 km was used for database searches and is considered appropriate for detecting conservation significant species in the south west region of Western Australia.

The likelihood of occurrence was determined for all conservation significant species and communities identified, using categories outlined in Table 7.

Table 7 Categories of likelihood of occurrence for species and communities

Likelihood Category	Flora	Fauna	Communities
Likely to occur	Habitat is present in the Survey Area and the species has been recorded in close proximity to the Survey Area.	Survey Area is within the known distribution of the species, habitat is present in the Survey Area and the species has been recorded in close proximity to the Survey Area.	Known occurrences of the community in close proximity to the Survey Area. Vegetation within the known occurrence appears to be congruent with vegetation in the Survey Area based on aerial imagery. Geographic location is similar to the Survey Area.
May occur	Habitat may be present and/or the species has been recorded in close proximity to the Survey Area.	Survey Area is within the known distribution of the species, marginal habitat may be present and/or the species has been recorded in close proximity to the Survey Area.	Known occurrence of the community in the local area, and/or vegetation within known occurrence appears to be congruent with vegetation in the Survey Area based on aerial imagery. Geographic location is similar to the Survey Area.
Unlikely to occur	No suitable habitat is present and the species has not been recorded in close proximity to the Survey Area.	Survey Area is outside the known distribution for the species, or no suitable habitat is present and the species has not been recorded in close proximity to the Survey Area.	Known occurrence of the community in close proximity to the Survey Area however geographic location does not occur in Survey Area.

4.2 Field Survey

4.2.1 Preliminary Site Assessment

A preliminary site assessment was conducted on 31 January 2019 by Ecologists Jared Leigh and Laura Fisher. Patches of remnant native vegetation were characterised including vegetation association, condition, and potential for utilisation by significant fauna species. Desktop review results were verified including confirmation of the absence of significant flora species and vegetation communities. An inventory of fauna species observed was also compiled.

4.2.2 Reconnaissance Flora and Vegetation Assessment

The flora and vegetation assessment included collecting data from traverses in areas of remnant native vegetation. The survey was completed by Ecologists Floora de Wit and Laura Fisher on 20 June 2019.

Five traverses were completed in areas of remnant native vegetation. Traverses included walking through the patch on foot and recording patch characteristics including landform, flora species and community complexity, and evidence of disturbance, Traverses were considered suitable for capturing the floristic data for the Project as all patches were mostly devoid of native vegetation species. Quadrats was not considered an efficient method for capturing floristic data for this Project.

Each traverse was given a unique site number, and the following parameters recorded:

- date
- location (accuracy of 5 m)
- soil details (type, colour, moisture)
- landform
- vegetation condition using the Keighery (1994) scale and description of disturbance
- fire history
- species list
    - estimated height
    - estimated percentage cover (for trees both percentage within quadrat and within community was recorded to enable better description of vegetation community).

4.2.3 Targeted Black Cockatoo Survey

A targeted Black Cockatoo survey was conducted to identify potential breeding, roosting and foraging habitat for the three threatened Black Cockatoo species that are likely to occur in the Survey Area. These are Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under the EPBC Act and under the WC Act), the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (Vulnerable under the EPBC Act and under the WC Act) and Baudin's Cockatoo *Calyptorhynchus baudinii* (Endangered under the EPBC Act and under the WC Act). The survey was conducted on 20 June 2019 in accordance with DSEWPaC (2012) and DotEE (2017) by Ecologists Floora de Wit and Laura Fisher.

4.2.3.1 Breeding Habitat

The Black Cockatoo breeding habitat assessment focussed on quantifying breeding and potential breeding trees within the Survey Area. Table 8 defines breeding habitat and identifies those trees that Black Cockatoos will utilise as breeding trees, according to DSEWPaC (2012).

The following information was collected for all potential breeding trees with suitable hollows or a Diameter at Breast Height (DBH) >500 mm (*Eucalyptus wandoo* >300 mm). Details collected for each tree included:

- location
- tree species
- DBH
- number of potentially suitable hollows

- hollow details – including dimensions, height from ground, direction, type of hollow, evidence of use, etc.

Table 8 Potential breeding habitat trees for Black Cockatoo species

Habitat	Carnaby's Cockatoo	Forest Red-Tailed Black Cockatoo	Baudin's Cockatoo
Specific breeding habitat	Generally in woodland or forest, but also breeds in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of salmon gum *E. salmonophloia*, wandoo, tuart, jarrah *E. marginata*, flooded gum *E. rudis*, york gum *E. loxophleba subsp. loxophleba*, powderbark *E. accedens*, karri and marri.	Generally in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of marri, karri, wandoo, bullich *E. megacarpa*, blackbutt *E. patens*, tuart and jarrah.	Generally in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of karri *Eucalyptus diversicolor*, marri *Corymbia calophylla*, wandoo *E.wandoo* and tuart *E. gomphocephala*.
Definition of breeding habitat	'Breeding habitat' is defined in these referral guidelines as trees of species known to support breeding within the range of the species which either have a suitable nest hollow OR are of a suitable DBH to develop a nest hollow. For most tree species, suitable DBH is 500 mm. Note that *E. wandoo* is DBH >300 mm.		

4.2.3.2 Roosting Habitat

Table 9 defines the suitable trees that the three Western Australian Black Cockatoo species may utilise as roosting trees. Both white-tailed Black Cockatoo species roost in or near riparian environments or near other permanent water sources. The Forest Red-Tailed Black Cockatoo prefers the edges of forests for roosting (DSEWPaC, 2012). Potential roosting trees were searched for and assessed during the field survey.

Evidence of roosting usually involves large amounts of bird scat beneath a large, mature tree, with a significant amount of broken branches, twigs etc. on the ground. Roosting sites were searched for throughout the Survey Area.

Table 9 Suitable Roosting Trees for the Three Western Australian Threatened Black Cockatoo Species

Carnaby's Cockatoo	Forest Red-Tailed Black Cockatoo	Baudin's Cockatoo
Generally in or near riparian environments or natural and artificial permanent water sources. Flat-topped yate *E. occidentalis*, salmon gum, wandoo, marri, karri, blackbutt, tuart, introduced eucalypts (for example blue gum) and introduced pines.	Tall jarrah, marri, blackbutt, tuart and introduced eucalypt trees within or on the edges of forests.	Generally in or near riparian environments or other permanent water sources. Jarrah, marri, flooded gum, blackbutt *E. patens*, tuart, and introduced eucalypts including blue gum *E. globulus*, and lemon scented gum *Corymbia citriodora*.

Source: DSEWPaC (2012).

4.2.3.3 Foraging Habitat

The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of breeding and potential breeding trees, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DotEE (2017) to produce a draft quality of foraging habitat scoring system, which has been slightly amended by AECOM (Table 12). This scoring system was utilised to

assess potential foraging habitat for Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo throughout the Survey Area.

The scoring tool is used by initially defining the quality of the overall habitat present (i.e. Very High Quality, High Quality, Quality and Low Quality) and then adding or subtracting points from this depending on the ecological values of the habitat (i.e. proximity to water, proximity to a known roost site, evidence of foraging material etc.). This determines an overall quantitative rating. Table 10 defines the levels of foraging habitat quality used during the assessment.

Table 11 defines the foraging and common food items for the three Western Australian Black Cockatoo species.

Table 10 Black Cockatoo Foraging Assessment Scoring

Score	Foraging Quality
1 – 3	Low Quality
4 – 6	Quality
7 – 8	High Quality
>8	Very High Quality

Table 11 Foraging and Common Food Items for Black Cockatoo Species

Species	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo	Baudin's Cockatoo
Foraging	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp. Forages in pine plantations (*Pinus* spp.), eucalypt woodland and forest that contains foraging species. Also individual trees and small stands of these species.	Jarrah and marri woodlands and forest, and edges of karri forests including wandoo and blackbutt, within the range of the subspecies.	Eucalypt woodlands and forest, and proteaceous woodland and heath. During the breeding season feed primarily on native vegetation, particularly marri. Outside the breeding season, may feed in fruit orchards (mostly apple and pear, but also persimmon) and tips of *Pinus* spp.
Foraging: common food items	Seeds, flowers and nectar of native proteaceous plant species (for example, *Banksia* spp., *Hakea* spp., *Dryandra* spp, and *Grevillea* spp), eucalypts and Callistemon. Also seeds of introduced species including *Pinus* spp., *Erodium* spp., wild radish, canola, almonds and pecan nuts; insects and insect larvae; occasionally flesh and juice of apples and persimmons.	Mostly seeds of marri and jarrah, also *Eucalyptus caesia*, *illyarrie E. erythrocorys* and some introduced eucalypts such as river red gum *E. camaldulensis* and flooded gum *E. grandis*, *Allocasuarina* cones, fruits of snottygobble *Persoonia longifolia* and mountain marri *Corymbia haematoxylon*. On the Swan Coastal Plain, often feed on introduced cape lilac *Melia azedarach*.	Mostly marri (seeds, flowers, nectar and grubs) and proteaceous trees and shrubs. Also other native seeds and introduced fruits; insects and insect larvae; pith of kangaroo paw *Anigozanthos flavidus*; juice of ripe persimmons; tips of *Pinus* spp. And seeds of apples and pears.

Source: DSEWPaC (2012).

Table 12 Quality of Foraging Habitat Assessment Tool

Initial Score	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo	Baudin's Cockatoo
10	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing
7	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species (e.g. *Banksia* sp., *Hakea* sp. and *Grevillea* sp.) as well as eucalypt (not mallee) woodland and forest that is dominated by foraging species. Does not include orchards, canola, or areas under a RFA	Jarrah and Marri woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies. Does not include areas under a RFA	Eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri. Does not include orchards or areas under RFA
5	Pine plantation, mallee eucalypts, introduced eucalypts and /or native vegetation with foraging species that are not dominant	Introduced eucalypts, introduced Cape lilac (*Melia acedarach*) and /or native vegetation with foraging species that are not dominant	Pine plantation or introduced eucalypts
1	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)
Additions: Context adjustor – attributes improving habitat quality			
+3	Is within the Swan Coastal Plain	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)	Is within the known foraging area
+3	Contains trees known to be used for breeding and / or with suitable nest hollows	Contains trees known to be used for breeding and / or with suitable nest hollows	Contains trees known to be used for breeding
+2	Primarily comprises Marri	Primarily contains Marri and / or Jarrah	Primarily contains marri
+2	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo)		
+1	Known to be a large or key roosting site		
Subtractions: Context adjustor – attributes reducing habitat quality			
-2	Does not contain evidence of foraging by species		
-2	No other foraging habitat within 6 km		
-1	Is >12km from known roosting site		
-1	Is >12 km from known breeding location		
-1	Is >2 km from watering point		
-1	Disease present (e.g. *Phytophthora cinnamomi* or Marri canker)		

Source: DotEE (2017) – amended by AECOM

4.3 Assumptions and Limitations

Limitations are inherent with any ecological assessment. The limitations associated with the ecological assessment are outlined in Table 13. The limitation assessment scale ranges from “not”, “minor”, “moderate”, “significant”.

Table 13 Limitations of the assessment

Limitation	Assessment
Availability of contextual information on the region	**Not a limitation** Sufficient contextual information is available on the Swan Coastal Plain.
Competency/experience of consultant conducting survey	**Not a limitation** Jared is an ecologist with over 15 years’ experience in the environmental industry who has conducted fauna surveys in a range of bioregions within Western Australia. Floora is an ecologist with over 10 years’ experience conducting surveys of similar scope. Laura is an ecologist with over two years’ experience in the environmental industry conducting surveys of similar scope.
Scope (i.e. what life forms were sampled)	**Minor limitation** All areas of potential foraging habitat were inspected and every potential breeding tree within the Survey Area was assessed for suitability. Due to size of some trees, vision of the entire tree was not always possible when looking for hollows, and in this case the precautionary principle was utilised.
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Minor Limitation** Floristic data was collected from all patches of native vegetation within the Survey Area. No direct or indirect evidence of the three Black Cockatoos were recorded during the survey. Potential Baudin’s Cockatoo *Calyptorhynchus baudinii* foraging evidence was recorded under a Marri tree in the January 2019 survey on a selection of Marri nuts. This cannot be confirmed with confidence due to the similarities of Baudin’s foraging markings comparative to other bird species. Fauna habitat mapping was conducted at a broad-scale. Mapping was conducted using hand-held computer (Samsung tablet) units and aerial photo interpretation. The accuracy of the mapping is subject to the accuracy of the unit and access to satellite information (generally < 6 metres). As such, these points should not be relied on for detailed design purposes. Floristic data was collected out of the defined ‘ideal survey season’. Additional spring surveys are unlikely to identify additional significant environmental values that were not able to be detected during the January and June survey events.
Sources of information	**Minor limitation** DBCA database, Naturemap, EPBC Act PMST, DoEE (2017) and DSEWPaC (2012) were utilised to inform the surveys.
Completeness (was relevant area fully surveyed)	**Not a limitation** The objectives of the surveys were met. Only areas included in the Survey Area were surveyed to assess their environmental values. If the areas of native vegetation outside the Survey Area require clearing an additional survey will be required.

Limitation	Assessment
Remoteness and/or access problems	**Minor limitation** The majority of the Survey Area was traversed on-ground and was accessible. One isolated patch in the northwest corner of the Survey Area was isolated from the main paddock by a hand-made drain which was full of water at the time of the June 2019 survey. Black Cockatoo assessments were conducted from the edge and are considered an adequate representation of the patch.
Timing, weather, season, cycle	**Not a limitation** The Survey Area is within the modelled distribution of all three Black Cockatoo species. The survey was completed outside the regular flowering season for species on the Swan Coastal Plain. However, due to the degradation of the site, an in-season survey is not expected to identify any other significant environmental=.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Not a limitation** The surveys were not disrupted or impacted.
Intensity (was the intensity adequate)	**Not a limitation** The Survey Area was assessed over two days which enabled sufficient time to assess each patch of remnant vegetation and record all potential Black Cockatoo breeding habitat trees.
Resources (degree of expertise available in identification)	**Not a limitation** The resources (time, equipment and expertise) were sufficient for the surveys. All surveyors have sufficient experience in the environmental industry and conducting relevant surveys.

5.0 Desktop Review Results

The PMST identified a number of Matters of National Environmental Significance (MNES) that may occur, or for which suitable habitat may occur within the Survey Area. Results of the PMST search as requested on 25 January 2019 are summarised in Table 14.

Table 14 Summary of PMST Results

MNES	Number of occurrences
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance (Ramsar Sites)	Peel-Yalgorup system, within 10 km of Ramsar
Listed Threatened Ecological Communities and Threatened Species	Two Threatened Ecological Communities: - *Banksia* Woodlands of the Swan Coastal Plain (EPBC: Endangered) - Clay Pans of the Swan Coastal Plain (EPBC: Critically Endangered) 24 listed threatened species including: - 12 listed fauna species - 12 listed flora species
Migratory Species	10 migratory species
Commonwealth Marine Areas	None

5.1 Threatened and Priority Ecological Communities

Two Threatened Ecological Communities (TECs) listed under the EPBC Act were identified in the desktop review, including the Banksia Woodlands of the Swan Coastal Plain (Banksia Woodlands TEC) and the Clay Pans of the Swan Coastal Plain.

The Banksia Woodlands TEC is listed as Endangered under the EPBC Act and relates to three State-listed TECs, and eight Priority Ecological Communities (PECs).

The Banksia Woodlands TEC incorporates woodland of Banksia species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of WA on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands.

The Clay Pans of the Swan Coastal Plain is listed as Critically Endangered under the EPBC Act. The Clay Pans TEC occurs where clay soils form an impermeable layer close to the surface with wetlands forming as a result of rainfall to fill them in winter, drying out to impervious pans in summer (DSEWPaC, 2012). Floristic composition is generally a shrubland over geophytes, herbs and sedges with no specific dominant species common across all occurrences.

The Clay Pans TEC corresponds to four ecological community types in WA including:

- Herb rich saline shrublands in clay pans (FCT07) – Vulnerable
- Herb rich shrublands in clay pans (FCT08) – Vulnerable
- Dense shrublands on clay flats (FCT09) – Vulnerable
- Shrublands on dry clay flats (FCT10a) – Endangered.

5.2 Conservation Significant Flora

A total of 39 Threatened and Priority flora species were identified during the desktop review as potentially occurring within the Survey Area. These include 26 species listed as Priority flora and 13 species listed under the WC Act and EPBC Act.

A review of habitat and spatial data determined that eight species are likely to within the Survey Area (Table 15). After reviewing the habitat present within the Survey Area following the site inspection, the likelihood of these species has been downgraded to 'may occur' or 'unlikely to occur' as no suitable habitat was present. All eight of these species are Threatened flora, listed under the EPBC Act and WC Act. Flora species considered likely to occur within the Survey Area are detailed in Appendix A including their conservation status and habitat.

Table 15 Threatened and Priority flora species that are 'likely to occur' or 'may occur' within the Survey Area

Taxon	State WC Act / DBCA	Federal EPBC Act	Likelihood of Occurrence	Post-Survey Likelihood
Andersonia gracilis	Vulnerable	Endangered	Likely to occur	Unlikely to occur
Diuris micrantha	Vulnerable	Vulnerable	Likely to occur	May occur
Diuris purdiei	Endangered	Endangered	Likely to occur	Unlikely to occur
Drakaea elastica	Critically Endangered	Endangered	Likely to occur	Unlikely to occur
Drakaea micrantha	Endangered	Vulnerable	Likely to occur	Unlikely to occur
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Critically Endangered	Likely to occur	Unlikely to occur
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Endangered	Endangered	Likely to occur	Unlikely to occur
Synaphea stenoloba	Critically Endangered	Endangered	Likely to occur	Unlikely to occur

5.3 Conservation Significant Fauna

The desktop review identified 26 conservation significant fauna species that could potentially occur within the Survey Area. The likelihood of occurrence of fauna species was determined by assessing the likely presence of suitable habitat in the Survey Area and reviewing the recent records and distribution of the species (Appendix B). The desktop assessment determined that:

- three species are 'likely to occur'
- 13 species 'may occur'
- ten species are 'unlikely to occur'.

After reviewing the habitat present within the Survey Area following the site inspection, the likelihood of these species has been amended, generally due to minimal or poor quality habitat being present. The revised assessment determined that:

- three species are 'likely to occur'
- seven species 'may occur'
- 16 species are 'unlikely to occur'.

Table 16 documents the ten threatened fauna species that 'may occur' or are 'likely to occur' within the Survey Area.

Table 16 Conservation significant fauna species considered as 'likely to occur' or 'may occur' within the Survey Area

Species	State WC Act / DBCA	Federal EPBC Act
Calidris ferruginea Curlew Sandpiper	Critically Endangered	Migratory
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	Vulnerable	Vulnerable
Calyptorhynchus baudinii Baudin's Cockatoo	Endangered	Vulnerable
Calyptorhynchus latirostris Carnaby's Cockatoo	Endangered	Endangered
Falco peregrinus Peregrine Falcon	Other specially protected fauna	-
Plegadis falcinellus Glossy Ibis	Migratory	Migratory
Tringa nebularia Common greenshank	Migratory	Migratory
Notamacropus Irma Western Brush Wallaby	Priority 4	-
Phascogale tapoatafa subsp. *wambenger* South-western Brush-tailed Phascogale	Species of special conservation interest	Vulnerable
Pseudocheirus occidentalis Western Ringtail Possum	Critically Endangered	Critically Endangered

6.0 Field Survey

6.1 Vegetation

6.1.1 Threatened and Priority Ecological Communities

No TECs or PECs were recorded in the Survey Area.

The Banksia Woodlands TEC was considered during the field survey. None of the patches of remnant native vegetation met the key diagnostic criteria that defines this TEC as outlined in the conservation advice. Furthermore, the significant degradation of vegetation confirms that vegetation is not representative of the Banksia Woodlands TEC.

The Clay Pans TEC incorporates a shrubland over species rich layer of geophytes, herbs and sedges. The degraded condition of the wetlands within the Survey Area has reduced vegetation to common pasture weeds and some native herbs and sedges. The continued eroding processes would consider the area unsuitable for representing the Clay Pans TEC.

6.1.2 Vegetation Communities

Six native vegetation communities were mapped within the Survey Area extending 18.98 ha which represents 6.72% of the total Survey Area (Table 17; Figure 3).

Tree death was prominent throughout all areas of native vegetation. Understorey was predominantly absent with some evidence of regrowth of herbs once inundated areas dried up.

Table 17 Vegetation types mapped within the Survey Area

Code	Description	Details
Cc	*Corymbia calophylla* medium open woodland over pasture weeds and grasses.	Survey effort: N/A. Survey Area: 5.72 ha Condition: Completely Degraded
CcApAc	*Corymbia calophylla* and *Banksia ilicifolia* low to mid open woodland with *Acacia pulchella* low sparse shrubland over *A*rctotheca calendula and *Hypochaeris glabra* low closed forbland.	Survey effort: one traverse (Waroona 02). Survey Area: 1.87 ha. Condition: Completely Degraded – Degraded
CcJp	*Corymbia calophylla* and *Melaleuca rhaphiophylla* tall open trees over *Juncus preissianus and Xanthorrhea preissii* low closed mixed sedge and shrubland.	Survey effort: one traverse (Waroona 05). Survey Area: 1.54 ha Condition: Completely Degraded – Degraded
EmKgAc	*Eucalyptus marginata* and *Banksia ilicifolia* low to mid open woodland with *Kunzea glabrescens and Acacia pulchella low* sparse shrubland over *Arctotheca calendula, *Ehrharta sp. and *Romula rosea* low closed mixed forb and grassland.	Survey effort: one traverse (Waroona 03). Survey Area: 4.42 ha Condition: Completely Degraded – Degraded
Mr	*Melaleuca rhaphiophylla* low open woodland over pasture weeds and grasses.	Survey effort: one traverse (Waroona 01). Survey Area: 3.55 ha Condition: Completely Degraded
MrJp	*Melaleuca rhaphiophylla* low open woodland with *Juncus preissianus* and *Solanum nigrun* low sparse shrubland over *Arctotheca calendula, ?Xanthosia huegelii,* and *Oxalis pes-caprae* low closed forbland.	Survey effort: one traverse (Waroona 04). Survey Area: 1.86 ha Condition: Degraded
Paddock	Cleared paddock comprising common pasture weeds.	Survey Area: 257.5 ha

Code	Description	Details
		Condition: Cleared

6.1.3 Condition

Vegetation condition was mapped as Completely Degraded to Degraded.

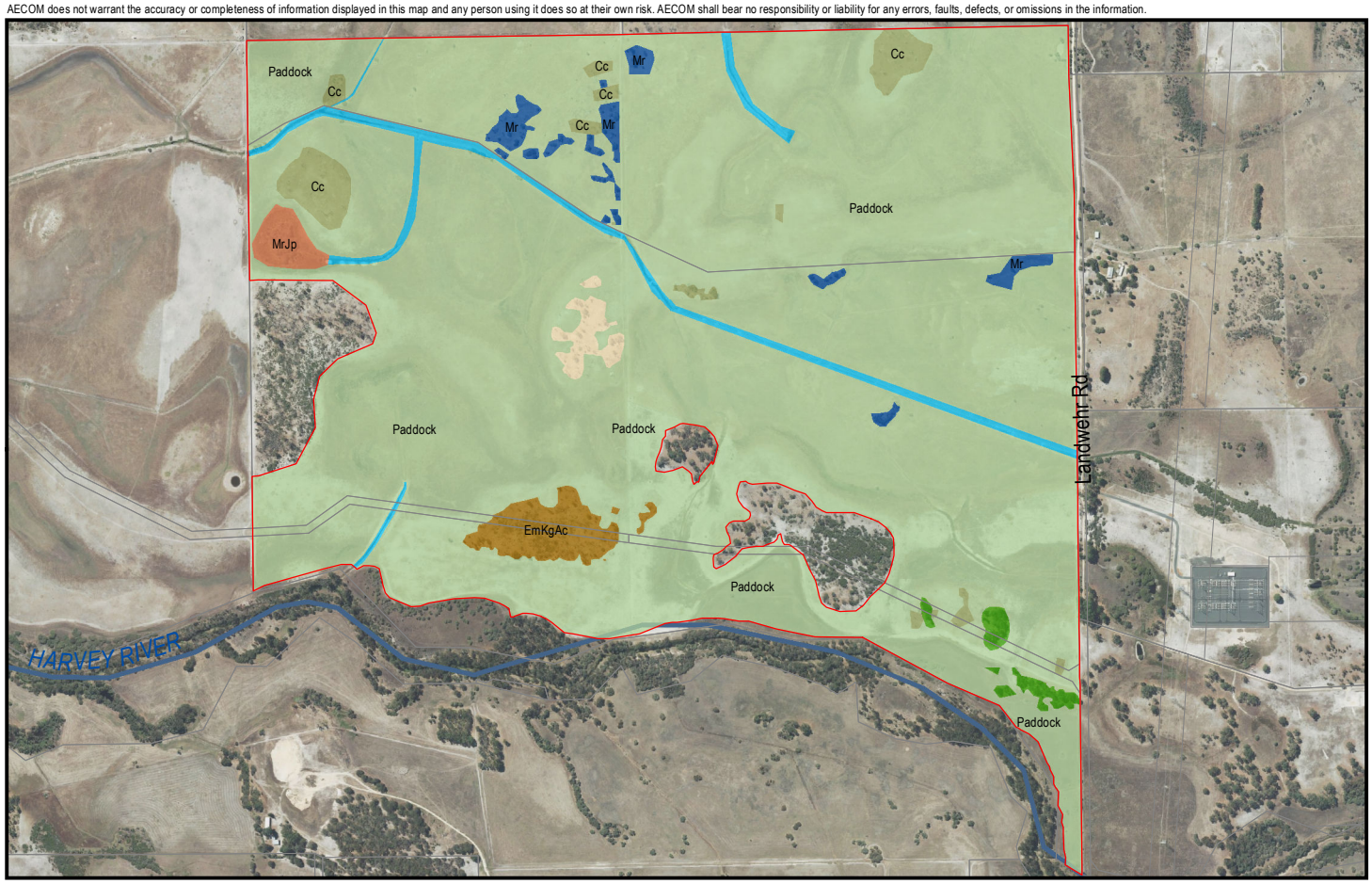
The condition reflects the current land use of agriculture. Areas of remnant native vegetation have not been fenced, therefore cattle grazing has contributed to the ongoing decline of vegetation condition.

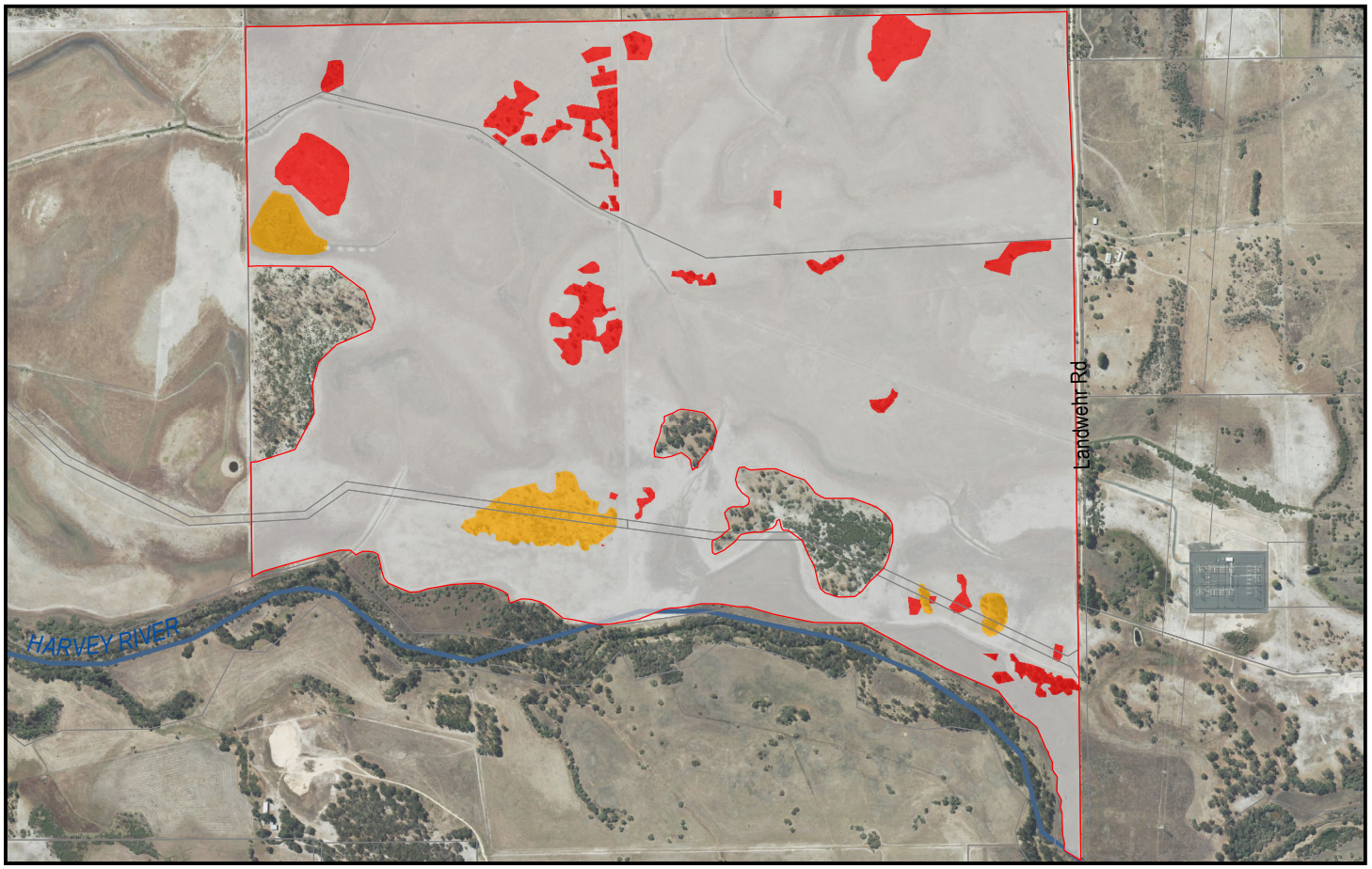
Altered hydrology may be affecting stands of trees, as noted by the numerous dead trees present. At this time we are unable exclude dieback as a contributing factor to vegetation decline.

The extent of the various vegetation condition categories mapped for the Survey Area present in Table 18 and Figure 3.

Table 18 Vegetation condition mapped in the Survey Area

Condition Scale	Survey Area (ha)
Cleared	263.8
Completely Degraded	12.13
Degraded	6.85





PROJECT ID 60605068
CREATED BY KW
APPROVED BY L.Fisher
LAST MODIFIED 30 JUL 2019

AECOM
www.aecom.com

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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 150 300 450 600
metres

1:17,500 when printed at A4

LEGEND

- Survey Area
- Cadastre

Vegetation Communities
- Cc
- CcApAc
- CcJp
- Drainage
- EmKgAc
- Mr
- MrJp
- Paddock

Vegetation Condition
- Completely Degraded
- Degraded
- Cleared

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Vegetation Communities and Condition

SOUTH ENERGY

WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure 3

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\05_EcologicalAssessmentUpdated\G60605068_Fig3_VegCommunitiesCondition.mxd (WyattK2)

A4 size

6.2 Fauna

6.2.1 Conservation Significant Fauna

Twenty-five vertebrate fauna species were recorded during the field survey. This comprised 18 bird, one reptile and six mammal species (Table 19). Of these, two were of conservation significance:

- Baudin's Cockatoo (*Calyptorhynchus latirostris*) - listed as Endangered under the EPBC Act and WC Act
- Tree Martin (*Petrochelidon nigricans*) - listed as Marine under the EPBC Act.

Species listed as Marine under the EPBC Act are only considered of conservation significance when recorded within Commonwealth Land. Given the Survey Area does not contain any Commonwealth land the Tree Martin is not considered conservation significant for the purposes of this Project and will not be discussed further.

Table 19 Fauna species recorded during the field survey

Species	Common Name	Status	Observation
Birds			
Anas superciliosa	Pacific Black Duck	Native	Flock of eight birds observed in drainage line to north of Survey Area
Artamus cinereus	Black-faced Woodswallow	Native	Several individuals observed around eucalypts to southeast of Survey Area
Aquila audax	Wedge-tailed Eagle	Native	Two birds observed flying over Survey Area
Barnardius zonarius semitorquatus	Australian Ring-neck Parrot	Native	Observed multiple times throughout Survey Area
Calyptorhynchus latirostris	Baudin's Cockatoo	Native	Possible foraging evidence recorded under Marri tree.
Coracina novaehollandiae	Black-faced Cuckooshrike	Native	One observed in mature eucalypt in paddock
Corvus coronoides	Australian Raven	Native	Heard and seen several times in Survey Area
Cracticus tibicen	Australian Magpie	Native	Common throughout Survey Area
Egretta novaehollandiae	White-faced Heron	Native	Observed flying over Survey Area
Eolophus roseicapilla	Pink and Grey Galah	Native	Two individuals observed in eucalypt
Gerygone fusca	Western Gerygone	Native	Heard in mixed eucalypt stand
Pachycephala rufiventris	Rufous Whistler	Native	Heard in riverine habitat
Pardalotus striatus	Striated Pardalote	Native	Heard in mature trees towards east of Survey Area
Pelecanus conspicillatus	Australian Pelican	Native	Two birds observed flying over Survey Area
Purpureicephalus spurius	Red-capped Parrot	Native	Probably foraging evidence observed beneath Marri to east of Survey Area
Petrochelidon nigricans	Tree Martin	Native	Observed several times throughout Survey Area
Rhipidura albiscapa	Grey Fantail	Native	Observed several times in trees within paddock

Species	Common Name	Status	Observation
Rhipidura leucophrys	Willie Wagtail	Native	Observed several times within native vegetation in and around paddock
Mammals			
Bos taurus	Domestic Cattle	Introduced	Scat and prints observed throughout Survey Area
Macropus fuliginosus	Western Grey Kangaroo	Native	Commonly observed in paddocks
Canis lupis	Feral Dog	Introduced	Tracks observed along tracks to east of Survey Area
Oryctolagus cuniculus	European Wild Rabbit	Introduced	Scat and digging observed in stand of mixed eucalypts
Sus scrofa	Feral Pig	Introduced	Diggings observed adjacent river to southeast of Survey Area
Vuples vulpes	European Red Fox	Introduced	Scat observed several times through Survey Area and one individual observed towards east of Survey Area
Reptiles			
Varanus gouldii	Sand Goanna	Native	Observed under eucalypt

Five introduced fauna species were recorded during the field survey. The species and their legal status under the BAM Act are listed below:

- Domestic Cattle (*Bos taurus*) – Permitted s11
- Feral Dog (*Canis lupis*) - Declared Pest – s22(2) (C3 Exempt)
- European Wild Rabbit (*Oryctolagus cuniculus*) (Feral) – Declared Pest – s22(2)
- Feral Pig (*Sus scrofa*) – Declared Pest – s22(2)
- European Red Fox (*Vulpes vulpes*) - Declared Pest - s22(2) (C3 Exempt).

Refer to Section 2.2.2 for explanations of BAM Act categories.

6.2.2 Fauna Habitats

Four broadly defined fauna habitats were mapped within the Survey Area. These comprise:

- Paddock with Scattered Trees and Drainage Areas: 235.04 ha
- Riparian Vegetation, Dams and Drainage: 31.32 ha
- Mixed Trees: 10.81 ha
- Stags: 5.31 ha

Table 20 describes these four fauna habitats and discusses the conservation significant fauna species that may potentially utilise these habitats, or aspects of these habitats.

Table 20 Broadscale Fauna Habitats of the Survey Area

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Photo
Paddock with Scattered Trees and Drainage Areas Extent: 235.04 ha	This habitat is predominantly cleared paddocks with scattered individual or clumps of large mature eucalypts (and other vegetation). It also contains multiple drainage lines and lower lying drainage areas of varying size. Some of the large eucalypts contain hollows and may provide significant fauna habitat. These trees may be classified as Black Cockatoo breeding and potential breeding trees, and it is recommended that they are avoided where possible.	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise the mature eucalypts for foraging, roosting and / or breeding habitat • Mammals including the South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*) and Western Ringtail Possum (*Pseudocheirus occidentalis*) may utilise the mature eucalypts and *Agonis flexuosa* • Western Brush Wallaby (*Notamacropus Irma)* may utilise the habitat • Waterbird species may also utilise aspects of this habitat when damp or flooded.	   
Riparian Vegetation, Dams and Drainage	This fauna habitat contains riparian vegetation, the dams and drainage lines. The riverine habitat contains mature Flooded	• Mammals including the Western Brush Wallaby (*Notamacropus Irma)* may utilise the riverine habitat • Waterbird species may also utilise aspects of this habitat.	

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Photo
Extent: 31.32 ha	Gums and Paperbarks, with a generally degraded understorey (weeds and feral animals [e.g. Feral Pigs]). Note that only the more significant drainage lines through the paddocks are identified and there are multiple other drainage lines / areas in the paddocks. The area of this habitat to the southeast area of the Survey Area directly north of the river appears to be a flood plain with cracking clays.		

Fauna Habitat	Description	Conservation Significant Species Potentially Utilising Habitat	Photo
Stags Extent: 5.31 ha	These are areas of mostly mature dead trees (stags) with no understorey.	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise these stags as breeding habitat.	
Mixed Trees Extent: 10.81 ha	This habitat predominantly comprises stands of mature eucalypts (*Eucalyptus marginata and Corymbia calophylla*) over a degraded and mostly cleared understorey. Proteaceous species and *Agonis flexuosa* was observed in several stands. These areas generally contain light grey sandy soils.	• Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) may utilise the mature eucalypts and proteaceous species within this habitat for foraging, roosting and / or breeding habitat • Mammals including the South-western Brush-tailed Phascogale (*Phascogale tapoatafa subsp. wambenger*), Western Ringtail Possum (*Pseudocheirus occidentalis*), and Western Brush Wallaby (*Notamacropus Irma)* may utilise this habitat depending on understorey and species present.	 

6.2.3 Conservation Significant Fauna Species

Based on the desktop assessment and the field survey, Carnaby's Cockatoo (*Calyptorhynchus latirostris),* Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)* and Baudin's Cockatoo *(Calyptorhynchus baudinii)* are considered to have the potential to utilise habitats within the Survey Area. Breeding and foraging habitat is present.

Marginal, generally poor quality and highly modified habitat also exists for the following species:

- Peregrine Falcon (*Falco peregrinus*) may utilise the larger eucalypts
- Western Brush Wallaby (*Notamacropus Irma*) which may utilise the areas of mixed trees and adjacent paddocks
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*) and the Western Ringtail Possum (*Pseudocheirus occidentalis*) which may utilise the areas of mixed trees, though these are generally smaller patches that are very isolated and of poor quality.
- wetland bird species including the Glossy Ibis *(Plegadis falcinellus),* Curlew Sandpiper (*Calidris ferruginea),* Common Greenshank *(Tringa nebularia),* Some of these species may utilise the poor quality drainage and wetland habitats, and areas within the paddocks which are highly modified but likely to flood over winter.

6.3 Black Cockatoos

6.3.1 Breeding and Potential Breeding Trees

The Survey Area contains 201 potential Black Cockatoo breeding trees of suitable DBH, of which 22 contain hollows potentially suitable for use by Black Cockatoos. Refer to Table 21 and Figure 4 for the details of the 22 trees including their location, species, height, DBH and number of suitable hollows.

A comprehensive list of all potential Black Cockatoo breeding trees is provided in Appendix C.

Table 21 Trees with potentially suitable Black Cockatoo hollows within the Survey Area

ID	Longitude	Latitude	Species	Height (m)	DBH (cm)	Number of suitable hollows
5	115.4829	-32.5310	Stag	15	124	1
19	115.4844	-32.5420	Stag	16	85	1
34	115.4839	-32.5356	Stag	18	83	1
42	115.4836	-32.5355	Stag	8	92	1
56	115.4732	-32.5319	Stag	15	97	2
63	115.4758	-32.5350	Stag	25	180	2
75	115.4755	-32.5351	Jarrah (*Eucalyptus marginata*)	22	128	1
79	115.4752	-32.5351	Stag	30	113	1
87	115.4759	-32.5335	Stag	15	124	1
91	115.4759	-32.5337	Stag	18	101	2
92	115.4759	-32.5336	Stag	10	113	1
97	115.4830	-32.5335	Stag	15	125	1
112	115.4829	-32.5314	Stag	24	76	2
114	115.4810	-32.5330	Stag	25	66	1
118	115.4890	-32.5330	Stag	12	98	1
141	1151.4835	-32.5357	Stag	30	222	3
152	115.4732	-32.5322	Stag	15	108	3

ID	Longitude	Latitude	Species	Height (m)	DBH (cm)	Number of suitable hollows
158	115.4759	-32.5346	Stag	8	105	1
170	115.4759	-32.5350	Stag	18	110	1
177	115.4810	-32.5350	Stag	10	87	3
190	115.4759	-32.5331	Stag	15	105	1
197	115.4810	-32.5329	Marri (*Corymbia calophylla)*	25	102	1

6.3.2 Roosting Trees

No roosting trees were identified within the Survey Area.

6.3.3 Foraging Habitat

Black Cockatoo foraging habitat predominantly comprises isolated patches of Marri trees within paddocks. Significant dead trees were recorded in these patches and this has reduced the foraging quality of several patches.

The Survey Area contains Carnaby's Cockatoo (*Calyptorhynchus latirostris)* foraging habitat (Figure 5), comprising:

- 1.80 ha of High Quality foraging habitat
- 2.59 ha of Quality foraging habitat.

No Carnaby's Cockatoo foraging evidence was recorded in the Survey Area however evidence has been recorded nearby.

The Survey Area contains Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* foraging habitat (Figure 5), comprising:

- 3.75 ha of Quality foraging habitat
- 0.64 ha of Low Quality foraging habitat.

No Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* foraging evidence was recorded in the Survey Area.

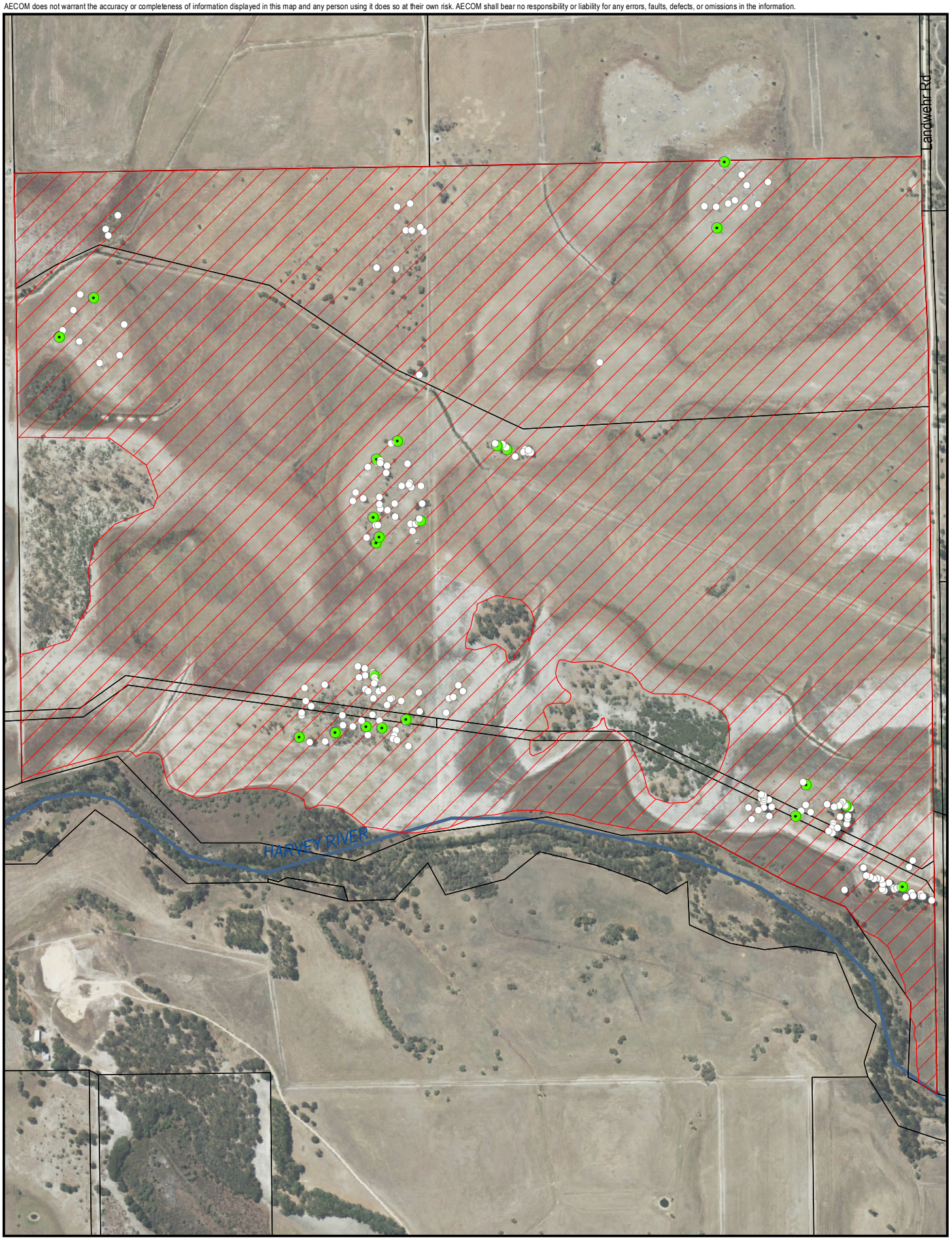
The Survey Area contains Baudin's Cockatoo (*Calyptorhynchus baudinii)* foraging habitat (Figure 5), comprising:

- 1.80 ha of High Quality foraging habitat
- 2.59 ha of Quality foraging habitat.

Potential foraging evidence of the Endangered Baudin's Cockatoo (*Calyptorhynchus latirostris*) was recorded under a Marri tree in the January 2019 survey (Plate 1).

Refer to Appendix D for the foraging quality assessments.

Plate 1 Possible Baudin's Cockatoo foraging evidence



PROJECT ID 60605068
CREATED BY KW
APPROVED BY L.Fisher
LAST MODIFIED 11 JUL 2019

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DATUM GDA 1994, PROJECTION MGA ZONE 50

0 100 200 300 400
metres

1:11,000 when printed at A4

LEGEND

- Survey Area
- Cadastre

Black Cockatoo Breeding Trees

- Hollows
- No Hollows

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Potential Black Cockatoo Breeding Trees

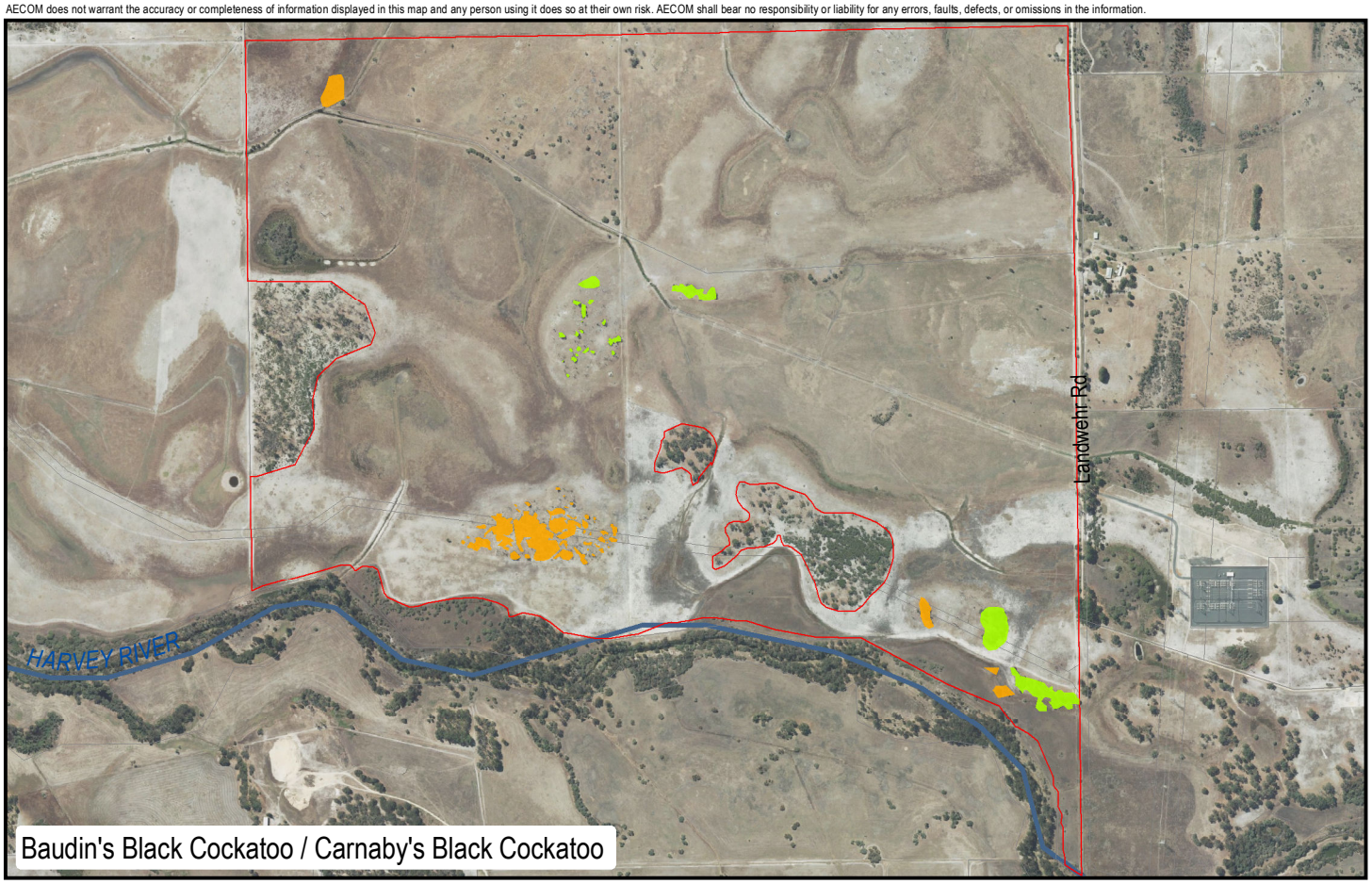
SOUTH ENERGY

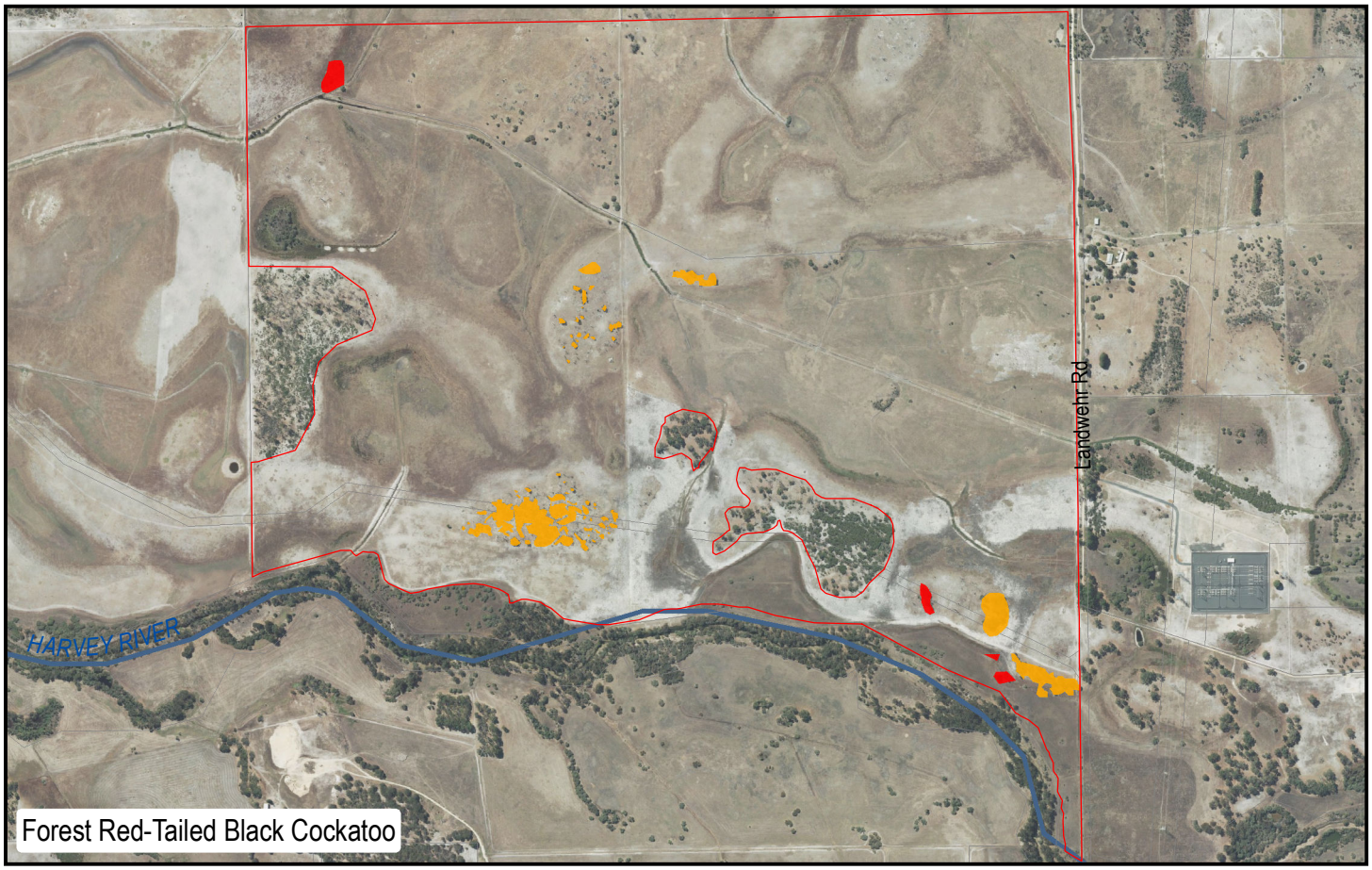
WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure 4

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\04_EcologicalAssessment\G60605068_Fig4_PotentialBlackCockatooBreedingTrees.mxd (wyattk2)

A4 size





PROJECT ID 60605068
CREATED BY KW
APPROVED BY J.Leigh
LAST MODIFIED 30 JUL 2019

AECOM
www.aecom.com

N

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 150 300 450 600
metres

1:17,500 when printed at A4

LEGEND

Black Cockatoo Foraging Quality
- High Quality
- Quality
- Low Quality

- Survey Area
- Cadastre

Data sources:

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Black Cockatoo Foraging Habitat

SOUTH ENERGY

WAROONA SOLAR FARM - ECOLOGICAL ASSESSMENT

Figure 5

Map Document: G:\GIS_Projects\WaroonaSolarFarm\02_MXDs\05_EcologicalAssessmentUpdated\G60605068_Fig5_BlackCockatooForagingHabitat.mxd (WyattK2)

A4 size

7.0 Conclusion

7.1 Summary

An ecological assessment was undertaken for the Waroona Solar Farm Project by two AECOM Ecologists. The ecological survey identified the following environmental values:

- Eight significant flora species were considered likely to occur in the Survey Area. The likelihood of these species was downgraded to 'may occur' or 'unlikely to occur' following the site inspection as no suitable habitat was present.
- A total of 18.98 ha of remnant native vegetation was mapped, varying in condition between Completely Degraded to Degraded. None of this vegetation represented a TEC or PEC.
- 22 trees containing potentially suitable breeding hollows for Black Cockatoos, with a further 179 potential breeding trees (with a suitable DBH and no potentially suitable hollows).
- A total of 4.39 ha of High Quality and Quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo, and a total of 4.39 ha of Quality and Low Quality foraging habitat for the Forest Red-tailed Black Cockatoo.
- The potential presence of seven other threatened fauna species (apart from the three Black Cockatoo species), though habitat for these species is generally limited, of poor quality and highly modified.

A constraint for the Project is the presence of foraging and breeding habitat for the three Western Australian Threatened Black Cockatoo species. This is discussed further in Section 7.2.

The survey effort for the Project is considered suitable for assessing the environmental values of the Survey Area.

7.2 Recommendations

It is recommended that South Energy retain native vegetation, Quality and High Quality Black Cockatoo foraging habitat and Black Cockatoo breeding and potential breeding trees where possible. Areas supporting both hollow bearing Black Cockatoo breeding trees and good quality Black Cockatoo foraging habitat should be prioritised. These generally include vegetation communities CcApAc, EmKgAc and CcJp (refer to Figure 3), which also aid in local flood mitigation of the Harvey River.

Clearing of more than one hectare of Quality (and above) Black Cockatoo foraging habitat, or any breeding habitat, has the potential to require a referral under the EPBC Act. We would recommend refining the Project footprint to minimise potential impacts to these areas, and / or hold a pre-referral meeting with the DoEE to confirm the requirement for a referral under the EPBC Act.

Planting areas onsite with Black Cockatoo foraging habitat and erecting Black Cockatoo nesting boxes are options for offsetting the clearing of Black Cockatoo breeding and foraging habitat. An initial assessment has determined that at least eight hectares of land is potentially available and suitable for planting of foraging species. This area is likely to be an underestimation depending on the ability to plant near infrastructure. An additional approximately seven hectares could potentially be planted with foraging species, but further investigation would be required to assess the suitability of this land due to its probable flooding and heavy clay nature. Flora species recommended to plant for Black Cockatoo foraging habitat would include *Banksia sessilis, B. ilicifolia, Allocasuarina fraseriana*, *Corymbia calophylla* and *Eucalyptus marginata,* as well as most locally endemic proteaceous species.

Clearing of native vegetation in Western Australia can also require a Native Vegetation Clearing Permit under Part V of the EP Act. This may need to be obtained prior to the clearing of the native vegetation in the Survey Area.

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Appendix A

Flora Desktop Results

Appendix A Flora Desktop Results

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Andersonia gracilis	VU	EN	PMST	*Andersonia gracilis* is currently known from the Badgingarra, Dandaragan and Kenwick areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus, Verticordia densiflora* and *Kunzea recurva* over sedges.	Likely to occur	Unlikely to occur
Acacia flagelliformis	P4		Naturemap	Sandy soils. Winter-wet areas.	May occur	May occur
Acacia semitrullata	P4		Naturemap	White / grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	May occur	May occur
Aponogeton hexatepalus	P4		Naturemap	Mud. Freshwater: ponds, rivers, claypans.	Unlikely to occur	Unlikely to occur
Blennospora doliiformis	P3		Naturemap	Grey or red clay soils over ironstone. Seasonally-wet flats.	Unlikely to occur	Unlikely to occur
Boronia capitata subsp. gracilis	P3		Naturemap	White / grey or black sand. Winter-wet swamps, hillslopes.	May occur	May occur
Caladenia huegelii	CR	EN	PMST	*Caladenia huegelii* is found on the Swan Coastal Plain within 20 km of the coast; from just north of Perth to the Busselton area over a distance of over 250 km. Throughout its range the species tends to favour areas of thick undergrowth. Soil is usually deep grey-white sand associated with the Bassendean sand-dune system. However, rare plants have been known to extend into the Spearwood system (in which calcareous yellow sands dominate) in some areas.	Unlikely to occur	Unlikely to occur
Caladenia speciosa	P4		Naturemap	White, grey or black sand.	May occur	May occur
Carex tereticaulis	P3		Naturemap	Black peaty sand.	Unlikely to occur	Unlikely to occur
Chamaescilla gibsonii	P3		Naturemap	Winter-wet flats, shallow water-filled claypans.	May occur	May occur

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Chamelaucium sp. Gingin (N.G.Marchant 6)	VU	EN	PMST	*Chamelaucium* sp. Gingin is endemic to Western Australia and is confined to the Gingin / Chittering area, where it is known from a range of only 3 km. There are six populations of this species which are highly fragmented. The species occurs on white/yellow sand supporting open low woodland with *Eucalyptus todtiana, Banksia attenuata* and Hibbertia sp.	Unlikely to occur	Unlikely to occur
Conostylis pauciflora subsp. pauciflora	P4		Naturemap	Grey sand, limestone. Hillslopes, consolidated dunes.	Unlikely to occur	Unlikely to occur
Diuris micrantha	VU	VU	Naturemap / PMST	*Diuris micrantha* is found from east of Kwinana and south towards the Frankland area. The species is known from seven populations and is found on dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps.	Likely to occur	May occur
Diuris purdiei	EN	EN	Naturemap	*Diuris purdiei* occurs from the south of Perth to near the Whicher Range. It grows in sand to sandy clay soils in areas subject to winter inundation, amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana, Eucalyptus calophylla, E. marginate and Nuytsia floribunda*.	Likely to occur	Unlikely to occur
Drakaea elastica	CE	EN	Naturemap	*Drakaea elastica* occurs on the Swan Coastal Plain over a range of 350 km from Cataby in the north to Busselton in the south. The species is known from 42 populations and occurs on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in *banksia* woodland or spearwood thicket vegetation.	Likely to occur	Unlikely to occur
Drakaea micrantha	EN	VU	Naturemap	The Dwarf Hammer-orchid is known from 32 populations that occur from Perth to Albany. The species is usually found in cleared fire breaks or open sandy patches that have been disturbed. The species occurs in infertile grey sands in *Banksia*, Jarrah and Common Sheoak woodland or forest.	Likely to occur	Unlikely to occur
Eleocharis keigheryi	VU	VU	PMST	*Eleocharis keigheryi* is known from 15 populations that occur between north of Eneabba and south-east to Qualeup. The species grows in clay or sandy loam, emergent in freshwater creeks and claypans.	May occur	May occur
Eucalyptus x balanites	CE	EN	PMST	*Eucalyptus balanites* is known from two populations, separated by 210 km. These two populations occur in Badgingarra National Park and City of Armadale. The species grows on light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands, open mallee woosland over shrubland or heathland with emergent mallees.	Unlikely to occur	Unlikely to occur

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Galium leptogonium	P3		Naturemap	No information available.	May occur	
Gastrolobium sp. Harvey (G.J. Keighery 16821)	P2		Naturemap	Black peaty sandy clay, brown sandy clay. Winter-wet flats, margins of billabongs.	May occur	Unlikely to occur
Haloragis aculeolata	P2		Naturemap	Black sand or clay over limestone. Winter-wet flats.	May occur	Unlikely to occur
Haloragis scoparia	P1		Naturemap	There is no information available for this species.	May occur	
Hemigenia microphylla	P3		Naturemap	Sandy clay, peaty clay, granite. Winter-wet depressions.	May occur	
Hibbertia spicata subsp. leptotheca	P3		Naturemap	Near-coastal limestone ridges, outcrops and cliffs.	Unlikely to occur	Unlikely to occur
Platysace filiformis	P3		Naturemap	Frequently on lateritic gravelly soils. Often in moist areas.	May occur	Unlikely to occur
Platysace ramosissima	P3		Naturemap	Sandy soils.	May occur	
Pterostylis frenchii	P2		Naturemap	Calcareous sand with limestone, laterite. Faltlands and gentle slopes.	May occur	Unlikely to occur
Schoenus natans	P4		Naturemap	Winter-wet depressions.	May occur	
Schoenus sp. Waroona (G.J. Keighery 12235)	P3		Naturemap	Clay or sandy clay. Winter-wet flats.	May occur	
Sphaerolobium calcicola	P3		Naturemap	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Unlikely to occur	Unlikely to occur
Stylidium longitubum	P4		Naturemap	Sandy clay, clay. Seasonal wetlands.	May occur	
Stylidium trudgenii	P3		Naturemap	Margins of winter-wet swamps, depressions.	May occur	
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CE	CE	PMST	*Synaphea* sp. Fairbridge Farm (D. Papenfus 696) is known from five populations that occur from Serpentine to Dardanup, south of Perth. The species grows in grey, clayey sand with lateritic pebbles in low woodland areas near winter flats.	Likely to occur	Unlikely to occur

Taxon	State WC Act / DBCA	Federal EPBC Act	Source	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
Synaphea odocoileops	P1		Naturemap	Brown-orange loam and sandy clay, granite. Swamps, winter-wet areas.	May occur	May occur
Synaphea sp. Pinjarra Plain (A.S. George 17182)	EN	EN	PMST	*Synaphea* sp. Pinjarra Plain (A.S. George 17182) is known from 12 populations in six locations occurring from Mundijong to West Coolup over a range of 54 km. The species grows on flat terrain on grey-brown sandy loams or heavier brown clay-sand overlain by laterite pebbles. The species occurs more often on boundaries of seasonal wetlands, in soils with moderate drainage.	Likely to occur	Unlikely to occur
Synaphea sp. Serpentine (G.R. Brand 103)	CE	CE	PMST	*Synaphea* sp. Serpentine (G.R. Brand 103) is known from six populations that occur from Byford to Serpentine over a range of 18 km. The species grows predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas.	May occur	May occur
Synaphea stenoloba	CE	EN	Naturemap / PMST	*Synaphea stenoloba* is known from 11 subpopulations that occur from south of Perth, from Pinjarra to Boyanup. The species grows in loamy soils in low lying areas that are occasionally inundated. Associated vegetation is generally swampy heath to 1 m high with scattered emergent *Nuytsia floribunda.*	Likely to occur	Unlikely to occur
Triglochin trichophora	P4		Naturemap	Sand, limestone. Swamps.	May occur	May occur
Tripterococcus sp. Brachylobus (A.S. George 14234)	P4		Naturemap	No information available.	May occur	May occur

Appendix B

Potentially Occurring Fauna Species

Appendix B Fauna Species that may occur in the Survey Area

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Birds							
Botaurus poiciloptilus Australasian Bittern	+		Endangered	EN	The Australasian Bittern is a large thick-necked bird, growing to a length of 66 to 76 cm. The Australasian Bittern occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. There are currently two known sub-populations including the south-eastern and the south-western sub-populations. It's preferred habitat is comprised of wetlands with tall dense vegetation where it forages in still, shallow water up to 0.3 m deep, edges of pools or waterways, or from platforms or mats of vegetation over deep water. Freshwater habitats dominated by sedges, rushes and reeds are preferred.	May occur	Unlikely to occur
Calidris canutus Red Knot	+		Endangered (Marine)	VU	The Red Knot is a widely distributed marine and migratory species. It is common In the north-west of Western Australia with populations in the tens of thousands recorded at 80-mile Beach, not far from the study area (Bamford et al. 2008). The species mainly inhabits intertidal mudflats, sand flats, in estuaries, bays and lagoons. They are occasionally seen on inland salt lakes and wetlands but hardly every use freshwater swamps.	Unlikely to occur	Unlikely to occur
Calidris ferruginea Curlew Sandpiper	+		Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	CE	The Curlew Sandpiper is a small, slim weighing 57 g. In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. In Western Australia, they are widespread around coastal and sub coastal plains from Cape Arid to the south-west Kimberley.	May occur	May occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Calidris ruficollis Red-necked Stint		+	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	The Red-necked Stint is the smallest wader in Australia and is distributed along most of the Australian coastline, with the greatest densities in Victoria and Tasmania. The nearest internationally important site for the species is the Alfred Cove Nature Reserve on the Swan River (DotE, 2015).	May occur	Unlikely to occur
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	+	+	Vulnerable	VU	The Forest red-tailed Black Cockatoo requires tree hollows of Karri (*E. diversicolor*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) forests to nest and breed. Flocks move out onto the Swan Coastal Plain in search of food from exotic trees such as the White Cedar (Johnstone et al, 2010). The foraging habitat for the species consists of Jarrah and Marri woodlands and forest within its range.	Likely to occur	Likely to occur
Calyptorhynchus baudinii Baudin's Cockatoo	+	+	Vulnerable	EN	Habitat critical to the survival of this species includes forests of Karri (*E. diversicolor*), Jarrah (E. *marginata*) and Marri (*C. calophylla*), in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well and west to the Eastern Strip of the Swan Coastal Plain including West Midland in the north, heading south through Armadale, Byford and continues south and towards the coast until Lake Clifton where it continues to hug the coastline to east of Albany (Johnstone *et al,* 2010).	Likely to occur	Likely to occur
Calyptorhynchus latirostris Carnaby's Cockatoo	+	+	Endangered	EN	Carnaby's Cockatoo is a postnuptial nomad and typically moves west soon after breeding. The species nests in hollows of smooth-barked eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*E. Wandoo)* but is not limited to these eucalypts. Diet consists of an array of Proteaceous and Eucalypt species prevalent on the Swan Coastal Plain. Foraging habitat, including *banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone *et al.,* 2010).	Likely to occur	Likely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Falco peregrinus Peregrine Falcon		+		S	A well-known falcon, the Peregrine inhabits a vast array of environs in Australia. Usually uncommon and migratory (Pizzey & Knight, 2007). This species lays its eggs in recesses of cliff faces, tree hollows or large abandoned nests (Bamford, 2008).	May occur	May occur
Leipoa ocellata Malleefowl	+		Vulnerable	VU	Mallefowl is found in semi-arid to arid shrublands and low woodlands of Australia's interior, particularly areas dominated by mallee trees and/or *Acacia* shrubs. The species is highly sensitive to grazing by sheep and other herbivores, and altered fire regimes (Benshemesh, 2007).	Unlikely to occur	Unlikely to occur
Numenius madagascariensis Eastern Curlew	+		Critically Endangered (Marine)	VU	The Eastern Curlew is Australia's largest shorebird and a long-haul flyer. It is easily recognisable, with its long, down-curved bill. It takes an annual migratory flight to Russia and north-eastern China to breed, arriving back home to Australia in August to feed on crabs and molluscs in intertidal mudflats. (DotEE, 2019).	May occur	Unlikely to occur
Oxyura australis Blue-billed Duck		+		P4	The Blue-billed Duck is endemic to south eastern and south western Australia. It prefers deep water in large permanent wetlands and swamps with aquatic vegetation. This species of duck is fully aquatic and rarely comes onto land (OEH, 2015).	Unlikely to occur	Unlikely to occur
Plegadis falcinellus Glossy Ibis		+	Migratory & Marine (Bonn)	IA	The Glossy Ibis occupies well vegetated wetlands, wet pastures, floodwaters, brackish wetlands and mudflats. This species is a non-breeding visitor to south-west Western Australia (Pizzey & Knight, 2007).	May occur	May occur
Rostratula australis Australian Painted-snipe	+		Endangered (Marine)	EN	The Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DotE, 2015) This species is a very rare summer visitor to the south-west of Western Australia. Breeding habitat in Western Australia is not quite known however a nest located near Moora was located in a tussock beside a swamp (Johnstone & Storr, 1998).	Unlikely to occur	Unlikely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Thinornis rubricollis Hooded Plover		+		P4	The Hooded Plover is a medium-sized sandy-brown plover. It has a black head and a white nape, and the black hindneck collar extends around and forks onto the breast. West of the Nullarbor Plain, Hooded Plovers are also often recorded on ocean beaches, but they are just as likely to be seen foraging at salt lakes, sometimes hundreds of kilometres from the coast (http://birdlife.org.au/bird-profile/hooded-plover, accessed Nov 2018).	Unlikely to occur	Unlikely to occur
Tringa nebularia May		+	Migratory & Marine (Bonn, CAMBA, JAMBA, ROKAMBA)	IA	The Common Greenshank is a largely built wader, weighing up to 190 g for both sexes. The species is found in inland wetlands and sheltered coastal habitats (DotEE, 2018).	May occur	May occur
Mammals							
Dasyurus geoffroii Chuditch, Western Quoll	+	+	Vulnerable	VU	Following European settlement, the range of this species contracted dramatically, from much of the continent to a small area in the south west. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008). Most records are found in the contiguous Jarrah forests of the south west of Western Australia (DotEE, 2018).	Unlikely to occur	Unlikely to occur
Hydromys chrysogaster Water-rat		+		P4	The Water Rat is one of the few Australian mammals adapted to the aquatic environment. It has a streamlined body and broad, partially webbed hind feet. The species occurs in the vicinity of permanent bodies of fresh or brackish water. Dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan, 2008).	May occur	Unlikely to occur
Isoodon fusciventer Quenda		+		P4	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).	May occur	Unlikely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Notamacropus Irma Western Brush Wallaby		+		P4	The Western Brush-wallaby occurs in the south-west of Western Australia. Its preferred habitat consists of open sclerophyll forest or woodland and favours open flats over scrub thickets. It is also found in larger areas of mallee and heathland in the wheat belt and is uncommon in wet sclerophyll forest (Van Dyck & Strahan, 2008).	May occur	May occur
Phascogale tapoatafa subsp. *wambenger* South-western Brush-tailed Phascogale		+	Vulnerable	CD	In the south-west, the Brush-tailed Phascogale has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees. Records are less common in high rainfall areas (DBCA, 2012).	May occur	May occur
Pseudocheirus occidentalis Western Ringtail Possum	+	+	Critically Endangered	CE	This species is restricted to the south-west corner of Western Australia. Closer to the coast it is closely associated with Peppermint (*Agonis flexuosa*) forest and woodland and Tuart (*Eucalyptus gomphocephala*) with a peppermint mid-story. Further from the coast the species is found in Jarrah (*Eucalyptus marginata*), Wandoo (*Eucalyptus wandoo*) and Marri (*Corymbia calophylla*) forest (Van Dyck & Strahan, 2008).	May occur	May occur
Other							
Ctenotus ora Coastal Plains Skink		+		P3	The Coastal Plains Skink is restricted to the dunes of the Swan Coastal Plain in heath in sandy soil. The species has a preference for sandy substrates with low vegetation with open eucalyptus woodland over *banksia*. It is known to occur as far north as Pinjarra and south as far as Yallingup Brook, where it occupies coastal dunes (Kay & Keogh, 2012).	Unlikely to occur	Unlikely to occur
Falsistrellus mackenziei Western False Pipistrelle		+		P4	Western False Pipistrelles live mainly in wet sclerophyll forests of Karri, Jarrah and Tuart eucalypts. They roost in hollows in old trees, branches and stumps, in colonies of 5 to 30 bats (OEH, 2015).	Unlikely to occur	Unlikely to occur

Species	Source		Commonwealth *EPBC Act*	State *WC Act*	Habitat	Likelihood of Occurrence	Post-Survey Likelihood
	EPBC	DBCA					
Geotria Australia Pouched Lamprey		+		P3	Adults spawn in the headwaters of freshwater rivers and streams. When the larvae hatch, they drift downstream and burrow into soft muddy sediments. After metamorphosis the young adults migrate downstream to estuaries and coastal waters where they feed (Bray & Gomon, 2018).	Unlikely to occur	Unlikely to occur
Idiosoma nigrum Swan Coastal Plain Shield-backed trapdoor spider		+		P3	This species can be found in burrows of heavy clay soils in areas of open York Gum (*Eucalyptus loxophleba*), Salmon Gum (*E. salmonophloia*) and Wandoo *E. wandoo*) woodland, where Acacia acuminata forms a sparse understorey (Avon Catchment Council, 2007).	Unlikely to occur	Unlikely to occur
Westralunio carteri Carter's Freshwater Mussel	+		Vulnerable	VU	This bivalve species is the only mussel species known to inhabit freshwater systems of south-west Western Australia (Klunzinger *et al*., 2014).	May occur	Unlikely to occur

Appendix C

Potential Black Cockatoo Trees within the Survey Area

Appendix C Potential Black Cockatoo Trees within the Survey Area

Table 22 Potential Black Cockatoo breeding trees within the Survey Area

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
0	Stag	12	86	0	
1	Stag	18	88	0	
2	Stag	18	74	0	
3	Stag	14	106	0	
4	Stag	15	124	1	
5	Stag	8	138	0	
6	Stag	15	102	0	
7	Stag	17	64	0	
8	Marri (*Corymbia calophylla*)	18	66	0	
9	Stag	18	56	0	
10	Marri (*Corymbia calophylla*)	30	83	0	
11	Stag	16	64	0	
12	Stag	16	58	0	
13	Marri (*Corymbia calophylla*)	22	81	0	
14	Stag	5	146	0	
15	Marri (*Corymbia calophylla*)	30	102	0	
16	Marri (*Corymbia calophylla*)	20	55	0	
17	Marri (*Corymbia calophylla*)	35	69	0	
18	Stag	16	85	1	
19	Marri (*Corymbia calophylla*)	20	54	0	
20	Marri (*Corymbia calophylla*)	18	55	0	
21	Marri (*Corymbia calophylla*)	20	53	0	
22	Marri (*Corymbia calophylla*)	20	60	0	
23	Marri (*Corymbia calophylla*)	30	81	0	
24	Marri (*Corymbia calophylla*)	18	53	0	
25	Marri (*Corymbia calophylla*)	20	53	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
26	Marri (*Corymbia calophylla*)	30	101	0	
27	Marri (*Corymbia calophylla*)	18	64	0	
28	Marri (*Corymbia calophylla*)	20	75	0	
29	Marri (*Corymbia calophylla*)	25	71	0	
30	Marri (*Corymbia calophylla*)	25	81	0	
31	Marri (*Corymbia calophylla*)	22	62	0	
32	Marri (*Corymbia calophylla*)	20	57	0	
33	Stag	18	83	1	
34	Marri (*Corymbia calophylla*)	25	73	0	
35	Marri (*Corymbia calophylla*)	22	57	0	
36	Marri (*Corymbia calophylla*)	20	56	0	
37	Marri (*Corymbia calophylla*)	20	60	0	
38	Stag	20	54	0	
39	Marri (*Corymbia calophylla*)	25	97	0	
40	Stag	16	89	0	
41	Stag	8	92	1	
42	Stag	20	98	0	
43	Marri (*Corymbia calophylla*)	25	67	0	
44	Marri (*Corymbia calophylla*)	25	85	0	
45	Stag	8	103	0	
46	Marri (*Corymbia calophylla*)	30	76	0	
47	Stag	12	59	0	
48	Stag	20	96	0	
49	Marri (*Corymbia calophylla*)	20	77	0	
50	Stag	30	190	0	
51	Stag	20	136	0	
52	Stag	20	113	0	
53	Stag	30	105	0	
54	Stag	25	94	0	1 hollow too deep

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
55	Stag	15	97	2	
56	Jarrah (*Eucalyptus marginata*)	30	110	0	
57	Jarrah (*Eucalyptus marginata*)	8	89	0	
58	Stag	20	90	0	
59	Stag	6	81	0	1 hollow too shallow
60	Stag	5	89	0	
61	Jarrah (*Eucalyptus marginata*)	30	152	0	
62	Stag	25	180	2	1 additional hollow looks deep
63	Stag	10	146	0	
64	Stag	25	113	0	Bees, many small hollows
65	Stag	25	94	0	
66	Stag	17	62	0	
67	Stag	18	133	0	
68	Jarrah (*Eucalyptus marginata*)	20	85	0	
69	Stag	30	117	0	Hollow used by Gallahs and bees
70	Stag	20	53	0	
71	Stag	16	55	0	
72	Stag	20	102	0	
73	*Eucalyptus accedens*	8	88	0	
74	Jarrah (*Eucalyptus marginata*)	0	112	0	
75	Jarrah (*Eucalyptus marginata*)	22	128	1	1 hollow, looks deep
76	Jarrah (*Eucalyptus marginata*)	18	104	0	
77	Jarrah (*Eucalyptus marginata*)	20	116	0	
78	Stag	30	113	1	
79	Stag	18	112	0	
80	Stag	20	86	0	
81	Stag	18	73	0	
82	Jarrah (*Eucalyptus marginata*)	20	65	0	
83	Jarrah (*Eucalyptus marginata*)	18	72	0	
84	Stag	14	149	0	
85	Stag	16	111	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
86	Stag	15	124	1	
87	Jarrah (*Eucalyptus marginata*)	20	76	0	
88	Stag	25	83	0	
89	Stag	18	103	0	
90	Stag	18	101	2	
91	Stag	10	113	1	
92	Jarrah (*Eucalyptus marginata*)	12	110	0	
93	Stag	25	103	0	
94	Stag	8	130	0	
95	Stag	17	75	0	
96	Stag	15	125	1	
97	Marri (*Corymbia calophylla*)	18	62	0	
98	Marri (*Corymbia calophylla*)	18	62	0	
99	Stag	5	99	0	
100	Stag	13	52	0	
101	Stag	15	65	0	
102	Stag	12	60	0	
103	Stag	18	62	0	
104	Stag	16	75	0	
105	Stag	12	56	0	
106	Stag	14	68	0	
107	Stag	12	87	0	
108	Stag	16	80	0	
109	Stag	10	76	0	
110	Stag	24	100	0	
111	Stag	24	76	2	
112	Stag	15	67	0	
113	Stag	25	66	1	
114	Marri (*Corymbia calophylla*)	22	54	0	
115	Marri (*Corymbia calophylla*)	25	78	0	
116	Stag	20	85	0	
117	Stag	12	98	1	
118	Stag	10	73	0	
119	Stag	10	169	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
120	Marri (*Corymbia calophylla*)	25	73	0	
121	Marri (*Corymbia calophylla*)	26	90	0	
122	Marri (*Corymbia calophylla*)	24	83	0	
123	Marri (*Corymbia calophylla*)	22	63	0	
124	Stag	14	51	0	
125	Stag	15	54	0	
126	Stag	24	133	0	
127	Stag	15	105	0	
128	Marri (*Corymbia calophylla*)	22	61	0	
129	Marri (*Corymbia calophylla*)	22	171	0	
130	Marri (*Corymbia calophylla*)	24	68	0	
131	Stag	20	160	0	1 hollow used by bees
132	Stag	4	180	0	
133	Stag	18	146	0	
134	Marri (*Corymbia calophylla*)	25	99	0	
135	Marri (*Corymbia calophylla*)	25	73	0	
136	Marri (*Corymbia calophylla*)	20	57	0	
137	Stag	18	81	0	
138	Stag	14	86	0	
139	Stag	15	148	0	
140	Stag	30	222	3	
141	Stag	18	51	0	
142	Marri (*Corymbia calophylla*)	12	59	0	
143	Marri (*Corymbia calophylla*)	20	99	0	
144	Stag	7	60	0	
145	Stag	12	99	0	
146	Stag	30	86	0	Hollow used by bees
147	Stag	20	54	0	
148	Stag	18	66	0	
149	Stag	24	81	0	
150	Stag	6	67	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
151	Stag	15	108	3	
152	Stag	6	121	0	
153	Stag	20	143	0	
154	Stag	24	99	0	
155	Stag	20	85	0	2 hollows. Facing up on very burnt trunk. Can't assess. Unlikely to be suitable for BCs
156	Stag	6	67	0	
157	Stag	8	105	1	
158	Stag	14	57	0	
159	Stag	12	177	0	
160	Jarrah (*Eucalyptus marginata*)	24	61	0	
161	Stag	10	90	0	
162	Stag	14	113	0	
163	Stag	10	60	0	
164	Stag	16	71	0	
165	Stag	12	132	0	3 hollows. Used by bees. Unable to assess. Unlikely to be suitable for BCs.
166	Jarrah (*Eucalyptus marginata*)	12	51	0	
167	Stag	18	96	0	
168	Stag	8	97	0	
169	Stag	18	110	1	
170	Stag	12	59	0	
171	Stag	8	56	0	
172	Stag	8	99	0	
173	Jarrah (*Eucalyptus marginata*)	14	83	0	
174	Stag	14	62	0	
175	Stag	12	50	0	
176	Stag	10	87	3	
177	Jarrah (*Eucalyptus marginata*)	22	71	0	
178	Stag	18	98	0	
179	Stag	3	131	0	
180	Stag	10	108	0	
181	Stag	16	59	0	
182	Stag	8	104	0	

FID	Species	Tree Height	DBH	Suitable Hollows	Hollow Comments
183	Marri (*Corymbia calophylla*)	18	76	0	
184	Stag	14	165	0	
185	Marri (*Corymbia calophylla*)	24	98	0	
186	Stag	8	76	0	
187	Marri (*Corymbia calophylla*)	14	63.5	0	
188	Marri (*Corymbia calophylla*)	14	60	0	
189	Stag	15	105	1	
190	Stag	14	94	0	
191	Marri (*Corymbia calophylla*)	12	63	0	
192	Marri (*Corymbia calophylla*)	18	99	0	
193	Marri (*Corymbia calophylla*)	16	64	0	
194	Stag	16	74	0	
195	Stag	12	68	0	
196	Marri (*Corymbia calophylla*)	25	102	1	
197	Stag	14	62	0	
198	Marri (*Corymbia calophylla*)	0	0	0	unable to access paddock
199	Marri (*Corymbia calophylla*)	0	0	0	unable to access paddock
200	Marri (*Corymbia calophylla*)	0	0	0	unable to access paddock

Appendix D

Black Cockatoo Foraging Habitat

Appendix D Carnaby's Cockatoo Foraging Habitat

Table 23 Carnaby's Cockatoo foraging habitat

Initial score	Is within the Swan Coastal Plain? (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (+2)	Known to be large or key roosting site (+2)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is > 12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2km from watering point (-1)	Disease Present (-1)	Final Score	Comments
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality Cc (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality Cc (no hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcApAc (hollows)
1	3	3	0	2	0	-2	0	0	0	0	-1	6	Quality EmKgPo (hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcJp (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality CcJp (no hollows)

Appendix D Forest Red-tailed Black Cockatoo Foraging Habitat

Table 24 Forest Red-tail Black Cockatoo Foraging Habitat

Initial score	Jarrah and/or Marri shows good recruitment (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily Contains Marri / jarrah (+2)	Contains trees with potential to be used for breeding (+2)	Known to be large or key roosting site (+2)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is > 12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2km from watering point (-1)	Disease Present (-1)	Final Score	Comments
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Quality Cc (hollows)
1	0	0	2	2	0	-2	0	0	0	0	-1	2	Low Quality Cc (no hollows)
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Quality CcApAc (hollows)
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Low Quality EmKgPo (hollows)
1	0	3	2	2	0	-2	0	0	0	0	-1	5	Quality CcJp (hollows)
1	0	0	2	2	0	-2	0	0	0	0	-1	2	Low Quality CcJp (no hollows)

Appendix D Baudin's Cockatoo Foraging Habitat

Table 25 Baudin's Cockatoo Foraging Habitat

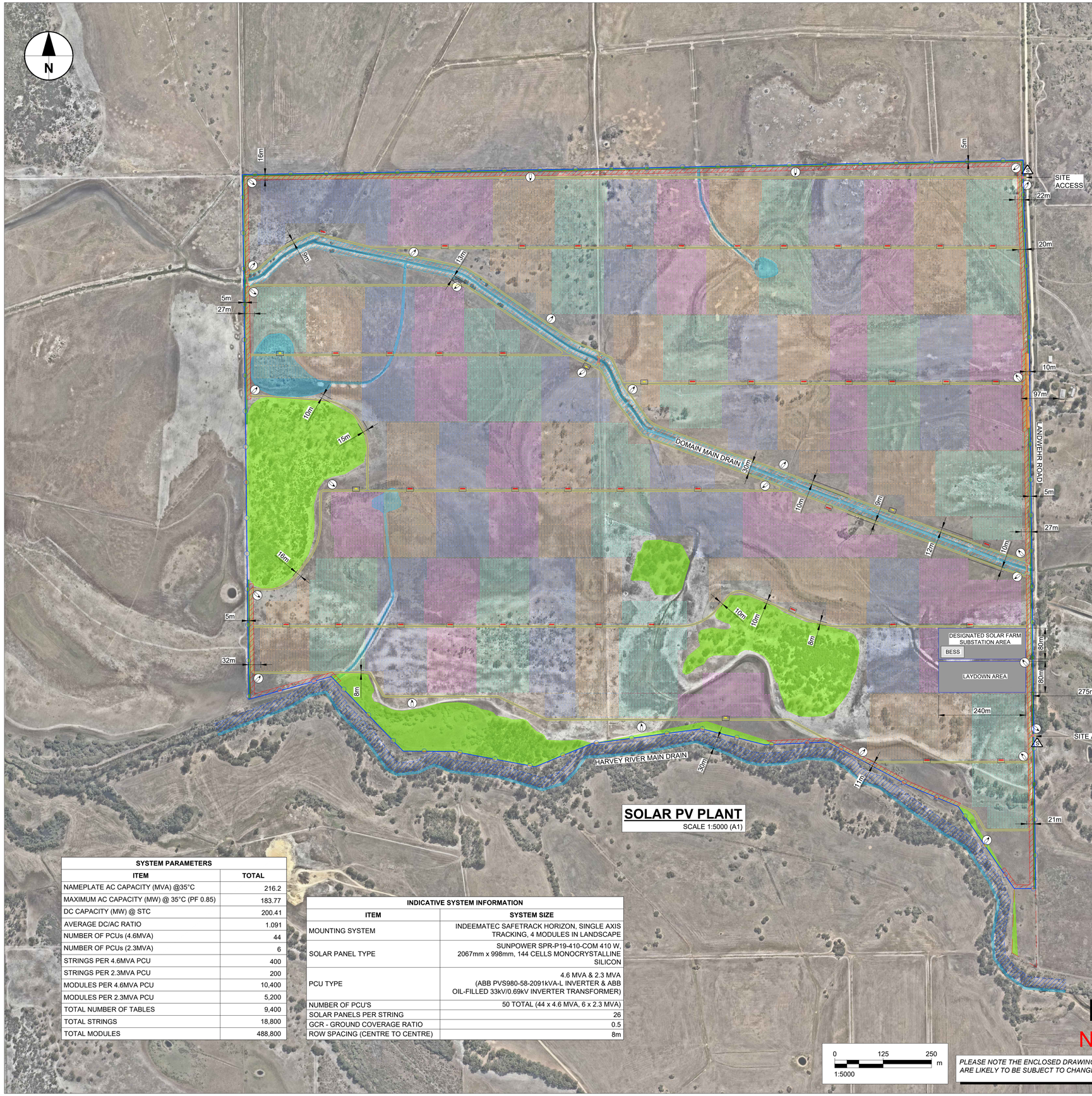
Initial score	Is within the known foraging area (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (+2)	Known to be large or key roosting site (+2)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is > 12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2km from watering point (-1)	Disease Present (-1)	Final Score	Comments
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality Cc (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality Cc (no hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcApAc (hollows)
1	3	3	0	2	0	-2	0	0	0	0	-1	6	Quality EmKgPo (hollows)
1	3	3	2	2	0	-2	0	0	0	0	-1	8	High Quality CcJp (hollows)
1	3	0	2	2	0	-2	0	0	0	0	-1	5	Quality CcJp (no hollows)

Appendix C

Concept Layout

Appendix C Concept Layout

Project Management Initials: Designer: J.C. Checked: C.O Approved: L.J ISO A1 594mm x 841mm



SOLAR PV PLANT

SCALE 1:5000 (A1)

0 125 250 m

1:5000

LEGEND

- SECURITY FENCE
- PROPERTY BOUNDARY
- 10m FIREBREAK ZONE FROM SECURITY FENCE
- MAIN ACCESS ROAD (4m WIDE)
- PROPOSED WATERWAY CROSSING
- 5m WIDE SCREEN PLANTING ZONE
- 10m WIDE SCREEN PLANTING ZONE
- NATIVE VEGETATION RETENTION AREA
- 15m WIDE WATERWAY CLEARANCE ZONE
- EXISTING WATER BODIES
- 30m WIDE RIVER CLEARANCE ZONE
- SINGLE AXIS TRACKING SOLAR ARRAY (NOTE 1)
- 4.6 MVA INVERTER & TRANSFORMER PCU
- 2.3 MVA INVERTER & TRANSFORMER PCU
- CCTV CAMERA
- SIGNAGE

NOTES:

1. COLOUR CODING OF SOLAR ARRAYS INDICATES THE SOLAR PANELS CONNECTED TO EACH PCU.
2. LOCATION OF PCUs TO BE CONFIRMED DURING DETAILED DESIGN.
3. PROPOSED ACCESS ROADS, PCU FOOTPRINT, LAYDOWN AREA, SITE ACCESS AND SUBSTATION & O&M FACILITY AREA ARE INDICATIVE ONLY.
4. ACCESS TRACK DESIGN TO BE UNDERTAKEN DURING THE DETAILED DESIGN PHASE. ACCESS TRACKS SHOWN ARE INDICATIVE ONLY.
5. A FOOTPRINT EQUIVALENT TO A 40FT CONTAINER HAS BEEN USED FOR THE INVERTER AND TRANSFORMER PCUs.
6. INTERNAL ACCESS ROADS ARE 4m WIDE.
7. SITE ENTRANCE GATES AND FENCING TO BE CONFIRMED DURING DETAILED DESIGN.
8. DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
9. SUBSTATION DIMENSIONS (240m x 80m) INCLUDE SOLAR FARM SUBSTATION EQUIPMENT, O&M FACILITY AND CONTROL ROOM.
10. SOLAR FARM SIGNAGE AS REQUIRED BY RELEVANT AUSTRALIAN STANDARDS AND LEGISLATION, AND TO MEET NETWORK OPERATOR'S OPERATIONAL REQUIREMENTS. APPLICABLE SIGNS TO BE INSTALLED AT ALL ENTRY POINTS AND EMERGENCY EXITS. PROPOSED SIGN LOCATIONS ARE INDICATIVE. ACTUAL SIGN LOCATION TO BE DETERMINED IN DETAILED DESIGN.
11. THE OFFSET AREAS ARE KEEP-OUT ZONES FOR TRACKER TABLES. ROADS AND FENCING ARE LOCATED WITHIN THESE OFFSET AREAS WHERE REQUIRED.
12. VEGETATION NOT IDENTIFIED WITHIN THE NATIVE VEGETATION RETENTION AREAS ON SITE TO BE REMOVED AND REBUILT WITHIN THE RETAINED ZONES (I.E. VEGETATION OFFSET).
13. ALL DAMS TO BE FILLED AND BUILT OVER.
14. SYSTEM PARAMETERS ARE CONCEPTUAL AND PRELIMINARY IN NATURE; THE PRESENTED QUANTITIES INCLUDE SEVERAL ASSUMPTIONS THAT MAY NOT REFLECT THE ACTUAL CONDITIONS OF THE SITE AND THE OPTIMAL CONFIGURATION OF THE SYSTEM.

SYSTEM PARAMETERS	
ITEM	TOTAL
NAMEPLATE AC CAPACITY (MVA) @35°C	216.2
MAXIMUM AC CAPACITY (MW) @ 35°C (PF 0.85)	183.77
DC CAPACITY (MW) @ STC	200.41
AVERAGE DC/AC RATIO	1.091
NUMBER OF PCUs (4.6MVA)	44
NUMBER OF PCUs (2.3MVA)	6
STRINGS PER 4.6MVA PCU	400
STRINGS PER 2.3MVA PCU	200
MODULES PER 4.6MVA PCU	10,400
MODULES PER 2.3MVA PCU	5,200
TOTAL NUMBER OF TABLES	9,400
TOTAL STRINGS	18,800
TOTAL MODULES	488,800

INDICATIVE SYSTEM INFORMATION	
ITEM	SYSTEM SIZE
MOUNTING SYSTEM	INDEEMATEC SAFETRACK HORIZON, SINGLE AXIS TRACKING, 4 MODULES IN LANDSCAPE
SOLAR PANEL TYPE	SUNPOWER SPR-P19-410-COM 410 W, 2067mm x 998mm, 144 CELLS MONOCRYSTALLINE SILICON
PCU TYPE	4.6 MVA & 2.3 MVA (ABB PVS980-58-2091kVA-L INVERTER & ABB OIL-FILLED 33kV/0.69kV INVERTER TRANSFORMER)
NUMBER OF PCU'S	50 TOTAL (44 x 4.6 MVA, 6 x 2.3 MVA)
SOLAR PANELS PER STRING	26
GCR - GROUND COVERAGE RATIO	0.5
ROW SPACING (CENTRE TO CENTRE)	8m

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR.

NOT FOR CONSTRUCTION

PLEASE NOTE THE ENCLOSED DRAWINGS ARE ONLY PRELIMINARY AND NOT FOR CONSTRUCTION, AND THEREFORE ARE LIKELY TO BE SUBJECT TO CHANGE.

AECOM

PROJECT

WAROONA SOLAR FARM CONCEPT DESIGN

WAROONA
Western Australia

CLIENT

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SOLAR FARM
CONCEPT LAYOUT

SHEET NUMBER

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