Neerabup Lot 2001 Pederick Rd Flora, Vegetation and Black Cockatoo Survey

DevelopmentWA

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Template 2.8.1

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Abbreviations

Abbreviation	Description
BaBmLW	*Banksia attenuata*, *B. menziesii* Low Woodland
BAM Act	State *Biosecurity and Agriculture Management Act 2007*
BC Act	State *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CLUSTER	Hierarchical clustering analysis
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height
DIDMS	Dieback Information Delivery and Management System
DotEE	Department of the Environment and Energy
DPIRD	Department of Primary Industry and Regional Development
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EmBAf	*Eucalyptus marginata*, *Banksia attenuata* and *Allocasuarina fraseriana* Low Woodland
ELA	Eco Logical Australia
FCT	Floristic Community Type
IBRA	Interim Biogeographic Regionalisation for Australia
MDS	Multi-Dimensional Scaling
NIA	Neerabup Industrial Area
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
PRIMER	Plymouth Routines in Multivariate Ecological Research
SCP	Swan Coastal Plain
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
SIMPLER	Similarity percentages analysis
SWA02	Swan Coastal Plain IBRA Bioregion, Perth Subregion
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Community
WA	Western Australia
WAH	Western Australian Herbarium
WONS	Weeds of National Significance

Executive Summary

Eco Logical Australia was engaged by DevelopmentWA to undertake a Detailed and Targeted flora and vegetation survey and a Black Cockatoo habitat assessment at Lot 2001 Pederick Road, Neerabup within the Neerabup Industrial Area. Lot 2001 Pederick Road comprises of two blocks, one previously cleared 9.9 hectare block north of Pederick Road and a 12.3 hectare block of remnant vegetation south of Pederick Road. The southern block is the target of this survey and will be referred to as 'the survey area'. The survey area, located in Neerabup, approximately 35 kilometres north of Perth, Western Australia, forms part of the Meridian Business Park within the Neerabup Industrial Area.

Vegetation communities were described through the establishment of three 10 x 10 metre quadrats. A Targeted survey was conducted to record occurrences of any conservation significant flora species or communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the State *Biodiversity Conservation Act 2016* or by the Department of Biodiversity, Conservation and Attractions. Opportunistic flora species were also recorded across the survey area.

A total of 100 taxa (88 native and 12 introduced taxa) from 76 genera and 34 families were recorded across the survey area. Two Priority flora species were identified in the survey area, with 5 individuals in one small population of the Priority 2 taxon *Acacia benthamii* and a single individual of the Priority 3 taxon *Pimelea calcicola*. None of the introduced taxa were listed as Declared Pests under the State *Biosecurity and Agriculture Management Act 2007* or as Weeds of National Significance.

A single vegetation community was identified within the survey area, namely '**EmBAf**: *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Banksia attenuata* Woodland over Open Shrubland of *Xanthorrhoea preissii* over Low Shrubland of *Hibbertia hypericoides*, *Stirlingia latiflora*, *Eremaea pauciflora*, *Desmocladus asper* and *Mesomelaena pseudostygia* on grey loamy sands', covering a total of 11.84 hectares (96.6% of the survey area). This community correlated with the previously described vegetation community 'EmBAf' by RPS (2006), described as *Eucalyptus marginata*, *Banksia attenuata*, *B. menziesii* and *Allocasuarina fraseri* Low Woodland.

There were three values pertaining to Matters of National Environmental Significance within the survey area, Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) habitat.

To identify potential Threatened and Priority Ecological Communities in the survey area, ELA quadrats and vegetation was compared to Floristic Community Types defined by Gibson *et al*. (1994). Results of the multivariate analysis infer that quadrats 1 and 2 are closely affiliated with Floristic Community Type 20a and quadrat 3 is closely affiliated with Floristic Community Type 28. Each of these Floristic Community Types is recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as Priority 3 by the Department of Biodiversity, Conservation and Attractions. Under the State *Biodiversity Conservation Act 2016*, Floristic Community Type 20a (SCP20a) is listed as an Endangered Threatened Ecological Community (TEC). Floristic Community Type 28 (SCP28) is not listed on a state level.

Vegetation within the survey area was also assessed against key diagnostic characteristics outlined in the '*Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*' (Threatened Species Scientific Community 2016). Following steps provided in this document, vegetation within the survey area is considered to represent floristic aspects of the Banksia Woodlands of the Swan Coastal Plain'' Threatened Ecological Community (11.84 hectares; 96.6% of the survey area).

Majority of the survey area was recorded as being in Excellent Condition (94.5%), with the remainder recorded as Good condition (2.1%) and Completely Degraded condition (3.4%). The Completely Degraded area consisted of vehicle tracks and/or firebreaks intersecting and surrounding the survey area.

The gradual senescence noted in the *Banksia* population, with the absence of *B. menziesii* in the overstorey as compared to previous surveys in the area, comprises a current and ongoing threat to the quality of the Threatened Ecological Community present. It is likely due to gradual lowering of the groundwater level in the area and may have wider consequences for the surrounding TEC bushlands.

An assessment of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo habitat was undertaken in accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral guidelines (Department of Sustainability, Environment, Water, Populations and Communities 2012). This involved assessing all significant tree species known to support potential suitable breeding and roosting habitat. Vegetation present within the survey area was assessed for its potential to provide foraging and roosting habitat for black cockatoos as per the EPBC Act referral guidelines, and the extent of potential suitable habitat within the survey area was mapped. Observations were also made of any black cockatoo foraging activity or feeding residue such as chewed Banksia cones and Jarrah nuts, and any black cockatoo individuals observed within the survey area.

The vegetation of the survey area was assessed for the quality of black cockatoo foraging habitat, with 100% of the vegetation (11.84 hectares) classified as 'Good' quality foraging habitat for Carnaby's Cockatoo and 'Moderate' quality foraging habitat for Forest Red-tailed Black Cockatoos. The assessment of significant trees for black cockatoo breeding and roosting habitat identified 53 potential habitat trees, 52 of which were Jarrah (*Eucalyptus marginata*) and one dead (unidentifiable) tree. Of these, five trees contained observable hollows from the ground.

1. Introduction

1.1 Project overview

Eco Logical Australia (ELA) understands that DevelopmentWA is planning resource extraction and industrial land development at Lot 2001 Pederick Road in Neerabup ('the project'). Lot 2001 Pederick Road comprises of two blocks, one previously cleared 9.9 hectare (ha) block north of Pederick Road and a 12.25 ha block of remnant vegetation south of Pederick Road. The southern block is the target of this survey and will be referred to as 'the survey area' (**Figure 1**). The survey area, located in Neerabup, approximately 35 kilometres (km) north of Perth, Western Australia, forms part of the Meridian Business Park within the Neerabup Industrial Area (NIA).

A desktop assessment of the project was undertaken in May 2016 (ELA 2016) and identified the following values pertaining to Matters of National Environmental Significance (MNES) in the survey area:

- 'Banksia Woodlands of the Swan Coastal Plain' ecological community, listed as Endangered (EN) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as Priority (P) 3 by the Department of Biodiversity, Conservation and Attractions (DBCA); and
- Habitat for Carnaby's Cockatoo (*Calyptorhynchus latirostris*), listed as EN under EPBC Act and *State Biodiversity Conservation Act 2016* (BC Act).

As recent changes in foraging preferences has caused the distribution of the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) to extend further north on the Swan Coastal Plain (Department of Agriculture, Water and the Environment (DAWE) 2020a), the survey area was also likely to provide suitable habitat for this species, listed as VU under EPBC Act and BC Act.

The recently listed Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (listed as EN under the EPBC Act) was also identified as potentially occurring within the survey area.

ELA were commissioned to undertake the following tasks to support the EPBC Referral and supporting documentation to the DAWE:

- Completion of a Detailed and Targeted flora and vegetation survey in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016), including:
  - Identification and mapping of vegetation communities, including identification of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs);
  - Assessment and mapping of vegetation structure, cover and condition; and
  - A Targeted survey for Federal, State and/or DBCA conservation listed flora species;
- Undertake a black cockatoo habitat assessment for black cockatoos, in accordance with the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) *EPBC Act referral guidelines for three threatened black cockatoo species* (SEWPaC 2012).

Figure 1: Lot 2001 Pederick Rd Neerabup and Survey Area

Legend

- Survey Area
- Lot 2001 Pederick Rd, Neerabup

0 200 400 800
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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2. Environmental Setting

2.1 Climate

The survey area is located in the Swan Coastal Plain bioregion (Swan Coastal Plain; SWA02) as defined by the Interim Biogeographic Regionalisation for Australia (IBRA; DAWE 2020b). This subregion is described as having a Mediterranean type climate, with total annual rainfall ranging between 600 and 1000 mm (Williams *et al*. 2002). The survey area receives, on average, a total of 733.2 mm of rainfall per year with most rainfall occurring during the winter months of June, July and August (127.8 mm, 144.5 mm and 125.5 mm respectively; BoM 2019).

2.2 Regional context

Environmental values for the region relevant to the survey area are presented in **Table 1**.

Table 1: Environmental values of the region

Existing environmental attributes	Survey area
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion (DAWE 2020b)	Swan Coastal Plain (SWA)
IBRA Subregion	Perth (SWA02) – commonly characterised by Tuart and heath on limestone soils and Banksia-Jarrah-Marri woodland on sandy soils. The subregional area is 1,333,901 ha (Mitchell et al. 2002).
Geology, landform and soils	Situated on the Spearwood Dune System (Spearwood 6) with soils derived from Tamala Limestone, characterised as yellow sands of quartz, coated with iron oxide (Government of Western Australia 2000). The Spearwood Sand Phase occurs within the survey area, characterised by undulating dunes with rocky crests on Aeolian sand over limestone.

2.3 Broad-scale vegetation mapping

Vegetation type and extent have been mapped at a regional scale by Beard (1990) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Primary Industries and Regional Development (DPIRD; previously Department of Agriculture and Food Western Australia (DAFWA)) has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002).

One vegetation association occurs within the survey area, 'Spearwood 6 – Medium woodland, tuart and jarrah' (**Table 2**). This vegetation association has less than 25% of its total pre-European extent remaining within the Swan Coastal Plain subregion (Government of Western Australia 2019).

Table 2: Beard (1990) / Shepherd et al. (2002) vegetation associations of the survey area

Vegetation association	Description	Pre-European extent (ha) within the Swan Coastal Plain (SWA02) subregion	Current extent (ha) within the Swan Coastal Plain (SWA02) subregion	Remaining (%)
Spearwood 6	Medium woodland, tuart and jarrah	56,343.01	13,362.25	23.72

2.4 Black cockatoos

The distribution of two species of black cockatoo overlaps with the survey area (Department of the Environment and Energy (DotEE) 2017); Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo. The survey area is part of a recent extension of the Forest Red-tailed Black Cockatoo distribution on the Swan Coastal Plain. Previously, this species was not observed further than approximately 20 km from the CBD on the northern Swan Coastal Plain (SEWPaC 2012), however changes in foraging preferences have caused more regular movements of this species onto the Swan Coastal Plain and around the Perth metropolitan area to feed on the introduced Cape Lilac (*Melia azedarach*; DAWE 2020a). Carnaby's Cockatoo has previously been recorded foraging within the survey area (ELA 2016), and there is a record of the Forest Red-tailed Black Cockatoo 2.2 km SSE of the survey area (DBCA 2007-2019).

Both species nest in hollows formed in large eucalypts. Carnaby's Cockatoo forage on a wide range of species, particularly proteaceous plants, while Red-tailed Black Cockatoos have a more restrictive diet, targeting *Eucalyptus*/*Corymbia* seeds, *Allocasuarina* cones, the fruits of Snottygobble (*Persoonia longifolia*) and the Cape Lilac. Common foraging, roosting and breeding flora species are summarised in **Table 3** (SEWPaC 2012).

Table 3: Black cockatoo breeding, foraging and roosting habitat. Table adapted from SEWPaC 2012.

Habitat	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo
Breeding	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 (*Eucalyptus salmonophloia*), Wandoo (*E. wandoo*), Tuart, Jarrah, Flooded Gum (*E. rudis*), York Gum (*E. loxophleba* subsp. *loxophleba*), Powderbark (*E. accedens*), Karri (*E. diversicolor*) and Marri (*Corymbia calophylla*).	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.
Foraging	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp., *Hakea* spp. and *Grevillea* spp. Forages in pine plantations (*Pinus* spp.), eucalypt woodland and forest that contains foraging species, and individual trees and small stands of these species. Common food items: seeds, flowers and nectar of native proteaceous plant species (for example, *Banksia* spp., *Hakea* spp. and *Grevillea* spp.), eucalypts and *Callistemon* spp. 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.	Jarrah and Marri woodlands and forest, and edges of Karri forests including Wandoo and Blackbutt, within the range of the subspecies. Common food items: 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 and Mountain Marri (*Corymbia haematoxylon*). On the Swan Coastal Plain, often feed on introduced Cape Lilac.
Night Roosting	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.

3. Methodology

3.1 Desktop review

3.1.1 Literature review

A desktop assessment Lot 2001 Pederick Road was previously prepared by ELA in May 2016 (ELA 2016). The objective of the desktop assessment was to review available biological survey reports completed in and around the survey area. This report has been summarised in Section 4.1. In addition, the following documents were reviewed:

- RPS (2006) - *Flora and Vegetation Report, Lots 4, 40, 41 & 1002, Neerabup Industrial Estate*;
- ATA Environmental (2007) - *Flora, Vegetation and Vertebrate Fauna Assessment. Neerabup Industrial Area;*
- ELA (2012) - *Ground Truthing of Environmental Values for Lot 4 Flynn Drive, Neerabup*;
- ELA (2013a) - *Targeted Flora and Fauna Assessment, Lot 4 Flynn Drive Neerabup*; and
- ELA (2013b) - *Flora and Fauna Technical Studies, Lot 1002 Pederick Road, Neerabup*.

3.1.2 Database searches

Prior to the field survey, ELA conducted a desktop assessment to gather information on potentially occurring conservation listed flora species within the survey area. The following databases were searched:

- EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act (DoEE 2019a); and
- DBCA and Western Australian Museum's NatureMap (DBCA 2007-2019).

A 5 km buffer around the central coordinate 386252 mE, 6494907 mN was applied for each of the above database searches for flora. These buffers were considered suitable based on species assemblages expected to occur within the survey area.

3.1.3 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken to identify conservation listed flora species that possibly occur within the survey area, identified from a review of the key datasets and literature as outlines above. Conservation codes, categories and criteria for flora and fauna protected under the EPBC Act and the BC Act are provided in **Appendix A**. Criteria used for this assessment is presented in **Appendix B**.

3.2 Field survey

3.2.1 Survey team and timing

The field survey was conducted on 21st November 2019 by Daniel Brassington (Botanist) and Briana Wingfield (Ecologist). The survey was undertaken under scientific collection licence SL012503 (Dan Brassington) and permit to take DRF collection licence TFL 15-1920 (Dan Brassington).

Based on climate data from the nearby Bureau of Meteorology (BoM) Perth weather station (station number 9225) a total of 145.6 mm of rainfall was received in the three months preceding the field survey (August-October), which is less than the average rainfall of 247.1 mm for the same period (BoM 2019).

3.2.2 Flora and vegetation survey

The flora and vegetation survey was conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). A total of three quadrats were established across the survey area to meet the requirement of three quadrats established per vegetation unit, as outlined in the EPA guidance statement (EPA 2016; **Figure 2**).

Fence droppers were used to mark the north-west corner of each quadrat. Dominant vegetation communities were described, with respect to dominant species, structure and overall condition. The survey involved the use of 10 x 10 m quadrats as recommended for the Swan Coastal Plain bioregion (EPA 2016). Opportunistic sampling of species not recorded within the quadrats was undertaken to supplement the existing list of species recorded from within the survey area.

Photos were taken from the north-west corner of each quadrat. The following data was recorded within each quadrat:

- Site details (site name, site number, observers, date and location);
- Environmental information including landform, soil type and colour, bare ground and leaf litter cover, rock outcropping and time since last fire event; and
- Biological information including vegetation structure, vegetation condition in accordance with Keighery (1994), degree of disturbance, species present and species percentage cover.

A Targeted survey was completed within the survey area to identify any conservation significant flora or communities potentially occurring, including:

- Threatened flora or TECs listed under the EPBC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice under the BC Act;
- PECs endorsed by the Western Australian Minister for the Environment;
- Priority (P) flora recognised by DBCA; and
- Bush Forever significant flora (Government of Western Australia 2000).

The survey methodology involved personnel walking transects across the survey area, with transects spaced (on average) 5-20 m apart depending on factors such as habitat type, disturbance (e.g. tracks) and landform. Locations of survey transects are shown in **Figure 2** below. Flora species able to be identified in the field were recorded, and voucher specimens of unfamiliar species were collected for

later identification. All collections were assigned a unique collecting number. For conservation significant flora species identified in the field, the following was recorded:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries;
- Associated habitat/landscape element;
- Time and date observed;
- Observer details; and
- A voucher specimen suitable for use as a reference specimen (if appropriate to do so for conservation significant flora).

3.2.3 Black cockatoo assessment

An assessment of Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo habitat was undertaken in accordance with the EPBC Act referral guidelines (SEWPaC 2012). This involved assessing all significant tree species known to support potential suitable breeding, roosting and foraging habitat. Significant breeding trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 millimetres (mm). Trees with a DBH greater than 500 mm are large enough to potentially contain hollows suitable for nesting black cockatoos or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). All potential breeding trees with a DBH of 500 mm or greater encountered within survey area was recorded.

Vegetation present within the survey area was assessed for its potential to provide foraging and roosting habitat for black cockatoos as per the EPBC Act referral guidelines (SEWPaC 2012), and the extent of potential suitable habitat within the survey area was mapped.

Observations were also made of any black cockatoo foraging activity or feeding residue such as chewed Banksia cones or Jarrah (*Eucalyptus marginata*) nuts, and any cockatoo individuals observed within the survey area.

3.3 Data analysis

3.3.1 Vegetation communities

Plymouth Routines in Multivariate Ecological Research v6 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites based on their species composition (Clarke and Gorley 2006). A presence/absence transformation was applied to the dataset to align with Gibson *et al.* (1994). Introduced species (weeds), specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set prior to analysis. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities. Previously assigned vegetation mapping codes and descriptions (ELA 2013a, 2013b) were retained during the current assessment to provide consistency between survey periods.

3.3.1.1 Floristic Community Type (FCT) Analysis

Floristic Community Type (FCT) refers to the vegetation types derived by Gibson et al. (1994) through the floristic survey of the Swan Coastal Plain (SCP). Species within the Gibson *et al*. (1994) data set were updated to align with current names as specified by FloraBase (DBCA and WAH 2019). Using current records, a number of species in the Gibson *et al*. (1994) data set were shown to be significant range extensions from the Swan Coastal Plain, where appropriate such cases were removed. In addition, excluded and misapplied names were removed from the data set and infra-specific names were reduced. The merged dataset was analysed using a combination of pre-treatments such as the inclusion and/or removal of introduced species and singletons. The removal of both singletons and introduced species from the merged dataset, an accepted pre-treatment for such analysis, produced the best results (e.g. stronger correlations; Clarke and Gorley 2006). Inclusion of such data (i.e. weeds and singletons) merely served to confound the dataset by introducing stochastic and 'site' artefact data. Transformed data were analysed using a combination of multivariate analysis routines including Bray-Curtis Similarity Matrices, Cluster Analysis (Flexible Beta single site insertion) and Multi-Dimensional Scaling (MDS).

To identify potential TECs and PECs in the survey area, ELA quadrats and vegetation communities were compared to FCTs defined by Gibson *et al*. (1994). To identify the presence of FCT's appropriate multivariate analyses comparing current data to that of Gibson *et al*. (1994) species by quadrat data, and inferences based on dominant species and geomorphology were used. Given the nature of the data (e.g. spatial and temporal differences), results and subsequent extrapolations, assigned FCT's within the survey area were inferred and not absolute, i.e. a vegetation code assigned to an FCT was inferred to comprise, to varying degrees, floristic aspects of that FCT as defined by Gibson *et al*. (1994). These FCTs were subsequently compared with vegetation communities delineated by ELA (2013a, 2013b, 2012) and ATA Environmental (2007).

3.3.1.2 Assessment of diagnostics to assess presence of Threatened Ecological Communities

The 'Banksia Woodlands of the Swan Coastal Plain' TEC is listed as Endangered under the EPBC Act (TSSC 2016). For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Listing Advice and/or Conservation Advice and Recovery Plan on the DAWE Species Profile and Threats Database (TSSC 2016). The Listing Advice and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations (TSSC 2016).

In order to determine whether the 'Banksia Woodlands of the Swan Coastal Plain' TEC is present in the survey area key diagnostic characteristics must be met under Section 2 of the Conservation Advice (TSSC 2016). The four-stage assessment identified by DAWE to ascertain the presence of the Banksia woodlands endangered ecological community within the site was undertaken by ELA following the field survey.

The 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community is listed as Critically Endangered under the EPBC Act (DotEE 2019b). For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Listing Advice and/or Conservation Advice on the DAWE Species Profile and Threats Database (DoEE 2019b). The Listing Advice and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations.

In order to determine whether the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC is present in the survey area key diagnostic characteristics must be met under Section 3.2 of the Conservation Advice (DoEE 2019b). The assessment identified by DotEE to ascertain the presence of the Tuart (*Eucalyptus gomphocephala*) woodlands endangered ecological community within the site was undertaken by ELA following the field survey.

3.4 Flora identification and nomenclature

Flora specimen identification was undertaken by ELA Botanist Daniel Brassington, with additional specimens confirmed by the Western Australian Herbarium (WAH). Species identification utilised taxonomic literature and keys and where required specimens were confirmed using the WAH collection. Suitable material that meets WAH specimen lodgement requirements, such as new incidences of Threatened or Priority flora, range extensions and good floristic material where current collections lack, will submitted along with Threatened and Priority Report forms to DBCA, as required by conditions of collection licences issued under the BC Act. Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (DBCA and WAH 2019).

3.5 Limitations

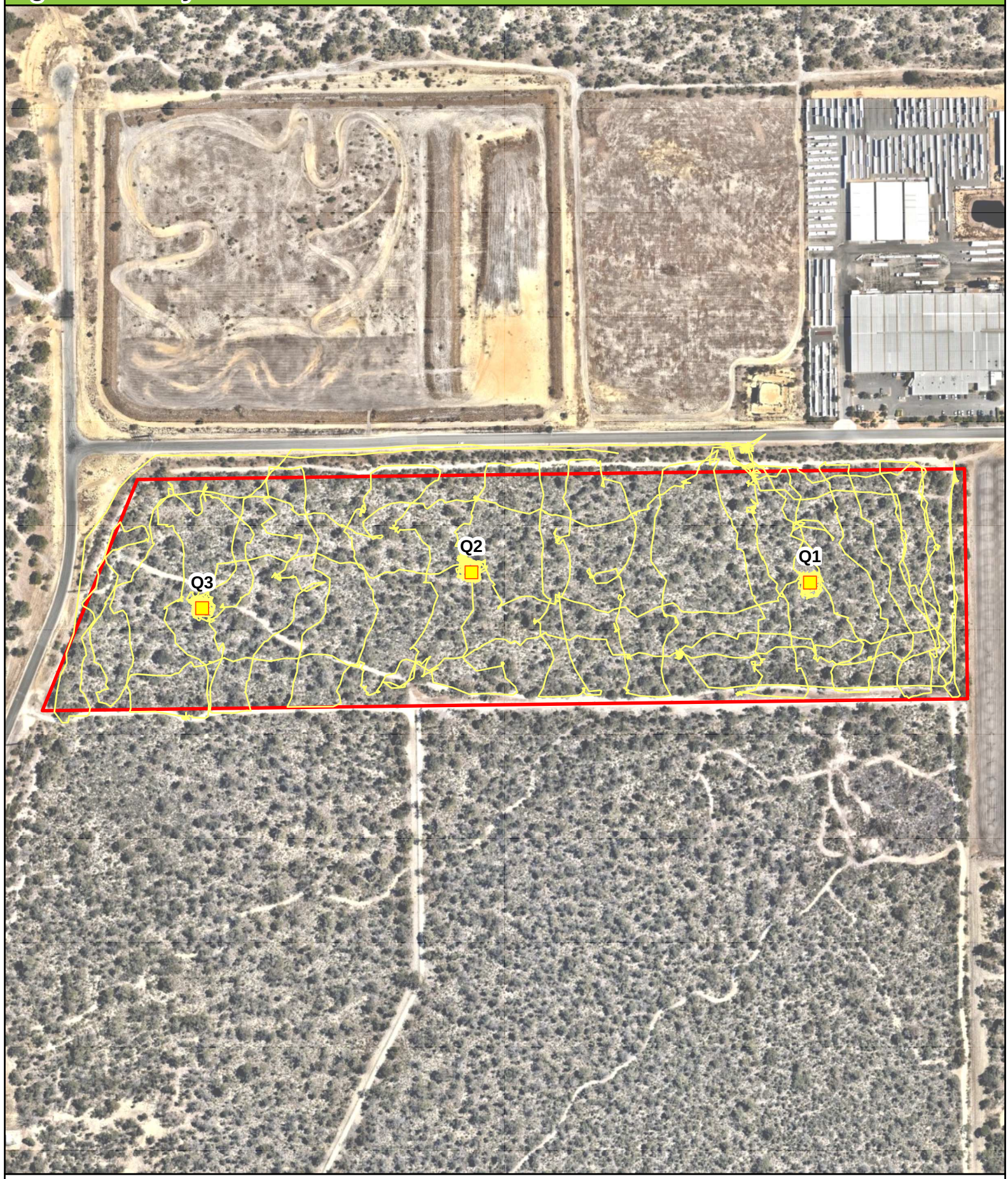
The EPA *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the detailed and targeted flora and vegetation for the survey area summarised in **Table 4** below.

Table 4: Survey limitations

Constraint	Limitations
Sources of information	**Not a constraint:** The Swan Coastal Plain has been well surveyed, with increasing survey work occurring due to the ongoing urban development of the Perth metropolitan area. A number of flora and fauna surveys have been undertaken in the survey area which have been utilised for the purposes of this survey. Gibson *et al* 1994 was a primary source for determination of methods, analysis and results for assessing FCTs. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. The information which was available was sufficient and as such sources of information were not considered a major limitation.
Scope of work	**Not a constraint:** The survey requirement for a Detailed and Targeted flora and vegetation survey in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) was adequately met.
Completeness of survey	**Not a constraint:** The area was surveyed to the satisfaction of the scope and a Detailed and Targeted flora and vegetation survey and a black cockatoo habitat assessment as per relevant guidelines.
Intensity of survey	**Not a constraint:** Survey effort was considered adequate to meet objectives of the scope. The area was surveyed for conservation significant flora species and vegetation communities by field staff undertaking transects across the survey area spaced 5-20 m apart on average. This method provided an accurate assessment of habitat characteristics and likelihood of conservation significant species. The number of quadrats established was sufficient to determine the vegetation communities present and to identify any vegetation of conservation significance.

Constraint	Limitations
Timing, weather, season, cycle	**Not a constraint:** The survey area is located in the Swan Coastal Plain bioregion of Western Australia. Recommended survey timing for this region is in spring (September – November; EPA 2016). The field survey was undertaken in mid-November. Many flora species were flowering at the time of the field survey or had sufficient material (fruit) available to identify the dominant and target species. The timing was appropriate for conducting this level of survey.
Disturbances	**Not a constraint:** Disturbances within the survey area included the presence of weeds, unauthorised access (walk trails and bike tracks) and edge effects. These disturbances did not negatively impact the ability to meet objectives outlined in the scope of works.
Resources	**Not a constraint:** The personnel conducting this field survey were both suitably qualified to identify specimens, having previously undertaken flora and vegetation assessments and black cockatoo habitat assessments on the Swan Coastal Plain.
Accessibility	**Not a constraint:** All relevant areas of the survey area were easily accessed and able to be surveyed.

Figure 2: Survey Effort



Legend

- Survey Area
- Quadrat (10mx10m)
- Tracklog

0 30 60 120
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4. Results

4.1 Desktop review

The PMST (DotEE 2019a) and NatureMap searches (DBCA 2007-2019) were undertaken to identify conservation significant flora species recorded within, or nearby to, the survey area. A total of 24 conservation listed flora were identified as having potential to occur within the survey area based on these database searches. A likelihood of occurrence assessment table is presented in **Appendix C**. Previous surveys did not record any conservation listed flora (ELA 2012, 2013a, 2013b).

The previous review of the area (ELA 2016) found that prior works carried out in the area were generally consistent with one another, with any differences seemingly based on the scale at which vegetation was assessed. A summary of previous findings is shown in **Table 5** below.

Table 5: Previous biological surveys and reports completed in the survey area and surrounds

Source	Environmental Aspect	Conclusion
Flora and Vegetation Report, Lots 4, 40, 41 & 1002, Neerabup Industrial Estate (RPS 2006)	Flora and vegetation	Vegetation was mapped as vegetation community EmBAf (*Eucalyptus marginata*, *Banksia menziesii*, *B. attenuata* and *Allocasuarina fraseriana* Low Woodland). Vegetation was mapped as being Completely Degraded through to Excellent.
Flora, Vegetation and Vertebrate Fauna Assessment. Neerabup Industrial Area (ATA Environmental 2007)	Flora, vegetation and vertebrate fauna.	Vegetation was mapped as Very Good condition vegetation community BaBmLW (*Banksia attenuata* and *B. menziesii* Low Woodland). Two black cockatoo potential breeding trees were recorded.
Ground Truthing of Environmental Values for Lot 4 Flynn Drive, Neerabup (ELA 2012)	Vegetation community and condition, occurrence of dieback and declared weeds, and Carnaby's Cockatoo habitat.	The results of ground truthing of specific environmental values previously identified by RPS (2006) and ATA Environmental (2007). The vegetation community south and north of the survey area was considered to be EmBAf. An additional 28 potential Black Cockatoo breeding trees were recorded, in comparison with the 15 trees mapped by ATA Environmental (2007).
Targeted Flora and Fauna Assessment, Lot 4 Flynn Drive Neerabup (ELA 2013a)	Targeted flora and fungi survey, re-assessment of ATA Environmental (2007) vegetation communities.	This survey had similar findings to ELA (2012). The vegetation community south and north of the survey area was considered to be EmBAf. One potential Carnaby's Cockatoo breeding tree was mapped within the survey area.
Flora and Fauna Technical Studies, Lot 1002 Pederick Road, Neerabup (ELA 2013b)	Targeted flora and fungi survey, re-assessment of ATA Environmental (2007) vegetation communities.	This survey was undertaken in the exact same survey area and in part resurveyed this section from ATA, 2007. The vegetation community was considered to be BaBmLW, as was found by ATA (2007) and was in Very Good condition across the majority of the survey area with a small area in Degraded condition in the north-east corner and a small area in Good condition in the south-west. A total of 48 potential Carnaby's Cockatoo breeding trees were identified, with seven trees observed containing hollows possibly suitable for Carnaby's Cockatoo nesting. Evidence of Carnaby's Cockatoo foraging activity was recorded.

4.2 Flora and Vegetation

4.2.1 Flora overview

A total of 100 taxa (88 native and 12 introduced taxa) from 76 genera and 34 families were recorded across the survey area. Families with the highest number of species included Fabaceae, Proteaceae and Myrtaceae, with 17, nine and eight species respectively. *Lomandra* and *Acacia* were the best represented genera with four and five species recorded respectively. A flora species list is provided in **Appendix D**.

Three quadrats were established in representative locations across the survey area, their locations shown in **Figure 2**. All three recorded a mixed Jarrah – *Banksia - Allocasuarina* woodland on grey sandy soils with differences mostly evident in the understory composition. Individual quadrat data is presented in **Appendix E** and a summary of each is presented below in **Table 6**.

Table 6 Quadrat Vegetation Summaries

Quadrat	Location (UTM) of North West Corner	Vegetation Description
Quadrat 1	50J 0385875 mE 6494668 mS	*Eucalyptus marginata* and *Allocasuarina fraseriana* Woodland over *Banksia attenuata* very open low woodland, over *Jacksonia sternbergiana* and *Xanthorrhoea preissii* very open shrubland, over *Stirlingia latiflora*, *Hibbertia hypericoides* and *Eremaea pauciflora* subsp. *pauciflora* low mid- shrubland, over *Desmocladus asper*, *Lyginia barbata*, *Mesomelaena pseudostygia*, *Petrophile linearis*, *Calytrix flavescens* and *Hypocalymma robustum* open sedgeland/low-shrubland.
Quadrat 2	50J 0385611 mE 6494676 mS	*Eucalyptus marginata* and *Allocasuarina fraseriana* Woodland over *Banksia attenuata* very open low woodland, over *Xanthorrhoea preissii* very open shrubland, over *Stirlingia latiflora* and *Eremaea pauciflora* subsp. *pauciflora* scattered mid-shrubs, over *Hibbertia hypericoides*, *Desmocladus asper*, *Mesomelaena pseudostygia*, *Lyginia imberbis*, *Calytrix flavescens* and *Hypocalymma robustum* low shrubland/sedgeland.
Quadrat 3	50J 0385401 mE 6494648 mS	*Eucalyptus marginata* Woodland over *Allocasuarina fraseriana* and *Banksia attenuata* very open low woodland, over *Xanthorrhoea preissii* shrubland, over *Hibbertia hypericoides*, *Stirlingia latifolia*, *Patersonia occidentalis, Hypocalymma robustum*, *Desmocladus asper* and *Mesomelaena pseudostygia* low shrubland/ sedgeland.

4.2.2 Conservation significant flora

No flora species listed as Threatened under the EPBC Act or BC Act were recorded within the survey area. Two DBCA listed Priority flora species were recorded within the survey area namely *Acacia benthamii* (P2) and *Pimelea calcicola* (P3).

Acacia benthamii was recorded opportunistically, with five individuals recorded from a single location within the survey area, near the southern boundary (**Figure 3** and **Figure 5**; confirmed at the WAH). This species was recorded as occurring within Open Forest of *Eucalyptus marginata* and *Allocasuarina fraseriana* over Woodland of *Banksia attenuata* on mid-slopes of grey loamy sand. Individuals of this species were not flowering at the time of the field survey.

Pimelea calcicola was recorded from a single individual within Quadrat 2 (**Figure 4** and **Figure 5**). This species was historically recorded as occurring within Open Forest of *Eucalyptus marginata* and

Allocasuarina fraseriana over Woodland of *Banksia attenuata* on mid-slopes of grey loamy sand. This individual was not in flower at the time of the field survey.

Of the 24 conservation flora species initially considered to possibly occur within the survey area, five were considered to have potential to occur due to presence of suitable habitat and detectability of these species during the field survey. The remaining 19 species were considered unlikely to occur within the survey area. A flora likelihood of occurrence assessment is presented in **Appendix C**.

Figure 3: ***Acacia benthamii*** **(P2) recorded within the survey area**

Figure 4: ***Pimelea calcicola*** **(P3). Source: WAH 1998-.**

Figure 5: Conservation significant flora recorded within the survey area

Legend

Survey Area

Priority Species

Acacia benthamii (P2)

Pimelea calcicola (P3)

0 30 60 120

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.2.3 Introduced flora

A total of 12 introduced (weed) species were recorded within the survey area, none of which are listed as Declared Plant species in Western Australia pursuant to Section 22 of the State *Biosecurity and Agriculture Management Act 2007* (BAM Act) or as Weeds of National Significance (WoNS). These are listed with the species list in **Appendix D**.

4.2.4 Vegetation communities

A single vegetation community was identified in the survey area, covering a total area of 11.84 ha (96.6% of the survey area), with tracks accounting for the remaining 0.42 ha (3.4%). This community is consistent with that described in previous surveys in and around the survey area (RPS 2006, ELA 2012, 2013a, 2013b). Quadrat data is presented in **Appendix E**. A description of community is presented in **Table 7**. Vegetation community mapping is presented in **Figure 6**.

Table 7: Vegetation community recorded within the survey area (as described in ELA 2013b)

Vegetation community description	Area (ha)	Portion of survey area (%)
EmBAf: *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Banksia attenuata* Woodland over Open Shrubland of *Xanthorrhoea preissii* over Low Shrubland of *Hibbertia hypericoides*, *Stirlingia latiflora*, *Eremaea pauciflora, Desmocladus asper* and *Mesomelaena pseudostygia* on grey loamy sands.	11.84	96.6
Tracks and/or firebreaks	0.42	3.4
Total	**12.25**	**100**

4.2.5 Conservation significant ecological communities

To identify potential TECs and PECs in the survey area, ELA quadrats and vegetation communities were compared to FCTs defined by Gibson *et al*. (1994; see **Section 3.3.1.1**).

Results of the multivariate analysis infer that quadrats 1 and 2 are closely affiliated with FCT 20a and quadrat 3 is closely affiliated with FCT 28 (**Table 8**). FCT 20a and 28 are recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as EN under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. Under the BC Act, the SCP20a TEC is listed as EN and is endorsed by the WA Minister for the Environment, while the SCP28 is not listed on a state level. All quadrats contain vegetation community EmBAf which covers 11.84 ha (96.6% of the survey area; as shown in **Table 7**).

Table 8: Relationship between ELA vegetation communities and FCTs defined by Gibson et al. (1994)

Inferred FCT	Vegetation community	Quadrat number	Closest affiliated sites (Gibson *et al*. 1994)
20a	EmBAf	1	M53, GOLF-1, LAND-1, KOON-1, KOON-2
		2	M53, GOLF-1, LAND-1, KOON-1, KOON-2
28		3	KING-1, TRIG-4, TRIG-3, WARI-1, WARI-2, KING-2

4.2.5.1 Banksia Woodlands of the Swan Coastal Plain TEC diagnostic

Vegetation communities were assessed against key diagnostic characteristics outlined in the Banksia Woodlands of the Swan Coastal Plain TEC approved conservation advice (TSSC 2016), in order to determine the presence of this TEC within the survey area. To be considered as part of the Banksia

Woodlands TEC a patch needs to meet at least the 'Good' condition category (TSSC 2016), therefore areas of Degraded or Completely Degraded condition within the survey area were not included in this assessment. Several of these diagnostic characteristics were met by the EmBAf vegetation community, as detailed in **Appendix G**.

A total of 11.84 ha of vegetation within the survey area was assessed as representing the Banksia Woodlands of the Swan Coastal Plain TEC. This comprised of:

- 11.58 ha of vegetation in Excellent condition; and
- 0.26 ha of vegetation in Good condition. Variation in condition of vegetation across a patch should not necessarily be considered to be evidence of multiple patches (TSSC 2016), therefore a precautionary approach was taken. Vegetation in Good condition was considered to be part of the greater patch, and was assessed as representing the Banksia Woodlands of the Swan Coastal Plain TEC.

4.2.5.2 Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain TEC diagnostic

Tuart (*Eucalyptus gomphocephala*) was not recorded in the survey area, therefore diagnostic characteristics were not undertaken for this TEC.

4.2.6 Vegetation condition

Vegetation condition within the survey area was classed based on the condition scale adapted from Keighery (1994) described in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). Majority of the survey area was considered to be in Excellent condition (11.58 ha; 94.5% of the survey area), with a thin band on the margins of the remnant bushland considered to be in Good condition (0.26 ha; 2.1% of the survey area). The margins of the survey area were cleared as road verges and firebreaks, with some vehicle tracks dissecting the survey area all considered as Completely Degraded (0.42 ha; 3.4%). Disturbances within the survey area included clearing of tracks, edge effects and fire. Vegetation condition within the survey area is presented in **Table 9** and **Figure 6** below.

Table 9: Vegetation condition within the survey area

Vegetation Condition	Area (ha)	Portion of survey area (%)
Excellent	11.58	94.5
Good	0.26	2.1
Completely Degraded	0.42	3.4
Total	**12.25**	**100**

Figure 6: Vegetation communities recorded within the survey area

Legend

- Survey Area
- Track

Vegetation community

- EmBAf - *Eucalyptus marginata, Banksia* and *Allocasuarina fraseriana* Low Woodland

0 30 60 120
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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Figure 7: Vegetation Condition recorded within the survey area

Legend

- Survey Area

Vegetation Condition Assessment

- Excellent
- Good
- Completely Degraded

0 30 60 120

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.3 Black cockatoo habitat assessment

Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black cockatoos is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area. Black cockatoo foraging habitat has been determined using vegetation associations defined in the vegetation assessment and from ground-truthing in the field. The quality of foraging habitat (as defined in **Table 10** below) for black cockatoos within the survey area has been assessed based on the availability and density of plant food sources observed in the field.

Table 10: Definition of black cockatoo foraging habitat quality

Foraging quality	Justification
Excellent	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (e.g. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (e.g. canopy and midstorey).
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (e.g. canopy).
Very Poor	Very low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species <10%) and presence of food sources at only one stratum (e.g. canopy).
Nil	Cleared areas or no suitable vegetation present.

Source: adapted from DotEE 2017 and SEWPaC 2012

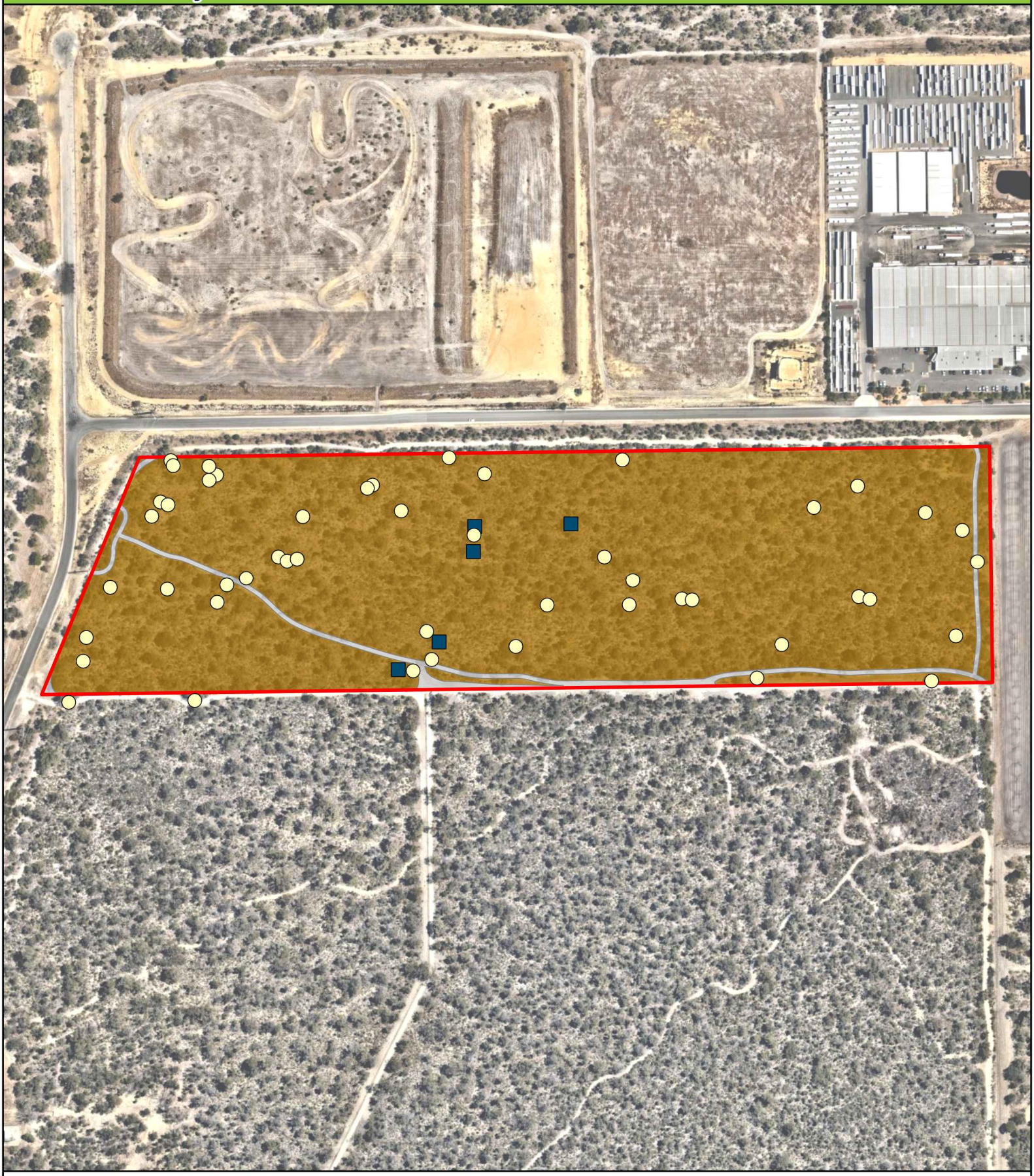
All vegetation within the survey area is considered to provide 'Good' quality foraging habitat for Carnaby's Cockatoo, as it contained native shrubland dominated by proteaceous plant species, particularly *Banksia* spp., with over 60% foliage cover (SEWPaC 2012).

The vegetation within the survey area was considered to provide 'Moderate' quality foraging habitat for Forest Red-tailed Black Cockatoo, as it contained foliage cover of suitable species (Jarrah/Sheoak (*Allocasuarina fraseriana*)) of between 20-40% at one stratum.

No black cockatoos were observed within the survey area. Jarrah and *Banksia* spp. chewed by an undetermined species of black cockatoo were observed during the field survey.

The black cockatoo breeding habitat assessment identified 53 potentially significant trees within the survey area, shown in **Figure 8** and detailed in **Appendix F**. These trees were all Jarrah except for one dead (unidentifiable) tree; Jarrah is a suitable breeding tree species for both species of black cockatoo. Of the 53 potentially suitable breeding trees recorded, only five had visible hollows greater than 100 mm diameter (trunk and/or spout hollows) visible from the ground. Detection of hollows via ground-based observations can be difficult and is therefore a limitation to breeding habitat assessments.

Figure 8: Black Cockatoo potential suitable foraging, breeding and roosting habitat within the survey area



Legend

- Survey Area
- Track
- Potential Foraging Habitat
- Trees DBH >500mm
- Trees DBH >500mm with visible hollow >10mm diameter

0 30 60 120
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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5. Discussion

5.1 Flora

A total of 100 taxa (88 native and 12 introduced taxa) from 76 genera and 34 families were recorded across the survey area. Families with the highest number of species included Fabaceae, Proteaceae and Myrtaceae, with 17, nine and eight species respectively. *Lomandra* and *Acacia* were the best represented genera with four and five species recorded respectively. Of the 12 introduced (weed) species recorded within the survey area, none are listed as Declared Pests under the BAM Act or as WoNS.

No flora species listed as Threatened under the EPBC Act or BC Act were recorded within the survey area. As outlined in **Section 4.2.2**, two priority flora species under the BC Act were recorded within the survey area; *Pimelea calcicola* (P3) and *Acacia benthamii* (P2). Both species were recorded within the **EmBAf** vegetation community: *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Banksia attenuata* Low Woodland over Shrubland of *Xanthorrhoea preissii* over Low Open Shrubland of *Hibbertia hypericoides*, *Stirlingia latiflora*, *Eremaea pauciflora, Desmocladus asper* and *Mesomelaena pseudostygia* on grey loamy sands. Neither of these species were recorded in the previous surveys (ATA 2007, ELA 2012, 2013a, 2013b).

The presence of the two Priority flora species in the current survey and not the previous may be attributed to the inconspicuous nature of the taxon or to recruitment post-2013. Unless flowering, both species are not readily noticeable in the understory and may therefore have gone un-noticed in prior surveys. Alternatively, given the seven-year gap between the current and preceding surveys, the presence of the two priority species may be due to recruitment in the intervening time and simply not present in the 2013 and 2007 surveys.

5.1.1 Acacia benthamii

A. benthamii (P2) is a spindly shrub to 1 m high with sharp, linear phyllodes 2-4.5 cm long by 2-4 mm wide and golden spherical flowers occurring singly or in pairs at the axils adjacent to the leaf bases (WWW 2019). It occurs in association with limestone breakaways but has been recorded mainly in sandy soils or dune systems of the Swan Coastal Plain (WWW 2019 and WAH 1998-).

Priority 2 species such as *Acacia benthamii*, are defined as 'Poorly-known species: species that are known from one or a few locations (generally five or less) which are potentially at risk'. These species are generally in need of further survey to determine extent of occurrence. *Acacia benthamii* is also listed in Bush Forever as a significant flora species of the Perth metropolitan area due to it being endemic to the Swan Coastal Plain (Government of WA 2000).

5.1.2 Pimelea calcicola

Pimelea calcicola is a small erect shrub growing to 1 m with a cluster of white to pink flowers in a terminal raceme forming a 'head' and opposite to decussate narrowly elliptic to elliptic leaves. It prefers sandy soils in association with coastal limestone ridges of the Swan Coastal Plain (Rye 1984 and WAH 1998-).

Priority 3 species such as *Pimelea calcicola*, are defined as 'Poorly-known species: species that are known from several locations, and the species does not appear to be under imminent threat'. These species may be in need of further survey to determine extent of occurrence.

5.2 Vegetation

A single vegetation community was identified in the survey area, covering a total area of 11.84 ha (96.6%), with tracks accounting for the remaining 0.42 ha (3.4%):

- **EmBAf**: *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Banksia attenuata* Woodland over Open Shrubland of *Xanthorrhoea preissii* over Low Shrubland of *Hibbertia hypericoides*, *Stirlingia latiflora*, *Eremaea pauciflora*, *Desmocladus asper* and *Mesomelaena pseudostygia* on grey loamy sands.

This vegetation community most closely aligned with the previously described vegetation community 'EmBAf' by RPS (2006), described as *Eucalyptus marginata*, *Banksia attenuata*, *B. menziesii* and *Allocasuarina fraseri* Low Woodland which is considered to represent the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as EN under the EPBC Act.

To identify potential TECs and PECs in the survey area, ELA quadrats and vegetation communities were compared to Floristic Community Types (FCTs) defined by Gibson *et al*. (1994). Results of the multivariate analysis infer that quadrats 1 and 2 are closely affiliated with FCT 20a and quadrat 3 is closely affiliated with FCT 28. FCT 20a and 28 are recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as EN under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. Under the BC Act, the SCP20a TEC is listed as EN and is endorsed by the WA Minister for the Environment, while the SCP28 is not listed on a state level.

It was noted that a structural component of the canopy, *Banksia menziesii*, recorded in both previous field surveys (ATA 2007 & ELA 2013b) was not recorded in this survey. It was also noted in the field that there were a lot of dead *Banksia* trees through the area. There are several common threats listed in the Banksia Woodlands TEC Advice (TSSC 2016), including 'Fragmentation and clearing, Dieback, Invasive species, Fire regime change, Hydrological degradation, Climate change, Grazing, Decline in pollination and seed dispersal fauna and loss of Keystone species.' This loss of the *B. menziesii* component of the overstory clearly reflects the 'loss of keystone species' threat to the Banksia Woodlands TEC, however the cause is likely to lie in a combination of other threats.

In the previous field survey at lot 2001 (ELA 2013b), two quadrats established by ATA (2007) were re-sampled. One quadrat was aligned roughly to the south-eastern part of the survey area and the other aligned in a roughly central western position. The eastern quadrat was assessed as correlating to the FCT 20a, which aligns with the assessment of quadrats 1 and 2 in this survey, which were the two easternmost quadrats (**Figure 2**). The western quadrats of both ELA (2013b) and this survey were both assessed as aligning to FCT 28. This demonstrates the FCT of the *Banksia* Woodlands have remained a stable community over the intervening time period.

The FCT20a community currently comes under the Interim Recovery Plan No. 359 as published by the Department of Parks and Wildlife (now DBCA) in 2016. The goal of the plan is to maintain or improve the overall condition of FCT20a in the known locations and reduce the level of threat with the aim of

ensuring it does not meet criteria for a higher threat rank. FCT28 is not covered under any current plans at a state level.

Vegetation condition within the survey area was classed based on the condition scale adapted from Keighery (1994) described in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). Majority of the survey area was considered to be in Excellent condition (11.58 ha; 94.5% of the survey area), with a thin band on the margins of the remnant bushland considered to be in Good condition (0.26 ha; 2.1% of the survey area). The margins of the survey area were cleared as road verges and firebreaks, with some vehicle tracks dissecting the survey area all considered as Completely Degraded (0.42 ha; 3.4%). Disturbances within the survey area included clearing of tracks, edge effects and fire.

The Dieback Information Delivery and Management System (DIDMS) showed records of *Phytophthora cinnamomi* within several kilometres, at the eastern end of Pederick Road, thus there is a potential for spread to the survey area. Given that there is a dominant *Xanthorrhoea* component in the understory, which is another species highly susceptible to dieback, combined with the apparent gradual decline over decades in *Banksia* abundance (pers. Obs.), it is unlikely due to *Phytophthora* species.

A concurrent survey, 1.5 km from the survey area, at Lot 503 Flynn Drive, Neerabup ran a specific analysis of the area for *Phytophthora cinnamomi* and found no evidence of the pathogen in that lot (Glevan 2020). This further lowers the likelihood of a presence of *P. cinnamon* at Lot 2001, Pederick Rd.

The threat of Hydrological Degradation, in this case groundwater abstraction leading to reduction or potential loss of keystone *Banksia* species was the target of a long running study in the area around Gnangara groundwater mound (Groom et. Al. 2001). The study found that both *Banksia attenuata* and *B. menziesii* showed a reduction in vigour due to long term reduction in groundwater levels. It was found that *B. attenuata* adapted to changes more readily than *B. menziesii*. The findings of this study closely resemble the observed decline of *Banksia* in the survey area and it could be expected further reduction in *Banksia* may be expected in the future.

5.3 Black cockatoos

No Carnaby's Cockatoos or Forest Red-tailed Black Cockatoos were observed within the survey area; however Carnaby's Cockatoos have been recorded during previous studies within the survey area. The foraging evidence observed on Jarrah and *Banksia* spp. could not be identified to the species of black cockatoo. However, given the foraging preferences of the two black cockatoo species, it is likely that the foraging on *Banksia* spp. can be attributed to Carnaby's Cockatoo. Black cockatoo foraging habitat was determined using vegetation associations defined in the vegetation assessment and from ground-truthing in the field. All vegetation within the survey area is considered to provide 'Good' quality foraging habitat for Carnaby's Cockatoo, as it contained native shrubland dominated by proteaceous plant species, particularly *Banksia* spp. (SEWPaC 2012), with a foliage cover of over 60%. The survey area was slightly less suitable for Forest Red-tailed Black Cockatoo foraging; the assessment determined the survey area provided 'Moderate' quality foraging habitat for this species as it had a lower foliage cover of suitable species (20-40%).

The Black cockatoo breeding habitat assessment identified 53 potentially significant trees within the survey area, of which all were Jarrah except for one dead (unidentifiable) tree. This number is an

increase from the 2013 survey carried out by ELA (2013b), which recorded 48 potential cockatoo breeding trees (based on trees with DBH >500 mm) within the same survey area. This increase is likely due to growth of the trees over the seven-year gap in survey effort and natural increase in trunk width.

Of the 53 potentially suitable breeding trees recorded, only five had visible hollows greater than 100 mm diameter (trunk and/or spout hollows) visible from the ground. This number is less than recorded by ELA in 2013 (seven hollows recorded; ELA 2013b). The reduction in number of hollows recorded may be attributed to observer differences or due to reduction of hollows from tree limbs falling. It should be noted that detection of hollows through ground-based observations is a limitation to breeding habitat assessment as suitable nest hollows may not be visible from the ground.

The increase in number of potential breeding trees over time indicates that the value of the cockatoo breeding habitat has risen over the intervening time between surveys and is likely to continue to grow, depending on future availability of hollows.

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Appendix A Framework for conservation significant flora and fauna ranking

CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa 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.
Critically Endangered (CE)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

The Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Specially protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

Threatened species (T)
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.

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

Category	Code	Description
Critically Endangered species	CR	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered species	EN	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
Vulnerable species	VU	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild, as follows:

Category	Code	Description
Extinct species	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 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.
Extinct in the wild species	EW	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

Categories are detailed below.

Category	Code	Description
Migratory species	MI	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes 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 fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Category	Code	Description
Species of special conservation interest (conservation dependent fauna)	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Other specially protected species	OS	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

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 fauna or flora.

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	*Poorly-known species* 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 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	*Poorly-known species* 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.

Category	Code	Definition
Priority 3	P3	*Poorly-known species* 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	*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 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 Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area • core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the survey area.
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area • the survey area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met): • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful.
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
Does not occur (one or more criteria requires to be met).	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix C Flora likelihood of occurrence assessment

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
Caladenia huegelii	EN	CR	PMST	Occurs in areas of mixed woodland of jarrah (*Eucalyptus marginata*), candlestick banksia (*Banksia attenuata*), holly banksia (*B. ilicifolia*) and firewood banksia (*B. menziesii*) with scattered sheoak (*Allocasuarina fraseriana*) and marri (*Corymbia calophylla*) over dense shrubs. Throughout its range the species tends to favour areas of dense undergrowth. Soil is usually deep grey-white sand usually 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.	Possible	One record within 5 km and suitable habitat present in the survey area. However, survey timing is outside the optimum flowering season.
Drakaea elastica	EN	CR	PMST	White sand over a dark sandy loam on low-lying damp areas near ephemeral lakes, or on the slopes adjacent to winter wet depressions, swamps.	Unlikely	Lack of suitable habitat within survey area, out of season for finding vegetative of flowering material.
Grevillea curviloba subsp. *incurva*	EN	CR	PMST	Amongst low trees, or tall (sclerophyll) shrubland; in sand, or clay; occupying winter wet flats.	Unlikely	Lack of suitable habitat within the survey area.
Melaleuca sp. *Wanneroo* (G.J. Keighery 16705)	EN	CR	NatureMap, PMST	Rugged limestone ridge. Mossy black sand.	Unlikely	Lack of suitable habitat within the survey area.
Thelymitra dedmaniarum	EN	CR	PMST	The cinnamon sun orchid grows in *Eucalyptus wandoo* (wandoo) and *E. accedens* (powderbark wandoo) woodlands on red-brown sandy-loam soil associated with dolerite and granite outcrops.	Unlikely	No suitable habitat within the survey area.
Diuris purdiei	EN	EN	PMST	Grey-black sand, moist. Winter-wet swamps.	Unlikely	No suitable habitat within the survey area.
Lepidosperma rostratum	EN	EN	PMST	Beaked Lepidosperma is associated with Marsh Banksia (*Banksia telmatiaea*) and Hairy Clawflower (*Calothamnus hirsutus*) and grows in sandy soil among low heath in a winterwet swamp.	Unlikely	Lack of suitable habitat within the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
Andersonia gracilis	EN	VU	PMST	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.	Unlikely	Lack of suitable habitat within the survey area.
Drakaea micrantha	VU	EN	PMST	Cleared firebreaks or open sandy patches that have been disturbed. Occurs in infertile grey sands, in Jarrah and Common Sheoak woodland or forest associated with Banksia species.	Unlikely	Lack of suitable habitat within survey area, out of season for finding vegetative of flowering material.
Anigozanthos viridis subsp. *terraspectans*	VU	VU	PMST	Occurs in winter-wet depressions where it grows on grey sandy clay loam, or grey sand, in low post-fire regenerating heath. It is associated with species such as Slender-leaved Banksia (*Banksia leptophylla*), melaleucas (*Melaleuca* spp.), Compact Featherflower (*Verticordia densiflora*), coneflowers (*Conostylis* spp.) and sedges.	Unlikely	No suitable habitat within the survey area.
Diuris micrantha	VU	VU	PMST	Brown loamy clay. Winter-wet swamps, in shallow water.	Unlikely	No suitable habitat within the survey area.
Eleocharis keigheryi	VU	VU	PMST	Keighery's *Eleocharis* grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks and claypans.	Unlikely	No suitable habitat within the survey area.
Eucalyptus argutifolia	VU	VU	NatureMap, PMST	Mallee. Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops	Unlikely	Lack of suitable habitat within the survey area.
Drosera patens	-	P1	NatureMap	Sandy soils. Margins of winter-wet depressions, swamps and lakes.	Unlikely	No suitable habitat within the survey area.
Drosera x sidjamesii	-	P1	NatureMap	Peaty sand. Along lake margins, close to winter high-water line.	Unlikely	Lack of suitable habitat within the survey area.

Species	Conservation status		Source[4]	Preferred habitat	Likelihood of occurrence	Justification of likelihood
	EPBC Act[1]	BC Act[2] / DBCA[3]				
Calectasia elegans	-	P2	NatureMap	Deep grey quartz sand in habitats experienced infrequent fires. *Banksia menziesii/attenuata* woodland.	Possible	Several records within 5 km in similar vegetation and soils. Flowering usual in November
Poranthera moorokatta	-	P2	NatureMap	White silica sand in open spaces between shrubs, not in shaded areas or in areas of high litter cover.	Unlikely	Known from only two locations; Kings Park and Ellenbrook. Lack of suitable habitat within the survey area. Outside recorded flowering season.
Stenanthemum sublineare	-	P2	NatureMap	Sand plain. Littered white sand. Banksia woodland.	Possible	Several records within 5 km of the survey area.
Cyathochaeta teretifolia	-	P3	NatureMap	Grey sand, sandy clay. Swamps, creek edges with Melaleuca.	Unlikely	Lack of suitable habitat within the survey area.
Stylidium maritimum	-	P3	NatureMap	On limestone outcrops in craterlike depressions filled with black sandy soil, grey sand-loam, slope, ridge, limestone.	Unlikely	Lack of suitable habitat within the survey area.
Styphelia filifolia	-	P3	NatureMap	Low lying sandy soils of the Swan Coastal Plain, with Banksia/Jarrah Woodland.	Possible	Suitable habitat but naturally sporadic, 1 record within 5 km.
Jacksonia sericea	-	P4	NatureMap	Calcareous and sandy soils in Banksia/Eucalypt woodland.	Possible	Several records within 5 km of the survey area.
Stylidium longitubum	-	P4	NatureMap	Seasonal wetland, flat ground, dark brown clay loam some peat, over clay. Poor drainage, wet during winter/spring.	Unlikely	Lack of suitable habitat within the survey area.
Tripterococcus sp. *Brachylobus* (A.S. George 14234)	-	P4	NatureMap	Grey sand to sandy clay, low-lying areas and seasonal wetlands. High variability in associated vegetation.	Unlikely	Lack of suitable habitat within the survey area.

[1]EPBC Act = Flora listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

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

[2]BC Act = Flora listed under the State *Biodiversity Conservation Act 2016*.

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora

[3]DBCA = Flora listed as Priority species under the Department of Biodiversity, Conservation and Attractions

P1 = Priority 1: Species that are known from one or a few locations (generally five or less) which are potentially at risk. Listed by DBCA

P2 = Priority 2: 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. Listed by DBCA.

P3 = Priority 3: Poorly known species that are known from several locations and the species does not appear to be under imminent threat. Listed by DBCA.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring. Listed by DBCA.

[4]NatureMap = NatureMap database search (DBCA 2007-2019)

PMST = EPBC Act Protected Matters Search Tool report (DAWE 2019b).

Appendix D Flora species list

Family	Species
Aizoaceae	*Carpobrotus virescens*
Amaranthaceae	*Ptilotus manglesii*
Anarthriaceae	*Lyginia barbata*
Anarthriaceae	*Lyginia imberbis*
Apiaceae	*Xanthosia huegelii*
Asparagaceae	*Lomandra micrantha*
Asparagaceae	*Lomandra sericea*
Asparagaceae	*Lomandra* sp.
Asparagaceae	*Lomandra suaveolens*
Asparagaceae	*Sowerbaea laxiflora*
Asparagaceae	*Thysanotus* sp.
Asteraceae	*Hypochaeris glabra**
Asteraceae	*Lagenophora huegelii*
Asteraceae	*Podotheca gnaphalioides*
Asteraceae	*Ursinia anthemoides**
Asteraceae	*Waitzia suaveolens* var. *suaveolens*
Campanulaceae	*Lobelia tenuior*
Casuarinaceae	*Allocasuarina fraseriana*
Casuarinaceae	*Allocasuarina humilis*
Colchicaceae	*Burchardia congesta*
Cyperaceae	*Lepidosperma apricola*
Cyperaceae	*Lepidosperma pubisquameum*
Cyperaceae	*Mesomelaena pseudostygia*
Cyperaceae	*Schoenus curvifolius*
Cyperaceae	*Tetraria octandra*
Dasypogonaceae	*Dasypogon bromeliiformis*
Dilleniaceae	*Hibbertia hypericoides*
Dilleniaceae	*Hibbertia subvaginata*
Ericaceae	*Conostephium pendulum*
Ericaceae	*Conostephium preissii*
Ericaceae	*Leucopogon parviflorus*
Fabaceae	*Acacia benthamii* (P2)
Fabaceae	*Acacia huegelii*
Fabaceae	*Acacia pulchella* var. *glaberrima*
Fabaceae	*Acacia sessilis*

Family	Species
Fabaceae	*Acacia willdenowiana*
Fabaceae	*Bossiaea eriocarpa*
Fabaceae	*Daviesia nudiflora* subsp. *nudiflora*
Fabaceae	*Daviesia triflora*
Fabaceae	*Gastrolobium nervosum*
Fabaceae	*Gompholobium confertum*
Fabaceae	*Gompholobium tomentosum*
Fabaceae	*Hardenbergia comptoniana*
Fabaceae	*Hovea trisperma*
Fabaceae	*Jacksonia furcellata*
Fabaceae	*Jacksonia sternbergiana*
Fabaceae	*Kennedia prostrata*
Fabaceae	*Daviesia triflora*
Geraniaceae	*Pelargonium capitatum**
Goodeniaceae	*Dampiera linearis*
Goodeniaceae	*Scaevola repens* var. *repens*
Haemodoraceae	*Anigozanthos humilis*
Haemodoraceae	*Anigozanthos manglesii*
Haemodoraceae	*Conostylis aculeata* subsp. *aculeata*
Haemodoraceae	*Conostylis juncea*
Haemodoraceae	*Conostylis setigera*
Haemodoraceae	*Haemodorum laxum*
Haloragaceae	*Gonocarpus pithyoides*
Hemerocallidaceae	*Arnocrinum preissii*
Hemerocallidaceae	*Corynotheca micrantha*
Hemerocallidaceae	*Dianella revoluta*
Hemerocallidaceae	*Tricoryne elatior*
Iridaceae	*Gladiolus caryophyllaceus**
Iridaceae	*Patersonia occidentalis*
Lamiaceae	*Hemiandra pungens*
Myrtaceae	*Calytrix flavescens*
Myrtaceae	*Calytrix fraseri*
Myrtaceae	*Eremaea pauciflora*
Myrtaceae	*Eucalyptus marginata*
Myrtaceae	*Hypocalymma robustum*
Myrtaceae	*Kunzea glabrescens*
Myrtaceae	*Regelia inops*

Family	Species
Myrtaceae	*Verticordia nitens*
Orchidaceae	*Disa bracteata**
Pittosporaceae	*Billardiera heterophylla*
Poaceae	*Aira cupaniana**
Poaceae	*Avena barbata**
Poaceae	*Briza maxima**
Poaceae	*Ehrharta longiflora**
Poaceae	*Eragrostis curvula**
Poaceae	*Vulpia muralis**
Polygalaceae	*Comesperma calymega*
Primulaceae	*Lysimachia arvensis**
Proteaceae	*Banksia attenuata*
Proteaceae	*Banksia dallanneyi*
Proteaceae	*Banksia menziesii*
Proteaceae	*Grevillea vestita*
Proteaceae	*Hakea trifurcata*
Proteaceae	*Persoonia saccata*
Proteaceae	*Petrophile linearis*
Proteaceae	*Petrophile macrostachya*
Proteaceae	*Stirlingia latifolia*
Restionaceae	*Desmocladus asper*
Restionaceae	*Hypolaena exsulca*
Rubiaceae	*Opercularia vaginata*
Stylidiaceae	*Stylidium repens*
Stylidiaceae	*Stylidium piliferum*
Thymelaeaceae	*Pimelea calcicola* (P3)
Xanthorrhoeaceae	*Xanthorrhoea preissii*
Zamiaceae	*Macrozamia riedlei*

* Introduced flora species

Appendix E Quadrat data

Quadrat	Date	Site type	Observer
1	21/11/2019	10 m x 10 m	DB
Condition	**Disturbances**	**Fire history (years)**	**Vegetation community**
Excellent	Pathogen	10-20	EmBAf, FCT 20a
Soil type	**Soil colour**	**Landform unit**	**Aspect/slope °**
Sand	Grey	Flat	SW
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	385874	6494668

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Allocasuarina fraseriana	8	U	Tree, palm
Banksia attenuata	3	U	Tree, palm
Eucalyptus marginata	20	U	Tree, palm
Bossiaea eriocarpa	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Calytrix flavescens	1	M	Shrub, cycad, grass-tree, tree-fern
Conostephium pendulum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium confertum	0.5	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Grevillea vestita	12	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	15	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia subvaginata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hovea trisperma	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	1	M	Shrub, cycad, grass-tree, tree-fern
Jacksonia sternbergiana	2	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	13	M	Shrub, cycad, grass-tree, tree-fern
Xanthorrhoea preissii	1	M	Shrub, cycad, grass-tree, tree-fern
Desmocladus flexuosus	3	G	Sedge
Mesomelaena pseudostygia	1	G	Sedge
Schoenus curvifolius	0.1	G	Sedge
Tetraria octandra	0.1	G	Sedge
*Aira cupaniana**	0.1	G	Other grass
*Briza maxima**	0.1	G	Other grass

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Lyginia barbata	0.5	G	Forb
Arnocrinum preissii	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Conostylis setigera R.Br. subsp. *setigera*	0.1	G	Forb
*Gladiolus caryophyllaceus**	0.1	G	Forb
Gonocarpus pithyoides	0.1	G	Forb
Lomandra sericea	0.1	G	Forb
Lomandra sp. (Indet)	0.1	G	Forb
Patersonia occidentalis	0.5	G	Forb
Stylidium repens	0.1	G	Forb

Quadrat	Date	Site type	Observer
2	21/11/2019	10 m x 10 m	DB
Condition	**Disturbances**	**Fire history (years)**	**Vegetation community**
Excellent	Pathogen	10-20	EmBAf, FCT 20a
Soil type	**Soil colour**	**Landform unit**	**Aspect/slope °**
Sand	Grey	Flat	SW
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	385611	6494676

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Allocasuarina fraseriana	6	U	Tree, palm
Banksia attenuata	4	U	Tree, palm
Eucalyptus marginata	15	U	Tree, palm
Acacia sessilis	0.5	M	Shrub, cycad, grass-tree, tree-fern
Acacia willdenowiana	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Bossiaea eriocarpa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Calytrix flavescens	1	M	Shrub, cycad, grass-tree, tree-fern
Conostephium pendulum	0.5	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.5	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.5	M	Shrub, cycad, grass-tree, tree-fern
Eremaea pauciflora	2	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	20	M	Shrub, cycad, grass-tree, tree-fern
Hovea trisperma	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	1	M	Shrub, cycad, grass-tree, tree-fern
Kennedia prostrata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.5	M	Shrub, cycad, grass-tree, tree-fern
Pimelea calcicola (P3)	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	1	M	Shrub, cycad, grass-tree, tree-fern
Xanthorrhoea preissii	4	M	Shrub, cycad, grass-tree, tree-fern
Desmocladus flexuosus	3	G	Sedge
Lepidosperma apricola	0.1	G	Sedge
Lepidosperma pubisquameum	0.1	G	Sedge
Mesomelaena pseudostygia	2	G	Sedge
Tetraria octandra	0.1	G	Sedge
*Briza maxima**	0.1	G	Other grass
*Ehrharta longiflora**	0.1	G	Other grass

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Vulpia myuros	0.1	G	Other grass
Lyginia barbata	1	G	Forb
Burchardia congesta	0.1	G	Forb
Dianella revoluta	0.1	G	Forb
*Gladiolus caryophyllaceus**	0.1	G	Forb
Haemodorum laxum	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Forb
Hypochaeris glabra	0.1	G	Forb
Lomandra sp. (Indet)	0.1	G	Forb
Lomandra suaveolens	0.1	G	Forb
Lomandra suaveolens	0.1	G	Forb
Patersonia occidentalis	0.1	G	Forb
Stylidium piliferum	0.1	G	Forb
*Ursinia anthemoides**	0.1	G	Forb
Xanthosia huegelii	0.1	G	Forb

Quadrat	Date	Site type	Observer
3	21/11/2019	10 m x 10 m	DB
Condition	**Disturbances**	**Fire history (years)**	**Vegetation community**
Excellent	Pathogen	10-20	EmBAf, FCT 28
Soil type	**Soil colour**	**Landform unit**	**Aspect/slope °**
Sand	Grey	Flat	SW
Rock type	**Outcropping %**	**Easting**	**Northing**
N/A	0	385401	6494649

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Allocasuarina fraseriana	4	U	Tree, palm
Banksia attenuata	1	U	Tree, palm
Eucalyptus marginata	30	U	Tree, palm
Billardiera heterophylla	0.1	M	Shrub, cycad, grass-tree, tree-fern
Bossiaea eriocarpa	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Conostephium pendulum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Conostephium preissii	0.5	M	Shrub, cycad, grass-tree, tree-fern
Corynotheca micrantha	0.5	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hemiandra pungens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	9	M	Shrub, cycad, grass-tree, tree-fern
Hovea trisperma	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	2	M	Shrub, cycad, grass-tree, tree-fern
Xanthorrhoea preissii	20	M	Shrub, cycad, grass-tree, tree-fern
Desmocladus flexuosus	2	G	Sedge
Lepidosperma apricola	0.1	G	Sedge
Mesomelaena pseudostygia	1	G	Sedge
Tetraria octandra	0.1	G	Sedge
*Briza maxima**	0.1	G	Other grass
*Ehrharta longiflora**	0.1	G	Other grass
Burchardia congesta	0.1	G	Forb
Conostylis aculeata subsp. *aculeata*	0.1	G	Forb
Conostylis juncea	0.1	G	Forb
*Gladiolus caryophyllaceus**	0.1	G	Forb
Haemodorum laxum	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Lobelia tenuior	0.1	G	Forb
Lomandra suaveolens	0.1	G	Forb
Lomandra suaveolens	0.1	G	Forb
Lyginia barbata	0.1	G	Forb
Patersonia occidentalis	2	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Tricoryne elatior	0.1	G	Forb
*Ursinia anthemoides**	0.1	G	Forb

Appendix F Potentially significant black cockatoo habitat trees within the Project Area

Tree number	Species	Hollows noted	DBH (cm)	Comment
1	*Eucalyptus marginata*	n/a	77	
2	*Eucalyptus marginata*	n/a	57.5	
3	*Eucalyptus marginata*	n/a	62	
4	*Eucalyptus marginata*	n/a	60 & 53	
5	*Eucalyptus marginata*	n/a	65	
6	*Eucalyptus marginata*	n/a	76	
7	*Eucalyptus marginata*	n/a	58	
8	*Eucalyptus marginata*	Trunk, spout	121	
9	*Eucalyptus marginata*	n/a	57	
10	*Eucalyptus marginata*	n/a	50	
11	*Eucalyptus marginata*	Trunk, spout	121	Older foraging evidence present (chewed Jarrah nuts)
12	*Eucalyptus marginata*	n/a	65	
13	*Eucalyptus marginata*	Trunk	67	
14	*Eucalyptus marginata*	n/a	64	
15	*Eucalyptus marginata*	Spout	90	
16	*Eucalyptus marginata*	n/a	56.5	
17	*Eucalyptus marginata*	n/a	52	
18	*Eucalyptus marginata*	n/a	96	
19	*Eucalyptus marginata*	n/a	53	
20	*Eucalyptus marginata*	n/a	140	Older foraging evidence present (chewed Jarrah nuts)
21	*Eucalyptus marginata*	n/a	74	
22	*Eucalyptus marginata*	n/a	55	
23	*Eucalyptus marginata*	n/a	119	
24	*Eucalyptus marginata*	n/a	55	
25	*Eucalyptus marginata*	n/a	80	
26	*Eucalyptus marginata*	n/a	74	
27	*Eucalyptus marginata*	n/a	68	
28	*Eucalyptus marginata*	n/a	64	
29	*Eucalyptus marginata*	n/a	68	
30	*Eucalyptus marginata*	n/a	67	
31	*Eucalyptus marginata*	n/a	60	

Tree number	Species	Hollows noted	DBH (cm)	Comment
32	*Eucalyptus marginata*	n/a	67	
33	*Eucalyptus marginata*	n/a	64	
34	*Eucalyptus marginata*	n/a	70	
35	*Eucalyptus marginata*	n/a	53	
36	*Eucalyptus marginata*	n/a	52	
37	*Eucalyptus marginata*	n/a	56 & 66	
38	*Eucalyptus marginata*	n/a	50	
39	*Eucalyptus marginata*	n/a	81	
40	*Eucalyptus marginata*	n/a	106	
41	*Eucalyptus marginata*	n/a	103	
42	*Eucalyptus marginata*	n/a	66 & 68	
43	*Eucalyptus marginata*	n/a	65	
44	*Eucalyptus marginata*	n/a	82	
45	*Eucalyptus marginata*	n/a	98	
46	*Eucalyptus marginata*	n/a	80	
47	*Eucalyptus marginata*	n/a	60	
48	*Eucalyptus marginata*	n/a	60	
49	*Eucalyptus marginata*	n/a	55.5	
50	*Eucalyptus marginata*	n/a	109	
51	*Eucalyptus marginata*	n/a	69	
52	Dead (unidentifiable) tree	Spout	100	
53	*Eucalyptus marginata*	n/a	53	

Appendix G Banksia Woodlands TEC Assessment

Step	Key diagnostic characteristics	Outcome
1	**Location and physical environment** The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion	Positive - The survey area is located on the Swan Coastal Plain and occurs on the Spearwood Dune System
	Soil and landform The *Banksia* Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands	Positive - Deep grey sandy soils recorded in the survey area; survey area located within the Spearwood Soil System.

	Structure
	The structure of the Banksia Woodlands is a low woodland to forest with these features:
	• A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the *Banksia* species identified under composition
	• Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy
	• An often highly species-rich understorey that consists of:
	  ○ A layer of sclerophyllous shrubs of various heights; and,
	  ○ A herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.
		Positive - Vegetation has a distinctive upper layer of sclerophyllous trees (*Eucalyptus marginata*) over *Banksia attenuata* and *Allocasuarina fraseriana*, with understory species richness mean across three 10mx10m quadrats at 35 species. A total species richness of 100 species was recorded across the survey area (88 of which were native).

	Composition
	• The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B. ilicifolia* (holly-leaved banksia); and
	• The patch must include at least one of the following diagnostic species:
	  ○ *Banksia attenuata* (candlestick banksia)
	  ○ *Banksia menziesii* (firewood banksia)
	  ○ *Banksia prionotes* (acorn banksia)
	  ○ *Banksia ilicifolia* (holly-leaved banksia).
		Positive - Canopy co-dominated by *Banksia attenuata*, emergent tree layer comprised of *Eucalyptus marginata*, co-dominant *Allocasuarina fraseriana* trees, high diversity of shrub and herb species, including 13 of the 16 listed widespread species of the sclerophyllous shrub layer, and in the herbaceous ground layer Cyperaceae (2 native species), Haemodoraceae (6 native species) and Restionaceae (2 native species).
		The contra-indicator species *Banksia littoralis* and *Banksia burdettii* were not recorded. None of these communities represent FCT 20c – Eastern shrublands and woodlands.

Step	Key diagnostic characteristics	Outcome

	• If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and
	• Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and
	• The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch***
	• Contra-indicators:
	  ○ Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present.
	  ○ Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community.
	  ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	

2	**Condition thresholds** • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch. • Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. • The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds.	Information - Several surveys were undertaken at this location, with the same diagnostic outcome, over a timespan of several years. Both showing affiliations with FCT 20a and 28.

Step	Key diagnostic characteristics	Outcome
	• Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (TSSC 2016). • A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.	
3	**Minimum patch size** Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m). Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category.	Positive - 94.5% of survey area was classified in *Excellent* Condition (as per the Technical Guidance). Vegetation in *Excellent* Condition in survey area greater than 0.5 ha in size (11.58 ha). 0.26 ha of vegetation was in *Good* condition and was considered to be part of the greater *Excellent* patch.
4	**Further information to assist in determining the presence of the ecological community and significant impacts** • The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes • A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. • Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic	Information - The total area considered the Banksia woodlands TEC in the survey area is 11.84 ha, which is a small part of a larger Jarrah, *Banksia* and *Allocasuarina* woodland present in remnant bushland to the south of the survey area.

Step	Key diagnostic characteristics	Outcome
	characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. • A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. • The recommended minimum buffer zone for the ecological community is 20–50 m from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

*The term 'woodland' has been chosen as the most typical structure, but the ecological community may also be considered to include examples of shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history. Similarly, component species of the dominant upper sclerophyllous layer may be variously considered 'tall or large shrubs' or 'small trees'.

** Refers to relevant *Banksia* species typically being amongst the most common plant species in the upper sclerophyllous layer. There may be localised exceptions to this, either as natural variation or due to disturbance history (e.g. fire).

*** Key species in the sclerophyllous shrub layer of the ecological community include members of the families Asteraceae, Dilleniaceae, Ericaceae, Fabaceae, Myrtaceae and Proteaceae. Widespread species include *Adenanthos cygnorum* (woolly bush), *Allocasuarina humilis* (dwarf sheoak), *Bossiaea eriocarpa* (common brown pea), *Conostephium pendulum* (pearl flower), *Daviesia* spp., *Eremaea pauciflora*, *Gompholobium tomentosum* (hairy yellow pea), *Hibbertia hypericoides* (yellow buttercups), *Jacksonia* spp., *Kunzea glabrescens, Petrophile linearis* (pixie mops), *Philotheca spicata* (pepper and salt), *Stirlingia latifolia* (blueboy), *Phlebocarya ciliata, Hypolaena exsulca* and *Xanthorrhoea preissii* (balga). Key species in the herbaceous ground layer include members of the families Cyperaceae, Droseraceae, Haemodoraceae, Orchidaceae, Restionaceae and "lilies" from various families. Widespread species include *Amphipogon turbinatus* (tufted beard grass), *Burchardia congesta* (milkmaids), *Caladenia* spp. (spider orchids), *Dasypogon bromeliifolius*

(pineapple bush), *Desmocladus flexuosus, Drosera erythrorhiza* (red ink sun dew), *Lepidosperma squamatum* (a tufted sedge), *Lomandra hermaphrodita, Lyginia barbata* (southern rush), *Lyginia imberbis, Mesomelaena pseudostygia* (semaphore sedge), *Patersonia occidentalis* (purple flag), *Podolepis* spp., *Stylidium brunonianum* (pink fountain trigger plant), *Stylidium piliferum* (common butterfly trigger plant), *Trachymene pilosa* (dwarf parsnip), and *Xanthosia huegelii* (heath xanthosia).

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