Biological Survey:
Kemerton Coogee Chemicals Expansion

Coogee Chemicals

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Template 2.8.1

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Abbreviations

Abbreviation	Description
BAM Act	State *Biosecurity and Agriculture Management Act 2007*
BC Act	State *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CLUSTER	Hierarchical Clustering
CR	Critically Endangered
DRF	Declared Rare Flora
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
ELA	Eco Logical Australia
EN	Endangered
EP Act	State *Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
FCT	Floristic Community Type
ha	hectare
IBRA	Interim-Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
JTSI	Department of Jobs, Tourism, Science and Innovation
km	kilometre
KSIA	Kemerton Strategic Industrial Area
m	metre
MDS	Multi-Dimensional Scaling
mm	millimetre
NVIS	National Vegetation Information System
P	Priority
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool

Abbreviation	Description
PRIMER	Plymouth Routines in Multivariate Ecological Research v6
SIMPER	Similarity Percentages
T	Threatened
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
VU	Vulnerable
WA	Western Australia
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WoNS	Weeds of National Significance

Executive Summary

Coogee Chemicals are proposing to expand their existing facility at 869 Marriott Road, Wellesley (the survey area; approximately 3.26 hectares (ha).

Eco Logical Australia (ELA) was engaged to undertake: a Targeted orchid survey in winter 2021, focussing on *Drakaea elastica* (listed as EN under the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and CR under the *Biodiversity Conservation Act 2016* [BC Act]) and *Drakaea micrantha* (listed as VU under the EPBC Act and EN under the BC Act); single-phase spring Detailed and Targeted flora and vegetation survey; Basic terrestrial fauna survey; Targeted black cockatoo habitat assessment; and Targeted Western Ringtail Possum survey to inform environmental approvals requirements

The Targeted Threatened orchid survey was undertaken on 2 August 2021 and the Detailed and Targeted flora and vegetation survey was undertaken on 16 September 2021. ELA have previously undertaken flora and vegetation and fauna surveys in the broader Kemerton area, with results being included in this report where they relate to the survey area.

A total of 62 flora species representing 28 families and 56 genera were recorded from the survey area. No Threatened flora species listed under the EPBC Act or the BC Act, were recorded within the survey area from the field survey. One flora species listed as Priority by DBCA, *Acacia semitrullata* (P4) was recorded within the survey area (68 individuals). *A. semitrullata* has been previously recorded from two locations within the Kemerton Strategic Industrial Area and surrounds.

A total of 10 introduced (weed) species were recorded within the survey area, representing 16.12% of the total number of species recorded. Of these, two species **Gomphocarpus fruticosus* (Narrowleaf Cottonbush) and **Zantedeschia aethiopica* (Arum Lily) are listed as Declared Plants under the BAM Act (s22[2]). None of these species are listed as Weeds of National Significance (WoNS).

Only one vegetation community was delineated and mapped within the survey area, covering a total of 2.08 ha (63.8%), EmKgXb: *Eucalyptus marginata* mid open woodland over *Banksia attenuata*, *Banksia ilicifolia* low woodland over *Kunzea glabrescens* tall sparse shrubland over *Xanthorrhoea brunonis, Bossiaea eriocarpa*, *Hibbertia hypericoides* mid open shrubland over *Dasypogon bromeliifolius*, *Hypolaena exsulca*, *Conostylis juncea* low sparse forbland. The remainder of the survey area was comprised of cleared areas (tracks, pasture) (0.90 ha; 27.6% of the survey area) and rehabilitation (0.28 ha; 8.6%).

One conservation significant vegetation community was inferred to occur with the survey area, namely 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community (TEC), which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. Multivariate analysis showed that the mapped vegetation community EmKgXb had a close affiliation with FCT 21c and to a lesser extent FCT 21a. Both FCT 21c and FCT 21a are recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. Vegetation community EmKgXb was assessed as representing the Banksia Woodlands of the Swan Coastal Plain TEC. The TEC within the survey area is connected to a much larger patch which extends to the south and the east.

Vegetation condition within the survey area ranged from Good to Degraded, based on the Keighery (1994) vegetation scale. Majority of the survey area was in Good condition (1.95 ha; 59.80%). Cleared areas (tracks etc.) accounted for 0.90 ha (27.6% of the survey area). Disturbances within the survey area included historic clearing, tracks and fire breaks.

A total of 19 fauna species were recorded as occurring within the survey area, comprising of 17 birds and two mammals (one native). Of the 19 species recorded, one (Forest Red-tailed Black Cockatoo [*Calyptorhynchus banksii* subsp. *naso*]) is listed as Threatened under the EPBC Act (Vulnerable) and BC Act (Vulnerable). No fauna species listed as Priority by DBCA were recorded. One introduced (pest) fauna species was recorded within the survey area; rabbit (*Oryctolagus cuniculus*).

A total of two fauna habitats were identified within the survey area, covering a total of 2.36 ha (72.4% of the survey area). The most widespread fauna habitat was Jarrah/banksia woodland, which accounted for 2.08 ha (63.8% of the survey area). Rehabilitation areas accounted for 0.28 ha (8.6% of the survey area), whilst cleared areas (tracks etc.) accounted for 0.90 ha (27.6% of the survey area).

Forest Red-tailed Black Cockatoo was the only species of black cockatoo recorded during the survey. This species was observed as a flock of eight birds foraging in a Marri tree adjacent to the survey area. Whilst neither the Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo nor Baudin's Cockatoo were actually recorded within the survey area, there is potential habitat present for all three species.

A total of 2.08 ha (63.80%) within the survey area is considered as providing 'Good' quality foraging habitat for all three black cockatoo species, namely Jarrah/banksia woodland fauna habitat. The remainder of the survey area is considered to provide 'Poor' quality or no foraging habitat for black cockatoos. The black cockatoo breeding habitat assessment identified four potentially suitable breeding trees within the survey area, all of which were *Eucalyptus marginata* (Jarrah). None of these contained potentially suitable hollows over 100 mm in diameter. All potential breeding trees recorded from the survey area provide suitable roosting habitat for black cockatoos as defined by the referral guidelines (DSEWPaC 2012).

Although not directly observed during the field survey, both the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Cockatoo (*Calyptorhynchus baudinii*) are considered as likely to occur within the survey area as it provides roosting and foraging habitat for these species and occurs within the species' ranges.

No Western Ringtail Possum individuals or secondary signs (e.g. dreys, scratchings, scats) were recorded within the survey area. Whilst there were large trees containing hollows within the survey area as detailed above, no signs of use by Western Ringtail Possums were observed. In addition, lack of *Agonis flexuosa* (Peppermint) within the survey area suggests that the vegetation within the survey area is not conducive to habitation by the species.

For the purposes of a Detailed and Targeted flora and vegetation survey, Basic terrestrial fauna survey, Targeted Black Cockatoo habitat assessment and Targeted Western Ringtail possum habitat assessment, adequate data was collected to define and assess the presence, extent and significance of flora, vegetation and fauna within the survey area.

Key findings of the biological survey include:

1. No Threatened orchid or other threatened species listed under the EPBC Act or BC Act were recorded during the survey;
2. One flora species listed as Priority by DBCA, *Acacia semitrullata* (P4) was recorded within the survey area (68 individuals), however the species is known to occur and is widely distributed in the larger KSIA;
3. One conservation significant vegetation community was inferred to occur with the survey area, namely 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community (TEC), which is currently listed as Threatened under the EPBC Act and as Priority 3 by DBCA, comprising 2.08 ha;Forest Red-tailed Black Cockatoo was the only species of black cockatoo recorded during the survey. This species was observed as a flock of eight birds foraging in a Marri tree adjacent to the survey area. Whilst neither the Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo nor Baudin's Cockatoo were actually recorded within the survey area, there is potential habitat present for all three species;
4. A total of 2.08 ha (63.80%) within the survey area is considered as providing 'Good' quality foraging habitat for all three black cockatoo species, namely Jarrah/banksia woodland fauna habitat. Notwithstanding this, habitat for all three species of Black Cockatoo is present within the greater Kemerton area;
5. No Western Ringtail Possum individuals or secondary signs (e.g. dreys, scratchings, scats) were recorded within the survey area. Whilst there were large trees containing hollows within the survey, no signs of use by Western Ringtail Possums were observed and the absence of *Agonis* sp. suggests that the vegetation within the survey area is not conducive to habitation by the species.

1. Introduction

1.1 Project background

Coogee Chemicals are proposing to expand their existing facility at 869 Marriott Road, Wellesley (the survey area; approximately 3.26 hectares (ha); Figure 1).

A desktop assessment was undertaken for the survey area to identify potential environmental values and inform environmental approvals that may be required to progress development. The overarching conclusion of the desktop assessment work was that significant environmental values, namely Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (TEC), black cockatoo foraging habitat, potential Western Ringtail Possum habitat and potential habitat for Threatened orchids, may occur within the survey area.

Eco Logical Australia (ELA) was engaged to undertake: a Targeted orchid survey in winter 2021, focussing on *Drakaea elastica* (listed as EN under the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and CR under the *Biodiversity Conservation Act 2016* [BC Act]) and *Drakaea micrantha* (listed as VU under the EPBC Act and EN under the BC Act); single-phase spring Detailed and Targeted flora and vegetation survey; Basic terrestrial fauna survey; Targeted black cockatoo habitat assessment; and Targeted Western Ringtail Possum survey to inform environmental approvals requirements. The objectives of this survey are outlined below:

- Undertake a desktop assessment to identify potential biological features and constraints within and in proximity of the survey area;
- Undertake a Targeted orchid survey in accordance with the Commonwealth Draft Survey Guidelines for Australia's Threatened Orchid species on surveying Australia's threatened orchids listed under the EPBC Act (Commonwealth of Australia [CoA] 2013) and Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016);
- Undertake a Detailed and Targeted flora and vegetation survey in accordance with EPA (2016);
- Undertake a Basic fauna survey in accordance with the EPA Technical Guidance: *Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (2020),
- Undertake a Targeted black cockatoo habitat assessment in accordance with the Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species* (2012); and
- Undertake a Targeted Western Ringtail Possum survey in accordance with the DSEWPaC *Survey Guidelines for Australia's threatened mammals* (2011) and Department of Parks and Wildlife (DPaW) *Western Ringtail Possum Recovery Plan* (2017).

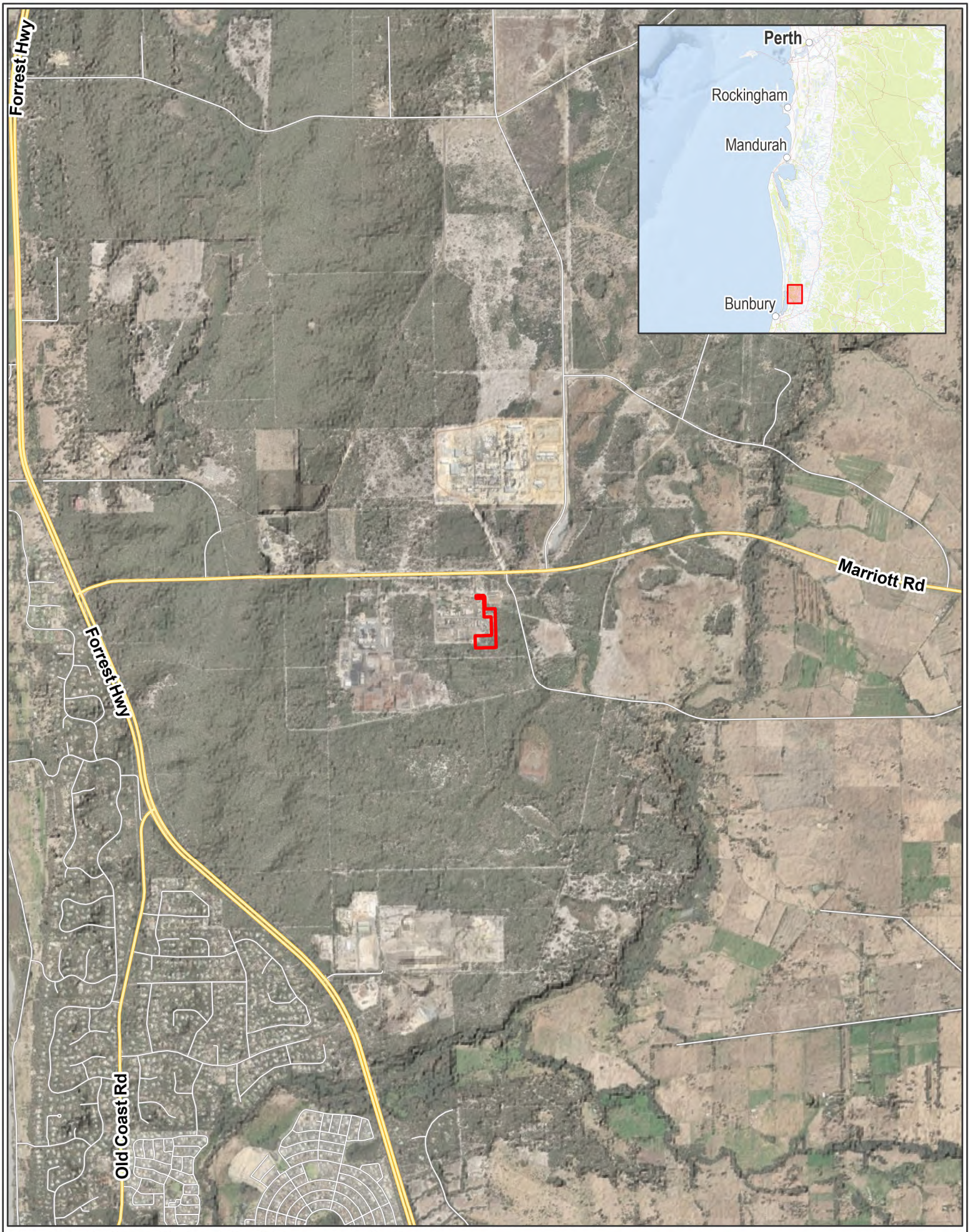

Figure 1: Location of the Expansion Area

Survey Area

N

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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2. Environmental setting

2.1 Climate

The Swan Coastal Plain experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell *et al*. 2002). Based on climate data from the nearby Bureau of Meteorology (BoM) Brunswick Junction weather station (station number 9513; climate data 1909 – current; located approximately 10 km south-east of the survey area) the region receives an annual average rainfall of 987.8 millimetres (mm), with most of the rainfall occurring during the winter months of June, July and August (195.1 mm, 189.9 mm and 145.3 mm respectively; BoM 2021).

In the 12 months preceding the Phase 1 Targeted threatened orchid survey (2 August 2021), the area received a total of 1101 mm, which is above the long-term average (Table 1; BoM 2021). A total of 495.8 mm of rainfall was recorded in the three months prior to the Phase 1 targeted threatened orchid survey, which is slightly less than the long-term average over the same time period (523.5 mm). Despite lower-than-average rainfall immediately prior to the survey, conditions were considered suitable with numerous orchid species having basal leaves present at the time of survey.

Table 1: Rainfall data recorded at the Brunswick Junction weather station (9513) 12 months prior to the Phase 1 field survey, compared to the long-term average

Month	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Total
Total monthly rainfall 2020 – 2021 (mm)	84.2	112	24.6	75	3.8	1.2	50.6	65.6	98.2	135.4	112	248.4	1101
Average monthly rainfall 1909 – current (mm)	145.3	97.6	59.6	32.1	15	12.1	13.6	23.9	50.5	138.5	195.1	189.9	987.8

In the 12 months preceding the Phase 2 detailed flora and vegetation survey (16 September 2021), the area received a total of 1012.8 mm, which is above the long-term average (Table 2; BoM 2021). A total of 446.4 mm of rainfall was recorded in the three months prior to the Phase 2 detailed flora and vegetation survey, which is less than the long-term average over the same time period (530.3 mm). Although below average, rainfall was sufficient to stimulate flowering across the majority of flora species occurring within the survey area. This resulted in very good survey conditions, with individual plants generally having reproductive material present (e.g. flowers, pods, seed), allowing for positive identification.

Table 2: Rainfall data recorded at the Brunswick Junction weather station (9513) 12 months prior to the Phase 2 field survey, compared to the long-term average

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Total
Total monthly rainfall 2020 – 2021 (mm)	112	24.6	75	3.8	1.2	50.6	65.6	98.2	135.4	112	248.4	86	1101
Average monthly rainfall 1909 – current (mm)	97.6	59.6	32.1	15	12.1	13.6	23.9	50.5	138.5	195.1	189.9	191.1	987.8

2.2 Landforms and soils

Soil Landscape Mapping - Systems mapping prepared by the Department of Primary Industries and Regional Development (DPIRD), provides and inventory and condition survey of lands at a 1: 250 000 scale (version April 2018; DPIRD 2020). One land system occurs within the survey area, as outlined in Table 3 and Figure 2.

Table 3: Land systems located within the survey area

Land system	Land system description	Total current extent mapped in Western Australia	Extent (ha) within the survey area	% of survey area	Proportion of current extent within the survey area (%)
Bassendean Dune System	Characterised by low *Banksia* woodlands (*B. attenuata, B. menziesii* and *B. ilicifolia*), *Eucalyptus todtiana* in the north, *Eucalyptus marginata* in the south, and *Nuytsia floribunda* over dense sclerophyll shrubs. The vegetation is located on dis-continuous older leached sands. Low lying areas, swamps, sumplands, creeks and rivers of this system are dominated by a mosaic of *Melaleuca preissiana*, *Melaleuca rhaphiophylla, Banksia littoralis, Casuarina obesa*, *Eucalyptus rudis* and/or sedges (Beard 1979).	518, 201.36	3.26	100	0.0006

One soil unit has been mapped across the survey area: Bassendean B6 Phase. This soil unit is described as *Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands*.

2.3 Interim-Biogeographic Regionalisation for Australia

The Interim Biogeographic Regionalisation for Australia (IBRA7) currently classifies 89 bioregions across Australia, based on a range of biotic and abiotic factors such as climate, vegetation, fauna, geology and landform (Thackway and Cresswell 1995; DAWE 2020b). These bioregions are currently further refined into 419 sub-regions representing more localised and homogenous geomorphological units in each bioregion (DAWE 2020b). IBRA divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (DAWE 2020b).

The survey area is located in the Swan Coastal Plain bioregion (SWA), which is further divided into two subregions: Dandaragan Plateau (SWA01) and Perth (SWA02). The survey area occurs within the Perth (SWA02) subregion, which is described as a low-lying coastal plain, mainly covered with woodlands and dominated by Banksia or Tuart on sandy soils (Mitchell et al. 2002).

2.4 Hydrology

Under the international RAMSAR agreement, wetlands are protected if they support a high level of attributes and functions. Australia has 65 RAMSAR wetlands identified, 12 of which are located within Western Australia. These are protected under the EPBC Act through applying management principles and arrangements with the Australian Government and individual states. Nationally significant wetlands are listed in the Directory of Important Wetlands in Australia (DIWA wetlands). There are no Ramsar or DIWA listed wetlands within the survey area, however the RAMSAR listed Yalgorup Lakes System is located approximately 13.5 km north-west of the survey area. Approximately 5 km north-east of the survey area is the Benger Swamp Nature Reserve.

At a State level, geomorphic wetlands have been evaluated and assigned management categories which provide guidance on how to manage and protect. The categories include:

- Conservation: wetlands which support a high level of attributes and functions and are of highest priority;
- Resource Enhancement: wetlands which may have undergone some modification but still supports substantial ecological attributes and functions, these are still priority wetlands; and
- Multiple Use: wetlands which support very little ecological attributes and functions.

One Resource Enhancement wetland (UFI 1530) occurs within the north-eastern portion of the survey area and extends to adjacent land to the east (Figure 3).

2.5 Broad-scale vegetation mapping

Vegetation type and extent have been mapped at a regional scale by Beard (1979) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:250,000, the DPIRD has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002).

One vegetation association occurs within the survey area: Bassendean 1000. The Bassendean 1000 vegetation association has less than 30% of the total pre-European extent remaining within the Perth bioregion (Government of Western Australia 2018; Table 4; Figure 4).

Table 4: Beard (1979) / Shepherd *et. al.* (2002) vegetation associations of the survey area

Vegetation association	Vegetation association description	Pre-European extent (ha) within the SWA2 sub-region	Current extent (ha) within the SWA2 sub-region	Remaining (%)	Extent (ha) within the survey area	Proportion of current extent within the survey area (%)
Bassendean 1000	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree (Melaleuca spp.)	94, 175.31	24, 869.20	26.41	3.26	0.013

2.6 System 6 Vegetation Complexes

Vegetation within the Perth metropolitan area has been described by Heddle *et al.* (1980) as vegetation complexes. As per this mapping, one vegetation complex occurs within the survey area (Table 5; Figure 5).

Table 5: System 6 vegetation complexes within the survey area and extent

System 6 code	Description	Total current extent mapped in Western Australia	Extent (ha) within the survey area	% of survey area	Proportion of current extent within the survey area (%)
Bassendean complex - central and south	Ranging from woodland of *Eucalyptus marginata – Allocasuarina fraseriana – Banksia* spp. to low woodland of *Melaleuca* spp., and sedgelands on the moister sites; this area includes the transition of *Eucalyptus marginata* to *Eucalyptus todtiana* in the vicinity of Perth. The southern transition of this Complex tends to comprise woodland of *Eucalyptus marginata - Corymbia calophylla* with well-defined second storey of *Allocasuarina fraseriana* and *Banksia grandis* on deeper soils and a closed scrub on moister sites.	22, 474.91	3.26	100	0.015

2.7 Areas of conservation significance

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under s. 51B of the State *Environmental Protection Act 1986* (EP Act). ESAs include areas declared as World Heritage, included on the Register of the National Estate, defined wetlands, and vegetation containing rare (Threatened) flora and TECs.

No ESAs occur within the survey area. The nearest ESA is located approximately 100 m to the south-west of the survey area, related to a Conservation Category Wetland and its associated buffer.

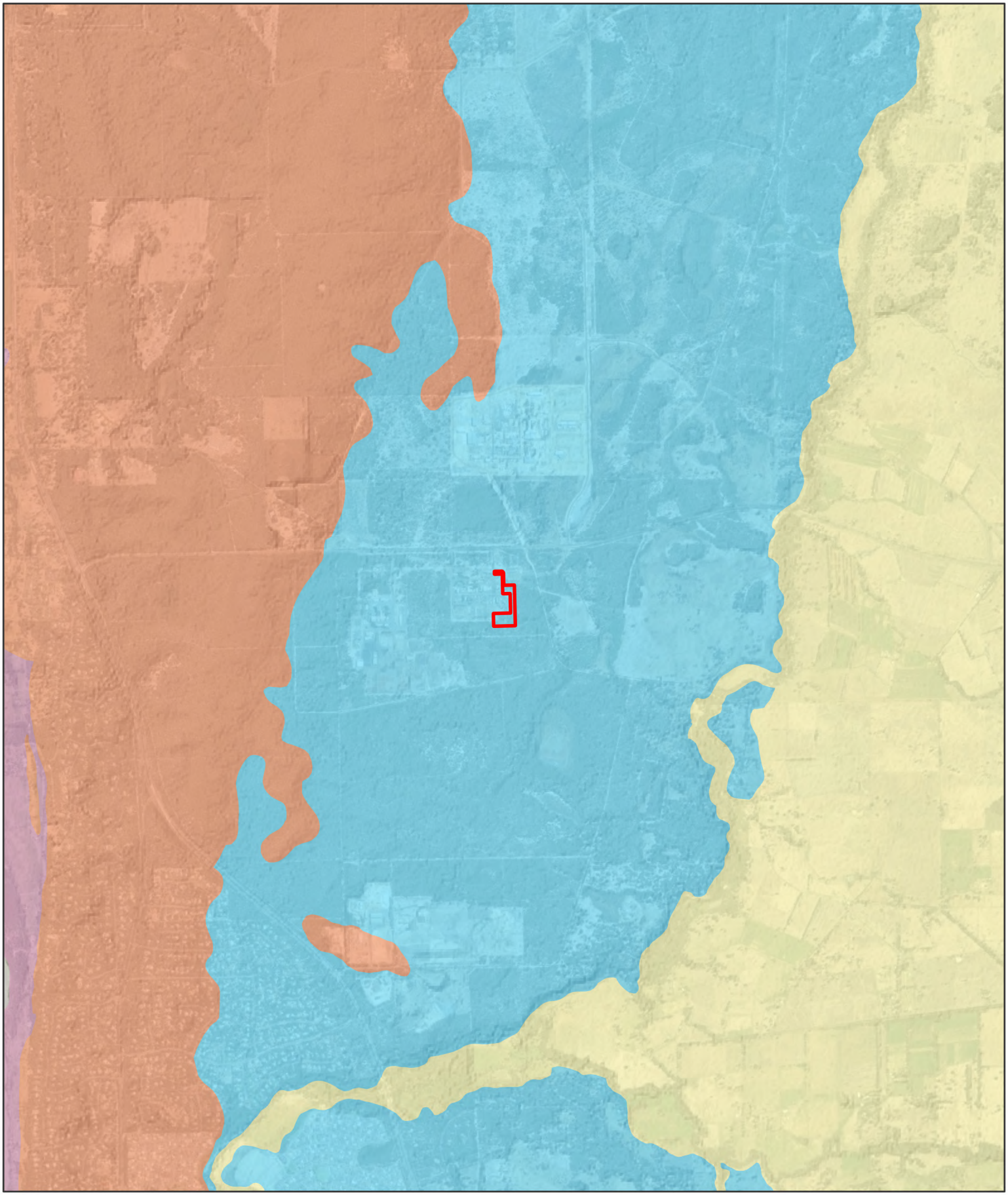

Figure 2: Land System Mapping

Survey Area

Land Systems

- Bassendean System
- Pinjarra System
- Spearwood System
- Vasse System

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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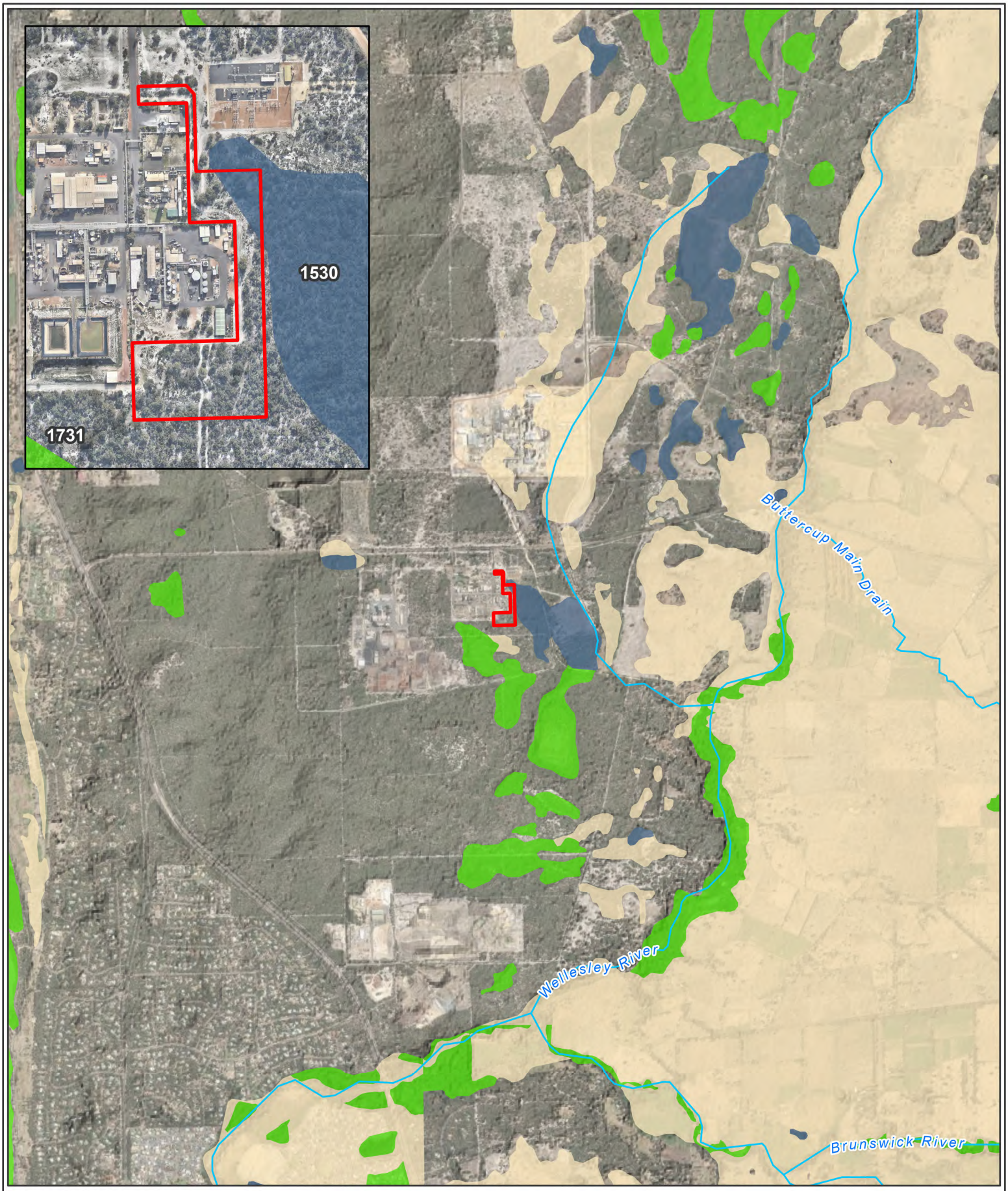

Figure 3: Hydrology

Survey Area

Drainage (Statewide)

Geomorphic Wetlands of the Swan Coastal Plain

Conservation

Multiple Use

Resource Enhancement

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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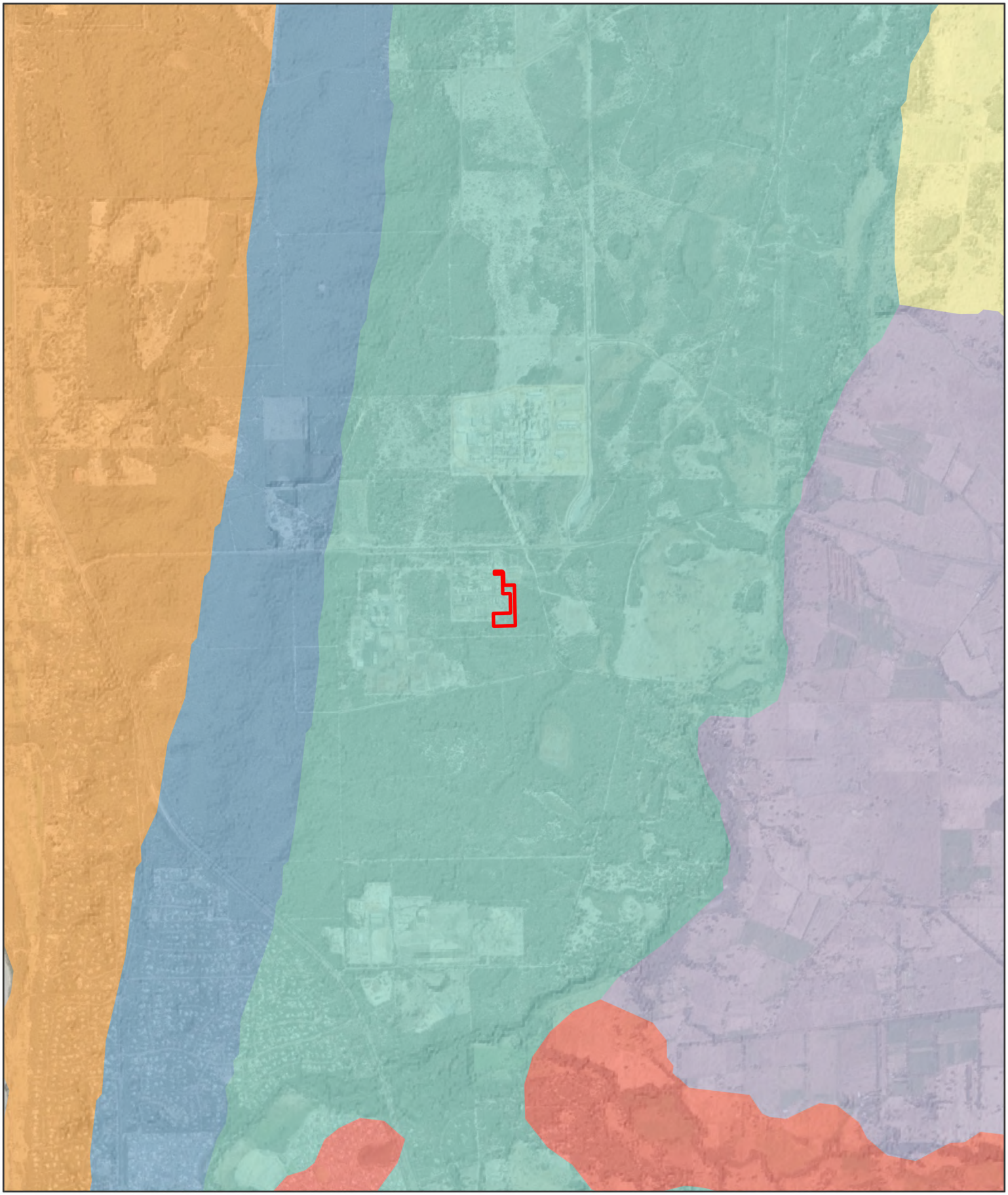

Figure 4: Broad Scale Vegetation Mapping

Survey Area

Pre-European Vegetation

- Bassendean (1000)
- Bassendean (1182)
- Pinjarra (968)
- Pinjarra (1182)
- Spearwood (6)
- Spearwood (998)

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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Figure 5: Heddle *et. al.* (1980) Vegetation Complexes

Survey Area

Vegetation Complexes of the Swan Coastal Plain

- Bassendean Complex-Central and South
- Cannington Complex
- Guildford Complex
- Karrakatta Complex-Central and South
- Southern River Complex
- Swan Complex
- Yoongarillup Complex

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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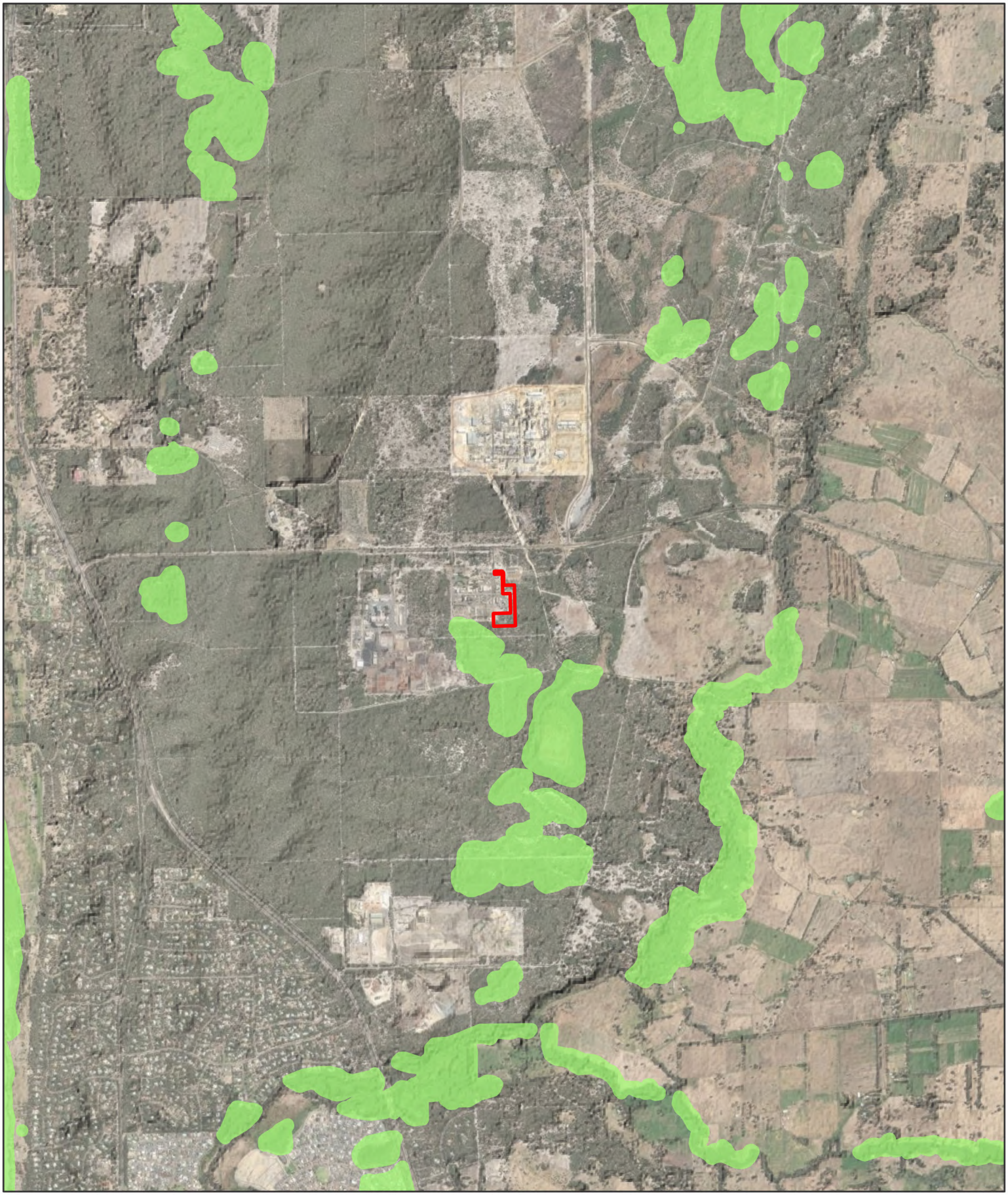

Figure 6: Environmentally Sensitive Areas (ESA)

Survey Area

Clearing Regulations - Environmentally Sensitive Area (ESA)

0 400 800 1,600

Metres

Datum/Projection:
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3. Methodology

3.1 Desktop review

3.1.1 Database searches and literature review

The following Commonwealth and State databases were searched for information relating to conservation listed flora and ecological communities in order to compile and summarise existing data to inform the field survey. Table 6 below presents the database searches undertaken. Applied buffers below are considered suitable based on flora and fauna assemblages expected to occur within the survey area. It should be noted that the buffers for the DBCA database searches are selected by DBCA on a case-by-case basis and are therefore not always consistent with other searches undertaken in the area.

Table 6: Database searches undertaken for the survey area

Database	Reference	Coordinates	Buffer (km)
EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act	DAWE 2020		20
DBCA and Western Australian Museum (WAM) NatureMap online database.	DBCA 2007-2021		20
DBCA Threatened and Priority flora database searches for Declared Rare Flora (DRF) listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority Flora.	DBCA 2021a	33.21°S 115.76°E	20
DBCA Threatened and Priority fauna database searches for Scheduled fauna listed under the EPBC Act or latest WA Wildlife Conservation (Specially Protected Fauna) Notice and Priority Fauna.	DBCA 2021b		22
DBCA Threatened and Priority Ecological Communities' database search	DBCA 2020c		10

3.1.2 Literature review

The following ecological surveys have been undertaken in the KSIA in the last two years and have been reviewed for this report.

- Eco Logical Australia. 2020. *Kemerton Strategic Industrial Area: Flora and Vegetation survey;*
- Bamford Consulting Ecologists. 2020. *Kemerton Strategic Industrial Area: Fauna assessment*;
- Eco Logical Australia. 2018a. *Kemerton Strategic Industrial Area: Flora and Fauna survey*;
- Eco Logical Australia. 2018b. *Detailed and Targeted Flora and Vegetation survey, Lot 19 Marriott Rd, Wellesley;* and
- Eco Logical Australia. 2018c. *Survey for conservation significant flora species and ecological communities, Marriott Rd, Kemerton.*

3.1.3 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken to identify conservation listed flora and fauna species that possibly occur within the survey area, identified from a review of key datasets and literature, as specified above. Conservation codes, categories and criteria for flora and fauna protected under the EPBC Act and the BC Act are provided in Appendix A (DBCA 2019a). Criteria used for this assessment is presented in Appendix B.

4. Field survey

4.1 Survey team and timing

4.1.1.1 Phase 1 – Targeted Threatened orchid survey

The Targeted Threatened orchid survey was conducted by Dr. Jeff Cargill (Senior Botanist), and Daniel Brassington (Botanist) on 2 August 2021.

4.1.1.2 Phase 2 – Detailed flora and vegetation survey

The Detailed and Targeted flora and vegetation survey was conducted by Dr. Jeff Cargill (Senior Botanist), Maitland Ely (Graduate Ecologist) and JZ Khoo (Graduate Environmental Scientist), on 16 September 2021. The survey team's relevant qualifications, experience and licences are provided in Table 7.

Table 7: Survey team

Name	Qualification	Relevant experience	Licences
Dr. Jeffry Cargill	BSc. Hons. PhD Environmental Sciences	Jeff has more than 12 years' experience in botanical and ecological studies throughout Western Australia including baseline vegetation studies (Reconnaissance and Detailed surveys), Targeted threatened and priority flora surveys, fauna and black cockatoo surveys, MNES surveys, environmental risk assessments and rehabilitation and vegetation monitoring programs.	Flora scientific collection licence: FB62000138 Declared Rare Flora (DRF) permit: TFL 48-1920
Daniel Brassington	BSc. Hons. Environmental Science	Daniel has experience in botanical surveys and environmental services throughout Western Australia. This includes baseline vegetation studies, threatened and priority flora surveys, weed surveys, rehabilitation and vegetation monitoring.	Flora scientific collection licence: SL012503 DRF permit: TFL 15-1920
Maitland Ely	BSc. Conservation Biology and Botany	Maitland is a recent graduate with ELA and has some experiences in ELA projects. This includes threatened and priority flora surveys, fauna and weed surveys.	N/A
JZ Khoo	BSc Marine Biology Hons Natural Resource Management	JZ is a recent graduate with ELA and has been exposed to and worked on numerous environmental impact assessments.	N/A

4.2 Flora and vegetation survey

4.2.1 Phase 1 – Targeted Threatened orchid survey (winter)

The Targeted Threatened orchid survey was conducted in accordance with CoA (2013) and EPA (2016). The Phase 1 survey was specifically designed to target the threatened orchid species *Drakaea elastica* and *Drakaea micrantha*. Surveys conducted in July and August are favoured for these species (particularly *D. elastica*), as both contain basal leaves that are relatively conspicuous in winter. Survey methodology involved personnel walking systematic foot-traverses of suitable habitat within the survey area. Location of survey transects is presented in Figure 7.

Where orchid individuals were identified in the field (basal leaf), locations were physically marked with flagging tape to enable field staff to revisit these locations during spring flowering. For individual plants identified in the field, the following data was collected:

- GPS coordinates of location (points for each individual plant or discrete population);
- Number of individuals in the population (recording a range of co-ordinates if necessary);
- Reproductive phase (basal leaf, flowering etc.);
- Description of the vegetation community and associated species at each location;
- Details on landform, soil type and site conditions;
- Photographs of the plant in situ and broader habitat; and
- Relevant notes such as potential threats to individuals and/or populations (e.g. weeds, clearing, dieback, herbivory).

4.2.2 Phase 2 – Detailed and Targeted flora and vegetation survey

The Detailed flora and vegetation survey was conducted in accordance with EPA (2016). The survey included:

- Description and mapping of vegetation types, including the presence of any Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) or wetland/riparian habitat, and compilation of a species inventory; and
- Vegetation condition mapping, adapted from Keighery (1994) and Trudgen (1988; EPA 2016), including the location of any identified Weeds of National Significance (WoNS) or Declared Pests listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act).

Stainless steel fence droppers were used to permanently 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). Photos were taken from the north-western corner of each quadrat. Where relevant, opportunistic sampling of species not recorded within the quadrats was undertaken to supplement the existing list of species recorded from within the survey area.

A total of three quadrats were established across the survey area (Figure 7). The following data was recorded within each quadrat:

- Vegetation structure and classes, cover of all species, dominant species list for each vegetation type (in accordance with the National Vegetation Information System (NVIS) Level V structure and floristics);
- Vegetation condition, in accordance with the scale outlined in EPA (2016) adapted from Keighery (1994);
- Full species list of both native and introduced species; and
- Relevant site data including coordinates, site photograph, soil, geology, drainage, slope etc. and any other relevant observational data.

The targeted survey was undertaken within the survey area to identify and record and conservation significant flora or communities potentially occurring, including:

- Threatened (T) 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; or
- Priority (P) flora recognised by DBCA.

The survey methodology involved personnel walking meandering transects across the survey area, with transects spaced (on average) 20 m apart. Locations of survey transects is shown in Figure 7. All encountered conservation listed flora and vegetation were recorded by taking the coordinates of each individual and/or a centroid coordinate location for a group of individuals (>100) within a 20 m radial circumference, using a GPS.

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 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).

The location of any Weeds of National Significance (WoNS) or Declared Pests listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act) were also recorded during the survey.

Flora specimen identification was undertaken by ELA botanist Daniel Brassington, with assistance from Dr Jeffry Cargill where required. The Western Australian Herbarium (WAH) was also utilised to confirm additional specimens. Species identification utilised taxonomic literature and keys and where required specimens were confirmed using the WAH reference collection. Suitable material that meets WAH specimen lodgement requirements, such as flowering material and range extensions, 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 2021).

4.3 Data analysis

4.3.1 Flora species accumulation curve

A flora species accumulation curve was undertaken to indicate adequacy of the survey effort (Clarke and Gorley 2006). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered adequate.

4.3.2 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). To down weight the relative contributions of quantitatively dominant species a 4th root transformation was applied to the species percentage cover dataset. 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. In addition, annuals were also removed from the dataset prior to analysis due to the likelihood of substantial differences between years based on seasonality of local rainfall events. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities.

4.4 Fauna survey

4.4.1 Basic fauna survey

The Basic fauna survey was conducted in accordance the EPA *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020). An assessment of fauna habitat in terms of its ability to support and sustain populations of fauna, along with an assessment of the likelihood of occurrence of conservation significant fauna species, was undertaken during the survey. The habitat characteristics and fauna database records used in assessing likelihood of occurrence for fauna included:

- Vegetation community, structure and condition;
- Soil and landform type;
- Extent and connectivity of bushland;
- Fauna species habitat preferences;
- Proximity of conservation significant fauna records; and
- Signs of species presence.

Opportunistic recordings of fauna species were made at all times during the field survey. These included visual sightings of active fauna such as reptiles and birds; records of bird calls; and signs of species presence such as tracks, diggings, burrows, scats and any other signs of fauna activity.

Nomenclature used for the vertebrate fauna species within this report follows the WAM Checklist of the Vertebrates of Western Australia (WAM 2020).

4.4.2 Targeted black cockatoo habitat assessment

All three species of black cockatoo occurring in Western Australia, Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo, and Baudin's Cockatoo are considered to potentially occur in the Wellesley area.

A Targeted black cockatoo habitat assessment was conducted in accordance with the *EPBC Act referral guidelines for three threatened black cockatoo species* (DSEWPaC 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 mm (> 300 mm for salmon gum and wandoo; DSEWPaC 2012). Trees with a DBH greater than 500 mm (or >300 mm for Salmon Gum and Wandoo) 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 the survey area were recorded with a GPS.

Hollows were considered 'suitable' if the entrance was >100 mm in diameter, >300 mm deep and aligned near vertical. If it was not possible to determine if a hollow was suitable or not it was categorised as 'potentially suitable'. Hollows that did not meet any of the requirements were categorised as 'unsuitable'. Trees that met the required measurements were inspected with a camera-pole for suitability of hollows for nesting and/or roosting and evidences of current or previous occupancy, including wear and chew marks around the entrance.

Vegetation present within the survey area was assessed for its potential to provide foraging and roosting habitat for black cockatoos as per the DSEWPaC guidelines (DSEWPaC 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, Jarrah and Marri nuts, and any black cockatoo individuals observed within the survey area.

4.4.3 Targeted Western Ringtail Possum habitat assessment

Western Ringtail Possums are known from the Wellesley area.

A Targeted Western Ringtail Possum survey was conducted in accordance with DSEWPaC *Survey Guidelines for Australia's threatened mammals* (2011) and Department of Parks and Wildlife (DPaW) *Western Ringtail Possum Recovery Plan* (2017). This involved a daytime survey of the site searching for dreys, tree hollows (and other potential daytime refuge habitat), scratchings, scats and individuals.

Vegetation communities critical to the species include (DPaW 2017, DEWHA 2009):

- Long unburnt mature remnants of peppermint (*Agonis flexuosa*) woodlands with high canopy continuity (core habitat);
- Jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) forests and woodlands;
- Coastal heath, jarrah/marri woodland and forest, peppermint woodlands, myrtaceous heaths and shrublands, Bullich (*Eucalyptus megacarpa*) dominated riparian zones and karri forest; and
- Limited disturbance and/or indices of fragmentation.

4.5 Limitations

The EPA Technical Guidance documents (EPA 2016, 2020) recommends including discussion of the limitations of the survey methods used. These limitations are summarised in Table 8. No limitations were identified.

Table 8: Survey limitations

Potential survey limitation	Impact on survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a limitation**. The Swan Coastal Plain has been well surveyed, with increasing survey work occurring due to the ongoing urban development. 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. Available information was sufficient to provide context at varying scales and therefore was not considered a limitation.
Scope (i.e. what life forms, etc., were sampled).	**Not a limitation**. The survey requirement of a Detailed and Targeted flora and vegetation survey and a Basic and Targeted fauna survey in accordance with relevant State and Federal legislation and EPA guidance documents was adequately met.

Potential survey limitation	Impact on survey
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a limitation**. Adequacy of sampling effort was tested via a species accumulation curve; approximately 81.87% of the flora potentially present within the survey area were recorded. This result is due to the degraded nature of the site, and as such, new weed species were being recorded at almost every quadrat. This is therefore considered to be an acceptable level of sample effort to compile a comprehensive flora inventory and subsequently accurately delineate vegetation communities present within the survey area.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a limitation**. The survey area was fully covered to meet requirements outlined in the scope of works. Quadrat locations were pre-selected using high resolution aerial photography, and confirmed in the field, to ensure all apparent vegetation communities identified were sampled, with multiple replications where possible. Site selection and replication was considered adequate to accurately analyse and discriminate sites based on species composition and subsequently delineate vegetation community boundaries.
Mapping reliability.	**Not a limitation**. Coverage of the survey area was considered to be good. High quality aerial maps were used for both the survey and subsequent vegetation mapping. Due to the nature of vegetation in the survey area, mapping boundaries of individual communities were discrete, and thus are considered accurate.
Timing, weather, season, cycle.	**Not a limitation**. 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 Detailed and Targeted flora and vegetation survey was undertaken in September 2021. 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. The Targeted orchid survey was undertaken in August, which is appropriate timing for species targeted during this survey.
Disturbances (fire, flood, accidental human intervention, etc.).	**Not a limitation**: Disturbances within the survey area included the presence of weeds, previous clearing, and rubbish dumping. These disturbances did not negatively impact the ability to meet objectives outlined in the scope of works.
Intensity (in retrospect, was the intensity adequate).	**Not a limitation**. The survey effort was adequately met. The area was searched for conservation significant flora and fauna species by field staff undertaking transects across the survey area spaced adequately apart. This method provides 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.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a limitation**. The number of personnel conducting this field survey in the given time was adequate to undertake the required level of survey. Additional resources, including equipment available, additional support and personnel were adequate.
Access problems (i.e. ability to access survey area).	**Not a limitation**. All relevant areas within the survey area were able to be accessed and surveyed.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a limitation**. The personnel conducting this field survey were suitably qualified to identify specimens, having previously undertaken flora and fauna surveys in the Swan Coastal Plain bioregion of Western Australia.

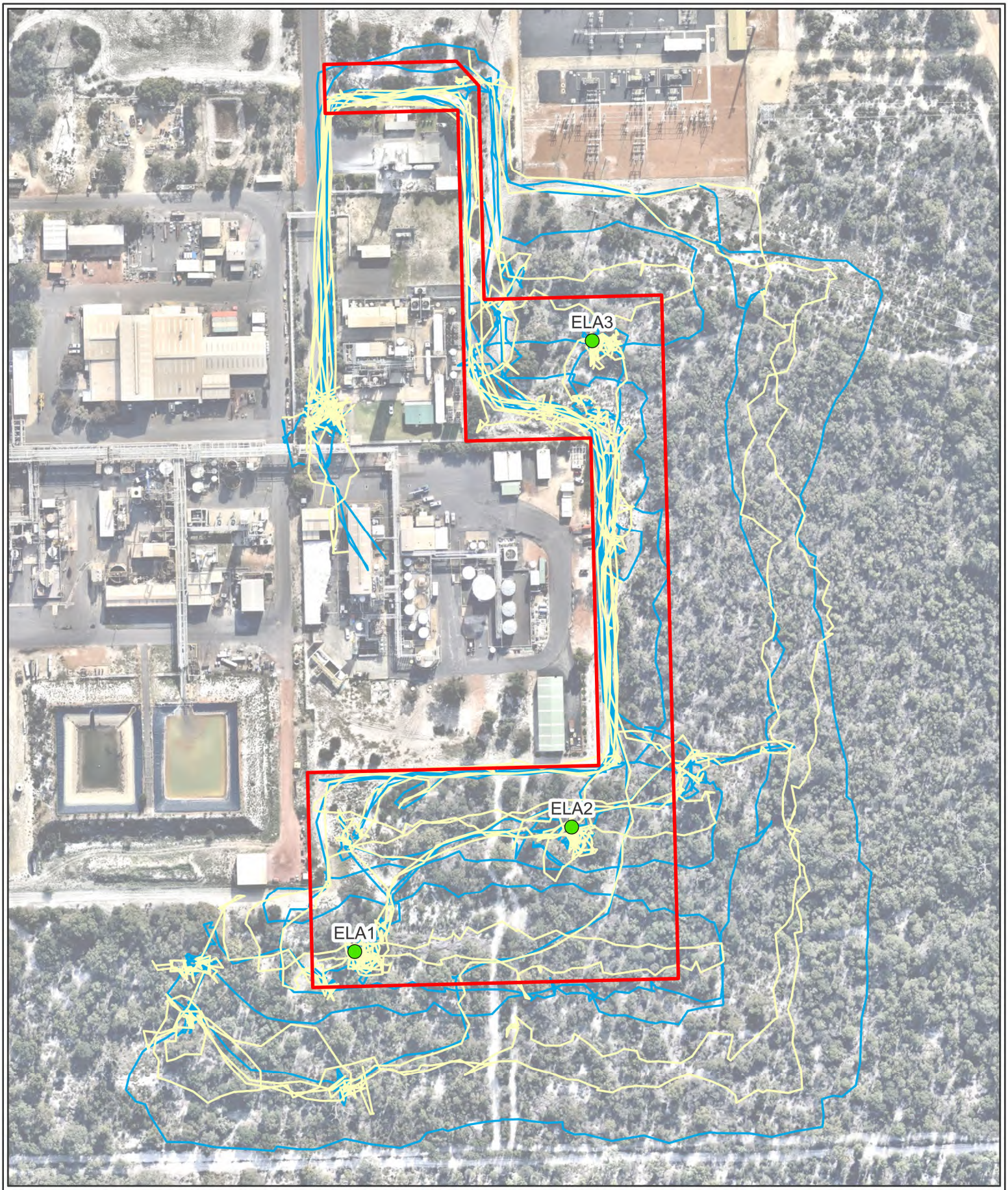

Figure 7: Survey Effort

Survey Area

Quadrat location

Survey Effort

Spring Survey

Winter Survey

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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5. Results

5.1 Desktop review

5.1.1 Conservation significant flora, fauna and ecological communities

The DBCA Threatened and Priority communities database search (DBCA 2021c) identified the Banksia Woodlands TEC (EPBC Endangered; WA P3) within the survey area (Figure 8). Four additional conservation significant communities were identified within 5 km of the survey area, of which buffers do not occur within the survey area (Table 9).

Table 9: Conservation significant ecological communities located within 10 km of the survey area

Community ID	Community Description	Conservation Code		Location
		EPBC Act	BC Act / DBCA	
Banksia WL SCP	Banksia dominated woodlands of the Swan Coastal Plain IBRA Region	EN	P3	Within the survey area
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	EN	P3	1 km south-west of the survey area
SCP25	Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands	-	P3	1 km west of the survey area
Tuart Woodlands	Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain	CR	P3	5 km west of the survey area
Coastal Saltmarsh	Subtropical and Temperate Coastal Saltmarsh	VU	P3	5 km west of the survey area

The DBCA Threatened and Priority Flora database search (DBCA 2021a), DBCA Threatened and Priority Fauna database search (DBCA 2021b), PMST (DAWE 2021a) and NatureMap search (DBCA 2007-2021) were undertaken to identify significant species recorded within, or nearby to, the survey area (current and historic from a 20 km radius). A total of 63 conservation listed flora (Figure 9) and 50 conservation listed fauna species (Figure 10) were identified as potentially occurring in the survey area.

Of the 63 conservation listed flora species identified from the desktop assessment as possibly occurring within the survey area, 30 species are considered as having the potential to occur based on availability of suitable habitat within the survey area, seasonal conditions and close proximity to previous records. Species of particular note include flora species which have been previously been recorded in the Kemerton area, including (ELA 2020):

- *Drakaea elastica* (EN (EPBC Act) and CR (BC Act));
- *Drakaea micrantha* (VU (EPBC Act) and EN (BC Act));
- *Carex tereticaulis* (Priority 3);
- *Acacia flagelliformis* (Priority 4);
- *Acacia semitrullata* (Priority 4) – recorded during this survey;
- *Caladenia speciosa* (Priority 4); and

- *Pultenaea skinneri* (Priority 4).

The remaining 33 species are considered as unlikely to occur due to lack of suitable habitat of these species and adequacy of search effort undertaken. The complete flora likelihood of occurrence assessment is presented in Appendix C.

Of the 50 conservation listed fauna species identified from the desktop assessment as possibly occurring within the survey area, the Forest Red-tailed Black Cockatoo was recorded as occurring within the survey area.

Of the remaining 49 species, 9 are considered as having the potential to occur within the survey area, based on the availability of suitable habitat and close proximity to nearby recent records:

- Western Ringtail Possum (*Pseudocheirus occidentalis*; CR under EPBC Act and BC Act);
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*; EN under EPBC Act and BC Act);
- Baudin's Cockatoo (*Calyptorhynchus baudinii*; EN under EPBC Act and BC Act);
- Black-stripe Minnow (*Galaxiella nigrostriatal*; EN under EPBC Act and BC Act);
- South-western Brush-tailed Phascogale (*Phascogale tapoatafa* subsp. *wambenger*; listed as CD under the BC Act);
- Coastal Plains Skink (*Ctenotus ora*); listed as P3 by DBCA;
- Perth Slider, Lined Skink (*Lerista lineata*); listed as P3 by DBCA;
- Quenda, South-western Brown Bandicoot (*Isoodon fusciventer*; listed as P4 by DBCA); and
- Western Brush Wallaby (*Notamacropus irma*; listed as P4 by DBCA).

The remaining 40 fauna species are considered as unlikely to occur within the survey area, based on lack of suitable habitat for these species, adequacy of search effort undertaken within the survey area and proximity of previous records (DBCA 2007-2021). The fauna likelihood of occurrence assessment is provided in Appendix D.

Aquatic and marine fauna species were not considered in the likelihood of occurrence assessment as the survey area does not contain core habitat that these species solely rely on for survival. However, species associated with wetlands and waterways, namely Black-stripe Minnow (*Galaxiella nigrostriatal*) and Carter's freshwater mussel (*Westralunio carteri*), have been considered, despite the survey area not impacting upon the waterways.

5.1.2 Previous surveys

A summary of the previous flora and vegetation and fauna surveys undertaken is provided in Table 10.

Table 10: Summary of previous surveys for KSIA

Survey	Summary	Implications for the survey area for this project
Kemerton Strategic Industrial Area: Flora and Vegetation survey (ELA 2020)	The Phase 1 survey was conducted for five days in July and two days in August 2019. The Phase 2 survey was conducted for eleven days in October 2019. Two Threatened flora species were recorded within the Project Area; *Drakaea elastica* (EN (EPBC Act) and CR (BC Act) and *Drakaea micrantha* (Vulnerable (EPBC Act) and EN (BC Act)). A total of eight DBCA listed Priority listed flora species were also recorded within the Project Area; *Caladenia swartsiorum* (Priority 2), *Carex tereticaulis* (Priority 3), *Dillwynia dillwynioides* (Priority 3), *Lasiopetalum membranaceum* (Priority 3), *Acacia flagelliformis* (Priority 4), *Acacia semitrullata* (Priority 4), *Caladenia speciosa* (Priority 4) and *Pultenaea skinneri* (Priority 4). The survey determined that both the 'Banksia Woodlands of the Swan Coastal Plain' and the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain Threatened Ecologically Communities occurs, to varying extents, throughout the Project Area.	Potential for the 'Banksia Woodlands of the Swan Coastal Plain' TEC and conservation significant flora species to occur.
Kemerton Strategic Industrial Area: Fauna assessment (Bamford Consulting Ecologists 2020)	The survey was conducted over ten days in November and December 2019. Conservation species of particular note because they are of high significance and have been recorded or are very likely to be present include Black-striped Minnow (present in adjacent wetlands), the Western Ringtail Possum (recorded just to the west of the survey area), the South-western Brush-tailed Phascogale (recorded in 2010 and 2012), Quenda (recorded), Western False Pipistrelle (recorded in 2010; uncertain record in 2019) and three Black Cockatoo species: Carnaby's, Baudin's and Red-tailed (all recorded).	Potential for all three species of black cockatoo and Western Ringtail Possum to occur.

Survey	Summary	Implications for the survey area for this project
Kemerton Strategic Industrial Area: Flora and Fauna survey (ELA 2018a)	The surveys were conducted over two days in September 2017. No Threatened flora taxa were recorded within the survey area; however, three Priority flora species were identified during field surveys (*Acacia semitrullata, Caladenia speciosa* and *Pultenaea skinneri*). *A. semitrullata* was widespread throughout remnant vegetation, while *C. speciosa* was recorded at three locations and *P. skinneri* at one. Eight vegetation communities were recorded within the study area, two of which were in Very Good or Excellent condition. Two vegetation communities are considered to represent the TEC *Banksia woodlands of the Swan Coastal Plain*. One of these communities is also listed as PEC (*Low lying Banksia attenuata woodlands or shrublands*) was also recorded.	Potential for the 'Banksia Woodlands of the Swan Coastal Plain' TEC and conservation significant flora species to occur.
Detailed and Targeted Flora and Vegetation survey, Lot 19 Marriott Rd, Wellesley (ELA 2018b)	The field survey was undertaken on 10 October 2018 using foot-traversing to search the area. A total of 74 taxa from 62 genera and 30 families were recorded within the study area. None of the flora species recorded are listed a Threatened under EPBC Act. One Priority species was recorded, *Acacia semitrullata* (P4). A total of 21 weed species were recorded within the study area, none of which are listed as Declared Plant species in Western Australia. Two vegetation communities were mapped, no TEC or PECs were recorded or inferred to occur within the area. Vegetation condition within the study area was recorded as ranging from Degraded to Good. Evidence of some areas in the early stages of regeneration	Potential for the 'Banksia Woodlands of the Swan Coastal Plain' TEC and conservation significant flora species to occur.
Survey for conservation significant flora species and ecological communities, Marriott Rd, Kemerton (ELA 2018c)	A total of 28 taxa from 27 genera and 19 families were recorded within the survey area. No Threatened or Priority flora species were recorded during the field surveys. Previously 26 conservation significant flora species were initially considered to be present or have the potential to be, however likely due to clearing and grazing the area was unlikely to support them. A single vegetation community was mapped within the survey area, potentially the *Banksia woodlands of the Swan Coastal Plain TEC*. The vegetation condition within the survey area was recorded as ranging from Completely Degraded to Good based on the EPAs *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.* A total of 11 weeds species were recorded within the survey area, none were listed as Declared Weeds.	Potential for the 'Banksia Woodlands of the Swan Coastal Plain' TEC and conservation significant flora species to occur.

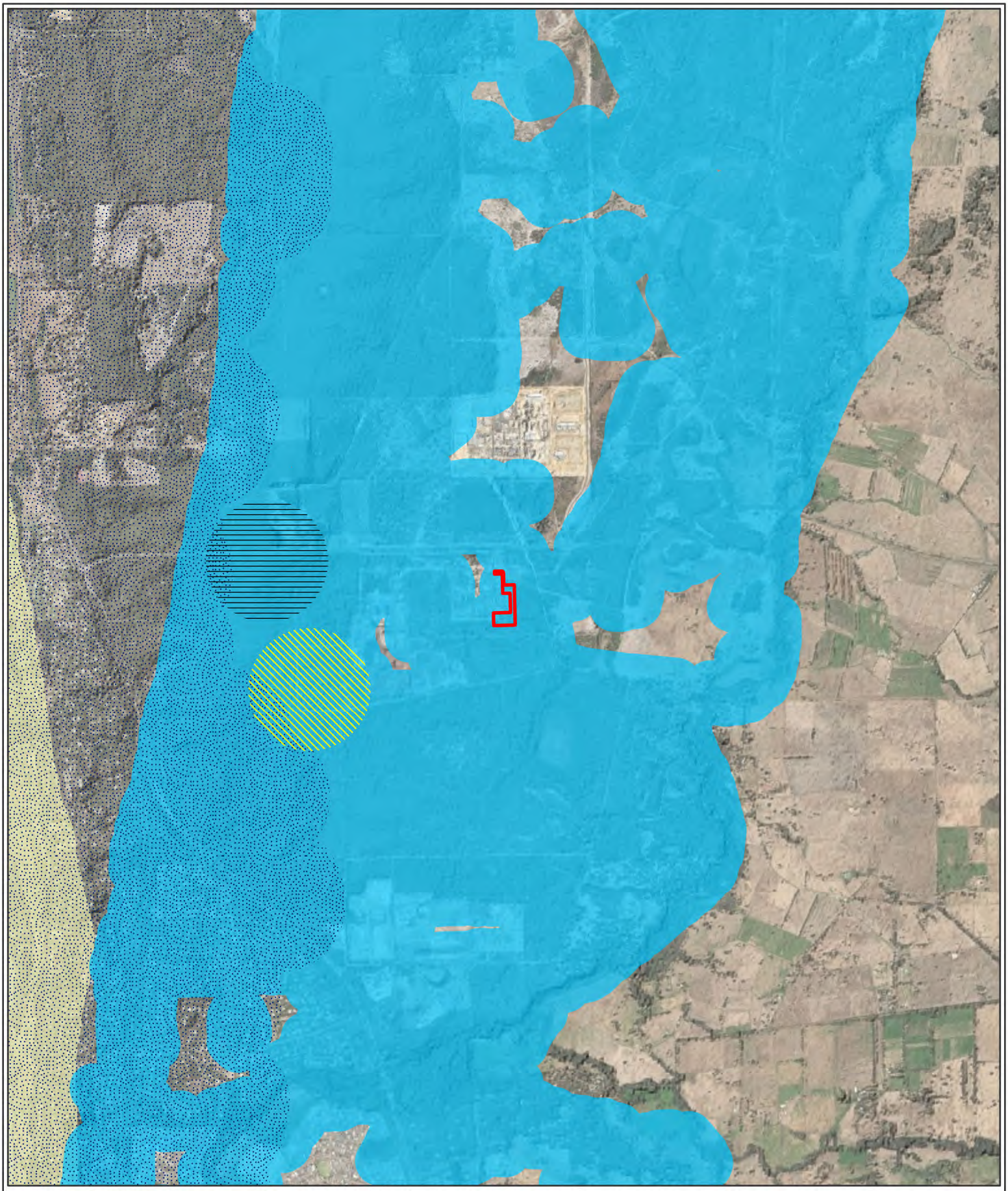

Figure 8: Conservation Significant Ecological Communities Previously Recorded

Survey Area

Conservation significant ecological communities

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region
- Low lying *Banksia attenuata* woodlands or shrublands
- Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands
- Subtropical and Temperate Coastal Saltmarsh
- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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Figure 9: Conservation Significant Flora Species Previously Recorded

Survey Area

Conservation significant flora

- Acacia flagelliformis (P4)
- Acacia semitrullata (P4)
- Caladenia huegelii (T)
- Caladenia speciosa (P4)
- Carex tereticaulis (P3)
- Dillwynia dillwynioides (P3)
- Diuris micrantha (T)
- Drakaea elastica (T)
- Drakaea micrantha (T)
- Lasiopetalum membranaceum (P3)
- Pterostylis frenchii (P2)
- Pultenaea skinneri (P4)
- Verticordia attenuata (P3)

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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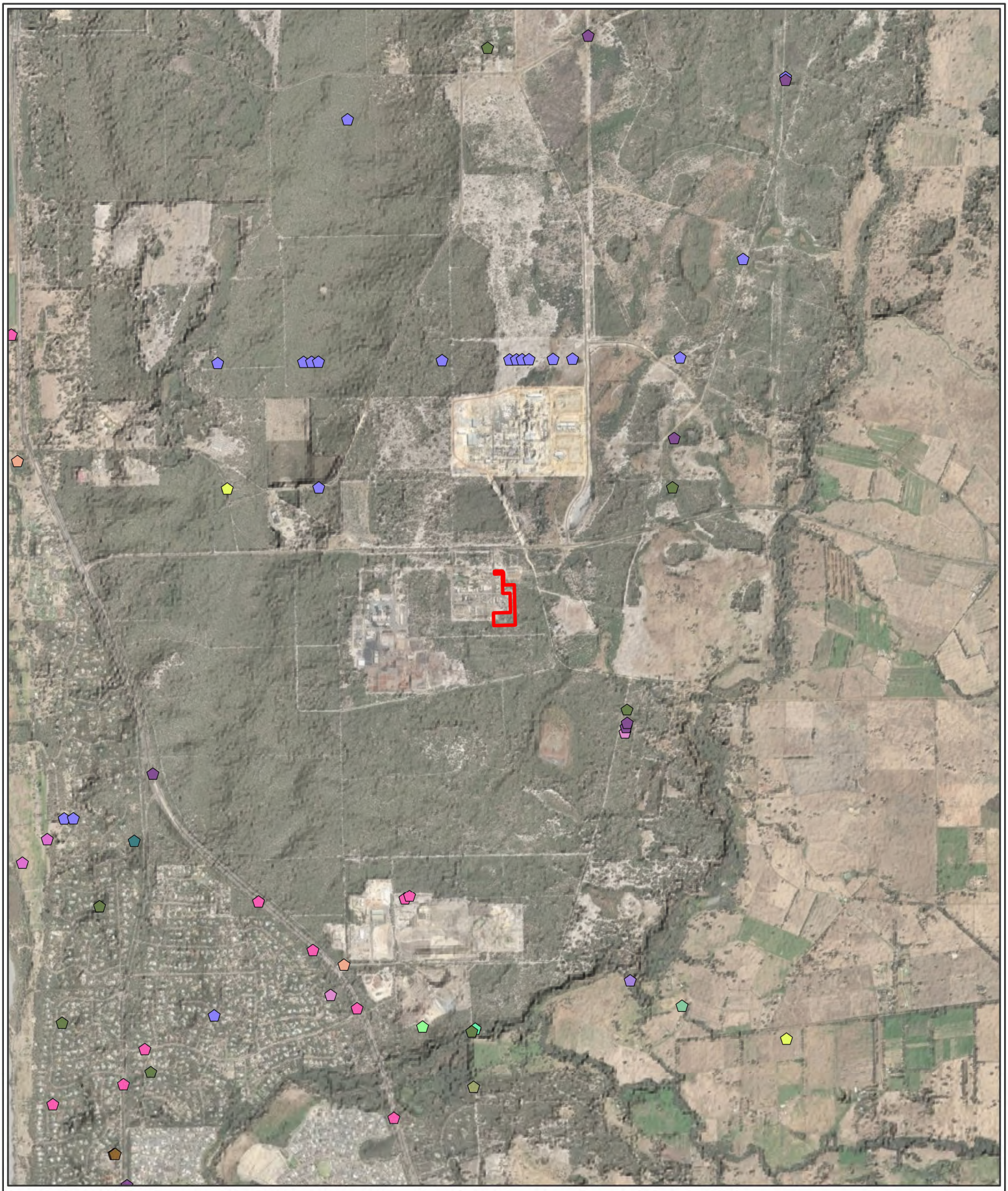

Figure 10: Conservation Significant Fauna Species Previously Recorded

Survey Area

Conservation significant fauna

- *Apus pacificus* (Fork-tailed swift, IA)
- *Arenaria interpres* (Ruddy turnstone, IA)
- *Botaurus poiciloptilus* (Australasian bittern, EN)
- *Calidris acuminata* (Sharp-tailed sandpiper, IA)
- *Calidris canutus* (Red knot, EN)
- *Calidris ferruginea* (curlew sandpiper, CR)
- *Calidris ruficollis* (Red-necked stint, IA)
- *Calidris tenuirostris* (Great knot, CR)
- *Calyptorhynchus banksii naso* (Forest red-tailed black cockatoo, VU)
- *Calyptorhynchus baudinii* (Baudin's cockatoo, EN)
- *Calyptorhynchus latirostris* (Carnaby's cockatoo, EN)
- *Calyptorhynchus* sp. 'white-tailed black cockatoo' (White-tailed black cockatoo, EN)
- *Charadrius leschenaultii* (Greater sand plover, large sand plover, VU)
- *Charadrius mongolus* (Lesser Sand Plover, EN)
- *Dasyurus geoffroii* (chuditch, western quoll, VU)
- *Falco peregrinus* (Peregrine falcon, OS)
- *Falsistrellus mackenziei* (Western false pipistrelle, western falsistrelle, P4)
- *Hydromys chrysogaster* (water-rat, rakali, P4)
- *Isoodon fusciventer* (Quenda, southwestern brown bandicoot, P4)
- *Limicola falcinellus* (Broad-billed sandpiper, IA)
- *Limosa lapponica* (Bar-tailed godwit, IA)
- *Limosa limosa* (Black-tailed godwit, IA)
- *Numenius madagascariensis* (Eastern curlew, CR)
- *Numenius phaeopus* (Whimbrel, IA)
- *Oxyura australis* (Blue-billed duck, P4)
- *Phascogale tapoatafa wambenger* (South-western brush-tailed phascogale, wambenger, CD)
- *Plegadis falcinellus* (Glossy ibis, IA)
- *Pluvialis fulva* (Pacific golden plover, IA)
- *Pluvialis squatarola* (Grey plover, IA)
- *Pseudocheirus occidentalis* (Western ringtail possum, ngwayir, CR)
- *Thalasseus bergii* (Crested tern, IA)
- *Tringa glareola* (Wood sandpiper, IA)
- *Tringa nebularia* (Common greenshank, greenshank, IA)
- *Tringa stagnatilis* (Marsh sandpiper, little greenshank, IA)

0 400 800 1,600

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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5.2 Flora and vegetation survey

5.2.1 Flora overview

A total of 62 flora species representing 28 families and 56 genera were recorded from the three quadrats established within the survey area and from opportunistic collections (totalling 13 species). Families with the highest number of species included Orchidaceae (7 species), Fabaceae (6 species) and Myrtaceae (5 species). A flora species list is provided in Appendix E and species by quadrat matrix is presented in Appendix F.

Average species richness per quadrat was 35.67 species, ranging from a low of 35 species in ELA01 and ELA03 to a high of 37 species in ELA02. Quadrat site data is presented in Appendix G.

5.2.2 Accumulated species – site surveyed (species-area curve)

A species accumulation curve was used to evaluate the adequacy of sampling (Figure 11). Only species data recorded from defined quadrats were used; no opportunistic flora collections were included. The asymptotic value was determined using Michaelis Menten modelling. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 59.86. Based on this value, and the total of 49 species recorded within the three quadrats, approximately 81.87% of the flora species potentially present within the survey area were recorded. This result, combined with the additional species recorded in relevés and opportunistically (13 species), indicates that the survey effort was adequate.

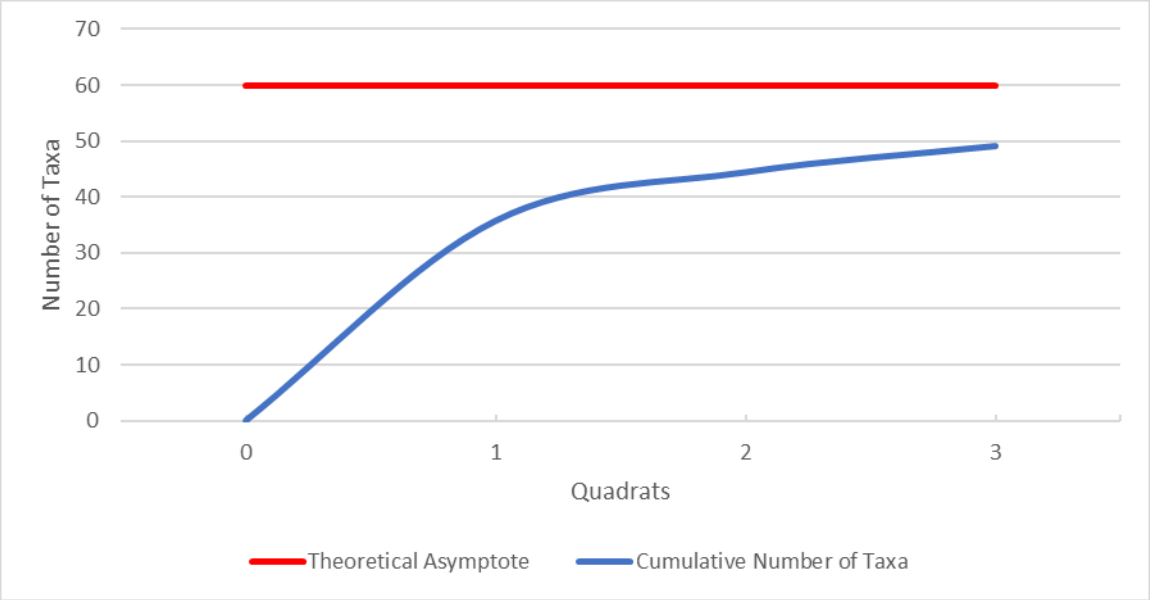

Figure 11: Average randomised species accumulation curve

Note: Only species recorded from quadrats were used to calculate the species accumulation curve and theoretical maximum number of species (asymptotic value).

5.2.3 Conservation significant flora

No Threatened flora species listed under the EPBC Act or the BC Act, were recorded within the survey area from the field survey.

Acacia semitrullata (Plate 1), listed as P4 by DBCA, was recorded from 26 point locations within the survey area, totalling 68 individuals. Locations of *Acacia semitrullata* within the survey area are shown in Figure 12. An additional 63 individuals were recorded directly adjacent to the survey area during the field survey.

Plate 1: *Acacia semitrullata* (Photo: J. Cargill)

5.2.4 Introduced flora

A total of 10 introduced (weed) species were recorded within the survey area, representing 16.12% of the total number of species recorded. Of these, two species **Gomphocarpus fruticosus* (Narrowleaf Cottonbush) and **Zantedeschia aethiopica* (Arum Lily) are listed as Declared Plants under the BAM Act (s22[2]) (Figure 13). None of these species are listed as Weeds of National Significance (WoNS).

5.2.5 Vegetation communities

Only one vegetation community was delineated and mapped within the survey area, covering a total of 2.08 ha (63.8%) (Table 11; Figure 14; Appendix H). Cleared areas (tracks etc.) accounted for 0.9 ha (27.6% of the survey area), whilst rehabilitation areas accounted for 0.28 ha (8.6%), respectively.

To provide context at a local scale, vegetation communities mapped within the survey area were compared to vegetation types mapped in the broader KSIA (ELA 2020) (Table 11). It should be noted that the vegetation types mapped in ELA (2020) for the broader KSIA were delineated at a much larger scale than the communities mapped in this report. This reflects the scale of both assessments, with the broader KSIA assessment being undertaken for over 2,000 ha and this assessment encompassing approximately 3.26 ha. The vegetation types mapped in ELA (2020) can be considered to be floristic 'supergroups' which may broadly resemble (or contain) multiple vegetation communities delineated at a finer scale.

Table 11: Vegetation communities recorded within the survey area

Vegetation community code	Quadrats	Corresponding vegetation type (ELA 2020)	Vegetation description	Extent of vegetation community in the survey area (ha)
EmKgXb	ELA01 ELA02 ELA03	V13	*Eucalyptus marginata* mid open woodland over *Banksia attenuata*, *Banksia ilicifolia* low woodland over *Kunzea glabrescens* tall sparse shrubland over *Xanthorrhoea brunonis, Bossiaea eriocarpa*, *Hibbertia hypericoides* mid open shrubland over *Dasypogon bromeliifolius*, *Hypolaena exsulca*, *Conostylis juncea* low sparse forbland.	2.08
R	N/A	-	Rehabilitation	0.28
Cleared	N/A	-	Cleared (tracks, pasture)	0.90
			Total	**3.26**

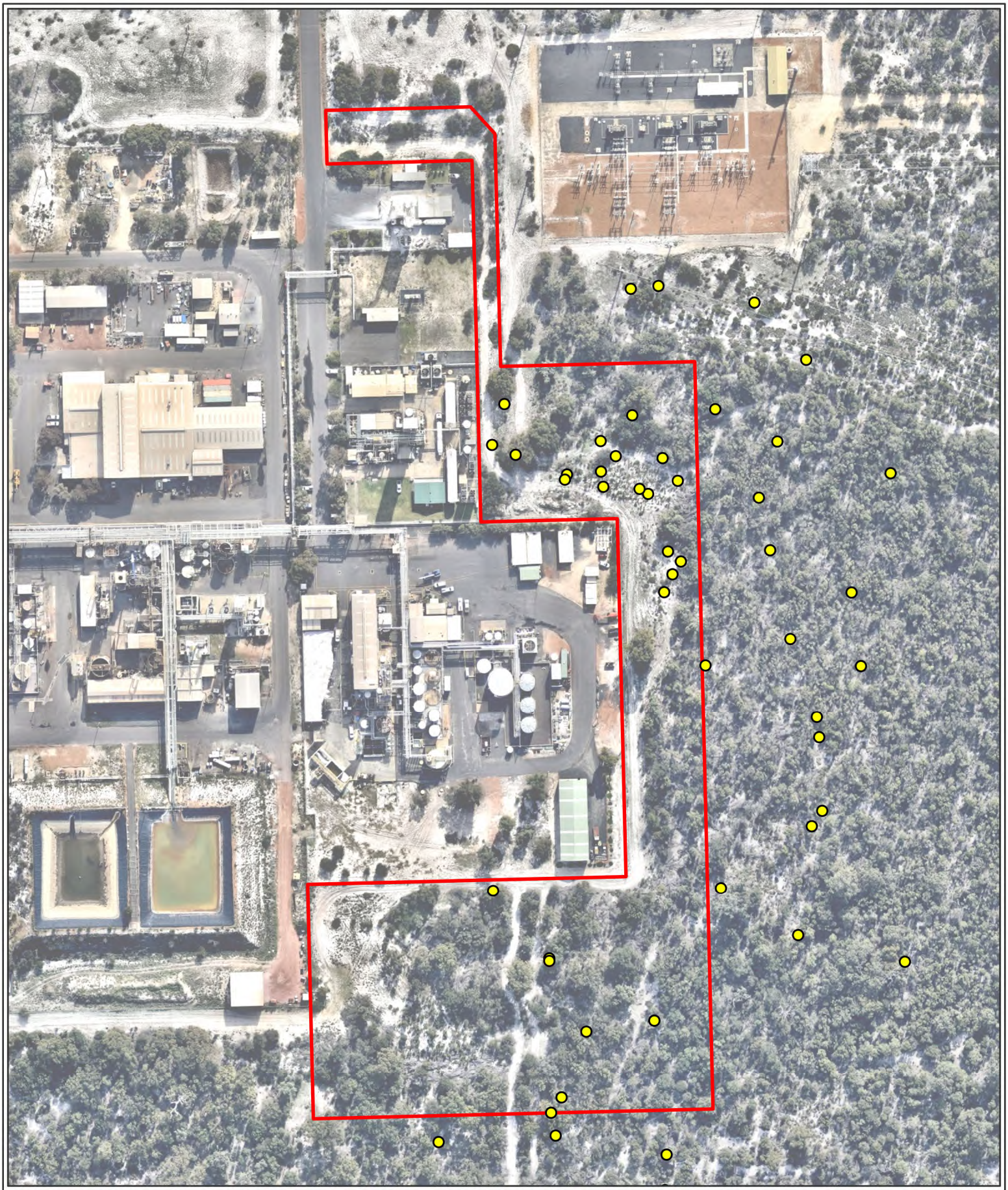

Figure 12: Conservation Significant Flora

Survey Area

Acacia semitrullata (P4)

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-GM Date: 28/10/2021

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Figure 13: Declared Pests within the survey area

Figure 14: Vegetation communities mapped within the survey area

5.2.6 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). Results of this analysis are shown below in Table 12.

Results of the multivariate analysis showed that quadrats within the sole mapped vegetation community EmKgXb had a close affiliation with FCT 21c and to a lesser extent FCT 21a. Both FCT 21c and FCT 21a are recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. FCT 21a is recognised as a subcomponent of the Tuart Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community; however, Tuart (*Eucalyptus gomphocephala*) was NOT recorded within the ELA vegetation community, and as such is not considered to form part of this TEC.

At a local scale, vegetation community EmKgXb was similar to vegetation type V13, mapped within the broader Kemerton Area (ELA 2020). Similarly, V13 was also shown to have floristic affiliations with FCT 21c and FCT 21a.

Table 12: Relationships between ELA vegetation communities and FCTs defined by Gibson *et al.* (1994)

FCT	ELA vegetation community	ELA quadrat number	Closest affiliated sites (Gibson et al. 1994)
21c	EmKgXb	ELA01	MODO-2 (21c; 42.85%), HYMUS-4 (21c; 40.00%), PLINE-7 (21c; 24.24%)
		ELA02	HYMUS-4 (21c; 38.71%)
21a	EmKgXb	ELA03	BULLER-1 (21a; 33.75%), CARD7 (21a; 38.96%), CORON-1 (21a; 41.38%), NINE-1 (21a; 40.00%),GUTHR-6 (21a; 42.22%), REDL-1 (21a; 47.52%), BULLER-2 (21a; 48.35%), AUSTRA-1 (21a; 37.65%), RIVD-2 (21a; 45.78%), DARD02 (21b; 42.48%), BOYAN01 (21b; 29.65%), BUFFER01 (21b; 3-.23%), MANEA-3 (21b; 43.96%), CAPEL-2 (21b; 36.14%), NINE-2 (21a; 47.19%), RUAB-1 (21b; 44.19%), RUAB-2 (21b; 35.44%), C71-2 (21b; 29.70%), CAPEL-7 (21a; 36.58%), DRAIN-1 (21a; 40.86%), KEME-2 (21a; 36.36%), CLIF-1 (21a; 38.38%), GUTHR-5 (21a; 44.89%), GUTHR-3 (21a; 39.58%), CRAMPT-1 (21a; 29.88%), CRAMPT-2 (21a; 39.17%)

5.2.6.1 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 Vegetation Community EmKgXb:

- **Location/landform** – the ecological community in question within the survey area is located on the Swan Coastal Plain and occurs on the Bassendean Dune System;
- **Structure and composition** – vegetation within the survey area is dominated or co-dominated by *Banksia attenuata*, with emergent trees of *Eucalyptus marginata*. A number of indicator species are also present. The understory contains high species diversity;
- **Condition thresholds** - the community was assessed and sampled in the highest condition representation available in the survey area and was completed in the most appropriate season for the Swan Coastal Plain; and
- **Minimum patch size** – vegetation meets the minimum patch size requirements for vegetation in Good or greater condition. Areas in Degraded condition are not considered part of the EPBC Act ecological community.

A total of 2.08 ha of vegetation within the survey area was assessed as representing the Banksia Woodlands of the Swan Coastal Plain TEC (Figure 15). This comprised of:

- 1.95 ha of vegetation in Good condition; and
- 0.13 ha of vegetation in Degraded condition. It is recognised that a single patch of a TEC may be degraded to some degree but still contributes to the overall function of the ecological community (TSSC 2016), therefore a precautionary approach was taken. This patch of the TEC contains vegetation that is for the majority, in Good condition.

The TEC within the survey area is connected to a much larger patch broadly mapped in ELA (2020) which extends to the south and the east (Figure 15).

5.2.7 Vegetation condition

Vegetation condition within the survey area ranged from Good to Degraded, based on the Keighery (1994) vegetation scale provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). Majority of the survey area was in Good condition (1.95 ha; 59.80%). Vegetation condition within the survey area is presented in Table 13 and Figure 16.

Cleared areas (tracks etc.) accounted for 0.90 ha (27.6% of the survey area). Disturbances within the survey area included historic clearing, tracks and fire breaks.

Table 13: Vegetation condition within the survey area

Condition	Extent (ha)	% of survey area
Good	1.95	59.80
Degraded	0.13	4.0
Cleared	0.90	27.6
Rehabilitation	0.28	8.6
Total	**3.26**	**100.0**

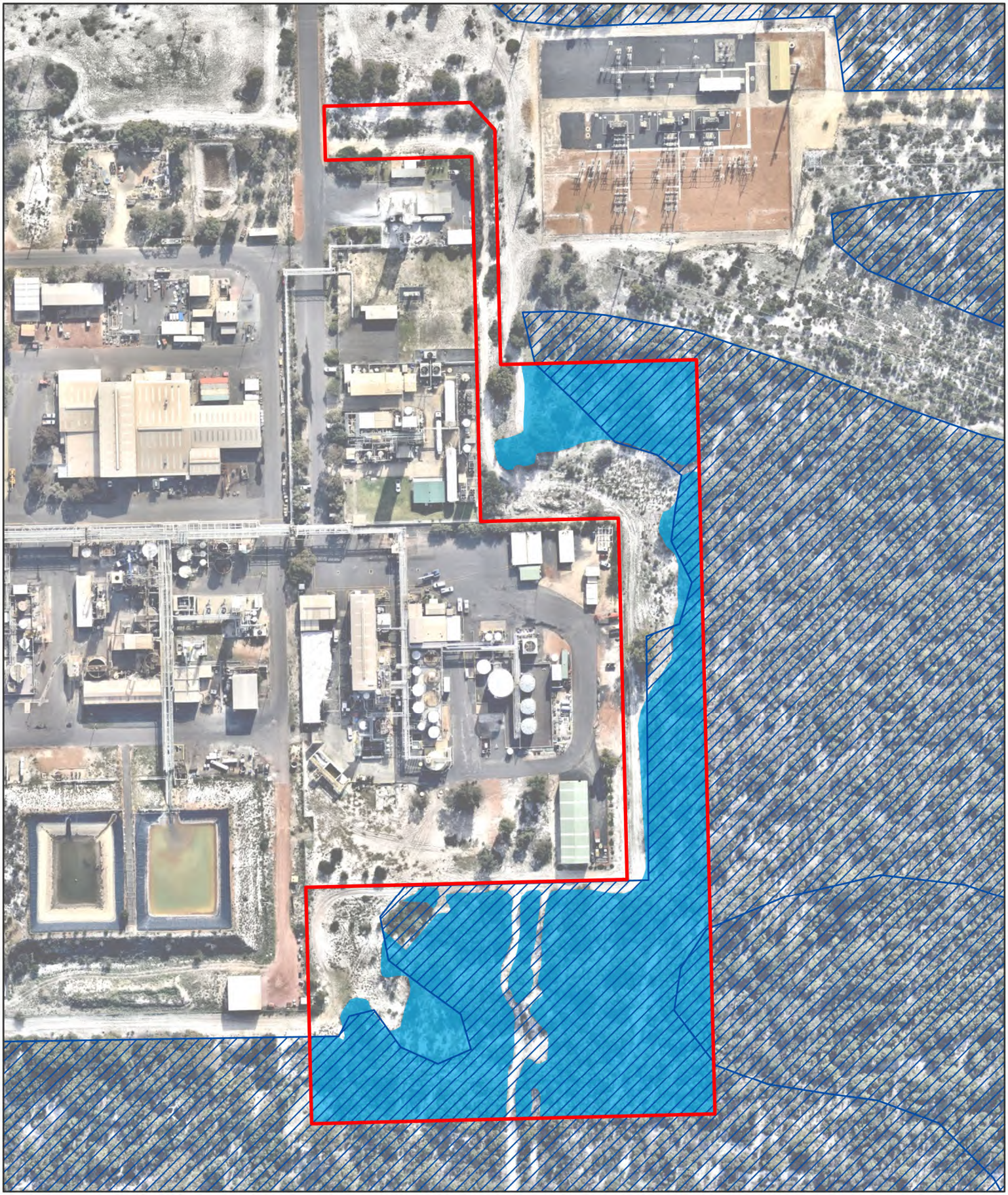

Figure 15: Conservation Significant Vegetation Communities

Survey Area

Banksia Woodlands TEC

Banksia Woodlands TEC (ELA 2020)

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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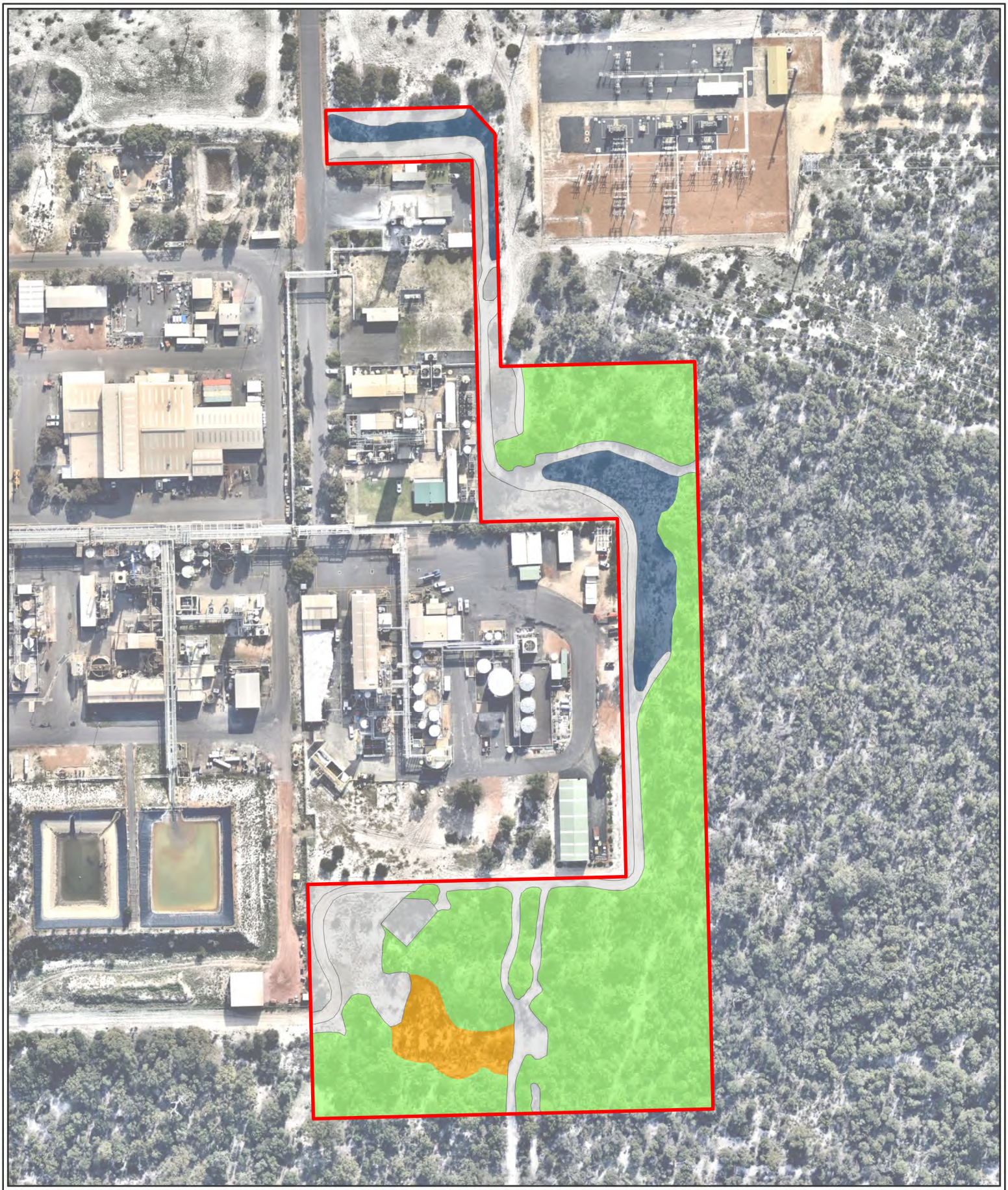

Figure 16: Vegetation Condition

Survey Area

Cleared (tracks etc.)

Vegetation Condition

Good

Degraded

Rehabilitation

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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5.3 Fauna survey

5.3.1 Fauna overview

A total of 19 fauna species were recorded as occurring within the survey area, comprising of 17 birds and two mammals (one native). A complete fauna species list is provided in Appendix J.

Of the 19 species recorded, one (Forest Red-tailed Black Cockatoo [*Calyptorhynchus banksii* subsp. *naso*]) is listed as Threatened under the EPBC Act (Vulnerable) and BC Act (Vulnerable). This species is discussed further in section 5.3.3. No fauna species listed as Priority by DBCA were recorded.

One introduced (pest) fauna species was recorded within the survey area; rabbit (*Oryctolagus cuniculus*).

5.3.2 Fauna habitat

A total of two fauna habitats were identified within the survey area, covering a total of 2.36 ha (72.4% of the survey area) (Table 14; Figure 17). The most widespread fauna habitat was Jarrah/banksia woodland, which accounted for 2.08 ha (63.8% of the survey area). Rehabilitation areas accounted for 0.28 ha (8.6% of the survey area), whilst cleared areas (tracks etc.) accounted for 0.90 ha (27.6% of the survey area).

Table 14: Extent of each fauna habitat in the survey area

Fauna habitat	Extent of fauna habitat in the survey area
Jarrah/banksia woodland	2.08 ha (63.8%)
Rehabilitation areas	0.28 ha (8.6%)
Cleared (tracks etc.)	0.90 ha (27.6%)
Total	**3.26 ha**

5.3.3 Black cockatoo habitat assessment

Forest Red-tailed Black Cockatoo was the only species of black cockatoo recorded during the survey. This species was observed as a flock of eight birds foraging in a Marri tree adjacent to the survey area. Whilst neither the Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo nor Baudin's Cockatoo were actually recorded within the survey area, there is potential habitat present for all three species – this is further discussed below.

5.3.3.1 Foraging habitat

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 within the survey area has been determined using vegetation associations defined in the vegetation assessment and from ground-truthing in the field. The quality of foraging habitat for black cockatoo species within the survey site (as defined in Table 15 below) has been assessed based on the availability and density of plant food sources.

Table 15: Definition and extent of black cockatoo foraging habitat quality within the survey area

Foraging quality	Justification	Extent within survey area
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).	2.08 ha (63.8%)
Poor	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species ≤10%) and food sources only present at one or two strata (e.g. canopy and midstorey).	0.28 ha (8.6%)
Nil	Cleared areas or no suitable vegetation present.	0.90 ha (27.6%)

A total of 2.08 ha (63.80%) within the survey area is considered as providing 'Good' quality foraging habitat for all three black cockatoo species, namely Jarrah/banksia woodland fauna habitat.

A total of 0.28 ha (8.6%) within the survey area is considered as providing 'Poor' quality foraging habitat for all three black cockatoo species, with Scattered *Eucalyptus* spp. occurring at a low cover.

The remainder of the survey area provides 'Nil' foraging habitat (0.90 ha; 27.6%) for black cockatoo species, predominantly comprised of cleared areas (tracks etc.).

Suitable foraging habitat for black cockatoo species within the survey area is presented in Figure 18.

5.3.3.2 Breeding and roosting habitat

The black cockatoo breeding habitat assessment identified four potentially suitable breeding trees within the survey area, all of which were *Eucalyptus marginata* (Jarrah). None of these contained potentially suitable hollows over 100 mm in diameter.

All potentially breeding trees recorded from the survey area provide suitable roosting habitat for black cockatoos as defined by the referral guidelines (DSEWPaC 2012).

5.3.4 Western Ringtail Possum habitat assessment

No Western Ringtail Possum individuals or secondary signs (e.g. dreys, scratchings, scats) were recorded within the survey area. Whilst there were large trees containing hollows within the survey area (refer to section 5.3.3), no signs of use by Western Ringtail Possums were observed. In addition, lack of *Agonis flexuosa* (Peppermint) within the survey area suggests that the vegetation within the survey area is not conducive to habitation by the species.

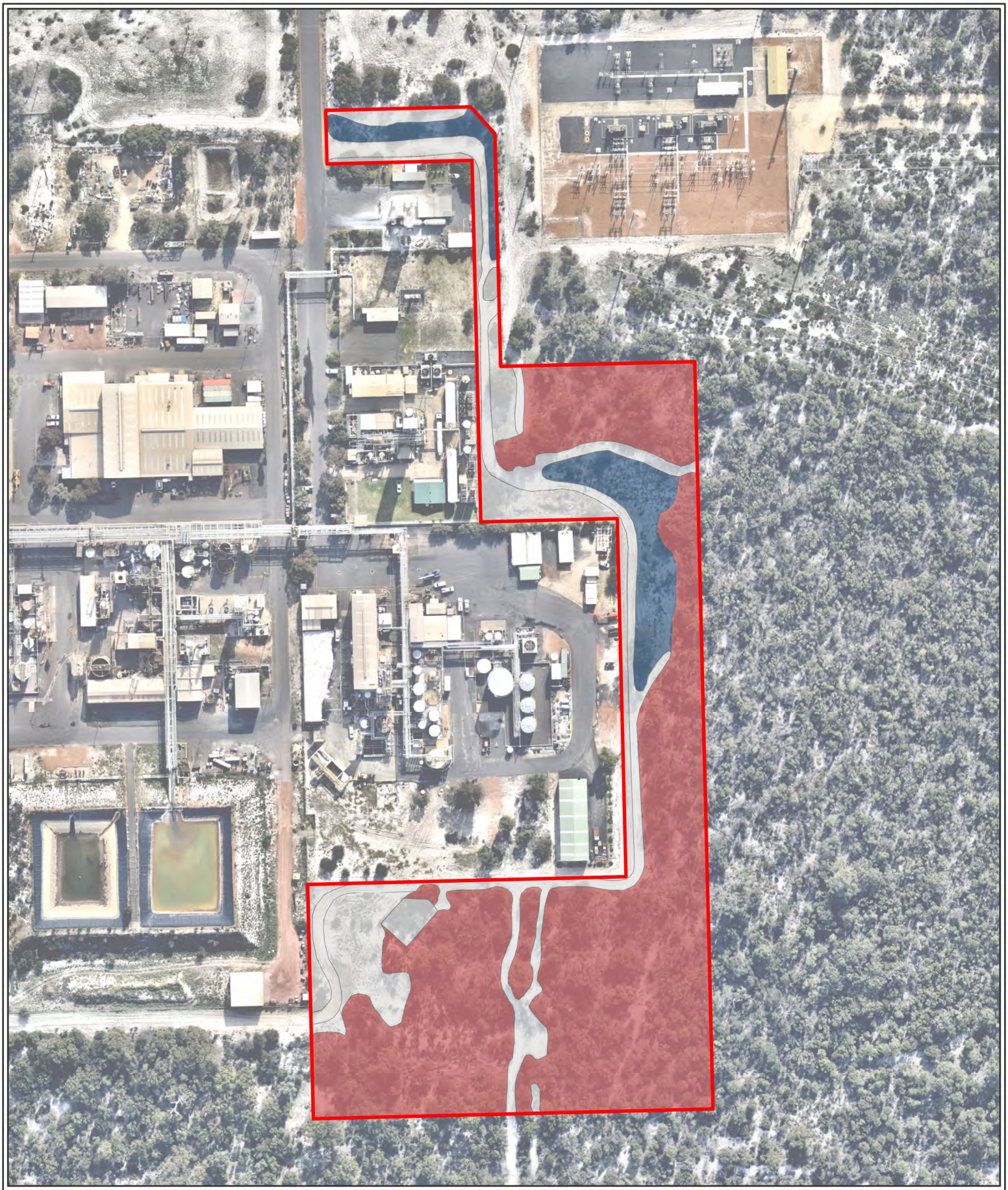

Figure 17: Fauna Habitat

Survey Area

Cleared (tracks etc.)

Fauna Habitat

Jarrah / *Banksia* woodland

Rehabilitation

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-SM Date: 28/10/2021

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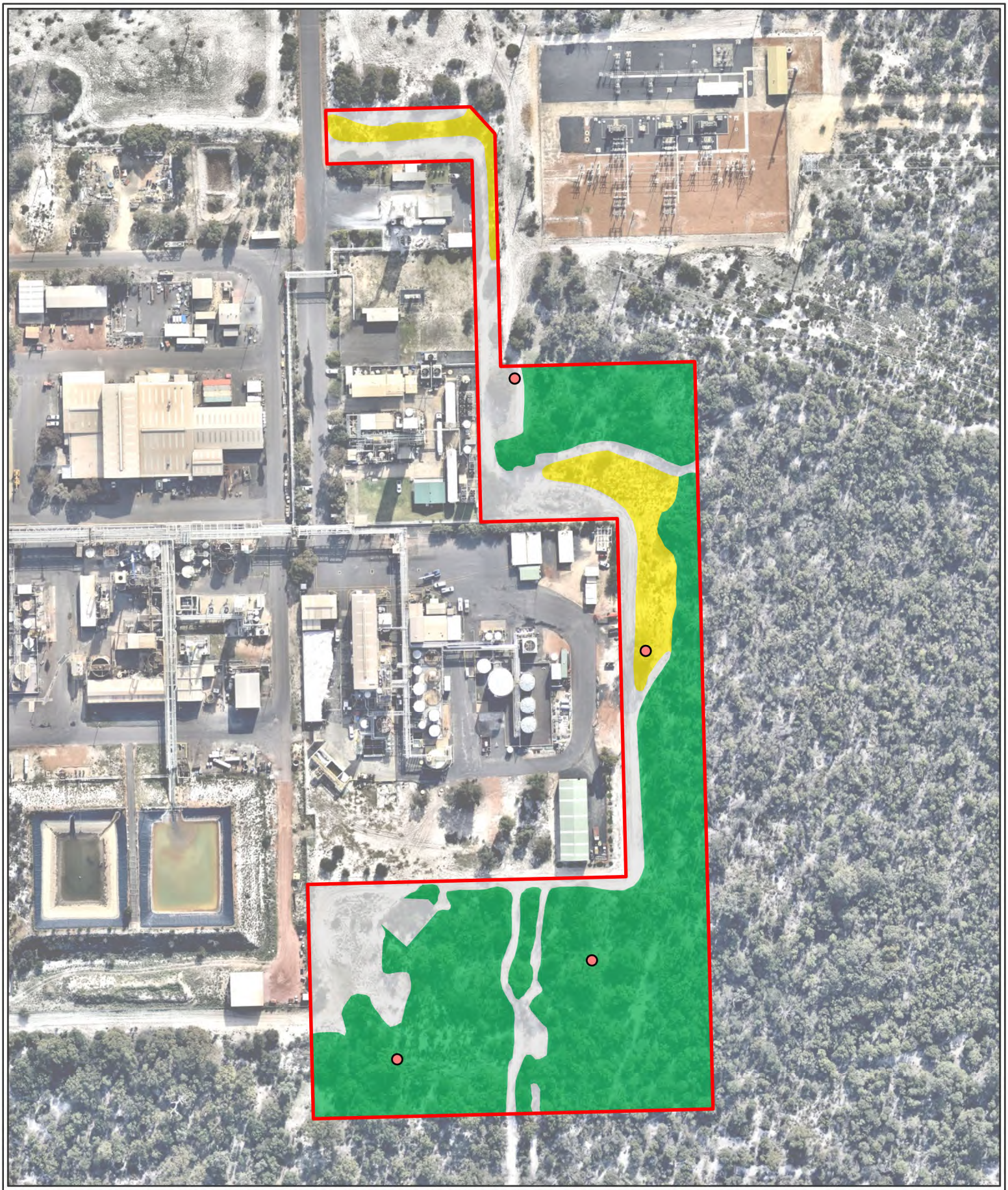

Figure 18: Black Cockatoo Potentially Suitable Habitat

Survey Area

Potential black cockatoo tree

Jarrah (*Eucalyptus marginata*), No suitable hollow

Black cockatoo habitat quality

Good

Poor

Nil

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 19510-GM Date: 28/10/2021

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6. Discussion

6.1 Flora

A total of 62 flora species representing 28 families and 56 genera were recorded from the survey area. More specifically, 49 species were recorded across three quadrats, with a further 13 species recorded from opportunistic collections. Average species richness per quadrat was 35.67 species which indicates the intact nature of the remnant vegetation within the survey area. Rehabilitation areas and cleared areas within the survey area had significantly lower species richness, however no quadrats were established in these areas given the level of degradation and immature vegetation present.

No Threatened flora species listed under the EPBC Act or the BC Act, were recorded within the survey area from the field survey.

One flora species listed as Priority by DBCA, *Acacia semitrullata* (P4) was recorded from 26 point locations within the survey area, totalling 68 individuals. An additional 63 individuals were recorded directly adjacent to the survey area during the field survey. *A. semitrullata* is a slender, erect, pungent shrub 0.2-0.7 m high with white-cream flowers (DBCA and WAH 2021). It is known from 146 records in the southwest of Western Australia over a range of approximately 190 km extending from the Whicher Range (between Busselton and Nannup) northeast to the Donnybrook area and north-northwest to Harvey**,** Western Australia (DBCA 2007-2021; Maslin 1978). On the Swan Coastal Plain, it frequently grows in open heath with emergent *Melaleuca preissiana* and *Nuytsia floribunda* adjacent to swamps in the deep, dark grey sands of the Bassendean Soil Association (Maslin 1978). It is also known to occur on white/grey sands and clay over laterite in sandplains and swampy areas (DBCA and WAH 2021).

A. semitrullata has been previously recorded from two locations within the Kemerton Strategic Industrial Area and within 5 km of this area (Coffey Environments 2008; Cardno 2010; DBCA 2021a). In addition to these historical records, ELA (2020) recorded this species from 27 point locations within the Kemerton Strategic Industrial Area, totalling 77 individuals, spanning eight vegetation communities, indicating the widespread nature of the species.

A total of 63 conservation listed flora species identified from the desktop assessment as possibly occurring within the survey area, of which 30 species have the potential to occur based on availability of suitable habitat within the survey area, seasonal conditions and close proximity to previous records. None of these species identified during the desktop assessment were recorded during the field survey.

A total of 10 introduced (weed) species were recorded within the survey area, representing 16.12% of the total number of species recorded. Of these, two species **Gomphocarpus fruticosus* (Narrowleaf Cottonbush) and **Zantedeschia aethiopica* (Arum Lily) are listed as Declared Plants under the BAM Act (s22[2]). None of these species are listed as Weeds of National Significance (WoNS).

6.2 Vegetation

Only one vegetation community was delineated and mapped within the survey area, covering a total of 2.08 ha (63.8%), EmKgXb: *Eucalyptus marginata* mid open woodland over *Banksia attenuata*, *Banksia ilicifolia* low woodland over *Kunzea glabrescens* tall sparse shrubland over *Xanthorrhoea brunonis,*

Bossiaea eriocarpa, *Hibbertia hypericoides* mid open shrubland over *Dasypogon bromeliifolius*, *Hypolaena exsulca*, *Conostylis juncea* low sparse forbland.

The remainder of the survey area was comprised of cleared areas (tracks etc.), accounting for 0.9 ha (27.6% of the survey area), whilst rehabilitation areas accounted for 0.28 ha (8.6%).

To provide context at a local scale, vegetation communities mapped within the survey area were compared to vegetation types mapped in the broader KSIA (ELA 2020). At a local scale, vegetation community EmKgXb was similar to vegetation type V13, mapped within the broader Kemerton Area (ELA 2020). V13 was described as: *Eucalyptus marginata* mid open woodland over *Banksia attenuata*, *Banksia ilicifolia* low woodland over *Xanthorrhoea preissi*, *Kunzea glabrescens* tall sparse shrubland over *Bossiaea eriocarpa*, *Conostephium pendulum*, *Hibbertia hypericoides* mid open shrubland over *Dasypogon bromeliifolius*, *Hypolaena exsulca*, *Conostylis juncea* low sparse forbland.

Results of the multivariate analysis showed that quadrats within the sole mapped vegetation community EmKgXb had a close affiliation with FCT 21c and to a lesser extent FCT 21a. Both FCT 21c and FCT 21a are recognised as being part of the 'Banksia Woodlands of the Swan Coastal Plain' ecological community, which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA. Similarly, V13 mapped in ELA (2020) was also shown to have floristic affiliations with FCT 21c and FCT 21a.

The EmKgXb vegetation community was 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. A total of 2.08 ha of vegetation community EmKgXb was assessed as representing the Banksia Woodlands of the Swan Coastal Plain TEC. This comprised of: 1.95 ha of vegetation in Good condition; and 0.13 ha of vegetation in Degraded condition. It is recognised that a single patch of a TEC may be degraded to some degree but still contributes to the overall function of the ecological community (TSSC 2016), therefore a precautionary approach was taken. This patch of the TEC contains vegetation that is for the majority, in Good condition. The TEC within the survey area is connected to a much larger patch broadly mapped in ELA (2020) which extends to the south and the east.

FCT 21a is recognised as a subcomponent of the Tuart Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community; however, Tuart (*Eucalyptus gomphocephala*) was NOT recorded within the ELA vegetation community, and as such is not considered to form part of this TEC.

Vegetation condition within the survey area ranged from Good to Degraded, based on the Keighery (1994) vegetation scale. Majority of the survey area was in Good condition (1.95 ha; 59.80%). Cleared areas (tracks etc.) accounted for 0.90 ha (27.6% of the survey area). Disturbances within the survey area included historic clearing, tracks and fire breaks.

More broadly, one vegetation association, Bassendean 1000 (Beard 1979) and one vegetation complex, Bassendean complex - central and south (Heddle *et al.* 1980) have been mapped across the survey area. The percentage impact to these landform factors as a result of the project is low (DPIRD 2020). Therefore, it is unlikely that the project would appreciably reduce the representativeness of vegetation associations or vegetation complexes in the local area or at a regional scale.

6.3 Fauna

A total of 19 fauna species were recorded as occurring within the survey area, comprising of 17 birds and two mammals (one native). Of the 19 species recorded, one (Forest Red-tailed Black Cockatoo [*Calyptorhynchus banksii* subsp. *naso*]) is listed as Threatened under the EPBC Act (Vulnerable) and BC Act (Vulnerable). No fauna species listed as Priority by DBCA were recorded.

A total of 50 conservation listed fauna species were identified from the desktop assessment as possibly occurring within the survey area, one of which, the Forest Red-tailed Black Cockatoo was recorded. Of the remaining 49 species, 9 are considered as having the potential to occur within the survey area, based on the availability of suitable habitat and close proximity to nearby recent records, however none of these species were recorded during the field survey.

One introduced (pest) fauna species was recorded within the survey area; rabbit (*Oryctolagus cuniculus*).

A total of two fauna habitats were identified within the survey area, covering a total of 2.36 ha (72.4% of the survey area). The most widespread fauna habitat was Jarrah/banksia woodland, which accounted for 2.08 ha (63.8% of the survey area). Rehabilitation areas accounted for 0.28 ha (8.6% of the survey area), whilst cleared areas (tracks etc.) accounted for 0.90 ha (27.6% of the survey area).

Forest Red-tailed Black Cockatoo was the only species of black cockatoo recorded during the survey. This species was observed as a flock of eight birds foraging in a Marri tree adjacent to the survey area. Whilst neither the Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo nor Baudin's Cockatoo were actually recorded within the survey area, there is potential habitat present for all three species.

A total of 2.08 ha (63.80%) within the survey area is considered as providing 'Good' quality foraging habitat for all three black cockatoo species, namely Jarrah/banksia woodland fauna habitat. The remainder of the survey area is considered to provide 'Poor' quality or no foraging habitat for black cockatoos.

The black cockatoo breeding habitat assessment identified four potentially suitable breeding trees within the survey area, all of which were *Eucalyptus marginata* (Jarrah). None of these contained potentially suitable hollows over 100 mm in diameter. All potentially breeding trees recorded from the survey area provide suitable roosting habitat for black cockatoos as defined by the referral guidelines (DSEWPaC 2012).

Although not directly observed during the field survey, both the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Cockatoo (*Calyptorhynchus baudinii*) are considered as likely to occur within the survey area as it provides suitable breeding, roosting and foraging habitat for these species and occurs within the species' ranges.

No Western Ringtail Possum individuals or secondary signs (e.g. dreys, scratchings, scats) were recorded within the survey area. Whilst there were large trees containing hollows within the survey area as detailed above, no signs of use by Western Ringtail Possums were observed. In addition, lack of *Agonis flexuosa* (Peppermint) within the survey area suggests that the vegetation within the survey area is not conducive to habitation by the species.

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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 (MI)	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.

Category	Code	Description
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.
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.
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.

Likelihood rating	Criteria
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	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	DAWE 2021a	A sub-shrub ranging from 0.25-0.65 tall. Flowers are yellow in colour, narrow, hairy and are openly spaced. Flowering occurs from September through to November. It can be found on areas with clayey-sand with lateritic pebbles and prefers low woodland areas that are situated near winter flats (DAWE 2021a).	**Unlikely** Preferred habitat does not occur in the survey area.
Synaphea sp. Serpentine (G.R. Brand 103)	CR	CR	DAWE 2021a	This species is a clumped subshrub reaching a height of up to 0.6 m. Flowers are yellow in colour, narrow, hairy and are openly spaced. Flowering occurs from late August through to November. Habitat for this species is grey-brown sandy loams to clay soil occurring on predominately flat, seasonally wet terrain (DAWE 2021a).	**Unlikely** Preferred habitat does not occur in the survey area.
Caladenia procera	EN	CR	DBCA 2021a, DBCA 2007-2021	A tall orchid reaching 70 cm tall. One to three spider-like flowers that are predominately greenish-yellow, characterised with dark maroon/pink lines and spots. Habitat for this species occurs within sandy-clay loam flats, generally occurring within Jarrah, Marri or Peppermint woodlands amongst dense heath and sedges, or shrubs (DAWE 2021a).	**Potential** Cryptic species with suitable habitat potentially occurring within the survey area.
Caladenia huegelii	EN	CR	DBCA 2021a, DBCA 2007-2021	A slender orchid 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils of the Bassendean and Spearwood systems in low mixed Banksia, Allocasuarina and Jarrah woodlands (DAWE 2021a).	**Potential** Cryptic species with suitable habitat potentially occurring within the survey area.
Drakaea elastica	EN	CR	DBCA 2021a, DAWE 2021a, DBCA 2007-2021	A slender flower stem up to 30 cm high with a single glossy green, heart shaped leaf. The single flower is 3 to 4 cm long. It can be found on bare patches of sand within dense vegetation in low lying winter-wet swamps. *D. elastica* often occurs with other orchid species (DAWE 2021a).	**Potential** Database search confirms that this species has previously been recorded 1 km north of the survey area.

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Austrostipa bronwenae	EN	EN	DBCA 2021a, DBCA 2007-2021	A perennial grass reaching up to 60 cm tall with green flowers that flower from October through to November. Habitat for this species occurs within wetlands consisting of muddy sand that are seasonally waterlogged (DAWE 2021a).	**Unlikely** Preferred habitat does not occur in the survey area e.g. muddy sands
Austrostipa jacobsiana	CR	EN	DBCA 2021.	A perennial, rhizomatous grass to 1.5m tall (including flower spikes). Leaves are to 45cm long, terete, rolled or involute, and the abaxial surface is not ribbed. The inflorescence is 10 to 20cm long. Flowering occurs in October through November. Fruit matures in November to December (Williams 2011).	**Unlikely** Although suitable habitat may occur, no known populations have been recorded locally.
Diuris purdiei	EN	EN	DAWE 2021a	A slender orchid to 0.35 m tall. Flowers are yellow and visible from September to October. Habitat for this species is grey-black sand substrates in winter-wet swamps which have high moisture (Western Australian Herbarium 1998-). It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *E*. marginata and *Nuytsia floribunda* (DAWE 2021a).	**Potential** Preferred habitat may occur within the survey area.
Andersonia gracilis	EN	VU	DAWE 2021a	Slender erect or open straggly shrub grows to 0.1-0.5(-1) m high. Grows in white/grey sand, sandy clay, gravelly loam in winter-wet areas and near swamps (WAH 1998 -).	**Unlikely** Although suitable habitat may occur, the extent of current records are confined to the northern Swan Coastal Plain.
Drakaea micrantha	VU	EN	DBCA 2021a, DAWE 2021a, DBCA 2007-2021	A tuberous, terrestrial herb which has a diminutive red and yellow flower, 1.2–2.5 cm long, on a stem that grows to 30 cm. Flowering occurs form September to October. Its heart-shaped leaf, about 1.5 cm long, is silvery grey with prominent green veins. Habitat for this species occurs within cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed in lower lying areas near wetlands under Spearwood (*Kunzea glabrescens*) thickets (Western Australian Herbarium 1998-, DAWE 2021a).	**Potential** Database search confirms that this species has previously been recorded 1 km north and south of the survey area.

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Diuris drummondii	VU	VU	DBCA 2021a, DAWE 2021a, DBCA 2007-2021	A tall orchid reaching 1 m tall, producing yellow flowers from November to December or January. Habitat for this species occurs within low-lying depressions in peaty and sandy clay swamps (DAWE 2021a).	**Unlikely** Preferred habitat does not occur in the survey area e.g. peaty and sandy clay swamps
Diuris micrantha	VU	VU	DBCA 2021a, DAWE 2021a, DBCA 2007-2021	A slender orchid to 60 cm tall. Flowers are yellow with reddish-brown markings and visible from September to October. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DAWE 2021a).	**Unlikely** Preferred habitat does not occur in the survey area e.g. peaty and sandy clay swamps
Eleocharis keigheryi	VU	VU	DBCA 2021a, DAWE 2021a, DBCA 2007-2021	A rhizomatous, tufted/clumped perennial herb, reaching a maximum diameter of 40 cm. When this species grows in water, there are numerous hair-like sterile stems at the base of the main stems. Flowering occurs from August to November but will extend to December if conditions are favourable. This species grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks and claypans (DAWE 2021a).	**Potential** Preferred habitat may occur within the survey area. Closest record to the survey area is 15 km south.
Banksia nivea subsp. *uliginosa*	EN	T	DAWE 2021; DBCA 2021	Swamp Honeypot grows as a mounded shrub up to 1.5 m tall and 1.5 m across (Brown et al. 1998; George 1996, 1999a). It has long leaves similar to *Dryandra nivea* and the flowers, which may vary in colour within a population, are well hidden within the bush. Flowers are yellowish-brown (Brown et al. 1998; Western Australian Herbarium 2007). Swamp Honeypot has subpopulations in two disjunct areas: Beenup and Busselton, Western Australia.	**Unlikely** Although suitable habitat may occur, the extent of current records are confined to the Scott River and Whicher regions.
Banksia squarrosa subsp. *argillacea*	VU	T	DAWE 2021; DBCA 2021	Erect, open, non-lignotuberous shrub, 1.2-4 m high. Flowers from June to November with yellow flowers on white /grey sand, gravelly clay or loam, winter-wet flats, clay flats.	**Potential** Preferred habitat may occur within the survey area.
Brachyscias verecundus	CR	T	DAWE 2021	Annual (or ephemeral), herb, 0.012-0.022 m high, entirely glabrous. Fl. white/cream. In a moss sward. On a granite outcrop.	**Potential** Preferred habitat may occur within the survey area.

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Chamelaucium sp. Gingin (N.G. Marchant 6)	EN	-	DAWE 2021	Open straggly shrub growing 1 to 2 m high with many slender, stiff branches that bear numerous 5-20 mm long axillary shoots. Its erect, glandular, bright green leaves are 5.4-11.5 mm long by 1.2-1.4 mm wide, and are scattered along the main branches, but are mostly crowded on numerous short axillary shoots. Gingin Wax is endemic to Western Australia and is confined to the Gingin/Chittering area, where it has a range of only 3 km.	**Unlikely** Although suitable habitat may occur, the extent of current records are confined to the Gingin and Chittering areas.
Chamelaucium sp. S coastal plain (R.D. Royce 4872)	VU	-	DAWE 2021	Royce's Waxflower forms an intricately branched spreading shrub up to 120 cm tall and 60 cm across. It has inconspicuous greenish-white flowers and young branches are coloured fawn to reddish. This species occurs on the Southern Swan Coastal Plain below the Whicher Range, near Busselton, Western Australia. There are a number of populations, many in close proximity, scattered between Capel, Busselton, Tutunup and Ambergate	**Potential** Preferred habitat may occur within the survey area.
Lambertia echinata subsp. *occidentalis*	EN	T	DAWE 2021; DBCA 2021	Known from a single wild population at the base of the Whicher Range where it is confined to highly restricted ironstone habitat. The habitat is a winter-wet area of shrubland over shallow sandy soils over ironstone.	**Unlikely** Preferred habitat does not occur within the survey area e.g. ironstone
Synaphea sp. Pinjarra Plain (A.S. George 17182)	EN	T	DAWE 2021; DBCA 2021	Erect, clumped shrub (sub-shrub), to 0.8 m high. Characterised by yellow flowers, from September to November. The species occurs on grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains.	**Unlikely** Although suitable habitat may occur, the extent of current records are confined to north near Mandurah and south of Bunbury
Synaphea stenoloba	EN	T	DAWE 2021; DBCA 2021	Caespitose shrub, 0.3-0.45 m high with yellow flowers from August to October. Occurs on sandy or sandy clay soils, winter-wet flats and granite.	**Unlikely** Preferred habitat does not occur within the survey area e.g. coastal sands
Acacia sp. Binningup (G. Cockerton et al. WB 37784)	-	P1	DBCA 2021a, DBCA 2007-2021	Low shrubs in clump to 1.5 m high. Sand.	**Unlikely**

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
					Preferred habitat does not occur within the survey area e.g. coastal sands
Boronia juncea subsp. *juncea*	-	P1	DBCA 2021a, DBCA 2007-2021	A slender or straggly shrub with pink flowers visible in April. Habitat for this species occurs on sand in low scrub areas (WAH 1998 –).	**Potential** Suitable habitat occurs within the survey area.
Caladenia uliginosa subsp. *patulens*	-	P1	DBCA 2021a, DBCA 2007-2021	A tuberous, perennial herb 0.2-0.35 m tall. Habitat for this species occurs on clay loam and gravel, well drained soils amongst dense shrubs (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. gravelly loams
Grevillea bipinnatifida subsp. *pagna*	-	P1	DBCA 2021a, DBCA 2007-2021	A lignotuberous shrub 0.2-0.7 m tall. Habitat for this species occurs on grey sandy clay and loam, ironstone in seasonal wetlands, swamps and roadsides (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. ironstone derived clays
Puccinellia vassica	-	P1	DBCA 2021a, DBCA 2007-2021	A caespitose, annual or perennial grass-like herb, 0.41-0.55 m high. Habitat for this species occurs on saline soils on the outer margins of coastal saltmarshes (WAH 1998 –).	**Unlikely** Preferred habitat does not occur within the survey area.
Synaphea odocoileops	-	P1	DBCA 2021a, DBCA 2007-2021	A tufted compact shrub, 0.2-0.5 m high. Habitat for this species occurs on brown-orange loam and sandy clay, granite in swamps, winter-wet areas (WAH 1998 -).	**Potential** Preferred habitat may occur within the survey area
Craspedia sp. Waterloo (G.J. Keighery 13724)	-	P2	DBCA 2021a, DBCA 2007-2021	Low herb to 15 cm tall. Blue/green leaves. Flowering spike to 30 cm tall. Pale yellow flowers when in flower. Seasonally wet plain. Brown clay/loam.	**Unlikely** Preferred habitat does not occur within the survey area e.g. Brown clay loams with *E. wandoo*
Grevillea rosieri	-	P2	DBCA 2021a, DBCA 2007-2021	A shrub flowering in July to September. Habitat for this species is sandy soil (WAH 1998 -).	**Unlikely**

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
					Preferred habitat does not occur within the survey area e.g. lateritic gravels
Pterostylis frenchii	-	P2	DBCA 2021a, DBCA 2007-2021	A tuberous herb 0.35 m tall with rosette leaves. Habitat for this species occurs on calcareous sand with limestone or laterite within flatlands and gentle slopes (WAH 1998 –).	**Unlikely** Preferred habitat does not occur within the survey area e.g. limestone flats
Stylidium acuminatum subsp. *acuminatum*	-	P2	DBCA 2021a, DBCA 2007-2021	Basally rosetted Stylidium. Scape to 40 cm long. Short stem below rosette. Pale yellow flowers when flowering. Brown gravelly clay/loam, brown lateritic loam soils	**Unlikely** Preferred habitat does not occur within the survey area e.g. Brown gravelly clay loams
Thelymitra variegate (Queen of Sheba)		P2	DBCA 2021a,	Tuberous, perennial, herb, 0.1-0.35 m high. Fl. orange & red & purple & pink, Jun to Sep. Sandy clay, sand, laterite	**Potential** Preferred habitat may occur within the survey area.
Angianthus drummondii	-	P3	DBCA 2021a, DBCA 2007-2021	An annual herb to 0.1 m high, flowering from October to December. Habitat for this species occurs on grey and brown clay soils, ironstone in seasonally wet flat areas (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. seasonally wet clay flats
Boronia capitata subsp. gracilis	-	P3	DBCA 2021a, DBCA 2007-2021	A slender shrub 0.3 – 0.6 m tall, producing pink flowers from June to November. This species generally occurs on white/grey or black sands associated with winter-wet swamps and hillslopes.	**Potential** Preferred habitat may occur within the survey area.
Carex tereticaulis	-	P3	DBCA 2021a, DBCA 2007-2021	A monoecious, rhizomatous, tufted perennial sedge, grass-like or herb, to 70 cm tall. Flowers are brown and visible September through to October. Habitat for this species is on substrate of black peaty sand (WAH 1998 –).	**Potential** Preferred habitat may occur within the survey area.
Chamaescilla gibsonii	-	P3	DBCA 2021a, DBCA 2007-2021	Herb (clumped and tuberous). Flowers are blue and visible in September. Habitat for this species is clay or sandy-clay substrate in winter-wet flats and shallow water-filled claypans (WAH 1998 –).	**Unlikely** Preferred habitat does not occur within the survey area.

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Cyathochaeta teretifolia	-	P3	DBCA 2021a, DBCA 2007-2021	A perennial grass-like sedge that can grow up to 2 m high and 1 m wide. Has a brown flower and can be found within swamps and along creek edges on grey sand/sandy clay (WAH 1998 –).	**Potential** Preferred habitat may occur within the survey area.
Dillwynia dillwynioides	-	P3	DBCA 2021a, DBCA 2007-2021	A decumbent or erect, slender shrub between 30−120 cm tall. Flowers are red & yellow/orange and visible from August to December. Habitat for this species occurs on sandy soils in winter-wet depressions (WAH 1998 –).	**Potential** Suitable habitat may occur within the survey area.
Hemigenia microphylla	-	P3	DBCA 2021a, DBCA 2007-2021	A slender shrub, 0.4-1.8 m high. Flowers are blue-purple and visible September to December. Habitat for this species is sandy clay, peaty clay and granite in winter-wet depressions (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. creeklines and winter-wet depressions.
Juncus meianthus	-	P3	DBCA 2021a	A tufted perennial herb, 0.05-0.2 m. Habitat for this species is on black sand, sandy clay, along creeks and seepage areas (WAH 1998 -).	**Potential** Preferred habitat may occur within the survey area
Lasiopetalum membranaceum	-	P3	DBCA 2021a, DBCA 2007-2021	Multi-stemmed shrub to 1 m tall. Flowers are pink-blue-purple and visible September to December. Habitat for this species is sandy substrate over limestone (WAH 1998 –).	**Unlikely** Preferred habitat does not occur within the survey area e.g. sands over limestone
Lomandra whicherensis	-	P3	DBCA 2021a, DBCA 2007-2021	Erect herb to 40 cm high. Upper slope to crest of broad ridge. Gravelly (lateritic) soil with brown sand over laterite.	**Unlikely** Preferred habitat does not occur within the survey area e.g. gravelly soil over laterite
Myriophyllum echinatum	-	P3	DBCA 2021a, DBCA 2007-2021	An annual herb, 0.02-0.03 m high. Habitat for this species is on clay in winter-wet flats (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. winter-wet clat-based depressions

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Platysace ramosissima	-	P3	DBCA 2021a, DBCA 2007-2021	A perennial herb to 0.3 m, flowering October to November. Habitat for this species is sandy soils.	**Potential** Preferred habitat may occur within the survey area
Schoenus benthamii	-	P3	DBCA 2021a, DBCA 2007-2021	A tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high, flowering from October to November. Habitat for this species includes white, grey sand, sandy clay in winter-wet flats and swamps (WAH 1998 -).	**Potential** Preferred habitat may occur within the survey area
Schoenus capillifolius	-	P3	DBCA 2021a, DBCA 2007-2021	A semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Habitat for this species includes brown mud on claypans (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. brown mud claypans
Schoenus sp. Waroona (G.J. Keighery 12235)	-	P3	DBCA 2021a, DBCA 2007-2021	A tufted annual, grass-like or herb (sedge), 0.02-0.06 m high. Habitat for this species includes clay or sandy clay, winter-wet flats (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. clayflats
Stylidium paludicola	-	P3	DBCA 2021a, DBCA 2007-2021	Reed-like perennial, herb, 0.35-1 m high, with leaves tufted, linear or subulate, 0.5-4 cm long, 0.5-1.5 m wide. Habitat for this species includes peaty sand over clay, winter wet habitats in Marri and Melaleuca woodland or shrubland (WAH 1998 -).	**Potential** Preferred habitat may occur within the survey area
Styphelia filifolia	-	P3	DBCA 2021a, DBCA 2007-2021	A shrub to 0.9 m high, from fire sensitive rootstock.	**Unlikely** Preferred habitat does not occur within the survey area e.g. yellow sands
Verticordia attenuata	-	P3	DBCA 2021a, DBCA 2007-2021	A shrub 0.4-1 m tall. Flowers are pink, occurring in December or January to May. Habitat for this species includes white or grey sand in winter-wet depressions (WAH 1998 –).	**Potential** Suitable habitat occurs within the survey area.

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Acacia flagelliformis	-	P4	DBCA 2021a, DBCA 2007-2021	A rush-like, erect or sprawling shrub between 0.3-0.75 m tall with yellow flowers visible from May to September. Habitat for this species occurs on sandy soils in winter-wet areas (WAH 1998 –).	**Potential** Suitable habitat occurs within the survey area.
Acacia semitrullata	-	P4	DBCA 2021a, DBCA 2007-2021	A slender, erect, pungent shrub, (0.1-) 0.2 m to 0.7(-1.5) m tall. Flowers are cream-white, occurring from May to October. Habitat for this species occurs on white/grey sand, sometimes over laterite and clay, within sandplains and swampy areas (WAH 1998 –).	**Likely** Previous record within the survey area (DBCA 2021a)
Aponogeton hexatepalus	-	P4	DBCA 2021a, DBCA 2007-2021	Rhizomatous, aquatic perennial herb, leaves floating, flowering July to October. Habitat for this species occurs on mud in freshwater: ponds, rivers, claypans.	**Potential** Preferred habitat may occur within the survey area
Boronia tenuis	-	P4	DBCA 2021a	A procumbent or erect slender shrub, 0.1-0.5 m high. Habitat for this species occurs on laterite, stony soils, granite (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. laterite soils
Caladenia speciosa	-	P4	DBCA 2021a, DBCA 2007-2021	A tuberous herb (perennial) to 60 cm tall. Flowers are white-pink and visible from September to October. This species is known to occupy a habitat with white, grey or black sandy substrate (WAH 1998 –).	**Potential** Preferred habitat may occur within the survey area
Eucalyptus rudis subsp. cratyantha	-	P4	DBCA 2021a, DBCA 2007-2021	A tree 5-20 m tall. Bark is rough and boxy. Flowers are white and visible from July to September. Habitat for this species occurs on loam on flats and hillsides (WAH 1998 –).	**Potential** Preferred habitat may occur within the survey area.
Meionectes tenuifolia	-	P4	DBCA 2021a, DBCA 2007-2021	Annual semi aquatic herb. Seasonally wet poorly drained flat. Grey sand.	**Unlikely** Preferred habitat does not occur within the survey area e.g. seasonally grey sand flats.

Species	Conservation status		Source	Habitat	Likelihood and justification
	EPBC Act	BC Act / DBCA			
Microtis quadrata	-	P4	DBCA 2021a	A terrestrial, perennial herb with an underground tuber. Flowering occurs from December to January, and is much more prolific after fire.	**Unlikely** Preferred habitat does not occur within the survey area e.g. brown clays over laterite
Ornduffia submersa	-	P4	DBCA 2021a, DBCA 2007-2021	An aquatic herb growing in water 60 cm deep with leaves and flowers floating on the surface. Petals white. Winter wetland	**Potential** Preferred habitat may occur within the survey area
Pultenaea skinneri	-	P4	DBCA 2021a, DBCA 2007-2021	A slender shrub 1-2 m tall. Flowers are yellow/orange and red, occurring from July to September. Habitat for this species includes sandy or clayey soils within winter-wet depressions (WAH 1998 –).	**Potential** Preferred habitat may occur within the survey area
Rumex drummondii	-	P4	DBCA 2021a, DBCA 2007-2021	A perennial herb, 0.6-0.9 m high, winter-wet disturbed areas.	**Potential** Preferred habitat may occur within the survey area
Senecio leucoglossus	-	P4	DBCA 2021a, DBCA 2007-2021	An annual herb to 1.3 m, flowering from August to December. Habitat for this species includes gravelly lateritic or granite soils, granite outcrops or slopes (WAH 1998 -).	**Unlikely** Preferred habitat does not occur within the survey area e.g. coastal sands
Tripterococcus sp. Brachylobus (A.S. George 14234)	-	P4	DBCA 2021a, DBCA 2007-2021	Annual herb up to 0.6 m grows in grey sand and clay soils in moist environments such as winter wet flats (WAH 1998 -).	**Potential** Preferred habitat may occur within the survey area.

Appendix D Fauna likelihood of occurrence assessment

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
Pseudocheirus occidentalis	Western Ringtail Possum	CR	CR	DBCA 2021b, DBCA 2007 - 2021, DAWE 2021a	Inhabit areas with *Agonis flexuosa* either as the dominant tree or understorey component of a eucalypt forest or woodland. Preference to areas with little fire disturbance and a continuous upper or mid-storey canopy.	**Potential** Suitable habitat is present and the closest previous record is 2km south-west of the survey area.
Calidris ferruginea	Curlew Sandpiper	CR, MI	VU, MI	DBCA 2021b, DBCA 2007 - 2021, DAWE 2021a	Predominantly inhabits the following: intertidal mudflats in sheltered coastal areas, non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They have also been occasionally recorded inland around ephemeral and permanent lakes, dams, waterholes and bore drains.	**Unlikely** No suitable habitat present within the survey area.
Bettongia penicillata subsp. *ogilbyi*	Woylie, Brush-tailed Bettong	EN	CR	DBCA 2021b, DBCA 2007 - 2021	Historically has a large range of habitats however, now restricted to open forest and woodland with a low understorey consisting of tussock grasses or woody scrub.	**Unlikely** Locally extinct except for relocated populations within enclosed reserves.
Botaurus poiciloptilus	Australasian Bittern	EN	EN	DBCA 2021b, DBCA 2007 – 2020, DAWE 2021a	Australasian Bitterns specialise in living in dense beds of reeds and rushes, where they are surprisingly difficult to see, as they are particularly well camouflaged.	**Unlikely** No suitable habitat present within the survey area.
Calyptorhynchus baudinii	Baudin's Cockatoo	EN	EN	DBCA 2021b, DBCA 2007 – 2020, DAWE 2021a	Predominantly occurs in eucalypt forests, especially Jarrah, Marri and Karri forests. Foraging occurs at all levels of the forest (from canopy to the ground), often feeding in the understorey on proteaceous trees and shrubs, especially Banksias and in orchards.	**Likely** Foraging habitat is present and previous records are located within 10 km of the survey area. Species was recorded in the KSIA, adjacent to the survey area

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
						(Bamford Consulting Ecologists 2020).
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN	DBCA 2021b, DBCA 2007 - 2021, DAWE 2021a	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland. Forages seasonally in pine plantations, around Perth metropolitan, and forests containing Marri, Karri and Jarrah.	**Likely** Breeding and foraging habitat is present and previous records are located within 10 km of the survey area. Species was recorded in the KSIA, adjacent to the survey area (Bamford Consulting Ecologists 2020).
Galaxiella nigrostriata	Black-stripe Minnow	EN	EN	DBCA 2021b, DBCA 2007 - 2021	Endemic to southwestern Australia where it is found in slow-running streams, ponds, swamps and ditches.	**Potential** Habitat found in the west of the survey area and closest record is 8km north.
Myrmecobius fasiatus	Numbat	EN	EN	DBCA 2021b, DBCA 2007 - 2021	Currently occur in upland Jarrah forest, open Eucalypt woodland, Banksia woodland and tall closed shrublands. The habitats would usually have an abundant number of termites in the soil, hollow logs and branches for shelter.	**Unlikely** Locally extinct except for relocated populations within enclosed reserves.
Psophodes nigrogularis nigrogularis	Western Whipbird (western heath)	EN	EN	DBCA 2021b, DBCA 2007 - 2021	The Western Whipbird (western heath) inhabits dense heath-like shrubby thickets on coastal dunes, and mallee woodland or shrubland with an open upperstorey above a dense shrubby understorey.	**Unlikely** This species is restricted to a small area east of Albany in coastal south-west WA.
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	DBCA 2021b, DBCA 2007 - 2021, DAWE 2021a	Inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall. Known to feed in more open agricultural areas and metropolitan Perth.	**Recorded** This species was recorded within the survey area – directly observed and from

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
						secondary signs (chewed marri nuts).
Dasyurus geoffroii	Chuditch, Western Quoll	VU	VU	DBCA 2021b, DBCA 2007 – 2020, DAWE 2021a	Inhabits a variety of different habitat types including rocky outcrops, eucalypt forests and woodlands, sandy lowlands, beaches, shrubland, grasslands and deserts. Predominantly though, rocky areas provide denning habitat and foraging is predominantly done within nearby grasslands and creek lines.	**Unlikely** Some suitable habitat is present within the survey area (eucalypt forests). However, there is a lack of rocky outcropping for denning habitat and the landscape is highly fragmented.
Falco hypoleucos	Grey Falcon	VU	VU	DAWE 2021a	Usually confined to the arid inland. It inhabits *Triodia* grassland, *Acacia* shrubland, and lightly timbered arid woodland.	**Unlikely** No suitable habitat present within the survey area.
Leipoa ocellata	Malleefowl	VU	VU	DAWE 2021a	Distributed across arid to semi-arid mallee, mulga or other dense litter-forming shrublands. Also inhabit dry forests dominated by other eucalypts, mulga and *Acacia* species.	**Unlikely** No suitable habitat present within the survey area.
Setonix brachyurus	Quokka	VU	VU	DBCA 2021b, DBCA 2007 - 2021	Densely vegetation swamps and occasionally tea-tree thickets on sandy soils along creek systems and dense heath slopes are the predominant habitat types the Quokka inhabits (DEC 2012c). Mainland populations are sparse and usually associated with *Taxandria linearifolia* swamp habitats within the northern Jarrah forest.	**Unlikely** No suitable habitat located within the survey area. Closest records are of populations located within enclosed sanctuaries.
Nannatherina balstoni	Balston's Pygmy Perch	VU	VU	DAWE 2021a	Balston's Pygmy Perch occurs in a number of highly fragmented, smaller subpopulations, which are confined to smaller streams within the major river systems of south-west. The species is extremely rare or lost from many other rivers of the south-west including Blackwood River, Frankland River, Margaret River and King River	**Unlikely** No suitable habitat present within the survey area.

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
Galaxiella nigrostriata	*Blackstriped Dwarf Galaxias, Black-stripe Minnow*	EN	EN	DAWE 2021a	Inhabits coastal wetlands of south-west Western Australia. During summer when ephemeral pools dry out, individuals burrow into the moist soil below to aestivate until the rains return in autumn.	**Unlikely** No suitable habitat present within the survey area.
Calidris melanotos	Pectoral Sandpiper	MI	MI	DAWE 2021a	The species is rarely recorded in Western Australia. It has been observed at the Nullarbor Plain, Reid, Stoke's Inlet, Grassmere Lake, Warden Lake, Dalyup and Yellilup Swamp, Swan River, Benger Swamp, Guraga Lake, Wittecarra, Harding River, coastal Gascoyne, the Pilbara and the Kimberley	**Unlikely** Rarely recorded in WA.
Calidris ruficollis	Red-necked Stint	MI	MI	DAWE 2021a	In Australasia, the Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals.	**Unlikely** No suitable habitat present within the survey area.
Calidris subminuta	Long-toed Stint	MI	MI	DAWE 2021a	Inhabits inshore coastal and estuarine waters, and some inland lakes and rivers	**Unlikely** No suitable habitat present within the survey area.
Gallinago megala	Swinhoe's Snipe	MI	MI	DAWE 2021a	Damp grasslands, edges of waterbodies, and muddy freshwater marshes.	**Unlikely** No suitable habitat present within the survey area.
Gallinago stenura	Pin-tailed snipe	MI	MI	DAWE 2021a	Species breeds in damp marshes and tundra in Arctic and boreal Russia. Birds in their non-breeding range use a variety of wetlands, often with common snipe, but may be found also in drier habitats.	**Unlikely** No suitable habitat present within the survey area.
Limicola falcinellus	Broad-billed Sandpiper	MI	MI	DAWE 2021a	Broad-billed Sandpiper mainly inhabits sheltered parts of the coast, where it can forage on exposed flats of soft mud or sand.	**Unlikely** No suitable habitat present within the survey area.

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
Limosa lapponica	Bar-tailed Godwit	MI	MI	DAWE 2021a	Bar-tailed Godwits inhabit estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia.	**Unlikely** No suitable habitat present within the survey area.
Limosa limosa	Black-tailed Godwit	MI	MI	DAWE 2021a	Primarily found along the coast on sand spits, lagoons and mudflats.	**Unlikely** No suitable habitat present within the survey area.
Numenius phaeopus	Whimbrel	MI	MI	DAWE 2021a	Whimbrels are found mainly on the coast, on tidal and estaurine mudflats, especially near mangroves.	**Unlikely** No suitable habitat present within the survey area.
Pandion haliaetus	Osprey	MI	MI	DAWE 2021a	The osprey breeds near freshwater lakes and rivers, and sometimes on coastal brackish waters. Rocky outcrops just offshore are used in Rottnest Island.	**Unlikely** No suitable habitat present within the survey area.
Philomachus pugnax	Ruff (Reeve)	MI	MI	DAWE 2021a	Breeds in marshes and wet meadows across northern Eurasia.	**Unlikely** No suitable habitat present within the survey area.
Pluvialis fulva	Pacific Golden Plover	MI	MI	DAWE 2021a	The Pacific Golden Plover is found on muddy, rocky and sandy wetlands, shores, paddocks, saltmarsh, coastal golf courses, estuaries and lagoons.	**Unlikely** No suitable habitat present within the survey area.
Tringa brevipes	Grey-tailed Tattler	MI	MI	DAWE 2021a	Grey-tailed Tattlers are usually seen in small flocks on sheltered coasts with reefs and rock platforms or with intertidal mudflats.	**Unlikely** No suitable habitat present within the survey area.
Tringa totanus	Common Redshank, Redshank	MI	MI	DAWE 2021a	Found in coastal areas, wetlands, salty marshes, damp meadows along with freshwater lakes, rivers, lagoons, and estuaries.	**Unlikely** No suitable habitat present within the survey area.

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
Actitis hypoleucos	Common Sandpiper	MI	MI	DBCA 2021b, DBCA 2007-2021, DAWE 2021a	Distributed across a range of wetland habitats including small ponds, large inlets and mudflats where they forage on the shore with vegetation close. Within WA they are mostly found in coastal habitats, but sometime venture inland.	**Unlikely** No suitable habitat present within the survey area.
Apus pacifcus	Fork-tailed Swift	MI	MI	DBCA 2021b, DAWE 2021a	Occurs within a range of dry or open habitats.	**Unlikely** No suitable habitat present within the survey area.
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	DBCA 2021b, DBCA 2007 - 2021, DAWE 2021a	Found within muddy edges of shallow fresh or brackish vegetated wetlands (lagoons, swamps, lakes and pools near the coast, dams, waterholes, soaks, bore drains and swamps, saltpans, saltpans and hypersaline salt lakes inland).	**Unlikely** No suitable habitat present within the survey area.
Pandion cristatus	Osprey	MI	MI	DBCA 2007 – 2020, DAWE 2021a	Inhabits inshore coastal and estuarine waters, and some inland lakes and rivers	**Unlikely** No suitable habitat present within the survey area.
Plegadis falcinellus	Glossy Ibis	MI	MI	DBCA 2021b, DBCA 2007 - 2021	The Glossy Ibis' preferred habitat for foraging and breeding are freshwater marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons.	**Unlikely** No suitable habitat present within the survey area.
Tringa glareola	Wood Sandpiper	MI	MI	DBCA 2021b, DBCA 2007 - 2021	The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums Eucalyptus camaldulensis and often with fallen timber.	**Unlikely** No suitable habitat present within the survey area.
Tringa nebularia	Common Greenshank	MI	MI	DBCA 2021b, DBCA 2007 -	Found within permanent and ephemeral wetlands (including swamps, lakes, dams, rivers and creeks).	**Unlikely**

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
				2021, DAWE 2021a		No suitable habitat present within the survey area.
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	MI	MI	DBCA 2021b, DBCA 2007 - 2021	The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In north Australia they prefer intertidal mudflats.	**Unlikely** No suitable habitat present within the survey area.
Phascogale tapoatafa subsp. *wambenger*	South-western Brush-tailed Phascogale	-	CD	DBCA 2021b, DBCA 2007 - 2021	Inhabits dry sclerophyll forests and open woodlands with trees with hollows and sparse ground cover.	**Potential** Marri and Jarrah woodland habitat within the survey area provide suitable habitat and closest record is within 1km north and south of the survey area.
Falco peregrinus	Peregrine Falcon	-	OS	DBCA 2021b, DBCA 2007 - 2021	Preferred habitat includes cliffs and wooded watercourse. The nesting habitat is predominantly cliff ledges, granite outcrops, quarries and in trees with old rave or Wedge-tailed Eagle nests.	**Unlikely** Suitable foraging habitat present within survey area but no suitable nesting habitat.
Ctenotus ora	Coastal Plains Skink	-	P3	DBCA 2021b, DBCA 2007 - 2021	The coastal plains skink has only been found in low numbers in a small stretch of sand dunes on the Swan Coastal Plain south of Perth.	**Potential** Species was recorded in the KSIA, adjacent to the survey area (Bamford Consulting Ecologists 2020).
Geotria australis	Pouched lamprey	-	P3	DBCA 2021b, DBCA 2007 - 2021	Records exist from many of the rivers of the south-west coast from Perth through to Albany.	**Unlikely** No suitable habitat present within the survey area.

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
Idiosoma sigillatum	Swan Coastal Plain shield-backed trapdoor spider	-	P3	DBCA 2021b, DBCA 2007 - 2021	Moderately widespread distribution in the Geraldton Sandplains and far northern Wheatbelt bioregions of south-western Western Australia.	**Unlikely** No suitable habitat present within the survey area.
Lerista lineata	Perth Slider, Lined Skink	-	P3	DBCA 2021b, DBCA 2007 - 2021	*Lerista lineata* has a small distribution on the Swan Coastal Plain, south of the Swan River and mostly near the coast.	**Potential** Species was recorded in the KSIA, adjacent to the survey area (Bamford Consulting Ecologists 2020).
Falsistrellus mackenziei	Western False Pipistrelle	-	P4	DBCA 2021b, DBCA 2007 - 2021	Inhabits wet sclerophyll forests which are dominated by Karri, Jarrah or Tuart within close proximity to permanent water sources (within 1.5 km). They forage in the understorey of the mature forests.	**Unlikely** No suitable habitat present within the survey area.
Hydromys chrysogaster	Water-rat, Rakali	-	P4	DBCA 2021b, DBCA 2007 - 2021	Inhabits areas with access permanent water (semi-aquatic) within a broad range of terrestrial habitats.	**Unlikely** No suitable habitat present within the survey area.
Isoodon fusciventer	Quenda, South-western Brown Bandicoot	-	P4	DBCA 2021b, DBCA 2007 - 2021	This species prefers areas of scrubby vegetation (often swampy areas) with a dense cover of up to one metre in height. They often forage in adjacent forest and woodland areas that is burnt regularly and in pastures and crops.	**Likely** Suitable habitat present within the survey area and the closest previous record is within 1km. Species was recorded in the KSIA, adjacent to the survey area (Bamford Consulting Ecologists 2020).

Species	Common name	Conservation status		Source	Habitat	Likelihood and justification
		EPBC Act	BC Act / DBCA			
Ixobrychus dubius	Australian Little Bittern	-	P4	DBCA 2021b, DBCA 2007 - 2021	It occurs in diverse freshwater swamp habitats, mainly where tall rushes, reeds, *Typha* (cumbungi), shrub thickets or other dense cover is inundated by at least 30 cm of water.	**Unlikely** No suitable habitat present within the survey area.
Notamacropus irma	Western Brush Wallaby	-	P4	DBCA 2021b, DBCA 2007 - 2021	Inhabits open forests or woodlands, preference to open, seasonally wet flats with low grasses and open scrubby thickets.	**Potential** Suitable habitat present within the survey area and the closest record is 6km north of the survey area. Species was recorded in the KSIA, adjacent to the survey area (Bamford Consulting Ecologists 2020).
Oxyura australis	Blue-billed Duck	-	P4	DBCA 2021b, DBCA 2007 - 2021	The Blue-billed Duck is endemic to Australia, being found in the temperate wetlands of the south-east and south-west parts of the continent.	**Unlikely** No suitable habitat present within the survey area.

Appendix E Flora species list

Family	Species	Method
Anarthriaceae	*Lyginia imberbis*	Quadrat
Apiaceae	*Platysace compressa*	Quadrat
Apocynaceae	**Gomphocarpus fruticosus*	Opportunistic
Araceae	**Zantedeschia aethiopica*	Opportunistic
Araliaceae	*Trachymene pilosa*	Quadrat
Asparagaceae	*Lomandra hermaphrodita*	Quadrat
Asparagaceae	*Thysanotus manglesianus*	Quadrat
Asparagaceae	*Lomandra caespitosa*	Opportunistic
Asteraceae	**Hypochaeris glabra*	Quadrat
Asteraceae	**Ursinia anthemoides*	Quadrat
Asteraceae	*Millotia tenuifolia*	Quadrat
Asteraceae	*Quinetia urvillei*	Quadrat
Caryophyllaceae	*Dasypogon bromeliifolius*	Quadrat
Colchicaceae	*Burchardia congesta*	Quadrat
Crassulaceae	*Crassula colorata*	Quadrat
Cyperaceae	*Isolepis marginata*	Quadrat
Cyperaceae	*Lepidosperma squamatum*	Opportunistic
Dilleniaceae	*Hibbertia huegelii*	Quadrat
Dilleniaceae	*Hibbertia hypericoides*	Quadrat
Dilleniaceae	*Hibbertia racemosa*	Quadrat
Droseraceae	*Drosera macrantha*	Quadrat
Droseraceae	*Drosera porrecta*	Quadrat
Ericaceae	*Conostephium pendulum*	Quadrat
Ericaceae	*Styphelia nitens*	Quadrat
Fabaceae	*Acacia pulchella*	Quadrat
Fabaceae	*Acacia semitrullata* (P4)	Quadrat
Fabaceae	*Bossiaea eriocarpa*	Quadrat
Fabaceae	*Daviesia divaricata*	Quadrat
Fabaceae	*Gompholobium tomentosum*	Quadrat
Fabaceae	*Hovea trisperma*	Opportunistic
Geraniaceae	**Erodium botrys*	Opportunistic
Haemodoraceae	*Conostylis juncea*	Quadrat
Haemodoraceae	*Phlebocarya ciliata*	Quadrat
Loranthaceae	*Nuytsia floribunda*	Opportunistic

Family	Species	Method
Myrtaceae	*Eucalyptus marginata*	Quadrat
Myrtaceae	*Hypocalymma angustifolium*	Quadrat
Myrtaceae	*Kunzea glabrescens*	Quadrat
Myrtaceae	*Melaleuca thymoides*	Quadrat
Myrtaceae	*Calytrix flavescens*	Quadrat
Orchidaceae	*Caladenia flava*	Quadrat
Orchidaceae	*Microtis media*	Quadrat
Orchidaceae	*Pterostylis ectypha*	Quadrat
Orchidaceae	*Pyrorchis nigricans*	Quadrat
Orchidaceae	*Thelymitra macrophylla*	Quadrat
Orchidaceae	*Diuris longifolia*	Opportunistic
Orchidaceae	*Pterostylis recurva*	Opportunistic
Phyllanthaceae	*Poranthera drummondii*	Quadrat
Poaceae	**Aira caryophyllea*	Quadrat
Poaceae	**Briza maxima*	Quadrat
Poaceae	**Ehrharta calycina*	Quadrat
Poaceae	**Holcus setiger*	Opportunistic
Primulaceae	**Lysimachia arvensis*	Opportunistic
Proteaceae	*Adenanthos meisneri*	Quadrat
Proteaceae	*Banksia attenuata*	Quadrat
Proteaceae	*Banksia ilicifolia*	Quadrat
Proteaceae	*Grevillea crithmifolia*	Opportunistic
Restionaceae	*Desmocladus flexuosus*	Quadrat
Restionaceae	*Hypolaena exsulca*	Quadrat
Stylidiaceae	*Stylidium brunonianum*	Quadrat
Stylidiaceae	*Stylidium schoenoides*	Opportunistic
Xanthorrhoeaceae	*Xanthorrhoea brunonis*	Quadrat
Zamiaceae	*Macrozamia riedlei*	Quadrat

Appendix F Flora species matrix

Family	Species	ELA01	ELA02	ELA03
Poaceae	**Aira caryophyllea*	X	X	X
Poaceae	**Briza maxima*	X	X	X
Poaceae	**Ehrharta calycina*		X	
Asteraceae	**Hypochaeris glabra*	X	X	X
Asteraceae	**Ursinia anthemoides*	X	X	X
Fabaceae	*Acacia pulchella*			X
Fabaceae	*Acacia semitrullata (P4)*		X	X
Proteaceae	*Adenanthos meisneri*	X	X	
Proteaceae	*Banksia attenuata*	X	X	X
Proteaceae	*Banksia ilicifolia*	X	X	
Fabaceae	*Bossiaea eriocarpa*	X	X	X
Colchicaceae	*Burchardia congesta*	X	X	X
Orchidaceae	*Caladenia flava*	X	X	X
Mytaceae	*Calytrix flavescens*	X	X	X
Ericaceae	*Conostephium pendulum*	X	X	X
Haemodoraceae	*Conostylis juncea*	X	X	X
Crassulaceae	*Crassula colorata*		X	
Caryophyllaceae	*Dasypogon bromeliifolius*	X	X	X
Fabaceae	*Daviesia divaricata*			X
Restionaceae	*Desmocladus flexuosus*	X	X	X
Droseraceae	*Drosera macrantha*	X		X
Droseraceae	*Drosera porrecta*	X	X	
Myrtaceae	*Eucalyptus marginata*	X	X	X
Fabaceae	*Gompholobium tomentosum*	X		
Dilleniaceae	*Hibbertia huegelii*			X
Dilleniaceae	*Hibbertia hypericoides*	X	X	X
Dilleniaceae	*Hibbertia racemosa*		X	
Myrtaceae	*Hypocalymma angustifolium*	X		
Restionaceae	*Hypolaena exsulca*	X	X	X
Cyperaceae	*Isolepis marginata*		X	
Myrtaceae	*Kunzea glabrescens*	X	X	X
Asparagaceae	*Lomandra hermaphrodita*	X	X	
Anarthriaceae	*Lyginia imberbis*	X	X	X
Zamiaceae	*Macrozamia riedlei*		X	X

Family	Species	ELA01	ELA02	ELA03
Myrtaceae	*Melaleuca thymoides*		X	X
Orchidaceae	*Microtis media*		X	
Asteraceae	*Millotia tenuifolia*			X
Haemodoraceae	*Phlebocarya ciliata*			X
Apiaceae	*Platysace compressa*	X		
Phyllanthaceae	*Poranthera drummondii*	X	X	
Orchidaceae	*Pterostylis ectypha*	X		X
Orchidaceae	*Pyrorchis nigricans*	X	X	X
Asteraceae	*Quinetia urvillei*	X	X	X
Stylidiaceae	*Stylidium brunonianum*		X	
Ericaceae	*Styphelia nitens*	X	X	X
Orchidaceae	*Thelymitra macrophylla*	X		X
Asparagaceae	*Thysanotus manglesianus*	X		X
Araliaceae	*Trachymene pilosa*	X	X	X
Xanthorrhoeaceae	*Xanthorrhoea brunonis*	X	X	X

Appendix G Quadrat data

Site name	Date	Site type	Observer
ELA01	17/9/2021	Quadrat 10 x 10m	JC/JZ/ME
Vegetation condition	**Disturbance notes**	**Age since fire (years)**	**Vegetation community**
Good	Grazing, Weeds, Tracks (Deep leaf, litter, weeds)	Moderate (10-20)	EmKgXb
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Banksia woodland emergent Jarrah	Flat	N/A	0
Soil colour	**Soil type**	**Rock type**	**Outcropping (%)**
Dark grey	Sand (Deep sand)	N/A	0
Easting		**Northing**	
384295		6323715	

Species	Cover (%)	Height (cm)	Sub-Stratum
Eucalyptus marginata	2	1200	Tree
Banksia attenuata	40	600	Lignotuberous tree or shrub
Banksia ilicifolia	1.5	700	Erect tree or shrub
Kunzea glabrescens	35	400	Shrub

Species	Cover (%)	Height (cm)	Sub-Stratum
Xanthorrhoea brunonis	10	100	Perennial tree-like monocot
Dasypogon bromeliifolius	5	20	Herbs
Adenanthos meisneri	10	50	Shrubs
****Ursinia anthemoides***	0.1	15	Herbs
****Hypochaeris glabra***	2.5	2	Herbs
Trachymene pilosa	0.05	5	Herbs
Pyrorchis nigricans	0.1	5	Herbs
Conostylis juncea	0.2	30	Grass-like or herbs
Hypolaena exsulca	0.1	20	Herbs
Bossiaea eriocarpa	0.1	30	Shrubs
Drosera porrecta	0.01	20	Herbs
Gompholobium tomentosum	0.1	40	Shrubs
Hibbertia hypericoides	0.5	35	Shrubs
Caladenia flava	0.01	10	Herbs
Pterostylis ectypha	0.01	10	Herbs
Lyginia imberbis	0.2	40	Grass-like or herbs
Quinetia urvillei	0.01	5	Herbs
****Aira caryophyllea***	0.01	10	Grass-like or herbs
Thysanotus manglesianus	0.01	CL	Herbs
****Briza maxima***	0.5	20	Grass-like or herbs
Desmocladus flexuosus	0.2	20	Herbs
Hypocalymma angustifolium	0.1	40	Shrubs
Platysace compressa	0.1	40	Herbs
Burchardia congesta	0.02	40	Herbs
Drosera macrantha	0.01	CL	Herbs or Climber
Calytrix flavescens	0.1	20	Shrubs
Lomandra hermaphrodita	0.01	30	Herbs
Thelymitra macrophylla	0.01	35	Herbs
Poranthera drummondii	0.01	5	Herbs
Styphelia nitens	0.2	50	Shrubs
Conostephium pendulum	0.2	35	Shrubs

Site name	Date	Site type	Observer
ELA02	17/9/2021	Quadrat 10 x 10m	JC/JZ/ME
Vegetation condition	**Disturbance notes**	**Age since fire (years)**	**Vegetation community**
Good	Grazing, weeds, tracks	Moderate (10-20)	EmKgXb
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Open Banksia with emergent Jarrah	Flat	N/A	0
Soil colour	**Soil type**	**Rock type**	**Outcropping (%)**
Grey	Sand (Deep sand)	N/A	0
Easting		**Northing**	
384399		6323775	

Species	Cover (%)	Height (cm)	Sub-Stratum
Eucalyptus marginata	30	1000	Tree
Banksia attenuata	35	600	Lignotuberous tree or shrubs
Banksia ilicifolia	1	600	Erect tree or shrub
Kunzea glabrescens	15	400	Shrubs

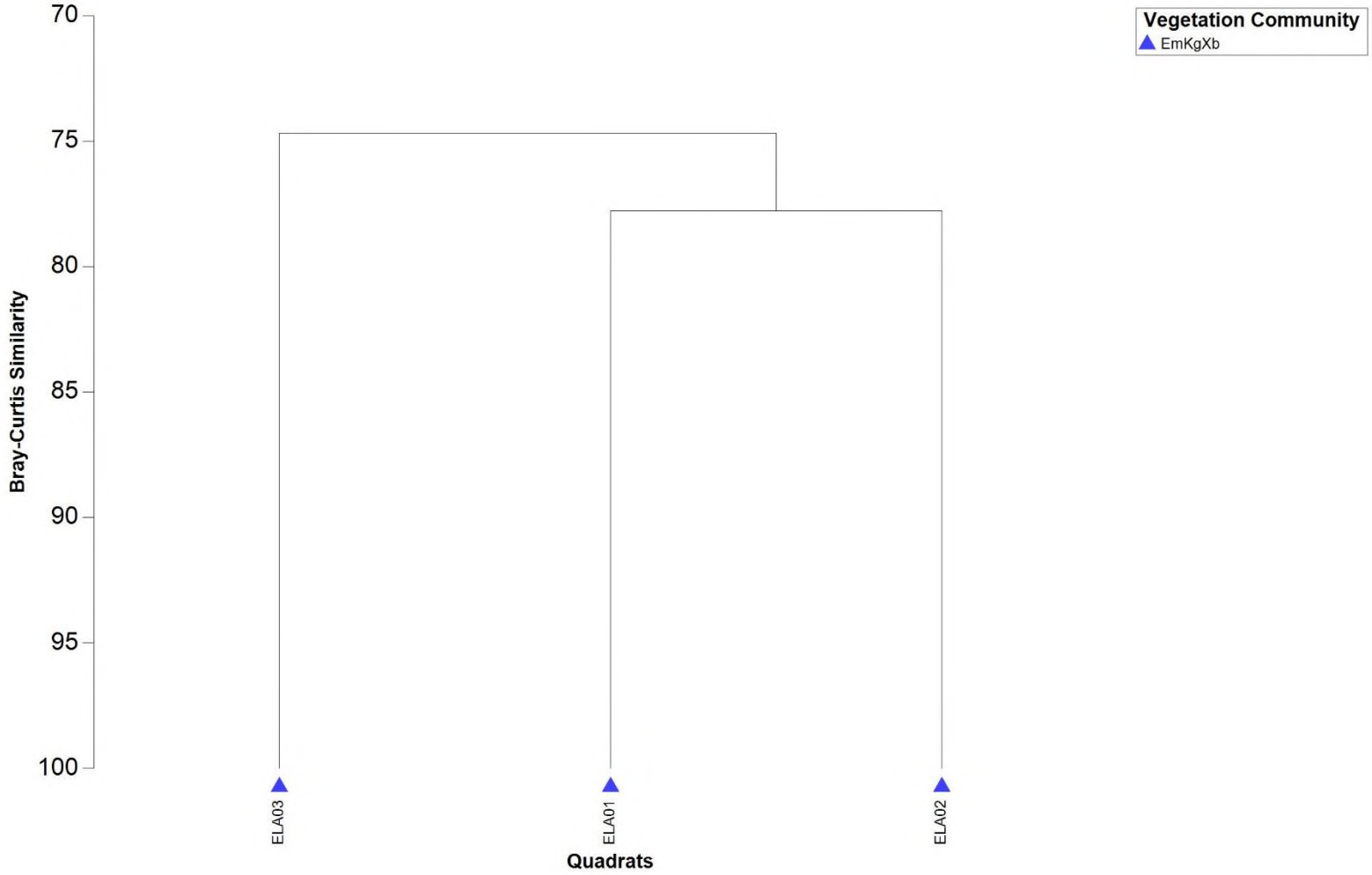
Species	Cover (%)	Height (cm)	Sub-Stratum
Xanthorrhoea brunonis	10	150	Perennial tree-like monocot
Macrozamia riedlei	0.2	50	Tree or cycad
Hibbertia hypericoides	5	20	Erect, spreadomg, twiggy shrubs
Hibbertia racemosa	0.5	30	Erect or ascending, spreading shrubs
Dasypogon bromeliifolius	25	15	Herbs
Lyginia imberbis	0.5	40	Grass like or herbs
****Hypochaeris glabra***	0.5	2	Herbs
****Ursinia anthemoides***	0.5	10	Herbs
****Aira caryophyllea***	0.02	5	Herbs
Quinetia urvillei	0.01	5	Herbs
Drosera porrecta	0.2	10	Herbs
Bossiaea eriocarpa	0.3	40	Shrubs
Poranthera drummondii	0.01	5	Herbs
Stylidium brunonianum	0.05	15	Herbs
Acacia semitrullata (P4)	0.05	30	Shrubs
****Ehrharta calycina***	0.1	40	Grass-like or herbs
****Briza maxima***	0.4	30	Grass-like or herbs
Conostylis juncea	0.2	30	Grass-like or herbs
Conostephium pendulum	0.5	40	Shrubs
Hypolaena exsulca	0.5	30	Herbs
Caladenia flava	0.01	15	Herbs
Styphelia nitens	0.1	40	Shrubs
Calytrix flavescens	0.1	30	Shrubs
Melaleuca thymoides	0.3	50	Shrubs
Burchardia congesta	0.01	40	Herbs
Trachymene pilosa	0.01	10	Herbs
Desmocladus flexuosus	0.08	20	Herb (sedge-like)
Crassula colorata	0.01	5	Herbs
Isolepis marginata	0.01	5	Grass-like or herbs
Microtis media	0.01	30	Herbs
Pyrorchis nigricans	0.1	2	Herbs
Adenanthos meisneri	2	50	Shrubs
Lomandra hermaphrodita	0.01	30	Herbs

Site name	Date	Site type	Observer
ELA03	17/9/2021	Quadrat 10 x 10m	JC/JZ/ME
Vegetation condition	**Disturbance notes**	**Age since fire (years)**	**Vegetation community**
Good	Grazing, weed cover (high weed cover)	Moderate (10-20)	EmKgXb
Habitat description	**Landform unit**	**Aspect**	**Slope %**
Open Banksia with emergent Jarrah	Flat	N/A	0
Soil colour	**Soil type**	**Rock type**	**Outcropping (%)**
Grey	Sand (Deep sand)	N/A	0
Easting		**Northing**	
384409		384409	

Species	Cover (%)	Height (cm)	Sub-Stratum
Eucalyptus marginata	2	1200	Trees
Banksia attenuata	40	600	Trees or Shrubs
Kunzea glabrescens	1.5	700	Shrubs

Species	Cover (%)	Height (cm)	Sub-Stratum
Xanthorrhoea brunonis	35	400	Perennial tree-like monocot
Bossiaea eriocarpa	10	100	Shrubs
Styphelia nitens	5	20	Shrubs
Conostephium pendulum	10	50	Tree
Acacia pulchella	0.1	15	Shrubs
Daviesia divaricata	2.5	2	Erect shrubs or trees
Melaleuca thymoides	0.05	5	Trees and shrubs
Lyginia imberbis	0.1	5	Grass-like or herbs
****Hypochaeris glabra***	0.2	30	Herbs
****Ursinia anthemoides***	0.1	20	Herbs
****Briza maxima***	0.1	30	Grass-like or herb
****Aira caryophyllea***	0.01	20	Grass-like or herbs
Quinetia urvillei	0.1	40	Herbs
Thelymitra macrophylla	0.5	35	Herbs
Caladenia flava	0.01	10	Herbs
Drosera macrantha	0.01	10	Herbs or climbers
Trachymene pilosa	0.2	40	Herbs
Thysanotus manglesianus	0.01	5	Herbs
Hypolaena exsulca	0.01	10	Herbs
Pterostylis ectypha	0.01	CL	Herbs
Conostylis juncea	0.5	20	Grass-like or herbs
Dasypogon bromeliifolius	0.2	20	Herbs
Burchardia congesta	0.1	40	Herbs
Phlebocarya ciliata	0.1	40	Grass-like or herbs
Desmocladus flexuosus	0.02	40	Herbs (sedge-like)
Hibbertia hypericoides	0.01	CL	Shrubs
Hibbertia huegelii	0.1	20	Shrubs
Calytrix flavescens	0.01	30	Shrubs
Pyrorchis nigricans	0.01	35	Herbs
Millotia tenuifolia	0.01	5	Herbs
Acacia semitrullata (P4)	0.2	50	Shrubs
Macrozamia riedlei	0.2	35	Tree or Cycad

Appendix H Hierarchical clustering diagram



Appendix I Banksia Woodlands Threatened Ecological Communities (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	The survey area is located on the Swan Coastal Plain.
	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	The survey area is located on the Bassendean Dune 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.
		The sole vegetation community mapped within the survey area which conforms to this structure:
		EmKgXb: *Eucalyptus marginata* mid open woodland over *Banksia attenuata, Banksia ilicifolia* low woodland over *Kunzea glabrescens* tall sparse shrubland over Xant*horrhoea brunonis, Bossiaea eriocarpa, Hibbertia hypericoides* mid open shrubland over *Dasypogon bromeliifolius, Hypolaena exsulca, Conostylis juncea* low sparse forbland.
		Refer to Appendix F for quadrat site data.

	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)	The canopy is dominated by the key diagnostic species *Banksia attenuata*. There is a presence of other co-dominant species including *Eucalyptus marginata* and *Corymbia calophylla.* Other indicator species recorded include *Banksia ilicifolia*. The community has a high diversity of shrubs and herb species with many indicator species recorded. 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
	○ *Banksia menziesii* (firewood banksia) ○ *Banksia prionotes* (acorn banksia) ○ *Banksia ilicifolia* (holly-leaved banksia). • 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.	The community was assessed and sampled in the highest condition representation available in each patch in the survey area. The survey was completed in spring, which is the most appropriate season to survey on the Swan Coastal Plain. The sole mapped vegetation community EmKgXb has been determined to represent FCT 21a and to a lesser extent, FCT 21c

Step	Key diagnostic characteristics	Outcome
	• 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. • 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.	(Gibson et al. 1994), which forms part of the Banksia Woodlands ecological community listing (TSSC 2016).
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.	The area of vegetation communities present within the survey area are presented in Table 11. EmKgXb covered a total of 2.08 ha within the survey area. This comprised of the following: • 1.95 ha of vegetation in Good condition; and • 0.13 ha of vegetation in Degraded condition. The TEC within the survey area is connected to a much larger patch broadly mapped in ELA (2020) which extends to the south and the east Therefore, 2.08 ha (i.e. the entirety of EmKgXb community) meets the minimum patch size requirements for the TEC.
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	A total of 2.08 ha of vegetation within the survey area was assessed as representing the Banksia Woodlands of the Swan Coastal Plain ecological community (TEC).

Step	Key diagnostic characteristics	Outcome
	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 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.	

Appendix J Fauna species list

Birds		
Anthochaera carunculata	Red Wattlebird	Observed/heard
Cracticus tibicen	Magpie	Heard
Grallina cyanoleuca	Magpie Lark	Observed
Corvus coronoides	Australian Raven	Observed/ heard
Threskiornis molucca	White Australian Ibis	Observed
Eolophus roseicapilla	Pink and Grey Galah	Heard
Barnardius zonarius	Australian Ringneck	Observed
Spilopelia senegalensis	Laughing Dove	Observed/ heard
Smicrornis brevirostris	Weebill	Heard
Haliastur sphenurus	Whistling Kite	Observed/ heard
Rhipidura leucophrys	White Wagtail	Observed
Lichenostomus virescens	Singing Honey Eater	Observed
Petroica goodenovii	Red Capped Robin	Observed
Dromaius novaehollandiae	Emu	Observed/ scats
Dacelo novaeguineae	Laughing Kookaburra	Heard
Malurus splendeds	Splendid Fairywren	Observed/ heard
Calyptorhynchus banksii subsp. *naso*	Forest Red-tail black cockatoo	Observed*/ heard
Mammals		
Oryctolagus cuniculus	Rabbit	Scats/ diggings
Macropus fuliginosus	Western Grey Kangaroo	Scats

*FORAGING IN MARRI TREE ADJACENT TO THE SURVEY AREA - FLOCK OF 8 BIRDS

Appendix K Black cockatoo potentially suitable breeding trees within the survey area

Tree ID	Species	DBH (mm)	Hollow and type	Foraging, roosting, breeding evidence	Eastings	Northings
2090	*Eucalyptus marginata*	653	-	-	384363	6324022
2091	*Eucalyptus marginata*	1440	-	-	384421	6323903
2097	*Eucalyptus marginata*	716	-	-	384312	6323724
2094	*Eucalyptus marginata*	850	-	-	384397	6323767

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