

**Lot 508 on Deposited Plan 414835 (Aboriginal Cultural and
Visitors Centre) Native Vegetation Clearing Permit
Application – Supporting Information**

Attachment 4

Black Cockatoo Habitat Assessment (Focused Vision Consulting 2020a)



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MEMORANDUM

Date	20 February 2020	Title	Black cockatoo Habitat Assessment - Aboriginal Cultural and Visitors Centre
Ref.	COC19001_MEM01_Rev3	Distribution	Sarah Robinson City of Cockburn
Authors	Will Bauer-Simpson Technician/Advisor Kellie Bauer-Simpson Principal Ecologist	Review/ Authorisation	Kellie Bauer-Simpson Principal Ecologist

Background

The City of Cockburn (the City) are investigating the opportunity to develop an Aboriginal Cultural and Visitors Centre on Progress Drive, Bibra Lake.

The Aboriginal Cultural and Visitors Centre facility will require outdoor undercover spaces of approximately 1,200 m², plus access to surrounding bushland for tours, and a total floor size of up to 1,500 m². Inside the centre, spaces will be required for static and interactive displays, a visitor's information centre, administration areas, a café, a retail shop, a number of multifunctional spaces for a variety of cultural awareness training, educational, and general activities.

The site is located on Lot 65L Progress Drive near the Corner of Gwilliam Drive in Bibra Lake, Western Australia on Bibra Lake Reserve 46787. Currently the site is partially cleared. The area expected to require clearing is within the study area assessed in this report, as shown in **Figure 1**.

The scope of work for this report is the Black-cockatoo habitat Assessment.



0 15 30 45 60 m
GDA 94 / MGA Zone 50



Legend

 Study Area



Figure 1 - Study Area

Methodology

The field survey took place over a single day on 22 August 2019, carried out by Senior Ecologist, Andrew Moore, assisted by Field Technician, Will Bauer-Simpson. Andrew has significant experience in surveys for Black-cockatoos and their habitat.

The Commonwealth Department of the Environment and Energy (DEE; formerly the Department of Sustainability, Environment, Water, Population and Communities) provides guidelines for the referral to the DEE of actions that may result in impact to Black-cockatoos (for assessment under the EPBC Act). The survey and analysis reported herein have been conducted in accordance with the existing referral guidelines (DSEWPaC 2012), with foraging habitat quality ratings provided in reference to those described in the revised draft guidelines (DEE 2017). In addition, survey methodology followed the recommendations listed on the DEE's Species Profile and Threats Database (DEE 2018a, b).

The designated study area was traversed on foot and surveyed in exhaustive detail, to observe and record all suitable foraging, roosting and nesting habitat for Black-cockatoos as summarised in **Table 1**.

Table 1 - Black-cockatoo Habitats

Habitat	Examples
Foraging habitat	Food source plants for Black-cockatoos include Jarrah (<i>Eucalyptus marginata</i>), Marri (<i>Corymbia calophylla</i>), Proteaceous species such as <i>Banksia</i> , <i>Hakea</i> and <i>Grevillea</i> , <i>Allocasuarina</i> , and <i>Anigozanthos</i> and introduced species such as Pines (<i>Pinus</i> spp.) and Cape Lilac (<i>Melia azedarach</i>), but also <i>Erodium</i> spp. and various species grown for fruit, nuts and seeds which grow in native shrubland, heathland, woodland or forest and agricultural areas.
Roosting habitat	These habitats include suitable trees (<i>Eucalyptus</i> or <i>Corymbia</i>) within or near riparian environments or natural or artificial water sources.
Breeding/nesting habitat	Any suitable species of tree trees with suitable nest hollows or a diameter at breast height of equal to or greater than 500 mm for Jarrah or Marri and 300 mm for Wandoo or Salmon Gum. More specifically, all individual trees observed to support suitable hollows within the study area.

Areas of habitat and individual trees recorded were documented in the field using electronic tablets equipped with the mobile mapping software, Mappt™. Customised data collection forms, tailored to the collection of Black-cockatoo habitat data were utilised, to spatially record habitat in direct reference to scoring scales described below.

Foraging habitat was examined, recorded and scored in accordance with **Table 2**.

Table 2 - Scoring System for the Assessment of Foraging Value of Vegetation for Carnaby's, Baudin's and Forest Red-Tailed Black-cockatoos

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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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, <i>Eucalyptus caesia</i> and <i>Eucalyptus erythrocorys</i>.
3	Low to Moderate foraging value. Examples: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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. Example: <ul style="list-style-type: none"> 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	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Woodland with tree banksias 20-40% projected foliage cover. Eucalypt woodland/forest with Marri 20-40% projected foliage cover. 	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> 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. 	<p>Moderate foraging value. Example:</p> <ul style="list-style-type: none"> Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with 20-40% projected foliage cover.
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Banksia woodlands with tree banksias >40%. Vegetation condition moderate due to weed invasion and some tree deaths. 	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> 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. 	<p>Moderate to High foraging value. Example:</p> <ul style="list-style-type: none"> 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	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> 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. 	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> 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. 	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> 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.

Whilst suitable roosting habitat is able to be identified and mapped based on tree species and their proximity to water sources, combined with knowledge or literature review regarding known roost sites, it is not possible to confirm the use of roosting habitat (identify a Black-cockatoo night-roost) outside the period during which they are known to occupy the Swan Coastal Plain. Black-cockatoos typically only reside (and roost) on the Swan Coastal Plain, outside their breeding period, which takes place in the Wheatbelt, from late winter to early summer. By July each year, most flocks will have departed for breeding in the Wheatbelt and won't typically return until around December. Therefore, the field assessment only identified habitat that could be considered suitable for roosting; that is, tall trees within approximately 2 km of water sources. A review of BirdLife Australia (WA) Great Cocky Count roost site data was also undertaken to assist in identifying whether or not the study area or surrounds represent known roosting habitat.

The tree habitat survey assessed each tree's status as a breeding/nesting tree, with or without hollows, with or without nesting evidence (for trees with hollows), or as potential future nesting trees (with a diameter at breast height of 500 mm or greater), and these were recorded and scored as per **Table 3**, which provides a scoring system to differentiate between trees of low, moderate and high potential as nest trees. The nest-tree rankings were developed by FVC's partner specialist team, BCE, who led the assessment.

Table 3 - Ranking System for Black-cockatoo Nesting and Potential Nesting Trees

Rank	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.
x	Where a hollow that is (otherwise) potentially suitable for Black-cockatoo nesting has been colonised by feral Honey Bees (<i>Apis mellifera</i>), and therefore rendered unusable, the nest-tree rank is preceded by 'x' (e.g. x2, x3, x4).

The resulting scores of **Tables 2** and **3** provide quantitative data for input into the Commonwealth Biodiversity Offsets Calculator, should a referral eventuate.

BCE have also developed a tree measurement protocol, based on Commonwealth guidelines which was utilised for the assessment, and is outlined in **Appendix 1**.

Results

Foraging Habitat

The study area is considered to provide foraging habitat for both Carnaby's Black-cockatoo and the Forest Red-tailed Black-cockatoo across the entire 1.51 ha extent, with the quality ranging from 'Negligible to Low' to 'Moderate to High' and is mostly 'Negligible to Low' for both species. Relatively small areas of 'Moderate to High' quality foraging habitat for both species occur within the study area, comprising 0.38 ha for Carnaby's Black-cockatoo, mostly where Banksia woodland occurs and also where Marri trees are supported (**Figure 2a**) and 0.25 ha for Forest Red-tailed Black-cockatoo at the southern end of the site (**Figure 2b**). The higher quality of foraging habitat is mostly due to the presence of key food source species for the respective species of Black-cockatoos (i.e. Banksia and Marri trees which provide nuts that form an important food source).

The areas of the varying quality of foraging habitat provided by the study area are summarised in **Table 4** and **Table 5**, for the Forest Red-tailed Black-cockatoo and Carnaby's Black-cockatoo, respectively, and spatially presented in the **Figure 2** series.

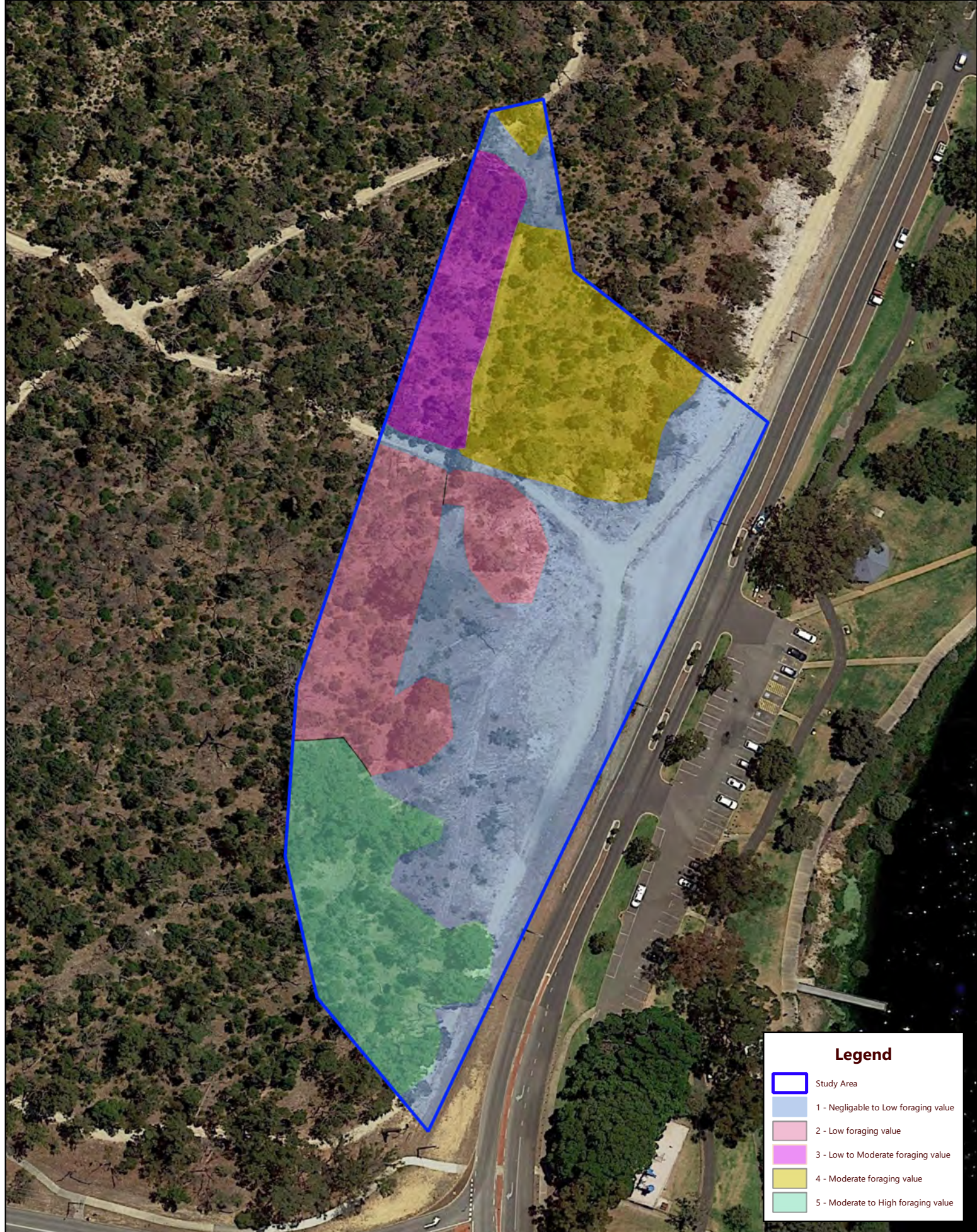
Table 4 - Summary of Foraging Habitat for Forest Red-tailed Black-cockatoo

Foraging Value	Area (hectares)
1 - Negligible to low foraging value	0.62
2- Low foraging value	0.26
3- Low to moderate foraging value	0.12
4 - Moderate foraging value	0.26
5 – Moderate to high foraging value	0.25
Total	1.51

Table 5 - Summary of Foraging Habitat for Carnaby's Black-cockatoo

Foraging Value	Area (hectares)
1 - Negligible to low foraging value	0.62
3- Low to moderate foraging value	0.26
4 - Moderate foraging value	0.25
5 – Moderate to high foraging value	0.38
Total	1.51

The draft revised referral guidelines for Black-cockatoos (DEE 2017) provides guidance for adjusting and therefore concluding foraging habitat scores that incorporate the 'context' of that habitat in any given situation, based on geographical location, the context of other foraging habitat, breeding habitat, roosting habitat and watering points, evidence of feeding, and the presence of important food source species (for the respective species). The context adjustors and the resulting score adjustments for the highest quality foraging habitat recorded for each is summarised in **Table 6**. The results of the context adjustment determine that the quality of foraging habitat for Carnaby's Black-cockatoo to be 'Very high' to 'High' and for Forest Red-tailed Black-cockatoo to be 'Moderate to high' or 'High'. Confirmation of the suitability of breeding hollows (discussed further below) would provide greater certainty in these results, if required.



Legend

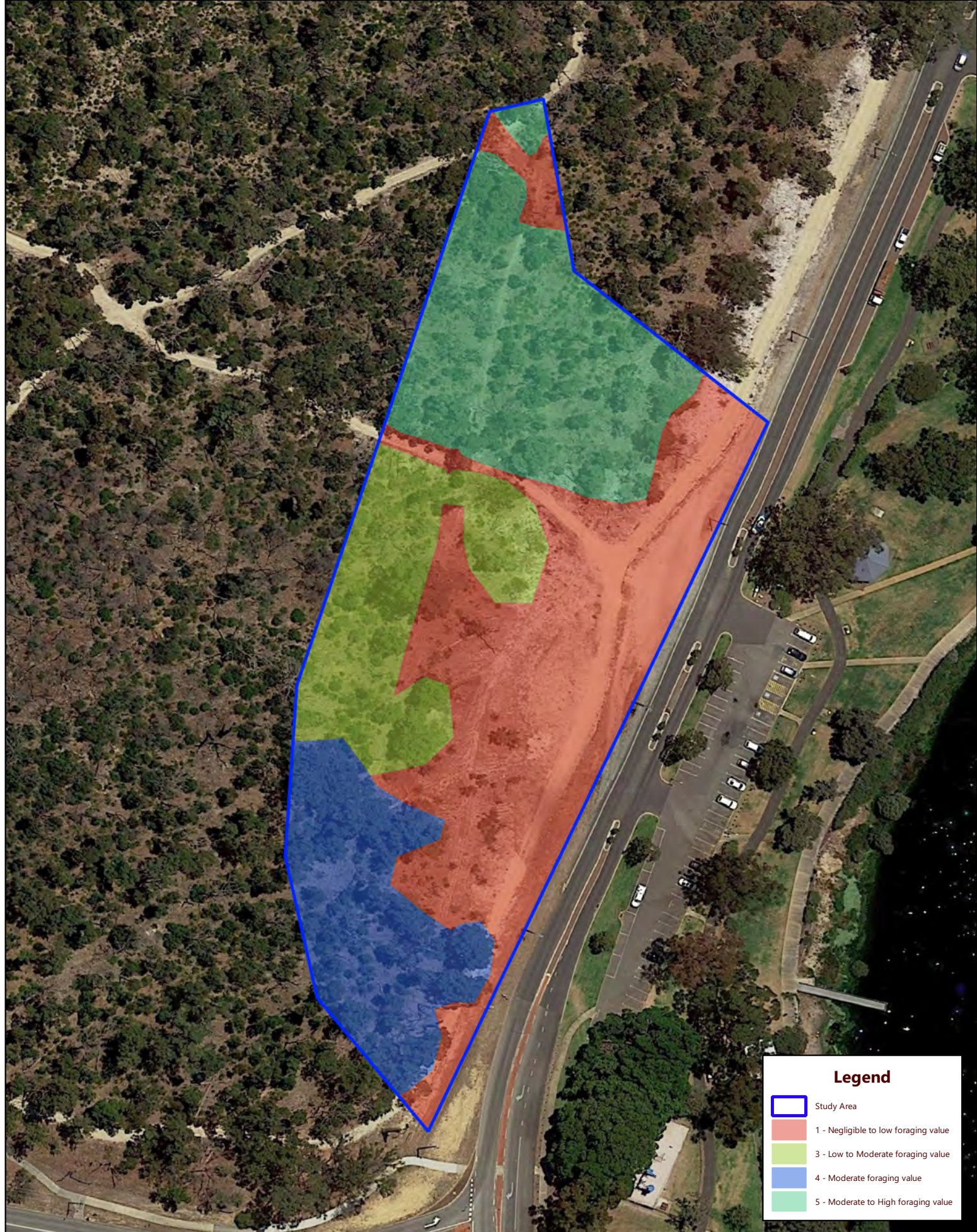
- Study Area
- 1 - Negligible to Low foraging value
- 2 - Low foraging value
- 3 - Low to Moderate foraging value
- 4 - Moderate foraging value
- 5 - Moderate to High foraging value

0 15 30 45 60 m
 GDA 94 / MGA Zone 50



Figure 2a - Forest Red-tailed Black-Cockatoo Foraging Habitat





Legend

- Study Area
- 1 - Negligible to low foraging value
- 3 - Low to Moderate foraging value
- 4 - Moderate foraging value
- 5 - Moderate to High foraging value

0 15 30 45 60 m
GDA 94 / MGA Zone 50



Figure 2b - Carnaby's Black-cockatoo Foraging Habitat

Table 6 – Context Adjustments for Black-cockatoo Foraging Habitat within the Study Area

Score Adjustment	Carnaby's Black-cockatoo	Result	Forest Red-tailed Black-cockatoo	Result
+3	Is within the Swan Coastal Plain (important foraging area)	+3	Jarrah and/or marri show good recruitment (i.e. evidence of young trees)	0
+3	Contains trees with suitable nest hollows	TBC (or +3)	Contains trees with suitable nest hollows	TBC (or +3)
+2	Primarily comprises marri	0	Primarily contains marri and/or jarrah	0
+2	Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo)	+2	Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo)	+2
+1	Is known to be a roosting site	0	Is known to be a roosting site	0
-2	No clear evidence of feeding debris	-2	No clear evidence of feeding debris	-2
-2	No other foraging habitat within 6 km	0	No other foraging habitat within 6 km	0
-1	Is > 12 km from a known breeding location	0	Is > 12 km from a known breeding location	0
-1	Is > 12 km from a known roosting site	0	Is > 12 km from a known roosting site	0
-1	Is > 2 km from a watering point	0	Is > 2 km from a watering point	0
-1	Disease present (e.g. <i>Phytophthora cinnamomi</i> or marri canker)	0	Disease present (e.g. <i>Phytophthora cinnamomi</i> or marri canker)	0
TOTAL ADJUSTMENT		+3 to 6		0 to +3
ADJUSTED (GREATEST) FORAGING VALUE		8 to 11 (‘High to Very high’ quality)		5 to 8 (‘Moderate to high’ to ‘High’ quality)

Roosting Habitat

Habitat that would be suitable Black-cockatoo roosting habitat was identified within the study area, mostly towards the southern end of the site, near Gwilliam Drive, where tall trees exist. Such trees may provide suitable roosting habitat due to their maturity and height as well as their proximity to waterbodies, including the adjacent Bibra Lake. Interrogation of the BirdLife Australia (WA) Great Cocky Count roost site database for the centre of the study site (388661 mE; 6449013 mN), plus a 12 km buffer did not confirm that the site or nearby surrounds are a known roost site. The nearest known roost sites are 875 m, 930 m and 1.4 km west north-west of the study area at Rinaldo Park, Elinor Reserve and Tempest Park in Coolbellup (**Figure 3**).

Breeding Habitat

A total of 22 trees considered potential current or future nesting trees for Black-cockatoos were recorded within the study area or in very close proximity of the study area boundary, as summarised in **Table 7**. The locations of the recorded potential breeding/nest trees are presented in **Figure 4**.

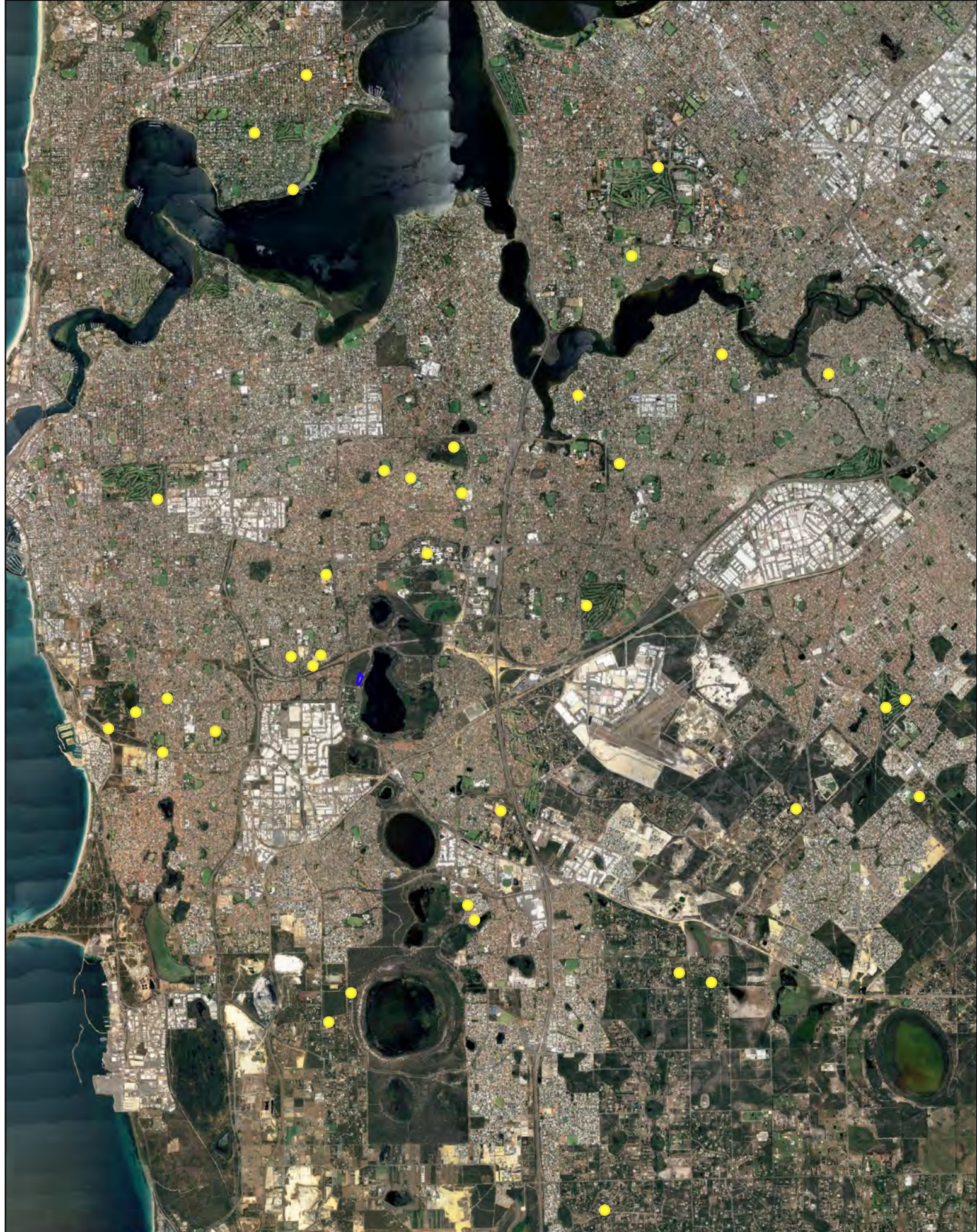
Four different tree species were recorded, namely, *Corymbia calophylla*, *Eucalyptus marginata*, *Eucalyptus gomhocephala* and *Allocasuarina fraseriana*. Of the 22 trees recorded within or very close to the study area, six were observed to support suitable (or potentially suitable) hollows for use by breeding Black-cockatoos, but with no evidence of nesting (e.g. chew marks) (Rank 3). The remaining 16 trees were not observed to contain any hollows (Rank 5). The details of each Rank 3 (potential nesting) tree are provided in **Appendix 2**.

The trees lacking hollows (Rank 5) are considered potential future nesting trees, due to their adequate size, which suggests they could provide hollows in the future (e.g. as a result of falling limbs or following the effects of fire). Those trees with visible (suitable or potentially suitable) hollows are considered suitable nesting trees, but with no evidence of nesting. Only hollows of sufficient aperture (opening diameter), depth and orientated at a suitable angle (near-vertical) are suitable for Black-cockatoo nesting. Confirmation of the suitability of breeding hollows is only possible from detailed inspections of each hollow via a camera pole or climbing inspection. Where necessary, such inspections are typically carried out as part of follow-up surveys.

Although the current referral guidelines (DSEWPac 2012) do not recognise *Allocasuarina fraseriana* as a suitable tree species for Black-cockatoo breeding/nesting, more recent anecdotal evidence suggest that many species additional to those listed by DSEWPac (2012), including *Allocasuarina fraseriana* do develop hollows suitable for use by breeding Black-cockatoos (Mike Bamford, pers. comm.).

Table 7 - Summary of Recorded Potential Breeding Trees

Tree No.	Location		Species	DBH (cm)	Tree Rank/Category
	mE	mN			
1	388635.416	6448894.771	<i>Eucalyptus gomphocephala</i>	110	3 - Potential hollow, no chew marks
2	388660.864	6449134.232	<i>Eucalyptus marginata</i> (Dead)	120	3 - Potential hollow, no chew marks
3	388661.298	6449013.558	<i>Eucalyptus marginata</i>	60	3 - Potential hollow, no chew marks
4	388670.988	6449053.471	<i>Eucalyptus marginata</i>	60	5 - Sufficient DBH, no hollows
5	388657.463	6449017.012	<i>Eucalyptus marginata</i> (Dead)	70	3 - Potential hollow, no chew marks
6	388646.431	6448923.392	<i>Eucalyptus marginata</i>	60	5 - Sufficient DBH, no hollows
7	388631.652	6448966.909	<i>Corymbia calophylla</i>	55	5 - Sufficient DBH, no hollows
8	388690.588	6449098.656	<i>Eucalyptus marginata</i>	65	5 - Sufficient DBH, no hollows
9	388639.340	6448990.140	<i>Corymbia calophylla</i>	60	5 - Sufficient DBH, no hollows
10	388657.841	6449083.685	<i>Eucalyptus gomphocephala</i>	60	5 - Sufficient DBH, no hollows
11	388705.809	6449087.139	<i>Eucalyptus gomphocephala</i>	70	5 - Sufficient DBH, no hollows
12	388630.410	6448956.062	<i>Corymbia calophylla</i>	55	5 - Sufficient DBH, no hollows
13	388648.221	6448930.434	<i>Corymbia calophylla</i>	50	5 - Sufficient DBH, no hollows
14	388640.983	6448912.278	<i>Corymbia calophylla</i> (Dead)	90	3 - Potential hollow, no chew marks
15	388706.255	6449083.900	<i>Eucalyptus marginata</i>	50	5 - Sufficient DBH, no hollows
16	388665.312	6449067.203	<i>Allocasuarina fraseriana</i>	60	5 - Sufficient DBH, no hollows
17	388672.864	6449075.712	<i>Eucalyptus marginata</i>	50	5 - Sufficient DBH, no hollows
18	388635.042	6449021.638	<i>Eucalyptus gomphocephala</i>	100	3 - Potential hollow, no chew marks
19	388619.781	6448967.257	<i>Corymbia calophylla</i>	50	5 - Sufficient DBH, no hollows
20	388620.321	6448969.591	<i>Corymbia calophylla</i>	50	5 - Sufficient DBH, no hollows
21	388637.611	6448959.359	<i>Corymbia calophylla</i>	50	5 - Sufficient DBH, no hollows
22	388621.568	6448916.056	<i>Corymbia calophylla</i>	50	5 - Sufficient DBH, no hollows



0 1.25 2.5 3.75 5 km

GDA 94 / MGA Zone 50



Legend



-  Study Area
-  Known Roost Site



Figure 3 - Known Regional Roost Sites



0 15 30 45 60 m
GDA 94 / MGA Zone 50



Legend

- Study Area
- Tree Rank**
- 3
- 5



Figure 4 - Recorded Potential Nesting Trees

Conclusions

The study area provides habitat for Black-cockatoos, consisting predominantly of certain suitable foraging habitat. No known roosting habitat nor any known or likely breeding habitat was recorded at the site, although trees that could be suitable for roosting and breeding do occur.

Foraging habitat for both Carnaby's Black-cockatoo and the Forest Red-tailed Black-cockatoo, ranging in quality from 'Negligible to Low' to 'Moderate to High' and mostly 'Negligible to Low' for both species was recorded. The best quality foraging habitat for Carnaby's Black-cockatoo occurs mostly within the central section of the study area and the best quality foraging habitat for Forest Red-tailed Black-cockatoos occurs mostly towards the fringes of the study area. When context adjustors are considered (applied only to vegetation components of the scoring system of 3 or greater), the foraging habitat quality scores are elevated to 'High to Very high' and 'Moderate to high' or 'High' quality for Carnaby's Black-cockatoos and Forest Red-tailed Black-cockatoos, respectively.

There are no known roost sites within the study area or its nearby vicinity, although the mature trees within the site, mostly at the southern end, provide habitat that could be suitable as a roost.

A total of 22 trees were recorded within or very close to the study area that are considered potential current or future nesting trees for Black-cockatoos. Of these trees, six support suitable (or potentially suitable) hollows for Black-cockatoo breeding. The remaining 16 trees were not observed to contain any hollows. No active nests nor trees with suitable hollows that also display evidence of use by breeding Black-cockatoos were recorded.

Closing

Should you require further information or clarification regarding the information provided in this report, please do not hesitate to contact the undersigned.

Best regards,

Kellie Bauer-Simpson
Director & Principal Ecologist/Environmental Manager
Focused Vision Consulting Pty Ltd

References

- BirdLife Australia (WA) Great Cocky Count roost site database search results for 388661 mE; 6449013 mN plus 12 km buffer, obtained 10 September 2019.
- Department of the Environment and Energy (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. Department of the Environment and Energy, Commonwealth of Australia, 2017, Canberra, Australian Capital Territory.
- DEE (2018a). *Calyptorhynchus banksii naso* in Species Profile and Threats Database. Department of the Environment. Available from: <http://www.environment.gov.au/sprat>
- DEE (2018b). *Calyptorhynchus latirostris* in Species Profile and Threats Database. Department of the Environment. Available from: <http://www.environment.gov.au/sprat>
- DSEWPaC. (2012). EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Capital Territory.

Appendix 1 Bamford Consulting Ecologists Black-cockatoo nesting-tree assessment protocol

Bamford Consulting Ecologists base Black-cockatoo nesting-tree assessments on Federal guidelines (DEE 2017; DotE 2018a, b, c) but also refer to the following when undertaking field surveys.

Measuring DBH

While Black-cockatoos generally nest towards the crown of a tree, the diameter of a tree at breast-height (DBH) can be indicative of the likelihood of hollow-formation in the upper trunk and can be used in the assessment of the 'value' of a tree to breeding Black-cockatoos. A DBH threshold of 500 mm (or 300 mm for Wandoo, *Eucalyptus wandoo*, and Salmon Gum, *E. salmonophloia*) is commonly used to delineate 'potential' nest-trees (DotE 2018a, b, c), however the tree has to be *functionally capable of supporting a nest hollow* and there are several exceptions where trees that meet a strict DBH threshold are excluded (e.g. those with low-forking into narrow-diameter trunks, or those that have been hollowed-out and 'opened' by fire). Thus, some discretion needs to be used when assessing trees.

The international standard for 'breast height' is 1.3 m (James and Shugart Jr 1970).

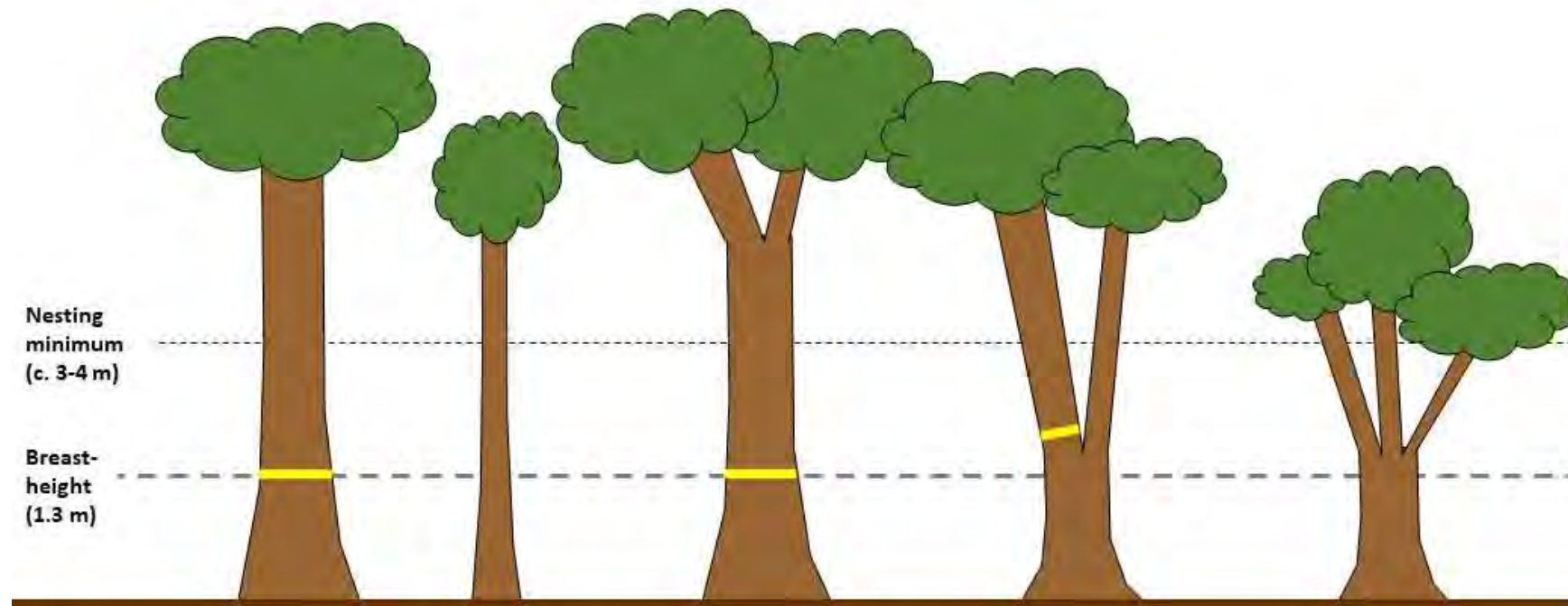
Only occasionally are trees close to perfectly cylindrical. As such, wherever possible, DBH should be 'representative' of the tree. In cases where the tree is approximately oval in cross-section, BCE measures the diameter of the shorter axis. Note that other methods such as circumference, or the quadratic average of the long and short axes are used in some applications, but logistic constraints generally require a more pragmatic approach. DBH should be reflective of the trunk above the nesting threshold (see below). Where a tree spreads at the base along one axis, the axis that best represents the trunk above is chosen for measurement.

Nest height minima

For Carnaby's Black-cockatoo, the minimum height of known nests is c. 3 m (Saunders 1979). For Forest Red-tailed Black-cockatoo, the minimum height of a known nest is 6.5 m (Johnstone *et al.* 2013a). Thus, a 3-4 m threshold seems a pragmatic "general" one to use for the purposes of field surveys where both species are likely and multiple tree species are under consideration.

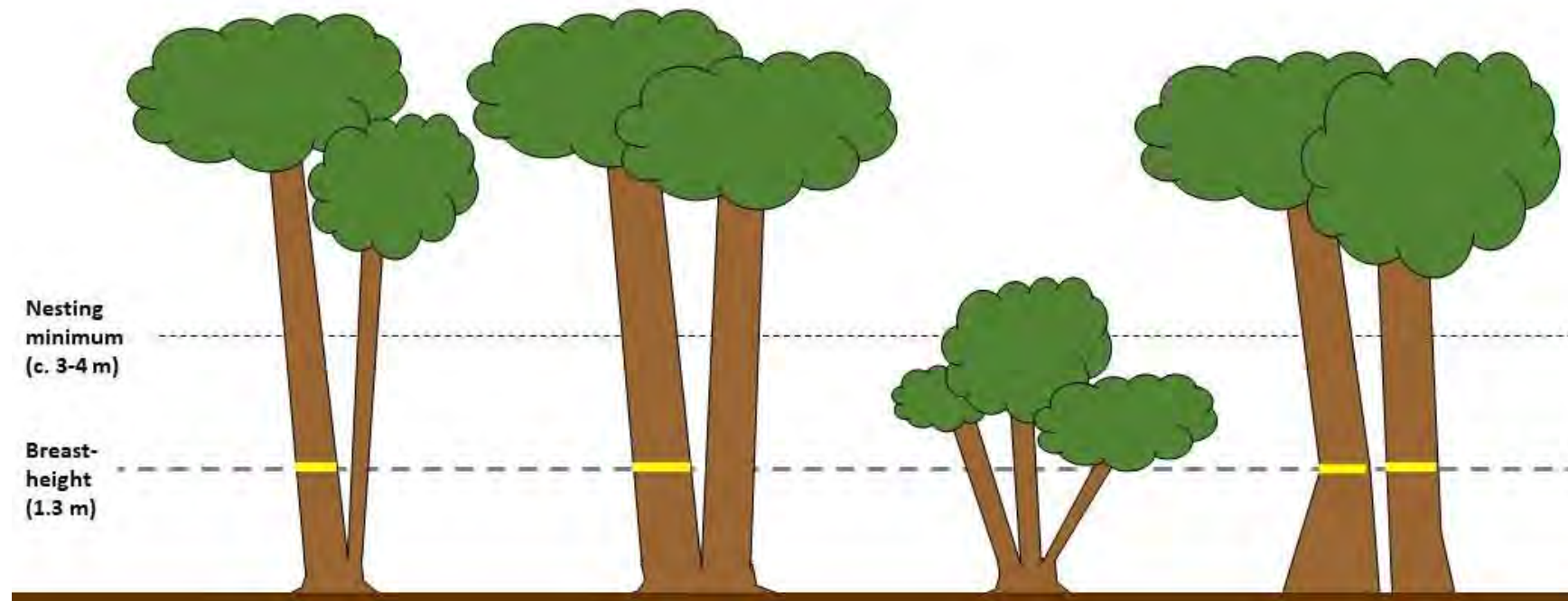
Tree forms

Quite obviously, trees have a range of forms and growth-habits. These can occasionally affect Black-cockatoo nesting-tree surveys. As such, the following table has been developed (with reference to the information above) to guide tree assessment.



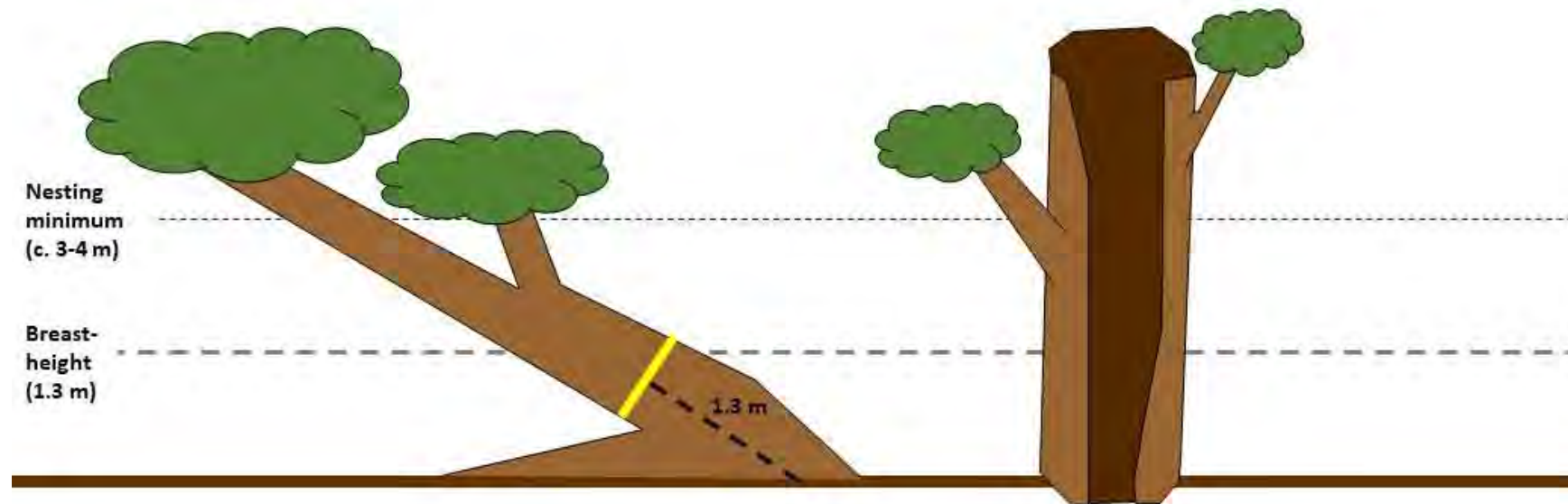
Tree Description:	Straight trunk. DBH > 500 mm*.	Straight trunk. DBH < 500 mm*.	Trunk forks above 3 m. DBH > 500 mm*.	Trunk forks between 1.3 m & 3 m. Diameter of at least one trunk above fork > c. 500 mm*.	Trunk forks between 1.3 m & 3 m. DBH > 500 mm* but <u>no</u> trunks above fork have diameter > c. 500 mm*.
Actions:	Measure DBH. Record species, life status and score for hollows. Waypoint tree.	Do not record.	Measure DBH. Record species, life status and score for hollows. Waypoint tree.	Measure/estimate diameter of <u>widest</u> trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.

* Or 300 mm DBH for Wandoo, Salmon Gum.



Tree Description:	Trunk forks below 1.3 m. Diameter of <u>one</u> trunk above fork > 500 mm*.	Trunk forks below 1.3 m. Diameter of <u>multiple</u> trunks above fork > 500 mm*.	Trunk forks below 1.3 m. DBH of all trunks < 500 mm*.	Two <u>separate</u> trees in very close proximity. Both with DBH > 500 mm.
Actions:	Measure DBH of relevant trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Measure DBH of <u>widest</u> trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.	For <u>both</u> trees... Measure DBH. Record species, life status and score for hollows. Waypoint <u>each</u> tree (i.e. 2 separate records).



* Or 300 mm DBH for Wandoo, Salmon Gum.






Tree Description:	Trunk leans dramatically. Diameter > 500 mm* at 1.3m from centre of tree base.	Trunk has been burnt out internally to create an <u>open</u> half-pipe shape (no potential nesting sites). DBH > 500 mm*.
Actions:	Measure diameter at 1.3 m from the central base point, along the midline of the tree. Record species, life status and score for hollows. Waypoint tree.	Do not record.

* Or 300 mm DBH for Wandoo, Salmon Gum.

Appendix 2 Summary of Black-cockatoo Potential Breeding Trees

Tree No.	Location	DBH (cm)	Rank	Photograph
1	mE 388630.989 mN 6448877.848	110	3 – Potential hollow, no chew marks	
2	mE 388664.602 mN 6449127.886	120	3 – Potential hollow, no chew marks	

Tree No.	Location	DBH (cm)	Rank	Photograph
3	mE 388661.298 mN 6449013.558	60	3 – Potential hollow, no chew marks	
5	mE 388657.463 mN 6449017.012	70	3 – Potential hollow, no chew marks	

Tree No.	Location	DBH (cm)	Rank	Photograph
14	mE 388651.267 mN 6448916.193	90	3 – Potential hollow, no chew marks	
18	mE 388645.245 mN 6449023.360	100	3 – Potential hollow, no chew marks	