Targeted Fauna Survey: Black Cockatoo

19.0 – 24.2 SLK Harvey-Quindanning Road, Harvey

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Abbreviations and acronyms

Common terms	
DBCA	WA Department of Biodiversity, Conservation and Attractions
DCCEEW	Federal Department of Climate Change, Energy, the Environment and Water
DWER	WA Department of Water and Environmental Regulation
EN	Endangered species
FRTBC	Forest Red-tailed Black Cockatoo
Locality / Study area	A 12 km buffer around the Survey area
Project	The proposed action
Survey area	Pegged extent between 19.0 – 24.2 SLK Harvey-Quindanning Road, Harvey
Suitable DBH tree	Tree of a suitable species and size Diameter at Breast Height (DBH) to develop large hollows:

	≥30 cm for Wheatbelt species (e.g. Wandoo, Salmon Gum) ≥50 cm most trees in the Southwest (e.g. Jarrah, Marri, Tuart) ≥75 cm for fast growing species (e.g. Karri or Eastern States Eucalypts)
VU	Vulnerable
WA	Western Australia
Legislation	
BC Act	WA Biodiversity Conservation Act 2016
EP Act	WA Environmental Protection Act 1986
EPBC Act	Federal Environment Protection and Biodiversity Conservation Act 1999
Measurements	
DBH	Diameter at Breast Height in centimetres
cm	Centimetre
ha	Hectare
km	Kilometre
m	Metre

Executive summary

The Shire of Harvey intends to undertake minor road widening between 19.0 and 24.2 Straight Line Kilometres (SLK) on the Harvey-Quindanning Road, Harvey, within the Shire of Harvey. Harvey is located approximately 130 kilometres (km) south of Perth.

The Shire engaged SW Environmental to conduct a targeted black cockatoo[1] survey to identify black cockatoo habitat values and inform the environmental assessment and approvals process. The survey included a desktop review and field survey in line with relevant State and Commonwealth guidelines.

The 'survey area' includes the proposed development footprint between 19.0 and 24.2 SLK within the Harvey-Quindanning Road reserve (7.48 ha, including 3.21 ha of maintenance zone or adjacent native vegetation, and 4.28 ha of existing road formation).

A summary of the black cockatoo habitat values is provided below:

- The survey area falls within the modelled distribution for all three black cockatoo species, within the known breeding range of Carnaby's cockatoos, with Baudin's cockatoos and FRTBC being likely to occur (DAWE 2022). There are scattered records for all three black cockatoo species locally (ALA 2024) (Birdlife Australia, 2024) (DBCA 2024).
- FRTBC and Baudin's cockatoo were observed during field surveys with foraging evidence.
- Black cockatoo habitat types within the survey are summarised below.
    - **VU 1** (2.44 ha) characterised by *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) dominated forest, occurring more commonly on the upper and mid slopes of the Survey Area. ***Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.***
    - **VU 2** (0.24 ha) characterised by the dominant presence of *Eucalyptus patens* (Blackbutt) along with Marri and occasional Jarrah. This VU occurred in the transition zone between VU 1 and VU 3 on the lower slopes of the Survey Area and in drainage lines. ***Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.***
    - **VU 3** (0.28 ha) characterised by the presence of *Eucalyptus rudis* (Flooded Gum) and *Melaleuca preissiana*; species that indicate wetter or seasonally inundated habitats. This VU was found to occur in lowest part of the Survey Area, with inundation evident in patches throughout the VU extent. ***Low quality foraging, and potential breeding habitat. Potential roost habitat.***
    - **VU 4** (0.06 ha) represents the vegetation within the transition line easement of previously cleared, regrowth native vegetation, representative of some VU 1

[1] Black cockatoos collectively refer to

- Forest red-tailed black cockatoo (*Calyptorhynchus banksii subsp. naso*) (Vulnerable under the EPBC Act and the BC Act)
- Baudin's cockatoo (*Zanda baudinii*) (Endangered under the EPBC Act and the BC Act)
- Carnaby's cockatoo (*Zanda latirostris*) (Endangered under the EPBC Act and the BC Act)

understorey species, inclusive of *Bossiaea aquifolium* and *Hypocalymma angustifolium* dominated shrubland, along with *Xanthorrhoea* sp., *Persoonia longifolia* and *Hakea* sp. No *Eucalyptus* or *Corymbia* spp. were observed regenerating within this area. ***Low quality foraging due to degraded condition, and no breeding habitat. No potential roost habitat.***

  - **VU 5** (0.19 ha) is characterised by the presence of plantation Blue Gums over native understorey vegetation consistent with VU 1 and 2. ***Potential roost habitat.***

- A total of 85 Suitable DBH trees were recorded within the survey area:
  - 31 Marri trees, of which only one had a hollow (ID 5). ID 5 contained one suitable breeding hollow with no evidence of use,
  - 28 Jarrah - none with hollows,
  - 18 Blackbutt - none with hollows,
  - 7 Flooded gums – none with hollows,
  - One dead tree – without hollows.
- In a local context the Survey Area occurs along a narrow, disturbed edge of State Forest, so the significance of individual trees for foraging would be low. Foraging habitat areas:
  - **VU 1 and 2** (2.68 ha) Moderate to high quality foraging habitat.
  - **VU 3 and 4** (0.34 ha) Low quality foraging habitat due to dominant species type or degraded condition.
  - **VU 5** (0.19 ha) No or low-quality foraging habitat.
- No evidence of night roosts were observed.
- Native vegetation remaining within 6 and 12 kms of the project is well represented, accounting for over 90 % of the land area. Most of the land within 12 kms is reserved. Given the narrow extent of the Survey Area along the road edge, the adjacent areas of Jarrah Forest are likely to provide more significant feed, breeding and roost habitat than those areas within the Survey footprint.

The following recommendations should be considered:

- Clearing should be minimised.
- Large trees should be retained where possible, particularly the Marris which are often preferred by black cockatoos for breeding.
- Suitable hollows with no evidence of use could still be used by black cockatoos. If the tree ID5 is proposed to be cleared, follow up surveys and stag watch undertaken in the known breeding periods immediately prior to clearing should be considered.
- An authorised fauna spotter should be present during clearing of Tree ID 5 to manage hollow dependant fauna.

Final impact footprints should be checked against the significant impact criteria for black cockatoos to determine the need to refer the project to DCCEEW.

1 Introduction

1.1 Project background

The Shire of Harvey intends to undertake minor road widening between 19.0 and 24.2 Straight Line Kilometres (SLK) on the Harvey-Quindanning Road, Harvey, within the Shire of Harvey (the Shire) (Appendix A – Figure 1). Harvey is located approximately 130 kilometres (km) south of Perth.

The 'survey area' includes the proposed development footprint between 19.0 and 24.2 SLK within the Harvey-Quindanning Road reserve (Appendix A – Figure 1). The total survey area encompasses 7.48 hectares (ha), including 3.21 ha of maintenance zone or adjacent native vegetation, and 4.28 ha of existing (cleared and constructed) road formation.

1.2 Scope

The Shire engaged SW Environmental to conduct a targeted black cockatoo survey to identify black cockatoo habitat values and inform the environmental assessment and approvals process. The survey included a desktop review and field survey in line with relevant State and Commonwealth guidelines.

Black cockatoos collectively refer to

- Forest red-tailed black cockatoo (*Calyptorhynchus banksii subsp. naso*) (Vulnerable under the EPBC Act and the BC Act)
- Baudin's cockatoo (*Zanda baudinii*) (Endangered under the EPBC Act and the BC Act)
- Carnaby's cckatoo (*Zanda latirostris*) (Endangered under the EPBC Act and the BC Act)

1.3 Regulatory context

Fauna in WA may be afforded protection under the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or Western Australia (WA) *Biodiversity Conservation Act 2016* (BC Act). At a federal level, any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval. It is also an offence to 'take' or 'disturb' threatened fauna in WA without Ministerial approval.

All three black cockatoo species targeted in this survey are listed under the EPBC and BC Acts as:

- EN: Endangered species (Baudin's cockatoo and Carnaby's cockatoo)
- VU: Vulnerable species (Forest Red-tailed Black-Cockatoo (FRTBC))

Key environmental legislation relevant to the survey is outlined in Table 1-1.

Table 1-1 Environmental legislation that may be relevant to the Project

Legislation	Responsible Government Department	Aspect
Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Matters of National Environmental Significance including threatened fauna and environmental offsets.
Biodiversity Conservation Act 2016 (BC Act)	WA Department of Biodiversity, Conservation and Attractions (DBCA)	Threatened species habitats, threatening processes, environmental pests and weeds.
Environmental Protection Act 1986 (EP Act)	Environmental Protection Authority or Department of Water and Environmental Regulation (DWER)	Environmental impact assessment, management and offsets.

1.3.1 Guidelines

Black cockatoo habitat is typically assessed by considering breeding, roosting and foraging habitat. The survey methodologies were developed with consideration of:

- Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3, EPA (2002).
- Environmental Protection Authority (2020) Technical Guidance – Terrestrial Guidance for Fauna Surveys for Environmental Impact Assessment. Perth, Western Australia.
- Commonwealth Matters of National Environmental Significance – *Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999*, Department of the Environment, Water, Heritage and the Arts (DEWHA)', (2009).
- Commonwealth *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), Zanda latirostris, Baudin's cockatoo (vulnerable), Zanda baudinii, and Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso* (SEWPaC 2012).
- Commonwealth *Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo (Zanda latirostris), Baudin's Cockatoo (Zanda baudinii) and the Forest Red-tailed Black-cockatoo (Calyptorhynchus banksii naso)* Department of Agriculture, Water and the Environment (2022).
- Department of Parks and Wildlife (2013). Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia.
- Department of Environment and Conservation (2008) Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan

1.3.2 EPBC Act considerations

The Commonwealth of Australia (2022) guideline applies to the three WA black cockatoo species listed as threatened species under the EPBC Act. This document provides guidance on what actions are likely and unlikely to require referral to the Minister for the Environment because they could have a significant impact on black cockatoos (SEWPAC 2012):

- Currently, the overall population trend for all three black cockatoo species is declining and is expected to continue to decline.
- The loss of breeding habitat is likely to require a referral.
- The loss of one or more known or suitable nesting trees is likely to require a referral.
- The loss of a known night roosting site is likely to require a referral.
- The loss of equal to or greater than one hectare of high-quality foraging habitat is likely to require a referral (as determined using the foraging quality scoring tool in Appendix B).
- The loss of one or more hectares of predominantly exotic habitat (e.g. pines) known to be utilised by black cockatoos is likely to require a referral.
- The loss of under 10 ha of low-quality foraging habitat is unlikely to require a referral (as determined using the foraging quality scoring tool in Appendix B).
- Light pruning or trimming of a night roosting site is unlikely to require a referral.

Once the final entire impact area (proposed action) is known, the proposal should be assessed against the DAWE (2022) Appendix A: Foraging quality scoring tool (template in Appendix B of this report). The scoring tool includes consideration of the three components used in the EPBC Act Offsets Assessment Guide (SEWPAC 2012a) in the calculation of habitat quality (site condition, site context and species stocking rate) by considering contextual factors relating to habitat quality to give a final habitat quality score.

2 Methods

2.1 Desktop review

A desktop review on the habitat and breeding, foraging and roosting requirements for all three black cockatoo species within a 12 km radius of the survey site was completed prior to the field survey. It included a review of:

- relevant literature on black cockatoos such as recovery plans, journal articles, survey guidelines and other publications, and
- spatial datasets, such as:
    - Atlas of Living Australia database (ALA, 2024),
    - BirdLife Australia's Atlas and Birdata datasets (Birdlife Australia, 2024),
    - Protected Matters Database (DCCEEW, 2024), and
    - Department of Biodiversity, Conservation and Attraction's Threatened and Priority Fauna Database and black cockatoo breeding and roosting records (DBCA, 2024).

2.2 Field survey

2.2.1 Site reconnaissance

Field surveys included diurnal surveys on the 2nd and 9th of September 2024 by Shane Priddle (Principal Ecologist), and Georgia Johnsen (Ecologist). The field surveys were completed to validate the desktop review and ground truth black cockatoo habitat. Evidence of black cockatoos (e.g. feed residue, whitewash, breeding and roosting evidence) and sightings were also noted. The survey methodology for black cockatoos is described below.

2.2.2 Black cockatoo survey methodology

The field survey methodology was based on the Commonwealth referral guidelines for black cockatoos (DAWE 2022, SEWPaC 2012) and black cockatoo species profiles provided in the desktop review (Section 3.2). The profiles are based on literature review and previous work and consultation with Tony Kirby, a recognised black cockatoo expert. Black cockatoo habitat surveys included an assessment of suitable DBH tree and hollow surveys, foraging habitat assessment, and roosting habitat.

Twelve kilometres (km) is referenced as a nominal distance in the consideration of wider local vegetation and habitat values. This distance exists as the maximum range that black cockatoos travel from their nesting site to forage (Commonwealth of Australia 2022).

Suitable DBH tree and hollow survey

Black cockatoos nest in hollows that form in large, typically native eucalypt trees, assessed as potential habitat or "Suitable DBH trees". In the Southwest, black cockatoos normally breed in *Corymbia calophylla* (Marri) or *Eucalyptus gomphocephala* (Tuart), however sometimes *Eucalyptus marginata* (Jarrah), *Eucalyptus rudis* (Flooded gum) or other native trees are utilised. Suitable DBH in a tree refers to a suitable Diameter at Breast Height measurement. Trees with a suitable DBH include those with a measurement ≥ 50 cm for most trees in the Southwest, ≥ 30 cm DBH for Wheatbelt species (e.g. *Eucalyptus wandoo* (Wandoo) and *Eucalyptus salmonophloia* (Salmon gum)), and ≥75 cm for fast growing trees, including eastern states eucalypts or Karri (*Eucalyptus diversicolor*). Suitable species are discussed further in Section 3.

Multi-stem trees typically had the largest stem measurements. Planted eastern states eucalypts such as Blue gums (normally *Eucalyptus saligna* or *Eucalyptus globulus*) are generally unlikely to develop hollows unless they are at an advanced age. As such, they were not recorded unless they were visibly senescing or had hollows observed. Trees laying over or considered to have no potential to develop hollows (burnt and close to falling over) were not recorded.

The black cockatoo breeding suitability of a hollow was based on an assessment of attributes including - but not limited to - hollow angle, access, entry (aperture) size, chamber size, and use by other animals. Bees hives (*Apis mellifera*) may render a hollow unsuitable for the short term. A ground-based assessment of each tree was made using binoculars. Trees were mapped by GPS (~2 m accuracy), with notes made on tree species and DBH size class. Hollows that were potentially suitable or likely to provide breeding habitat were further assessed by drone or pole camera. Results noted as *confirmed* or *not confirmed* indicate whether closer inspection (pole cam or drone) was conducted. Application of the pole camera and/or use of drones were carried out in line with animal ethics requirements.

The number of hollows (limited to the most suitable hollows), aperture size, angle, height, breeding suitability, evidence of use was recorded. Criterion and descriptions are provided in Table 2-1.

Table 2-1 Suitable DBH tree and hollow classes and descriptions

Class	Description
Tree with suitable DBH without hollows	Suitable DBH tree (described above) that do not have hollows.
Tree with suitable DBH with unsuitable hollow	Suitable DBH tree with a hollow with multiple attributes that would make the hollow unlikely to suitable for breeding such as the entry aperture, internal dimensions, height off ground or angle. Unlikely to be used by black cockatoos in the future in current form
Tree with potentially suitable size hollow with no signs of use	Suitable DBH tree that may have a suitable hollow but with a single attribute that might reduce the suitability of the hollow for breeding, such as the marginal entry aperture size, coned out internal dimensions, low height off ground or oblique angle. The hollow has no evidence of use (chew marks, scarring, eggs, woodchips, etc). Possible but unlikely to be used by black cockatoos in the future in current form.
Tree with suitable size hollow with no signs of use	Suitable DBH tree with a hollow with suitable attributes for breeding (suitable entry size, internal dimensions, height off ground and angle). The hollow has no evidence of use (chew marks, scarring, eggs, woodchips, etc) and whilst not currently being used could be used in future.

Tree with potentially suitable size hollow with signs of use	Suitable DBH tree that may have a suitable hollow but with a single attribute that might reduce the suitability of the hollow for breeding, such as the marginal entry aperture size, coned out internal dimensions, low height off ground or oblique angle. The hollow has evidence of use (chew marks, scarring, eggs, woodchips, etc). The evidence is more likely to be caused by other species but black cockatoo use could not be ruled out without further survey.
Tree with suitable size hollow with signs of use	Suitable DBH tree with a hollow with suitable attributes for breeding (suitable entry size, internal dimensions, height off ground and angle). The hollow has evidence of use (chew marks, scarring, eggs, woodchips, etc) consistent with black cockatoo use (previous or current).
Known nesting tree	Suitable DBH tree with a known nesting hollow (cockatoos observed using the hollow and assumed to be breeding).

Foraging habitat assessment

The quality of potential black cockatoo foraging habitat was described based on structural vegetation mapping, with presence or absence of key feed species. Key feed species are defined in the species' profiles in Section 3. Feed residue was noted. Foraging habitat was assigned in categories shown in Table 2-2. A list of plant species classified as primary or secondary foraging plants is provided as Appendix C.

Table 2-2 Foraging habitat category and description

Category	Description
No foraging habitat	Dead trees, or plant species that are not known to be frequently fed on
Low quality foraging habitat	Low quality foraging habitat include secondary foraging habitat such as trees that are not known to be frequently fed on and are not considered a sustaining resource, or known feed species that are isolated or disease affected. Examples include dieback (e.g. *Phytophthora* spp.) affected Jarrah or *Banksia* or severely Marri Canker (*Quambalaria coyrecup*) affected Marri
Moderate to high foraging habitat quality	Moderate to high quality foraging habitat includes primary feed species (e.g. *Banksia*, Jarrah, Marri or pine trees) in patches or as paddock trees near other large patches or breeding hollows (known or likely) or native vegetation in good or better condition (EPA 2016) with suitable shrub species, e.g. *Callistemon*, *Hakea*, *Grevillea* spp, or tree species.

Roosting habitat survey

Direct and indirect evidence of black cockatoo roosting within trees on site was noted if observed. Secondary evidence was also noted, such as the presence of moulted or preened feathers or down, clipped branches and whitewash. Dusk surveys were not undertaken. The presence of tall native and non-native trees may provide potential roosting habitat.

2.2.3 Animal ethics

The survey conformed to Section 4 of the *Australian code of practice for the care and use of animals for scientific purposes* (National Health and Medical Research Council 2004). No animals were captured or collected during the survey. Surveys were also carried out under Scientific Use License *Animal Welfare Act 2002* Licence to use animals for scientific purposes: Licence No: U285/ 2022-2024 and Wildlife Animal Ethics Committee (WAEC) Permit: WAEC 22-08-88. No nesting black cockatoos were directly disturbed during this survey.

2.3 Limitations

Survey limitations are identified in Table 2-3 in accordance with *Technical Guidance* (EPA 2020).

Table 2-3 Survey limitations and constraints assessed against the EPA's Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020

Aspect	Constraint	Comment
Competency / experience	No	Suitably qualified individuals carried out the work. Shane Priddle (Ba Science; Certified Environmental Practitioner No.310) lead the survey and has nearly 25 years' experience conducting black cockatoo surveys throughout NSW and WA.
Scope	No	The targeted fauna survey scope is adequate to provide the information required to support a planning assessment in relation to black cockatoos.
Adequacy of the survey intensity and proportion of survey achieved	No	Suitable survey effort has been adopted to identify black cockatoo habitat values associated with the survey area. A precautionary approach has been adopted.
The proportion of the task achieved and further work	No	The surveys were completed adequately, to a sufficient level with respect to the scope.
Timing/weather/season	No	The surveys were completed in suitable weather in spring.
Disturbances	No	There were no disturbances that affected the survey.
Intensity	No	The survey effort was adequate to meet the project scope.
Completeness	No	The entire survey area was surveyed (GPS track logged).
Resources	No	The surveys were completed adequately.
Access problems	No	The site was within public road reserve and was accessible.
Identification of hollows	Low	Known limitations inherent in the survey of hollows include bias with surveyors, times, differing familiarity with tree types, levels of expertise, survey conditions such as weather and time of day, and survey technique (Gorrod & Keith 2008, Rayner et al. 2011). Ground counts of hollows are subjective. Some hollows may be missed, obscured, particularly hollows in branches and vertical hollows. As well as providing inaccurate counts of hollow abundance, ground surveys provide incomplete or inaccurate information on hollow dimensions and use of hollows by fauna (Koch 2008). Generally, ground-based surveys lead to overestimation of hollows (Rayner et al. 2011, Author

Aspect	Constraint	Comment
		pers obs.). This limitation was reduced by checking hollows with a pole camera or drone for suitability where possible. Hollow characteristics may change over time. There is some risk, although low, that black cockatoos may be breeding in a hollow where evidence of use is not visible or hollow characteristics are atypical. Not all active cockatoo hollows show signs of heavy chewing, and active or past breeding hollows may be missed. Also, some animals such a Little corella (*Cacatua sanguinea*) or Galah (*Eolophus roseicapilla*) may use black cockatoo hollows at other times of the year or between years. The author has extensive experience in the identification and assessment of hollows in the Southwest of WA and is considered competent in relation to this skill. The results are provided based on experience and professional judgement however absolute certainty cannot be guaranteed.

3 Desktop review

The survey area falls within the Region 3 Jarrah Forest referral guideline region (DAWE 2022), within the modelled distribution for all three black cockatoo species, within the known breeding range of Carnaby's cockatoos, with Baudin's cockatoos and FRTBC being likely to occur (DAWE 2022). There are scattered records for all three black cockatoo species locally (ALA 2024) (Birdlife Australia, 2024) (DBCA 2024). Species profiles are provided below for further context.

3.1 Black cockatoo species profiles

Baudin's cockatoo (*Zanda baudinii*)
EN (EPBC Act), EN (BC Act)

Baudin's cockatoo is a large, iconic forest cockatoo endemic to the southwest corner of WA. Depending on their region of origin, Baudin's cockatoo is a resident, a post nuptial nomad or migrant, with the bulk of the population vacating the coldest parts of their range (the Karri Forest) in the autumn and migrating northwards during the non-breeding season. Small numbers also appear resident in a few places, including Leeuwin – Naturaliste Ridge and Manjimup (Johnstone and Kirkby 2008). Flock sizes vary from small family groups to large aggregations at roosting sites.

Breeding mainly takes place in forested areas from August to November (egg laying dates) (Tony Kirkby pers comm.) (DAWE 2022). Baudin's cockatoo breeds in woodland or forest but may also breed in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many *Eucalyptus* species may provide suitable hollows), particularly Karri, Marri, Jarrah, Wandoo, Bullich and Tuart (DAWE 2022).

In the non-breeding season, Baudin's cockatoo is mainly an inhabitant of Jarrah Marri Forest but is also frequently in farmland and orchards. It feeds on a variety of foods, including nectar and seeds from *Hakea* and *Banksia* spp., rarely Jarrah, the pith of Kangaroo Paw (*Anigozanthos flavidus*); tips of *Pinus* spp.; *Macadamia* spp., almonds and pecans; seeds of apples and pears; and apples, persimmons, and macadamias. Overall, its main food is Marri, from which it takes seeds, flowers, grubs, and nectar. Its long bill is adapted to removing seeds from Marri fruit capsules (DAWE 2022).

Roost sites are usually in or near riparian environments or other permanent water sources in tall trees; any tree may provide roosting habitat, but particularly Jarrah, Flooded Gum, Blackbutt, Tuart and introduced *Eucalyptus* species (Blue Gum, Lemon Scented Gum) (DAWE 2022) (Johnstone and Kirkby 2008).

Carnaby's cockatoo (*Zanda latirostris*)
EN (EPBC Act), EN (BC Act)

Carnaby's cockatoo mainly occurs in or near eucalypt woodlands, especially those dominated by Wandoo or Salmon Gum, and sometimes reported in forests of Marri, Jarrah, Karri and Tuart. The species is a postnuptial nomad, tending to move west after breeding. Nesting occurs mainly in the Wheatbelt but is increasingly occurring on the west and south coast. This species is currently expanding its breeding range westward and south into the Jarrah Marri Forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain. This may be due to climate change (Cale 2003, SPRAT 2019, WA Museum 2010).

Breeding occurs mainly from early July to mid-December normally in woodland or forest, but also breeds in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly Salmon Gum, Wandoo, Tuart, Jarrah, Flooded Gum, York Gum,

Powderbark, Karri and Marri (DAWE 2022). Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick. For example, the presence of adjacent pine forest or remnant vegetation existing adjacent to the nest site (Johnstone and Kirkby, Undated).

The species prefers to forage in native shrubland, kwongan heathland and woodland dominated by proteaceous plant species on seeds, flowers and nectar of *Banksia* spp., *Hakea* spp. and *Grevillea* spp., as well as *Callistemon* spp. and Marri, in pine plantations, eucalypt woodland and forest that contains foraging species, individual trees and small stands of these species. It also feeds on seeds of introduced species including *Pinus* spp., *Erodium* spp., wild radish, canola, almonds, macadamia and pecan nuts; insects and insect larvae; occasionally apples and persimmons; and liquidambar (DAWE 2022).

Carnaby's cockatoos roost near riparian environments or natural and artificial permanent water sources. Any tall trees may provide roosting habitat, but particularly Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced Eucalyptus spp. and introduced pines (DAWE 2022).

Forest Red-tailed Black Cockatoo (FRTBC) (*Calyptorhynchus banksii naso*)
VU (EPBC Act), VU (BC Act)

The FRTBC is a large, iconic forest cockatoo, endemic to the southwest corner of WA. FRTBC occurs throughout the Jarrah Marri Karri forested areas but in recent years has been foraging out on to the Swan Coastal Plain. Group sizes vary from small family groups and pairs to larger gatherings at roost sites.

FRTBC generally breed in woodland or forest but may also breed in partially cleared woodland or forest, including isolated trees. They nest in hollows in live or dead trees (many *Eucalyptus* species may provide suitable hollows), particularly Marri, Karri, Wandoo, Bullich, Blackbutt, Tuart and Jarrah (DAWE 2022) (Johnstone Kirkby and Sarti 2015). FRTBC have been recorded breeding in all months but with peaks in Spring and Autumn following Marri fruit flushes. There are also years when very little - if any - breeding takes place (Johnstone and Kirkby unpublished data).

FRTBC feed mainly on the seeds of Jarrah and Marri in woodlands and forest, and in the edges of Karri forests, including amongst Wandoo and Blackbutt. The species forage on *Allocasuarina* cones, the fruits of Snottygobble and Mountain Marri. Other less important foods include Blackbutt, Bullich, *Allocasuarina fraseriana*, *Hakea* spp., Tuart, Redheart Moit and Bushy Yate. Also**,** some introduced *Eucalyptus* spp. such as the River Red Gum and Rose Gum. On the Swan Coastal Plain, the species often feed on introduced Cape Lilac, *Eucalyptus caesia*, *E. erythrocorys*, Lemon-scented Gum and Kaffir Plum (DAWE 2022).

FRTBC are known to roost within any tall trees that may provide roosting habitat, particularly tall Jarrah, Marri, Blackbutt, Tuart and introduced *Eucalyptus* trees or large trees on the edges of forests (DAWE 2022).

3.2 Black cockatoo breeding requirements

All three black cockatoos rely on large hollows for breeding which take many years to form. The onset of hollow formation is dependent on damage to the tree, from animals (normally termites) or snapped / dropped branches, then further rotting. Fire does not appear to be a hollow-forming process; it may reduce the number of hollows available over time (Author pers obs.). Young and healthy trees can quickly heal after damage - trees less than 100 years old are unlikely to contain large hollows. For nesting, black cockatoos show a preference for:

- Large senescing trees,
- Hollows not angled more than 45 degrees from vertical,

- Entrances of at least 12 cm but usually much larger (20-30 cm),
- Deep or well-sheltered hollows in main trunks, or large branches which can provide a floor space of at least 30 cm diameter or more.

All three species of black cockatoo are of similar size and utilise similar types of hollows when breeding. The actual species of tree is likely unimportant to each species. For example, Carnaby's cockatoo nest in Marri trees in the Marri Forest and Wandoo in the Wheatbelt. All three species are known to use the same individual hollows when not occupied in the breeding season by another black cockatoo species (Kirkby pers comm, 2019). Suitable hollows may be used interchangeably with other medium sized birds such as corellas, Galah, ducks and owls. Marri and Jarrah trees are considered by Commonwealth of Australia (SEWPAC 2012, DAWE 2022) to be large enough to develop hollows once they are >50 cm DBH. Wheatbelt species such as Wandoo and Salmon Gum may develop hollows at 30 cm DBH (DAWE 2022). Planted eastern states *Eucalyptus* spp. such as Blue gums are generally unlikely to develop hollows unless they are at an advanced age (at least 75cm DBH but usually much larger).

Hollows suitable for use by black cockatoos are usually in trees that are at least 120 years old but usually much older. Supporting literature identifies suitable breeding hollows as occurring in

- Trees over 150 years old (Koch 2009),
- Marri trees of a mean age of ~200 years and Jarrah (~300 years), with an average tree being inhabited at ~400 years for Marri and ~500 years for Jarrah (Inions et al. 1989),
- Marri trees aged between 140 and 410 years of age (Johnstone et al 2015),
- Jarrah trees aged between 120 and 150 years (Whitford et al 2013),
- Marri trees aged at ~450 years, utilised by the medium sized Long-billed Corella (smaller than black cockatoos) (Mawson et al. 1994), and
- Jarrah trees of over 1000 years (as stags) (Wayne 2005).

While breeding, black cockatoos will generally forage within a 6–12 km radius of their nesting site. Following breeding, birds assemble into flocks and move through the landscape searching for food, usually foraging within 6 kms of a night roost (Commonwealth of Australia 2012). Black cockatoos rely on access to watering points in selecting night roost sites, with roost sites usually within 2 kms of a watering point where they often drink in the afternoon following daytime feeding (DAWE 2022).

3.3 Habitat in a local context

3.3.1 Local habitat remaining

In a local context, the Survey Area is located almost centrally within an extensive State Forest and Reserve system within the Northern Jarrah Forest (JF1) IBRA (sub) bioregion. Native vegetation remaining within 6 and 12 kms of the project (the extent typically travelled by breeding black cockatoos), is well represented, accounting for 91 % of the area within 6 km and over 92 % within 12 km. Nearly all of this area (98.5 %) within 6 km and 92.7 % of land within 12 kms is reserved (refer to Appendix A, Figure 3). Given the narrow extent of the Survey Area along the road edge, the adjacent areas of Jarrah Forest are likely to provide more significant feed, breeding and roost habitat than those areas within the Survey footprint.

Table 3-1 Areas of DBCA reserves and native vegetation remaining within the foraging distances (6-12 km) from the Survey Area (SLIP 2024)

Foraging range	Total area (ha)	Reserved (DBCA) %, Area (ha)	Native vegetation (including regrowth) remaining % of total area, Area (ha)
6 km	17,045	98.5 % (16,787 ha)	91.0 % (15,515 ha)
12 km	56,460	92.7 % (52,340 ha)	92.1 % (52,000 ha)

3.3.2 Important Bird Areas

Important Bird Areas (IBAs) are defined by Birdlife International as conservation priorities. There are no IBAs associated with or within 20 km of the Survey Area.

3.3.3 Existing records

The DBCA (2024) database provides the following local black cockatoo records:

- A total of 199 black cockatoo records (10 records of Baudin's cockatoo between 1998-2018, 3 Carnaby's cockatoo records between 2002-2015, and 8 FRTBC between 1997-2018),
- no known black cockatoo breeding sites recorded, and
- one roost recorded over 3 surveys approximately 10 km west of the project. The abbreviation WT below refers to White-tailed (both Baudin's and Carnaby's cockatoo).

Table 3-2 DBCA recorded roost sites within 12 km of the survey area

SITE CODE	WT total	WT Max count	FRTBC total	FRTBC max count	No. of surveys
HARSUNR001	227	120	6	6	3

4 Results and discussion

4.1 Black cockatoo observations

Small family groups of Baudin's cockatoos and FRTBC were observed flying over the site or in close proximity to the site during the surveys.

4.2 Habitat types

4.2.1 Vegetation units

Five floristically similar, broad Vegetation Units (VUs) were identified during the survey. Evidence of previous clearing activity (road construction and maintenance) was observed across multiple patches of vegetation within the clearing envelope, with such areas existing as a regenerative form of their representative VU:

- **VU 1** (2.44 ha) is characterised by *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) dominated forest, occurring more commonly on the upper and mid slopes of the Survey Area. Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.
- **VU 2** (0.24 ha) is characterised by the dominant presence of *Eucalyptus patens* (Blackbutt) along with Marri and occasional Jarrah. This VU occurred in the transition zone between VU 1 and VU 3 on the lower slopes of the Survey Area and in drainage lines. Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.
- **VU 3** (0.28 ha) is characterised by the presence of *Eucalyptus rudis* (Flooded Gum) and *Melaleuca preissiana*; species that indicate wetter or seasonally inundated habitats. This VU was found to occur in lowest part of the Survey Area, with inundation evident in patches throughout the VU extent. Low quality foraging, and potential breeding habitat. Potential roost habitat.
- **VU 4** (0.06 ha) represents the vegetation within the transition line easement of previously cleared, regrowth native vegetation, representative of some VU 1 understorey species, inclusive of *Bossiaea aquifolium* and *Hypocalymma angustifolium* dominated shrubland, along with *Xanthorrhoea* sp., *Persoonia longifolia* and *Hakea* sp. No *Eucalyptus* or *Corymbia* spp. were observed regenerating within this area. Low quality foraging due to degraded condition, and no breeding habitat. No potential roost habitat.
- **VU 5** (0.19 ha) is characterised by the presence of plantation Blue Gums over native understorey vegetation consistent with VU 1 and 2. Potential roost habitat.

Full descriptions of the above VUs are detailed in Table 4-1, with vegetation mapping presented in Figure 3. The most widely represented VU within the Survey Area was VU 1 (2.44 ha).

Jarrah and Marri are important tree species for black cockatoos as they may develop suitable breeding hollows and are generally considered high quality foraging habitat. Paperbark trees are not considered high quality black cockatoo habitat or high priority species for black cockatoos. The planted Blue Gums hold low value for black cockatoos within the context of the site.

Table 4-1 Survey Area broad Vegetation Units

VU	Description	Survey Area Extent (ha)	Representative Photos
VU 1	Mid open forest of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over over isolated or clumps of trees (*Banksia* spp.), generally towards the eastern end of the Survey Area, over open shrubland (inc. *Hakea* spp. *Bossiaea aquifolium*), with isolated grass-trees (*Xanthorrhoea* sp.) and cycads (*Macrozamia riedlei*) over open shrubland (*Hypocalymma angustifolium*, *Hibbertia* spp.) and open fernland areas. Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.	2.44 ha	 

VU 2	Mid, open forest of *Eucalyptus patens*, *Corymbia calophylla* and occasional *Eucalyptus marginata* subsp. *marginata* over isolated trees (*Banksia* and *Acacia* spp.) over open shrubland (inc. *Bossiaea aquifolium*, *Trymalium odoratissimum* subsp. *trifidum*) with isolated grass-trees (*Xanthorrhoea* sp.) and cycads (*Macrozamia riedlei*) over open shrubland (inc. *Hypocalymma angustifolium*) and open fernland areas. Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.	0.24 ha	 

VU 3	Isolated trees of *Eucalyptus patens* over woodland of *Eucalyptus rudis* and *Melaleuca preissiana* over sparse to open shrubland over sparse to open sedgeland over open forbland. Low quality foraging, and potential breeding habitat. Potential roost habitat.	0.28 ha	 

VU 4	Isolated trees of *Persoonia longifolia* over sparse (RHS) to open (LHS) shrubland dominated by *Bossiaea aquifolium* and *Hypocalymma angustifolium*. Low quality foraging due to degraded condition, and no breeding habitat. No potential roost habitat.	0.06 ha	 

			
VU 5	Open woodland of Blue Gums over scattered, isolated trees (inc. *Persoonia longifolia*) over sparse understorey shrubland (inc. *Hypocalymma angustifolium*, *Trymalium odoratissimum* subsp. *trifidum*, *Bossiaea aquifolium*). No or low-quality foraging, and no breeding habitat. Potential roost habitat.	0.19 ha	

Note that a regenerative form of the representative Vegetation Units is evident across the majority of the clearing envelope due to previous clearing disturbance.

4.3 Habitat trees and breeding

4.3.1 Habitat trees

A total of 85 Suitable DBH trees were recorded and mapped in Appendix A Figure 5. They include:

- 31 Marri trees, of which only one had hollows (ID 5),
- 28 Jarrah - none with hollows,
- 18 Blackbutt - none with hollows,
- 7 Flooded gums – none with hollows,
- One dead tree – without hollows.

The full list of Suitable DBH trees is provided in Appendix D.

4.3.2 Hollow assessment

An assessment of the potentially suitable black cockatoo hollows (based on attributes) for evidence of use is summarised in Table 4-1. Of the 85 suitable DBH trees one tree (ID 5) had a confirmed potentially suitable black cockatoo breeding hollow, but one close inspection by drone and pole camera did not have any evidence of black cockatoo use. Several other trees were also inspected further but found not to be hollow.

Photo 4-1 Tree ID 5 with Hollow 1 large potentially suitable hollow but with no evidence of use.

Photo 4-2 Tree ID 5 with Hollow 1 large potentially suitable hollow but with no evidence of use (increased exposure).

Photo 4-3 Tree ID 5 with Hollow 2 large hollow entrance but hollow not deep enough.

Photo 4-4 Tree ID 5 with Hollow 3 large hollow entrance but hollow not deep enough.

Photo 4-5 Tree ID 5 with Hollow 3 large hollow entrance but hollow not deep enough.

4.3.3 Foraging habitat

No Carnaby's cockatoo feeding residue was observed during the surveys, although suitable habitat exists. Both Baudin's cockatoo and FRTBC feed residue were observed at different points (chewed Marri fruit), with FRTBC feed residue being more abundant. Within the context of the broader habitat, as the Survey Area occurs along a narrow, disturbed edge of extensive tracts of State Forest, the significance of individual trees for foraging is low. Black cockatoo foraging habitat quality is mapped in Appendix A Figure 6. Habitat types are summarised below.

- **VU 1 and 2** (2.68 ha) Moderate to high quality foraging habitat.
- **VU 3 and 4** (0.34 ha) Low quality foraging habitat due to dominant species type or degraded condition.
- **VU 5** (0.19 ha) No or low-quality foraging habitat.

4.4 Roosts

No evidence of night roosts were observed within the survey area, although different roosts may be used by different species at different times of the year. Suitable trees for roosts could occur within all Vus, except for VU 4, which had been cleared and maintained for the powerline easement. Within the local context, there are extensive adjacent areas that are likely to provide a greater quantity and better-quality potential roost trees.

5 Conclusions and recommendations

A summary of the black cockatoo habitat values of the 7.48 ha survey area (which includes 3.21 ha of maintenance zone or adjacent native vegetation) between 19.0 – 24.2 SLK Harvey-Quindanning Road, Harvey, is provided below:

- The survey area falls within the modelled distribution for all three black cockatoo species, within the known breeding range of Carnaby's cockatoos, with Baudin's cockatoos and FRTBC being likely to occur (DAWE 2022). There are scattered records for all three black cockatoo species locally (ALA 2024) (Birdlife Australia, 2024) (DBCA 2024).
- FRTBC and Baudin's cockatoo were observed during field surveys with foraging evidence.
- Black cockatoo habitat types within the survey are summarised below.
    - **VU 1** (2.44 ha) characterised by *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) dominated forest, occurring more commonly on the upper and mid slopes of the Survey Area. ***Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.***
    - **VU 2** (0.24 ha) characterised by the dominant presence of *Eucalyptus patens* (Blackbutt) along with Marri and occasional Jarrah. This VUT occurred in the transition zone between VU 1 and VU 3 on the lower slopes of the Survey Area and in drainage lines. ***Moderate to high quality foraging, and potential breeding habitat. Potential roost habitat.***
    - **VU 3** (0.28 ha) characterised by the presence of *Eucalyptus rudis* (Flooded Gum) and *Melaleuca preissiana*; species that indicate wetter or seasonally inundated habitats. This VU was found to occur in lowest part of the Survey Area, with inundation evident in patches throughout the VU extent. ***Low quality foraging, and potential breeding habitat. Potential roost habitat.***
    - **VU 4** (0.06 ha) represents the vegetation within the transition line easement of previously cleared, regrowth native vegetation, representative of some VU 1 understorey species, inclusive of *Bossiaea aquifolium* and *Hypocalymma angustifolium* dominated shrubland, along with *Xanthorrhoea* sp., *Persoonia longifolia* and *Hakea* sp. No *Eucalyptus* or *Corymbia* spp. were observed regenerating within this area. ***Low quality foraging due to degraded condition, and no breeding habitat. No potential roost habitat.***
    - **VU 5** (0.19 ha) is characterised by the presence of plantation Blue Gums over native understorey vegetation consistent with VU 1 and 2. ***Potential roost habitat.***
- A total of 85 Suitable DBH trees were recorded within the survey area:
    - 31 Marri trees, of which only one had a hollow (ID 5). ID 5 contained one suitable breeding hollow with no evidence of use,
    - 28 Jarrah - none with hollows,
    - 18 Blackbutt - none with hollows,
    - 7 Flooded gums – none with hollows,
    - One dead tree – without hollows.

- In a local context, the Survey Area occurs along a narrow, disturbed edge of State Forest, so the significance of individual trees for foraging would be low. Foraging habitat areas:
    - **VU 1 and 2** (2.68 ha) Moderate to high quality foraging habitat.
    - **VU 3 and 4** (0.34 ha) Low quality foraging habitat due to dominant species type or degraded condition.
    - **VU 5** (0.19 ha) No or low-quality foraging habitat.
- No evidence of night roosts were observed.
- Native vegetation remaining within 6 and 12 kms of the project is well represented, accounting for over 90 % of the land area. Most of the land within 12 kms is reserved. Given the narrow extent of the Survey Area along the road edge, the adjacent areas of Jarrah Forest are likely to provide more significant feed, breeding and roost habitat than those areas within the Survey footprint.

The following recommendations should be considered:

- Clearing should be minimised.
- Large trees should be retained where possible, particularly the Marris which are often preferred by black cockatoos for breeding.
- Suitable hollows with no evidence of use could still be used by black cockatoos. If the tree ID5 is proposed to be cleared, follow up surveys and stag watch undertaken in the known breeding periods immediately prior to clearing should be considered.
- An authorised fauna spotter should be present during clearing of Tree ID 5 to manage hollow dependant fauna.

Final impact footprints should be checked against the significant impact criteria for black cockatoos to determine the need to refer the project to DCCEEW.

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Appendix A Figures

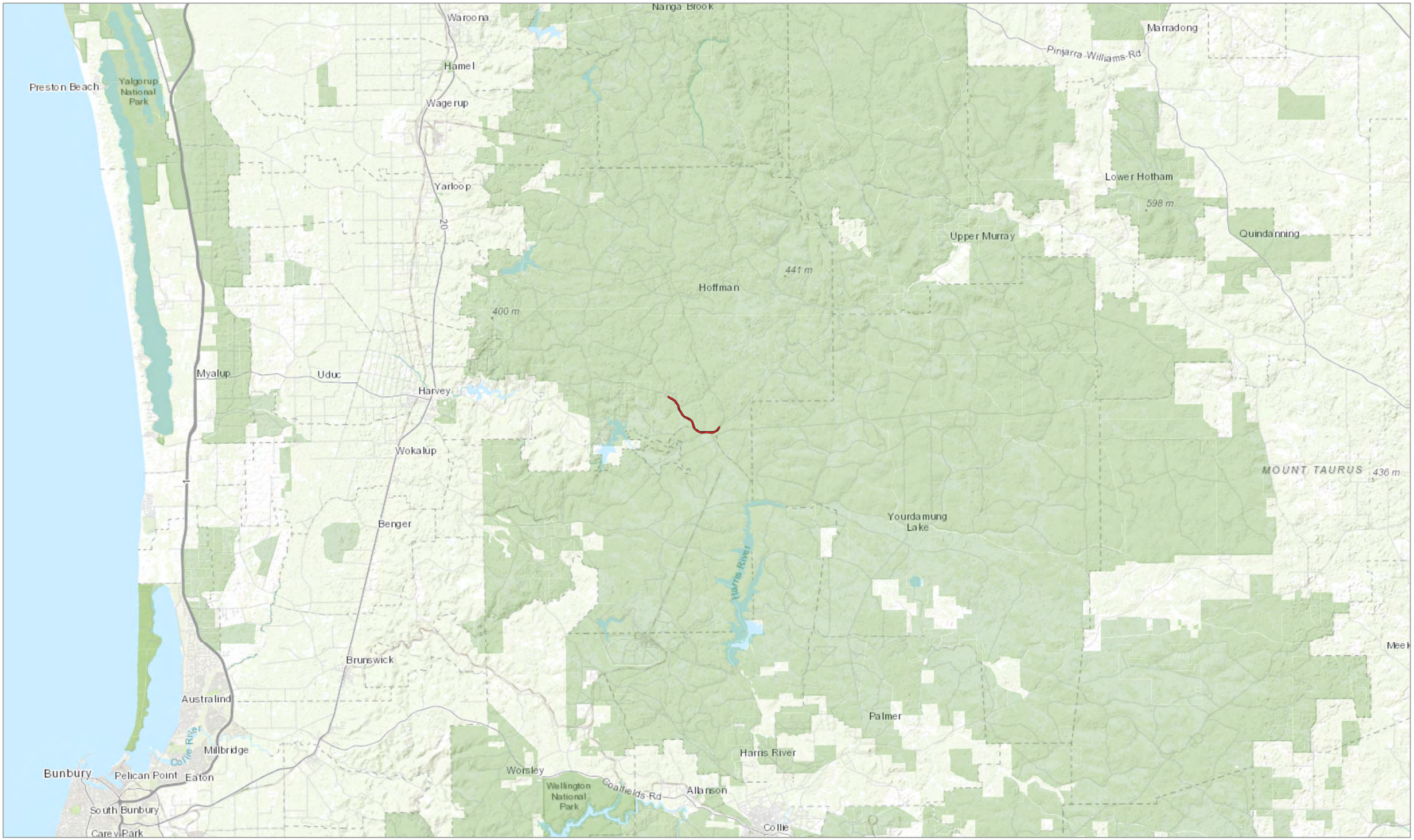
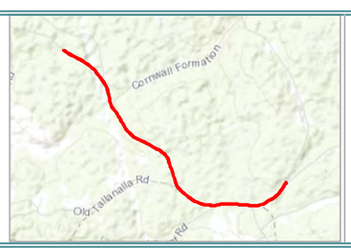


Figure 1 - Location

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Project extent

DBCA managed land



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N

SW environmental

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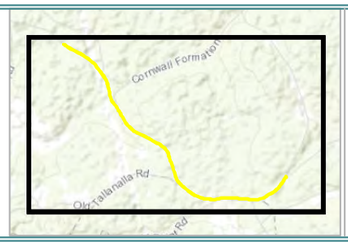
Ref: SW546
Date: 11/09/2024 Author: SP

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

Figure 2 - Survey Area

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

- Project extent
- Road
- Minor drainage line
- DBCA managed land



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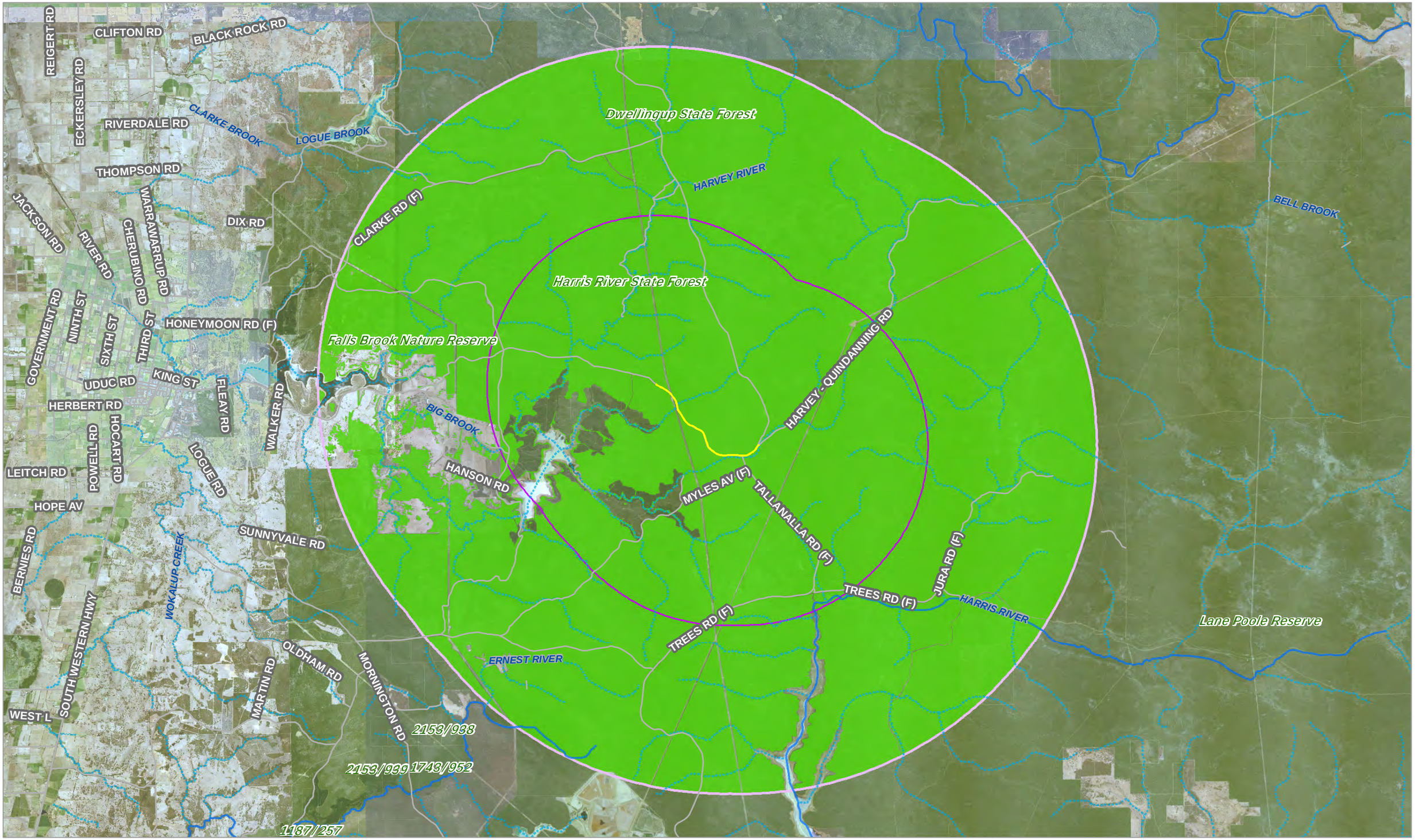
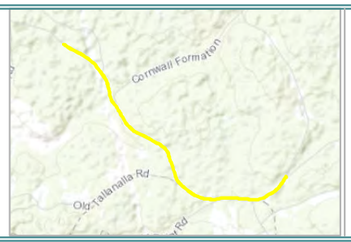


Figure 3 - Vegetation remaining within 6 and 12 km of the survey area

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Project extent
Road
Major watercourse
Minor drainage line
6 km buffer
12 km buffer
Native vegetation remaining (SLIP 2024)
DBCA managed land



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Date: 11/09/2024 Author: SP

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

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HARVEY - QUINDANNING RD

19.1
19.2
19.3
19.4
19.5
19.6
19.7
19.8
19.9
20.0
20.1

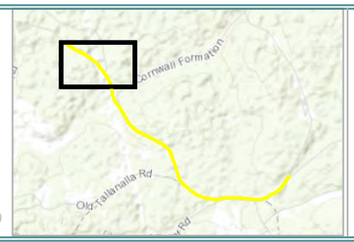
Figure 4 Habitat types (Vegetation Units)

HARVEY QUINDANNING
ROAD 19.0 - 24.2 SLK

Date: 4/09/2024 Author: SP
Ref: SW546

Road
Clearing

Vegetation unit
VU 1
VU 2
VU 3
VU 4
VU 5



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GRID: GDA zone 50

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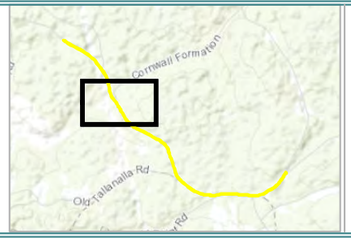
Figure 4 Habitat types (Vegetation Units)

HARVEY QUINDANNING
ROAD 19.0 - 24.2 SLK

Road
Clearing

Vegetation unit
VU 1
VU 2
VU 3
VU 4
VU 5



A3 @ 1:3000

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GRID: GDA zone 50

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Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

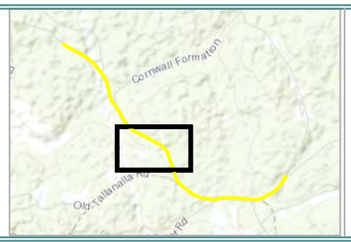
Ref: SW546 Date: 4/09/2024 Author: SP

Figure 4 Habitat types (Vegetation Units)

HARVEY QUINDANNING
ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 4/09/2024 Author: SP

Road
Clearing
Vegetation unit
VU 1
VU 2
VU 3
VU 4
VU 5



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www.swenvironmental.com.au

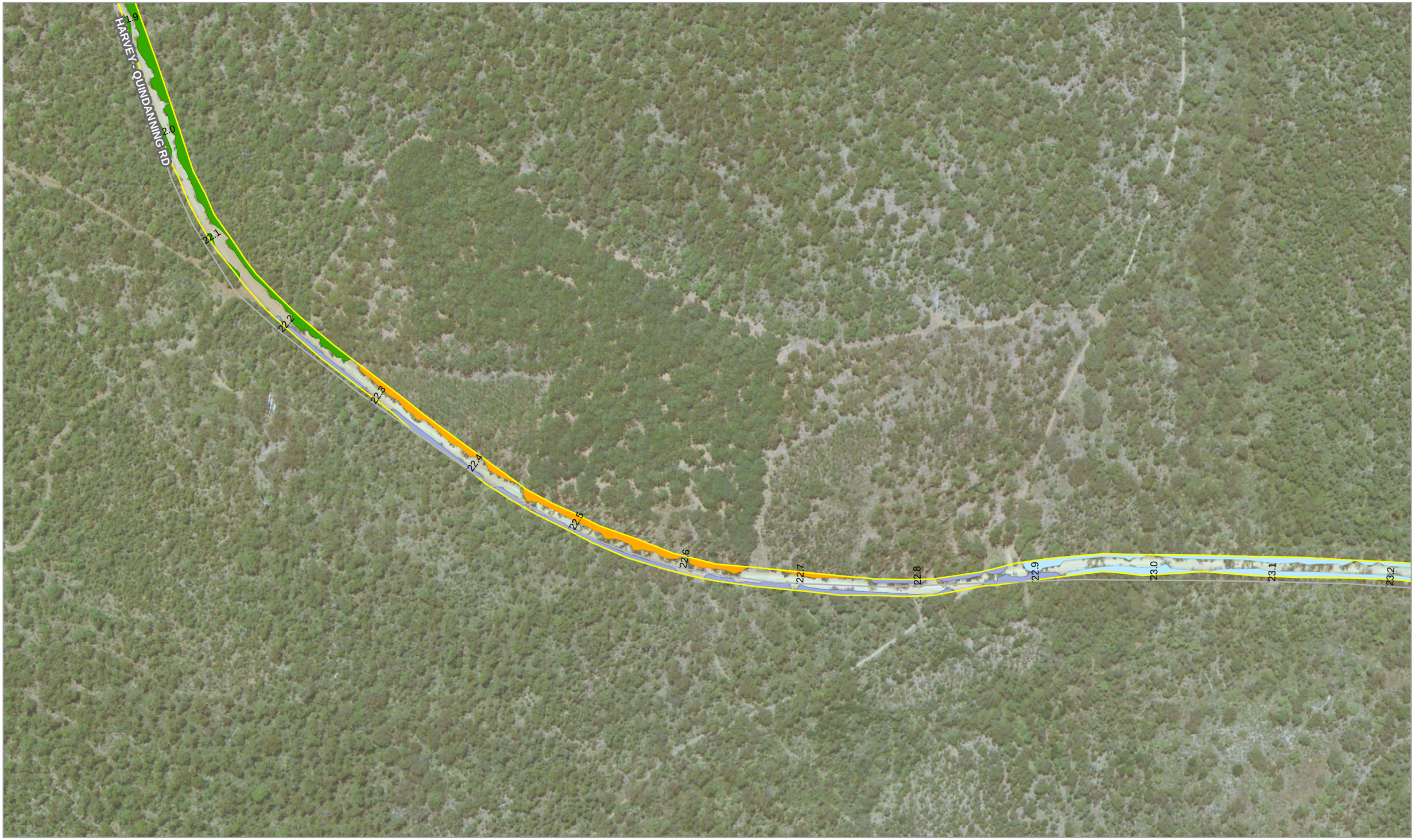
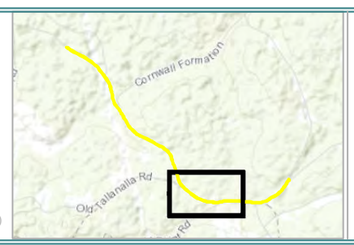


Figure 4 Habitat types (Vegetation Units)

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Road
Clearing
Vegetation unit
VU 1
VU 2
VU 3
VU 4
VU 5



A3 @ 1:3000

0 20 40 80 m

N

GRID: GDA zone 50

Ref: SW546
Date: 4/09/2024 Author: SP

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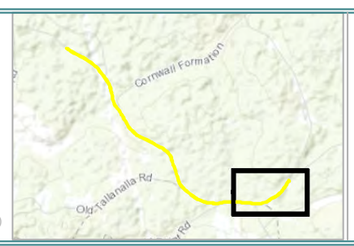
Figure 4 Habitat types (Vegetation Units)

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 4/09/2024 Author: SP

Road
Clearing

Vegetation unit
VU 1
VU 2
VU 3
VU 4
VU 5



A3 @ 1:3000

0 20 40 80 m

GRID: GDA zone 50

N

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

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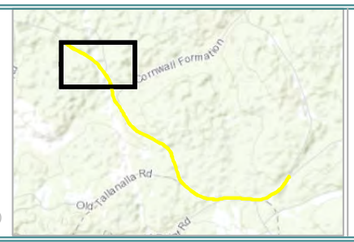
Figure 5 - Black cockatoo breeding trees

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 11/09/2024 Author: SP

- Suitable DBH no hollows
- Suitable size no signs C
- Project extent
- Road
- Minor drainage line
- DBCA managed land



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

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Figure 5 - Black cockatoo breeding trees

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 11/09/2024 Author: SP

DBCA managed land
Suitable DBH no hollows
Project extent
Road
Minor drainage line

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

A3 @ 1:3000
0 10 20 40 m
GRID: GDA zone 50

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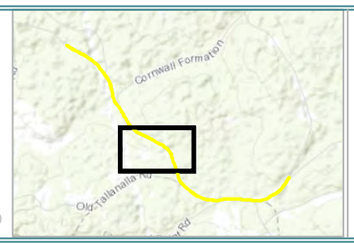
Figure 5 - Black cockatoo breeding trees

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

- Suitable DBH no hollows
- Project extent
- Road
- DBCA managed land

Ref: SW546
Date: 11/09/2024 Author: SP



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

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HARVEY - QUINDANNING RD

Harris River State Forest

56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79

22.0 22.1 22.2 22.3 22.4 22.5 22.6 22.7 22.8 22.9 23.0 23.1 23.2

Figure 5 - Black cockatoo breeding trees

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

DBCA managed land

Suitable DBH no hollows

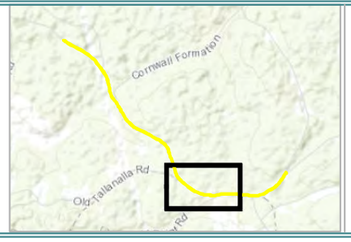
Project extent

Road

Minor drainage line

Ref: SW546
Date: 11/09/2024 Author: SP

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

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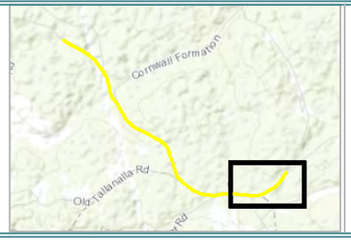
Figure 5 - Black cockatoo breeding trees

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 11/09/2024 Author: SP

DBCA managed land
Suitable DBH no hollows
Project extent
Road
Minor drainage line



A3 @ 1:3000
0 10 20 40 m
GRID: GDA zone 50

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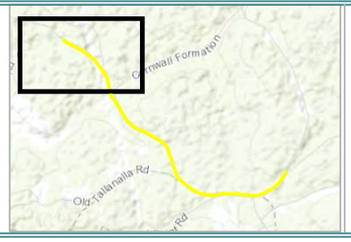
Figure 6 - Black cockatoo foraging habitat quality

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 12/09/2024 Author: SP

- Project extent
- Moderate to high quality foraging habita (VU 1; VU 2)
- Low quality foraging habitat (VU 3; VU 4)
- Road
- Minor drainage line
- DBCA managed land



Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

A3 @ 1:5000

0 25 50 100 m

GRID: GDA zone 50

N

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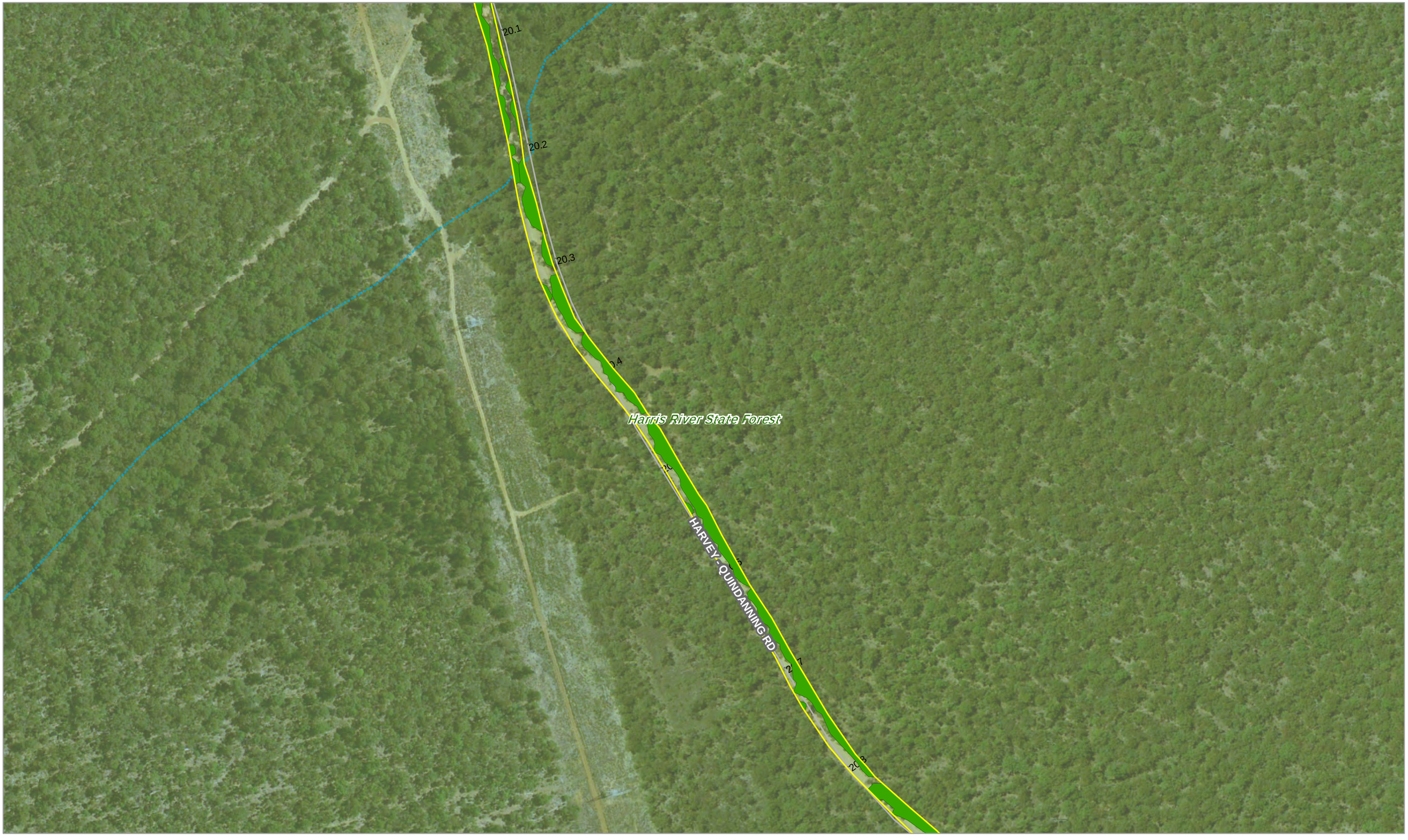
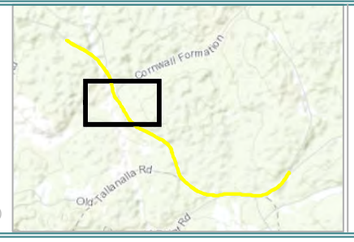


Figure 6 - Black cockatoo foraging habitat quality

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 12/09/2024 Author: SP

- Project extent
- Moderate to high quality foraging habita (VU 1; VU 2)
- Road
- Minor drainage line
- DBCA managed land



Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

A3 @ 1:3000

0 20 40 80 m

GRID: GDA zone 50

N

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Figure 6 - Black cockatoo foraging habitat quality

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

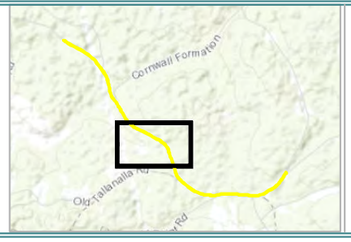
Ref: SW546
Date: 11/09/2024 Author: SP

Project extent

Moderate to high quality foraging habita (VU 1; VU 2)

Road

DBCA managed land



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

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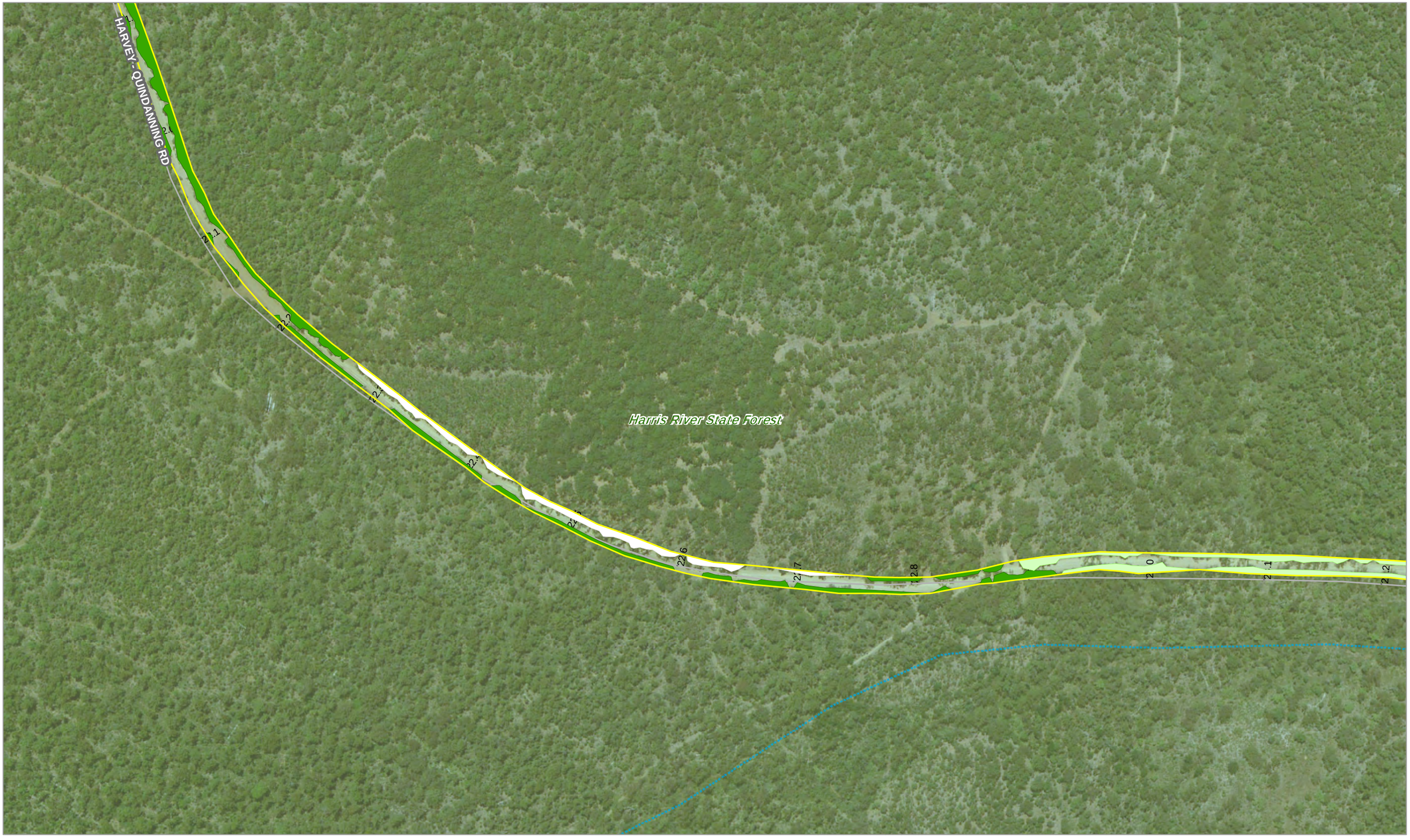


Figure 6 - Black cockatoo foraging habitat quality

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Project extent

Moderate to high quality foraging habita (VU 1; VU 2)

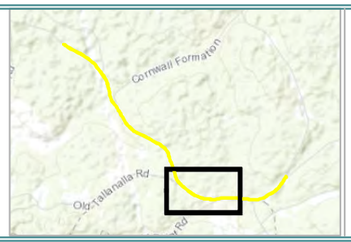
Low quality foraging habitat (VU 3; VU 4)

No or low-quality foraging habitat (VU 5)

Road

Minor drainage line

DBCA managed land



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

Ref: SW546
Date: 11/09/2024 Author: SP

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Figure 6 - Black cockatoo foraging habitat quality

HARVEY QUINDANNING ROAD 19.0 - 24.2 SLK

Ref: SW546
Date: 11/09/2024 Author: SP

Project extent

Moderate to high quality foraging habita (VU 1; VU 2)

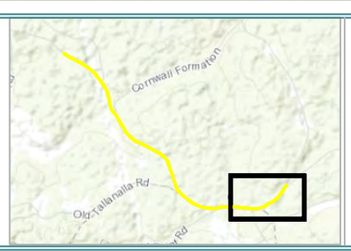
Low quality foraging habitat (VU 3; VU 4)

Road

Minor drainage line

DBCA managed land

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

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Appendix B Commonwealth black cockatoo foraging quality scoring tool template (SEWPAC 2012)

Table A1 Foraging quality scoring tool template

Starting score		Baudin's Cockatoo	Carnaby's Cockatoo	Forest Red-tailed Black-Cockatoo
10		**Start at a score of 10** if your site is native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly Marri, within the range of the species, including along roadsides and parkland cleared areas. Can include planted vegetation. **This tool only applies to sites equal to or larger than 1 hectare in size.**	**Start at a score of 10** if your site is native shrubland, kwongan heathland or woodland, dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, within the range of the species, including along roadsides and parkland cleared areas. Also includes planted native vegetation. **This tool only applies to sites equal to or larger than 1 hectare in size.**	**Start at a score of 10** if your site is Jarrah or Marri woodland and/or forest, or if it is on the edge of Karri forest, or if Wandoo and Blackbutt occur on the site, within the range of the subspecies, including along roadsides and parkland cleared areas. **This tool only applies to sites equal to or larger than 1 hectare in size.**
Attribute	Sub-tractions	Context adjustor (attributes reducing functionality of foraging habitat)		
Foraging potential	**-2**	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	**Subtract 2** from your score if there is no evidence of feeding debris on your site.
Connectivity	**-2**	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.

Proximity to breeding	**-2**	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.
Proximity to roosting	**-1**	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.
Impact from significant plant disease	**-1**	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.
Total score		*8*	*10*	*10*
Appraisal		To support your habitat score, you should provide an overall appraisal of the habitat on the impact site and within 20km of the impact area to clearly explain and justify the score. It should include discussion on the foraging habitat's proximity to other resources (e.g. exact distance to proximate resources), frequency of use of proximate sites, the degree of evidence and description of vegetation type and condition.		

Appendix C Black cockatoo foraging plants

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
*Acacia baileyana**	Cootamundra wattle	Tree		Secondary		Groom 2011
Acacia pentadenia	Karri wattle	Tree		Secondary		Groom 2011
Acacia saligna	Orange wattle	Tree		Secondary		Groom 2011
Agonis flexuosa	Peppermint tree	Tree		Secondary		Groom 2011
Allocasuarina fraseriana	Sheaok	Tree	Secondary		Secondary	DoEE 2017; Johnstone et al. 2010; Johnstone et al. 2017; Johnstone & Storr 1998
Allocasuarina spp.	Allocasuarina	Tree		Secondary	Secondary	DoEE 2017; Groom 2011; Johnstone et al. 2010; DSEWPaC 2012
Anigozanthos flavidus	Tall kangaroo paw	Herb	Secondary			DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010
*Araucaria heterophylla**	Norfolk Island pine	Tree		Secondary		DoEE 2017; Groom 2011
Banksia ashbyi	Ashby's banksia	Tree or tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Saunders 1980
Banksia attenuata	Slender banksia	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Saunders 1980
Banksia baxteri	Baxter's banksia	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia carlinoides	Pink dryandra	Medium or small shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia coccinea	Scarlet banksia	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia dallaneyi	Couch honeypot dryandra	Medium or small shrub	Secondary	Secondary		DoEE 2017; Groom 2011
Banksia ericifolia	Health-leaved banksia	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia fraseri	Dryandra	Medium or small shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia gardneri	Prostrate banksia	Medium or small shrub	Secondary	Secondary		DoEE 2017; Groom 2011
Banksia grandis	Bull banksia	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998; Saunders 1980; Main Roads 2023
Banksia hookeriana	Hooker's banksia	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia ilicifolia	Holly banksia	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998; Main Roads 2023
Banksia kippistiana	Dryandra	Medium or small shrub	Secondary	Primary		DoEE 2017; Groom 2011
Banksia leptophlla		Medium or small shrub	Secondary	Secondary		DoEE 2017; Groom 2011
Banksia lindleyana	Porcupine banksia	Medium or small shrub	Secondary	Primary		DoEE 2017; Johnstone et al. 2010
Banksia littoralis	Swamp banksia	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998; Saunders 1980

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
Banksia menziesii	Firewood banksia	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Saunders 1980
Banksia mucronulata	Swordfish dryandra	Medium or small shrub	Secondary	Primary		DoEE 2017; Groom 2011
Banksia nivea	Honeypot dryandra	Medium or small shrub	Secondary	Primary		DoEE 2017; Groom 2011; Saunders 1980
Banksia nobilis	Golden dryandra	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Saunders 1980
Banksia praemorsa	Cut-leaf banksia	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Saunders 1980
Banksia prolata		Medium or small shrub	Secondary	Primary		DoEE 2017; Johnstone et al. 2010
Banksia prionotes	Acorn Banksia	Tree	Secondary	Primary		Groom 2011
Banksia quercifolia	Oak-leaved banksia	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998
Banksia speciosa	Showy banksia	Tree	Secondary	Secondary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia spp.		Shrub or tree	Secondary	Primary		DoEE 2017; DSEWPaC 2012; Saunders 1979
Banksia squarrosa	Pingle	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
Banksia tricuspida	Pine banksia	Tree	Secondary	Secondary		DoEE 2017; Groom 2011
Banksia undata	Urchin dryandra	Tall shrub	Secondary	Primary		DoEE 2017; Groom 2011
Banksia verticillata	Granite banksia	Tree	Secondary	Secondary		DoEE 2017; Groom 2011; Saunders 1980
Banksioa sessilis	Parrot bush	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998; Saunders 1980
Banksia prionotes	Acorn banksia	Tree	Secondary	Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010
*Brassica campestris**	Canola	Herb		Secondary		DoEE 2017; Groom 2011
Callistemon spp.		Tall shrub	Secondary	Secondary		DoEE 2017; Johnstone et al. 2010
Callistemon viminalis	Captain cook bottlebrush	Tall shrub		Secondary		Groom 2011
Callitris spp.		Shrub or tree		Secondary		Groom 2011; Johnstone et al. 2010
*Casuarina cunninghamniana**	River sheoak	Tree	Secondary	Secondary		Groom 2011
*Citrullus lanatus**	Pie or afghan melon	Climber	Secondary	Primary		Groom 2011; Johnstone et al. 2010
Carya iollnoiensis	Pecan	Tree	Secondary	Secondary		DoEE 2017; Groom 2011; Groom 2014; Johnstone et al. 2010
Corymbia calophylla	Marri	Tree	Primary	Primary	Primary	DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010; Johnstone et al. 2017; Johnstone & Kirkby 1999; Johnstone & Kirkby 2008; Johnstone & Storr 1998; Saunders 1979
*Corymbia citriodora**	Lemon scented gum	Tree	Secondary	Secondary	Secondary	DSEWPaC 2012; Groom 2011; Johnstone et al. 2010; Johnstone et al. 2017

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
Corymbia ficifolia	Red flowering gum	Tree		Secondary		Groom 2011
Corymbia haematoxylon	Mountain marri	Tree		Secondary	Secondary	DoEE 2012; DoEE 2017; Groom 2011
*Corymbia maculata**	Spotted gum	Tree		Secondary		-
Darwinia citriodora	Lemon-scented darwinia	Medium or small shrub	Secondary	Secondary		Groom 2011; Johnstone et al. 2010
*Diospryros sp.**	Sweet persimmon	Tree	Secondary	Secondary		DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone et al. 2010
Eremophila glabra	Tarbush	Tall shrub		Secondary		Groom 2011
*Erodium aureum**		Herb		Secondary		Groom 2011
*Erodium botrys**	Long storksbill	Herb	Secondary	Secondary		Groom 2011; Johnstone & Storr 1998; Johnstone et al. 2010
Erodium spp.		Herb	Secondary	Secondary		DoEE 2017; Johnstone et al. 2010; Main Roads 2023
Eucalyptus accedens	Powderbark	Tree				-
Eucalyptus caesia	Silver princess	Tree		Primary	Secondary	DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone et al. 2010; Johnstone et al. 2017
Eucalyptus camaldulensis	River red gum	Tree		Secondary	Secondary	DoEE 2012; DoEE 2017
Eucalyptus decipiens	Red heart/moit	Tree			Secondary	Johnstone et al. 2017
Eucalyptus diversicolor	Karri wattle	Tree		None	Primary	DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010; Johnstone & Storr 1998
Eucalyptus erythrocorys	Illyarrie	Tree		Secondary	Secondary	DSEWPaC 2012; DoEE 2017; Johnstone et al. 2017, Johnstone et al. 2010
*Eucalyptus globulus**	Tasmanian blue gum	Tree		None		-
Eucalyptus gomphocephala	Tuart	Tree		Primary	Secondary	DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone et al. 2010
*Eucalyptus grandis**	Rose gum	Tree		None	Secondary	DoEE 2012; DoEE 2017
Eucalyptus lehmannii	Bushy yate	Tree			Secondary	Johnstone et al. 2017
Eucalyptus leucoxylon	Yellow gum	Tree		Secondary		Groom 2017
Eucalyptus longicornis	Red morrell	Tree		None		-
Eucalyptus loxophleba	York gum	Tree		Secondary		DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone et al. 2010
Eucalyptus marginata	Jarrah	Tree	Secondary	Primary	Primary	DSEWPaC 2012; DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone et al. 2017; Johnstone & Kirkby 1999; Johnstone & Storr 1998; Saunders 1980
Eucalyptus megacarpa	Bullich	Tree				-
Eucalyptus occidentalis	Swamp yate	Tree		None		-

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
Eucalyptus patens	Blackbutt	Tree		Primary	Primary	DoEE 2017; Groom 2011; DSEWPaC 2012; Johnstone et al. 2010; Johnstone & Kirkby 1999; Johnstone & Storr 1998
Eucalyptus pleurocarpa	Tallerack	Tree		Primary		Groom 2011
Eucalyptus preissiana	Bell-fruited mallee	Tree		Primary		Groom 2011
Eucalyptus robusta	Swamp mahogany	Tree		Primary		Groom 2011; Johnstone et al. 2010
Eucalyptus rudis	Flooded gum	Tree		None		-
Eucalyptus salmonophloia	Salmon gum	Tree		Primary		DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone et al. 2010
Eucalyptus salubris	Gimlet	Tree		None		-
Eucalyptus staeri	Albany blackbutt	Tree			Secondary	Johnstone & Storr 1998
Eucalyptus todtiana	Coastal blackbutt	Tree		Primary		Groom 2011; Johnstone et al. 2010; Johnstone & Kirkby 2008; Saunders 1980
Eucalyptus wandoo	Wandoo	Tree	Secondary	Primary	Primary	DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998; Saunders 1980
Ficus sp.	Fig	Tree		Secondary		Groom 2011
Grevillea armigera	Prickly toothbrushes	Tall shrub		Primary		Groom 2011
Grevillea bipinnatifida	Fuschia grevillea	Medium or small shrub		Primary		Groom 2011
Grevillea hookeriana	Red toothbrushes	Tall shrub		Primary		Groom 2011
Grevillea paniculata	Kerosene bush	Tall shrub		Primary		Groom 2011
Grevillea paradoxa	Bottlebrush grevillea	Medium or small shrub		Primary		Groom 2011
Grevillea petrophiloides	Pink poker	Tall shrub		Primary		Groom 2011
Grevillea robusta	Silky oak	Tree		Primary		Groom 2011; Johnstone et al. 2010
Grevillea spp.		Shrub or tree				DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010; Saunders 1979
Grevillea wilsonii	Native fuchsia	Shrub	Secondary			Johnstone et al. 2010
Hakea auriculata		Tall shrub				Groom 2011; Saunders 1980
Hakea candolleana		Medium or small shrub		Primary		Groom 2011
Hakea circumalata	Coastal hakea	Medium or small shrub		Primary		Groom 2011
Hakea commutata		Medium or small shrub		Primary		Groom 2011
Hakea conchifolia	Shell-leaved hakea	Medium or small shrub		Primary		Groom 2011
Hakea costata	Ribbed hakea	Medium or small shrub		Primary		Groom 2011
Hakea cristata	Snail hakea	Medium or small shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
Hakea cucullata	Snail hakea	Tall shrub		Primary		Groom 2011
Hakea cyclocarpa	Ramshorn	Medium or small shrub		Primary		Groom 2011; Saunders 1980
Hakea eneabba		Medium or small shrub		Primary		Groom 2011
Hakea erinacea	Hedgehog hakea	Medium or small shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010
Hakea falcata	Sickle hakea	Tall shrub		Primary		Groom 2011
Hakea flabellifolia	Fan-leaved hakea	Medium or small shrub		Primary		Groom 2011
Hakea gilbertii		Medium or small shrub		Primary		Groom 2011; Saunders 1980
Hakea incrassata	Golfball or marble hakea	Medium or small shrub		Primary		Groom 2011; Johnstone et al. 2010
Hakea lasiantha	Woolly flowered hakea	Tall shrub		Primary		Groom 2011; Johnstone et al. 2010
Hakea lasianthoides		Tall shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010
Hakea laurina	Pin-cushion hakea	Tree		Primary		Groom 2011; Johnstone et al. 2010
Hakea lissocarpha	Honeybush	Medium or small shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010; Saunders 1980
Hakea marginata		Medium or small shrub	Secondary	Primary		Johnstone et al. 2010
Hakea megalosperma	Lesueur hakea	Medium or small shrub		Primary		Groom 2011
Hakea multilineata	Grass leaf hakea	Tall shrub		Primary		Groom 2011
Hakea neospathulata		Shrub		Primary		Groom 2011
Hakea obliqua	Needles and corks	Tall shrub		Primary		Groom 2011; Saunders 1980
Hakea oleifolia	Dungyn	Tree		Primary		Groom 2011
Hakea pandanicarpa subsp. crassifolia	Thick-leaved hakea	Tall shrub		Primary		Groom 2011
Hakea petiolaris	Sea urchin hakea	Tall to medium shrub		Primary		Groom 2011
Hakea polyanthema		Medium or small shrub		Primary		Groom 2011
Hakea preissii	Needle tree	Tall shrub		Primary		Groom 2011
Hakea prostrata	Harsh hakea	Tall to mediumshrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010; Saunders 1980; Main Roads 2023
Hakea psilorrhyncha		Tall shrub		Primary		Groom 2011
Hakea ruscifolia	Candle hakea	Tall shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010; Saunders 1980
Hakea scoparia	Kangaroo bush	Tall shrub		Primary		Groom 2011
Hakea smilacifolia		Medium or small shrub		Primary		Groom 2011
Hakea spp.			Secondary	Primary		DoEE 2017; DSEWPaC 2012; Saunders 1979
Hakea stenocarpa	Narrow-fruited hakea	Medium or small shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010
Hakea spathulata		Medium or small shrub		Primary		Groom 2011

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
Hakea sulcata	Furrowed hakea	Medium or small shrub		Primary		Groom 2011
Hakea trifurcata	Two-leaved hakea	Tall shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010; Saunders 1980; Main Roads 2023
Hakea undulata	Wavey-leaved hakea	Tall shrub	Secondary	Primary		Groom 2011; Johnstone et al. 2010; Saunders 1980; Main Roads 2023
Hakea varia	Variable-leaved hakea	Tall shrub	Secondary	Primary		Groom 2011; Saunders 1980
*Harpephyllum caffrum**	Kaffir plum	Tree			Secondary	Johnstone et al. 2017
*Helianthus annuus**	Sunflower	Herb		Secondary		Groom 2011; Johnstone et al. 2010
Hibiscus sp.	Hibiscus	Tall shrub		Secondary		Groom 2011
Isopogon scabriusculus		Medium or small shrub		Primary		Groom 2011
*Jacaranda mimosifolia**	Jacaranda'	Tree	Secondary	Secondary		Groom 2011; Johnstone et al. 2010
Jacksonia furcellata	Grey stinkwood	Medium or small shrub		Secondary		Groom 2011
Kingia australis	Kingia	Tree-like monocot	Secondary			Johnstone et al. 2010
Lambertia inermis	Chittick	Tree		Secondary		Groom 2011; Johnstone & Storr 1998
Lambertia multiflora	Many-flowered honeysuckle	Medium or small shrub		Secondary		Groom 2011; Saunders 1980
*Liquidamber styaciflua**	Liquid amber	Tree		Primary	Secondary	Groom 2011; Groom 2014; Johnstone et al. 2010
Lupinus sp.*	Lupin	Herb		Secondary		Groom 2011; Saunders 1980
*Macadamia integrifolia**	Macadamia	Tree	Secondary	Primary		Grooms 2011; Groom 2014; Johnstone et al. 2010
*Malus domestica**	Apple	Tree	Secondary	Secondary		DoEE 2017; DSEWPaC 2012; Groom 2011; Johnstone & Storr 1998; Johnstone et al. 2010
Melaleuca leuropoma		Medium or small shrub		Secondary		Groom 2011; Saunders 1980
*Melia azedarach**	Cape lilac or white cedar	Tree		Secondary	Primary	Groom 2011; Johnstone et al. 2010
Mesomeleana spp.		Grass		Primary		Groom 2011; Johnstone et al. 2010
*Olea europea**	Olive	Tree			Secondary	Johnstone et al. 2017
Persoonia longifolia	Snottygobble	Tree or shrub			Secondary	DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010; Johnstone & Kirkby 1999; Johnstone & Storr 1998
*Pinus caneriensis**	Canary island pine	Tree		Secondary		Groom 2011; Johnstone et al. 2010
*Pinus caribea**	Caribbean pine	Tree		Secondary		Groom 2011; Johnstone et al. 2010
*Pinus pinaster**	Pinaster or maritime pine	Tree		Primary		Groom 2011
*Pinus radiata**	Radiata pine	Tree	Secondary	Primary		Groom 2011; Johnstone et al. 2010
Pinus spp.*		Tree	Secondary	Primary		DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010; Johnstone & Storr 1998; Saunders 1979
*Protea**	'Pink Ice'	Tree or tall shrub		Primary		Groom 2011

Species	Common name	Habit	Baudin's cockatoo	Carnaby's cockatoo	FRTBC	Reference
*Protea repens**		Tree or tall shrub		Primary		Groom 2011
Protea spp.*		Tree or tall shrub		Secondary		Johnstone et al. 2010
*Prunus amygdalus**	Almond tree	Tree		Primary		DoEE 2017; Groom 2011; Johnstone et al. 2010; Johnstone & Storr 1998
*Pyrus communis**	European pear	Tree	Secondary			DoEE 2017; DSEWPaC 2012; Johnstone et al. 2010; Johnstone & Storr 1998
*Quercus spp.**		Tree	Secondary			Johnstone et al. 2010
*Raphanus raphanistrum**	Wild radish	Herb		Secondary		DoEE 2017; Groom 2011
Reedia spathacea		Sedge	Secondary			Johnstone et al. 2010
*Rumex hypogaeus**	Doublegee	Herb		Secondary		Saunders 1980
*Stenocarpus sinuatus**		Tree		Secondary		Johnstone et al. 2010
*Syzygium smithii**	Lilly pilly	Tree or shrub		Secondary		Groom 2011
*Tipuana tipu**	Tipu or rosewood tree	Tree		Primary		Groom 2011, Groom 2014
Xanthorrhoea preissii	Grass tree	Grass	Secondary	Primary		Groom 2011; Johnstone et al. 2010
Xylomelum occidentale	Woody pear	Tree or tall shrub		Secondary		Groom 2011

*Not native to the study area

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Appendix D Tree survey

Tree ID	Species	DBH	Comments	Hollows[2]	H1 size	H1 type	H1 height
1	Jarrah	56	Suitable DBH no hollows	0			
2	Marri	70	Suitable DBH no hollows	0			
3	Jarrah	54	Suitable DBH no hollows	0			
4	Marri	50	Suitable DBH no hollows	0			
5	Marri	107	Suitable size no signs C	3	10 to 15cm	Knot angle suitable	to 10m
6	Jarrah	52	Suitable DBH no hollows	0			
7	Jarrah	51	Suitable DBH no hollows	0			
8	Jarrah	51	Suitable DBH no hollows	0			
9	Jarrah	54	Suitable DBH no hollows	0			
10	Jarrah	65	Suitable DBH no hollows	0			
11	Marri	55	Suitable DBH no hollows	0			
12	Marri	74	Suitable DBH no hollows	0			
13	Marri	50	Suitable DBH no hollows	0			
14	Jarrah	50	Suitable DBH no hollows	0			
15	Jarrah	54	Suitable DBH no hollows	0			
16	Marri	69	Suitable DBH no hollows	0			
17	Marri	58	Suitable DBH no hollows	0			
18	Blackbutt	70	Suitable DBH no hollows	0			
19	Jarrah	76	Suitable DBH no hollows	0			
20	Blackbutt	82	Suitable DBH no hollows	0			
21	Blackbutt	99	Suitable DBH no hollows	0			
22	Blackbutt	53	Suitable DBH no hollows	0			
23	Blackbutt	60	Suitable DBH no hollows	0			
24	Blackbutt	70	Suitable DBH no hollows	0			
25	Marri	59	Suitable DBH no hollows	0			
26	Marri	51	Suitable DBH no hollows	0			
27	Marri	65	Suitable DBH no hollows	0			
28	Marri	63	Suitable DBH no hollows	0			
29	Marri	57	Suitable DBH no hollows	0			
30	Jarrah	51	Suitable DBH no hollows	0			
31	Jarrah	54	Suitable DBH no hollows	0			
32	Jarrah	50	Suitable DBH no hollows	0			
33	Jarrah	67	Suitable DBH no hollows	0			
34	Jarrah	50	Suitable DBH no hollows	0			
35	Marri	66	Suitable DBH no hollows	0			
36	Jarrah	99	Suitable DBH no hollows	0			
37	Jarrah	50	Suitable DBH no hollows	0			
38	Jarrah	51	Suitable DBH no hollows	0			
39	Jarrah	53	Suitable DBH no hollows	0			
40	Marri	51	Suitable DBH no hollows	0			
41	Blackbutt	64	Suitable DBH no hollows	0			
42	Marri	51	Suitable DBH no hollows	0			
43	Jarrah	50	Suitable DBH no hollows	0			
44	Jarrah	55	Suitable DBH no hollows	0			
45	Marri	56	Suitable DBH no hollows	0			
46	Jarrah	50	Suitable DBH no hollows	0			

[2] Only most suitable hollow described

Tree ID	Species	DBH	Comments	Hollows[2]	H1 size	H1 type	H1 height
47	Marri	53	Suitable DBH no hollows	0			
48	Jarrah	58	Suitable DBH no hollows	0			
49	Marri	55	Suitable DBH no hollows	0			
50	Marri	66	Suitable DBH no hollows	0			
51	Marri	55	Suitable DBH no hollows	0			
52	Jarrah	54	Suitable DBH no hollows	0			
53	Jarrah	50	Suitable DBH no hollows	0			
54	Blackbutt	63	Suitable DBH no hollows	0			
55	Jarrah	67	Suitable DBH no hollows	0			
56	Marri	53	Suitable DBH no hollows	0			
57	Jarrah	56	Suitable DBH no hollows	0			
58	Marri	52	Suitable DBH no hollows	0			
59	Marri	54	Suitable DBH no hollows	0			
60	Marri	51	Suitable DBH no hollows	0			
61	Marri	71	Suitable DBH no hollows	0			
62	Blackbutt	50	Suitable DBH no hollows	0			
63	Marri	59	Suitable DBH no hollows	0			
64	Blackbutt	64	Suitable DBH no hollows	0			
65	Dead	100	Suitable DBH no hollows	0			
66	Blackbutt	60	Suitable DBH no hollows	0			
67	Blackbutt	80	Suitable DBH no hollows	0			
68	Marri	65	Suitable DBH no hollows	0			
69	Marri	62	Suitable DBH no hollows	0			
70	Marri	85	Suitable DBH no hollows	0			
71	Blackbutt	64	Suitable DBH no hollows	0			
72	Flooded gum	81	Suitable DBH no hollows	0			
73	Flooded gum	75	Suitable DBH no hollows	0			
74	Flooded gum	65	Suitable DBH no hollows	0			
75	Blackbutt	62	Suitable DBH no hollows	0			
76	Flooded gum	68	Suitable DBH no hollows	0			
77	Flooded gum	61	Suitable DBH no hollows	0			
78	Flooded gum	100	Suitable DBH no hollows	0			
79	Flooded gum	55	Suitable DBH no hollows	0			
80	Blackbutt	64	Suitable DBH no hollows	0			
81	Blackbutt	53	Suitable DBH no hollows	0			
82	Blackbutt	116	Suitable DBH no hollows	0			
83	Blackbutt	62	Suitable DBH no hollows	0			
84	Marri	57	Suitable DBH no hollows	0			
85	Jarrah	52	Suitable DBH no hollows	0			