

MEMORANDUM

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|---------------|----------------------------------|---------------------|---|
| Date | 19 February 2020 | Title | Black-cockatoo Habitat Tree Survey Results – Eighth and Forrest Roads |
| Ref. | COA18002_MEM01_Rev2 | Distribution | Megan Stone 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.



GDA 94 / MGA Zone 50



Legend
Study Area

Figure 1 - Study Area

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 (<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

Foraging habitat for Black-Cockatoos is given a score out of ten to indicate the quality of that foraging habitat. The scoring system used (developed by FVC's specialist partner team, BCE, in consultation with DEE) is comprised of the following three scores (which are described in more detail below):

- a score out of six for vegetation composition, condition and structure, in accordance with **Table 2**
- a score out of three for site context, in accordance with **Table 3**
- a score out of one for stocking rate (Black-Cockatoo species density).

The resulting total score reflects the quality of Black-Cockatoo foraging habitat and allows application of the Commonwealth biodiversity offsets calculator (DSEWPaC 2012b).

The vegetation composition score is based on the presence, density/abundance, condition and proportions of food source plants for the relevant species of Black-Cockatoo. A selection of key examples applicable to each of the scores for the three Black-Cockatoo species is presented in **Table 2**.

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

| Quality 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. |

| Quality 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. Example:</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. Example:</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. |

The site context score is species-specific as it depends upon factors such as the vegetation type and extent, and the presence of breeding birds. Scores for site context are guided by **Table 3**, noting that 'local area' is defined as within a 15 km radius of the centre point of the project area. To assign a score for site context, a maximum score of three is applied where foraging habitat is known or found to support breeding birds, or it can also be applied in fragmented landscapes where there is little foraging habitat remaining and thus what is left has a high contextual value.

Table 3 – Key to Black-cockatoo Site Context Score for Foraging Habitat Quality

| Site Context Score | % of Existing Native Vegetation within the 'Local Area' that the Study Site Represents | |
|--------------------|--|---------------------------|
| | 'Local' Breeding Known/Likely | 'Local' Breeding Unlikely |
| 3 | > 5% | > 10% |
| 2 | 1 - 5% | 5 - 10% |
| 1 | 0.1 - 1% | 0.1 - 5% |
| 0 | < 0.1% | < 0.1% |

The score for stocking rate/species density (0 or 1), is based upon the relevant Black-Cockatoo species being either abundant or not abundant, and is species-specific. A score of 1 is applied where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is considered to be when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is applied when the species is recorded or reported very infrequently and there is little or no foraging evidence.

Breeding Habitat

The tree habitat survey of the project area assessed each tree's status as a breeding tree or as a potential future breeding tree (with a diameter at breast height [DBH] of 500 mm or greater). Trees were scored as per **Table 4**, which provides a ranking system to differentiate between trees of low, moderate and high potential as nest trees for Black-Cockatoos. The nest-tree rankings were developed by BCE, who have also developed a tree measurement protocol, based on Commonwealth guidelines which was utilised for the assessment, and is outlined in **Appendix 1**.

Table 4 - Ranking System for Black-cockatoo Breeding Trees and Potential Breeding Trees

| Rank | Description of Tree and Hollows/Activity |
|------|--|
| 0 | Tree large (DBH +/- 500 mm), but not tall, may be with thinner or branching trunks, so does not contain and no potential for hollows. |
| 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 > 10 m). |
| 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). |

Roosting Habitat

Suitable trees for roosting (tall trees of at least 10 m in height, within 2 km of water) were also documented in the field to assist in the determination of potentially suitable roosting habitat.

Results

For the purposes of mapping habitat for Black-cockatoos, the broad habitats of the study area were mapped, resulting in the following:

1. Cleared - roads or verges
2. Parks and gardens
3. Tall woodland - Eucalypts, predominantly *Eucalyptus botryooides*
4. Woodland - Eucalypts, including *Corymbia calophylla* and *Eucalyptus camaldulensis*.

Each of these broad habitats was then able to be scored for foraging habitat quality and roosting habitat suitability. Individual trees were assessed for nesting suitability.

Foraging Habitat

Foraging habitat for all three species of Threatened Black-Cockatoo (Baudin's, Carnaby's and Forest Red-tailed Black-Cockatoos) is supported by the study area and ranges in value from 0 (no foraging value) to 4 (moderate foraging value), which is summarised in **Table 5** and spatially presented for each species in the **Figure 2** series.

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 vegetation within the study area is generally considered to represent low (and moderate at best) value foraging habitat for Black-cockatoo species, despite evidence of Cockatoos utilising the area for feeding, including with the addition of adjusters for context and species stocking rate. The low score for 'context' is due to the low proportionate area of habitat that is supported by the small study area in comparison with the local area, biased by the vast areas of remaining forest to the east.

Table 1 - Summary of Foraging Habitat Quality within the Study Area

| Habitat | Habitat Quality Scores | | | | Area (ha) | % of Project Area |
|---|----------------------------|---------|-------------------------------|-------------|-----------|-------------------|
| | Vegetation Characteristics | Context | Stocking Rate/Species Density | Total Score | | |
| Carnaby's Black-Cockatoo | | | | | | |
| Cleared | 0 | NA* | NA* | 0 | 2.414 | 63 |
| Parks and gardens | 1 | NA* | NA* | 1 | 0.457 | 12 |
| Tall Woodland | 2 | NA* | NA* | 2 | 0.351 | 9 |
| Woodland | 3 | 0 | 1 | 4 | 0.590 | 15 |
| Baudin's Black-Cockatoo | | | | | | |
| Cleared | 0 | NA* | NA* | 0 | 2.414 | 63 |
| Parks and gardens | 0 | NA* | NA* | 0 | 0.457 | 12 |
| Tall Woodland | 0 | NA* | NA* | 0 | 0.351 | 9 |
| Woodland | 3 | 0 | 0 | 3 | 0.590 | 15 |
| Forest Red-tailed Black-Cockatoo | | | | | | |
| Cleared | 0 | NA* | NA* | 0 | 2.414 | 63 |
| Parks and gardens | 0 | NA* | NA* | 0 | 0.457 | 12 |
| Tall Woodland | 0 | NA* | NA* | 0 | 0.351 | 9 |
| Woodland | 3 | 0 | 1 | 4 | 0.590 | 15 |

Foraging Habitat Quality Scores:

0 = none/negligible; 1 = negligible to low; 2 = low; 3 = low to moderate; 4 = moderate; 5 = moderate to high; 6 = high; 7+ = very high

*Vegetation characteristic scores ≤ 2 are not further analysed and are considered of negligible foraging value.

Roosting Habitat

The Tall Woodland and Woodland habitats would be suitable Black-cockatoo roosting habitat which occur along Forrest Road and totals 0.941 ha (**Figure 3**). These areas are 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 77 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 6**. A tree designated #50 was later determined to be a duplicate of Tree #25, so has been removed.

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 6 - 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 | <i>Eucalyptus ?wandoo</i> | 30 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 2 | 405291 | 6441502 | <i>Eucalyptus rudis</i> | 60 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 3 | 405234 | 6441495 | <i>Corymbia calophylla</i> | 50 | 4 - Potential hollow but unsuitable angle/orientation | Yes | Medium |
| 4 | 405261 | 6441472 | <i>Eucalyptus rudis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 5 | 405355 | 6441524 | <i>Eucalyptus rudis</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 6 | 405341 | 6441520 | <i>Corymbia calophylla</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 7 | 405281 | 6441505 | <i>Eucalyptus rudis</i> | 50 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 8 | 405262 | 6441488 | <i>Eucalyptus rudis</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 9 | 405252 | 6441489 | <i>Corymbia calophylla</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 10 | 405195 | 6441456 | <i>Corymbia calophylla</i> | 70 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 11 | 405175 | 6441450 | <i>Corymbia calophylla</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 12 | 405578 | 6441516 | <i>Eucalyptus botryooides</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 13 | 405284 | 6441476 | <i>Eucalyptus rudis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 14 | 405224 | 6441473 | <i>Corymbia calophylla</i> | 50 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 15 | 405538 | 6441529 | <i>Eucalyptus camaldulensis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 16 | 405693 | 6441508 | <i>Eucalyptus botryooides</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 17 | 405456 | 6441540 | <i>Eucalyptus botryooides</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 18 | 405715 | 6441505 | <i>Eucalyptus botryooides</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 19 | 405216 | 6441469 | <i>Corymbia calophylla</i> | 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 | <i>Eucalyptus botryoides</i> | 70 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 21 | 405608 | 6441513 | <i>Eucalyptus botryoides</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 22 | 405401 | 6441521 | <i>Eucalyptus rudis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 23 | 405564 | 6441521 | <i>Eucalyptus camaldulensis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 24 | 405319 | 6441535 | <i>Eucalyptus ?wandoo</i> | 65 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 25 | 405646 | 6441507 | <i>Eucalyptus botryoides</i> | 65 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 26 | 405344 | 6441523 | <i>Corymbia calophylla</i> | 50 | 2 - Sufficient DBH, suitable hollow with chew marks | Yes | High |
| 27 | 405411 | 6441523 | <i>Eucalyptus rudis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 28 | 405670 | 6441510 | <i>Eucalyptus botryoides</i> | 65 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 29 | 405699 | 6441507 | <i>Eucalyptus botryoides</i> | 65 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 30 | 405311 | 6441621 | <i>Eucalyptus ?wandoo</i> | 45 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 31 | 405237 | 6441481 | <i>Corymbia calophylla</i> | 50 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 32 | 405580 | 6441521 | <i>Eucalyptus camaldulensis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 33 | 405378 | 6441506 | <i>Eucalyptus rudis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 34 | 405688 | 6441510 | <i>Eucalyptus botryoides</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 35 | 405705 | 6441507 | <i>Eucalyptus botryoides</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 36 | 405569 | 6441519 | <i>Eucalyptus camaldulensis</i> | 70 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 37 | 405630 | 6441508 | <i>Eucalyptus botryoides</i> | 65 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 38 | 405384 | 6441500 | <i>Eucalyptus rudis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 39 | 405513 | 6441531 | <i>Eucalyptus camaldulensis</i> | 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 | <i>Eucalyptus botryooides</i> | 60 | 4 - Potential hollow but unsuitable angle/orientation | Yes | Medium |
| 41 | 405305 | 6441509 | <i>Corymbia calophylla</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 42 | 405602 | 6441512 | <i>Eucalyptus botryooides</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 43 | 405657 | 6441510 | <i>Eucalyptus botryooides</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 44 | 405678 | 6441510 | <i>Eucalyptus botryooides</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 45 | 405337 | 6441621 | <i>Corymbia calophylla</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 46 | 405519 | 6441527 | <i>Eucalyptus camaldulensis</i> | 70 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 47 | 405650 | 6441507 | <i>Eucalyptus botryooides</i> | 60 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 48 | 405368 | 6441525 | <i>Eucalyptus rudis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 49 | 405497 | 6441533 | <i>Eucalyptus camaldulensis</i> | 55 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 51 | 405319 | 6441517 | <i>Corymbia calophylla</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 52 | 405550 | 6441525 | <i>Eucalyptus camaldulensis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 53 | 405291 | 6441521 | <i>Corymbia calophylla</i> | 55 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 54 | 405557 | 6441524 | <i>Eucalyptus camaldulensis</i> | 50 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 55 | 405591 | 6441515 | <i>Eucalyptus botryooides</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 56 | 405399 | 6441518 | <i>Eucalyptus rudis</i> | 50 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 57 | 405335 | 6441519 | <i>Corymbia calophylla</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 58 | 405346 | 6441527 | <i>Eucalyptus rudis</i> | 60 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 59 | 405257 | 6441489 | <i>Corymbia calophylla</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 60 | 405313 | 6441511 | <i>Eucalyptus rudis</i> | 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 | | | | | |
| 61 | 405173 | 6441446 | <i>Corymbia calophylla</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 62 | 405326 | 6441525 | <i>Corymbia calophylla</i> | 50 | 3 - Potential hollow, no chew marks | Yes | Medium |
| 63 | 405266 | 6441491 | <i>Eucalyptus rudis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 64 | 405560 | 6441525 | <i>Eucalyptus camaldulensis</i> | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 65 | 405359 | 6441644 | <i>Eucalyptus</i> sp. 3 | 50 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 66 | 405053 | 6441901 | <i>Corymbia calophylla</i> | 60 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 67 | 405185 | 6441447 | <i>Corymbia calophylla</i> | 80 | 5 - Sufficient DBH, no hollows | Yes | Low-Medium |
| 68 | 405171 | 6441438 | <i>Corymbia calophylla</i> | 50 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 69 | 405770 | 6441534 | <i>Corymbia calophylla</i> | 60 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 70 | 405458 | 6441566 | <i>Eucalyptus</i> sp. 4 | 50 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 71 | 405332 | 6441486 | <i>Corymbia calophylla</i> | 50 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 72 | 405361 | 6441493 | <i>Eucalyptus rudis</i> | 55 | 3 - Potential hollow, no chew marks | No | Medium |
| 73 | 405323 | 6441485 | <i>Eucalyptus rudis</i> | 65 | 3 - Potential hollow, no chew marks | No | Medium |
| 74 | 405297 | 6441460 | <i>Eucalyptus camaldulensis</i> | 50 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 75 | 405310 | 6441539 | <i>Eucalyptus ?wandoo</i> | 70 | 4 - Potential hollow but unsuitable angle/orientation | No | Medium |
| 76 | 405460 | 6441564 | <i>Eucalyptus</i> sp. 4 | 50 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 77 | 405279 | 6441470 | <i>Eucalyptus rudis</i> | 50 | 5 - Sufficient DBH, no hollows | No | Low-Medium |
| 78 | 405349 | 6441486 | <i>Eucalyptus rudis</i> | 130 | 3 - Potential hollow, no chew marks | No | Medium |

Note: All unidentified *Eucalyptus* trees are non-endemic. Tree #50 was determined to be a duplicate, so has been omitted from the list.

Seven differing tree species were recorded, namely *Eucalyptus rudis*, *Corymbia calophylla*, *Eucalyptus botryoides*, *Eucalyptus camaldulensis*, *Eucalyptus ?wandoo*, *Eucalyptus* sp. 3 (unidentified) and *Eucalyptus* sp. 4 (unidentified). Two 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. Both of the unidentified tree species are non-endemic.

A total of 59 of the recorded trees are of adequate DBH, but do not support observable hollows (Rank 5), and are therefore not classified as nesting trees, but potential future 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).



0 50 100 150 200 m

GDA 94 / MGA Zone 50

Figure 2a - Black-cockatoo Foraging Habitat (Carnaby's Black-cockatoo)

Legend

- Study Area
- 0 = none/negligible
- 1 = negligible to low
- 2 = low
- 4 = moderate





0 50 100 150 200 m

GDA 94 / MGA Zone 50

Figure 2b - Black-cockatoo Foraging Habitat (Baudin's Black-cockatoo)

Legend

- Study Area
- 0 = none/negligible
- 3 = low to moderate





0 50 100 150 200 m

GDA 94 / MGA Zone 50

Figure 2c - Black-cockatoo Foraging Habitat (Forest Red-tailed Black-cockatoo)



- Legend**
- Study Area
 - 0 = none/negligible
 - 4 = moderate




0 50 100 150 200 m

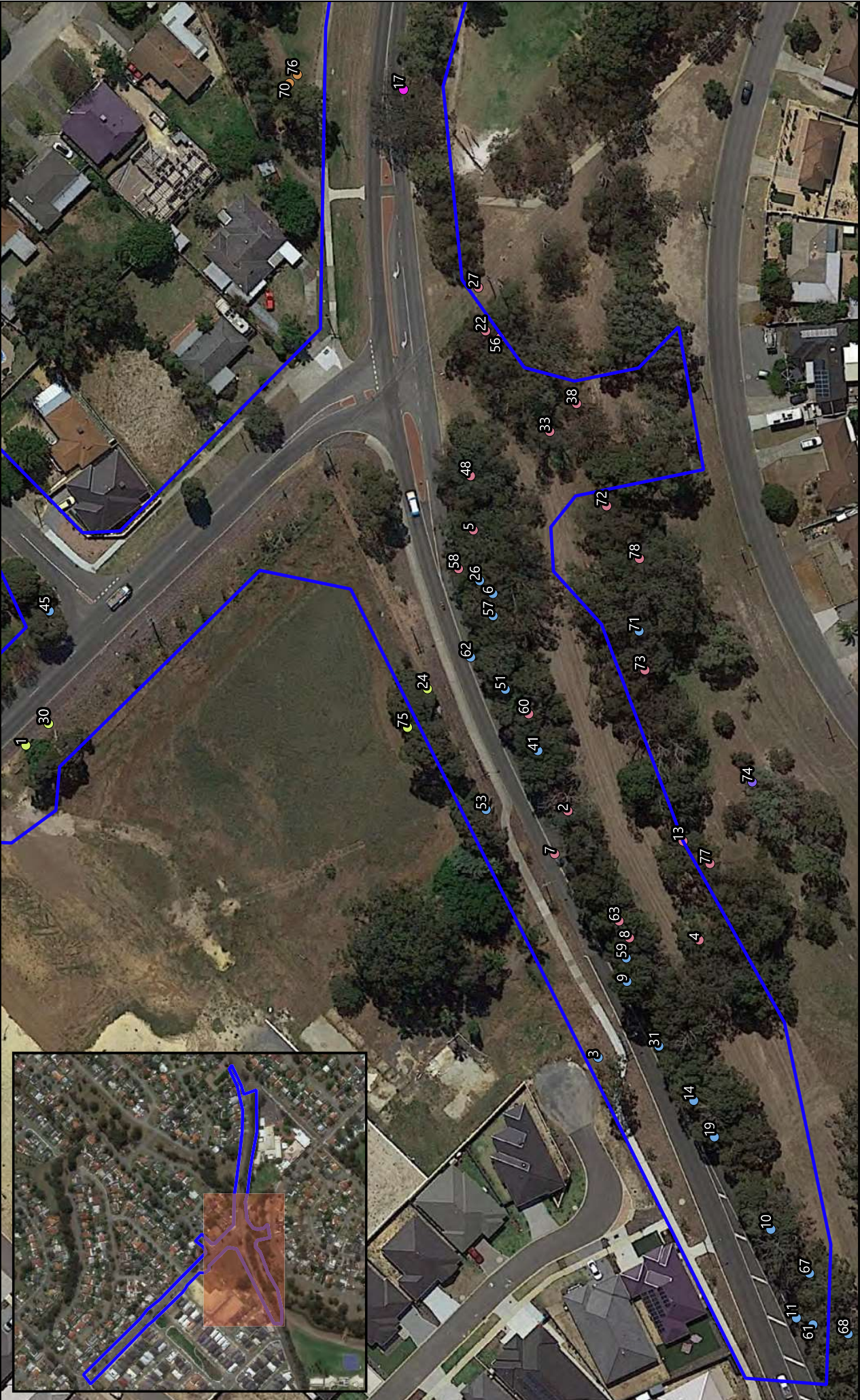
GDA 94 / MGA Zone 50

**Figure 3 - Suitable Black-cockatoo
Roosting Habitat**



Legend

-  Study Area
-  Suitable Roosting Habitat











0 15 30 45 60 m

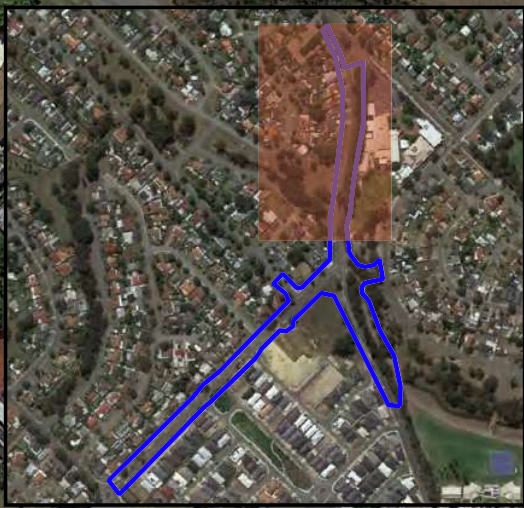
GDA 94 / MGA Zone 50

Figure 4a - Recorded Potential Nesting Trees

Legend

-  Study Area
-  Eucalyptus sp. 3
-  Eucalyptus sp. 4
-  Eucalyptus camaldulensis
-  Eucalyptus botryoides
-  Corymbia calophylla
-  Eucalyptus ?wandoo
-  Eucalyptus rudis





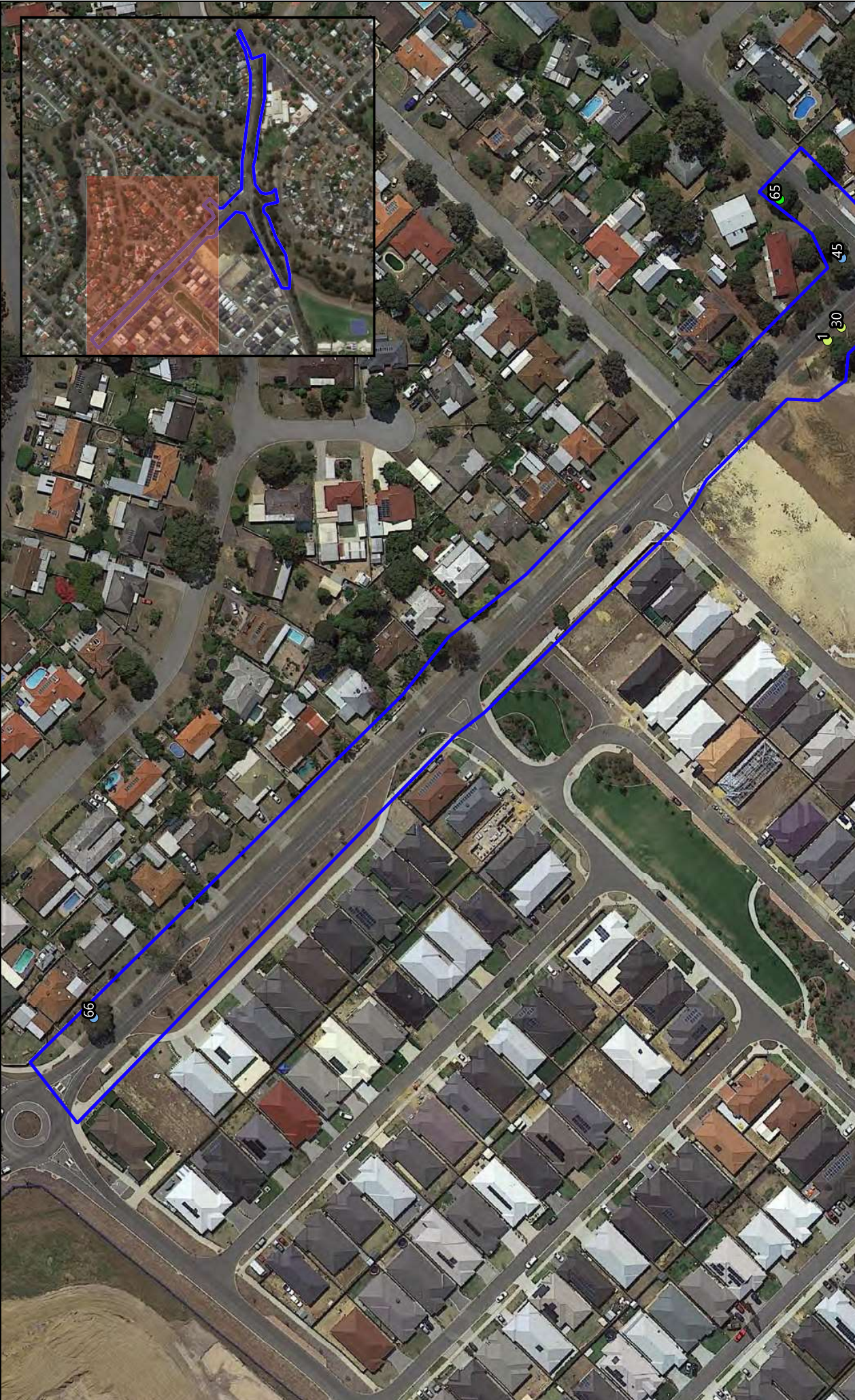
GDA 94 / MGA Zone 50



Legend

- Study Area
- Eucalyptus sp. 3
- Eucalyptus sp. 4
- Eucalyptus camaldulensis
- Corymbia calophylla
- Eucalyptus ?wandoo
- Eucalyptus rudis
- Eucalyptus botryoides

Figure 4b - Recorded Potential Nesting Trees



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



- Legend**
- Study Area
 - Eucalyptus sp. 3
 - Corymbia calophylla
 - Eucalyptus sp. 4
 - Eucalyptus camaldulensis
 - Eucalyptus ?wandoo
 - Eucalyptus botryoides

Figure 4c - Recorded Potential Nesting Trees

Conclusions

The study area is generally considered to represent low (moderate at best) quality 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 Forrest Road, within the Woodland and Tall Woodland habitat could all 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), is recommended, 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
Focused Vision Consulting Pty Ltd

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.

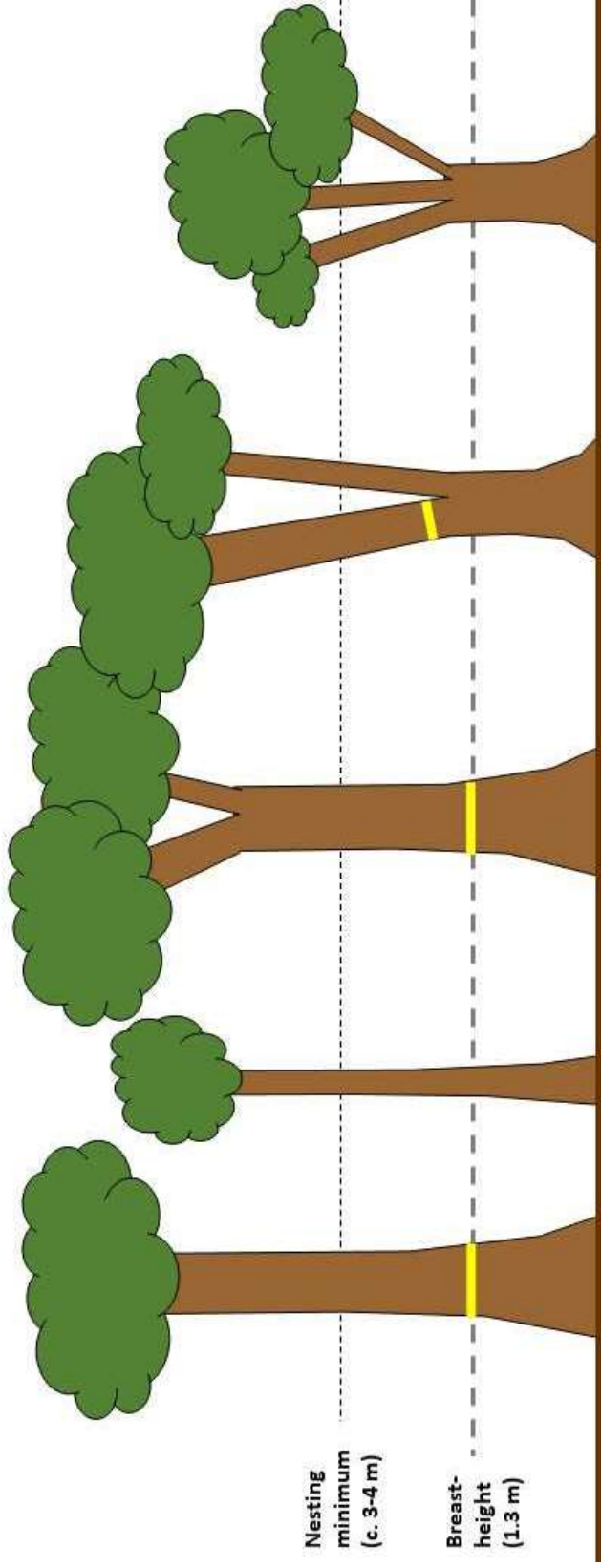
Nest height minima

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.

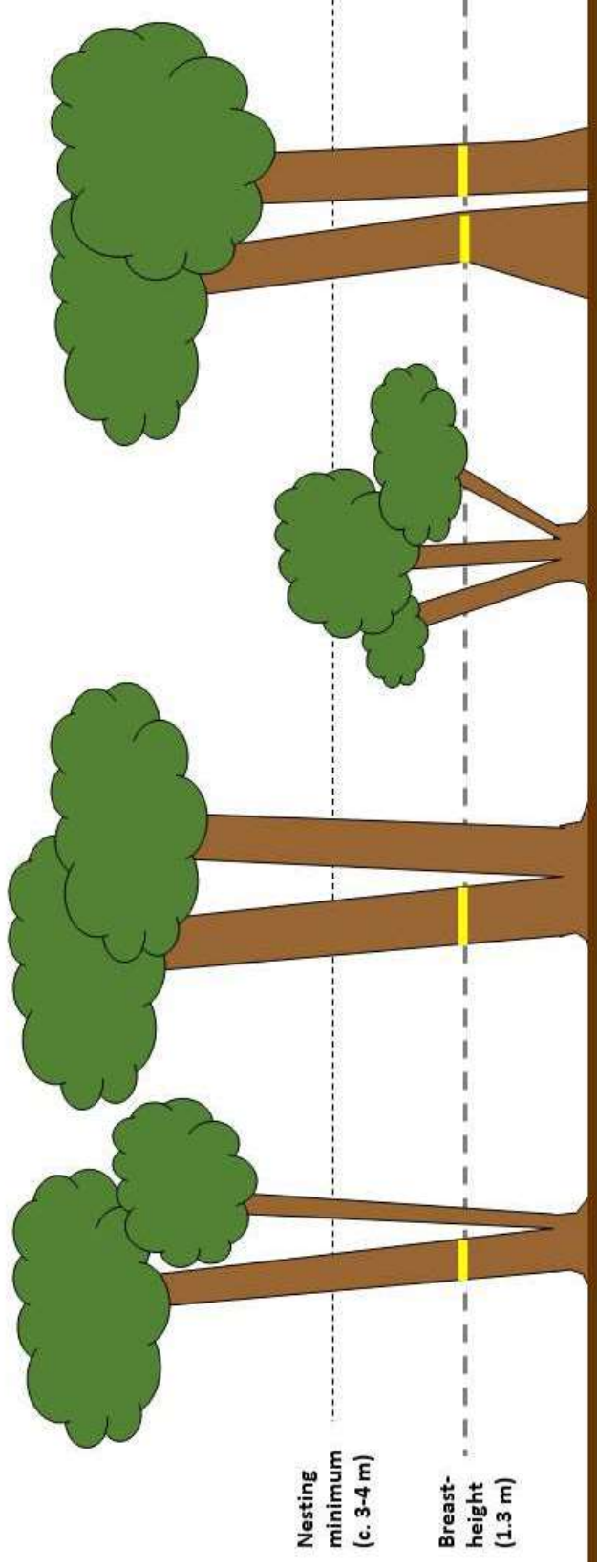


Nesting minimum (c. 3-4 m)

Breast-height (1.3 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.

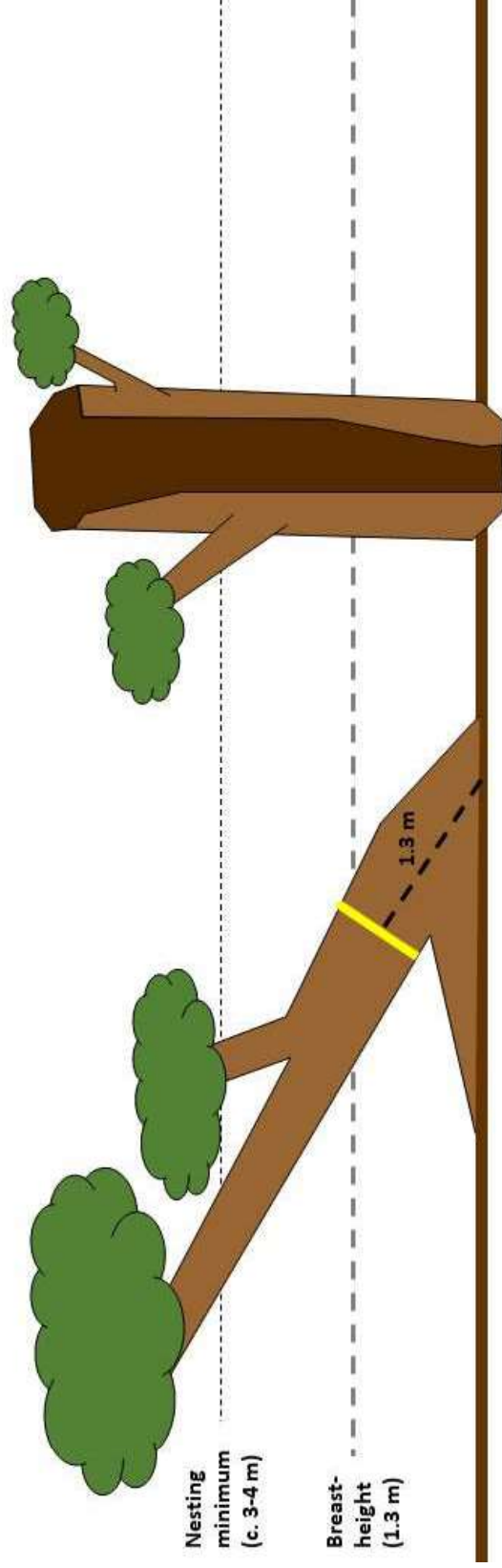


Nesting minimum
(c. 3-4 m)

Breast-height
(1.3 m)

| Tree Description: | Trunk forks below 1.3 m. Diameter of one 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 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 <u>open half-pipe shape</u> (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.