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MEMORANDUM

Date	22 October 2018	**Title**	Black-cockatoo Habitat Tree Survey Results – Eighth and Forrest Roads
Ref.	COA18002_MEM01_Rev0	**Distribution**	Luke Rogers City of Armadale
Author	Lisa Chappell Senior Botanist	**Review**	Kellie Bauer-Simpson Principal Ecologist

Background

The City of Armadale (the City) is proposing future road upgrade works on Eighth Road and Forrest Road. Focused Vision Consulting Pty Ltd (FVC) was commissioned to undertake a Black-cockatoo habitat tree survey within the study area (**Figure 1**).

The site borders part of the Armadale Redevelopment Area, and the road upgrades are necessary to cater for increased traffic. A number of the trees that are likely to be cleared to enable road widening and construction are considered suitable potential breeding, roosting and/ or foraging habitat for Black-cockatoos due to their size and species.

This correspondence presents the findings of the field assessment for Black-cockatoo nesting trees within the study area (**Figure 1**), as recorded by FVC, supported by specialist partner consultants, Bamford Consulting Ecologists (BCE).

Scope of Work

The scope of work was to undertake an assessment of each tree for habitat potential within the study area in accordance with guidance outlined in the 'EPBC Act Referral Guidelines for Three Threatened Black-cockatoo Species', and was required to meet the following objectives:

1. Identify significant trees for breeding/roosting and/or foraging potential, and prioritised based on habitat and environmental value to inform road design (including mapping references and a GPS location of each assessed tree).
2. Support an application for EPBC Approval, and/or for a Clearing Permit.

0 50 100 150 200 m

GDA 94 / MGA Zone 50

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Legend

Study Area

Figure 1 - Study Area

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Methodology

The field survey took place over a single day on 27 August 2018, carried out by Senior Zoologist, Katherine Chuk, assisted by Senior Botanist, Lisa Chappell. Katherine 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 with strong reference to both the existing guidelines (DSEWPaC 2012) as well as the recently revised draft guidelines (DEE 2017). In addition, survey methodology followed the recommendations listed on the DEE's Species Profile and Threats Database (DEE 2018a, c).

The designated study area was traversed on foot and surveyed in exhaustive detail, to observe and record all suitable foraging, roosting or 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 (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Proteaceous species such as *Banksia, Hakea* and *Grevillea*; *Allocasuarina*, and *Anigozanthos* and introduced species such as Pines (*Pinus* spp.) and Cape Lilac (*Melia azedarach*), but also *Erodium* 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 (*Eucalyptus* or *Corymbia*) 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: • Shrubland in which species of foraging value, such as shrubby banksias, with <10% projected foliage cover. • Open eucalypt woodland/mallee of small-fruited species. • Paddocks with melons or other weeds (a short-term, seasonal food source).	Low foraging value. Example: • Woodland or forest with scattered specimens of known food plants (e.g. Marri and Jarrah) but projected foliage cover of these 1-<5%. Could include urban areas with scattered foraging trees.	Low foraging value. Examples: • Open eucalypt woodland (i.e. Marri, Jarrah, Wandoo, Blackbutt or Karri). Projected foliage cover of these 1-<5% • Urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *Eucalyptus erythrocorys*.
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, with 10-20% projected foliage cover. • Woodland with tree banksias 2-10% projected foliage cover. • Eucalypt woodland/mallee of small-fruited species; Marri, if present, <10% project foliage cover.	Low to Moderate foraging value. Examples: • Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 5-<10%. • Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of 10-<20% can be considered low-to-moderate because of poor long-term viability without management.	Low to Moderate foraging value. Examples: • Eucalypt woodland (i.e. Marri, Jarrah, Wandoo, and Blackbutt), if present, <10% project foliage cover.

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

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 data was also undertaken to assist in identifying whether or not the study area supports, or may support 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 assisted with the assessment and reporting.

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 (*Apis mellifera*), 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 has 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

Foraging habitat for Black-cockatoos is supported by the study area and ranges in value from 0 (no foraging value) to 3 (low to moderate foraging value), totalling 3.81 hectares in total, which is spatially presented in **Figure 2**. The majority of the study area does not support any foraging habitat, or habitat with a foraging value of 0, largely due the cleared roads and verges present. Foraging habitat along Eighth Road, is largely confined to isolated trees. Better quality foraging habitat occurs along the southern verge of Forrest Road. Evidence of Black-cockatoos utilising this area for foraging such as chewed Marri nuts were noted.

The study area is generally considered to represent low (and low to moderate at best) value foraging habitat for Black-cockatoo species, despite evidence of Cockatoos utilising the area for feeding.

The total area of foraging habitat across the range of values recorded is summarised in **Table 4**.

Table 4 Summary of Foraging Habitat within the Study Area

Foraging Value	Area (hectares)
0 - No foraging value	2.41
1 - Negligible to low foraging value	0.46
2 - Low foraging value	0.35
3 - Low to moderate foraging value	0.59
Total	**3.81**

Roosting Habitat

Habitat that would be suitable Black-cockatoo roosting habitat was identified along Forrest Road (**Figure 3**). The roosting habitat occurs in three slightly separate areas (0.013 ha, 0.103 ha and 1.065 ha), totalling 1.181 ha. This area is considered to be suitable roosting habitat due to the maturity and height of the trees, and their close proximity to a flowing drainage channel crossing Forrest Road. No known roost sites are known to occur within the vicinity of the study area, based on records from the Great Cocky Count (Birds Australia), and therefore, this area of trees cannot be confirmed as a roost site.

Breeding Habitat

A total of 78 trees considered potential current or future nesting trees for Black-cockatoos were recorded within or within close proximity to the study area, as summarised in **Table 5**. Of these, 67 trees specifically fall within the study area and 11 occur just outside the bounds of the designated study area.

The majority of potential breeding/nest trees occur along Forrest Road. Only five potential nesting trees occur along Eighth Road. The locations of the recorded potential breeding/nest trees are presented in **Figure 4**.

Table 5 Summary of Recorded Potential Nest Trees

Tree No.	Location		Species	DBH (cm)	Tree Rank/Category	Within study area?	Value/ Concern
	mE	mN					
1	405306	6441627	*Eucalyptus ?wandoo*	30	5 - Sufficient DBH, no hollows	Yes	Low-Medium
2	405291	6441502	*Eucalyptus rudis*	60	3 - Potential hollow, no chew marks	Yes	Medium
3	405234	6441495	*Corymbia calophylla*	50	4 - Potential hollow but unsuitable angle/orientation	Yes	Medium
4	405261	6441472	*Eucalyptus rudis*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
5	405355	6441524	*Eucalyptus rudis*	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
6	405341	6441520	*Corymbia calophylla*	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
7	405281	6441505	*Eucalyptus rudis*	50	3 - Potential hollow, no chew marks	Yes	Medium
8	405262	6441488	*Eucalyptus rudis*	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
9	405252	6441489	*Corymbia calophylla*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
10	405195	6441456	*Corymbia calophylla*	70	5 - Sufficient DBH, no hollows	Yes	Low-Medium
11	405175	6441450	*Corymbia calophylla*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
12	405578	6441516	*Eucalyptus* sp. 6	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
13	405284	6441476	*Eucalyptus rudis*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
14	405224	6441473	*Corymbia calophylla*	50	3 - Potential hollow, no chew marks	Yes	Medium
15	405538	6441529	*Eucalyptus* sp. 5	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
16	405693	6441508	*Eucalyptus* sp. 6	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
17	405456	6441540	*Eucalyptus* sp. 6	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
18	405715	6441505	*Eucalyptus* sp. 6	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
19	405216	6441469	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium

Tree No.	Location		Species	DBH (cm)	Tree Rank/Category	Within study area?	Value/ Concern
	mE	mN					
20	405587	6441517	*Eucalyptus* sp. 6	70	5 - Sufficient DBH, no hollows	Yes	Low-Medium
21	405608	6441513	*Eucalyptus* sp. 6	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
22	405401	6441521	*Eucalyptus rudis*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
23	405564	6441521	*Eucalyptus* sp. 5	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
24	405319	6441535	*Eucalyptus ?wandoo*	65	5 - Sufficient DBH, no hollows	Yes	Low-Medium
25	405646	6441507	*Eucalyptus* sp. 6	65	5 - Sufficient DBH, no hollows	Yes	Low-Medium
26	405344	6441523	*Corymbia calophylla*	50	2 - Sufficient DBH, suitable hollow with chew marks	Yes	High
27	405411	6441523	*Eucalyptus rudis*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
28	405670	6441510	*Eucalyptus* sp. 6	65	5 - Sufficient DBH, no hollows	Yes	Low-Medium
29	405699	6441507	*Eucalyptus* sp. 6	65	5 - Sufficient DBH, no hollows	Yes	Low-Medium
30	405311	6441621	*Eucalyptus ?wandoo*	45	5 - Sufficient DBH, no hollows	Yes	Low-Medium
31	405237	6441481	*Corymbia calophylla*	50	3 - Potential hollow, no chew marks	Yes	Medium
32	405580	6441521	*Eucalyptus* sp. 5	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
33	405378	6441506	*Eucalyptus rudis*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
34	405688	6441510	*Eucalyptus* sp. 6	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
35	405705	6441507	*Eucalyptus* sp. 6	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
36	405569	6441519	*Eucalyptus* sp. 5	70	5 - Sufficient DBH, no hollows	Yes	Low-Medium
37	405630	6441508	*Eucalyptus* sp. 6	65	5 - Sufficient DBH, no hollows	Yes	Low-Medium
38	405384	6441500	*Eucalyptus rudis*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
39	405513	6441531	*Eucalyptus* sp. 5	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium

Tree No.	Location		Species	DBH (cm)	Tree Rank/Category	Within study area?	Value/ Concern
	mE	mN					
40	405666	6441509	*Eucalyptus* sp. 6	60	4 - Potential hollow but unsuitable angle/orientation	Yes	Medium
41	405305	6441509	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
42	405602	6441512	*Eucalyptus* sp. 6	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
43	405657	6441510	*Eucalyptus* sp. 6	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
44	405678	6441510	*Eucalyptus* sp. 6	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
45	405337	6441621	*Corymbia calophylla*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
46	405519	6441527	*Eucalyptus* sp. 5	70	3 - Potential hollow, no chew marks	Yes	Medium
47	405650	6441507	*Eucalyptus* sp. 6	60	3 - Potential hollow, no chew marks	Yes	Medium
48	405368	6441525	*Eucalyptus rudis*	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
49	405497	6441533	*Eucalyptus* sp. 5	55	5 - Sufficient DBH, no hollows	Yes	Low-Medium
50	405646	6441507	*Eucalyptus* sp. 6	65	5 - Sufficient DBH, no hollows	Yes	Low-Medium
51	405319	6441517	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
52	405550	6441525	*Eucalyptus* sp. 5	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
53	405291	6441521	*Corymbia calophylla*	55	3 - Potential hollow, no chew marks	Yes	Medium
54	405557	6441524	*Eucalyptus* sp. 5	50	3 - Potential hollow, no chew marks	Yes	Medium
55	405591	6441515	*Eucalyptus* sp. 6	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
56	405399	6441518	*Eucalyptus rudis*	50	3 - Potential hollow, no chew marks	Yes	Medium
57	405335	6441519	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
58	405346	6441527	*Eucalyptus rudis*	60	3 - Potential hollow, no chew marks	Yes	Medium
59	405257	6441489	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium

Tree No.	Location		Species	DBH (cm)	Tree Rank/Category	Within study area?	Value/ Concern
	mE	mN					
60	405313	6441511	*Eucalyptus rudis*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
61	405173	6441446	*Corymbia calophylla*	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
62	405326	6441525	*Corymbia calophylla*	50	3 - Potential hollow, no chew marks	Yes	Medium
63	405266	6441491	*Eucalyptus rudis*	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
64	405560	6441525	*Eucalyptus* sp. 5	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
65	405359	6441644	*Eucalyptus* sp. 3	50	5 - Sufficient DBH, no hollows	Yes	Low-Medium
66	405053	6441901	*Corymbia calophylla*	60	5 - Sufficient DBH, no hollows	Yes	Low-Medium
67	405185	6441447	*Corymbia calophylla*	80	5 - Sufficient DBH, no hollows	Yes	Low-Medium
68	405171	6441438	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	No	Low-Medium
69	405770	6441534	*Corymbia calophylla*	60	5 - Sufficient DBH, no hollows	No	Low-Medium
70	405458	6441566	*Eucalyptus* sp. 4	50	5 - Sufficient DBH, no hollows	No	Low-Medium
71	405332	6441486	*Corymbia calophylla*	50	5 - Sufficient DBH, no hollows	No	Low-Medium
72	405361	6441493	*Eucalyptus rudis*	55	3 - Potential hollow, no chew marks	No	Medium
73	405323	6441485	*Eucalyptus rudis*	65	3 - Potential hollow, no chew marks	No	Medium
74	405297	6441460	*Eucalyptus* sp. 5	50	5 - Sufficient DBH, no hollows	No	Low-Medium
75	405310	6441539	*Eucalyptus ?wandoo*	70	4 - Potential hollow but unsuitable angle/orientation	No	Medium
76	405460	6441564	*Eucalyptus* sp. 4	50	5 - Sufficient DBH, no hollows	No	Low-Medium
77	405279	6441470	*Eucalyptus rudis*	50	5 - Sufficient DBH, no hollows	No	Low-Medium
78	405349	6441486	*Eucalyptus rudis*	130	3 - Potential hollow, no chew marks	No	Medium

Note: All unidentified Eucalyptus trees are non-endemic

Six differing tree species where recorded, namely *Eucalyptus rudis, Corymbia calophylla, Eucalyptus* ?*wandoo, Eucalyptus* sp. 4, *Eucalyptus* sp. 5 and *Eucalyptus* sp. 6. A number of the planted, *Eucalyptus* species were not fully identified, however confirmation of their identification is not considered important, as Black-cockatoos demonstrate nesting preference for *Eucalyptus* or *Corymbia* species equally, as long as the suitable DBH has been met and suitable hollows are available. All of the unidentified trees are non-endemic species.

A total of 59 of the recorded trees (52 within the study area, seven outside the study area) are of adequate DBH, but do not support observable hollows (Rank 5), and are therefore not classified as nesting trees, but potential nesting trees only. Three trees were found to contain a potentially suitable hollow, however the orientation of the hollow is not suitable for Black-cockatoos (Rank 4) and therefore, would be unlikely to represent a nesting tree. Such trees are also classed as potential nesting trees only.

Fourteen trees recorded a Rank of '3', with observable hollows of suitable angle and orientation, but with no evidence (e.g. chew marks) of Black-cockatoo use. These trees are also only considered potential nesting trees, since hollows do not appear to support active nests. Active nests are observable between July and December, when Carnaby's Black-cockatoos are known to nest.

One tree, Tree 26, a *Corymbia calophylla* (located at 405344 mE, 6441523 mN), was observed to provide a suitable hollow and exhibited chew marks around the entrance (Rank 2). Due to the presence of a suitable hollow with evidence of use (chew marks), this tree is considered likely to be a breeding tree (active nest not confirmed) and is considered to be of high conservation value.

Figure 2 - Black cockatoo Foraging Habitat

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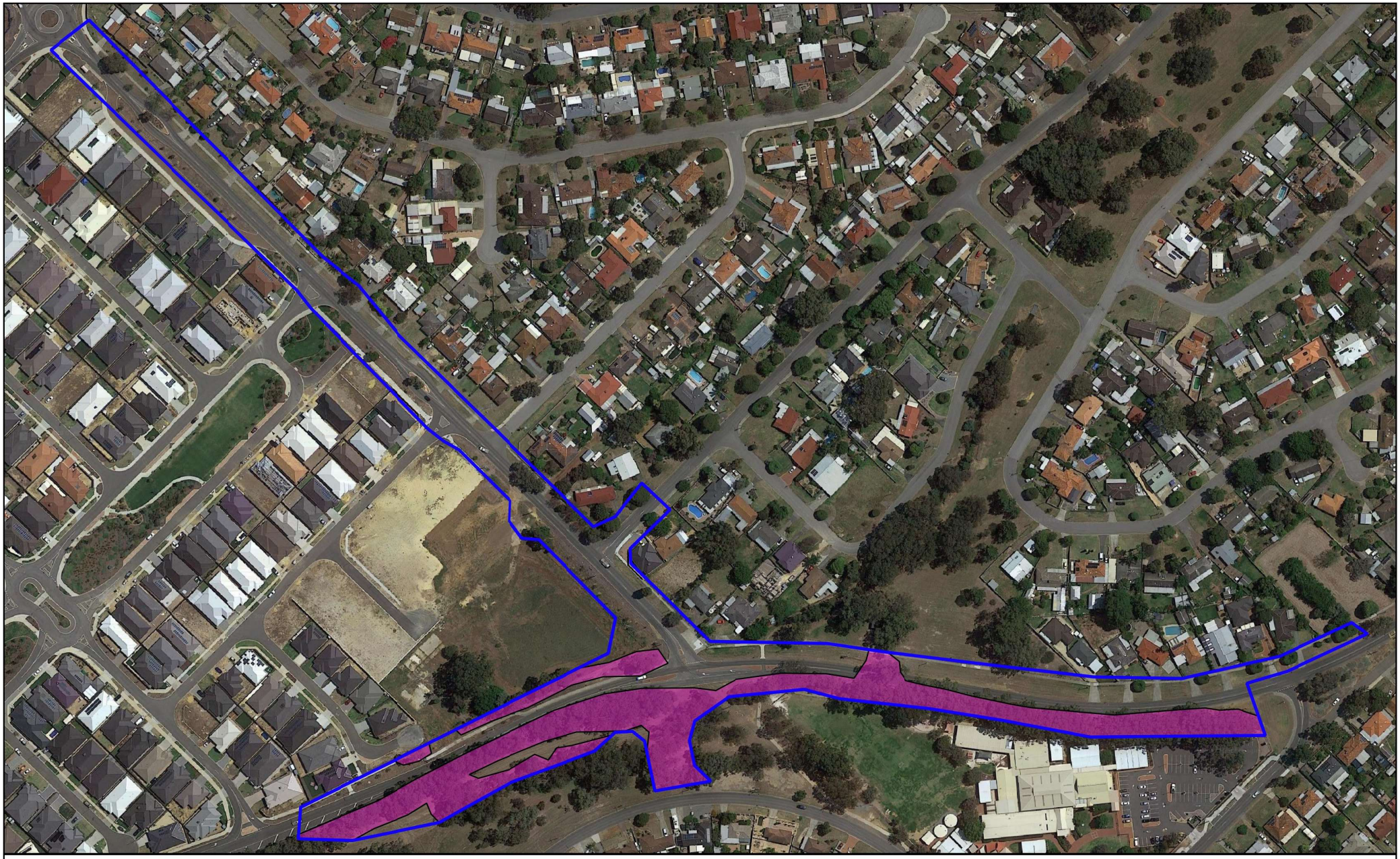

Figure 3 - Suitable Black cockatoo Roosting Habitat

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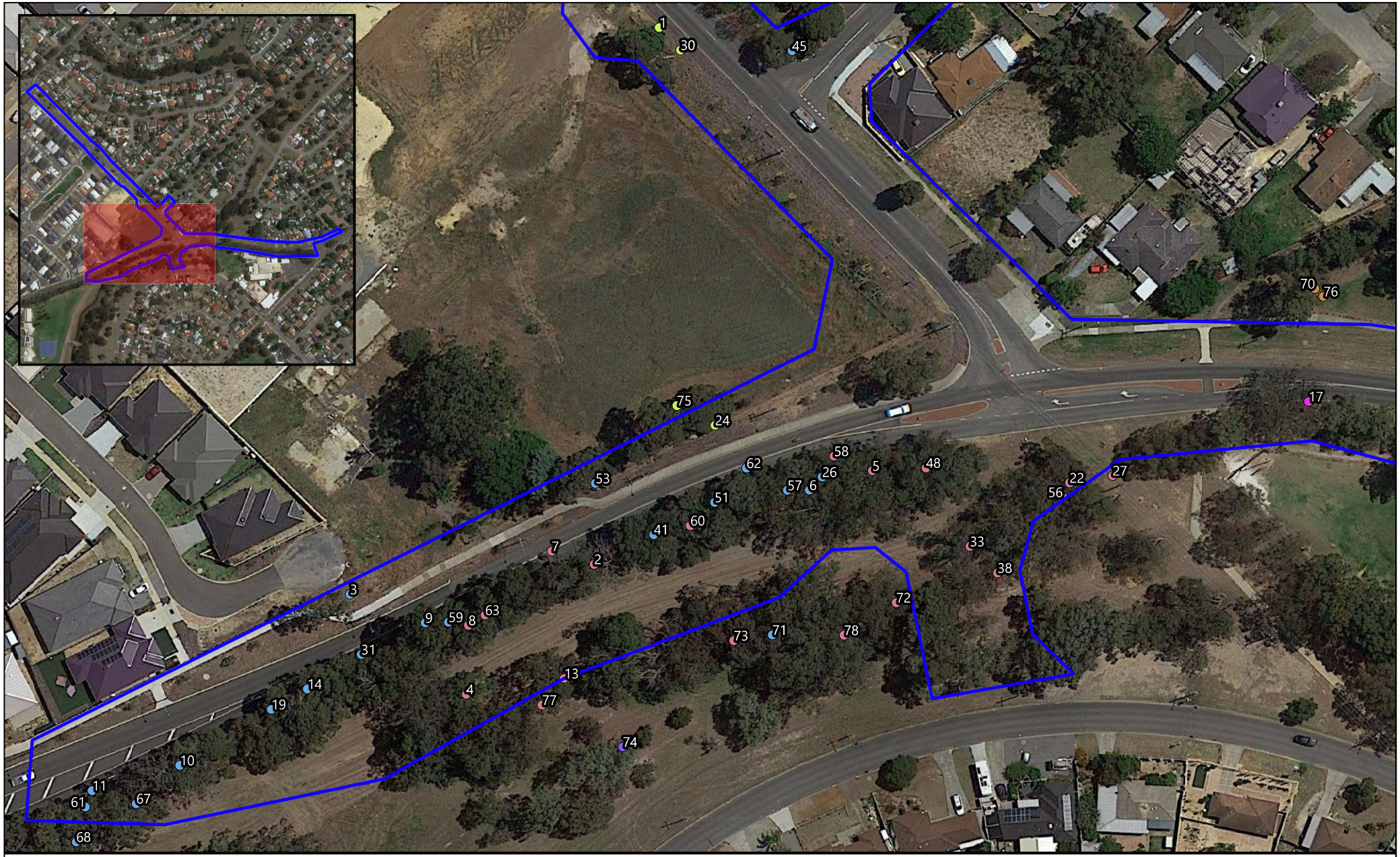

Figure 4a - Recorded Potential Nesting Trees

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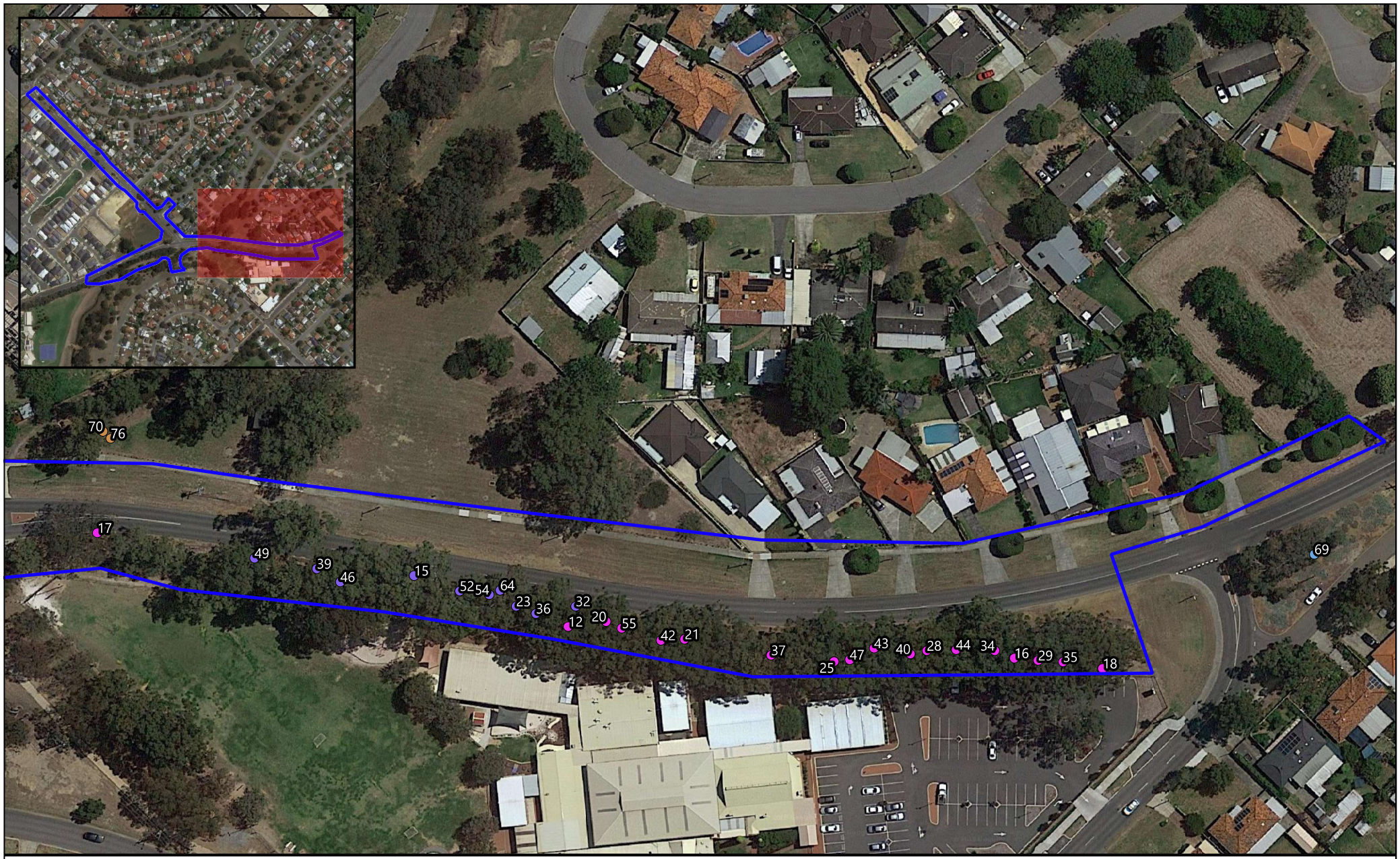

0 15 30 45 60 m

GDA 94 / MGA Zone 50

N

Legend

- Study Area
- Corymbia calophylla
- Eucalyptus ?wandoo
- Eucalyptus rudis
- Eucalyptus sp. 3
- Eucalyptus sp. 4
- Eucalyptus sp. 5
- Eucalyptus sp. 6

Figure 4b - Recorded Potential Nesting Trees

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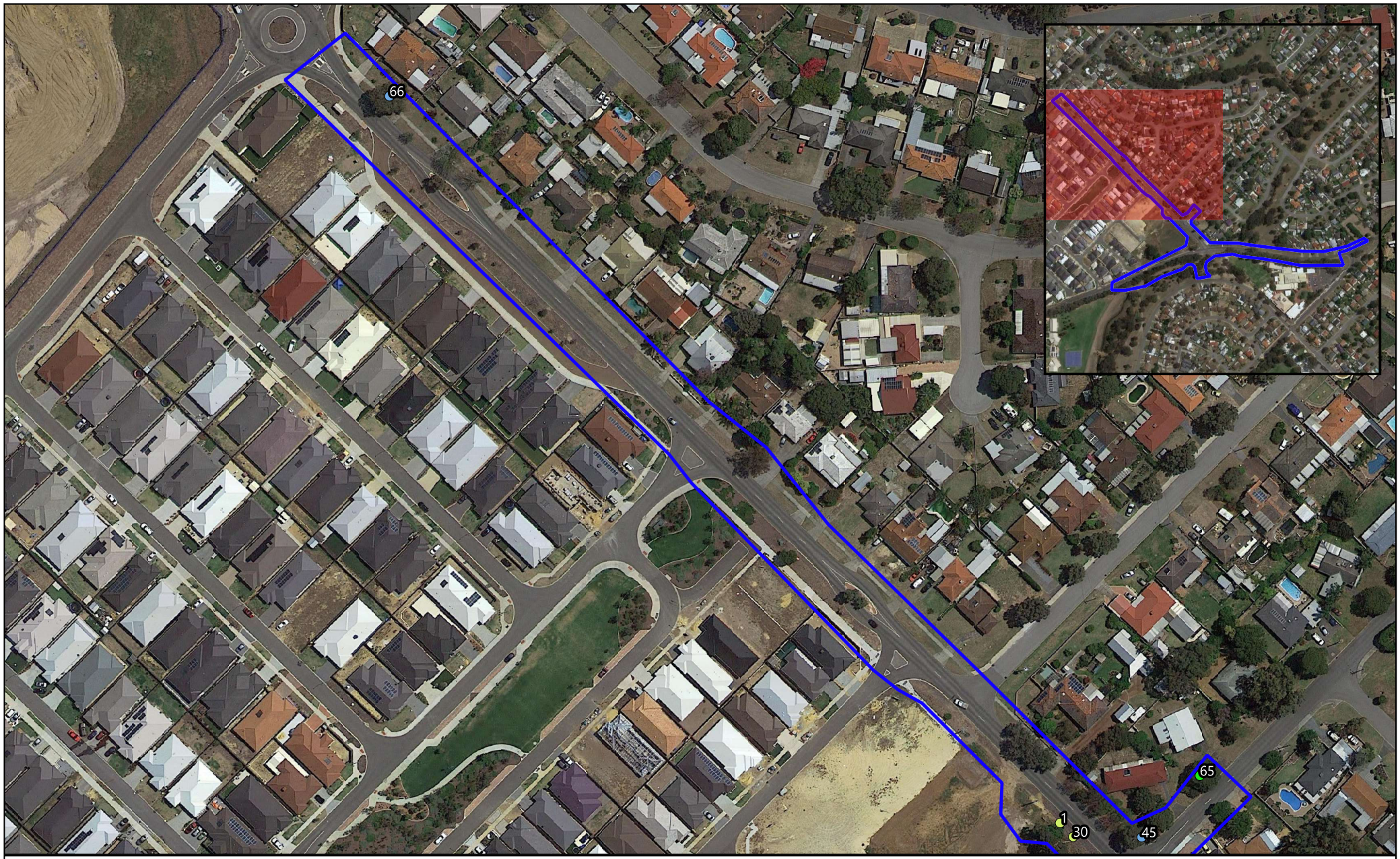

0 15 30 45 60 m

GDA 94 / MGA Zone 50

N

Legend

- Study Area
- Corymbia calophylla
- Eucalyptus ?wandoo
- Eucalyptus rudis
- Eucalyptus sp. 3
- Eucalyptus sp. 4
- Eucalyptus sp. 5
- Eucalyptus sp. 6

Figure 4c - Recorded Potential Nesting Trees

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COA18002 22 October 2018

Conclusions

The study area is generally considered to represent low (low to moderate at best, in some small areas) value foraging habitat for Black-cockatoo species, despite some evidence of Cockatoos utilising the area for feeding.

There are no known roost sites within the study area or its vicinity, although the mature trees along the study area's full extent on Forrest Road all provide habitat that could be suitable as a roost.

One tree, Tree 26, a *Corymbia calophylla,* was observed to provide a hollow and exhibited chew marks around the entrance (Rank 2). Due to the presence of a suitable hollow with evidence of activity (chew marks), this tree is considered to be of high conservation value and should be retained if possible.

Where any of the potential nesting trees with hollows (rank of '3' or higher) are proposed to be impacted, a follow-up survey during the breeding season (July to December), would be required to confirm the nesting status of each. Such a survey would involve inspection of the hollows to find evidence of an active nest containing chicks.

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
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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.

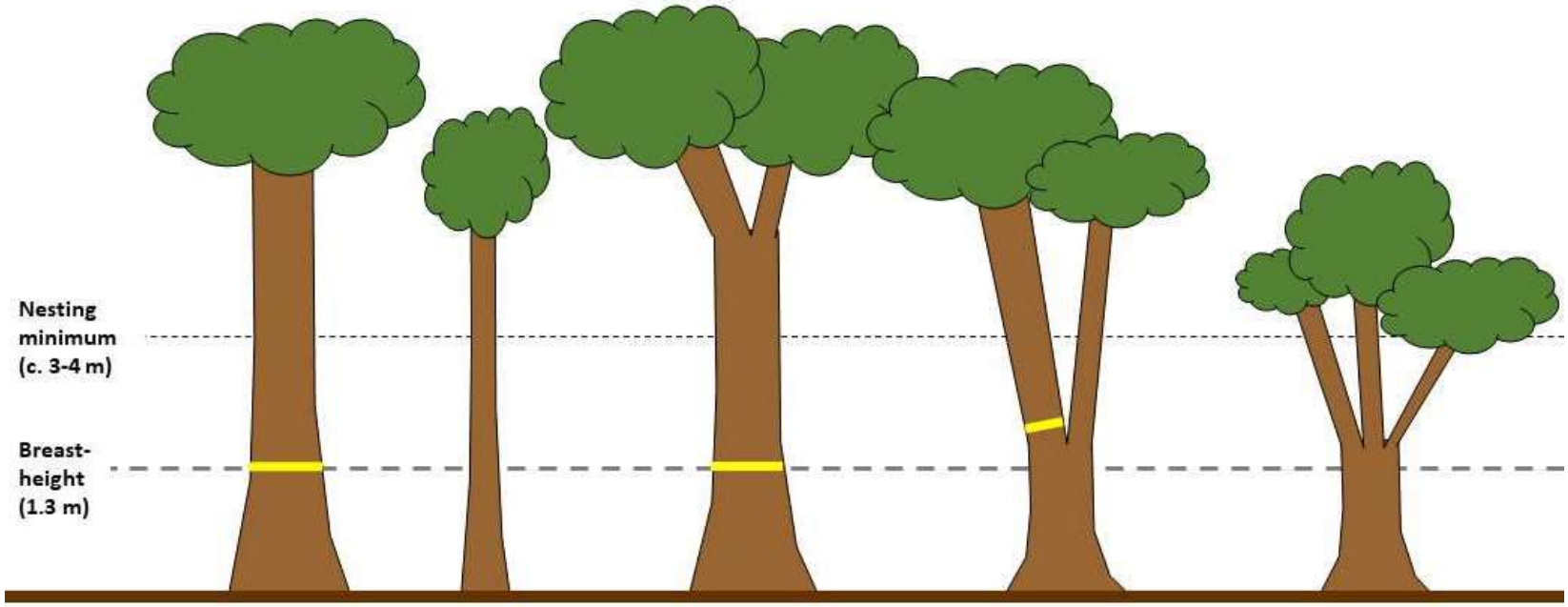
Nest height minima

For Carnaby's Black-cockatoo, the minimum height of known nests is c. 3 m (Saunders 1979)[1]. 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

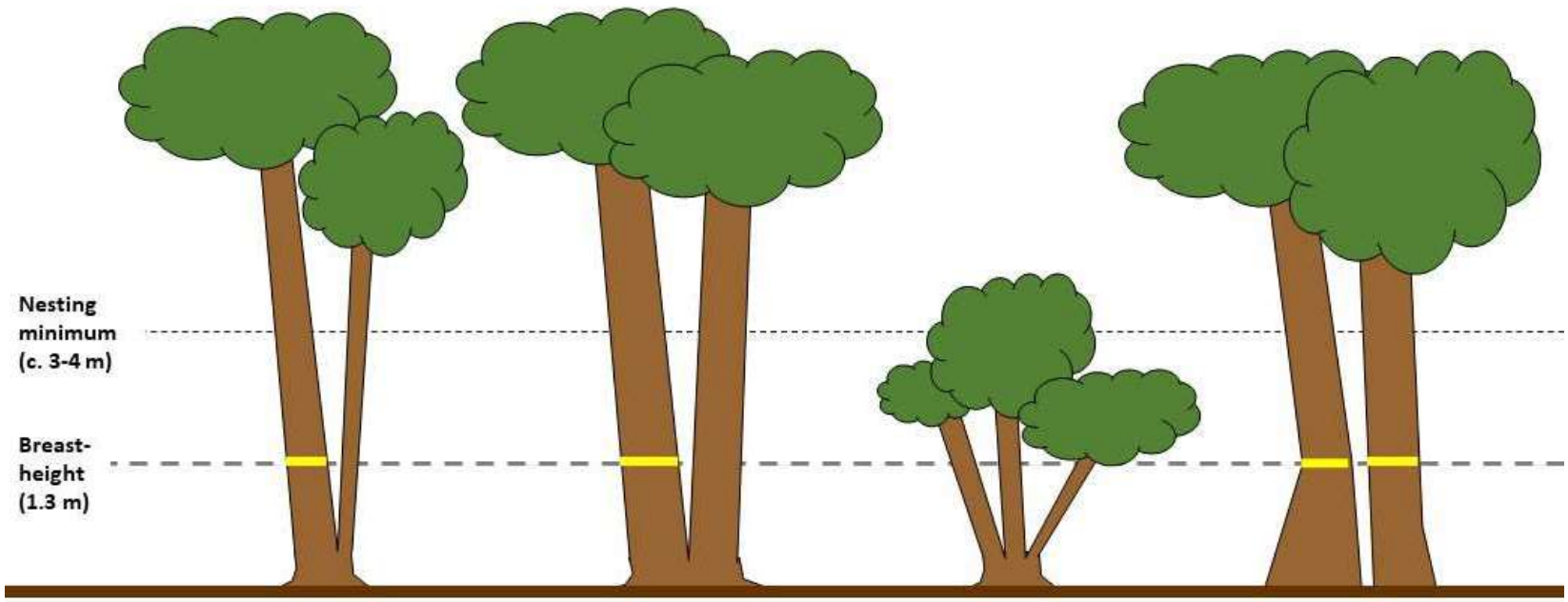
Quite obviously, trees have a range of forms and growth-habits. These can occasionally affect Black-cockatoo nesting-tree surveys. As such, the following table has been developed (with reference to the information above) to guide tree assessment.

[1] Although nests as low as 2 m (in Wandoo or Salmon Gum) were recorded, 95% of nests were above 3 m.



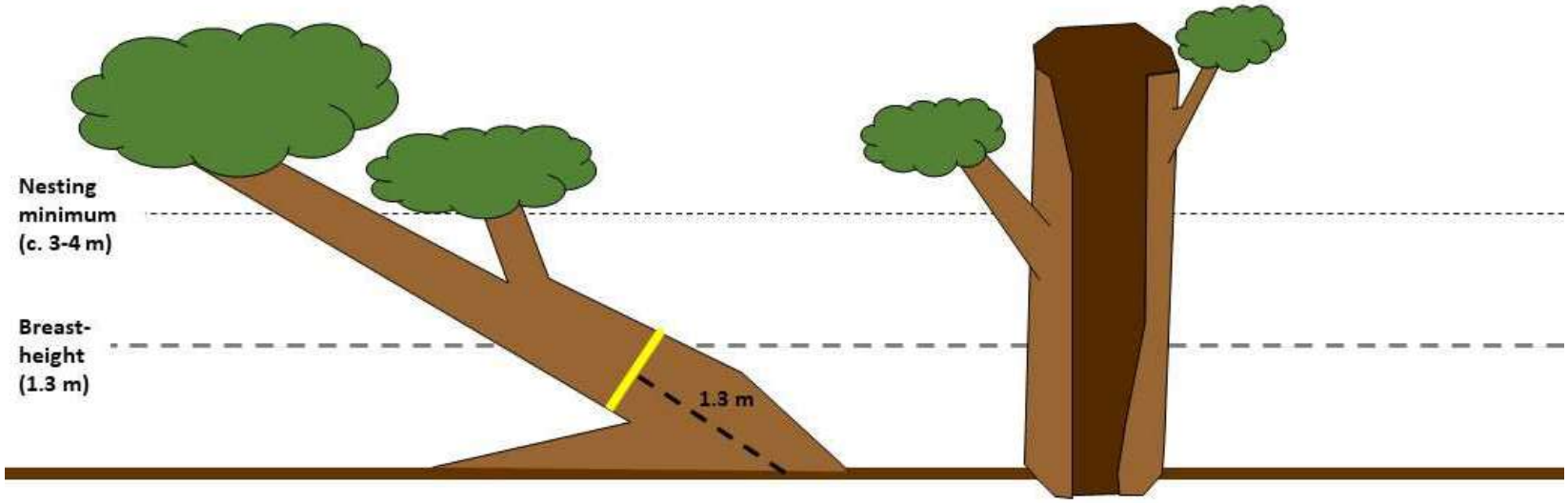
Tree Description:	Straight trunk. DBH > 500 mm*.	Straight trunk. DBH < 500 mm*.	Trunk forks above 3 m. DBH > 500 mm*.	Trunk forks between 1.3 m & 3 m. Diameter of at least one trunk above fork > c. 500 mm*.	Trunk forks between 1.3 m & 3 m. DBH > 500 mm* but no trunks above fork have diameter > c. 500 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 widest 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 one trunk above fork > 500 mm*.	Trunk forks below 1.3 m. Diameter of multiple trunks above fork > 500 mm*.	Trunk forks below 1.3 m. DBH of all trunks < 500 mm*.	Two separate 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 widest trunk above fork. Note number of trunks. Record species, life status and score for hollows. Waypoint tree.	Do not record.	For both trees... Measure DBH. Record species, life status and score for hollows. Waypoint each 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 open 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.