FLORA, VEGETATION AND FAUNA ASSESSMENT

PROPOSED VERDE DRIVE EXTENSION

FEBRUARY 2019

CITY OF COCKBURN

FOCUSED VISION consulting

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Document History

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EXECUTIVE SUMMARY

The City of Cockburn (the City) is proposing extension works to Verde Drive. Focused Vision Consulting Pty Ltd (FVC) was commissioned by the City to undertake the necessary studies, which included a spring flora, vegetation and fauna/habitat assessment of the proposed footprint, supplementing the results of a previous assessments of the same scope, carried out the for Cockburn Central East (CCE) Local Structure Plan, (LSP) during the springs of 2016 and 2017. This report presents the findings of the assessments conducted within the study area.

A total of 3.48 hectares (ha), encompassing a number of lots within the Cockburn Central East Local Structure Plan (CCE LSP) area were assessed for flora, vegetation and fauna values by experienced personnel. Ecological assessments were carried out across the study area during the springs of 2016, 2017 and 2018, by Principal Ecologist, Kellie Bauer-Simpson (2016, 2017 and 2018), Senior Zoologist, Greg Harewood (2016), Senior Botanist, Gabriela Martinez (2017), and Field Technician, Will Bauer-Simpson (2016 and 2017).All assessments were conducted in accordance with current Technical Guidance of the Environmental Protection Authority (EPA).

The key findings, conclusions and recommendations arising from the flora, vegetation, fauna and habitat assessment within the study area are as follows:

- No Threatened flora under the WC Act or under the EPBC Act, nor and State-significant Priority flora were recorded, despite targeted surveys for *Caladenia huegelii* in suitable habitats in 2017.
- Two intact vegetation units, BaXp and Mp were described and mapped within the study area.
- The condition of the vegetation ranges from 'Completely Degraded' to 'Good', with the majority in 'Degraded - Completely Degraded' condition.
- One of the recorded vegetation units, BaXp, is considered representative of the Banksia woodland of the Swan Coastal Plain. However, due to the degraded nature of this vegetation, referral to DEE is not required and due to the lack of connected Banksia woodland in the surrounding area, further assessment to determine patch extent and other values related to the TEC is not warranted.
- Four fauna species of conservation-significance are known to occur in the area; Carnaby's Black-cockatoo, Forest Red-tailed Black-cockatoo, Perth Lined Lerista and Quenda, with a further three, Peregrine Falcon, Eastern Grey Egret and an unnamed cricket that may possibly occur.
- Evidence of Threatened Carnaby's Black-cockatoos and Forest Red-tailed Black-cockatoo, as well as the Priority 5 species, Southern Brown Bandicoot/Quenda was recorded during the field assessment.
- Two intact fauna habitats, consisting of Banksia woodland and a Paperbark woodland/swamp, as well as degraded areas were described and mapped across the study area.
- The Banksia woodland habitat is suitable foraging habitat for two Threatened Black-cockatoos species, although, the foraging value of this habitat in the study area is low and since the total area present is less than one hectare, referral to the Commonwealth DEE is not required.

The following mitigation measures and other recommendations are suggested for consideration with regards to proposed impacts to biological values:

- If possible, minimise clearing and residual impacts on areas of native vegetation and fauna habitat, particularly areas of intact Banksia woodland, which:
    - is representative of a Commonwealth TEC, albeit degraded
    - provides foraging habitat for Threatened Black-cockatoos, albeit low quality habitat.
- If possible, minimise clearing and residual impacts on areas of native vegetation and fauna habitat, particularly areas of intact Paperbark woodland/swamp, which:
    - provides habitat for the Priority 5 species, Quenda
    - supports the majority of the better quality vegetation in the Verde Drive extension study area, albeit in only 'Degraded to Good' condition.

- Undertake a fauna trapping and translocation program prior to clearing, specifically aimed Quenda.
- Maintain the presence of a suitably qualified zoologist on site during clearing, so that any fauna that may be encountered can be relocated to adjacent bushland areas.

Below is a summary of the outcomes of the assessment against the ten clearing principles for the entire proposed Verde Drive extension, and impact mitigation/management and/or further study recommendations and comments:

- The proposed clearing is at variance with principle 2 (b), due to the presence of suitable foraging habitat for Threatened Black-cockatoos, and likely habitat for Priority 5 Quenda.
    - Impact mitigating recommendation:
        - Avoid or minimise clearing areas of intact habitat, especially the Banksia Woodland habitat.
- The proposed clearing is at variance with principle 4 (d), due to the presence of the Banksia woodland TEC at the site.
    - Recommendation:
        - Avoid or minimise clearing areas of intact Banksia woodland.
- The proposed clearing is at variance with principle 6 (f), due to the presence of a wetland at the site.
    - Recommendation:
        - Obtain advice from the Department of Water and Environmental Regulation (DWER) regarding the specific proposed impacts for the Verde Drive extension.
- The proposed clearing may be at variance with principle 7 (g), due to the likelihood that it will cause appreciable land degradation.
    - Recommendation:
        - Consider options to offset impacts of further degradation by enhancement of areas that are currently degraded and may be retained.
- The proposed clearing may be at variance with principle 9 (i), due to the potential impacts on surface water and groundwater.
    - Impact mitigating recommendations:
        - Minimise the areas of clearing of riparian/wetland vegetation where possible.
        - Ensure suitable drainage features are incorporated into road design to avoid potential adverse impacts from run-off, and on surface and groundwater quality.
- The proposed clearing is unlikely to be, but may be at variance with principle 10 (j), due to the potential (although unlikely) to cause flooding.
    - Recommendation:
        - Ensure suitable drainage features are incorporated into road design to avoid potential flooding.

Based on the outcomes of the assessments against the ten clearing principles neither portion of the project is required to prepare and submit a referral to the Commonwealth Department of the Environment and Energy (DEE) for impacts to Matters of National Environmental Significance (MNES). It is recommended, however, that both portions of the project investigate the need for a Native Vegetation Clearing Permit (NVCP) with the State Department of Water and Environmental Regulation (DWER), given concluded variance with a number of the clearing principles, for both portions of proposed clearing.

1. INTRODUCTION

1.1 BACKGROUND

The City of Cockburn (the City) is proposing extension works to Verde Drive. A reconnaissance (formerly Level 1) flora and vegetation survey and Level 1 Fauna survey was required to address the requirements of a clearing permit application under the *Environmental Protection Act (1986)* and *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Focused Vision Consulting Pty Ltd (FVC) was commissioned by the City to undertake the necessary studies, which included a 2018 spring flora, vegetation and fauna assessment of the proposed footprint, supplementing the results of a previous assessment of the same scope, carried out the for Cockburn Central East (CCE) Local Structure Plan, (LSP) during the springs of 2016 and 2017. This report presents the findings of the assessments conducted within the study area.

A total of 3.48 hectares (ha), encompassing a number of lots within the Cockburn Central East Local Structure Plan (CCE LSP) area were assessed for flora, vegetation and fauna values, as shown in **Figure 1**.

1.2 LOCATION

The study area is located approximately 20 km south of the Perth CBD, on the eastern side of the Kwinana Freeway and is comprised of numerous Lots between Cutler Road and Knock Place, Cockburn Central (**Figure 1**). A summary of the properties is presented in **Table 1**.

1.3 SCOPE OF WORK

The scope of work required to be fulfilled was as follows:

- Undertake a desktop assessment of the flora, vegetation, fauna and habitat values
- Undertake a reconnaissance (formerly referred to as a Level 1) flora and vegetation assessment of the study area
- Undertake a vegetation condition assessment within the study area
- Undertake a Level 1 fauna and habitat assessment of the study area
- Undertake a Level 1 Black-cockatoo habitat assessment of the study area
- Prepare a submit a technical report that presents the assessment findings and is suitable to assist in the City's preparation of approvals documentation for both State and Commonwealth regulatory authorities.

Study results were to be based on results from recent flora, vegetation and fauna surveys of the broader area as part of the CCE LSP project, carried out during spring 2016 and 2017, supplemented by an in-fill field inspection for flora, vegetation and fauna values, carried out during spring 2018.

Figure 1 - Study Area

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COC18001 03 December 2018

2. EXISTING ENVIRONMENT

2.1 CLIMATE

The Swan Coastal Plain has a warm Mediterranean climate which is characterised by hot dry summers and cool to mild wet winters (Mitchell *et al.* 2002). Jandakot (Site Number 009172) is one of the Bureau of Meteorology (BoM) meteorological recording stations, which has been recording since 1989 and has recorded an average annual rainfall of 818.6 mm (BoM 2018). The annual mean maximum temperature ranges from 17.9°C in winter to 31.6°C in summer (BoM 2018) (**Figure 2**).

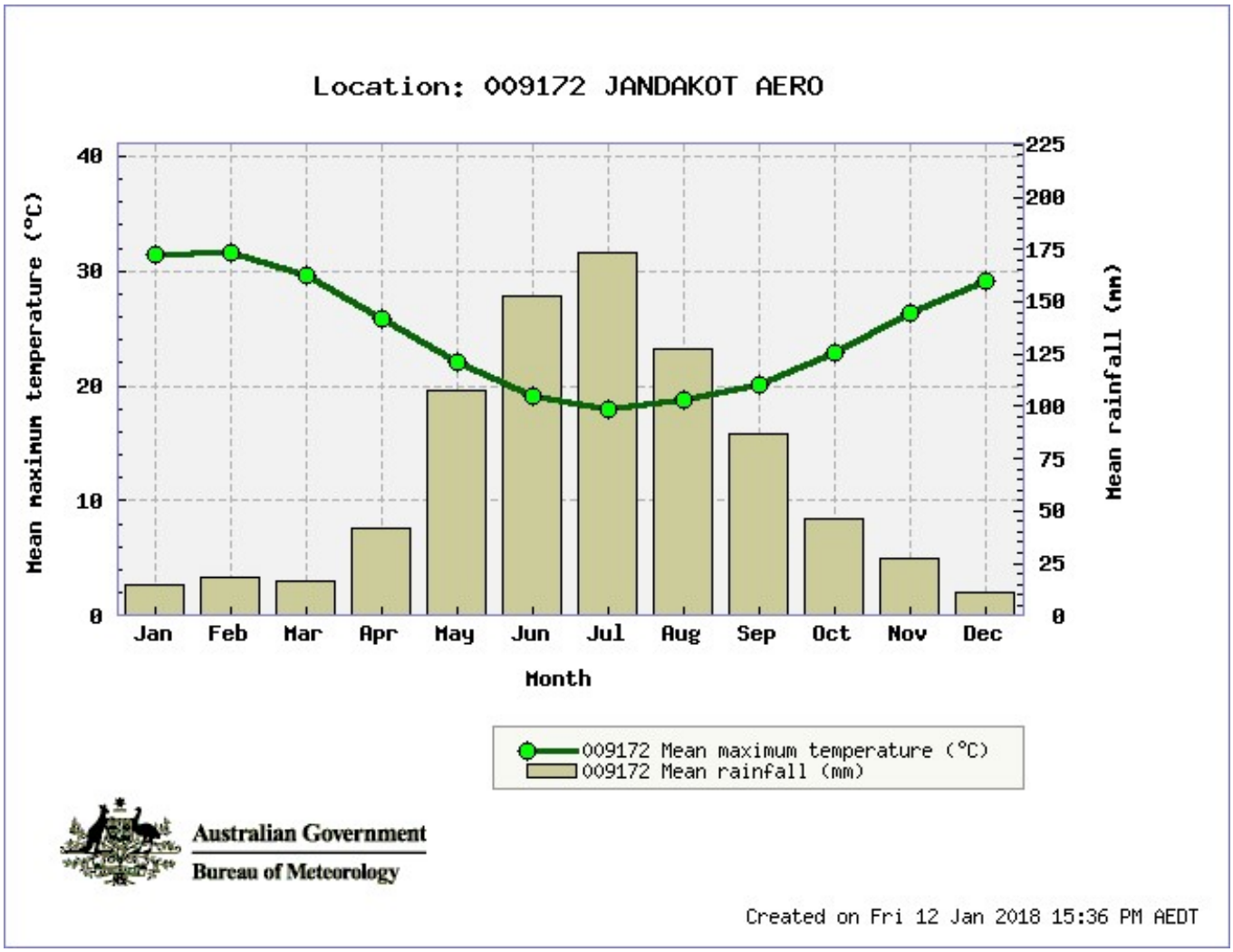

Figure 2 - Climate Data for Jandakot

2.2 IBRA REGION

There are 89 recognised Interim Biogeographic Regionalisation for Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (Commonwealth of Australia 2013). The study area lies within the Perth subregion (SWA2) of the Swan Coastal Plain IBRA region (Mitchell *et al.* 2002).

The Swan Coastal Plain region is characterised by a low-lying coastal plain, mainly covered by woodlands. The Perth subregion is composed of Heath and/or Tuart woodlands on limestone, Banksia and Jarrah woodlands on Quaternary marine dunes of various ages, and Marri on colluvial and alluvials (Mitchell *et al.* 2002).

2.3 GEOLOGY AND SOILS

The Swan Coastal Plain supports five major geomorphological systems (landforms) that lie parallel to the coast. From west to east these are; Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward and McArthur 1980; Gibson *et al.* 1994). The study area is situated on the Bassendean Dunes System (Government of Western Australia 2000).

The Bassendean Dune System consists of very old leached sands to various depths (GHD 2015) and are the oldest of the three dune systems occurring on the Swan Coastal Plain. Sands within this system contain very little silt or clay and very low levels of nutrient elements (ESWA 2016).

Soils of the study area are mapped as three sub units of the Bassendean System (Schoknecht *et al.* 2004). They are described as:

- 212Bs_B2 – Flat to very gently undulating sandplain with well to moderate well drained deep bleached grey sands with a pale yellow B horizon or weak iron organic hardpan
- 212Bs_B3 - Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam
- 212Bs_B4 – Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depth generally greater than 1.5 m by clay or less frequently a strong iron organic hardpan.

2.4 VEGETATION

In Western Australia (WA), there are two datasets that map native vegetation by type prior to European settlement; Vegetation association mapping based on published and unpublished mapping of J.S. Beard at 1:250,000 scale; and Vegetation complex mapping for the south-west of Western Australia (Heddle *et al.* 1980).

2.4.1 Vegetation Association (Beard 1981)

Beard (1981) broadly describes the vegetation of the Bassendean System as Banksia low woodland dominated by *Banksia attenuata, B. menziesii, B. ilicifolia, Eucalyptus todtiana and Nuytsia floribunda,* with *Allocasuarina fraseriana* joining the tree layer south of Gingin, and *Eucalyptus marginata* replacing *Eucalyptus todtiana* south of Lake Gnangara. The vegetation association of the study area is referred to as Vegetation Association 1001, and is described as medium very sparse woodland; jarrah, with low woodland; Banksia and Allocasuarina (Beard 1981).

The remaining extent of Vegetation Association 1001 within WA, the Swan Coastal Plain and the City of Cockburn is summarised in **Table 1** and its Pre-European extent is presented in **Figure 3**.

Table 1 - Pre-European Vegetation of the Study Area (Beard 1990, DBCA 2017b)

Veg. Association No.	Veg. System Association	Broad Vegetation Description	Extent Context	Pre–European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent Protected (IUCN I –IV)
1001	1001.1	e2Mb cbLi - Medium very sparse woodland; jarrah, with low woodland; Banksia & Casuarina	Western Australia	57,410.23	12,791.61	22.28	2.80
			Swan Coastal Plain	57,410.23	12,791.61	22.28	2.80
			City of Cockburn	7,328.39	2,102.24	28.69	4.08

2.4.2 Vegetation Complexes

Heddle *et al.* (1980) divided the Swan Coastal Plain into medium to large areas based on soil and landform units, with the vegetation within these areas defined in terms of floristic composition, growth-form dominance, species composition and stratal structure. The Heddle Vegetation Complexes are used to estimate areas of remaining vegetation and determine (in part) if an area is below a predetermined percentage for which clearing is not permitted (EPA 2006).

According to Heddle *et al.* (1980), the 'Bassendean complex - central and south' occurs within the study area (**Figure 4**). This complex is described as ranging from woodland of *Eucalyptus marginata – Allocasuarina fraseriana – Banksia* spp., to low woodland of *Melaleuca* spp. and sedgelands on moister sites.

The Environmental Protection Authority's (EPA) priority for conservation in the Perth and Peel regions is to secure at least 30% of all vegetation complexes within 'unconstrained area' and in the remaining 'constrained' areas a target of 10% applies (EPA 2015). The following key criteria are applied to vegetation clearing from a biodiversity perspective, which justifies the retention targets (EPA 2000):

- the 'threshold level' below which species loss appears to accelerate exponentially within an ecosystem level, is regarded as being at a level of 30% (of the pre-European, i.e. pre-1750 extent of the vegetation type)
- a level of 10% of the original extent of a vegetation community is regarded as being a level representing Endangered
- clearing which would increase the threat level to a vegetation community should be avoided.

Although approximately 32.4% of the original extent of the 'Bassendean Complex – central and south' remains in the City of Cockburn (WALGA 2013) (**Table 2**), which is within the threshold level of the EPA (2000) objective, there is 27.7% of the complex remaining within the broader Swan Coastal Plain.

Table 2 - Vegetation Complex Within the Study Area (Heddle *et al.* 1980, WALGA 2013)

Vegetation Complex	Location	Pre–European Extent (ha)	Current Extent (ha)	% Remaining
Bassendean Complex - Central and South	Swan Coastal Plain	87,392.73	24,206.24	27.70
	City of Cockburn	6,850	2,217.37	32.37

The documented remaining extents for both vegetation association (Beard 1990) and vegetation complex (Heddle *et al.* 1980) of the study area within the Swan Coastal Plain fall below the minimum 30% threshold level (**Table 1** and **Table 2**) and therefore do not meet the EPA objective for retention for the purpose of biodiversity conservation.

0 150 300 450 600 m

GDA 94 / MGA Zone 50

Legend

Study Area

Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina

Figure 3 - Pre-European Vegetation

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0 150 300 450 600 m

GDA 94 / MGA Zone 50

Figure 4 - Vegetation Complex

Legend

Study Area

Bassendean complex - Central and South

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3. METHODOLOGY

3.1 TIMING AND EXPERTISE

Ecological assessments were carried out across the study area during the springs of 2016, 2017 and 2018.

A reconnaissance flora and vegetation survey was undertaken by Principal Ecologist, Kellie Bauer-Simpson on 27 and 29 September 2016.

A day time Level 1 fauna assessment was conducted by Senior Zoologist, Greg Harewood, on 27 September 2016.

A targeted Threatened and Priority Flora survey, specifically focussing on *Caladenia huegelii*, was carried out Kellie Bauer-Simpson and Gabriela Martinez (Senior Botanist), assisted by Will Bauer-Simpson (Field Technician) on 27 September 2017.

Kellie Bauer-Simpson also carried out an in-fill survey, inspecting flora, vegetation and fauna values in a small area outside the 2016 and 2017 study area extent, on 29 November 2018.

The field assessors have 18, 20 and 30 years of experience conducting ecological surveys in the south-west.

3.2 GUIDANCE

The assessments for flora, vegetation, fauna and habitat (including Black-cockatoo habitat) values, were recorded and reported in accordance with:

- EPA (2016a) *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment*
- EPA (2016b) *Technical Guidance Sampling methods for Terrestrial vertebrate fauna*
- DSEWPaC (2012) *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered)* Calyptorhynchus latirostris; *Baudin's cockatoo (vulnerable)* Calyptorhynchus baudinii; *Forest red-tailed black cockatoo (vulnerable)* Calyptorhynchus banksii naso.

This report also references the findings of the following previous reports:

- FVC (2016) *Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment.* Report prepared for the City of Cockburn.
- FVC (2018) *Cockburn Central East Local Structure Plan (CCE LSP) Area, Targeted* Caladenia huegelii *survey.* Report prepared for the City of Cockburn.

3.3 DESKTOP REVIEW

Results of searches of the Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority Flora and Fauna and Ecological Communities databases were compiled for the 2016 desktop assessment. Other available information was also sourced through searches of NatureMap and the Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool, for Matters of National Environmental Significance (MNES) associated with the site.

The suite of information gathered from the desktop assessment was used to generate potential species lists tailored to the study area, with a focus on Threatened and Priority flora, fauna and ecological communities, as well as fauna species recognised under international treaties (JAMBA, CAMBA, ROKAMBA and the Bonn Convention), and assisted in determining species and areas of the study site to particularly focus on during the field assessment.

A review of the following publicly available information was included:

- DBCA NatureMap Species Report (**Appendix A**), providing:
  - flora and fauna species listed as rare (Threatened (T)) or likely to become extinct
  - flora and fauna species protected under international agreements (IA)
  - other specially protected fauna (Scheduled)
  - flora and fauna species listed as Priority 1 to 5 (P1, P2, P3, P4, P5)
  - other non-conservation taxa recorded or known to the area.
- EPBC Act Protected Matters (MNES) search results for the study area (**Appendix B**), providing results relevant to:
  - the following MNES:
    - World Heritage Properties
    - National Heritage Places
    - Wetlands of International Importance
    - Listed Threatened Ecological Communities
    - Listed Threatened Species (flora and fauna)
    - Listed Migratory Species.
  - the following other matters protected by the EPBC Act:
    - Commonwealth Land
    - Commonwealth Heritage Places
    - Critical Habitats
    - Commonwealth Reserves (Terrestrial).
- spatial data sourced from DBCA for:
  - Threatened and Priority flora, across the study area
  - Threatened, Priority and conservation significant vertebrate fauna, across the study area
  - Threatened and Priority Ecological Communities, across the study area.

Information from these sources is indicative only and local knowledge and information also needs to be considered when determining what actual species may be present within the specific area being investigated.

3.4 FIELD ASSESSMENT

3.4.1 Flora and Vegetation

3.4.1.1 Reconnaissance Survey

A reconnaissance survey (formerly referred to as 'Level 1') for flora and vegetation values was carried by Principal Ecologist, Kellie Bauer-Simpson on 27 and 29 September 2016, throughout the entire CCE LSP study area.

The survey was conducted utilising non-permanent quadrats to characterise vegetation where it was determined to be in good or better condition. Observations and opportunistic data collection was also carried out continuously within and throughout the study area with a particular focus on Threatened and Priority flora and ecological communities, potentially supported by the sites.

In accordance with EPA requirements for flora and vegetation assessments (EPA 2016a), data were collected from non-permanent quadrats (flora and vegetation assessment areas) where native vegetation was found to be in 'Good' or better condition; and relevés (detailed data collection points) where vegetation was not in 'Good' or better condition.

Where quadrats were utilised, a 10 m x 10 m area was marked out and a single peg (galvanised fence-dropper) was installed in the north-west corner (in case the site has to be revisited) in accordance with EPA guidance (EPA 2016a).

The following information was collected within each quadrat or relevé:

- observer
- date
- location/site
- GPS location (GDA94)
- representative photograph
- soil type and colour
- topography
- vegetation condition/degradation/disturbances (e.g. weed invasion, fire)
- flora species observed, including average height and projected foliage cover of dominant species within each stratum
- vegetation unit, described in accordance with Level 5 of the National Vegetation Information System (NVIS)
- vegetation condition, assessed against the currently accepted scale; an adaptation of the Keighery (1994) and Trudgen (1991) condition scales.

The vegetation communities present within the study area was described to National Vegetation Information System (NVIS) Level 5, in accordance with the applicable methodologies (DEH 2003) in combination with the Muir (1977) Structural Vegetation Classifications (**Appendix C**).

Observations and opportunistic records were also noted continuously within and throughout the study area.

3.4.1.2 Vegetation Condition

Vegetation condition was assessed and documented at each quadrat and relevé and at appropriate locations throughout the Study Area using the current bushland condition scale which is an adaptation of Keighery (1994) and Trudgen (1991), as described in EPA (2016a).

3.4.1.3 Weeds

A search of the Department of Primary Industries and Regional Development (DPIRD) (previously Department of Agriculture and Food) databases was also consulted to determine if any of the recorded species are listed as Declared Plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) (DPIRD 2018).

3.4.1.4 Targeted Flora Survey

On September 27 2017, a targeted search for Threatened and Priority flora potentially supported by the site was conducted, with a focus on the Threatened flora species, *Caladenia huegelii*. The entire site was traversed on foot by Kellie Bauer-Simpson, Gabriela Martinez and Will Bauer-Simpson.

If individuals or suspected individuals of *Caladenia huegelii* or other Threatened of Priority flora were observed, the following data was to be recorded:

- GPS location of each individual plant allowing an inventory of the number of plants/population size
- vegetation type and condition at the recorded location
- condition of plants/populations recorded.

3.4.1.5 Data Analysis

The flora and vegetation data collected from the quadrats, relevés and opportunistic observations contributed to the flora inventory for the study site.

The vegetation communities of the study area were defined by data collected within quadrats and opportunistically between, and how they relate to other environmental features such as soil type and landform.

The vegetation communities present within the study area were described to National Vegetation Information System (NVIS) Level 5, in accordance with the applicable methodologies (DEH 2003) in combination with the Muir (1977) Structural Vegetation Classifications (**Appendix C**).

3.4.2 Fauna Assessment

A day time Level 1 fauna assessment of the site was conducted in accordance with EPA (2016b) by Senior Zoologist Greg Harewood on 27 September 2016. The fauna assessment incorporated results of the desktop assessment, plus a field assessment addressing habitat mapping, targeted survey for relevant fauna species of conservation significance, and collection of a terrestrial vertebrate fauna species list, from opportunistic observations made on site.

Fauna species and direct evidence of fauna activity was observed and recorded continuously whilst on site. Secondary evidence of fauna species such as tracks, scats, skeletal remains, foraging evidence or calls were also noted.

The fauna habitats present within the study area were described based on site observations and detailed vegetation community data. Habitat assessment also took into account factors important to fauna such as soil and geology type, bare ground, debris (i.e. leaf litter, wood, logs, etc.), lower and ground strata density (cover), canopy height/cover/density and presence of or proximity to surface water.

3.4.3 Black-Cockatoo Habitat Assessment

Methods employed during the Black-cockatoo habitat assessment followed guidelines published by former entity of the Department of Environment and Energy (DEE) (Commonwealth of Australia 2012), which states that surveys for Carnaby's Black-cockatoo, Baudin's Black-cockatoo and Forest red-tailed Black-cockatoo habitat should:

- be done by a suitably qualified person with experiences in vegetation or cockatoo surveys; dependant on the survey being undertaken
- maximise the chance of detecting the species habitat and/or signs of use
- determine the context of the site within the broader landscape
- account for uncertainty and errors (false presence and absences)
- include collation for existing data on known locations of breeding and feeding birds and night roost locations.

Habitat used by Black-cockatoos have been placed into three categories by the DEE (Commonwealth of Australia 2012), these being:

- breeding habitat
- foraging habitat
- night roosting habitat.

3.4.3.1 Black-Cockatoo Breeding Habitat

The Black-cockatoo breeding habitat assessment involved the identification of all suitable tree species (native, endemic species only) within the subject site that had a diameter at breast height (DBH) of equal to or over 50 cm. The DBH of each tree was estimated using a pre-made 50 cm "caliper".

Target trees included any *Corymbia* and *Eucalyptus* species of a suitable size that may have been present. Other trees such as peppermints, banksia, sheoak and melaleuca species were not assessed as they typically do not develop hollows that are used by Black-cockatoos.

The location of each tree over the DBH threshold was recorded with a GPS and details on tree species, number and size of hollows (if any) were noted.

Potential hollows were placed into one of four categories, based on the size of the apparent hollow entrance. These categories are:

- Small = ~<5 cm diameter (i.e. entrance too small for a Black-cockatoo)
- Medium = ~5 cm-10 cm diameter (i.e. entrance too small for a Black-cockatoo)
- Large = ~>10 cm diameter (entrance large enough for a Black-cockatoo but possible hollow appears to be unsuitable for nesting i.e. wrong orientation, too small, too low or too shallow)
- Large (cockatoo) = ~>10 cm diameter (entrance appears big enough to provide access to a possible hollow that may be suitable for a Black-cockatoo to use for nesting).

Based on this assessment, trees present within the study area have been placed into one of four categories:

- Tree <50 cm DBH or an unsuitable species (not recorded)
- Tree ≥50 cm DBH, no hollows seen
- Tree ≥50 cm DBH, one or more hollows seen, none of which were considered suitable for Black-cockatoos to use for nesting
- Tree ≥50 cm DBH, one or more hollows seen, with at least one considered possibly suitable for Black-cockatoos to use for nesting.

For the purposes of this assessment, a tree containing a potential cockatoo nest hollow was generally defined as any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by a Black-cockatoo for the purpose of nesting/ breeding. Hollows that have an entrance greater than about 10 cm in diameter and would allow the entry of a Black-cockatoo into a suitably orientated and sized branch/trunk were recorded as a "potential" Black-cockatoo nest hollow.

Identified hollows were examined using binoculars for evidence of actual use by Black-cockatoos, for example, chewing around the hollow entrance or scarring and scratch marks on trunks and branches.

3.4.3.2 Black-Cockatoo Foraging Habitat

The location and nature of Black-cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the field survey was recorded. The nature and extent of potential foraging habitat present was also documented, irrespective of the presence of any actual foraging evidence.

3.4.3.3 Black-Cockatoo Roosting Habitat

Direct and indirect evidence of Black-cockatoos roosting within trees was noted if observed, for example, branch clippings, droppings or moulted feathers, where such habitat exists within or near study areas, in order to assess the local presence of night-roosting habitat.

4. RESULTS

4.1 FLORA

4.1.1 Desktop Assessment

The DBCA database search results, NatureMap Species Report and the MNES Report returned 23 results for the potential presence of conservation significant flora, based on records within close proximity to the study area (**Table 3**, **Figure 5**).

Previously recorded significant flora comprises seven Commonwealth and State listed Threatened flora, one Priority 1, one Priority 2, seven Priority 3 and seven Priority 4 species. Of these, based on known distribution, current records and preferred habitat type, one species (*Jacksonia gracillima*, P3) is considered likely to occur, eight species may occur and 14 are considered unlikely to occur (**Table 3**). Interrogation of the databases indicates that no species of conservation significance have been previously recorded within the study area.

Spatial data for Threatened flora in the region provided by the City also shows previously recorded occurrences of *Caladenia huegelii* recorded at a site less than 1 km south west of the study area. The distance between these populations and the study area is such that any proposed development or clearing would have no impact, including indirect impacts, on these populations.

4.1.2 Field Assessment

A total of 77 flora species, from 66 genera and 38 families were recorded within the vegetation units also supported by the Verde Drive extension study area, during the field survey of the CCE LSP area, combined with the field investigation of gap areas conducted in 2018. The total includes 33 (42.86%) native species and 44 (57.14%) introduced (weed) species. The most dominant families recorded were Fabaceae, Myrtaceae and Poaceae. The full list of vascular flora species recorded and representative communities in which they occur are detailed in **Appendix D**, with the data collected within each quadrat presented in **Appendix E**.

None of the recorded flora species are of conservation significance, listed as either Threatened flora under the State WC Act, nor the Commonwealth EPBC Act, or as Priority Flora by DBCA.

Four of the introduced (weed) species recorded are listed as Declared Pest plants under the BAM Act. These are:

- **Asparagus asparagoides* (Bridal Creeper)
- **Echium plantagineum* (Paterson's Curse)
- **Zantedeschia aethiopica* (Arum Lily)
- **Gomphocarpus fruticosus* (Narrow-leaf Cotton Bush).

Declared Pest species require management under the BAM Act and are categorised as follows:

- C1 – Exclusion
- C2 – Eradication
- C3 – Management.

**Asparagus asparagoides* and **Zantedeschia aethiopica* require C3 management for the whole of the State. **Echium plantagineum* and **Gomphocarpus fruticosus* require C3 management in a variety of areas around the State but no specific management is required within the study area (DAFWA 2016).

4.1.2.1 Threatened and Priority Flora

During spring (September) 2017, the broader CCE LSP study area was traversed on foot as part of a targeted survey of potentially occurring Threatened species, in particular *Caladenia huegelii*. Despite the extensive targeted searches of the study area, no *Caladenia huegelii* individuals were recorded. The proposed Verde Drive extension study area is not considered to provide suitable habitat for *Caladenia huegelii,* with the Banksia woodland (which would ordinarily provide suitable habitat) areas present in significantly degraded condition.

Table 3 - Threatened and Priority Flora with the Potential to occur within the Study Area

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence	Source
Caladenia huegelii	Endangered	Critically Endangered	Tuberous, perennial, herb, 0.25-0.6 m high. Flowers green & cream & red, September to October.	Closed Banksia woodland. *Banksia* sp., *Stirlingia latifolia, Hibbertia* spp., *Hypocalymma robustum, Conostephium pendulum*. Coastal plain. Grey sand.	May occur - suitable habitat occurs within the study area.	EPBC DBCA
Drakaea elastica	Endangered	Critically Endangered	Tuberous, perennial, herb, 0.12-0.3 m high. Flowers red & green & yellow, October to November.	White or grey sand. Low-lying situations adjoining winter-wet swamps.	Unlikely to occur - Not previously recorded within the City of Cockburn.	EPBC
Diuris purdiei	Endangered	Endangered	Tuberous, perennial, herb, 0.15-0.35 m high. Flowers yellow, September to October.	Grey-black sand, moist. Winter-wet swamps.	May occur - suitable habitat occurs within the study area.	EPBC
Lepidosperma rostratum	Endangered	Endangered	Rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5 m high. Flowers brown.	Peaty sand, clay.	Unlikely to occur - Not previously recorded within the City of Cockburn.	EPBC
Andersonia gracilis	Endangered	Vulnerable	Slender erect or open straggly shrub, 0.1-1 m high. Flowers white-pink-purple, September to November.	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Unlikely to occur - Not previously recorded within the City of Cockburn.	EPBC
Drakaea micrantha	Vulnerable	Endangered	Tuberous, perennial, herb, 0.15-0.3 m high. Flowers red & yellow, September to October.	White-grey sand.	May occur - suitable habitat occurs within the study area.	EPBC
Diuris micrantha	Vulnerable	Vulnerable	Tuberous, perennial, herb, 0.15-0.35 m high. Flowers yellow, September to October.	Grey-black sand, moist. Winter-wet swamps.	May occur - suitable habitat occurs within the study area.	EPBC
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)		Priority 1	Shrub, 0.35-0.5 m high. Flowers yellow, August.	Grey-yellow sand with laterite. Low open heath.	Unlikely to occur. Species commonly known from the Coorow area.	DBCA
Thelymitra variegata		Priority 2	Tuberous, perennial, herb, 0.1-0.35 m high. Flowers orange & red & purple & pink, June to September.	Sandy clay, sand, laterite. In yellow sand. With *Banksia attenuata*, *Allocasuarina fraseri, Hibbertia hypericoides.*	May occur - suitable habitat occurs within the study area. Closest record occurs along Russell Road.	DBCA
Byblis gigantea		Priority 3	Small, branched perennial, herb (or sub-shrub), to 0.45 m high. Flowers pink-purple/white, September to December or January.	Sandy-peat swamps. Seasonally wet areas.	Unlikely to occur - Suitable habitat not present within the study area.	DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence	Source
Cyathochaeta teretifolia		Priority 3	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Flowers brown.	Grey sand, sandy clay. Swamps, creek edges.	Unlikely to occur - Suitable habitat not present within the study area. Common wetland species.	DBCA
Dampiera triloba		Priority 3	Erect spreading branched herb to 30 cm tall. Leaves clustered. Erect perennial, herb or shrub, to 0.5 m high. Flowers Blue, August to December .	Dark brown/black peaty soils. Coastal plain. Damp peaty sand. Low woodland to open forest of E*ucalyptus rudis, Banksia attenuata* and *Melaleuca preissiana*.	Unlikely to occur - Suitable habitat not present within the study area.	DBCA
Eryngium pinnatifidum subsp. *palustre* (G.J. Keighery 13459)		Priority 3	Tuberous perennial herb.	Black sand. Grey sand over clay. Winter wet depression.	Unlikely to occur - Not previously recorded within the City of Cockburn.	DBCA
Jacksonia gracillima		Priority 3	Low spreading semi-prostrate shrub, buds and flowers, flowers orange. Decumbent perennial to 0.3 m high x 1.4 m diam.	Grey and. Banksia woodland. Low Forest A, Associated species: *Allocasuarina fraseriana, Banksia menziesii.*	Likely to occur - Suitable habitat present within the study area.	DBCA
Phlebocarya pilosissima subsp. *pilosissima*		Priority 3	Shortly rhizomatous, compactly tufted perennial, grass-like or herb, 0.15-0.4 m high. Flowers cream-white, August to October.	Sand ridge. In Banksia woodland. White or grey sand, lateritic gravel.	May occur - Previously recorded from the Jandakot Area.	DBCA
Stylidium paludicola		Priority 3	Reed-like perennial, herb, 0.35-1 m high, Inflorescence racemose. Flowers pink, October to December.	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland. In swampy areas.	Unlikely to occur - Suitable habitat not present within the study area.	DBCA
Dodonaea hackettiana		Priority 4	Erect shrub or tree, 1-5 m high. Flowers yellow-green/red, mainly July to October.	Sand. Outcropping limestone. Eucalyptus marginata open forest, with grasses.	May occur - Previously recorded from the Wattleup Area.	DBCA
Microtis quadrata		Priority 4	Erect herb 0.4m high. Flowers Cream/white, October to November.	Sandy clay loam. Flat terrain, swamp. *Melaleuca, Nuytsia, Eucalyptus calophylla* very open low woodland over heath.	Unlikely to occur - Suitable habitat not present within the study area.	DBCA
Ornduffia submersa		Priority 4	Aquatic annual 0.3m high.	Ephemeral creek, Flat open depression.	Unlikely to occur - Suitable habitat not present within study area. Not previously recorded within the City of Cockburn.	DBCA
Stylidium longitubum		Priority 4	Erect annual (ephemeral), herb, 0.05-0.12 m high. Flowers pink, October to December.	Sandy clay, clay. Seasonal wetlands.	Unlikely to occur - Suitable habitat not present within study area.	DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence	Source
Thysanotus glaucus		Priority 4	Caespitose, glaucose perennial, herb, 0.1-0.2 m high. Flowers purple, October to December or January to March.	White, grey or yellow sand, sandy gravel.	May occur - Suitable habitat present within the study area, however not previously recorded within the City of Cockburn.	DBCA
Tripterococcus sp. Brachylobus (A.S. George 14234)		Priority 4	Slender erect multi-stemmed shrub to 40 cm. Flowers orange-yellow, in full flower.	Winter wet flats, peaty sand over clay. *Hypocalymma angustifolium* low heath.	Unlikely to occur - Suitable habitat not present within study area.	DBCA
Verticordia lindleyi subsp. *lindleyi*		Priority 4	Erect shrub, 0.2-0.75 m high. Flowers pink, May or November to December or January.	Sand, sandy clay. Winter-wet depressions.	Unlikely to occur - Suitable habitat not present within study area.	DBCA

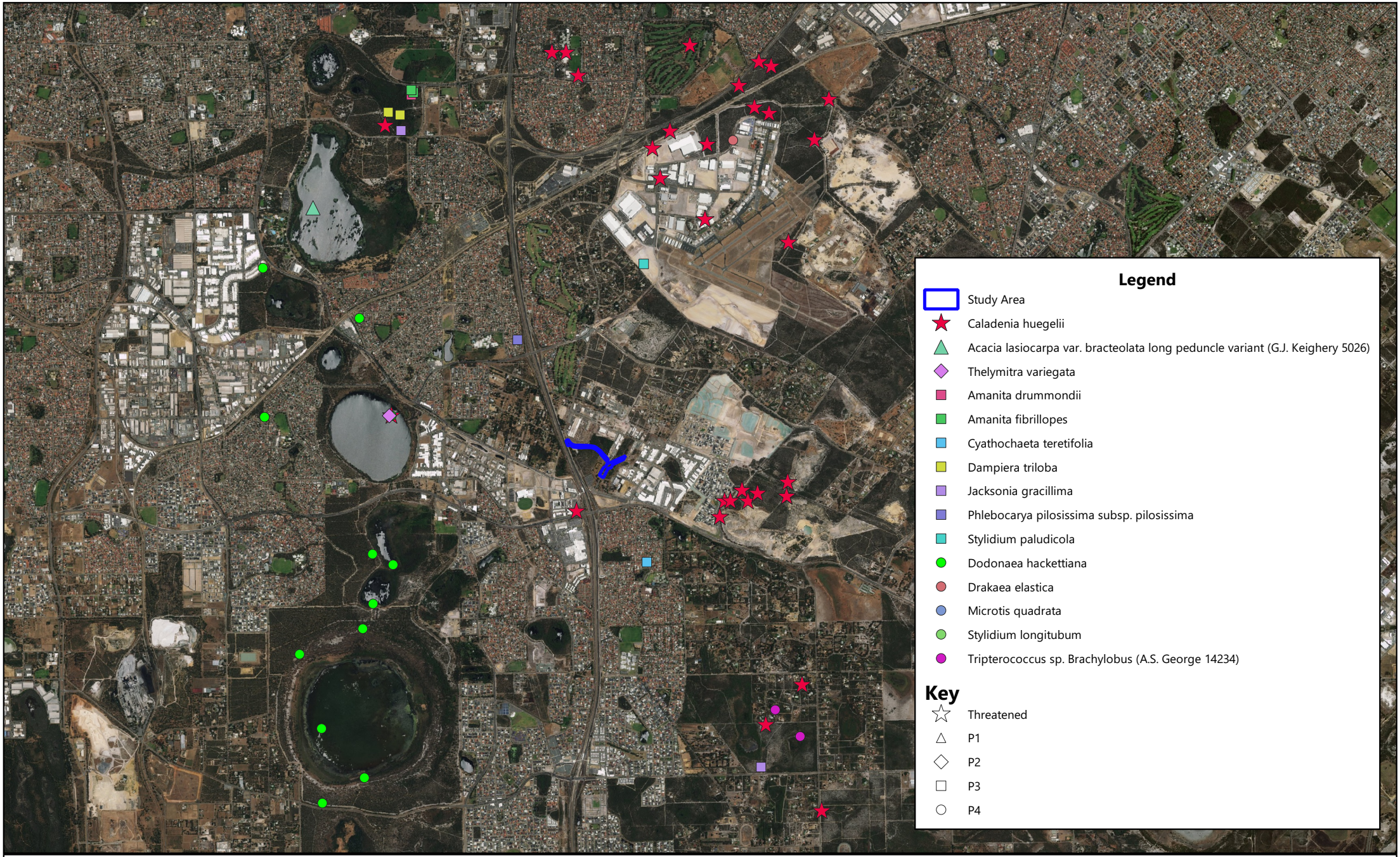

Figure 5 - Threatened and Priority Flora

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4.2 VEGETATION

4.2.1 Desktop Assessment

4.2.1.1 Threatened and Priority Ecological Communities

A review of DBCA Threatened and Priority Ecological Communities (TEC and PEC) database and the EPBC Protected Matters Search Tool identified the presence of the Endangered Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region Ecological Community (Banksia woodlands TEC) (**Appendix B**, **Figure 6**) within the study area. At a State level, various sub-types of this community type are also listed as Priority Ecological Communities (PECs), including SCP22, which is a sub-set of the Banksia woodlands TEC.

The Banksia woodlands TEC is associated with some soils of the Swan Coastal Plain with a prominent tree layer of Banksia sometimes with scattered Eucalypts and other tree species among or emerging above the canopy. The understorey is comprised of a species rich mix of sclerophyllous shrubs, graminoids and forbs (Threatened Species Scientific Committee 2016).

The Banksia woodlands TEC is largely restricted to the Swan Coastal Plain IBRA bioregion, within the Perth (SWA02) and Dandaragan (SWA01) sub-regions. It extends into the adjacent Jarrah Forrest IBRA region (JA01 and JA02 sub-regions) and areas of the Whicher and Darling escarpments where pockets of Banksia woodland may occur. This TEC mainly occurs on deep Bassendean and Spearwood sands or occasionally on Quindalup sands at the eastern edge (Threatened Species Scientific Committee 2016).

No other TECs or PECs are known to be supported by the study area, based on the database search results.

4.2.2 Field Assessment

4.2.2.1 Vegetation

Two intact vegetation units and one degraded variant of one of the intact units were described and delineated within the study area, as described in **Table 4**. Additionally, areas described as completely degraded or supporting only planted and non-endemic species were also defined. The intact vegetation units, BaXp and Mp each occupy about one third of the total study area, with the remaining third occupied by (mostly) completely degraded or planted areas and degraded areas of the Mp vegetation unit (**Table 4**).

The extent of each of the defined vegetation units is spatially mapped in **Figure 7**.

Table 4 – Vegetation Units of the Study Area

Vegetation Unit	Description	Area (ha) within Study Area	% of Study Area
BaXp	Low Woodland A of *Banksia attenuata* and *Banksia ilicifolia* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina* and **Actotheca calendula*, in grey sands.	1.18	33.91
Mp	Low Woodland A of occasional *Eucalyptus rudis* over *Melaleuca preissiana* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina*, in brown loamy sands.	1.13	32.47
Mp(d)	Degraded areas of Mp (above).	0.22	6.32
i	Completely degraded areas of planted trees and shrubs and weeds, or weeds only, with occasional *Adenanthos cygnorum* subsp. *cygnorum* and *Xanthorrhoea preissii*, in grey or brown sands.	0.71	20.40
Cleared		0.24	6.90

4.2.2.2 Vegetation Condition

The condition of the vegetation was found to range from 'Completely Degraded' to 'Good'. The majority of the study area is considered to be in 'Degraded - Completely Degraded' condition. The vegetation condition across the study area is summarised in **Table 5** and presented in **Figure 8**.

Table 5 – Vegetation Condition of the Study Area

Condition Category	Area (ha) within Study Area	% of Study Area
Completely Degraded	0.46	13.22
Degraded - Completely Degraded	1.87	53.74
Degraded	0.96	27.59
Degraded - Good	0.17	4.89
Good	0.02	0.57

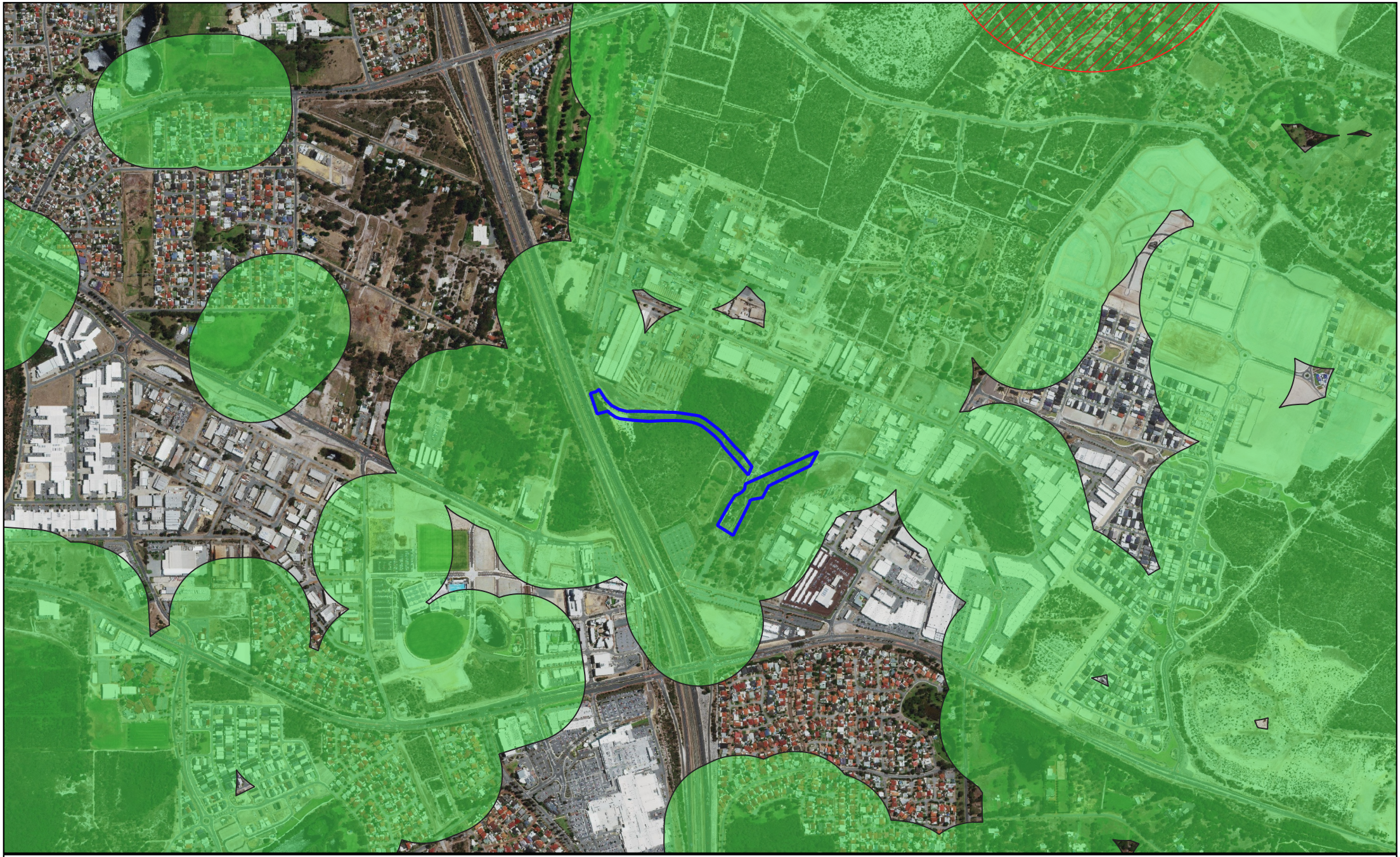

Figure 6 - Threatened and Priority Ecological Communities

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Figure 7 - Vegetation Units

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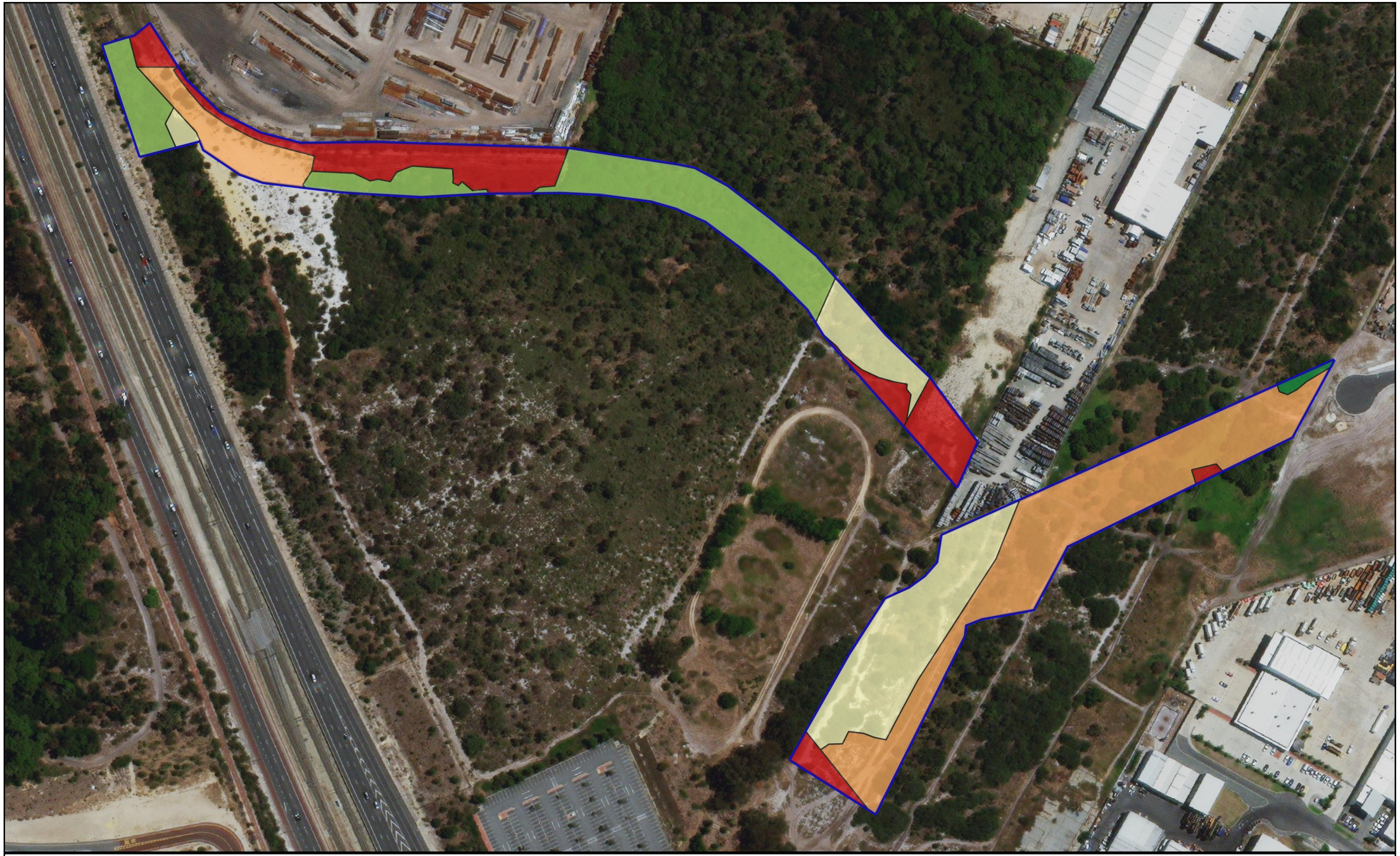

Figure 8 - Vegetation Condition

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4.3 FAUNA

4.3.1 Desktop Assessment

A total of 143 native fauna species have been previously recorded in the vicinity of the study area, some of which have the potential to occur within the study area. This includes, 11 mammals (comprising eight bat species), 97 birds, 26 reptiles and 10 frog species. An additional 12 introduced species may frequent the area.

4.3.1.1 Conservation Significant Fauna

The conservation significant vertebrate fauna species potentially occurring within or utilising the study area identified through the literature review and field observations is summarised in **Table 6** with database records presented in **Figure 9**.

Based on known distributions, current records and preferred habitat types, four of these species are known to occur in the area (Carnaby's Black-cockatoo, Forest Red-tailed Black-cockatoo, Perth Lined Lerista and Quenda) and three may possibly occur (Peregrine Falcon, Eastern Grey Egret and an unnamed cricket). Seven of the species listed in **Table 6** are unlikely to occur and 17 species would not occur (considered locally extinct etc.).

Of the species listed as known to or possibly occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Commonwealth legislation. In addition, one migratory and three DBCA priority species are also listed as potentially present (some likely only on a seasonal basis).

The full fauna assessment report (Harewood 2016) is presented in **Appendix F**.

Table 6 - Conservation Significant Fauna Previously Recorded or Potentially Occurring within the Study Area

Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts
Graceful Sun Moth	*Synemon gratiosa*	P4	No	Would Not Occur	None
Unnamed Bee	*Leioproctus contrarius*	P3	No	Would Not Occur	None
Unnamed Cricket	*Throscodectes xiphos*	P1	Yes	Possible	Loss/modification of areas of habitat
Perth Lined Lerista	*Lerisita lineata*	P3	Yes	Known to Occur	Loss/modification of areas of habitat
Black-striped Snake	*Neelaps calonotos*	P3	Yes/Marginal	Unlikely-Appears to be locally extinct	None
Malleefowl	*Leipoa ocellata*	S3, Mig	No	Would Not Occur – locally/regionally extinct	None
Hooded Plover	*Thinornis rubricollis tregellasi*	P4	No	Would Not Occur	None
Australasian Bittern	*Botaurus poiciloptilus*	S2, EN	No/Marginal	Unlikely	None
Eastern Great Egret	*Ardea alba*	S5, Mig	Yes/Marginal	Possible during seasonal inundation events only.	Loss/modification of areas of marginal habitat
Cattle Egret	*Ardea ibis*	S5, Mig	No/Marginal	Unlikely	None
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Mig	No	Would Not Occur	None
Osprey	*Pandion haliaetus*	S5, Mig	No	Would Not Occur	None
Peregrine Falcon	*Falco peregrinus*	S7	Yes	Possible	Loss/modification of areas of foraging habitat
Glossy Ibis	*Plegadis falcinellus*	S5, Mig	No/Marginal	Unlikely	None
Blue-billed Duck	*Oxyura australis*	P4	No	Would Not Occur	None
Australian Painted Snipe	*Rostratula australis/benghalensis*	S2, S5, Mig EN	No	Would Not Occur	None
Grey Wagtail	*Motacilla cinerea*	S5, Mig	No	Would Not Occur	None
Other Migratory shorebirds/wetland species	Various	S5, Mig	No	Would Not Occur	None
Carnaby`s Black Cockatoo	*Calyptorhynchus latirostris*	S2, EN	Yes	Known to occur	Loss/modification of areas of habitat
Baudin`s Black Cockatoo	*Calyptorhynchus baudinii*	S2, VU	No/Marginal	Unlikely – outside of normal range	None
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	S3, VU	Yes	Known to occur	Loss/modification of areas of habitat

Common Name	Genus & Species	Conservation Status	Habitat Present	Likelihood of Occurrence	Possible Impacts
Masked Owl	*Tyto novaehollandae novaehollandae*	P3	No/Marginal	Unlikely	None
Fork-tailed Swift	*Apus pacificus*	S5, Mig	Yes	Unlikely	None
Numbat	*Myrmecobius fasciatus*	S3, VU	No	Would Not Occur – locally extinct	None
Quenda/Southern Brown Bandicoot	*Isoodon obesulus fusciventer*	P4	Yes	Known to occur	Loss/modification of a small area of habitat
Western Ringtail Possum	*Pseudocheirus occidentalis*	S2, VU	No	Would Not Occur – locally extinct	None
Western Brush Wallaby	*Macropus irma*	P4	No	Would Not Occur	None
Tammar	*Macropus eugenii derbianus*	P4	No	Would Not Occur – locally extinct	None
Quokka	*Setonix brachyurus*	S3, VU	No	Would Not Occur – locally extinct	None
Western False Pipistrelle	*Falsistrellus mackenziei*	P4	No/Marginal	Would Not Occur – locally extinct	None
Water Rat	*Hydromys chrysogaster*	P4	No	Would Not Occur	None

Figure 9 - Threatened and Priority Fauna

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4.3.2 Field Assessment

Opportunistic fauna observations made during the September 2016 field survey are included in **Appendix F**. A total of 25 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the one-day survey period. The use of the study area by five introduced species was also confirmed.

Evidence of three fauna species of conservation significance was observed during the field assessment. Carnaby's Black-cockatoo, listed as Endangered under the EPBC Act and as Schedule 2 under the WC Act was observed from evidence of chewed Banksia cones. The Forest Red-tailed Black-cockatoo, listed as Vulnerable under the EPBC Act and as Schedule 3 under the WC Act was observed flying overhead during the field survey and GHD also recorded this species flying over the area in 2015 (GHD 2015). Further evidence of this species' use of the site was evidenced from chewed Coastal Blackbutt (*Eucalyptus todtiana*) fruits. Diggings attributed to the Southern Brown Bandicoot/Quenda, a DBCA-listed Priority 5 species, were also found at several locations.

A fauna assessment of some areas of the currently defined study area was carried out by GHD in October 2015. During this assessment, which included a single day survey by a zoologist, in addition to several days by ornithologists from Birdlife Australia, 34 native fauna species were recorded. Eight introduced species were also observed.

GHD reported both Carnaby's and Forest Red-tailed Black-cockatoos as flying over the area, and the Rainbow Bee-eater (listed migratory species) was observed nesting in a sand embankment along North Lake Road.

Evidence of the Southern Brown Bandicoot was also observed and the Perth Lined Lerista (skink; DBCA Priority 3 species) was also recorded.

Combining the results of the September 2016 field assessment and those of the GHD (2015) field assessment, a total of 47 fauna species have was recorded within the study area (as summarised in **Table 7**), these being comprised of:

- 34 birds (including four introduced species)
- five reptiles
- six mammals (including four introduced species)
- two frogs.

Table 7 – Summary of Potential Vertebrate Fauna Species

Group	Total No. Potential Species	Potential No. Specially Protected Species	Potential No. Migratory Species	Potential No. Migratory Species	No. Species Recorded in Study Area During Survey
Amphibians	10	0	0	0	2
Reptiles	26	0	0	1	5
Birds	103[6]	3	2	0	34[4]
Non-Volant Mammals	9[6]	0	0	1	6[4]
Volant Mammals (Bats)	8	0	0	0	0
Total	**155[12]**	**3**	**2**	**2**	**47[8]**

NB: Detailed results presented in **Appendix F**

Superscript = No. of introduced species included in total

4.3.3 Fauna Habitats

Despite significant disturbance in some areas from past and current land uses, some sections of the study area are in relatively good condition and provide value as habitat to native fauna.

The broader CCE LSP study area was found to support five habitat types, consisting of woodlands and woodland/wetlands, one open heath/scrub and degraded areas. Within this, the proposed Verde Drive extension area supports two of these habitats; Banksia Woodland and Paperbark Woodland/Swamp, as described below, with their proportions in the study area listed in **Table 8** and their spatial extent presented in **Figure 10**.

Table 8 - Summary of Fauna Habitats

Habitat	Area (ha) within Study Area	% of Study Area
Banksia Woodland	0.88	25.29
Paperbark Woodland/Swamp	1.62	46.55
Degraded Open Areas	0.98	28.16

4.3.3.1 Banksia Woodland

The Banksia Woodland habitat consists of an overstorey of Banksia species (*Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia*), occasionally with Coastal Blackbutt (*Eucalyptus todtiana*), over native shrubs and herbs, as well as grassy weeds in more degraded areas. The soils are deep, loose sands, mostly pale grey, but also light brown with some more loamy constituents in lower lying areas. The overstorey layer is up to 7 m tall and sparse in some areas, but denser in areas of better condition. The native understorey is degraded in some areas, but annually (during late winter and spring) is quite densely covered in weeds, and provides a moderate leaf litter cover. Many of the mid-strata shrubs, such as Grasstrees which dominate throughout the habitat, have foliage mostly down to the ground, providing good coverage for ground dwelling mammals and reptiles and with spacing suitable to enable easy movement. The open sand lenses are known to provide suitable habitat for the Perth Lined Lerista (Priority 4). The composition of Proteaceous species and other food source plants (e.g. *Eucalyptus todtiana*) for Threatened Black-cockatoos is quite abundant and varied, including most significantly, the presence of consistent Banksia stands. This habitat type does not support large trees suitable for nesting or night roosting habitat for Black-cockatoos.

4.3.3.2 Paperbark Woodland/Swamp

The Paperbark Woodland/Swamp habitat occurs in lower lying areas of the study site and is dominated by *Melaleuca preissiana*, which occurs occasionally with the introduced shrub, **Acacia longifolia* and mostly occurs over native shrubs such as *Hypocalymma angustifolium* or over dense stands of weeds, commonly **Fumaria capreolata*. The understorey density is similar across the habitat during late winter and spring, regardless of whether it consists of native species or weeds, and in such densities, provides ideal habitat for small ground-dwelling mammals and reptiles, including Southern Brown Bandicoots, for which evidence was apparent during the field assessment. Soils in the Paperbark Woodland/Swamp habitat type range from grey sands to brown loamy sands in the lower lying and wetter areas in the centre of the section west of the freeway, and in the northern-most sections north of the train station carpark. Soils are heavier and more compact than in the Banksia Woodland habitat. The overstorey is up to 9 m tall, with some very old and tall *Melaleuca preissiana* specimens present. There are few species present that provide foraging habitat for Threatened Black-cockatoos and large trees suitable for nesting or night roosting habitat for Black-cockatoos are largely absent.

4.3.3.3 Degraded Open Areas

The Degraded Open Areas provide very little habitat for native fauna, with a high potential for vulnerability to native and introduced predators in most areas. This habitat type consists of mostly cleared areas supporting dense areas of weeds. A section in the north, immediately east of the Freeway includes rehabilitation which is sparse and appears to be regeneration of the Paperbark Woodland/Wetland habitat. Some areas of the study area, in the east and north-eastern sections support this habitat type in the form of mostly introduced and disturbance shrubs; mostly **Leptospermum laevigatum* (Victorian Teatree) and *Adenanthos cygnorum*, a native disturbance opportunist. In such areas, although not naturally occurring nor endemic, better coverage, food sources and therefore habitat is provided, which is more akin to that of the intact woodland habitats.

There is a lack of suitable foraging, nesting and night-roosting habitat for Threatened Black-cockatoos in the Open Degraded Areas.

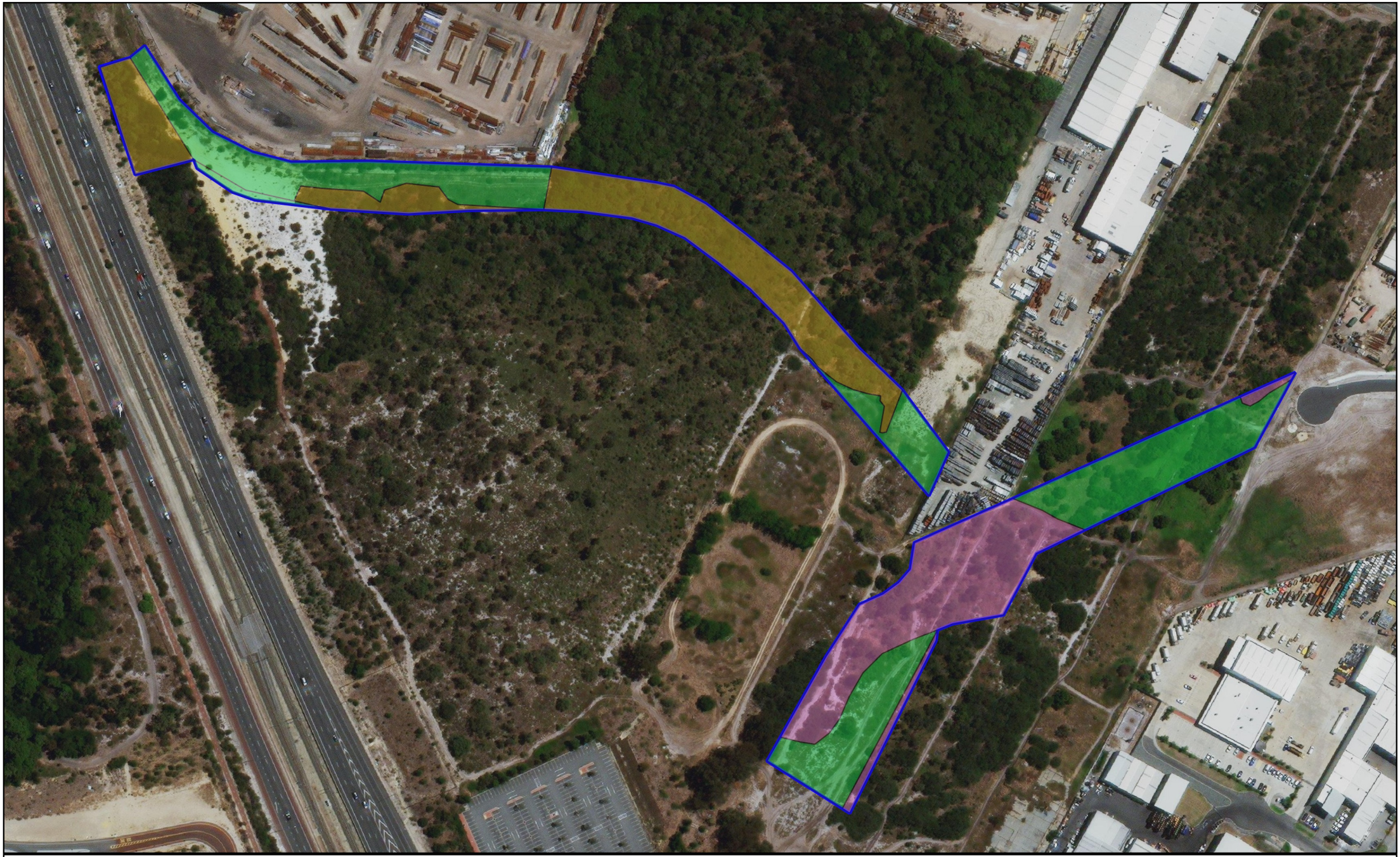

Figure 10 - Fauna Habitats

4.3.4 Black-Cockatoo Habitat Assessment

4.3.4.1 Breeding Habitat

No trees meeting the criteria of a 'Black-cockatoo breeding habitat' as defined by the DEE (Commonwealth of Australia 2017) were observed within the study area.

A review of available data showed no known records of Black-cockatoos breeding near the study area, the closest documented site being near Karnup/Baldivis approximately 20 km to the south (Johnstone *et al.* 2011).

4.3.4.1 Foraging Habitat

The main foraging resource observed within the study area is represented by *Banksia attenuata* and *Banksia menziesii*. These dominant plant species are supplemented to varying degrees by smaller shrub species such as *Allocasuarina humilis* and *Xanthorrhoea preissii*. Other documented foraging species (e.g. *Eucalyptus marginata*) are represented by a relatively small number of individuals within the site, and would not contribute to the total potential food resource to any significant degree.

Generally, the Banksia Woodland habitat is considered suitable foraging habitat for Black-cockatoos, which totals 0.88 ha and 25.29% of the study area.

Evidence of Black-cockatoos foraging onsite was observed during the field assessment in the form of chewed Banksia cones. This evidence was attributed to Carnaby's Black-cockatoos, based on chew patterns. No evidence (new or old) of Jarrah or Sheoak being utilised as a food source was observed which would suggest that the Forest Red-tailed Black-cockatoo is an infrequent visitor. The Forest Red-tailed Black-cockatoo does not utilise Banksia as a food source, however excluding the preferred food source (Marri), the species often feeds on Jarrah and, in some circumstances, Sheoak.

In 2012, Terrestrial Ecosystems, as part of their assessment of a development project at the Hammond Park Primary School (1 km north of the study site) assessed all areas of native vegetation within an area 1.5 km to the east and west and 2 km to the north and south of the school site, to ascertain their suitability for providing foraging habitat for Black-cockatoos (Terrestrial Ecosystems 2012). This assessment identified 726 ha of foraging habitat in the surrounding areas, with 430 ha secured in Bush Forever tenure (Harry Warring Marsupial Reserve and Thompson's Lake Nature Reserve).

4.3.4.2 Roosting Habitat

No existing night-roosting trees (trees used at night by Black-cockatoos to rest) were positively identified during the field survey, and given the lack of large trees present, Black-cockatoos are considered very unlikely to use the study area for this purpose.

A review of available data showed no known records of Black-cockatoos roosting in the immediate vicinity. However, roost sites have been identified within the north-east section of Thomson's Lake Nature Reserve, about 6 km to the north and a similar distance to the east in Wandi (Johnstone *et al.* 2011).

5. DISCUSSION

5.1 FLORA

A total of 77 flora species, from 66 genera and 38 families were recorded, which represents relatively low floristic diversity for the Swan Coastal Plain. Furthermore, the proportion of introduced flora (weeds) recorded is significant, with more than half of the species (57.14%) non-natives. This is due to the large degree of existing clearing and ongoing disturbances, also a result of the close proximity of the study area to infrastructure, and areas of busy human activity, such as major transport arteries and cleared industrial areas. A major ongoing disturbance at the site has been observed to result from off-road vehicles accessing the site along the numerous cleared sand-tracks present.

Four of the introduced (weed) species recorded are listed as Declared Pest plants under the BAM Act. *Asparagus asparagoides* (Bridal creeper) and *Zantedeschia aethiopica* (Arum Lily) require C3 management for the whole of the State, including within the study area. *Echium plantagineum* and *Gomphocarpus fruticosus* require C3 management in some areas around the State but not within the study area, where no specific control measures are required (DAFWA 2016).

Asparagus asparagoides (Bridal Creeper) is regarded as one of Australia's worst weeds due to its invasiveness, potential for spread and economic and environmental impacts (DEE 2016b). Rare native plants are threatened with extinction by Bridal Creeper. The species forms a thick mat of underground tubers which impedes the root growth of other native plants and often prevents seedling establishment (DEE 2016b).

Zantedeschia aethiopica (Arum Lily) occurs in pasture and bushland, particularly in damp areas. It is able to form large spreading monocultures that choke native species, reduce biodiversity and decrease habitat and food resources for native animals (Cape to Cape Catchment Group 2016). The two aforementioned species are listed as Declared Pest plants under the BAM Act and as such, landholders are required to manage and control them to reduce the size of infestations and prevent the spread of these weeds.

None of the recorded flora species are listed as Threatened under the WC Act or under the EPBC Act, nor are any listed as Priority Flora under the WC Act. It is considered unlikely that any flora species of conservation significance are supported by the small study area, which aligns through mostly degraded vegetation.

5.2 VEGETATION

The study area supports two intact vegetation units and one degraded unit, as well as areas described as completely degraded or supporting only planted and non-endemic species. Areas of the higher quality vegetation are found in the approximate centre of the study area, where vegetation unit Mp occurs. In this location, the proposed Verde Drive extension alignment also passes through better condition ("degraded to good') vegetation. The vegetation in this area is likely less degraded due to its relative inaccessibility, and fewer impacts from off-road vehicles.

Both of the intact vegetation communities have been analysed in relation to species presence/absence and landform/soil types, in comparison to the Gibson *et al.* (1994) dataset, in order to assign inferred Floristic Community Types (FCTs). A summary of the results of this analysis is presented below in **Table 9**, including the conservation status with regards to current TEC and PEC status, and the Gibson *et al.* (1994) reservation and risk of extinction classification.

Table 9 - Inferred FCTs of the Intact Vegetation Units Recorded

Vegetation Unit	Brief Community Description	Inferred FCT	FCT Title	Conservation Significance
BaXp	Banksia over *Xanthorrhoea preissii* woodland	21a	Central *Banksia attenuata* – *Eucalyptus marginata* woodlands	Commonwealth TEC Not a State TEC or PEC FCT: well reserved; low risk
Mp	*Melaleuca preissiana* woodland/swamp	4	*Melaleuca preissiana* damplands	Not a Commonwealth or State TEC or PEC FCT: well reserved; low risk

Both inferred FCTs were documented in Gibson *et al.* (1994) as "well reserved" and at "low risk" of extinction, and although none of the community types have been previously listed as a TEC or PEC in WA, the Commonwealth listing of the Banksia Woodlands of the Swan Coastal Plain TEC (DEE 2016a) encompasses a number of Banksia woodlands, including those equivalent to FCT 21a. This community type is typically described as having a prominent tree layer of Banksias with scattered Eucalypts and a species rich understorey. Although a formal diagnosis of the presence of this TEC (which is more complicated than analysing results of a Level 1 or Level 2 flora and vegetation assessment) has not been carried out, it can be concluded that the TEC is represented in the study area by areas supporting the BaXp vegetation unit.

To be considered as part of the EPBC Act-listed Banksia woodland TEC, a patch should meet at least the 'Good' condition category (Threatened Species Scientific Committee 2016). None of the areas of vegetation unit BaXp within the study area meet this minimum condition threshold.

Although very degraded/modified patches are not protected as the ecological community listed under the EPBC Act, it is recognised that patches that do not meet the condition thresholds may still retain important natural values and may be critical to protecting those patches that meet minimum thresholds (Threatened Species Scientific Committee 2016).

In addition to the areas of BaXp within the study area falling below the condition threshold, none of the immediate surrounding areas support Banksia woodland in at least 'Good' condition, which could consider such areas as part of a regional patch, as per the Conservation Advice (Threatened Species Scientific Committee 2016). Therefore, further diagnosis of the existence of the Banksia woodland TEC or its patch is not warranted, and referral of proposed clearing impacts to the DEE is not required.

The condition of the vegetation throughout the proposed Verde Drive extension alignment was found to range from 'Good' to 'Completely Degraded' in accordance with the current accepted condition scale (EPA 2016a). The majority of the study area is considered to be in 'Degraded - Completely Degraded' condition.

One of the EPA's objectives is to retain at least 10% of the pre-European extent of vegetation types in constrained areas in the Perth and peel regions (EPA 2015). The study area supports the Bassendean Complex - Central and South, which, according to the Local Biodiversity Program study (Western Australian Local Government Association 2013), is represented by 27.70% of its pre-European extent. This percentage exceeds the EPA threshold, based on a pre-European extent of 87,392.73 ha and 24,206.24 ha documented by WALGA in 2013 as remaining.

5.3 FAUNA

The desktop review determined that 17 terrestrial fauna species of conservation significance have previously been recorded within the vicinity of the study area. The likelihood of the occurrence of these species in the study area has been assessed, which concluded that Carnaby's Black-cockatoo, Forest Red-tailed Black-cockatoo, Perth Lined Lerista and Quenda are known to occur, and that the Peregrine Falcon, Eastern Grey Egret and an unnamed cricket may possibly occur. Field observations confirmed the presence of Carnaby's Black-cockatoo, Forest Red-tailed Black-cockatoo and Quenda utilising the site (or flying overhead, in the case of Forest Red-tailed Black-cockatoo).

5.3.1 Carnaby's Black-cockatoo

Carnaby's Black-cockatoo is listed as Schedule 2 under the WC Act and as Endangered under the EPBC Act. The species is confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km east south-east of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

The habitat of Carnaby's Black-cockatoo includes forests, woodlands, heathlands, farms. The species feeds preferentially on Banksia, Hakeas and Marri, but also other Proteaceous species and fruits from introduced trees such as Pines and Cape Lilac.

Carnaby's Black-cockatoo has specific nesting site requirements, with nests mostly in smoothed-barked eucalypts and in hollows ranging from 2.5 to 12 m above the ground, an entrance from 23 to 30 cm in diameter and a depth of 0.1 to 2.5 m (Johnstone and Storr 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe 2003). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain, including the region between Mandurah and Bunbury. Carnaby's Black-cockatoo has been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (Ron Johnstone, *pers. comm.)* and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby's Black-cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders 1986). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28 to 29 days. The young depart the nest 10 to 12 weeks after hatching (Saunders 1977; Smith and Saunders 1986).

Evidence of foraging activity was observed at the study site during the September 2016 field assessment in the form of chewed banksia cones. Most of the remnant vegetation containing banksia and jarrah within the site represents potential foraging habitat. Carnaby's Black-cockatoo was also recorded flying over the study area by GHD in 2015 (GHD 2015), and overfly activity of the species is regularly observed in the Cockburn region (Kellie Bauer-Simpson, *pers. comm.*).

There are no trees within the proposed Verde Drive extension alignment that would be considered by the DEE as potential Black-cockatoo breeding habitat.

No evidence of Black-cockatoo night roosting on site was observed during a dusk observation on 27 September 2016, and the site is not a known roost as per Great Cocky Count data.

The potential impact of the proposed Verde Drive extension on Carnaby's Black-cockatoo would be loss and/or modification of some areas of foraging habitat, which are represented within the Banksia Woodland habitat type. The foraging value of this habitat, is, however, considered low (Greg Harewood, *pers. comm.*).

5.3.2 Forest Red-tailed Black-cockatoo

The Forest Red-Tailed Black-cockatoo is listed as Schedule 3 under the WC Act and as Vulnerable under the EPBC Act. The species is found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Preferred habitat for Forest Red-Tailed Black-cockatoos is Eucalypt forests. The species feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble and nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black-cockatoo range from 8 to 14 m above ground, the entrance 12 to 41 cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding for the species commences in winter/spring. There are few records of breeding in the Forest Red-tailed Black-cockatoo (Johnstone and Storr 1998), but eggs are known to be laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone *pers. comm.*). The incubation period is 29 to 31 days and young fledge at eight to nine weeks (Simpson and Day 2010).

Individuals of this species were observed flying overhead during the field survey and GHD also recorded this species flying over the area in 2015 (GHD 2015). Some foraging evidence (chewed Coastal Blackbutt fruits) was also attributed to this species during the spring 2016 field assessment, though Carnaby's Black-cockatoos also utilise this food source. All areas of remnant vegetation containing Jarrah, Coastal Blackbutt and Sheoak (The Banksia Woodland habitat) within the site represents potential foraging habitat.

The potential impact of the proposed Verde Drive extension on the Forest Red-tailed Black-cockatoo would be loss and/or modification of some areas of foraging habitat, which are represented within the Banksia Woodland habitat type. The foraging value of this habitat, is, however, considered low (Greg Harewood, *pers. comm.*).

5.3.3 Perth Lined Lerista

Lerista lineata is listed as Priority 3 by DBCA and is found along the lower west coast from north of Perth and south to Leschenault Peninsula/Kemerton. It has also been found at Rottnest Island and Garden Island (Storr *et al.* 1999), but is most typically found in the southern suburbs of Perth (Bush *et al.* 2002).

This small species of skink inhabits white sands (Storr *et al.* 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter (Nevill 2005) particularly in association with banksias (Bush *et al.* 2002).

Lerista lineata was recorded within the study area by GHD (2015) and has been recorded in other nearby bush remnants (ENV 2009, Phoenix 2010). Most of the Banksia dominated habitat appears to be suitable for this species to persist. This species is also known to inhabit gardens (Nevill 2005, Bush *et al.* 2010) so may persist in degraded areas and subsequent to development.

The potential impact of the proposed Verde Drive extension on *Lerista lineata* would be loss and/or modification of some areas of habitat.

5.3.4 Quenda

Quenda/Southern Brown Bandicoot is listed as Priority 5 by DBCA. They are widely distributed near the south-west coast from Guilderton north of Perth to east of Esperance. Quenda have a patchy distribution across the Swan Coastal Plain and have been translocated to a number of locations throughout the south-west (DEC 2012c).

Quenda tend to inhabit scrubby, often swampy, vegetation with dense cover up to 1 m high, and often feed in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. On the Swan Coastal Plain, Quenda are often associated with wetlands (DEC 2012c). Within the study area, Quenda could occur within either the Banksia Woodland or Paperbark Woodland/Swamp habitats, especially where understorey is dense.

The potential impact of the proposed Verde Drive extension on Quenda would be loss and/or modification of some areas of habitat. Although Quenda are locally common around Perth and parts of the south-west, so the survival of the species as a whole would not be compromised. Prior to clearing vegetation for the road construction, Quenda could be trapped and relocated, as they are easily trapped and respond well to translocation.

5.4 FAUNA HABITATS

The two intact habitat types (plus degraded areas) defined and mapped for the study area vary in quality and value in terms of providing for native fauna, including species of conservation significance.

The Open Degraded Areas habitat provides very little value for native fauna.

The Paperbark Woodland/Swamp habitat provides for a number of native birds, small mammals and reptiles, in particular in better quality sections east of the Kwinana Freeway. This habitat type is likely to support populations of the Priority 5 species, Southern Brown Bandicoot/Quenda.

Of greatest significance with regards to habitat for conservation-significant fauna is the Banksia Woodland habitat, which occupies 0.88 ha of the Verde Drive extension study area. This habitat type is suitable foraging habitat for Threatened Black-cockatoos. Clearing of an area of this habitat greater than one hectare would require referral to the Commonwealth DEE. However, the total area present of this habitat is less than one hectare, therefore referral to the Commonwealth DEE is not required.

5.5 ASSESSMENT AGAINST THE CLEARING PRINCIPLES

The project has been broadly assessed against the Department of Water and Environmental Regulation's (DWER's) ten clearing principles, based on information collected during the assessments. A summary of this assessment (for the entire proposed Verde Drive extension area) and recommendations for impact avoidance is provided below in **Table 10**. Results of the same assessment for the City of Cockburn and the State Government portions of the study area (east and west of the storage yards, respectively) are summarised in **Tables 11** and **12**, respectively, with recommendations regarding likely approvals requirements also provided.

Table 10 – Broad Assessment Against the Clearing Principles for the Entire Study Area

Principle	Assessment	Outcome	Avoidance or Mitigation Recommendation/ Comment
1 (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	Two intact vegetation units and one degraded variant of one of the intact units, comprising 77 vascular flora species (42.86% native) were recorded. Two different vertebrate fauna habitats were found to be supported by the site, with 25 vertebrate fauna species recorded during the field assessment. This diversity is considered moderately low. No species of Priority flora were recorded during the field surveys conducted in September 2016, September 2017 and November 2018. The vegetation communities present at the site are not equivalent to any listed Priority Ecological Communities.	Proposed clearing is not at variance with this principle.	NA
2 (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.	Two fauna habitats were defined and mapped across the study site, which includes 0.88 ha of the Banksia Woodland habitat which is suitable for foraging by Threatened Black-cockatoos. No potential Black-cockatoo habitat trees occur within the study area. The Paperbark Woodland/Swamp habitat is likely to support populations of the Priority 5 species, Southern Brown Bandicoot/Quenda.	Proposed clearing is at variance with this principle.	Minimise clearing of intact native fauna habitat, especially areas of Banksia woodland.
3 (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora	A number of Threatened flora species were determined to potentially be supported by the study area, based on the results of the desktop review. Some of the site is considered suitable habitat for the Threatened orchid, *Caladenia huegelii*. However, no rare (Threatened) flora were recorded during any of the field assessments.	Proposed clearing is not at variance with this principle.	NA
4 (d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a Threatened Ecological Community (TEC).	The BaXp vegetation unit within the study area is representative of the Commonwealth-listed Banksia woodlands TEC.	Proposed clearing is at variance with this principle.	Minimise clearing of areas of Banksia woodland.
5 (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in areas that have been extensively cleared.	The study area supports the Bassendean Complex-Central and South, which, according to the Local Biodiversity Program study (Western Australian Local Government Association 2013), is represented by 27.70% of its pre-European extent. This percentage exceeds the 10% EPA threshold for constrained areas of the Perth and Peel regions ((EPA, 2015), based on a pre-European extent of 87,392.73 ha and 24,206.24 ha documented by WALGA in 2013 as remaining.	Proposed clearing is not at variance with this principle.	NA

Principle	Assessment	Outcome	Avoidance or Mitigation Recommendation/ Comment
6 (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	The study area traverses one geomorphic "Multiple Use" Wetland, which has been classified as a dampland (WA Atlas 2016). No other water waterways or wetlands are present within the immediately adjacent areas or are linked to the study area through surface drainage (GHD 2015). Multiple Use (M category) allows for development in conjunction with the management of wetland values, in the context of water, town and environmental planning.	Proposed clearing is at variance with this principle.	Although the site supports a wetland, the classification of that wetland should allow for development in conjunction with suitable management. Obtaining further advice from DWER regarding the specific proposed impacts for the Verde Drive extension is recommended.
7 (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The extent of existing clearing in the region of the study area is significant, comprising adjacent infrastructure and light commercial developments. The remnant vegetation present within the study area is mostly very degraded, although some better-quality areas exist. Proposed clearing would result in further land degradation, although in the context of existing degradation, this is not considered significantly appreciable.	Proposed clearing may be at variance with this principle.	Further degradation from clearing could be offset by enhancement of areas that are currently degraded, via appropriate management of weeds, bush fire risk, drainage and storm water, and by implementation of an appropriate rehabilitation/revegetation plan for any natural areas retained.
8 (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The nearest conservation reserve to the study area is Thomson Lake Nature Reserve, located approximately 3 km to the south-west of the study site. Any proposed clearing would not impact on this conservation area.	Proposed clearing is not at variance with this principle.	NA

Principle	Assessment	Outcome	Avoidance or Mitigation Recommendation/ Comment
9 (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Data relating to groundwater (depth to) in the study area has not been made available and an analysis of surface water and groundwater has not been carried out as part of the flora and fauna assessment. However, generally, clearing of riparian and wetland vegetation that interacts with groundwater may have impacts on groundwater levels and potentially quality. Some areas of vegetation in the study area are specifically growing in association with surface or groundwater features, particularly the Mp vegetation unit. Clearing vegetation can have impacts on surface water flows from rainfall run-off and this could impact the quality of surface water. However, there are no apparent areas of surface water in the study area, and the free draining sands present would be expected to result in negligible effects on surface run-off.	Proposed clearing may be at variance with this principle.	Minimise the areas of clearing of riparian/wetland vegetation where possible. Ensure suitable drainage features are incorporated into the road design to avoid potential adverse impacts from run-off, and on surface and groundwater quality.
10 (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate the incidence or intensity of flooding.	Proposed clearing has the potential to cause flooding within and around the proposed Verde Drive road extension, however, the free draining sands of the study area are likely to limit this. Furthermore, any proposed development would incorporate suitable drainage features that would appropriately direct surface water and avoid any flooding in adjacent natural areas, if retained.	Proposed clearing is unlikely to be at variance with this principle.	Ensure suitable drainage features are incorporated into the road design to avoid potential flooding.

Table 11 – Results of Assessment Against the Clearing Principles and Approvals Recommendations for the City of Cockburn Portion

Principle	Outcome for this Portion of the Study Area	Avoidance or Mitigation Recommendation/ Comment	Recommendations Regarding Referral or Approvals
1 (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	Proposed clearing is not at variance with this principle.	NA	NA
2 (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.	Proposed clearing is at variance with this principle.	Minimise clearing of intact native fauna habitat, especially areas of Banksia woodland.	Since total proposed clearing impacts to Black-cockatoo foraging habitat is less than 1 ha, referral to the Commonwealth DEE is not required. Since the proposed clearing of all areas of intact habitat is at variance with this clearing principle, it is recommended that the need for a Native Vegetation Clearing Permit (NVCP) be investigated with DWER.
3 (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora	Proposed clearing is not at variance with this principle.	NA	NA
4 (d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a Threatened Ecological Community (TEC).	Proposed clearing is at variance with this principle.	Minimise clearing of areas of Banksia woodland.	Since total proposed clearing impacts to Banksia woodlands TEC are less than those of the patch sizes which apply at different condition thresholds, referral to the Commonwealth DEE is not required. Since the proposed clearing of all areas of vegetation unit BaXp is at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.
5 (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in areas that have been extensively cleared.	Proposed clearing is not at variance with this principle.	NA	NA
6 (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	Proposed clearing is not variance with this principle.	NA	NA

Principle	Outcome for this Portion of the Study Area	Avoidance or Mitigation Recommendation/ Comment	Recommendations Regarding Referral or Approvals
7 (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Proposed clearing may be at variance with this principle.	Further degradation from clearing could be offset by enhancement of areas that are currently degraded, via appropriate management of weeds, bush fire risk, drainage and storm water, and by implementation of an appropriate rehabilitation/revegetation plan for any natural areas retained.	Since the proposed clearing of all areas of intact native vegetation may be at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.
8 (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Proposed clearing is not at variance with this principle.	NA	NA
9 (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Proposed clearing is not at variance with this principle.	NA	NA
10 (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate the incidence or intensity of flooding.	Proposed clearing is unlikely to be at variance with this principle.	Ensure suitable drainage features are incorporated into the road design to avoid potential flooding.	Since the proposed clearing of all areas of intact native vegetation may be at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.

Table 12 – Results of Assessment Against the Clearing Principles and Approvals Recommendations for the State Government Portion

Principle	Outcome for this Portion of the Study Area	Avoidance or Mitigation Recommendation/ Comment	Recommendations Regarding Referral or Approvals
1 (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	Proposed clearing is not at variance with this principle.	NA	NA
2 (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.	Proposed clearing may be at variance with this principle.	Minimise clearing of intact native fauna habitat (Paperbark woodland/swamp).	Since the proposed clearing of all areas of intact habitat is at variance with this clearing principle, it is recommended that the need for a Native Vegetation Clearing Permit (NVCP) be investigated with DWER.
3 (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora	Proposed clearing is not at variance with this principle.	NA	NA
4 (d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a Threatened Ecological Community (TEC).	Proposed clearing is not at variance with this principle.	NA	NA
5 (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in areas that have been extensively cleared.	Proposed clearing is not at variance with this principle.	NA	NA
6 (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	Proposed clearing is at variance with this principle.	Although the site supports a wetland, the classification of that wetland should allow for development in conjunction with suitable management. Obtaining further advice from the Department of Water regarding the specific proposed impacts for the Verde Drive extension is recommended.	Since the proposed clearing of all areas of intact native vegetation associated with the wetland generally supporting the Mp vegetation unit is at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.

Principle	Outcome for this Portion of the Study Area	Avoidance or Mitigation Recommendation/ Comment	Recommendations Regarding Referral or Approvals
7 (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Proposed clearing may be at variance with this principle.	Further degradation from clearing could be offset by enhancement of areas that are currently degraded, via appropriate management of weeds, bush fire risk, drainage and storm water, and by implementation of an appropriate rehabilitation/ revegetation plan for any natural areas retained.	Since the proposed clearing of all areas of intact native vegetation may be at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.
8 (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Proposed clearing is not at variance with this principle.	NA	NA
9 (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Proposed clearing may be at variance with this principle.	Minimise the areas of clearing of riparian/wetland vegetation where possible. Ensure suitable drainage features are incorporated into the road design to avoid potential adverse impacts from run-off, and on surface and groundwater quality.	Since the proposed clearing of all areas of intact native vegetation may be at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.
10 (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate the incidence or intensity of flooding.	Proposed clearing is unlikely to be at variance with this principle.	Ensure suitable drainage features are incorporated into the road design to avoid potential flooding.	Since the proposed clearing of all areas of intact native vegetation may be at variance with this clearing principle, it is recommended that the need for a NVCP be investigated with DWER.

6. CONCLUSION AND RECOMMENDATIONS

The key findings, conclusions and recommendations arising from the flora, vegetation, fauna and habitat assessment within the study area are as follows:

- No Threatened flora under the WC Act or under the EPBC Act, nor and State-significant Priority flora were recorded, despite targeted surveys for *Caladenia huegelii* in suitable habitats in 2017.
- Two intact vegetation units, BaXp and Mp were described and mapped within the study area.
- The condition of the vegetation ranges from 'Completely Degraded' to 'Good', with the majority in 'Degraded - Completely Degraded' condition.
- One of the recorded vegetation units, BaXp, is considered representative of the Banksia Woodland of the Swan Coastal Plain. However, due to the degraded nature of this vegetation, referral to DEE is not required and due to the lack of connected Banksia in the surrounding area, further assessment to determine patch extent and other values related to the TEC is not warranted.
- Four fauna species of conservation-significance are known to occur in the area; Carnaby's Black-cockatoo, Forest Red-tailed Black-cockatoo, Perth Lined Lerista and Quenda, with a further three, Peregrine Falcon, Eastern Grey Egret and an unnamed cricket that may possibly occur.
- Evidence of Threatened Carnaby's Black-cockatoos and Forest Red-tailed Black-cockatoo, as well as the Priority 5 species, Southern Brown Bandicoot/Quenda was recorded during the field assessment.
- Two intact fauna habitats, consisting of Banksia woodland and a Paperbark woodland/swamp, as well as degraded areas were described and mapped across the study area.
- The Banksia Woodland habitat is suitable foraging habitat for the two Threatened Black-cockatoos species, although, the foraging value of this habitat in the study area is low and since the total area present is less than one hectare, referral to the Commonwealth DEE is not required.

The following mitigation measures and other recommendations are suggested for consideration with regards to proposed impacts to biological values:

- If possible, minimise clearing and residual impacts on areas of native vegetation and fauna habitat, particularly areas of intact Banksia woodland, which:
    - is representative of a Commonwealth TEC, albeit degraded
    - provides foraging habitat for Threatened Black-cockatoos, albeit low quality habitat
- If possible, minimise clearing and residual impacts on areas of native vegetation and fauna habitat, particularly areas of intact Paperbark woodland/swamp, which:
    - provides habitat for the Priority 5 species Quenda
    - supports the majority of the better quality vegetation in the Verde Drive extension study area, albeit in only 'Degraded to Good' condition.
- Undertake a fauna trapping and translocation program prior to clearing, specifically aimed at the Priority 5 species, Quenda.
- Maintain the presence of a suitably qualified zoologist on site during clearing, so that any fauna that may be encountered can be relocated to adjacent bushland areas.

Below is a summary of the outcomes of the assessment against the ten clearing principles for the entire proposed Verde Drive extension, and impact mitigation/management and/or further study recommendations and comments:

- The proposed clearing is at variance with principle 2 (b), due to the presence of suitable foraging habitat for Threatened Black-cockatoos, and likely habitat for Priority 5 Quenda.
    - Impact mitigating recommendation:
        - Avoid or minimise clearing areas of intact habitat, especially the Banksia Woodland habitat.

- The proposed clearing is at variance with principle 4 (d), due to the presence of the Banksia woodland TEC at the site.
    - Recommendation:
        - Avoid or minimise clearing areas of intact Banksia woodland.
- The proposed clearing is at variance with principle 6 (f), due to the presence of a wetland at the site.
    - Recommendation:
        - Obtain advice from the Department of Water and Environmental Regulation (DWER) regarding the specific proposed impacts for the Verde Drive extension.
- The proposed clearing may be at variance with principle 7 (g), due to the likelihood that it will cause appreciable land degradation.
    - Recommendation:
        - Consider options to offset impacts of further degradation by enhancement of areas that are currently degraded and may be retained.
- The proposed clearing may be at variance with principle 9 (i), due to the potential impacts on surface water and groundwater.
    - Impact mitigating recommendations:
        - Minimise the areas of clearing of riparian/wetland vegetation where possible.
        - Ensure suitable drainage features are incorporated into road design to avoid potential adverse impacts from run-off, and on surface and groundwater quality.
- The proposed clearing is unlikely to be, but may be at variance with principle 10 (j), due to the potential (although unlikely) to cause flooding.
    - Recommendation:
        - Ensure suitable drainage features are incorporated into road design to avoid potential flooding.

Based on the outcomes of the assessments against the ten clearing principles neither portion of the project is required to prepare and submit a referral to the Commonwealth DEE for impacts to MNES. It is recommended, however, that both portions of the project investigate the need for a NVCP with DWER, given concluded variance with a number of the clearing principles, for both portions of proposed clearing.

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Appendix A - DBCA Naturemap Search Report

NatureMap
Mapping Western Australia's biodiversity

CCE LSP Project Area

Printed by Guest user on 26/9/2016

Query details : Current Names Only=Yes; Core Datasets Only=Yes; Method='By Polygon';Vertices=32° 07' 45" S,115° 50' 59" E 32° 07' 45" S,115° 50' 60" E 32° 07' 18" S,115° 51' 03" E 32° 06' 42" S,115° 51' 09" E 32° 06' 47" S,115° 51' 28" E 32° 07' 11" S,115° 52' 36" E 32° 07' 42" S,115° 52' 13" E 32° 07' 36" S,115° 51' 56" E 32° 07' 40" S,115° 51' 32" E 32° 07' 45" S,115° 50' 59" E ;

Search Results

Selected

- Selected Species

All Results

- Non-conservation taxon
- Priority 1
- Priority 5
- Protected under international agreement
- Rare or likely to become extinct

Reference Layers

Major WA Towns

Major WA Towns

Major WA Towns

Roads

- Sealed
- Unsealed
- Track

State Borders

Australian Continent

Department of Parks and Wildlife
museum

NatureMap is a collaborative project of the Department of Parks and Wildlife, Western Australia, and the Western Australian Museum.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 02/11/2016

Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 52' 10" E,32° 07' 43" S
Buffer	2km

Area (ha)		1255.81
Taxa:	Naturalised	12
	Native	132
Endemics:		0
Families:		73
Genera:		121
Conservation Status:	-	135
	1	1
	3	1
	T	3
	5	2
	IA	2
MS Status:	-	144
Rank:	-	133
	subsp.	11

Top Ten Families

		Species	Records
1.	Rallidae	9	19
2.	Scincidae	8	12
3.	Anatidae	7	38
4.	Meliphagidae	6	38
5.	Myrtaceae	6	6
6.	Psittacidae	6	29
7.	Cyperaceae	4	4
8.	Elapidae	4	8
9.	Threskiornithidae	3	15
10.	Fabaceae	3	4

Top Ten Genera

		Species	Records
1.	*Tiliqua*	3	4
2.	*Anthochaera*	2	17
3.	*Pseudonaja*	2	3
4.	*Anas*	2	23
5.	*Isoodon*	2	25
6.	*Porzana*	2	2
7.	*Phlebocarya*	2	2
8.	*Phalacrocorax*	2	16
9.	*Hibbertia*	2	2
10.	*Fulica*	2	5

[1]Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 02/11/2016

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 52' 10" E,32° 07' 43" S
Buffer 2km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
3.	25536	*Accipiter fasciatus (Brown Goshawk)*			
4.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
5.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
6.	24312	*Anas gracilis (Grey Teal)*			
7.	24316	*Anas superciliosa (Pacific Black Duck)*			
8.	25553	*Anhinga melanogaster (Darter)*			
9.	44629	*Anilios australis*			
10.	24561	*Anthochaera carunculata (Red Wattlebird)*			
11.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
12.	24340	*Ardea novaehollandiae (White-faced Heron)*			
13.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
14.	17234	*Austrostipa compressa*			
15.	24318	*Aythya australis (Hardhead)*			
16.	17737	*Azolla pinnata*			
17.		*Barnardius zonarius*			
18.	741	*Baumea articulata (Jointed Rush)*			
19.	744	*Baumea laxa*			
20.	24319	*Biziura lobata (Musk Duck)*			
21.	16636	*Boronia crenulata subsp. viminea*			
22.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
23.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
24.	5415	*Calothamnus lateralis*			
25.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
26.	5458	*Calytrix flavescens (Summer Starflower)*			
27.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
28.	2794	*Carpobrotus aequilaterus (Angular Pigface)*	Y		
29.	6214	*Centella asiatica*			
30.	24373	*Charadrius melanops (Black-fronted Dotterel)*			
31.	43380	*Chelodina colliei (Oblong Turtle)*			
32.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
33.	24980	*Christinus marmoratus (Marbled Gecko)*			
34.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
35.	1858	*Conospermum amoenum (Blue Smokebush)*			
36.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
37.	25592	*Corvus coronoides (Australian Raven)*			
38.	25595	*Cracticus tibicen (Australian Magpie)*			
39.	25596	*Cracticus torquatus (Grey Butcherbird)*			
40.	25399	*Crinia glauerti (Clicking Frog)*			
41.	25400	*Crinia insignifera (Squelching Froglet)*			
42.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
43.	25027	*Ctenotus australis*			
44.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain pop P3), skink)*			
45.	16245	*Cyathochaeta teretifolia*		P3	
46.	40660	*Cycnogeton huegelii*			
47.	24322	*Cygnus atratus (Black Swan)*			
48.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
49.		*Descolea maculata*			
50.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
51.	11105	*Echinochloa crus-galli*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.		*Elanus axillaris*			
53.	25250	*Elapognathus coronatus (Crowned Snake)*			
54.		*Eolophus roseicapillus*			
55.	25727	*Fulica atra (Eurasian Coot)*			
56.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
57.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
58.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
59.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
60.	20483	*Gastrolobium linearifolium*			
61.	25530	*Gerygone fusca (Western Gerygone)*			
62.	6161	*Gonocarpus pithyoides*			
63.	24443	*Grallina cyanoleuca (Magpie-lark)*			
64.	25410	*Heleioporus eyrei (Moaning Frog)*			
65.	25119	*Hemiergis quadrilineata*			
66.	5134	*Hibbertia huegelii*			
67.	5173	*Hibbertia subvaginata*			
68.	24491	*Hirundo neoxena (Welcome Swallow)*			
69.	921	*Isolepis producta*			
70.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P5	
71.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
72.	1188	*Juncus pallidus (Pale Rush)*			
73.	15498	*Kunzea glabrescens (Spearwood)*			
74.	13562	*Lachenalia aloides*	Y		
75.	6777	*Lachnostachys albicans*			
76.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
77.		*Latrodectus hasseltii*			
78.	8099	*Leontodon saxatilis (Hairy Hawkbit)*	Y		
79.	25005	*Lialis burtonis*			
80.	25661	*Lichmera indistincta (Brown Honeyeater)*			
81.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
82.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
83.	25388	*Litoria moorei (Motorbike Frog)*			
84.	7408	*Lobelia tenuior (Slender Lobelia)*			
85.	6458	*Lysinema elegans*			
86.	25654	*Malurus splendens (Splendid Fairy-wren)*			
87.	25758	*Megalurus gramineus (Little Grassbird)*			
88.	34676	*Meionectes brownii (Swamp Raspwort)*			
89.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
90.	5987	*Melaleuca viminea (Mohan)*			
91.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
92.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
93.	15419	*Microtis media subsp. media*			
94.	25192	*Morethia obscura*			
95.	24223	*Mus musculus (House Mouse)*	Y		
96.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
97.	25252	*Notechis scutatus (Tiger Snake)*			
98.	14293	*Oenothera indecora subsp. bonariensis*	Y		
99.	16347	*Oenothera laciniata*	Y		
100.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
101.	25682	*Pardalotus striatus (Striated Pardalote)*			
102.	7090	*Parentucellia viscosa (Sticky Bartsia)*	Y		
103.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
104.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
105.	24409	*Phaps chalcoptera (Common Bronzewing)*			
106.	1478	*Phlebocarya ciliata*			
107.	1479	*Phlebocarya filifolia*			
108.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
109.	4141	*Phyllota gracilis*			
110.		*Phytophthora cinnamomi*			
111.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
112.	4524	*Platytheca galioides*			
113.	25722	*Polytelis anthopeplus (Regent Parrot)*			
114.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
115.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
116.	25732	*Porzana pusilla (Baillon's Crake)*			
117.	24771	*Porzana tabuensis (Spotless Crake)*			
118.	25511	*Pseudonaja affinis (Dugite)*			
119.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
120.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
121.	4181	*Pultenaea reticulata*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
122.		*Purpureicephalus spurius*			
123.	24245	*Rattus rattus (Black Rat)*	Y		
124.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
125.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
126.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
127.	7785	*Stylidium repens (Matted Triggerplant)*			
128.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
129.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
130.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
131.	1716	*Thelymitra tigrina (Tiger Orchid)*			
132.	24844	*Threskiornis molucca (Australian White Ibis)*			
133.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
134.	33994	*Throscodectes xiphos (cricket)*		P1	
135.	1318	*Thysanotus arbuscula*			
136.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
137.	25519	*Tiliqua rugosa*			
138.	25207	*Tiliqua rugosa subsp. rugosa*			
139.	4383	*Tribulus terrestris (Caltrop)*	Y		
140.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
141.	24808	*Tringa nebularia (Common Greenshank)*		IA	
142.	98	*Typha domingensis (Bulrush, Djandjid)*			
143.	24386	*Vanellus tricolor (Banded Lapwing)*			
144.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix B - EPBC Protected Matters Search Report

Australian Government
Department of the Environment and Energy

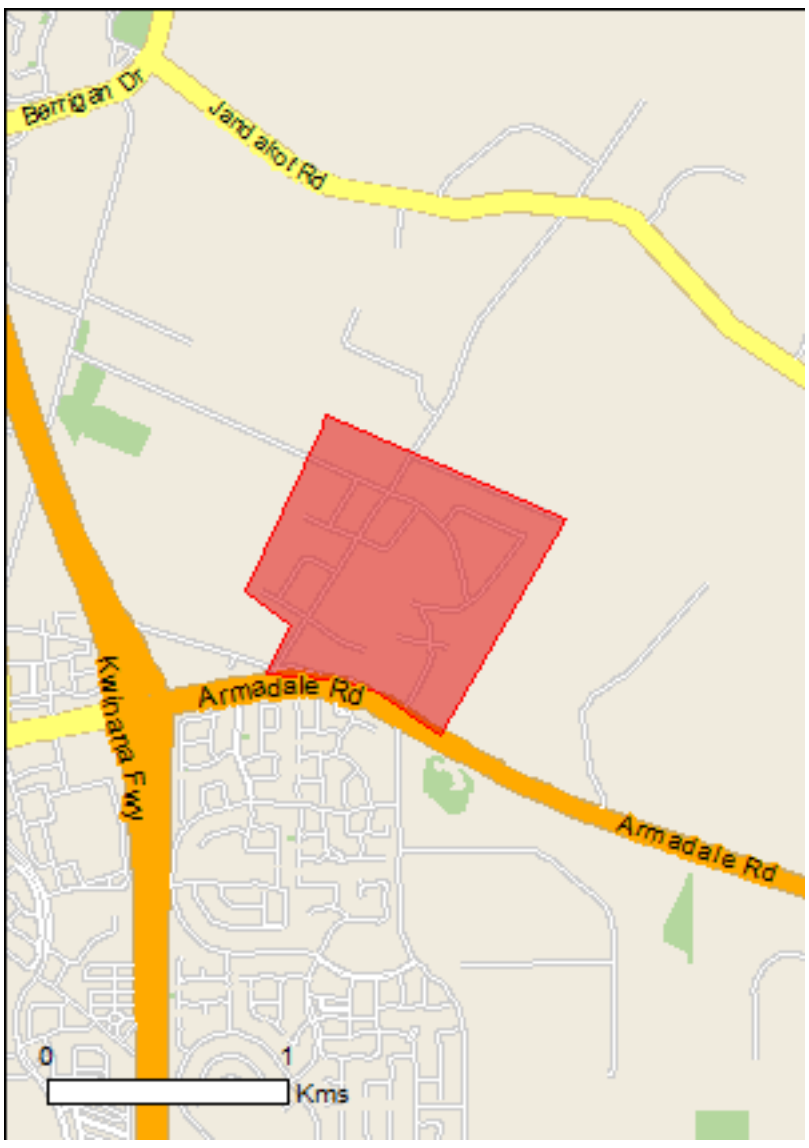
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/11/16 15:36:33



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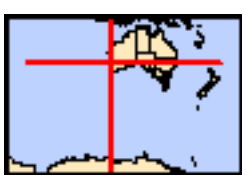

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	17
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	40
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain	Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat may occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.118471 115.866329,-32.121706 115.875255,-32.128539 115.870621,-32.127122 115.868046,-32.126758 115.866372,-32.126686 115.86517,-32.126613 115.86414,-32.125123 115.865042,-32.124032 115.863325,-32.118762 115.866243,-32.118471 115.866329

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-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix C- Structural Vegetation Classifications (Muir 1977)

Life Form/Height Class	Canopy Cover			
	Dense 70-100%	**Mid-dense 30-70%**	**Sparse 10-30%**	**Very sparse 2-10%**
Trees >30m Trees 15-30m Trees 5-15m Trees <5m	Dense tall forest Dense forest Dense low forest A Dense low forest B	Tall forest Forest Low forest A Low forest B	Tall woodland Woodland Low woodland A Low woodland B	Open tall woodland Open woodland Open low woodland A Open low woodland B
Mallee tree form Mallee shrub form	Dense tree mallee Dense shrub mallee	Tree mallee Shrub mallee	Open tree mallee Open shrub mallee	Very open tree mallee Very open shrub mallee
Shrubs >2m Shrubs 1.5-2m Shrubs 1-1.5m Shrubs 0.5-1m Shrubs <0.5m	Dense thicket Dense heath A Dense heath B Dense low heath C Dense low heath D	Thicket Heath A Heath B Low heath C Low heath D	Scrub Low scrub A Low scrub B Dwarf scrub C Dwarf scrub D	Open scrub Open low scrub A Open low scrub B Open dwarf scrub C Open dwarf scrub D
Mat plants Hummock grass Bunch grass >0.5m Bunch grass <0.5m Herbaceous spp.	Dense mat plants Dense hummock grass Dense tall grass Dense low grass Dense herbs	Mat plants Mid-dense hummock grass Tall grass Low grass Herbs	Open mat plants Hummock grass Open tall grass Open low grass Open herbs	Very open mat plants Open hummock grass Very open tall grass Very open low grass Very open herbs
Sedges >0.5m Sedges <0.5m	Dense tall sedges Dense low sedges	Tall sedges Low sedges	Open tall sedges Open low sedges	Very open tall sedges Very open low sedges
Ferns Mosses, Liverwort	Dense ferns Dense mosses	Ferns Mosses	Open ferns Open mosses	Very open ferns Very open mosses

Appendix D - Flora Species by Vegetation Unit

* denotes introduced (weed) species
DP denotes Declared Pest plants

Family	Species	N/I	Vegetation Unit		
			BaXp	Mp	i
Aizoaceae	*Carpobrotus edulis*	*	+		+
Apiaceae	*Daucus glochidiatus*	*	+		
Apocynaceae	*Gomphocarpus fruticosus*	DP	+		
Araceae	*Zantedeschia aethiopica*	DP		+	
Asparagaceae	*Asparagus asparagoides*	DP		+	
Asphodelaceae	*Trachyandra divaricata*	*			+
Asteraceae	*Arctotheca calendula*	*		+	+
	Hypochaeris glabra	*	+	+	+
	Osteospermum ecklonis	*			+
	Sonchus oleraceus	*	+		+
	Ursinia anthemoides	*	+		+
Boraginaceae	*Echium plantagineum*	DP	+		
Brassicaceae	*Brassica tournefortii*	*			+
Cactaceae	*Opuntia* sp.	*			+
Casuarinaceae	*Allocasuarina fraseri*		+		
Crassulaceae	*Crassula colorata*				+
Cyperaceae	*Isolepis marginata*		+		+
	Lepidosperma longitudinale			+	
Dasypogonaceae	*Dasypogon bromeliifolius*		+		
Dilleniaceae	*Hibbertia subvaginata*			+	
Ecdeiocoleaceae	*Ecdeiocolea monostachya*				+
Elaeocarpaceae	*Tetratheca hirsuta*			+	
Ericaceae	*Leucopogon australis*			+	
Euphorbiaceae	*Euphorbia terracina*	*			+
	Ricinus communis	*	+		
Fabaceae	*Acacia longifolia*	*			+
	Acacia pulchella			+	
	Acacia saligna		+		
	Chamaecytisus palmensis	*	+		+
	Jacksonia furcellata		+		
	Lupinus cosentinii	*			+
	Medicago polymorpha	*		+	
	Trifolium campestre	*	+		+
	Vicia hirsuta	*			+
	Vicia sativa subsp. *nigra*	*	+		+
Geraniaceae	*Erodium botrys*	*	+		
	Pelargonium capitatum	*	+		+
Iridaceae	*Freesia alba × leichtlinii*	*			+
	Gladiolus caryophyllaceus	*	+		+
	Watsonia meriana	*			+
Lauraceae	*Cassytha racemosa*			+	
Loranthaceae	*Nuytsia floribunda*		+		+
Malvaceae	*Brachychiton diversifolius*				+
Meliaceae	*Melia azedarach*	*			+
Myrtaceae	*Astartea scoparia*			+	
	Eucalyptus gomphocephala				+
	Eucalyptus marginata		+		
	Eucalyptus petiolaris				+
	Eucalyptus rudis			+	
	Eucalyptus todtiana		+		
	Hypocalymma angustifolium		+	+	

* denotes introduced (weed) species
DP denotes Declared Pest plants

Family	Species	N/I	Vegetation Unit		
			BaXp	Mp	i
	Kunzea glabrescens			+	+
	Leptospermum laevigatum	*		+	+
	Melaleuca preissiana		+		+
	Pericalymma ellipticum			+	
	Regelia inops		+		
Oleaceae	*Olea europaea*	*			+
Orchidaceae	*Thelymitra crinita*			+	
Orobanchaceae	*Orobanche minor*	*	+		
Oxalidaceae	*Oxalis pes-caprae*	*	+		+
Papaveraceae	*Fumaria capreolata*	*	+	+	+
Poaceae	*Briza maxima*	*	+	+	
	Briza minor	*		+	
	Bromus arenarius	*	+		+
	Cynodon dactylon	*			+
	Ehrharta calycina	*			+
	Ehrharta longiflora	*	+	+	+
	Lagurus ovatus	*			+
	Lolium rigidum	*	+		+
Primulaceae	*Lysimachia arvensis*	*	+		
Proteaceae	*Adenanthos cygnorum*				+
	Adenanthos obovatus		+		
	Banksia attenuata				+
	Banksia menziesii		+		
Solanaceae	*Solanum linnaeanum*	*			+
Xanthorrhoeaceae	*Xanthorrhoea preissii*				+
Zamiaceae	*Macrozamia riedlei*				
	Total	44	35	22	43

Appendix E - Vegetation Quadrat Data

BaXp

Low Woodland A of *Banksia attenuata* and *Banksia ilicifolia* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina* and **Actotheca calendula*, in grey sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat	Woodland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Grey
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	4 (Good)
Disturbance Type	Weeds; Vehicle tracks
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 25**%**

Species	Dominant Height (m)	Form	% cover
Banksia attenuata	6	Tree	6
Banksia ilicifolia	7	Tree	3
Allocasuarina fraseriana		Tree	1
Banksia menziesii		Tree	1
Eucalyptus marginata		Tree	1
Eucalyptus todtiana		Tree	1
Melaleuca preissiana		Tree	1
Xanthorrhoea preissii	1.5	Shrub	3
Kunzea glabrescens	3	Shrub	2
*Acacia longifolia**	3	Shrub	1
Acacia saligna		Shrub	1
Adenanthos obovatus		Shrub	1
*Chamaecytisus palmensis**		Shrub	1
*Gomphocarpus fruticosus** (DP)		Shrub	1
Hypocalymma angustifolium		Shrub	1
Jacksonia furcellata		Shrub	1
Nuytsia floribunda		Shrub	1
Regelia inops		Shrub	1
*Ricinus communis**		Shrub	1
*Fumaria capreolata**		Climber	1
*Arctotheca calendula**	0.2	Herb	10
*Carpobrotus edulis**		Herb	1
Dasypogon bromeliifolius		Herb	1
*Daucus glochidiatus**		Herb	1
*Echium plantagineum** (DP)		Herb	1
*Erodium botrys**		Herb	1
*Gladiolus caryophyllaceus**		Herb	1
*Hypochaeris glabra**		Herb	1
*Lysimachia arvensis**		Herb	1
*Orobanche minor**		Herb	1
*Oxalis pes-caprae**		Herb	1
*Pelargonium capitatum**		Herb	1
*Raphanus raphanistrum**		Herb	1
*Sonchus oleraceus**		Herb	1
*Trifolium campestre**		Herb	1
*Ursinia anthemoides**		Herb	1
Vicia sativa subsp. *nigra**		Herb	1
Isolepis marginata		Sedge	1
*Ehrharta calycina**	1	Grass	40
*Briza maxima**		Grass	1
*Bromus arenarius**		Grass	1
*Ehrharta longiflora**		Grass	1
*Lolium rigidum**		Grass	1

Mp

Low Woodland A of occasional *Eucalyptus rudis* over *Melaleuca preissiana* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longifolia*, over mostly weeds, dominated by **Ehrharta calycina*, in brown loamy sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	10 m x 10 m
Habitat/Waterway	Woodland/Wetland
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Brown
Soil Texture	Loamy Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	3-4 (Good to Very Good)
Disturbance Type	Weeds
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 40**%**

Species	Dominant Height (m)	Form	% cover
Melaleuca preissiana	9	Tree	9
Eucalyptus rudis	12	Tree	2
Kunzea glabrescens	3	Shrub	20
*Acacia longifolia**	4	Shrub	4
Xanthorrhoea preissii	2	Shrub	3
Acacia pulchella		Shrub	1
Astartea scoparia		Shrub	1
Hibbertia subvaginata		Shrub	1
Hypocalymma angustifolium		Shrub	1
*Leptospermum laevigatum**		Shrub	1
Leucopogon australis		Shrub	1
Pericalymma ellipticum		Shrub	1
Tetratheca hirsuta		Shrub	1
*Asparagus asparagoides** (DP)		Climber	1
Cassytha racemosa		Climber	1
*Fumaria capreolata**		Climber	1
*Arctotheca calendula**		Herb	1
*Hypochaeris glabra**		Herb	1
*Medicago polymorpha**		Herb	1
Thelymitra crinita		Herb	1
*Zantedeschia aethiopica** (DP)		Herb	1
Lepidosperma longitudinale		Sedge	1
*Ehrharta calycina**	1	Grass	50
*Briza maxima**		Grass	1
*Briza minor**		Grass	1
*Ehrharta longiflora**		Grass	1

i

Completely degraded areas of planted trees and shrubs and weeds, or weeds only, with occasional *Adenanthos cygnorum* subsp. *cygnorum* and *Xanthorrhoea preissii,* in grey or brown sands.

Botanist	Kellie Bauer-Simpson
Quadrat Dimensions	Relevé
Habitat/Waterway	Degraded; Shrubland/Grassland Mosaic
Slope	Gentle
Surface Layer	Loose Soil
Soil Colour	Grey/brown
Soil Texture	Sand
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - N/A
Vegetation Condition	6 (Completely Degraded)
Disturbance Type	Weeds; Vehicle tracks
Time since Fire	No Evidence
Leaf Litter Distribution/Cover	Scattered; 5**%**

Typical Species	Form	% cover
*Brachychiton diversifolius**	Tree	1
*Eucalyptus petiolaris**	Tree	1
*Melia azedarach**	Tree	1
*Olea europaea**	Tree	1
*Leptospermum laevigatum**	Shrub	15
Adenanthos cygnorum subsp. *cygnorum*	Shrub	10
*Acacia longifolia**	Shrub	1
Opuntia sp.*	Shrub	1
*Solanum linnaeanum**	Shrub	1
Xanthorrhoea preissii	Shrub	1
*Fumaria capreolata**	Climber	1
*Arctotheca calendula**	Herb	1
*Brassica tournefortii**	Herb	1
*Chamaecytisus palmensis**	Herb	1
*Euphorbia terracina**	Herb	1
*Freesia alba × leichtlinii**	Herb	1
*Gladiolus caryophyllaceus**	Herb	1
*Hypochaeris glabra**	Herb	1
*Lupinus cosentinii**	Herb	1
*Osteospermum ecklonis**	Herb	1
*Oxalis pes-caprae**	Herb	1
*Pelargonium capitatum**	Herb	1
*Sonchus oleraceus**	Herb	1
*Trachyandra divaricata**	Herb	1
*Trifolium campestre**	Herb	1
*Ursinia anthemoides**	Herb	1
*Vicia hirsuta**	Herb	1
Vicia sativa subsp. *nigra**	Herb	1

Typical Species	Form	% cover
*Watsonia meriana**	Herb	1
Ecdeiocolea monostachya	Sedge	1
Isolepis marginata	Sedge	1
*Ehrharta calycina**	Grass	60
*Bromus arenarius**	Grass	1
*Carpobrotus edulis**	Grass	1
*Cynodon dactylon**	Grass	1
*Ehrharta longiflora**	Grass	1
*Lagurus ovatus**	Grass	1
*Lolium rigidum**	Grass	1

Appendix F - Fauna Assessment Report (Harewood 2016)

Fauna Assessment

of

Cockburn Central East

Local Structure Plan Area

NOVEMBER 2016

Version 1

On behalf of:
Focused Vision Consulting

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Acronyms/Abbreviations:

ALA: Atlas of Living Australia www.ala.org.au

BA: Birdlife Australia (Formerly RAOU, Birds Australia).

BC Bill: Biodiversity Conservation Bill (2015). WA Government.

°C: Degrees Celsius.

CALM: Department of Conservation and Land Management (now DPaW), WA Government.

CAMBA: China Australia Migratory Bird Agreement 1998.

CBD: Central Business District.

DBH: Diametre at Breast Height – tree measurement.

DEC: Department of Environment and Conservation (now DPaW), WA Government.

DEH: Department of Environment and Heritage (now DotEE), Australian Government.

DEP: Department of Environment Protection (now DER), WA Government.

DER: Department of Environment Regulation (formerly DEC, DoE), WA Government.

DEWHA: Department of the Environment, Water, Heritage and the Arts (now DotEE), Australian Government

DMP: Department of Mines and Petroleum (formerly DoIR), WA Government.

DoE: Department of Environment (now DER/DPaW), WA Government.

DotE: Department of the Environment (now DotEE), Australian Government.

DotEE: Department of the Environment and Energy (formerly SEWPaC, DWEHA, DEH & DotE), Australian Government.

DoIR: Department of Industry and Resources (now DMP), WA Government.

DPaW: Department of Parks and Wildlife (formerly DEC, CALM, DoE), WA Government.

EP Act: *Environmental Protection Act 1986*, WA Government.

EPA: Environmental Protection Authority, WA Government.

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999,* Australian Government.

ha: Hectare (10,000 square metres).

IBRA: Interim Biogeographic Regionalisation for Australia.

IUCN: International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union.

JAMBA: Japan Australia Migratory Bird Agreement 1981.

km: Kilometre.

m: Metre.

mm: Millimetre.

RAOU: Royal Australia Ornithologist Union.

ROKAMBA: Republic of Korea-Australia Migratory Bird Agreement 2007.

SEWPaC: Department of Sustainability, Environment, Water, Population and Communities (now DotEE), Australian Government

SSC: Species Survival Commission, International.

TEC: Threatened Ecological Community.

WA: Western Australia.

WAM: Western Australian Museum, WA Government.

WC Act: *Wildlife Conservation Act 1950*, WA Government.

SUMMARY

This report details the results of a fauna assessment of Cockburn Central East Local Structure Plan area (the study area). The study area is made up of a number of individual lots or part lots having a combined area of approximately 29.5 ha.

It is understood that development of the area is proposed and the fauna assessment reported on here represents one of several technical reports that will be used to inform, guide and support the preparation and implementation of the Cockburn Central East Local Structure Plan by providing an understanding of the suite of environmental values present.

The scope of works was to conduct a level 1 fauna survey as defined by the EPA (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include targeted assessment of the site's significance to these particular species. To comply with the scope of works the assessment has included a literature review and single daytime reconnaissance survey.

Descriptions, approximate areas and examples images of the main fauna habitats present within the study area are provided in Table 1.

About 32.4 % of the remnant vegetation remaining within the study area (~9.5 ha) is comprises of a *banksia* dominated low woodland. Lower lying areas are mainly comprised of low woodlands dominated by paperbark (*Melaleuca preissiana*) (~32.3 % - 9.3 ha). Most of the remaining areas are cleared/highly degraded and are dominated by introduced weeds and grasses with occasional native trees and shrubs.

Fauna habitat values of the remaining native vegetation would appear to be relatively good despite some disturbance in the form of tree deaths (presumably from dieback/fires), felling of live and dead trees for firewood collection and common invasive weeds.

Biodiversity values would have however been reduced a certain degree from original pre-disturbance levels due to the overall fragmentation of vegetation in the wider area primarily for market gardens, residential developments, road construction, along with the likelihood of more frequent fires and the likely presence of feral predators such as cats and foxes. Very few trees containing hollows of any size were recorded.

Opportunistic fauna observations made during the September 2016 survey are listed in Appendix B. A total of 25 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the one day survey period. The use of the study area by five introduced species was also confirmed.

Evidence of two listed threatened species was observed (Carnaby's black-cockatoo - chewed *banksia* cones, forest red-tailed black cockatoo – chewed blackbutt fruits).

Diggings attributed to the southern brown bandicoot, a DPaW Priority 4 species, were also found at several locations.

A fauna assessment of some areas of the currently defined study area was carried out by GHD in October 2015. During this assessment, which included a single day survey buy a zoologist in addition to several days by ornithologists from Birdlife Australia, 34 native fauna species were recorded. Eight introduced species were also observed.

GHD reported both Carnaby's and forest red-tailed black cockatoos as flying over the area, and the rainbow bee-eater (listed migratory species) was observed nesting in a sand embankment along North Lake Road. Evidence of the southern brown bandicoot (DPaW Priority 4 species) was observed and the Perth lined skink (DPaW Priority 3 species) was also recorded.

During the course of these two assessments a total of 47 fauna species have was recorded within the study area, these being comprised of:

- 34 birds (includes 4 introduced species);
- 5 reptiles;
- 6 mammals (includes 4 introduced species); and
- 2 frogs.

The black cockatoo habitat tree assessment identified 18 trees with a DBH of ≥50cm. Most trees (12) appeared not to contain hollows of any size. Five trees appeared to contained small hollows or possible small hollows, considered by the Author as unlikely to be suitable for black cockatoos to use for nesting purposes. One of these hollows appeared to be in use by galahs.

One tree was identified as containing a hollow that appeared possibly big enough to allow the entry of a black cockatoo into a suitably sized and orientated trunk but no evidence of actual use was observed. The probability of this actually representing a hollow that would be used by black cockatoos can be regarded as being very low.

Additional details on each habitat tree observed can be found in Appendix D.

Following is a list of the main flora species recorded within the study area during the fauna assessment that are known to be used as a direct food source (i.e. fruits or flowers) by one or more species of black cockatoo:

- Jarrah - *Eucalyptus marginata;*
- Coastal Blackbutt - *Eucalyptus todtiana;*
- Sheoak - *Allocasuarina fraseriana;*

- Candelstick Banksia - *Banksia attenuata;*
- Firewood Banksia - *Banksia menziesii;*
- Holly-leaved Banksia - *Banksia ilicifolia;* and
- Grass Tree - *Xanthorrhoea preissii.*

A small amount of evidence of black cockatoos foraging onsite was observed during the field assessment in the form of chewed banksia cones (B. attenuata & B. menziesii) and coastal blackbutt fruits. This evidence was attributed to Carnaby's black-cockatoo and the forest red-tailed black cockatoo respectively.

Foraging habitat within the subject site is mainly comprised of areas of vegetation mapped as containing banksia, coastal blackbutt and jarrah (unit codes BaEt and BaXp). These two units occupy about 9.5 ha (~32.4%) of the study area.

No existing roosting trees (trees used at night by black cockatoos to rest) were positively identified during the survey.

With respect to native vertebrate fauna, 11 mammals (includes eight bat species), 96 bird, 26 reptile and 10 frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 143 native animals that are listed as potentially occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law, these being two species of black cockatoo (Carnaby's and the forest red-tailed black-cockatoo) and the peregrine falcon. In addition, two migratory species (the rainbow bee-eater and great egret) and two DPaW priority species (Perth lined lerista and the southern brown bandicoot) are known to or may utilise the area at times.

With respect to vertebrate fauna in general, no substantial impacts are anticipated as a consequence of development at the site. In cases where some impact is anticipated, the degree of the impact is only expected to be low and relates to the loss of areas of habitat, but as most species are common and widespread, with most if not all likely to have secure populations in nearby reserves, no overall change in their conservation status is anticipated, despite a possible localised reduction in habitat extent.

Constraints on development within the study area will largely be centred on the presence of habitat used or potentially used by threatened fauna species in particular those listed under the *EPBC Act*, namely black cockatoos. The potential impacts on these species and/or their habitat will need to be taken into consideration during the planning and construction phases of the project.

The full extent of clearing that may be required at the site is yet to be determined so impacts on *EPBC Act* threatened fauna species identified as utilising the site cannot be fully determined at this stage. It is however recommended that dialogue be commenced with the DotEE so that possible legislative requirements are fully understood.

It is also recommended that DPaW or other relevant experts be contacted regarding the current status and distribution of the unnamed cricket (*Throscodectes xiphos*) (Priority 1 DPaW species), which appears, based on available information, to be confined to remnant bushland in the Cockburn East area.

A series of other recommendations aimed at mitigating and minimising potential impacts on fauna and fauna habitat in general are also provided in Section 9. These should be taken into consideration during planning and development and implemented if considered reasonable and practicable.

1. INTRODUCTION

This report details the results of a fauna assessment of Cockburn Central East Local Structure Plan area (the study area). The study area is situated about 18 kms south of the Perth CBD in south west WA and is centred at approximately 32.21492°S and 115.85916°E.

The study area is made up of a number of individual lots or part lots having a combined area of approximately 29.5 ha. Most of the defined study area is covered by remnant native bushland of some type though significant portions have been subject to historical disturbances to varying degrees.

2. DEVELOPMENT PROPOSAL

It is understood that development of the area is proposed and the fauna assessment reported on here represents one of several technical reports that will be used to inform, guide and support the preparation and implementation of the Cockburn Central East Local Structure Plan by providing an understanding of the suite of environmental values present.

It is also anticipated that the information contained within this report will be used by regulatory authorities to assess the potential impact of the proposal on fauna and fauna habitats as part of any required approval process on a local, state and federal level.

3. SCOPE OF WORKS

The scope of works was to conduct a level 1 fauna survey as defined by the EPA (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include a targeted assessment of the site's significance to these species.

The fauna assessment has therefore included:

1. Level 1 Fauna Survey (to EPA standard);

2. Black Cockatoo Habitat Assessment ("habitat trees" = DBH $\geq$50cm, existing and potential nest hollows, foraging and roosting habitat); and

3. Report summarising methods, results and discussion on likely constraints on development within the defined study area.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black-cockatoo *Calyptorhynchus baudinii*, Carnaby's black-cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black-cockatoo *Calyptorhynchus banksii naso*.

4. METHODS

4.1 POTENTIAL FAUNA INVENTORY – LITERATURE REVIEW

4.1.1 Database Searches

Searches of the following databases were undertaken to aid in the compilation of a list of vertebrate fauna potentially occurring within the study area:

- DPaW's NatureMap Database Search (combined data from DPaW, WAM, BA, ALA and consultant's reports) (DPaW 2016); and
- Protected matters search tool (DotEE 2016).

It should be noted that lists produced during the abovementioned database searches contain observations/inferred distributions from a broader area than the subject site and therefore may include species that would only ever occur as vagrants due to a lack of suitable habitat or the presence of only marginal habitat within the subject site itself. The databases also often include or are based on very old records and in some cases, certain fauna species have become locally or regionally extinct.

Information from these sources should therefore be taken as indicative only and local knowledge and information needs to be taken into consideration when determining what actual species may be present within the specific area being investigated. Fauna considered unlikely to be present even if appearing in these database searches are not shown in the potential species list.

4.1.2 Previous Fauna Surveys in the Area

Fauna surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publicly available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling the potential fauna assemblage for the general area.

Those reports referred to included, but were not limited to:

- 360 Environmental (2012). Lots 124 and 125 Frankland Avenue Hammond Park: Graceful Sun Moth Survey & Site Based (*Lomandra*) Habitat Assessment. Report prepared for WorldStyle Furniture Wholesaler, Perth.

- Bamford Consulting Ecologists (2011). Threatened Fauna Assessment: Lots 42-44 Frankland Road, Hammond Park. Report prepared for Bayley Environmental Services.

- Bamford Consulting Ecologists (2012). Lot 123 Wattleup Road, Hammond Park. Significant Fauna Assessment. Report prepared for Bayley Environmental Services.

- Ecoscape (2009). Fauna Survey for Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park. Unpublished report for Gold Estates and the Department of Housing.

- Emerge Associates (Emerge) (2011). Level 1 Fauna Survey and Habitat Assessment - Various Allotments, Mandogalup. Unpublished report prepared for Qube Mandogalup Land Development Company.

- ENV (2009). Jandakot Airport Fauna Survey. Unpublished report for Jandakot Airport Holdings Pty Ltd.

- GHD (2012). Report for Hammond Park Primary School. Flora and Fauna Assessment. Unpublished report for the Department of Education.

- GHD (2015). North Lake Road Extension Ecological Assessment. Unpublished report for the City of Cockburn.

- Harewood, G. (2005). Fauna Assessment, Mandogalup. Unpublished report for Cardno BSD.

- Harewood, G. (2006). Fauna Assessment, Lot 121 Wattleup Road, Wattleup. Unpublished report for Cardno BSD.

- Harewood, G. (2009). Fauna Survey (Level 2) East Rockingham WWTP Site & Pipeline Corridors. Unpublished report for ERM.

- Harewood, G. (2011a). Fauna Assessment Lot 9001 and Lot 35 Barfield Road, Hammond Park. Unpublished report for Mainlake Holdings Pty Ltd.

- Harewood, G. (2011b). Fauna Underpass Monitoring Spring 2010 – Perth Mandurah Rail Line. Unpublished report for the Public Transport Authority of Western Australia.

- Harewood, G. (2014a). Fauna Assessment of Lot 33 Barfield Road, Hammond Park. Unpublished report for West Coast Plan (on behalf of the Passione Family).

- Harewood, G. (2014b). Fauna Assessment of Lots 109 and 110 Wattleup Road, Hammond Park. Unpublished report for Emerge Associates.

- Harewood, G. (2014c). Fauna Assessment of Lots 1, 111 & 810 Wattleup Road, Hammond Park. Unpublished report for Emerge Associates.

- Phoenix Environmental Sciences (2011). Vertebrate Fauna Survey for the Roe Highway Extension Project. Unpublished report for South Metro Connect.

- Strategen (2013). Mandogalup Black Cockatoo Habitat Survey. Unpublished Report for Satterley Property Group.

- Terrestrial Ecosystems (2012). Level 1 Fauna Assessment for Hammond Park Primary School. Unpublished report for Taylor Robinson.

As with the databases searches some reports refer to species that would not occur in the study area due to a lack of suitable habitat (extent and/or quality) and this fact was taken into consideration when compiling the potential fauna species list for the study area. It should also be noted that the NatureMap database is likely to include some records from previous fauna surveys in the area including some of those listed above.

4.1.3 Existing Publications

The following represent the main publications used to identify and refine the potential fauna species list for the study area:

- Anstis, M. (2013). Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.

- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Victoria.

- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). Reptiles and Frogs in the Bush: Southwestern Australia. UWA Press, Nedlands.

- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2010). Field Guide to Reptiles and Frogs of the Perth Region. UWA Press, Nedlands.

- Churchill, S. (2008). Australian Bats. Second Edition, Allen & Unwin.

- Cogger, H.G. (2014). Reptiles and Amphibians of Australia. 7th Edition. CSIRO Publishing.
- Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth Western Australia.
- Johnstone, R.E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.
- Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.
- Morgan, D.L., Beatty, S.J., Klunzinger, M.W, Allen, M.G. and Burnham, Q.E (2011). Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South Western Australia. Published by SERCUL.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1983). Lizards of Western Australia II: Dragons and Monitors. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1990). Lizards of Western Australia III: Geckos and Pygopods. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1999). Lizards of Western Australia I: Skinks. Revised Edition, WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (2002). Snakes of Western Australia. Revised Edition, WA Museum, Perth.
- Tyler M.J. & Doughty P. (2009). Field Guide to Frogs of Western Australia, Fourth Edition, WA Museum, Perth.
- Van Dyck, S., Gynther, I. & Baker, A. Eds (2013). Field Companion to The Mammals of Australia. Queensland Museum.
- Wilson, S. and Swan, G. (2013). A Complete Guide to Reptiles of Australia. Reed, New Holland, Sydney.

4.1.4 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). Administered by the Australian Government DotEE;

- *Wildlife Conservation Act 1950 (WC Act).* Administered by the Western Australian DPaW (Govt. of WA 2015);

- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and the

- DPaW Priority Fauna list. A non-legislative list maintained by the DPaW for management purposes (DPaW 2015).

The *EPBC Act* also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);

- China Australia Migratory Bird Agreement 1998 (CAMBA);

- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and

- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note - Species listed under JAMBA are also protected under Schedule 5 of the *WC Act*.)

All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance (NES) under the *EPBC Act*.

The conservation status of all vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the study area has been assessed using the most recent lists published in accordance with the above-mentioned instruments and is indicated as such in the fauna listings of this report. A full listing of conservation codes are provided in Appendix A.

A number of other species not listed in official lists can also be considered of local or regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range.

While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000). The bird species are often referred to as Bush Forever Decreaser Species. The three categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh)
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp)
- Extinct in the Perth region (code Be)

The presence of Bush Forever species should be taken into some consideration when determining the fauna values of an area. Bush Forever decreaser species are indicated as such within the species list held in Appendix B.

4.1.5 Likelihood of Occurrence – Vertebrate Fauna of Conservation Significance

Fauna of conservation significance identified during the literature review as previously being recorded in the general area were assessed and ranked for their likelihood of occurrence within the study area itself. The rankings and criteria used were:

- Would Not Occur: There is no suitable habitat for the species in the study area and/or there is no documented record of the species in the general area since records have been kept and/or the species is generally accepted as being locally/regionally extinct (supported by a lack of recent records).
    - Locally Extinct: Populations no longer occur within a small part of the species natural range, in this case within 10 or 20km of the study area. Populations do however persist outside of this area.
    - Regionally Extinct: Populations no longer occur in a large part of the species natural range, in this case within the southern forest regions. Populations do however persist outside of this area.
- Unlikely to Occur: The study area is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment. Individuals of some species may occur occasionally as vagrants/transients especially if suitable habitat is located nearby but the subject site itself would not support a population or part population of the species.
- Possibly Occurs: The study area is within the known distribution of the species in question and habitat of at least marginal quality was identified as being present during the field assessment, supported in some cases by recent records being documented in literature from within or near the subject site. In some cases, while a species may be classified as possibly being present at times, habitat may be marginal (e.g. poor quality, fragmented,

limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

- Known to Occur: The species in question was positively identified as being present (for sedentary species) or as using the study area as habitat for some other purpose (for non-sedentary/mobile species) during the field survey. This information may have been obtained by direct observation of individuals or by way of secondary evidence (e.g. foraging debris, tracks and scats). In some cases, while a species may be classified as known to occur, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

4.1.6 Taxonomy and Nomenclature

Taxonomy and nomenclature for vertebrate fauna species used in this report is generally taken from the DPaW's WA Fauna Census Database which is assumed to follow Aplin and Smith (2001) for amphibians and reptiles and Johnstone (2001) for birds. Jackson and Groves (2015) has been used for mammals.

Common names are taken from the Western Australia Museum (WAM) recognised primary common name listings when specified, though where common names are not provided they have been acquired from other publications. Sources include Cogger (2014), Wilson and Swan (2013), Van Dyck & Strahan (2013), Christidis and Boles (2008), Bush *et al.* (2010), Bush *et al.* (2007), Tyler & Doughty (2009), and Glauret (1961). Not all common names are generally accepted.

4.1.7 Invertebrates of Conservation Significance

For this project, the assessment for conservation significant invertebrates has been limited to those listed by the DPaW and *EPBC Act* database searches (which rely on distribution records and known habitat preferences).

No assessment of the potential for SREs to be present has been made as it can be difficult to identify significant invertebrate species due to uncertainties in determining the range-restrictions of many species due to lack of surveys, lack of taxonomic resolutions within target taxa and problems in identifying certain life stages.

Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002).

4.2 SITE SURVEYS

The daytime reconnaissance survey of the site was carried out on the 27 September, 2016 by Greg Harewood (Zoologist).

4.2.1 Fauna Habitat Assessment

The vegetation communities identified during the botanical survey of the site carried out by Focused Vision Consulting (2016) have been used as the basis for a classification of broad fauna habitats types. This information has been supplemented with observations made during the fauna assessment.

The main aim of the habitat assessment was to determine if it was likely that any species of conservation significance would be utilising the areas that maybe impacted on as a consequence of development at the site. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

As part of the desktop literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the field survey the habitats within the study area were assessed and specific elements identified, if present, to determine the likelihood of listed threatened species utilising the area and its significance to them.

4.2.2 Opportunistic Fauna Observations

Opportunistic observations of fauna species were made during all field survey work which involved a series of close spaced transects across the site during the day while searching microhabitats such as logs, rocks, leaf litter and observations of bird species with binoculars. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard.

4.2.3 Black Cockatoo Habitat Assessment

The following methods were employed to comply with the defined scope of works and are based on guidelines published by the federal DotEE (SEWPaC 2012) which states that surveys for Carnaby's, Baudin's and forest red-tailed black cockatoo habitat should:

- be done by a suitably qualified person with experience in vegetation or cockatoo surveys, depending on the type of survey being undertaken;
- maximise the chance of detecting the species' habitat and/or signs of use;
- determine the context of the site within the broader landscape—for example, the amount and quality of habitat nearby and in the local region (for example, within 10 km);
- account for uncertainty and error (false presence and absences); and
- include collation of existing data on known locations of breeding and feeding birds and night roost locations.

Habitat used by black cockatoos have been placed into three categories by the DotEE (SEWPaC 2012) these being:

- Breeding Habitat;
- Foraging Habitat; and
- Night Roosting Habitat.

To comply with the requested scope of works and in line with the published guidelines the following was carried out.

4.2.3.1 Black Cockatoo Breeding Habitat

The black cockatoo breeding habitat assessment involved the identification of all suitable breeding trees species (native, endemic species only) within the subject site that had a DBH of equal to or over 50cm. The DBH of each tree was estimated using a pre-made 50 cm "caliper".

Target tree species included marri and jarrah or any other *Corymbia/Eucalyptus* species of a suitable size that may have been present. Peppermints, *banksia*, sheoak and *melaleuca* tree species (for example) were not assessed as they typically do not develop hollows that are used by black cockatoos.

The location of each tree identified as being over the threshold DBH was recorded with a GPS and details on tree species, number and size of hollows (if any) noted. Trees observed to contain hollows (of any size/type) were marked with "H" using spray paint for easy future reference.

Based on this assessment trees present within the subject site have been place into one of four categories:

- Tree < 50cm DBH or an unsuitable species (not recorded);
- Tree ≥50cm DBH, no hollows seen;
- Tree ≥50cm DBH, one or more hollows seen, none of which were considered suitable for black cockatoos to use for nesting; or
- Tree ≥50cm DBH, one or more hollows seen, with at least one considered suitable for black cockatoos to use for nesting.

For the purposes of this assessment a tree containing a potential cockatoo nest hollow was defined as:

Generally, any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by a black cockatoo

for the purpose of nesting/breeding. Hollows that had an entrance greater than about 10cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk were recorded as a "potential black cockatoo nest hollow".

Identified hollows were examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Trees with possible nest hollows were also scratched and raked with a large stick/pole in attempt to flush any sitting birds from hollows and calls of chicks were also listened for. It should be noted that the survey may have been conducted outside of the main breeding season of one or more of the three species of black cockatoo.

4.2.3.2 Black Cockatoo Foraging Habitat

The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the reconnaissance survey was recorded. The nature and extent of potential foraging habitat present was also documented irrespective of the presence of any actual foraging evidence.

4.2.3.3 Black Cockatoo Roosting Habitat

Direct and indirect evidence of black cockatoos roosting within trees was with the subject site was noted if observed (e.g. branch clippings, droppings or moulted feathers).

5. SURVEY CONSTRAINTS

No seasonal sampling has been carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. It should also be recognised that site conditions can change with time.

Some fauna species are reported as potentially occurring within the study area based on there being suitable habitat (quality and extent) within the study area or immediately adjacent. With respect to opportunistic observations, the possibility exists that certain species may not have been detected during field investigations due to:

- seasonal inactivity during the field survey;
- species present within micro habitats not surveyed;

- cryptic species able to avoid detection; and
- transient wide-ranging species not present during the survey period.

Lack of observational data on some species should therefore not necessarily be taken as an indication that a species is absent from the site.

The habitat requirements and ecology of many of the species known to occur in the wider area are often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitat or microhabitat within the study area. As a consequence of this limitation the potential fauna list produced is most likely an overestimation of those species that actually utilise the study area for some purpose. Some species may be present in the general area but may only use the study area itself on rare occasions or as vagrants/transients.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any fauna species that would possibly occur within the study area (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the Author, has been listed as a potential species.

During the black cockatoo habitat survey trees with hollows were searched for. It should be noted that identifying hollows suitable for fauna species from ground level has limitations. Generally the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of observations was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can increase or decrease beyond this range.

6. RESULTS

6.1 POTENTIAL FAUNA INVENTORY - LITERATURE REVIEW

A list of fauna species considered most likely to occur in the study area has been compiled from information obtained during the desktop study and is presented in Appendix B. This listing was refined after information gathered during the site reconnaissance survey was assessed.

The results of some previous fauna surveys carried out in the general area are summarised in this species listing as are the DPaW NatureMap database search

results. The raw database search results from NatureMap (DPaW 2016) and the Protected Matters Search Tool (DotEE 2016) are contained within Appendix C.

The list of potential fauna takes into consideration that firstly the species in question is not known to be locally extinct and secondly that suitable habitat for each species, as identified during the habitat assessment, is present within the study area, though compiling an accurate list has limitations (see Section 5 above) and therefore as discussed the listing is likely to be an overestimation of the fauna species that actually use the site for some purpose.

With respect to native vertebrate fauna, 11 mammals (includes eight bat species), 97 bird, 26 reptile and 10 frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times. Twelve species of introduced animals could also frequent the area.

Of the 143 native animals that are listed as potentially occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law. In addition, two migratory and two DPaW priority species are also listed as potentially present (some likely only on a seasonal basis).

6.2 SITE SURVEYS

6.2.1 Fauna Habitat Assessment

Descriptions, approximate areas and examples images of the main fauna habitats (based on plant communities mapped by Focused Vision Consulting 2016) present within the study area are provided in Table 1.

Table 1: Main Fauna Habitats within the Study Area

Unit Code	Fauna Habitat Description	Example Image
BaEt	Low Woodland A of *Banksia attenuata* and *Eucalyptus todtiana* over *Xanthorrhoea preissii* over *Dasypogon bromeliifolius* and *Phlebocarya ciliata* in pale grey sands. 9.1 ha (~31.0 % of total area).	

Unit Code	Fauna Habitat Description	Example Image
BaXp	Low Woodland A of *Banksia attenuata* and *Banksia ilicifolia* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longiflora*, over mostly weeds, dominated by **Ehrharta calycina* and **Actotheca calendula*, in grey sands. 0.4 ha (~1.4 % of total area).	
Xp	Low Scrub A of *Xanthorrhoea preissii* over *Dasypogon bromeliifolius, Phlebocarya ciliata* and **Ehrharta calycina*, in grey sands. 1.2 ha (~4.1 % of total area).	
Mp	Low Woodland A of occasional *Eucalyptus rudis* over *Melaleuca preissiana* over occasionally dominant patches of *Kunzea glabrescens*, with *Xanthorrhoea preissii* and **Acacia longiflora*, over mostly weeds, dominated by **Ehrharta calycina*, in brown loamy sands. 8.3 ha (~28.2 % of total area).	
MpAl	Low Woodland A of *Melaleuca preissiana* over **Acacia longiflora*, over mostly weeds, dominated by **Ehrharta calycina* and **Ehrharta longiflora* in brown loamy sands. 1.0 ha (~4.1 % of total area).	

Unit Code	Fauna Habitat Description	Example Image
ErAl (d)	Degraded areas of *Eucaluptus rudis* over **Acacia longiflora* over weeds, dominated by **Ehrharta calycina* and **Ehrharta longiflora* in brown loamy sands. 0.1 ha (~0.4 % of total area).	
Eg (d)	Degraded areas of *Eucaluptus gomphocephala* over weeds, dominated by **Ehrharta calycina* and **Ehrharta longiflora* in brown loamy sands. 0.2 ha (~0.8 % of total area).	
Mp d & i	Completely degraded areas of planted trees and shrubs and weeds, or weeds only, with occasional *Melaleuca preissiana*, *Adenanthos cygnorum* subsp. *cygnorum* and *Xanthorrhoea preissii,* in grey or brown sands. 4.7 ha (~16.1 % of total area).	

Fauna habitat values of the remaining native vegetation would appear to be relatively good despite some disturbance in the form of tree deaths (presumably from dieback/fires), felling of live and dead trees for firewood collection and common invasive weeds. Biodiversity values would have however been reduced a certain degree from original pre-disturbance levels due to the overall fragmentation of vegetation in the wider area primarily for market gardens, residential developments, road construction, along with the likelihood of more frequent fires and the likely presence of feral predators such as cats and foxes. Very few trees containing hollows of any size were recorded (see Section 6.2.3.1).

Figure 5 - Fauna Habitats

6.2.2 Opportunistic Fauna Observations

Opportunistic fauna observations made during the September 2016 survey are listed in Appendix B. A total of 25 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the one day survey period. The use of the study area by five introduced species was also confirmed.

Evidence of two listed threatened species was observed (Carnaby's black-cockatoo - chewed *banksia* cones, forest red-tailed black cockatoo – chewed blackbutt fruits). Diggings attributed to the southern brown bandicoot, a DPaW Priority 4 species, were also found at several locations.

A fauna assessment of some areas of the currently defined study area was carried out by GHD in October 2015. During this assessment, which included a single day survey buy a zoologist in addition to several days by ornithologists from Birdlife Australia, 34 native fauna species were recorded. Eight introduced species were also observed.

GHD reported both Carnaby's and forest red-tailed black cockatoos as flying over the area, and the rainbow bee-eater (listed migratory species) was observed nesting in a sand embankment along North Lake Road. Evidence of the southern brown bandicoot (DPaW Priority 4 species) was observed and the Perth lined skink (DPaW Priority 3 species) was also recorded.

During the course of these two assessments a total of 47 fauna species have was recorded within the study area, these being comprised of:

- 34 birds (includes 4 introduced species);
- 5 reptiles;
- 6 mammals (includes 4 introduced species); and
- 2 frogs.

6.2.3 Black Cockatoo Habitat Assessment

6.2.3.1 Black Cockatoo Breeding Habitat Assessment

Trees considered potentially suitable for black cockatoos to use as nesting habitat (using DotEE criteria - SEWPaC 2012, but ultimately subject to a suitable hollow being present or developing and a range of other factors) which were found within the study area was limited to one specimen of one species this being:

- Tuart - *Eucalyptus gomphocephala;*
- Jarrah – *Eucalyptus marginata*;
- Flooded Gum – *Eucalyptus rudis*; and
- Planted Non-Endemic *Eucalyptus sp.*

It should be noted that the propensity to develop hollows suitable for black cockatoo varies greatly between tree species. For example, relative to tuart, jarrah and flooded gum trees rarely develop hollows that are then used by black cockatoos for breeding.

A summary of the potential black cockatoo habitat trees observed within the survey area is provided in Table 2 below.

Table 2: Summary of Potential Black Cockatoo Habitat Trees (DBH ≥50cm) within the Study Area

Lot Number	Total Number of Habitat Trees	Number of Trees with No Hollows Observed	Number of Trees with Hollows Considered Unsuitable for Nesting Black Cockatoos	Number of Trees with Hollows Considered Possibly Suitable for Nesting Black Cockatoos	Tree Species			
					Tuart	Jarrah	Flooded Gum	Non-endemic
33	8	6	2	0	8	0	0	0
36	4	4	0	0	4	0	0	0
801	1	0	1	0	0	0	1	0
802	1	0	0	1	0	0	1	0
9500	4	2	2	0	0	2	0	2
Total	**18**	**12**	**5**	**1**	**12**	**2**	**2**	**2**

The assessment identified 18 trees with a DBH of >50cm. Most trees (12) appeared not to contain hollows of any size. Five trees appeared to contained small hollows or possible small hollows, considered by the Author as unlikely to be suitable for black cockatoos to use for nesting purposes. One of these hollows appeared to be in use by galahs.

One tree was identified as containing a hollow that appeared possibly big enough to allow the entry of a black cockatoo into a suitably sized and orientated trunk but no

evidence of actual use was observed. The probability of this actually representing a hollow that would be used by black cockatoos can be regarded as being very low.

Additional details on each habitat tree observed can be found in Appendix D.

6.2.3.2 Black Cockatoo Foraging Habitat

Following is a list of the main flora species recorded within the study area during the fauna assessment that are known to be used as a direct food source (i.e. fruits or flowers) by one or more species of black cockatoo:

- Jarrah - *Eucalyptus marginata;*
- Coastal Blackbutt - *Eucalyptus todtiana;*
- Sheoak - *Allocasuarina fraseriana;*
- Candelstick Banksia - *Banksia attenuata;*
- Firewood Banksia - *Banksia menziesii;*
- Holly-leaved Banksia - *Banksia ilicifolia;* and
- Grass Tree - *Xanthorrhoea preissii.*

A number of other tree/shrub species present (e.g. tuart, flooded gum and *acacia* sp.) are also utilised as a food source but to a much smaller degree than those listed.

A small amount of evidence of black cockatoos foraging onsite was observed during the field assessment in the form of chewed *banksia* cones (*B. attenuata & B. menziesii*) and coastal blackbutt fruits. This evidence was attributed to Carnaby's black-cockatoo and the forest red-tailed black cockatoo respectively.

Foraging habitat within the subject site is mainly comprised of areas of vegetation mapped as containing *banksia*, coastal blackbutt and jarrah (unit codes BaEt and BaXp). These two units occupy about 9.5 ha (~32.4%) of the study area.

6.2.3.3 Black Cockatoo Roosting Habitat

No existing roosting trees (trees used at night by black cockatoos to rest) were positively identified during the survey and given the limited number of larger trees present black cockatoos are considered very unlikely to use the study area for this purpose.

Figure 6 - Habitat Trees

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6.3 FAUNA INVENTORY – SUMMARY

6.3.1 Vertebrate Fauna

Table 3 summarises the number of vertebrate fauna species potentially occurring within or utilising at times the study area, based on results from the literature review and observations made during the field assessment carried out in September 2016 combined with those of GHD from October 2015 (GHD 2015). A complete list of vertebrate fauna possibly inhabiting or frequenting the study area is located in Appendix B.

Not all species listed as potentially occurring within the study area in existing databases and publications (i.e. *EPBC Act* Threatened Fauna and Migratory species lists, DPaW's NatureMap database, various reports and publications) are shown in the expected listing in Appendix B. Some species have been excluded from this list based largely on the lack of suitable habitat at the study site and in the general area or known local extinction even if suitable habitat is present.

Table 3: Summary of Potential Vertebrate Fauna Species (as listed in Appendix B)

Group	Total number of potential species	Potential number of specially protected species	Potential number of migratory species	Potential number of priority species	Number of species recorded in the area during field surveys
Amphibians	10	0	0	0	2
Reptiles	26	0	0	1	5
Birds	103[6]	3	2	0	34[4]
Non-Volant Mammals	9[6]	0	0	1	6[4]
Volant Mammals (Bats)	8	0	0	0	0
Total	**155[12]**	**3**	**2**	**2**	**47[8]**

Superscript = number of introduced species included in total.

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the site (either on a regular or infrequent basis) because of the precautionary approach adopted for the assessment. At any one time, only a small proportion of the listed potential species are likely to be present.

6.3.2 Vertebrate Fauna of Conservation Significance

A review of the *EPBC Act* threatened fauna list, DPaW's Threatened Fauna Database and Priority List, unpublished reports and scientific publications identified over 27 specially protected, priority or migratory vertebrate fauna species as potentially occurring in the general vicinity of the study area. Of these species, most that have no potential whatsoever to utilise the study area for any purpose have been omitted from the potential list for the site (Appendix B), principally due to lack of suitable habitat on-site (including extent and/or quality) or known local extinction.

In summary, five vertebrate fauna species of conservation significance have been positively identified as utilising the study area for some purpose during the survey reported on here and/or during GHD's survey in 2015 (GHD 2015), these species being:

- *Lerista lineata* Perth Lined Lerista – P3 (DPaW Priority Species)
  Recorded within the study area by GHD (2015) and in other nearby bush remnants (ENV 2009, Phoenix 2010). Most of the banksia dominated habitat appears to be suitable for this species to persist. This species is known to inhabit gardens (Nevill 2005, Bush et al. 2010) so may persist in degraded areas and subsequent to development.

- *Calyptorhynchus latirostris* Carnaby`s Black-Cockatoo – S2 (*WC Act*), Endangered (*EPBC Act*)
  Individuals of this species were observed flying overhead during the field survey. GHD also recorded this species flying over the area in 2015 (GHD 2015). Some foraging evidence (chewed coastal blackbutt fruits) was also attributed to this species though Carnaby's black cockatoos also utilise this resource. All areas of remnant vegetation containing jarrah, coastal blackbutt and sheoak within the site represents potential foraging habitat.

  All of the 18 large trees (>50cm DBH) recorded during the field survey would be considered by the DotEE as potential black cockatoo breeding habitat though only one appears to possibly contain a hollow of a size potentially suitable for this purpose. The possibility of this tree or any others being used for breeding proposes now or in the future can be considered to be extremely low. No evidence of overnight roosting on site was observed.

- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – S3 (*WC Act*), Vulnerable (*EPBC Act*)
  Foraging evidence attributed to this species was observed during the site survey (chewed banksia cones) and most of the remnant vegetation containing banksia and jarrah within the site represents potential foraging habitat. Recorded flying over the area by GHD in 2015 (GHD 2015).

  All of the 18 large trees (>50cm DBH) recorded during the field survey would be considered by the DotEE as potential black cockatoo breeding habitat

though only one appears to possibly contain a hollow of a size potentially suitable for this purpose. The possibility of this tree or any others being used for breeding proposes now or in the future can be considered to be extremely low. No evidence of overnight roosting on site was observed.

- *Merops ornatus* Rainbow Bee-eater – S5 (*WC Act*), Migratory (*EPBC Act*)
  Recorded by GHD (2015) breeding in a sand embankment along North Lake Road in 2015 and it is likely to utilise the study area in small numbers during the summer migratory period. This species is a common seasonal visitor to south west. Population numbers at any one location would however never be significant as the species usually breeds in pairs and only rarely in small colonies (Johnstone and Storr 1998).

- *Isoodon obesulus fusciventer* Southern Brown Bandicoot – P4 (DPaW Priority Species)
  Evidence of this species foraging (i.e. diggings) in some sections of the study area was observed during site survey. Also recorded by GHD in 2015 (GHD 2015). Potentially present within the study area wherever dense shrubby groundcover occurs.

Based on the habitats present and current documented distributions it is considered possible that two additional species may use the study area for some purpose at times. As no evidence of any was found their status within the study area remains uncertain.

These species are:

- *Ardea alba* Eastern Great Egret – S5 (*WC Act*), Migratory (*EPBC Act*)
  This species may occasionally utilise seasonally flooded wetland areas (dry during the survey period) for foraging and possibly roosting but these appear to represent marginal habitat at best. Unlikely to breed onsite.

- *Falco peregrinus* Peregrine Falcon – S7 (*WC Act*),
  Individuals of this species potentially utilise some sections of the study area as part of a much larger home range but would only occur rarely and is unlikely to breed onsite.

Note: Habitat for some of these species on-site, while considered possibly suitable, may be marginal in extent/quality and species listed may only visit the area for short periods, or as rare/uncommon vagrants/transients.

A number of other species of conservation significance, while possibly present in the wider area (e.g. Harry Waring Marsupial Reserve, Thomson Lake Nature Reserve, Bibra Lake/Jandakot Airport bushland), are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat and/or the presence of feral predators. Details on

conservation significant species and reasons for the omission of some from the potential listing are provided in Appendix E and Table 4.

Thirty bird species that potentially frequent or occur in the study area are noted as Bush Forever Decreaser Species in the Perth Metropolitan Region (three species was recorded during the field survey). Decreaser species are a significant issue in biodiversity conservation in the Perth section of the coastal plain as there have been marked reductions in range and population levels of many sedentary bird species as a consequence of disturbance and land clearing (Dell & Hyder-Griffiths *2002).*

6.3.3 Invertebrate Fauna of Conservation Significance

Three invertebrate species of conservation significance appeared in the DPaW database search (DPaW 2016), this being the graceful sun moth (*Synemon gratiosa* – Priority 4), and unnamed bee (*Leioproctus contrarius* – Priority 3) and an unnamed cricket (*Throscodectes xiphos* – Priority 1).

The flora survey (Focused Vision Consulting 2016) within the study area did not identify any specimens of the plant species normally associated with the presence of the graceful sun moth (i.e. *Lomandra hermaphrodita* and *L. maritima*). It is therefore considered very unlikely that GSM would persist onsite. Previous surveys in nearby areas have found no evidence of the GSM and its absence was also attributed to the lack of favourable habitat (i.e. *Lomandra hermaphrodita and L. maritima)* (Bamford 2011, 2012 and 360 Environmental 2012)).

The unnamed bee (*Leioproctus contrarius*) has never been recorded in this specific area and its status onsite is uncertain, however, given that much of the site is degraded and the necessary plant species for a population of this species to persist appear to be absent it is not regarded as a potential species.

Based on NatureMap records it appears that the unnamed cricket (*Throscodectes xiphos*) is known only from bushland within or near the study area. The current status on site is however uncertain with the most recent DPaW record for area being from 1999 (DPaW 2016). The life history and habitat preferences of this species do not appear to be documented.

Additional information on this species can be found in Appendix E.

7. FAUNA VALUES

7.1 LOCAL CONSERVATION SIGNIFICANCE OF THE STUDY AREA

The local (sub-regional) conservation significance of the study area has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present that is poorly represented in the general vicinity;
- Fauna habitat present that is in better condition than other similar locations in the general vicinity.
- Fauna habitat within the study area supporting species of conservation or other significance; and

Several nature reserves, forming parts of the Beeliar Regional Park, are present in relatively close proximity to the study area (e.g. Frankland Park, Harry Waring Marsupial Reserve and Thompson's Lake Nature Reserve) and it can be expected that the fauna species/habitats present within the study area would be well represented in these areas. It is also likely that the fauna species of conservation significance identified as present and/or likely to use the study area as habitat would also utilise these larger reserves or have populations present within them. No evidence was gathered that would suggest the habitats present within the study area are of a better quality than found in these nearby conservation reserves.

Even though the site has some value as fauna habitat, if considered in isolation, it is too small (< 20ha) to be considered of local conservation significance or for long term retention for conservation purposes. The primary issue being that small areas of bushland are subject to significant edge affects which degrade their habitat quality over time, further reducing their already limited capacity to harbour populations of most fauna species.

Despite this the study area appear to have some value as black cockatoo foraging habitat which is primarily represented by a *banksia* dominated woodland (some of which have also recently been listed as a TEC (threatened ecological community)).

The site may also be harbouring the only known population of the DPaW listed Priority 1 cricket (*Throscodectes xiphos*), though its current distribution and status onsite is either unknown or not documented.

7.2 VALUE OF THE STUDY AREA AS AN ECOLOGICAL LINKAGE

Corridors of native vegetation can be very important for the dispersal of species in otherwise cleared landscapes. Any areas of remnant vegetation making up part of a linkage is therefore of great value by facilitating the movement of species that cannot fly great distances or utilise cleared/developed land. Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of an areas regional significance.

Within the Beeliar Regional Park Management Plan (CALM 2006) and Bush Forever Volume 1 document (Figure 6 - Government of Western Australia 2000a) greenway corridors throughout the metropolitan area were identified.

The study area itself was not identified as part of any Greenway corridor within these documents but lies to the east of a main north-south linkage which runs along Kwinana Freeway. This corridor does not provide a link to any major remnant bushland areas and is probably only of limited value to a small number of fauna species.

8. POTENTIAL IMPACTS

In general the most significant potential impacts to fauna of any development include:

- Loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees);
- Fragmentation of vegetation/fauna habitat which may restrict the movement of some fauna species;
- Modifications to surface hydrology, siltation of creek lines;
- Changes to fire regimes;
- Pollution (e.g. oil spills);
- Noise/Light/Dust;
- Spread of plant pathogens (e.g. dieback) and weeds;
- Potential increase in the number of predatory introduced species (e.g. cats);
- Death or injury of fauna during clearing and construction; and
- An increase in fauna road kills subsequent to development.

The exact location and the total extent of clearing that may take place has yet to be decided, however based on the habitats present and the maximum extent of clearing that could take place (i.e. the entire site) the possible impacts on species of conservation significance previously recorded in the general area has been assessed, a summary of which is provided in Table 4 below. Additional information on specific fauna species is provided in Appendix E.

Table 4: Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance (continues on following pages).

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Graceful Sun Moth	*Synemon gratiosa*	P4	No	Would Not Occur	None
Unnamed Bee	*Leioproctus contrarius*	P3	No	Would Not Occur	None
Unnamed Cricket	*Throscodectes xiphos*	P1	Yes	Possible	Loss/modification of areas of habitat
Perth Lined Lerista	*Lerisita lineata*	P3	Yes	Known to Occur	Loss/modification of areas of habitat
Black-striped Snake	*Neelaps calonotos*	P3	Yes/Marginal	Unlikely-Appears to be locally extinct	None
Malleefowl	*Leipoa ocellata*	S3, Mig	No	Would Not Occur – locally/regionally extinct	None
Hooded Plover	*Thinornis rubricollis tregellasi*	P4	No	Would Not Occur	None
Australasian Bittern	*Botaurus poiciloptilus*	S2, EN	No/Marginal	Unlikely	None
Eastern Great Egret	*Ardea alba*	S5, Mig	Yes/Marginal	Possible during seasonal inundation events only.	Loss/modification of areas of marginal habitat
Cattle Egret	*Ardea ibis*	S5, Mig	No/Marginal	Unlikely	None
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Mig	No	Would Not Occur	None
Osprey	*Pandion haliaetus*	S5, Mig	No	Would Not Occur	None
Peregrine Falcon	*Falco peregrinus*	S7	Yes	Possible	Loss/modification of areas of foraging habitat
Glossy Ibis	*Plegadis falcinellus*	S5, Mig	No/Marginal	Unlikely	None
Blue-billed Duck	*Oxyura australis*	P4	No	Would Not Occur	None
Australian Painted Snipe	*Rostratula australis/benghalensis*	S2, S5, Mig EN	No	Would Not Occur	None
Grey Wagtail	*Motacilla cinerea*	S5, Mig	No	Would Not Occur	None
Other Migratory shorebirds/wetland species	Various	S5, Mig	No	Would Not Occur	None
Carnaby`s Black Cockatoo	*Calyptorhynchus latirostris*	S2, EN	Yes	Known to occur	Loss/modification of areas of habitat
Baudin`s Black Cockatoo	*Calyptorhynchus baudinii*	S2, VU	No/Marginal	Unlikely – outside of normal range	None

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	S3, VU	Yes	Known to occur	Loss/modification of areas of habitat
Masked Owl	*Tyto novaehollandae novaehollandae*	P3	No/Marginal	Unlikely	None
Fork-tailed Swift	*Apus pacificus*	S5, Mig	Yes	Unlikely	None
Rainbow Bee-eater	*Merops ornatus*	S5, Mig	Yes	Known to Occur (seasonal only)	Loss/modification of areas of habitat
Numbat	*Myrmecobius fasciatus*	S3, VU	No	Would Not Occur – locally extinct	None
Southern Brown Bandicoot	*Isoodon obesulus fusciventer*	P4	Yes	Known to occur	Loss/modification of a small area of habitat
Western Ringtail Possum	*Pseudocheirus occidentalis*	S2, VU	No	Would Not Occur – locally extinct	None
Western Brush Wallaby	*Macropus irma*	P4	No	Would Not Occur	None
Tammar	*Macropus eugenii derbianus*	P4	No	Would Not Occur – locally extinct	None
Quokka	*Setonix brachyurus*	S3, VU	No	Would Not Occur – locally extinct	None
Western False Pipistrelle	*Falsistrellus mackenziei*	P4	No/Marginal	Unlikely – locally extinct	None
Water Rat	*Hydromys chrysogaster*	P4	No	Would Not Occur	None

9. CONSIDERATIONS FOR PLANNING AND DEVELOPMENT

With respect to vertebrate fauna in general, no substantial impacts are anticipated as a consequence of development at the site. In cases where some impact is anticipated, the degree of the impact is only expected to be low and relates to the loss of small areas of habitat, but as most species are common and widespread with most if not all likely to persist in nearby reserves, no overall change in their conservation status is anticipated, despite a possible localised reduction in habitat extent. There are substantial areas of similar habitat in nearby areas and most if, not all species likely to utilise the study area will persist in these locations despite development of the site.

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The fauna assessment results do however indicate that the primary considerations required during ongoing development planning should be focussed on the identified presence of habitat used or potentially used by some threatened fauna species in particular those listed under the *EPBC Act*, namely the two species of black cockatoo.

The assessment identified the presence of black cockatoo breeding, foraging and possible roosting habitat within the subject site. Commonwealth referral guidelines for black cockatoos, published by the DotEE (SEWPaC 2012), indicate that clearing of any actual or potential breeding habitat trees, over 1 ha of foraging habitat or any roost trees would be considered as having a high risk of "significant impact" on one or more of the black cockatoo species and therefore potentially in breach of the *EPBC Act*.

This fact will need to be taken into consideration during the course of ongoing planning and once progressed to a point where areas to be impacted on are defined, the actual need to refer the proposal to the DotE, can then be reviewed.

The site may also be harbouring the only known population of the DPaW listed Priority 1 cricket (*Throscodectes xiphos*), though its current distribution and status within the study area is either unknown or not documented. The potential presence of this species will also need to be taken into consideration during future development planning.

10. RECOMMENDATIONS

The following recommendations are provided for guidance during ongoing planning and during development when it proceeds. This listing is not exhaustive and management plans and possible offsets will need to be finalised after liaison with relevant regulatory authorities (e.g. DPaW and DotEE). It is recommended that:

- Dialogue with DotEE be commenced to determine if referral of the overall project is required to ensure compliance with the *EPBC Act* with respect to impacts on black cockatoo habitat and also the *banksia* woodland present onsite.

- DPaW or other relevant experts be contacted regarding the current status and distribution of the unnamed cricket (*Throscodectes xiphos*), which appears, based on available information, to be confined to remnant bushland in the Cockburn East area.

- Future planning for the overall development should aim to avoid the need to clear as much of the existing vegetation as possible. Reducing the area of vegetation requiring removal will minimise possible offset requirements that maybe set by DotEE, if the project requires referral.

- A fauna management plan should be formulated for implementation during all clearing operations carried out during site development. Components of the management plant should include (where considered relevant) but not be limited to:

- A pre-clearing fauna trapping and relocation programme with primary focus on southern brown bandicoots but also other terrestrial vertebrate species such as reptiles and frogs.

- During clearing operations a suitably experienced “fauna spotter” should be employed to inspect vegetation, logs, trees and hollows (where possible) before clearing with the aim of capture and relocating any fauna observed.

- Native fauna injured during clearing or normal site operations should be taken to a designated veterinary clinic or a DPaW nominated wildlife carer.

- During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained.

- Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas etc. so that:

    - previously disturbed areas are used where possible; and

    - areas of sensitive vegetation targeted for retention are avoided.

- Any fuel and chemical storage facilities should be located appropriate distance away from wetlands and be suitably bunded.

- No dead, standing or fallen timber should be removed unnecessarily. Logs (hollow or not) and other debris resulting from land clearing should be used to enhance fauna habitat in untouched and rehabilitated areas if possible.

- Rehabilitating and re-vegetating areas with local native plants used by threatened species in landscape packages. Wherever landscape planting is carried out it should include a high percentage of black cockatoo feed and habitat plants specifically *Eucalyptus, Corymbia, Banksia, Hakea*, and *Allocasuarina*. The final selection of suitable species should be carried out after liaison with appropriate experts or local land care groups to ascertain which species are most suitable for the area.

- All contractors/staff working on site should be made aware that native fauna is protected.

- Any holes, pits or trenches required for services should be kept open for only as long as necessary and suitable escape ramps (45° batter) and bridging

provided if the site is to be left unattended for extended periods. Significant sized holes, pits or trenches should be inspected for fauna immediately prior to filling.

11. CONCLUSION

The fauna assessment within the study area was undertaken for the purposes of categorising the fauna assemblages and identifying fauna habitats present. A targeted assessment of black cockatoo habitat within the area was also carried out.

With respect to native vertebrate fauna, 11 mammals (includes eight bat species), 96 bird, 26 reptile and 10 frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the study area at times.

Of the 143 native animals that are listed as potentially occurring in the area, three are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law, these being two species of black cockatoo (Carnaby's and the forest red-tailed black-cockatoo) and the peregrine falcon. In addition, two migratory species (the rainbow bee-eater and great egret) and two DPaW priority species (Perth lined lerista and the southern brown bandicoot) are known to or may utilise the area at times.

With respect to vertebrate fauna in general, no substantial impacts are anticipated as a consequence of development at the site. In cases where some impact is anticipated, the degree of the impact is only expected to be low and relates to the loss of areas of habitat, but as most species are common and widespread, with most if not all likely to have secure populations in nearby reserves, no overall change in their conservation status is anticipated, despite a possible localised reduction in habitat extent.

Constraints on development within the study area will largely be centred on the presence of habitat used or potentially used by threatened fauna species in particular those listed under the *EPBC Act*, namely black cockatoos. The potential impacts on these species and/or their habitat will need to be taken into consideration during the planning and construction phases of the project.

The full extent of clearing that may be required at the site is yet to be determined so impacts on *EPBC Act* threatened fauna species identified as utilising the site cannot be fully determined at this stage. It is however recommended that dialogue be commenced with the DotEE so that possible legislative requirements are fully understood.

It is also recommended that DPaW or other relevant experts be contacted regarding the current status and distribution of the unnamed cricket (*Throscodectes xiphos*) (Priority 1 DPaW species), which appears, based on available information, to be confined to remnant bushland in the Cockburn East area.

A series of other recommendations aimed at mitigating and minimising potential impacts on fauna and fauna habitat in general are also provided in Section 9. These should be taken into consideration during planning and development and implemented if considered reasonable and practicable.

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APPENDIX A

CONSERVATION CATEGORIES

***EPBC Act (1999)* Threatened Fauna Categories**

Threatened fauna may be listed under Section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) in any one of the following categories:

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) 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	A species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation Dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the *EPBC Act*

Note: Only species in those categories marked with an asterix are matters of national environmental significance (NES) under the *EPBC Act*.

Wildlife Conservation (Specially Protected Fauna) Notice 2015 Categories

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

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
Schedule 1 Critically Endangered species	CR	Threatened species considered to be facing an extremely high risk of extinction in the wild.
Schedule 2 Endangered species	EN	Threatened species considered to be facing a very high risk of extinction in the wild.
Schedule 3 Vulnerable species	VU	Threatened species considered to be facing a high risk of extinction in the wild.
Schedule 4 Presumed extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died.
Schedule 5 Migratory birds protected under an international agreement	IA	Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds.
Schedule 6 Fauna that is of special conservation need as 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.
Schedule 7 Other specially protected fauna.	OS	Fauna otherwise in need of special protection to ensure their conservation.

Western Australian DPaW Priority Fauna Categories

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

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

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

Category	Code	Description
Priority 1 Poorly Known Species.	P1	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 Poorly Known Species.	P2	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 Poorly Known Species.	P3	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 Rare, Near Threatened and other species in need of monitoring.	P4	(a) Rare: Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened: Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

***IUCN Red List* Threatened Species Categories**

The *IUCN Red List of Threatened Species*™ is a checklist of taxa that have undergone an extinction risk assessment using the *IUCN Red List Categories and Criteria*.

Categories are summarized below.

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.
Not Evaluated	NE	Taxa which has not been evaluated.

A full list of categories and their meanings are available at:

http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria

APPENDIX B

FAUNA OBSERVED OR POTENTIALLY IN STUDY AREA

Observed and Potential Vertebrate Fauna List

Cockburn Central East - Local Structure Plan Area

Compiled by Greg Harewood - November 2016

Approximate centroid = 32.21492°S and 115.85916°E

Recorded (Sighted/Heard/Signs/Captured) = X

A = Harewood, G. (2016). Fauna Assessment of Cockburn Central East - Local Structure Plan Area. Unpublished report for Focused Vison Consulting.

B = GHD (2015). North Lake Road Extension Ecological Assessment. Unpublished report for the City of Cockburn

C = ENV (2009). Jandakot Airport Fauna Survey. Unpublished report for Jandakot Airport Holdings Pty Ltd.

D = Phoenix Environmental Sciences (2011). Vertebrate Fauna Survey for the Roe Highway Extension Project. Unpublished report for South Metro Connect.

E = Harewood, G. (2009) Fauna Survey (Level 2) East Rockingham WWTP Site and Pipeline Corridors. Unpublished report for ERM.

F = DPaW (2016). NatureMap Database search. “By Circle” 115° 51' 36" E, 32° 07' 18" S – Study area (plus 8km buffer), 06/0102016.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Amphibia								
Myobatrachidae Ground or Burrowing Frogs								
Crinia georgiana	Quacking Frog	LC			X	X		X
Crinia glauerti	Clicking Frog	LC				X		X
Crinia insignifera	Squelching Froglet	LC				X		X
Geocrinia leai	Ticking Frog	LC						
Heleioporus eyrei	Moaning Frog	LC		X		X		X
Limnodynastes dorsalis	Western Banjo Frog	LC		X	X	X		X
Myobatrachus gouldii	Turtle Frog	LC				X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Pseudophryne guentheri	Crawling Toadlet	LC						X
Hylidae Tree or Water-Holding Frogs								
Litoria adelaidensis	Slender Tree Frog	LC			X	X		X
Litoria moorei	Motorbike Frog	LC				X		X
Reptilia								
Diplodactylidae Geckoes								
Strophurus spinigerus	Soft Spiny-tailed Gecko						X	X
Gekkonidae Geckoes								
Christinus marmoratus	Marbled Gecko					X	X	X
Pygopodidae Legless Lizards								
Aprasia repens	Sandplain Worm Lizard					X		X
Delma fraseri	Fraser's Legless Lizard				X		X	X
Lialis burtonis	Burton's Legless Lizard					X	X	X
Pygopus lepidopodus	Common Scaly Foot				X	X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Agamidae Dragon Lizards								
Ctenophorus adelaidensis	Southern Heath Dragon							X
Pogona minor	Western Bearded Dragon			X	X	X	X	X
Varanidae Monitor's or Goanna's								
Varanus gouldii	Gould's Sand Monitor			X				X
Varanus tristis	Racehorse Monitor						X	

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Scincidae Skinks								
Acritoscincus trilineatum	Southwestern Cool Skink				X	X		
Cryptoblepharus buchananii	Fence Skink				X	X	X	X
Ctenotus australis	Western Ctenotus					X	X	X
Ctenotus fallens	West Coast Ctenotus					X	X	X
Ctenotus impar	Odd-striped Ctenotus							X
Egernia napoleonis	Salmon-bellied Skink					X		X
Hemiergis quadrilineata	Two-toed Mulch Skink				X	X	X	X
Lerista elegans	West Coast Four-toed Lerista				X	X	X	X
Lerista lineata	Perth Lined Lerista	P3		X		X		X
Menetia greyii	Dwarf Skink				X	X	X	X
Morethia lineoocellata	West Coast Pale-flecked Morethia					X	X	X
Morethia obscura	Shrubland Pale-flecked Morethia					X	X	X
Tiliqua rugosa	Bobtail		X		X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Elapidae Elapid Snakes								
Notechis scutatus	Tiger Snake					X		X
Pseudonaja affinis	Dugite			X	X	X	X	X
Simoselaps bertholdi	Jan's Banded Snake							X
Aves								
Phasianidae Quails, Pheasants								
Coturnix pectoralis	Stubble Quail	LC						X
Coturnix ypsilophora	Brown Quail	LC			X			X
Anatidae Geese, Swans, Ducks								
Anas gracilis	Grey Teal	LC				X		X
Anas superciliosa	Pacific Black Duck	LC			X	X		X
Chenonetta jubata	Australian Wood Duck	LC						X
Tadorna tadornoides	Australian Shelduck	LC				X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Ardeidae Herons, Egrets, Bitterns								
Ardea alba	Great Egret	S5 Mig CA JA				X		X
Ardea novaehollandiae	White-faced Heron	LC				X		X
Ardea pacifica	White-necked Heron	LC						X
Threskiornithidae Iibises, Spoonbills								
Platalea flavipes	Yellow-billed Spoonbill	LC				X		X
Threskiornis molucca	Australian White Ibis	LC	X	X	X	X		X
Threskiornis spinicollis	Straw-necked Ibis	LC	X		X	X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Accipitridae Kites, Goshawks, Eagles, Harriers								
Accipiter cirrocephalus	Collared Sparrowhawk	Bp LC			X		X	X
Accipiter fasciatus	Brown Goshawk	Bp LC		X		X	X	X
Aquila audax	Wedge-tailed Eagle	Bp LC				X		X
Aquila morphnoides	Little Eagle	Bp LC			X		X	X
Circus approximans	Swamp Harrier	LC				X		X
Circus assimilis	Spotted Harrier	LC						X
Elanus caeruleus	Black-shouldered Kite	LC			X	X	X	X
Haliastur sphenurus	Whistling Kite	Bp LC				X	X	X
Hamirostra isura	Square-tailed Kite	Bp LC						

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Falconidae Falcons								
Falco berigora	Brown Falcon	Bp LC						X
Falco cenchroides	Australian Kestrel	LC	X	X	X	X	X	X
Falco longipennis	Australian Hobby	LC			X	X	X	X
Falco peregrinus	Peregrine Falcon	S7 Bp LC					X	X
Rallidae Rails, Crakes, Swamphens, Coots								
Fulica atra	Eurasian Coot	LC				X		X
Gallinula tenebrosa	Dusky Moorhen	Bh LC				X		X
Gallinula ventralis	Black-tailed Native-hen	LC				X		X
Gallirallus philippensis	Buff-banded Rail	LC						X
Porphyrio porphyrio	Purple Swamphen	LC				X		X
Porzana fluminea	Australian Spotted Crake	LC						X
Porzana pusilla	Baillon's Crake	LC						X
Porzana tabuensis	Spotless Crake	LC						X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Turnicidae Button-quails								
Turnix varia	Painted Button-quail	Bp LC						X
Columbidae Pigeons, Doves								
Columba livia	Domestic Pigeon	Introduced				X		X
Ocyphaps lophotes	Crested Pigeon	LC			X	X		X
Phaps chalcoptera	Common Bronzewing	Bh LC			X		X	X
Streptopelia chinensis	Spotted Turtle-Dove	Introduced		X	X	X		X
Streptopelia senegalensis	Laughing Turtle-Dove	Introduced		X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Psittacidae Parrots								
Cacatua roseicapilla	Galah	LC	X	X	X	X	X	X
Cacatua sanguinea	Little Corella	LC			X	X		X
Cacatua tenuirostris	Eastern Long-billed Corella	Introduced						X
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	S3 VU Bp VU A2c+3c+4c	X	X	X	X		X
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	S2 EN Bp EN A2bcde+3bcde+4bcde	X	X	X	X	X	X
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	LC						X
Neophema elegans	Elegant Parrot	LC				X		X
Platycercus icterotis icterotis	Western Rosella (western ssp)	Bp LC						
Platycercus spurius	Red-capped Parrot	LC	X	X	X	X	X	X
Platycercus zonarius	Australian Ringneck Parrot	LC	X	X	X	X	X	X
Polytelis anthopeplus	Regent Parrot	LC						X
Trichoglossus haematodus	Rainbow Lorikeet	Introduced	X	X	X	X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Cuculidae Parasitic Cuckoos								
Cacomantis flabelliformis	Fan-tailed Cuckoo	LC		X	X			X
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	LC			X		X	
Chrysococcyx lucidus	Shining Bronze Cuckoo	LC	X		X	X		X
Cuculus pallidus	Pallid Cuckoo	LC						
Strigidae Hawk Owls								
Ninox novaeseelandiae	Boobook Owl	LC				X		X
Tytonidae Barn Owls								
Tyto alba	Barn Owl	LC					X	X
Podargidae Frogmouths								
Podargus strigoides	Tawny Frogmouth	LC						X
Caprimulgidae Nightjars								
Eurostopodus argus	Spotted Nightjar	LC						X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Aegothelidae Owlet-nightjars								
Aegotheles cristatus	Australian Owlet-nightjar	LC				X		X
Halcyonidae Tree Kingfishers								
Dacelo novaeguineae	Laughing Kookaburra	Introduced	X	X		X	X	X
Todiramphus sanctus	Sacred Kingfisher	LC				X		X
Meropidae Bee-eaters								
Merops ornatus	Rainbow Bee-eater	S5 Mig JA LC		X		X	X	X
Maluridae Fairy Wrens, GrassWrens								
Malurus splendens	Splendid Fairy-wren	Bh LC	X	X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Acanthizidae Thornbills, Geryones, Fieldwrens & Whitefaces								
Acanthiza apicalis	Broad-tailed Thornbill	Bh LC				X	X	X
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh LC			X	X		X
Acanthiza inornata	Western Thornbill	Bh LC				X	X	X
Gerygone fusca	Western Gerygone	LC	X	X	X	X	X	X
Sericornis frontalis	White-browed Scrubwren	Bh LC				X	X	X
Smicrornis brevirostris	Weebill	Bh LC				X	X	X
Pardalotidae Pardalotes								
Pardalotus punctatus	Spotted Pardalote	LC				X		X
Pardalotus striatus	Striated Pardalote	LC		X	X	X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Meliphagidae Honeyeaters, Chats								
Acanthorhynchus superciliosus	Western Spinebill	LC			X	X		X
Anthochaera carunculata	Red Wattlebird	LC	X	X	X	X	X	X
Anthochaera lunulata	Western Little Wattlebird	Bp LC		X	X	X		X
Epthianura albifrons	White-fronted Chat	LC			X			X
Lichenostomus virescens	Singing Honeyeater	LC	X	X	X	X	X	
Lichmera indistincta	Brown Honeyeater	LC	X	X	X	X	X	X
Phylidonyris melanops	Tawny-crowned Honeyeater	Bp LC						X
Phylidonyris nigra	White-cheeked Honeyeater	Bp LC			X	X		X
Phylidonyris novaehollandiae	New Holland Honeyeater	Bp LC	X	X	X	X	X	X
Petroicidae Australian Robins								
Petroica multicolor	Scarlet Robin	Bh LC					X	X
Neositтidae Sitellas								
Daphoenositta chrysoptera	Varied Sittella	Bh LC				X	X	X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Pachycephalidae Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers								
Colluricincla harmonica	Grey Shrike-thrush	Bh LC			X	X	X	X
Pachycephala pectoralis	Golden Whistler	Bh LC			X			X
Pachycephala rufiventris	Rufous Whistler	LC	X	X	X	X	X	X
Dicruridae Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo								
Grallina cyanoleuca	Magpie-lark	LC		X	X	X	X	X
Rhipidura fuliginosa	Grey Fantail	LC	X			X	X	X
Rhipidura leucophrys	Willie Wagtail	LC	X	X	X	X	X	X
Campephagidae Cuckoo-shrikes, Trillers								
Coracina novaehollandiae	Black-faced Cuckoo-shrike	LC	X	X	X	X	X	X
Lalage tricolor	White-winged Triller	LC						

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Artamidae Woodswallows, Butcherbirds, Currawongs								
Artamus cinereus	Black-faced Woodswallow	Bp LC						X
Artamus cyanopterus	Dusky Woodswallow	Bp LC				X		X
Cracticidae Currawongs, Magpies & Butcherbirds								
Cracticus tibicen	Australian Magpie	LC	X	X	X	X	X	X
Cracticus torquatus	Grey Butcherbird	LC	X	X	X	X	X	X
Corvidae Ravens, Crows								
Corvus coronoides	Australian Raven	LC	X	X	X	X	X	X
Motacillidae Old World Pipits, Wagtails								
Anthus australis	Australian Pipit	LC					X	
Dicaeidae Flowerpeckers								
Dicaeum hirundinaceum	Mistletoebird	LC						X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Hirundinidae Swallows, Martins								
Hirundo neoxena	Welcome Swallow	LC				X	X	X
Hirundo nigricans	Tree Martin	LC		X	X	X	X	X
Sylviidae Old World Warblers								
Cincloramphus cruralis	Brown Songlark	LC						X
Cincloramphus mathewsi	Rufous Songlark	LC						X
Zosteropidae White-eyes								
Zosterops lateralis	Silvereye	LC	X	X	X	X	X	X
Mammalia								
Peramelidae Bandicoots								
Isoodon obesulus fusciventer	Southern Brown Bandicoot	P4 LC	X	X	X	X	X	
Phalangeridae Brushtail Possums, Cuscuses								
Trichosurus vulpecula	Common Brushtail Possum	LC				X		X

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Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Molossidae Freetail Bats								
Austronomus australis	White-striped Freetail-bat	LC			X	X		X
Ozimops kitcheneri	Southern Freetail-bat	LC				X	X	
Vespertilionidae Ordinary Bats								
Chalinolobus gouldii	Gould's Wattled Bat	LC			X	X	X	X
Chalinolobus morio	Chocolate Wattled Bat	LC						
Nyctophilus geoffroyi	Lesser Long-eared Bat	LC				X		X
Nyctophilus gouldi	Gould's Long-eared Bat	LC						
Nyctophilus major	Western Long-eared Bat	LC					X	
Vespadelus regulus	Southern Forest Bat	LC			X	X	X	X
Muridae Rats, Mice								
Mus musculus	House Mouse	Introduced		X	X	X	X	X
Rattus rattus	Black Rat	Introduced			X	X	X	X

WC Act Status - S1 to S7, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DPaW Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status	A	B	C	D	E	F
Canidae Dogs, Foxes								
Canis lupus familiaris	Dog	Introduced	X	X			X	
Vulpes vulpes	Red Fox	Introduced	X		X	X	X	X
Felidae Cats								
Felis catus	Cat	Introduced		X	X	X	X	X
Leporidae Rabbits, Hares								
Oryctolagus cuniculus	Rabbit	Introduced	X	X	X	X	X	X

WC Act Status - S1 to S7, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DPaW Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria for others.

APPENDIX C

DPaW & EPBC DATABASE SEARCH RESULTS

NatureMap
Mapping Western Australia's biodiversity

NatureMap Cockburn

Created By Greg Harewood on 06/10/2016

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 51' 36" E,32° 07' 18" S
Buffer	8km
Group By	Species Group

Species Group	Species	Records
Amphibian	10	883
Bird	229	33753
Fish	11	11
Invertebrate	178	657
Mammal	27	1349
Reptile	49	1702
TOTAL	**504**	**38355**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25410	*Heleioporus eyrei (Moaning Frog)*			
5.		*Heleioporus sp.*			
6.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
7.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
8.	25388	*Litoria moorei (Motorbike Frog)*			
9.	25420	*Myobatrachus gouldii (Turtle Frog)*			
10.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Bird					
11.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
12.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
13.	24262	*Acanthiza inornata (Western Thornbill)*			
14.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
15.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
16.	25536	*Accipiter fasciatus (Brown Goshawk)*			
17.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
18.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
19.	24831	*Acrocephalus australis subsp. gouldi (Australian Reed Warbler)*			
20.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
21.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
22.	24310	*Anas castanea (Chestnut Teal)*			
23.	24312	*Anas gracilis (Grey Teal)*			
24.	24313	*Anas platyrhynchos (Mallard)*			
25.	24315	*Anas rhynchotis (Australasian Shoveler)*			
26.		*Anas sp.*			
27.	24316	*Anas superciliosa (Pacific Black Duck)*			
28.	25553	*Anhinga melanogaster (Darter)*			
29.		*Anhinga novaehollandiae*			
30.		*Anser anser*			
31.		*Anser sp.*			
32.	24561	*Anthochaera carunculata (Red Wattlebird)*			
33.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
34.	24285	*Aquila audax (Wedge-tailed Eagle)*			
35.	25556	*Ardea alba (Great Egret)*			
36.	24337	*Ardea garzetta subsp. nigripes (Little Egret)*			
37.	25558	*Ardea ibis (Cattle Egret)*		IA	
38.	24338	*Ardea ibis subsp. coromanda (Cattle Egret)*		IA	
39.	41324	*Ardea modesta (Eastern Great Egret)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				IA	
40.	24340	*Ardea novaehollandiae (White-faced Heron)*			
41.	24341	*Ardea pacifica (White-necked Heron)*			
42.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
43.	24352	*Artamus cinereus subsp. melanops (Black-faced Woodswallow)*			
44.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
45.		*Aythya (Nyroca) australis*			
46.	24318	*Aythya australis (Hardhead)*			
47.		*Barnardius zonarius*			
48.	24319	*Biziura lobata (Musk Duck)*			
49.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
50.	25715	*Cacatua roseicapilla (Galah)*			
51.	25716	*Cacatua sanguinea (Little Corella)*			
52.		*Cacatua sp.*			
53.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
54.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
55.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
56.		*Cairina moschata*			
57.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
58.	24780	*Calidris alba (Sanderling)*		IA	
59.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
60.	24786	*Calidris melanotos (Pectoral Sandpiper)*		IA	
61.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
62.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
63.	24790	*Calidris tenuirostris (Great Knot)*		T	
64.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
65.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
66.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)*		T	
67.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
68.		*Calyptorhynchus sp.*			
69.	25574	*Charadrius dubius (Little Ringed Plover)*		IA	
70.	24373	*Charadrius melanops (Black-fronted Dotterel)*			
71.	24376	*Charadrius rubricollis (Hooded Plover)*		P4	
72.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
73.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
74.		*Cheramoeca leucosterna*			
75.		*Chroicocephalus novaehollandiae*			
76.	25601	*Chrysococcyx lucidus (Shining Bronze Cuckoo)*			
77.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
78.	24288	*Circus approximans (Swamp Harrier)*			
79.	24289	*Circus assimilis (Spotted Harrier)*			
80.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
81.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
82.	24399	*Columba livia (Domestic Pigeon)*	Y		
83.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
84.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
85.	24416	*Corvus bennetti (Little Crow)*			
86.	25592	*Corvus coronoides (Australian Raven)*			
87.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
88.		*Corvus sp.*			
89.	24671	*Coturnix pectoralis (Stubble Quail)*			
90.	25701	*Coturnix ypsilophora (Brown Quail)*			
91.	24673	*Coturnix ypsilophora subsp. australis (Brown Quail)*			
92.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
93.	25595	*Cracticus tibicen (Australian Magpie)*			
94.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
95.	25596	*Cracticus torquatus (Grey Butcherbird)*			
96.		*Cygnus (Chenopis) atratus*			
97.	24322	*Cygnus atratus (Black Swan)*			
98.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
99.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
100.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
101.		*Egretta garzetta*			
102.		*Egretta novaehollandiae*			
103.		*Elanus axillaris*			
104.	25540	*Elanus caeruleus (Black-shouldered Kite)*			
105.		*Elseyornis melanops*			
106.		*Eolophus roseicapillus*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
107.	24567	*Epthianura albifrons (White-fronted Chat)*			
108.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
109.	24368	*Eurostopodus argus (Spotted Nightjar)*			
110.	25621	*Falco berigora (Brown Falcon)*			
111.	25622	*Falco cenchroides (Australian Kestrel)*			
112.	25623	*Falco longipennis (Australian Hobby)*			
113.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
114.	25727	*Fulica atra (Eurasian Coot)*			
115.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
116.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
117.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
118.	24764	*Gallinula ventralis (Black-tailed Native-hen)*			
119.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
120.	42314	*Gavicalis virescens (Singing Honeyeater)*			
121.		*Gelochelidon nilotica*			
122.	25530	*Gerygone fusca (Western Gerygone)*			
123.	24271	*Gerygone fusca subsp. fusca (Western Gerygone)*			
124.	24735	*Glossopsitta porphyrocephala (Purple-crowned Lorikeet)*			
125.	24443	*Grallina cyanoleuca (Magpie-lark)*			
126.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*		IA	
127.	24295	*Haliastur sphenurus (Whistling Kite)*			
128.	25734	*Himantopus himantopus (Black-winged Stilt)*			
129.	24775	*Himantopus himantopus subsp. leucocephalus (Black-winged Stilt)*			
130.	24491	*Hirundo neoxena (Welcome Swallow)*			
131.	25629	*Hirundo nigricans (Tree Martin)*			
132.		*Hydroprogne caspia*			
133.		*Ixobrychus dubius*			
134.	25637	*Larus novaehollandiae (Silver Gull)*			
135.	25661	*Lichmera indistincta (Brown Honeyeater)*			
136.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
137.	25741	*Limosa limosa (Black-tailed Godwit)*		IA	
138.	25683	*Lonchura castaneothorax (Chestnut-breasted Mannikin)*			
139.		*Lophoictinia isura*			
140.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
141.		*Malurus (Malurus) splendens*			
142.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
143.	25654	*Malurus splendens (Splendid Fairy-wren)*			
144.	24583	*Manorina flavigula (Yellow-throated Miner)*			
145.	25758	*Megalurus gramineus (Little Grassbird)*			
146.		*Megalurus sp.*			
147.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
148.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
149.	24736	*Melopsittacus undulatus (Budgerigar)*			
150.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
151.		*Microcarbo melanoleucos*			
152.	25693	*Microeca fascinans (Jacky Winter)*			
153.	25542	*Milvus migrans (Black Kite)*			
154.	25610	*Myiagra inquieta (Restless Flycatcher)*			
155.	24738	*Neophema elegans (Elegant Parrot)*			
156.	24739	*Neophema petrophila (Rock Parrot)*			
157.	25747	*Ninox connivens (Barking Owl)*			
158.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
159.	24820	*Ninox novaeseelandiae subsp. boobook (Boobook Owl)*			
160.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
161.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
162.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
163.	25679	*Pachycephala pectoralis (Golden Whistler)*			
164.	24623	*Pachycephala pectoralis subsp. fuliginosa (Golden Whistler)*			
165.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
166.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
167.		*Pandion cristatus*			
168.	24299	*Pandion haliaetus subsp. cristatus (Osprey)*			
169.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
170.	25682	*Pardalotus striatus (Striated Pardalote)*			
171.	24628	*Pardalotus striatus subsp. murchisoni (Striated Pardalote)*			
172.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
173.		*Petrochelidon (Hylochelidon) nigricans*			
174.	24659	*Petroica goodenovii (Red-capped Robin)*			
175.	24663	*Phaethon rubricauda (Red-tailed Tropicbird)*		P4	
176.	25697	*Phalacrocorax carbo (Great Cormorant)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
177.	24665	*Phalacrocorax fuscescens (Black-faced Cormorant)*			
178.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
179.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
180.	25699	*Phalacrocorax varius (Pied Cormorant)*			
181.	24409	*Phaps chalcoptera (Common Bronzewing)*			
182.	25587	*Phaps elegans (Brush Bronzewing)*			
183.	25669	*Phylidonyris nigra (White-cheeked Honeyeater)*			
184.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
185.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
186.	25720	*Platycercus icterotis (Western Rosella)*			
187.	24747	*Platycercus spurius (Red-capped Parrot)*			
188.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
189.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
190.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
191.	24382	*Pluvialis fulva (Pacific Golden Plover)*		IA	
192.	24383	*Pluvialis squatarola (Grey Plover)*		IA	
193.	25703	*Podargus strigoides (Tawny Frogmouth)*			
194.	25704	*Podiceps cristatus (Great Crested Grebe)*			
195.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
196.	25722	*Polytelis anthopeplus (Regent Parrot)*			
197.		*Porphyrio (Porphyrio) porphyrio*			
198.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
199.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
200.		*Porzana (Porzana) tabuensis subsp. tabuensis*			
201.	24769	*Porzana fluminea (Australian Spotted Crake)*			
202.	25732	*Porzana pusilla (Baillon's Crake)*			
203.	24771	*Porzana tabuensis (Spotless Crake)*			
204.		*Purpureicephalus spurius*			
205.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
206.	25613	*Rhipidura fuliginosa (Grey Fantail)*			
207.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
208.	24454	*Rhipidura leucophrys subsp. leucophrys (Willie Wagtail)*			
209.		*Rostratula australis*			
210.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
211.	30948	*Smicrornis brevirostris (Weebill)*			
212.	24528	*Sterna hybrida subsp. javanica (Whiskered Tern)*			
213.	24329	*Stictonetta naevosa (Freckled Duck)*			
214.	25597	*Strepera versicolor (Grey Currawong)*			
215.	24426	*Strepera versicolor subsp. plumbea (Grey Currawong)*			
216.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
217.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
218.	30950	*Streptopelia senegalensis subsp. senegalensis (Laughing Turtle-Dove)*	Y		
219.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
220.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
221.	25552	*Tadorna radjah (Radjah Shelduck)*			
222.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
223.		*Thinornis rubricollis*			
224.	24844	*Threskiornis molucca (Australian White Ibis)*			
225.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
226.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
227.	24309	*Todiramphus sanctus subsp. sanctus (Sacred Kingfisher)*			
228.		*Tribonyx ventralis*			
229.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
230.	24754	*Trichoglossus haematodus subsp. rubritorquis (Red-collared Lorikeet)*			
231.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
232.	24808	*Tringa nebularia (Common Greenshank)*		IA	
233.	25761	*Turnix varia (Painted Button-quail)*			
234.	24849	*Turnix varia subsp. varia (Painted Button-quail)*			
235.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
236.	24855	*Tyto novaehollandiae subsp. novaehollandiae (Masked Owl (southern subsp))*		P3	
237.	25577	*Vanellus miles (Masked Lapwing)*			
238.	24386	*Vanellus tricolor (Banded Lapwing)*			
239.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Fish

240.		*Acentrogobius bifrenatus*			
241.		*Afurcagobius suppositus*			
242.		*Apogon rueppellii*			
243.		*Atherinomorus vaigiensis*			
244.		*Carassius auratus*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
245.		*Cnidoglanis macrocephalus*			
246.		*Craterocephalus mugiloides*			
247.		*Meuschenia venusta*			
248.		*Pelates sexlineatus*			
249.		*Sillago burrus*			
250.		*Torquigener pleurogramma*			

Invertebrate

251.		*Acantholophus hypoleucus*			
252.		*Acercella falcipes*			
253.		*Akamptogonus novarae*			
254.		*Allothereua maculata*			
255.		*Aname mainae*			
256.		*Aname tepperi*			
257.		*Antichiropus variabilis*			
258.		*Aptorchis sp.*			
259.		*Araneus cyphoxis*			
260.		*Araneus eburneiventris*			
261.		*Araneus senicaudatus*			
262.		*Archiargiolestes parvulus*			
263.		*Archiargiolestes pusillus*			
264.		*Arcuatula glaberrima*			
265.		*Arenopsaltria fullo*			
266.		*Argiope trifasciata*			
267.		*Arkys walckenaeri*			
268.		*Arrenurus balladoniensis*			
269.		*Arrenurus sp.*			
270.		*Artoria flavimana*			
271.		*Artoria linnaei*			
272.		*Artoria taeniifera*			
273.		*Austracantha minax*			
274.		*Australiobates sp.*			
275.		*Austroagrion cyane*			
276.		*Austrochiltonia sp.*			
277.		*Austrolestes annulosus*			
278.		*Austropeplea lessoni*			
279.		*Austropsocus occidentalis*			
280.		*Backobourkia heroine*			
281.		*Ballarra longipalpus*			
282.		*Biphyllocera kirbyana*			
283.		*Blaste furcilla*			Y
284.		*Blaste lunulata*			Y
285.		*Blaste taylori*			Y
286.		*Botelloides ludbrookae*			Y
287.		*Bothriembryon (Bothriembryon) bulla*			
288.		*Bothriembryon (Bothriembryon) kendricki*			
289.		*Castiarina anchoralis*			
290.		*Castiarina crenata*			
291.		*Castiarina darkinensis*			Y
292.		*Castiarina rufipennis*			
293.		*Catasarcus bilineatus*			
294.		*Catasarcus intermedius*			
295.		*Catasarcus spinipennis*			
296.		*Cercophonius sulcatus*			
297.		*Clynotis albobarbatus*			
298.		*Coptotermes michaelseni*			
299.		*Cormocephalus aurantiipes*			
300.		*Cormocephalus novaehollandiae*			
301.		*Cormocephalus rubriceps*			
302.		*Coxiella (Coxiella) striatula*			
303.		*Crustulina bicruciata*			
304.		*Cryptoerithus quobba*			
305.		*Cubicorhynchus crenicollis*			
306.		*Cyclosa trilobata*			
307.		*Cyrtophora parnasia*			
308.		*Daphnella (Hemidaphne) souverbiei*			
309.		*Dexerra angularis*			
310.		*Dingosa serrata*			
311.		*Diphucephala furcata*			
312.		*Dysmicoccus macrozamiae*			
313.		*Ecnomina cohibilis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
					Y
314.		*Ecnomus pansus*			
315.		*Eodelena convexa*			
316.		*Eodelena lapidicola*			
317.		*Eriophora biapicata*			
318.		*Erythracarus decoris*			
319.		*Ethmostigmus rubripes*			
320.		*Eylais sp.*			
321.		*Frankliniella schultzei*			
322.		*Gea theridioides*			
323.		*Geitoneura minyas*			
324.		*Glyptophysa (Glyptophysa) georgiana*			
325.		*Grandidierella sp.*			
326.		*Helicoverpa armigera*			
327.		*Helicoverpa punctigera*			
328.		*Hellyethira litua*			
329.		*Hemicordulia tau*			
330.		*Hemisaga denticulata*			
331.		*Henicops dentatus*			
332.		*Heteronympha merope subsp. duboulayi*			
333.		*Heterorotula multiformis*			
334.		*Hogna crispipes*			
335.		*Idiommata blackwalli*			
336.		*Iridomyrmex conifer*			
337.		*Isopeda leishmanni*			
338.		*Ixodes australiensis*			
339.		*Kangarosa properipes*			
340.		*Lampona cylindrata*			
341.		*Latrobiella guttatus*			
342.		*Latrodectus hasseltii*			
343.	33982	*Leioproctus contrarius (bee)*		P3	
344.		*Limnesia sp.*			
345.		*Longepi woodman*			
346.		*Lycidas michaelseni*			
347.		*Lycosa ariadnae*			
348.		*Lycosa gilberta*			
349.		*Maratus pavonis*			
350.		*Metaballus frontalis*			
351.		*Metaballus litus*			
352.		*Missulena granulosa*			
353.		*Missulena occatoria*			
354.		*Mituliodon tarantulinus*			
355.		*Mitzoruga insularis*			
356.		*Myrmecia chasei*			
357.		*Myrmecia infima*			
358.		*Nanometa gentilis*			
359.		*Nassarius sp.*			
360.		*Nebothriomyrmex majeri*			
361.		*Neopolystoma macleayi*			Y
362.		*Neopolystoma tinsleyi*			Y
363.		*Neosparassus sp.*			
364.		*Nephila edulis*			
365.		*Neumania sp.*			
366.		*Nicodamus mainae*			
367.		*Notiasemus glauerti*			
368.		*Notoncus hickmani*			
369.		*Notoperata syncope*			
370.		*Occasitermes occasus*			
371.		*Occiperipatoides sp.*			
372.		*Oecetis pechana*			
373.		*Oecetis sp.*			
374.		*Onthophagus vermiculatus*			
375.		*Orthetrum caledonicum*			
376.		*Oxus sp.*			
377.		*Pachysaga australis*			
378.		*Paralamyctes cammooensis*			Y
379.		*Paramphisopus sp.*			
380.		*Pediana occidentalis*			
381.		*Peripsocus maoricus*			
382.		*Phenasteron longiconductor*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
383.		*Pinkfloydia harveii*			
384.		*Piona cumberlandensis*			
385.		*Piona murleyi*			
386.		*Podykipus collinus*			
387.		*Poltys laciniosus*			
388.		*Prionosternum scutatum*			
389.		*Ptycta cornigera*			Y
390.		*Ptycta emarginata*			Y
391.		*Ptycta improcera*			Y
392.		*Pulvinaria sp.*			
393.		*Raveniella cirrata*			
394.		*Raveniella peckorum*			
395.		*Rybaxis sp.*			
396.		*Sclerorrhinella crawshawi*			
397.		*Scolopendra laeta*			
398.		*Servaea melaina*			
399.		*Simaetha tenuior*			
400.		*Smeringopus natalensis*			
401.		*Solaenodolichopus pruvoti*			
402.		*Sphenophorus brunnipennis*			
403.		*Spiroxys sp.*			Y
404.		*Steatoda capensis*			
405.		*Succinea (succinea)*			
406.		*Supunna funerea*			
407.		*Supunna picta*			
408.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
409.		*Synemon sp.*			
410.		*Synothele michaelseni*			
411.		*Synothele rastelloides*			
412.		*Talaurinus carbonarius*			
413.		*Talaurinus sp.*			
414.		*Tamopsis darlingtoniana*			
415.		*Tellina sp.*			
416.		*Tetragnatha demissa*			
417.		*Tetragnatha nitens*			
418.		*Thalotia conica*			
419.	33994	*Throscodectes xiphos (cricket)*		P1	Y
420.		*Tinytrema yarra*			
421.		*Triplectides australis*			
422.		*Urabunana sp.*			
423.		*Urodacus novaehollandiae*			
424.		*Venator immansueta*			
425.		*Venatrix pullastra*			
426.		*Xanthagrion erythroneurum*			
427.		*Zachria flavicoma*			
428.		*Zoila friendii*			
Mammal					
429.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
430.	24189	*Falsistrellus mackenziei (Western False Pipistrelle)*		P4	
431.	24041	*Felis catus (Cat)*	Y		
432.	30916	*Funambulus pennanti (Indian Palm Squirrel)*	Y		
433.	24215	*Hydromys chrysogaster (Water-rat)*		P4	
434.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P5	
435.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
436.	24131	*Macropus eugenii subsp. derbianus (Tammar Wallaby (WA subsp))*		P5	
437.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
438.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
439.	24223	*Mus musculus (House Mouse)*	Y		
440.	24042	*Mustela putorius (European Polecat, Ferret)*	Y		
441.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
442.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
443.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
444.	24243	*Rattus fuscipes (Western Bush Rat)*			
445.	24244	*Rattus norvegicus (Brown Rat)*	Y		
446.	24245	*Rattus rattus (Black Rat)*	Y		
447.		*Rattus sp.*			
448.	24145	*Setonix brachyurus (Quokka)*		T	
449.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
450.	24185	*Tadarida australis (White-striped Freetail-bat)*			
451.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
452.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
453.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
454.	24206	*Vespadelus regulus (Southern Forest Bat)*			
455.	24040	*Vulpes vulpes (Red Fox)*	Y		

Reptile

456.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
457.	44629	*Anilios australis*			
458.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
459.	42380	*Brachyurophis fasciolatus subsp. fasciolatus (Narrow-banded Shovel-nosed Snake)*			
460.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
461.	43380	*Chelodina colliei (Oblong Turtle)*			
462.	24980	*Christinus marmoratus (Marbled Gecko)*			
463.	30893	*Cryptoblepharus buchananii*			
464.	25020	*Cryptoblepharus plagiocephalus*			
465.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
466.	25027	*Ctenotus australis*			
467.	25039	*Ctenotus fallens*			
468.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain pop P3), skink)*			
469.	25047	*Ctenotus impar*			
470.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
471.	24999	*Delma grayii*			
472.	25468	*Demansia psammophis (Yellow-faced Whipsnake)*			
473.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
474.	25100	*Egernia napoleonis*			
475.	25250	*Elapognathus coronatus (Crowned Snake)*			
476.	24959	*Gehyra variegata*			
477.	25119	*Hemiergis quadrilineata*			
478.	25366	*Hydrophis elegans (Elegant Seasnake, Bar-bellied Seasnake)*			
479.	25131	*Lerista distinguenda*			
480.	25133	*Lerista elegans*			
481.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
482.	25005	*Lialis burtonis*			
483.	25184	*Menetia greyii*			
484.	25191	*Morethia lineoocellata*			
485.	25192	*Morethia obscura*			
486.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
487.	25249	*Neelaps calonotos (Black-striped Snake)*		P3	
488.	25252	*Notechis scutatus (Tiger Snake)*			
489.	25253	*Parasuta gouldii*			
490.	25509	*Pletholax gracilis (Keeled Legless Lizard)*			
491.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
492.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
493.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
494.		*Pogona sp.*			
495.	25511	*Pseudonaja affinis (Dugite)*			
496.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
497.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
498.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
499.	24942	*Strophurus spinigerus subsp. spinigerus*			
500.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
501.	25519	*Tiliqua rugosa*			
502.	25204	*Tiliqua rugosa subsp. aspera*			
503.	25207	*Tiliqua rugosa subsp. rugosa*			
504.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government

Department of the Environment

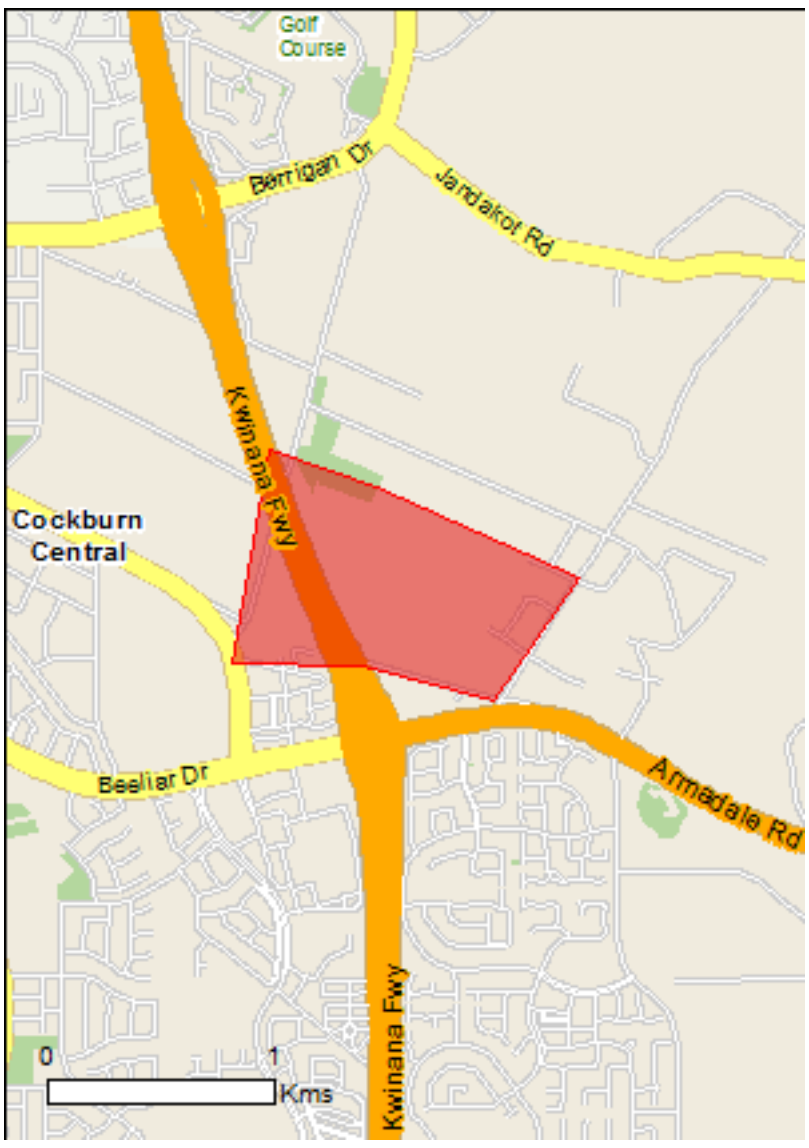
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 26/09/16 19:59:27



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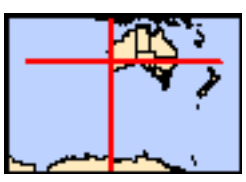
Coordinates

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	16
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	40
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat may occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.125249 115.858998,-32.125268 115.858998,-32.125122 115.853741,-32.117944 115.855308,-32.119216 115.859492,-32.122269 115.867603,-32.126431 115.864213,-32.125249 115.858998

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX D

BLACK COCKATOO HABITAT TREE DETAILS

Habiat Trees (DBH >50cm)
Datum - GDA 95

Waypoint Number	Zone	mE	mN	Lot Number	Tree Species	Tree Height (m)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
wpt001	50H	392023	6445500	9500	Jarrah	15-20	1	Knot Hole	5-10			No Signs	No Signs	No	Depth of hollows unknown
wpt002	50H	392058	6445521	9500	Jarrah	15-20	2	Knot Hole	5-10	Spout Branch	5-10	Bees	No Signs	No	Partly Dead - Depth of hollows unknown
wpt003	50H	392054	6445367	9500	Unknown Euc	20+	0					No Signs	No Signs	No	Planted Non-endemic
wpt004	50H	392024	6445383	9500	Unknown Euc	20+	0					No Signs	No Signs	No	Planted Non-endemic
wpt005	50H	392547	6445161	33	Dead Tuart	20+	1	Knot Hole	10-20			Galahs	Galahs	No	Galah in attendance - Depth of hollows unknown
wpt006	50H	392552	6445161	33	Tuart	20+	0					No Signs	No Signs	No	
wpt007	50H	392556	6445152	33	Tuart	20+	0					No Signs	No Signs	No	
wpt008	50H	392557	6445147	33	Tuart	20+	0					No Signs	No Signs	No	
wpt009	50H	392614	6445213	33	Tuart	20+	0					No Signs	No Signs	No	
wpt010	50H	392597	6445225	33	Tuart	20+	0					No Signs	No Signs	No	
wpt011	50H	392590	6445226	33	Tuart	15-20	1	Spout Branch	5-10			No Signs	No Signs	No	Depth of hollows unknown
wpt012	50H	392571	6445205	33	Tuart	20+	0					No Signs	No Signs	No	
wpt013	50H	392571	6445204	36	Tuart	15-20	0					No Signs	No Signs	No	
wpt014	50H	392515	6445202	36	Tuart	20+	0					No Signs	No Signs	No	
wpt015	50H	392524	6445224	36	Tuart	20+	0					No Signs	No Signs	No	
wpt016	50H	392524	6445222	36	Tuart	20+	0					No Signs	No Signs	No	
wpt017	50H	392436	6445361	801	Flooded Gum	20+	1	Fissure	5-10			No Signs	No Signs	No	Depth of hollows unknown
wpt018	50H	392497	6445689	802	Dead Flooded Gum	10-15	2	Knot Hole	5-10	Spout Trunk	20+	No Signs	No Signs	Yes	Depth of hollows unknown

APPENDIX E

SIGNIFICANT SPECIES PROFILES

Graceful Sun Moth *Synemon gratiosa*

Status and Distribution: Listed as Priority 4 by the DPaW.

The GSM was up until a few years ago thought to be confined to a small number of bush reserves in the northern suburbs of Perth. Targeted survey work since that time by several consultants and DPaW have extended the known range of the species north to Leeman and south as far as Binningup (Bishop *et al.* 2010b).

Survey work carried out in 2010 expanded the previously document area of occupancy of the GSM from 18km^2 to 43 km^2 and the extent of occurrence from 230km^2 to 2,015km^2. The area of occupancy is potentially a conservative estimate at this stage and if habitat anticipated to be occupied by GSM is included, the area of occupancy may be as high as 119 km^2 (Bishop *et al.* 2010b). Additional surveys have been carried out in 2011 north and south of the known range and these may also expand the species range (results not as yet publically available).

The conservation status of the graceful sun-moth was change at a state level in 2012 from Schedule 1 to Priority 4 and it has also been delisted from the *EPBC Act* threatened species list altogether as a consequence of the additional information illustrating the species much greater range and abundance.

Habitat: The graceful sun-moth is currently only known from two general vegetation types:

- Banksia woodland/woolly bush on deep sands, in the northern suburbs of Perth on the Swan Coastal Plain. In these sites the GSM breeds on *Lomandra hermaphrodita*, which often occurs in low numbers.

- Open areas of herbland, heathland and shrubland on Quindalup soils (sand and limestone) close to the coast where it breeds on *Lomandra maritima*, which is often present in reasonable numbers and may even be a dominant understorey herb. Sites on limestone may have both *Lomandra* species present.

The presence of these two *Lomandra* species therefore provides a good indication of prospective habitat, however, sufficient numbers and densities of these plants are thought to be necessary to sustain a viable breeding colony of Graceful Sun-Moths.

Likely presence in study area: The flora survey (Focused Vision Consulting 2016) within the study area did not identify any specimens of the plant species normally associated with the presence of the GSM (i.e. *Lomandra hermaphrodita* and *L. maritima*). It is therefore considered very unlikely that GSM would persist onsite. Previous surveys in nearby areas have found no evidence of the GSM and its absence was also attributed to the lack of favourable habitat (i.e. *Lomandra hermaphrodita and L. maritima)* (Bamford 2011, 2012 and 360 Environmental 2012)).

Potential impact of development: No impact on this species or its preferred habitat is considered likely to occur as a consequence of development at the site occurring.

Unnamed Bee Leioproctus contrarius

Status and Distribution: Listed as Priority 3 by the DPaW. Total distribution not documented, however recent surveys have shown that it is more widespread than previously thought.

Habitat: This species of native bee is apparently dependent on flowers of *Goodeniaceae* **and possibly** *Lechenaultia stenosepala***.**

Likely presence in survey area: Never recorded in this specific area and the status onsite is uncertain, however, given that much of the site is degraded and the necessary plant species for a population of this species to persist appear to be absent it is not regarded as a potential species.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Unnamed Cricket *Throscodectes xiphos*

Status and Distribution: Listed as Priority 1 by the DPaW. This species of Tettigoniid cricket is known only from the Cutler Road area within/near the study area (DPaW 2016).

Habitat: Life history and habits not documented/unknown.

Likely presence in study area: Based on NatureMap records it appears that the unnamed cricket (Throscodectes xiphos) is known only from bushland within the study area. The current status on site is however uncertain with the most recent DPaW record for the study area being from 1999 (DPaW 2016).

Potential impact of proposed development: Loss/modification of some areas of habitat.

Perth Lined Lerista *Lerista lineata*

Status and Distribution: Listed as Priority 3 by DPaW. Found in the lower west coast from north of Perth south to Leschenault Peninsula/Kemerton. It has also been found at Rottnest Island and Garden Island (Storr *et al.* 1999). Found in the southern suburbs of Perth (Bush *et al.* 2002).

Habitat: This small species of skink inhabits white sands (Storr *et al*. 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter (Nevill 2005) particularly in association with banksias (Bush *et al.* 2002).

Likely presence in study area: Recorded within the study area by GHD (2015) and in other nearby bush remnants (ENV 2009, Phoenix 2010). Most of the banksia dominated

habitat appears to be suitable for this species to persist. This species is known to inhabit gardens (Nevill 2005, Bush *et al.* 2010) so may persist in degraded areas and subsequent to development.

Potential impact of development: Loss/modification of some areas of habitat.

Black-striped Snake *Neelaps calonotos*

Status and Distribution: Listed as Priority 3 by DPaW. Found in the lower west coast from Lancelin to Mandurah. It is locally abundant but is under threat due to land clearing (Storr *et al.* 1999).

Habitat: This species of snake favours sandy soils supporting heath and banksia/eucalypt woodland (Nevill 2005).

Likely presence in study area: Status in area difficult to determine, however the lack of recent records in the general area despite several detailed surveys (e.g. Rockingham, East Rockingham, Bibra Lake, Jandakot) suggests that it no longer persists in the southern Perth suburbs. Not listed as a potential species.

Potential impact of development: No impact anticipated as this species is considered unlikely to be present.

Malleefowl *Leipoa ocellata*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as Vulnerable under the *EPBC Act*. Originally common, but now generally rare to uncommon and patchily distributed.

Current distribution mainly southern arid and semi-arid zones, north to Shark Bay, Jingemarra, Colga Downs and Yeelirrie, east to Earnest Giles Range, Yeo Lake, lower Ponton Creek and to Eucla and west and south to Cockleshell Gully, the Wongan Hills, Stirling Range, Beaufort Inlet, Hatters Hill, Mt Ragged and Point Malcolm (Johnstone and Storr 1998).

Habitat: Mainly scrubs and thickets of mallee *Eucalyptus* spp., boree *Melaleuca lanceolata* and bowgada *Acacia linophylla*, also dense litter forming shrublands.

Likely presence in study area: This species is regionally extinct and would never, under normal circumstances occur anywhere on the Swan Coastal Plain.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Hooded Plover (western) *Thinornis rubricollis tregellasi*

Status and Distribution: The western subspecies of the hooded plover is listed as Priority 4 by DPaW and as Vulnerable C1 by the IUCN. Breeds on south-west Western

Australian coast, from Cape Naturaliste to Eyre, and on inland lakes as far north-east as L. Cowan and L. Moore and north-west to Yalgorup Lakes, south of Perth.

Habitat: Broad sandy ocean beaches and bays, coastal and inland salt lakes (Pizzey & Knight 2012).

Likely presence in study area: No suitable habitat. Not listed as a potential species.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Australasian Bittern *Botaurus poiciloptilus*

Status and Distribution: Classified as Schedule 2 under the WC Act and as Endangered under the EPBC Act. The species is uncommon to rare (Morcombe 2004), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt Arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2004) such as beds of tall dense *Typha, Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in study area: The seasonal wetland habitats onsite (dry at the time of the survey) appear unsuitable for this species to utilise though it may occur very occasionally. Not listed as a potential species

Potential impact of development: No impact on this species or its preferred habitat will occur.

Eastern Great Egret *Ardea alba*

Status and Distribution: This species of egret is listed under Schedule 5 of the *WC Act*, as Migratory under the EPBC Act and under international agreements to which Australia is a signatory. The eastern great egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe 2004).

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe 2004).

Likely presence in study area: This species may occasionally utilise seasonally flooded wetland areas (dry during the survey period) for foraging and possibly roosting but these appear to represent marginal habitat at best. Unlikely to breed onsite.

Potential impact of development: Loss/modification of some areas of habitat though impacts unlikely to be significant.

Cattle Egret *Ardea ibis*

Status and Distribution: This species of egret is listed under Schedule 5 of the *WC Act,* as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The cattle egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe 2004).

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe 2004).

Likely presence in study area: This species is uncommon in the south west and tends to prefer open paddocks with livestock so not considered a potential species for this area.

Potential impact of development: No impact on this species or its preferred habitat will occur.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Status and Distribution: This species is listed as Migratory and Marine under the *EPBC Act* and under international agreements to which Australia is a signatory. White-bellied sea eagles are moderately common to common on Kimberley and Pilbara islands, coasts and estuaries, on Bernier, Dorre and Dirk Hartog Is., in Houtman Abrolhos and in the Archipelago of the Recherche; rare to uncommon elsewhere (Johnstone and Storr 1998). Also found in New Guinea, Indonesia, China, southeast Asia and India. Scarce near major coastal cities (Morcombe 2004).

Habitat: They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe 2004). White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in study area: May fly over on rare occasions given presence of nearby lake/river systems and ocean but there is no suitable habitat for this species inside the study area.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Osprey *Pandion haliaetus*

Status and Distribution: This species of egret is listed under Schedule 5 of the *WC Act*, as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. Moderately common to very common in sheltered seas around the north and west coast islands south to 31°S; uncommon to common on mainland coasts,

estuaries and large rivers north of tropic, rare to uncommon elsewhere (Johnstone and Storr 1998).

Habitat: Coasts, estuaries, bays, inlets, islands, and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Ascends larger rivers (Pizzey & Knight 2012). Constructs nests on prominent headland, large trees, communication towers (Simpson & Day 2010).

Likely presence in study area: May fly over on rare occasions given presence of nearby lake systems and ocean but there is no suitable habitat for this species inside the study area.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Peregrine Falcon *Falco peregrinus*

Status and Distribution: This species is listed as Schedule 7 under the *WC Act*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2004). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in study area: Individuals of this species potentially utilise some sections of the study area as part of a much larger home range but would only occur rarely and is unlikely to breed onsite.

Potential impact of development: Loss/modification of some areas of foraging habitat. Very unlikely to breed onsite. No significant impact likely.

Glossy Ibis *Plegadis falcinellus*

Status and Distribution: This species is listed as Schedule 5 under the *WC Act* and as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The glossy ibis frequents swamps and lakes throughout much of the Australian mainland, but is most numerous in the north. It is a non-breeding visitor to Tasmania and the south-west of Western Australia. The Glossy Ibis is both migratory and nomadic. Its range expands inland after good rains, but its main breeding areas seem to be in the Murray-Darling Basin of New South Wales and Victoria, the Macquarie Marshes in New South Wales, and in southern Queensland. Glossy ibis often move

north in autumn, then return south to their main breeding areas in spring and summer (Pizzey & Knight 2012).

Habitat: Well vegetated wetlands, wet pastures, rice fields, floodwaters, floodplains, brackish or occasionally saline wetlands, mangroves, mudflats, occasionally dry grasslands (Pizzey & Knight 2012).

Likely presence in study area: The seasonal wetland areas (dry during the survey period) within the study area appear to be too densely vegetated for this species and it is considered unlikely to occur.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Blue-billed Duck *Oxyura australis*

Status and Distribution: Recently listed as Priority 4 by DPaW (DPaW 2015). Rare to moderately common (most plentiful on the Swan Coastal Plain and in the Great Southern). South-western: north to Lake Pinjarrega and east to Esperance; vagrant further north and east (as far as Thundelarra and Kalgoorlie). Also south-eastern Australian and Tasmania (Johnstone and Storr 1998).

Habitat: Well vegetated freshwater swamps, large dams and lakes, winters on more open water (Morcombe 2004). Occasionally salt lakes and estuaries freshened by floodwaters (Johnstone and Storr 1998).

Likely presence in study area: The seasonal wetland areas within the study area (dry during the survey period) appear to be too densely vegetated for this species and it is considered unlikely to occur.

Potential impact of development: No impact on these species or their preferred habitat will occur.

Australian Painted Snipe *Rostratula australis/benghalensis*

Status and Distribution: This species is listed as Schedule 2 and 5 under the *WC Act* and as Endangered and Migratory under the *EPBC Act*. Sparsely distributed in better watered regions: Kimberley, North West and South Western divisions. Also, eastern Australia and Tasmanian (Johnstone and Storr 1998).

Habitat: Well vegetated shallows and margins of wetlands, dams, sewerage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea tree scrub, open timber. Requires dense low cover (Morcombe 2004).

Likely presence in study area: There is no suitable habitat for this species within the study area.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Grey Wagtail *Motacilla cinerea*

Status and Distribution: The grey wagtail is listed as Schedule 5 under the *WC Act* and as Migratory under the *EPBC Act* including international agreements to which Australia is a signatory. A rarely recorded, accidental vagrant that has on a few occasions been recorded on widely separated parts of the Australian coastline (Pizzey & Knight 2012).

Habitat: In Australia, near running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields (Pizzey & Knight 2012).

Likely presence in study area: This species is an "accidental vagrant" (Pizzey & Knight 2012) and therefore the likelihood of occurrence is extremely low. Not listed as potential species as it would only occur very rarely, if ever and then only for brief periods.

Potential impact of development: No significant impact on this species or its preferred habitat will occur.

Other Migratory Shorebirds/Wetland Bird Species

A number of migratory shorebirds and wetland birds are listed as potentially occurring in the general area. Not all specific species are discussed in detail.

Status and Distribution: Most migratory shorebirds are listed under Schedule 5 of the *WC Act* and/or the *EPBC Act.* Some are also listed under international agreements to which Australia is a signatory. All species are either widespread summer migrants to Australia or residents. State and Federal conservation status varies between species.

Habitat: Varies between species but includes beaches and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, saltwork ponds, estuaries, lagoons, mudflats sandbars, pastures, airfields, sports fields and lawns.

Likely presence in study area: The seasonal wetland areas within the study area (dry during the survey period) appear to be too densely vegetated for any of these species to utilise and none are considered likely to occur.

Potential impact of development: No impact on these species or their preferred habitat will occur.

Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

Status and Distribution: Listed as Scheduled 3 under the *WC Act* and as Vulnerable under the *EPBC Act*. Found in the humid and subhumid south west, mainly hilly interior,

north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Habitat: Eucalypt forests, feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble. The forest red-tailed black-cockatoo nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding commences in winter/spring. There are few records of breeding in the Forest Red-tailed Black Cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone pers. comm.). Incubation period 29 – 31 days. Young fledge at 8 to 9 weeks (Simpson and Day 2010).

J	F	M	A	M	J	J	A	S	O	N	D

Period in which breeding is most likely to commence
Period in which fledging/weening could extend through

Likely presence in study area: Individuals of this species were observed flying overhead during the field survey. GHD also recorded this species flying over the area in 2015 (GHD 2015). Some foraging evidence (chewed coastal blackbutt fruits) was also attributed to this species though Carnaby's black cockatoos also utilise this resource. All areas of remnant vegetation containing jarrah, coastal blackbutt and sheoak within the site represents potential foraging habitat.

All of the 18 large trees (≥50cm DBH) recorded during the field survey would be considered by the DotEE as potential black cockatoo breeding habitat though only one appears to possibly contain a hollow of a size potentially suitable for this purpose. The possibility of this tree or any others being used for breeding proposes now or in the future can be considered to be extremely low. No evidence of overnight roosting on site was observed.

Potential impact of development: Loss/modification of some areas of habitat.

Baudin's Black-Cockatoo *Calyptorhynchus baudinii*

Status and Distribution: Listed as Scheduled 2 under the *WC Act* and as Vulnerable under the *EPBC Act*. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998). On the southern Swan Coastal Plain this cockatoo is in some areas resident but mainly a migrant moving from the deep south-west to the central and northern Darling Range. Between March and September most flocks move north and are concentrated in

the northern parts of the Darling Range. During this period birds forage well out onto the southern Swan Coastal Plain to areas such as Harvey, Myalup, Bunbury, Capel, Dunsborough and Meelup. While generally more common in the Darling Range this species can also be common on parts of the southern Swan Coastal Plain especially in mid-August – September when flocks begin to return to their breeding quarters (Johnstone 2008).

Habitat: Mainly eucalypt forests where it feeds primarily on the Marri seeds, (Morcombe 2004), Banksia, Hakeas and *Erodium* sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998). This species of cockatoo nests in large tree hollows, 30–40 cm in diameter and more than 30 cm deep (Saunders 1974).

Baudin's Black-Cockatoo breeds in late winter and spring, from August to November or December (Gould 1972; Johnstone 1997; Saunders 1974; Saunders *et al*. 1985). Eggs laid in October (Johnstone and Storr 1998). Based on observations at currently known nest sites breeding mainly occurs within the October-December period (Ron Johnstone pers. comms.). Incubation is 28 – 30 days. Young fledge at 8 to 9 weeks (Simpson and Day 2010).

J	F	M	A	M	J	J	A	S	O	N	D

Period in which breeding is most likely to commence
Period in which fledging/weening could extend through

Likely presence in study area: No evidence of this species using the study area was observed. This species is only rarely recorded in this section of the coastal plain so it is considered unlikely to frequent the site except on rare occasions.

Potential impact of development: No impact on this species or its preferred habitat is anticipated.

Carnaby's Black- Cockatoo *Calyptorhynchus latirostris*

Status and Distribution: Carnaby's black-cockatoo is listed as Scheduled 2 under the *WC Act* and as Endangered under the *EPBC Act*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Habitat: Forests, woodlands, heathlands, farms; feeds on Banksia, Hakeas and Marri. Carnaby's black-cockatoo has specific nesting site requirements. Nests are mostly in smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including the region between Mandurah and Bunbury. Carnaby's black-cockatoo has been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (Ron Johnstone pers. comm.) and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby's black-cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders 1986). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10–12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).

J	F	M	A	M	J	J	A	S	O	N	D

Period in which breeding is most likely to commence
Period in which fledging/weening could extend through

Likely presence in study area: Foraging evidence attributed to this species was observed during the site survey (chewed banksia cones) and most of the remnant vegetation containing *banksia* and jarrah within the site represents potential foraging habitat. Recorded flying over the area by GHD in 2015 (GHD 2015).

All of the 18 large trees (>50cm DBH) recorded during the field survey would be considered by the DotEE as potential black cockatoo breeding habitat though only one appears to possibly contain a hollow of a size potentially suitable for this purpose. The possibility of this tree or any others being used for breeding proposes now or in the future can be considered to be extremely low. No evidence of overnight roosting on site was observed.

Potential impact of development: Loss/modification of some areas of habitat.

Masked Owl *Tyto novaehollandae novaehollandae*

Status and Distribution: Listed as Priority 3 by DPaW. Found north to Yanchep and east to Yealering, Gnowangerup and Albany, casual further north. Locally common in south west but generally uncommon (Johnstone and Storr 1998).

Habitat: Roosts and nests in heavy forest, hunts over open woodlands and farmlands (Morcombe 2004). Probably breeding in forested deep south west with some autumn–winter wanderings northwards (Johnstone and Storr 1998).

Likely presence in Study Area: Status on-site and in the general area is difficult to determine but habitat appears largely unsuitable. May occasionally be present but not listed as a potential species as the frequency of occurrence would be very low and only for limited periods.

Potential impact of development: No impact on this species will occur.

Fork-tailed Swift *Apus pacificus*

Status and Distribution: The fork-tailed swift is listed as Schedule 5 under the *WC Act,* as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. It is a summer migrant (Oct-Apr) to Australia (Morcombe 2004).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe 2004).

Likely presence in study area: This species is potentially an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats. Not listed as a potential species.

Potential impact of development: No impact on this species will occur.

Rainbow Bee-eater *Merops ornatus*

Status and Distribution: This species is listed as Schedule 5 under the *WC Act,* as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The rainbow bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe 2004).

Habitat: Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe 2004). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.

Likely presence in study area: Recorded by GHD (2015) breeding in a sand embankment along North Lake Road in 2015 and it is likely to utilise the study area in small numbers during the summer migratory period. This species is a common seasonal visitor to south west. Population numbers at any one location would however never be significant as the species usually breeds in pairs and only rarely in small colonies (Johnstone and Storr 1998).

Potential impact of development: Modification and/or loss of some areas of habitat but impacts will not be significant.

Numbat *Myrmecobius fasciatus*

Status and Distribution: Listed as Scheduled 3 under the *WC Act* and as Vulnerable under the *EPBC Act*. Once occurred across much of arid and semi arid southern Australia, now restricted to a few remnant forests of wandoo, powderbark wandoo or

jarrah in South west WA (Menkhorst & Knight 2011). Rare, scattered. Found only at Dryandra, Perup and six other translocation sites (Van Dyck & Strahan 2008).

Habitat: Generally dominated by eucalypts that provide hollow logs and branches for shelter and termites for food (Van Dyck & Strahan 2008).

Likely presence in study area: This species is locally and regionally extinct.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Southern Brown Bandicoot *Isoodon obesulus fusciventer*

Status and Distribution: Listed as Priority 4 by DPaW. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (DPaW information pamphlet) and Nambung National Park (DPaW pers. coms.)

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas can thrive in more open habitat subject to exotic predator control (DPaW information pamphlet).

Likely presence in study area: Evidence of this species foraging (i.e. diggings) in some sections of the study area was observed during site survey. Also recorded by GHD in 2015 (GHD 2015). Potentially present within the study area wherever dense shrubby groundcover occurs.

Potential impact of development: Loss of some existing and potential habitat. Some possibility that individuals maybe killed or injured during clearing operations.

Western Ringtail Possum *Pseudocheirus occidentalis*

Status and Distribution: Listed as Scheduled 2 under the *WC Act* and as Vulnerable under the *EPBC Act.* Common in suitable habitat (de Tores 2008). The highest densities of this species are recorded in Peppermint habitat near Busselton area; relatively high densities are found in Jarrah/Marri forest at Perup (de Tores 2008).

The western ringtail possum (WRP) has a restricted distribution in south-western Western Australia. Most known populations (natural and translocated) are now restricted to near coastal areas of the south west from the Dawesville area to the Waychinicup National Park. Inland, it is also known to be relatively common in a small part of the lower Collie River valley, the Perup Nature Reserve and surrounding forest blocks near Manjimup.

Habitat: The western ringtail possum was once located in a variety of habitats including coastal peppermint, coastal peppermint-tuart, jarrah-marri associations, sheoak woodland, and eucalypt woodland and mallee. Coastal populations mostly inhabit peppermint-tuart associations with highest densities in habitats with dense, relatively lush vegetation. Inland, the largest known populations occur in the Upper Warren area east of Manjimup (Wayne *et al* 2005). In this area the peppermint tree is naturally absent and jarrah-marri associations constitute the species refuge and foraging habitat. In areas where peppermint is absent or rare WRPs have been observed feeding predominately on young jarrah, *Nuytsia floribunda* and *Allocasuarina fraseriana* (G Harewood pers. obs.*).*

Likely presence in study area: This species is locally extinct.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Quokka Setonix brachyurus

Status and Distribution: Listed as Scheduled 3 under the *WC Act,* **Vulnerable under the** *EPBC Act* **and as Vulnerable (B1ab(ii,iii)) by the IUCN. Rare and restricted in south west W.A. from south of Perth to Two Peoples Bay. The distribution of the quokka includes Rottnest and Bald Islands, and at least 25 known sites on the mainland, including Two Peoples Bay Nature Reserve, Torndirrup National Park, Mt Manypeaks National Park, Walpole-Nornalup National Park, and various swamp areas through the south-west forests from Jarrahdale to Walpole.**

Habitat: Mainland populations of this species are currently restricted to densely vegetated coastal heaths, swamps, riverine habitats including tea-tree thickets on sandy soils along creek systems where they are less vulnerable to predation. The species is nocturnal.

Likely presence in study area: This species is locally extinct.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Western Brush Wallaby *Macropus irma*

Status and Distribution: Listed as Priority 4 by DPaW. The western brush wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (DPaW information pamphlet nd).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DPaW information pamphlet nd).

Likely presence in study area: Recorded in Jandakot (ENV 2009) and possibly present in small numbers in other larger remnants in the wider area but the species is unlikely to persist within the study area itself.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Tammar *Macropus eugenii derbianus*

Status and Distribution: Listed as Priority 4 by DPaW. Formerly widespread in SW WA and Eyre Peninsula SA, now reduced to tiny populations on the mainland and some offshore islands. Re-introduce in recent times to several national parks and sanctuaries along the Avon Valley including Walyunga National Park

Habitat: Inhabits dense coastal heath and scrub and some dry sclerophyll forest with dense patches of cover.

Likely presence in study area: Locally extinct.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Western False Pipistrelle *Falsistrellus mackenziei*

Status and Distribution: Listed as Priority 4 by DPaW. Listed as vulnerable by the ICUN. Confined to south west W.A. south of Perth and east to the wheat belt. Most records from Karri forests but also recorded in wetter stands of jarrah and tuart and woodlands on the Swan Coastal Plain (Menkhorst and Knight 2011). Range appears to be contracting southwards, presumably due to drying climate. Not recorded north of Collie in recent times (Bob Bullen 2010, pers. comm.)

Habitat: This species of bat occurs in high forest and coastal woodlands. It roosts in small colonies in tree hollows and forages at canopy level and in the cathedral-like spaces between trees.

Likely presence in study area: Rarely recorded in this area in recent times. Not listed as a potential species.

Potential impact of development: No impact on this species is anticipated.

Water Rat *Hydromys chrysogaster*

Status and Distribution: Listed as Priority 4 by DPaW. The water rat is widely distributed around Australia and its offshore islands, New Guinea and some adjacent islands. It occurs in fresh brackish water habitats in the south-west of Western Australia, but occurs in marine environments along the Pilbara coastline and offshore islands. Previous survey work in the south west suggested this species was relatively common and widespread though difficult to capture (Christensen *et al.* 1985, How *et al.*1987).

Habitat: The water rat occupies habitat near permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen *et al.* 1985).

Likely presence in study area: No suitable habitat.

Potential impact of development: No impact on this species will occur.

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