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# Black Cockatoo Habitat Assessment, Roe Highway

## Final Report

Prepared for  
Main Roads  
by Strategen

September 2018

# **Black Cockatoo Habitat Assessment, Roe Highway**

## **Final Report**

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September 2018

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## **Client: Main Roads**

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
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## Table of contents

<b>1. Introduction</b>	<b>2</b>
1.1 Objectives	2
1.2 Background to Protected Fauna	4
1.2.1 EPBC Act	4
1.2.2 WC Act	4
1.2.3 DBCA Priority Lists	4
1.3 Background Ecological Information for Black Cockatoos	5
1.3.1 Carnaby's Black Cockatoo	5
1.3.2 Baudin's Black Cockatoo	6
1.3.3 Forest Red-tailed Black Cockatoo	6
<b>2. Methods</b>	<b>8</b>
<b>3. Results</b>	<b>9</b>
3.1 Potential Breeding Habitat	9
3.2 Foraging Habitat	10
3.3 Foraging Habitat Quality Score	10
<b>4. Discussion</b>	<b>17</b>
4.1 Potential Breeding Habitat	17
4.2 Foraging Habitat	17
4.3 Habitat Quality	19
<b>5. References</b>	<b>20</b>

## List of tables

Table 1: Reinspected hollows and their related dimensions	10
Table 2: DEE Black Cockatoo foraging habitat scoring tool (DEE 2017).	11

## List of figures

Figure 1: The Survey Area	3
Figure 2: Black Cockatoo habitat and potential breeding trees	14
Figure 3: Black Cockatoo habitat quality score	15

## List of appendices

Appendix 1 Conservation significant flora, fauna and ecological community definitions
Appendix 2 Black Cockatoo distribution maps
Appendix 3 Black Cockatoo Potential Breeding Trees
Appendix 4 Hollow Photos

## 1. Introduction

Strategen Environmental (Strategen) was commissioned by Main Roads Western Australia (Main Roads) to undertake a Black Cockatoo habitat assessment for the Kalamunda Road Roe Highway upgrade.

Strategen understands that Main Roads is proposing to construct a grade separation at the intersection of Roe Highway and Kalamunda Road in Maida Vale (Survey Area), with construction expected to commence in late 2018 (Figure 1). The Survey Area is 80 ha in total and covers approximately 4.6 km with additional areas associated with intersections.

The proposed development of the site has the potential to impact native vegetation and as such, a Black Cockatoo habitat assessment was deemed necessary to determine the environmental values of the potential clearing area.

Clearing of vegetation may result in the removal of vegetation potentially containing habitat for Forest Red-tailed Black-Cockatoos (FRTBC), Baudin's Black Cockatoos (BBC) and Carnaby's Black-Cockatoos (CBC). All three species of Black Cockatoos are listed as Threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Wildlife Conservation Act 1950* (WC Act). Given this, an assessment of the habitat values is required to support potential future assessment and approval requirements and to inform development design.

This report presents the findings of the Black Cockatoo habitat assessment undertaken for the Survey Area.

### 1.1 Objectives

The objectives of the work undertaken were to:

- undertake a Black Cockatoo habitat assessment
- define and map Black Cockatoo habitat within the Survey Area
- prepare a report summarising the findings.

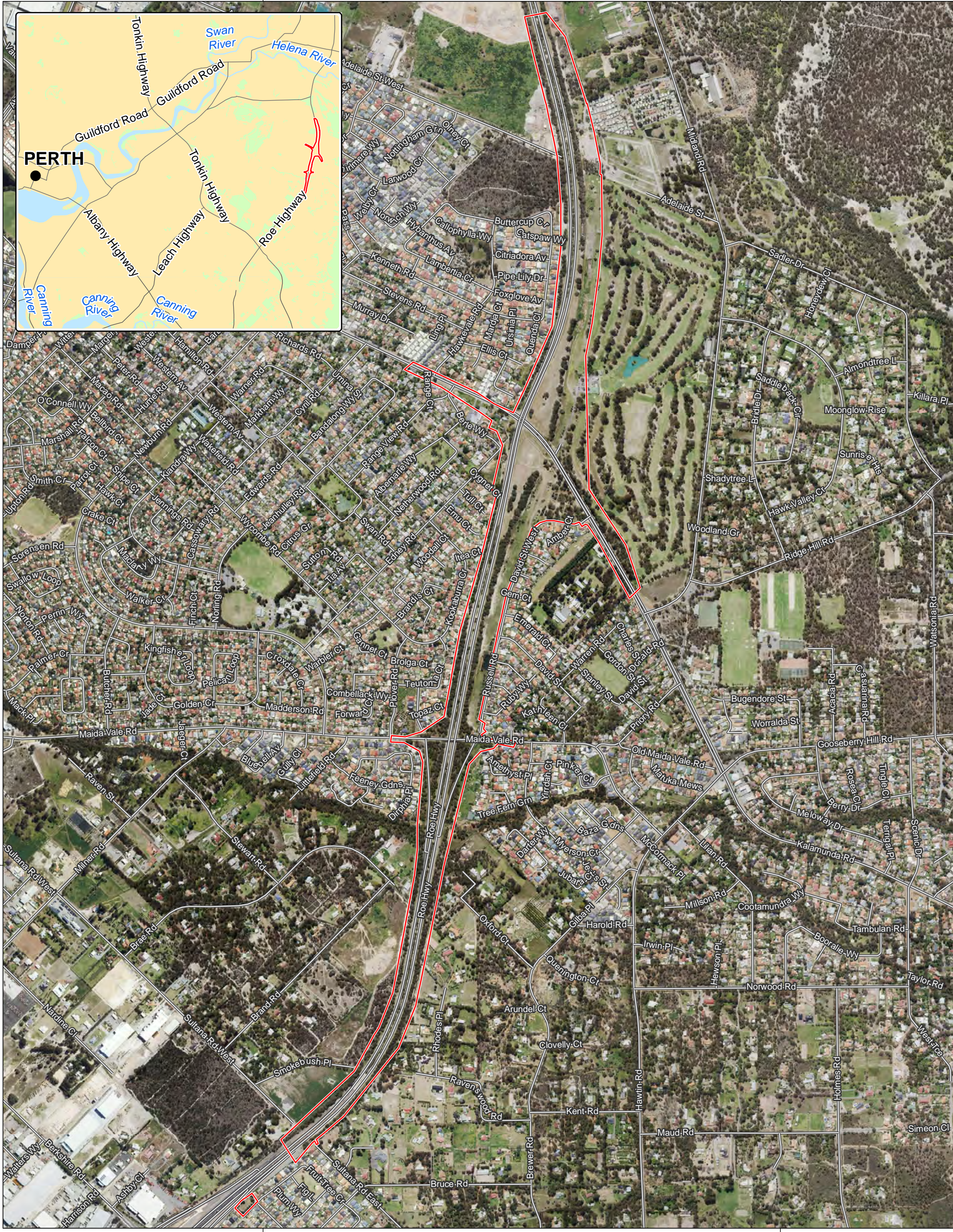


Figure 1: Site location

Scale 1:14,000 at A3

0 50 100 150 200 250 Meters

Coordinate System: GDA 1994 MGA Zone 50  
Note that positional errors may occur in some areas  
Date: 5/02/2018  
Author: DWhite

Source: Proposed environmental boundary,  
24/01/2018 Main Roads 2018; Aerial: Landgate 2018.



Proposed environmental boundary  
Roads



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## 1.2 Background to Protected Fauna

Western Australian flora and fauna is protected formally and informally by various legislative and non-legislative measures, which are as follows:

Legislative measures:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- Wildlife Conservation Act 1950 (WC Act)
- Environmental Protection Act 1986 (EP Act)
- Biosecurity and Agriculture Management Act 2007 (BAM Act).

Non-legislative measures:

- Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) Priority lists for flora, ecological communities and fauna
- Weeds of National Significance
- Recognition of locally significant populations by the DBCA.

A short description of each is given below. Other definitions, including species conservation categories, are provided in Appendix 1.

### 1.2.1 EPBC Act

The EPBC Act aims to protect matters of national environmental significance (MNES). Under the EPBC Act, the Commonwealth Department of the Environment and Energy (DEE) lists threatened species and communities in categories determined by criteria set out in the Act ([www.environment.gov.au/epbc/index.html](http://www.environment.gov.au/epbc/index.html)) (Appendix 1).

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are listed as Endangered under the EPBC Act. The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (FRTBC) is classified as Vulnerable.

Projects likely to cause a significant impact on MNES should be referred to the DEE for assessment under the EPBC Act.

### 1.2.2 WC Act

The WA DBCA lists flora and fauna under the provisions of the WC Act as protected according to their need for protection (Appendix 1).

Under the WC Act Fauna are classified as Schedule 1 to Schedule 7 according to their need for protection. Under the WC Act both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered (Schedule 2) and the FRTBC is listed as Vulnerable (Schedule 3).

### 1.2.3 DBCA Priority Lists

The DBCA lists 'Priority' flora and fauna that have not been assigned statutory protection as Declared Rare or 'Scheduled' under the WC Act, but which are under consideration for declaration as DRF or 'Scheduled' fauna. Flora and fauna assessed as Priority 1-3 are in urgent need of further survey. Priority 4 flora and fauna require monitoring every 5-10 years and Priority 5 flora and fauna are subject to a specific conservation programme (Appendix 1).

The DBCA maintains a list of PECs which identifies ecologically valuable communities that need further investigation before possible nomination for TEC status. Once listed, a community is a PEC, and when endorsed by the Western Australian Minister of Environment becomes a TEC, and protected as an ESA under Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Appendix 1).

## 1.3 Background Ecological Information for Black Cockatoos

All three species of Black Cockatoo (Carnaby's Cockatoo, Baudin's Cockatoo and FRTBC) could potentially occur in the Survey Area. The distribution of all three species can be seen in the 2017 DEE distribution maps in Appendix 2.

### 1.3.1 Carnaby's Black Cockatoo

Carnaby's Cockatoo is endemic to south-west WA, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last half century, and is now locally extinct in some areas (Johnstone & Storr 1998; Shah 2006). In the last 45 years (prior to Cale 2003) the species has suffered a 50% reduction in its abundance (Cale 2003). More recent information suggests this decline has continued. This reduction is due to the clearing of core breeding habitat in the wheatbelt, the deterioration of nesting hollows, and clearing of food resources on the Swan Coastal Plain (SCP) (Cale 2003). The total population of Carnaby's Cockatoo was estimated to be 40,000 in 2008 (Johnstone & Kirkby 2008). Since then, trend analyses of the seven Great Cocky Counts 2010 – 2016 identified strong indications that the population of Carnaby's Black-Cockatoo inhabiting the Perth-Peel Coastal Plain continues to decline.

Carnaby's Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Food plants include a variety of Eucalyptus species, such as Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Swan River Blackbutt (*Eucalyptus patens*), Coastal Blackbutt (*Eucalyptus todtiana*), Caesia (*Eucalyptus caesia*) and Salmon Gum (*Eucalyptus salmonophloia*), as well as Pine trees (*Pinus* sp.), Grevillea, Allocasuarina, and Hakea species (Shah 2006). Marri nuts that are damaged extensively, especially on the main body of the nut, are likely to have been chewed by Carnaby's Cockatoo. The 'levering' of Marri nuts by Carnaby's Cockatoos tends to leave different marks on the fruit casings, particularly in the location of indentations by the lower mandible and in the amount of damage caused to the rim of the fruit casing. Carnaby's Cockatoos also generally feed on green Marri nuts that are soft enough for their beaks to manipulate. The seeds from a variety of Banksia species and the cones of Pine trees provide the highest energetic yield (Cooper *et al.* 2002).

Breeding has been recorded from early July to mid-December, and primarily occurs in the wheatbelt in the semi-arid and subhumid interior (Johnstone & Storr 1998). However, this species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp (e.g. Wungong Dam Catchment) and into the Tuart (*Eucalyptus gomphocephala*) forests of the SCP including Yancheep, Baldivis, Lake Clifton and near Bunbury (Johnstone & Kirkby 2011).

Carnaby's Cockatoo display strong pair bonds and mate for life. They nest in hollows of smooth-barked eucalypts particularly Salmon Gum and Wandoo (*Eucalyptus wandoo*) but nests have also been found in other Eucalypt species including York Gum (*Eucalyptus loxophleba*), Flooded Gum (*Eucalyptus rudis*), the rough-barked Marri and Tuart (Johnstone & Kirkby 2011). In most nests in Tuart, eggs are laid on a mat of wood chips at the bottom of a large hollow (mostly top entry hollows) ranging from a few cm's to five m deep (Johnstone & Kirkby 2011). Clutch size is 1–2 eggs, more typically two; only one young is reared (Saunders 1986). Incubation lasts for 29 days and only the female incubates and broods. The nestling is brooded by the female during which time both rely on food from the male. Once brooding is complete, the female then leaves the nest each day at dawn, sometimes returning mid-morning (with the male) to feed the chick (Johnstone & Kirkby 2011). After approximately three weeks she ceases to brood and the chick is fed by one or both parents in the morning and in the late evening (Johnstone & Kirkby 2011).

Approximately 87% (525,732 ha) of potential Carnaby's Cockatoo habitat (i.e. areas of vegetation that contain flora species and vegetation types that could support the species' breeding, feeding and night roosting activities) has been cleared in the wheatbelt since European settlement (DEC 2012). The south-west region is now a severely fragmented landscape and the further loss of foraging habitat, the lack of suitable breeding sites, climate change, alterations in the landscape, changing forest structure with almost every part of the Jarrah-Marri forest logged in the past and with most trees too young to form hollows, and competition with exotic species, exacerbate the future conservation of Carnaby's Cockatoo (Johnstone & Kirkby 2011).



### 1.3.2 Baudin's Black Cockatoo

This species is distributed through the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the SCP (south of the Swan River), south to Bunbury and across to Albany (Johnstone & Kirkby 2011). Baudin's Cockatoo rarely occurs near the coast north of Mandurah, and rarely occurs north of the Swan River (Johnstone & Kirkby 2008, Johnstone & Storr 1998). Baudin's Cockatoo usually occur in small flocks of up to 30, or occasionally up to 50 and rarely in aggregations of up to 1200 (Johnstone & Kirkby 2008). Baudin's Cockatoo is distinguished from Carnaby's Cockatoo by its longer bill and slightly different call.

This species forages primarily in Eucalypt forest, where it feeds on Marri seeds, flowers, nectar and buds. They also feed on a wide range of seeds of Eucalyptus, Banksia, Hakea and Pines (*Pinus* sp.) as well as fruiting apples and pears and beetle larvae from under the bark of trees (Johnstone & Kirkby 2008, Johnstone & Storr 1998). Baudin's Cockatoo forages at all levels of the forest, from the canopy to the ground, often feeding in the understorey on proteaceous trees and shrubs, especially Banksia, and in orchards both in trees and on dropped or fallen fruit on the ground.

The breeding biology of this species is poorly known. It has been recorded breeding in the deep south-west, north to the Whicher Range and Lowden and also isolated records at Wungong Catchment, Serpentine (hills area) and east to Kojonup and near Albany (Johnstone & Kirkby 2008). They nest in large, mostly vertical, hollows of Karri (*E. diversicolor*), Marri, Wandoo, and Bullich (*E. megacarpa*). Baudin's Cockatoos display strong pair bonds are monogamous and most likely mate for life (Johnstone & Kirkby 2008). The pair remains together all year round except when the female is incubating and brooding. Both adults play a part in selecting the nest hollow, but only the female is responsible for renovation and preparing the hollow for breeding. Preparation of the hollow consists of chewing around the entrance of the hollow and down one part of the interior wall. Pairs have also been recorded prospecting for hollows in most months and outside the breeding range (Johnstone & Kirkby 2008).

### 1.3.3 Forest Red-tailed Black Cockatoo

The FRTBC is distributed through the humid and subhumid south-west of WA from Gingin through the Darling Ranges to the south-west from Bunbury to Albany (primarily in the hilly interior) (Johnstone & Storr 1998, Johnstone *et al.* 2013a). In these areas, the FRTBC inhabits dense Jarrah, Karri, and Marri forests that receive more than 600 mm average annual rainfall (Johnstone & Storr 1998). However, in recent years the FRTBC has moved on to the SCP to forage in the Perth metropolitan area (Johnstone & Kirkby 2011). The FRTBC occurs in pairs or small flocks, or occasionally large flocks of up to 200 birds (Johnstone & Storr 1998).

The FRTBC feeds primarily on Marri and Jarrah fruit, but also Tuart and to a lesser extent on Blackbutt, Albany Blackbutt (*E. staeri*), Karri, Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*) (Johnstone *et al.* 2013b). The FRTBC can obtain energy faster when feeding on Marri and Jarrah than other food sources (Cooper *et al.* 2002), and these two-plant species make up most of their diet (Johnstone *et al.* 2013b).

FRTBC shear the base of Marri nuts at a 45° angle to remove seeds (the 'bottom slice' method), while Baudin's Cockatoos use their elongated upper mandible to pry seeds out, leaving the nut intact (the 'lever') (Johnstone & Kirkby 1999, Cooper *et al.* 2002). Carnaby's Cockatoos may use either technique to feed on Marri nuts, but generally with some modification, e.g. the 'slicing' of fruits may occur along the side of the fruit casing.

The FRTBC is monogamous and pairs nest in tree hollows from 6.5 – 33 m above ground and most nests are in large and old mature Marri, and these trees are the most important nesting tree throughout the FRTBC range (Johnstone *et al.* 2013a). Nest trees of the FRTBC have a mean circumference at breast height of 2.79 m, a mean estimated age of 222 years and a mean overall height of 20.24 m (Johnstone *et al.* 2013a).

Breeding has been recorded in all months, with peaks in April-June and August-October. Only one egg is laid, which the female incubates for 29 to 31 days, before a nestling hatches and weighs between 27 and 32 g. The female remains in the hollow during incubation and only leaves for a short period in the evening to be fed by the male, usually at dusk (Johnstone *et al.* 2013b). Brooding is for up to 10 days, after which the female leaves the nest between dawn and dusk. Pairs of birds appear to recognise each other by calls, not responding to calls by others in the area. Chicks only respond when the parent is heard and are fully feathered at 48 days (Johnstone *et al.* 2013b).

## 2. Methods

The Black Cockatoo habitat assessment was undertaken on 29 and 30 January 2018 by two Strategen personnel with relevant experience as specified by the *EPBC Act Revised draft referral guidelines for three threatened black cockatoo species* (DEE 2017).

The habitat assessment involved traversing the Survey Area by foot. Any trees meeting the following criteria for potential breeding and foraging habitat were recorded, marked and electronically logged using a hand held Global Positioning System (GPS) unit:

- native trees (e.g. Jarrah, Tuart, Marri)
- diameter at breast height (DBH)  $\geq 500$  mm ( $\geq 300$  mm for Wandoo and Salmon Gum)
- suitable sized nest hollow i.e. large enough entrance and adequate depth
- evidence of feeding (chewed cones, seed and nut material)
- opportunistic observations of Black Cockatoos in the Survey Area.

As stated above, the Black Cockatoo habitat assessment considered the recently revised draft referral guidelines for three threatened Black Cockatoo species (DEE 2017) and the previous referral guidelines where relevant (DSEWPaC 2012). These draft guidelines include an assessment of Black Cockatoo foraging habitat quality, by attributing a habitat quality score. The quality score included the elements above as well as the following:

- the presence of all plant species that provide foraging, including non-native food sources used by Black Cockatoos
- use as a roosting site
- the vegetation present in the surrounding area (i.e. at least 12 km from the impact area, including proximity to any breeding habitat, roosting sites or watering points)
- numbers of any known nesting trees.

### **Revisit – hollow inspection**

At the request of Main Roads an additional assessment was undertaken on the 30 August 2018 to reinspect five hollows (originally observed from the ground) in four potential breeding trees. The hollows were inspected in greater detail which included undertaking the following (some of which was undertaken during the original assessment [see dot points above]):

- measure the size of the hollow opening
- height of the hollow off the ground
- angle of the hollow
- depth of the hollow
- examine hollows in detail with binoculars
- assess and photograph hollows in detail with a Canon long lens camera (75 – 300 mm).

If the hollows were identified as being too small from the ground for Black Cockatoos to be able to enter and therefore to potentially breed in, the trees were not climbed for further inspection.

Further to this, please note that not all the hollow features outlined above might be measurable, particularly hollow depth if the tree is deemed unsafe to climb or if the aspect/direction of the hollow makes it too difficult to measure (because it is obstructed in some way).

### 3. Results

During the habitat assessment, numerous (approximately 30) FRTBC were heard calling from many locations, seen flying overhead and observed feeding on Marri nuts and Cape Lilac in the Survey Area (Plate 1).



Plate 1: FRTBC Feeding in Cape lilac in the Survey Area.

#### 3.1 Potential Breeding Habitat

Four species of Eucalypts, Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Tuart (*Eucalyptus gomphocephala*) and Wandoo (*Eucalyptus wandoo*) recorded in the Survey Area, are considered Black Cockatoo potential breeding habitat when DBH is  $\geq 500$  mm ( $\geq 300$  mm for Wandoo). The Survey Area contains 547 potential breeding trees with a DBH  $\geq 500$  mm ( $\geq 300$  for Wandoo) - Marri (418), Jarrah (84), Tuart (18) and Wandoo (27). The dimensions and the locations of the potential breeding trees are displayed in Figure 2 and Appendix 3.

There were few observable hollows present in these trees when viewed from the ground. A total of five hollows were detected from the ground across four potential breeding trees i.e. trees that had a DBH  $\geq 500$  mm (Appendix 3). Of these five hollows, two were considered to have entrances that were high enough or large enough for Black Cockatoos to utilise ( $> 5$  m and  $> 100$  mm diameter). From the ground, however, it was considered unlikely that any of the five hollows were deep enough for Black Cockatoos to breed in, or European honey bees were present.

##### **Revisit – hollow inspection**

The five hollows in the four trees were re-examined. Measurements were estimated and photos were taken to help illustrate the hollows assessed (Table 1, Appendix 3 & Appendix 4) None of the hollows were deemed large enough for Black Cockatoos to enter and therefore to potentially breed in.

Table 1: Reinspected hollows and their related dimensions (measurements are in cm and m). N/A = not applicable because hollow opening was not large enough to warrant further inspection.

*Tree Number	#Hollow opening	Depth of hollow	Height of hollow	Angle of hollow
28	8 x 8 cm	N/A	11 m	45°
116 (hollow 1)	7 x 5 cm	N/A	10 m	90°
116 (hollow 2)	Not a hollow but a large linear opening	N/A	7 m	90°
398	8 x 8 cm	N/A	9 m	45°
420	7 x 7 cm	N/A	5 m	60°

\*See Appendix 3 for species and location details.

# See Appendix 4 for photos of hollows.

### 3.2 Foraging Habitat

There is a total of 33 ha of foraging habitat in the Survey Area (Figure 2).

Foraging species in the Survey Area consist of, Coastal Blackbutt (*Eucalyptus todtiana*), *Banksia attenuata*, *Banksia menziesii*, *Allocasuarina* spp., *Acacia* spp., *Callistemon* spp., *Xanthorrhoea preissii* and the introduced Cape Lilac (*Melia azedarach*). It is important to note that the majority of the Survey Area is regrowth, from previous clearing undertaken during road construction.

The same potential breeding trees (above) are also considered foraging species and includes trees that are of various sizes, however, all are considered mature (i.e. had fruit or large enough to produce fruit). Chewed Marri nuts with markings considered likely to be from all three species of Black Cockatoo were observed throughout the site, particularly under Marri trees (Plate 3 and Plate 3). Chewed Jarrah, *Allocasuarina*, Coastal Blackbutt and Cape Lilac nuts were also observed throughout the Survey Area. As noted above, FRTBC were observed feeding on Marri and Cape Lilac nuts in the Survey.

No roosts were identified in the Survey Area during the assessment. The Great Cocky Count data from 2017 was examined and more than 36 roosting sites were within 12 km of the Survey Area, five of which were within 1.5 km (Birdlife 2017).

### 3.3 Foraging Habitat Quality Score

The Draft Black Cockatoo foraging habitat scoring tool (DEE 2017) was used to determine the quality of Black Cockatoo foraging habitat in the Survey Area (Table 2). As per the scoring tool, the Survey Area has an overall score of either 8 or 10, giving it a habitat quality score of "Very High Quality". The aspects of the table that are applicable to the Survey Area have been highlighted in bold text. The Survey Area contains 6.45 ha of habitat quality score 8 and 26.08 ha of habitat quality score of 10 (Figure 3).

High quality foraging habitat, particularly in proximity to roosting sites and/or breeding sites, demands protection. Foraging habitat with a score of 7 or above is considered high quality and is important for the long-term survival and recovery of Black Cockatoos. Impacts to high quality foraging habitat should be referred.

As previously stated, it is important to note that these guidelines are currently in draft form. As such, the foraging habitat quality score has the potential to be altered in the future, if the final guidelines change considerably.

Table 2: DEE Black Cockatoo foraging habitat scoring tool (DEE 2017).

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for FRTBC
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of, successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .
7 (High quality)	<b>Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA.</b>	<b>Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under a RFA.</b>	<b>Jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. Does not include areas under a RFA.</b>
5 (Quality)	Pine plantation or introduced eucalypts.	Pine plantation or introduced eucalypts.	Introduced eucalypts as well as the introduced Cape lilac ( <i>Melia azedarach</i> ).
1 (Low quality)	<b>Individual foraging plants or small stand of foraging plants.</b>	<b>Individual foraging plants or small stand of foraging plants.</b>	<b>Individual foraging plants or small stand of foraging plants.</b>
Additions	Context adjustor – attributes improving functionality of foraging habitat	Context adjustor – attributes improving functionality of foraging habitat	Context adjustor – attributes improving functionality of foraging habitat
+3	<b>Is within the Swan Coastal Plain (important foraging area).</b>	<b>Is within the known foraging area.</b>	<b>Jarrah and/or marri show good recruitment (i.e. evidence of young trees).</b>
+3	Contains trees with suitable nest hollows.	Contains trees with suitable nest hollows.	Contains trees with suitable nest hollows.
+2	<b>Primarily contains Marri.</b>	<b>Primarily contains Marri.</b>	<b>Primarily contains Marri and/or Jarrah.</b>
+2	<b>Contains trees with potential to be used for breeding (DBH &gt; 500 mm).</b>	<b>Contains trees with potential to be used for breeding (DBH &gt; 500 mm).</b>	<b>Contains trees with potential to be used for breeding (DBH &gt; 500 mm).</b>
+1	Is known to be a roosting site.	Is known to be a roosting site.	Is known to be a roosting site
Subtractions	Context adjustor – attributes reducing functionality of foraging habitat	Context adjustor – attributes reducing functionality of foraging habitat	Context adjustor – attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris.	No clear evidence of feeding debris.	No clear evidence of feeding debris.
-2	No other foraging habitat within 6 km.	No other foraging habitat within 6 km.	No other foraging habitat within 6 km.
-1	Is > 12 km from a known breeding location.	Is > 12 km from a known breeding location.	Is > 12 km from a known breeding location.
-1	Is > 12 km from a known roosting site.	Is > 12 km from a known roosting site.	Is > 12 km from a known roosting site.
-1	Is > 2 km from a watering point.	Is > 2 km from a watering point.	Is > 2 km from a watering point.

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for FRTBC
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of, successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .
7 (High quality)	<b>Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA.</b>	<b>Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under a RFA.</b>	<b>Jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. Does not include areas under a RFA.</b>
5 (Quality)	Pine plantation or introduced eucalypts.	Pine plantation or introduced eucalypts.	Introduced eucalypts as well as the introduced Cape lilac ( <i>Melia azedarach</i> ).
-1	Disease present (e.g. <i>Phytophthora cinnamomic</i> or marri canker).	Disease present (e.g. <i>Phytophthora cinnamomic</i> or marri canker).	Disease present (e.g. <i>Phytophthora cinnamomic</i> or marri canker).



Plate 2: Evidence of foraging on Marri nuts by FRTBC in the Survey Area



Plate 3: Evidence of foraging on Marri nuts by FRTBC in the Survey Area



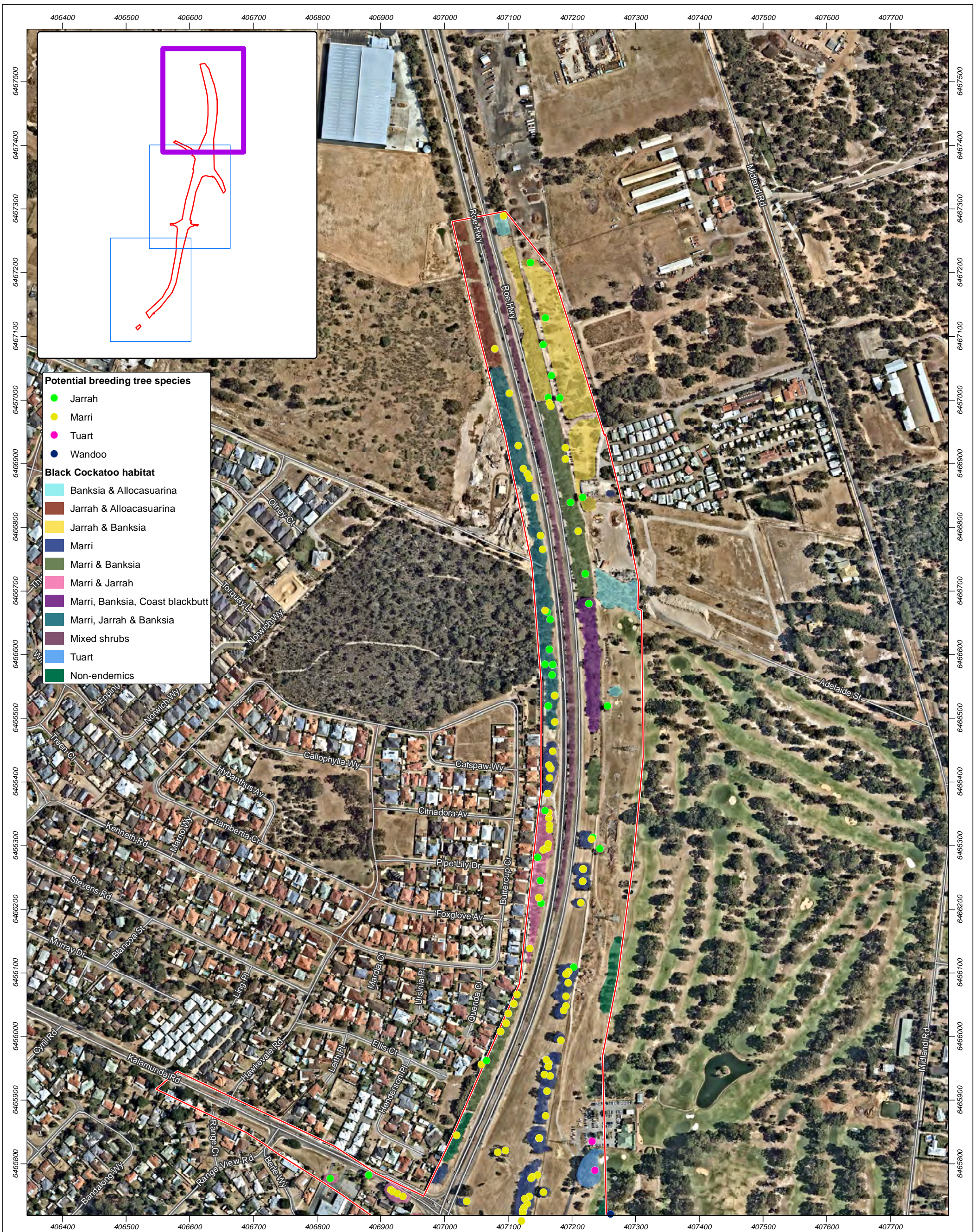
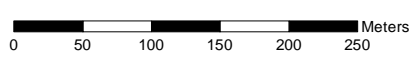


Figure 2: Black Cockatoo foraging and potential breeding habitat

Scale 1:5,500 at A3



Coordinate System: GDA 1994 MGA Zone 50

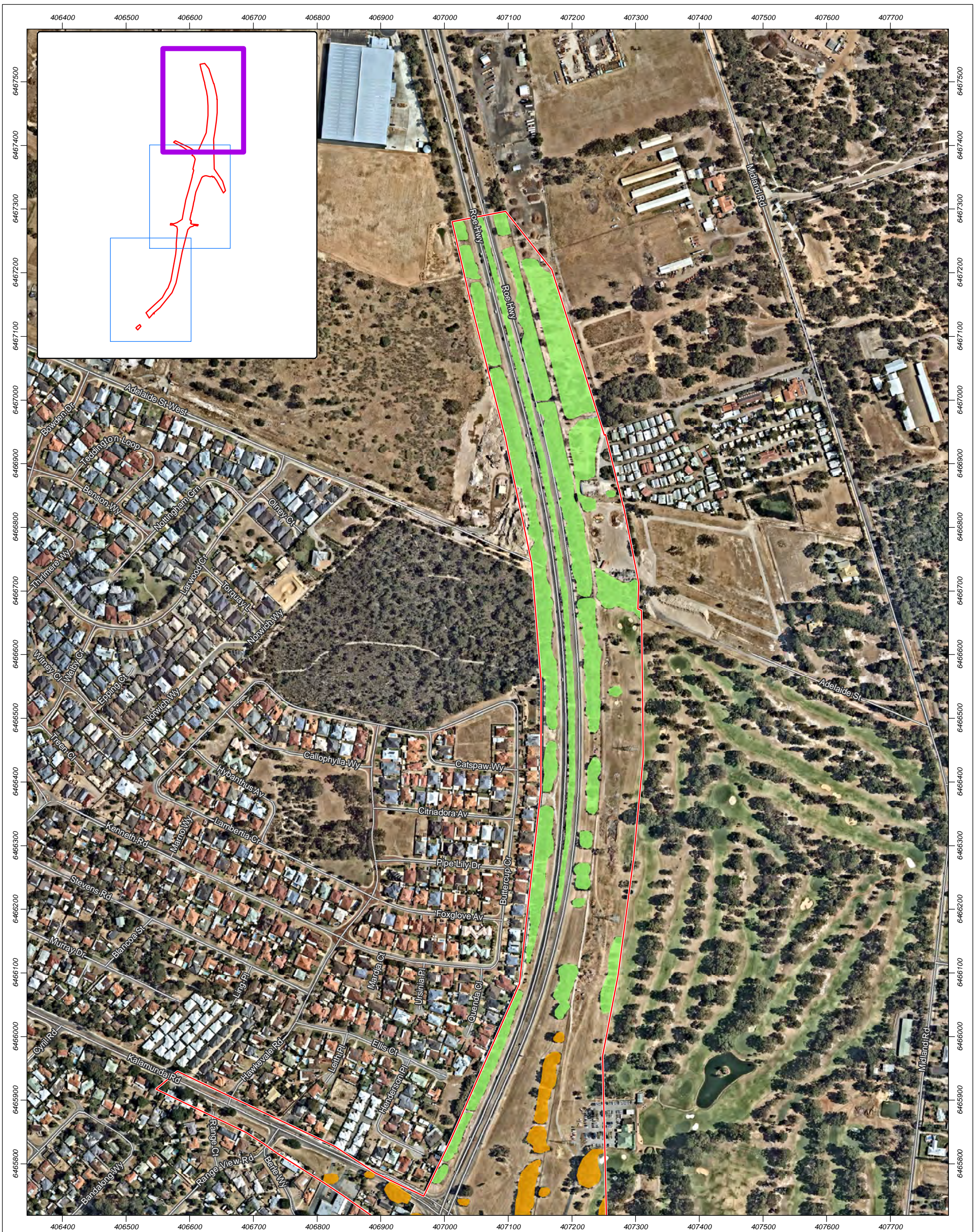
Note that positional errors may occur in some areas

Date: 5/02/2018

Author: DWhite

Source: Proposed environmental boundary,  
24/01/2018 Main Roads 2018; Aerial: Nearmaps 2017/12;  
Roads: Main Roads 2017.

Path: Q:\Consult\2018\MRO\MRO18027\01\_GIS\_documents\ArcMap\_documents\MRO18027\_G001\_RevA.mxd



**Figure 3: Black Cockatoo foraging quality score**

Scale 1:5,500 at A3



- Proposed environmental boundary
- Roads

**Black Cockatoo foraging quality score**

- 8
- 10

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 5/02/2018

Author: DWhite

Source: Proposed environmental boundary, 24/01/2018 Main Roads 2018; Aerial: Nearmaps 2017/12; Roads: Main Roads 2017.



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## 4. Discussion

During the Black Cockatoo habitat assessment, potential foraging and breeding habitat was identified in the Survey Area.

### 4.1 Potential Breeding Habitat

Black Cockatoos breed in large hollow-bearing trees, generally within woodlands or forests (Johnstone *et al.* 2013a). The size of the tree can be a useful indication of the hollow-bearing potential of the tree. Trees of suitable DBH are potentially important for maintaining breeding in the long-term, through maintaining the integrity of the habitat and allowing trees to provide future nest hollows. Maintaining the long-term supply of trees of a size to provide suitable nest hollows is particularly important in woodland stands that are known to support Black Cockatoo breeding (DSEWPac 2012).

The Black Cockatoo habitat assessment revealed that the Survey Area contains Marri, Jarrah, Tuart and Wandoo trees which have reached a size to be considered potential future hollow bearing trees, therefore potential breeding trees (i.e.  $\geq 500$  mm [ $\geq 300$  mm for Wandoo]) according to the EPBC Act revised draft referral Black Cockatoo guidelines.

In total, 547 trees were recorded which met the criteria to be classed as a potential breeding tree. This suggests that these trees may develop hollows and have the potential to be used for breeding in the future. To be suitable for Black Cockatoos, the hollow entrances need to be large enough for cockatoos to enter and of adequate depth (and the hollows need to have a large enough and relatively flat floor space) (Johnstone *et al.* 2013a).

A total of five hollows in four trees were identified during the first habitat assessment and were not considered suitable for nesting. A reinspection of these hollows, but in greater detail was undertaken and this reinspection also determined that these five hollows were unsuitable for Black Cockatoos to nest in. Primarily because their entrance opening were too small. The minimum entrance size of a hollow to be considered suitable for FRTBC to breed in is 10 x 12 cm and the mean size is 30 x 34 cm (all hollow openings were below the minimum size) (see Table 1 and Appendix 4). Work undertaken on CBC indicate that their hollows have a vertical opening of about 27 cm (Saunders & Dawson 2017) – again all the hollow openings examined during this survey were much smaller (see Table 1 and Appendix 4). In addition, the hollow entrances on all four trees were between five and 11 m above ground and therefore likely too low to be suitable, as Black Cockatoos generally use hollows that are on average at 14.5 m above the ground (Johnstone *et al.* 2013).

### 4.2 Foraging Habitat

There were other Marri, Jarrah, Tuart and Wandoo trees in the Survey Area, however, they all had a DBH of  $< 500$  mm ( $< 300$  mm for Wandoo) and therefore are not considered as potential breeding trees. These trees, however, are all considered to be foraging habitat. The Survey Area also contained other known foraging species including Coastal Blackbutt, *Banksia attenuata*, *Banksia menziesii*, *Allocasuarina* spp., *Acacia* spp., *Callistemon* spp., *Xanthorrhoea preissii* and Cape Lilac.

All three Black Cockatoo species leave unique feeding patterns on Marri nuts as they extract the seeds. Each species has a different style – from the inelegant “chomp-chomp” style of the FRTBC and Carnaby’s Cockatoo to the delicate style of the Baudin’s Cockatoo which use their long upper beak to extract the Marri seeds (WAM 2013).

During the habitat assessment, approximately 30 FRTBC were heard calling from many locations, seen flying overhead and observed feeding on Marri nuts and Cape Lilac in the Survey Area. Evidence of FRTBC and Carnaby’s foraging was recorded throughout the Survey Area, with many chewed Marri, Cape Lilac and Coastal Blackbutt nuts, as well as Banksia cones were observed (Plate 4 and Plate 5).

No roosts were identified in the Survey Area during the assessment. The Great Cocky Count data from 2017 was examined and five roosts were within 1.5 km of the Survey Area (Birdlife 2017).



Plate 4: Evidence of foraging on Cape lilac nuts by FRTBC in the Survey Area



Plate 5: Evidence of foraging on Marri nuts by FRTBC in the Survey Area

### 4.3 Habitat Quality

The DEE 2017 foraging habitat scoring tool was used to determine the quality of the habitat. The quality of foraging habitat varies depending upon how Black Cockatoos use that habitat in that location.

Black cockatoos rely on foraging resources to provide sufficient energy for their movements across their range. Availability of foraging habitat plays a particularly critical role in the post-breeding period, when birds need to build condition after breeding, and are teaching juveniles where these foraging resources are located. Losing foraging resources across the range increases the likelihood that birds won't regain condition after breeding, and won't breed again the following season, and that juveniles won't survive to become part of the adult population (DEE 2017).

The Survey Area was given two quality score ratings 8 or 10. Both scores however, result in a classification of "Very High Quality" for the Survey Area. The Survey Area contains 6.45 ha of habitat quality score 8 and 26.08 ha of habitat quality score 10 (Figure 3).

The habitat score was attributed to the Survey Area from applicable starting scores and then additions and subtractions based on functionality of foraging habitat. The difference in the score is mainly because of some areas being considered native shrubland and/or woodland, containing native eucalypts (score 10), or being considered individual trees and small stands of Marri and Jarrah (score 8) at different locations.

Adjustors were applied regarding attributes improving functionality of the foraging habitat. These included location (Swan Coastal Plain) as well as presence of potential breeding habitat and foraging habitat (including Marri and Jarrah). Adjustors were also applied regarding attributes reducing functionality of the foraging habitat, including distance to breeding and roosting sites. It was found that, for example, more than 36 roosting sites from the great Cocky Count 2017 were within 12 km of the Survey Area, five of which were within 1.5 km (Birdlife 2017).

## 5. References

- Birdlife Australia 2017. Great Cocky Count 2017.
- Cale, B. 2003, Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Perth: Department of Conservation and Land Management.
- Cooper, C. E., Withers, P. C., Mawson, P. R., Bradshaw, S. D., Prince, J., & Robertson, H. 2002, Metabolic ecology of cockatoos in the south-west of Western Australia. *Australian Journal of Zoology* 50, 67–76.
- Department of Energy and Environment (DEE) 2017, Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo. Commonwealth of Australia, 2017.
- Department of Environment and Conservation (DEC) 2013, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, [Online], Government of Western Australia, Available from: [https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions\\_categories\\_and\\_criteria\\_for\\_threatened\\_and\\_priority\\_ecological\\_communities.pdf](https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf)
- Department of Biodiversity, Conservation and Attractions (DBCA) 2017, *Conservation Codes for Western Australian Flora and Fauna*, Government of Western Australia, Perth.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPac) 2012 *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*, Australian Government, Canberra.
- Johnstone, R. E., Kirkby, T., & Sarti, K. 2013a, The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. *Pacific Conservation Biology* 19, 121-142.
- Johnstone, R. E., Kirkby, T., & Sarti, K. 2013b, The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding behaviour and diet. *Pacific Conservation Biology* 19, 143-155.
- Johnstone, R. E., & Kirkby, T. 1999, Food of the forest red-tailed black cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. *Western Australian Naturalist* 22, 167–177.
- Johnstone, R. E. & Kirkby, T. 2011, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes. Perth: Department of Planning.
- Johnstone, R. E. & Storr, G. M. 1998, *Handbook of Western Australian Birds*. Volume 1 - Non-Passerines (Emu to Dollarbird). Oxford University Press.
- Saunders, D.A. 1986, Breeding season, nesting success and nestling growth in Carnaby's Cockatoo, over 16 years at Coomallo Creek, and a method for assessing the viability of population in other areas. *Australian Wildlife Research*, 13, 261-73.
- Saunders D. A. and Dawson R. 2017, Cumulative learnings and conservation implications of a long-term study of the endangered Carnaby's Cockatoo *Calyptorhynchus latirostris*. *Australian Zoologist* 40, 1-19.
- Shah, B. 2006, Conservation of Carnaby's Black Cockatoo on the Swan Coastal Plain, WA. Perth: Birds Australia.

**Appendix 1**  
**Conservation significant flora, fauna**  
**and ecological community definitions**

## *Conservation Codes for Western Australian Flora and Fauna (Parks and Wildlife 2017)*

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

Categories of specially protected fauna and flora are:

### **T Threatened species**

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

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

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

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

### **CR Critically endangered species**

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

### **EN Endangered species**

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

### **VU Vulnerable species**

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

### **EX Presumed extinct species**

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.



**IA Migratory birds protected under an international agreement**

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

**CD Conservation dependent fauna**

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

**OS Other specially protected fauna**

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

***Priority Flora and Fauna***

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

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

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

**1 Priority 1: Poorly-known species**

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

**2 Priority 2: Poorly-known species**

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

**3 Priority 3: Poorly-known species**

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

**4 Priority 4: Rare, Near Threatened and other species in need of monitoring:**

**(a) Rare.** Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

**(b) Near Threatened.** Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

**(c)** Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

### *Definition of Threatened Ecological Communities (DEC 2013)*

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

#### **Presumed Totally Destroyed (PD)**

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

**A)** Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats, or

**B)** All occurrences recorded within the last 50 years have since been destroyed.

#### **Critically Endangered (CR)**

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

**A)** The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply:

- geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years)
- modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

**B)** Current distribution is limited, and one or more of the following apply:

- geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years)
- there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
- there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

**C)** The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

### **Endangered (EN)**

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

**A)** The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply:

- the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years)
- modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

**B)** Current distribution is limited, and one or more of the following apply”

- geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years)
- there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes
- there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

**C)** The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

### **Vulnerable (VU)**

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

**A)** The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

**B)** The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

**C)** The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

### *Definition of Priority Ecological Communities (DEC 2013)*

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

#### **Priority One: Poorly-known ecological communities**

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

#### **Priority Two: Poorly-known ecological communities**

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

#### **Priority Three: Poorly known ecological communities**

- Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation
- communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat
- communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

#### **Priority Four**

Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. These include:

**a) Rare.** Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

**b) Near Threatened.** Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

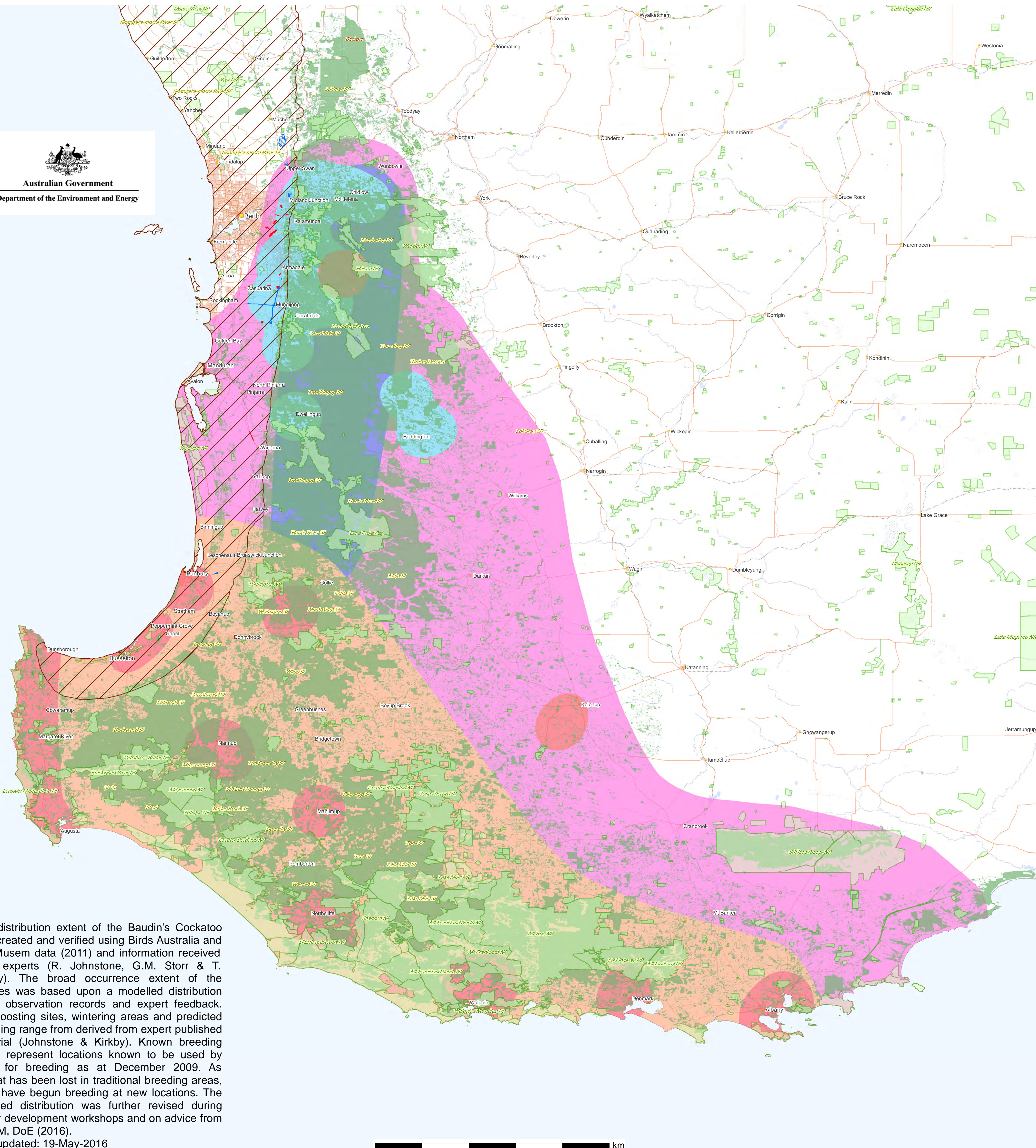
**c)** Ecological communities that have been removed from the list of threatened communities during the past five years.

#### **Priority Five: Conservation Dependent ecological communities**

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

**Appendix 2**  
**Black Cockatoo distribution maps**

# Map 2: Modelled distribution for Baudin's Cockatoo (*Calyptorhynchus baudinii*)



The distribution extent of the Baudin's Cockatoo was created and verified using Birds Australia and WA Museum data (2011) and information received from experts (R. Johnstone, G.M. Storr & T. Kirkby). The broad occurrence extent of the species was based upon a modelled distribution using observation records and expert feedback. The roosting sites, wintering areas and predicted breeding range from derived from expert published material (Johnstone & Kirkby). Known breeding areas represent locations known to be used by birds for breeding as at December 2009. As habitat has been lost in traditional breeding areas, birds have begun breeding at new locations. The mapped distribution was further revised during policy development workshops and on advice from WHaM, DoE (2016).  
Last updated: 19-May-2016

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INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at <http://www.environment.gov.au/biodiversity/threatened/index.html>

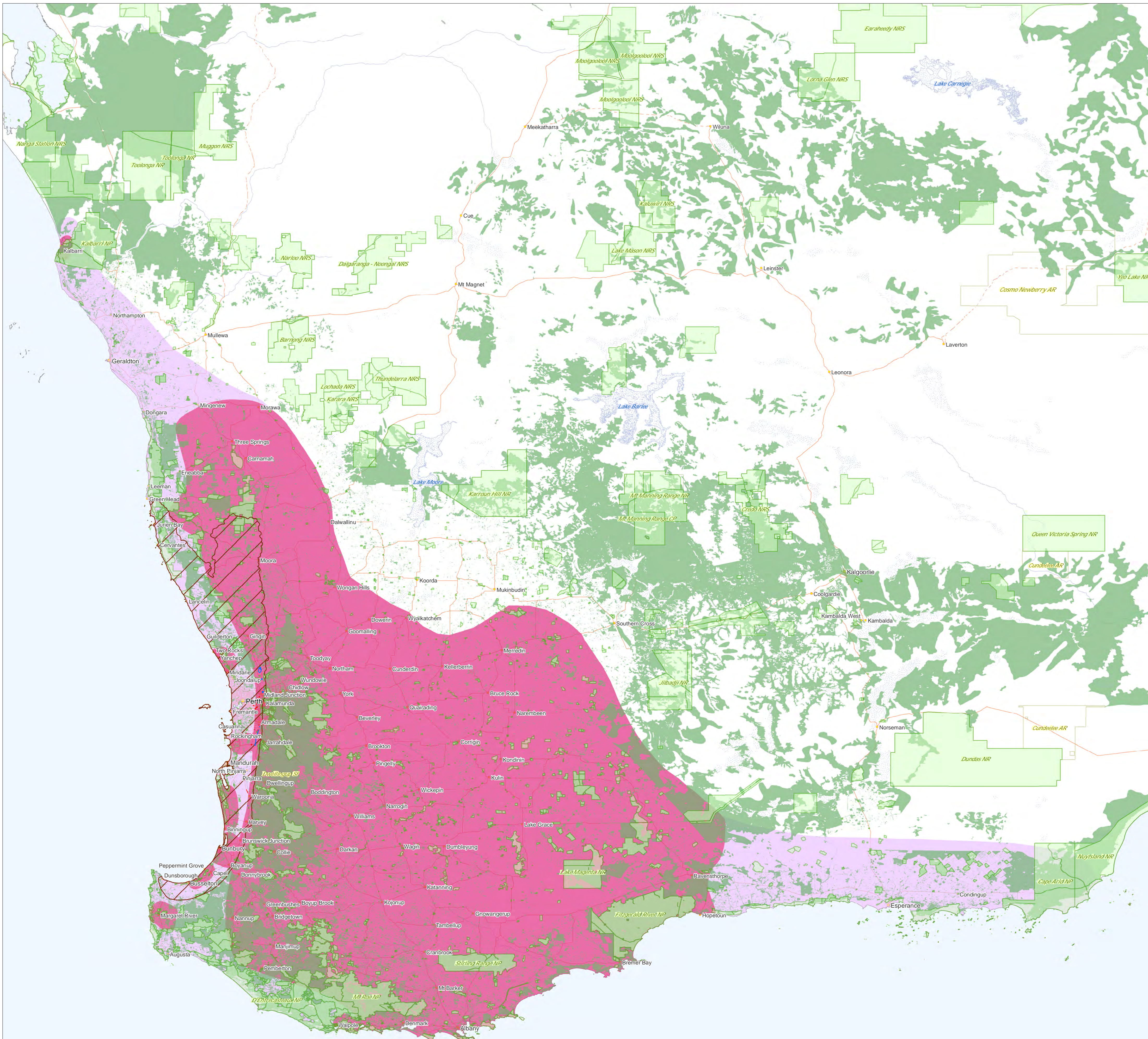
**Produced by:**  
Environmental Resources Information Network 2016

**Contextual data source:**  
National Vegetation Information System (NVIS 4.2) 2016  
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 2012  
Collaborative Australian Protected Area Database (CAPAD) 2014  
Geoscience Australia GEODATA TOPO 250K Topographic Data Series 3 2006

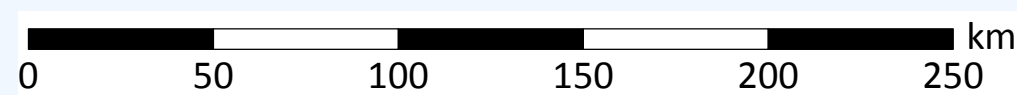
Projection: Geographic  
Datum: GDA94

Ecological Communities		Cities & Towns
	Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	
	Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	
	Banksia Woodlands of the Swan Coastal Plain	
	Conservation Areas	
	Jarrah, Karri and Marri (NVIS 4.2)	
Species		
	Known Breeding Areas	
	Predicted Breeding Range	
	Known Foraging Areas	
	Main Wintering Area	
	Species Likely to Occur	

# Map 3: Modelled distribution for Carnaby's Cockatoo (*Calyptorhynchus latirostris*)



The distribution extent of the Carnaby's Cockatoo was created and verified using Birds Australia and WA Museum data (2016) and information received from experts (R. Johnstone, 2011). The broad occurrence extent of the species was based upon a modelled distribution using observation records and expert feedback. The mapped distribution was revised during policy development workshops and on advice from WHaM, DoE (2016). Last updated: 19-May-2016.



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INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at <http://www.environment.gov.au/biodiversity/threatened/index.html>

**Produced by:**  
Environmental Resources Information Network 2016

**Contextual data source:**  
National Vegetation Information System (NVIS 4.2) 2016  
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 2012  
Collaborative Australian Protected Area Database (CAPAD) 2014  
Geoscience Australia GEODATA TOPO 250K Topographic Data Series 3 2006

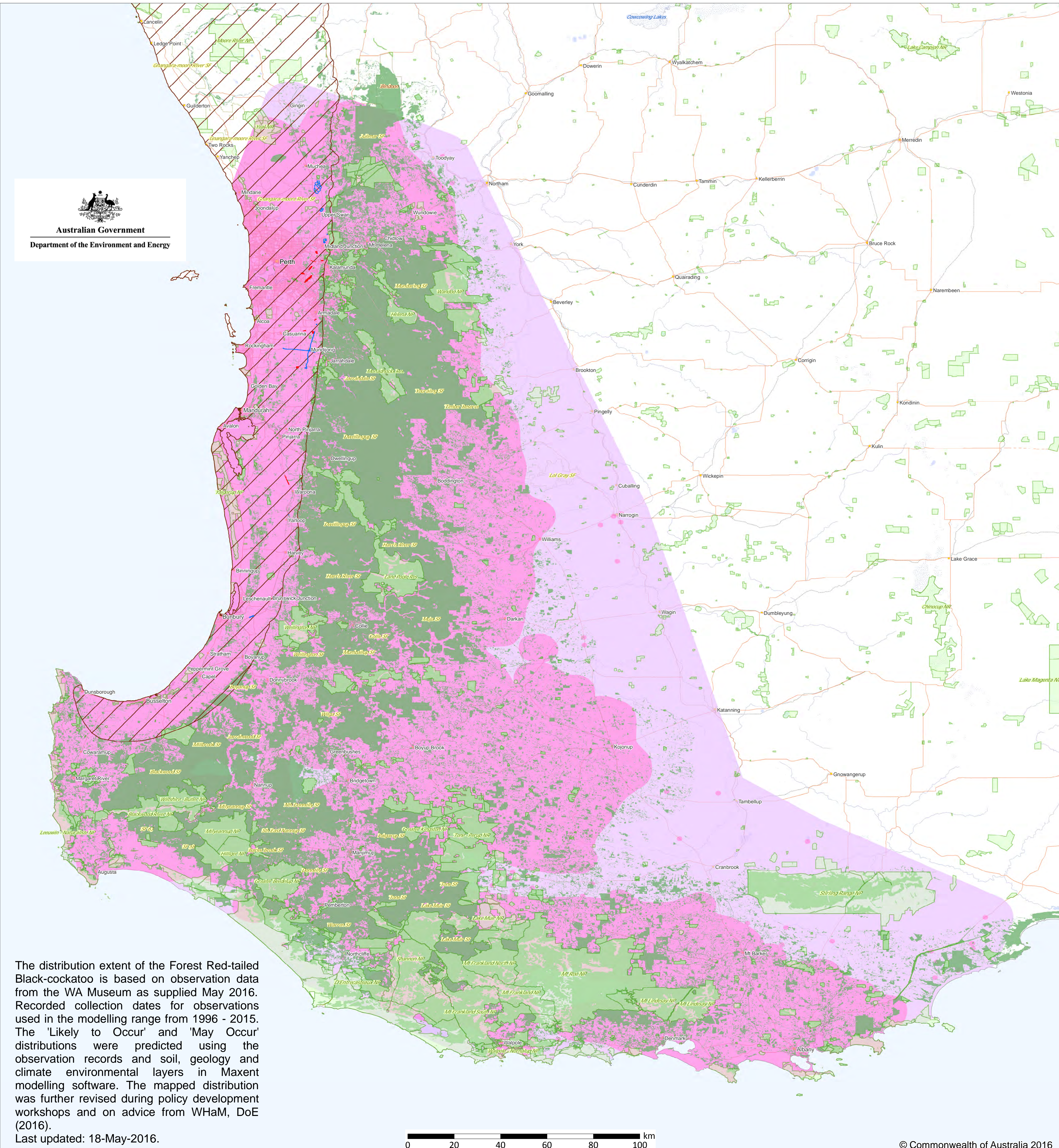
Projection: Geographic  
Datum: GDA94

- Conservation Areas
- Jarrah, Karri, Marri, Salmon Gum, Wandoo, Banksia, Grevillea, Dryandra and Hakea (NVIS 4.2)
- Species**
- Breeding Range
- Non-breeding Range
- Ecological Communities**
- Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain
- Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain
- Banksia Woodlands of the Swan Coastal Plain

- Cities & Towns
- Roads (sealed)
- Roads (unsealed)
- State Border
- Major Rivers
- Lakes/Reservoirs
- Non-perennial Lakes



# Map 4: Modelled distribution for Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)



The distribution extent of the Forest Red-tailed Black-cockatoo is based on observation data from the WA Museum as supplied May 2016. Recorded collection dates for observations used in the modelling range from 1996 - 2015. The 'Likely to Occur' and 'May Occur' distributions were predicted using the observation records and soil, geology and climate environmental layers in Maxent modelling software. The mapped distribution was further revised during policy development workshops and on advice from WHaM, DoE (2016).  
Last updated: 18-May-2016.

INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at <http://www.environment.gov.au/biodiversity/threatened/index.html>

**Produced by:**  
Environmental Resources Information Network 2016

**Contextual data source:**  
National Vegetation Information System (NVIS 4.2) 2016  
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 2012  
Collaborative Australian Protected Area Database (CAPAD) 2014  
Geoscience Australia GEODATA TOPO 250K Topographic Data Series 3 2006

Projection: Geographic  
Datum: GDA94

- Conservation Areas
- Jarrah, Karri and Marri (NVIS 4.2)
- Species**
- Likely to Occur
- May Occur
- Ecological Communities**
- Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain
- Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain
- Banksia* Woodlands of the Swan Coastal Plain
- Cities & Towns
- Roads (sealed)
- Roads (unsealed)
- Railways
- State Border
- Major Rivers
- Lakes/Reservoirs
- Non-perennial Lakes

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**Appendix 3**  
**Black Cockatoo Potential Breeding**  
**Trees**

Tree No.	Species	Easting	Northing	DBH Size	No. Hollows	Hollow Size	Notes
1	Marri	407093	6467289	A	0	N/A	
2	Marri	407093	6467289	A	0	N/A	
3	Jarrah	407159	6467129	A	0	N/A	
4	Jarrah	407155	6467087	A	0	N/A	
5	Jarrah	407168	6467038	A	0	N/A	
6	Jarrah	407163	6467004	B	0	N/A	
7	Marri	407165	6466995	A	0	N/A	
8	Marri	407167	6466990	A	0	N/A	
9	Jarrah	407181	6467003	B	0	N/A	
10	Marri	407174	6467960	A	0	N/A	
11	Marri	407190	6466925	A	0	N/A	
12	Marri	407190	6466907	A	0	N/A	
13	Jarrah	407217	6466847	A	0	N/A	
14	Jarrah	407198	6466839	A	0	N/A	
15	Marri	407210	6466794	A	0	N/A	
16	Jarrah	407221	6466727	A	0	N/A	
17	Jarrah	407227	6466680	B	0	N/A	
18	Jarrah	407256	6466519	A	0	N/A	Burnt
19	Jarrah	407233	6466313	A	0	N/A	
20	Marri	407231	6466310	A	0	N/A	
21	Jarrah	407244	6466295	A	0	N/A	
22	Marri	407218	6466263	A	0	N/A	
23	Marri	407218	6466263	A	0	N/A	
24	Marri	407218	6466263	A	0	N/A	
25	Marri	407217	6466244	A	0	N/A	
26	Marri	407217	6466244	A	0	N/A	
27	Marri	407214	6466210	A	0	N/A	
28	Jarrah	407203	6466109	B	1	<100 mm	
29	Marri	407195	6466102	A	0	N/A	Splits at 2m
30	Marri	407192	6466098	A	0	N/A	Chewed nuts
31	Marri	407191	6466098	A	0	N/A	Chewed nuts
32	Marri	407194	6466084	A	0	N/A	Chewed nuts
33	Marri	407191	6466063	A	0	N/A	Chewed nuts
34	Marri	407191	6466048	A	0	N/A	Chewed nuts
35	Marri	407187	6466041	A	0	N/A	Chewed nuts
36	Marri	407183	6465994	A	0	N/A	Chewed nuts
37	Marri	407164	6465958	A	0	N/A	Chewed nuts
38	Marri	407163	6465953	A	0	N/A	Chewed nuts
39	Marri	407163	6465953	A	0	N/A	Chewed nuts
40	Marri	407160	6465963	A	0	N/A	Chewed nuts
41	Marri	407157	6465940	A	0	N/A	Chewed nuts
42	Marri	407166	6465938	A	0	N/A	Chewed nuts
43	Marri	407161	6465914	A	0	N/A	Chewed nuts
44	Marri	407159	6465875	A	0	N/A	Chewed nuts
45	Marri	407149	6465840	A	0	N/A	Chewed nuts
46	Marri	407149	6465840	A	0	N/A	Chewed nuts
47	Marri	407149	6465840	A	0	N/A	Chewed nuts
48	Marri	407149	6465840	A	0	N/A	Chewed nuts
49	Marri	407149	6465840	A	0	N/A	Chewed nuts
50	Marri	407096	6465821	A	0	N/A	Chewed nuts
51	Marri	407084	6465818	A	0	N/A	Chewed nuts
52	Marri	407146	6465782	A	0	N/A	Chewed nuts

53	Marri	407138	6465779	A	0	N/A	Chewed nuts
54	Marri	407136	6465777	A	0	N/A	Chewed nuts
55	Marri	407133	6465749	A	0	N/A	Chewed nuts
56	Marri	407126	6465745	A	0	N/A	Chewed nuts
57	Marri	407130	6465737	A	0	N/A	Chewed nuts
58	Marri	407125	6465731	A	0	N/A	Chewed nuts
59	Marri	407123	6465727	A	0	N/A	Chewed nuts
60	Marri	407123	6465723	A	0	N/A	Chewed nuts
61	Marri	407123	6465723	A	0	N/A	Chewed nuts
62	Marri	407121	6465710	A	0	N/A	Chewed nuts
63	Marri	407121	6465710	A	0	N/A	Chewed nuts
64	Marri	407118	6465697	A	0	N/A	Chewed nuts
65	Marri	407113	6465674	A	0	N/A	Chewed nuts
66	Marri	407114	6465668	A	0	N/A	Chewed nuts
67	Marri	407111	6465657	A	0	N/A	Chewed nuts
68	Marri	407107	6465653	A	0	N/A	Chewed nuts
69	Marri	407035	6465741	A	0	N/A	Chewed nuts
70	Marri	407019	6465845	A	0	N/A	Chewed nuts
71	Marri	407019	6465845	A	0	N/A	Chewed nuts
72	Marri	407059	6465641	A	0	N/A	Chewed nuts
73	Marri	407058	6465956	A	0	N/A	Chewed nuts
74	Jarraah	407066	6465962	A	0	N/A	Chewed nuts
75	Marri	407088	6466008	A	0	N/A	Chewed nuts
76	Marri	407088	6466008	A	0	N/A	Chewed nuts
77	Marri	407097	6466021	A	0	N/A	Chewed nuts
78	Marri	407097	6466021	A	0	N/A	Chewed nuts
79	Marri	407100	6466036	A	0	N/A	Chewed nuts
80	Marri	407100	6466036	A	0	N/A	Chewed nuts
81	Marri	407109	6466051	A	0	N/A	Chewed nuts
82	Marri	407109	6466051	A	0	N/A	Chewed nuts
83	Marri	407114	6466066	A	0	N/A	Chewed nuts
84	Marri	407134	6466138	A	0	N/A	Chewed nuts
85	Jarraah	407152	6466209	A	0	N/A	Chewed nuts
86	Marri	407148	6466218	A	0	N/A	Chewed nuts
87	Marri	407148	6466218	A	0	N/A	
88	Jarraah	407151	6466245	A	0	N/A	
89	Jarraah	407151	6466245	A	0	N/A	
90	Jarraah	407146	6466281	A	0	N/A	
91	Jarraah	407146	6466281	A	0	N/A	
92	Marri	407155	6466293	A	0	N/A	
93	Marri	407157	6466294	A	0	N/A	
94	Marri	407162	6466296	A	0	N/A	
95	Marri	407163	6466302	A	0	N/A	
96	Marri	407165	6466325	A	0	N/A	
97	Marri	407165	6466332	A	0	N/A	
98	Marri	407164	6466343	A	0	N/A	
99	Marri	407164	6466352	A	0	N/A	
100	Jarraah	407158	6466355	A	0	N/A	
101	Marri	407162	6466382	A	0	N/A	
102	Marri	407165	6466406	A	0	N/A	
103	Marri	407167	6466421	A	0	N/A	
104	Marri	407164	6466426	A	0	N/A	
105	Marri	407170	6466448	A	0	N/A	

106	Marri	407173	6466494	A	0	N/A	
107	Jarrah	407163	6466519	A	0	N/A	
108	Jarrah	407173	6466536	A	0	Stag	
109	Marri	407173	6466535	A	0	N/A	
110	Jarrah	407169	6466568	A	0	N/A	
111	Jarrah	407170	6466584	A	0	N/A	
112	Jarrah	407170	6466584	A	0	N/A	
113	Jarrah	407158	6466585	A	0	N/A	
114	Jarrah	407165	6466608	A	0	N/A	
115	Jarrah	407166	6466655	A	0	N/A	
116	Jarrah	407161	6466667	B	2	1x > 100 mm. Not suitable. 1 x < 100 mm	
117	Marri	407158	6466669	A	0	N/A	
118	Marri	407154	6466765	A	0	N/A	
119	Marri	407151	6466787	A	0	N/A	
120	Marri	407142	6466847	A	0	N/A	
121	Marri	407133	6466877	A	0	N/A	
122	Marri	407130	6466884	A	0	N/A	
123	Marri	407124	6466892	A	0	N/A	
124	Marri	407116	6466928	A	0	N/A	
125	Marri	407102	6467010	A	0	N/A	
126	Marri	407079	6467080	A	0	N/A	
127	Tuart	407111	6465348	A	0	N/A	
128	Tuart	407110	6465350	A	0	N/A	
129	Tuart	407113	6465358	A	0	N/A	
130	Tuart	407118	6465351	A	0	N/A	
131	Jarrah	407141	6465349	A	0	N/A	
132	Jarrah	407144	6465344	A	0	N/A	
133	Wandoo	407163	6465348	A	0	N/A	
134	Wandoo	407171	6465346	A	0	N/A	
135	Wandoo	407171	6465346	A	0	N/A	
136	Wandoo	407171	6465346	A	0	N/A	
137	Wandoo	407171	6465346	A	0	N/A	
138	Wandoo	407171	6465346	A	0	N/A	
139	Wandoo	407196	6465343	A	0	N/A	
140	Wandoo	407196	6465343	A	0	N/A	
141	Wandoo	407196	6465343	A	0	N/A	
142	Wandoo	407224	6465342	A	0	N/A	
143	Wandoo	407224	6465342	A	0	N/A	
144	Wandoo	407224	6465342	A	0	N/A	
145	Wandoo	407222	6465367	A	0	N/A	
146	Wandoo	407221	6465373	A	0	N/A	
147	Wandoo	407218	6465376	A	0	N/A	
148	Wandoo	407209	6465377	A	0	N/A	
149	Wandoo	407199	6465381	A	0	N/A	
150	Marri	407196	6465392	A	0	N/A	
151	Wandoo	407192	6465401	A	0	N/A	
152	Wandoo	407186	6465426	A	0	N/A	
153	Jarrah	407174	6465454	A	0	N/A	
154	Jarrah	407156	6465461	A	0	N/A	
155	Wandoo	407129	6465470	A	0	N/A	
156	Wandoo	407116	6465556	A	0	N/A	
157	Wandoo	407092	6465563	A	0	N/A	
158	Wandoo	407093	6465554	A	0	N/A	

159	Jarrah	407057	6465515	A	0	N/A	
160	Marri	407044	6465510	A	0	N/A	
161	Marri	407036	6465500	A	0	N/A	
162	Marri	407034	6465494	A	0	N/A	
163	Jarrah	407032	6465491	A	0	N/A	
164	Jarrah	407026	6465483	A	0	N/A	
165	Marri	407031	6465478	A	0	N/A	
166	Marri	407033	6465471	A	0	N/A	
167	Marri	407037	6465469	A	0	N/A	
168	Jarrah	407037	6465468	A	0	N/A	
169	Marri	407035	6465465	A	0	N/A	
170	Jarrah	407035	6465460	A	0	N/A	
171	Jarrah	407034	6465461	A	0	N/A	
172	Marri	407026	6465453	A	0	N/A	
173	Jarrah	407020	6465449	A	0	N/A	
174	Marri	407020	6465448	A	0	N/A	
175	Marri	407016	6465424	A	0	N/A	
176	Marri	407015	6465424	A	0	N/A	
177	Marri	407012	6465417	A	0	N/A	
178	Marri	407011	6465413	A	0	N/A	
179	Marri	407010	6465403	A	0	N/A	
180	Marri	406995	6465389	A	0	N/A	
181	Marri	406996	6465393	A	0	N/A	
182	Marri	406977	6465461	A	0	N/A	
183	Marri	406976	6465436	A	0	N/A	
184	Marri	406979	6465410	A	0	N/A	
185	Marri	406955	6465409	A	0	N/A	
186	Marri	406951	6465393	A	0	N/A	
187	Marri	406956	6465385	A	0	N/A	
188	Marri	406959	6465383	A	0	N/A	
189	Marri	406982	6465368	A	0	N/A	
190	Marri	406981	6465368	A	0	N/A	
191	Marri	406983	6465362	A	0	N/A	
192	Marri	406982	6465337	A	0	N/A	
193	Jarrah	406961	6465324	A	0	N/A	
194	Marri	406961	6465324	A	0	N/A	
195	Jarrah	406966	6465320	A	0	N/A	
196	Jarrah	406949	6465287	A	0	N/A	
197	Marri	406948	6465286	A	0	N/A	
198	Jarrah	406944	6465272	A	0	N/A	
199	Marri	406943	6465271	A	0	N/A	
200	Marri	406943	6465260	A	0	N/A	
201	Marri	406943	6465252	A	0	N/A	
202	Marri	406939	6465254	A	0	N/A	
203	Marri	406935	6465251	A	0	N/A	
204	Marri	406935	6465251	A	0	N/A	
205	Marri	406935	6465251	A	0	N/A	
206	Marri	406929	6465249	A	0	N/A	
207	Marri	406918	6465218	A	0	N/A	
208	Marri	406920	6465209	A	0	N/A	
209	Marri	406920	6465209	A	0	N/A	
210	Jarrah	406918	6465198	A	0	N/A	
211	Marri	406922	6465193	A	0	N/A	
212	Marri	406913	6465184	A	0	N/A	

213	Marri	406913	6465184	A	0	N/A	
214	Marri	406908	6465173	A	0	N/A	
215	Marri	406901	6465150	A	0	N/A	
216	Marri	406903	6465146	A	0	N/A	
217	Marri	406900	6465141	A	0	N/A	
218	Marri	406900	6465130	A	0	N/A	
219	Marri	406898	6465125	A	0	N/A	
220	Marri	406899	6465105	A	0	N/A	
221	Marri	406898	6465101	A	0	N/A	
222	Marri	406898	6465101	A	0	N/A	
223	Marri	406897	6465087	A	0	N/A	
224	Marri	406897	6465087	A	0	N/A	
225	Marri	406894	6465077	A	0	N/A	
226	Marri	406890	6465065	A	0	N/A	
227	Marri	406872	6465046	A	0	N/A	
228	Marri	406873	6465035	A	0	N/A	
229	Marri	406873	6465022	A	0	N/A	
230	Marri	406871	6465014	A	0	N/A	
231	Marri	406871	6465014	A	0	N/A	
232	Marri	406869	6465006	A	0	N/A	
233	Marri	406859	6464992	A	0	N/A	
234	Marri	406859	6464992	A	0	N/A	
235	Marri	406859	6464992	A	0	N/A	
236	Marri	406859	6464992	A	0	N/A	
237	Marri	406859	6464992	A	0	N/A	
238	Marri	406859	6464992	A	0	N/A	
239	Marri	406849	6464943	A	0	N/A	
240	Marri	406848	6464940	A	0	N/A	
241	Marri	406848	6464910	A	0	N/A	
242	Marri	406837	6464892	A	0	N/A	
243	Marri	406838	6464884	A	0	N/A	
244	Marri	406839	6464882	A	0	N/A	
245	Marri	406837	6464862	A	0	N/A	
246	Marri	406837	6464862	A	0	N/A	
247	Marri	406837	6464849	A	0	N/A	
248	Marri	406837	6464849	A	0	N/A	
249	Marri	406837	6464849	A	0	N/A	
250	Marri	406833	6464843	A	0	N/A	
251	Marri	406827	6464828	A	0	N/A	
252	Marri	406830	6464824	A	0	N/A	
253	Marri	406830	6464824	A	0	N/A	
254	Marri	406825	6464818	A	0	N/A	
255	Marri	406825	6464818	A	0	N/A	
256	Marri	406824	6464806	A	0	N/A	
257	Marri	406824	6464806	A	0	N/A	
258	Marri	406824	6464806	A	0	N/A	
259	Marri	406824	6464799	A	0	N/A	
260	Marri	406816	6464786	A	0	N/A	
261	Marri	406814	6464782	A	0	N/A	
262	Marri	406810	6464755	A	0	N/A	
263	Marri	406809	6464742	A	0	N/A	
264	Marri	406808	6464733	A	0	N/A	
265	Marri	406806	6464732	A	0	N/A	
266	Marri	406806	6464732	A	0	N/A	

267	Marri	406800	6464717	A	0	N/A	
268	Marri	406800	6464709	A	0	N/A	
269	Marri	407661	6464555	A	0	N/A	
270	Marri	406805	6464695	A	0	N/A	
271	Marri	406804	6464694	A	0	N/A	
272	Marri	406801	6464674	A	0	N/A	
273	Marri	406798	6464672	A	0	N/A	
274	Marri	406792	6464669	A	0	N/A	
275	Marri	406792	6464633	A	0	N/A	
276	Marri	406791	6464629	A	0	N/A	
277	Marri	406790	6464625	A	0	N/A	
278	Marri	406646	646445	A	0	N/A	
279	Marri	406785	6464608	A	0	N/A	
280	Marri	406643	6464446	A	0	N/A	
281	Marri	406781	6464571	A	0	N/A	
282	Marri	406774	6464564	A	0	N/A	
283	Marri	406772	6464553	A	0	N/A	
284	Marri	406801	6464532	A	0	N/A	
285	Marri	406658	6464370	A	0	N/A	
286	Marri	406658	6464370	A	0	N/A	
287	Marri	406658	6464370	A	0	N/A	
288	Marri	406697	6464342	A	0	N/A	
289	Marri	406697	6464342	A	0	N/A	
290	Marri	406697	6464342	A	0	N/A	
291	Marri	406712	6464342	A	0	N/A	
292	Marri	406622	6464503	A	0	N/A	
293	Marri	406622	6464505	A	0	N/A	
294	Marri	406627	6464508	A	0	N/A	
295	Marri	406636	6464512	A	0	N/A	
296	Marri	406645	6464505	A	0	N/A	
297	Marri	406643	6464522	A	0	N/A	
298	Marri	406647	6464532	A	0	N/A	
299	Marri	406685	6464528	A	0	N/A	
300	Marri	406691	6464529	A	0	N/A	
301	Marri	406695	6464524	A	0	N/A	
302	Marri	406707	6464540	A	0	N/A	
303	Marri	406633	6464523	A	0	N/A	
304	Marri	406633	6464523	A	0	N/A	
305	Marri	406633	6464523	A	0	N/A	
306	Marri	406633	6464523	A	0	N/A	
307	Marri	406715	6464543	A	0	N/A	
308	Marri	406718	6464554	A	0	N/A	
309	Marri	406701	6464555	A	0	N/A	
310	Marri	406717	6464598	A	0	N/A	
311	Marri	406717	6464598	A	0	N/A	
312	Marri	406719	6464612	A	0	N/A	
313	Marri	406719	6464619	A	0	N/A	
314	Marri	406719	6464623	A	0	N/A	
315	Marri	406726	6464634	A	0	N/A	
316	Marri	406725	6464636	A	0	N/A	
317	Marri	406729	6464662	A	0	N/A	
318	Marri	406732	6464663	A	0	N/A	
319	Marri	406732	6464663	A	0	N/A	
320	Marri	406738	6464671	A	0	N/A	



321	Marri	406738	6464671	A	0	N/A	
322	Marri	406734	6464680	A	0	N/A	
323	Marri	406736	6464690	A	0	N/A	
324	Marri	406738	6464714	A	0	N/A	
325	Marri	406740	6464729	A	0	N/A	
326	Marri	406738	6464735	A	0	N/A	
327	Marri	406744	6464746	A	0	N/A	
328	Marri	406751	6464777	A	0	N/A	
329	Marri	406750	6464789	A	0	N/A	
330	Marri	406750	6464800	A	0	N/A	
331	Jarrah	406756	6464809	A	0	N/A	
332	Jarrah	406757	6464827	A	0	N/A	
333	Marri	406763	6464836	A	0	N/A	
334	Marri	406761	6464854	A	0	N/A	
335	Marri	406772	6464871	A	0	N/A	
336	Marri	406769	6464872	A	0	N/A	
337	Marri	406798	6465021	A	0	N/A	
338	Marri	406803	6465031	A	0	N/A	
339	Marri	406811	6465033	A	0	N/A	
340	Marri	406831	6465136	A	0	N/A	
341	Marri	406406	6465014	A	0	N/A	
342	Marri	406849	6465192	A	0	N/A	
343	Marri	406871	6465255	A	0	N/A	
344	Marri	406871	6465284	A	0	N/A	
345	Marri	406875	6465310	A	0	N/A	
346	Marri	406883	6465331	A	0	N/A	
347	Marri	406890	6465368	A	0	N/A	
348	Marri	406956	6465626	A	0	N/A	
349	Jarrah	406957	6465642	A	0	N/A	
350	Marri	406955	6465652	A	0	N/A	
351	Marri	406959	6465658	A	0	N/A	
352	Marri	406959	6465658	A	0	N/A	
353	Marri	406961	6465663	A	0	N/A	
354	Marri	406964	6465680	A	0	N/A	
355	Marri	406965	6465688	A	0	N/A	
356	Marri	406767	6464502	A	0	N/A	
357	Marri	406767	6464502	A	0	N/A	
358	Marri	406769	6464498	A	0	N/A	
359	Marri	406765	6464506	A	0	N/A	
360	Marri	406768	6464515	A	0	N/A	
361	Marri	406754	6464472	A	0	N/A	
362	Marri	406757	6464461	A	0	N/A	Chewed nuts
363	Marri	406757	6464461	A	0	N/A	Chewed nuts
364	Marri	406758	6464463	A	0	N/A	
365	Marri	406774	6464465	A	0	N/A	Chewed nuts
366	Marri	406787	6464459	A	0	N/A	Chewed nuts
367	Marri	406788	6464453	A	0	N/A	Chewed nuts
368	Marri	406760	6464437	A	0	N/A	
369	Marri	406752	6464433	A	0	N/A	
370	Marri	406749	6464426	A	0	N/A	
371	Marri	406746	6464423	A	0	N/A	
372	Marri	406774	6464416	A	0	N/A	
373	Marri	406740	6464390	A	0	N/A	
374	Marri	406754	6464366	A	0	N/A	

375	Marri	406805	6464417	A	0	N/A	Burnt
376	Marri	406794	6464403	A	0	N/A	Burnt
377	Marri	406794	6464403	A	0	N/A	
378	Tuart	406774	6464355	A	0	N/A	
379	Marri	406752	6464320	A	0	N/A	
380	Marri	406752	6464281	A	0	N/A	
381	Marri	406750	6464262	A	0	N/A	
382	Marri	406734	6464256	A	0	N/A	Chewed nuts
383	Marri	406742	6464225	A	0	N/A	
384	Marri	406739	6464215	A	0	N/A	
385	Marri	406732	6464197	A	0	N/A	
386	Marri	406711	6464088	A	0	N/A	
387	Marri	406692	6464016	A	0	N/A	
388	Marri	406688	6463995	A	0	N/A	
389	Jarrah	406676	6463968	A	0	N/A	
390	Jarrah	406677	6463949	A	0	N/A	
391	Jarrah	406663	6463919	A	0	N/A	
392	Jarrah	406662	6463911	A	0	N/A	
393	Marri	406661	6463900	A	0	N/A	
394	Marri	406658	6463871	A	0	N/A	Chewed nuts
395	Marri	406654	6463863	A	0	N/A	
396	Jarrah	406658	6463863	A	0	N/A	
397	Jarrah	406654	6463844	A	0	N/A	
398	Jarrah	406654	6463824	A	1	< 100 mm. Not suitable	
399	Marri	406641	6463774	A	0	N/A	
400	Marri	406623	6463744	A	0	N/A	
401	Marri	406623	6463740	A	0	N/A	
402	Marri	406623	6463740	A	0	N/A	
403	Marri	406611	6463697	A	0	N/A	
404	Marri	406607	6463688	A	0	N/A	
405	Marri	406599	6463616	A	0	N/A	
406	Jarrah	406604	6463613	A	0	N/A	
407	Marri	406601	6463559	A	0	N/A	
408	Marri	406584	6463534	A	0	N/A	Chewed nuts
409	Marri	406584	6463533	A	0	N/A	
410	Jarrah	406584	6463529	A	0	N/A	
411	Marri	406573	6463513	A	0	N/A	
412	Marri	406571	6463503	A	0	N/A	
413	Marri	406567	6463469	A	0	N/A	Chewed nuts
414	Marri	406564	6463463	A	0	N/A	
415	Marri	406553	6463443	A	0	N/A	
416	Jarrah	406553	6463442	A	0	N/A	
417	Marri	406547	6463427	A	0	N/A	
418	Marri	406550	6463414	A	0	N/A	
419	Jarrah	406550	6463389	A	0	N/A	
420	Jarrah	406475	6463248	A	1	<100 mm	Bees in hollow
421	Jarrah	406475	6463248	A	0	N/A	
422	Jarrah	406471	6463240	A	0	N/A	
423	Jarrah	406449	6463208	A	0	N/A	
424	Jarrah	406441	6463193	A	0	N/A	
425	Jarrah	406434	6463175	A	0	N/A	
426	Marri	406397	6463130	A	0	N/A	
427	Marri	406380	6463103	A	0	N/A	

428	Marri	406367	6463106	A	0	N/A	
429	Jarrah	406350	6463091	A	0	N/A	
430	Tuart	406359	6463076	A	0	N/A	
431	Tuart	406347	6463057	A	0	N/A	
432	Marri	406328	6463040	A	0	N/A	
433	Marri	406314	6463046	A	0	N/A	
434	Marri	406304	6463030	A	0	N/A	
435	Jarrah	406291	6463011	B	0	N/A	Chewed nuts
436	Marri	406283	6463005	A	0	N/A	
437	Jarrah	406273	6462998	A	0	N/A	
438	Marri	406255	6462994	A	0	N/A	
439	Marri	406252	6462992	A	0	N/A	
440	Marri	406164	6462925	B	0	N/A	Chewed nuts
441	Marri	406161	6462910	A	0	N/A	
442	Marri	406170	6463007	A	0	N/A	
443	Marri	406173	6463009	A	0	N/A	
444	Marri	406202	6463042	A	0	N/A	
445	Marri	406213	6463050	A	0	N/A	
446	Marri	406225	6463055	A	0	N/A	
447	Marri	406244	6463065	A	0	N/A	
448	Marri	406245	6463072	A	0	N/A	
449	Marri	406250	6463076	A	0	N/A	
450	Marri	406263	6463086	A	0	N/A	
451	Marri	406278	6463099	A	0	N/A	
452	Marri	406300	6463115	A	0	N/A	
453	Marri	406302	6463134	A	0	N/A	
454	Marri	406300	6463140	A	0	N/A	
455	Marri	406310	6463141	A	0	N/A	
456	Marri	406327	6463150	A	0	N/A	
457	Marri	406331	6463154	A	0	N/A	
458	Marri	406338	6463170	A	0	N/A	
459	Marri	406343	6463179	A	0	N/A	
460	Jarrah	406425	646326	A	0	N/A	
461	Marri	406450	6463369	A	0	N/A	
462	Marri	406459	6463380	A	0	N/A	
463	Marri	406463	6463385	A	0	N/A	
464	Marri	406472	6463395	A	0	N/A	
465	Marri	406470	6463409	A	0	N/A	2 branches > 500
466	Marri	406472	6463416	A	0	N/A	
467	Marri	406476	6463418	A	0	N/A	Chewed nuts
468	Marri	406482	6463421	A	0	N/A	
469	Jarrah	406481	6463431	A	0	N/A	3 branches > 500
470	Marri	406488	6463440	A	0	N/A	
471	Marri	406493	6463478	A	0	N/A	
472	Marri	406517	6463516	A	0	N/A	
473	Marri	406526	6463550	A	0	N/A	Chewed nuts
474	Marri	406526	6463550	A	0	N/A	Chewed nuts
475	Jarrah	406524	6463563	A	0	N/A	
476	Marri	406527	6463585	A	0	N/A	Chewed nuts
477	Marri	406553	6463700	A	0	N/A	
478	Marri	406566	6463788	A	0	N/A	Chewed nuts
479	Marri	406586	6463906	A	0	N/A	
480	Jarrah	406585	6463923	A	0	N/A	
481	Jarrah	406586	6463948	A	0	N/A	

482	Jarrah	406583	6463951	A	0	N/A	
483	Jarrah	406585	6463953	A	0	N/A	
484	Jarrah	406591	6463965	A	0	N/A	
485	Marri	406600	6463972	A	0	N/A	
486	Marri	406599	6463978	A	0	N/A	
487	Jarrah	406600	6463998	A	0	N/A	
488	Marri	406601	6464002	A	0	N/A	
489	Marri	406600	6464010	A	0	N/A	
490	Marri	406603	6464043	A	0	N/A	
491	Marri	406608	6464048	A	0	N/A	
492	Marri	406597	6464076	A	0	N/A	
493	Jarrah	406608	6464093	A	0	N/A	
494	Marri	406608	6464093	A	0	N/A	
495	Marri	406609	6464104	A	0	N/A	
496	Marri	406608	6464109	A	0	N/A	
497	Wandoo	406598	6464114	A	0	N/A	
498	Wandoo	406598	6464116	A	0	N/A	
499	Marri	406611	6464192	A	0	N/A	
500	Marri	406611	6464209	A	0	N/A	
501	Marri	406614	6464253	A	0	N/A	
502	Marri	406621	6464259	A	0	N/A	
503	Marri	406628	6464271	A	0	N/A	
504	Marri	406617	6464298	A	0	N/A	
505	Jarrah	406609	6464459	A	0	N/A	
506	Marri	406628	6464455	A	0	N/A	Chewed
507	Marri	406636	6464463	A	0	N/A	
508	Marri	406637	6464473	A	0	N/A	
509	Marri	406641	6464449	A	0	N/A	Chewed nuts
510	Marri	406653	6464371	A	0	N/A	
511	Marri	406658	6464327	A	0	N/A	
512	Jarrah	406662	6464326	A	0	N/A	
513	Marri	406673	6464341	A	0	N/A	
514	Marri	406676	6464370	A	0	N/A	
515	Marri	406687	6464410	A	0	N/A	
516	Marri	406686	6464421	A	0	N/A	Chewed nuts
517	Marri	406703	6464466	A	0	N/A	
518	Marri	406703	6464466	A	0	N/A	
519	Tuart	407232	6465835	B	0	N/A	
520	Tuart	407236	6465790	B	0	N/A	
521	Wandoo	407261	6465721	A	0	N/A	
522	Jarrah	407255	6465684	B	0	N/A	
523	Marri	407259	6465669	B	0	N/A	
524	Wandoo	407236	6465660	A	0	N/A	
525	Tuart	407300	6465407	B	0	N/A	4 branches > 500
526	Tuart	407416	6465111	A	0	N/A	
527	Marri	407390	6465200	A	0	N/A	
528	Tuart	407373	6465231	A	0	N/A	
529	Tuart	407377	6465238	A	0	N/A	
530	Tuart	407385	6465254	A	0	N/A	
531	Tuart	407365	6465287	A	0	N/A	
532	Tuart	407345	6465300	A	0	N/A	
533	Tuart	407327	6465304	A	0	N/A	
534	Marri	407251	6465413	A	0	N/A	
535	Tuart	407179	6465571	B	0	N/A	

536	Marri	407413	6465080	B	0	N/A	Chewed nuts
537	Marri	407408	6465086	A	0	N/A	Chewed nuts
538	Marri	407396	6465106	A	0	N/A	Chewed nuts
539	Marri	407385	6465118	A	0	N/A	Chewed nuts
540	Jarrah	407135	6467215	A	0	N/A	
541	Marri	407155	6465755	A	0	N/A	
542	Marri	406916	6465759	A	0	N/A	
543	Marri	406919	6465756	A	0	N/A	
544	Marri	406926	6465753	A	0	N/A	
545	Marri	406935	6465749	A	0	N/A	
546	Jarrah	406881	6465782	A	0	N/A	
547	Jarrah	406821	6465777	A	0	N/A	

**Appendix 4**  
**Hollow Photo**

Jarrah 28

Plate 12: Hollow < 100 mm



Plate 13: Hollow < 100 mm



Jarrah 116

Plate 6: Hollow < 100 mm



Plate 7: Hollow < 100 mm





Jarrah 116

Plate 8: Hollow > 100 mm



Plate 9: Hollow > 100 mm



Jarrah 398

Plate 14: Hollow < 100 mm



Plate 15: Hollow < 100 mm



Jarrah 420

Plate 10: Hollow < 100 mm



Plate 11: Hollow < 100 mm

