Basic Fauna and Targeted Black Cockatoo Assessment

Stock Road Corridor, Bullsbrook

Project No: EP20-089(03)

Prepared for Department of Planning, Lands and Heritage
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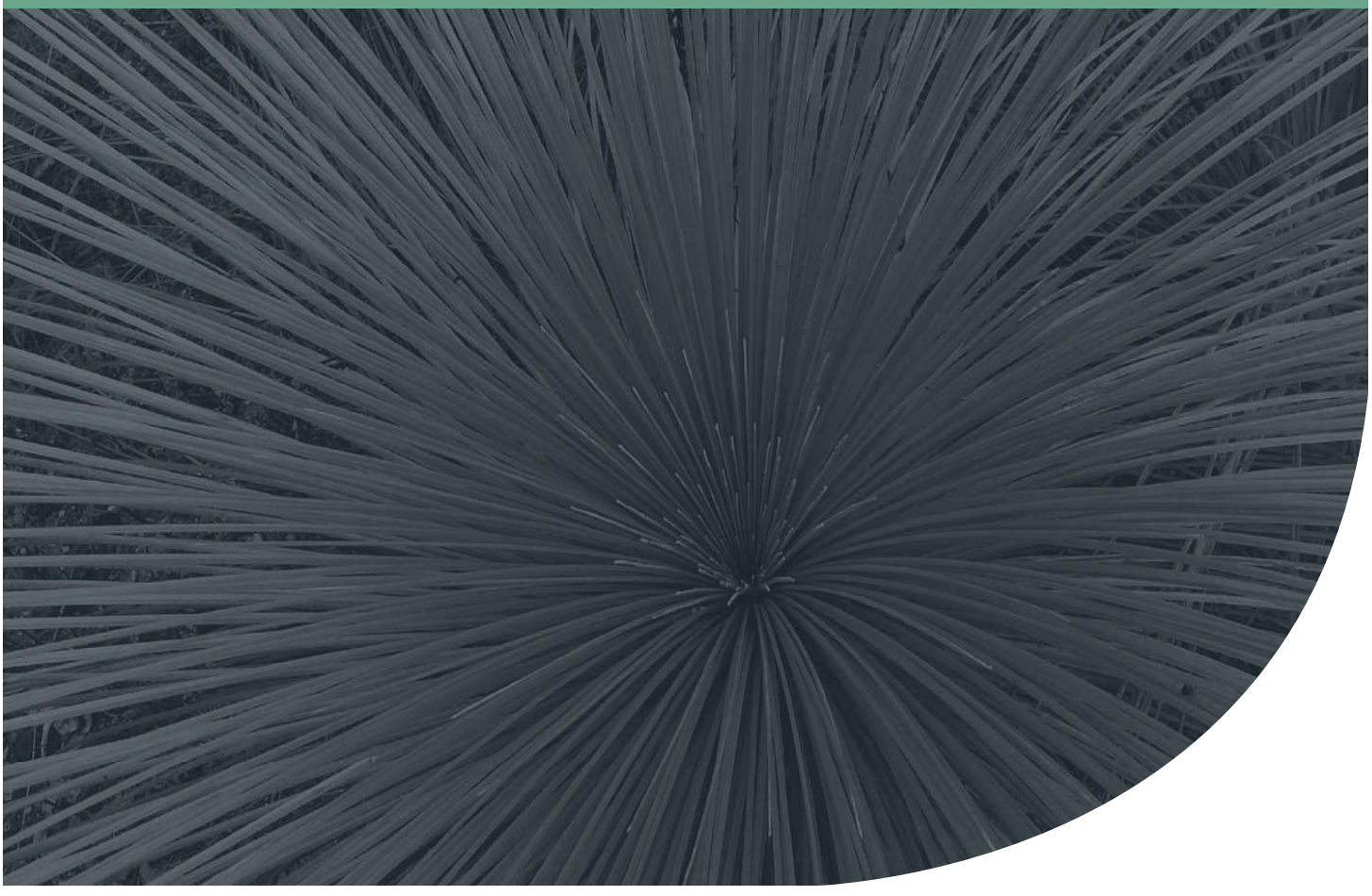

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Executive Summary

The Department of Planning, Lands and Heritage (DPLH) are undertaking a range of investigations with respect to the potential widening of a portion of Stock Road in Bullsbrook, between Tonkin Highway and Great Northern Highway (referred to as the 'site'). Emerge were engaged to conduct a 'basic' fauna and a 'targeted' black cockatoo assessment to provide information on the fauna values within the site to inform the planning process for the site.

As part of the assessment a desktop review of relevant background information was completed, and a field survey was undertaken on 9 September 2020. During the field survey the fauna habitat within the site was mapped and its suitability to provide habitat for conservation significant fauna was determined. A targeted black cockatoo survey was also undertaken to determine the presence of habitat for threatened black cockatoo species.

Outcomes of the basic fauna survey include the following:

- The majority of the site (85.26%) supports highly disturbed **grassland** habitat which provides limited habitat value to native fauna and is likely to be primarily used by common and widespread native and non-native fauna with non-specific habitat requirements. The highest fauna habitat value in the site is associated with the ***Acacia* spp. shrubland** habitat which occurs over 0.1% of the site.
- A total of 25 native and three introduced fauna species were recorded in the site, of which none are of conservation significance.
- Eight species of conservation significance were considered to have potential or are likely to occur within the site. Carnaby's cockatoo and forest red-tailed black cockatoo are considered likely to occur in the site. The pacific swift, peregrine falcon, quenda, rakali, Carter's freshwater mussel and *Leioproctus contrarius* (a shot tongued bee) are considered to have potential to occur within the site. Further targeted surveys would need to be undertaken to confirm if and to what extend these species utilise the site.

Outcomes of the targeted black cockatoo survey include the following:

- No records of black cockatoos were made during the field survey. However, the site occurs within the modeled distribution and breeding range of Carnaby's cockatoo and forest red-tailed black cockatoo and both species are considered likely to occur.
- A total of 98 habitat trees were recorded in the site, of which none contain hollows that are suitable for breeding by black cockatoos. Therefore, the site does currently not provide breeding habitat for any of the three species of black cockatoo.
- No evidence of black cockatoo roosting activity was observed within the site. Potential roosting habitat that is suitable for all three species of black cockatoo occurs within the site in the form of large native and non-native trees.
- A total of 1.58 ha of primary foraging habitat for Carnaby's cockatoo and 1.52 ha for forest red-tailed black cockatoo were recorded in the site. The site also contains 0.99 ha of secondary foraging habitat for Carnaby's cockatoo and 0.7 ha for forest red-tailed black cockatoo. Extensive areas of additional remnant native vegetation that may provide foraging habitat for both species of black cockatoo occur in the local area in proximity to the site.

- The overall black cockatoo habitat quality score for the site was determined to be four out of ten (moderate) for Carnaby's cockatoo and five out of ten (moderate) for forest red-tailed black cockatoo. The site scored highest for the foraging habitat component for forest red-tailed black cockatoo and highest for the breeding habitat component for Carnaby's cockatoo.

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DPLH	Department of Planning, Lands and Heritage
DPaW	Department of Parks and Wildlife (now DBCA)
DAWE	Department of Agriculture, Water and the Environment
WA Museum	Western Australian Museum

Table A2: Abbreviations – General terms

General terms	
EN	Endangered
EX	Extinct
VU	Vulnerable
MI	Migratory
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5

General terms	
BAM Act	*Biosecurity and Agriculture Management Act 2007*
EBPC Act	*Environment Protection and Biodiversity Conservation Act 1999*
BC Act	*Biodiversity Conservation Act 2016*

Table A4: Abbreviations – units of measurement

Units of measurement	
DBH	Diameter at breast height
cm	Centimetre
ha	Hectare
km	Kilometre
m	Metre
mm	Millimetre
m AHD	m in relation to the Australian height datum

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1 Introduction

1.1 Project background

The Department of Planning, Lands and Heritage (DPLH) are undertaking a range of investigations to inform the potential widening of a portion of Stock Road in Bullsbrook, between Tonkin Highway and Great Northern Highway. The area being investigated comprises the Stock Road reserve and portions of adjacent private properties (an area referred to herein as the 'site'). The site is approximately 56.56 hectares (ha) in size and is shown in **Figure 1**.

The site is located approximately 31 kilometres (km) north east of the Perth Central Business District and comprises multiple different zones and reserves under the Metropolitan Region Scheme, including 'rural', 'primary regional roads', 'other regional roads', 'railways' and 'industrial'. Similarly, the site is zoned a combination of 'general rural' and 'landscape' and reserved for 'regional reserve - other regional road' and 'regional reserve – railway' under the City of Swan Local Planning Scheme 17.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by DPLH to provide environmental consultancy services to support the planning process for the site. The purpose of this assessment is to provide sufficient information on the fauna values within the site to inform this process, with particular focus on identifying habitat for threatened species of black cockatoo.

The scope of work was specifically to conduct a terrestrial vertebrate fauna assessment to the standard required of a 'basic' fauna survey and a 'targeted' black cockatoo survey with reference to the *Environmental Protection Authority's* (EPA's) technical guidance (EPA 2020) and the *Environment Protection and Biodiversity Conservation* Act black cockatoo referral guidelines (DSEWPaC 2012a). Note that a basic fauna survey was referred to as a 'level 1' survey in previous EPA technical guidance documentation (EPA 2016).

As part of this scope of work, the following tasks were undertaken:

- Desktop assessment of relevant background information pertaining to the site and surrounds, including database and literature searches for fauna species.
- Field survey to identify fauna species and fauna habitats within the site, including potential habitat for species of black cockatoo.
- Compilation of a list of fauna species with potential to occur within the site as identified from the desktop assessment and opportunistically recorded as part of the field survey.
- Identification of potential habitat for conservation significant fauna species and an assessment of likelihood of occurrence.
- An assessment of the quality of black cockatoo habitat within the site.
- Mapping of fauna and black cockatoo habitat.
- Documentation of the desktop assessment, survey methodology and results into a report.

2 Environmental Context

2.1 Climate

Climate has a strong influence on the fauna habitat and species present in a region and a site. The south west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters.

A total of 66.6 millimetres (mm) of rainfall was recorded between September and December 2020 prior to the field survey from the Pearce RAAF WA weather station (Bureau of Meteorology (BoM) weather station number 009053), which is the closest weather station, located approximately 1.9 km north of the site. Temperatures at the Pearce RAAF WA weather station, which is the closest temperature recording weather station, ranged from a mean minimum of 10.1^{0}C to a mean maximum of 21.5^{0}C (BoM 2021).

The total rainfall recorded in September 2020 when the field survey was undertaken (refer **Section 3.2**) was similar to the average rainfall of 68.2 mm for September recorded from the Pearce RAAF WA weather station between 1937 and 2020 (BoM 2021). The mean maximum and minimum temperatures recorded for September 2020 were also similar to the average temperatures recorded at the Pearce RAAF WA weather station which range from a mean minimum of 8.8^{o}C to a mean maximum of 20.1^{0}C in December (BoM 2021).

2.2 Geomorphology and soils

Landform and soils influence fauna habitat and species at regional and local scales. The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area.

The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side has formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side is comprised of three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004).

The site lies on the eastern side of the Swan Coastal Plain which comprises the Pinjarra Plain geomorphological unit. The Pinjarra Plain comprises a relatively flat landscape, but also supports numerous channels that result in waterlogging and the formation of seasonal swamps (Seddon 2004).

Examination of soil mapping places the majority of the site within the 'Beermullah' soil association, which is described as 'poorly drained plain; saline and solonetzic soils, bog iron ore and some shallow sands over bog iron' (Churchward and McArthur 1980). The western portion of the site lies within the 'Yanga' soil association, which is described as a 'poorly drained plain with grey sandy benches and intervening swamps; also areas of bog iron ore, marl' (Churchward and McArthur 1980). The eastern portion of the site lies within the 'Guildford' soil association, which is described as a 'flat plain with medium textured deposits; yellow duplex soils' (Churchward and McArthur 1980). The soil associations mapped within the site by Churchward and McArthur (1980) are shown in **Figure 2**.

The site is not known to contain any restricted landforms or unique geological features.

2.3 Topography

The elevation of the site ranges from 35 m in relation to the Australian height datum (mAHD) on the western side of the site to 41 mAHD on the eastern side of the site, with the central portion of the site being the lowest at 26 mAHD near Ellen Brook (DoW 2008) (**Figure 2**).

2.4 Hydrology and wetlands

Wetlands include "areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries" (Wetlands Advisory Committee 1977). Many wetlands provide important fauna habitat and support high levels of fauna biodiversity and endemism.

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance* (DBCA 2017e)
- *A Directory of Important Wetlands in Australia* (DBCA 2018*)*.

No Ramsar or listed 'important wetlands' are located within or near the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2020) shows the following three wetland or water related features in the site that are associated with Ellen Brook, as shown in **Figure 3**.

- watercourse - major, non-perennial
- watercourse - minor, non-perennial
- drain – major.

On the Swan Coastal Plain the Department of Biodiversity, Conservation and Attractions (DBCA) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) (DBCA 2017d). DBCA maintains the *Geomorphic Wetlands of the Swan Coastal Plain* dataset, which further categorises geomorphic wetland features into specific management categories to guide land use and conservation (DBCA 2020). Note that as this dataset was drafted at a regional scale the boundaries of mapped wetland features are often inconsistent with physical wetland boundaries.

A review of the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DBCA 2020) indicated that the following wetland features occur within the site:

- Two large 'multiple use' category wetland (MUW) features (UFIs 15282 and 15732) classified as palusplain wetlands occur across the majority of the site. UFI 15282 occurs in the eastern portion of the site and extends beyond the site to the north, east and south. UFI 15732, named

'Ellen Brook Floodplain', occurs in the western portion of the site and extends beyond the site to the north, west and south.

- One 'conservation' category wetland (CCW) feature (UFI 15734) lies between the UFIs 15282 and 15732 in the central portion of the site, and extends beyond the site to the north and south. This feature is named 'Ellen Brook Floodplain' and generally aligns with the Ellen Brook watercourse. A small portion of another 'conservation' category wetland feature (UFI 12433) lies in the south eastern portion of the site. Both of these features are classified as palusplain wetlands.

The locations of the geomorphic wetlands in the site are shown in **Figure 3**.

2.5 Regional vegetation

Vegetation types and resulting fauna habitats strongly influence the diversity and composition of fauna taxa present within an area. Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000). The site is contained within the 'SWA02' or Perth subregion, which is characterised as mainly containing *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla* (marri) on less leached soils (Beard 1990). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic fauna species.

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Vegetation association mapping by Beard *et al.* (2013) shows the majority of the site as comprising vegetation association 'Pinjarra 4'. This association is described as 'medium woodland; marri (*Corymbia calophylla*) and wandoo (*Eucalyptus wandoo*)' (Beard *et al.* 2013). The eastern portion of the site is mapped as vegetation association 'Pinjarra 3' which is described as 'medium forest; jarrah (*Eucalyptus marginata*) – marri' (Beard *et al.* 2013).

2.6 Historic land use

Review of historical images available from 1965 onwards shows that the portion of Stock Road within the site was present as a dirt track from at least 1965 and was later sealed in parts (WALIA 2021). The majority of the site was cleared of native vegetation prior to 1965 and vegetation clearing since then appears to have been minor. Vegetation in the western portion of the site within the rail reserve appears to have been subject to disturbance since 1965 and intensive vegetation clearing is visible in the image from 2000 when the railway crossing was bituminised. Revegetation (or natural regeneration) is visible along the railway reserve in the image from 2004.

2.7 Significant fauna

2.7.1 Threatened fauna species

Certain fauna taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, fauna taxa may be listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval.

In Western Australia fauna species may also be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act). It is an offence to 'take' or 'disturb' threatened fauna without Ministerial approval.

Threatened fauna species listed under the EPBC Act and/or BC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Further information on threatened species and their categories is provided in **Appendix A**.

2.7.2 Priority fauna species

Fauna species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the Department of Biodiversity, Conservation and Attractions (DBCA) *Priority Fauna List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes. Further information on priority species and their categories is provided in **Appendix A**.

2.7.3 Migratory fauna species

Migratory fauna species that migrate to Australia and its external territories or pass though or over Australian waters during their annual migrations are protected under Commonwealth and State legislation. At a Commonwealth level, migratory fauna taxa may be listed as 'migratory' under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval. Further information on migratory species is provided in **Appendix A**.

2.7.4 Specially protected fauna species

In Western Australia, fauna species that are of special conservation interest, including migratory species, cetaceans, species subject to international agreement or species otherwise in need of special protection may be listed as 'specially protected' under the BC Act. Further information on specially protected species and their categories is provided in **Appendix A**.

2.7.5 Pest fauna species

The term 'pest fauna' can refer to any animal that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Pest fauna species are generally not native but some Australian or West Australian fauna may also be considered pests.

A particularly invasive or detrimental pest species may be listed as a 'declared pest' pursuant to Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread. Further information on categories of declared pests is provided in **Appendix A**.

2.8 Black cockatoos

Three threatened species of black cockatoo occur in the south west of Western Australia (referred to herein collectively as 'black cockatoos'):

- *Calyptorhynchus latirostris* (Carnaby's cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Calyptorhynchus baudinii* (Baudin's cockatoo) which is listed as 'endangered' under the EPBC Act and the BC Act.
- *Calyptorhynchus banksii naso* (forest red-tailed black cockatoo) which is listed as 'vulnerable' under the EPBC Act and the BC Act.

Broad-scale maps are available for the modelled distribution of Baudin's cockatoo, Carnaby's cockatoo and forest red-tailed black cockatoo (DSEWPaC 2011; DoEE 2016a, c). The modelled distribution maps also include 'known breeding areas' and 'predicted breeding range' for Baudin's cockatoo and 'breeding range' and 'non-breeding range' for Carnaby's cockatoo. No breeding range modelling is available for forest red-tailed black cockatoo but the species is known to breed mainly in the jarrah forest region (DBCA 2017b) and in small populations on the Swan Coastal Plain within the Baldivis, Stake Hill, Lake McLarty and Capel area and increasingly in the Perth metropolitan area (DAWE 2020).

Each black cockatoo species has a defined breeding season, with Baudin's cockatoo breeding from August/September to February/March and Carnaby's cockatoo breeding from July/August to January/February (DSEWPaC 2012b). Forest red-tailed black cockatoo breeds in October/November but may breed in March/April if there is good autumn rainfall (DSEWPaC 2012b). There is also evidence that forest red-tail black cockatoos breed throughout the year, with peaks in April – June and August – October (Johnstone *et al.* 2013).

Black cockatoo habitat is conventionally separated into breeding, roosting and foraging categories.

2.9 Black cockatoo habitat

2.9.1 Breeding habitat

Black cockatoos nest in hollows that form in large trees and so 'breeding habitat' is typically assessed as 'habitat' trees. Generally, habitat trees are native eucalypts with a hollow that is suitable for a black cockatoo to nest within or that are of sufficient size that a suitable nest hollow could develop in time (DSEWPaC 2012b). Any tree that has a suitable hollow may provide breeding habitat for black cockatoos. However, as a tree may need to be more than 200 years old before it develops a suitable hollow, remnant native eucalypts are most likely to be recorded as habitat trees.

The suitability of a tree hollow for use by black cockatoos is principally contingent on its physical dimensions and orientation. Local studies indicate that to be suitable a hollow must generally:

- have an entrance opening of at least 10 cm but preferably 20-30 cm (Saunders *et al.* 1982; Groom 2010; Johnstone *et al.* 2013) (Groom 2010; Saunders et al. 1982; Johnstone et al 2013)
- be located at least 3 m from the ground (Saunders 1979b; Johnstone and Storr 1998; Groom 2010; Saunders 2014)

- be located in a trunk or branch that is generally large enough to contain a hollow that has a floor diameter of at least 40 cm and depth of 50-200 cm such that it could house an adult black cockatoo and nestlings (Saunders 1979a; Johnstone and Storr 1998; Saunders 2014; DPaW 2015)
- have vertical or near vertical orientation (Johnstone and Kirkby 2008; Johnstone *et al.* 2013).

The minimum size for a habitat tree is typically determined through measurement of trunk 'diameter at breast height' (DBH). For most native eucalypts minimum DBH is defined as ≥50 centimetres (cm). However, for some eucalypts such as *Eucalyptus wandoo* (wandoo) and *Eucalyptus salmonophloia* (salmon gum) that are known to form suitable hollows at smaller size a DBH of ≥30 cm is applied (DSEWPaC 2012b).

Breeding habitat is also generally expected to be located within 7 km of food and water resources (Saunders 1990).

Department of Environment and Conservation (DEC, now Department of Biodiversity, Conservation and Attractions (DBCA)) and fauna experts, have identified and mapped breeding habitat used by Carnaby's cockatoo in the Swan Coastal Plain and Jarrah Forest regions (Glossop *et al.* 2011). This dataset includes point records of breeding from a range of sources. Breeding sites were classified as 'confirmed' where eggs or chicks were recorded and 'possible' where observations relating to Carnaby's cockatoo breeding that did not include actual records of eggs or chicks (e.g. chewed hollows or records of breeding or nesting behaviour by an expert observer).

A 12 km buffer applies to each site to 'reflect the flexible use of these areas by cockatoos and to indicate the important zone for access to potential feeding habitat' (Glossop *et al.* 2011). Glossop *et al.* (2011) state that the areas mapped in the dataset are not a comprehensive record of Carnaby's cockatoo breeding and that many nesting sites remain unknown.

While this dataset only applies to Carnaby's cockatoo, the information it contains is also applicable for Baudin's cockatoo and forest red-tailed black cockatoo as they have similar breeding habitat requirements. That is, breeding habitat that is suitable for Carnaby's cockatoo is likely to also be suitable for Baudin's cockatoo and forest red-tailed black cockatoo, if located within the latter species respective breeding range.

BirdLife Australia also maintain a database of confirmed black cockatoo breeding sites which is accessible via a paid search system. BirdLife Australia have advised that their database is comprised of data collected during surveys by staff and volunteers of which most (>99%) surveys are of Carnaby's cockatoo. BirdLife Australia further advises that their dataset is not comprehensive and that an absence of nest records does not necessarily indicate a lack of breeding activity.

The Carnaby's cockatoo recovery plan also identifies 13 'important bird areas' for Carnaby's cockatoo, which are identified as 'sites of global bird conservation importance' (DPaW 2013b). These 'important bird areas' comprise sites supporting at least 20 breeding pairs or 1% of the population regularly utilising an area in the non-breeding part of the range.

2.9.2 Roosting habitat

Roosts are trees that black cockatoos reside and rest within during the day and overnight. Generally, roosting habitat comprises taller trees which may be native or non-native species (DSEWPaC 2012b).

Roosts are often located near a water source and within 6 km to 12 km of foraging resources (Shah 2006; DSEWPaC 2012b; Le Roux 2017). The use of a particular roost site may vary over time depending on the local availability of water and food.

BirdLife Australia undertakes annual monitoring of black cockatoo overnight roost sites as part of the annual 'Great Cocky Count' community-based survey. Information gathered from these monitoring events provides roost locations and records of black cockatoo numbers (Peck *et al.* 2019).

2.9.3 Foraging habitat

Black cockatoos feed on the fruit and seeds of a range of native and non-native plants species. 'Foraging habitat' is therefore vegetation that contains plant species known to be foraged on by black cockatoos.

Glossop et al. (2011) mapped 'areas requiring investigation as Carnaby's cockatoo feeding habitat' for the Swan Coastal Plain and Jarrah Forest regions, based on regional vegetation mapping that may contain plant species known to be foraged upon by Carnaby's cockatoo. Note that this dataset does not include observations or point records of Carnaby's cockatoo feeding. This dataset represents areas of vegetation that may potentially provide foraging habitat for Carnaby's cockatoo.

Given this dataset was created in 2011 and in order to account for clearing of native vegetation that has occurred since this time, Emerge have updated this dataset using the current native vegetation extent as provided by DPIRD (2019a) to only show potential foraging habitat that currently exists (Emerge Associates 2020a).

Pine plantations also provide an important food source for Carnaby's cockatoo, but were not included in the Glossop et al. (2011) dataset. Mapping of pine plantations is available from the Forest Products Commission (Forest Products Commission 2020).

The Glossop et al. (2011) dataset is broadly applicable to other black cockatoos as many plant species that are foraged upon by Carnaby's cockatoo are also consumed by Baudins' cockatoo (e.g. fruit of *Banksia* spp., *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah)) and forest red-tailed black cockatoo (e.g. jarrah and marri fruit). However, using the Glossop et al. (2011) potential foraging habitat dataset for forest red-tailed cockatoos likely overestimates available foraging habitat as it includes multiple plant species that are not consumed by this species (e.g. *Banksia* spp.), and to a lesser extent the foraging value is also over-estimated for Baudin's cockatoo.

Emerge Associates (2020b) have used a similar methodology to Glossop et al. (2011) to define potential foraging habitat for forest-red tailed cockatoos. Specifically, DBCA (2019) regional vegetation complex mapping has been used to determine which areas of remnant vegetation support plant species known to be foraged upon by forest red-tailed cockatoos, including *Allocasuarina fraseriana* (sheoak), *Corymbia calophylla* (marri), *Eucalyptus gomphocephala* (tuart) and *Eucalyptus marginata* (jarrah). Where these vegetation complexes intersect remnant vegetation mapped by DPIRD (2019b) they were considered to represent potential foraging habitat for forest red-tailed cockatoos.

2.10 Bush Forever

The Government of Western Australia's Bush Forever policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of *Bush Forever* is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 2000). *Bush Forever* sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

Bush Forever Site 296 (Ellen Brook, Upper Swan) lies within the central portion of the site and generally aligns with the Ellen Brook watercourse. This linear site extends beyond to the north and south, connecting to other *Bush Forever* sites. The location of the part of Bush Forever Site 296 associated with the site is shown in **Figure 3**.

2.11 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection* (Clearing of Native Vegetation) *Regulations 2004* and have been identified to protect native vegetation values of areas surrounding values such as significant wetlands, threatened flora, threatened communities and *Bush Forever* sites. Within an ESA none of the exemptions under the *Environmental Protection* (Clearing of Native Vegetation) *Regulations 2004* apply. However, exemptions under Schedule 6 of the EP Act still apply, which includes any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

Two ESAs are located within the eastern portion of the site. One is a circular shape and extends to the south of the site, appearing to be associated with UFI 12433 (refer **Section 2.4**). The other occurs as a linear shape in the site and appears to be associated with the Ellen Brook watercourse, and also extends north and south of the site. The locations of these ESAs in relation to the site are shown in **Figure 3**.

2.12 DBCA managed or legislated land

DBCA has tenure of or interests in numerous areas of land across the state for a range of purposes. Tenure categories include national parks, nature reserves, conservation parks, marine parks, marine nature reserves, marine management areas, section 5(1)(g) reserves, state forest and timber reserves. These areas are mapped within the *Legislated Lands and Waters (DBCA 2017a)* and *Lands of Interest* (DBCA 2017c) datasets. The *Legislated Lands and Waters (DBCA 2017a)* dataset includes lands subject to the following legislation; the *Conservation and Land Management Act 1984* (CALM Act 1984), *Swan and Canning Rivers Management Act 2006* (SCRM Act) and lands identified under the *Land Administration Act 1997* (LA Act). The *Lands of Interest* (DBCA 2017c) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands comprise of crown land and freehold land which DBCA has been acknowledged by the Department of Lands as the responsible agency.

No DBCA managed or legislated lands and waters are located within or adjacent to the site. Multiple DBCA managed or legislated lands or waters are located within the wider area of the site. The closest

DBCA legislated lands to the site are Walyunga National Park located approximately 1.5 km to the east, Twin Swamps Nature reserve approximately 1.7 km to the south and Gnangara-Moore River State Forest approximately 2.9 km to the west. The locations of these lands in relation to the site are shown in **Figure 3**.

2.13 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). This study was extended beyond the Perth Metropolitan Region through the South West Biodiversity Project, resulting in the identification and mapping of the South West regional ecological linkages (Molloy *et al.* 2009).

One mapped ecological linkage (No. 27) occurs within the site. This linkage is associated with Ellen Brook watercourse and extends beyond the site to the north and south, connecting to other linkages. The location of this linkage is shown in **Figure 3**.

2.14 Previous surveys

Emerge previously undertook a 'Level 1' fauna assessment in combination with a targeted black cockatoo assessment of a portion of the site in February 2019 (Emerge Associates 2019), on behalf of the City of Swan. The site boundary for the previous survey encompassed the central portion of the current site boundary. Eight fauna habitats were identified within the site. One conservation significant fauna species, forest red-tailed black cockatoo, was observed within the site. A total of 83 black cockatoo habitat trees were recorded in the site, of which none contained hollows that are suitable for breeding by black cockatoos. Approximately 4.71 ha of potential black cockatoo foraging habitat was recorded in the site. A dusk roost survey was also undertaken and no roosting by black cockatoos was detected in the site.

Harewood (2010) conducted a 'Level 1' fauna assessment in combination with a targeted black cockatoo assessment over a larger area which included the northern portion of the site. The survey identified small areas of potential foraging, breeding and roosting habitat for black cockatoos were identified. No records of conservation significant fauna species were made during the field survey.

3 Methods

3.1 Desktop assessment

3.1.1 Basic fauna

A search was conducted for fauna species that have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2020a), *NatureMap* (DBCA 2021), DBCA's conservation significant fauna database (reference no. FAUNA6602), previous surveys and literature references.

3.1.2 Targeted black cockatoo

A search was conducted of publicly available regional studies and spatial datasets that provide information on black cockatoo records and potential habitat mapping (Glossop *et al.* 2011; DPaW 2013a; DoEE 2016a, c, b; Emerge Associates 2020a, b).

3.2 Field survey

One ecologist from Emerge visited the site on the 9 September 2020 during the day to conduct the basic fauna survey and targeted black cockatoo field survey. The survey was conducted from approximately 10:00 AM until 3:00 PM.

The weather conditions prior to and during the survey were warm and dry with temperatures ranging from a minimum of 9°C to maximum of 25°C (AccuWeather 2021).

3.2.1 Basic fauna

Transects were traversed across the site, during the day, and the characteristics of fauna habitat and presence of fauna species was recorded. Microhabitats such as logs, rocks and leaf litter were investigated and secondary evidence of species presence such as tracks, scats, skeletal remains, foraging evidence or calls was also noted.

An opportunistic fauna species list was compiled and fauna habitat values were described, with particular reference to conservation significant fauna species with potential to occur within the site.

3.2.2 Targeted black cockatoo

Transects were traversed across the site and the presence of potential black cockatoo breeding, night roosting and foraging habitat was recorded. If observed, the presence of black cockatoos within or near the site was noted. Active searches for secondary evidence of breeding, roosting and foraging activity such as chew marks, branch clippings, droppings, moulted feathers and chewed marri or banksia fruit were conducted.

3.2.2.1 Breeding habitat

A 'habitat tree' was defined as a native eucalypt that is typically known to support black cockatoo breeding such as marri, jarrah, blackbutt, tuart, wandoo, salmon gum or to a lesser extent flooded gum, with a DBH ≥50 cm or DBH ≥30 cm for wandoo or salmon gum. As any tree that has a suitable hollow may provide breeding habitat for black cockatoos, other tree species were also considered to be habitat trees if they contained a suitable hollow.

To be suitable for use as breeding habitat by black cockatoos it was considered a hollow must:

- have an entrance opening of at least 10 cm but preferably 20-30 cm (Saunders *et al.* 1982; Groom 2010; Johnstone *et al.* 2013).
- be located at least 3 m from the ground (Saunders 1979b; Johnstone and Storr 1998; Groom 2010; Saunders 2014).
- be located in a trunk or branch that is generally large enough to contain a hollow that has a floor diameter of at least 40 cm and depth of 50-200 cm such that it could house an adult black cockatoo and nestlings (Saunders 1979a; Johnstone and Storr 1998; Saunders 2014; DPaW 2015).
- have vertical or near vertical orientation (Johnstone and Kirkby 2008; Johnstone *et al.* 2013).

Occasionally, native eucalypts were encountered that met DBH requirements but did not contain a trunk/branch of a sufficient size to support a hollow suitable for use by black cockatoos. For example, the tree may have been less than 3 m tall or had a trunk that forked between 1.3 m and 3 m in height and after the fork no limbs had a diameter such that they could contain a suitable hollow. These trees were not recorded as habitat trees as the likelihood they would ever form a suitable hollow was low.

Habitat trees were individually identified, tagged and the attributes outlined in **Table 1** were recorded for each tree.

Table 1: Attributes recorded for each habitat tree in the site

Attribute	Description
Tag	Unique identifier on a metal tag was nailed to each habitat tree
Image	Each habitat tree was individually photographed
GPS location	The location of each habitat tree was recorded using a handheld GPS unit
Tree species	Species and common name were identified
Diameter at breast height (DBH) (cm)	DBH was measured at breast height (1.3 metres) using a diameter tape
Hollows potentially suitable for breeding by a black cockatoo	Number of hollows potentially suitable for breeding by a black cockatoo (assessed from ground level only)

Hollows that appeared potentially suitable for use by a black cockatoo from the ground were further inspected using a drone and/or a pole-mounted camera. During the hollow inspection the internal dimensions of the hollow were confirmed, if possible, and an assessment was made for signs of use such as chew marks around the hollow entrance, nesting material, feathers or the presence of birds within the hollow.

All recorded habitat trees were assigned to a category listed in **Table 2**.

Table 2: Habitat tree categories

Category	Specifications
Nest	The tree contains a hollow used by black cockatoos for breeding as confirmed by records of black cockatoos, their eggs or fledglings or other evidence of recent nesting activity by black cockatoos
Potential nest	The tree contains one or more hollows that are suitable for use by black cockatoos as breeding habitat as confirmed by internal hollow inspection^ and evidence of use by an unidentified bird such as feathers, chew marks or nest material has been recorded within a hollow
Suitable hollow(s)	The tree contains one or more hollows that are suitable for use by black cockatoos as breeding habitat as confirmed by internal hollow inspection^
Potentially suitable hollow(s)	The tree contains or is suspected to contain one or more hollows that have the potential to be suitable for use by black cockatoos when either viewed from the ground or following an internal hollow inspection that was inconclusive^
No suitable hollow(s)	The tree does not contain hollow(s) that have the potential to be suitable for use by black cockatoos when viewed from the ground or contains hollows that were determined to be unsuitable for use by black cockatoos by internal inspection^

*^Hollow determined to be suitable for use as breeding habitat by black cockatoos as listed above in **Section 3.2.2.1***

3.2.2.2 Roosting habitat

The site was assessed for the presence of active or historical roosts and its potential to provide roosting habitat for black cockatoos. Groups of tall native and non-native trees were generally assumed to provide potential roosting habitat.

No evening roost survey was undertaken within the site. The site was searched during daytime surveys on other dates for secondary evidence of roosting activity, such as branch clippings, droppings or moulted feathers.

3.2.2.3 Foraging habitat

Foraging habitat was identified by comparing the literature on plant species known to be foraged upon by black cockatoos (Davies 1966; Saunders 1980; Johnstone and Storr 1998; Johnstone and Kirkby 1999; Groom 2011; Johnstone *et al.* 2011; DSEWPaC 2012a) against the vegetation within the site.

Foraging habitat was then further classified as primary or secondary foraging habitat. Primary foraging plants were defined as those with historical and contemporary records of regular consumption by black cockatoos. Secondary foraging plants were defined as plants that black cockatoos have been recorded consuming occasionally or that, based on their limited extent or agricultural origin, should not be considered a sustaining resource. Each patch of foraging habitat was assigned a percentage cover value for primary and secondary foraging plants and non-foraging plants (that is the balance of the patch that was neither a primary or secondary foraging option). A list of plant species classified as primary or secondary foraging plants is provided as **Appendix B**.

Secondary evidence of black cockatoo foraging, such as chewed marri, jarrah, tuart or banksia fruits, was searched for within the site and allocated to a species where possible. The locations of black cockatoo foraging evidence within the site were mapped using a hand-held GPS unit.

3.3 Data analysis

3.3.1 Desktop assessment

A total number of species within the desktop assessment search area was calculated by adding the total count of non-conservation significant species provided by *NatureMap* to the combined number of conservation significant species provided by *NatureMap* and *Protected Matters Search Tool*.

Habitat requirements of conservation significant vertebrate fauna was specifically reviewed in relation to habitat within the site to determine a total number of conservation significant fauna species with potential to occur. Fauna species with no potential to occur within the site were excluded from this count (e.g. marine mammals and marine fish).

3.3.2 Fauna habitat

Fauna habitats were described according to the dominant flora species and vegetation type present, as determined from observations made during the field survey and information provided in the '*Detailed Flora and Vegetation Assessment'* (Emerge Associates 2021b). The identified fauna habitats were mapped on aerial photography with the boundaries interpreted from aerial photography, previously identified plant communities (Emerge Associates 2021b) and notes taken in the field.

3.3.3 Likelihood of occurrence

Information on habitat preferences and distribution of conservation significant fauna species with potential occur within the site or wider area was reviewed and assessed against the general site conditions and fauna habitat types recorded during the field survey.

Based on the results of the desktop assessment and information recorded during the field survey, an assessment of the likelihood of occurrence of conservation significant fauna within the site was undertaken using the categories outlined in **Table 3**.

Table 3: Likelihood of occurrence assessment categories and definitions

Likelihood	Definition
Recorded	The species was recorded during the current field survey or during previous field surveys.
Likely	The site contains suitable habitat for the species and it is likely the species may occur based on presence of a recent historical record within or close to the site.
Possible	The site contains habitat of at least marginal quality and/or extent for the species and the site is located within the known distribution range of the species which is supported by recent literature records from near the site.
Unlikely	The site contains no or marginal habitat for the species and/or no recent literature records occur near the site.

3.3.4 Black cockatoo habitat

Habitat trees were classified according to the scheme outlined in **Table 2** and mapped on aerial imagery. A complete summary of the recorded attributes of habitat trees was compiled in a tabular format.

Foraging habitat was mapped on aerial photography with the boundaries interpreted from aerial photography and notes taken in the field.

Foraging habitat was described according to the dominant flora species and vegetation type present, as determined from observations made during the field survey. Primary and secondary foraging habitat was mapped on aerial photography with the boundaries interpreted from aerial photography and notes taken in the field. Patches of vegetation comprising a combination of primary and secondary foraging plants were mapped as 'mixed' foraging habitat. As it was not always possible to separate non-foraging plants from foraging plants, some of the mapped foraging habitat may also include a proportion of non-foraging plant species.

3.3.4.1 Overall black cockatoo habitat quality

As part of environmental impact assessment and offset calculation, the Department of Agriculture, Water and the Environment (DAWE) requires that a score out of ten is provided for the overall quality of back cockatoo habitat (DAWE 2020). DAWE does not provide a methodology for scoring habitat quality but instead specifies that an assessment of quality should be undertaken by an experienced technical expert (DSEWPaC 2012a).

Emerge have developed a method to provide a systematic assessment of overall back cockatoo habitat quality. The method assesses and scores the quality of breeding, roosting and foraging habitat separately and then provides an overall quality score out of ten, based on the highest score determined for the respective habitat categories. The assessment methodology is detailed in **Appendix C**.

3.4 Nomenclature and sources of information

Taxonomy and nomenclature of scientific and common names for fauna species follow *the Western Australian Museum* (WAM) Checklist of the *Terrestrial Vertebrate Fauna of Western Australia* (WAM 2020). Where common names were not provided by *Western Australian Museum* (WAM 2020), these have been derived from other sources as noted.

Literature listed in **Appendix A** represent the main publications used to identify fauna species and habitats within the site.

3.5 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA's document *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) is provided in **Table 4**.

Table 4: Evaluation of survey methodology against standard constraints outlined in the EPA's Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)

Constraint	Degree of limitation	Details
Level of survey	No limitation	A basic survey (desktop study and field survey) in combination with a targeted black cockatoo survey was undertaken. The level of survey and survey effort are considered adequate to assess the fauna and black cockatoo habitat values within the site.
Scope	No limitation	The survey focused on vertebrate fauna and habitat values, with particular focus on black cockatoos and other conservation significant taxa with potential to occur within the site.
Proportion of fauna identified, recorded and/or collected.	No limitation	All observed vertebrate fauna were identified.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	No limitation	Adequate information was available from database searches and previous surveys.
The proportion of the task achieved and further work which might be needed.	No limitation	The task was achieved in its entirety.
Experience level of personnel	No limitation	This fauna assessment was undertaken by qualified ecologists with three-years' experience. Technical review was undertaken by a senior environmental consultant with 10 years' experience in ecological surveys in Western Australia
Suitability of timing, weather and season	No limitation	Survey timing is not considered to be of great importance for basic fauna assessments. The weather conditions during the survey were usual for the time of year and timing is therefore not considered a limitation to this fauna assessment.
Completeness	No limitation	The desktop assessment, field survey and targeted black cockatoo components of the survey were completed comprehensively.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
Survey intensity	Minor limitation	Only the 3 m of Lot 1361 closest to Stock Road could be accessed and so some of the habitat trees located within this lot could not be accessed sufficiently enough to assess the presence and suitability of hollows. Therefore, a combination of inspecting trees from the edge of the accessed area and using habitat tree information previously recorded by Emerge Associates (2019) was used for the current assessment. It is assumed that the value of habitat trees previously recorded has not changed in the intervening period. However, it is possible that hollows and/or additional habitat trees could have been missed. In addition, an internal hollow inspection could not be undertaken for habitat trees located in the area that was not able to be accessed.
Influence of disturbance	No limitation	The intensity of the survey was adequate given the size of the site and the habitat values present.
Adequacy of resources	No limitation	The site is highly modified due to historical disturbance. However, no recent disturbance was noted that may have affected outcomes of the survey.

Table 4: Evaluation of survey methodology against standard constraints outlined in the EPA's Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020) (continued)

Constraint	Degree of limitation	Details
Compliance with EPA (2020) guidance	Minor limitation	The EPA guidance requires that a full list of all fauna species with potential to occur within the site is compiled. As part of this assessment a comprehensive list of fauna species of conservation significance was compiled. Non-conservation taxa with potential to occur within the site were not compiled into a list but are provided as raw data in **Appendix D**. Given that all species with potential to occur within the site are still identified within the relevant appendices this is not considered to affect the outcomes of this assessment.
	Very minor limitation	The EPA guidance recommends that the *Australian Faunal Directory* (DAWE 2020b) nomenclature is used for bird species. This assessment uses the WAM *Checklist of the Terrestrial Vertebrate Fauna of Western Australia* (WAM 2020) nomenclature for birds and therefore does not strictly comply.

4 Results

4.1 General site conditions

The site is located on a flat to gently sloping plain, with a channel present where the Ellen Brook watercourse intersects in a north-south direction. Soils in the site range from grey sand in the western portion including Ellen Brook, to red/brown sand/clay in the eastern portion.

All roads within the site are bituminised, except the central portion of Stock Road which is a sand track. A single-track railway line with level bitumen crossing is present in the western portion of the site, adjacent to Railway Parade. The remainder of the site comprises road reserve and portions of private properties. The private properties are currently used for agricultural purposes such as stock grazing.

The road reserve, rail reserve and private properties in the site support a combination of native and non-native vegetation. The majority of the site comprises agricultural land with occasional native trees and shrubs over non-native pasture grasses. Many of the patches of native vegetation in the site are isolated and support a high cover of non-native grasses. Vegetation along Ellen Brook is part of a larger patch that extends beyond the site but comprises native trees over a predominantly non-native understorey. Vegetation in the rail reserve extends beyond the site and mainly comprises native shrubs and occasional trees over non-native vegetation. Native shrubland exists in a small portion of the rail reserve within the site and extends beyond the site to the north east.

4.2 Fauna habitat

Historical disturbance has significantly compromised habitat values within the site. The majority of the native vegetation has been cleared and the site now predominantly comprises non-native and weed species with scattered or patches of native and non-native trees and shrubs.

A total of nine fauna habitats were identified within the site: '***Casuarina obesa* forest**', '***Corymbia calophylla* and *Melaleuca huegelii* woodland**', '***Corymbia calophylla* forest**', '***Eucalyptus wandoo* woodland**', '**grassland**', '***Melaleuca* spp. shrubland**', '**Scattered native and non-native trees and shrubs**', '***Acacia saligna* shrubland**' and '**wooded creek line**'.

A description and the area of each habitat is provided in **Table 5** and representative photographs of each are provided in **Plate 1** to **Plate 9**. The location of each habitat is shown on **Figure 4**.

Table 5: Fauna habitats identified within the site

Fauna habitat classification	Description	Area (ha)
Casuarina obesa forest	Open forest *Casuarina obesa* over non-native grassland (**Plate 1**.	3.34
Corymbia calophylla and *Melaleuca huegelii* woodland	Occasional *Corymbia calophylla* over tall shrubland *Melaleuca huegelii* over closed non-native grassland over occasional *Baumea juncea* (**Plate 2**)	0.27
Corymbia calophylla forest	Forest *Corymbia calophylla* over non-native grassland (**Plate 3**).	0.55
Eucalyptus wandoo woodland	Woodland *Eucalyptus wandoo* over non-native grassland or occasional native species (**Plate 4**).	0.45
Grassland	Heavily disturbed areas comprising bare ground, pavement, roads or building structures (**Plate 5**).	48.23
Melaleuca spp. shrubland	Shrubland *Melaleuca viminea*/*M. rhaphiophylla*/*M. preissiana* over non-native grassland (**Plate 6**).	0.76
Scattered native and non-native trees and shrubs	Heavily disturbed areas comprising scattered native (*Eucalyptus wandoo*, *Corymbia calophylla, Eucalyptus rudis, *Eucalyptus gomphocephala*) and non-native trees over weeds and planted vegetation (**Plate 7**).	2.40
Acacia saligna shrubland	Tall shrubland *Acacia saligna* over shrubland to closed shrubland *Grevillea obtusifolia*, *Banksia telmatiaea*, *Regelia ciliata* and *Stylobasium australe* over herbland *Acanthocarpus canaliculatus* and *Scaevola lanceolata* over non-native grassland (**Plate 8**).	0.05
Wooded creek line	Creek line with open forest *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over sparse herbland *Lobelia anceps* over open non-native grassland (**Plate 9**).	0.51
Total		**56.56**

*Plate 1: **Casuarina obesa forest** habitat*

Plate 2: ***Corymbia calophylla and Melaleuca huegelii woodland*** *habitat*

Plate 3: ***Corymbia calophylla forest*** *habitat*

*Plate 4: **Eucalyptus wandoo woodland** habitat*

*Plate 5: **Grassland** habitat*

Plate 6: ***Melaleuca spp. woodland*** *habitat*

Plate 7: ***Scattered native and non-native trees and shrubs*** *habitat*

*Plate 8: **Acacia saligna shrubland** habitat*

*Plate 9: **Wooded creekline** habitat*

4.3 Fauna

4.3.1 Desktop assessment

A total number of 362 fauna species were identified from database searches as occurring or potentially occurring within 10 km of the site[1] as listed in **Appendix D.**

Of these species, 37 are conservation significant, including 17 threatened, nine priority, nine migratory fauna, one conservation dependent and one other specially protected species as listed in **Appendix E**.

4.3.2 Species inventory

A total of 25 native and three introduced fauna species were directly recorded during the field survey. None of the fauna species recorded during the field survey are of conservation significance. A complete species list is provided in **Appendix F**.

4.3.3 Conservation significant fauna

No fauna species of conservation significance were recorded within the site.

Eight fauna species of conservation significance were considered 'likely' or 'possible' to occur in the site based on habitat requirements, species distribution and site conditions as shown in **Table 6**.

The remainder of the conservation significant fauna species identified in the desktop assessment (29 species) are considered 'unlikely' to occur in the site due to lack of suitable habitat or because the site lies outside of the species known distribution. Fauna species classed as unlikely to occur are listed in **Appendix F**.

Table 6: Summary of conservation significant fauna species recorded or deemed possible or likely to occur within the site

Species	Common name	Level of significance		Habitat	Likelihood of occurrence within the site
		BC Act	EPBC Act		
Birds					
Apus pacificus	Pacific swift	MI	MI	Aerial, migratory species that is most often seen over inland plains and sometimes above open areas, foothills or in coastal areas. Sometimes occurs over settled areas, including towns, urban areas and cities (Johnstone and Storr 1998).	**Possible:** May opportunistically occur in or fly over the site on commute or while searching for prey.

[1] Includes native and non-native species

Table 6: Summary of conservation significant fauna species recorded or deemed possible or likely to occur within the site (continued)

Species	Common name	Level of significance		Habitat	Likelihood of occurrence within the site
		BC Act	EPBC Act		
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	VU	VU	*Eucalypt* and *Corymbia* forests, often in hilly interior. More recently also observed in more open agricultural and suburban areas including Perth metropolitan area. Attracted to seeding *Corymbia calophylla*, *Eucalyptus marginata*, introduced *Melia azedarach* and *Eucalyptus* spp. trees (Johnstone and Storr 1998).	**Likely**: Potential roosting and foraging habitat present.
Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN	Mainly proteaceous scrubs and heaths and adjacent eucalypt woodlands and forests; also plantations of *Pinus* spp. Attracted to seeding *Banksia* spp., *Dryandra* spp., *Hakea* spp., *Eucalyptus* spp., *Corymbia calophylla*, *Grevillea* spp., and *Allocasuarina* spp. (Johnstone and Storr 1998).	**Likely**: Potential roosting and foraging habitat present.
Falco peregrinus	Peregrine falcon	OS	-	Mainly found around cliffs along coasts, rivers, ranges and around wooded watercourses and lakes (Johnstone and Storr 1998).	**Possible**: May opportunistically occur in or fly over the site on commute or while searching for prey.
Mammals					
Hydromys chrysogaster	Rakali	P4	-	Areas with permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen et al. 1985).	**Possible:** Potential habitat present. May pass through the site, particularly along Ellen Brook.
Isoodon fusciventer	Quenda	P4	-	Dense scrubby, often swampy, vegetation with dense cover up to one metre high (DEC 2012).	**Possible**: Potentially suitable habitat present.
Invertebrate					
Leioproctus contrarius	a short-tongued bee	P3	-	Life history and habits are poorly documented/ unknown. It has been recorded only on flowers of *Goodeniaceae* and possibly Lechenaultia stenosepala (Bamford 2003).	**Possible:** Potential habitat in the form of *Goodeniaceae* plant species are present in the site. Historical records of this species occur approximately 3 km north of the site.

Table 6: Summary of conservation significant fauna species recorded or deemed possible or likely to occur within the site (continued)

Species	Common name	Level of significance		Habitat	Likelihood of occurrence within the site
		BC Act	EPBC Act		
Westralunio carteri	Carter's freshwater mussel	VU	VU	Occurs in greatest abundance in slower flowing streams with stable sediments that are soft enough for burrowing amongst woody debris and exposed tree roots. Also occupies lentic systems including large water supply dams and even on-stream farm dams. Salinity tolerance quite low (Morgan et al. 2011).	**Possible:** Potentially suitable habitat present. Historical records of this species within Ellen Brook approximately 1.6 km south of the site.

4.3.4 Declared pests

Two species listed as a declared pests (C3) pursuant to the BAM Act, **Oryctolagus cuniculus* (rabbit) and *Vulpes vulpes* (fox), were identified from scats within the site.

4.4 Black cockatoos

4.4.1 Desktop assessment

Publicly available regional datasets relating to black cockatoo distribution, records and extent of habitat types were reviewed in relation to the site and surrounding area, as summarised in **Table 7** and shown in **Figure 5.** Detailed information on each dataset considered as part of the desktop review is provided in **Appendix A**. As detailed in **Table 7**, the site lies outside of the modelled distribution of Baudin's cockatoo and this species is not considered further in this section.

Table 7: Summary of black cockatoo background review

Category		Site context	Source
Species distribution		• Site is located outside of the modelled distribution of Baudin's cockatoo. • Site is within the modelled distribution of Carnaby's cockatoo and within its breeding range. • Site is within the modelled distribution for forest red-tailed black cockatoo and within its known breeding range.	(DoEE 2016a, b, c)
Breeding sites		• No nesting records occur within the site or within 12 km of the site[2].	*BirdLife Australia* database search (2021)
Carnaby's cockatoo breeding areas (12 km radius surrounding breeding sites)		• No confirmed breeding areas intersect the site. • No possible breeding areas intersect the site.	(Glossop *et al.* 2011)
Important bird areas for Carnaby's cockatoo		• The is located within the Northern Swan Coastal Plain important bird area.	(DPaW 2013b)
Roost site		• None within the site • 13 roost sites within 12 km of the site (see **Table 2** and **Table 3**): o 9 associated with white-tailed^ black cockatoos o 1 associated with forest red-tailed black cockatoos o 3 associated with white^ and red-tailed black cockatoos	*BirdLife Australia* database search (2021)
Foraging habitat	White-tailed black cockatoo^	• Two small patches of potential native foraging habitat are mapped as potential native white-tailed black cockatoo foraging habitat. • Extensive areas of potential native foraging habitat mapped within the wider area of the site.	(Emerge Associates 2020a)
	White-tailed black cockatoo^	• No pine plantations are mapped over the site. • A large area of pine plantation, associated with the Gnangara planation occurs within 12 km of the site.	(Forest Products Commission 2020)
	Forest red-tailed black cockatoo^	• Multiple small patches of potential native foraging habitat are mapped within the site. • Extensive areas of potential native foraging habitat mapped within the wider area of the site.	(Emerge Associates 2020b)

^Carnaby's and/or Baudin's cockatoo

[2] Breeding of Carnaby's cockatoo is considered likely to occur within 12 km of the site (Birdlife 2021). Nesting records occur approximately 16 km to the east and 18km to the north-east. Given this and the presence of suitable habitat to the east and north-east, undetected breeding may have occurred within 12 km of the site.

Table 8: White-tailed black cockatoos recorded in roosts within 12 km of the site (Birdlife Australia 2021)

Roost ID	Year and number of individuals								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
SWABULR002	NS	18	117	120	328	NS	178	0	260
SWABULR003	NS	NS	NS	NS	NS	NS	8	0	0
SWABULR004	NS	NS	NS	NS	NS	NS	0	5	0
SWAELLR001	NS	NS	NS	NS	14	NS	280	0	0
SWAHENR002	NS	NS	NS	NS	NS	NS	NS	50	0
SWALEXR002	185	0	NS	0	0	0	0	NS	NS
SWAMELR001	500	41	0	20	480	0	NS	268	0
SWAVINR003	NS	NS	NS	NS	NS	NS	21	0	0
WANJANR007	NS	16	NS	0	NS	0	NS	NS	NS
WANMARR001	0	20	NS	0	NS	71	0	770	0
WANMARR003	542	152	10	16	147	280	4	1260	625
WANMARR005	NS	NS	NS	NS	NS	NS	NS	0	350

NS = not surveyed

Table 9: Forest red-tailed black cockatoo recorded in roosts within 12 km of the site (Birdlife Australia 2021)

Roost ID	Year and number of individuals					
	2014	2015	2016	2017	2018	2019
SWABULR002	0	NS	0	26	0	0
SWAMELR001	0	0	NS	129	0	0
SWAVINR003	NS	NS	31	5	0	0
SWABULR005	NS	NS	NS	NS	41	0

NS = not surveyed

4.4.2 Habitat

4.4.2.1 Breeding

A total of 98 black cockatoo habitat trees were recorded within the site, of which none contained hollows that are suitable for breeding by black cockatoos[3]. The locations of habitat trees within the site are shown in **Figure 6**.

[3] Note that some habitat trees in the western portion of the site within Lot 1361 were assessed during the previous survey by Emerge Associates (2019) or were recorded from afar during the current survey due to access limitations. However, no potentially suitable hollows were visible during either assessment.

The habitat trees comprised 25 *Corymbia calophylla* (marri), five *Eucalyptus rudis* (flooded gum), 57 Eucalyptus wandoo (wandoo) and four stags (dead trees).

An internal hollow inspection was undertaken for one habitat tree, which was originally assessed to potentially contain a suitable hollow based on the initial inspection from ground level. Following an internal inspection, the hollow was determined to be unsuitable for breeding by black cockatoos as the internal dimensions were too small for black cockatoos. No evidence of use for breeding by black cockatoos was recorded in the site.

A summary of the habitat trees recorded within the site is provided in **Table 10** and an inventory in **Appendix G**.

Table 10: Habitat trees recorded within the site

Category	No. trees	No. suitable hollows
Confirmed nest	0	0
Potential nest	0	0
Suitable hollow(s)	0	0
Potentially suitable hollow(s)	0	0
No suitable habitat	98	0
Total	**98**	**0**

4.4.2.2 Roosting

No roosts or secondary evidence of roosting were observed within the site during the survey.

Native and non-native trees within the site have the potential to provide roosting habitat for black cockatoos.

4.4.2.3 Foraging

Primary foraging habitat in the site is predominantly comprised of *Grevillea* spp., marri and wandoo. Secondary foraging plants include *Acacia saligna* (orange wattle), *Allocasuarina fraseriana* (sheoak), *Corymbia citriodora* (lemon scented gum), **Eucalyptus camaldulensis* (river red gum)[4], *Eucalyptus gomphocephala* (tuart).

A summary of foraging habitat within the site is provided in **Table 11**.

Table 11: Dominant primary and secondary black cockatoo foraging plants recorded within the site

Common name	Black cockatoo species and foraging plant category	
	Carnaby's	Forest red-tailed
Grevillea spp.	Primary	-
Lemon scented gum	Secondary	Secondary
Marri	Primary	Primary

[4] Note that * denotes non-native species.

Table 11: Dominant primary and secondary black cockatoo foraging plants recorded within the site (continued)

Common name	Black cockatoo species and foraging plant category	
	Carnaby's	Forest red-tailed
Orange wattle	Secondary	-
River red gum	-	Secondary
Tuart	Secondary	Secondary
Wandoo	Primary	Primary

A total of 3.43 ha of foraging habitat was mapped within the site for Carnaby's cockatoo and 2.64 ha for forest red-tailed black cockatoo as shown in **Figure 7** to **Figure 8**. This comprises a combination of primary, secondary and non-foraging plants as detailed in **Table 12.**

The foraging plants within the site occur as scattered trees and small patches of vegetation. Therefore, it was not always possible to separate the foraging habitat from non-foraging plants which resulted in a relatively high cover of non-foraging plants within patches mapped as foraging habitat as outlined in **Table 12**.

Table 12: Proportion of primary, secondary and non-foraging plants within patches of foraging habitat

	Black cockatoo species and area (ha)	
	Carnaby's	Forest red-tailed
Primary foraging plants	1.58	1.52
Secondary foraging plants	0.99	0.70
Non-foraging plants	0.85	0.41
Total	**3.43 (2.58 of foraging plants)**	**2.64 (2.23 of foraging plants)**

4.4.2.4 Overall quality

The outcome of the overall black cockatoo habitat quality assessment is provided in **Table 13** and summarised in **Table 14**. The site was determined to have an overall habitat score of five for forest red-tailed black cockatoo and four for Carnaby's cockatoo, out of a maximum possible score of 10, which is 'moderate' using the scale provided in **Appendix C**. The full results of the quality assessment are provided in **Appendix H**.

Table 13: Habitat quality

Habitat category	Black cockatoo species and score	
	Carnaby's	Forest red-tailed
Breeding	4	4
Roosting	2	2
Foraging	3	5
Overall score	**4 (Moderate)**	**5 (Moderate)**

Table 14: Summary of attributes contributing to black cockatoo habitat quality scores

Habitat category	Quality component category	Attributes and black cockatoo species	
		Carnaby's	Forest red-tailed
Breeding	Site condition	The site supports habitat trees without suitable hollows.	The site supports habitat trees without suitable hollows.
	Site context	No confirmed Carnaby's nest tree occurs within 6 km of the site and 5,229.102 ha of potential Carnaby's cockatoo foraging habitat is mapped within 6 km of the site.	No confirmed forest-red-tailed nest tree occurs within 6 km of the site and 2,795.47 ha of potential forest red-tailed black cockatoo foraging habitat is mapped within 6 km of the site.
	Species stocking rate	N/A – no evidence of breeding was recorded within the site.	N/A – no evidence of breeding was recorded within the site.
Roosting	Site condition	The site supports potential roosting habitat.	The site supports potential roosting habitat.
	Site context	The site is located more than 1 km from a large roost and more than 500 m from a small roost. The site is located near a water source.	The site is located more than 1 km from a large roost and more than 500 m from a small roost. The site is located near a water source.
	Species stocking rate	N/A - no evidence of roosting was recorded within the site.	N/A - no evidence of roosting was recorded within the site.
Foraging	Site condition	The site supports foraging habitat that is proportionally of 46.19% primary foraging plants.	The site supports foraging habitat that is proportionally of 57.56% primary foraging plants.
	Site context	Confirmed white-tailed black cockatoo roosts occur within 6 km of the site, indicating the foraging habitat within the site may be used by the birds utilising the roosts.	Confirmed forest red-tailed black cockatoo roosts occur within 6 km of the site, indicating the foraging habitat within the site may be used by the birds utilising the roosts.
	Species stocking rate	No evidence of foraging by Carnaby's cockatoo was recorded in the site.	No evidence of foraging by forest red-tailed black cockatoo was recorded in the site.

5 Discussion

5.1 Fauna and fauna habitat values

The 25 native fauna species opportunistically recorded within the site are all generally common and widespread across the Swan Coastal Plain.

The highest fauna habitat values in the site occur as very small patches but extend beyond the site. The ***Acacia saligna* shrubland** habitat occurs over 0.1% of the site and provides a dense native shrub layer and microhabitats such as logs, rocks and leaf litter, which is likely to extend further north of the site within the existing railway reserve. The **wooded creek line** habitat associated with the Ellen Brook occurs over 0.91% of the site and provides value to native fauna as a water source and as a wildlife corridor.

The ***Casuarina obesa* forest**, ***Corymbia calophylla* and *Melaleuca huegelii* woodland**, ***Corymbia calophylla* forest**, **Melaleuca shrubland** and ***Eucalyptus wandoo* woodland** habitats occur over 9.49% of the site and provide a relatively intact cover of native trees but native understorey vegetation and microhabitats are largely absent. Therefore, these habitats would primarily be used by native arboreal fauna species.

The **scattered native and non-native trees and shrubs** habitat provides varying value to native fauna depending on the plant species and density present and extends over 4.24% of the site. This habitat is likely to be primarily used by arboreal fauna species.

The remainder of the site supports highly disturbed **grassland** habitat (85.26% of the site). This habitat provides limited habitat value to native fauna and is likely to be primarily be used by common and widespread native and non-native fauna with non-specific habitat requirements.

5.2 Conservation significant fauna

No fauna species of conservation significance were recorded in the site during the field survey. It was anticipated that forest red-tailed black cockatoos and Carnaby's cockatoos would be recorded within or near the site as these species are known to occur in the vicinity of the site. The fact that they were not recorded can likely be attributed to the limited time spent on site (5 hours). Forest red-tailed black cockatoos were previously recorded in the site (Emerge Associates 2019).

In addition to Carnaby's cockatoo and forest red-tailed black cockatoo which are deemed 'likely' to occur in the site, six species of conservation significance were considered to have potential to occur in the site.

Apus pacificus (pacific swift) and *Falco peregrinus* (peregrine falcon) may opportunistically fly over or utlise habitat within the site as part of a much larger home range. The ***Acacia saligna* shrubland** and areas with dense grass cover in the site provide potential habitat for *Isodoon fusciventer* (quenda).

The **wooded creekline** habitat provides potential habitat for *Hydromys chrysogaster* (rakali) and *Westraluniocateri* (Carter's freshwater mussel). Records for both species occur on Ellen Brook further downstream. Rakali may potentially use Ellen Brook to travel between habitats and may occur in the

site for short periods but is unlikely to reside in the site. Carter's freshwater mussel may seasonally occur in the site when the part of Ellen Brook that occurs in the site is flowing. Targeted surveys would need to be undertaken to confirm whether either of these species occur in the site.

Leioproctus contrarius (a short-tongued bee) has historically been recorded approximately 3 km north of the site in 1954. No recent records occur near the site. However, this may be due to a lack of survey effort. The species is generally poorly understood and has previously only been recorded on *Goodeniaceae* plant species and possibly on *Leschenaultia stenosepala* (Bamford Consulting Ecologists 2003). Two species of *Goodeniaceae* were recorded in the ***Acacia saligna* shrubland** and ***Melaleuca* shrubland** in the site: *Dampiera linearis* and *Scaevola lanceolata* (Emerge Associates 2021a). *D. linearis* and *S. lanceolata* are common species that occur in a range of habitats and are likely to also occur in the local and wider region. Given that potential host plants occur in the site and the presence of historical records in the wider area of the site *Leioproctus contrarius* is considered to have potential to occur in the site. Further targeted surveys would need to be undertaken to confirm whether it actually occurs and to what extend it utilises the site.

5.3 Black cockatoos

5.3.1 Habitat

5.3.1.1 Breeding

None of the 98 habitat trees recorded in the site currently contain hollows that are suitable for breeding by black cockatoos. Therefore, the site does currently not contain suitable breeding habitat for any of the species of black cockatoo. All of the habitat trees within the site have the potential to form hollows in the future but it will likely take many years for hollows to form that are suitable for use by black cockatoos.

5.3.1.2 Roosting

No signs of roosting were observed during the field survey and the BirdLife Australia dataset does not include any roost records in the site. The previous roost survey also did not record roosting by black cockatoos (Emerge Associates 2019).

Therefore, there is no reason to suspect that roosting currently occurs in the site. Nevertheless, the site contains tall trees that have the potential to provide roosting habitat for black cockatoos.

5.3.1.3 Foraging

The site contains approximately 2.58 ha of foraging habitat for Carnaby's cockatoo which is approximately 0.01% of the mapped potential foraging habitat within 12 km of the site for Carnaby's cockatoo. For forest red-tailed black cockatoo the site contains approximately 2.23 ha of foraging habitat, which is approximately 0.02% of the mapped potential foraging habitat for forest red-tailed black cockatoo within 12 km. As such, the foraging habitat in the site comprises a relatively small area compared to the potential foraging habitat located in the wider area of the site.

5.3.1.4 Overall quality

Of the two species of black cockatoo that occur in the vicinity of the site the vegetation in the site rated highest for forest red-tailed black cockatoo, owing to its foraging score. The foraging score for forest red-tailed black cockatoo is higher than Carnaby's cockatoos foraging score due to a higher proportion of primary to secondary foraging species (>50%). However, it should be noted that the total area of primary foraging habitat in the site for Carnaby's cockatoo is larger than the area of primary foraging habitat for forest red-tailed black cockatoo. Due to the smaller total area of foraging habitat mapped as foraging habitat for forest red-tailed black cockatoo the relative proportion of primary foraging plants to secondary or non-foraging plants appears higher.

For Carnaby's cockatoo the vegetation in the site scored highest for its potential breeding value. This is primarily due to the presence of more than 1000 hectares of mapped potential foraging habitat within 6 km of the site. A large area of potential foraging habitat within 12 km of an area is considered to increase its breeding potential as it indicates that enough foraging resources may be available to support breeding, if suitable hollows were present.

The roosting score was consistent between the two species and, as no evidence of roosting was recorded within the site, roosting quality was determined from basic habitat condition attributes (tall trees).

6 Conclusions

6.1 Fauna and fauna habitat

The majority of the site (85.26%) supports highly disturbed **grassland** habitat which provides limited habitat value to native fauna and is likely to be primarily be used by common and widespread native and non-native fauna with non-specific habitat requirements. The highest fauna habitat value in the site is associated with the ***Acacia* saligna shrubland** habitat which occurs over a small portion (0.1% of the site).

A total of 25 native and three introduced fauna species were recorded in the site, of which none are of conservation significance.

Eight species of conservation significance were considered to have potential to occur within the site. Carnaby's cockatoo and forest red-tailed black cockatoo are considered likely to occur and a further six species are considered to have potential to occur: pacific swift, peregrine falcon, quenda, rakali, Carter's freshwater mussel and *Leioproctus contrarius* (a shot tongued bee). Targeted surveys would need to be undertaken to confirm if and to what extend these species utilise the site.

6.2 Black cockatoos

No records of black cockatoos were made during the field survey. However, the site occurs within the modeled distribution and breeding range of Carnaby's cockatoo and forest red-tailed black cockatoo and both species are considered likely to occur.

A total of 98 habitat trees were recorded in the site, of which none contain hollows that are suitable for breeding by black cockatoos. Therefore, the site does currently not provide breeding habitat for black cockatoos.

No evidence of black cockatoo roosting activity was observed within the site. Potential roosting habitat that is suitable for all three species of black cockatoo occurs within the site in the form of tall native and non-native trees.

A total of 1.58 ha of primary foraging habitat for Carnaby's cockatoo and 1.52 ha for forest red-tailed black cockatoo were recorded in the site. The site also contains 0.99 ha of secondary foraging habitat for Carnaby's cockatoo and 0.70 ha for forest red-tailed black cockatoo. Extensive areas of additional remnant native vegetation that may provide foraging habitat for both species of black cockatoo occur in the wider area of the site.

The overall black cockatoo habitat quality score for the site was determined to be four (moderate) for Carnaby's cockatoo and five (moderate) for forest red-tailed black cockatoo. The site scored highest for the breeding habitat component for Carnaby's cockatoo and highest for the foraging habitat component for forest red-tailed black cockatoo.

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Figures

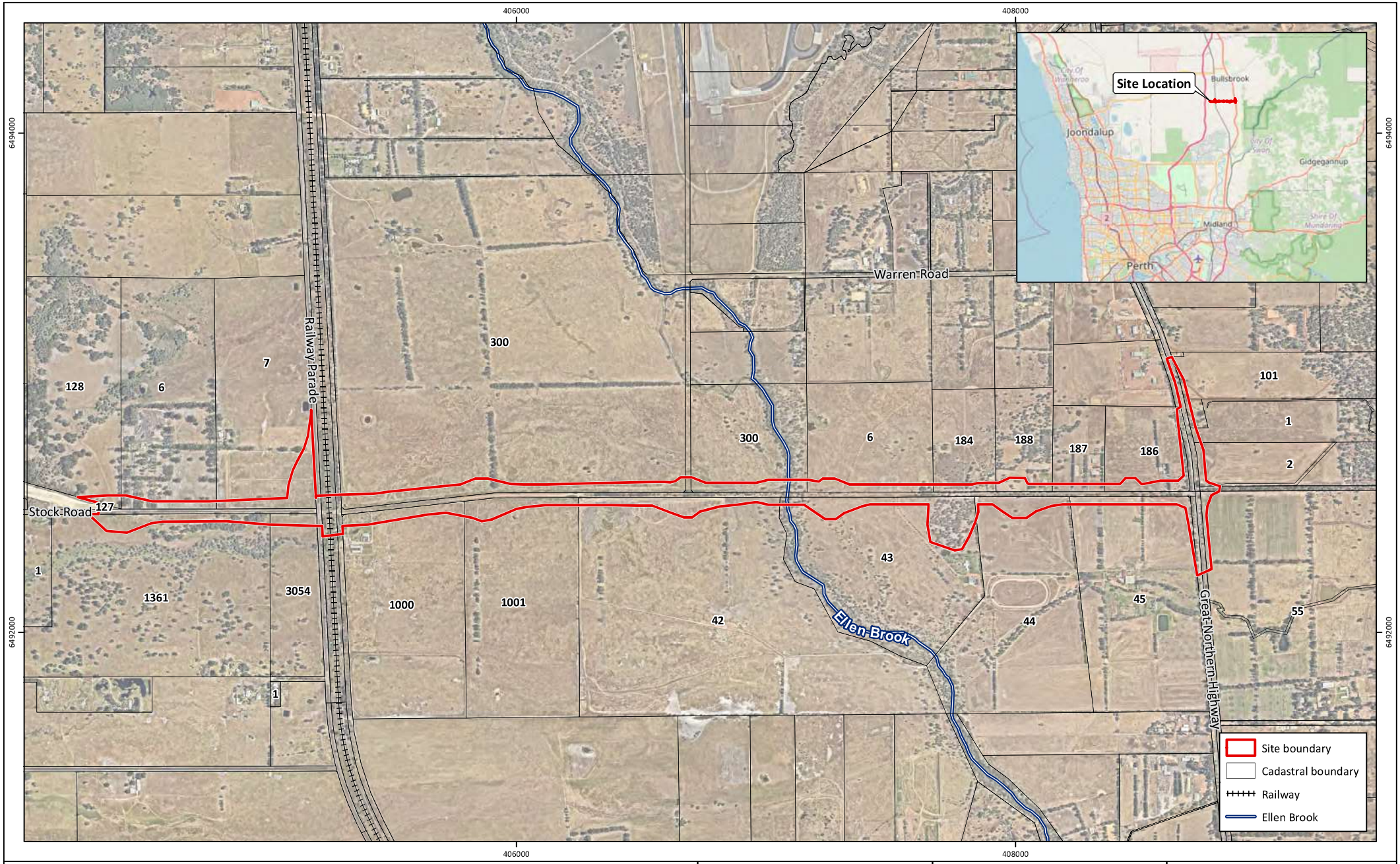

Figure 1: Site Location

Project: Basic Fauna and Targeted Black Cockatoo Assessment
Stock Road Corridor, Bullsbrook
Client: Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F19a
Drawn: GAR
Date: 12/03/2021
Checked: MS
Approved: RAW
Date: 12/03/2021

N

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Metres
Scale: 1:20,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

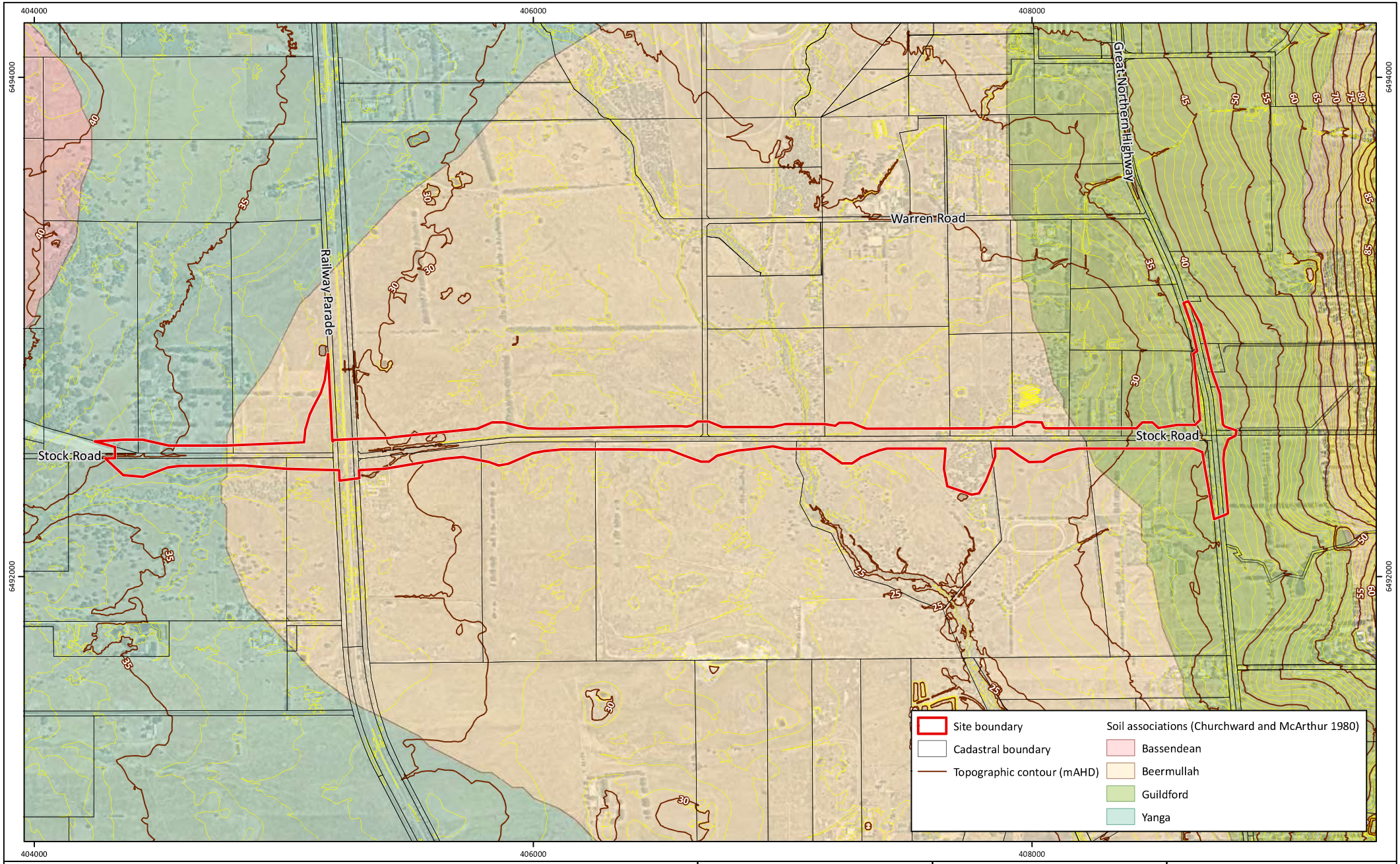

Figure 2: Soils and Topography

Project:	Basic Fauna and Targeted Black Cockatoo Assessment Stock Road Corridor, Bullsbrook
Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F20a

Drawn:	GAR
Date:	12/03/2021
Checked:	MS
Approved:	RAW
Date:	12/03/2021

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Metres

Scale: 1:20,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

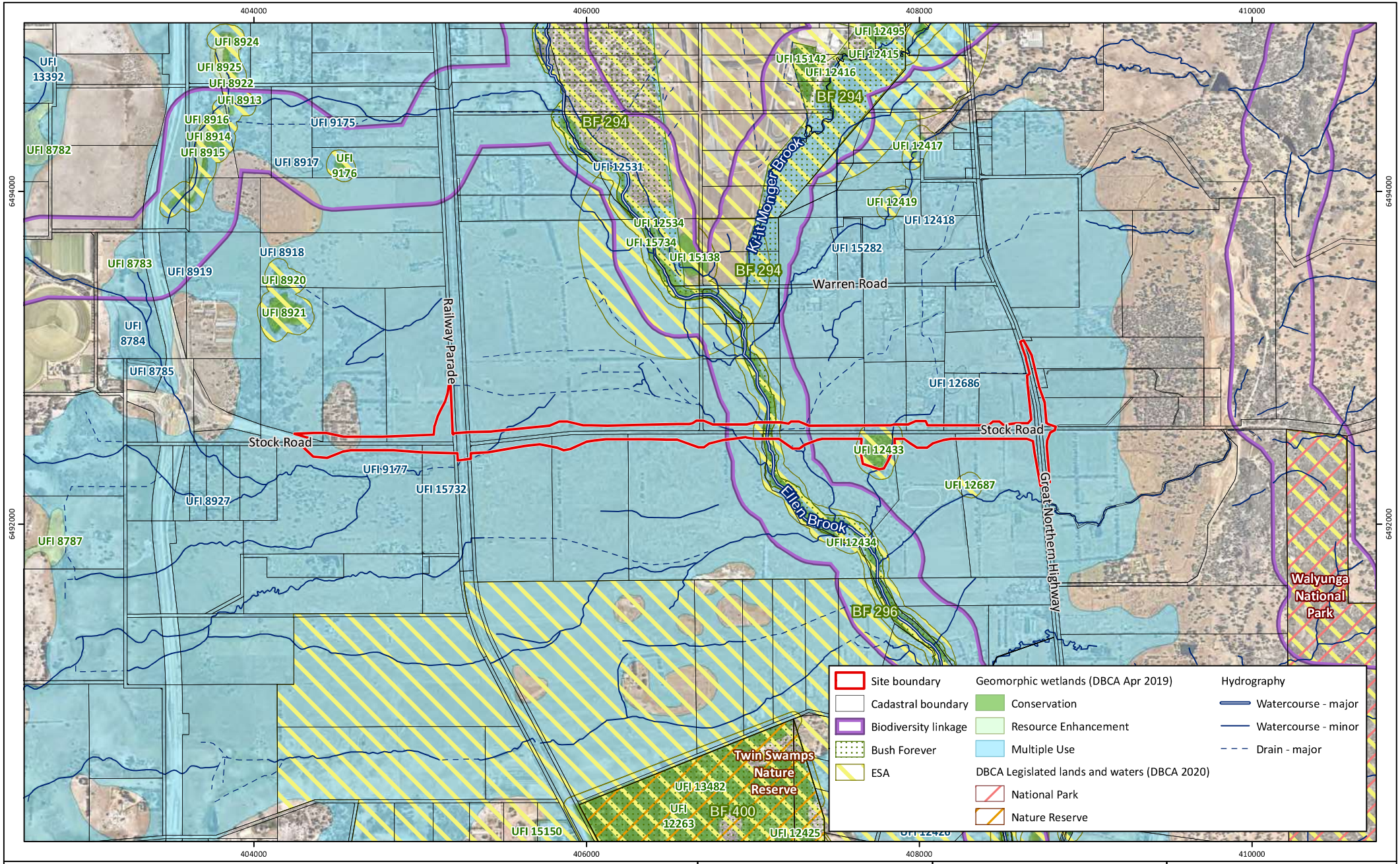

Figure 3: Environmental Features

Project:	Basic Fauna and Targeted Black Cockatoo Assessment Stock Road Corridor, Bullsbrook
Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F21a

Drawn:	GAR
Date:	12/03/2021
Checked:	MS
Approved:	RAW
Date:	12/03/2021

N

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Metres

Scale: 1:30,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

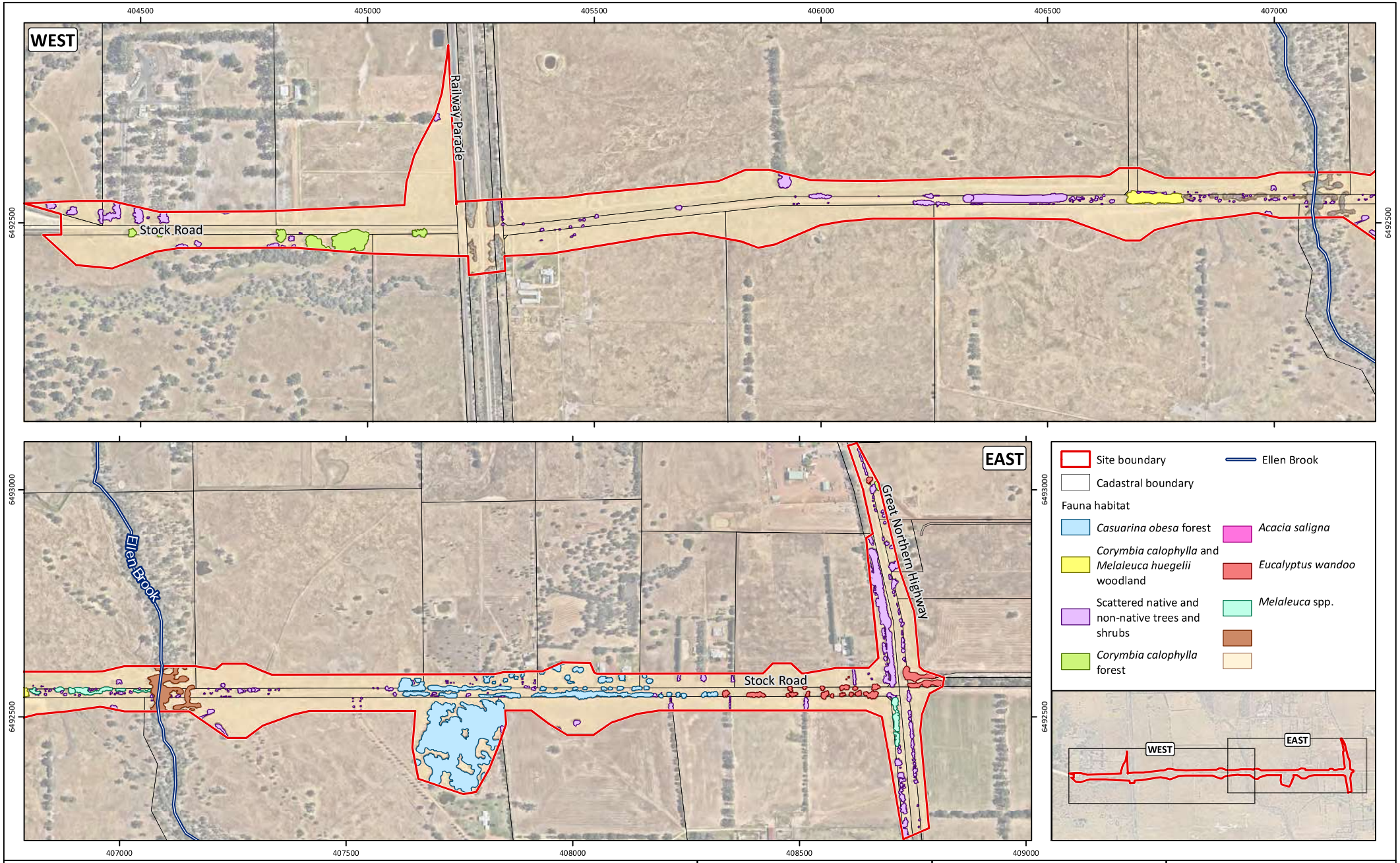

Figure 4: Fauna Habitat

Project:	Basic Fauna and Targeted Black Cockatoo Assessment Stock Road Corridor, Bullsbrook
Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F22a

Drawn:	GAR
Date:	12/03/2021
Checked:	MS
Approved:	RAW
Date:	12/03/2021

N

0 100 200 300
Metres

Scale: 1:11,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

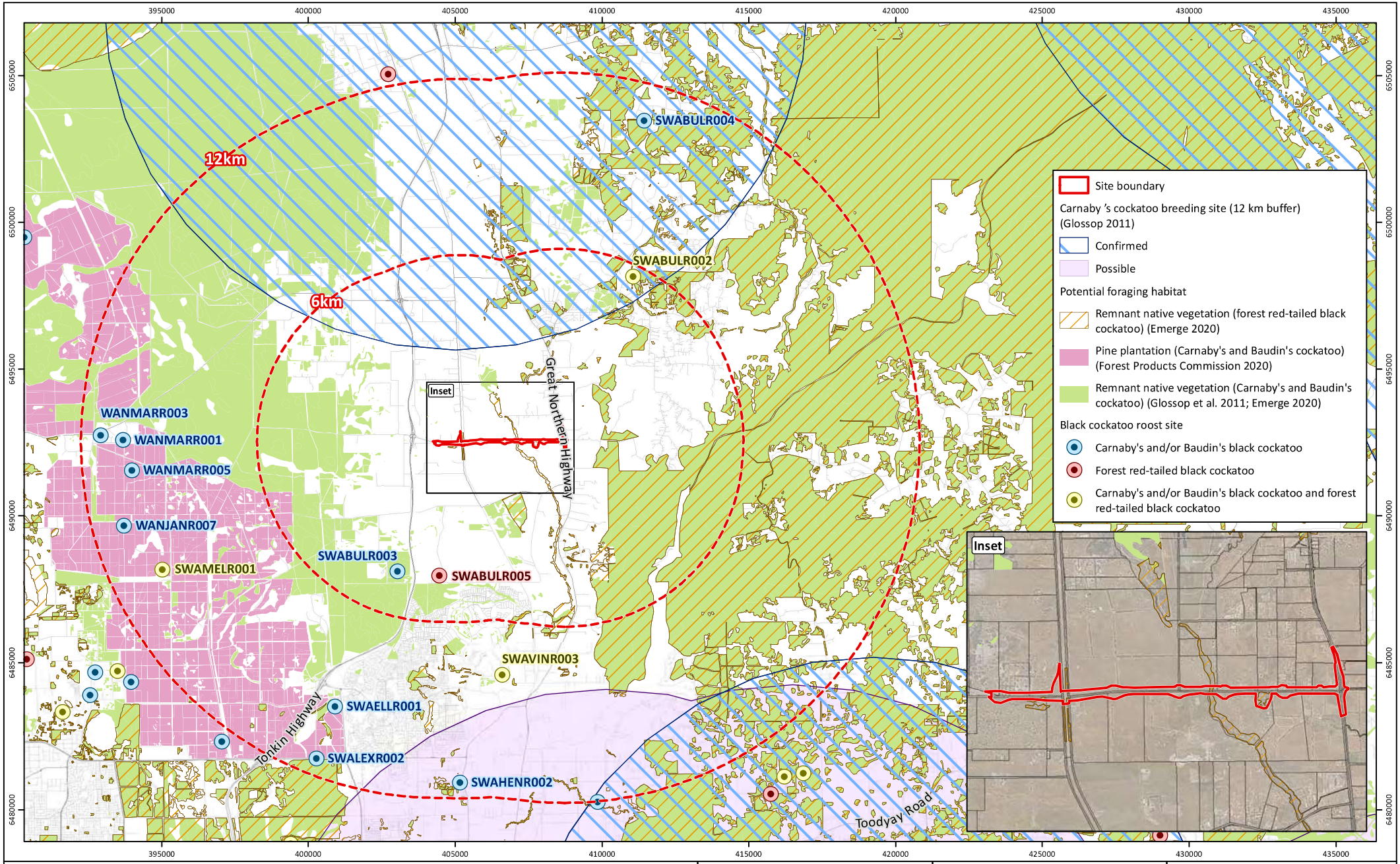

Figure 5: Black Cockatoo Habitat Context

Project:	Basic Fauna and Targeted Black Cockatoo Assessment Stock Road Corridor, Bullsbrook
Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F23a

Drawn:	GAR
Date:	12/03/2021
Checked:	MS
Approved:	RAW
Date:	12/03/2021

N

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Kilometers

Scale: 1:62,938@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

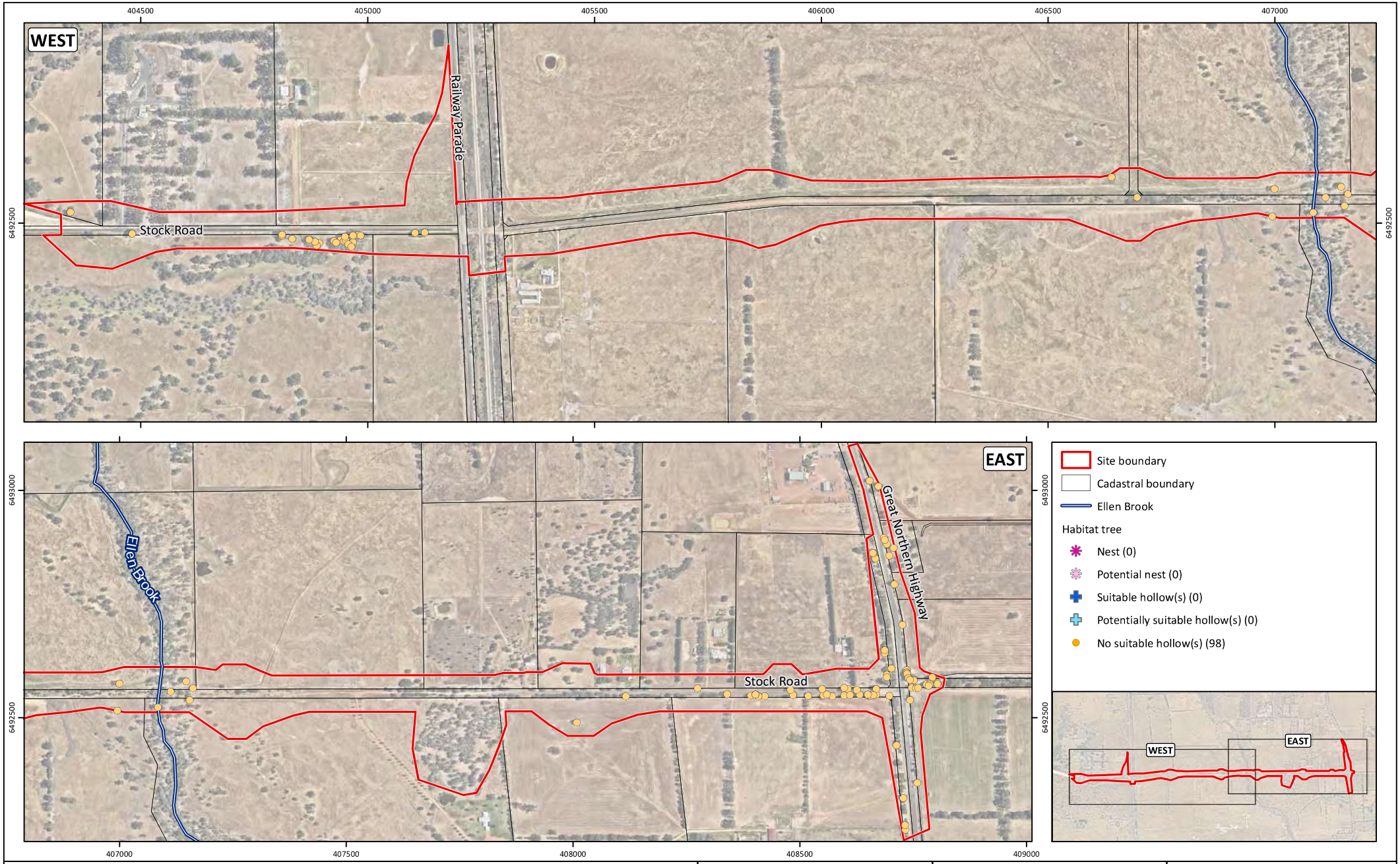

Figure 6: **Black Cockatoo Habitat Trees**

Project: Basic Fauna and Targeted Black Cockatoo Assessment
Stock Road Corridor, Bullsbrook
Client: Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F26a
Drawn: GAR
Date: 12/03/2021
Checked: MS
Approved: RAW
Date: 12/03/2021

N

0 100 200 300
Metres
Scale: 1:11,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

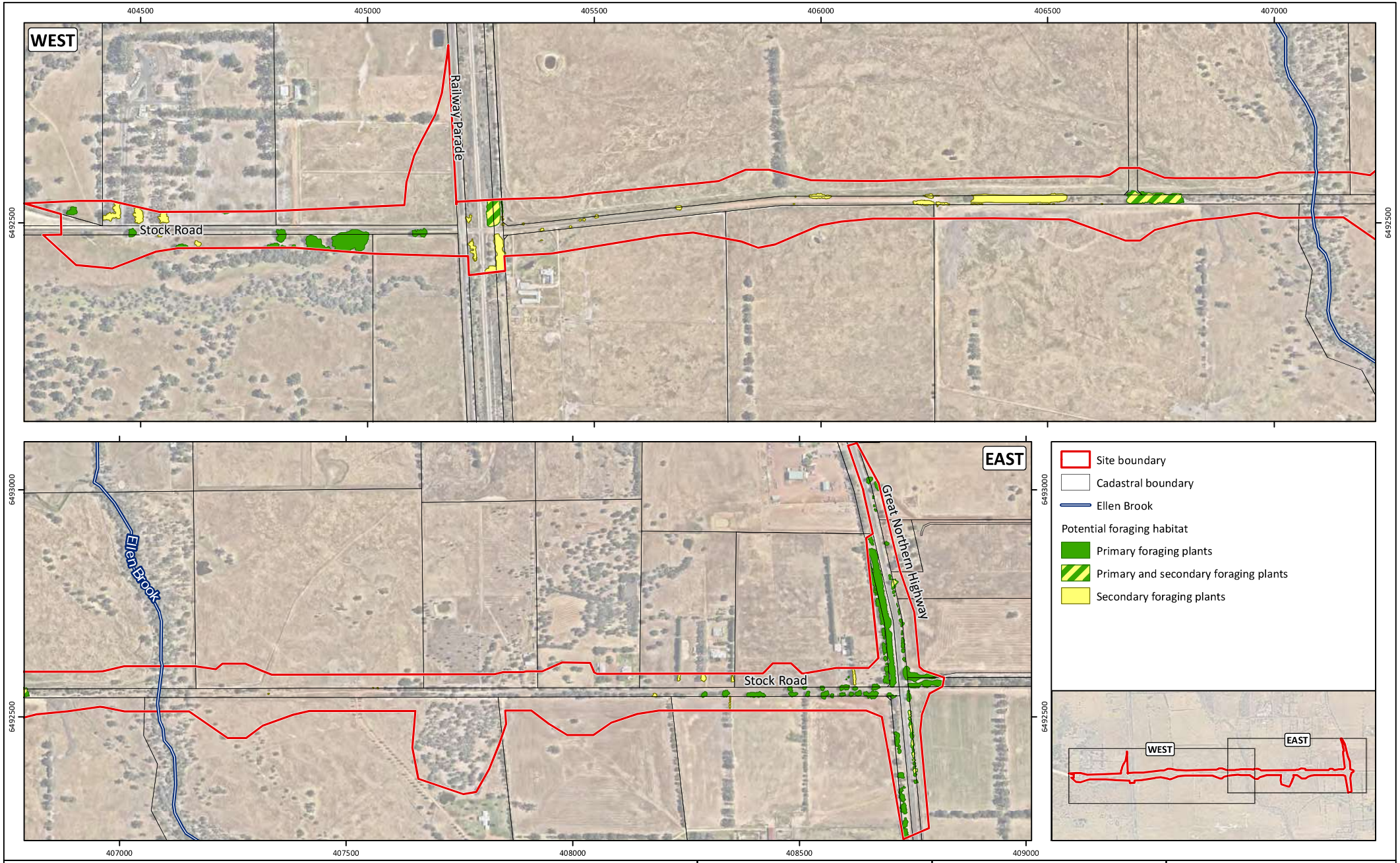

Figure 7: Potential Carnaby's Cockatoo Foraging Habitat

Project:	Basic Fauna and Targeted Black Cockatoo Assessment Stock Road Corridor, Bullsbrook
Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F24a

Drawn:	GAR
Date:	12/03/2021
Checked:	MS
Approved:	RAW
Date:	12/03/2021

N

0 100 200 300
Metres

Scale: 1:80,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

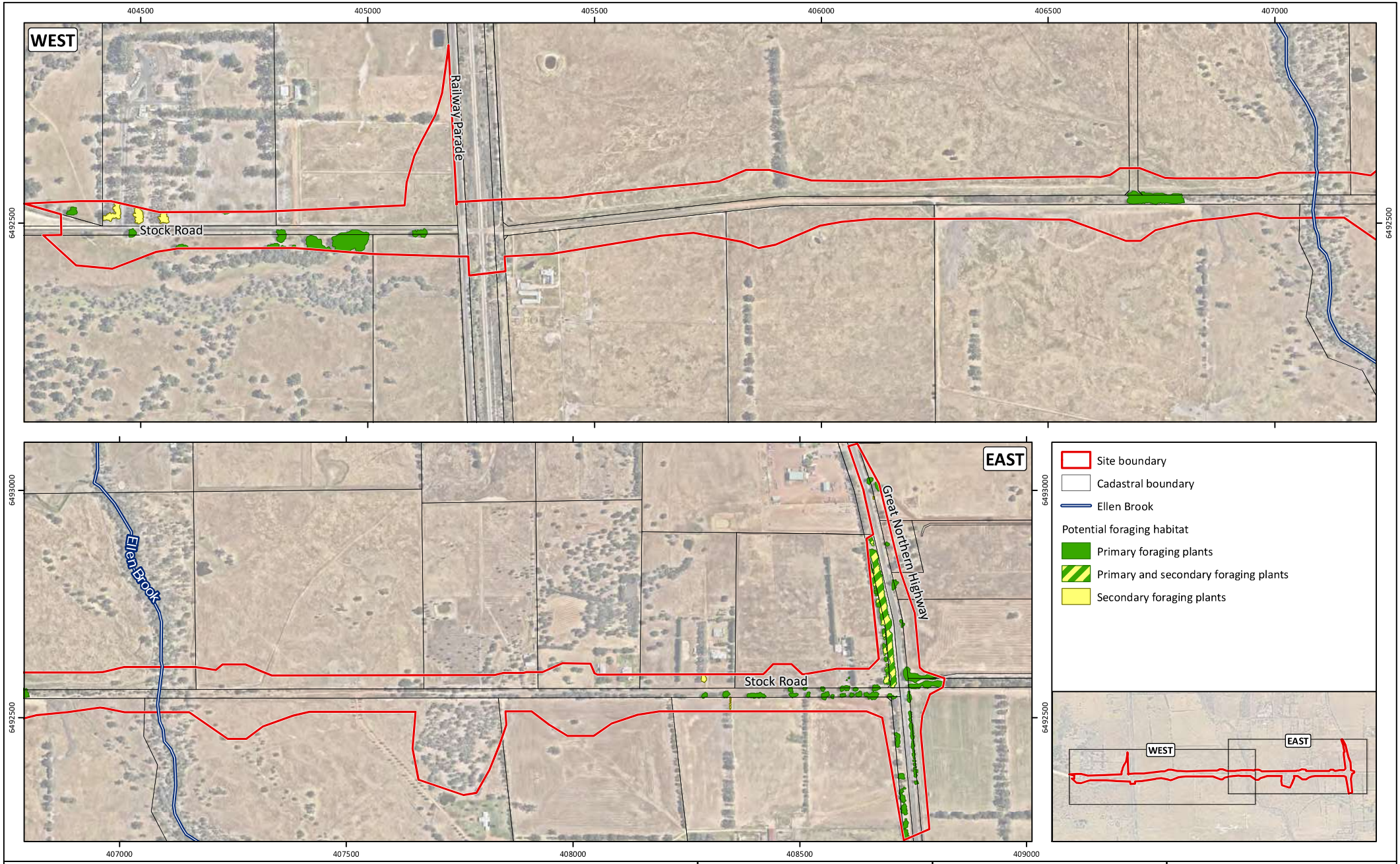

Figure 8: Potential Forest Red-tailed Black Cockatoo Foraging Habitat

Project: Basic Fauna and Targeted Black Cockatoo Assessment
Stock Road Corridor, Bullsbrook
Client: Department of Planning, Lands and Heritage

Plan Number:
EP20-089(03)--F25a
Drawn: GAR
Date: 12/03/2021
Checked: MS
Approved: RAW
Date: 12/03/2021

N

0 100 200 300
Metres
Scale: 1:80,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Additional Information

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Conservation Significant Fauna

Threatened and priority fauna

Fauna species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, fauna species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as 'threatened', 'migratory' or 'marine' as described in **Table 1**.

Migratory species comprise birds recognised under international treaties including:

- *Japan Australia Migratory Bird Agreement 1981* (JAMBA)
- *China Australia Migratory Bird Agreement 1998* (CAMBA)
- *Republic of Korea-Australia Migratory Bird Agreement 2007* (ROKAMBA)
- *Bonn Convention 1979* (The Convention on the Conservation of Migratory Species of Wild Animals).

Fauna species listed as threatened and migratory are protected in Australia as 'matters of national environmental significance' (MNES) under the EPBC Act.

Table 1: Definitions of conservation significant fauna species pursuant to the EPBC Act

Conservation Code	Category
X	Threatened Fauna –Extinct There is no reasonable doubt that the last member of the species has died.
EW[#]	Threatened Fauna –Extinct in the Wild Taxa which are known only to survive in cultivation, captivity or as a naturalised population outside its past range, or taxa which have not been recorded in its known and/or expected habitat despite appropriate exhaustive surveys.
CR[#]	Threatened Fauna – Critically Endangered Taxa which are considered to be facing an extremely high risk of extinction in the wild.
EN[#]	Threatened Fauna – Endangered Taxa which are considered to be facing a very high risk of extinction in the wild.
VU[#]	Threatened Fauna – Vulnerable Taxa which are considered to be facing a high risk of extinction in the wild.
Migratory[#]	Migratory Fauna All migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and All native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Ma	Marine Fauna Species in the list established under s248 of the EPBC Act

[#]matters of national environmental significance (MNES) under the EPBC Act

In Western Australia, fauna taxa may be classed as 'threatened', 'extinct', or 'specially protected' under the *Biodiversity Conservation Act 2016* (BC Act), which is enforced by Department of Biodiversity Conservation and Attractions (DBCA) (DBCA 2019). The definitions of these categories are provided in **Table 2**.

Table 2: Definitions of specially protected fauna schedules under the BC Act (DBCA 2019)

Category	Conservation Code	Definition
Threatened	CR	Critically endangered Threatened species considered to be facing an extremely high risk of extinction in the wild in the immediate future.
	EN	Endangered Threatened species considered to be facing a very high risk of extinction in the wild in the near future.
	VU	Vulnerable Threatened species considered to be facing a high risk of extinction in the wild in the medium-term future.
Extinct	EX	Extinct Species where there is no reasonable doubt that the last member of the species has died.
	EW	Extinct in the wild Species that is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form. Note that no species are currently listed as EW.
Specially protected	MI	Migratory species Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth Includes birds that subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds.
	CD	Species of special conservation interest (conservation dependent fauna) Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
	OS	Other specially protected species Fauna otherwise in need of special protection to ensure their conservation.

Fauna species that may be threatened or near threatened but lack sufficient information to be legislatively listed may be added to the DBCA's *Priority Fauna List* (DBCA 2018). Species listed under priorities 1-3 comprise possible threatened species that do not meet survey criteria or are otherwise data deficient. Species listed under priority 4 are those that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons (DBCA 2019).

Priority fauna species are considered during State approval processes. Priority fauna categories and definitions are listed in **Table 3** (DBCA 2019).

Table 3: Definitions of priority fauna categories on DBCA's Priority Fauna List (DBCA 2019)

Conservation Code	Category
P1	Priority 1 – Poorly known Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2 – Poorly known Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3 – Poorly known Species that are known from several locations and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	(a) Priority 4 – Rare species Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Priority 4 – Near Threatened Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Priority 4 – Other Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Pest fauna

A number of legislative and policy documents exist in relation to pest fauna management at state and national levels. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the principle legislation guiding pest fauna management in Western Australia and lists declared pest species.

Declared Pests

Part 2.3.23 of the BAM Act requires a person must not; "*a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest*".

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 4**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in

Table 5.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the 'declared pest - s22(2)' category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in **Table 6**.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA 2016).

Table 4: Legal status of declared pest species listed under the BAM Act (DAFWA 2016)

Category	Description
Declared Pest Prohibited - s12	May only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest s22(2)	Must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia

Table 5: Control categories of declared pest species listed under the BAM Act (DAFWA 2016)

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management

Category	Description
	Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Table 6: Keeping categories of declared pest species listed under the BAM Act (DAFWA 2016)

Category	Description
Prohibited	Can only be kept under a permit for public display and education purposes, and/or genuine scientific research, by entities approved by the state authority.
Exempt	No permit or conditions are required for keeping.
Restricted	Organisms which, relative to other species, have a low risk of becoming a problem for the environment, primary industry or public safety and can be kept under a permit by private individuals.

Literature

The main literature used for identifying fauna and fauna habitats is listed in **Table 7** below.

Table 7: Standard literature used for identifying fauna species and habitats.

Conservation Code	Category
Birds	Johnstone and Storr (1998b), Johnstone and Storr (1998a), Pizzey and Knight (2012), Slater *et al.* (2003)
Mammals	Menkhorst and Knight (2011), Triggs (2003)
Amphibia	Tyler and Doughty (2009), Bush *et al.* (2002)
Reptiles	Bush *et al.* (2002)

References

General references

Department of Biodiversity, Conservation and Attractions (DBCA) 2018, *Threatened and Priority Fauna List 15 February 2018*, Perth.

Department of Biodiversity Conservation and Attractions (DBCA) 2019, *Conservation Codes for Western Australian Flora and Fauna - last updated 3 January 2019*.

Appendix B

Black Cockatoo Foraging Plants

		Foraging category as assigned by Emerge			
Species name	**Common name**	**CBC**	**BBC**	**FRTBC**	**Literature references**
Acacia baileyana	Cootamundra wattle	Secondary			Groom 2011
Acacia pentadenia	Karri wattle	Secondary			Groom 2011
Acacia saligna	Orange wattle	Secondary			Groom 2011
Agonis flexuosa	Peppermint tree	Secondary			Groom 2011
Allocasuarina fraseriana	Sheoak		Secondary	Secondary	Johnstone & Storr 1998; Johnstone et al. 2010; Johnstone 2017; DoEE 2017
Allocasuarina spp.		Secondary		Secondary	Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Anigozanthos flavidus	Tall kangaroo paw		Secondary		Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017
Araucaria heterophylla	Norfolk island pine	Secondary			Groom 2011; DoEE 2017
Banksia ashbyi	Ashby's banksia	Primary	Secondary		Saunders 1980; Groom 2011; DoEE 2017
Banksia attenuata	Slender banksia	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia baxteri	Baxter's banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia carlinoides	Pink dryandra	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia coccinea	Scarlet banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia dallanneyi	Couch honeypot dryandra	Primary	Secondary		Groom 2011; DoEE 2017
Banksia ericifolia	Heath-leaved banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia fraseri		Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia gardneri	Prostrate banksia	Primary	Secondary		Groom 2011; DoEE 2017
Banksia grandis	Bull banksia	Primary	Secondary		Saunders 1980; Johnstone & Storr 1998; Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia hookeriana	Hooker's banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia ilicifolia	Holly banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; Johnstone & Storr 1998; DoEE 2017
Banksia kippistiana		Primary	Secondary		Groom 2011; DoEE 2017
Banksia leptophylla		Primary	Secondary		Groom 2011; DoEE 2017
Banksia lindleyana	Porcupine banksia	Primary	Secondary		Johnstone et al. 2010; DoEE 2017

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Banksia littoralis	Swamp banksia	Primary	Secondary		Saunders 1980; Groom 2011Johnstone & Storr 1998; Johnstone et al. 2010; DoEE 2017
Banksia menziesii	Firewood banksia	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia mucronulata	Swordfish dryandra	Primary	Secondary		Groom 2011; DoEE 2017
Banksia nivea	Honeypot dryandra	Primary	Secondary		Saunders 1980; Groom 2011; DoEE 2017
Banksia nobilis	Golden dryandra	Primary	Secondary		Saunders 1980; Groom 2011; DoEE 2017
Banksia praemorsa	Cut-leaf banksia	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia prionotes	Acorn banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia prolata		Primary	Secondary		Johnstone et al. 2010; DoEE 2017
Banksia quercifolia	Oak-leaved banksia	Primary	Secondary		Johnstone & Storr 1998; Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia sessilis	Parrot bush	Primary	Secondary		Saunders 1980; Johnstone & Storr 1998; Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia speciosa	Showy banksia	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia spp.		Primary	Secondary		Saunders 1979; DSEWPaC 2012; DoEE 2017
Banksia squarrosa	Pingle	Primary	Secondary		Johnstone et al. 2010; Groom 2011; DoEE 2017
Banksia tricuspis	Pine banksia	Primary	Secondary		Groom 2011; DoEE 2017
Banksia undata	Urchin dryandra	Primary	Secondary		Groom 2011; DoEE 2017
Banksia verticillata	Granite banksia	Primary	Secondary		Saunders 1980; Groom 2011; DoEE 2017
Brassica campestris	Canola	Secondary			Groom 2011; DoEE 2017
Callistemon spp.		Secondary	Secondary		Johnstone et al. 2010; DoEE 2017
Callistemon viminalis	Captain cook bottlebrush	Secondary			Groom 2011
Callitris sp.		Secondary			Johnstone et al. 2010; Groom 2011
Carya illnoinensis	Pecan	Primary	Secondary		Johnstone et al. 2010; Groom 2011; Groom 2014; DoEE 2017
Casuarina cunninghamiana	River sheoak	Secondary			Groom 2011
Citrullus lanatus	Pie or afghan melon	Secondary			Johnstone et al. 2010; Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Corymbia calophylla	Marri	Primary	Primary	Primary	Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017; Johnstone 2017; Saunders 1979; Johnstone & Kirkby 2008
Corymbia citriodora	Lemon scented gum	Secondary	Secondary	Secondary	Johnstone et al. 2010; DSEWPaC 2012; Groom 2011; Johnstone 2017
Corymbia ficifolia	Red flowering gum	Secondary			Groom 2011
Corymbia haematoxylon	Mountain marri	Secondary		Secondary	Groom 2011; DoEE 2012; DoEE 2017
Corymbia maculata	Spotted gum	-	-	-	-
Darwinia citriodora	Lemon-scented darwinia	Secondary	Secondary		Groom 2011; Johnstone et al. 2010
Diospryros sp.	Sweet persimmon	Secondary	Secondary		Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Eremophila glabra	Tarbush	Secondary			Groom 2011
Erodium aureum		Secondary			Groom 2011
Erodium botrys	Long storksbill	Secondary	Secondary		Groom 2011; Johnstone & Storr 1998; Johnstone et al. 2010
Erodium spp.		Secondary	Secondary		Johnstone et al. 2010; DoEE 2017
Eucalyptus accedens	Powderbark	-	-	-	-
Eucalyptus caesia	Silver princess	Secondary		Secondary	Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017; Johnstone 2017
Eucalyptus camaldulensis	River red gum			Secondary	DoEE 2012; DoEE 2017
Eucalyptus decipiens	Red heart/moit			Secondary	Johnstone 2017
Eucalyptus diversicolor	Karri			Primary	Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017; Johnstone & Storr 1998
Eucalyptus erythrocorys	Illyarrie	Secondary		Secondary	DSEWPaC 2012; DoEE 2017; Johnstone 2017, Johnstone et al. 2010
Eucalyptus globulus	Tasmanian blue gum	-	-	-	-
Eucalyptus gomphocephala	Tuart	Secondary		Secondary	Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Eucalyptus grandis	Flooded gum, rose gum			Secondary	DoEE 2012; DoEE 2017

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Eucalyptus lehmannii	Bushy yate			Secondary	Johnstone 2017
Eucalyptus leucoxylon	Yellow gum	Secondary			Groom 2014
Eucalyptus longicornis	Red morrell	-	-	-	-
Eucalyptus loxophleba	York gum	Secondary			Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Eucalyptus marginata	Jarrah	Primary	Secondary	Primary	Saunders 1980; Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017; Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone 2017
Eucalyptus megacarpa	Bullich	-	-	-	-
Eucalyptus occidentalis	Swamp yate	-	-	-	-
Eucalyptus patens	Blackbutt	Primary		Primary	Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017; Johnstone 2017; Groom 2011
Eucalyptus pleurocarpa	Tallerack	Secondary			Groom 2011
Eucalyptus preissiana	Bell-fruited mallee	Secondary			Groom 2011
Eucalyptus robusta	Swamp mahogany	Secondary			Johnstone et al. 2010; Groom 2011
Eucalyptus rudis	Flooded gum	-	-	-	-
Eucalyptus salmonophloia	Salmon gum	Primary			Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DSEWPaC 2012; DoEE 2017
Eucalyptus salubris	Gimlet	-	-	-	-
Eucalyptus staeri	Albany blackbutt			Secondary	Johnstone & Storr 1998
Eucalyptus todtiana	Coastal blackbutt	Secondary			Saunders 1980; Johnstone et al. 2010; Groom 2011; Johnstone & Kirkby 2008
Eucalyptus wandoo	Wandoo	Primary	Secondary	Primary	Saunders 1980; Johnstone et al. 2010; Groom 2011; DSEWPaC 2012; DoEE 2017
Ficus sp.	Fig	Secondary			Groom 2011
Grevillea armigera	Prickly toothbrushes	Primary			Groom 2011
Grevillea bipinnatifida	Fuschia grevillea	Primary			Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Grevillea hookeriana	Red toothbrushes	Primary			Groom 2011
Grevillea hookeriana subsp. apic	Black toothbrushes	Primary			Groom 2011
Grevillea paniculata	Kerosene bush	Primary			Groom 2011
Grevillea paradoxa	Bottlebrush grevillea	Primary			Groom 2011
Grevillea petrophiloides	Pink poker	Primary			Groom 2011
Grevillea robusta	Silky oak	Primary			Johnstone et al. 2010; Groom 2011
Grevillea spp.		Primary			Saunders 1979; Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017
Grevillea wilsonii	Native fuchsia		Secondary		Johnstone et al. 2010
Hakea auriculata		Primary			Saunders 1980; Groom 2011
Hakea candolleana		Primary			Groom 2011
Hakea circumalata	Coastal hakea	Primary			Groom 2011
Hakea commutata		Primary			Groom 2011
Hakea conchifolia	Shell-leaved hakea	Primary			Groom 2011
Hakea costata	Ribbed hakea	Primary			Groom 2011
Hakea cristata	Snail hakea	Primary	Secondary		Groom 2011; Johnstone et al. 2010
Hakea cucullata	Snail hakea	Primary			Groom 2011
Hakea cyclocarpa	Ramshorn	Primary			Saunders 1980; Groom 2011
Hakea eneabba		Primary			Groom 2011
Hakea erinacea	Hedgehog hakea	Primary	Secondary		Johnstone et al. 2010; Groom 2011
Hakea falcata	Sickle hakea	Primary			Groom 2011
Hakea flabellifolia	Fan-leaved hakea	Primary			Groom 2011
Hakea gilbertii		Primary			Saunders 1980; Groom 2011
Hakea incrassata	Golfball or marble hakea	Primary			Johnstone et al. 2010; Groom 2011
Hakea lasiantha	Woolly flowered hakea	Primary			Johnstone et al. 2010; Groom 2011
Hakea lasianthoides		Primary	Secondary		Johnstone et al. 2010; Groom 2011
Hakea laurina	Pin-cushion hakea	Primary			Johnstone et al. 2010; Groom 2011
Hakea lissocarpha	Honeybush	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011
Hakea marginata			Secondary		Johnstone et al. 2010

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Hakea megalosperma	Lesueur hakea	Primary			Groom 2011
Hakea multilineata	Grass leaf hakea	Primary			Groom 2011
Hakea neospathulata		Primary			Groom 2011
Hakea obliqua	Needles and corks	Primary			Saunders 1980; Groom 2011
Hakea oleifolia	Dungyn	Primary			Groom 2011
Hakea pandanicarpa subsp. crassifolia	Thick-leaved hakea	Primary			Groom 2011
Hakea petiolaris	Sea urchin hakea	Primary			Groom 2011
Hakea polyanthema		Primary			Groom 2011
Hakea preissii	Needle tree	Primary			Groom 2011
Hakea prostrata	Harsh hakea	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011
Hakea psilorrhyncha		Primary			Groom 2011
Hakea ruscifolia	Candle hakea	Primary	Secondary		Saunders 1980; Groom 2011; Johnstone et al. 2010
Hakea scoparia	Kangaroo bush	Primary			Groom 2011
Hakea smilacifolia		Primary			Groom 2011
Hakea spp.		Primary	Secondary		Saunders 1979; DSEWPaC 2012; DoEE 2017
Hakea stenocarpa	Narrow-fruited hakea	Primary	Secondary		Johnstone et al. 2010; Groom 2011
Hakea sulcata	Furrowed hakea	Primary			Groom 2011
Hakea trifurcata	Two-leaved hakea	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011
Hakea undulata	Wavy-leaved hakea	Primary	Secondary		Saunders 1980; Johnstone et al. 2010; Groom 2011
Hakea varia	Variable-leaved hakea	Primary	Secondary		Saunders 1980; Groom 2011
Harpephyllum caffrum	Kaffir plum			Secondary	Johnstone 2017
Helianthus annuus	Sunflower	Secondary			Johnstone et al. 2010; Groom 2011
Hibiscus sp.	Hibiscus	Secondary			Groom 2011
Isopogon scabriusculus		Secondary			Groom 2011
Jacaranda mimosifolia	Jacaranda	Secondary	Secondary		Johnstone et al. 2010; Groom 2011

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Jacksonia furcellata	Grey stinkwood	Secondary			Groom 2011
Kingia australis	Kingia		Secondary		Johnstone et al. 2010
Lambertia inermis	Chittick	Secondary			Johnstone & Storr 1998; Groom 2011
Lambertia multiflora	Many-flowered honeysuckle	Secondary			Saunders 1980; Groom 2011
Liquidamber styraciflua	Liquid amber	Primary		Secondary	Johnstone et al. 2010; Groom 2011; Groom 2014; Personal observation
Lupinus sp.	Lupin	Secondary			Saunders 1980; Groom 2011
Macadamia integrifolia	Macadamia	Primary	Secondary		Johnstone et al. 2010; Grooms 2011; Groom 2014
Malus domestica	Apple	Secondary	Secondary		Johnstone et al. 2010; Johnstone & Storr 1998; DSEWPaC 2012; DoEE 2017; Groom 2011
Melaleuca leuropoma		Secondary			Saunders 1980; Groom 2011
Melia azedarach	Cape lilac or white cedar	Secondary		Primary	Johnstone et al. 2010; Groom 2011
Mesomeleana spp.		Secondary			Johnstone et al. 2010; Groom 2011
Olea europea	Olive			Secondary	Johnstone 2017
Persoonia longifolia	Snottygobble			Secondary	Johnstone & Storr 1998; Johnstone & Kirkby 1999; Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017
Pinus canariensis	Canary island pine	Primary			Johnstone et al. 2010; Groom 2011
Pinus caribea	Caribbean pine	Primary			Johnstone et al. 2010; Groom 2011
Pinus pinaster	Pinaster or maritime pine	Primary			Groom 2011
Pinus radiata	Radiata pine	Primary	Secondary		Johnstone et al. 2010; Groom 2011
Pinus spp.		Primary	Secondary		Johnstone & Storr 1998; Saunders 1979; Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017
Protea 'Pink Ice'		Secondary			Groom 2011
Protea repens		Secondary			Groom 2011
Protea spp.		Secondary			Johnstone et al. 2010

Species name	Common name	Foraging category as assigned by Emerge			Literature references
		CBC	BBC	FRTBC	
Prunus amygdalus	Almond tree	Secondary			Johnstone & Storr 1998; Johnstone et al. 2010; Groom 2011; DoEE 2017
Pyrus communis	European pear		Secondary		Johnstone & Storr 1998; Johnstone et al. 2010; DSEWPaC 2012; DoEE 2017
Quercus spp.	Oak		Secondary		Johnstone et al. 2010
Raphanus raphanistrum	Wild radish	Secondary			Groom 2011; DoEE 2017
Reedia spathacea			Secondary		Johnstone et al. 2010
Rumex hypogaeus	Doublegee	Secondary			Saunders 1980
Stenocarpus sinuatus		Secondary			Johnstone et al. 2010
Syzygium smithii	Lilly pilly	Secondary			Groom 2014
Tipuana tipu	Tipu or rosewood tree	Primary			Groom 2011, Groom 2014
Xanthorrhoea preissii	Grass tree	Secondary	Secondary		Groom 2011; Johnstone et al. 2010
Xylomelum occidentale	Woody pear	Secondary			Groom 2014

CBC=Carnaby's cockatoo, BBC=Baudin's cockatoo and FRTBC=Forest red-tailed black cockatoo

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Appendix C

Black Cockatoo Habitat Quality Assessment (Emerge 2020)

Introduction

As part of environmental impact assessment and offset calculation, the Department of Agriculture, Water and the Environment (DAWE) requires that a score out of ten is provided for the overall quality of back cockatoo habitat within a site (DAWE 2020). DAWE does not provide a methodology for scoring habitat quality, specifying instead that an assessment of quality should be undertaken by an experienced technical expert (DSEWPaC 2012).

Emerge Associates (Emerge) have developed this method to provide a systematic assessment of overall black cockatoo habitat quality. Black cockatoo habitat is conventionally separated into breeding, roosting and foraging categories. Our method assesses and scores the quality of breeding, roosting and foraging habitat separately and then provides an overall quality score (out of ten) based on the highest score determined for the respective habitat categories.

Methodology

The International Organization for Standardization defines 'quality' as the "*degree to which a set of inherent characteristics fulfils requirements*" (ISO 9000 2020). Developing an objective scoring system for quality is therefore challenging, as quality is both relative and, to some extent, subjective. An ecological value like habitat may also have a wide range of characteristics, with varying relevance to the requirements of a species and that may be independent, interdependent or contrasting with other characteristics, such that habitat quality must be assessed holistically to be properly understood.

The three categories of black cockatoo habitat are intrinsically linked in that breeding and roosting activity is directly related to the availability of foraging and watering resources surrounding nests or roosts (Saunders 1990; Shah 2006; Le Roux 2017). Black cockatoos can also move over large distances within their range to access breeding and foraging habitat and will not necessarily return to the same locations within a year or across years (Saunders 1980; Johnstone and Kirkby 2008; Johnstone *et al.* 2017; Peck *et al.* 2019). Therefore, evaluating the overall quality of black cockatoo habitat requires acknowledgement of the relationships between the different habitat categories and the potential for use of all habitats within a site, given the condition of each habitat, the sites' location and the history of use of habitat within a site by black cockatoos.

While breeding, roosting and foraging habitat are interrelated, we suggest that the different habitat categories should not be scored cumulatively as this can overestimate quality. That is, if a site contains multiple categories of habitat it does not necessarily contain greater quality habitat. For example, a site that contains a roost is not necessarily of higher overall quality if it also contains breeding habitat.

Alternatively, averaging the scores from all three habitat categories can act to underestimate habitat, since certain types of habitat are recorded less frequently than others and therefore their absence would act to devalue quality. For example, the likelihood of recording a roost is generally low compared to recording foraging or breeding habitat but a site that lacks a roost is not necessarily of lower overall quality.

Hence, our scoring system selects the highest habitat category score to represent overall habitat quality. Adopting the highest score from any habitat category within a site avoids over or under estimating habitat quality because the most important value always drives, or is reflected in, the overall score.

To provide a score for each habitat category, the following three 'quality components' are considered as recommended by DAWE (DAWE 2020):

- Site condition which is the "*condition of a site in relation to the ecological requirements of a threatened species or ecological community. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features".*
- Site context which is the "*relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species or ecological community. This includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species or community*".
- Species stocking rate which is the "*usage and/or density of a species at a particular site...It includes considerations such as survey data for a site in regards to a particular species population or, in the case of a threatened ecological community this may be a number of different populations. It also includes consideration of the role of the site population in regards to the overall species population viability or community extent*".

A habitat quality assessment should aim to combine current information on the status of black cockatoos and habitat characteristics within a site with the best available information regarding the status of black cockatoo populations and black cockatoo habitat within areas surrounding a site. Black cockatoo habitat assessments for a given site don't typically allow scope for physical survey of areas surrounding a site and so the ability to obtain new information is usually limited to that which can be obtained within a site. Therefore, we considered that, when assessing the above components, site condition is best defined from a current survey, site context is best defined from literature and relevant databases (Glossop *et al.* 2011; DPaW 2013; DoEE 2016a, c, b; Peck *et al.* 2019) and information on species stocking rate is best obtained from a combination of current survey, previous survey or databases (Glossop *et al.* 2011; DPaW 2013; DoEE 2016a, c, b; Peck *et al.* 2019).

Method

The *Habitat Quality Scale* provided as **Plate 1** outlines the attributes measured within each habitat category and quality component. It also shows the associated quality classification (low, moderate or high) and score (1-10).

As shown in the *Habitat Quality Scale*, the highest scores are reserved for habitat that has active or historical roosts or nests as it is considered that the presence of black cockatoos provides the best indication of the quality of habitat. Foraging habitat is weighted lower than breeding and roosting habitat as the occurrence of roost or nests provides the best confirmation that foraging habitat surrounding a site is adequate and therefore worthy of a higher quality score. Therefore, a maximum

total of ten is achievable for breeding habitat and a total of eight is achievable for both roosting and foraging habitat (refer **Plate 1**).

The *Habitat Scoring Tool* provided as **Plate 2** is an *Excel* spreadsheet document that is used to determine a quality score for each habitat category component by answering queries about habitat within and surrounding the site. A quality score is calculated for each habitat category by summing maximum scores for each query. Because maximum scores are selected, multiple answers may be provided for any query where appropriate without exaggerating the quality score. For key confirmed habitat such as roosts or nests, the scoring tool ensures that relevant, higher scores are achieved irrespective of whether all preceding queries have been answered positively (for example a roost always scores 7 or 8 irrespective of whether other quality criteria have been met).

The highest score from any of the three habitat categories is then adopted as the overall score for black cockatoo habitat quality within the site.

Black Cockatoo Habitat Quality Assessment

Emerge Black Cockatoo Habitat Quality Assessment - Scale

		Habitat Quality Score									
		Low			Moderate			Moderate - High	High		
	Quality Component	1	2	3	4	5	6	7	8	9	10
Breeding habitat	Site condition	Habitat trees with suitable hollows occur within the site AND / OR habitat trees without suitable hollows occur within the site					Habitat trees with suitable hollows occur within the site			N/A	
	Site context	No nest has been recorded within 12 km of the site AND <100 ha of potential foraging habitat occurs within 6 km of the site	A nest(s) (active, historical or potential) has been recorded within 12 km of the site AND / OR >100 ha of potential native foraging habitat occurs within 6 km of the site				A nest(s) (active, historical or potential) has been recorded within 6 km of the site AND / OR >1000 ha of potential native foraging habitat occurs within 6 km of the site				
	Species stocking rate	No evidence of black cockatoos nesting has been recorded within the site						A potential nest(s) occurs within the site OR a historical nest(s) has been recorded within the site	A Potential nest(s) occurs within the site AND a historical nest(s) has been recorded within the site	An active nest(s) occurs within the site	An active nest(s) occurs within the site AND a historical nest(s) has been recorded within the site
Roosting habitat	Site condition	Trees potentially suitable for roosting occur within the site						N/A			
	Site context	No water source occurs within or nearby the site	A water source occurs within or nearby the site OR no water source occurs within or nearby the site								
		No roost has been recorded within 1 km of the site	A small roost (active or historical) has been recorded within 500 m of the site OR a large roost (active or historical) has been recorded within 1 km of the site OR no roost has been recorded within 1 km of the site								
	Species stocking rate	No roost has been recorded within the site				A small roost (active or historical) has been recorded within the site	A large roost (active or historical) has been recorded within the site	An active small roost occurs within the site	An active large roost occurs within the site		
	Site condition	Foraging habitat with 1-10% primary foraging plants occurs within the site	Foraging habitat with 1-50% primary foraging plants occurs within the site		Foraging habitat with 1-100% primary foraging plants occurs within the site		Foraging habitat with 10-100% primary foraging plants occurs within the site	Foraging habitat with 50-100% primary foraging plants occurs within the site		N/A	
	Site context	No nest or roost has been recorded within 12 km of the site	A nest(s) (active, potential or historical) AND / OR a roost(s) (active or historical) has been recorded within 12 km of the site					A nest(s) (active, potential or historical) has been recorded within 6 km of the site			
	Species stocking rate	No evidence of foraging by black cockatoos has been recorded within the site	Evidence of foraging by black cockatoos may have been recorded within the site (limted or abundant)						Abundant evidence of foraging by black cockatoos has been recorded in the site		

Note that breeding, roosting and foraging habitat are assessed separately and the highest score is the overall quality score.

Black Cockatoo Habitat Scale definitions

'Habitat tree' is a native eucalypt that is typically known to support black cockatoo breeding such as marri, jarrah, blackbutt, tuart, wandoo, salmon gum or to a lesser extent flooded gum, with a DBH ≥50 cm or D3H ≥30 cm for wandoo or salmon gum (DSEWPaC 2012).

'Nest' is a hollow in which black cockatoo breeding has been recorded. A nest is **'active'** if breeding was recorded within the last 2 years and **'historical'** if breeding was recorded more than 2 years ago. A hollow with potential secondary signs of breeding (e.g. chew marks) or a hollow with potential signs of breeding that could not be attributed to a bird species is a **'potential'** nest.

'Roost' is a black cockatoo roost site confirmed by a roost survey (e.g. BirdLife Australia Great Cocky Count). A roost is considered **'large'** if more than 150 individuals were recorded and **'small'** if less than 150 individuals were recorded (BirdLife Australia 2019). A roost is **'active'** if roosting was

'Primary foraging plants' are plants with historical and/or contemporary records of regular consumption by black cockatoos, including native and non-native plant species.

Plate 1: Black Cockatoo Habitat Quality Scale

Black Cockatoo Habitat Quality Assessment - Scoring Tool (Carnaby's cockatoo)
<insert site name>

		Query		Answer	Potential score	Site score	Sum
Breeding habitat	Site condition	1.1	The site contains:				
			habitat tree(s) with suitable hollow(s)		2.0	0.0	0.0
			habitat tree(s) without suitable hollow(s)		1.0	0.0	
	Site context	1.2	The site is located:				
			within 6 km of a nest(s) (active, historical or potential)		1.0	0.0	0.0
			6-12 km from a nest(s) (active, historical or potential)		0.5	0.0	
		1.3	The site is located within 6 km of:				
			>1000 ha of potential foraging habitat		3.0	0.0	0.0
			100 to 1000 ha of potential foraging habitat		1.0	0.0	
	Species stocking rate	1.4	The site contains:				
			historical nest(s)		1.0	0	0.0
			The site contains:				
			active nest(s)		3.0	0	
			potential nest(s)		1.0	0	0.0
			Score	0	10.0		
Roosting habitat	Site condition	2.1	The site contains trees potentially suitable for roosting		1.0	0.0	0.0
		2.2	The site contains a water source or one exists nearby		1.0	0.0	
	Site context	2.3	The site is located:				
			within 1 km of a large roost (≥150 individuals) (active or historical)		1.0	0.0	0.0
			within 500 m of a small roost (< 150 individuals) (active or historical)		1.0	0.0	
	Species stocking rate	2.4	The site contains:				
			a historical record of a large roost (≥150 individuals)		2.0	0	
			a historical record of a small roost (<150 individuals)		1.0	0	0.0
			The site contains:				
			an active record of a large roost (≥150 individuals)		2.0	0.0	0.0
			an active record of a small roost (<150 individuals)		1.0	0.0	
			Score	0	7.0		
Foraging habitat	Site condition	3.1	The site contains foraging habitat comprising:				
			≥50% primary foraging plants		4.0	0.0	0.0
			≥10% to <50% primary foraging plants		2.0	0.0	
			<10% primary foraging plants		1.0	0.0	
	Site context	3.2	The site is located:				
			within 6 km of a nest(s) (active, historical or potential)		2.0	0.0	0.0
			6-12 km from a nest(s) (active, historical or potential)		1.00	0.0	
		3.3	The site is located:				
			within 6 km of a roost(s) (active or historical)		1.0	0.0	
			6-12 km from a roost(s) (active or historical)		0.5	0.0	
	Species stocking rate	3.4	The site contains:				
			abundant evidence of foraging		2.0	0.0	0.0
			limited evidence of foraging		1.0	0.0	
			Score	0	8.0		

SUMMARY		
Habitat category	**Score**	**Habitat quality**
Breeding	0	No habitat
Roosting	0	No habitat
Foraging	0	No habitat
Overall habitat quality score	**0**	No habitat

Note:
1. Within the breeding category, a score of 9 applies if an active nest(s) occurs within the site and a score of 10 applies if an active nest(s) and a historical nest(s) occurs within the site, regardless of the answer to other queries in this category
2. Within the roosting category, a score of 7 applies if a small roost occurs within the site and a score of 8 applies if a large roost occurs within the site, regardless of the answer to other queries in this category.
3. The final score consists of the highest score from each habitat category

Plate 2: Black Cockatoo Habitat Scoring Tool

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Appendix D

Database Search Results

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 17/02/2021

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116° 01' 11" E,31° 41' 54" S
Buffer 10km
Group By Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	322	4503
Other specially protected fauna	1	2
Priority 3	3	22
Priority 4	4	69
Protected under international agreement	1	1
Rare or likely to become extinct	11	541
TOTAL	**342**	**5138**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
2.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
3.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
4.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
5.	34027	*Galaxiella nigrostriata (Black-stripe Minnow, black-striped dwarf galaxias)*		T	
6.	33983	*Leioproctus douglasiellus (a short-tongued bee)*		T	
7.	24168	*Macrotis lagotis (Bilby, Dalgyte, Ninu)*		T	
8.	24142	*Petrogale lateralis subsp. lateralis (Black-flanked Rock-wallaby, Black-footed Rock-wallaby)*		T	
9.	25345	*Pseudemydura umbrina (Western Swamp Tortoise, Western Swamp Turtle)*		T	
10.	48237	*Rostratula australis (Australian Painted Snipe)*		T	
11.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
Protected under international agreement					
12.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
Other specially protected fauna					
13.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
Priority 3					
14.	48579	*Euoplos inornatus (inornate trapdoor spider (northern Jarrah Forest))*		P3	
15.	33982	*Leioproctus contrarius (a short-tongued bee)*		P3	
16.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
Priority 4					
17.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
18.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
19.	48024	*Notamacropus eugenii subsp. derbianus (Tammar Wallaby, Tammar)*		P4	
20.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
Non-conservation taxon					
21.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
22.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
23.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
24.	24262	*Acanthiza inornata (Western Thornbill)*			
25.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
26.		*Acariformes sp.*			
27.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
28.	25536	*Accipiter fasciatus (Brown Goshawk)*			
29.		*Acercella falcipes*			
30.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
31.	25755	*Acrocephalus australis (Australian Reed Warbler)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
32.		*Allothereua maculata*			
33.		*Amblyomma triguttatum*			
34.		*Amphisopodidae sp.*			
35.		*Aname mainae*			
36.		*Aname tepperi*			
37.	24312	*Anas gracilis (Grey Teal)*			
38.	24313	*Anas platyrhynchos (Mallard)*			
39.		*Anas platyrhynchos subsp. domesticus*			
40.	24316	*Anas superciliosa (Pacific Black Duck)*			
41.		*Ancylidae sp.*			
42.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
43.	44629	*Anilios australis*			
44.	44650	*Anilios waitii*			
45.		*Anopheles atratipes*			
46.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
47.	24561	*Anthochaera carunculata (Red Wattlebird)*			
48.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
49.	25670	*Anthus australis (Australian Pipit)*			
50.	24599	*Anthus australis subsp. australis (Australian Pipit)*			
51.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
52.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
53.	24285	*Aquila audax (Wedge-tailed Eagle)*			
54.		*Araneus cyphoxis*			
55.	24340	*Ardea novaehollandiae (White-faced Heron)*			
56.	24341	*Ardea pacifica (White-necked Heron)*			
57.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
58.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
59.		*Austracantha minax*			
60.		*Austrogomphus (Zephyrogomphus) lateralis*			
61.	47713	*Austronomus australis (White-striped Free-tailed Bat)*			
62.	24318	*Aythya australis (Hardhead)*			
63.		*Backobourkia brounii*			
64.		*Badumna insignis*			
65.		*Baetidae sp.*			
66.		*Barnardius zonarius*			
67.	24251	*Bos taurus (European Cattle)*	Y		
68.		*Bostockia porosa*			
69.	42380	*Brachyurophis fasciolatus subsp. fasciolatus (Narrow-banded Shovel-nosed Snake)*			
70.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
71.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
72.	25715	*Cacatua roseicapilla (Galah)*			
73.	25716	*Cacatua sanguinea (Little Corella)*			
74.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
75.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
76.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
77.		*Caenidae sp.*			
78.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
79.		*Carassius auratus*			
80.		*Ceinidae sp.*			
81.		*Ceratopogonidae sp.*			
82.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
83.		*Cercophonius sulcatus*			
84.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
85.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
86.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
87.	33939	*Cherax cainii (Marron)*			
88.		*Cherax quinquecarinatus*			
89.		*Cherax sp.*			
90.		*Chironominae sp.*			
91.		*Chironomus aff. alternans (V24) (CB)*			
92.	24980	*Christinus marmoratus (Marbled Gecko)*			
93.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
94.	24432	*Chrysococcyx lucidus subsp. plagosus (Shining Bronze Cuckoo)*			
95.	24288	*Circus approximans (Swamp Harrier)*			
96.		*Cladocera (unident.)*			
97.		*Clinohelea sp. 1 (SAP)*			
98.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
99.	24399	*Columba livia (Domestic Pigeon)*	Y		
100.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
101.		*Corduliidae sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
102.		*Corixidae sp.*			
103.		*Cormocephalus aurantiipes*			
104.		*Cormocephalus strigosus*			
105.		*Cormocephalus turneri*			
106.	25592	*Corvus coronoides (Australian Raven)*			
107.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
108.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
109.	25595	*Cracticus tibicen (Australian Magpie)*			
110.	25596	*Cracticus torquatus (Grey Butcherbird)*			
111.	25456	*Crenadactylus ocellatus (Clawless Gecko)*			
112.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
113.	25398	*Crinia georgiana (Quacking Frog)*			
114.	25399	*Crinia glauerti (Clicking Frog)*			
115.	25400	*Crinia insignifera (Squelching Froglet)*			
116.	30893	*Cryptoblepharus buchananii*			
117.	25020	*Cryptoblepharus plagiocephalus*			
118.		*Cryptochironomus griseidorsum*			
119.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
120.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
121.	25027	*Ctenotus australis*			
122.	25039	*Ctenotus fallens*			
123.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain subpop P3), skink)*			
124.	25047	*Ctenotus impar*			
125.		*Culicidae sp.*			
126.		*Culiseta atra*			
127.		*Curculionidae sp.*			
128.	24322	*Cygnus atratus (Black Swan)*			
129.		*Cyprinus carpio*			
130.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
131.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
132.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
133.	24999	*Delma grayii*			
134.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
135.		*Dingosa serrata*			
136.	25469	*Diplodactylus granariensis*			
137.	24929	*Diplodactylus granariensis subsp. granariensis*			
138.	24470	*Dromaius novaehollandiae (Emu)*			
139.		*Dugesiidae sp.*			
140.		*Dytiscidae sp.*			
141.	25251	*Echiopsis curta (Bardick)*			
142.		*Ecnomina F group*			
143.		*Edelia vittata*			
144.	25096	*Egernia kingii (King's Skink)*			
145.	25100	*Egernia napoleonis*			
146.		*Egretta garzetta*			
147.		*Egretta novaehollandiae*			
148.		*Elanus axillaris*			
149.	24290	*Elanus caeruleus subsp. axillaris (Australian Black-shouldered Kite)*			
150.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
151.		*Enchytraeidae sp.*			
152.		*Eolophus roseicapillus*			
153.	24567	*Epthianura albifrons (White-fronted Chat)*			
154.		*Eucyclops edytae*			Y
155.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
156.	24472	*Falco cenchroides subsp. cenchroides (Australian Kestrel, Nankeen Kestrel)*			
157.	25623	*Falco longipennis (Australian Hobby)*			
158.	24041	*Felis catus (Cat)*	Y		
159.	25727	*Fulica atra (Eurasian Coot)*			
160.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
161.	34028	*Galaxias occidentalis (Western Minnow)*			
162.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
163.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
164.		*Gambusia sp.*			
165.	42314	*Gavicalis virescens (Singing Honeyeater)*			
166.	24959	*Gehyra variegata*			
167.	25530	*Gerygone fusca (Western Gerygone)*			
168.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
169.	24443	*Grallina cyanoleuca (Magpie-lark)*			
170.		*Gripopterygidae sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
171.		*Gyrinidae sp.*			
172.	24295	*Haliastur sphenurus (Whistling Kite)*			
173.		*Harpacticoida sp*			
174.		*Hebridae sp.*			
175.	25408	*Heleioporus albopunctatus (Western Spotted Frog)*			
176.	25409	*Heleioporus barycragus (Hooting Frog)*			
177.	25410	*Heleioporus eyrei (Moaning Frog)*			
178.	25411	*Heleioporus inornatus (Whooping Frog)*			
179.		*Hemicordulia tau*			
180.		*Hemicorduliidae sp.*			
181.	25115	*Hemiergis initialis subsp. initialis*			
182.	25475	*Hemiergis peronii*			
183.	25119	*Hemiergis quadrilineata*			
184.		*Henicops dentatus*			
185.	42408	*Hesperoedura reticulata*			
186.	47965	*Hieraaetus morphnoides (Little Eagle)*			
187.	24491	*Hirundo neoxena (Welcome Swallow)*			
188.		*Holconia westralia*			
189.		*Hydridae sp.*			
190.		*Hydroptilidae sp.*			
191.		*Idiommata blackwalli*			
192.		*Karaops ellenae*			
193.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
194.		*Latrodectus hasseltii*			
195.		*Lepidoptera sp.*			
196.		*Leptoceridae sp.*			
197.	25128	*Lerista christinae*			
198.	25133	*Lerista elegans*			
199.	25148	*Lerista lineopunctulata*			
200.	25165	*Lerista praepedita*			
201.	25005	*Lialis burtonis*			
202.	25661	*Lichmera indistincta (Brown Honeyeater)*			
203.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
204.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
205.	25388	*Litoria moorei (Motorbike Frog)*			
206.		*Lophoictinia isura*			
207.		*Lymnaeidae sp.*			
208.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
209.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
210.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
211.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
212.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
213.	25654	*Malurus splendens (Splendid Fairy-wren)*			
214.	24583	*Manorina flavigula (Yellow-throated Miner)*			
215.	47997	*Melanodryas cucullata (Hooded Robin)*			
216.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
217.	25184	*Menetia greyii*			
218.	24598	*Merops ornatus (Rainbow Bee-eater)*			
219.		*Mesamphisopodidae sp.*			
220.		*Mesostigmata sp.*			
221.		*Microcarbo melanoleucos*			
222.	25693	*Microeca fascinans (Jacky Winter)*			
223.		*Microvelia sp.*			
224.		*Missulena granulosa*			
225.		*Mituliodon tarantulinus*			
226.		*Monohelea sp. 4 (SAP)*			
227.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
228.	25191	*Morethia lineoocellata*			
229.	25192	*Morethia obscura*			
230.	24223	*Mus musculus (House Mouse)*	Y		
231.	25610	*Myiagra inquieta (Restless Flycatcher)*			
232.	25420	*Myobatrachus gouldii (Turtle Frog)*			
233.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
234.		*Nematoda sp.*			
235.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
236.	24738	*Neophema elegans (Elegant Parrot)*			
237.		*Nephila edulis*			
238.	25252	*Notechis scutatus (Tiger Snake)*			
239.		*Notonectidae sp.*			
240.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
241.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
242.		*Oecobius navus*			
243.		*Oligochaeta sp.*			
244.		*Oniscidae sp.*			
245.		*Orthocladiinae SO3 sp. A (SAP)*			
246.		*Orthocladiinae sp.*			
247.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
248.		*Ostracoda (unident.)*			
249.		*Oxyethira sp.*			
250.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
251.		*Palaemonidae sp.*			
252.		*Paracyclops sp.*			
253.		*Paralimnophyes pullulus (V42)*			
254.		*Paramerina levidensis*			
255.	25253	*Parasuta gouldii*			
256.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
257.	25682	*Pardalotus striatus (Striated Pardalote)*			
258.		*Pedidromus velox*			Y
259.	48061	*Petrochelidon nigricans (Tree Martin)*			
260.	48066	*Petroica boodang (Scarlet Robin)*			
261.	24659	*Petroica goodenovii (Red-capped Robin)*			
262.	25697	*Phalacrocorax carbo (Great Cormorant)*			
263.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
264.		*Phalacrocorax sp.*			
265.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
266.	25699	*Phalacrocorax varius (Pied Cormorant)*			
267.	24409	*Phaps chalcoptera (Common Bronzewing)*			
268.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
269.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
270.		*Physidae sp.*			
271.		*Piona murleyi*			
272.		*Planorbidae sp.*			
273.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
274.	25720	*Platycercus icterotis (Western Rosella)*			
275.	24747	*Platycercus spurius (Red-capped Parrot)*			
276.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
277.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
278.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
279.	25509	*Pletholax gracilis (Keeled Legless Lizard)*			
280.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
281.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
282.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
283.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
284.	30854	*Polytelis anthopeplus subsp. westralis (Regent Parrot)*			
285.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
286.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
287.		*Procladius paludicola*			
288.	25261	*Pseudechis australis (Mulga Snake)*			
289.	25511	*Pseudonaja affinis (Dugite)*			
290.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
291.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
292.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
293.		*Purpureicephalus spurius*			
294.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
295.	24245	*Rattus rattus (Black Rat)*	Y		
296.	48096	*Rhipidura albiscapa (Grey Fantail)*			
297.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
298.		*Richardsonianidae sp.*			
299.		*Rotifera sp.*			
300.		*Scirtidae sp.*			
301.		*Scolopendra laeta*			
302.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
303.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
304.		*Simuliidae sp.*			
305.	30948	*Smicrornis brevirostris (Weebill)*			
306.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
307.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
308.		*Sternopriscus sp.*			
309.	25597	*Strepera versicolor (Grey Currawong)*			
310.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
311.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
312.	25518	*Strophurus spinigerus*			
313.	24943	*Strophurus spinigerus subsp. inornatus*			
314.	24942	*Strophurus spinigerus subsp. spinigerus*			
315.		*Tabanidae sp.*			
316.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
317.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
318.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
319.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
320.		*Tanypodinae sp.*			
321.		*Tanytarsus barbitarsis*			
322.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
323.		*Tasmanicosa leuckartii*			
324.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
325.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
326.	25519	*Tiliqua rugosa*			
327.	25204	*Tiliqua rugosa subsp. aspera*			
328.	25207	*Tiliqua rugosa subsp. rugosa*			
329.		*Tipulidae sp.*			
330.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
331.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
332.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
333.	48147	*Turnix varius (Painted Button-quail)*			
334.	24851	*Turnix velox (Little Button-quail)*			
335.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
336.	24983	*Underwoodisaurus milii (Barking Gecko)*			
337.		*Urodacus novaehollandiae*			
338.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
339.	25526	*Varanus tristis (Racehorse Monitor)*			
340.	24206	*Vespadelus regulus (Southern Forest Bat)*			
341.	24040	*Vulpes vulpes (Red Fox)*	Y		
342.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

EPBC Act Protected Matters Report

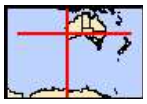
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 11/02/21 12:08:58

Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	39
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	16
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	12
Regional Forest Agreements:	1
Invasive Species:	37
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area
Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Fish		
Galaxiella nigrostriata Blackstriped Dwarf Galaxias, Black-stripe Minnow [88677]	Endangered	Species or species habitat known to occur within area
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Extinct within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Translocated population known to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat may occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat may occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat known to occur within area
Diplolaena andrewsii [6601]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Grevillea althoferorum [64906]	Endangered	Species or species habitat likely to occur within area
Grevillea christineae Christine's Grevillea [64520]	Endangered	Species or species habitat known to occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Pseudemydura umbrina Western Swamp Tortoise [1760]	Critically Endangered	Translocated population known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - MUCHEA ARMAMENT RANGE
Defence - PEARCE - AP11OBSTRUCTION BEACON NO.5
Defence - PEARCE - AP15 WATER TREATMENT PLANT
Defence - PEARCE - AP17 WATER SUPPLY TANKS
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK
Defence - PEARCE - AP2 OBSTRUCTION BEACON NO.2
Defence - PEARCE - AP3 RADAR STATION BULLSBROOK
Defence - PEARCE - AP4 AERIAL FARM
Defence - PEARCE - AP5 OPERATIONS SITE
Defence - PEARCE - AP6 OBSTRUCTION BEACON NO.3
Defence - PEARCE - AP7 OBSTRUCTION BEACON NO.1
Defence - PEARCE - AP8 BORE SITES
Defence - PEARCE - AP9 OBSTRUCTION BEACON NO.4
Defence - PEARCE - RAAF BASE
Defence - VACANT LAND - BULLSBROOK AP102

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bullsbrook	WA
Ellen Brook	WA
Neaves Road	WA
Paruna	WA
Swan River	WA
Twin Swamps	WA
Unnamed WA46564	WA
Unnamed WA46875	WA
Unnamed WA46919	WA
Unnamed WA46920	WA

Name	State
Unnamed WA49300	WA
Walyunga	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area

Name	Status	Type of Presence
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Ellen Brook Swamps System	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.6984 116.01967

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix E

Conservation Significant Species and Likelihood of Occurrence Assessment

Species name	Common name	Level of significance		Habitat	Likelihood of occurrence
		WA	EPBC Act		
Apus pacificus	Pacific swift	MI	MI	Aerial, migratory species that is most often seen over inland plains and sometimes above open areas, foothills or in coastal areas. Sometimes occurs over settled areas, including towns, urban areas and cities (Pizzey & Knight 2012).	**Possible** May opportunistically occur in or fly over the site on commute or while searching for prey.
Botaurus poiciloptilus	Australasian bittern	EN	EN	In or over water, in tall reedbeds, sedges, rushes, cumbungi, lignum. Also occurs in ricefields, drains in tussocky paddocks and occasionally in saltmarshes and brackish wetlands.	**Unlikely** No suitable habitat present.
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	Occurs in tidal mudflats, saltmarshes and mangroves, as well as, shallow fresh,brackish or saline inland wetlands. It is also known from floodwaters, irrigated pastures and crops, sewage ponds, saltfields.	**Unlikely** No suitable habitat present.
Calidris ferruginea	Curlew sandpiper	CR	CR (MI)	Mainly shallows of estuaries and near-coastal saltlakes (including saltwork ponds) and drying near-coastal freshwater lakes and swamps. Also beaches and near-coastal sewage ponds.	**Unlikely** No suitable habitat present.
Calidris melanotos	Pectoral sandpiper	MI	MI	Mainly fresh waters (swamps, lagoons, river pools, irrigation channels and sewage ponds); also samphire flats around estuaries and saltlakes (Johnstone & Storr 1998).	**Unlikely** No suitable habitat present.

		WA	EPBC Act		
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	VU	VU	Eucalypt and Corymbia forests, often in hilly interior. More recently also observed in more open agricultural and suburban areas including Perth metropolitan area. Attracted to seeding Corymbia calophylla, Eucalyptus marginata, introduced Melia azdarach and Eucalyptus spp. trees.	**Likely** Potential roosting and foraging habitat present.
Calyptorhynchus baudinii	Baudin's cockatoo	EN	EN	Mainly eucalypt forests. Attracted to seeding Corymbia calophylla, Banksia spp., Hakea spp., and to fruiting apples and pears (Johnstone and Storr 1998).	**Unlikely** No suitable habitat present.
Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN	Mainly proteaceous scrubs and heaths and adjacent eucalypt woodlands and forests; also plantations of Pinus spp. Attracted to seeding Banksia spp., Dryandra spp., Hakea spp., Eucalyptus spp., Corymbia calophylla, Grevillea spp., and Allocasuarina spp. (Johnstone and Storr 1998).	**Likely** Potential roosting and foraging habitat present.
Falco peregrinus	Peregrine falcon	OS	-	Mainly found around cliffs along coasts, rivers, ranges and around wooded watercourses and lakes (Johnstone and Storr 1998).	**Possible** May opportunistically occur in or fly over the site on commute or while searching for prey.
Leipoa ocellata	Mallefowl	VU	VU	Scrubs and thickets of Eucalyptus spp.,	**Unlikely**

		WA	EPBC Act		
Motacilla cinerea	Grey wagtail	MI	MI	In Australia mostly near running water in disused quarries, sandy and rocky streams in escarpments and rainforests, sewage ponds, ploughed fields and airfields (Pizzey & Knight 2012).	**Unlikely** No suitable habitat present.
Numenius madagascariensis	Eastern curlew	CR	CR (MI)	Mainly tidal mudflats; also reef flats, sandy beaches and rarely near-coastal lakes (including saltwork ponds) (Johnstone and Storr 1998).	**Unlikely** No suitable habitat present.
Pandion haliaetus	Osprey	MI	MI	Coasts, estuaries, bays, inlets, islands, and surrounding waters; coral atolls, reefs, lagoons, rock cliffs, stacks (Pizzey & Knight 2012).	**Unlikely** No suitable habitat present.
Plegadis falcinellus	Glossy Ibis	MI	MI	Well-vegetated wetlands, wet pasture, ricefields, floodwaters, floodplains, brackish or occasionally saline wetlands, mangroves, mudflats and occasionally dry grassland (Pizzey & Knight 2012).	**Unlikely** No suitable habitat present.
Rostratula australis	Australian painted snipe	EN	EN	Mainly shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (Marchant and Higgins 1993).	**Unlikely** No suitable habitat present.
Tringa glareola	Wood sandpiper	MI	MI	Mainly shallow fresh waters (lagoons, swamps, claypans, river pools, dams, bore overflows and sewage ponds); occasionally brackish swamps, rarely saltlakes and estuaries (Pizzey & Knight).	**Unlikely** No suitable habitat present.

		WA	EPBC Act		
Tringa hypoleucos	Common sandpiper	MI	MI	Edge of sheltered waters salt or fresh, e.g. estuaries, mangrove creeks, rocky coasts, near-coastal saltlakes (including saltwork ponds), river pools, lagoons, claypans, drying swamps, flood waters, dams and sewage ponds. Preferring situations wherelow perches are available (Johnstone & Storr 1998).	**Unlikely** No suitable habitat present.
Tringa nebularia	Common greenshank	MI	MI	Mudflats, estuaries, saltmarshes, margins of lakes, wetlands, claypans (fresh amd saline), commercial saltfields, sewage ponds (Pizzey & Knight 2012).	**Unlikely** No suitable habitat present.
Fish					
Galaxiella nigrostriata	Black-stripe minnow	EN	EN	Seasonally dry coastal wetlands. Permanent or ephemeral spring-fed headwater streams, ponds, roadside ditches and small creeks in sandy wetland areas with thick vegetation. Also occurs in the shallow areas of some freshwater lakes with thick vegetation. The water is usually highly tannin-stained and acidic (pH 4.5-6.5) (Bray and Gomon 2017).	**Unlikely** No suitable habitat present.
Invertebrate					
Euoplos inornatus	Inornate trapdoor spider	P3	-	Has previously been recorded in jarrah forest, including near clay banks and granite outcrop. Most records are from the Darling scarp/Jarrah Forest Region, with limited records from the Swan Coastal Plain (DBCA 2020).	**Unlikely** No suitable habitat present.

		WA	EPBC Act		
Hesperocolletes douglasi	Douglas's broad-headed bee	CR	CR	Banksia woodland vegetation (Pille Arnold 2019).	**Unlikely** No suitable habitat present.
Leioproctus contrarius	a short-tongued bee	P3	-	Life history and habits are poorly documented/ unknown. It has been recorded only on flowers of Goodeniaceae and possibly Lechenaultia stenosepala (Bamford 2003).	**Possible** Potential habitat in the form of Goodeniaceae plant species are present in the site. Historical records of this species occur approximately 3 km north of the site.
Leioproctus douglasiellus	a short-tongued bee	EN	CR	Life history and habits are poorly documented/ unknown. It has been recorded only on the flowers of Goodenia filiformis and Anthotium junctiforme (Houston 2000).	**Unlikely** No suitable habitat present.
Synemon gratiosa	Graceful sunmoth	P4	-	Coastal heathland on Quindalup dunes where it is restricted to secondary sand dunes due to the abundance of the preferred host plant Lomandra maritima. Banksia woodland on Spearwood and Bassendean dunes, where the second known host plant L. hermaphrodita is widespread (DEC 2011).	**Unlikely** No suitable habitat present.

		WA	EPBC Act		
Westralunio carteri	Carter's freshwater mussel	VU	VU	Occurs in greatest abundance in slower flowing streams with stable sediments that are soft enough for burrowing amongst woody debris and exposed tree roots. Also occupies lentic systems including large water supply dams and even on-stream farm dams. Salinity tolerance quite low (Morgan et al. 2011).	**Possible** Potentially suitable habitat present. Species was previously recorded within Ellen Brook approximately 1.6 km south of the site.
Mammals					
Bettongia penicillata ogilbyi	Woylie	CR	EN	Woodlands and adjacent heaths with a dense understorey of shrubs, particularly Gastrolobium spp. (TSSC 2018).	**Unlikely** No suitable habitat present.
Dasyurus geoffroii	Chuditch	VU	VU	Wide range of habitats from woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. Appears to utilise native vegetation along road sides in the wheatbelt (DEC 2012b).	**Unlikely** No suitable habitat present.
Hydromys chrysogaster	*Rakali*	P4	-	Areas with permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen et al. 1985).	**Possible** Potential habitat present.
Isoodon fusciventer	*Quenda*	P4	-	Dense scrubby, often swampy, vegetation with dense cover up to one metre high (DEC 2012)	**Possible** Potentially suitable habitat present.

		WA	EPBC Act		
Macrotis lagotis	*Bilby*	VU	VU	Open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises and hummock grassland (spinifex) growing on sandplains and dunes, drainage systems, salt lake systems and other alluvial areas (DBCA 2017a).	**Unlikely** No suitable habitat present.
Notamacropus eugenii derbianus	*Tammar wallaby*	P4	-	Dry sclerophyll forest, Banksia spp. woodlands and shrublands, typically favouring dense low vegetation that provides dense cover (Christensen and Strahan 1983).	**Unlikely** No suitable habitat present.
Notamacropus irma	*Western brush wallaby*	P4	-	Dry sclerophyll forest, Banksia spp. woodlands and shrublands, typically favouring dense low vegetation that provides dense cover (Christensen and Strahan 1983).	**Unlikely** No suitable habitat present.
Petrogale lateralis lateralis	*Black-footed rock-wallaby*	EN	EN	Occurs in rocky habitats with complex cave and crevices. Permanent water appears to be essential component of species habitat (DBCA 2017).	**Unlikely** No suitable habitat present.
Phascogale tapoatafa wambenger	*South-western brush-tailed phascogale*	CD	-	Dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover (Triggs 2003).	**Unlikely** No suitable habitat present.
Reptiles					
Ctenotus gemmula	-	P3	-	Pale soils supporting heathlands and usually in association with Banksia spp. (Bush et al. 2002)	**Unlikely** No suitable habitat present.

		WA	EPBC Act		
Neelaps calonotos	*Black-striped snake*	P3	-	Coastal and near-coastal dunes, sandplains supporting heathlands and Banksia spp. woodlands (Bush et al. 2002).	**Unlikely** No suitable habitat present.
Pseudemydura umbrina	*Western swamp tortoise*	CR	CR	Clay based ephemeral swamps (Bush et al. 2002).	**Unlikely** No suitable habitat present.

Note: CE=critically endangered, EN=endangered, VU=vulnerable, CD=conservation dependent, MI=migratory, OS=other specially protected, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4. Species recorded or considered to potentially occur within the site are shaded green.

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Appendix F

Species List

Fauna List
Stock Road and Adjacent Lots, Bullsbrook

Category	Status	Species name	Common name	Record type
Birds				
	*	*Cacatua roseicapilla*	Galah	Sight
		Coracina novaehollandiae	Black-faced cuckoo-shrike	Sight
		Corvus coronoides	Australian raven	Sight
		Cracticus tibicen	Australian magpie	Sight
		Falco cenchroides	Australian kestrel	Sight
		Gerygone fusca	Western gerygone	Sight
		Gralinna cyanoleuca	Magpie-lark	Sight
		Ocyphaps iophotes	Crested pigeon	Sight
		Petrochelidon nigricans	Tree martin	Sight
		Rhipidura leucophrys	Willie wagtail	Sight
		Tadorna tadornoides	Australian shelduck	Sight
		Zonarius semitorquatus	Australian ringneck	Sight
		Anthochaera carunculata	Red wattlebird	Sight
		Chenonetta jubeta	Australian wood duck	Sight
		Cracticus torquatus	Grey butcherbird	Sight
		Threskiornis molucca	Australian White Ibis	Sight
		Pachycephala rufiventris	Rufous whistler	Sight
		Egretta novaehollandiae	White-faced heron	Sight
		Threskiornis spinicollis	Straw-necked ibis	Sight
		Cacatua sanguinea	Little corella	Sight
		Phylidonyris novaehollandiae	New Holland honeyeater	Sight
		Acanthiza chrysorrhoa	Yellow-rumped thornbill	Sight
		Smicrornis brevirostris westraliensis	Weebill	Sight
		Colluricincla harmonica rufiventris	Grey shrike-thrush	Sight
		Hirundo neoxena	Welcome swallow	Sight
		Zosterops lateralis	Grey-breasted white-eye	Sight
Mammals				
	*DP	*Oryctolagus cuniculus*	Rabbit	Sight
	*DP	*Vulpes vulpes*	Red fox	Scats

Note: * denotes introduced fauna species, DP=declared pest under the BAM Act

Appendix G

Black Cockatoo Habitat Tree Data

Tag No.	Easting	Northing	DBH (cm)	Species	Category	Notes
737	408697.66	6492547.81	71	*Eucalyptus wandoo*	No suitable hollow(s)	
735	408758.31	6492356.38	83	*Eucalyptus wandoo*	No suitable hollow(s)	
756	406999.83	6492575.60	92	*Eucalyptus rudis*	No suitable hollow(s)	
747	408402.05	6492550.57	40	*Eucalyptus wandoo*	No suitable hollow(s)	
744	408484.65	6492550.12	59	*Eucalyptus wandoo*	No suitable hollow(s)	
721	408708.48	6492793.61	73	*Eucalyptus wandoo*	No suitable hollow(s)	
740	408632.33	6492550.74	74	*Eucalyptus wandoo*	No suitable hollow(s)	
758	408339.57	6492551.47	55	*Eucalyptus wandoo*	No suitable hollow(s)	
734	408742.95	6492539.19	62	*Eucalyptus wandoo*	No suitable hollow(s)	
458	408518.64	6492548.33	50	*Corymbia calophylla*	No suitable hollow(s)	
477	404939.79	6492463.10	63	*Corymbia calophylla*	No suitable hollow(s)	
748	408402.05	6492550.57	35	*Eucalyptus wandoo*	No suitable hollow(s)	
452	408713.42	6492439.04	47	*Eucalyptus wandoo*	No suitable hollow(s)	
473	404892.66	6492456.47	55	*Corymbia calophylla*	No suitable hollow(s)	
467	405104.85	6492478.91	57	*Corymbia calophylla*	No suitable hollow(s)	
448	408746.59	6492565.38	63	*Eucalyptus wandoo*	No suitable hollow(s)	
436	408726.37	6492704.33	32	*Eucalyptus wandoo*	No suitable hollow(s)	
447	408756.38	6492565.02	98	*Eucalyptus wandoo*	No suitable hollow(s)	
437	408736.39	6492596.25	50	*Eucalyptus wandoo*	No suitable hollow(s)	
444	408778.78	6492573.19	38	*Eucalyptus wandoo*	No suitable hollow(s)	
478	404947.65	6492461.27	57	*Corymbia calophylla*	No suitable hollow(s)	
457	408559.20	6492550.48	32	*Eucalyptus wandoo*	No suitable hollow(s)	
0	408687.23	6492648.37	55	*Eucalyptus wandoo*	No suitable hollow(s)	
462	408605.69	6492562.58	51	*Eucalyptus wandoo*	No suitable hollow(s)	
469	404810.81	6492472.66	65	*Corymbia calophylla*	No suitable hollow(s)	
465	404480.84	6492476.61	76	*Corymbia calophylla*	No suitable hollow(s)	
463	408625.43	6492561.43	53	*Eucalyptus wandoo*	No suitable hollow(s)	
456	408611.11	6492549.89	98	*Eucalyptus wandoo*	No suitable hollow(s)	
468	404810.95	6492474.78	90	*Corymbia calophylla*	No suitable hollow(s)	
479	404951.83	6492463.21	54	*Corymbia calophylla*	No suitable hollow(s)	
435	408706.36	6492874.21	97	*Eucalyptis rudis*	No suitable hollow(s)	

Tag No.	Easting	Northing	DBH (cm)	Species	Category	Notes
453	408668.35	6492562.92	79	*Eucalyptus wandoo*	No suitable hollow(s)	
482	404967.03	6492458.13	52	*Corymbia calophylla*	No suitable hollow(s)	
754	407112.34	6492557.39	51	*Eucalyptus rudis*	No suitable hollow(s)	
474	404887.66	6492451.08	74	*Corymbia calophylla*	No suitable hollow(s)	
757	406696.45	6492557.38	61	*Corymbia calophylla*	No suitable hollow(s)	
443	408787.01	6492573.17	37	*Eucalyptus wandoo*	No suitable hollow(s)	
464	406995.12	6492515.39	61	*Eucalyptus rudis*	No suitable hollow(s)	
459	408479.22	6492561.46	67	*Eucalyptus wandoo*	No suitable hollow(s)	
461	408597.81	6492566.15	59	*Eucalyptus wandoo*	No suitable hollow(s)	
445	408783.82	6492570.90	58	*Eucalyptus wandoo*	No suitable hollow(s)	
434	408661.16	6492862.70	57	*Eucalyptus wandoo*	No suitable hollow(s)	
454	408662.21	6492549.55	74	*Eucalyptus wandoo*	No suitable hollow(s)	
475	404925.22	6492461.29	62	*Corymbia calophylla*	No suitable hollow(s)	
466	405125.59	6492479.54	63	*Corymbia calophylla*	No suitable hollow(s)	
442	408803.63	6492577.05	37	*Eucalyptus wandoo*	No suitable hollow(s)	
441	408803.82	6492574.05	50	*Eucalyptus wandoo*	No suitable hollow(s)	
460	408549.03	6492563.28	50	*Eucalyptus wandoo*	No suitable hollow(s)	
484	404978.45	6492474.08	62	*Corymbia calophylla*	No suitable hollow(s)	
472	404883.70	6492459.36	52	*Corymbia calophylla*	No suitable hollow(s)	
430	408701.60	6492608.56	38	*Eucalyptus wandoo*	No suitable hollow(s)	
470	404833.40	6492465.88	68	*Eucalyptis rudis*	No suitable hollow(s)	
476	404930.47	6492457.04	96	*Corymbia calophylla*	No suitable hollow(s)	
450	408732.23	6492252.64	36	*Eucalyptus wandoo*	No suitable hollow(s)	
455	408649.87	6492550.67	54	*Eucalyptus wandoo*	No suitable hollow(s)	
485	404967.28	6492472.87	60	*Corymbia calophylla*	No suitable hollow(s)	
752	408116.40	6492547.61	51	*Eucalyptis rudis*	No suitable hollow(s)	
480	404950.14	6492470.72	52	*Corymbia calophylla*	No suitable hollow(s)	
438	408739.60	6492587.36	59	*Eucalyptus wandoo*	No suitable hollow(s)	
451	408731.76	6492262.85	30	*Eucalyptus wandoo*	No suitable hollow(s)	
440	408792.08	6492589.25	68	*Eucalyptus wandoo*	No suitable hollow(s)	
439	408743.30	6492583.77	69	*Eucalyptus wandoo*	No suitable hollow(s)	

Tag No.	Easting	Northing	DBH (cm)	Species	Category	Notes
471	404870.95	6492463.89	75	*Corymbia calophylla*	No suitable hollow(s)	
483	404984.53	6492473.38	61	*Corymbia calophylla*	No suitable hollow(s)	
718	408686.75	6492891.87	67	*Eucalyptis rudis*	No suitable hollow(s)	
446	408760.73	6492565.38	37	*Eucalyptus wandoo*	No suitable hollow(s)	
481	404956.84	6492453.83	102	*Corymbia calophylla*	No suitable hollow(s)	
-9999	408673.43	6493010.03	50	*Corymbia calophylla*	No suitable hollow(s)	
753	407154.38	6492538.82	55	*Eucalyptis rudis*	No suitable hollow(s)	
-9999	408653.53	6493022.52	100	*Eucalyptus wandoo*	No suitable hollow(s)	
722	408735.63	6492604.74	55	*Eucalyptus wandoo*	No suitable hollow(s)	
745	408422.35	6492547.20	62	*Eucalyptus wandoo*	No suitable hollow(s)	
739	408656.15	6492548.83	50	*Eucalyptus wandoo*	No suitable hollow(s)	
749	408392.08	6492549.37	41	*Eucalyptus wandoo*	No suitable hollow(s)	
741	408597.68	6492548.98	68	*Eucalyptus wandoo*	No suitable hollow(s)	
719	408691.90	6492882.45	71	*Eucalyptus wandoo*	No suitable hollow(s)	
738	408668.45	6492551.37	40	*Eucalyptus wandoo*	No suitable hollow(s)	
720	408697.49	6492857.77	55	*Stag*	No suitable hollow(s)	
717	408685.07	6492896.80	100	*Stag*	No suitable hollow(s)	
716	408666.09	6492851.01	93	*Eucalyptus wandoo*	No suitable hollow(s)	
725	408751.21	6492582.72	63	*Eucalyptus wandoo*	No suitable hollow(s)	
723	408735.87	6492599.75	54	*Eucalyptus wandoo*	No suitable hollow(s)	
746	408408.78	6492547.65	46	*Eucalyptus wandoo*	No suitable hollow(s)	
724	408735.87	6492599.75	57	*Eucalyptus wandoo*	No suitable hollow(s)	
0	408687.03	6492642.61	40	*Eucalyptus wandoo*	No suitable hollow(s)	
751	408274.72	6492565.31	53	*Stag*	No suitable hollow(s)	
0	408691.88	6492594.28	50	*Eucalyptus wandoo*	No suitable hollow(s)	
755	407084.68	6492523.40	67	*Eucalyptus rudis*	No suitable hollow(s)	
0	408691.38	6492589.52	50	*Eucalyptus wandoo*	No suitable hollow(s)	
743	408551.88	6492549.44	50	*Eucalyptus wandoo*	No suitable hollow(s)	
736	408727.70	6492322.67	36	*Eucalyptus wandoo*	No suitable hollow(s)	
742	408571.71	6492547.58	56	*Eucalyptus wandoo*	No suitable hollow(s)	
Not tagged	404344.78	6492524.11	65	*Corymbia calophylla*	No suitable hollow(s)	

Tag No.	Easting	Northing	DBH (cm)	Species	Category	Notes
Not tagged	407146.74	6492580.16	95	*Eucalyptus rudis*	No suitable hollow(s)	
Not tagged	406639.77	6492601.98	90	*Stag*	No suitable hollow(s)	
Not tagged	408008.02	6492489.76	112	*Eucalyptus rudis*	No suitable hollow(s)	
Not tagged	407161.47	6492564.96	60	*Eucalyptus rudis*	No suitable hollow(s)	
Not tagged	404963.98	6492448.43	0	*Corymbia calophylla*	No suitable hollow(s)	

Appendix H

Overall Habitat Quality Assessment

Emerge Black Cockatoo Habitat Quality Assessment - Scale

		Habitat Quality Score									
		Low			Moderate			Moderate - High	High		
	Quality Component	1	2	3	4	5	6	7	8	9	10
Breeding habitat	Site condition	Habitat trees with suitable hollows occur within the site AND / OR habitat trees without suitable hollows occur within the site					Habitat trees with suitable hollows occur within the site			N/A	
	Site context	No nest has been recorded within 12 km of the site AND <100 ha of potential foraging habitat occurs within 6 km of the site	A nest(s) (active, historical or potential) has been recorded within 12 km of the site AND / OR >100 ha of potential native foraging habitat occurs within 6 km of the site				A nest(s) (active, historical or potential) has been recorded within 6 km of the site AND / OR >1000 ha of potential native foraging habitat occurs within 6 km of the site				
	Species stocking rate	No evidence of black cockatoos nesting has been recorded within the site						A potential nest(s) occurs within the site OR a historical nest(s) has been recorded within the site	A Potential nest(s) occurs within the site AND a historical nest(s) has been recorded within the site	An active nest(s) occurs within the site	An active nest(s) occurs within the site AND a historical nest(s) has been recorded within the site
Roosting habitat	Site condition	Trees potentially suitable for roosting occur within the site						N/A			
	Site context	No water source occurs within or nearby the site	A water source occurs within or nearby the site OR no water source occurs within or nearby the site								
		No roost has been recorded within 1 km of the site	A small roost (active or historical) has been recorded within 500 m of the site OR a large roost (active or historical) has been recorded within 1 km of the site OR no roost has been recorded within 1 km of the site								
	Species stocking rate	No roost has been recorded within the site				A small roost (active or historical) has been recorded within the site	A large roost (active or historical) has been recorded within the site	An active small roost occurs within the site	An active large roost occurs within the site		
	Site condition	Foraging habitat with 1-10% primary foraging plants occurs within the site	Foraging habitat with 1-50% primary foraging plants occurs within the site		Foraging habitat with 1-100% primary foraging plants occurs within the site		Foraging habitat with 10-100% primary foraging plants occurs within the site	Foraging habitat with 50-100% primary foraging plants occurs within the site		N/A	
	Site context	No nest or roost has been recorded within 12 km of the site	A nest(s) (active, potential or historical) AND / OR a roost(s) (active or historical) has been recorded within 12 km of the site					A nest(s) (active, potential or historical) has been recorded within 6 km of the site			
	Species stocking rate	No evidence of foraging by black cockatoos has been recorded within the site	Evidence of foraging by black cockatoos may have been recorded within the site (limted or abundant)						Abundant evidence of foraging by black cockatoos has been recorded in the site		

Note that breeding, roosting and foraging habitat are assessed separately and the highest score is the overall quality score.

Black Cockatoo Habitat Scale definitions

'**Habitat tree**' is a native eucalypt that is typically known to support black cockatoo breeding such as marri, jarrah, blackbutt, tuart, wandoo, salmon gum or to a lesser extent flooded gum, with a DBH ≥50 cm or DBH ≥30 cm for wandoo or salmon gum (DSEWPaC 2012).

'**Nest**' is a hollow in which black cockatoo breeding has been recorded. A nest is '**active**' if breeding was recorded within the last 2 years and '**historical**' if breeding was recorded more than 2 years ago. A hollow with potential secondary signs of breeding (e.g. chew marks) or a hollow with potential signs of breeding that could not be attributed to a bird species is a '**potential**' nest.

'**Roost**' is a black cockatoo roost site confirmed by a roost survey (e.g. BirdLife Australia Great Cocky Count). A roost is considered '**large**' if more than 150 individuals were recorded and '**small**' if less than 150 individuals were recorded (BirdLife Australia 2019). A roost is '**active**' if roosting was

'**Primary foraging plants**' are plants with historical and/or contemporary records of regular consumption by black cockatoos, including native and non-native plant species.

Black Cockatoo Habitat Quality Assessment - Scoring Tool (Carnaby's cockatoo)
Stock Road and Adjacent Lots, Bullsbrook

		Query		Answer	Potential score	Site score	Sum
Breeding habitat	**Site condition**	1.1	The site contains:				
			habitat tree(s) with suitable hollow(s)	N	2.0	0.0	1.0
			habitat tree(s) without suitable hollow(s)	Y	1.0	1.0	
	Site context	1.2	The site is located:				
			within 6 km of a nest(s) (active, historical or potential)	N	1.0	0.0	0.0
			6-12 km from a nest(s) (active, historical or potential)	N	0.5	0.0	
		1.3	The site is located within 6 km of:				
			>1000 ha of potential foraging habitat	Y	3.0	3.0	3.0
			100 to 1000 ha of potential foraging habitat	Y	1.0	1.0	
	Species stocking rate	1.4	The site contains:				
			historical nest(s)	N	1.0	0	0.0
			The site contains:				
			active nest(s)	N	3.0	0	
			potential nest(s)	N	1.0	0	0.0
			Score	4	10.0		
Roosting habitat	**Site condition**	2.1	The site contains trees potentially suitable for roosting	Y	1.0	1.0	2.0
		2.2	The site contains a water source or one exists nearby	Y	1.0	1.0	
	Site context	2.3	The site is located:				
			within 1 km of a large roost (≥150 individuals) (active or historical)	N	1.0	0.0	0.0
			within 500 m of a small roost (< 150 individuals) (active or historical)	N	1.0	0.0	
	Species stocking rate	2.4	The site contains:				
			a historical record of a large roost (≥150 individuals)	N	2.0	0	
			a historical record of a small roost (<150 individuals)	N	1.0	0	0.0
			The site contains:				
			an active record of a large roost (≥150 individuals)	N	2.0	0.0	0.0
			an active record of a small roost (<150 individuals)	N	1.0	0.0	
			Score	2	7.0		
Foraging habitat	**Site condition**	3.1	The site contains foraging habitat comprising:				
			≥50% primary foraging plants	N	4.0	0.0	
			≥10% to <50% primary foraging plants	Y	2.0	2.0	2.0
			<10% primary foraging plants	N	1.0	0.0	
	Site context	3.2	The site is located:				
			within 6 km of a nest(s) (active, historical or potential)	N	2.0	0.0	
			6-12 km from a nest(s) (active, historical or potential)	N	1.00	0.0	1.0
		3.3	The site is located:				
			within 6 km of a roost(s) (active or historical)	Y	1.0	1.0	
			6-12 km from a roost(s) (active or historical)	Y	0.5	0.5	
	Species stocking rate	3.4	The site contains:				
			abundant evidence of foraging	N	2.0	0.0	0.0
			limited evidence of foraging	N	1.0	0.0	
			Score	3	8.0		

SUMMARY		
Habitat category	**Score**	**Habitat quality**
Breeding	4	Moderate
Roosting	2	Low
Foraging	3	Low

Overall habitat quality score	**4**	Moderate

Note:

1. Within the breeding category, a score of 9 applies if an active nest(s) occurs within the site and a score of 10 applies if an active nest(s) and a historical nest(s) occurs within the site, regardless of the answer to other queries in this category
2. Within the roosting category, a score of 7 applies if a small roost occurs within the site and a score of 8 applies if a large roost occurs within the site, regardless of the answer to other queries in this category.
3. The final score consists of the highest score from each habitat category

Black Cockatoo Habitat Quality Assessment - Scoring Tool (forest red-tailed black cockatoo)
Stock Road and Adjacent Lots, Bullsbrook

		Query		Answer	Potential score	Site score	Sum
Breeding habitat	**Site condition**	1.1	The site contains:				
			habitat tree(s) with suitable hollow(s)	N	2.0	0.0	1.0
			habitat tree(s) without suitable hollow(s)	Y	1.0	1.0	
	Site context	1.2	The site is located:				
			within 6 km of a nest(s) (active, historical or potential)	N	1.0	0.0	0.0
			6-12 km from a nest(s) (active, historical or potential)	N	0.5	0.0	
		1.3	The site is located within 6 km of:				
			>1000 ha of potential foraging habitat	Y	3.0	3.0	3.0
			100 to 1000 ha of potential foraging habitat	Y	1.0	1.0	
	Species stocking rate	1.4	The site contains:				
			historical nest(s)	N	1.0	0	0.0
			The site contains:				
			active nest(s)	N	3.0	0	
			potential nest(s)	N	1.0	0	0.0
			Score	4	10.0		
Roosting habitat	**Site condition**	2.1	The site contains trees potentially suitable for roosting	Y	1.0	1.0	2.0
		2.2	The site contains a water source or one exists nearby	Y	1.0	1.0	
	Site context	2.3	The site is located:				
			within 1 km of a large roost (≥150 individuals) (active or historical)	N	1.0	0.0	0.0
			within 500 m of a small roost (< 150 individuals) (active or historical)	N	1.0	0.0	
	Species stocking rate	2.4	The site contains:				
			a historical record of a large roost (≥150 individuals)	N	2.0	0	
			a historical record of a small roost (<150 individuals)	N	1.0	0	0.0
			The site contains:				
			an active record of a large roost (≥150 individuals)	N	2.0	0.0	0.0
			an active record of a small roost (<150 individuals)	N	1.0	0.0	
			Score	2	7.0		
Foraging habitat	**Site condition**	3.1	The site contains foraging habitat comprising:				
			≥50% primary foraging plants	Y	4.0	4.0	4.0
			≥10% to <50% primary foraging plants	N	2.0	0.0	
			<10% primary foraging plants	N	1.0	0.0	
	Site context	3.2	The site is located:				
			within 6 km of a nest(s) (active, historical or potential)	N	2.0	0.0	1.0
			6-12 km from a nest(s) (active, historical or potential)	N	1.00	0.0	
		3.3	The site is located:				
			within 6 km of a roost(s) (active or historical)	Y	1.0	1.0	
			6-12 km from a roost(s) (active or historical)	Y	0.5	0.5	
	Species stocking rate	3.4	The site contains:				
			abundant evidence of foraging	N	2.0	0.0	0.0
			limited evidence of foraging	N	1.0	0.0	
			Score	5	8.0		

SUMMARY		
Habitat category	**Score**	**Habitat quality**
Breeding	4	Moderate
Roosting	2	Low
Foraging	5	Moderate

Overall habitat quality score	**5**	Moderate

Note:

1. Within the breeding category, a score of 9 applies if an active nest(s) occurs within the site and a score of 10 applies if an active nest(s) and a historical nest(s) occurs within the site, regardless of the answer to other queries in this category
2. Within the roosting category, a score of 7 applies if a small roost occurs within the site and a score of 8 applies if a large roost occurs within the site, regardless of the answer to other queries in this category.
3. The final score consists of the highest score from each habitat category