

Bindaring Park Bassendean - Fauna Assessment



Wetland habitat within Bindaring Park study area (Rob Browne-Cooper)

Prepared for: Coterra Environment
Level 3, 25 Prowse Street,
WEST PERTH, WA 6005

Prepared by: Robert Browne-Cooper and Mike Bamford
M.J. & A.R. Bamford Consulting Ecologists
23 Plover Way
KINGSLEY WA 6026



6th April 2017

Summary

Bamford Consulting Ecologists was commissioned by Coterra Environment to conduct a Level 1 fauna assessment (desktop review and site inspection) of Bindaring Park in Bassendean (the study area). The fauna survey is required to provide information on the ecological values for the Town of Bassendean's Stage 2 Bindaring Wetland Concept Plan Development. This plan include developing design options (within wetland area) to enhance ecological values and habitat.

The purpose of this report is to provide information on the fauna values of the habitat, particularly for significant species, and an overview of the ecological function of the site within the local and regional context. This assessment focuses on vertebrate fauna associated with the wetland and surrounding parkland vegetation within the study area, with consideration for connectivity with the Swan River. An emphasis is placed on locally-occurring conservation significant species and their habitat. Relevant species include Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo, and other local native species such as the Water Rat or Rakali.

The fauna investigations were based on a desktop assessment and a field survey conducted in February 2017. The desktop study identified 180 vertebrate fauna species as potentially occurring in the Bindaring Park study area (see Table 3 and Appendix 5): five fish, 6 frogs, 20 reptiles, 134 birds, 8 native and 7 introduced mammals. Note that this assemblage comes from databases and includes species that may occur occasionally on the site, but for which it is not important (such as birds that rarely fly overhead).

A total of 40 vertebrate species was recorded during the field survey. These were predominantly species of locally abundant birds that persist in urbanised settings and metropolitan wetland reserves

Key fauna values are:

Fauna assemblage. Depauperate and missing most of the most mammal fauna with the exception of small bat species and Rakali. Also low in richness of birds and reptiles.

Species of conservation significance. A large number of significant species may be present in the wider region, but for the majority of these there is little if any suitable habitat other than the wetland which may provide habitat for the Rakali. Significant species of note that are likely to occur on the site regularly include both the Forest Red-tailed and Carnaby's Black-Cockatoos, and Rakali. There is also a suite of birds recognised as declining in the Perth region and some of these were recorded as present.

Vegetation and Substrate Associations (VSAs). Four VSAs were identified. Most of the site contains open parkland (VSA 4) and remnant Flooded Gum trees (VSA 3). The lake and fringing vegetation (VSA 1) provides a small put important wetland habitat for urban wetland wildlife such as waterbirds, frogs and potentially the Rakali).

Patterns of biodiversity. Detailed patterns of biodiversity could not be examined, but it can be predicted that biodiversity will be concentrated in areas of even degraded native vegetation. The wetland, including the associated vegetation, are likely to be particularly important.

Key ecological processes. Main processes currently affecting the fauna assemblage in the survey area include habitat size and loss, connectivity and feral species (plants and animals), and local hydrology. Proximity and connectivity with the Swan River is important providing some degree of habitat linkage with this estuarine system. This linkage means the site is likely to have more species (especially birds) using the site regularly than might otherwise be the case, and it has a role in supporting biodiversity in nearby areas. Therefore connectivity with the River is an important local ecological process. Local hydrology may be important particularly if drainage causes short-term fluctuations in wetland water levels.

Recommendations relate to wetland and bushland management for fauna habitat value. These include:

- Further improve the quality and density of native vegetation cover, including the habitat linkage along the drainage line into the Swan River.
- Discourage the presence of feral species, particularly cats and foxes, by control measures and public awareness of responsible pet ownership. Some local government authorities have restrictions on cats near environmentally sensitive areas
- Maintain effective drainage through the lake and wetland habitat and into the Swan River; install signage into local residential streets and drains so that local residents are informed about the need to minimise domestic pollutants (herbicides, fertilisers, detergents, petroleum products) entering the wetland and River. If possible, monitor water level changes and determine if a natural cycle of seasonal rise and fall is taking place or can be established.
- Manage weeds long-term to replace weeds with native species, particularly wetland understorey and ground cover species such as sedge, native rushes and shrubs.
- Prevent the expansion of high risk species that are present such as Caster oil seedlings growing in the northeast corner of the study area.

Contents

Summary.....	i
Contents.....	iii
List of Tables	iv
List of Figures	v
List of Appendices	v
1 Introduction	6
1.1 Introduction.....	6
1.2 Description of Survey Area.....	6
1.3 Regional Description	7
2 Methods.....	9
2.1 Overview.....	9
2.2 Desktop Assessment	9
2.2.1 Sources of information	9
2.2.2 Previous Fauna Surveys.....	10
2.2.3 Nomenclature and taxonomy.....	10
2.2.4 Interpretation of species lists.....	11
2.3 Field Survey.....	12
2.3.1 Overview.....	12
2.3.2 Dates and Personnel.....	12
2.3.3 Vegetation and Substrate Associations.....	12
2.3.4 Black-Cockatoos.....	12
2.3.5 Rakali.....	13
2.3.6 Quenda.....	13
2.3.7 Opportunistic observations.....	13
2.4 Survey Limitations.....	13
3 Results.....	15
3.1 Vegetation and Substrate Associations.....	15
3.2 Vertebrate Fauna	17
3.2.1 Overview of fauna assemblage.....	17

3.2.2	Species of conservation significance	21
3.2.3	Introduced or feral species	23
3.2.4	Black-Cockatoo habitat assessment	24
3.2.4.1	Black-Cockatoo foraging habitat	24
3.2.4.2	Black-Cockatoo breeding habitat	25
3.2.4.3	Black-Cockatoo roosting habitat	26
3.3	Patterns of biodiversity	27
3.4	Ecological processes	28
3.5	Summary of Fauna Values	29
4	Recommendations	30
5	References	31
6	Appendices	35

List of Tables

Table 1.	Sources of information used for the desktop assessment.	10
Table 2.	Survey limitations as outlined by EPA (2004).	13
Table 3.	Composition of vertebrate fauna assemblage expected to occur in the study area.	19
Table 4.	Conservation status of significant fauna expected to occur within the study area.	20
Table 5.	Introduced fauna species expected to occur in survey area	23
Table 6.	Feral bee hive locations within the study area	24
Table 7.	Summary of potential nesting trees recorded within Study Area.	26
Table 8.	Species expected to occur in the survey area	48
Table 9.	Species returned in database searches which are unlikely to occur in the survey area.	55

List of Figures

Figure 1. Location of the Study Area	7
Figure 2. IBRA Subregions of Western Australia	8
Figure 3. Vegetation and Substrate Associations.....	17
Figure 4. Black Cockatoo and Water Rat habitat values.....	27

List of Appendices

Appendix 1. Black-cockatoos background information.....	35
Appendix 2. Explanation of fauna values.....	42
Appendix 3. Categories used in the assessment of conservation status.....	45
Appendix 4. Ecological and threatening processes identified under legislation and in the literature.....	46
Appendix 5. Vertebrate Fauna expected to occur in the Upper Swan site.....	48
Appendix 6. Vertebrate species returned in database searches but unlikely to occur in survey area.	55
Appendix 7. Scoring system for the assessment of Black-Cockatoo foraging values.....	57
Appendix 8. Grading system used to assess potential nest trees for Black-Cockatoos.....	59
Appendix 9. Black cockatoo potential nest tree data.....	60
Appendix 10. Annotated list of fauna recorded during the field survey.....	62
Appendix 11. Additional photographs taken within the study area.....	63

1 Introduction

1.1 Introduction

Bamford Consulting Ecologists was commissioned by Coterra Environment to conduct a Level 1 fauna assessment (desktop review and site inspection) of Bindaring Park in Bassendean (the study area). The fauna survey is required to provide information on the ecological values for the Town of Bassendean's Stage 2 Bindaring Wetland Concept Plan Development. This plan includes developing design options (within wetland area) to enhance ecological values and habitat.

The purpose of this report is to provide information on the fauna values of the habitat, particularly for significant species, and an overview of the ecological function of the site within the local and regional context. This assessment focuses on vertebrate fauna associated with the wetland and surrounding parkland vegetation within the study area, with consideration for connectivity with the Swan River. An emphasis is placed on locally-occurring conservation significant species and their habitat. Relevant species include Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*, Forest Red-tailed Black-Cockatoo *Calyptorhynchus banksii naso*, and other local native species such as the Water Rat or Rakali *Hydromys chrysogaster*.

1.2 Description of Survey Area

The study area is located approximately 10 kilometres east-north-east of Perth CBD (see Figure 1) within the Town of Bassendean. The study area is within residential Bassendean and lies on an alluvial plain immediately north-west of the upper reaches of the Swan River. Drainage from the surrounding urban area flows into the lake within the study area and then feeds into the Swan River via a small creekline. This creekline meanders through the study area and drains into the Swan River in an approximately south-west direction, although the creek was not flowing at the time of the site inspection. The site is approximately 580 metres in length and 430 metres in width. It consists of parkland, a wetland and the associated drainage creekline.

The lake within study area supports native wetland vegetation including flooded gums, paperbark, sheoak trees, and emergent reeds and sedges, as well as numerous exotic grasses and other weeds. The open parkland around the lake includes remnant flooded gums and patches of exotic eucalypt trees, and conifers.

The geography of the site is described as alluvial plain of the Pinjarra Plain with grey-brown clayey-loams. Sandy substrate within parkland areas may have been introduced for lawn growth. Being situated adjacent to the upper Swan River, the study area is subject to occasional flooding with a 20 year flood level of approximately 1.8 metres indicated.

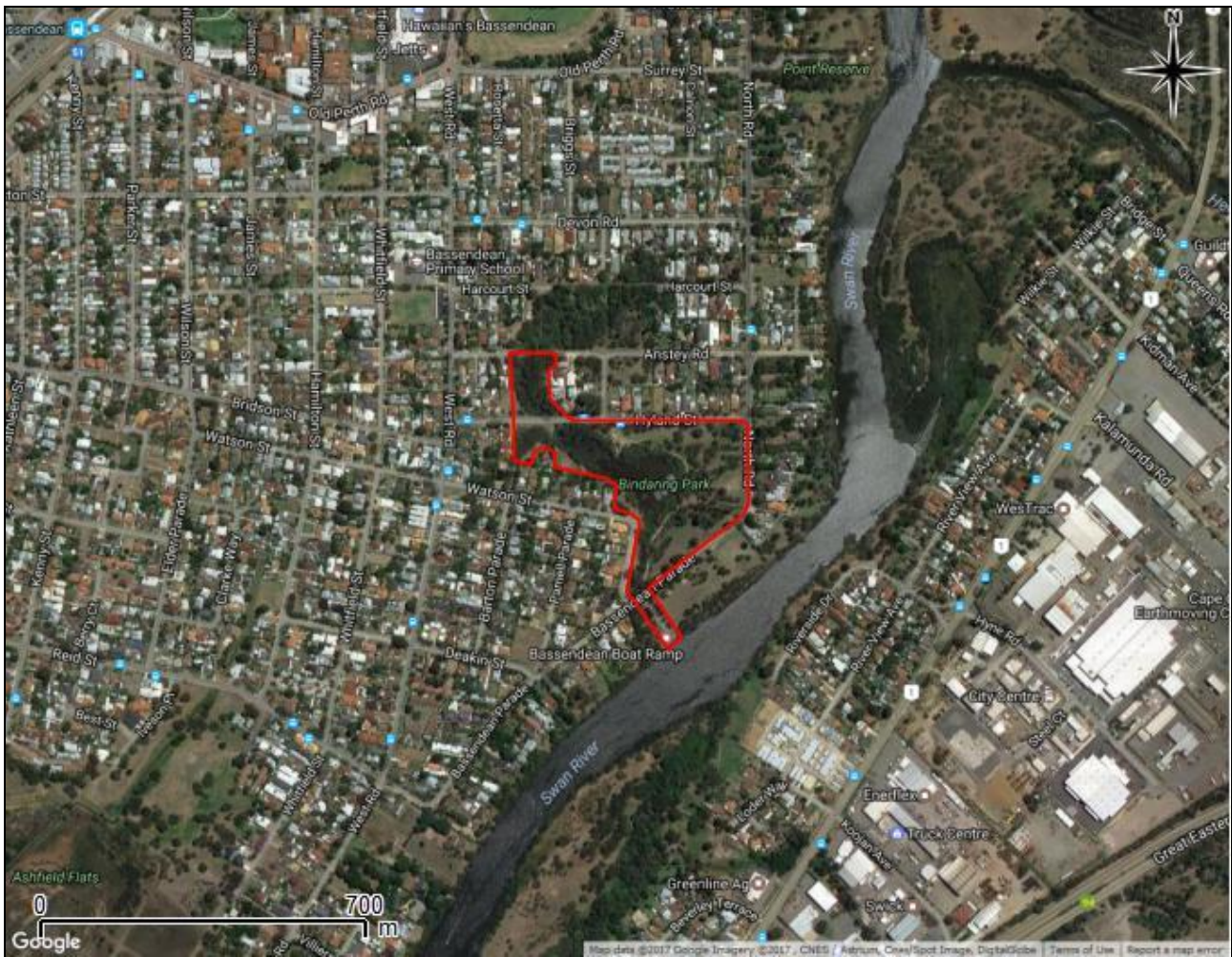


Figure 1. Location of the Study Area

1.3 Regional Description

The Interim Biogeographic Regionalisation of Australia (IBRA) (Environment Australia, 2000) has identified 26 bioregions in Western Australia which are further divided into subregions. Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell, 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA, 2004). The Survey Area lies in the Swan Coastal Plain Perth Subregion (DSEWPac 2012) as shown in Figure 2.

The subregion is broadly characterised by 'low lying coastal plain covered with woodland dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The subregion is composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone' (Mitchell *et al.* 2002). The site is distinctive as it lies on the eastern edge of the sub-region (thus close to the Darling Escarpment) and the soils are those of an alluvial river flat.

The Swan Coastal Plain Perth Subregion is extensively developed. The site is a remnant area of swampy bushland with cleared portions having remnant Flooded Gum and exotic trees.

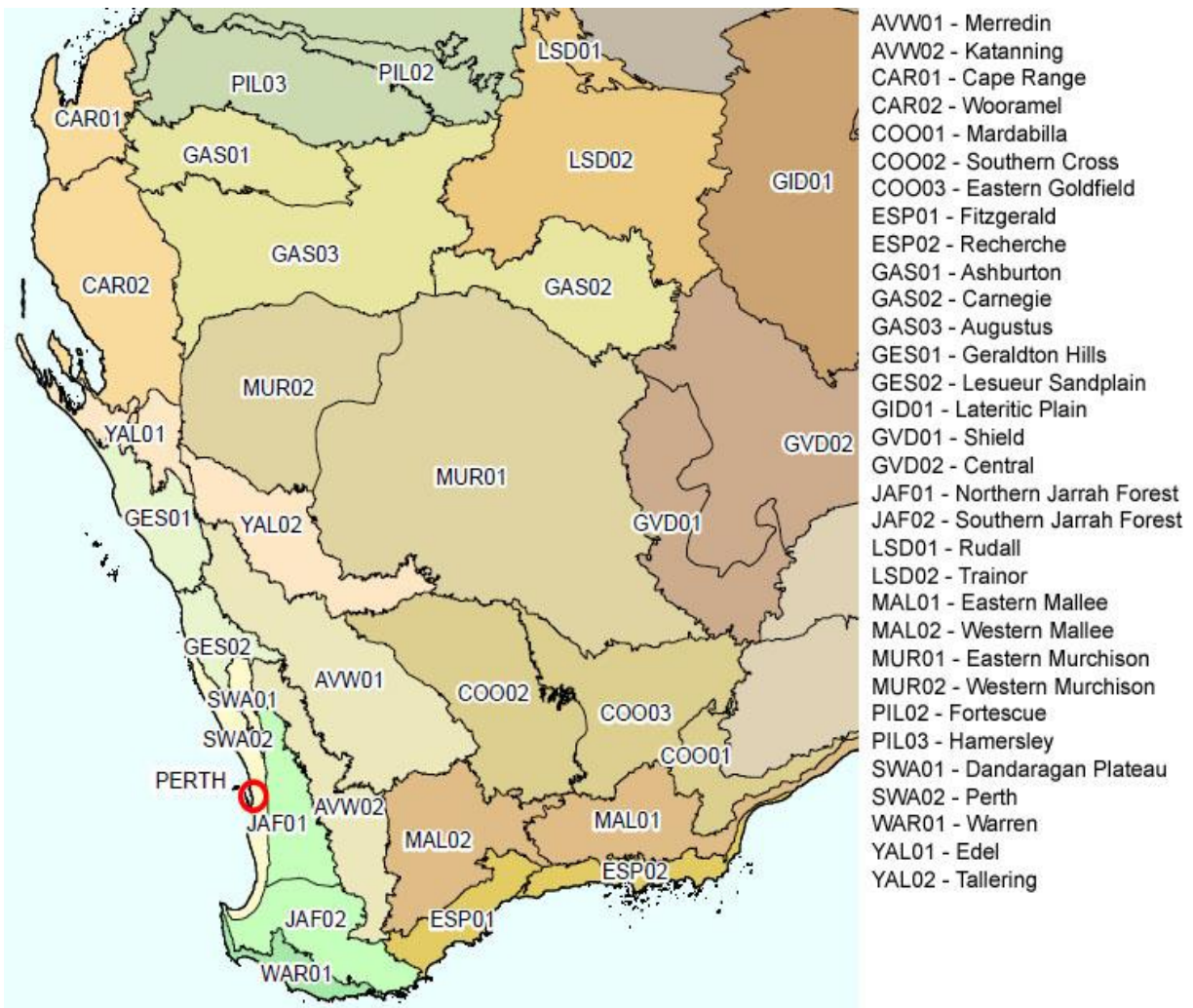


Figure 2. IBRA Subregions of Western Australia

Note that the study area lies in the SWA02 IBRA subregion.

2 Methods

2.1 Overview

The approach to fauna impact assessment was carried out with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection, and Commonwealth biodiversity legislation (EPA 2002; EPA 2004). The EPA proposes two levels of investigation that differ in the approach to field investigations, Level 1 being a review of data and a site reconnaissance to place data into the perspective of the site, and Level 2 being a literature review and intensive field investigations (e.g. trapping and other intensive sampling). The level of assessment recommended by the EPA is determined by the size and location of the proposed disturbance, the sensitivity of the surrounding environment in which the disturbance is planned, and the availability of pre-existing data.

The following approach and methods is divided into three groupings that relate to the stages and the objectives of the fauna assessment:

- Desktop assessment. The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the study area based on unpublished and published data using a precautionary approach.
- Field investigations. The purpose of the field investigations is to gather information on this assemblage: confirm the presence of as many species as possible (with an emphasis on species of conservation significance), place the list generated by the desktop review into the context of the environment of the study area, collect information on the distribution and abundance of this assemblage, and develop an understanding of the study area's ecological processes that maintain the fauna. Note that field investigations cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more sampling over multiple years and seasons. For example, in an intensive trapping study, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford (2010) has found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling.

2.2 Desktop Assessment

2.2.1 Sources of information

Information on the fauna assemblage of the survey area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies. Databases accessed were the DPaW NatureMap (incorporating the Western Australian Museum's FaunaBase and the DPaW Threatened and Priority Fauna Database), BirdLife Australia's Atlas Database (BA), the EPBC Protected Matters Search Tool and the BCE database (Table 1). Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

- Frogs: Tyler and Doughty (2009) and Anstis (2013);
- Reptiles: Storr *et al.* (1983, 1990, 1999, 2002); and Wilson and Swan (2013);
- Birds: Blakers *et al.* (1984); Johnstone and Storr (1998, 2004) and Barrett *et al.* (2003); and

- Mammals: Menkhorst & Knight (2004); Churchill (2008); and Van Dyck and Strahan (2008).

Table 1. Sources of information used for the desktop assessment.

Database	Type of records held on database	Area searched
NatureMap (DPaW 2017)	Records in the WAM and DPaW databases. Includes historical data and records on Threatened and Priority species in WA.	Point search: 115° 57' 30" E by 31° 54' 40" S plus 10 km buffer. Searched February 2017
BirdLife Australia Atlas Database (Birdlife Australia 2017)	Records of bird observations in Australia, 1998-2014.	Point search: 115° 57' 30" E by 31° 54' 40" S plus 10 km buffer. Searched February 2017
EPBC Protected Matters (DotE 2017)	Records on matters of national environmental significance protected under the EPBC Act.	Point search: 115° 57' 30" E by 31° 54' 40" S plus 10 km buffer. Searched February 2017
Atlas of Living Australia (ALA 2017)	Records in the ALA, and various State Government agency. Includes historical data and records on Threatened and Priority species in WA.	Point search: 115° 57' 30" E by 31° 54' 40" S plus 10 km buffer. Searched February 2017
Birdlife Australia Great Cockey Count roost data 2010 to 2014 (Unpublished data)	Black Cockatoo roost sites (confirmed, potential, and unconfirmed)	Roost site locations within Swan Shire.

2.2.2 Previous Fauna Surveys

The desktop assessment included a review of a fauna survey conducted by Basnett and Bamford (2014) in Bayswater approximately 2 km south-west of the study area. The report provides data on locally occurring terrestrial vertebrate assemblages recorded in a proximal site along the Swan River.

2.2.3 Nomenclature and taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2016. English names of species, where available, are used throughout the text; Latin species names are presented with corresponding English names in tables in the appendices.

2.2.4 *Interpretation of species lists*

Species lists generated from the review of sources of information are generous as they include records drawn from a large region and possibly from environments not represented in the survey area. A number of these species can be discounted based on the historical nature of some data for locally extinct species, highly urbanised surroundings, and small size of the study area. Therefore, some species that were returned by one or more of the data searches have been excluded because their ecology, current distribution or the environment within the survey area, meant that it was highly unlikely that these species would be present.

Even though the Swan River is not within the study area boundary, there is a hydrological link between the two via a creekline, and the close proximity means that a number of estuarine species are considered in this assessment due to their potential occurrence. Fauna species returned by the desktop review that are associated with the upper Swan River are considered to be potentially present in the study area whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. Species returned from databases but excluded from species lists as unlikely to occur are presented in Appendix 6.

Interpretation of species lists generated through the desktop review included assigning an expected status within the survey area to species of conservation significance. This is particularly important for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive. The status categories used are:

- Resident: species with a population permanently present in the survey area;
- Regular migrant or visitor: species that occur within the survey area regularly in at least moderate numbers, such as part of annual cycle;
- Irregular Visitor: species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the survey area in at least moderate numbers and for some time;
- Vagrant: species that occur within the survey area unpredictably, in small numbers and/or for very brief periods. Therefore, the survey area is unlikely to be of importance for the species; and
- Locally extinct: species that has not been recently recorded in the local area and therefore is almost certainly no longer present in the survey area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times, or may have been previously confirmed as present. The status categories are assigned conservatively. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence that the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals.

2.3 Field Survey

2.3.1 Overview

The field survey included several components:

- identification of VSAs;
- targeted searching for conservation significant fauna, particularly Rakali, black-cockatoos species and Quenda;
- assessment of the site for black-cockatoo habitat values (foraging, breeding and roosting), and
- opportunistic fauna observations.

2.3.2 Dates and Personnel

The study area was visited on the 23rd of February 2017 by Mr Robert Browne-Cooper (B.Sc) who also prepared the fauna assessment report together with Dr Mike Bamford (B.Sc. Hons. Ph.D.).

2.3.3 Vegetation and Substrate Associations

Vegetation and Substrate Associations (VSAs) within the study area were assessed as part of the field investigations. All major or remnant VSAs were visited to develop an understanding of major fauna habitat types present, their extent and connectivity to assess the likelihood of conservation significant species being present.

2.3.4 Black-Cockatoos

Ecological values for Black-Cockatoos were assessed based on the definitions of breeding, foraging and roosting habitat as defined the EPBC Act referral guidelines for black cockatoos (DSEWPaC, 2012), with foraging and nesting values assessed using systems developed by Bamford Consulting (outlined below).

Foraging habitat assessment

Black-cockatoos, particularly Carnaby's Black-Cockatoo and the Forest Red-tailed Black-Cockatoo, forage widely in suitable vegetation in the Perth region and leave distinctive chew marks on dropped feeding material such as Marri and jarrah pods, banksia cones, as well as exotic food sources such as pine cones and cape lilac berries. Targeted searches were made for these signs below potential foraging habitat within the study area. The areas of remnant vegetation within the site were assessed for foraging value based on the method outlined in Appendix 7. Foraging habitat value was then mapped (Figure 4).

Breeding habitat assessment

The EPBC Act referral guidelines for black cockatoos (DSEWPaC, 2012) lists tree species known to be nesting habitat including Flooded Gum trees present within the study area. These trees were assessed for Black-Cockatoo breeding activity and potential tree suitability for nesting. For all trees with a trunk diameter (DBH) greater than 50 cm the following data was recorded:

- Tree species;
- GPS waypoint location;
- DBH;
- Tree status (alive or dead);
- presence of any competing species present (e.g. feral bees, corella)
- Tree class in terms of Black-Cockatoo nest potential (refer to Appendix 8).

Data on potential breeding trees is presented in Appendix 9 and locations shown in Figure 4.

Roosting habitat assessment

Vegetation was assessed for roosting habitat potential based on tree species present and canopy height, and on the occurrence of local confirmed or potential roosting sites (based upon records from the Great Cocky Count (Finn *et al.* 2014) which is a collation of roost data recorded frog 2010 to 2014.

2.3.5 *Rakali*

The Rakali or Water Rat *Hydromys chrysogaster* is a mammal of conservation significance that is expected to occur within the Bindaring Park study area. This species can be detected based on signs of activity within swampy areas. Targeted searches were carried out looking for feeding residue and foot prints in areas of suitable wetland habitat.

2.3.6 *Quenda*

The Quenda or Southern Brown Bandicoot *Isodon obesulus* is a mammal of conservation significance that is known to persist in metropolitan bushland reserves. It leaves distinctive foraging excavations and also leaves distinctive tracks particularly in firm moist sandy substrates. Targeted searches for tracks and diggings were made.

2.3.7 *Opportunistic observations*

At all times, observations of fauna were noted when they contributed to the accumulation of information on the fauna of the site. These included such casual observations as birds or reptiles seen while walking through the study area. Other observations included introduced species (i.e. feral bees, foxes etc) and potential weeds that may be management considerations.

2.4 Survey Limitations

The EPA Guidance Statement 56 (EPA 2004) outlines a number of limitations that may arise during surveying. These survey limitations are discussed in the context of the BCE fauna survey at the survey area in Table 2.

Table 2. Survey limitations as outlined by EPA (2004).

EPA Limitation	BCE Comment
Level of survey.	Level 1 (desktop study with site assessment). Survey intensity was deemed adequate due to the small area, availability of previous data base records, and studies in the region.
Competency/experience of the consultant(s) carrying out the survey.	The authors have had extensive experience in conducting desktop reviews and have conducted multiple fauna surveys in the Perth Region with surveys focussed on relevant local considerations including wetland management, black cockatoos assessment, quenda and Rakali.

EPA Limitation	BCE Comment
Scope. (What faunal groups were sampled, and were some sampling methods not able to be employed because of constraints?)	The site investigation targeted descriptions of the environment and fauna values for the significant species potentially occurring or known to occur.
Proportion of fauna identified, recorded and/or collected.	Key significant species were identified and the desktop provided information on other species.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include a previous fauna survey in the Bullsbrook area (Basnett and Bamford 2014) and databases (BA, DPaW, EPBC, BCE database).
The proportion of the task achieved and further work which might be needed.	This report provides fauna values for significant species.
Timing/weather/season/cycle.	There were no constraints from the weather and conditions allowed personnel to move around readily.
Disturbances (e.g. fire, flood, accidental human intervention etc.) that affected results of survey.	None.
Intensity. (In retrospect, was the intensity adequate?)	All major VSAs were visited and significant species habitat and traces were identified.
Completeness (e.g. was relevant area fully surveyed).	Site was fully surveyed.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Field personnel have extensive experience with fauna detection and habitat assessment in the region.
Remoteness and/or access problems.	There were no remoteness/access problems encountered.
Availability of contextual (e.g. biogeographic) information on the region.	Extensive regional information was available and was consulted.

3 Results

3.1 Vegetation and Substrate Associations

Four Vegetation and Substrate Associations (VSAs) were identified across the study area. The location and extent of VSAs are shown in Figure 3, and Plates 1 to 4. The VSAs include:

- VSA1 - Wetland. This VSA includes the main lake, peripheral swampy areas, and the creek that feeds into the Swan River. Wetland vegetation includes the associated emergent and fringing vegetation of Melaleuca, Casuarina, occasional Flooded Gum, reeds, sedges, and exotic grasses such as Kykuyu and Couch, and other low weeds. This VSA includes some small areas of native vegetation plantings on the edge of the lake.
- VSA2 - Exotic tree plantings. Small patches or individual trees including pines, conifers, non-native eucalypt tree, cape lilac. Woodland lacking understorey and with ground layer of exotic grasses and other pasture weed on alluvial clay soil.
- VSA3 - Open Flooded Gum Parkland. Sparse Flooded Gum parkland areas over mown grass and low weeds on alluvial loam clay soil. Effectively an open woodland with no understorey over exotic grasses and other pasture weed on alluvial clay soil.
- VSA4 - Cleared open space. Areas of mown grasses and low weeds with little or no Flooded Gums present on clay loam and sandy areas.

Plate 1. VSA 1 – Wetland.



Plate 2. VSA 2 – Exotic tree plantings.



Plate 3. VSA 3 - Open Flooded Gum woodland.



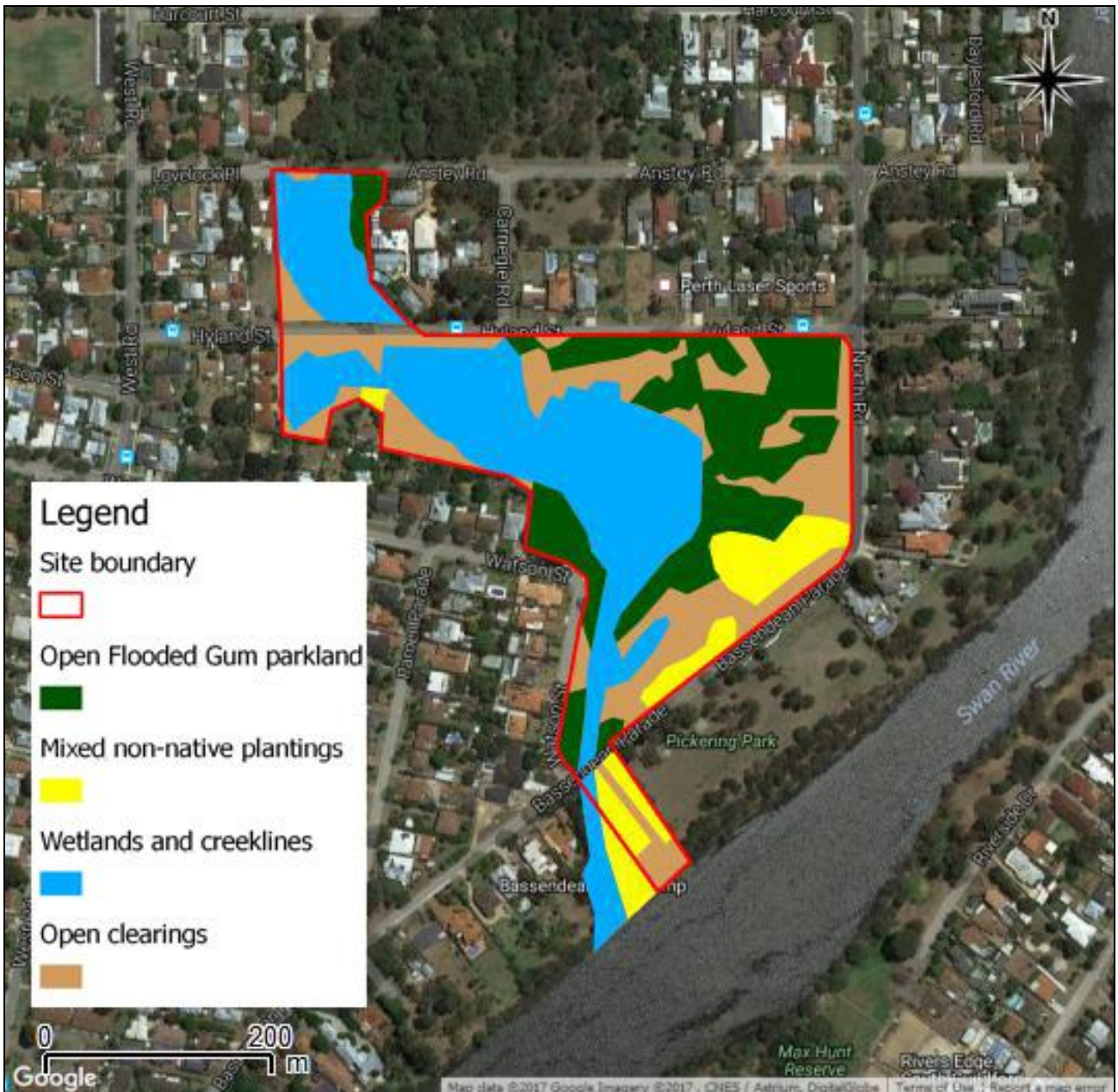


Figure 3. Vegetation and Substrate Associations

3.2 Vertebrate Fauna

3.2.1 Overview of fauna assemblage

The desktop study identified 180 vertebrate fauna species as potentially occurring in the Bindaring Park study area (see Table 3 and Appendix 5): five fish, 6 frogs, 20 reptiles, 134 birds, 8 native and 7 introduced mammals. Fauna observed during the field visit are listed in Appendix 5, and an annotated list of fauna species recorded is included in Appendix 10. A total of 40 vertebrate species was recorded during the field survey. These were predominantly species of locally abundant birds that persist in urbanised settings and metropolitan wetland reserves.

No native fish species were recorded although four native species that can be expected seasonally are Western Minnow *Galaxia occidentalis*, and Swan River Goby *Pseudogobius olorum*. Introduced fish species recorded are detailed in the section below.

In addition to the two recorded frog species, several other common local species are likely to occur such as the Motorbike Frog and Ticking Frog. Other regionally occurring frog species are unlikely to occur due to the lack of suitable extensive wetland habitat, and changes to the natural flood cycles of urban wetlands caused by drainage alterations.

The paucity of low strata vegetation in the parkland and open space areas limits the reptile species assemblage expected to occur, although several reptiles known to persist in highly degraded environments were recorded such as the Snake-eyed (fence) Skink, Common Dwarf Skink and Two-toed Earless Skink. Another common local species associated with wetland habitat and likely to occur is the Western Three-lined Skink.

Of the 34 bird species recorded, many are common waterbirds that are expected to be residents or regular visitors to the wetland within Bindaring Park such as Yellow-billed Spoonbill, Australasian Grebe, Pink-eared Duck, White-faced Heron and Dusky Moorhen. Several woodland birds that persist in remnant local bushland were recorded including the Red-capped Parrot, Western Gerygone, Rufous Whistler, Striated Pardalote and Grey Fantail.

Native mammals potentially occurring include Common Brush-tail Possum, and several common local bats such as Gould's Wattleed Bat. The Rakali (Water Rat) potentially inhabits or regularly visits the wetland environment (see section 3.2.2). No signs of Quenda were detected, and this species is unlikely to be present within the study area.

The vertebrate assemblage potentially includes 41 species of conservation significance (

Table 4). For all significant species listed, comments are included regarding the expected type or frequency of occurrence. The desktop review also returned many species that do not occur in the site, such as locally extinct species and migratory shorebirds known to occur locally in tidal areas of the Swan-Canning River system. These are listed in Appendix 6.

The overall fauna assemblage reflects the impact of historical habitat loss and introduced species, as well as the level of resilience of a number of species that persist in urban and parkland settings locally and more widely across Swan Coastal subregion. Key features of the fauna assemblage expected in the survey area are:

- **Uniqueness:** The assemblage is likely to be typical of local remnant small wetlands and parklands along the Swan-Canning River system and in the eastern portion of the Swan Coastal Plain.
- **Completeness:** The assemblage of species from the study area has a paucity of native mammals, reptile and bird species. Some frogs may also be absent. Some smaller woodland bird species make use of the site based on species recorded during the field assessment. Waterbirds are well-represented due to presence of the wetland and proximity to Swan River. Many of the species from all fauna classes listed (fish, frogs, reptiles, birds and mammals) are associated with the lake and associated wetland vegetation or surrounding Flooded Gum trees.
- **Richness:** The assemblage is likely to vary annually and seasonally. The degraded condition of much of the survey area means some species may be absent or uncommon visitors. Overall, the site has low species richness compared with pre-disturbance levels, but is locally rich in species due to the extent or surrounding urbanisation.

Table 3. Composition of vertebrate fauna assemblage expected to occur in the study area.

Note: Values in parenthesis are numbers of introduced species included in the total. CS – Conservation Significance.

Taxon	Number of species expected	Significant fauna expected		
		CS1	CS2	CS3
Fish	5	0	0	0
Frogs	6	0	0	0
Reptiles	20	0	0	0
Birds	134 (34)	16	1	21
Native Mammals	8 (3)	0	2	1
Introduced Mammals	7	-	-	-
Total	180 (37)	16	3	22

Table 4. Conservation status of significant fauna expected to occur within the study area.

See Appendix 3 for descriptions of conservation significance levels. Species recorded are indicated and the predicted status of each species in the survey area is also given (as per Section 3.2.2). *Presence inferred from foraging residue (chewed seed pods).

EPBC Act listed species: V = Vulnerable, E = Endangered, C = Critically Endangered, M = Migratory.

WC Act listed species: S1 – S7 = Schedule 1 - 7, DEC Priority Species: P1 - P5 = Priority 1 - 5.

Species	Conservation Significance			Expected status in Study area
	CS1	CS2	CS3	
Blue-billed Duck <i>Oxyura australis</i>		P4		occasional visitor
Musk Duck <i>Biziura lobata</i>			X	regular visitor
Pink-eared Duck <i>Malacorhynchus membranaceus</i>			X	regular visitor. Recorded
Freckled Duck <i>Stictonetta naevosa</i>			X	Occasional visitor
White-necked Heron <i>Ardea pacifica</i>			X	occasional visitor
Eastern Great Egret <i>Ardea modesta</i>	M, S5			regular visitor
Cattle Egret <i>Ardea ibis</i>	M, S5			vagrant
Little Egret <i>Egretta garzetta</i>	M, S5			occasional visitor
Grey Plover <i>Pluvialis squatarola</i>	M, S5			vagrant
Common Sandpiper <i>Acticus hypoleucos</i>	M, S5			occasional visitor
Red-necked Stint <i>Calidris ruficollis</i>	M, S5			vagrant
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	M, S5			vagrant
Curlew Sandpiper <i>Calidris ferruginea</i>	M, E, S5			vagrant
Common Greenshank <i>Tringa nebularia</i>	M, S5			occasional visitor
Caspian Tern <i>Hydroprogne caspia</i>	M, S5			occasional visitor
Common Bronzewing <i>Phaps chalcoptera</i>			X	occasional visitor
Fork-tailed Swift <i>Apus pacificus</i>	M, S5			migrant
Brown Goshawk <i>Accipiter fasciatus</i>			X	occasional visitor
Collared Sparrowhawk <i>Accipiter cirrhocephalus</i>			X	occasional visitor
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>			X	occasional visitor
Little Eagle <i>Hieraaetus morphnoides</i>			X	occasional visitor
Peregrine Falcon <i>Falco peregrinus</i>	S7			occasional visitor
Carnaby's Black-Cockatoo <i>Calyptorhynchus latirostris</i>	E, S2			regular visitor. Recorded*
Baudin's Black-Cockatoo <i>Calyptorhynchus baudinii</i>	V, S2			occasional visitor
Forest Red-tailed Black-Cockatoo <i>C. banksii naso</i>	V, S3			regular visitor. Recorded
Rainbow Bee-eater <i>Merops ornatus</i>	S5			migrant. Recorded
Splendid Fairy-wren <i>Malurus splendens</i>			X	occasional visitor
White-winged Fairy-wren <i>Malurus leucopterus</i>			X	occasional visitor
White-browed Scrubwren <i>Sericornis frontalis</i>			X	occasional visitor
Weebill <i>Smicronis brevirostris</i>			X	Resident. Recorded
Inland Thornbill <i>Acanthiza apicalis</i>			X	vagrant
Yellow-rumped Thornbill <i>Acanthiza chrysorrhoa</i>			X	occasional visitor
Western Wattlebird <i>Anthochaera lunulata</i>			X	occasional visitor
White-cheeked Honeyeater <i>Phylidonyris nigra</i>			X	occasional visitor
New Holland Honeyeater <i>P. novaehollandiae</i>			X	regular visitor. Recorded
Rufous Whistler <i>Pachycephala rufiventris</i>			X	regular visitor. Recorded
Varied Sittella <i>Daphoenositta chrysoptera</i>			X	vagrant
Black-faced Woodswallow <i>Artamus cinereus</i>			X	vagrant
Common Brush-tail Possum <i>Trichosurus vulpecula</i>			X	occasional visitor
Western False Pipistrelle <i>Falsistrellus mackenziei</i>		P4		occasional visitor
Rakali or Water Rat <i>Hydromys chrysogaster</i>		P4		occasional visitor

3.2.2 *Species of conservation significance*

Details on species of conservation significance returned from the database and expected (including those recorded) to occur in the survey area (even as vagrants) are presented in Table 4. This list includes 15 CS1 species, 3 CS2 species and 21 CS3 species. Note that species extinct within the region and that may have been present historically on the basis of broad patterns of distribution, and species highly unlikely to be present based on their biology, have not been included but are presented in Appendix 6.

The suite of significant species includes many that are expected to occur only as vagrants or occasional visitors (Table 4), and thus for which the study area is of low ecological importance. Other species and groups of species may utilise the study area more regularly and are discussed below.

Black-Cockatoos

Foraging signs of both Forest Red-tailed and Carnaby's Cockatoos were found in the study area, and both species are likely to be regular visitors to the site as they are known to occur locally and regionally on the Perth Swan Coastal Plain and Darling Range. The site also contains potential nesting trees for Black-Cockatoos based on the definition within the EPBC Act referral guidelines (DSEWPaC 2012). Details about habitat values of the site for Black-Cockatoos are presented in Section 3.2.4.

Migratory Wetland Birds

This group includes three egret species, a plover, several sandpipers and one tern, although only the Eastern Great Egret is expected to be present regularly. The Bindaring Park wetland lacks extensive areas of shallow water or mud flats favoured by most of the sandpipers, while the Little and Cattle Egrets generally occur only occasionally and in small numbers around Perth.

Fork-tailed Swift

A summer migrant species that can occur aerially over a wide range of environments throughout much of coastal and inland Australia. This species does not breed in Australia, but may occur on an occasional basis on the Perth Swan Coastal bioregion. It exists largely independently of terrestrial ecosystems.

Peregrine Falcon

This species is known to occur over a wide range of environments throughout most of Australia. Preferred nesting locations include a range of highly elevated location with steep topography such as rocky hills, breakaways, cliffs and will also nest on high artificial structures. It will also nest in very large, horizontally-aligned tree hollows, with such a nest in Whiteman Park (M. Bamford pers. obs.). The Bindaring Park site could therefore provide a suitable nesting site within the mature eucalypt trees, and is at least likely to be within the foraging range of a pair of the species who would thus be regular visitors.

Rainbow Bee-eater

Until recently listed as migratory under the EPBC Act, and still listed as Schedule 5 (migratory) under the WA *Wildlife Conservation Act*, this species is a common summer migrant that breeds in the Perth area. The site represents foraging habitat, and the open clearings (VSA 4) are potential breeding habitat. This species is widespread and frequently uses areas cleared of native vegetation and other disturbed environments.

Conservation Significance level 3 birds

This suite of birds is considered to be of local conservation significance (CS3) because they have been identified in the Bush Forever Report (Dell and Banyard 2000) as declining in the Perth region and being reliant on native vegetation. For many of the species this conclusion has been reinforced by Davis *et al.* (2012). These are species reliant to varying degrees on large and interconnected areas of native vegetation within the urban landscape. They make up a large proportion of the significant birds that may use remnant vegetation within the Bindaring Park site. Three of these species (Weebill, New Holland Honey-eater, and Rufous Whistler) were observed in the survey area (

Table 4). In addition, a pair of Pink-eared Ducks was observed within the open water of the lake (VSA 1), and the other four CS3 species were heard calling within the woodland habitat of the Bindaring Park (VSA 3).

Rakali

This species was not recorded during the field survey, but is likely to be a resident or frequent visitor to Bindaring Park due to close proximity to the Swan River, and the suitable dense wetland vegetation (VSA 1) which is mapped in Figure 4. Databases have recorded this species on the Swan River near the Garret Road Bridge (Bamford Consulting database). Bindaring Park was not included in the recent Rakali survey conducted by WWF and DPaW (Trocini *et al.* 2015), but that survey did confirm the presence of the species at multiple locations around Perth.

Western False Pipistrelle

May occur in nearby forest to east and individuals could occasionally fly along the Swan River. The site itself provides virtually no habitat for this species.

3.2.3 *Introduced or feral species*

The desktop study identified 16 introduced fauna species as potentially occurring in the Bindaring Park study area (Table 5). No evidence of the European Red Fox or Rabbit were observed within the site, however both species commonly occur in urban parkland and bushland areas. Domestic and feral cats are also highly likely to frequently hunt within Bindaring Park. Mosquito Fish *Gambusia holbrooki* were found to be abundant within the lake and other feral fish such as carp potentially occur. Feral bee hives were found to be occupying a number of tree hollows within the study area. The location and description of each is provided in Table 6.

Table 5. Introduced fauna species expected to occur in survey area

This list is based on desktop review and field investigation and includes species either recorded or expected to occur.

Common Name	Latin Name	Expected Status
FISH		
Goldfish	<i>Carassius auratus</i>	Resident
Carp	<i>Cyprinus carpio</i>	Possible resident, Ellen Brook
Mosquito Fish	<i>Gambusia holbrooki</i>	Resident (recorded)
BIRDS		
Eastern Long-billed Corella	<i>Cacatua tenuirostris</i>	Visitor
Rock Dove	<i>Columba livia</i>	Visitor
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Resident (recorded)
Spotted Turtle-Dove	<i>Streptopelia chinensis</i>	Resident
Laughing Turtle-Dove	<i>Streptopelia senegalensis</i>	Resident (recorded)
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	Regular visitor (recorded)
MAMMALS		

Common Name	Latin Name	Expected Status
Domestic Dog	<i>Canis lupus familiaris</i>	Resident (recorded)
Feral Cat	<i>Felis catus</i>	Resident (recorded)
House Mouse	<i>Mus musculus</i>	Resident
Rabbit	<i>Oryctolagus cuniculus</i>	Resident
Brown Rat	<i>Rattus norvegicus</i>	Resident
Black Rat	<i>Rattus rattus</i>	Resident (recorded)
European Red Fox	<i>Vulpes vulpes</i>	Resident

Table 6. Feral bee hive locations within the study area

Waypoint coordinates	Description
50 J 401488 6468765	feral bee hive in non-native Eucalyptus tree
50 J 401277 6469138	feral bee hive in Melaleuca tree hollow
50 J 401272 6469126	feral bee hive in Flooded Gum tree hollow
50 J 401624 6469005	feral bee hive in Flooded Gum tree hollow
50 J 401273 6469153	feral bee hive in Flooded Gum tree hollow

3.2.4 Black-Cockatoo habitat assessment

3.2.4.1 Black-Cockatoo foraging habitat

Each of the VSAs in the survey area was assessed and scored for black-cockatoo foraging value based on the abundance of forage species present. Foraging value was assigned to each VSA for any black-cockatoo species. The scoring system appears in Appendix 7 while Appendix 1 lists plant species used for foraging by black-cockatoos. Results are mapped on Figure 4.

The bulk of the site is of negligible or very low foraging value (score of 1). Low foraging value areas include non-native Eucalypt trees and Flooded Gum open parkland having low ranked foraging species present. Pine trees are mapped as low-to moderate foraging value (score of 3) based on the small area and low density of trees. Frequency with which black-cockatoos visit the site for foraging will depend on the success of flowering and pollination, and consequently seed production, and this will vary from year to year. Appendix 11 illustrates recently chewed Pine cones and Cape Lilac berries found in the study area, indicating visits by both Carnaby's and Forest Red-tailed Black-Cockatoos.

Both Forest Red-tailed and Carnaby's Black-Cockatoos are likely to be regular visitors to the site as both species are known to occur locally and regionally on the Perth Swan Coastal Plain and Darling Range. Throughout the Perth metropolitan area, very small patches know foraging tree species, and even individual trees, including non-native species, are important foraging resources for both these black-cockatoos.

3.2.4.2 *Black-Cockatoo breeding habitat*

Within Bindaring Park, 50 potential nesting trees were recorded during the field survey. These are all Flooded Gums as summarised in Table 7 and shown in Figure 4. Appendix 9 provides details including coordinates and a potential nesting value score for each tree. The potential nesting tree scoring system is outlined in Appendix 8. All of the listed trees are alive and have a DBH greater than 500 mm as per the Commonwealth guidelines (DSEWPaC 2012). The majority of these trees scored a 5 (no hollows but tree of a suitable size), but there were two Flooded Gums recorded with visible potential nest hollows of suitable size (score of 3). Breeding tree suitability not only depends on hollow characteristics, but also on quality and quantity of nearby foraging habitat available during breeding. In addition, tree species is an important consideration, i.e. Some tree species such as Wandoo and Marri are considered to be of primary or high breeding value (favoured tree species) for Carnaby's and Forest Red-tailed Black-Cockatoos respectively. Flooded Gums are considered as secondary breeding value for black-cockatoos.

Table 7. Summary of potential nesting trees recorded within Study Area.

nesting value score	Number of trees
3. Potential nest hollows of suitable size and inclination visible	2
4. Potential but marginally suitable (non-preferred) hollows visible	3
5. Tree of suitable size but no hollows visible or considered likely because of tree structure	45

3.2.4.3 *Black-Cockatoo roosting habitat*

Black-Cockatoos tend to have traditional roosting sites, often large trees close to water, and these have been documented in the Great Cocky Count (Finn *et al.* 2014). There are no known roost trees within Bindaring Park although this park does have the characteristics that make it a potential roost, such as tall trees and adjacent freshwater body. The nearest know roost site is in Guildford, approximately 1.5 kilometres north-east of Bundaring Park.



Figure 4. Black Cockatoo and Water Rat habitat values

This figure presents the wetland as Rakali foraging habitat, mature Flooded Gums as potential breeding trees for Black-Cockatoos, and scores vegetation within the study area as either low or low to moderate value foraging habitat.

3.3 Patterns of biodiversity

Investigating patterns of biodiversity can be complex and is often beyond the scope even of level 2 investigations. However, the level of disturbance and the shape of the survey site are both significant factors in patterns of biodiversity. Within the project area, VSAs 1 and 3 may have higher biodiversity than other VSAs, but in such a fragmented landscape subject to extensive historical clearing they cannot be considered in isolation.

A large proportion of the study area consists of remnant Flooded Gums and predominantly exotic pasture grasses and other weeds. Fauna reliant upon undisturbed native vegetation and/or soil may be absent or uncommon. This would be especially important for species dependent upon the understorey, such as small woodland birds (e.g. thornbills, fairy-wrens) and a range of reptile species.

The wetland habitat within the study area has a number of weed species present but remains intact in terms of native wetland vegetation structure, and has a degree of connectivity with wetland habitat to the adjacent north, and connectivity with the Swan River via the drainage channel. The fauna assemblage, particularly avian, is likely to be bolstered by the proximity to the Swan River. Davis *et al.* (2012) investigated bird assemblages in the Perth urban area in relation to the degree of habitat fragmentation, and noted the importance of large and interconnected reserves for avian biodiversity.

Although the fauna assemblage of the area is low in species richness due to factors such as size of remnant, isolation, habitat loss and degradation, and impacts of feral species, the site is locally rich because of the extent of surrounding urbanisation. It may even be rich for a small reserve because it encompasses a range of environments and because of the proximity of the river.

3.4 Ecological processes

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (see Appendix 4 for descriptions and other ecological processes). These include:

Local hydrology. The Wetland and associated habitat is dependent on seasonal drainage from surrounding urban areas. Runoff from these areas can potentially introduce nutrients and other pollutants, and overall water level cycles will influence the wetland vegetation community as well as species such as frogs and waterbirds. Intermittent runoff can result in short-term fluctuations in wetland water levels that disrupt the breeding cycles of some frogs and waterbirds.

Fire. Woodlands and wetlands of the Perth Swan Coastal bioregion are fire-adapted but the flora and fauna assemblages can be altered by too-frequent or too-infrequent fires; and even by fire exclusion. However Bindaring Park is likely to be managed to exclude fire due to the urban setting. In the natural bushland setting, fire season may be important in seed germination. Lack of fire could reduce recruitment of the remnant woodland vegetation and hence the biodiversity and resilience of the area.

Feral species and interactions with over-abundant native species. The fauna assemblage within remnant vegetation of the survey areas has been impacted by feral species (loss of a major component of the mammal fauna). Introduced rodents may cause further degradation to the native vegetation and, in combination with introduced predators (cats and foxes), reduce the capacity of the area to support native fauna diversity. Feral bees using tree hollows for hives will be displacing some fauna such as small hollow-roosting bat species, and hollow nesting birds.

Habitat degradation due to weed invasion. Weeds are prevalent within the study area and generally reduce natural habitat quality, although weeds can be an important component of the fauna habitat in disturbed or small fragmented areas where most of the original plant species and vegetation structure is missing. For example, VSA 1 has tall and moderately dense growth of kikuyu and other introduced grasses and other weeds, and potentially provides cover for small birds and reptiles in the absence of an understorey of native plants.

Connectivity and landscape permeability. There is a degree of connectivity of the wetland with the Swan River; this linkage has been highlighted in Figure 4 as an important connection with the Swan River

for wildlife. Remaining areas of relatively isolated bushland and wetland areas have an increasingly important function as stepping stones for mobile species between the larger permanent conservation reserves and other remnants associated with the Swan River system.

3.5 Summary of Fauna Values

The desktop study identified 179 vertebrate fauna species as potentially occurring in the Bindaring Park study area including five fish, 6 frogs, 20 reptiles, 133 birds, 8 native and 7 introduced mammals. The vertebrate assemblage includes 37 species of conservation significance, with the most likely to frequently use the site being the Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo and Water Rat (Rakali).

Fauna assemblage. Depauperate, and missing most medium-sized and small mammals, as well as many birds and reptiles.

Species of conservation significance. A large number of significant species may be present in the wider region, but for the majority of these there is little if any suitable habitat other than the wetland which may provide habitat for and Rakali. Significant species of note that are likely to occur on the site regularly include both the Forest Red-tailed and Carnaby's Black-Cockatoos, and Rakali. There is also a suite of birds recognised as declining in the Perth region and some of these were recorded as present.

Vegetation and Substrate Associations (VSAs). There are four VSAs identified. Most of the site contains open parkland clearing (VSA 4) and remnant Flooded Gum trees (VSA 3). The lake and fringing vegetation (VSA 1), provides a small but important wetland habitat for urban wetland wildlife such as waterbirds, frogs and potentially the Water Rat (Rakali).

Patterns of biodiversity. Detailed patterns of biodiversity could not be examined, but it can be predicted that biodiversity will be concentrated in areas of native vegetation even where this is degraded. The wetland, including the associated vegetation is likely to be particularly important.

Key ecological processes. Main processes currently affecting the fauna assemblage in the survey area include habitat size and loss, connectivity and feral species (plants and animals), and local hydrology. Proximity and connectivity with the Swan River is important providing some a degree of habitat linkage with this estuarine system. This linkage means the site is likely to have more species (especially birds) using the site regularly than might otherwise be the case, and it has a role in supporting biodiversity in nearby areas. Therefore connectivity with the River is an important local ecological process. Local hydrology may be adversely affecting the fauna assemblage if runoff is episodic and creates short-term fluctuations in wetland water levels.

4 Recommendations

Habitat fragmentation

- Further improve the quality, and density of native vegetation cover including the important habitat linkage along the drainage line into the Swan River.

Species interactions

- Discourage the presence of feral species, particularly cats and foxes, by control measures and public awareness of pet control.
- Encourage responsible pet ownership. Some local government authorities have restrictions on cats near environmentally sensitive areas.

Hydrological changes

- Maintain effective drainage through the lake and wetland habitat and into the Swan River.
- Install signage into local residential streets and drains so that local residents are informed about the need to minimise domestic pollutants (herbicides, fertilisers, detergents, petroleum products) entering the wetland and River.
- If possible, monitor water level changes and determine if a natural cycle of seasonal rise and fall is taking place or can be established.

Habitat degradation due to weed invasion

- Manage weeds long-term to replace weeds with native species, particularly wetland understorey and ground cover species such as sedge, native rushes and shrubs.
- Prevent the establishment of high risk species that are present such as Caster oil seedlings growing in the northeast corner of the study area.

5 References

- Anstis, M. (2013). *Tadpoles and Frogs of Australia*. New Holland Publishers, Sydney.
- Bamford, M.J. (1995). Predation by feral cats upon lizards. *Western Australian Naturalist* 20: 191-196.
- Bamford, M.J. (2008). Local Extinction of Fairy-wrens due to Cat Predation? *Amytornis* 1(1): 25-26.
- Bamford, M.J. and Calver, M.C. (2012). Cat predation and suburban lizards; a 22 year study at a suburban Australian property. *The Open Conservation Biology Journal* 6: 25-29.
- Bamford, M., Bancroft, W. and Sibbell, N. (2010). Twenty years and two transects; spatial and temporal variation in local patterns of biodiversity – frogs, reptiles and small mammals. Presentation at 2010 conference of the Ecological Society of Australia, Canberra.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The new atlas of Australian birds*. Melbourne: Birds Australia.
- Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984). *The Atlas of Australian Birds*. Royal Australasian Ornithologists Union. Melbourne University Press.
- Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. (2010). *Field Guide to Reptiles and Frogs of the Perth Region*. WA Museum, Perth.
- Cale, B. (2003). *Carnaby's Black-Cockatoo (Calyptorhynchus latirostris) Recovery Plan*. Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management, Wanneroo, Western Australia.
- Calver, M., Lymbery, A., McComb, J. and Bamford, M. (2009). *Environmental Biology*. Cambridge University Press, Melbourne.
- Christidis, L. and Boles, W. E. (2008). *Systematics and Taxonomy of Australian Birds*. CSIRO Publishing, Collingwood, Victoria.
- Churchill, S. (2008). *Australian Bats*. Reed New Holland Press, Sydney.
- Davies, S. J. J. F. (1966). The movements of the White-tailed Black-Cockatoos (*Calyptorhynchus baudinii*) in south-western Australia. *The Western Australian Naturalist* 10: 33-42.
- Davis, R. D., Gole, C. and Roberts, J. D. (2012). Impacts of urbanisation on the native avifauna of Perth, Western Australia. *Urban Ecosystems* 15 (4).
- Dell, J. and Banyard, J. (eds). (2000). *Bush Forever*. Vol. 2. Dept of Environmental Protection, Perth.
- DEC. (2007). *Forest Black Cockatoo (Baudin's Cockatoo Calyptorhynchus baudinii and Forest Red-tailed Black-Cockatoo Calyptorhynchus banksia naso) Recovery Plan 2007 – 2016*. Western Australian Wildlife Management Program No. 42. Department of Environment and Conservation, Perth, Western Australia.
- DEC. (2012). *Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan*. Western Australian Wildlife Management Program No. 52. Department of Environment and Conservation, Perth, Western Australia.
- Department of the Environment (2014a). EPBC Protected Matters Search Tool. (accessed March 2016).

- Department of the Environment (2014b). Key Threatening Processes. <http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl> (accessed May 2014).
- Department of Environmental Protection (2000). Bush Forever Volume 2. Government of Western Australia, Perth.
- Department of Parks and Wildlife (WA) (2014). NatureMap Database. <http://naturemap.dec.wa.gov.au/default.aspx> (accessed March 2016).
- Department of Sustainability, Environment, Water, Population and Communities (2012). EPBC Act referral guidelines for three threatened black cockatoo species.
- DEWHA. (2009b). Approved Conservation Advice for *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo). Department of the Environment, Water, Heritage and the Arts, Canberra, Australia.
- DEWHA.(2010). Survey guidelines for Australia's threatened birds. Department of the Environment, Water, Heritage and the Arts, Canberra, Australia.
- Doughty, P. and Maryan, B. (2010a). Checklist of the Amphibians of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Doughty, P. and Maryan, B. (2010b). Checklist of the Reptiles of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- DSEWPaC. (2012). Interim Biogeographic Regionalisation for Australia, Version 7. Map produced by ERIN for the National Reserve Systems Section, Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra, May 2012.
- DSEWPaC. (2012a). *Calyptorhynchus banksii naso* in Species Profile and Threats Database. Department of Sustainability, Environment, Water, Population and Communities. Available from: <http://www.environment.gov.au/sprat>
- DSEWPaC. (2012b). *Calyptorhynchus baudinii* in Species Profile and Threats Database. Department of Sustainability, Environment, Water, Population and Communities. Available from: <http://www.environment.gov.au/sprat>
- DSEWPaC. (2012c). *Calyptorhynchus latirostris* in Species Profile and Threats Database. Department of Sustainability, Environment, Water, Population and Communities. Available from: <http://www.environment.gov.au/sprat>
- Environment Australia. (2000). Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1 - Summary Report. Environment Australia, Department of Environment and Heritage, Canberra, Australian Capital Territory.
- Environmental Protection Authority (2002). Terrestrial Biological surveys as an Element of Biodiversity Protection. Position Statement No. 3. Environmental Protection Authority, Perth, Western Australia.
- Environmental Protection Authority. (2004). Guidance for the assessment of environmental factors: Terrestrial fauna surveys for environmental impact assessment in Western Australia. No. 56. Environmental Protection Authority, Perth, Western Australia.

- Environmental Protection Authority and Department of Environment and Conservation (2010) Technical Guide - Terrestrial Vertebrate Fauna surveys for Environmental Impact Assessment (eds B.M. Hyder, J. Dell and M.A. Cowan). Perth, Western Australia.
- Everard, C. and Bamford, M. (2015). From Monitoring on the Gnangara Mound 2003 to 2014. Unpubl. report to the Dept of Water by Bamford Consulting Ecologists, Kingsley.
- Finn, H., Barrett, G., Groom, C., Blythman, M., and Williams, M. (2014). The 2014 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoos (*Calyptorhynchus latirostris*) and Forest Red-tailed Black-Cockatoos (*Calyptorhynchus banksia naso*). Final Report – June 2014. Perth Region NRM.
- Garnett, S., Szabo, J. and Dutson, G. (2011). The Action Plan for Australian Birds 2010. CSIRO Publishing.
- Groom, C. (2011). Plants Used by Carnaby's Black Cockatoo. Department of Environment and Conservation, Perth, Western Australia.
- How, R. A., Cooper, N. K. and Bannister, J. L. (2009). Checklist of the Mammals of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Johnstone, R.E., Johnstone, C. and Kirkby, T. (2011). Black-cockatoos on the Swan Coastal Plain. Report prepared for the Department of Planning, Western Australia, by the Western Australian Museum, Welshpool, Western Australia.
- Johnstone, R.E. and Kirkby, T. (1999). Food of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. The Western Australian Naturalist 22: 167-177.
- Johnstone, R.E. and Kirkby, T. (2008). Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (*Calyptorhynchus baudinii*) in South-west Western Australia. Records of the Western Australian Museum 25: 107-118.
- Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds Vol 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth.
- Johnstone, R.E. and Storr, G.M. (2004). Handbook of Western Australian Birds. Vol 2: Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth.
- Kabat, A. P., Scott, R., Kabat, T. J. and Barrett, G. (2012). 2011 Great Cocky Count: Population estimates and identification of roost sites for the Carnaby's Cockatoo (*Calyptorhynchus latirostris*). Report prepared for the Western Australian Department of Environment and Conservation by BirdLife Australia Floreat, Western Australia.
- Mace, G. and Stuart, S. (1994). Draft IUCN Red List Categories, Version 2.2. Species; Newsletter of the Species Survival Commission. IUCN - The World Conservation Union. No. 21-22: 13-24.
- Menkhorst, P. and Knight, F. (2004). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.
- Mitchell, D. Williams, K., and Desmond, A. (2002) Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain. A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002.
- Saunders, D. A. (1974). Breeding biology of the Short-billed form of the White-tailed Black Cockatoo *Calyptorhynchus baudinii latirostris* (Carnaby). Emu 74: 292-293.
- Saunders, D. A. (1979a). The availability of tree hollows for use as nest sites by White-tailed Black Cockatoos. Australian Wildlife Research 6: 205-216.

- Saunders, D. A. (1979b). Distribution and taxonomy of the White-tailed and Yellow-tailed Black-Cockatoos *Calyptorhynchus* spp. Emu 79.
- Saunders, D. A. (1980). Food and movements of the short-billed form of the White-tailed Black Cockatoo. Australian Wildlife Research 7: 257-269.
- Saunders, D. A. (1986). Breeding season, nestling success and nestling growth in Carnaby's Black-Cockatoo, *Calyptorhynchus funereus latirostris*, over 16 years at Coomallo Creek, and a method for assessing the viability of populations in other areas. Australian Wildlife Research 13: 261-273.
- Saunders, D. A., Smith, G. T. and Rowley, I. (1982). The availability and dimensions of tree hollows that provide nest sites for cockatoos (Psittaciformes) in Western Australia. Australian Wildlife Research 9: 541-556.
- Soule, M. E., Mackey, B. G., Recher, H. F., Williams, J. E., Woinarski, J. C. Z., Driscoll, D., Dennison, W. C. and Jones, M. E. (2004). The role of connectivity in Australian conservation. Pacific Conservation Biology 10: 266-279.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (1983). Lizards of Western Australia. II. Dragons and Monitors. W.A. Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (1990). Lizards of Western Australia. III. Geckoes and Pygopodids. W.A. Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (1999). Lizards of Western Australia. I. Skinks. Revised Edition. W.A. Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone, R.E. (2002). Snakes of Western Australia. W.A. Museum, Perth.
- Thackway, R. and Cresswell, I.D. (1995). An Interim Biogeographic Regionalisation for Australia: A framework for establishing the national system of reserves, Version 4.0. Australian Nature Conservation Agency, Canberra.
- Trocini, S., Barrett, G., Howard, K. and Ramalho, C. (2015). Rakali Community Survey 2014-2015. Report prepared by WWF-Australia and the Western Australian Department of Parks and Wildlife. WWF-Australia, Perth, WA.
- Tyler, M.J., and Doughty, p. (2009). Field Guide to Frogs of Western Australia. 4th Ed. W.A. Museum, Perth.
- Van Dyck, S. and Strahan, R. (Eds.) (2008). Mammals of Australia. 3rd Edition. Australian Museum, Sydney.
- Whitford, K. R. (2001). Dimensions of tree hollows used by birds and mammals in the jarrah forest: improving the dimensional description of potentially usable hollows. Calmscience 3: 499-511.
- Whitford, K. R. (2002). Hollows in jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) trees I. Hollow sizes, tree attributes and ages. Forest Ecology and Management 160: 201-214.
- Whitford, K. R. and Williams, M. R. (2002). Hollows in jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) trees II. Selecting trees to retain for hollow dependent fauna. Forest Ecology and Management 160: 215-232.
- Wilson S, Swan G (2013) A Complete Guide to Reptiles of Australia. Fourth edition. New Holland Publishers (Australia), Sydney.

6 Appendices

Appendix 1. Black-cockatoos background information.

Species, ecology, habitat requirements and threats

The three south-western Western Australian taxa of black-cockatoo are listed in Table i. All species are listed under both the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999 and the Western Australian Wildlife Conservation Act 1950), as indicated in Table i. Two of these are likely to occur in the vicinity of the project area (Forest Red-tailed and Carnaby's Black-Cockatoo), with Baudin's Black-Cockatoo not expected (in the Perth area this species is generally restricted to the Darling Range and/or the very eastern edge of the Swan Coastal Plain).

Table i. Black-cockatoos likely to occur in the vicinity of the project area.

The status of each species under the Environment Protection and Biodiversity Conservation Act 1999 (EPBCA 1999) and the Western Australian Wildlife Conservation Act 1950 (WCA 1950) is shown.

Species	EPBCA 1999	WCA 1950
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo Vulnerable	Schedule 1 (Vulnerable)
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo Endangered	Schedule 1 (Endangered)
<i>Calyptorhynchus baudinii</i>	Baudin's Black-Cockatoo Vulnerable	Schedule 1 (Endangered)

There is considerable published information on the ecology of, and threats to, these black-cockatoo species. Key references include:

- Action plans (Garnett et al. 2011);
- Recovery plans (Cale 2003; DEC 2007; DEC 2012);
- EPBC guidelines (DEWHA 2010);
- Commonwealth listing and conservation advice (DEWHA 2009a, b);
- The federal Department of Sustainability, Environment, Water, Population and Communities' (SEWPaC; formerly DEWHA) Species Profile and Threats (SPRAT) Database (DSEWPaC 2012a, b, c);
- Scientific literature (Davies 1966; Saunders 1974, 1979a, b, 1980; Saunders et al. 1982; Saunders 1986; Johnstone and Storr 1998; Higgins 1999; Johnstone and Kirkby 1999, 2008); and
- Major reports (Johnstone et al. 2011; Kabat et al. 2012).

Much of this information has been compiled by DSEWPaC (2012a, b, c, d). Summarising this work further, there are several salient points for assessing the potential value of the project area for black-cockatoos:

Key ecology

- All species are long-lived with low annual reproduction rates and cannot, therefore, rapidly increase their population size.
- Carnaby's and Baudin's Black-Cockatoos undergo regular, seasonal migration between breeding and non-breeding areas.

- Forest Red-tailed Black-Cockatoos are currently considered not to undergo regular migration. In recent years there appears to have been a distinct expansion of the range of this species on to the Swan Coastal Plain, including many suburbs within the Perth metropolitan area.
- In recent years there have been considerable shifts in the breeding ecology, distribution and movement patterns of Forest Red-tailed and Carnaby's Black-Cockatoos. These may be a response to habitat degradation/clearing and/or climatic factors.

Key habitat requirements

- All species are reliant on large tree-hollows in eucalypts, in which they breed. Each species has its own preference for nesting tree species and its own geographical breeding range (although these overlap between species). There is a solid understanding of these preferences (see Table ii for summary).
- All species primarily feed on plant seeds and flowers, but also consume wood-boring insect larvae when available. Each species has its own preference for food plant species (with considerable overlap). There is a solid understanding of these preferences (see Table ii for summary).

Key threats

- Key threatening processes include illegal shooting, habitat loss, habitat degradation, nest hollow shortage, competition for available nest hollows from other parrots and feral Honeybees (*Apis mellifera*), and illegal trade.

Nesting tree size and hollow dimensions

Black-cockatoos require tree hollows that have an entrance diameter of more than 100 mm (Whitford 2001). Internal dimensions may be more important than entrance diameter, although these are much more difficult to assess (Whitford 2001; Gibbons and Lindenmayer 2002; Whitford and Williams 2002). For Forest Red-tailed Black-Cockatoos, the minimum height of a nesting hollow was 4.4 m above the ground (Whitford 2001). The minimum diameter at breast height (DBH) of a nesting tree was 608 mm and the minimum age of an actual nesting tree was 214 years (Whitford 2002). In the study by Whitford and Williams (2002) the youngest tree to bear a hollow that was potentially suited to Forest Red-tailed Black-Cockatoos was 131 years (although this was not used). In general, hollows of sufficient size to support black-cockatoos do not form until trees at least 230 years old, and the majority of nests are found in 300-500 year old trees (Johnstone 2006). DSEWPac (2010, 2011, 2012a, b, c, d) recommend that surveys for potential hollow-bearing trees should identify trees greater than 500 mm DBH (to include trees that are likely to become hollow-bearing in the next 50 years).

Table ii. Plants known to be used for foraging, roosting and nesting by black-cockatoos in south-western Western Australia. Data compiled from the literature (Davies 1966; Saunders 1974, 1979a, b, 1980; Saunders et al. 1982; Saunders 1986; Johnstone and Storr 1998; Higgins 1999; Johnstone and Kirkby 1999, 2008; Groom 2011; Johnstone et al. 2011; DSEWPac 2012a, b; c, R. Johnstone pers. comm.).

FRTBC = Forest Red-tailed Black-Cockatoo, CBC = Carnaby's Black-Cockatoo, BBC = Baudin's Black-Cockatoo.

Plant status: blank = Western Australian native, AN = Australian native (but not naturally occurring in Western Australia), E = exotic (i.e. not native to Australia).

F = foraging, R = roosting, N or n = nesting (main and less commonly used species, respectively).

Plant species present within the study directly relevant to Black Cockatoos are highlighted.

Plant Species	Plant Status	FRTBC	CBC	BBC
Acacia baileyana (Cootamundra Wattle)	AN		F	
Acacia pentadenia (Karri Wattle)			F	
Acacia saligna (Orange Wattle)			F	
Agonis flexuosa (Peppermint Tree)			F	
Allocasuarina fraseriana (Sheoak)		F		F
Anigozanthos flavidus (Tall Kangaroo Paw)				F
Araucaria heterophylla (Norfolk Island Pine)	E		F	
Banksia ashbyi (Ashby's Banksia)			F	
Banksia attenuata (Slender Banksia)			F	
Banksia baxteri (Baxter's Banksia)			F	
Banksia carlinoides (Pink Dryandra)			F	
Banksia coccinea (Scarlet Banksia)			F	
Banksia dallanneyi (Couch Honey-pot Dryandra)			F	
Banksia ericifolia (Heath-leaved Banksia)	AN		F	
Banksia fraseri (Dryandra)			F	
Banksia gardneri (Prostrate Banksia)			F	
Banksia grandis (Bull Banksia)			F	F
Banksia hookeriana (Hooker's Banksia)			F	
Banksia ilicifolia (Holly Banksia)			F	F
Banksia kippistiana (Dryandra)			F	
Banksia leptophylla			F	
Banksia lindleyana (Porcupine Banksia)				F
Banksia littoralis (Swamp Banksia)			F	F
Banksia menziesii (Firewood or Menzie's Banksia)			F	
Banksia mucronulata (Swordfish Dryandra)			F	
Banksia nivea (Honey-pot Dryandra)			F	
Banksia nobilis (Golden Dryandra)			F	
Banksia praemorsa (Cut-leaf Banksia)			F	F
Banksia prionotes (Acorn Banksia)			F	

Plant Species	Plant Status	FRTBC	CBC	BBC
<i>Banksia quercifolia</i> (Oak-leaved Banksia)			F	F
<i>Banksia sessilis</i> (Parrot Bush)			F	F
<i>Banksia speciosa</i> (Showy Banksia)			F	
<i>Banksia squarrosa</i> (Pingle)			F	F
<i>Banksia tricuspis</i> (Lesueur Banksia or Pine Banksia)			F	
<i>Banksia undata</i> (Urchin or Cut-leaf Dryandra)			F	
<i>Banksia verticillata</i> (Granite Banksia)			F	
<i>Brassica campestris</i> (Canola, Rape)	E		F	
<i>Callistemon</i> spp.				F
<i>Callistemon viminalis</i> (Captain Cook Bottlebrush)	AN		F	
<i>Callitris</i> sp.			F	
<i>Carya illinoensis</i> (Pecan)	E		F	F
<i>Casuarina cunninghamiana</i> (River Sheoak)	AN		F	
<i>Citrullus lanatus</i> (Pie or Afghan Melon)	E		F	
<i>Corymbia calophylla</i> (Marri)		F,N	F,n,R	F,n
<i>Corymbia ficifolia</i> (Red Flowering Gum)			F	
<i>Corymbia haematoxylon</i> (Mountain Marri)			F	
<i>Corymbia maculata</i> (Spotted Gum)			R	
<i>Darwinia citriodora</i> (Lemon-scented Darwinia)	AN		F	F
<i>Diospyros</i> sp. (Sweet Persimmon)	E		F	F
<i>Eremophila glabra</i> (Tarbush)			F	
<i>Erodium aureum</i> (Corkscrew Grass or Storksbill)	E		F	
<i>Erodium botrys</i> (Corkscrew Grass or Storksbill)	E		F	F
<i>Eucalyptus caesia</i> (Silver Princess)			F	
<i>Eucalyptus camaldulensis</i> (River Red Gum)	AN		R	
<i>Eucalyptus citriodora</i> (Lemon Scented Gum)	AN	F	F,R	F
<i>Eucalyptus diversicolor</i> (Karri)		n	n	N
<i>Eucalyptus globulus</i> (Tasmanian Blue Gum)	AN		R	
<i>Eucalyptus gomphocephala</i> (Tuart)		n	F,n,R	
<i>Eucalyptus grandis</i> (Flooded Gum, Rose Gum)	AN		R	
<i>Eucalyptus longicornis</i> (Red Morrell)			n	
<i>Eucalyptus loxophleba</i> (York Gum)			F,n	
<i>Eucalyptus marginata</i> (Jarrah)		F,N	F,n,R	F
<i>Eucalyptus megacapa</i> (Bullich)		n		n
<i>Eucalyptus occidentalis</i> (Swamp Yate)			n	
<i>Eucalyptus patens</i> (Blackbutt)		F	F,R	

Plant Species	Plant Status	FRTBC	CBC	BBC
<i>Eucalyptus pleurocarpa</i> (Tallerack)			F	
<i>Eucalyptus preissiana</i> (Bell-fruited Mallee)			F	
<i>Eucalyptus robusta</i> (Swamp Mahogany)			F,R	
<i>Eucalyptus rudis</i> (Flooded Gum)			n,R	
<i>Eucalyptus salmonophloia</i> (Salmon Gum)			F,N	
<i>Eucalyptus salubris</i> (Gimlet)			n	
<i>Eucalyptus tottiana</i> (Coastal Blackbutt or Prickly Bark)			F	
<i>Eucalyptus wandoo</i> (Wandoo)			F,N,R	F,n
<i>Ficus</i> sp. (Fig)			F	
<i>Grevillea armigera</i> (Prickly Toothbrushes)			F	
<i>Grevillea bipinnatifida</i> (Fuschia Grevillea)			F	
<i>Grevillea hookeriana</i> (Red Toothbrushes)			F	
<i>Grevillea hookeriana</i> subsp. <i>apiculoba</i> (Black Toothbrushes)			F	
<i>Grevillea paniculata</i> (Kerosene Bush)			F	
<i>Grevillea paradoxa</i> (Bottlebrush Grevillea)			F	
<i>Grevillea petrophiloides</i> (Pink Poker)			F	
<i>Grevillea robusta</i> (Silky Oak)			F	
<i>Grevillea wilsonii</i> (Native Fuchsia)				F
<i>Hakea auriculata</i>			F	
<i>Hakea candolleana</i>			F	
<i>Hakea circumalata</i> (Coastal Hakea)			F	
<i>Hakea commutata</i>			F	
<i>Hakea conchifolia</i>			F	
<i>Hakea costata</i> (Ribbed Hakea)			F	
<i>Hakea cristata</i> (Snail Hakea)			F	F
<i>Hakea cucullata</i> (Snail Hakea)			F	
<i>Hakea cyclocarpa</i> (Ramshorn)			F	
<i>Hakea eneabba</i>			F	
<i>Hakea erinacea</i> (Hedgehog Hakea)			F	F
<i>Hakea falcata</i> (Sickle Hakea)			F	
<i>Hakea flabellifolia</i> (Fan-leaved Hakea)			F	
<i>Hakea gilbertii</i>			F	
<i>Hakea incrassata</i> (Golfball or Marble Hakea)			F	
<i>Hakea lasiantha</i> (Woolly Flowered Hakea)			F	
<i>Hakea lasianthoides</i>			F	F

Plant Species	Plant Status	FRTBC	CBC	BBC
Hakea laurina (Pin-cushion hakea)			F	
Hakea lissocarpa (Honeybush)			F	F
Hakea marginata				F
Hakea megalosperma (Lesueur Hakea)			F	
Hakea multilineata (Grass Leaf Hakea)			F	
Hakea obliqua (Needles and Corks)			F	
Hakea oleifolia (Dungyn or Olive-leaved Hakea)			F	
Hakea pandanicarpa subsp. crassifolia (Thick-leaved Hakea)			F	
Hakea petiolaris (Sea Urchin Hakea)			F	
Hakea polyanthema			F	
Hakea preissii (Needle Tree)			F	
Hakea prostrata (Harsh Hakea)			F	F
Hakea psilorrhyncha			F	
Hakea ruscifolia (Candle Hakea)			F	F
Hakea scoparia (Kangaroo Bush)			F	
Hakea smilacifolia			F	
Hakea spathulata			F	
Hakea stenocarpa (Narrow-fruited Hakea)			F	F
Hakea sulcata (Furrowed Hakea)			F	
Hakea trifurcata (Two-leaved Hakea)			F	F
Hakea undulata (Wavy-leaved Hakea)			F	
Hakea varia (Variable-leaved Hakea)			F	F
Helianthus annuus (Sunflower)	E		F	
Hibiscus sp. (Hibiscus)	E		F	
Isopogon scabriusculus			F	
Jacaranda mimosifolia (Jacaranda)	E		F	F
Jacksonia furcellata (Grey Stinkwood)			F	
Kingia australis (Kingia)				F
Lambertia inermis (Chittick)			F	
Lambertia multiflora (Many-flowered Honeysuckle)			F	
Liquidamber styraciflua (Liquid Amber)	E		F	
Lupinus sp. (Lupin)	E		F	
Macadamia integrifolia (Macadamia)	E		F	F
Malus domestica (Apple)	E		F	F
Melaleuca leuropoma			F	

Plant Species	Plant Status	FRTBC	CBC	BBC
Melia azedarach (Cape Lilac or White Cedar)	E	F	F	
Mesomeleana sp.			F	
Perossonia longifolia (Snottygobble)		F		
Pinus canariensis (Canary Island Pine)	E		F	
Pinus caribea (Caribbean Pine)	E		F	
Pinus pinaster (Pinaster or Maritime Pine)	E		F,R	
Pinus radiata (Radiata Pine)	E		F,R	F
Protea 'Pink Ice'	E		F	
Protea repens	E		F	
Prunus amygdalus (Almond Tree)	E		F	
Pyrus communis (European Pear)	E			F
Quercus spp. (Oak spp.)	E			F
Raphanus raphanistrum (Wild Radish)	E		F	
Reedia spathacea				F
Tipuana tipu (Tipu or Rosewood Tree)	E		F	
Xanthorrhoea preissii (Grass Tree)			F	F

Appendix 2. Explanation of fauna values.

Fauna values are the features of a site and its fauna that contribute to biodiversity, and it is these values that are potentially at threat from a development proposal. Fauna values can be examined under the five headings outlined below. It must be stressed that these values are interdependent and should not be considered equal, but contribute to an understanding of the biodiversity of a site. Understanding fauna values provides opportunities to predict and therefore mitigate impacts.

Assemblage characteristics

Uniqueness. This refers to the combination of species present at a site. For example, a site may support an unusual assemblage that has elements from adjacent biogeographic zones, it may have species present or absent that might be otherwise expected, or it may have an assemblage that is typical of a very large region. For the purposes of impact assessment, an unusual assemblage has greater value for biodiversity than a typical assemblage.

Completeness. An assemblage may be complete (i.e. has all the species that would have been present at the time of European settlement), or it may have lost species due to a variety of factors. Note that a complete assemblage, such as on an island, may have fewer species than an incomplete assemblage (such as in a species-rich but degraded site on the mainland).

Richness. This is a measure of the number of species at a site. At a simple level, a species rich site is more valuable than a species poor site, but value is also determined, for example, by the sorts of species present.

Vegetation/substrate associations (VSAs)

VSAs combine broad vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna. The term habitat is widely used in this context, but by definition an animal's habitat is the environment that it utilises (Calver et al. 2009), not the environment as a whole. Habitat is a function of the animal and its ecology, rather than being a function of the environment. For example, a species may occur in eucalypt canopy or in leaf-litter on sand, and that habitat may be found in only one or in several VSAs. VSAs are not the same as vegetation types since these may not incorporate soil and landform, and recognise floristics to a degree that VSAs do not. Vegetation types may also not recognise minor but often significant (for fauna) structural differences in the environment. VSAs also do not necessarily correspond with soil types, but may reflect some of these elements.

Because VSAs provide the habitat for fauna, they are important in determining assemblage characteristics. For the purposes of impact assessment, VSAs can also provide a surrogate for detailed information on the fauna assemblage. For example, rare, relictual or restricted VSAs should automatically be considered a significant fauna value. Impacts may be significant if the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna. The disturbance of even small amounts of habitat in a localised area can have significant impacts to fauna if rare or unusual habitats are disturbed.

Patterns of biodiversity across the landscape

This fauna value relates to how the assemblage is organised across the landscape. Generally, the fauna assemblage is not distributed evenly across the landscape or even within one VSA. There may be zones of high biodiversity such as particular environments or ecotones (transitions between VSAs). There may also be zones of low biodiversity. Impacts may be significant if a wide range of species is affected even if most of those species are not significant per se.

Species of conservation significance

Species of conservation significance are of special importance in impact assessment. The conservation status of fauna species in Australia is assessed under Commonwealth and State Acts such as the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the Western Australian Wildlife Conservation Act 1950 (Wildlife Conservation Act). In addition, the Western Australian Department of Environment and Conservation (DEC) recognises priority levels, while local populations of some species may be significant even if the species as a whole has no formal recognition. Therefore, three broad levels of conservation significance can be recognised and are used for the purposes of this report, and are outlined below. A full description of the conservation significance categories, schedules and priority levels mentioned below is provided in Appendix 3.

Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts.

Species listed under the EPBC Act are assigned to categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) and reviewed by Mace and Stuart (1994), or are listed as migratory. Migratory species are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of South Korea Australia Migratory Bird Agreement (ROKAMBA), and/or the Convention on the Conservation of Migratory Species of Wild Animals (CMS; also referred to as the Bonn Convention). The Wildlife Conservation Act uses a series of Schedules to classify status, but also recognizes the IUCN categories and ranks species within the Schedules using the categories of Mace and Stuart (1994).

Conservation Significance (CS) 2: Species listed as Priority by the DEC but not listed under State or Commonwealth Acts.

In Western Australia, the DEC has produced a supplementary list of Priority Fauna, being species that are not considered threatened under the Wildlife Conservation Act but for which the DEC feels there is cause for concern. Some Priority species are also assigned to the Conservation Dependent category of the IUCN.

Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

This level of significance has no legislative or published recognition and is based on interpretation of distribution information, but is used here as it may have links to preserving biodiversity at the genetic level (EPA 2002). If a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Conservation significance is applied to allow for the preservation of genetic richness at a population level, and not just at a species level. Species on the edge of their range,

or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3, as may colonies of waterbirds. The Western Australian Department of Environmental Protection, now DPaW, used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan (DEP 2000).

Invertebrate species considered to be short range endemics (SREs) also fall within the CS3 category, as they have no legislative or published recognition and their significance is based on interpretation of distribution information. Harvey (2002) notes that the majority of species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Pseudoscorpionida (pseudoscorpions), Schizomida (schizomids), Diplopoda (millipedes), Phreatoicidea (phreatoicidean crustaceans), and Decapoda (freshwater crayfish). The poor understanding of the taxonomy of many of the short-range endemic species hinders their conservation (Harvey 2002).

Introduced species

In addition to these conservation levels, species that have been introduced (INT) are indicated throughout the report. Introduced species may be important to the native fauna assemblage through effects by predation and/or competition.

Ecological processes upon which the fauna depend

These are the processes that affect and maintain fauna populations in an area and as such are very complex; for example, populations are maintained through the dynamic of mortality, survival and recruitment being more or less in balance, and these are affected by a myriad of factors. The dynamics of fauna populations in a project may be affected by processes such as fire regime, landscape patterns (such as fragmentation and/or linkage), the presence of feral species and hydrology. Impacts may be significant if processes are altered such that fauna populations are adversely affected, resulting in declines and even localised loss of species. Threatening processes as outlined below are effectively the ecological processes that can be altered to result in impacts upon fauna.

Appendix 3. Categories used in the assessment of conservation status.

IUCN categories (based on review by Mace and Stuart 1994) as used for the Environment Protection and Biodiversity Conservation Act 1999 and the Western Australian Wildlife Conservation Act 1950.

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (Ex)	Taxa known to survive only in captivity.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern.	Taxa that are not Threatened.

Schedules used in the WA Wildlife Conservation Act 1950

Schedule 1 (S1)	Critically Endangered fauna.
Schedule 2 (S2)	Endangered fauna
Schedule 3 (S3)	Vulnerable Migratory species listed under international treaties.
Schedule 4 (S4)	Presumed extinct fauna
Schedule 5 (S5)	Migratory birds under international agreement
Schedule 6 (S6)	Conservation dependant fauna
Schedule 7 (S7)	Other specially protected fauna

WA Department of Environment and Conservation Priority species (species not listed under the Wildlife Conservation Act 1950, but for which there is some concern).

Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4. (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

Appendix 4. Ecological and threatening processes identified under legislation and in the literature.

Ecological processes are processes that maintain ecosystems and biodiversity. They are important for the assessment of impacts of development proposals, because ecological processes make ecosystems sensitive to change. The issue of ecological processes, impacts and conservation of biodiversity has an extensive literature. Following are examples of the sorts of ecological processes that need to be considered.

Ecological processes relevant to the conservation of biodiversity in Australia (Soule et al. 2004):

- Critical species interactions (highly interactive species);
- Long distance biological movement;
- Disturbance at local and regional scales;
- Global climate change;
- Hydroecology;
- Coastal zone fluxes;
- Spatially-dependent evolutionary processes (range expansion and gene flow); and
- Geographic and temporal variation of plant productivity across Australia.

Threatening processes (EPBC Act)

Under the EPBC Act, a key threatening process is an ecological interaction that threatens or may threaten the survival, abundance or evolutionary development of a threatened species or ecological community. There are currently 20 key threatening processes listed by the federal Department of the Environment (DotE 2014b):

- Competition and land degradation by rabbits.
- Competition and land degradation by unmanaged goats.
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*).
- Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South.
- Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations.
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis.
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris.
- Invasion of northern Australia by Gamba Grass and other introduced grasses.
- Land clearance.
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.
- Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean.
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.
- Novel biota and their impact on biodiversity.
- Predation by European red fox.
- Predation by exotic rats on Australian offshore islands of less than 1000 km² (100,000 ha).
- Predation by feral cats.

- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs.
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species.
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*).
- The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant).

General processes that threaten biodiversity across Australia (The National Land and Water Resources Audit):

- Vegetation clearing;
- Increasing fragmentation, loss of remnants and lack of recruitment;
- Firewood collection;
- Grazing pressure;
- Feral animals;
- Exotic weeds;
- Changed fire regimes;
- Pathogens;
- Changed hydrology—dryland salinity and salt water intrusion;
- Changed hydrology— such as altered flow regimes affecting riparian vegetation; and
- Pollution.

In addition to the above processes, DSEWPaC has produced Significant Impact Guidelines that provide criteria for the assessment of the significance of impacts. These criteria provide a framework for the assessment of significant impacts. The criteria are listed below.

- Will the proposed action lead to a long-term decrease in the size of a population?
- Will the proposed action reduce the area of occupancy of the species?
- Will the proposed action fragment an existing population?
- Will the proposed action adversely affect habitat critical to the survival of a species?
- Will the proposed action disrupt the breeding cycle of a population?
- Will the proposed action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?
- Will the proposed action result in introducing invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?
- Will the proposed action introduce disease that may cause the species to decline?
- Will the proposed action interfere with the recovery of the species?

Appendix 5. Vertebrate Fauna expected to occur in the Upper Swan site.

These lists are derived from the results of database and literature searches and from previous field surveys conducted in the local area. These are:

- Naturamap = Naturemap Database, searched February 2017;
- BA = Birdlife Australia's Birdata database, searched February 2017;
- EPBC = EPBC Protected Matters Search, searched February 2017;

Status codes:

- CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 2 for full explanation.
- EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory (see Appendix 3).
- Wildlife Conservation Act listings: for all CS1 species S1 to 7 = Schedules 1 to 7 respectively, (see Appendix 3) with rankings shown in square parentheses: [e] = endangered, [v] = vulnerable.
- DEC Priority species: P1 to P5 = Priority 1 to 5 (see Appendix 3).
- LS= considered to be of local significance by Bamford Consulting Ecologists (Appendix 2).

Table 8. Species expected to occur in the survey area.

Fish Species	Cons. Signif.	Database searches	BCE	Status in Study area
Gobionellinae (gobies)				
Swan River Goby <i>Pseudogobius olorum</i>		√		resident
Galaxiidae (minnows)				
Western Minnow <i>Galaxia occidentalis</i>		√		Occasional visitor
Poeciliidae (mosquito fish)				
Mosquito Fish <i>Gambusia holbrooki</i>	INT	√	√	resident
Cyprinidae (goldfish and carp)				
Goldfish <i>Carassius auratus</i>	INT	√		resident
Carp <i>Cyprinus carpio</i>	INT	√		resident
Total		5	1	

Frog Species	Cons. Signif.	Database searches	BCE	Status in Study area
Hylidae (tree-frogs)				
Slender Tree-Frog <i>Litoria adelaidensis</i>		√	√	resident
Motorbike Frog <i>Litoria moorei</i>		√		resident
Myobatrachidae (ground frogs)				
Clicking Frog <i>Crinia glauerti</i>		√		resident
Squelching Froglet <i>Crinia insignifera</i>		√		vagrant
Moaning Frog <i>Heleioporus eyrei</i>		√		resident
Banjo Frog <i>Limnodynastes dorsalis</i>		√	√	resident
Total	0	6	2	

Reptile Species	Cons. Signif	Database	BCE	Status in Study area
Cheluidae (side-necked tortoises)				
Long-necked Tortoise <i>Chelodina collei</i>		√		resident
Gekkonidae (geckoes)				
Marbled Gecko <i>Christinus marmoratus</i>		√		resident
Spiny-tailed Gecko <i>Strophurus spinigerus</i>		√		resident
Pygopodidae (legless lizards)				
Sandplain Worm Lizard <i>Aprasia repens</i>		√		vagrant
Agamidae (dragon lizards)				
Western Bearded Dragon <i>Pogona minor</i>		√		vagrant
Varanidae (monitors or goannas)				
Gould's Sand Goanna <i>Varanus gouldii</i>		√		vagrant
Scincidae (skinks)				
South-west Cool Skink <i>Acritoscincus trilineatum</i>		√		resident
Fence Skink <i>Cryptoblepharus buchananii</i>		√	√	resident
West Coast Ctenotus <i>Ctenotus fallens</i>		√		vagrant
King's Skink <i>Egernia kingii</i>		√		occasional visitor
Mourning Skink <i>Egernia luctuosa</i>		√		vagrant
Two-toed Skink <i>Hemiergis quadrilineata</i>		√	√	resident
Four-toed Lerista <i>Lerista elegans</i>		√		resident
Common Dwarf Skink <i>Menetia greyii</i>		√	√	resident
Spotted Morethia <i>Morethia lineoocellata</i>		√		vagrant
Shrubland Morethia <i>Morethia obscura</i>		√		vagrant
Bobtail <i>Tiliqua rugosa</i>		√		resident
Typhlopidae (blind snakes)				
Southern Blind Snake <i>Anilius australis</i>		√		occasional visitor
Elapidae (front-fanged snakes)				
Tiger Snake <i>Notechus scutatus</i>		√		occasional visitor
Dugite <i>Pseudonaja affinis</i>		√		regular visitor
Total	0	20	3	

Bird Species	Cons. Signif.	Database	BCE	Status in Study area
Phasianidae (quails)				
Brown Quail <i>Coturnix ypsilophora</i>		√		vagrant
Stubble Quail <i>Coturnix pectoralis</i>		√		vagrant
Anatidae (ducks, geese, teal)				
Black Swan <i>Cygnus atratus</i>		√		regular visitor
Chestnut Teal <i>Anas castanea</i>		√		occasional visitor

Bird Species	Cons. Signif.	Database	BCE	Status in Study area
Grey Teal <i>Anas gracilis</i>		√	√	resident
Domestic Waterfowl (domestic ducks and geese of several species)	INT	√		regular visitor
Australasian Shoveler <i>Anas rhynchotis</i>		√		occasional visitor
Pacific Black Duck <i>Anas superciliosa</i>		√	√	resident
Blue-billed Duck <i>Oxyura australis</i>	CS2, P4	√		occasional visitor
Hardhead (White-eyed Duck) <i>Aythya australis</i>		√		occasional visitor
Musk Duck <i>Biziura lobata</i>	CS3	√		regular visitor
Australian Wood Duck <i>Chenonetta jubata</i>		√	√	resident
Pink-eared Duck <i>Malacorhynchus membranaceus</i>	CS3	√	√	regular visitor
Freckled Duck <i>Stictonetta naevosa</i>	CS3	√		Occasional visitor
Australian Shelduck <i>Tadorna tadornoides</i>		√		regular visitor
Anhingidae (darters)				
Darter <i>Anhinga melanogaster</i>		√		occasional visitor
Phalacrocoracidae (cormorants)				
Great Cormorant <i>Phalacrocorax carbo</i>		√		occasional visitor
Pied Cormorant <i>Phalacrocorax varius</i>		√		occasional visitor
Little Black Cormorant <i>Phalacrocorax sulcirostris</i>		√		occasional visitor
Little Pied Cormorant <i>Phalacrocorax melanoleucos</i>		√		occasional visitor
Podicipididae (grebes)				
Great Crested Grebe <i>Podiceps cristatus</i>		√		occasional visitor
Hoary-headed Grebe <i>Poliiocephalus poliocephalus</i>		√		occasional visitor
Australasian Grebe <i>Tachybaptus novaehollandiae</i>		√	√	resident
Pelecanoididae (pelicans)				
Australian Pelican <i>Pelecanus conspicillatus</i>		√		regular visitor
Ardeidae (herons and egrets)				
White-faced Heron <i>Egretta novaehollandiae</i>		√	√	regular visitor
White-necked Heron <i>Ardea pacifica</i>		√		Occasional vagrant
Eastern Great Egret <i>Ardea modesta</i>	CS1	√		regular visitor
Cattle Egret <i>Ardea ibis</i>	CS1	√		vagrant
Little Egret <i>Egretta garzetta</i>	CS1	√		vagrant
Nankeen Night Heron <i>Nycticorax caledonicus</i>		√		regular visitor
Threskionithidae (ibis and spoonbills)				
Australian White Ibis <i>Threskiornis molucca</i>		√	√	regular visitor
Glossy Ibis <i>Plegadis falcinellus</i>		√		vagrant
Straw-necked Ibis <i>Threskiornis spinicollis</i>		√		regular visitor
Yellow-billed Spoonbill <i>Platalea flavipes</i>		√	√	regular visitor
Rallidae (crakes and rails)				
Buff-banded Rail <i>Rallus philippensis</i>		√		occasional visitor
Baillon's Crake <i>Porzana pusilla</i>		√		occasional visitor
Australian Spotted Crake <i>Porzana fluminea</i>		√		occasional visitor

Bird Species	Cons. Signif.	Database	BCE	Status in Study area
Spotless Crake <i>Porzana tabuensis</i>		√		occasional visitor
Dusky Moorhen <i>Gallinula tenebrosa</i>		√	√	resident
Purple Swampphen <i>Porphyrio porphyrio</i>		√		resident
Eurasian Coot <i>Fulica atra</i>		√	√	resident
Recurvirostridae (stilts and avocets)				
Black-winged Stilt <i>Himantopus himantopus</i>		√		regular visitor
Banded Stilt <i>Cladorhynchus leucocephalus</i>		√		vagrant
Red-necked Avocet <i>Recurvirostra novaehollandiae</i>		√		vagrant
Charadriidae (lapwings and plovers)				
Grey Plover <i>Pluvialis squatarola</i>	CS1	√		vagrant
Red-capped Plover <i>Charadrius ruficapillus</i>		√		vagrant
Black-fronted Dotterel <i>Eseyornis melanops</i>		√		vagrant
Red-kneed Dotterel <i>Erythronyx cinctus</i>		√		vagrant
Banded Lapwing <i>Vanellus tricolor</i>		√		vagrant
Scolopacidae (sandpipers and stints)				
Common Sandpiper <i>Acticus hypoleucos</i>	CS1	√		occasional visitor
Red-necked Stint <i>Calidris ruficollis</i>	CS1	√		vagrant
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	CS1	√		vagrant
Curlew Sandpiper <i>Calidris ferruginea</i>	CS1	√		vagrant
Common Greenshank <i>Tringa nebularia</i>	CS1	√		occasional visitor
Laridae (gulls and terns)				
Whiskered Tern <i>Chilidonias hybrida</i>		√		occasional visitor
Crested Tern <i>Thalasseus bergii</i>		√		occasional visitor
Caspian Tern <i>Hydroprogne caspia</i>	CS1	√		occasional visitor
Silver Gull <i>Chroicocephalus novaehollandiae</i>		√		regular visitor
Columbidae (pigeons and doves)				
Rock Dove (Domestic Pigeon) <i>Columba livia</i>	INT	√		regular visitor
Laughing Dove <i>Streptopelia senegalensis</i>	INT	√		resident
Spotted Dove <i>Streptopelia chinensis</i>	INT	√	√	resident
Common Bronzewing <i>Phaps chalcoptera</i>	CS3	√		occasional visitor
Crested Pigeon <i>Ocyphaps lophotes</i>		√		occasional visitor
Podargidae (frogmouths)				
Tawny Frogmouth <i>Podargus strigoides</i>		√		occasional visitor
Apodidae (swifts)				
Fork-tailed Swift <i>Apus pacificus</i>	CS1	√		migrant
Pandionidae (ospreys)				
Eastern Osprey <i>Pandion cristatus</i>		√		occasional visitor
Accipitridae (kites, hawks and eagles)				
Black-shouldered Kite <i>Elanus axillaris</i>		√		occasional visitor
Square-tailed Kite <i>Lophoictinia isura</i>				occasional visitor
Whistling Kite <i>Haliastur sphenurus</i>		√		occasional visitor

Bird Species	Cons. Signif.	Database	BCE	Status in Study area
Swamp Harrier <i>Circus approximans</i>		√		occasional visitor
Brown Goshawk <i>Accipiter fasciatus</i>	CS3	√		occasional visitor
Collared Sparrowhawk <i>Accipiter cirrhocephalus</i>	CS3	√		resident
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	CS3	√		occasional visitor
Little Eagle <i>Hieraaetus morphnoides</i>	CS3	√		occasional visitor
Falconidae (falcons)				
Peregrine Falcon <i>Falco peregrinus</i>	CS1	√		occasional visitor
Australian Hobby <i>Falco longipennis</i>		√		occasional visitor
Brown Falcon <i>Falco berigora</i>				occasional visitor
Nankeen Kestrel <i>Falco cenchroides</i>		√		occasional visitor
Cacatuidae (cockatoos)				
Carnaby's Black-Cockatoo <i>Calyptorhynchus latirostris</i>	CS1	√	√	regular visitor
Baudin's Black-Cockatoo <i>Calyptorhynchus baudinii</i>	CS1	√		occasional visitor
Forest Red-tailed Black-Cockatoo <i>Calyptorhynchus banksii naso</i>	CS1	√	√	regular visitor
Sulphur-crested Cockatoo <i>Cacatua galerita</i>	INT	√		vagrant
Galah <i>Cacatua roseicapilla</i>		√	√	regular visitor
Eastern Long-billed Corella <i>Cacatua tenuirostris</i>	INT	√		regular visitor
Western Corella <i>Cacatua pastinator</i>		√		occasional visitor
Little Corella <i>Cacatua sanguinea</i>		√	√	regular visitor
Psittacidae (lorikeets and parrots)				
Rainbow Lorikeet <i>Trichoglossus haematodus</i>	INT	√	√	regular visitor
Australian Ringneck <i>Barnardius zonarius</i>		√	√	regular visitor
Red-capped Parrot <i>Purpureicephalus spurius</i>		√	√	regular visitor
Cuculidae (cuckoos)				
Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i>		√		occasional visitor
Pallid Cuckoo <i>Cuculus pallidus</i>		√		occasional visitor
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalis</i>		√		occasional visitor
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>		√		occasional visitor
Strigidae (hawk-owls)				
Southern Boobook <i>Ninox novaeseelandiae</i>		√		resident
Tytonidae (barn owls)				
Barn Owl <i>Tyto alba</i>		√		occasional visitor
Halcyonidae (forest kingfishers)				
Sacred Kingfisher <i>Todiramphus sanctus</i>		√	√	regular visitor
Laughing Kookaburra <i>Dacelo novaeguineae</i>	INT	√	√	resident
Meropidae (bee-eaters)				
Rainbow Bee-eater <i>Merops ornatus</i>	CS3	√	√	migrant
Maluridae (fairy-wrens)				
Splendid Fairy-wren <i>Malurus splendens</i>	CS3	√		occasional visitor

Bird Species	Cons. Signif.	Database	BCE	Status in Study area
White-winged Fairy-wren <i>Malurus leucopterus</i>	CS3	√		occasional visitor
Pardalotidae (pardalotes)				
Striated Pardalote <i>Pardalotus striatus</i>		√	√	resident
Spotted Pardalote <i>Pardalotus punctatus</i>		√		Regular visitor
White-browed Scrubwren <i>Sericornis frontalis</i>	CS3	√		Occasional visitor
Weebill <i>Smicronis brevirostris</i>	CS3	√	√	resident
Western Gerygone <i>Gerygone fusca</i>		√	√	regular visitor
Inland Thornbill <i>Acanthiza apicalis</i>	CS3	√		vagrant
Yellow-rumped Thornbill <i>Acanthiza chrysorrhoa</i>	CS3	√		vagrant
Meliphagidae (honeyeaters)				
Red Wattlebird <i>Anthochaera carunculata</i>		√	√	resident
Western Wattlebird <i>Anthochaera lunulata</i>	CS3	√		occasional visitor
Singing Honeyeater <i>Lichenostomus virescens</i>		√	√	resident
Brown Honeyeater <i>Lichmera indistincta</i>		√		resident
White-naped Honeyeater <i>Melithreptus chloropsis</i>		√		occasional visitor
White-cheeked Honeyeater <i>Phylidonyris nigra</i>	CS3	√		occasional visitor
New Holland Honeyeater <i>P. novaehollandiae</i>	CS3	√	√	regular visitor
White-fronted Chat <i>Epthianura albifrons</i>		√		vagrant
Acrocephalidae (reed-warblers)				
Australian Reed-Warbler <i>Acrocephalus australis</i>		√		occasional visitor
Megaluridae (grassbirds)				
Little Grassbird <i>Megalurus gramineus</i>		√		occasional visitor
Rufous Songlark <i>Cincloramphus mathewsi</i>		√		vagrant
Brown Songlark <i>Cincloramphus cruralis</i>		√		vagrant
Zosteropidae (white-eyes)				
Silvereye <i>Zosterops lateralis</i>		√	√	regular visitor
Pachycephalidae (whistlers)				
Rufous Whistler <i>Pachycephala rufiventris</i>	CS3	√	√	regular visitor
Dicuridae (flycatchers)				
Magpie-lark <i>Grallina cyanoleuca</i>		√	√	resident
Grey Fantail <i>Rhipidura fuliginosa</i>		√	√	resident
Willie Wagtail <i>Rhipidura leucophrys</i>		√	√	resident
Neosittidae (sittella)				
Varied Sittella <i>Daphoenositta chrysoptera</i>	CS3	√		vagrant
Campephagidae (cuckoo-shrikes)				
Black-faced Cuckoo-shrike <i>C. novaehollandiae</i>		√		resident
White-winged Triller <i>Lalage sueurii</i>		√		vagrant
Artamidae (woodswallows)				
Black-faced Woodswallow <i>Artamus cinereus</i>	CS3	√		occasional visitor
Dusky Woodswallow <i>Artamus cyanopterus</i>				occasional visitor
Grey Butcherbird <i>Cracticus torquatus</i>		√		

Bird Species	Cons. Signif.	Database	BCE	Status in Study area
Australian Magpie <i>Gymnorhina tibicen</i>		√	√	resident
Corvidae (ravens and crows)				
Australian Raven <i>Corvus coronoides</i>		√	√	resident
Motacillidae (pipits and true wagtails)				
Australian Pipit <i>Anthus novaeseelandiae</i>		√		regular visitor
Dicaeidae (flower-peckers)				
Mistletoebird <i>Dicaeum hirundinaceum</i>		√		regular visitor
Hirundinidae (swallows)				
White-backed Swallow <i>Cheramoeca leucosternus</i>				occasional visitor
Welcome Swallow <i>Hirundo neoxena</i>		√		regular visitor
Tree Martin <i>Petrochelidon nigricans</i>		√		regular visitor
Fairy Martin <i>Petrochelidon ariel</i>		√		occasional visitor
Total expected	34	133	34	

Mammal Species	Cons. Signif.	Database	BCE	Status in study area
Phalangeridae (brush-tail possums)				
Brush-tailed Possum <i>Trichosurus vulpecula</i>	CS3	√		occasional visitor
Mollosidae (mastiff bats)				
White-striped Bat <i>Tadarida australis</i>		√		regular visitor
Vespertilionidae (vesper bats)				
Southern Forest Bat <i>Vespadelus regulus</i>		√		occasional visitor
Gould's Wattled Bat <i>Chalinolobus gouldii</i>		√		regular visitor
Chocolate Wattled Bat <i>Chalinolobus morio</i>		√		occasional visitor
Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>		√		occasional visitor
Western False Pipistrelle <i>Falsistrellus mackenziei</i>	CS2, P4			occasional visitor
Muridae (rats and mice)				
House Mouse <i>Mus musculus</i>	INT	√		resident
Water-rat or Rakali <i>Hydromys chrysogaster</i>	CS2, P4	√		regular visitor
Brown Rat <i>Rattus norvegicus</i>	INT	√		resident
Black Rat <i>Rattus rattus</i>	INT	√		resident
Leporidae (rabbits and hares)				
Rabbit <i>Oryctolagus cuniculus</i>	INT	√		occasional visitor
Canidae (foxes and dogs)				
European Red Fox <i>Vulpes vulpes</i>	INT	√		regular visitor
Dog <i>Canis lupus</i>	INT	√		regular visitor
Felidae (cats)				
Feral Cat <i>Felis catus</i>	INT	√		regular visitor

Appendix 6. Vertebrate species returned in database searches but unlikely to occur in survey area.

Database searches often return species that may have been recorded historically but are now extinct in a region. Databases can also include species found nearby but unlikely to be present in the study area due to lack of suitable habitat (e.g. aquatic species) or ecological barriers preventing them from reaching the area (e.g. island species). There are also some errors, out-of-date Latin names, zoo specimens and subtleties of distribution that are not recognised in databases. All of the species listed below are considered unlikely to be found in the survey area (some species could occur as very rare vagrants).

Table 9. Species returned in database searches which are unlikely to occur in the survey area.

Common name	Latin name	Native / Introduced
FISH		
Western Minnow	<i>Galaxias occidentalis</i>	Native
Black-striped Minnow	<i>Galaxiella nigrostriata</i>	Native
REPTILES		
Western Swamp Tortoise	<i>Pseudemydura umbrina</i>	Native
Odd-striped Skink	<i>Ctenotus impar</i>	Native
Bold Striped Sand Skink	<i>Lerista christinae</i>	Native
West Coast Worm Skink	<i>Lerista praepedita</i>	Native
Western Bluetongue Skink	<i>Tiliqua occipitalis</i>	Native
Stone Gecko	<i>Diplodactylus granariensis</i>	Native
Granite Worm Lizard	<i>Aprasia pulchella</i>	Native
Keeled Legless Lizard	<i>Pletholax gracilis</i>	Native
Southern Heath Dragon	<i>Ctenophorus adelaidensis</i>	Native
Shovel-nosed Snake	<i>Brachyurophis semifasciatus</i>	Native
Black-striped Snake	<i>Neelaps calonotos</i>	Native
BIRDS		
Black-faced Cormorant	<i>Phalacrocorax fuscescens</i>	Native
Grey Wagtail	<i>Motacilla cinerea</i>	Native
Malleefowl	<i>Leipoa ocellata</i>	Native
Australian Painted-snipe	<i>Rostratula australis</i>	Native
Hooded Plover	<i>Charadrius rubricollis</i>	Native
Blue-breasted Fairy-wren	<i>Malurus pulcherrimus</i>	Native
Jacky Winter	<i>Micrieca fascinans</i>	Native
European Goldfinch	<i>Carduelis carduelis</i>	Introduced
House Sparrow	<i>Passer domesticus</i>	Introduced
Common Starling	<i>Sturnus vulgaris</i>	Introduced
Common Blackbird	<i>Turdus merula</i>	Introduced
MAMMALS		
Chuditch	<i>Dasyurus geoffroii</i>	Native
Bilby, Dalgyte or Walpiri	<i>Macrotis lagotis</i>	Native
Honey Possum	<i>Tarsipes rostratus</i>	Native
Black-flanked Rock-Wallaby	<i>Petrogale lateralis lateralis</i>	Native
Brush Wallaby	<i>Macropus irma</i>	Native
Pig	<i>Sus scrofa</i>	Introduced

Appendix 7. Scoring system for the assessment of Black-Cockatoo foraging values.

Site score	Description of vegetation		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples would be salt lakes and bare ground.	No foraging value. No eucalypts or other potential sources of food.	No foraging value. No eucalypts (i.e. Marri, Jarrah, Wandoo, Blackbutt or Karri) or other potential sources of food.
1	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these <2%. Could include urban areas with scattered foraging trees. Blue Gum plantations are considered to have a score of 1 as foraging by Black-Cockatoos has been reported but appears to be unusual.	Negligible to low foraging value. Scattered specimens of known food plants (e.g. Marri and Jarrah) but projected foliage cover of these <1%. Could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these <1%. Could include urban areas with scattered foraging trees.
2	Low foraging value. Examples: Shrubland in which species of foraging value, such as shrubby banksias, with <10% projected foliage cover. Open eucalypt woodland/mallee of small-fruited species. Paddocks with melons or other weeds (a short-term, seasonal food source).	Low foraging value. Example: Woodland or forest with scattered specimens of known food plants (e.g. Marri and Jarrah) but projected foliage cover of these 1-<5%. Could include urban areas with scattered foraging trees.	Low foraging value. Examples: Open eucalypt woodland (i.e. Marri, Jarrah, Wandoo, Blackbutt or Karri). Projected foliage cover of these 1-<5% Urban areas with scattered food plants such as Cape Lilac, Euc. caesia and E. erythrocorys.
3	Low to Moderate foraging value. Examples: Shrubland in which species of foraging value, such as shrubby banksias, with 10-20% projected foliage cover. Woodland with tree banksias 2-10% projected foliage cover. Eucalypt woodland/mallee of small-fruited species; Marri, if present, <10% project foliage cover.	Low to Moderate foraging value. Examples: Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 5-<10%. Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of 10-<20% can be considered low-to-moderate because of poor long-term viability without management.	Low to Moderate foraging value. Examples: Eucalypt woodland (i.e. Marri, Jarrah, Wandoo, and Blackbutt), if present, <10% project foliage cover.

Site score	Description of vegetation		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
4	Moderate foraging value. Examples: Woodland with tree banksias 20-40% projected foliage cover. Eucalypt woodland/forest with Marri 20-40% projected foliage cover.	Moderate foraging value. Examples: Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 10-<20%. Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of 20-<40% can be considered moderate because of poor long-term viability without management. Areas of orchards and especially those with apples can be considered of moderate value.	Moderate foraging value. Examples: Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with 20-40% projected foliage cover.
5	Moderate to High foraging value. Examples: Banksia woodlands with tree banksias >40%. Vegetation condition moderate due to weed invasion and some tree deaths.	Moderate to High foraging value. Examples: Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 20-<40%. Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of >40% can be considered moderate because of poor long-term viability without management.	Moderate to High foraging value. Examples: Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with >40% projected foliage cover. Vegetation condition moderate due to weed invasion and some tree deaths.
6	High foraging value. Example: Banksia woodlands of key species (e.g. <i>B. attenuata</i> , <i>B. menziesii</i>) with projected foliage cover >60%. Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.	High foraging value. Example: Eucalypt woodland/forest with a high proportion of Marri (>40% projected foliage cover). Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.	High foraging value. Example: Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with >60% projected foliage cover. Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.

Appendix 8. Grading system used to assess potential nest trees for Black-Cockatoos.

The following class descriptions relate to the tree class data presented in Appendix 9.

Class	Description of tree and hollows /activity
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows but hollows or potential hollows are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black-Cockatoos.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

Appendix 9. Black cockatoo potential nest tree data.

Coordinates	Tree species	DBH (cm)	Tree class	Tree status
50 J 401470 6468654	Flooded Gum (<i>Eucalyptus rudis</i>)	90	5	Alive
50 J 401457 6468680	Flooded Gum (<i>Eucalyptus rudis</i>)	51	5	Alive
50 J 401459 6468732	Flooded Gum (<i>Eucalyptus rudis</i>)	80	5	Alive
50 J 401447 6468735	Flooded Gum (<i>Eucalyptus rudis</i>)	75	5	Alive
50 J 401453 6468761	Flooded Gum (<i>Eucalyptus rudis</i>)	95	5	Alive
50 J 401449 6468774	Flooded Gum (<i>Eucalyptus rudis</i>)	150	5	Alive
50 J 401437 6468887	Flooded Gum (<i>Eucalyptus rudis</i>)	90	5	Alive
51 J 401430 6468890	Flooded Gum (<i>Eucalyptus rudis</i>)	80	5	Alive
52 J 401430 6468897	Flooded Gum (<i>Eucalyptus rudis</i>)	80	5	Alive
50 J 401602 6468905	Flooded Gum (<i>Eucalyptus rudis</i>)	120	3	Alive
50 J 401613 6468923	Flooded Gum (<i>Eucalyptus rudis</i>)	55	5	Alive
50 J 401637 6468972	Flooded Gum (<i>Eucalyptus rudis</i>)	60	5	Alive
50 J 401634 6468976	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401643 6468982	Flooded Gum (<i>Eucalyptus rudis</i>)	85	5	Alive
50 J 401633 6468982	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401624 6469005	Flooded Gum (<i>Eucalyptus rudis</i>)	100	3	Alive
50 J 401621 6469029	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401633 6469044	Flooded Gum (<i>Eucalyptus rudis</i>)	120	5	Alive
50 J 401592 6469041	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401570 6469028	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401570 6469003	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401559 6468979	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401555 6469042	Flooded Gum (<i>Eucalyptus rudis</i>)	60	5	Alive
50 J 401551 6469042	Flooded Gum (<i>Eucalyptus rudis</i>)	100	4	Alive
50 J 401549 6469042	Flooded Gum (<i>Eucalyptus rudis</i>)	90	4	Alive
50 J 401517 6469042	Flooded Gum (<i>Eucalyptus rudis</i>)	180	5	Alive
50 J 401482 6469039	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401470 6469035	Flooded Gum (<i>Eucalyptus rudis</i>)	55	5	Alive
50 J 401461 6469034	Flooded Gum (<i>Eucalyptus rudis</i>)	90	5	Alive
50 J 401437 6468985	Flooded Gum (<i>Eucalyptus rudis</i>)	95	5	Alive
50 J 401409 6468998	Flooded Gum (<i>Eucalyptus rudis</i>)	55	5	Alive
50 J 401415 6469041	Flooded Gum (<i>Eucalyptus rudis</i>)	60	5	Alive
50 J 401292 6469014	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401318 6469058	Flooded Gum (<i>Eucalyptus rudis</i>)	80	4	Alive
50 J 401301 6469061	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401246 6469086	Flooded Gum (<i>Eucalyptus rudis</i>)	51	5	Alive
50 J 401267 6469160	Flooded Gum (<i>Eucalyptus rudis</i>)	60	5	Alive
50 J 401284 6469162	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401291 6469164	Flooded Gum (<i>Eucalyptus rudis</i>)	55	5	Alive
50 J 401297 6469165	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401273 6469153	Flooded Gum (<i>Eucalyptus rudis</i>)	60	5	Alive
50 J 401271 6469151	Flooded Gum (<i>Eucalyptus rudis</i>)	51	5	Alive
50 J 401271 6469141	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401274 6469133	Flooded Gum (<i>Eucalyptus rudis</i>)	70	5	Alive
50 J 401275 6469126	Flooded Gum (<i>Eucalyptus rudis</i>)	100	5	Alive

Coordinates	Tree species	DBH (cm)	Tree class	Tree status
50 J 401271 6469121	Flooded Gum (<i>Eucalyptus rudis</i>)	80	5	Alive
50 J 401278 6469101	Flooded Gum (<i>Eucalyptus rudis</i>)	90	5	Alive
50 J 401322 6469043	Flooded Gum (<i>Eucalyptus rudis</i>)	55	5	Alive
50 J 401509 6468989	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive
50 J 401547 6468924	Flooded Gum (<i>Eucalyptus rudis</i>)	65	5	Alive

Appendix 10. Annotated list of fauna recorded during the field survey.

Note: non-native species are indicated by asterisk.

	Fish	Notes
1	Mosquito Fish *	Abundant in lake
	Frogs	
2	Banjo Frog	several calling in lake amongst emergent Melaleuca
3	Slender Tree Frog	several calling in lake amongst emergent Melaleuca
	Reptiles	
4	Snake-eyed Skink	active on flooded gum
5	Common Dwarf Skink	active in native garden bed
6	Two-toed Earless Skink	under leaf-litter near wetland
	Birds	
7	Red Wattlebird	several observed and heard calling
8	Magpie Lark	observed and heard calling
9	Grey Butcherbird	heard calling
10	Australian Magpie	several observed and heard calling
11	Striated Pardalote	heard calling
12	Australian Raven	observed and heard calling
13	Rainbow Bee-eater	one heard calling
14	Forest Red-tailed Black Cockatoo	several small groups flying over study area and foraging residue (chewed cape lilac)
15	Carnaby's Cockatoo	foraging residue (chewed pine cones)
16	Red-capped Parrot	two observed
17	Little Corella	heard calling
18	Galah	several in flooded gums
19	Australian Ringneck	several observed
20	Rainbow Lorikeet *	observed and heard calling
21	Willie Wagtail	heard calling
22	Weebill	several heard and two observed
23	Grey Fantail	several heard and observed
24	Silvereye	several heard and observed
25	Singing Honeyeater	two heard calling
26	Western Gerygone	one heard
27	Rufous Whistler	one female observed
28	Grey Teal	on open water
29	Pink-eared Duck	a pair on open water
30	Wood Duck	several on open water
31	Pacific Black Duck	on open water
32	Eurasian Coot	several on open water
33	Australasian Grebe	on open water
34	White-faced Heron	observed in wetland shallows
35	Australian White Ibis	several perched in paperbarks
36	Yellow-billed Spoonbill	within wetland shallows
37	Spotted Dove *	observed and heard calling
38	Dusky Moorhen	heard calling within wetland
40	Laughing Kookaburra *	heard calling within study area

Appendix 11. Additional photographs taken within the study area.



Foraging residue of Forest Red-tailed Black Cockatoo (chewed cape lilac berries)



Foraging residue of Carnaby's Black-Cockatoo (chewed pine cones)



Pink-eared Ducks using wetland habitat



White-faced Heron using wetland habitat



Red Wattlebird using woodland habitat



Feral bees swarm in Flooded Gum tree hollow