

# Appendix A – Ecological Assessment Reports for the Albemarle Kemerton Plant 2017

Eco Logical Australia 2017 c



## Kemerton Industrial Area Spring Flora and Fauna Survey

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Project Manager	Joel Collins (08) 9227 1070 Suites 1 and 2, 49 Ord Street West Perth WA 6005
Prepared by	Jeni Morris
Reviewed by	Lisa Adams, Joel Collins
Approved by	Lisa Adams
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# Abbreviations

Abbreviation	Description
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation
DotEE	Department of the Environment and Energy
ELA	Eco Logical Australia
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
GPS	Global Positioning System
ha	hectare
IBRA	Interim Biogeographical Regionalisation for Australia
km	kilometres
m	metre
mm	millimetres
PMST	Protected Matters Search Tool
S2V	S2V Consulting
TEC	Threatened Ecological Community
WA	Western Australia
WAH	Western Australia Herbarium
WAM	Western Australian Museum
WC Act	<i>Wildlife Conservation Act 1950 (State)</i>

# Executive summary

Eco Logical Australia was engaged by S2V Consulting to undertake a desktop review and a spring flora and fauna survey for a study area within Kemerton Industrial Area, Western Australia. The purpose of this work was to develop a stand-alone report collating existing biological data and information, supplemented with data recorded during the spring field survey.

Eco Logical Australia reviewed existing reports and data previously undertaken within the study area, and undertook a flora and fauna survey to verify and update findings of the desktop assessment where required. The site inspection was undertaken over two days from 4-5 September 2017.

The conservation significant flora species *Acacia semitrullata* (Priority 4), has been previously recorded within the study area with 59 individuals recorded in the western section of the study area during the field survey, and were confined almost entirely to the 'Xanthorrhoea open shrubland over Perennial Veldt Grass open grassland in previously cleared farmland'. This species occurs in remnant vegetation in Degraded condition.

Six vegetation communities have been previously recorded within the study area, as well as an area of pine plantation, and these were validated during the field survey. Of these vegetation communities, one is considered to represent the *Environmental Protection and Biodiversity Conservation Act 1999* listed 'Banksia Woodlands of the Swan Coastal Plain' Threatened Ecological Community. Previous studies have one vegetation community within the study area which closely resemble the Priority Ecological Community 'Low lying *Banksia attenuata* woodlands or shrublands' (Priority 3).

The condition of native vegetation within the study area ranges from Good to Completely Degraded. The most intact areas of native vegetation with the highest quality are in the southern portion of the study area, with a narrow section on the western side and a patch on the eastern side in Good condition. Remaining areas of the study area are in Degraded and Completely Degraded condition due to historical clearing and land uses (e.g. pine plantations, previously cleared farmland and grazing).

Foraging evidence of the *Wildlife Conservation Act 1950* Schedule 2 and *Environment Protection and Biodiversity Conservation Act 1999* Endangered species Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) was observed within the study area during the site inspection. The *Wildlife Conservation Act 1950* Schedule 3 and *Environment Protection and Biodiversity Conservation Act 1999* Vulnerable species Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) has also previously been recorded as occurring within the study area. A likelihood of occurrence assessment determined that another two conservation significant species are likely to occur within the study area: Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Rainbow Bee-eater (*Merops ornatus*).

The study area contains vegetation which represents low, moderate and high quality foraging habitat for the conservation significant Black Cockatoo species (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). Areas of high quality foraging habitat consist of 'pine plantation' and 'Eucalyptus and Banksia woodland', and cover approximately 49.7% (37.5 hectares) of the study area. Areas of moderate quality foraging habitat consist of 'sedgeland' and 'woodland over sedgeland', and cover 19.3% (14.6 hectares) of the study area. The remaining 31% (23.4 hectares) is considered as low quality foraging habitat for these species.

The Geomorphic Wetlands Swan Coastal Plain dataset indicates that four wetlands intersect with the study area, all of which are listed as 'Multiple Use' wetlands. These wetlands cover approximately 40.2% (30.9 hectares) of the study area, confined mostly to the east. These wetlands consist of Dampland and



Sumpland. There are no 'Conservation' or 'Resource Enhancement' management category wetlands in the study area.

# 1 Introduction

Eco Logical Australia (ELA) was engaged by S2V Consulting (S2V) to undertake a desktop review and a spring flora and fauna survey within Kemerton Industrial Area, Western Australia (the study area). The purpose of this work was to develop a stand-alone report collating existing biological data and information, supplemented with data recorded during the spring field survey.

ELA reviewed existing reports and data previously undertaken within the study area, and undertook a flora and fauna survey to verify and update findings of the desktop assessment where required. The site inspection was undertaken over two days from 4-5 September 2017.

This report is based on the following:

- A desktop study utilising previous studies and data to extract and describe known flora, vegetation and fauna values and characteristics that occur on site;
- A field survey to facilitate the observation of species in flower and the occurrence of annual and annually reviewed perennial species, and to validate previously recorded flora, vegetation and fauna values.

This report encompasses all available biological data and information in order to inform environmental assessment and approvals processes for any future works within the study area.

## 1.1 Study area

The study area is approximately 22 kilometres (km) north of Bunbury, Western Australia. The study area is bound by Marriott Road to the south and an unnamed road to the west within the Kemerton Industrial Area. The northern and eastern boundaries are bound by agricultural land (**Figure 1-1**).



Figure 1-1: Location of the study area

## 2 Methodology

### 2.1 Desktop assessment

#### 2.1.1 Climate

The study area is in the Perth subregion, which experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell et al. 2002). Based on climate data from the nearby Bureau of Meteorology (BoM) Brunswick Junction Weather Station (Station number 9513, rainfall data 1972 – current, approximately 10 km east of the study area), the study area has received a total of 440.6 millimetres (mm) of rainfall in the three months prior to the site inspection in September 2017, which is below the annual average rainfall of 533.4 mm for the same period (BoM 2017).

Based on climate data from the nearby BoM Bunbury Weather Station (Station number 9965, temperature data 1972 – current, approximately 27 km southwest of the study area), mean monthly maximum temperatures in the area range from 17.2°C in July to 30.1°C in February, and mean monthly minimum temperatures range from 7°C in July to 15.9°C in February (BoM 2017).

#### 2.1.2 Regional context

Environmental values for the region relevant to the study area are presented in **Table 2-1**.

**Table 2-1: Environmental values of the region**

Existing Environment Attributes	Study Area
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion*	Swan Coastal Plain
IBRA Subregion*	Perth (SWA2)
Soil landscape system**	Bassendean Sands and Guilford Formation
Vegetation complex^	Bassendean complex

\*Department of the Environment and Energy [DotEE] 2017a

\*\*Government of Western Australia 2000

^Hedde et al. 1980

#### 2.1.3 Broad-scale vegetation mapping

Vegetation of the Swan Coastal Plain has been mapped and described by Hedde et al. (1980) as 'vegetation complexes', which represent the structural and floristic description linked to geomorphology (Environmental Protection Authority [EPA] 2016).

Vegetation type and extent has also been mapped at a broader regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on Beard's (1975) mapping at a scale of 1:1,000,000, the Department of Agriculture and Food Western Australia has compiled a list of the types and extent of vegetation associations across WA (Shepherd et al. 2002).

The study area is situated in the Bassendean complex – central and south, vegetation association 1000. The remaining pre-European extent of vegetation association 1000 on the Swan Coastal Plain is 25.49% (Government of Western Australia 2016). The remaining pre-European extent of vegetation association 1000 on the Swan Coastal Plain within all DBCA managed lands is 8.12%.

#### 2.1.4 Historical datasets

The primary sources of information for the collation of relevant site ecological data include:

- *Targeted Ecological Surveys for Kemerton Industrial Park* (ELA 2014);
- *Desktop Assessment of Selected Lots within Kemerton Industrial Area* (ELA 2017a); and
- *Kemerton Industrial Area Additional Assessment of Proposed Access Road Area* (ELA 2017b).

These reports provide a compilation of all existing ecological data and results for studies undertaken within the Kemerton Industrial Area, and include the results of surveys undertaken.

The studies undertaken by ELA (ELA 2014; ELA 2017a; ELA 2017b) consolidate a number of reports and datasets pertaining to the Kemerton Industrial Area and surrounds, including:

- AECOM (2012) '*Kemerton Industrial Park: Threatened Orchid Survey*';
- Bamford Consulting (2011) '*Black Cockatoo and Western Ringtail Possum Habitat Assessment, Kemerton Industrial Park, Bunbury*';
- Cardno (2010a) '*Kemerton Industrial Core: Flora and Vegetation Survey*';
- Cardno (2010b) '*Kemerton Industrial Core: Fauna Survey*';
- Coffey Environments (2007) '*Kemerton Industrial Park Environmental Overview for the KIP Strategy Plan*';
- Coffey Environments (2008) '*Flora, Vegetation, Wetlands and Fauna Assessment Kemerton Industrial Park*';
- Mattiske Consulting (2011a) '*EPBC Act Significance Criteria Review of the Proposed Kemerton Industrial Park Development*';
- Mattiske Consulting (2011b) '*EPBC Act Significance Test of the Proposed Subdivision of 510 Marriott Road, Kemerton*';
- Muir Environmental (1999a) '*Report of Biological Survey – Phase 1: Kemerton Industrial Estate Volume 1 Report*';
- Muir Environmental (1999b) '*Summary Report – Kemerton Industrial Area Phase 1 Biological Survey*';
- Paul Armstrong and Associates (1999a) '*Kemerton Industrial Estate (Original Core Zone) Spring 1999 Rare Flora Search*';
- Paul Armstrong and Associates (1999b) '*Kemerton Industrial Estate (Expanded Core Zone) Mid- and Late Spring 1999 Rare Flora Search*';
- Paul Armstrong and Associates (1999c) '*Kemerton Industrial Estate (Support Industry Area) Mid- and Late Spring 1999 Rare Flora Search*'; and
- Paul Armstrong and Associates (2007) '*Review of Vegetation Types Monitored within the Kemerton Industrial Estate and Identification of Deficiencies.*'

Vegetation mapping available for the Kemerton Industrial Area consolidated in ELA (2017a; 2017b) include:

- Vegetation mapping by Muir (1999c) which covers the whole of Kemerton Industrial Area;
- Vegetation mapping by Coffey (2008) which covers part of the core within Kemerton Industrial Area;
- Vegetation mapping by Cardno (2010a) which covers the core of Kemerton Industrial Area;
- Vegetation condition mapping by Mattiske (2011c) which covers the whole of Kemerton Industrial Area;
- Heddl et al. (1980) vegetation complex mapping which covers the whole of Kemerton Industrial Area; and

- Geomorphic Wetlands Swan Coastal Plain dataset (Department of Environment and Conservation [DEC] 2013a).

### 2.1.5 Database searches and likelihood of occurrence

The following Commonwealth and State databases were searched for information relating to conservation listed flora, fauna and ecological communities, to compile and summarise existing data to inform the field survey. **Table 2-2** presents the database searches undertaken around the central coordinate (383935m E, 6324968m N).

**Table 2-2: Database searches**

Database	Reference	Buffer (km)
Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act. Accessed August 2017.	DotEE 2017b	10
NatureMap online flora and fauna database. Accessed August 2017.	Department of Biodiversity, Conservation and Attractions (DBCA) 2007 - 2017	10
Threatened Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority listed flora <sup>1</sup> , acquired by LandCorp in December 2012.	DEC 2012	n/a
Threatened Ecological Communities database search, acquired by LandCorp in January, 2013.	DEC 2013b	n/a

A likelihood of occurrence assessment was undertaken by ELA (2017b) in order to identify conservation listed flora and fauna species that possibly occur within the study area, identified from a review of key datasets and literature. This assessment (Section 3.1.1; Section 3.3.2) was updated for the current field survey, using existing species records and based on the results of the field survey.

The following criteria was used:

- Known to occur: Recorded from the study area, through database search results and/or from previous surveys of the study area (<20 years);
- Likely to occur: The study area is within the species current distribution and contains suitable habitat for the species, however;
  - The species utilises seasonal habitat or has a large home range, so is not always present/visible in the study area; and/or
  - Survey limitations identified.
- Potential to occur: The study area is within the species current distribution and contains habitat, however (at least two of below);
  - The study area is located on the edge of the species range or it has a patchy distribution; and/or
  - Survey limitations identified; and/or
  - Habitat is less suitable; and/or
  - Species is cryptic, and/or difficult to record utilising traditional survey methods.
- Unlikely to occur: The study area is within the species current distribution and either:
  - contains habitat, was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species; or
  - the habitat is modified and unlikely to support the species and survey limitations identified.
- Does not occur: The study area is within the species current distribution, and was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species. The study area may not contain suitable habitat. There is certainty that the species is not present in the study area.

## 2.2 Field survey

### 2.2.1 Survey team and timing

A field survey was undertaken by ELA Ecology Manager / Senior Botanist Joel Collins from 4 to 5 September 2017. Joel's relevant qualifications are outlined below in **Table 2-3**.

**Table 2-3: Survey team**

Name	Qualifications	Relevant Experience	Licence Numbers
Joel Collins	Bagri Hort (Hons)	Scientific collection licence: SL012090 Declared Rare Flora licence: 9-1718	Extensive biological surveys throughout the South-West bioregions with significant experience on the Swan Coastal Plain

### 2.2.2 Flora and vegetation survey

A Detailed and Targeted flora and vegetation survey was undertaken in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

Three quadrats were established in addition to relevés previously established by ELA (2017a; 2017b) in order to supplement information on vegetation communities and species presence within the study area (**Figure 2-1**). The survey involved the use of 10 metre (m) x 10 m quadrats. Photos were also taken from the northwest corner of each quadrat.

A targeted survey was completed within the study area to identify any Threatened or Priority species, including:

- Threatened flora listed under the EPBC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice; and
- Priority flora recognised by DBCA.

The targeted survey methodology involved personnel walking meandering transects across the study area as well as outside the study boundary (if required). In addition to point locations, the following data was collected for any conservation listed species identified in the study area:

- Number of individuals and/or percent cover (recording a range of coordinates if necessary);
- Estimates were made for groups of individuals within a 20 m radius and for large populations to record a significant area polygon;
- Reproductive phase (flowering, fruiting, etc.);
- Description of dominant vegetation unit in which the species was located;
- Associated dominant species; and
- Photograph of the plant in-situ.

Except where specifically noted, the field survey was undertaken using an Android Nexus 7 tablet operating the ArcGIS Collector app. It should be noted that these units can have errors of 3-20 m (subject to availability of satellites on the day) with an average of 5 m, which is comparable to a standard Global Positioning System (GPS) unit.



### 2.2.3 Fauna survey

A Level 1 fauna survey was undertaken to assess for the presence of fauna species and species assemblages, and to validate previously mapped fauna habitat and Black Cockatoo foraging habitat within the study area (ELA 2014; 2017a; 2017b).

The fauna survey was undertaken in accordance with:

- EPA *Technical Guide: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004);
- EPA *Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna* (EPA 2016b); and
- Commonwealth EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species (SEWPaC 2012).

Opportunistic fauna observations were made during the field survey, including visual sightings of active fauna such as reptiles and birds, records of bird calls and signs of species presence such as tracks, diggings, burrows, scats or any other signs of fauna activity.

### 2.2.4 Taxonomy and nomenclature

#### *Flora*

Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (Western Australia Herbarium [WAH] 2016). Voucher specimens were collected in the field of all actual or potential conservation listed flora species. Collections were made of other species, if required, that commonly occurred in the habitat of the conservation listed species to enable correct identification. All collections were assigned a unique collection number.

Specimen identification was undertaken by ELA Senior Botanist Joel Collins. Species identification utilised taxonomic literature and keys with all specimens confirmed using the WAH reference collection.

#### *Fauna*

Nomenclature used for the vertebrate fauna species within this report follows the Western Australian Museum (WAM) Checklist of the Vertebrates of Western Australia (WAM 2015). Where common names were not stated for certain species, the following references were consulted:

- Amphibians and reptiles: Bush et al. (2010);
- Reptiles: Wilson and Swan (2013);
- Birds: Morcombe (2007); and
- Mammals: Menkhorst and Knight (2011).

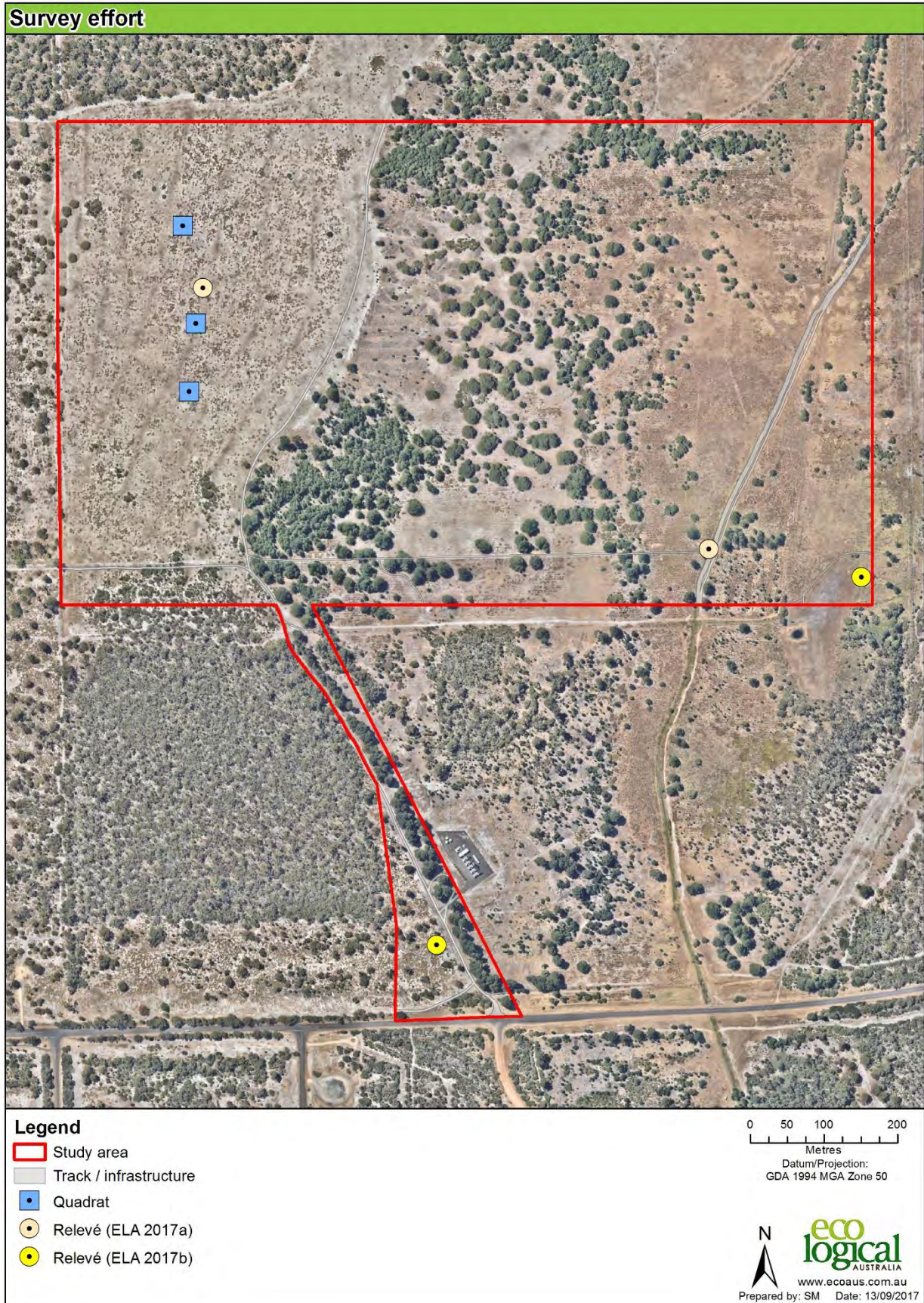


Figure 2-1: Survey effort



## 3 Results

### 3.1 Flora

Results from the field survey, and from relevés established by ELA in early 2017 (2017a; 2017b), found a total of 32 dominant species within the study area, which includes 20 species of native and 12 species of introduced flora (weeds). The most common family recorded was Myrtaceae (6 species), followed by Fabaceae (5 species) and Asteraceae (4 species). The most common genera recorded was *Acacia*, with three species recorded.

Of the weed species recorded within the study area, *Zantedeschia aethiopica* (Arum Lily) is listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Common weed species observed within the study area during the field survey included *Ursinia anthemoides* subsp. *anthemoides* (*Ursinia*), *Hypochaeris glabra* (Smooth Catsear), *Ehrharta calycina* (Perennial Veldt Grass), and *Cynodon dactylon* (Couch). In particular, *Ehrharta calycina* (Perennial Veldt Grass) is widespread and occurs in previously cleared areas in high densities, such as in the western portion of the study area.

#### 3.1.1 Conservation significant flora

One conservation significant flora species *Acacia semitrullata* (Priority 4) has previously been recorded within the study area (ELA 2017a; 2017b). This species was targeted during the current field survey with 59 individuals recorded within the western section of the study area, and confined almost entirely to the 'Xanthorrhoea open shrubland over Perennial Veldt Grass open grassland in previously cleared farmland' vegetation community (**Figure 3-1; Appendix G**).

Following the field survey, the likelihood of occurrence ratings of conservation listed flora species identified in ELA 2017a and 2017b were revised to provide a more accurate reflection of the likelihood of these species occurring, based on the current habitat and condition within the study area.

The database searches identified an additional 33 flora species of conservation significance which may occur within the study area. Of these, the likelihood of occurrence for all potentially occurring flora species listed under the EPBC Act and the WC Act was reduced to 'No' (**Appendix B**). This was due to the study being well surveyed and the lack of suitable habitat available for these species within the study area.

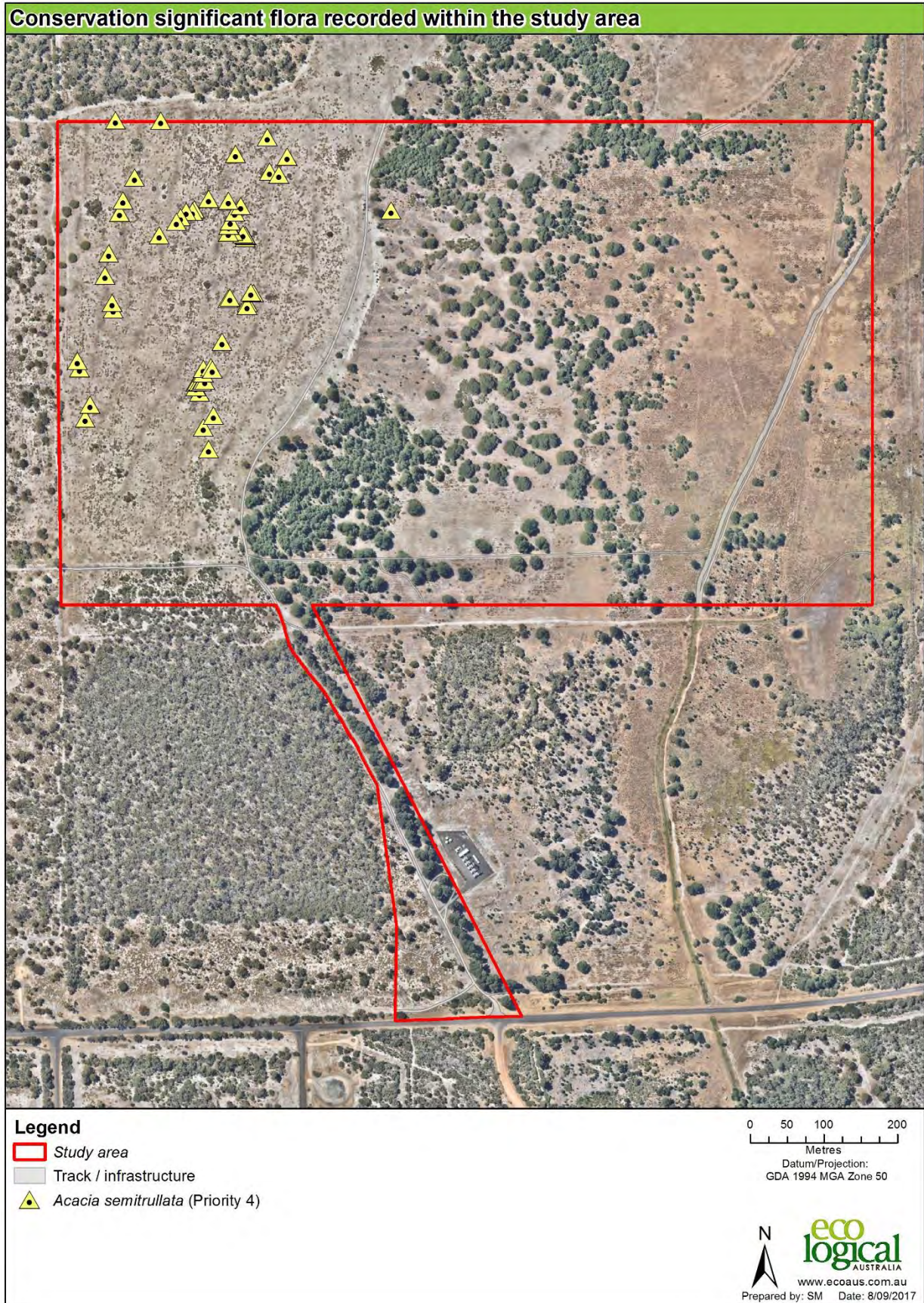


Figure 3-1: Conservation significant flora recorded within the study area



## 3.2 Vegetation

### 3.2.1 Vegetation communities

Vegetation mapping undertaken for the broader Kemerton Industrial Area (Cardno 2010a; updated by ELA 2014) was reviewed and refined by ELA in early 2017 (ELA 2017a; 2017b). This mapping was reviewed for the current desktop assessment and ground-truthed during the field survey, with no amendments required. The study area was found to support six of the vegetation communities described by ELA (2017a; 2017b; **Table 3-1**), as well as an area of pine plantation, covering 41.9% (31.6 hectares [ha]) of the study area. These include:

- **CcKg**: *Corymbia* closed forest over mixed shrubland and rushes;
- **EmKgMr**: *Eucalyptus* and *Banksia* low open woodland over tall sparse shrubland and mixed shrubland;
- **ErMpJk**: *Eucalyptus* isolated trees over *Melaleuca* and *Pinus* sp. low open woodland over sedgeland over very open grassland;
- **PEr**: *Pinus* and *Eucalyptus* low open woodland in low lying seasonal dampland;
- **PJp**: *Pinus* sp. open woodland over closed rushland in low lying seasonal dampland; and
- **XbEc**: *Xanthorrhoea* open shrubland over Perennial Veldt Grass open grassland in previously cleared farmland.

The most common occurring vegetation community found within the study area was XbEc: *Xanthorrhoea brunonis* open shrubland over *Ehrharta calycina* (Perennial Veldt Grass) open grassland in previously cleared farmland (22.9 ha, 30.4%). Mapping of these vegetation communities is present in **Figure 3-2**.

### 3.2.2 Vegetation condition



Based on previous condition mapping undertaken within the study area (ELA 2017a; 2017b), the condition of native vegetation within the study area ranges from Good to Completely Degraded, with no amendments made during the field survey (**Figure 3-3**). The most intact areas of native vegetation with the highest quality are in the southern portion of the study area (1.7 ha, 2.2%), with a narrow section on the western side and a patch on the eastern side in Good condition. The eastern section and the remaining areas of the southern portion of the study area are in Completely Degraded condition, covering 67.4% (50.8 ha). The remaining areas, covering 30.4% (22.9 ha), are in Degraded condition. Areas with lower condition were experiencing disturbances such as previous clearing/logging, rubbish dumping proliferation of tracks, grazing, edge effects and weeds. The previous disturbances have led to a significant decrease in native species diversity across the study area.



### 3.2.3 Threatened and priority ecological communities



Previous surveys (Cardno 2010a and Coffey 2008) that included the study area found one vegetation community closely resembling Floristic Community Type (FCT) 21c. This FCT is listed by Department of Biodiversity, Conservation and Attractions (DBCA) as the Priority Ecological Community (PEC) 'Low lying *Banksia attenuata* woodlands or shrublands' (Priority 3; DBCA 2017). This PEC is represented by the vegetation community EmKgMr.

One Threatened Ecological Community (TEC) has previously been recorded within the study area: 'Banksia Woodlands of the Swan Coastal Plain' (ELA 2017b), listed as Endangered under the EPBC Act (DotEE 2016). Following the steps provided in the Conservation Advice administered by the Commonwealth government, the vegetation community described by ELA (2017b) 'EmKgMr' is considered to represent the 'Banksia Woodlands of the Swan Coastal Plain' TEC, as it meets the relevant guideline criteria (DotEE 2016; **Figure 3-2**). This vegetation community occurs in 2.4% (1.8 ha) of the study area and is considered to be in Good condition.

Table 3-1: Vegetation communities within the study area as confirmed during the site inspection

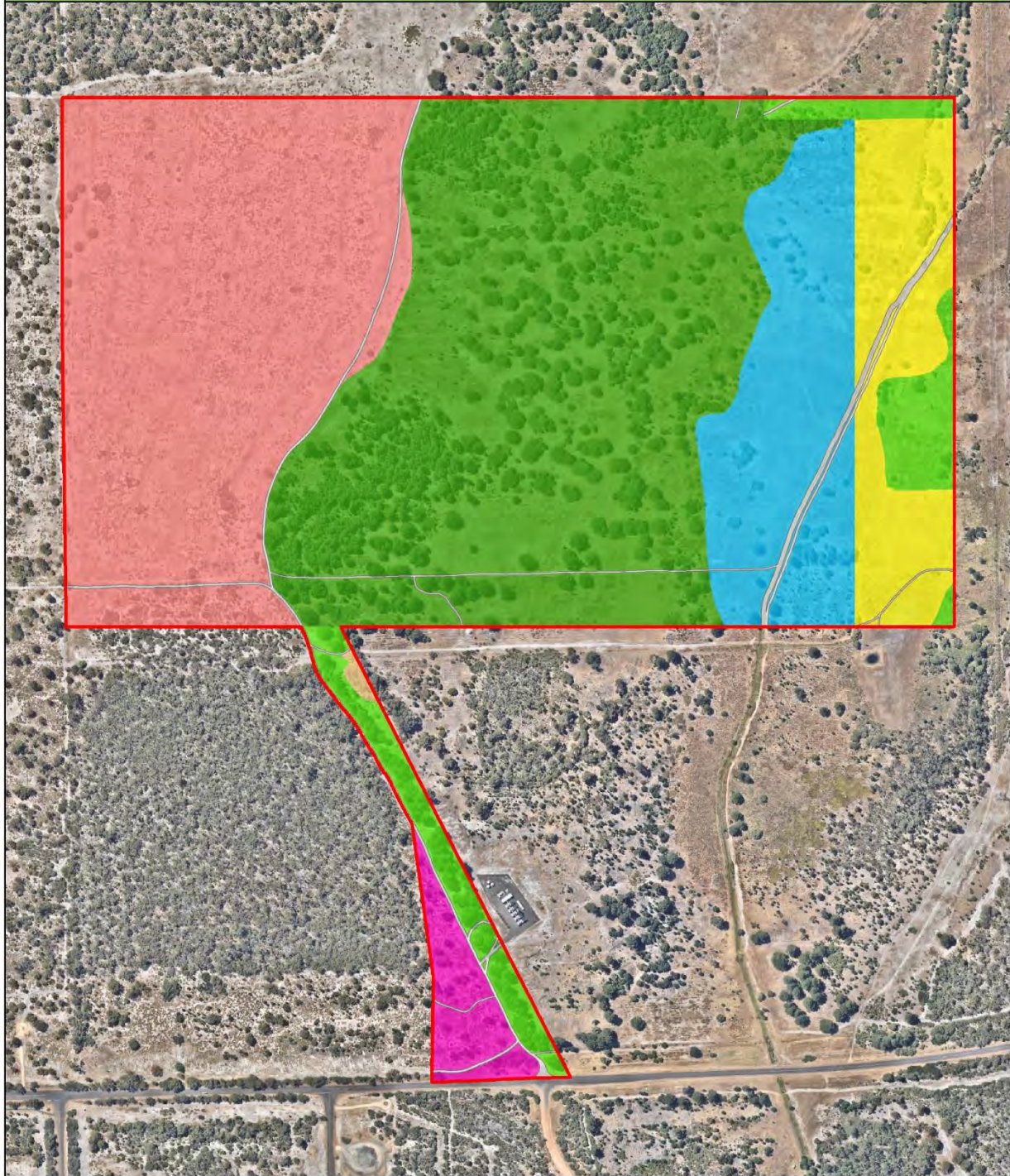
Vegetation community	Description	Condition	Approximate extent within the study area	Photo
CcKg	<i>Corymbia calophylla</i> closed forest over <i>Kunzea glabrescens</i> tall open shrubland over <i>Astartea scoparia</i> and <i>Xanthorrhoea brunonis</i> open shrubland over <i>Hypocalymma angustifolium</i> low open shrubland over <i>Juncus pallidus</i> isolated clumps of rushes.	Good	0.1 ha (0.2%)	
EmKgMr	<i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Banksia ilicifolia</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Macrozamia riedlei</i> and <i>Xanthorrhoea brunonis</i> shrubland.	Completely Degraded - Excellent	1.8 ha (2.4%)	

Vegetation community	Description	Condition	Approximate extent within the study area	Photo
ErMpJk	<i>Eucalyptus rudis</i> isolated trees over <i>Melaleuca preissiana</i> and <i>Pinus radiata</i> low open woodland over <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Juncus pallidus</i> sedgeland over * <i>Cynodon dactylon</i> very open grassland in low lying seasonal Dampland.	Completely Degraded	6.0 ha (7.9%)	
PEr	<i>Pinus radiata</i> and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal Dampland.	Completely Degraded	4.1 ha (5.5%)	

Vegetation community	Description	Condition	Approximate extent within the study area	Photo
PJp	<i>Pinus</i> sp. open woodland over <i>Hypocalymma angustifolium</i> and <i>Astartea scoparia</i> isolated shrubs over * <i>Cynodon dactylon</i> (Couch) sparse grassland over <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Juncus pallidus</i> closed rushland in low lying seasonal dampland.	Completely Degraded	8.9 ha (11.7%)	
XbEc	<i>Xanthorrhoea brunonis</i> open shrubland with <i>Acacia pulchella</i> and <i>Jacksonia furcellata</i> isolated shrubs over * <i>Ehrharta calycina</i> (Perennial Veldt Grass) open grassland in previously cleared farmland. Associated species include <i>Acacia semitrullata</i> (Priority 4).	Degraded	22.9 ha (30.4%)	



Vegetation communities within the study area



**Legend**

Study area  
 Track / infrastructure

**Vegetation community**

<p><span style="background-color: #ffc0cb; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> CcKg: <i>Corymbia calophylla</i> closed forest over open shrubland of mixed myrtaceous shrubs and <i>Xanthorrhoea brunonis</i> over <i>Juncus pallidus</i> isolated clumps of rushes</p> <p><span style="background-color: #90ee90; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> EmKgMr: <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Banksia ilicifolia</i> low open woodland over <i>Kunzea glabrescens</i> tall sparse shrubland over <i>Macrozamia nedlei</i> and <i>Xanthorrhoea brunonis</i> shrubland</p>	<p><span style="background-color: #ffff00; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> ErMpJk: <i>Eucalyptus rudis</i> isolated trees over <i>Melaleuca preissiana</i> and <i>Pinus radiata</i> low open woodland over <i>Juncus</i> spp. sedgeland over *<i>Cynodon dactylon</i> very open grassland</p> <p><span style="background-color: #90ee90; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> PER: <i>Pinus radiata</i> and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal dampland</p> <p><span style="background-color: #add8e6; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> PJP: <i>Pinus</i> sp. open woodland over <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Juncus pallidus</i> closed rushland in low lying seasonal dampland</p> <p><span style="background-color: #90ee90; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> Pine plantation</p> <p><span style="background-color: #ffc0cb; border: 1px solid black; display: inline-block; width: 15px; height: 10px;"></span> XbEc: <i>Xanthorrhoea brunonis</i> open shrubland over *<i>Ehrharta calycina</i> (Perennial Veldt Grass) open grassland in previously cleared farmland</p>	<p>0 50 100 200 Metres</p> <p>Datum/Projection: GDA 1994 MGA Zone 50</p> <p> <b>eco logical AUSTRALIA</b> www.ecoaus.com.au</p> <p>Prepared by: SM Date: 19/09/2017</p>
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Figure 3-2: Vegetation communities within the study area



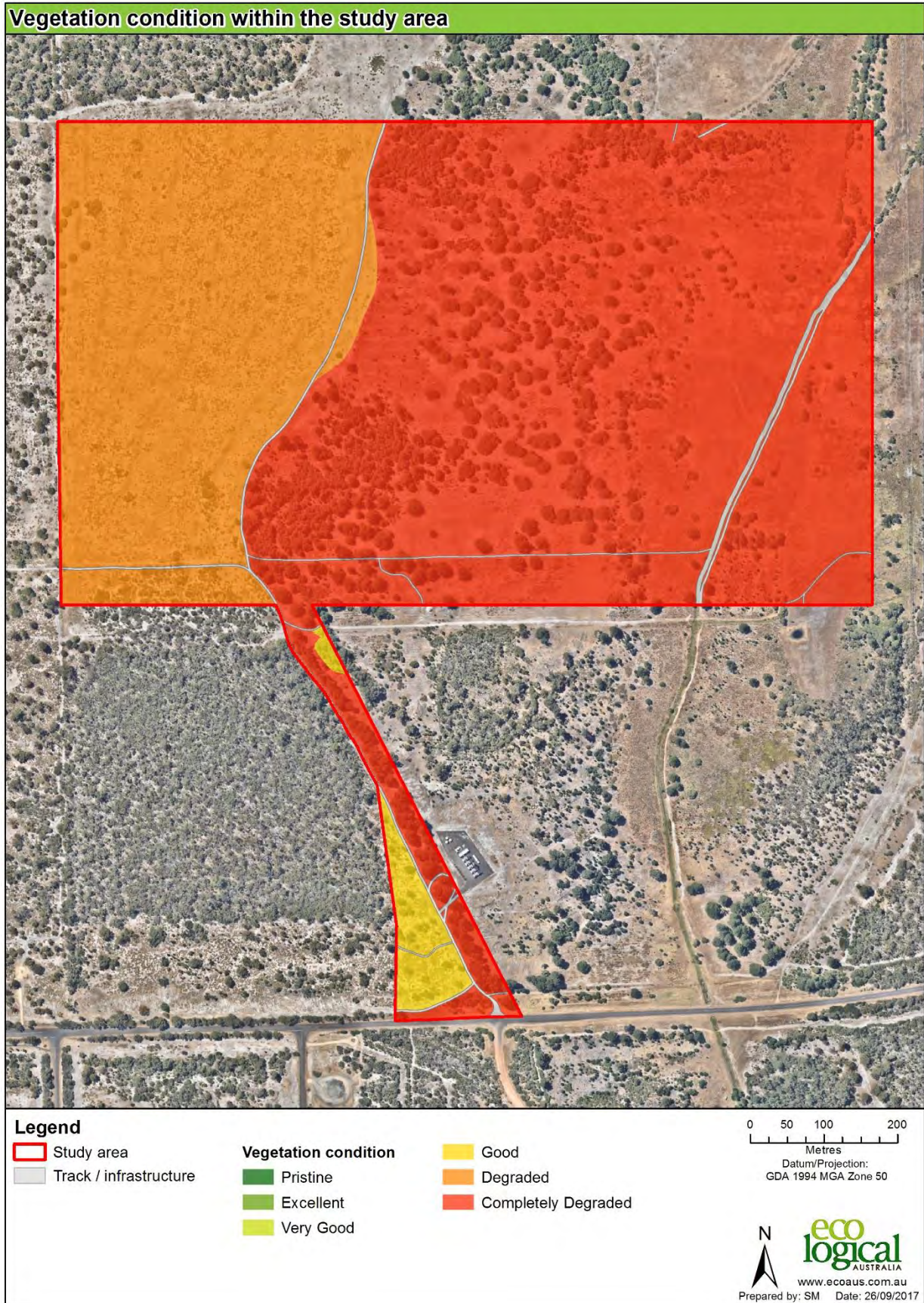


Figure 3-3: Vegetation condition within the study area

### 3.3 Fauna

#### 3.3.1 Fauna species

A total of 22 fauna species, or signs of species, were observed during the field survey, including 19 bird species, two mammal species and one reptile. A full species list of fauna recorded within the study area is included in **Appendix E**.

#### 3.3.2 Conservation significant fauna

Two conservation significant species have been previously recorded within the study area including: the WC Act Schedule 2 and EPBC Act Endangered species Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and WC Act Schedule 3 and EPBC Act Vulnerable species Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*). Evidence of Carnaby's Black Cockatoo and Forest Red-tailed Black-Cockatoo foraging has been previously observed within the study area by ELA (2017a). These species were not directly observed during the current field survey, however evidence of Carnaby's Black Cockatoo, in the form of chewed pine cones, was recorded within the study area.

Following the field survey, the likelihood of occurrence ratings of conservation listed fauna species identified in ELA 2017a and 2017b were revised to provide a more accurate reflection of the likelihood of these species occurring, based on the current habitat and condition within the study area.

The database searches identified an additional 54 fauna species of conservation significance which may occur within the study area. Of these, two are considered as likely to occur within the study area: *Calyptorhynchus baudinii* (Baudin's Cockatoo) and *Merops ornatus* (Rainbow Bee-eater). In addition to these species considered likely to occur, a further four are considered as having the potential to occur:

- *Ardea ibis* (Cattle Egret);
- *Ardea modesta* (Eastern Great Egret);
- *Falco peregrinus* (Peregrine Falcon); and
- *Macropus irma* (Western Brush Wallaby).

The remaining 48 species are considered unlikely to occur in or around the study area (**Appendix C**).

#### 3.3.3 Fauna habitats

Broad fauna habitats previously identified by ELA (2017a; 2017b) were ground-truthed during the field survey and mapping was updated to reflect the current extent of fauna habitat within the study area. Broad fauna habitats that occur within the study area include:

- Marri forest;
- *Eucalyptus/Banksia* Woodland;
- Pine plantation (with *Eucalyptus*);
- Woodland over sedgeland;
- Sedgeland;
- Regenerating farmland; and
- Pine plantation.

Pine plantation is the most commonly occurring fauna habitat type, covering 41.9% (31.6%) of the study area. The second most common fauna habitat is 'Regenerating farmland', covering 30.4% (22.9 ha) of the study area. Extent of fauna habitats within the study area can be found in **Table 3-2** and **Figure 3-4**.

**Table 3-2: Fauna habitat types within the study area**

Fauna habitat type	Description	Extent within the study area
Marri forest	Marri forest over mixed myrtaceous shrubland and <i>Xanthorrhoea</i> over isolated clumps of rushes on fringes of low lying damp areas	0.1 ha (0.2%)
<i>Eucalyptus/Banksia</i> Woodland	Woodland of Jarrah and Marri with <i>Banksia</i> sp. low open woodland over <i>Xanthorrhoea</i> shrubland on uplands	1.8 ha (2.4%)
Pine plantation (with Eucalyptus)	<i>Pinus</i> sp. and <i>Eucalyptus rudis</i> low open woodland in low lying seasonal dampland	4.1 ha (5.5%)
Woodland over sedgeland	Woodland to low open woodland of Flooded Gum, <i>Melaleuca</i> and <i>Pinus</i> sp. over <i>Kunzea</i> shrubland and sedgeland of <i>Juncus</i> sp. on seasonally inundated areas/damplands	6.0 ha (7.9%)
Sedgeland	<i>Juncus</i> sp. closed rushland in low lying seasonal dampland with scattered pine trees	8.9 ha (11.7%)
Regenerating farmland	Previously cleared farmland with <i>Xanthorrhoea</i> open shrubland over and open grassland of Perennial Veldt Grass	22.9 ha (30.4%)
Pine plantation	<i>Pinus</i> species (planted)	31.6 ha (41.9%)

Black Cockatoo foraging and breeding habitat undertaken by ELA in 2017 (2017a; 2017b) has been updated to reflect those habitats present within the study area (**Figure 3-5**). There are two habitats within the study area that are considered as providing high quality foraging habitat for Black Cockatoos. These are 'pine plantation', which is located across the centre of the study area and '*Eucalyptus/Banksia* woodland,' which is located in the southern section of the study area (**Figure 3-5**). These habitats cover a total of 49.7% (37.5 ha) of the study area. The 'sedgeland' and 'woodland over sedgeland' habitat types are considered moderate foraging value for Black Cockatoo species, as these areas contain scattered pine trees and cover 19.3% (14.6 ha) of the study area. The remaining areas are considered to be of low value for Black Cockatoo foraging.

There is one small area of Marri forest within the study area that is considered as providing high potential breeding value for Black Cockatoos, which is confined to the north-eastern edge in the south of the study area, covering 0.2% (0.1 ha) of the study area (**Figure 3-6**). The remainder of the study area is considered low value for potential breeding habitat for Black Cockatoos (**Figure 3-6**).

The entire study area provides habitat for the Rainbow Bee-eater (*Merops ornatus*; listed as Schedule 5 under the WC Act), which is considered as being likely to occur. This species is likely to occur only on a transitional basis utilising the study area opportunistically for foraging. The study area is unlikely to be a significant feeding or breeding site for this species.



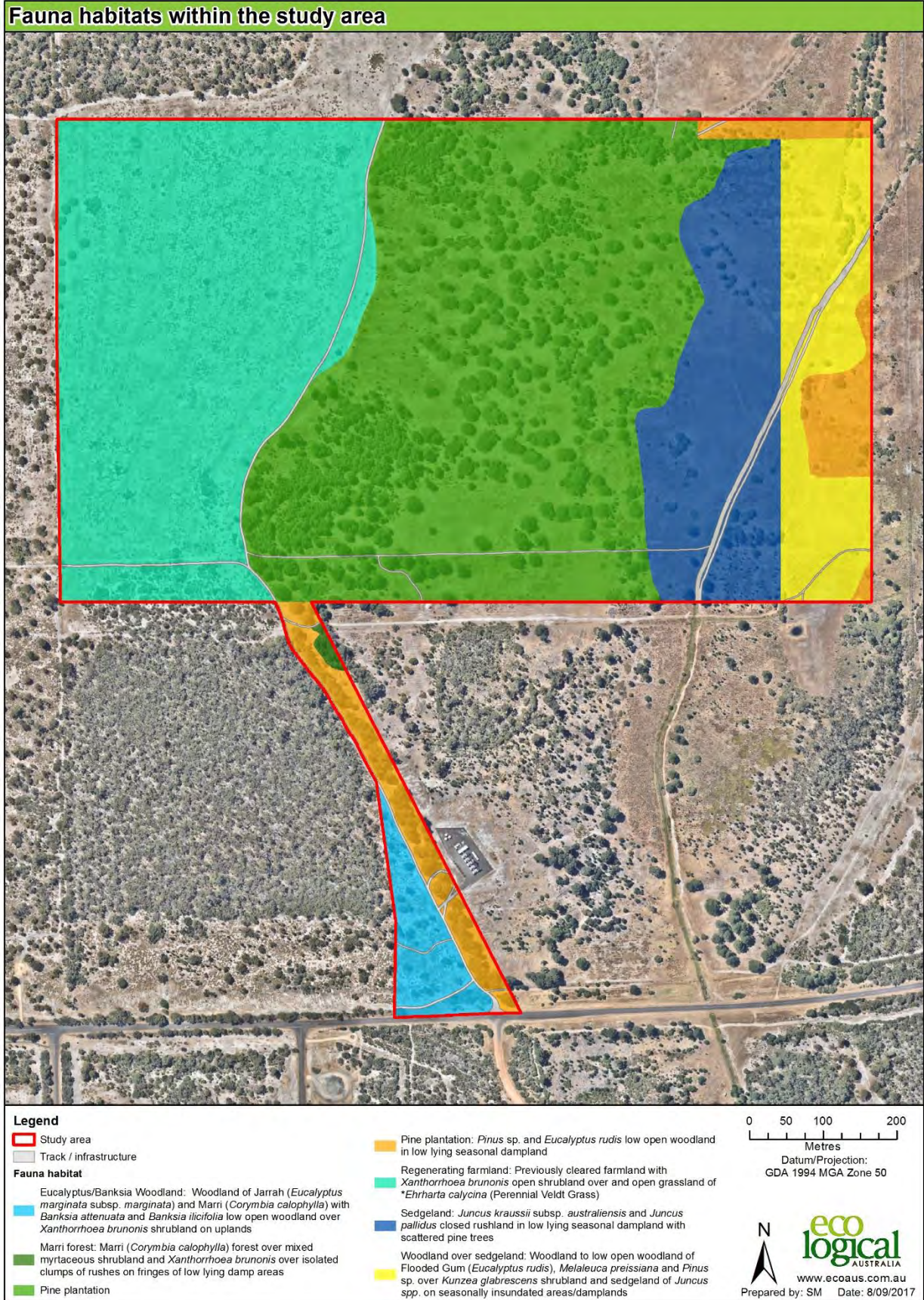


Figure 3-4: Fauna habitats within the study area



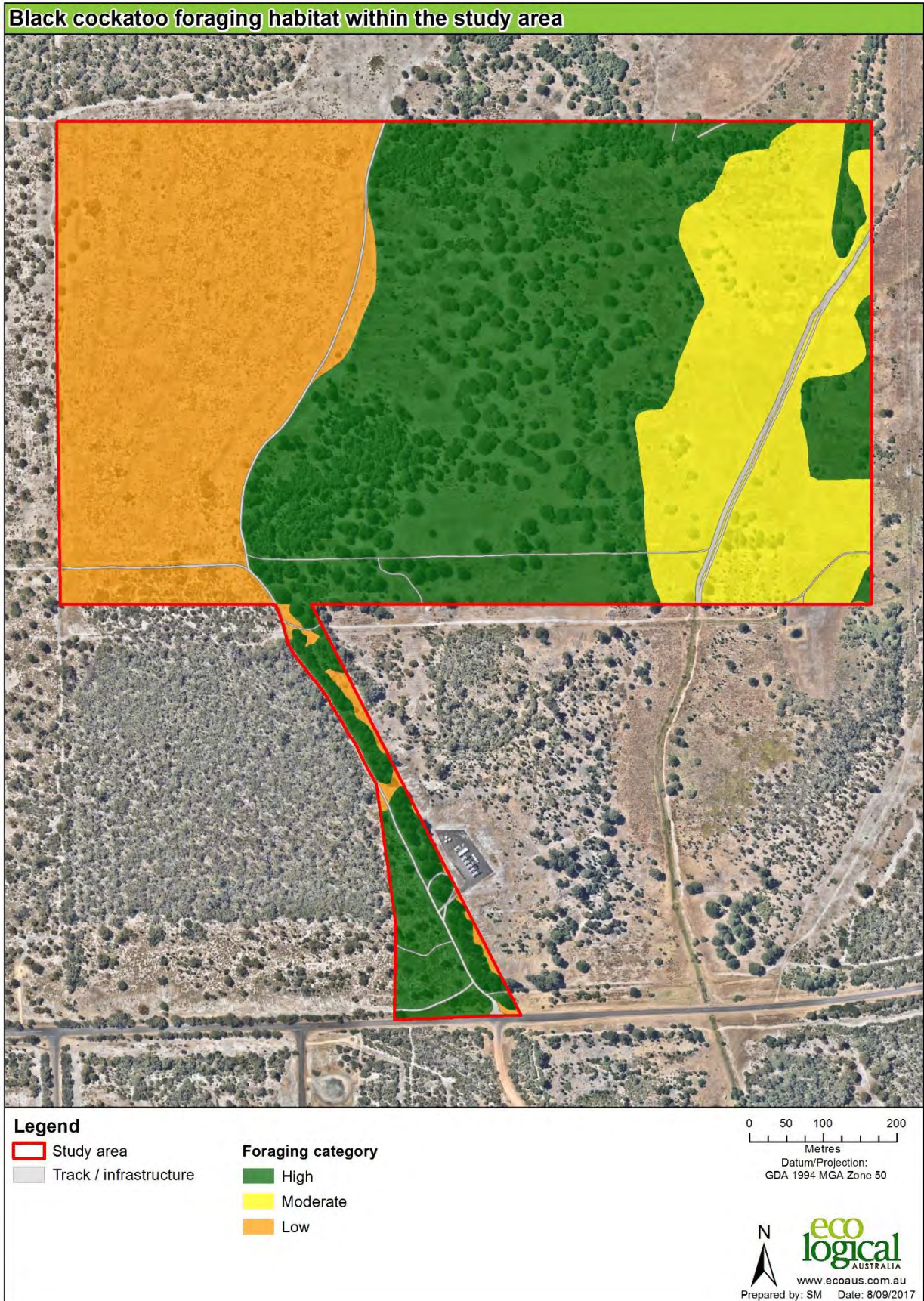


Figure 3-5: Black Cockatoo foraging habitat



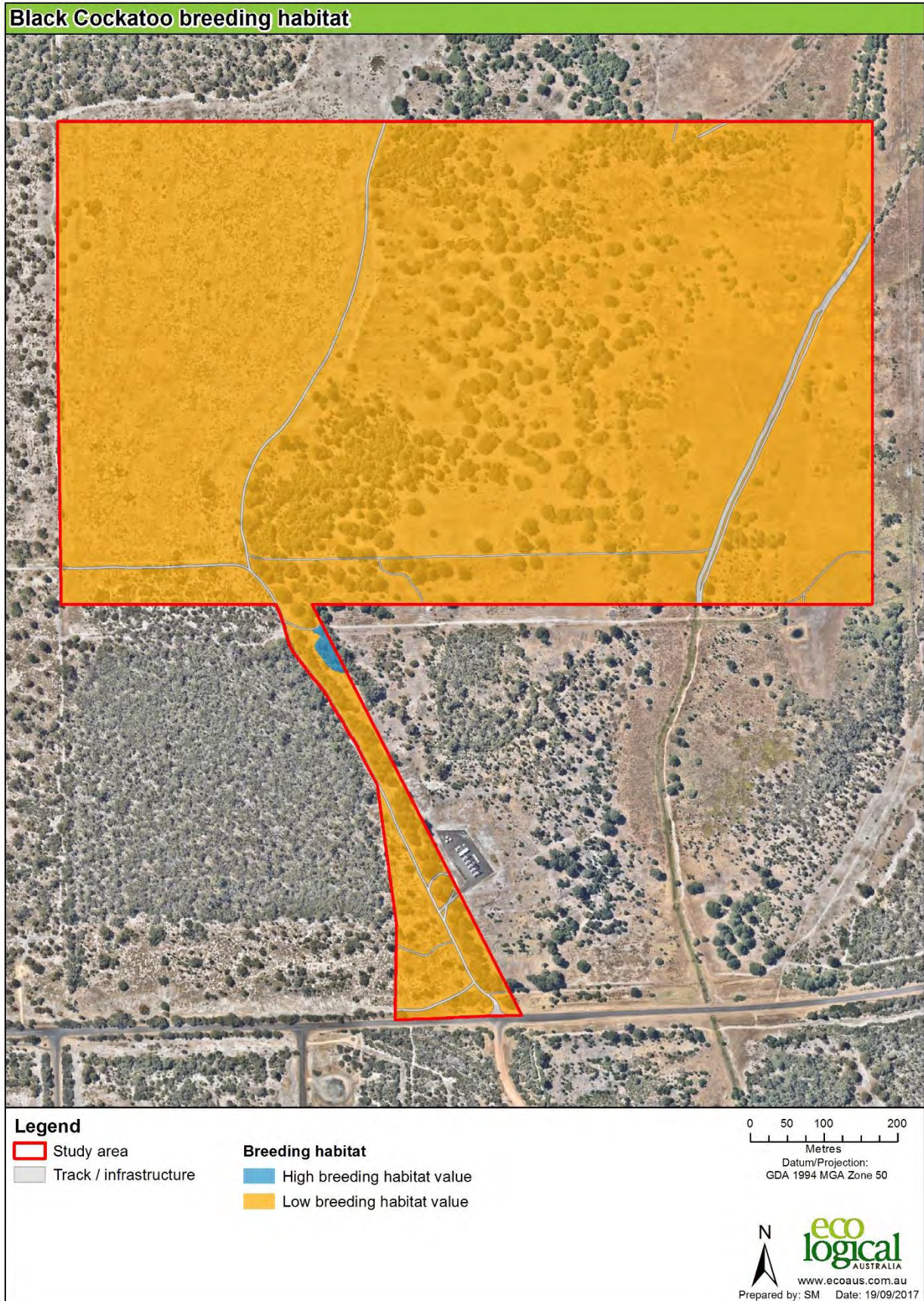


Figure 3-6: Black Cockatoo breeding habitat

### 3.4 Wetlands

Broad wetland mapping has been coordinated by DBCA and included in the Geomorphic Wetlands Swan Coastal Plain dataset (DBCA 2017; State of Western Australia 2012). This dataset contains information on the location, boundaries, classification, management categories and unique feature identifier numbers of wetlands on the Swan Coastal Plain (DBCA 2017; State of Western Australia 2012). Wetland Conservation category descriptions are provided in **Table 3-3**.

**Table 3-3: Wetland Conservation categories\***

Management category	Description	Objective
Conservation	Wetlands that support a high level of attributes and functions	To preserve and protect existing values
Resource Enhancement	Wetlands that may have been modified or degraded, but still support substantial attributes and functions	To manage, restore and protect towards improving conservation value
Multiple Use	Wetlands with few remaining important attributes and functions	To use, develop and manage the wetland in the context of ecologically sustainable development and best management catchment planning

\*Department of Parks and Wildlife 2013

The Geomorphic Wetlands Swan Coastal Plain dataset indicates that four wetlands intersect with the study area, all of which are listed as 'Multiple Use' wetlands. These wetlands cover approximately 40.2% (30.9 hectares) of the study area, confined mostly to the east (**Figure 3-7**). These wetlands consist of Dampland and Sumpland. There are no 'Conservation' or 'Resource Enhancement' management category wetlands in the study area.



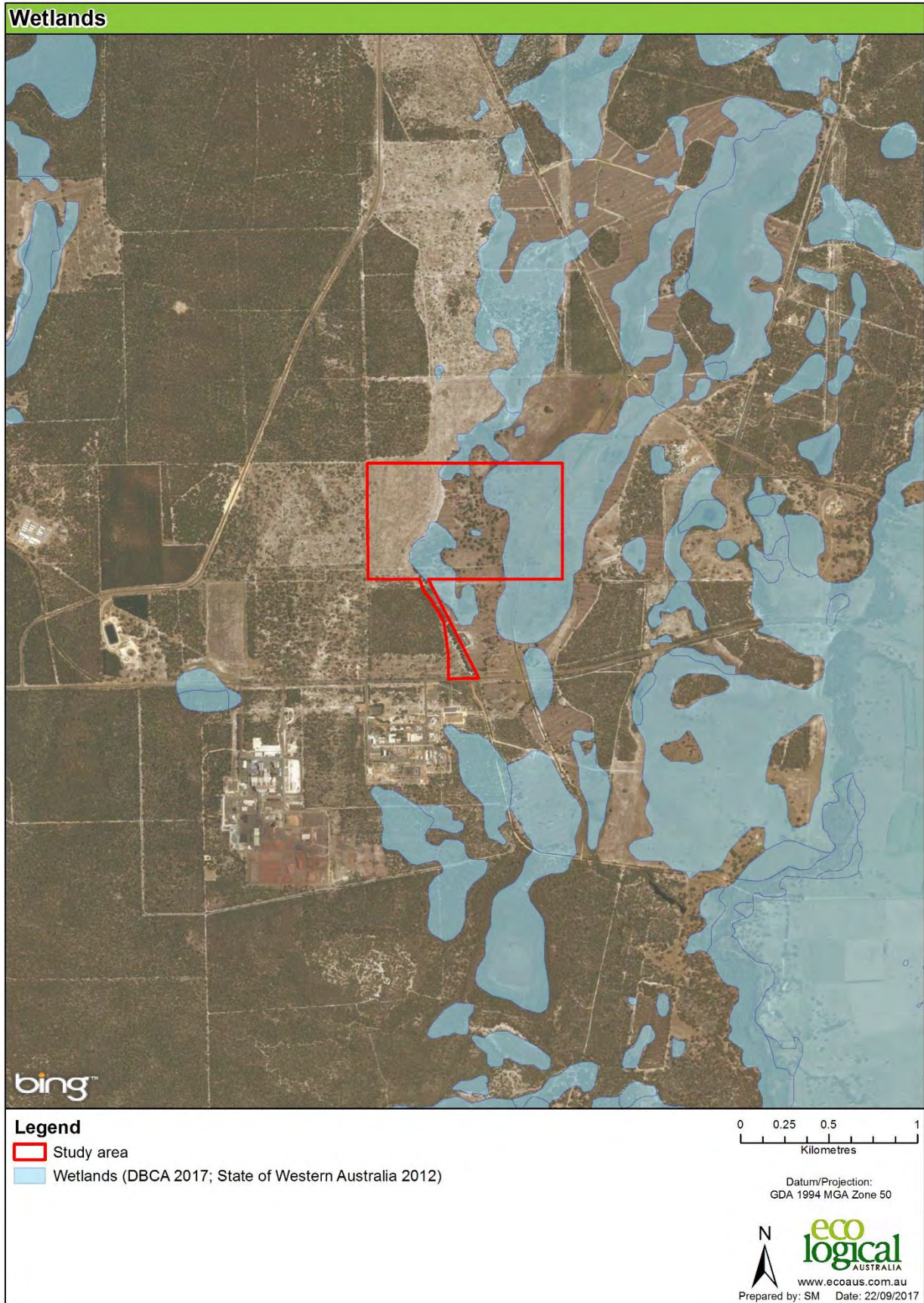


Figure 3-7: Wetlands within and in proximity to the study area

## 4 Summary and conclusion

Six vegetation communities were found to occur within in the study area, as well as an area of pine plantation which covers 41.9% (31.6 ha) of the study area. Of the six vegetation communities recorded, EmKgMr is considered to represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC as it meets the relevant guideline criteria (DotEE 2016). Previous studies have also found one vegetation community closely resembling the PEC 'Low lying *Banksia attenuata* woodlands or shrublands (Priority 3; DBCA 2017). This PEC is represented by the vegetation community EmKgMr

The most commonly occurring vegetation community found within the study area, XbEc: *Xanthorrhoea brunonis* open shrubland over \**Ehrharta calycina* (Perennial Veldt Grass) open grassland in previously cleared farmland (22.9 ha, 30.4%), supports the WC Act conservation significant flora species, *Acacia semitrullata* (Priority 4), which was observed at 58 locations within this vegetation community during the field survey, and at one location within the pine plantation.

Remnant vegetation in Good condition within the study area is confined to the south, with a narrow section on the western side and a patch on the eastern side. Remaining areas of the study area are in Degraded and Completely Degraded condition due to historical clearing and land uses. Areas of pine plantation, partially cleared pine plantation and previously cleared paddocks, though regenerating with native species, were found to be in Completely Degraded condition.

Vegetation communities containing Pine, *Eucalyptus* and/or *Banksia*, described during the site inspection, provide high - moderate quality foraging habitat for the conservation significant fauna species, Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). One small patch of Marri forest is considered as high quality potential breeding habitat for these species.

Approximately 40.2% (30.9 hectares) of the study area is a mapped wetland assigned a management category of 'Multiple Use', which is a wetland possessing few remaining important attributes and functions, except for local hydrological function. Consideration should be given to the implications of draining and/or filling in of the wetland on local hydrology if proposed for development.

A summary of ecological values within the study area is presented in **Table 4**.

**Table 4-1: Summary of ecological values occurring within the study area**

Ecological value	Western lot
Overview	Comprises small areas of remnant vegetation and more significant areas disturbed through historical activities such as clearing and plantations.
Conservation significant flora	<p><i>Acacia semitrullata</i> (Priority 4) has previously recorded at several locations and was observed during the site inspection at 59 locations within the study area.</p> <p>The study area is unlikely to support other conservation significant species based on the study being well surveyed and the lack of suitable habitat available for these species within the study area.</p>
Vegetation communities	<p>Contains six vegetation communities, the largest of which consists of <i>Xanthorrhoea</i> open shrubland over Perennial Veldt grass and occurs in the west of the study area (22.9 ha, 30.4%). Remaining areas comprise:</p> <ul style="list-style-type: none"> <li>• <i>Corymbia</i> closed forest over mixed shrubland and rushes;</li> <li>• <i>Eucalyptus</i> and <i>Banksia</i> low open woodland over tall sparse shrubland and mixed shrubland;</li> <li>• <i>Eucalyptus</i> isolated trees over <i>Melaleuca</i> and <i>Pinus</i> sp. low open woodland over sedgeland over very open grassland;</li> <li>• <i>Pinus</i> and <i>Eucalyptus</i> low open woodland in low lying seasonal dampland;</li> <li>• <i>Pinus</i> sp. open woodland over closed rushland in low lying seasonal dampland; and</li> <li>• <i>Xanthorrhoea</i> open shrubland over Perennial Veldt Grass open grassland in previously cleared farmland.</li> </ul>
Vegetation condition	Mostly in Completely Degraded and Degraded condition. Small area of Very Good condition.
Conservation significant vegetation	<p>One vegetation community has been previously determined to represent the PEC 'Low lying <i>Banksia attenuata</i> woodlands or shrublands' (Priority 3; DBCA 2017). This PEC is represented by the vegetation community EmKgMr.</p> <p>One vegetation community EmKgMr is considered to represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC as they meet the relevant guideline criteria (DotEE 2016). This vegetation community occurs in 2.4% (1.8 ha) of the study area and is considered to be in Good condition.</p>
Conservation significant fauna	Two conservation significant species have been previously recorded within the study area: Carnaby's Black and the Forest Red-tailed Black-Cockatoo. Evidence of Carnaby's Black Cockatoo and Forest Red-tailed Black-Cockatoo foraging has been previously observed within the study area by ELA. This species was not directly observed during the current field survey, however evidence in the form of chewed pine cones was recorded from within the study area.
Fauna habitats	Seven fauna habitats identified. The most widespread is pine plantation. Remaining habitats include Marri forest, Eucalyptus/Banksia woodland, woodland over sedgeland, sedgeland, regenerating farmland and pine plantation with Eucalyptus.
Habitats to support conservation significant fauna known or likely to occur	The pine plantation provides high foraging value for for the Carnaby's Cockatoo and Baudin's Cockatoo. This habitat covers approximately 42% over the centre of the study area. Areas of <i>Eucalyptus/Banksia</i> woodland also provide high foraging habitat

Ecological value	Western lot
	<p>for these species, as well as the Forest Red-tailed Black-Cockatoo, and cover approximately 2.4 % of the study area in the southeast.</p> <p>Areas of Marri woodland, covering a small section of the study area in the south, provide high potential breeding habitat for Black Cockatoo species.</p>
Wetlands	<p>Approximately 30.9 ha (40.2 %) of the study area is mapped wetland. This wetland has been assigned a wetland classification of Dampland and Sumpland, with a management category of 'Multiple Use' which is a wetland which has few remaining important attributes and functions, except for local hydrological function.</p>

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# Appendix A Framework for conservation significant flora and fauna in Western Australia

## CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

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

### Threatened species (T)

Published as Specially Protected under the Wildlife Conservation Act 1950, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the *Wildlife Conservation Act 1950 (WA)*.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the *Wildlife Conservation Act 1950 (WA)*

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using International Union for Conservation of Nature (IUCN) Red List categories and criteria as detailed below.

Schedule	Code	Description
<b>Schedule 1</b> Critically Endangered species	S1 (CR)	Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950 (WA)</i> , in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
<b>Schedule 2</b> Endangered species	S2 (EN)	Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950 (WA)</i> , in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
<b>Schedule 3</b> Vulnerable species	S3 (VU)	Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the <i>Wildlife Conservation Act 1950 (WA)</i> , in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.



Schedule	Code	Description
<p><b>Schedule 4</b></p> <p>Presumed extinct species</p>	S4 (EX)	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 <i>Wildlife Conservation Act 1950</i> (WA), 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.
<p><b>Schedule 5</b></p> <p>Migratory birds protected under an international agreement</p>	S5 (IA)	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 <i>Wildlife Conservation Act 1950</i> (WA), in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
<p><b>Schedule 6</b></p> <p>Conservation dependent fauna</p>	S6 (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> (WA), in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
<p><b>Schedule 7</b></p> <p>Other specially protected fauna</p>	S7 (OS)	Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the <i>Wildlife Conservation Act 1950</i> (WA), in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

### Priority species (P)

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

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

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Category	Code	Definition
Priority 1	P1	<p><i>Poorly-known species</i></p> <p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and</p>

Category	Code	Definition
		rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	P2	<i>Poorly-known species</i> Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	P3	<i>Poorly-known species</i> Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations 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 locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	P4	<i>Rare, Near Threatened and other species in need of monitoring</i>  (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 are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.  (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

## Appendix B Flora Likelihood Assessment

Species	Conservation Code			Source			Likelihood assessment
	EPBC Act	WC Act	DBCA	Nature Map	PMST	LandCorp dataset	
<i>Acacia flagelliformis</i>	-	-	P4	X	-	-	No
<i>Acacia semitrullata</i>	-	-	P4	X	-	X	Known
<i>Andersonia gracilis</i>	EN	S3	T	-	X	-	No
<i>Austrostipa bronwenae</i>	-	S2	T	X	-	-	No
<i>Banksia nivea</i> subsp. <i>uliginosa</i>	EN	S2	T	-	X	-	No
<i>Banksia squarrosa</i> subsp. <i>argillacea</i>	VU	S3	T	-	X	-	No
<i>Boronia juncea</i> subsp. <i>juncea</i>	-	-	P1	X	-	X	No
<i>Brachyscias verecundus</i>	CR	S1	T	-	X	-	No
<i>Caladenia huegelii</i>	EN	S1	T	X	X	-	No
<i>Caladenia procera</i>	CR	S1	T	X	X	-	No
<i>Caladenia speciosa</i>	-	-	P4	X	-	X	No
<i>Carex tereticaulis</i>	-	-	P3	X	-	-	No
<i>Chamaescilla gibsonii</i>	-	-	P3	X	-	-	No
<i>Chamelaucium</i> sp. S coastal plain (R.D.Royce 4872)	VU	S3	T	-	X	-	No
<i>Cyathochaeta teretifolia</i>	-	-	P3	X	-	-	No
<i>Darwinia whicherensis</i>	EN	S1	T	-	X	-	No
<i>Dillwynia dillwynioides</i>	-	-	P3	X	-	X	No
<i>Diuris drummondii</i>	VU	S3	T	X	-	X	No
<i>Diuris micrantha</i>	VU	S3	T	X	X	X	No
<i>Diuris purdiei</i>	EN	S2	T	-	X	-	No
<i>Drakaea elastica</i>	EN	S1	T	X	X	X	No
<i>Drakaea micrantha</i>	VU	S2	T	X	X	X	No
<i>Eleocharis keigheryi</i>	VU	S3	T	-	X	-	No
<i>Lambertia echinata</i> subsp. <i>occidentalis</i>	EN	S1	T	-	X	-	No
<i>Lasiopetalum membranaceum</i>	-	-	P3	X	-	-	No
<i>Microtis quadrata</i>	-	-	P4	-	-	X	No
<i>Pterostylis frenchii</i>	-	-	P2	X	-	-	No
<i>Puccinellia vassica</i>	-	-	P1	X	-	-	No
<i>Pultenaea skinneri</i>	-	-	P4	X	-	X	No
<i>Synaphea</i> sp. Fairbridge Farm	CR	S1	T	-	X	-	No
<i>Synaphea</i> sp. Fairbridge Farm (D.Papenfus 696)	CR	S1	T	-	X	-	No
<i>Synaphea stenoloba</i>	EN	S1	T	-	X	-	No
<i>Tripterococcus</i> sp. Brachylobus (A.S. George 14234)	-	-	P4	X	-	-	No
<i>Verticordia attenuata</i>	-	-	P3	X	-	-	No

<sup>1</sup>CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora (CR) under the WC Act.

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora (EN) under the WC Act.

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora (VU) under the WC Act.

T = Threatened species: flora that has been declared likely to become extinct or is rare, or otherwise in need of special protection, pursuant to section 23F(2) of the WC Act.

P1 = Priority 1: poorly known species that are known from one or a few locations which are potentially at risk, and are in urgent need of further survey. Listed by DBCA.

P2 = Priority 2: poorly known species known from one or a few locations, some of which are on lands managed primarily for nature conservation, and are in urgent need of further survey. Listed by DBCA.

P3 = Priority 3: poorly-known species known from several specimens or records but not under imminent threat, and need further survey. Listed by DBCA.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by DBCA.

<sup>2</sup>NatureMap = NatureMap database search (DBCA 2007 - 2017)

PMST = EPBC Act Protected Matters Report (DoEE 2017b).

## Appendix C Fauna Likelihood Assessment

Species	Conservation Status <sup>1</sup>		Source <sup>2</sup>		Likelihood assessment
	WC Act / DBCA	EPBC Act	Nature Map	PMST	
<i>Actitis hypoleucos</i> (Common Sandpiper)	-	IA	X	-	Unlikely
<i>Anous tenuirostris</i> subsp. <i>melanops</i> (Australian Lesser Noddy)	S2	VU	X	X	Unlikely
<i>Ardea ibis</i> (Cattle Egret)	S5	M	X	-	Potential
<i>Ardea modesta</i> (Eastern Great Egret)	S5	M	X	-	Potential
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	S2	EN	X	X	Unlikely
<i>Calidris acuminata</i> (Sharp-tailed Sandpiper)	S5	IA, M	X	-	Unlikely
<i>Calidris canutus</i> (Red Knot)	S5	EN	-	X	Unlikely
<i>Calidris ferruginea</i> (Curlew Sandpiper)	S3, S5	CR	-	X	Unlikely
<i>Calidris tenuirostris</i> (Great Knot)	S3, S5	CR, IA, M	X	-	Unlikely
<i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)	S3	VU	X	X	Known
<i>Calyptorhynchus baudinii</i> (Baudin's Cockatoo)	S2	VU	X	X	Likely
<i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo)	S2	EN	X	X	Known
<i>Charadrius leschenaultii</i> (Greater Sand Plover)	S3	VU, IA, M	X	-	Unlikely
<i>Dasyurus geoffroyi</i> (Chuditch)	S3	VU	X	X	Unlikely
<i>Diomedea amsterdamensis</i> (Amsterdam Albatross)	S1, S5	EN	-	X	Unlikely
<i>Diomedea dabbenena</i> (Tristan Albatross)	S1, S5	EN	-	X	Unlikely
<i>Diomedea epomophora</i> (Southern Royal Albatross)	S3, S5	VU	-	X	Unlikely
<i>Diomedea exulans</i> (Wandering Albatross)	S3, S5	VU	-	X	Unlikely
<i>Diomedea sanfordi</i> (Northern Royal Albatross)	S2, S5	EN	-	X	Unlikely
<i>Falco peregrinus</i> (Peregrine Falcon)	S7	-	X	-	Potential
<i>Falsistrellus mackenziei</i> (Western False Pipistrelle)	P4	-	X	-	Unlikely
<i>Galaxiella nigrostriata</i> (Black-stripe Minnow)	S2	-	X	--	Unlikely
<i>Halobaena caerulea</i> (Blue Petrel)	-	VU	-	X	Unlikely
<i>Hydromys chrysogaster</i> (Water-rat)	P4	-	X	-	Unlikely
<i>Isodon obesulus</i> subsp. <i>fusciventer</i> (Quenda)	P4	-	X	-	Unlikely
<i>Ixobrychus dubius</i> (Australian Little Bittern)	P4	-	X	-	Unlikely
<i>Leipoa ocellata</i> (Malleefowl)	S3	VU	-	X	Unlikely
<i>Lerista lineata</i> (Perth Slider)	P3	-	X	-	Unlikely
<i>Limosa lapponica</i> (Bar-tailed Godwit)	S3	IA, M	X	-	Unlikely
<i>Limosa lapponica baueri</i> (Western Alaskan Bar-tailed Godwit)	S3	VU	-	X	Unlikely
<i>Limosa lapponica menzbieri</i> (Northern Siberian Bar-tailed Godwit)	S3	CR	-	X	Unlikely
<i>Macronectes giganteus</i> (Southern Giant Petrel)	S5	EN, IA, M	X	X	Unlikely

Species	Conservation Status <sup>1</sup>		Source <sup>2</sup>		Likelihood assessment
	WC Act / DBCA	EPBC Act	Nature Map	PMST	
<i>Macronectes halli</i> (Northern Giant Petrel)	S5	VU	-	X	Unlikely
<i>Macropus irma</i> (Western Brush Wallaby)	P4	-	X	-	Potential
<i>Merops ornatus</i> (Rainbow Bee-eater)	S5	-	X	-	Likely
<i>Myrmecobius fasciatus</i> (Numbat)	S2	VU	X	-	Unlikely
<i>Numenius madagascariensis</i> (Eastern Curlew)	S3	CR, IA, M	X	X	Unlikely
<i>Oxyura australis</i> (Blue-billed Duck)	P4	-	X	-	Unlikely
<i>Pachyptila turtur subantarctica</i> (Fairy Prion)	-	VU	-	X	Unlikely
<i>Phoebastria fusca</i> (Sooty Albatross)	S2, S5	VU	-	X	Unlikely
<i>Plegadis falcinellus</i> (Glossy Ibis)	S5	IA, M	X	-	Unlikely
<i>Pluvialis fulva</i> (Pacific Golden Plover)	S5	IA, M	X	-	Unlikely
<i>Pluvialis squatarola</i> (Grey Plover)	S5	IA, M	X	-	Unlikely
<i>Pseudocheirus occidentalis</i> (Western Ringtail Possum)	S1	VU	X	X	Unlikely
<i>Pterodroma mollis</i> (Soft-plumaged Petrel)	-	VU	-	X	Unlikely
<i>Rostratula australis</i> (Australian Painted Snipe)	S2	EN	-	X	Unlikely
<i>Setonix brachyurus</i> (Quokka)	S3	VU	-	X	Unlikely
<i>Sternula nereis nereis</i> (Australian Fairy Tern)	-	VU	-	X	Unlikely
<i>Thalassarche carteri</i> (Indian Yellow-nosed Albatross)	S2, S5	VU	-	X	Unlikely
<i>Thalassarche cauta cauta</i> (Shy Albatross)	-	VU	-	X	Unlikely
<i>Thalassarche cauta steadi</i> (White-capped Albatross)	S5	VU	-	X	Unlikely
<i>Thalassarche impavida</i> (Campbell Albatross)	S3, S5	VU	-	X	Unlikely
<i>Thalassarche melanophris</i> (Black-browed Albatross)	S2, S5	VU	-	X	Unlikely
<i>Tringa glareola</i> (Wood Sandpiper)	S5	IA, M	X	-	Unlikely
<i>Tringa nebularia</i> (Common Greenshank)	S5	IA, M	X	-	Unlikely
<i>Tringa stagnatilis</i> (Marsh Sandpiper)	S5	IA, M	X	X	Unlikely

<sup>1</sup>CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

M = listed as Migratory species under the EPBC Act.

IA = migratory species protected under an international agreement under the EPBC Act.

S1 = Schedule 1: Fauna that is rare or is likely to become extinct as critically endangered fauna (CR) under the WC Act.

S2 = Schedule 2: Fauna that is rare or likely to become extinct as endangered fauna (EN) under the WC Act.

S3 = Schedule 3: Fauna that is rare or likely to become extinct as vulnerable fauna (VU) under the WC Act.

S5 = Schedule 5: Migratory birds protected under an international agreement (IA) under the WC Act.

S7 = Schedule 7: Other specially protected fauna (OS) under the WC Act.

P3 = Priority 3: poorly-known species known from several specimens or records but not under imminent threat, and need further survey. Listed by DBCA.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by Department of DBCA.

<sup>2</sup>NatureMap = NatureMap database search (DBCA 2007 - 2017)

PMST = EPBC Act Protected Matters Report (DoEE 2017b).

## Appendix D Flora species list

Family	Species	Common name
Araceae	* <i>Zantedeschia aethiopica</i>	Arum Lily
Asparagaceae	<i>Lomandra</i> sp.	-
Asteraceae	* <i>Arctotheca calendula</i>	Capeweed
	* <i>Hypochaeris glabra</i>	Smooth Catsear
	* <i>Silybum marianum</i>	Variegated Thistle
	* <i>Ursinia anthemoides</i>	Ursinia
Crassulaceae	* <i>Crassula colorata</i>	Dense Stonecrop
Dasygogonaceae	<i>Dasygogon bromeliifolius</i>	Pineapple Bush
Droseraceae	<i>Drosera macrantha</i>	Bridal Rainbow
Euphorbiaceae	* <i>Euphorbia terracina</i>	Geraldton Carnation Weed
Fabaceae	<i>Acacia pulchella</i>	Prickly Moses
	<i>Acacia pulchella</i> var. <i>goadbyi</i>	-
	<i>Acacia semitrullata</i> (P4)	-
	<i>Daviesia decurrens</i> subsp. <i>decurrens</i>	-
	<i>Jacksonia furcellata</i>	Grey Stinkwood
Geraniaceae	* <i>Erodium cygnorum</i>	Blue Heronsbill
Iridaceae	* <i>Romulea rosea</i>	Guildford Grass
Juncaceae	<i>Juncus kraussii</i> subsp. <i>australiensis</i>	-
	<i>Juncus pallidus</i>	Pale Rush
Myrtaceae	<i>Astartea scoparia</i>	Common Astartea
	<i>Corymbia calophylla</i>	Marri
	<i>Eucalyptus rudis</i>	Flooded Gum
	<i>Hypocalymma angustifolium</i>	White Myrtle
	<i>Kunzea glabrescens</i>	Spearwood
	<i>Melaleuca preissiana</i>	Moonah
Phytolaccaceae	* <i>Phytolacca octandra</i>	Red Ink Plant
Pinaceae	<i>Pinus pinaster</i>	Pinaster Pine
Poaceae	* <i>Cynodon dactylon</i>	Couch
	* <i>Ehrharta calycina</i>	Perennial Veldt Grass
Proteaceae	<i>Banksia attenuata</i>	Slender Banksia

Family	Species	Common name
	<i>Banksia ilicifolia</i>	Holly-leaved Banksia
Xanthorrhoeaceae	<i>Xanthorrhoea brunonis</i>	-



## Appendix E Fauna species list

Group	Species	Common name
Birds	<i>Anas superciliosa</i>	Pacific Black Duck
	<i>Anthochaera carunculata</i>	Red Wattlebird
	<i>Anthus novaeseelandiae</i>	Australasian Pipit
	<i>Barnardius zonarius</i>	Australian Ringneck
	<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo (foraging)
	<i>Corvus coronoides</i>	Australian Raven
	<i>Cracticus nigrogularis</i>	Pied Butcherbird
	<i>Cracticus tibicen</i>	Australian Magpie
	<i>Dacelo novaeguineae</i>	Kookaburra
	<i>Hirundo neoxena</i>	Welcome Swallow
	<i>Lichenostomus virescens</i>	Singing Honeyeater
	<i>Lichmera indistincta</i>	Brown Honeyeater
	<i>Malurus pulcherrimus</i>	Blue-breasted Fairywren
	<i>Phaps chalcoptera</i>	Common Bronzewing
	<i>Rhipidura albiscapa</i>	Grey Fantail
	<i>Rhipidura leucophrys</i>	Willy Wagtail
	<i>Smicromis brevirostris</i>	Weebill
	<i>Strepera versicolor</i>	Grey Currawong
<i>Tadorna tadornoides</i>	Australian Shelduck	
<i>Threskiornis moluccus</i>	Australian White Ibis	
Mammals	<i>Macropus fuliginosus</i>	Western Grey Kangaroo
	<i>Oryctolagus cuniculus</i>	Rabbit (diggings)
Reptiles	<i>Tiliqua rugosa</i>	Bobtail

## Appendix F Site data

Site number	Date	Site type	Observer
ELA16	05/09/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Degraded	384117	6325187



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Jacksonia furcellata</i>	1	M	Shrubs 1-2 m
<i>Xanthorrhoea brunonis</i>	20	M	Shrubs under 1 m
<i>Lomandra</i> sp.	0.1	L	Sedges
* <i>Ehrharta calycina</i>	1	L	Herbs
* <i>Arctotheca calendula</i>	0.1	L	Herbs
<i>Erodium cygnorum</i>	0.1	L	Herbs
* <i>Hypochaeris glabra</i>	0.1	L	Herbs
* <i>Romulea rosea</i>	0.1	L	Herbs
* <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	0.1	L	Herbs

Site number	Date	Site type	Observer
ELA17	05/09/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Degraded	384127	6325280



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Jacksonia furcellata</i>	1	M	Shrubs 1-2 m
<i>Xanthorrhoea brunonis</i>	22	M	Shrubs under 1 m
<i>Acacia pulchella</i> var. <i>goadbyi</i>	0.1	M	Shrubs under 1 m
* <i>Ehrharta calycina</i>	1	L	Herbs
* <i>Arctotheca calendula</i>	0.1	L	Herbs
<i>Erodium cygnorum</i>	0.1	L	Herbs
* <i>Hypochoeris glabra</i>	0.1	L	Herbs
* <i>Romulea rosea</i>	0.1	L	Herbs
* <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	0.1	L	Herbs

Site number	Date	Site type	Observer
ELA18	05/09/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Degraded	384109	6325412



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Xanthorrhoea brunonis</i>	10	M	Shrubs under 1 m
<i>Acacia semitrullata</i>	0.1	M	Shrubs under 1 m
<i>Acacia pulchella</i> var. <i>goadbyi</i>	0.1	M	Shrubs under 1 m
* <i>Ehrharta calycina</i>	1	L	Herbs
* <i>Arctotheca calendula</i>	0.1	L	Herbs
<i>Drosera macrantha</i>	0.1	L	Herbs
<i>Erodium cygnorum</i>	0.1	L	Herbs
* <i>Hypochaeris glabra</i>	0.1	L	Herbs
* <i>Romulea rosea</i>	0.1	L	Herbs
* <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	0.1	L	Herbs

Site number	Date	Site type	Observer
ELA09	06/07/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Good	384454	6324436



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Eucalyptus marginata subsp. marginata</i>	2	U	Trees under 10 m
<i>Banksia ilicifolia</i>	1	U	Trees under 10 m
<i>Kunzea glabrescens</i>	2	M	Shrubs over 2 m
<i>Xanthorrhoea brunonis</i>	45	M	Shrubs under 1 m
<i>Macrozamia riedlei</i>	2	M	Shrubs under 1 m



Site number	Date	Site type	Observer
ELA13	05/09/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Completely Degraded	385031	6324936



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Eucalyptus rudis</i>	1	U	Trees 10-30 m
<i>Melaleuca preissiana</i>	5	U	Trees under 10 m
<i>Pinus pinaster</i>	1	U	Trees under 10 m
* <i>Cynodon dactylon</i>	5	L	Grasses
<i>Juncus kraussii subsp. australiensis</i>	30	L	Sedges
<i>Juncus pallidus</i>	30	L	Sedges



Site number	Date	Site type	Observer
ELA01	05/09/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Degraded	384136	6325328



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Banksia ilicifolia</i>	5	U	Trees under 10 m
<i>Daviesia decurrens</i> subsp. <i>decurrens</i>	0.1	M	Shrubs 1-2 m
<i>Kunzea glabrescens</i>	0.1	M	Shrubs 1-2 m
<i>Xanthorrhoea brunonis</i>	10	M	Shrubs under 1 m
<i>Acacia pulchella</i>	0.1	M	Shrubs under 1 m
<i>Acacia semitrullata</i>	0.1	M	Shrubs under 1 m
* <i>Ehrharta calycina</i>	15	L	Grasses
* <i>Hypochaeris glabra</i>	0.1	L	Herbs
* <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	0.1	L	Herbs

Site number	Date	Site type	Observer
ELA02	05/09/2017	Quadrat 10x10 m	JC
Landform	Condition	Easting	Northing
Bassendean Complex	Completely Degraded	384824	6324974



Taxon	Cover (%)	Stratum*	Sub-Stratum
<i>Pinus pinaster</i>	10	U	Trees 10-30 m
<i>Astartea scoparia</i>	0.1	M	Shrubs 1-2 m
<i>Hypocalymma angustifolium</i>	1	M	Shrubs under 1 m
* <i>Cynodon dactylon</i>	5	L	Grasses
<i>Juncus kraussii</i> subsp. <i>australiensis</i>	75	L	Sedges
<i>Juncus pallidus</i>	1	L	Sedges

# Appendix G Conservation significant flora locations

Species	Coordinates	
	Easting	Northing
<i>Acacia semitrullata</i> (Priority 4)	384392	6325434
<i>Acacia semitrullata</i> (Priority 4)	384144	6325110
<i>Acacia semitrullata</i> (Priority 4)	384137	6325139
<i>Acacia semitrullata</i> (Priority 4)	384151	6325155
<i>Acacia semitrullata</i> (Priority 4)	384132	6325186
<i>Acacia semitrullata</i> (Priority 4)	384127	6325194
<i>Acacia semitrullata</i> (Priority 4)	384127	6325200
<i>Acacia semitrullata</i> (Priority 4)	384129	6325201
<i>Acacia semitrullata</i> (Priority 4)	384132	6325201
<i>Acacia semitrullata</i> (Priority 4)	384135	6325201
<i>Acacia semitrullata</i> (Priority 4)	384137	6325202
<i>Acacia semitrullata</i> (Priority 4)	384139	6325203
<i>Acacia semitrullata</i> (Priority 4)	384137	6325212
<i>Acacia semitrullata</i> (Priority 4)	384137	6325219
<i>Acacia semitrullata</i> (Priority 4)	384147	6325221
<i>Acacia semitrullata</i> (Priority 4)	384150	6325217
<i>Acacia semitrullata</i> (Priority 4)	384163	6325255
<i>Acacia semitrullata</i> (Priority 4)	384171	6325314
<i>Acacia semitrullata</i> (Priority 4)	384197	6325308
<i>Acacia semitrullata</i> (Priority 4)	384197	6325304
<i>Acacia semitrullata</i> (Priority 4)	384205	6325322
<i>Acacia semitrullata</i> (Priority 4)	384202	6325322
<i>Acacia semitrullata</i> (Priority 4)	384174	6325315
<i>Acacia semitrullata</i> (Priority 4)	384194	6325396
<i>Acacia semitrullata</i> (Priority 4)	384195	6325399
<i>Acacia semitrullata</i> (Priority 4)	384194	6325400
<i>Acacia semitrullata</i> (Priority 4)	384191	6325402
<i>Acacia semitrullata</i> (Priority 4)	384178	6325405

Species	Coordinates	
	Easting	Northing
<i>Acacia semitrullata</i> (Priority 4)	384171	6325403
<i>Acacia semitrullata</i> (Priority 4)	384172	6325413
<i>Acacia semitrullata</i> (Priority 4)	384174	6325419
<i>Acacia semitrullata</i> (Priority 4)	384180	6325431
<i>Acacia semitrullata</i> (Priority 4)	384188	6325440
<i>Acacia semitrullata</i> (Priority 4)	384227	6325486
<i>Acacia semitrullata</i> (Priority 4)	384240	6325482
<i>Acacia semitrullata</i> (Priority 4)	384251	6325507
<i>Acacia semitrullata</i> (Priority 4)	384224	6325533
<i>Acacia semitrullata</i> (Priority 4)	384181	6325510
<i>Acacia semitrullata</i> (Priority 4)	384171	6325447
<i>Acacia semitrullata</i> (Priority 4)	384144	6325449
<i>Acacia semitrullata</i> (Priority 4)	384125	6325435
<i>Acacia semitrullata</i> (Priority 4)	384123	6325432
<i>Acacia semitrullata</i> (Priority 4)	384114	6325432
<i>Acacia semitrullata</i> (Priority 4)	384106	6325424
<i>Acacia semitrullata</i> (Priority 4)	384101	6325418
<i>Acacia semitrullata</i> (Priority 4)	384077	6325400
<i>Acacia semitrullata</i> (Priority 4)	383977	6325151
<i>Acacia semitrullata</i> (Priority 4)	383983	6325170
<i>Acacia semitrullata</i> (Priority 4)	383969	6325219
<i>Acacia semitrullata</i> (Priority 4)	383966	6325230
<i>Acacia semitrullata</i> (Priority 4)	384015	6325300
<i>Acacia semitrullata</i> (Priority 4)	384013	6325308
<i>Acacia semitrullata</i> (Priority 4)	384004	6325345
<i>Acacia semitrullata</i> (Priority 4)	384009	6325375
<i>Acacia semitrullata</i> (Priority 4)	384024	6325430
<i>Acacia semitrullata</i> (Priority 4)	384028	6325447
<i>Acacia semitrullata</i> (Priority 4)	384044	6325478
<i>Acacia semitrullata</i> (Priority 4)	384018	6325556
<i>Acacia semitrullata</i> (Priority 4)	384079	6325555





#### HEAD OFFICE

Suite 2, Level 3  
668-672 Old Princes Highway  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

#### CANBERRA

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 0145  
F 02 9542 5622

#### COFFS HARBOUR

35 Orlando Street  
Coffs Harbour Jetty NSW 2450  
T 02 6651 5484  
F 02 6651 6890

#### PERTH

Suite 1 & 2  
49 Ord Street  
West Perth WA 6005  
T 08 9227 1070  
F 02 9542 5622

#### DARWIN

16/56 Marina Boulevard  
Cullen Bay NT 0820  
T 08 8989 5601  
F 08 8941 1220

#### SYDNEY

Suite 1, Level 1  
101 Sussex Street  
Sydney NSW 2000  
T 02 8536 8650  
F 02 9542 5622

#### NEWCASTLE

Suites 28 & 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 0125  
F 02 9542 5622

#### ARMIDALE

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2685  
F 02 9542 5622

#### WOLLONGONG

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2200  
F 02 9542 5622

#### BRISBANE

Suite 1, Level 3  
471 Adelaide Street  
Brisbane QLD 4000  
T 07 3503 7192  
F 07 3854 0310

#### HUSKISSON

Unit 1, 51 Owen Street  
Huskisson NSW 2540  
T 02 4201 2264  
F 02 9542 5622

#### NAROOMA

5/20 Canty Street  
Narooma NSW 2546  
T 02 4302 1266  
F 02 9542 5622

#### MUDGEES

Unit 1, Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1234  
F 02 6372 9230

#### GOSFORD

Suite 5, Baker One  
1-5 Baker Street  
Gosford NSW 2250  
T 02 4302 1221  
F 02 9542 5622

#### ADELAIDE

2, 70 Pirie Street  
Adelaide SA 5000  
T 08 8470 6650  
F 02 9542 5622

1300 646 131

[www.ecoaus.com.au](http://www.ecoaus.com.au)