



APPENDIX F

**LOCKYER PROJECT
ASSESSMENT FOR
CARNABY'S BLACK-
COCKATOO (BCE 2024)**



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**Energy Resources Limited Lockyer Project
assessment for Carnaby's Black-Cockatoo**

BACKGROUND

Energy Resources Limited, a wholly owned subsidiary of Mineral Resources Limited (MinRes), is planning to develop the Lockyer Gas Project, between Mingenew and Dongara in the mid-west region of Western Australia. The project consists of a network of wells and pipelines delivering to a central processing facility (CPF), and a pipeline to the west to connect to existing gas transport infrastructure (the Dampier to Perth Natural Gas Pipeline). The project consists mostly of linear infrastructure with larger areas for wells, and the largest area for the CPF (Figure 1).

The Lockyer Project lies within a landscape substantially cleared for agriculture (primarily grain cropping), but with some patches of remnant vegetation in blocks and along road reserves. The project area also straddles the Irwin River which retains a more or less continuous riverine woodland. Some planting of treelines for shelter and windbreak has taken place, using mostly non-native eucalypts.

Investigations for Environmental Impact Assessment (EIA) have been carried out and include targeted studies on assessing habitat suitability for Carnaby's Black-Cockatoo *Zanda* (formerly *Calyptorhynchus*) *latirostris*. These studies were carried out by Phoenix Environmental Sciences (2023a; 2023b) and addressed all species of conservation significance, but with Carnaby's Black-Cockatoo being of particular interest. Two surveys were undertaken as the infrastructure layout was altered between surveys. Studies focussed on Carnaby's Black-Cockatoo as the species is listed as Endangered under the federal *Environment Protection and Biodiversity Conservation* (1999) (EPBC Act), and as Schedule 2, Division 2 (Endangered) under the *WA Biodiversity Conservation Act* (2016), and the project area lies on the northern limit of the main breeding range of the species, but within its non-breeding range, as identified in the EPBC Act referral guidelines (DAWE 2022). The purpose of these studies was to determine if there was sufficient risk to the species posed by the proposed action to require the project to be referred under the EPBC Act to the federal Department of Climate Change, the Environment, Energy and Water (DCCEEW; formerly DAWE).

Phoenix Environmental Services (2023b) concluded that the study area (limited to development areas in their report) provided no nesting habitat and limited foraging habitat for Carnaby's Black-Cockatoo, and that therefore the species would be an irregular visitor. No comment was made on roosting in the area. Based on DAWE (2022), the project would therefore constitute a low risk to the species (no or negligible loss of breeding or foraging habitat) and would not require referral. However, there was uncertainty with some aspects of the report, such as the identification of large numbers of potential nest trees, and therefore MinRes requested Bamford Consulting Ecologists (BCE) to undertake a peer review of the report, and to provide advice

on the status and habitats of the species in the project area. This information is required to support the approval process and to better inform decisions surrounding referral.

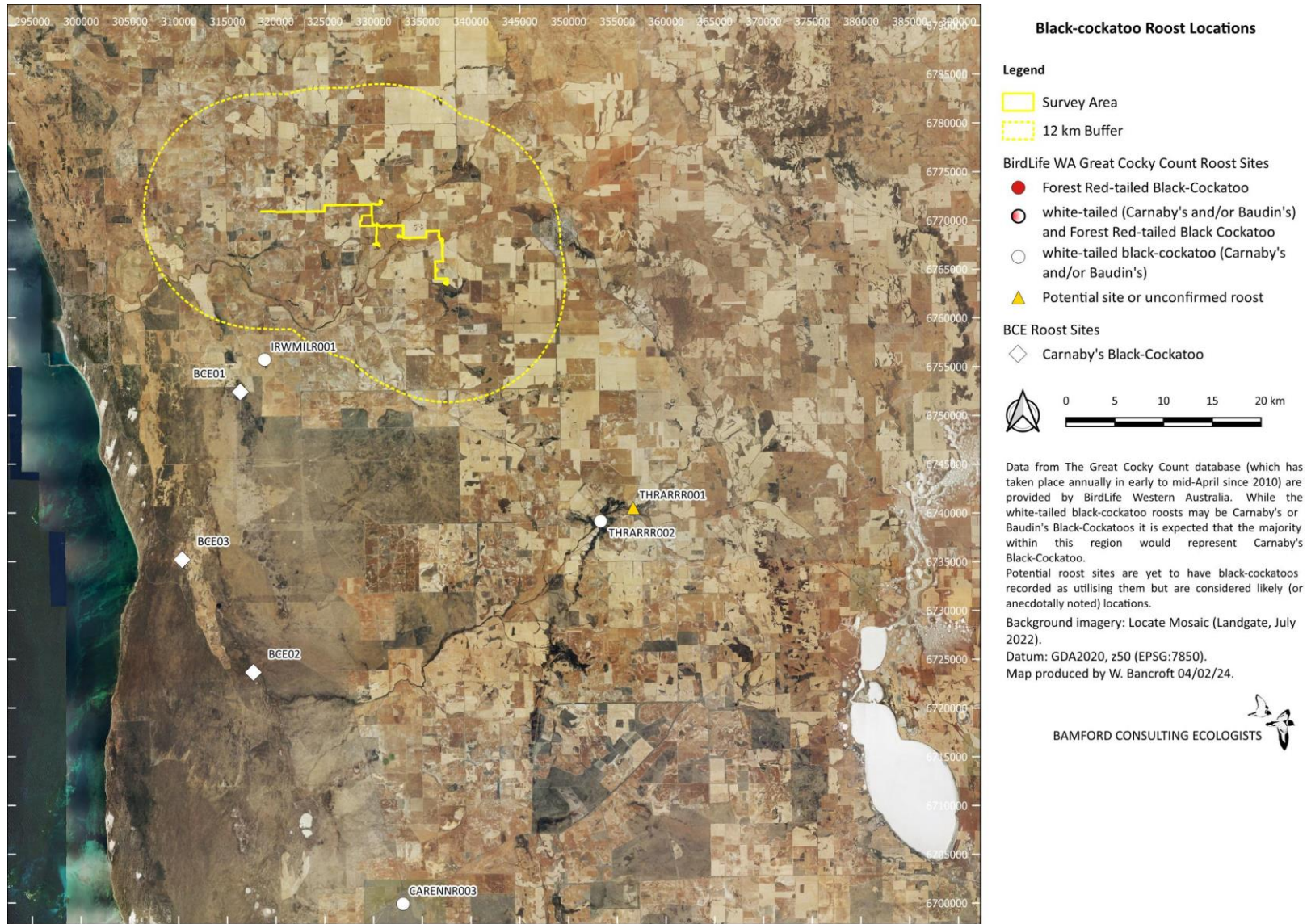


Figure 1. Overview map of the Lockyer Project area, including locations of known black-cockatoo roosts.

APPROACH

The approach for these investigations consists of a review of Phoenix Environmental Sciences (2023b; hereafter referred to as Phoenix), a site visit to familiarise BCE personnel with the project area, and preparation of a memo (this report) on the review of the previous report and including observations from the site visit and advice on the status and habitats of Carnaby's Black-Cockatoo in the project area and its surrounds.

The site inspection took place on 20th January 2024 and personnel were Dr Mike Bamford and Dr Wes Bancroft. Both have extensive experience with black-cockatoo assessments. Rachel Bagshaw (MinRes) guided BCE personnel. During the site inspection, the majority of the project area was visited (Figure 1), with notes and photographs being taken of the project area and its surrounds. Understanding the broader landscape is important to understanding how the species may utilise the area.

Advice on the status and habitat values of the project area for Carnaby's Black-Cockatoo is based upon methods developed by BCE for assessing the value of trees as potential nest trees (Appendix 1) and for assigning a foraging value to vegetation (Appendix 2).

Advice on the significance of impacts is also drawn from the referral guidelines (DAWE 2022) with the most relevant table reproduced in Appendix 3.

The following sections combine the review of the Phoenix reports, observations from the site inspection, and advice on the status and habitats of Carnaby's Black-Cockatoo in the project area under key headings related to the biology of the species.

POTENTIAL NEST TREES

Phoenix Environmental Sciences (2023b) based their nest tree assessment on guidance from DAWE (2022). This guidance is somewhat ambiguous and differs both from earlier versions, and from information in the Species Profile and Threats Database (SPRAT; DCCEE). For example, the guidance states that 'suitable nest hollows are only found in live trees with a DBH of at least 500 mm' (see Appendix 3), whereas earlier guidance and SPRAT set a minimum DBH of 300 mm for some eucalypt species (Wandoo and Salmon Gum), and put no limitation on trees being alive or dead. In other projects, BCE has recorded nests in dead trees, and nests in trees of around 300 mm DBH. The guidance does note that trees with a DBH in the range of 300-500 mm DBH have the potential to develop hollows in the future. In trying to interpret current guidance, Phoenix laboriously recorded locations and descriptions of all trees with a DBH >300 mm, although the guidance suggests such details only for nest trees, and suggest only 'An estimated number and location of potential nesting trees'. The trees recorded by Phoenix were almost all planted eucalypts within and adjacent to the development area so were in rows along fencelines (Plate 1) and occasionally in small plantations (Plate 2). Phoenix recorded 593 trees as potential nest trees, but 400 of these were in the 300-500 mm DBH range so only 193 trees had DBH >500 mm. Furthermore, only one tree (with a DBH >500 mm) had a hollow that might have been large enough for use by black-cockatoos. Another 38 trees had small hollows currently not suited for use by black-cockatoos. In photographs of some of the trees provided by Phoenix, many displayed a growth habit (sprawling and multi-stemmed) that meant they were unlikely ever to provide a more or less vertical hollow of sufficient size to be favoured by black-cockatoos. Using the BCE ranking system for assessing nesting potential of trees (see Appendix 1), and even accepting a minimum DBH of 300 mm, 552 of the trees would be assigned a rank of 5, the 40 trees with small hollows could be assigned a rank of 4,

while just one tree would be assigned a rank of 3. With the exception of that one tree, the trees recorded by Phoenix are therefore, at best, potential future breeding trees. This one tree is along the Midlands Road (Figure 2). This indicates an extremely limited nesting resource for Carnaby's Black-Cockatoo in the development area, and this resource is further limited by the low quality of forging habitat (see below). It should be noted that while these trees are in the development area, very few will be directly impacted as the pipeline in particular will run alongside lines of trees.

Phoenix assessed potential nesting trees only within the development area, whereas the largest trees in the landscape are along watercourses (Irwin River and branches). It is likely that if a thorough assessment for nest trees was carried out along the riverine woodland, potentially suitable nest trees would be found. Indeed, the Inland Red-tailed Black-Cockatoo (*Calyptrorhynchus banksia escondidus* - not listed as a significant species) is present in the area and very likely breeds in large tree hollows along watercourses. The project area crosses major watercourses in two locations (Michael's Crossing and Kelly's Crossing), and at both locations there were large trees (Plate 3 and Plate 4). The pipeline will be taken under the watercourses at these crossings using horizontal directional drilling, with entry points >50m from the treeline. The pipeline under rivers will be at a depth of at least 16m, so no impact on trees or on surface flow is expected. The majority of the pipeline alignment passes through farmland where no trees are present (Plate 5).

No information is provided by Phoenix on the nearest known breeding area. This would require requesting information from the government database.

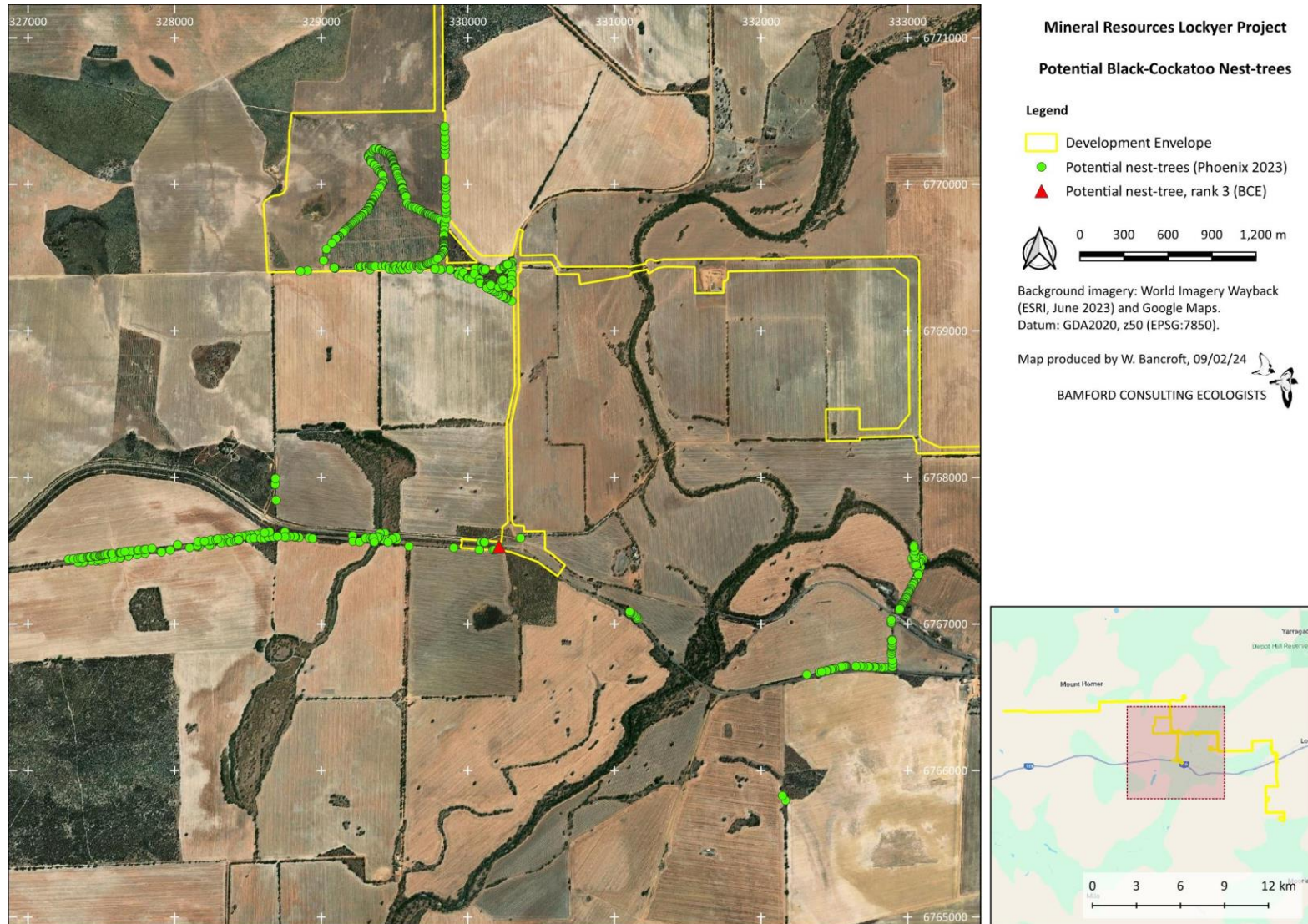


Figure 2. Distribution of potential nesting trees recorded by Phoenix Environmental. The red triangle indicates the location of the one tree that had a hollow possibly suitable for black-cockatoos.

FORAGING HABITAT

Phoenix assessed different vegetation types using the scoring tool developed by the DAWE (2022) and the BCE method (Appendix 2). As noted by Phoenix, the former method tends to over-estimate foraging value due to the assumption of a high value unless certain parameters are not met, and to no consideration being given to vegetation condition or to the details of plant species present. With the BCE method, there is recognition of vegetation type and actual quality of plants as foraging habitat, and allowance for the context and abundance of the species.

Phoenix recorded vegetation types only within the development footprint and concluded that using the BCE approach, all vegetation types had negligible or low foraging value (in contrast, the DAWE (2022) system gave some vegetation types a very high foraging value). The BCE site visit did not allow for a thorough survey of vegetation types, but there were some areas close to but outside the development footprint with vegetation types that had not been recorded by Phoenix. Table 1 presents a reassessment of foraging values of different vegetation types, including notes on some types not considered by Phoenix. Although outside the actual development footprint, these additional and adjacent vegetation types will affect the abundance of the species in the vicinity of the project.

In Table 1, it is proposed that Farmland, Non-native eucalypt plantations, *Tagyaste* plantation, Acacia shrubland and Eucalypt woodland be given a vegetation score of 1 and a total score of 1. In comparison, Phoenix assigned these vegetation types a score of 0. This difference is slight but Carnaby's Black-Cockatoo will occasionally feed in such areas, including taking the seeds of weeds in crops and pasture. Two vegetation types not recognised by Phoenix (Banksia Woodland and Mixed Woodland) are included as, although they lie outside the project area, they are nearby. Banksia low, open woodland occurred west of the CPF and along parts of the verge of Pincher's Road (Plate 6). It included *Banksia attenuata* which is a key forage species for Carnaby's Black-Cockatoo, as well as a small (few hectares) patch of *Banksia sessilis* thicket. These areas of woodland were partly degraded, largely due to livestock, but foraging signs of the species were found on Banksia woodland by Phoenix (their location L007) and in the BCE site visit very nearby (about 400m to the north of L007). The foraging signs found by BCE were *B. attenuata* cones from which seeds had been extracted and were about a year old, so foraging possibly occurred in Autumn 2023. The Banksia low woodland (foraging value 3; assigned a vegetation score of only 2/6 due to poor condition) and the Mixed woodland (foraging value 2; Plate 7) were a very small part of the landscape. Note that there were patches of food plants (*Hakea* sp.) in the Mixed woodland but the plants were at low density and often absent.

All vegetation types were assigned an abundance score of 0. This reflects the low abundance of Carnaby's Black-cockatoo in the area. They were not observed during the (brief) BCE inspection or the more extensive field investigations carried out by Phoenix. Mineral Resources personnel (R. Bagshaw pers. comm.) report very occasional sightings of small groups. Foraging signs found by BCE were old and only at one location, which further suggest the species is present only intermittently and in small numbers.

While there are slight differences between the Phoenix and BCE interpretation, overall the landscape provides limited foraging value for Carnaby's Black-Cockatoo. Even the highest foraging value vegetation, the banksia low woodland, is of low foraging value and small in extent. Furthermore, it is so degraded that the foraging value is likely to decline over the next few decades.

Table 1. Foraging value of broad vegetation types based on the BCE method (Appendix 2).

Vegetation type	Vegetation score (/6)	Context score (/3)	Abundance score (/1)	Total (/10)
Farmland (cleared)	1	0	0	1
Non-native eucalypt plantation	1	0	0	1
<i>Tagysaste</i> plantation	1	0	0	1
<i>Acacia</i> shrubland	1	0	0	1
Eucalypt woodland (including riparian)	1	0	0	1
Banksia open, low woodland (north-west of the CPF and part of Pincher's Road verge; outside development area)	2	1	0	3
Mixed woodland, shrubland and native pine (south of Ned Deep Well and north-east of the CPF; outside development area)	2	0	0	2

NB. Where vegetation score is 0-2, context and abundance scores are set to zero except where they can be used to recognise subtle differences in value. In this case, the Banksia low woodlands are the only examples of these key foraging species being present and thus have a small context value.

ROOSTING HABITAT

The Phoenix report mentions roosting habitat but makes no mention of the key source of information for roosting locations in the region (the Great Cocky Count (GCC) database) and provides no comment on roosting habitat in the study area or within the region. It does state that there are no known roosts within 20km, but according to the GCC database, there are two roosts within 20km lying to the south-west (Figure 1) [Error! Reference source not found.](#). All known roosts in the region are within or close to the large areas of native vegetation (largely kwongan and banksia low woodlands) in the Beekeepers' and Yandanogo Reserves and adjacent crown land. The 12 km buffer used on [Error! Reference source not found.](#) is the maximum distance birds are likely to fly from a nesting site when foraging (Saunders 1980). Ryken *et al.* (2023) provide data to show that daily distances travelled outside the breeding season can be much greater than this, although with average daily distances (not in a straight line) of c. 8 to 21km.

Although no roosts are recorded in the project area or nearby, surveys for the GCC are incomplete, while the occasional sightings of Carnaby's Black-Cockatoo indicate that birds may roost occasionally at sites not recorded, although at <20km from the project area, the two known roosts to the south-west may be the source of the occasional bird seen in the area. The species favours tall trees or groups of tall trees near water for roosting (DAWE 2022) and therefore there are abundant potential roost sites along the Irwin River.

CONCLUSIONS

The Lockyer Project area lies within the range of Carnaby's Black-Cockatoo, but the species is almost certainly an irregular, non-breeding visitor for the following reasons:

- There are few records of either birds or foraging signs despite multiple visits by experienced scientists. The species has almost certainly declined in the region as widely discussed in the literature.
- There is little foraging habitat and none of even moderate quality. This is partly due to the nature of the landscape but also due to extensive clearing for agriculture. Remnant areas of Banksia low woodland are only of low foraging value as they are badly degraded, with such decline in condition likely to continue unless management actions are taken. This banksia woodland would formerly have been more extensive, but much of the original native vegetation in the area consisted of eucalypt woodlands and shrubland that would only have been of low (3/10), or possibly low-moderate (4/10) foraging value.
- There is some breeding habitat in large trees along the Irwin River (outside impact areas), with some of these trees almost certainly having hollows of suitable dimensions to support breeding by Carnaby's Black-Cockatoo. Almost all the trees recorded within or adjacent to the development area as potential nest trees by Phoenix are highly unlikely to be suitable for breeding (currently). Only one of the 593 trees recorded had a possibly suitable hollow (location indicated on Figure 2), and 400 of the trees were below the DAWE (2022) criterion for potential nest trees.
- While breeding habitat is present along the Irwin River, the limited extent and poor quality of foraging habitat is very unlikely to support breeding.



Plate 1. Non-native eucalypts planted along a fenceline around the proposed CPF.



Plate 2. Plantation of non-native eucalypts south-west of the CPF.



Plate 3. A large River Red Gum Eucalyptus camaldulensis at Michael's Crossing. Rank of 4 as a potential nest tree



Plate 4. A River Red Gum Eucalyptus camaldulensis at Kelly's Crossing. Probably rank of 4 as a potential nest tree but there is a hollow only just too small for black-cockatoos (arrowed).



Plate 5. Route of pipeline across paddocks south of Michael's Crossing.



Plate 6. Banksia low, open woodland north-west of the CPF. Note dead trees and absence of understorey.



Plate 7. Mixed woodland and shrubland south of Ned Deep Well. The vegetation is degraded along the margin with farmland but in moderate to good condition elsewhere.

REFERENCES

- DAWE (2022). DAWE (2022). Referral guideline for 3 WA threatened black-cockatoo species: Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and the Forest Red-tailed Blackcockatoo, Department of Agriculture, Water and the Environment, Canberra, February.
- Phoenix Environmental Sciences (2023a). Targeted fauna survey for the Lockyer Development Project. June 2023.
- Phoenix Environmental Sciences (2023b). Targeted fauna survey for the Lockyer Development Project. Prepared for Energy Resources Limited. December 2023.
- Ryken, S., Warren, K.S., Yeap, L., Jackson, B., Mawson, P.R., Dawson, R. and Shephard, J.M. (2023). Movement of Carnaby's Black-Cockatoo (*Zanda latirostris*) across different agricultural regions in Western Australia. Pacific Conservation Biology doi:10.1071/PC23015.
- Saunders, D. A. (1980). Food and movements of the Short-billed form of the White-tailed Black Cockatoo. Australian Wildlife Research 7: 257-269.

Appendix 1. Ranking system for the assessment of potential nest trees for Black-Cockatoos (revised 8/01/21).

Ranks	Description of tree and hollows/activity
1	Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.
2	Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old.
3	Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows <5m so in a Wheatbelt breeding site a lower criterion may be more appropriate.
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. Trees with low but otherwise suitable hollows can also be assigned a rank or 4, depending on the species of black-cockatoo likely to be present.
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.

NB. Black-cockatoos favour vertical hollows for the nest chamber, but the hollow entrance may be vertical (a chimney hollow), have a side entrance or have a horizontal spout entrance.

Appendix 2. Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos. Revised 6th February 2023

Bamford Consulting Ecologists

Introduction

Application of the Offset Assessment Guide (offsets guide) developed by the federal environment department for assessing Black-Cockatoo foraging habitat requires the calculation of a score out of 10. The following system has been developed by Bamford Consulting Ecologists (BCE) with assistance from Quessentia Consulting to provide an objective scoring system that is practical and can be used by trained field zoologists with experience in the environments frequented by the species.

The foraging value score provides a numerical value that reflects the significance of vegetation as foraging habitat for Black-Cockatoos, and this numerical value is designed to provide the information needed by the Federal Department of Agriculture, Water and the Environment (DAWE) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. It can also be influenced by the abundance of the species (referred to as species stocking rate) at the site. The BCE scoring system for value of foraging habitat has three components as detailed above. These three components are drawn from the DAWE offsets guide (<https://www.agriculture.gov.au/sites/default/files/documents/offsets-how-use.pdf>).

but the scoring approach was developed by BCE and includes a fourth (moderation) component.

Note that the scoring system can only be applied within the range of the species or at least where the species could reasonably be expected to occur based upon existing information.

Calculating the total score (out of 10) requires the following steps:

- A Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus
- B Site context. Determining a score out of three for the context of the site; plus
- C Species stocking rate. Determining a score out of one for species density.
- D Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

The BCE scoring system places the greatest weight on site condition (scale of 0 to 6) because this has the highest influence on the foraging values of a site, which in turn is the fundamental driver in meeting ecological requirements for continued survival.

Site context has a lower weight (scale of 0 to 3) in recognition of the mobility of the species, which means they can access good foraging habitat even in fragmented landscapes, but allowing for recognition of the extent of available habitat in a region and context in relation to activity (such as breeding and roosting). The application of scoring site context is further discussed below.

Species stocking rate is given a low weight (0 to 1) as it is a means only of recognising that a species may or may not be abundant at a site, but that abundance is dependent upon site condition and context and is thus not an independent variable. The abundance of a species is also sensitive to sampling effort, and to seasonal and annual variation, and is therefore an unreliable indicator of actual importance of a site to a species.

Calculation of scores and the moderation process are described in detail below.

A. Site condition. Vegetation composition, condition and structure scoring

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
0	<p>No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> • Water bodies (e.g. salt lakes, dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes. • Mown grass 	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits). 	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).
1	<p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees; • Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source; • Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual). 	<p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. This could include urban areas with scattered foraging trees.</p>	<p>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.</p>

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
2	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> • Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover; • Woodland with tree banksias 2-5% projected foliage cover; • Eucalypt woodland/mallee of small-fruited species; • Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source. 	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> • Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover; • Urban areas with scattered foraging trees. • Paddocks with <i>Erodium</i> spp. and other weeds. 	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> • Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah or Sheoak) 1-5% projected foliage cover; • Urban areas with scattered food plants such as Cape Lilac, <i>Eucalyptus caesia</i> and <i>E. erythrocorys</i>. • Paddocks with <i>Erodium</i> spp. and other weeds.

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
3	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> • Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover; • Woodland with tree banksias 5-20% projected foliage cover; • Eucalypt Woodland with Marri 5- 10% projected foliage cover. • Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly degraded understorey (poor long-term viability without management); 	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> • Eucalypt Woodland with known food plants (especially Marri) 5-10% projected foliage cover; • Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly degraded understorey (poor long-term viability without management); • Managed revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability). • Paddocks with <i>Erodium</i> spp. and other weeds at a high density or close to high value forest. 	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> • Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly-degraded understorey (poor long-term viability without management); • Managed revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).

Site Score	Description of Vegetation Values		
	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/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover; Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover; Eucalypt Woodland/Forest with Marri 20-60% projected foliage cover. Depending on understorey condition (and thus long-term viability) and Marri density, may downgrade to 3 or upgrade to 5. 	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. Eucalypt Woodland/Forest with diverse, healthy understorey and known food trees (especially Marri) 10-20% projected foliage cover. Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits). 	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; Sheoak Forest with 40-60% projected foliage cover.
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover; Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; Pine plantations with trees more than 10 years old (but see pine note below in moderation section). 	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Forest with 40-60% projected foliage cover; Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. 	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Forest with 40-60% projected foliage cover; Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. Sheoak Forest with > 60% projected foliage cover.

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
6	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term). 	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> Marri-Jarra Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term). 	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> Marri-Jarra Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).

Vegetation structural class terminology follows Keighery (1994).

B. Site context.

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access foraging sites. Based on BCE observations, Black-Cockatoos are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with DEE, provides a *guide* to the assignment of site context scores. Note that 'local area' is defined as within a 15 km radius of the centre point of the study site. This is greater than the maximum distance of 12km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

Site Context Score	Percentage of the 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%	1 - 5%
0	< 0.1%	< 1%

The table above provides weighting for where nearby breeding is known (or suspected) and for the proportion of foraging habitat within 15km represented by the site being assessed. Some adjustments may be needed based on the judgement of the assessor and in relation to the likely function of the site. For example, a small area of foraging habitat (eg 0.5% of such habitat within 15km) could be upgraded to a context of 2 if it formed part of a critical movement corridor. In contrast, the same sized area of habitat, of the same local proportion, could be downgraded if it were so isolated that birds could never access it. Adjustments to context score are further discussed below (moderation of scores).

C. Species density (stocking rate).

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignment of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is 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 used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate condition score that is part of a network of such habitat where a black-cockatoo species is known would get a species

density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low.

D. Moderation of scores for the calculation of a value out of 10.

The calculation out of 10 requires the vegetation characteristics (out of 6) to be combined with the scores given for context and species density. It is considered that the context and density scores are not independent of vegetation characteristics; otherwise habitat of absolutely no value for black-cockatoo foraging (such as concrete or a wetland) could get a foraging score out of 10 as high as 4 if it occurred in an area where the species breed (context score of 3) and are abundant (species density score of 1). Similarly, vegetation of negligible or low characteristics which could not support black-cockatoos could be assigned a score as high as 6 out of 10. In that case, the score of 6 would be more a reflection of nearby vegetation of high characteristics than of the foraging value of the negligible to low scoring vegetation. The Black-Cockatoos would only be present because of vegetation of high characteristics, so applying the context and species density scores to vegetation of low characteristics would not give a true reflection of their foraging value.

For this reason, the context and species density scores need to be moderated for the vegetation characteristic score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. A simple approach is to assign a context and species density score of zero to sites with a Condition score of low (2), negligible (1) or none (0), on the basis that birds will not use such areas unless they are adjacent to at least low-moderate quality foraging habitat (≥ 3). The approach to calculating a score out of 10 can be summarised as follows:

vegetation composition, condition and structure score (out of 6)	context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances; such as when very close to a major breeding area or if strategically located along a movement corridor. It could also get an elevated context score if it is the only foraging habitat in an area and birds are present, and also if it is immediately alongside at least moderately good foraging habitat, on the basis that birds are more likely to utilise it if they are nearby. Species density score might also be raised if there is a high likelihood of the birds actually being present. Context score can also be used to give a fine adjustment to the total score, such as if there are two vegetation types with the same vegetation composition score, but one may be slightly better foraging habitat and covers a larger area. Moderation is a means by which fairly subtle differences in overarching foraging value can be recognised.

Pine plantations

Pine plantations are an important foraging resource for Carnaby's Black-Cockatoo (only) but are not directly comparable with native vegetation. In comparing native vegetation with pine plantations for the purpose of calculating offsets, the following should be noted:

- Pine plantations are a commercial crop established with the intention of being harvested and thus have short-term availability (30-50 years), whereas native vegetation is available indefinitely if protected. Due to the temporary nature of pines as a food source, site condition and context differs between pines and native vegetation.
- Although pines provide a high abundance of food in the form of seeds, they are a limited food resource compared with native vegetation which provides seeds, insect larvae, flowers and nectar. The value of insect larvae in the diet of Carnaby's Black-Cockatoo has not been quantified, but in the vicinity of Perth, the birds forage very heavily on insect larvae in young cones of *Banksia attenuata* in winter, ignoring the seeds in these cones and seeds in older cones on the same trees (Scott and Black 1981; M. Bamford pers. obs.). This suggests that insect larvae are of high nutritional importance immediately prior to the breeding season.
- Pine plantations have very little biodiversity value other than their importance as a food source for Carnaby's Black-Cockatoos. They inhibit growth of other flora. While this is not a factor for direct consideration with respect to Carnaby's Black-Cockatoo, it is a factor in regional conservation planning of which offsets for the cockatoos are a part.

Taking the above points into consideration, it is possible to assign pine plantations a foraging value as follows:

- Site condition. The actual foraging value of pines is high. Stock *et al.* (2013) report that it takes nearly twice as many seeds of *Pinus pinaster* to meet the daily energy requirements for Carnaby's Black-Cockatoo compared with Marri, and three times as many *P. pinaster* seeds compared with Slender Banksia. However, pines are planted at a high density so the food supply per hectare can be high. Taking account of the lack of variety of food from pines, this suggests a site condition score of 4 or 5 out of 6 (5 is used in Section A above). As a source of food, pines are thus comparable to the best banksia woodland. This site condition score then needs to be adjusted to take account of the short-term nature of the food supply (for pine plantations to be harvested. Where pines are 'ornamental, such as in some urban contexts, they can be treated as with other trees in urban landscapes). The foraging value of a site after pines are harvested will effectively be 0, or possibly 1 if there is some retention. It is proposed that this should approximately halve the site condition score; young pine plantations could be redacted slightly less than old plantations on the basis that a young plantation provides a slightly longer term food supply. If a maximum site condition score of 5 is given, then a young plantation (>10 but <30 years old) could be assigned a score of 3, and an old plantation (>30 years old) could be assigned a score of 2. Plantations <10 years old and thus not producing large quantities of cones could also get a score of 2, but recognising they may increase in value.
- Site context. Although a temporary food source, pines can be very important for Carnaby's Black-Cockatoo in some contexts; they could be said to carry populations in

areas where there is little native vegetation. The system for assigning a context score as outlined above (Section B) also applies to pines. Thus, a context score of 3 can be given where pines are a significant proportion of foraging habitat (>5% if breeding occurs; >10% if no breeding), but where pines are a small part of the foraging landscape they will receive a context score of less than this.

- Species density. As outlined above (Section C), pines will receive a species density score of 1 where Carnaby's Black-Cockatoo are regular visitors. This is irrespective of an old plantation having a moderated condition score of 2.

Based on the above, pine plantations that represent a substantial part of the foraging landscape, such as in the region immediately north of Perth, would receive a total score (out of 10) of 6; young plantations in this area would receive a score of 7. In contrast, isolated and small plantations in rural landscapes could receive a score of just 2 if they are only a small proportion of foraging habitat and Carnaby's Black-Cockatoos are not regularly present.

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Appendix 3.

(Table A2) Types of additional information that might be considered during the assessment and approval stage.

Type of habitat	Types of additional information
Breeding	<ul style="list-style-type: none"> • The number and location (e.g., in or adjacent to breeding habitat; in normal breeding range; away from breeding habitat; or outside of known breeding range.) of known nesting trees, i.e. trees of each species currently or recently used for breeding. • The number and location of suitable nesting trees, i.e. trees of each species with suitable hollows. • An estimated number and location of potential nesting trees. Potential nesting trees have a suitable diameter at breast height (DBH) to develop a nest hollow, but do not have hollows. For most species of trees, suitable nest hollows are only found in live trees with a DBH of at least 500 mm. Trees suitable to develop a nest hollow in the future are 300-500 mm DBH. Note that many species of eucalypt may develop suitable hollows for breeding. • Landscape characteristics around the impact site, including details of foraging habitat in proximity (e.g. up to 12 km) to the breeding habitat and the location and details of watering points that could support the use of the breeding habitat.
Night roosting	<ul style="list-style-type: none"> • The number and location of trees of each species currently or recently used for night roosting (known night roosting site). • The frequency of use of the night roost site (daily, weekly, monthly or annually). • The potential of the site to be used as night roosting despite no evidence of roosting (including the number and size of potential roosting trees). • Landscape characteristics around the impact site, including details of foraging habitat in proximity (e.g. up to 20 km) to the night roosting habitat and the location and details of watering points that could support the use of the night roosting habitat.
Foraging	<ul style="list-style-type: none"> • The presence, extent and density (including foliage cover and flowering density) of all plant species that provide foraging, including non-native food sources used by black cockatoos. • The distribution and size of foraging habitat in proximity (e.g. up to 12 km) to the impact site. • Presence and prevalence of plant disease (such as dieback disease <i>Phytophthora</i> spp., Marri Canker (<i>Quambalaria coyrecup</i>) or any other plant diseases), or impact site degradation (such as cleared, disturbed or degraded areas). • The fire history of the impact site. • Landscape characteristics around the impact site, including details of roosting and breeding habitat in proximity (e.g. up to 20km for roosting and 12km for breeding) and the location and details of watering points that could support the use of the foraging habitat.

Extracted from DAWE 2022, *Referral guideline for 3 WA threatened black-cockatoo species: Carnaby's, Baudin's and the Forest Red-tailed Black- Cockatoos*. Department of Agriculture, Water and the Environment, Canberra, February.