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ENVIRONMENTAL SCIENCES

Flora and vegetation, and Carnaby's Cockatoo habitat assessment for potential offset property near Brookton

Prepared for Jacobs

January 2019

Final Report

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Prepared for Jacobs

Final Report

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EXECUTIVE SUMMARY

The Walebing to Wubin Project is a component of Main Roads Western Australia's Great Northern Highway Muchea to Wubin Stage 2 Upgrades Project (GNH M2W Project). Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) assessment for Walebing to Wubin (EPBC 2016/7761), environmental offsets are required to compensate for the loss of up to 15 ha of EPBC Act listed 'Eucalypt Woodlands of the Western Australian Wheatbelt' Threatened Ecological Community (TEC).

Main Roads Western Australia (Main Roads) is investigating a property with environmental offset characteristics potentially suitable for the GNH M2W Project near Brookton, in the Shire of Beverley (the study area).

Phoenix Environmental Sciences (Phoenix) was engaged by the Arup Jacobs Joint Venture and Main Roads, known as the Integrated Project Team (IPT) to undertake:

- an initial high level vegetation and black cockatoo habitat assessment of the study area in May 2018
- a subsequent detailed vegetation survey and further black cockatoo habitat assessment in the study area in September 2018.

The study area occupies a total of 574.31 ha over three lots: Lot 6063, Lot 5164 and Lot 4865.

A desktop review was undertaken prior to the detailed spring survey to identify potential flora and vegetation values. Desktop information was also reviewed on the occurrence of Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo to determine the likelihood of occurrence of each species in the study area.

The detailed flora and vegetation survey included sampling within bounded vegetation quadrats and unbounded relevés, targeted searches for significant species and vegetation, as well as traversing the study area to record additional flora taxa present at the time of the survey and condition of the vegetation. Assessment and mapping of the extent of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC was undertaken using a key and customised data collection template derived from conservation advice for the TEC. The survey for Carnaby's Cockatoo habitat included assessment and mapping of potential breeding trees, breeding habitat and foraging habitat, as well as opportunistic records of feeding residues.

A total of 200 plant taxa (including subspecies and varieties) representing 108 genera and 42 families were recorded in the field surveys. This total comprised 165 (82.5%) native and 35 (17.5%) introduced species. No Threatened flora species were recorded during the field survey. One Priority flora species was recorded; a specimen of a *Scholtzia* taxon from the survey has been identified as either *Scholtzia* sp. Duck Pool (M. E. Trudgen MET5427) (Priority 3) or *Scholtzia* sp. Yenyening Lakes (A. Gunness 2824) (Priority 2). A significant range extension (~100 km WSW of the closest record) was also recorded for *Triglochin longicarpa*, making this record locally significant.

Remnant native vegetation covers 401 ha, or approximately 70% of the study area. Nine vegetation types were mapped in the study area comprising a samphire shrubland, a mosaic of *Melaleuca* shrubland and samphire shrubland, open *Eucalyptus* woodland over *Melaleuca* shrubland, three *Eucalyptus* woodlands, a *Casuarina* woodland, a *Banksia*/*Allocasuarina* woodland and a low *Melaleuca* woodland. The condition of remnant vegetation ranged from Excellent to Degraded. Just under one third of the survey area was Completely Degraded (comprising cleared areas, pasture and access tracks).

Three of the vegetation types (352, 946 and 1023) were considered representative of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC. The extent of vegetation assessed as TEC covered 139.3 ha comprising 24.3% of the study area and 34.7% of the remnant vegetation present in the study area. This area exceeds the 15 ha to be removed in the Walebing to Wubin work package.

A total of 323 potential breeding trees and 144.2 ha of potential breeding habitat for Carnaby's Cockatoo was recorded in the study area. Sixteen of 25 hollows recorded had evidence of use (chewing around the hollow entrance) but were considered most likely to be from Galahs. A total of 237.6 ha of suitable foraging habitat for Carnaby's Cockatoo was mapped in the study area, of which 15.62 ha was considered quality foraging habitat. Only a single possible record of Carnaby's Cockatoo foraging evidence was observed during the field survey; the lack of further foraging evidence in the vicinity of the chewing suggests it was most likely not from a Black Cockatoo. Although the study area provides some areas of suitable habitat for Carnaby's Cockatoo, there was no apparent evidence of current or recent use by the species.

1 INTRODUCTION

1.1 BACKGROUND

The Walebing to Wubin Project is a component of Main Roads Western Australia's Great Northern Highway Muchea to Wubin Stage 2 Upgrades Project (GNH M2W Project). Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) assessment for Walebing to Wubin (EPBC 2016/7761), environmental offsets are required to compensate for the loss of up to 15 ha of EPBC Act listed 'Eucalypt Woodlands of the Western Australian Wheatbelt' Threatened Ecological Community (TEC).

Main Roads Western Australia (Main Roads) is investigating a property with environmental offset characteristics potentially suitable for the GNH M2W Project near Brookton, in the Shire of Beverley (the study area; Figure 1-1).

The study area occupies a total of 574.4 ha and is comprised three lots (Figure 1-1):

- Lot 6063 – 124.4 ha
- Lot 5164 – 160.4 h
- Lot 4865 – 289.6 ha.

An initial site visit was conducted by the Department of Biodiversity, Conservation and Attractions (DBCA) Wheatbelt Regional Manager Greg Durrell on 14 February 2018. The following observations were noted:

- the site contributes to the Avon River corridor
- the site incorporates deep yellow sands generally poorly conserved
- the site is likely to contain the EPBC Act listed 'Eucalypt Woodlands of the Western Australian Wheatbelt' TEC
- the site adds to the protection status of the P3 *Grevillea roycei*
- the landowner has not seen Black Cockatoos at the site.

Phoenix Environmental Sciences (Phoenix) was subsequently engaged by the Arup Jacobs Joint Venture and Main Roads, known as the Integrated Project Team (IPT) to undertake a Level 1–equivalent vegetation and black cockatoo habitat assessment of the study area. This high level assessment was undertaken in May 2018 (Phoenix 2018). The survey identified potential presence of ~143 ha of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC, as well as suitable foraging, breeding and roosting habitat for Carnaby's Cockatoo.

IPT subsequently engaged Phoenix to undertake a detailed vegetation survey and further black cockatoo habitat assessment in the study area. This report consolidates and presents the findings of both the initial high level assessment and the subsequent surveys.

Jacobs - Northern Highway Muchea to Wubin Stage 2 Upgrades Project

Project No	1219
Date	17-Dec-18
Drawn by	IH
Map author	GW

0 1.25 2.5 5
Kilometres

1:150,000 (at A4) GDA 1994 MGA Zone 50

\\phoenixserver\Office-Server\GIS\Projects\GNH\1219-GNH-JA-ECO\Mapping\MapDocuments\Figures\1219_1-1_ProjectLocation.mxd

Study area

Figure 1-1

Location of the study area

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1.2 SCOPE OF WORK

1.2.1 Vegetation survey and TEC assessment

The scope of work was to undertake a single season detailed survey (spring 2018) of remnant vegetation in the study area (Figure 1-1) and to assess the presence, quality and extent of vegetation consistent with the Eucalypt Woodlands of the Western Australian Wheatbelt TEC.

1.2.1 Carnaby's Cockatoo survey

The scope included an evaluation of remnant vegetation in the study area for Carnaby's Cockatoo foraging and breeding habitat criteria. This would include a high-level assessment of foraging habitat quality, and the presence of breeding habitat.

2 METHODS

Where practicable, survey design, methodology and report-writing adhere to relevant principles and guidelines, including:

- Environmental Factor Guideline: Flora and vegetation (EPA 2016a)
- Technical Guidance: Flora and vegetation survey (EPA 2016c)
- Eucalypt Woodlands of the Western Australian Wheatbelt TEC conservation advice (Department of the Environment 2016)
- Technical Guidance: Sampling methods for terrestrial vertebrate fauna (DER no date)
- Technical Guidance: Terrestrial fauna surveys (DER no date)
- Revised draft referral guideline for three Threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorynchus baudinii*, Forest Red-tailed Cockatoo (Vulnerable) *Calyptorhynchus banksii naso* (DoEE 2017).

2.1 DESKTOP REVIEW

2.1.1 Flora and vegetation

Prior to the field survey, available survey information (e.g. available technical reports and spatial data) was reviewed to identify ecological values in detail. A species list, field guide and maps of potential key ecological values and defined vegetation types from previous surveys conducted in the study area was prepared to guide field survey effort.

As part of the desktop review, searches of relevant technical databases were undertaken to identify records and habitat of significant flora and vegetation. Searches and reviews of relevant biological databases were undertaken within a 40 km buffer (if possible) of the survey area and include:

- Department of Biodiversity, Conservation and Attractions (DBCA) threatened and priority flora, fauna (black cockatoo data) and ecological communities databases
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool
- DBCA NatureMap database.

2.1.2 Carnaby's Cockatoo

A desktop review of the occurrence of Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo was undertaken to determine the likelihood of occurrence of each species in the study area, including potential to forage, roost and/or nest.

To determine the extent of occurrence of black cockatoo species in the vicinity of the study area, all records of the species available on NatureMap (DBCA 2019a) were mapped and reviewed, including recent and historic records. Where possible, recent records within the last five years were delineated from historic records to determine current predicted ranges due to changes distribution and foraging activities over the past decade.

In addition to naturemap records, any previous published data or information on the three species were examined to identify any potential records not presented in NatureMap, including current and past published reports for the Great Cocky Count surveys and other unpublished survey reports or observations from the surrounding area (i.e. landowner observations).

As the study area only falls within the modelled distribution for Carnaby's Cockatoo, this species was the focus of the foraging assessment. The study area occurs outside of the modelled distribution for Baudin's Cockatoo and Forest Red-tailed Black Cockatoo.

2.2 DETAILED FLORA AND VEGETATION SURVEY

The detailed flora and vegetation survey was conducted over a four-day period from 18-21 September 2018 and involved a combination of sampling within bounded vegetation quadrats located in representative native vegetation, relevés (unbound areas), targeted searches for significant species and vegetation, as well as traversing the study area to record additional flora taxa present at the time of the survey and condition of the vegetation. Sampling sites for the flora and vegetation assessment included all sites assessed in the previous survey (Phoenix 2018), and additional sites in other areas identified as potential TEC in relation with previously defined vegetation in Lots 4865, 5164 and 6063, landform and land systems mapping (Figure 2-1). A total of 24 quadrats and four relevés were sampled throughout the study area (Figure 2-1; Appendix 1).

Sampling sites for the Avon Wheatbelt bioregion consist of quadrats of 10 m x 10 m in dimension for understorey and 20 m x 20 m in dimension for overstorey. The intensity of sampling aimed to provide a minimum of three quadrats per vegetation unit (EPA 2016b) and was determined by the complexity of the flora and vegetation. All quadrats were orientated (where possible) in a north-south direction measured out with a tape measure, the NW corner permanently marked with a steel fence dropper. The coordinates of each corner were recorded in WGS84 datum using a handheld GPS. The following attributes were recorded at each quadrat:

- site code
- location, with GPS coordinates (estimate of their accuracy) and datum
- size and shape of quadrat
- photograph/s from north-west corner
- landform and soil description
- dominant growth form, height, cover and species for the three traditional strata (upper, mid and ground) compatible with NVIS Level V (ESCAVI 2003)

- any other location information that might be useful in vegetation classification including slope, aspect, litter, fire history, vegetation/landform/soil correlations
- assessment of vegetation condition and description of disturbances in accordance with vegetation condition scale for assessment within the South West and Interzone Botanical Province (EPA 2016b) (Table 2-1)
- a comprehensive species list, including weeds
- quadrat marking method.

Species well known to the survey botanist were identified in the field, while species that were not known were collected and assigned a unique number to facilitate tracking. Plant species collected during the survey were subsequently identified by the use of local and regional flora keys and by comparison with the named species held at the Western Australian Herbarium. Plant taxonomists who are considered to be an authority on a particular plant group were consulted, when necessary.

A targeted survey was conducted for significant flora identified in the desktop review as potentially occurring in the study area. For each population of significant flora recorded, the following information was documented:

- location (as points for individual plants or as polygons for populations)
- description of the vegetation association and condition in which the species was located
- estimation of population size
- map showing distribution within the study area, and in the wider surrounds.

Assignment of vegetation descriptions for the current survey followed the same method as that utilised for surveys of work packages along the Muchea to Wubin Stage 2 Upgrades Project (Phoenix 2015, 2016b, 2017). A review of previous vegetation surveys conducted for the GNH between Muchea and Wubin identified that various methods have been used to delineate vegetation associations. Two assessments (ENV 2007; Western Botanical 2006) utilised an approach where descriptions of vegetation undertaken in the field were subsequently matched with those of Shepherd *et al.* (2002). This approach was adopted for the flora and vegetation assessments undertaken for the Muchea to Wubin Stage 2 Upgrades Project (Phoenix 2015, 2016b, 2017), because:

- matching the vegetation recorded to the vegetation associations of Shepherd *et al.* (2002) facilitated assessment of the significance at a regional level
- the study area traverses areas that are highly impacted by multiple land uses, particularly broad scale clearing for agriculture, which have substantially altered natural community structure and values
- of the previous vegetation assessments available for review, Western Botanical (2006) and ENV (2007) were the only studies that provided a description of the methods undertaken to determine vegetation types facilitating replication of the methodology.

This approach was subsequently utilised for the current survey to provide a consistent method to facilitate comparison between the proposed offset area and the area to be disturbed in the Walebing to Wubin work package. Vegetation descriptions from quadrats and relevés were grouped according to similarity of community structure (i.e. canopy levels) and species composition. These were matched with the vegetation associations of Shepherd *et al.* (2002) according to the presence of the predominant overstorey species (e.g. York Gum *Eucalyptus loxophleba*, Salmon Gum *Eucalyptus salmonophloia*) or combination of species and the prevalent community structure (i.e. woodland, shrubland, etc.).

Table 2-1 Vegetation condition rating scale (EPA 2016b)

Code	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

Jacobs - Northern Highway Muchea to Wubin Stage 2 Upgrades Project

Project No	1240
Date	31-Jan-19
Drawn by	IH
Map author	GW

0 0.25 0.5 1
Kilometres

1:30,000 (at A4) GDA 1994 MGA Zone 50

Study area
Survey site type
Quadrat
Relevé
TEC sites

Figure 2-1

Survey site locations

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2.3 TEC ASSESSMENT

An initial site-based assessment was undertaken for presence and extent of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC in autumn (1-3 May 2018) and was supplementd by additional survey in spring (18-21 September 2018). The method applied was consistent with the methodology employed by Phoenix in the surveys completed for the GNH M2W Project (Phoenix 2016a, 2017) and in accordance within sampling protocols summarised in the TEC conservation advice (Department of the Environment 2016).

Assessment and mapping of the extent of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC was undertaken using a key and customised data collection template derived from conservation advice for the TEC (Threatened Species Scientific Committee 2015a).

Prior to the field assessment, previous mapping of potential TEC in the study area (Phoenix 2018) was uploaded to digital tablets. During the field assessment, quadrats surveys were undertaken throughout the mapped TEC areas to assist in defining and mapping eucalypt woodland vegetation types. Vegetation unit boundaries were confirmed in the field.

TEC assessment sites were subsequently evaluated against the diagnostic criteria for the TEC (refer to Appendix 2). The data was captured electronically in the field using Phoenix's customised data collection template (Mobile Data Studio) for the TEC.

In determining the presence of the TEC, features of the remnant woodland patch including vegetation condition, patch size and the density of mature trees was considered. To establish the area of the patch in the field, maps of the remnant woodland patches throughout the study area that potentially represent the TEC were uploaded to digital tablets.

Suitable patches were foot-searched, and the number of mature trees counted to determine if density was sufficient for the patch to be considered representative of the TEC.

2.4 CARNABY'S COCKATOO HABITAT ASSESSMENT

A survey for Carnaby's Cockatoo habitat was carried out with consideration to the EPBC Act referral guidelines for threatened black cockatoo species (DSEWPaC 2012a) over two field surveys undertaken concurrently with flora and vegetation surveys on 1–3 May and 18–21 September 2018.

Breeding habitat for black cockatoos is defined in the EPBC referral guidelines (DSEWPaC 2012a) as "trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 mm. For Salmon Gum and Wandoo, suitable DBH is 300 mm". Breeding habitat for Carnaby's Cockatoo generally consists of woodland or forest; however, the species is also known to breed in former woodland or forest which is now isolated trees (DSEWPaC 2012). Refer to Table 2-2 for known species of breeding trees.

The location of potential breeding trees for Carnaby's Cockatoo was recorded at survey site locations in the study area. Each site covered an area of at least 1 ha. Both live and dead tree species known to be suitable for nesting were inspected for presence of hollows, evidence of use e.g. wear and chew marks around hollow entrance and recorded using a GPS.

Foraging habitat quality, opportunistic records of feeding residues and evidence of night roosting were also noted during the site visits. Night roost sites are trees or groups of trees where there are records or recent evidence of night roosting. They can be identified from presence of clipped leaves and branches and droppings under suitable trees. Roosting habitat for Carnaby's Cockatoo is generally in or near riparian features or natural and artificial permanent water sources. Known roosting tree

species include Flat-topped Yate, Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced eucalypts (e.g. Blue Gum) and introduced pines (DSEWPaC 2012).

Table 2-2 Known breeding trees for WA black cockatoo species[1] (DSEWPaC 2012a)

Species	DBH (mm)
Eucalyptus salmonophloia (Salmon Gum)	300
Eucalyptus wandoo	300
Eucalyptus rudis (Flooded Gum)	500
Eucalyptus loxophleba subsp. *loxophleba* (York Gum)	500
Eucalyptus accedens (Powderbark)	300
Eucalyptus camaldulensis[2] (River Red Gum)	500

[1] list excludes species for which study area is outside the known species distribution, as provided in FloraBase. [2] not mentioned in DSEWPaC (2012a) referral guidelines; however, is known to be used for breeding (T. Kirkby pers. comm. April 2015).

Mapping of potential breeding and foraging habitat within the study area was undertaken utilising field survey results and data from the flora and vegetation survey.

Foraging habitat for Carnaby's Cockatoo is determined from the presence of plant species that are known food sources and evidence of feeding, such as direct observation of birds or feeding residues (chewed nuts or cones). The referral guidelines (DSEWPaC 2012) define 'quality' habitat by black cockatoo use of the habitat (as opposed to overall quality of the vegetation).

Many plant species have been recognised to be utilised as a food resource by Carnaby's Cockatoo (DSEWPaC 2012; Finn 2012) but relative 'importance' of each species varies considerably. While some plants are known staple food resources for the species (e.g. several *Banksia* species), other plants have been identified from few observations.

In order to account for this variability in mapping quality foraging habitat, a rating was applied to food plant species recorded in the study area based on regional records of foraging activity. Plant species lists from vegetation quadrats of the vegetation survey were initially reviewed to identify species known to be used as food (as well as breeding and roosting) by Carnaby's Cockatoo. Species were then rated for importance as a food resource on a scale of 1 to 10 where a rating of 10 is highest importance and a rating of 1 is lowest importance. The rating took into account:

- records of foraging activity from survey work undertaken by the WA Museum in the general region
- broader knowledge of core food plants for Carnaby's Cockatoo
- abundance of food resource, e.g. amount of seed typically produced
- seasonality of food supply, e.g. Carnaby's Cockatoo takes nectar from Salmon Gum and Wandoo but only for a limited period.

Vegetation types in quadrats containing known plant species were selected and percentage cover of each plant species over the quadrat was given a rating from 1–3, where:

1 = 0.1–19%

2 = 20–49%

3 = >50%.

The importance rating for each plant species in each quadrat was then multiplied by the cover rating and the values for all plants in each quadrat summed to derive an overall quality rating for the quadrat which was assigned to one of three categories:

0 = no value

1-19 = habitat of low value

> 20 = 'quality' habitat.

Vegetation polygons without a quadrat were extrapolated from adjacent polygons of the same vegetation type. Polygons with cleared vegetation, pasture or planted vegetation types have no foraging value and so were ignored.

It is emphasised that the rating assessment was a subjective exercise and relative importance of each species will vary between locations.

To generate an area-based map of breeding habitat, potential breeding trees identified from the field surveys were displayed over vegetation associations mapped in the flora and vegetation survey. Polygons of remnant vegetation types that contained potential breeding trees were defined as 'breeding habitat in vegetation types representing remnant native vegetation'. All other potential breeding trees, many occurring as isolated remnant trees within pastures were displayed as points only and labelled 'potential breeding trees in vegetation types not representing remnant native vegetation'.

3 EXISTING ENVIRONMENT

3.1 INTERIM BIOGEOGRAPHIC REGIONALISATION OF AUSTRALIA

The study area is situated within the Katanning (AW2) subregion of the Avon Wheatbelt bioregion. The Katanning subregion is characterized as (Beecham 2001):

> An area of active drainage dissecting a Tertiary plateau in Yilgarn Craton. Gently undulating landscape of low relief. Proteaceous scrub-heaths, rich in endemics, on residual lateritic uplands and derived sandplains; mixed eucalypt, *Allocasuarina huegeliana* and Jam-York Gum woodlands on Wuaternary alluvials and cluvials. Witin this, the Katanning subregion is the erosional surface of gently undulating rises to low hills with abrupt breakaways. Continious stream channels that flow in most years. Soil formed in colluvium or in-situ weathered rock. Includes woodland of Wandoo, York Gum and Salmon Gum with Jam and Casuaria. The climate is semi-arid (dry) warm Mediterranean.

3.2 LAND SYSTEMS AND SOILS

The Department of Agriculture and Food Western Australia has defined the land systems of the region encompassing the study area from landforms, soils, vegetation and aerial photography, providing the largest-scale interpretation of vegetation units for the study area. The study area occurs entirely within a single land system, the Goomalling System. The Goomalling System is described as poorly drained valley flats in the northern zone of Katanning subregion, with grey deep sandy duplex (sometimes alkaline) and saline wet soil. York Gum-Jam-Wandoo-Salmon Gum-Sheoak woodland.

According to the Atlas of Australian Soils (Bureau of Rural Sciences 1991), two soil units are present within the study area:

- Sl28 – Broad flat valleys with small clay pans and salt-lake remnants in some localities: chief soils are hard alkaline yellow soils underlain by acid lateritic clays below depths of from 2 to 4 ft; and other soils on lunettes and dunes some of which are gypseous.
- Va63 – Valley plains and terraces: chief soils are hard alkaline yellow mottled soils. Associated are small areas of a range of soils both containing laterite or large amounts of ironstone gravels.

3.3 CLIMATE AND WEATHER

The climate of the Kattaning subregion is semi-arid dry warm Mediteranean (Beecham 2001). The nearest Bureau of Meterology (BoM) weather station with comprehensive data collection and historic climate data is located at Brookton (no.010524, Latitude: -32.37°S, Longitude 117.01°E approximately 18 km south-west of the study area. Brookton records the highest maximum mean monthly temperature (33^{o}C) in January, the lowest maximum mean (16.1^{o}C) in July (BoM 2018) (Figure 3-1). Highest minimum mean (16^{o}C) in February and the lowest (4.5^{o}C) in July (BoM 2018) (Figure 3-1). Average annual rainfall is 451.5mm with June and July recording the highest monthly averages (83.9mm and 84.9 mm respectively).

Daily mean maximum and minimum temperatures for Brookton in the 12 months preceeding the survey (September 2017-August 2018) were mostly equal to the annual long term averages (Figure 3-1). Rainfall was only just below average with 430.8 mm recorded over the previous year. In the three months prior to the survey there was 208 mm recorded, which was slightly below average (Figure 3-1).

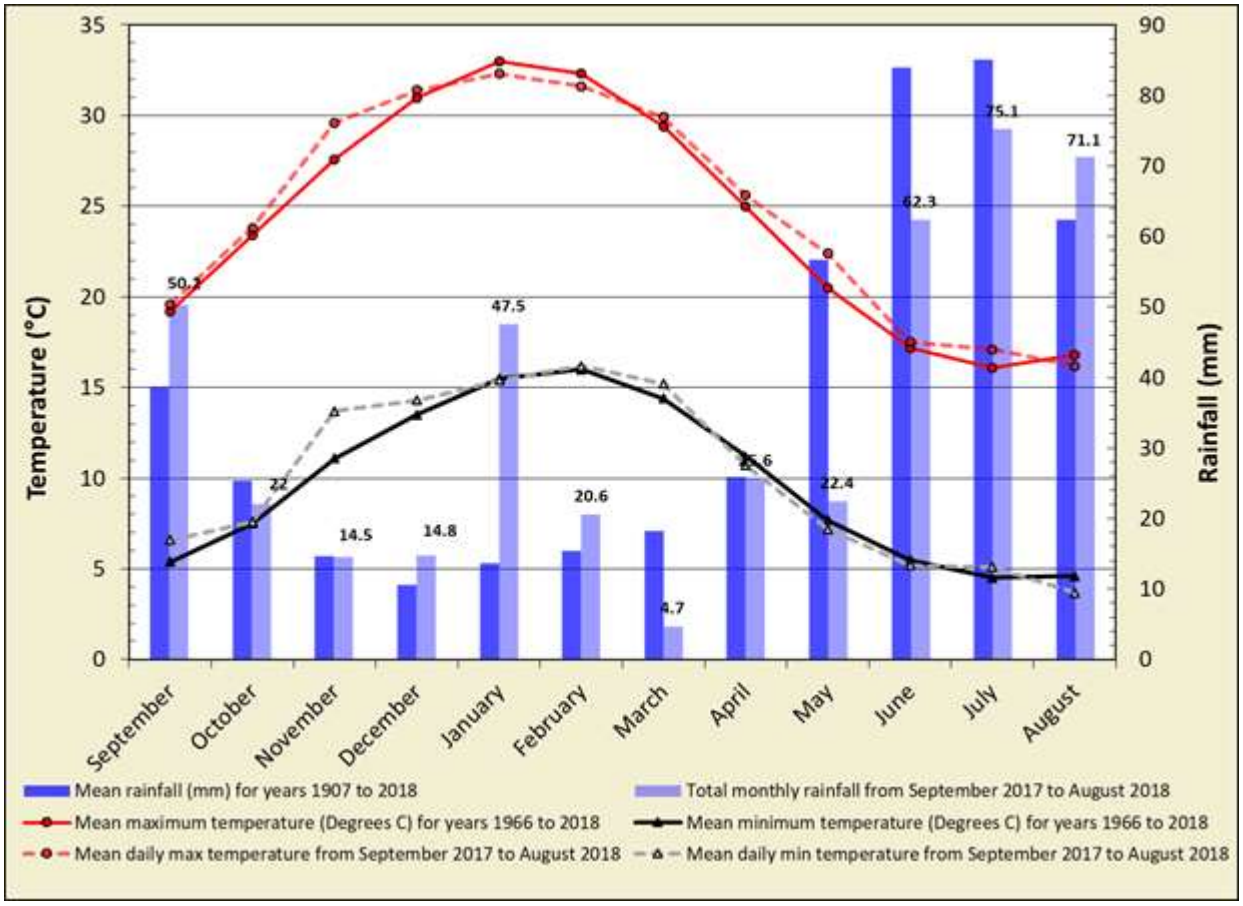


Figure 3-1 Climate data (average monthly temperatures and rainfall records) and recent observations prior to the field survey (BoM 2018)

4 RESULTS

4.1 DESKTOP REVIEW

4.1.1 Flora and vegetation

4.1.1.1 Significant flora

A total of 121 significant flora species were identified in the desktop review within 40 km of the study area, including 28 listed as Threatened under the EPBC Act and/or WC Act and 93 Priority species listed by the DBCA (Table 4-1; Figure 4-1). Nine species are listed as Critically Endangered under the WC Act; one also has the same status under the EPBC Act, the remainder being Endangered or not listed under the EPBC Act. Seven species are listed as Endangered, and 11 as Vulnerable under the WC Act. Nine are Priority 1, 18 Priority 2, 38 Priority 3 and 26 Priority 4 (Table 4-1).

Table 4-1 Records of significant flora species identified within a 40 km buffer of the study area in the desktop review

Species	Status	Nearest record to study area	Habitat
Acacia adjutrices	P3 (DBCA)	20 km south-west	Loam or clay on laterite hills, in sandplain scrub, normally in association with Eucalyptus wandoo (Maslin 2014)
Acacia alata var. *platyptera*	P4 (DBCA)	30 km south-west	Clay, gravelly sandy clay on lateritic ridges and clay flats (DBCA 2019a).
Acacia anarthros	P3 (DBCA)	19 km east	Lateritic gravelly soils on slopes (DBCA 2019a).
Acacia arcuatilis	P2 (DBCA)	38 km north-east	Sand or sandy loam, sometimes with lateritic gravel on undulating plains and rises (DBCA 2019a).
Acacia ataxiphylla subsp. *magna*	EN (EPBC & WC Acts)	18.4 km north-east	Sandy soils on lateritic ironstone rises and flats (DBCA 2019a).
Acacia brachypoda	EN (EPBC Act); VU (WC Act)	10.4 km west	Sandy clay or loam in low-lying seasonal swampy areas (DBCA 2019a).
Acacia campylophylla	P3 (DBCA)	22 km south-east	Lateritic gravelly soils (DBCA 2019a).
Acacia cochlocarpa subsp. *cochlocarpa*	EN (EPBC Act); CR (WC Act)	28.1 km south-east	Clayey or sandy and often gravelly soils (DBCA 2019a).
Acacia cuneifolia	P4 (DBCA)	21 km north-west	Sand, clay or loam over granite on granite outcrops, hills and rocky watercourses (DBCA 2019a).
Acacia inophloia	P3 (DBCA)	38.7 km north-east	Yellow sand and gravelly granitic soils on roadside or base of granitic rock or in wetland (DBCA 2019a).

Species	Status	Nearest record to study area	Habitat
Acacia lirellata subsp. *lirellata*	P3 (DBCA)	12.5 km south-west	Sand and loamy soils over laterite in swamps, near roadverge (DBCA 2019a)
Acacia phaeocalyx	P3 (DBCA)	21.8 km north-east	Yellow or white sand, often over laterite on flats and hillsides (DBCA 2019a).
Acacia ridleyana	P3 (DBCA)	21.3 km north-east	Grey or yellow/brown sand, gravelly clay and granitic loam on hillside (DBCA 2019a).
Acacia sclerophylla var. *teretiuscula*	P1 (DBCA)	13.6 km north-west	Clay and loamy soils on plain, clay pan or hillside over laterite or granite (DBCA 2019a).
Acacia tuberculata	P2 (DBCA)	30 km south-east	Brown clay loam, grey sand, laterite on granite outcrops or watercourse (DBCA 2019a).
Acacia vittata	P2 (DBCA)	13.6 km north-west	Grey sand, sandy clay. Margins of seasonal lakes (DBCA 2019a).
Acacia volubilis	EN (EPBC Act); CR (WC Act)	17 km north-east	Gravelly sand, sandy clay on plain or hillside over laterite or granite (DBCA 2019a).
Allocasuarina fibrosa	VU (EPBC & WC Acts)	28.7 km north	Sand over laterite on low ridges on quartz outcrops (DBCA 2019a).
Andersonia carinata	P2 (DBCA)	14.1 km north	White sand, gravelly lateritic soils on plains (DBCA 2019a).
Angianthus prostratus	P3 (DBCA)	30.8 km north-east	Red clay or loamy soils in saline depressions (DBCA 2019a).
Anigozanthos bicolor subsp. *exstans*	P3 (DBCA)	10.9 km west	White sand, sandy clay loam (DBCA 2019a).
Anthotium odontophyllum	P3 (DBCA)	30 km south-east	Sandy, clay or loamy soils over laterite. Eucalypt woodland over low heath (DBCA 2019a).
Arnocrinum drummondii	P3 (DBCA)	34.4 km north	White or yellow sand on plain or hillside (DBCA 2019a).
Arthropodium sp. Yenyenning (G.J. Keighery & N. Gibson 2957)	P1 (DBCA)	15 km east	Seasonal dampland in white saline clay over clay (DBCA 2019a).
Austrostipa blackii	P3 (DBCA)	6.4 km west	Red-brown shallow sandy clay loam soils in winter wet depression in bare orange clay loam on rocky banded ironstone formation ridge or basalt outcrop or in creekline (DBCA 2019a).
Baeckea sp. Tampia Hill (J.C. Anway 327)	P1 (DBCA)	Within 40 km	Laterite slope with well drained, moist, yellow brown sand in dry grey sand – clay (DBCA 2019a).
Baeckea sp. Youndegin Hill (A.S. George 15772)	P1 (DBCA)	Within 40 km	Yellow sand, red sandy clay, laterite along road verges (DBCA 2019a).

Species	Status	Nearest record to study area	Habitat
Banksia cuneata	EN (EPBC & WC Acts)	11.7 km south-east	Grey, yellow or yellow-brown sand on slopes or plains (DBCA 2019a).
Banksia cynaroides	P4 (DBCA)	37.8km south-east	Gravelly sand or clay loam over laterite (DBCA 2019a).
Banksia dallanneyi subsp. *agricola*	P2 (DBCA)	1.6 km west	Sandy loam or sand over laterite (DBCA 2019a).
Banksia horrida	P3 (DBCA)	32.7 km north-east	Sand, sometimes with gravel over laterite on slopes (DBCA 2019a).
Banksia ionthocarpa subsp. *chrysophoenix*	EN (EPBC Act); CR (WC Act)	17.6 km south-east	Brown sandy loam, sandy clays, laterite, granite. Undulating sandplains, winter-damp sites (DBCA 2019a).
Banksia rufa subsp. *tutanningensis*	P2 (DBCA)	30 km north	Grey sand on lateritic rises (DBCA 2019a).
Banksia seneciifolia	P4 (DBCA)	36.9 km south-east	Sandy loam, sand on rocky hillslopes (DBCA 2019a).
Banksia subpinnatifida var. *subpinnatifida*	P2 (DBCA)	34.12 km south	Gravelly loam over laterite on hillside (DBCA 2019a).
Banksia wonganensis	P4 (DBCA)	30 km south-east	Gravelly loam on lateritic rises (DBCA 2019a).
Beaufortia burbidgeae	P3 (DBCA)	14.6 km south	Ironstone (massive laterite) on hilltops and upper slopes in heath or as a subshrub in woodland, occasionally on sand over laterite (Burbidge 2016)
Boronia capitata subsp. *capitata*	EN (EPBC Act); VU (WC Act)	37.28 km south-east	Sand, often over laterite in sandplains (DBCA 2019a).
Brachyloma mogin	P3 (DBCA)	13 km north-west	Grey clayey sand in swamp flat (DBCA 2019a).
Caladenia integra	P4 (DBCA)	39.3 km south-east	Clayey loam on granite outcrops and rocky slopes (DBCA 2019a).
Caladenia williamsiae	EN (EPBC Act); CR (WC Act)	13.7 km south	Red loamy soil on lateritic ridgetop (DBCA 2019a).
Caladenia x *triangularis*	P4 (DBCA)	33.5 km south	Low undulating heavy loam country (DBCA 2019a).
Calectasia pignattiana	VU (EPBC & WC Acts)	35.4 km north-east	Sand to sandy clay over granite or laterite, gravel on plains and gentle slopes (DBCA 2019a).
Calothamnus brevifolius	P4 (DBCA)	7.4 km south	White/grey or yellow sand over laterite on slopes or plains (DBCA 2019a).
Calytrix nematoclada	P3 (DBCA)	28.2 km north-east	Yellow or grey sand in sandplains (DBCA 2019a).

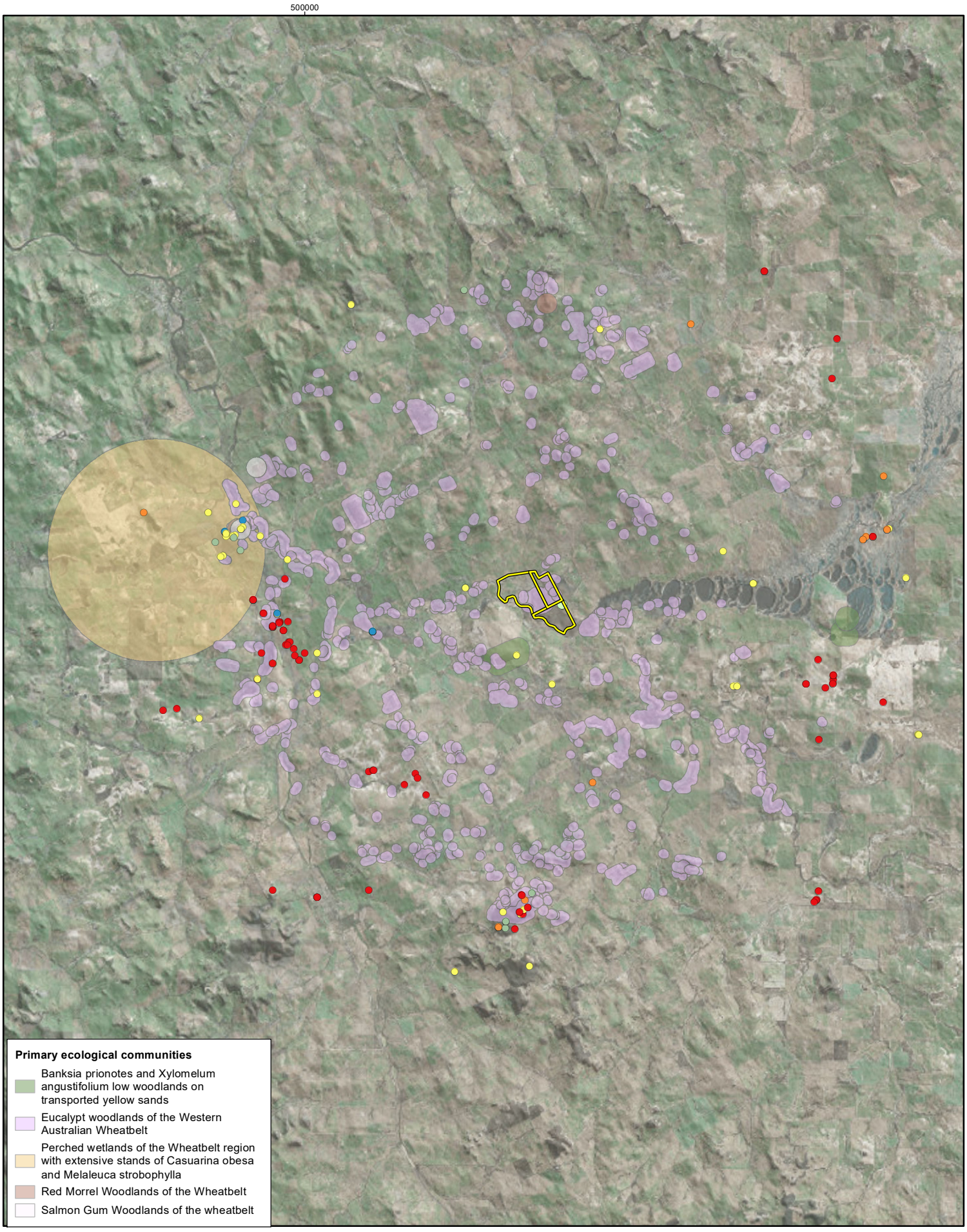
Species	Status	Nearest record to study area	Habitat
Calytrix sagei	P2 (DBCA)	12.7 km north-west	In varied habitats including the margins of salt lakes and in sandy clay with underlying granite (Rye 2013)
Chamelaucium sp. Dryandra (D. Rose 446)	P2 (DBCA)	Within 40 km	Brown sandy loam or clay with ironstone gravel over laterite or granite on slope on breakaway (DBCA 2019a).
Conospermum eatoniae	P3 (DBCA)	8.4 km south-east of	Deep white sand, sandy clay loam over laterite over granite on slope above swamp near salt lake (DBCA 2019a).
Conospermum galeatum	CR (WC Act)	35.1 km north-east	Yellow sand on plains or slopes (DBCA 2019a).
Cryptandra beverleyensis	P3 (DBCA)	13.6 km north-west	Clay soils sometimes also with sand, often with lateritic gravel, in eucalypt woodlands, often with Wandoo or Salmon Gum dominant (Rye 2007)
Darwinia sp. Dryandra (G.J. Keighery 9295)	P4 (DBCA)	Within 40 km	Gravelly clay on lateritic ridges (DBCA 2019a).
Darwinia sp. Wyalgima Hill (L.W. Sage, J.P. Pigott & E.B. Pigott LWS1549)	P1 (DBCA)	Within 40 km	Brown lateritic soil on hills, ridge lines (DBCA 2019a).
Darwinia thymoides subsp. St Ronans (J.J. Alford & G.J. Keighery 64)	P4 (DBCA)	Within 40 km	Exposed sheet granite fringed by laterite with exposed boulders and rubble in dry loam - clay over boulders and granite (DBCA 2019a).
Daviesia oxylobium	P4 (DBCA)	35 km north-east	Sandy lateritic soils on undulating plains (DBCA 2019a).
Daviesia uncinata	P3 (DBCA)	22.7 km east	Gravelly lateritic sand, loamy sand on undulating plains (DBCA 2019a).
Dicrastylis reticulata	P3 (DBCA)	34 km south	Sandy soils, often over granite amongst granite rock, hills and flats (DBCA 2019a).
Eleocharis keigheryi	VU (EPBC & WC Acts)	21.4 km north-west	Clay, sandy loam, emergent in freshwater: creeks and claypans (DBCA 2019a).
Epitriche demissus	P2 (DBCA)	30.3 km north-east	Sandy and clayey soils in saline depressions or lake edges (DBCA 2019a).
Eremophila glabra subsp. York (P.G. Wilson 12172 B)	P1 (DBCA)	12.8 km north-west	Red-brown clay loam over granite (DBCA 2019a).
Eremophila serpens	P4 (DBCA)	35.8 km north-west	White/grey sand, alluvium, loam in winter-wet depressions, sub-saline flats, drainage lines and salt lakes (DBCA 2019a).

Species	Status	Nearest record to study area	Habitat
Eremophila sp. Beverley (K. Kershaw KK 2438)	P1 (DBCA)	10.9 km west	Low lying plain with grey clay / loam soil or brown sandy loam (DBCA 2019a).
Eucalyptus erythronema subsp. *inornata*	P3 (DBCA)	23.4 km north-east	variety of landscapes, usually in sites of good drainage, from lateritic and sandy gravel rises to slight slopes of pale red to grey loams (Nicolle & French 2012)
Eucalyptus exilis	P4 (DBCA)	21 km south-west	Occurs in lateritic soils of good drainage, usually on higher landscapes (Nicolle & French 2012)
Eucalyptus loxophleba x *wandoo*	P4 (DBCA)	27.5 km north-east	Sandy clay or loam on margin of drainage line (DBCA 2019a).
Eucalyptus sargentii subsp. *onesis*	P3 (DBCA)	14.6 km north-west	Occurs on margins of lakes and broad, natural drainage systems (Nicolle & French 2012)
Eucalyptus spathulata subsp. *salina*	P3 (DBCA)	8.2 km east	Grey-white sand, pale brown sandy clay over granite in saline soils on flats, broad valley floors, saline depressions, edges salt lakes and rises (DBCA 2019a).
Eucalyptus subangusta subsp. *virescens*	P3 (DBCA)	38 km north-east	Yellow sand, white clay over granite on plain (DBCA 2019a).
Eutaxia rubricarina	P3 (DBCA)	11.8 km north-west	Red sandy loam, cracking clay with calcrete and quartz on flats, slopes, valley floors, road verges (DBCA 2019a).
Frankenia drummondii	P3 (DBCA)	17 km east	Sand on lake edges (DBCA 2019a).
Frankenia glomerata	P4 (DBCA)	16.2 km east	White sand or sand loam in saline environment or floodplain (DBCA 2019a).
Gastrolobium densifolium	P4 (DBCA)	37.8 km north-east	Sandy soils on undulating dunes (DBCA 2019a).
Gastrolobium stipulare	P4 (DBCA)	24 km south-west	Yellow-grey sand, gravelly clay loam, laterite on slopes, ridges (DBCA 2019a).
Glyceria drummondii	EN (EPBC & WC Acts)	21 km north-west	Brown to grey clay localised hollows in claypans in seasonally flooded areas (DBCA 2019a).
Gonocarpus intricatus	P4 (DBCA)	35 km north-east	Sand on granite outcrops and hills (DBCA 2019a).
Grevillea dryandroides subsp. *hirsuta*	EN (EPBC Act); VU (WC Act)	22.6 km east	White or yellow sand on laterite (DBCA 2019a).
Grevillea roycei	P3 (DBCA)	1.6 km west	White or yellow sand on hillslope or plain (DBCA 2019a).

Species	Status	Nearest record to study area	Habitat
Grevillea scapigera	EN (EPBC Act); CR (WC Act)	22.4 km east	Sandy or gravelly lateritic soils (DBCA 2019a).
Guichenotia seorsiflora	CR (EPBC & WC Acts)	31.8 km north-east	Sandy clay with lateritic gravel on breakaways (DBCA 2019a).
Hakea aculeata	VU (EPBC Act); EN (WC Act)	17.3 km south-west	Sand, loam or clay on road verge (DBCA 2019a).
Hemiandra coccinea	P3 (DBCA)	33.1 km north-east	White or grey, often gravelly sand on sandplains, gravel pits (DBCA 2019a).
Hemigenia platyphylla	P4 (DBCA)	27.5 km north-west	Sandy and loamy soils on granite rocks and slopes (DBCA 2019a).
Hibbertia glabriuscula	P3 (DBCA)	32.7 km north-east	Yellow sand over laterite on sandplains with some laterite breakaways (DBCA 2019a).
Hibbertia glomerata subsp. *wandoo*	P3 (DBCA)	14.3 km south	Lateritic soils in wandoo woodland and from pockets of jarrah-marri within wandoo woodland (DBCA 2019a).
Hibbertia montana	P4 (DBCA)	14.3 km north-east	Loam over granite, lateritic soils, gravel on granite rocks, lateritic ridges, boulders and hills (DBCA 2019a).
Jacksonia quairading	EN (EPBC & WC Acts)	31 km north-east	Red laterite nodules on plains (DBCA 2019a).
Lasiopetalum pterocarpum	EN (EPBC Act); CR (WC Act)	20.1 km south-west	Dark red-brown loam or clayey sand over granite on sloping banks near creeklines (DBCA 2019a).
Lasiopetalum rotundifolium	EN (EPBC & WC Acts)	18.1 km south-west	Gravelly clayey sand on hill (DBCA 2019a).
Lasiopetalum sp. Weam Reserve (M. Hislop 2755)	P2 (DBCA)	14.9 km south	Orange brown sand and lateritic gravel over laterite (DBCA 2019a).
Lechenaultia laricina	EN (EPBC Act); VU (WC Act)	21.7 km west	Sand, gravelly loam on plain and road verge near seasonally wet swamp (DBCA 2019a).
Lepidosperma sp. Meckering (R. Davis WW 27-32)	P3 (DBCA)	13.5 km north-west	Grey sandy loam over gravel. Clay at depth. Brown clay over laterite (DBCA 2019a).
Leucopogon audax	P2 (DBCA)	13.5 km south	lateritic, upland sites (one collection records it growing over a granitic substrate) in heath or open Eucalyptus accedens or E. drummondii woodland (Hislop 2014)
Leucopogon cymbiformis	P2 (DBCA)	32.7 km north-east	White/grey or yellow sand, lateritic gravelly soils. Sandplains, wet flats, foothills (DBCA 2019a).

Species	Status	Nearest record to study area	Habitat
Leucopogon sp. Brookton (K. Kershaw & L. Kerrigan KK 2192)	P1 (DBCA)	Within 40 km	Red-brown sandy clay & gravel, yellow sandy loam, laterite. Low plains, mid-slopes of valleys, degraded roadsides (DBCA 2019a).
Levenhookia pulcherrima	P2 (DBCA)	13.2 km north-west	Brown sandy loam over granite-quartz on plain or slope (DBCA 2019a).
Melaleuca sciotostyla	EN (EPBC & WC Acts)	30 km north	Orange clayey sand with lateritic pebbles on scree slopes (DBCA 2019a).
Persoonia hakeiformis	P2 (DBCA)	34.3 km south-west	Gravelly clay loam or sand over laterite on lateritic ridges (DBCA 2019a).
Polianthion biloculare	P4 (DBCA)	35.1 km south	Shallow loam on laterite ridges (DBCA 2019a).
Ptilotus fasciculatus	EN (EPBC Act); P4 (DBCA)	15.4 km east	Flat, sandy brown / grey well-drained moist loam or clay in salt drainage or watercourse (DBCA 2019a).
Rinzia crassifolia	P1 (DBCA)	39 km north-east	Lateritic sand or clay on rises and outcrops (DBCA 2019a).
Roycea pycnophylloides	EN (EPBC Act); VU (WC Act)	15.7 km east	Sandy soils, clay on saline flats (DBCA 2019a).
Scaevola tortuosa	P1 (DBCA)	35.9 km north-east	Sandy clay on margins of salt lakes (DBCA 2019a).
Schoenus capillifolius	P3 (DBCA)	21 km north-west	Brown mud on claypans (DBCA 2019a).
Stylidium coatesianum	P2 (DBCA)	36.7 km south-east	Lateritic soils on upper slopes, breakaways in open woodland and mallee shrubland (DBCA 2019a).
Stylidium coroniforme subsp. *amblyphyllum*	CR (WC Act)	30 km north	Lateritic soils on breakaways in Eucalypt woodland, Dryandra shrubland (DBCA 2019a).
Stylidium exappendiculatum	P3 (DBCA)	38 km south-east	seasonal damp clay/loam along drainage line or white sand over laterite (DBCA 2019a).
Stylidium expeditionis	P4 (DBCA)	40 km south-east	Yellow-brown sandy loam or white sand over laterite on hillslopes and plains (DBCA 2019a).
Stylidium longitubum	P4 (DBCA)	32.7 km west	Sandy clay, clay in seasonal wetlands (DBCA 2019a).
Stylidium scabridum	P4 (DBCA)	38.4 km north	Sand in open woodland or heath (DBCA 2019a).
Stylidium squamellosum	P2 (DBCA)	34.4 km north-east	Brown to red-brown clay loam in winter-wet habitats and depressions, open woodland, shrubland (DBCA 2019a).

Species	Status	Nearest record to study area	Habitat
Stylidium tenuicarpum	P4 (DBCA)	14 km south	Sandy loam over laterite or granite on rock outcrops, hillslopes, breakaways in shrubland, open woodland (DBCA 2019a).
Stylidium uniflorum subsp. *extensum*	P3 (DBCA)	12.8 km north-west	clayey sand or clayey loam on gentle hillslopes in open E. wandoo woodland, dense Allocasuarina woodland, or E. salmonophloia and E. longicornis woodland, sometimes in association with granite outcropping (Wege 2015)
Synaphea boyaginensis	P2 (DBCA)	31.4 km south-west	Gravelly clay-loam on granite or laterite outcrop (DBCA 2019a).
Synaphea tripartita	P3 (DBCA)	32.9 km north-east	Lateritic gravel, sand, clay with ironstone gravel over laterite on road verge or plain (DBCA 2019a).
Tetratheca retrorsa	P3 (DBCA)	37.1 km south-east	Dark brown sandy loam on lateritic breakaways or granite outcrop (DBCA 2019a)
Thomasia glabripetala	VU (EPBC & WC Acts)	37.8 km north-west	Yellow/brown sand or loam over granite on road verge (DBCA 2019a).
Thomasia montana	VU (EPBC & WC Acts)	17.4 km south-west	Loamy soils on rocky granite knolls and lateritic hills (DBCA 2019a).
Thysanotus tenuis	P3 (DBCA)	12.9 km north-west	Clay, sandy clay, loam over granite on slopes (DBCA 2019a).
Verticordia fimbrilepis subsp. *fimbrilepis*	EN (EPBC Act); VU (WC Act)	18 km south-east	Gravelly sandy or clayey soils on flats or road verges (DBCA 2019a).
Verticordia huegelii var. *tridens*	P3 (DBCA)	39.1 km south-east	Sandy or gravelly loam in winter-wet areas and low hills (DBCA 2019a).
Verticordia lindleyi subsp. *lindleyi*	P4 (DBCA)	35.7 km north-west	Sand, sandy clay in winter-wet depressions (DBCA 2019a).
Xanthoparmelia fumigata	P1 (DBCA)	6.4 km west	Brown clayey sand over granite or laterite beside creek or wetland (DBCA 2019a).



Jacobs - Northern Highway Muchea to Wubin Stage 2 Upgrades Project

Project No	1240
Date	17-Dec-18
Drawn by	IH
Map author	GW

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Study area

Significant flora conservation status

- P1
- P2
- P3
- P4
- T

Figure 4-1

Records of significant flora species, TECs and PECs in vicinity of study area

PHOENIX ENVIRONMENTAL SCIENCES

4.1.1.2 Introduced flora

The desktop review identified records for 177 introduced species (Table 4-2), including six records of Weeds of National Significance (WoNS): **Asparagus asparagoides, *Chrysanthemoides monilifera* subsp*. monilifera*, **Lycium ferocissimum*, **Opuntia elatior*, **Opuntia monacantha* and **Tamarix aphylla*. All the WoNS are also listed as Declared Pests with the exception of **Lycium ferocissimum*. Three additional weeds are listed as Declared Pests but not WoNS: **Echium plantagineum*, **Moraea flaccida* and **Moraea miniata*.

Table 4-2 Records of introduced flora identified in the desktop review

Family	Species	WoNS	Declared Pest
Poaceae	**Aira caryophyllea*		
Poaceae	**Aira cupaniana*		
Poaceae	**Aira praecox*		
Alliaceae	**Allium neapolitanum*		
Alliaceae	**Allium orientale*		
Amaranthaceae	**Amaranthus albus*		
Asteraceae	**Arctotheca calendula*		
Papaveraceae	**Argemone ochroleuca* subsp. *ochroleuca*		
Poaceae	**Arundo donax*		
Asparagaceae	**Asparagus asparagoides*	Y	S22(2) (Exempt)
Chenopodiaceae	**Atriplex prostrata*		
Poaceae	**Avellinia michelii*		
Poaceae	**Avena barbata*		
Poaceae	**Avena fatua*		
Orobanchaceae	**Bartsia trixago*		
Brassicaceae	**Brassica tournefortii*		
Brassicaceae	**Brassica* x *napus*		
Poaceae	**Briza maxima*		
Poaceae	**Briza minor*		
Poaceae	**Bromus diandrus*		
Poaceae	**Bromus hordeaceus*		
Poaceae	**Bromus madritensis*		
Poaceae	**Bromus rubens*		
Boraginaceae	**Buglossoides arvensis*		
Dicranaceae	**Campylopus introflexus*		
Gentianaceae	**Centaurium erythraea*		
Gentianaceae	**Centaurium tenuiflorum*		
Asteraceae	**Chrysanthemoides monilifera* subsp. *monilifera*	Y	S12 (C2 Prohibited)
Gentianaceae	**Cicendia quadrangularis*		

Family	Species	WoNS	Declared Pest
Asteraceae	**Cichorium intybus*		
Asteraceae	**Cirsium vulgare*		
Aizoaceae	**Cleretum papulosum* subsp. *papulosum*		
Apiaceae	**Conium maculatum*		
Asteraceae	**Conyza sumatrensis*		
Asteraceae	**Cotula bipinnata*		
Asteraceae	**Cotula coronopifolia*		
Crassulaceae	**Crassula natans*		
Crassulaceae	**Crassula natans* var. *minus*		
Euphorbiaceae	**Croton setiger*		
Poaceae	**Cynodon dactylon*		
Cyperaceae	**Cyperus tenellus*		
Cyperaceae	**Cyperus tenuiflorus*		
Solanaceae	**Datura ferox*		
Solanaceae	**Datura stramonium*		
Scrophulariaceae	**Dischisma capitatum*		
Asteraceae	**Dittrichia graveolens*		
Boraginaceae	**Echium plantagineum*		S22(2) (Exempt)
Poaceae	**Ehrharta longiflora*		
Onagraceae	**Epilobium ciliatum*		
Poaceae	**Eragrostis curvula*		
Geraniaceae	**Erodium botrys*		
Geraniaceae	**Erodium cicutarium*		
Euphorbiaceae	**Euphorbia peplus*		
Frankeniaceae	**Frankenia pulverulenta*		
Iridaceae	**Freesia alba* x *leichtlinii*		
Papaveraceae	**Fumaria bastardii*		
Papaveraceae	**Fumaria capreolata*		
Papaveraceae	**Fumaria densiflora*		
Papaveraceae	**Fumaria muralis* subsp. *muralis*		
Rubiaceae	**Galium divaricatum*		
Rubiaceae	**Galium murale*		
Asteraceae	**Gazania linearis*		
Iridaceae	**Gladiolus angustus*		
Iridaceae	**Gladiolus tristis*		
Poaceae	**Hainardia cylindrica*		
Boraginaceae	**Heliotropium europaeum*		

Family	Species	WoNS	Declared Pest
Poaceae	**Hordeum glaucum*		
Poaceae	**Hordeum hystrix*		
Poaceae	**Hordeum leporinum*		
Poaceae	**Hordeum marinum*		
Asteraceae	**Hypochaeris glabra*		
Iridaceae	**Ixia maculata*		
Juncaceae	**Juncus acutus*		
Juncaceae	**Juncus acutus* subsp. *acutus*		
Juncaceae	**Juncus bufonius*		
Juncaceae	**Juncus capitatus*		
Asteraceae	**Lactuca saligna*		
Plumbaginaceae	**Limonium sinuatum*		
Plantaginaceae	**Linaria maroccana*		
Linaceae	**Linum usitatissimum*		
Poaceae	**Lolium loliaceum*		
Poaceae	**Lolium perenne*		
Poaceae	**Lolium remotum*		
Poaceae	**Lolium rigidum*		
Solanaceae	**Lycium ferocissimum*	Y	
Primulaceae	**Lysimachia arvensis*		
Lythraceae	**Lythrum hyssopifolia*		
Fabaceae	**Medicago polymorpha*		
Fabaceae	**Melilotus albus*		
Aizoaceae	**Mesembryanthemum crystallinum*		
Aizoaceae	**Mesembryanthemum nodiflorum*		
Poaceae	**Molineriella minuta*		
Asteraceae	**Monoculus monstrosus*		
Campanulaceae	**Monopsis debilis*		
Campanulaceae	**Monopsis debilis* var. *depressa*		
Iridaceae	**Moraea flaccida*		S22(2) (Exempt)
Iridaceae	**Moraea lewisiae*		
Iridaceae	**Moraea miniata*		S22(2) (Exempt)
Iridaceae	**Moraea setifolia*		
Scrophulariaceae	**Nemesia strumosa*		
Apocynaceae	**Nerium oleander*		
Onagraceae	**Oenothera stricta*		
Onagraceae	**Oenothera stricta* subsp. *stricta*		

Family	Species	WoNS	Declared Pest
Cactaceae	**Opuntia elatior*	Y	S22(2) (C3 Restricted)
Cactaceae	**Opuntia monacantha*	Y	S22(2) (C3 Restricted)
Asparagaceae	**Ornithogalum arabicum*		
Oxalidaceae	**Oxalis bowiei*		
Oxalidaceae	**Oxalis corniculata*		
Oxalidaceae	**Oxalis flava*		
Oxalidaceae	**Oxalis hirta*		
Oxalidaceae	**Oxalis pes-caprae*		
Oxalidaceae	**Oxalis purpurea*		
Poaceae	**Parapholis incurva*		
Orobanchaceae	**Parentucellia latifolia*		
Poaceae	**Paspalum distichum*		
Poaceae	**Pentameris airoides* subsp. *airoides*		
Caryophyllaceae	**Petrorhagia dubia*		
Boraginaceae	**Phacelia tanacetifolia*		
Poaceae	**Phalaris canariensis*		
Poaceae	**Phalaris paradoxa*		
Arecaceae	**Phoenix dactylifera*		
Scrophulariaceae	**Phyllopodium cordatum*		
Pinaceae	**Pinus halepensis*		
Plantaginaceae	**Plantago coronopus*		
Plantaginaceae	**Plantago coronopus* subsp. *commutata*		
Polygonaceae	**Polygonum aviculare*		
Poaceae	**Polypogon monspeliensis*		
Asteraceae	**Pseudognaphalium luteoalbum*		
Poaceae	**Puccinellia ciliata*		
Lythraceae	**Punica granatum*		
Brassicaceae	**Raphanus raphanistrum*		
Resedaceae	**Reseda lutea*		
Resedaceae	**Reseda luteola*		
Iridaceae	**Romulea rosea*		
Iridaceae	**Romulea rosea* var. *australis*		
Iridaceae	**Romulea rosea* var. *communis*		
Polygonaceae	**Rumex acetosella*		
Polygonaceae	**Rumex crispus*		
Polygonaceae	**Rumex hypogaeus*		

Family	Species	WoNS	Declared Pest
Caryophyllaceae	**Sagina maritima*		
Lamiaceae	**Salvia verbenaca*		
Caryophyllaceae	**Silene gallica* var. *gallica*		
Solanaceae	**Solanum rostratum*		
Solanaceae	**Solanum triflorum*		
Asteraceae	**Sonchus oleraceus*		
Poaceae	**Sorghum halepense*		
Iridaceae	**Sparaxis pillansii*		
Caryophyllaceae	**Spergularia diandra*		
Caryophyllaceae	**Spergularia rubra*		
Asteraceae	**Symphyotrichum squamatum*		
Tamaricaceae	**Tamarix aphylla*	Y	S22(2) (Exempt)
Tamaricaceae	**Tamarix parviflora*		
Tamaricaceae	**Tamarix ramosissima*		
Zygophyllaceae	**Tribulus terrestris*		
Fabaceae	**Trifolium arvense*		
Fabaceae	**Trifolium arvense* var. *arvense*		
Fabaceae	**Trifolium campestre*		
Fabaceae	**Trifolium dubium*		
Fabaceae	**Trifolium glomeratum*		
Fabaceae	**Trifolium hirtum*		
Fabaceae	**Trifolium resupinatum* var. *resupinatum*		
Fabaceae	**Trifolium subterraneum*		
Fabaceae	**Trifolium tomentosum*		
Fabaceae	**Trifolium tomentosum* var. *tomentosum*		
Asteraceae	**Ursinia anthemoides*		
Asteraceae	**Ursinia anthemoides* subsp. *anthemoides*		
Asteraceae	**Vellereophyton dealbatum*		
Fabaceae	**Vicia monantha*		
Fabaceae	**Vicia monantha* subsp. *triflora*		
Fabaceae	**Vicia sativa* subsp. *nigra*		
Poaceae	**Vulpia bromoides*		
Poaceae	**Vulpia muralis*		
Poaceae	**Vulpia myuros*		
Poaceae	**Vulpia myuros* forma *myuros*		
Campanulaceae	**Wahlenbergia capensis*		
Scrophulariaceae	**Zaluzianskya divaricata*		

4.1.1.3 Vegetation associations

Regional scale vegetation mapping by Shepherd *et al.* (2002) mapped five vegetation associations in the survey area (Figure 4-2, Table 4-3):

- Association 352 – Medium woodland; York gum
- Association 948 - Medium woodland; York gum & river gum
- Association 950 – Medium woodland; *Casuarina obesa*
- Association 1049 – Medium woodland; wandoo, York gum, salmon gum, morrel & gimlet
- Association 1147 - Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region.

Shepherd *et al.* (2002) have assigned the status of vegetation remaining (to pre-European extent) into five classes:

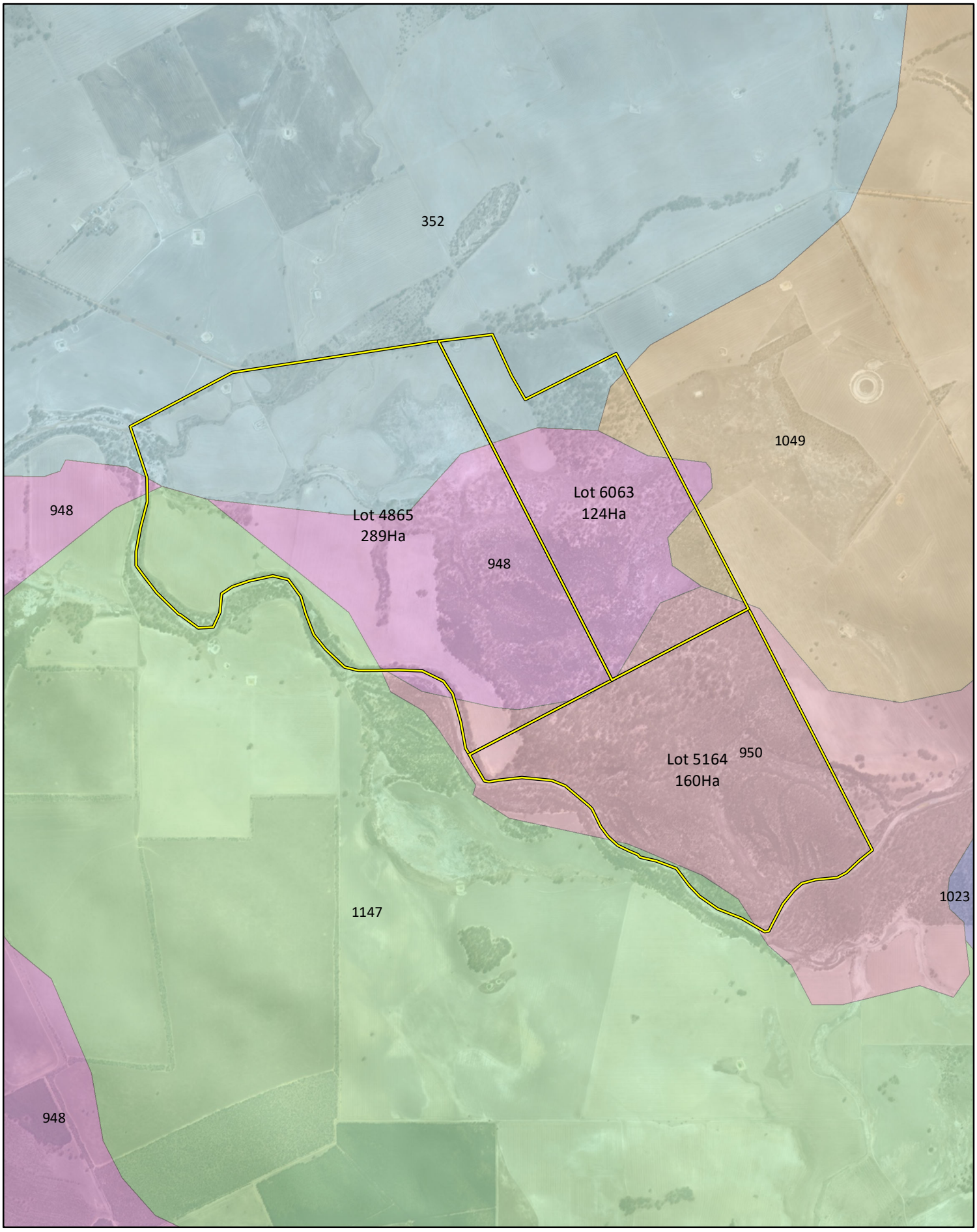
- Presumed Extinct – probably no longer present in the bioregion
- Endangered (EN)[1] – <10% of pre-European extent remains
- Vulnerable (VU)[1] – 10-30% of pre-European extent exists
- Depleted (D)[1] – >30-50% of pre-European extent exists
- Least Concern (LC) – >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

In accordance to these classes Association 950 mapped for the study area is assigned LC as more than 50% or Pre-European extent remains at the Statewide scale. Association 948 is D with just over 30% pre-European extent remaining, Association 352 VU with just over 20% remaining and Associations 1049 and 1147 EN with less than 10% remaining. The status remains the same for all the vegetation associations if applied at the bioregional or subregional scale.

Table 4-3 Statewide extent of Pre-European vegetation associations present in the study area (DBCA 2018a)

Vegetation association	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Current extent in DBCA managed lands (%)
352	724,268.73	142,018.85	19.61	8.92
948	1,441.06	442.92	30.74	1.50
950	496.91	287.14	57.78	8.04
1049	833,384.77	56,618.34	6.79	5.96
1147	42,855.40	4,074.26	9.51	10.28

[1] or a combination of depletion, loss of quality, current threats and rarity gives a comparable status.



PERTH

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Map author	GW

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Study area

Vegetation associations

- 352
- 948
- 950
- 1023
- 1049
- 1147

Figure 4-2

***Shepherd et al*. (2002) vegetation associations of the study area**

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4.1.1.4 Threatened and priority ecological communities

A search of the Protected Matters Search Tool (DoEE 2018) and DBCA threatened and priority ecological communities database identified one EPBC Act listed TEC that may occur within the study area, Eucalypt Woodlands of the Western Australian Wheatbelt, which is listed as Critically Endangered under the EPBC Act (Table 4-4).

The initial assessment in May 2018 identified the presence of the Eucalypt Woodlands of the Western Australian Wheatbelt within the study area and comprised approximately 25% of the total study area (Phoenix 2018).

Table 4-4 Threatened and Priority Ecological Communities recorded near the study area

Community identification	Community name	TEC (WC Act)	TEC (EPBC Act)	PEC	Nearest location
Toolibin	Perched wetlands of the Wheatbelt region with extensive stands of *Casuarina obesa* and *Melaleuca strobophylla*	Endangered			11.5 km west of study area
Low level sandplains	*Banksia prionotes* and *Xylomelum angustifolium* low woodlands on transported yellow sands			Priority 1	1.3 km south-west of study area
Red Morrel Woodland[1]	Red Morrel Woodlands of the Wheatbelt		Critically Endangered	Priority 1	12.8 km north of the study area
Salmon Gum Woodlands[2]	Salmon Gum Woodlands of the wheatbelt		Critically Endangered	Priority 3	12.6 km north-west of the study area
Wheatbelt Woodlands	Eucalypt woodlands of the Western Australian Wheatbelt		Critically Endangered	Priority 3	Within study area

[1] A component of the Eucalypt woodlands of the Western Australian Wheatbelt EPBC Act listed TEC.
2. Returned in the DBCA threatened and priority ecological communities database, a component of the Eucalypt woodlands of the Western Australian Wheatbelt EPBC Act listed TEC but is not specifically listed in DBCA's Priority Ecoloigical Communities list (DBCA 2019b).

4.1.1 Carnaby's Cockatoo

No Black Cockatoo species have previously been recorded within the study area which occurs within the modelled distribution for Carnaby's Cockatoo (Department of the Environment and Energy 2017; DSEWPaC 2012) (Table 4-5). The nearest record of any Black Cockatoo species is Carnaby's Black Cockatoo, approximately 11.5 km south of the study area in 2011 (Table 4-5). Forest Red-tailed Cockatoos have previously been recorded within 30 km of the study area and the study area occurs just outside the modelled distribution of the species (Table 4-5). Previous records of Baudin's Cockatoo within 20 km of the study area are dated 1980 and are unlikely to represent the current distribution of the species (Table 4-5). It is also possible these records may be in error or misidentifications. It was also noted that the landowners have not previously observed any Black Cockatoo species within the study area or in the near vicinity.

The majority of records for the three species are located from northwest of the study area, along the coast and south-west forests, to well southeast of the study area (DBCA 2018b). Distribution of records

within the last five years in relation to the study area are all located from northwest of the study area to southeast, primarily following the coastline and south-west forests with no records located directly north to directly southeast of the study area (DBCA 2018b).

The annual community-based survey for black cockatoo species, the Great Cocky Count, does not include any survey sites in current or previous counts within 50 km of the study area (Peck *et al.* 2017). No known roost sites occur within close proximity to the study area and no breeding events are known to have occurred within or in the vcinity of the study area.

As the study area falls outside of the modelled diustribution and area of previous records for Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo, only Carnaby's Cockatoo is discussed further.

Table 4-5 Location of the study area in relation to modelled distribution and records of threatened black cockatoo species

Species	Within modelled distribution of species (Department of the Environment and Energy 2017; DSEWPaC 2012)	Nearest record to study area (DBCA 2018b)	Nearest record to study area within 5 years (DBCA 2018b)
Carnaby's Cockatoo	Well within modelled 'Breeding Range'	~11.5 km S (2011)	~31.5 km S (2018) and ~ 33 km SW (2016)
Baudin's Cockatoo	Outside of modelled distribution	~16 km N (1980) and ~19 km S (1980)	~52.5 km W (2014)
Forest Red-tailed Cockatoo	Just outside of modelled ('May Occur') distribution	~26 km WSW (2010)	~40 km WSE (2017)

4.2 FIELD SURVEY

4.2.1 Flora and vegetation

A total of 200 plant taxa (including subspecies and varieties) representing 108 genera and 42 families were recorded in the study area. This total comprised 165 (82.5%) native and 35 (17.5%) introduced (weed) species. The list of flora species recorded in the field is presented in Appendix 3.

4.2.1.1 Significant flora

No Threatened flora species were recorded during the field survey.

A specimen of a *Scholtzia* taxon collected from the study area could not be definitively identified due to a lack of sufficient taxonomic characters. The specimen was shown to Barbara Rye at the WA Herbarium by taxonomist Frank Obbens, who identified it as either *Scholtzia* sp. Duck Pool (M. E. Trudgen MET5427) (P3) or *Scholtzia* sp. Yenyening Lakes (A. Gunness 2824) (P2) (see section 4.2.1.1.1 and 4.2.1.1.2). Barbara Rye expects to publish a paper in 2019 where these two taxa will be formally named as sub-species of one species and are likely to maintain the Priority flora listing (Frank Obbens pers. comm. to Dr Grant Wells 13/12/2018).

The *Scholtzia* specimen collected in the study area was not recognised as a significant species in the field and therefore the size and distribution of the population in the study area is unknown. The

specimen was collected during a quadrat survey (Figure 4-4) with a recorded foliage cover of 15% equivalent to the second highest cover recorded for all species present indicating the species was common within the quadrat. Notably, the study area would represent a range extension for either of the Priority *Scholtzia* taxa.

The *Scholtzia* occurred in low *Eucalyptus rudis* subsp. *rudis* and *Casuarina obesa* woodland over tall *Melaleuca brophyi*, *M*. *viminea* subsp. *viminea* and *Scholtzia* shrubland shrubland over low open *Rhagodia drummondii* and *Verticordia densiflora* var. *caespitosa* shrubland in whitish sandy loam.

The study area also represents a range extension (~100 km WSW of the closest record on (DBCA 2018b) for *Triglochin longicarpa* which is thereby considered a significant species (EPA 2016b) for the area (Figure 4-4).

No other Priority flora were recorded in the survey.

4.2.1.1.1 Scholtzia sp. Duck Pool

Status: Priority 3

Description: Large spreading shrub to 3 m tall and 5 m wide with pale pink flowers that turn white (DBCA 2019a) (Figure 4-3).

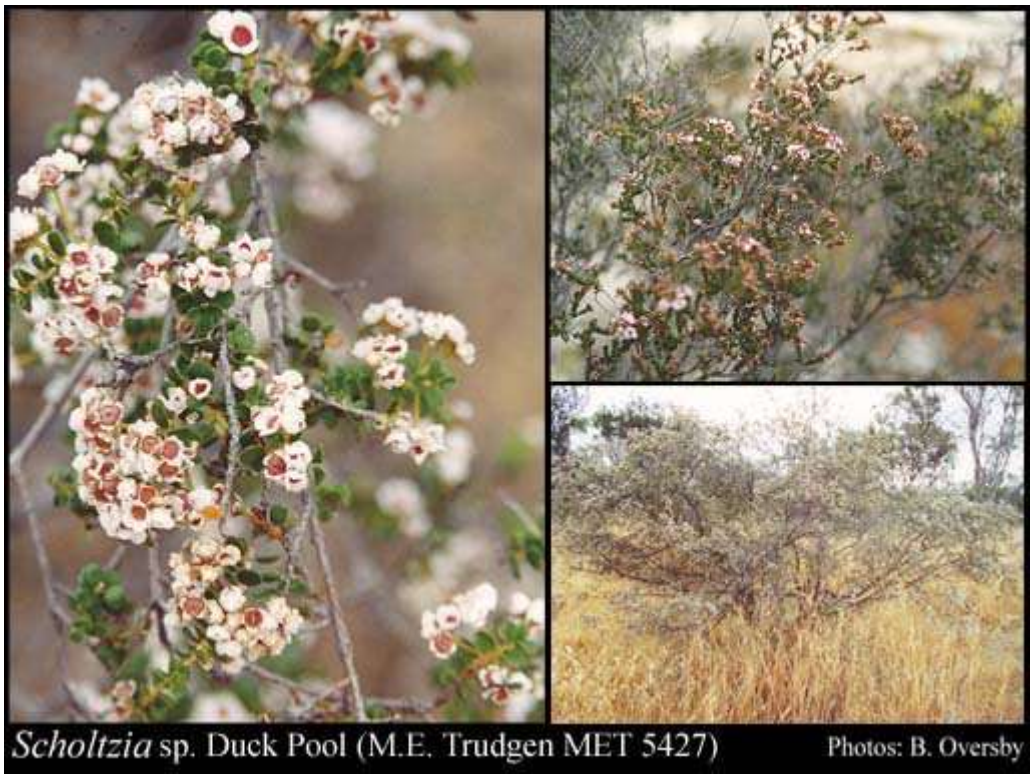

Figure 4-3 *Scholtzia* sp. Duck Pool (DBCA 2019a)

Distribution and ecology: Recorded only in the Avon Wheatbelt bioregion the species is known from 15 records (DBCA 2019a). Habitat descriptions include:

- low sand drift in saline channel complex (river floor) in *Scholtzia* high open shrubland over *Chamelaucium*, *Jacksonia* scattered low shrubs and Restionaceae, Cyperaceae ssp. sedgeland
- flood fringe of saline river
- sand rise in saline river

- floodplain of river in *Casuairina obesa* and *Melaleuca* spp. scrub
- open *Melaleuca thyoides* and Myrtaceae spp. shrubland with samphires in greyish white sand in river channel.

Population sizes provided in records for the species (DBCA 2019a) range from 4 plants to comments of the species being abundant or locally common.

4.2.1.1.2 Scholtzia sp. Yenyening Lakes

Status: Priority 2

Description: Spreading shrub to 3 m tall and 3 m wide with bright pink flowers (DBCA 2019a).

Distribution and ecology: Recorded only in the Avon Wheatbelt bioregion the species is known from 11 records (DBCA 2019a). Habitat descriptions include:

- on lower slopes of deep yellow sands on the edge of *Banksia prionotes* low woodland
- lower slope bordering a sline pool in a dense stand of *Melaleuca brophyii*, *M. thyoides* and *M.* sp. Wongan Hills
- on a sand rise (light yellow brown sand) on the edge of a salt flat
- on the edge of a wind deposted sand ridge dropping off to a saline lake.

Population sizes provided in records for the species (DBCA 2017) are limited to an observation that the species was dominant within a band.

4.2.1.2 Introduced flora

Of the 35 introduced flora recorded in the study area (Table 4-6), one species, *Moraea miniata* (two-leaf cape tulip) is a Declared Pest. *Moraea miniata* was recorded at a single location in the study area. No other introduced flora recorded during the survey were a Declared Pest or WoNS.

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Map author	GW

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- Study area
- *Triglochin longicarpa* (range extension)
- *Scholtzia* sp. Duck Pool (P3)/ *Scholtzia* sp. Yenyening Lakes (P2)

Figure 4-4

Location of significant flora in the study area

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Table 4-6 Introduced flora species recorded during the field survey

Species	No. of survey locations
**Aira caryophyllea*	3
**Aira cupaniana*	1
**Arctotheca calendula*	23
**Brassica tournefortii*	1
*Brassicaceae sp.	1
**Bromus diandrus*	2
**Bromus rubens*	4
**Bromus ?rubens*	
**Bromus* sp.	1
**Cotula bipinnata*	15
**Ehrharta longiflora*	8
**Hordeum leporinum*	4
**Hypochaeris glabra*	9
**Limonium sinuatum*	1
**Lolium rigidum*	4
**Lolium ?perenne*	1
**Lolium ?rigidum*	1
**Lupinus cosentinii*	1
**Lysimachia arvensis*	8
**Medicago polymorpha*	1
**Mesembryanthemum nodiflorum*	5
**Monoculus monstrosus*	1
**Moraea miniata*	1
**Moraea setifolia*	1
**Parapholis incurva*	1
**Parentucellia latifolia*	2
**Pentameris airoides*	1
**Romulea rosea*	2
**Romulea* sp.	
**Trifolium tomentosum* var. *tomentosum*	1
**Trifolium* sp.	
**Ursinia anthemoides*	3
**Ursinia anthemoides* subsp. *anthemoides*	9
**Vulpia muralis*	6
**Wahlenbergia capensis*	1

4.2.1.3 Vegetation associations

Remnant native vegetation covers 401 ha, or approximately 70% of the study area. In total, nine vegetation types were mapped in the study area (Figure 4-5; Table 4-7). The vegetation comprised a samphire shrubland, a mosaic of *Melaleuca* shrubland and samphire shrubland, open *Eucalyptus* woodland over *Melaleuca* shrubland, three *Eucalyptus* woodlands, a *Casuarina* woodland, a *Banksia*/*Allocasuarina* woodland and a low *Melaleuca* woodland. The most prominent vegetation type mapped in the study area was the *Eucalyptus* woodland 1023 (17.3%) followed by the samphire shrubland 676 (14.9%) (Table 4-8).

The nine vegetation associations recorded exceeds the five mapped for the area by Shepherd *et al.* (2002) reflecting the greater intensity of the current survey. Notably three of the five vegetation associations mapped for the area by Shepherd *et al.* (2002) were not recorded during the current survey:

- Association 948 – York and river gum
- Association 1049 – Medium woodland; wandoo, York gum, salmon gum, morrel & gimlet
- Association 1147 - Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region.

Association 948 comprises *Eucalyptus loxophleba* (York) and *E. camaldulensis* (river gum); *Eucalyptus camaldulensis* was not recorded in the study area. Association 1049 contains gimlet (*Eucalyptus salubris*) which was not recorded in the study area. The shrublands of the study area were considered to be more representative of the samphire and *Melaleuca* shrublands selected rather than Association 1147.

Table 4-7 Vegetation associations recorded in the study area

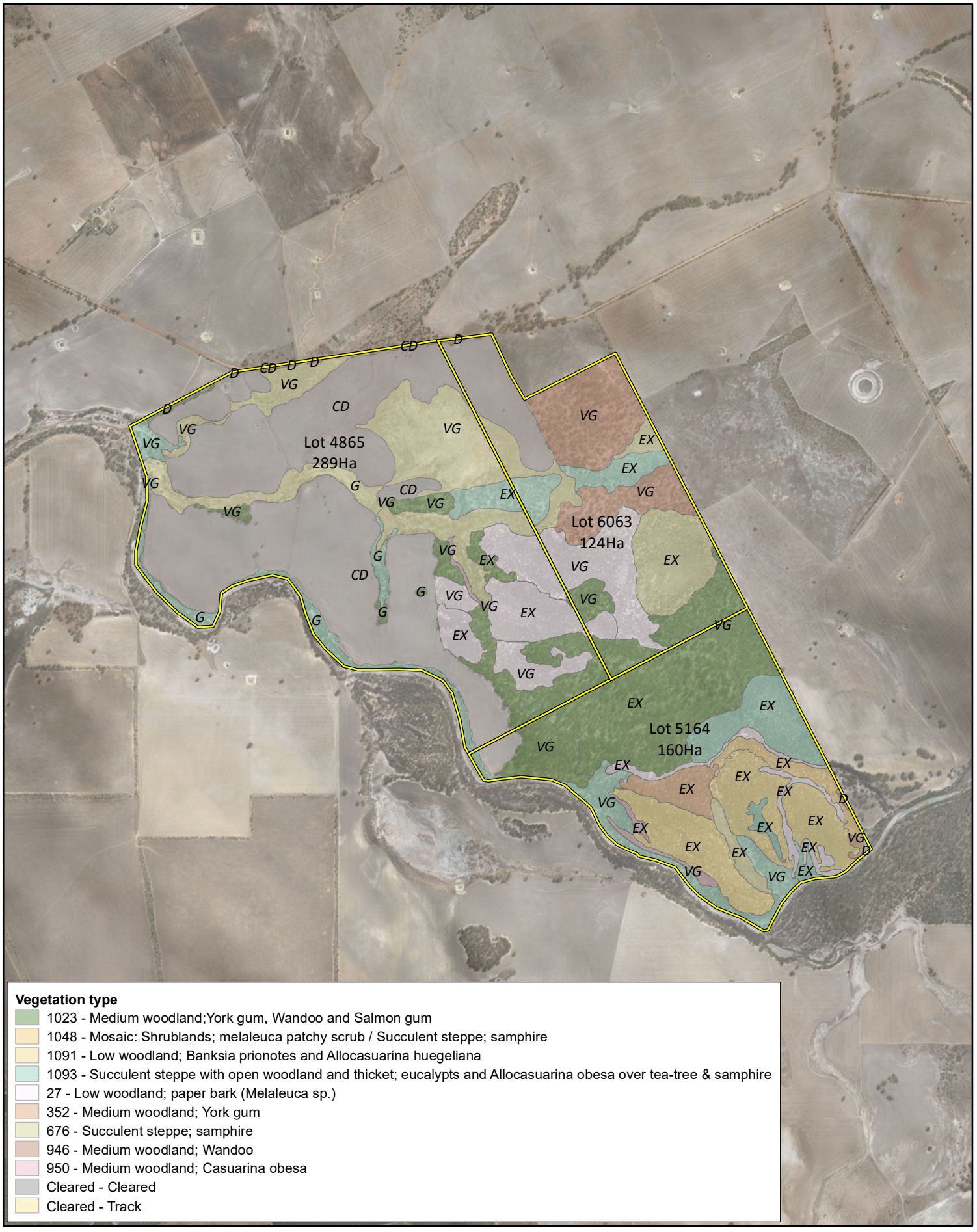
Vegetation Type	Description	Quadrat	Photograph
27	Low woodland; paperbark (*Melaleuca* sp.)	B0009, B0010, B0011, B0012	
352	Medium woodland; York gum	B002	
676	Succulent steppe; samphire	B0014, B0027	

Vegetation Type	Description	Quadrat	Photograph
946	Medium woodland; wandoo	B0015, B0017, B0026, B0029	
950	Medium woodland; *Casuarina obesa*	B0013, B0018	
1023	Medium woodland; York gum, wandoo & salmon gum (*Eucalyptus salmonophloia*)	B0005, B0006, B0007, B0008, B0019, B0020, B0021, B0022, B0023, B0024, B0025	

Vegetation Type	Description	Quadrat	Photograph
1048	Mosaic: Shrublands; melaleuca patchy scrub / Succulent steppe; samphire	B0003	
1091	Low woodland; *Banksia prionotes* & *Allocasuarina huegelianna*	B0001, B0016	
1093	Succulent steppe with open woodland & thicket; eucalypts & *Casuarina obesa* over teatree & samphire	B0004	

Table 4-8 Extent of vegetation types recorded in the study area

Vegetation type	Extent (ha)	Proportion of study area	Proportion of remnant vegetation
27	60.5	10.5%	15.1%
352	7.9	1.4%	2.0%
676	85.8	14.9%	21.4%
946	35.8	6.2%	8.9%
950	3.3	0.6%	0.8%
1023	99.4	17.3%	24.8%
1048	5.9	1.0%	1.5%
1091	38.9	6.8%	9.7%
1093	63.7	11.1%	15.9%
No vegetation (cleared)	173.2	30.2%	N/A
Total	574.3	100%	100%



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Study area

Figure 4-5

Vegetation types in the study area

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4.2.1.4 Vegetation condition

No vegetation in the study area was considered to be in pristine condition (Table 4-9). Almost one third (30.2%) of the study area was Completely Degraded comprising cleared areas, pasture and access tracks). The condition of remnant vegetation in the study area ranged from Degraded (0.4%) to Excellent (47.8%). Vegetation in Very Good to Excellent condition occupied 65.4% of the study area (Figure 4-6).

Table 4-9 Extent of vegetation condition within the study area

Condition rating	Condition extent in study area (ha)	% of study area	% of remnant vegetation
Pristine	0	0	0
Excellent	191.6	33.4	47.8
Very Good	183.7	32.0	45.8
Good	24.0	4.2	6.0
Degraded	1.7	0.3	0.4
Completely Degraded	173.2	30.2	NA
Total	574.3	100.00	100.00

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Kilometres

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Study area

Vegetation condition

- CD
- D
- EX
- G
- VG

Figure 4-6

Vegetation condition in the study area

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4.2.1.5 Threatened and Priority Ecological Communities

Three of the vegetation types (352, 946 and 1023) were considered representative of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC (Figure 4-7). The results of the diagnostic analysis for the TEC are summarised in Table 4-10. The vegetation types considered representative of the TEC covered 139.3 ha comprising 24.3% of the total study area and 34.7% of the remnant vegetation present in the study area. A considerably larger TEC area was present in Lots 5164 and 6063 compared with Lot 4865 (Table 4-11).

The condition of remnant vegetation representative of the TEC was predominantly Very Good to Excellent (98.7%).

None of the other TEC/PEC identified by the desktop assessment to be in close proximity to the study area were considered to be represented. The Toolibin TEC did not occur as *Melaleuca strobophylla* was not recorded in the study area. The P1 low level sandplains PEC was not recorded as *Xylomelum angustifolium* was not recorded in the study area. *Eucalyptus longicornis* (Red Morrel) was recorded in the study area but was not the dominant tree species in any of the communities and therefore the Red Morrel woodland TEC was not considered to be represented. *Eucalyptus salmonophloia* (Salmon Gum) was also recorded in the study area but was co-dominant with other *Eucalyptus* species and subsequently the Salmon Gum woodland TEC was not considered to be represented.

Table 4-10 Eucalypt Woodlands of the WA Wheatbelt TEC site assessment

Quadrat #	Veg. code	Veg. association	Eucalypt woodland quadrat?	Veg. condition	Diagnostic 1 - Location	Diagnostic 2 – Min. crown canopy	Diagnostic 3 - Dominant tree canopy	Understorey category	Understorey species	Diagnostic 5 - Vegetation condition	Outcome	Comment
BO002	1023	Medium woodland; York gum, wandoo and salmon gum	Yes	Excellent	Brookton: Location: AVW02	Yes, > 10%	Dominant species (45% cover) *Eucalyptus salmonophloia* (40%) *E. loxophleba* (5%)	Bare to sparse understorey	Shrubs: *Hakea preissii* Chenopods: *Maireana brevifolia, M. trichoptera*, *Rhagodia drummondii*, *Tecticornia* spp.	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO004	950	Medium woodland: *Casuarina obesa*	No	Excellent	Brookton: Location: AVW02	No, < 10%					Not TEC	
BO005	1023	Medium woodland; York gum, wandoo and salmon gum	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (25% cover) *Eucalyptus loxophleba* (15%) *E. wandoo* (10%)	Bare to sparse understorey	Shrubs: *Hakea preissii* Chenopods: *Maireana trichoptera*, *Rhagodia drummondii*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO006	1023	Medium woodland; York gum, wandoo and	Yes	Excellent	Brookton: Location: AVW02	Yes, > 10%	Dominant species (30% cover) *Eucalyptus salmonophloia*	Bare to sparse understorey	Shrubs: *Hakea preissii*, *Scaevola spinescens* Chenopods: *Maireana trichoptera*, *Rhagodia drummondii*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total	TEC	

Quadrat #	Veg. code	Veg. association	Eucalypt woodland quadrat?	Veg. condition	Diagnostic 1 - Location	Diagnostic 2 – Min. crown canopy	Diagnostic 3 - Dominant tree canopy	Understorey category	Understorey species	Diagnostic 5 - Vegetation condition	Outcome	Comment
		salmon gum					(25%) *E. wandoo* (5%)		Graminoids: *Lomandra effusa*	vegetation cover in the understorey layers. Mature trees may be present or absent.		
BO007	1023	Medium woodland; York gum, wandoo and salmon gum	Yes	Excellent	Brookton: Location: AVW02	Yes, > 10%	Dominant species (45% cover) *Eucalyptus salmonophloia* (40%) *E. loxophleba* (5%)	Bare to sparse understorey	Shrubs: *Melaleuca acuminata*, *Hakea preissii* Chenopods: *Maireana trichoptera*, *Rhagodia drummondii* Graminoids: *Lomandra effusa*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO008	1023	Medium woodland; York gum, wandoo and salmon gum	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (45% cover) *Eucalyptus salmonophloia* (30%) *E. loxophleba* (15%)	Bare to sparse understorey	Shrubs: *Melaleuca acuminata, M. adnata* Chenopods *Maireana trichoptera*, *Rhagodia drummondii*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO015	946	Medium woodland; Wandoo	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (15% cover): *Eucalyptus wandoo*	Bare to sparse understorey	Chenopods: *Maireana trichoptera*, *Rhagodia drummondii* Graminoids: *Lomandra effusa*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total	TEC	

Quadrat #	Veg. code	Veg. association	Eucalypt woodland quadrat?	Veg. condition	Diagnostic 1 - Location	Diagnostic 2 – Min. crown canopy	Diagnostic 3 - Dominant tree canopy	Understorey category	Understorey species	Diagnostic 5 - Vegetation condition	Outcome	Comment
										vegetation cover in the understorey layers. Mature trees may be present or absent.		
BO017	946	Medium woodland; Wandoo	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (25% cover) *Eucalyptus wandoo* (25%)	Bare to sparse understorey	Shrubs: *Melaleuca atroviridis*, *Hakea preissii* Chenopods: *Maireana trichoptera*, *Rhagodia drummondii* Forbs: *Podolepis capillaris* Graminoids: *Lomandra effusa*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO019	1023	Medium woodland; York gum, wandoo and salmon gum	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (25% cover) *Eucalyptus wandoo* (25%) *E. salmonophloia* (5%)	Bare to sparse understorey	Shrubs: *Hakea preissii* Chenopods: *Maireana brevifolia*, *M. trichoptera*, *Rhagodia drummondii* Graminoids: *Lomandra effusa*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO020	1023	Medium woodland; York gum, wandoo and	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (25% cover) *Eucalyptus*	Bare to sparse understorey	Chenopods: *Atriples semibaccata*, *Maireana brevifolia*	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total	NOT TEC	Patch size too small (1.00962 ha)

Quadrat #	Veg. code	Veg. association	Eucalypt woodland quadrat?	Veg. condition	Diagnostic 1 - Location	Diagnostic 2 – Min. crown canopy	Diagnostic 3 - Dominant tree canopy	Understorey category	Understorey species	Diagnostic 5 - Vegetation condition	Outcome	Comment
		salmon gum					*salmonophloia* (25%)			vegetation cover in the understorey layers. Mature trees may be present or absent.		
BO021	1023	Medium woodland; York gum, Wandoo and Salmon gum	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (30% cover) *Eucalyptus loxophleba* (25%) *E. salmonophloia* (5%)	Bare to sparse understorey	Asteraceae, Chenopods: *Tecticornia* spp, *Maireana* spp.	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	TEC	
BO023	1023	Medium woodland; York gum, Wandoo and Salmon gum	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (30% cover) *Eucalyptus loxophleba* (30%)	Bare to sparse understorey	Chenopods: *Rhagodia drummondii, Maireana* spp.	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total vegetation cover in the understorey layers. Mature trees may be present or absent.	NOT TEC	Patch size too small (0.19 ha)
BO024	1023	Medium woodland; York gum, Wandoo and	Yes	Very good	Brookton: Location: AVW02	Yes, > 10%	Dominant species (30% cover) *Eucalyptus loxophleba*	Bare to sparse understorey	Chenopods: *Tecticornia spp, Rhagodia drummondii, Maireana* spp.	TEC Patch Type: non-roadside, > 2 ha. Category A. Exotic plant species account for > 30% of total	NOT TEC	Patch size too small (0.47 ha)

Quadrat #	Veg. code	Veg. association	Eucalypt woodland quadrat?	Veg. condition	Diagnostic 1 - Location	Diagnostic 2 – Min. crown canopy	Diagnostic 3 - Dominant tree canopy	Understorey category	Understorey species	Diagnostic 5 - Vegetation condition	Outcome	Comment
		Salmon gum					(25%) *E. wandoo* (5%)			vegetation cover in the understorey layers. Mature trees may be present or absent.		

PERTH

Jacobs - Northern Highway Muchea to Wubin Stage 2 Upgrades Project

Project No	1240
Date	5/22/2019
Drawn by	IH
Map author	GW

0 0.2 0.4 0.8

Kilometres

1:25,000 (at A4) GDA 1994 MGA Zone 50

Study area

TEC

Figure 4-7

Extent of Eucalypt Woodlands of the WA Wheatbelt TEC in the study area

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Table 4-11 Vegetation representative of the TEC in the study area

Location	Study area (ha)	TEC area (ha)	% TEC
Lot 4865	289.6	22.9	7.9%
Lot 5164	160.4	64.3	40.1%
Lot 6063	124.4	52.1	37.4%
Total	574.3	139.3	24.3%
Total remnant vegetation	401.1		34.7%

4.2.1.1 Local and regional significance of vegetation

Vegetation type 1093 may be considered locally significant as it represents habitat for the Priority flora *Scholtzia* sp. Duck Pool/*Scholtzia* sp. Yenyening Lakes. In addition, vegetation type 1023 may be considered locally significant as it represents habitat for the locally significant flora *Triglochin longicarpa*. Both of these vegetation types may be considered regionally significant as they are classed as Vulnerable with less than 30% of pre-European extent remaining, as are vegetation types 352 and 946.

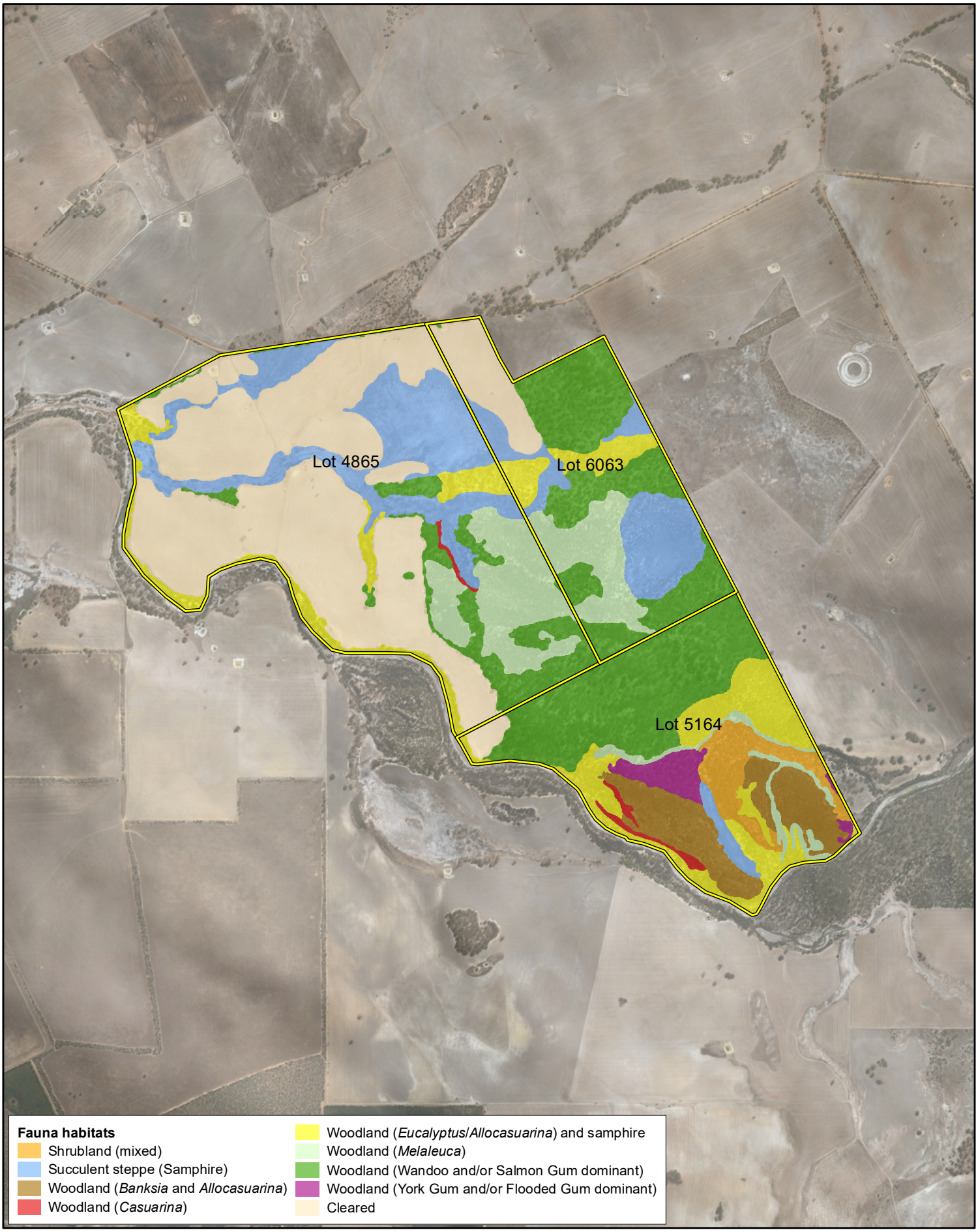
4.2.2 Carnaby's Cockatoo habitat

Eight fauna habitats were recorded in the study area of which two are suitable for Carnaby's Cockatoo breeding and four are suitable foraging habitats for the species, i.e contain flora species Carnaby's Cockatoo are known to feed on (Table 4-12; Figure 4-8).

Table 4-12 Habitats in the study area (ha) and suitability for Carnaby's Cockatoo

Habitat	Foraging	Breeding	Lot 4865	Lot 5164	Lot 6063	Total area
Shrubland (mixed)				15.0		15.0
Succulent steppe (Samphire)			55.0	3.4	27.0	85.5
Woodland (*Banksia* and *Allocasuarina*)	✓			29.71		29.7
Woodland (*Casuarina*)			0.8	2.47		3.3
Woodland (eucalypt/*Allocasuarina* and samphire)	✓		19.7	34.3	9.7	63.7
Woodland (*Melaleuca*)			32.6	7.5	19.6	59.6
Woodland (Wandoo and/or Salmon Gum dominant)	✓	✓	26.8	57.2	52.3	136.3
Woodland (York Gum and/or Flooded Gum dominant)	✓	✓		7.9		7.9
Cleared			154.6	2.8	15.8	173.2

A total of 144.2 ha of potential breeding habitat was recorded in the study area (Table 4-12). The most prospective habitat was the Wandoo and Salmon Gum dominated woodlands which occupy 136.3 ha in the study area and contained potential breeding trees. A further 7.86 ha of York Gum and/or Flooded Gum woodland was also present in the study area (Figure 4-8) but no potential breeding trees were recorded at the survey sites within this habitat. Within the three lots, potential breeding habitat was highest in Lot 5164 followed by Lot 6063 and then Lot 4865 (Figure 4-8).



Jacobs
Brookton Potential Offset Property

Project No	1219
Date	5/22/2019
Drawn by	IH
Map author	GW, RE

0 0.2 0.4 0.8
Kilometres

1:25,000 (at A4) GDA 1994 MGA Zone 50

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Study area

Figure 4-8

Fauna habitats in the study area

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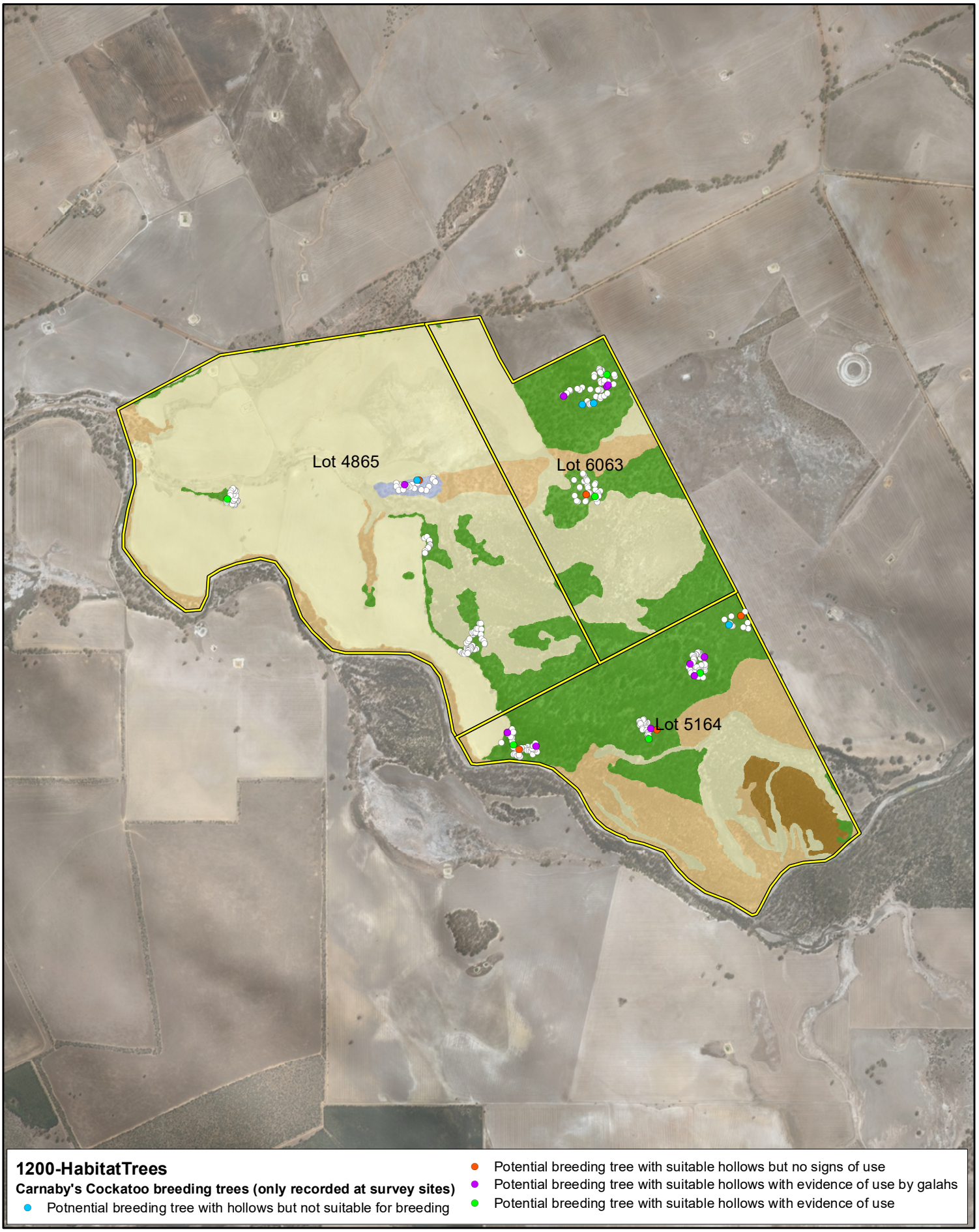
A total of 323 potential breeding trees for Carnaby's Cockatoo were recorded in the study area, all within Wandoo or Salmon Gum Woodlands and were either Wandoo (*Eucalyptus wandoo*) or Salmon Gum (*E. salmonophloia*) (Figure 4-9; Appendix 4). Of these, 25 had hollows, including 21 which were suitable for breeding (size, shape, location in tree etc.). Sixteen of the hollows had evidence of use (chewing around the hollow entrance); however, ten of these had galah scarring in the trunk which is indicative of Galah (*Eolophus roseicapilla*) nesting activity. Carnaby's Cockatoo may also breed in hollows that Galahs have used; however, given the high abundance of galahs observed throughout the woodland areas, it is much more likely they have used these hollows.

A total of 237.6 ha of suitable foraging habitat for Carnaby's Cockatoo was mapped in the study area (Figure 4-9). This consisted of eucalypt woodlands and banksia woodlands. The highest value foraging habitats contained proteaceous species that Carnaby's Cockatoos are known to feed on (*Banksia prionotes* and *Banksia littoralis*); these occupied 29.7 ha within the study area of which 15.62 ha was considered quality foraging habitat (Figure 4-9). The remaining 207.9 ha was considered lower value foraging habitat comprising mostly of *Eucalyptus* species (Figure 4-9).

A single possible record of foraging evidence was observed during the field survey; however, the degraded condition of the *Banksia* fruit and potential chewings could not be definitively identified as a Black Cockatoo species with certainty. No other evidence of foraging or occurrence by any Black Cockatoo species was observed during the field survey.

Roosting habitat also occurs in the study area, typically tall trees close to water, and may occur in any of the woodland habtiats.



1200-HabitatTrees

Carnaby's Cockatoo breeding trees (only recorded at survey sites)

- Potnential breeding tree with hollows but not suitable for breeding
- Potential breeding tree with suitable hollows but no signs of use
- Potential breeding tree with suitable hollows with evidence of use by galahs
- Potential breeding tree with suitable hollows with evidence of use

Jacobs
Brookton Potential Offset Property

Project No	1219
Date	5/22/2019
Drawn by	IH
Map author	GW, RE

0 0.2 0.4 0.8
Kilometres

1:25,000 (at A4) GDA 1994 MGA Zone 50

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Study area

Carnaby's Cockatoo habitat

- Breeding habitat and low value foraging habitat
- Breeding habitat and quality foraging habitat
- Low value foraging habitat
- Quality foraging habitat
- No habitat value

Figure 4-9

Carnaby's Cockatoo foraging and breeding habitat in the study area

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5 CONCLUSION

Three vegetation types most prominent in the study area were representative of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC and covered 24.3% of the total study area (139.3 ha of 574.3 ha) within three tenements. The communities were in Very Good to Excellent condition. There is therefore sufficient extent of the TEC within the study area to offset the 15 ha to be removed in the Whalebing to Wubin component of the GNH M2W Project. In addition, the study area contains vegetation representative of four vegetation associations classed as Vulnerable with less than 30% of pre-European extent remaining.

The study area also contains a hitherto unknown population of a Priority *Scholtzia* taxon that requires recollecting in order to determine which Priority taxon is present (*Scholtzia* sp. Duck Pool or *Scholtzia* sp. Yenyening Lakes) and represents a range extension for the locally significant species *Triglochin longicarpa*.

Suitable foraging, breeding, and roosting habitat for Carnaby's Cockatoo was present at the site; however, given the absence of any direct observations or observations of foraging evidence during the field surveys, the large population of galahs which are known to compete for hollows (Department of the Environment and Energy 2018), and the limited roosting and food resources in the broader vicinity of the study area due to extensive clearing, it is unclear if the species actually utilises the site. Although the study area provides some areas of suitable habitat for Carnaby's Cockatoo, there was no apparent evidence of current or recent use by the species.

The single possible record of foraging evidence observed during the field survey could not be identified as a Black Cockatoo species with certainty. The lack of further foraging evidence in the vicinity of the chewing suggests it was not from a Black Cockatoo which would likely result in a greater amount of evidence remaining from foraging activities, particularly as Black Cockatoo species often forage in small to large groups and less frequently individually.

The closest NatureMap record of Carnabys Cockatoo is located approximately 11.5 km south of the study area and there are several records within 35 km of the study area, mostly to the west in areas of large patches of native remnant vegetation. The entire Wheatbelt region is considered potential breeding habitat (DSEWPaC 2009); however, due to extensive clearing, the population of Carnaby's Cockatoo has declined significantly across the region, particularly in the peripherals of the species former range.

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Appendix 1 Quadrat data

Appendix 2 Summary and Key to identification of Eucalypt woodlands of the Western Australian Wheatbelt TEC

Description based on (Department of the Environment 2015a): The Eucalypt woodlands of the Western Australian Wheatbelt TEC is composed of eucalypt woodlands dominated by a complex mosaic of eucalypt species with a single tree or mallet form over an understorey that is highly variable in structure and composition. A mallet habit refers to a eucalypt with a single, slender trunk and steep-angled branches that give rise to a dense crown. Many eucalypt species are considered iconic within the Wheatbelt landscape, for example, Eucalyptus salmonophloia (salmon gum), E. loxophleba subsp. loxophleba (York gum), Eucalyptus rudis subsp. rudis, E. salubris (gimlet), E. wandoo (wandoo) and the mallet group of species. Associated species may include Acacia acuminata (jam), Corymbia calophylla (marri) and Eucalyptus marginata (jarrah). The understorey structures are often bare to sparse, herbaceous, shrub of heath, chenopod-dominated, thickets (Melaleuca spp.) and saline areas with Tecticornia spp. The main diagnostic features include location, minimum crown cover of the tree canopy of 10% in a mature woodland, presence of key species and a minimum condition according to scale of Keighery (1994) that depends on size of a patch, weed cover and presence of mature trees. A patch is defined as a discrete and mostly continuous area of the ecological community and may include small-scale variations and disturbances, such as tracks or breaks, watercourses/drainage lines or localised changes in vegetation that do not act as a permanent barrier or significantly alter its overall functionality. Each patch of the community includes a buffer zone, an area that lies immediately outside the edge of a patch but is not part of the ecological community. The buffer zone is designed to minimise this risk to the ecological community.

Woodland vegetation with a very sparse eucalypt tree canopy and woodlands dominated by mallee forms characterised by multiple stems of similar size arising at or near ground level are not part of the ecological community. The ecological community is not likely to be present if it is dominated by non-eucalypt species in the tree canopy, for instance Acacia acuminata (jam) or Allocasuarina huegeliana (rock sheoak) even though these species may be present as an understorey or minor canopy component.

The community occupies a transitional zone between the wetter forests associated with the Darling Range and the southwest coast, and the low woodlands and shrublands of the semi-arid to arid interior. The Wheatbelt region where the ecological community occurs mostly encompasses two IBRA2 subregions: Avon Wheatbelt subregion AVW01 Merredin and Avon Wheatbelt subregion AVW02 Katanning. Patches of the ecological community may extend into adjacent areas of the primary Wheatbelt bioregions, such as the easternmost parts of the Jarrah Forest bioregion forming an extension of the Avon Wheatbelt landscape in that they comprise areas subject to similar climate, landscape and threats. These outlier patches generally occur south of Northam, extending around the vicinity of localities such as Wandering, Williams, Kojonup and Mount Barker (All locations south of Perth), and are limited to areas that are not on the Darling range, receive less than 600 mm mean annual rainfall and overlie the Yilgarn Craton geology. A third IBRA2 subregion includes Mallee subregion MAL02 Western Mallee and is located south of Perth. The ecological community is generally associated with the flatter, undulating relief, including drainage lines and saline areas.

The WA Wheatbelt woodlands ecological community potentially corresponds to 45 Beard (Shepherd et al. 2002) vegetation associations. The most likely equivalents are with the 37 associations that are dominant or unique within the Wheatbelt regions.

Diagnostic 1 Location

Survey location occurs within one of the following three regions:

- Avon Wheatbelt bioregion - subregions AVW01 Merredin and AVW02 Katanning
- Mallee bioregion - MAL02 Western Mallee only

• Jarrah Forest bioregion – outlying patches in the eastern parts of JAF01 Northern Jarrah Forests and JAF02 Jarrah Forests adjacent to the Avon Wheatbelt, and are effectively an extension of the Avon Wheatbelt landscape. Within the Jarrah Forest bioregion, the ecological community occurs on landscapes that fall below 600 mm mean annual rainfall (Figure 1), are off the Darling Range, associated with the Yilgarn Craton geology and are generally heavily cleared. This covers the eastern to southeastern-most parts of the bioregion. The ecological community generally falls within the 300 to 600 mm average annual rainfall isohyets. The isohyets based on the latest 30-year average between 1976 to 2005 (BoM 2016) are most applicable to the current climatic regime.

……2

Survey location occurs within region:

• Jarrah Forest bioregion – outlying patches in the eastern parts of JAF01 Northern Jarrah Forests and JAF02 Jarrah Forests adjacent to the Avon Wheatbelt. Within the Jarrah Forest bioregion, the ecological community occurs on landscapes that ARE ABOVE the 600 mm isohyet, are ON the Darling Range, NOT associated with the Yilgarn Craton geology and are NOT generally heavily cleared. This covers the eastern to southeastern-most parts of the bioregion. It generally DOES NOT fall within the 300 to 600 mm average annual rainfall isohyets. The isohyets based on the latest 30-year average between 1976 to 2005 (BoM 2016) are most applicable to the current climatic regime.

……NOT TEC

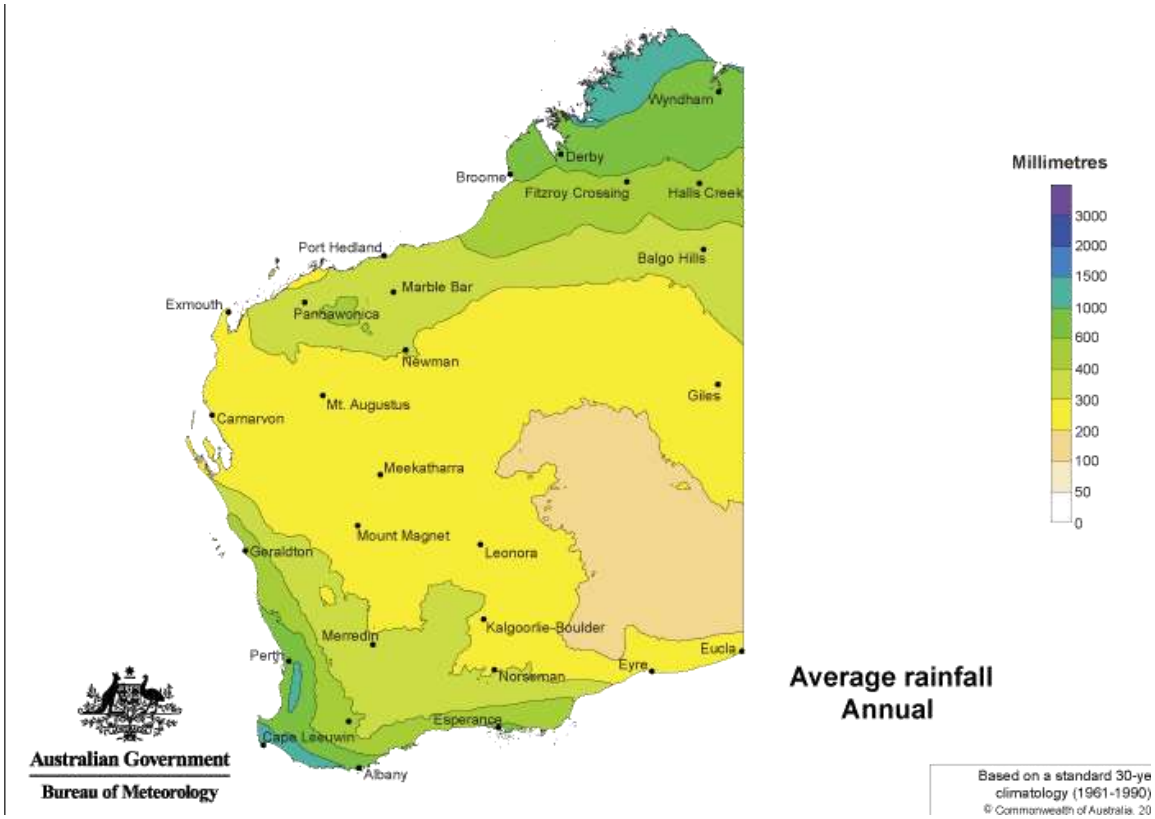

Figure 1 Isohyets of Western Australia (BoM 2016)

Diagnostic 2 Minimum crown canopy

The structure of the ecological community is a woodland in which the minimum crown cover of the tree canopy in a mature eucalypt woodland is 10% (crowns measured as if they are opaque). The maximum tree canopy cover usually is up to 40%. It may be higher in certain circumstances, for instance trees with a mallet growth form (multi-stemmed upper canopy) may be more densely spaced, or disturbances such as fire may result in an increased cover of canopy species during regeneration.

……3

Crown cover of trees less than 10% but area recently disturbed (e.g. fire), presence of seedlings and/or saplings.

……3

Crown cover of trees less than 10%, no evidence of recent disturbance, no presence of seedlings or saplings.

……NOT TEC

Diagnostic 3 Dominant Eucalyptus tree canopy

One or more of the key tree species in Table 1 are dominant or co-dominant, the trees are predominantly single trunked, not mallee (multi-stemmed).

……4

Other species are present in the tree canopy (e.g. species in Table 2 or other taxa) but these collectively do not occur as dominants in the tree canopy.

……4

Dominant woodlands with a mallee subcanopy (lower tree layer of mallee or non-eucalypt tree species). Upper eucalypt tree canopy must be present dominated by key woodland species in Table 2 and have cover of 10% or more.

……4

Other species are present in the tree canopy (e.g. species in Table 2 or other taxa) and these collectively do occur as dominants in the tree canopy.

……NOT TEC

Table 1 Key eucalypt species. One or more of these species are dominant or co-dominant within a given patch of the ecological community

Scientific name	Common name/s
Eucalyptus accedens	powder-bark; powder-bark wandoo
Eucalyptus aequioperta	Welcome Hill gum
Eucalyptus alipes	Hyden mallet
Eucalyptus astringens subsp. *astringens*	brown mallet
Eucalyptus capillosa	wheatbelt wandoo
Eucalyptus densa subsp. *densa*	narrow-leaved blue mallet
Eucalyptus extensa	yellow mallet
Eucalyptus falcata	silver mallet
Eucalyptus gardneri subsp. *gardneri*	blue mallet

Eucalyptus goniocarpa	Lake King mallet
Eucalyptus kondininensis	Kondinin blackbutt
Eucalyptus longicornis	red morrel
Eucalyptus loxophleba subsp. *loxophleba*	York gum
Eucalyptus melanoxylon	black morrel
Eucalyptus mimica subsp. *continens*	hooded mallet
Eucalyptus mimica subsp. *mimica*	Newdegate mallet
Eucalyptus myriadena	small-fruited gum; blackbutt
Eucalyptus occidentalis	flat-topped yate
Eucalyptus ornata	ornamental silver mallet; ornate mallet
Eucalyptus recta	Mt Yule silver mallet; Cadoux mallet
Eucalyptus rudis subsp. *rudis*	flooded gum
Eucalyptus salicola	salt gum; salt salmon gum
Eucalyptus salmonophloia	salmon gum
Eucalyptus salubris	gimlet
Eucalyptus sargentii subsp. *sargentii*	salt river gum
Eucalyptus singularis	ridge-top mallet
Eucalyptus spathulata subsp. *spathulata*	swamp mallet
Eucalyptus spathulata subsp. *salina*	Salt River mallet
Eucalyptus urna	merrit
Eucalyptus wandoo subsp. *pulverea*	wandoo
Eucalyptus wandoo subsp. *wandoo*	wandoo

Table 2 Associated canopy species that may be present within the ecological community but are not dominant or co-dominant[1]

Scientific name	Common name/s
Acacia acuminata	jam
Allocasuarina huegeliana	rock sheoak
Corymbia calophylla	marri
Eucalyptus annulata	prickly-fruited mallee
Eucalyptus arachnaea subsp. *arachnaea*	black-stemmed mallee
Eucalyptus arachnaea subsp. *arrecta*	black-stemmed mallet
Eucalyptus armillata	flanged mallee
Eucalyptus calycogona subsp. *calycogona*	square-fruited mallee
Eucalyptus camaldulensis subsp. *arida*	river red gum
Eucalyptus celastroides subsp. *virella*	wheatbelt mallee
Eucalyptus cylindriflora	Goldfields white mallee
Eucalyptus decipiens	redheart; moit
Eucalyptus drummondii	Drummond's mallee
Eucalyptus eremophila	sand mallee
Eucalyptus erythronema subsp. *erythronema*	red-flowered mallee
Eucalyptus erythronema subsp. *inornata*	yellow-flowered mallee
Eucalyptus eudesmioides	Kalbarri mallee

Eucalyptus flocktoniae subsp. *flocktoniae*	Flockton's mallee
Eucalyptus gittinsii subsp. *illucida*	northern sandplain mallee
Eucalyptus incrassata	ridge-fruited mallee
Eucalyptus kochii subsp. *plenissima*	Trayning mallee
Eucalyptus leptopoda subsp. *leptopoda*	Merredin mallee; Tammin mallee
Eucalyptus loxophleba subsp. *gratiae*	Lake Grace mallee
Eucalyptus loxophleba subsp. *lissophloia*	smooth-barked York gum
Eucalyptus loxophleba subsp. *supralaevis*	blackbutt York gum
Eucalyptus macrocarpa	mottlecah
Eucalyptus marginata	jarrah
Eucalyptus moderata	redwood mallee
Eucalyptus obtusiflora	Dongara mallee
Eucalyptus olivina	olive-leaved mallee
Eucalyptus orthostemon	diverse mallee
Eucalyptus perangusta	fine-leaved mallee
Eucalyptus phaenophylla	common southern mallee
Eucalyptus phenax subsp. *phenax*	white mallee
Eucalyptus pileata	capped mallee
Eucalyptus platypus subsp. *platypus*	moort
Eucalyptus polita	Parker Range mallet
Eucalyptus sheathiana	ribbon-barked mallee
Eucalyptus sporadica	Burngup mallee
Eucalyptus subangusta subsp. *subangusta*	grey mallee

The list is not comprehensive and presents the more common taxa encountered.

Diagnostic 4 Native understorey

A native understorey is present but is of variable composition, being a combination of grasses, other herbs and shrubs. A list of key species is summarised in Table 3. Any one of the structural understorey categories may or may not be present.

Bare to sparse understorey (e.g. under some mallet woodlands).

……5

Herbaceous understorey – a ground layer of forbs and/or graminoids though a few, scattered shrubs may be present.

……5

Scrub or heath understorey – comprises a mixture of diverse shrubs of variable height and cover. A ground layer of herbs and grasses is present to variable extent.

……5

Chenopod-dominated understorey – a subset of the scrub category in which the prominent species present are saltbushes, bluebushes and related taxa (e.g. Atriplex, Enchylaena, Maireana, Rhagodia and Sclerolaena).

……5

Thickets of taller shrub species understorey (e.g. Melaleuca pauperiflora, M. acuminata, M. uncinata, M. lanceolata, M. sheathiana, M. adnata, M. cucullata and/or M. lateriflora, Allocasuarina campestris

with Melaleuca hamata or M. scalena). A range of other shrub and ground layer species may occur among or below the thickets.

……5

Salt tolerant species understorey (e.g. samphire, Tecticornia spp.).

……5

Shrublands or herblands in which the tree canopy layer is very sparse to absent, either naturally or maintained so through long-term disturbance. Native vegetation where a tree canopy was formerly present is often referred to as 'derived' or 'secondary' vegetation. These sites would fall below the 10 per cent minimum canopy cover threshold for a woodland.

……NOT TEC

Table 3 Understorey species

Scientific name	Common name/s
Shrubs	
Acacia acuaria	
Acacia colletioides	wait-a-while
Acacia erinacea	
Acacia hemiteles	
Acacia lasiocalyx	silver wattle
Acacia lasiocarpa	panjang
Acacia leptospermoides	
Acacia mackeyana	
Acacia merrallii	
Acacia microbotrya.	manna wattle
Acacia pulchella	prickly moses
Allocasuarina acutivalvis	
Allocasuarina campestris	
Allocasuarina humilis	dwarf sheoak
Allocasuarina lehmanniana	dune sheoak
Allocasuarina microstachya	
Argyroglottis turbinata	
Astroloma epacridis	
Banksia armata	prickly dryandra
Banksia sessilis	parrot bush
Beyeria brevifolia	
Bossiaea divaricata	
Bossiaea eriocarpa	common brown pea
Bossiaea halophila	
Callistemon phoeniceus	lesser bottlebrush
Calothamnus quadrifidus	one-sided bottlebrush
Calothamnus quadrifidus subsp. *asper*	one-sided bottlebrush
Comesperma integerrimum	
Conostylis setigera	
Dampiera lavandulacea	
Darwinia sp. Karonie	
Daviesia nematophylla	
Daviesia triflora	
Dodonaea bursariifolia	
Dodonaea inaequifolia	

Dodonaea pinifolia	
Dodonaea viscosa	sticky hopbush
Eremophila decipiens	slender fuchsia
Eremophila ionantha	violet-flowered eremophila
Eremophila oppositifolia	weeooka
Eremophila scoparia	broom bush
Exocarpos aphyllus	leafless ballart
Gastrolobium microcarpum	sandplain poison
Gastrolobium parviflorum	
Gastrolobium spinosum	prickly poison
Gastrolobium tricuspidatum	
Gastrolobium trilobum	bullock poison
Grevillea acuaria	
Grevillea huegelii	
Grevillea tenuiflora	tassel grevillea
Hakea laurina	pincushion hakea
Hakea lissocarpha	honey bush
Hakea multilineata	grass-leaf hakea
Hakea petiolaris	sea urchin hakea
Hakea preissii	needle tree
Hakea varia	variable-leaved hakea
Hibbertia commutata	
Hibbertia exasperata	
Hibbertia hypericoides	yellow buttercups
Hovea chorizemifolia	holly-leaved hovea
Hypocalymma angustifolium	white myrtle
Leptomeria preissiana	
Leptospermum erubescens	roadside teatree
Lycium australe	
Australian boxthorn	
Melaleuca acuminata	
Melaleuca adnata	
Melaleuca atroviridis	
Melaleuca brophyi	
Melaleuca cucullata	
Melaleuca cuticularis	saltwater paperbark
Melaleuca halmaturorum	
Melaleuca hamata	
Melaleuca hamulosa	
Melaleuca lanceolata	
Rottnest teatree	
Melaleuca lateriflora	gorada
Melaleuca marginata	
Melaleuca pauperiflora	boree
Melaleuca radula	graceful honeymyrtle
Melaleuca rhaphiophylla	swamp paperbark
Melaleuca scalena	
Melaleuca strobophylla	
Melaleuca teuthidoides	
Melaleuca thyoides	
Melaleuca uncinata group	broom bush

Melaleuca viminea	mohan
Olearia muelleri	
Goldfields daisy	
Olearia sp. Kennedy Range	
Petrophile divaricata	
Petrophile shuttleworthiana	
Petrophile squamata	
Petrophile striata	
Phebalium filifolium	slender phebalium
Phebalium lepidotum	
Phebalium microphyllum	
Phebalium tuberculosum	
Pimelea argentea	silvery-leaved pimelea
Pittosporum angustifolium	
Platysace maxwellii	karno
Rhadinothamnus rudis	
Santalum acuminata	quandong
Santalum spicatum	sandalwood
Scaevola spinescens	currant bush
Senna artemisioides	
Styphelia tenuiflora	common pinheath
Templetonia sulcata	centipede bush
Trymalium elachophyllum	
Trymalium ledifolium	
Westringia cephalantha	
Xanthorrhoea drummondii	
Chenopods	
Atriplex acutibractea	toothed saltbush
Atriplex paludosa	marsh saltbush
Atriplex semibaccata	berry saltbush
Atriplex stipitata	mallee saltbush
Atriplex vesicaria	bladder saltbush
Enchylaena lanata / tomentosa complex	barrier saltbush
Maireana brevifolia	small-leaf bluebush
Maireana erioclada	
Maireana marginata	
Maireana trichoptera	downy bluebush
Rhagodia drummondii	
Rhagodia preissii	
Sclerolaena diacantha	grey copperburr
Tecticornia spp.	samphire
Threlkeldia diffusa	coast bonefruit
Forbs	
Actinobole uliginosum	flannel cudweed
Asteridea athrixioides	
Blennospora drummondii	
Borya nitida	pincushions
Borya sphaerocephala	pincushions
Brachyscome ciliaris	
Brachyscome lineariloba	
Caesia micrantha	pale fringe-lily

Caladenia flava	cowslip orchid
Calandrinia calyptrata	pink purslane
Calandrinia eremaea	twining purslane
Calotis hispidula	bindy eye
Carpobrotus modestus	inland pigface
Centipeda crateriformis subsp. *crateriformis*	
Chamaescilla corymbosa	blue squill
Chamaexeros serra	little fringe-leaf
Cotula coronopifolia	waterbuttons
Crassula colorata	dense stonecrop
Crassula exserta	
Dampiera juncea	rush-like dampiera
Dampiera lindleyi	
Daucus glochidiatus	Australian carrot
Dianella brevicaulis	
Dichopogon capillipes	
Disphyma crassifolium	round-leaved pigface
Drosera macrantha	bridal rainbow
Erodium cygnorum	blue heronsbill
Gilberta tenuifolia	
Gnephosis drummondii	
Gnephosis tenuissima	
Gnephosis tridens	
Gonocarpus nodulosus	
Goodenia berardiana	
Helichrysum leucopsideum	
Helichrysum luteoalbum	Jersey cudweed
Lagenophora huegelii	
Lawrencella rosea	
Lepidium rotundum	veined peppercress
Podolepis capillaris	wiry podolepis
Podolepis lessonii	
Podotheca angustifolia	sticky longheads
Poranthera microphylla	small poranthera
Pterostylis sanguinea	
Ptilotus spathulatus	
Rhodanthe laevis	
Senecio glossanthus	slender groundsel
Spergularia marina	
Stylidium calcaratum	book triggerplant
Thysanotus patersonii	
Trachymene cyanopetala	
Trachymene ornata	spongefruit
Trachymene pilosa	native parsnip
Velleia cycnopotamica	
Waitzia acuminata	orange immortelle
Zygophyllum ovatum	dwarf twinleaf
Graminoids	
Amphipogon caricinus - strictus complex	greybeard grass
Austrostipa elegantissima	
Austrostipa hemipogon	

Austrostipa nitida	
Austrostipa trichophylla	
Centrolepis polygyna	wiry centrolepis
Desmocladus asper	
Desmocladus flexuosus	
Gahnia ancistrophylla	hook-leaf saw sedge
Gahnia australis	
Harperia lateriflora	
Juncus bufonius	toad rush
Lachnagrostis filiformis	blowngrass
Lepidosperma leptostachyum	
Lepidosperma resinosum	
Lepidosperma sp. aff. tenue	
Lepidosperma tenue	
Lepidosperma viscidum	sticky sword sedge
Lomandra effusa	scented matrush
Lomandra micrantha subsp. *micrantha*	small-flower matrush
Lomandra nutans	
Meeboldina coangustata	
Mesomelaena preissii	
Neurachne alopecuroides	foxtail mulga grass
Rytidosperma caespitosum	
Rytidosperma setaceum group	
Schoenus nanus	tiny bog-rush
Schoenus sculptus	gimlet bog-rush
Schoenus subfascicularis	

Diagnostic 5 Vegetation condition

Minimum condition for patches of the WA Wheatbelt Woodlands ecological community. For each category, both the weed cover and mature tree presence criteria must apply plus one of either patch size or patch width, depending on whether the patch is a roadside remnant or not.

Category A:

Patch corresponds to a condition of pristine / excellent / very good (Keighery, 1994) or a high RCV (RCC, 2014).

Exotic plant species account for 0 to 30% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Mature trees (diameter at breast height (dbh) of 30 cm or above) may be present or absent.

Patch size (non-roadside) 2 ha or more with no gap in native vegetation cover exceeding 50 m width.

……TEC

Patch width roadside only (based on the native understorey component not width of the tree canopy) 5 m or more.

……TEC

Patch corresponds to a condition of pristine / excellent / very good (Keighery, 1994) or a high RCV (RCC, 2014).

Exotic plant species account for 0 to 30% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Mature trees (diameter at breast height (dbh) of 30 cm or above) may be present or absent.

Patch size (non-roadside) less than 2 ha.

……NOT TEC

Patch width roadside only (based on the native understorey component not width of the tree canopy) less than 5 m.

……NOT TEC

Category B:

Patch corresponds to a condition of good (Keighery, 1994) or a medium-high RCV (RCC, 2014).

Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Mature trees are present with at least 5 trees per 0.5 ha.

Patch size (non-roadside) 2 ha or more with no gap in native vegetation cover exceeding 50 m width.

……TEC

Patch width roadside only (based on the native understorey component not width of the tree canopy) 5 m or more.

……TEC

Patch corresponds to a condition of good (Keighery, 1994) or a medium-high RCV (RCC, 2014), AND retains important habitat features.

Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Mature trees are present with at least 5 trees per 0.5 ha.

Patch size (non-roadside) less than 2 ha.

…… ……NOT TEC

Patch width roadside only (based on the native understorey component not width of the tree canopy) less than 5 m.

…… ……NOT TEC

Category C:

Patch corresponds to a condition of good (Keighery, 1994) or a medium-high RCV (RCC, 2014), AND retains important habitat features.

Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Less than 5 mature trees per 0.5 ha are present.

Minimum patch size (non-roadside) 5 ha or more.

……TEC

Patch size (non- roadside) less than 5 ha

…… ……NOT TEC

Category D:

Patch corresponds to a condition of degraded to good (Keighery, 1994) or a medium-Low to medium-high RCV (RCC, 2014).

Exotic plant species account for more than 50 to 70% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Mature trees are present with at least 5 trees per 0.5 ha.

Minimum patch size (non-roadside) 5 ha or more.

……TEC

Patch width roadside only (based on the native understorey component not width of the tree canopy) 5 m or more

……TEC

Patch corresponds to a condition of degraded to good (Keighery, 1994) or a medium-low to medium-high RCV (RCC, 2014).

Exotic plant species account for more than 50 to 70% of total vegetation cover in the understorey layers (i.e. below the tree canopy).

Less than 5 mature trees per 0.5 ha are present.

…… ……NOT TEC

Appendix 3 Flora species inventory for the study area

Family	Taxon
Aizoaceae	**Mesembryanthemum nodiflorum*
Amaranthaceae	*Ptilotus declinatus*
Amaranthaceae	*Ptilotus humilis*
Amaranthaceae	*Ptilotus manglesii*
Amaranthaceae	*Ptilotus polystachyus*
Anarthriaceae	*Lyginia imberbis*
Apiaceae	*Daucus glochidiatus*
Araliaceae	*Hydrocotyle ?pilifera* subsp. *glabrata*
Araliaceae	*Hydrocotyle callicarpa*
Araliaceae	*Hydrocotyle pilifera* var. *glabrata*
Araliaceae	*Hydrocotyle rugulosa*
Araliaceae	*Trachymene ?pilosa*
Araliaceae	*Trachymene cyanopetala*
Araliaceae	*Trachymene ornata*
Araliaceae	*Trachymene pilosa*
Asparagaceae	*Acanthocarpus canaliculatus*
Asparagaceae	*Arthropodium dyeri*
Asparagaceae	*Dichopogon ?preissii*
Asparagaceae	*Dichopogon capillipes*
Asparagaceae	*Dichopogon preissii*
Asparagaceae	*Lomandra caespitosa*
Asparagaceae	*Lomandra effusa*
Asparagaceae	*Sowerbaea laxiflora*
Asparagaceae	*Thysanotus ?manglesianus*
Asteraceae	*Actinobole uliginosum*
Asteraceae	*Angianthus preissianus*
Asteraceae	**Arctotheca calendula*
Asteraceae	*Blennospora ?drummondii*
Asteraceae	*Blennospora ?phlegmatocarpa*
Asteraceae	*Blennospora phlegmatocarpa*
Asteraceae	*Brachyscome iberidifolia*
Asteraceae	*Brachyscome perpusilla*
Asteraceae	*Brachyscome* sp.
Asteraceae	*Calotis hispidula*
Asteraceae	**Cotula bipinnata*
Asteraceae	*Cotula cotuloides*

Family	Taxon
Asteraceae	*Erymophyllum tenellum*
Asteraceae	*Gnephosis ?tridens*
Asteraceae	*Gnephosis tenuissima*
Asteraceae	*Hyalochlamys globifera*
Asteraceae	*Hyalosperma glutinosum* subsp. *glutinosum*
Asteraceae	**Hypochaeris glabra*
Asteraceae	*Lawrencella rosea*
Asteraceae	*Millotia tenuifolia* var. *tenuifolia*
Asteraceae	**Monoculus monstrosus*
Asteraceae	*Podolepis aristata* subsp. *aristata*
Asteraceae	*Podolepis capillaris*
Asteraceae	*Podolepis lessonii*
Asteraceae	*Podolepis tepperi*
Asteraceae	*Podotheca angustifolia*
Asteraceae	*Pogonolepis stricta*
Asteraceae	*Rhodanthe chlorocephala* subsp. *rosea*
Asteraceae	*Rhodanthe citrina*
Asteraceae	*Rhodanthe laevis*
Asteraceae	*Rhodanthe manglesii*
Asteraceae	*Senecio glossanthus*
Asteraceae	*Siloxerus multiflorus*
Asteraceae	**Ursinia anthemoides*
Asteraceae	**Ursinia anthemoides* subsp. *anthemoides*
Asteraceae	*Waitzia nitida*
Brassicaceae	**Brassica tournefortii*
Brassicaceae	**Brassicaceae* sp.
Campanulaceae	**Wahlenbergia capensis*
Caryophyllaceae	*Spergularia marina*
Casuarinaceae	*Allocasuarina huegeliana*
Casuarinaceae	*Casuarina obesa*
Celastraceae	*Stackhousia ?pubescens*
Centrolepidaceae	*Centrolepis polygyna*
Chenopodiaceae	*Atriplex codonocarpa*
Chenopodiaceae	*Atriplex lindleyi*
Chenopodiaceae	*Atriplex semibaccata*
Chenopodiaceae	*Atriplex* sp.
Chenopodiaceae	*Enchylaena lanata*

Family	Taxon
Chenopodiaceae	*Enchylaena tomentosa var. tomentosa*
Chenopodiaceae	*Maireana brevifolia*
Chenopodiaceae	*Maireana enchylaenoides*
Chenopodiaceae	*Maireana trichoptera*
Chenopodiaceae	*Maireana triptera*
Chenopodiaceae	*Rhagodia drummondii*
Chenopodiaceae	*Tecticornia indica subsp. bidens*
Chenopodiaceae	*Tecticornia lepidosperma*
Chenopodiaceae	*Tecticornia pergranulata* subsp. *pergranulata*
Chenopodiaceae	*Tecticornia* sp. (sterile 1)
Chenopodiaceae	*Tecticornia* sp. (Sterile)
Crassulaceae	*Crassula colorata*
Crassulaceae	*Crassula colorata* var. *acuminata*
Crassulaceae	*Crassula colorata* var. *colorata*
Crassulaceae	*Crassula extrorsa*
Cyperaceae	*Mesomelaena preissii*
Droseraceae	*Drosera glanduligera*
Droseraceae	*Drosera intricata*
Droseraceae	*Drosera* sp.
Ericaceae	*Conostephium preissii*
Fabaceae	*Acacia acuminata*
Fabaceae	*Acacia bidentata*
Fabaceae	*Acacia ligustrina*
Fabaceae	*Acacia lineolata* subsp. *lineolata*
Fabaceae	*Acacia meisneri*
Fabaceae	*Acacia microbotrya*
Fabaceae	*Daviesia aphylla*
Fabaceae	*Daviesia incrassata* subsp. *teres*
Fabaceae	*Isotropis cuneifolia* subsp. *cuneifolia*
Fabaceae	*Isotropis juncea*
Fabaceae	**Lupinus cosentinii*
Fabaceae	**Medicago polymorpha*
Fabaceae	*Templetonia sulcata*
Fabaceae	**Trifolium* sp.
Fabaceae	**Trifolium tomentosum* var. *tomentosum*
Frankeniaceae	*Frankenia pauciflora*
Geraniaceae	*Pelargonium havlasae*

Family	Taxon
Goodeniaceae	*Goodenia berardiana*
Goodeniaceae	*Goodenia pulchella*
Goodeniaceae	*Scaevola spinescens*
Haemodoraceae	*Conostylis prolifera*
Hemerocallidaceae	*Corynotheca micrantha var. micrantha*
Hemerocallidaceae	*Dianella revoluta*
Hemerocallidaceae	*Dianella revoluta* ?*var. divaricata*
Hemerocallidaceae	*Tricoryne humilis*
Iridaceae	**Moraea miniata*
Iridaceae	**Moraea setifolia*
Iridaceae	**Romulea rosea*
Iridaceae	**Romulea* sp.
Juncaginaceae	*Triglochin isingiana*
Juncaginaceae	*Triglochin longicarpa*
Juncaginaceae	*Triglochin minutissima*
Juncaginaceae	*Triglochin mucronata*
Juncaginaceae	*Triglochin nana*
Myrtaceae	*Calytrix leschenaultii*
Myrtaceae	*Eremaea pauciflora*
Myrtaceae	*Eremaea pauciflora* var. *pauciflora*
Myrtaceae	*Eucalyptus* ?*orthostemon*
Myrtaceae	*Eucalyptus* ?*wandoo*
Myrtaceae	*Eucalyptus capillosa* subsp. *capillosa*
Myrtaceae	*Eucalyptus longicornis*
Myrtaceae	*Eucalyptus loxophleba* subsp. *loxophleba*
Myrtaceae	*Eucalyptus rudis* subsp. *rudis*
Myrtaceae	*Eucalyptus salmonophloia*
Myrtaceae	*Eucalyptus* sp.
Myrtaceae	*Eucalyptus wandoo*
Myrtaceae	*Eucalyptus wandoo* subsp. *wandoo*
Myrtaceae	*Leptospermum erubescens*
Myrtaceae	*Melaleuca acuminata*
Myrtaceae	*Melaleuca acuminata* subsp. *websteri*
Myrtaceae	*Melaleuca adnata*
Myrtaceae	*Melaleuca atroviridis*
Myrtaceae	*Melaleuca brophyi*
Myrtaceae	*Melaleuca hamulosa*

Family	Taxon
Myrtaceae	*Melaleuca lateriflora*
Myrtaceae	*Melaleuca subtrigona*
Myrtaceae	*Melaleuca tuberculata* var. *tuberculata*
Myrtaceae	*Melaleuca viminea* subsp. *viminea*
Myrtaceae	*Scholtzia* sp. Duck Pool/*Scholtzia* sp. Yenyening Lake
Myrtaceae	*Verticordia densiflora* var. *cespitosa*
Myrtaceae	*Verticordia subulata*
Orchidaceae	*Caladenia flava*
Orchidaceae	*Caladenia macrostylis*
Orchidaceae	*Caladenia radialis*
Orchidaceae	*Thelymitra antennifera*
Orobanchaceae	**Parentucellia latifolia*
Plantaginaceae	*Plantago debilis*
Plumbaginaceae	**Limonium sinuatum*
Poaceae	**Aira caryophyllea*
Poaceae	**Aira cupaniana*
Poaceae	*Austrostipa ?elegantissima*
Poaceae	*Austrostipa elegantissima*
Poaceae	*Austrostipa flavescens*
Poaceae	*Austrostipa nitida*
Poaceae	*Austrostipa sp.*
Poaceae	**Bromus ?rubens*
Poaceae	**Bromus diandrus*
Poaceae	**Bromus rubens*
Poaceae	**Bromus* sp.
Poaceae	**Ehrharta longiflora*
Poaceae	*Eragrostis dielsii*
Poaceae	**Hordeum leporinum*
Poaceae	**Lolium ?perenne*
Poaceae	**Lolium ?rigidum*
Poaceae	**Lolium rigidum*
Poaceae	*Neurachne alopecuroidea*
Poaceae	**Parapholis incurva*
Poaceae	**Pentameris airoides*
Poaceae	*Poaceae sp.*
Poaceae	**Vulpia muralis*
Polygalaceae	*Comesperma integerrimum*

Family	Taxon
Portulacaceae	*Calandrinia calyptrata*
Portulacaceae	*Calandrinia eremaea*
Primulaceae	**Lysimachia arvensis*
Proteaceae	*Banksia littoralis*
Proteaceae	*Banksia prionotes*
Proteaceae	*Grevillea huegelii*
Proteaceae	*Hakea preissii*
Restionaceae	*Desmocladus asper*
Restionaceae	*Lepidobolus preissianus*
Rubiaceae	*Opercularia vaginata*
Scrophulariaceae	*Eremophila lehmanniana*
Stylidiaceae	*Levenhookia dubia*
Stylidiaceae	*Stylidium ?piliferum*
Stylidiaceae	*Stylidium dichotomum*
Surianaceae	*Stylobasium australe*
Xanthorrhoeaceae	*Xanthorrhoea preissii*

Appendix 4 List of potential breeding trees for Carnaby's Cockatoo

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT001	No	No	No		*E. salmonophloia*	300	511508	6432343
HT002	No	No	No		*E. salmonophloia*	300	511494	6432334
HT003	No	No	No		*E. salmonophloia*	300	511487	6432332
HT004	No	No	No		*E. salmonophloia*	450	511479	6432326
HT005	No	No	No		*E. salmonophloia*	450	511472	6432334
HT006	No	No	No		*E. salmonophloia*	400	511474	6432332
HT007	No	No	No		*E. salmonophloia*	500	511467	6432323
HT008	Yes	Yes	No	Hollow at 2 m. Too Small.	*E. salmonophloia*	500	511463	6432327
HT009	No	No	No		*E. salmonophloia*	500	511450	6432323
HT010	No	No	No		*E. salmonophloia*	600	511438	6432304
HT011	No	No	No		*E. salmonophloia*	700	511434	6432302
HT012	No	No	No		*E. salmonophloia*	500	511444	6432300
HT013	No	No	No		*E. salmonophloia*	500	511452	6432296
HT014	No	No	No		*E. salmonophloia*	300	511465	6432289
HT015	No	No	No		*E. salmonophloia*	300	511469	6432290
HT016	No	No	No		*E. salmonophloia*	300	511463	6432302
HT017	No	No	No		*E. salmonophloia*	500	511463	6432298
HT018	No	No	No		*E. salmonophloia*	300	511502	6432319
HT019	No	No	No		*E. salmonophloia*	300	511512	6432321
HT020	No	No	No		*E. salmonophloia*	500	511524	6432317
HT021	No	No	No		*E. salmonophloia*	400	511531	6432302
HT022	No	No	No		*E. salmonophloia*	500	511555	6432314
HT023	No	No	No		*E. salmonophloia*	500	511543	6432322
HT024	No	No	No		*E. salmonophloia*	360	511535	6432328
HT025	No	No	No		*E. salmonophloia*	360	511533	6432328
HT026	No	No	No		*E. salmonophloia*	300	511530	6432330
HT027	No	No	No		*E. salmonophloia*	300	511530	6432344

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT028	No	No	No		*E. salmonophloia*	500	511537	6432344
HT029	Yes	Yes	Possible	Hollow at 10 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. salmonophloia*	500	511549	6432345
HT030	No	No	No		*E. salmonophloia*	500	511546	6432358
HT031	No	No	No		*E. salmonophloia*	500	511435	6432339
HT032	Yes	Yes	Yes	Hollow at 8 m. Old chewing around hollow entrance.	*E. salmonophloia*	400	511432	6432353
HT033	No	No	No		*E. salmonophloia*	600	511428	6432368
HT034	No	No	No		*E. salmonophloia*	500	511428	6432370
HT035	No	No	No		*E. salmonophloia*	400	511428	6432386
HT036	No	No	No		*E. salmonophloia*	500	511421	6432394
HT037	No	No	No		*E. salmonophloia*	750	511421	6432391
HT038	No	No	No		*E. salmonophloia*	700	511404	6432408
HT039	Yes	Yes	Possible	Hollow at 8 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. salmonophloia*	1000	511402	6432412
HT040	No	No	No		*E. wandoo*	300	511424	6432425
HT041	No	No	No		*E. wandoo*	300	511426	6432431
HT042	No	No	No		*E. wandoo*	380	511433	6432417
HT043	No	No	No		*E. salmonophloia*	350	511375	6432362
HT044	Yes	No	No	Hollow at 5 m. Too small.	*E. wandoo*	500	511782	6434082
HT045	No	No	No		*E. wandoo*	460	511809	6434096
HT046	No	No	No		*E. wandoo*	400	511819	6434084
HT047	No	No	No		*E. wandoo*	380	511822	6434079
HT048	No	No	No		*E. wandoo*	320	511828	6434084
HT049	Yes	No	No		*E. wandoo*	350	511840	6434086
HT050	No	No	No		*E. wandoo*	300	511842	6434088
HT051	No	No	No		*E. wandoo*	400	511852	6434118
HT052	No	No	No		*E. wandoo*	700	511876	6434108
HT053	No	No	No		*E. wandoo*	400	511880	6434118
HT054	No	No	No		*E. wandoo*	450	511894	6434120
HT055	No	No	No		*E. wandoo*	600	511909	6434136
HT056	Yes	Yes	Possible	Hollow at 8 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. wandoo*	700	511905	6434171
HT057	No	No	No		*E. wandoo*	500	511911	6434176
HT058	Yes	Yes	Possible	Hollow at 5 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. wandoo*	500	511913	6434178
HT059	No	No	No		*E. salmonophloia*	700	511941	6434182

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT060	No	No	No		*E. salmonophloia*	500	511913	6434196
HT061	No	No	No		*E. wandoo*	1000	511948	6434219
HT062	No	No	No		*E. salmonophloia*	600	511947	6434229
HT063	No	No	No		*E. wandoo*	600	511907	6434226
HT064	Yes	Yes	Yes	Hollow at 8 m. Chewing around hollow entrance.	*E. salmonophloia*	700	511907	6434230
HT065	No	No	No		*E. salmonophloia*	700	511901	6434230
HT066	No	No	No		*E. salmonophloia*	800	511882	6434232
HT067	No	No	No		*E. salmonophloia*	500	511877	6434243
HT068	No	No	No		*E. salmonophloia*	400	511885	6434249
HT069	No	No	No		*E. salmonophloia*	500	511885	6434251
HT070	No	No	No		*E. wandoo*	300	511882	6434256
HT071	No	No	No		*E. salmonophloia*	760	511871	6434257
HT072	No	No	No		*E. salmonophloia*	1100	511868	6434261
HT073	No	No	No		*E. wandoo*	700	511868	6434253
HT074	No	No	No		*E. wandoo*	320	511868	6434256
HT075	No	No	No		*E. salmonophloia*	400	511871	6434246
HT076	No	No	No		*E. salmonophloia*	500	511874	6434243
HT077	No	No	No		*E. salmonophloia*	800	511845	6434230
HT078	No	No	No		*E. wandoo*	1000	511845	6434218
HT079	No	No	No		*E. wandoo*	900	511874	6434196
HT080	No	No	No		*E. wandoo*	400	511877	6434189
HT081	No	No	No		*E. wandoo*	700	511894	6434189
HT082	No	No	No		*E. salmonophloia*	1000	511894	6434201
HT083	No	No	No		*E. wandoo*	350	511877	6434150
HT084	No	No	No		*E. wandoo*	300	511868	6434153
HT085	No	No	No		*E. wandoo*	300	511862	6434149
HT086	No	No	No		*E. wandoo*	600	511823	6434155
HT087	No	No	No		*E. wandoo*	500	511784	6434164
HT088	No	No	No		*E. wandoo*	500	511771	6434148
HT089	No	No	No		*E. wandoo*	900	511757	6434160
HT090	No	No	No		*E. wandoo*	350	511723	6434146
HT091	No	No	No		*E. wandoo*	300	511721	6434149

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT092	No	No	No		*E. wandoo*	300	511721	6434149
HT093	No	No	No		*E. wandoo*	500	511705	6434133
HT094	No	No	No		*E. wandoo*	500	511682	6434124
HT095	Yes	Yes	Possible	Hollow at 8 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. wandoo*	500	511689	6434121
HT096	No	No	No		*E. salmonophloia*	1000	510984	6433400
HT097	No	No	No		*E. salmonophloia*	800	510994	6433408
HT098	No	No	No		*E. salmonophloia*	600	511007	6433387
HT099	No	No	No		*E. salmonophloia*	700	511010	6433367
HT100	No	No	No		*E. salmonophloia*	600	511010	6433361
HT101	No	No	No		*E. salmonophloia*	500	511005	6433355
HT102	No	No	No		*E. salmonophloia*	300	511003	6433350
HT103	No	No	No		*E. salmonophloia*	350	511003	6433349
HT104	No	No	No		*E. wandoo*	350	510986	6433332
HT105	No	No	No		*E. salmonophloia*	800	510986	6433325
HT106	No	No	No		*E. salmonophloia*	800	510986	6433323
HT107	No	No	No		*E. salmonophloia*	1000	511162	6432827
HT108	No	No	No		*E. salmonophloia*	650	511175	6432817
HT109	No	No	No		*E. salmonophloia*	700	511183	6432818
HT110	No	No	No		*E. salmonophloia*	600	511186	6432813
HT111	No	No	No		*E. salmonophloia*	500	511193	6432826
HT112	No	No	No		*E. salmonophloia*	600	511196	6432841
HT113	No	No	No		*E. salmonophloia*	300	511206	6432843
HT114	No	No	No		*E. salmonophloia*	400	511209	6432851
HT115	No	No	No		*E. salmonophloia*	450	511209	6432858
HT116	No	No	No		*E. salmonophloia*	400	511196	6432867
HT117	No	No	No		*E. salmonophloia*	500	511206	6432876
HT118	No	No	No		*E. salmonophloia*	600	511212	6432886
HT119	No	No	No		*E. salmonophloia*	300	511229	6432912
HT120	No	No	No		*E. salmonophloia*	350	511232	6432918
HT121	No	No	No		*E. salmonophloia*	300	511232	6432918

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT122	No	No	No		*E. salmonophloia*	450	511222	6432922
HT123	No	No	No		*E. salmonophloia*	400	511232	6432923
HT124	No	No	No		*E. salmonophloia*	500	511242	6432922
HT125	No	No	No		*E. wandoo*	300	511246	6432938
HT126	No	No	No		*E. wandoo*	300	511252	6432938
HT127	No	No	No		*E. salmonophloia*	800	511262	6432968
HT128	No	No	No		*E. salmonophloia*	750	511262	6432968
HT129	No	No	No		*E. salmonophloia*	700	511269	6432965
HT130	No	No	No		*E. wandoo*	450	511272	6432937
HT131	No	No	No		*E. wandoo*	300	511269	6432912
HT132	No	No	No		*E. wandoo*	380	511272	6432890
HT133	No	No	No		*E. wandoo*	400	511285	6432877
HT134	No	No	No		*E. salmonophloia*	400	511289	6432861
HT135	No	No	No		*E. wandoo*	300	511289	6432864
HT136	No	No	No		*E. wandoo*	300	511245	6432838
HT137	No	No	No		*E. salmonophloia*	320	511236	6432836
HT138	No	No	No		*E. salmonophloia*	350	511223	6432845
HT139	No	No	No		*E. salmonophloia*	400	511223	6432847
HT140	No	No	No		*E. salmonophloia*	420	511227	6432854
HT141	No	No	No		*E. salmonophloia*	400	511218	6432847
HT142	No	No	No		*E. salmonophloia*	300	511218	6432845
HT143	No	No	No		*E. salmonophloia*	300	511216	6432837
HT144	No	No	No		*E. salmonophloia*	400	511213	6432832
HT145	No	No	No		*E. salmonophloia*	300	511204	6432830
HT146	No	No	No		*E. salmonophloia*	400	511204	6432818
HT147	No	No	No		*E. salmonophloia*	500	511203	6432815
HT148	Yes	Yes	No	Hollow at 6 m.	*E. salmonophloia*	800	512162	6432428
HT149	Yes	Yes	Possible	Hollow at 6 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. salmonophloia*	700	512129	6432434
HT150	No	No	No		*E. salmonophloia*	300	512109	6432442
HT151	No	No	No		*E. salmonophloia*	300	512111	6432440
HT152	No	No	No		*E. salmonophloia*	300	512103	6432450

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT153	No	No	No		*E. salmonophloia*	400	512114	6432462
HT154	No	No	No		*E. salmonophloia*	320	512114	6432462
HT155	No	No	No		*E. salmonophloia*	320	512103	6432462
HT156	No	No	No		*E. salmonophloia*	360	512098	6432464
HT157	No	No	No		*E. salmonophloia*	400	512098	6432471
HT158	No	No	No		*E. salmonophloia*	400	512095	6432479
HT159	No	No	No		*E. salmonophloia*	400	512092	6432476
HT160	No	No	No		*E. salmonophloia*	350	512071	6432471
HT161	No	No	No		*E. salmonophloia*	400	512076	6432460
HT162	No	No	No		*E. salmonophloia*	400	512076	6432452
HT163	No	No	No		*E. salmonophloia*	450	512079	6432458
HT164	No	No	No		*E. salmonophloia*	400	512089	6432436
HT165	No	No	No		*E. salmonophloia*	300	512087	6432427
HT166	No	No	No		*E. salmonophloia*	400	512111	6432424
HT167	No	No	No		*E. salmonophloia*	400	512116	6432416
HT168	No	No	No		*E. salmonophloia*	500	512119	6432412
HT169	No	No	No		*E. salmonophloia*	500	512114	6432399
HT170	No	No	No		*E. salmonophloia*	400	512119	6432398
HT171	No	No	No		*E. salmonophloia*	500	512116	6432385
HT172	No	No	No		*E. salmonophloia*	550	512116	6432384
HT173	Yes	Yes	Yes	Hollow at 9 m. Hollow looks worn around the entrance.	*E. wandoo*	400	512119	6432382
HT174	No	No	No		*E. salmonophloia*	500	512119	6432378
HT175	No	No	No		*E. salmonophloia*	400	512121	6432379
HT176	No	No	No		*E. salmonophloia*	800	512407	6432726
HT177	No	No	No		*E. wandoo*	350	512403	6432736
HT178	No	No	No		*E. salmonophloia*	400	512405	6432750
HT179	No	No	No		*E. salmonophloia*	800	512401	6432755
HT180	No	No	No		*E. salmonophloia*	500	512403	6432763
HT181	No	No	No		*E. salmonophloia*	500	512403	6432761

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT182	No	No	No		*E. salmonophloia*	500	512404	6432759
HT183	No	No	No		*E. wandoo*	350	512387	6432756
HT184	No	No	No		*E. salmonophloia*	300	512342	6432764
HT185	No	No	No		*E. salmonophloia*	320	512340	6432764
HT186	Yes	Yes	Possible	Hollow at 10 m. Galah scarring in trunk.	*E. salmonophloia*	500	512328	6432762
HT187	No	No	No		*E. salmonophloia*	400	512331	6432758
HT188	No	No	No		*E. salmonophloia*	1000	512322	6432748
HT189	No	No	No		*E. salmonophloia*	400	512322	6432746
HT190	No	No	No		*E. salmonophloia*	900	512331	6432732
HT191	No	No	No		*E. wandoo*	350	512337	6432714
HT192	No	No	No		*E. salmonophloia*	1100	512357	6432726
HT193	No	No	No		*E. salmonophloia*	500	512358	6432748
HT194	No	No	No		*E. salmonophloia*	400	512358	6432748
HT195	No	No	No		*E. salmonophloia*	500	512363	6432746
HT196	No	No	No		*E. salmonophloia*	400	512384	6432727
HT197	No	No	No		*E. salmonophloia*	1000	512378	6432727
HT198	No	No	No		*E. salmonophloia*	400	512381	6432720
HT199	No	No	No		*E. salmonophloia*	300	512384	6432717
HT200	No	No	No		*E. salmonophloia*	500	512384	6432717
HT201	Yes	Yes	Yes	Hollow at 3 m. Chewing around hollow entrance.	*E. salmonophloia*	500	512381	6432714
HT202	Yes	Yes	Possible	Hollow at 5 m. Chewing around hollow entrance. Galah scarring in trunk.	*E. salmonophloia*	700	512352	6432701
HT203	No	No	No		*E. salmonophloia*	700	512372	6432695
HT204	No	No	No		*E. wandoo*	300	512375	6432695
HT205	No	No	No		*E. salmonophloia*	500	512396	6432691
HT206	No	No	No		*E. wandoo*	400	512385	6432789
HT207	No	No	No		*E. salmonophloia*	350	512398	6432793
HT208	Yes	Yes	Possible	Hollow at 5 m. Galah scarring in trunk.	*E. salmonophloia*	500	512402	6432798
HT209	No	No	No		*E. salmonophloia*	500	512387	6432811
HT210	No	No	No		*E. salmonophloia*	300	512379	6432820
HT211	No	No	No		*E. salmonophloia*	300	512376	6432820

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT212	No	No	No		*E. salmonophloia*	320	512376	6432813
HT213	No	No	No		*E. salmonophloia*	400	512376	6432813
HT214	No	No	No		*E. salmonophloia*	400	512374	6432816
HT215	No	No	No		*E. salmonophloia*	350	512371	6432822
HT216	No	No	No		*E. salmonophloia*	350	512368	6432820
HT217	No	No	No		*E. salmonophloia*	380	512361	6432808
HT218	No	No	No		*E. salmonophloia*	400	512358	6432810
HT219	No	No	No		*E. salmonophloia*	350	512349	6432802
HT220	No	No	No		*E. salmonophloia*	300	512349	6432803
HT221	No	No	No		*E. salmonophloia*	320	512343	6432802
HT222	No	No	No		*E. salmonophloia*	500	512349	6432790
HT223	No	No	No		*E. salmonophloia*	500	512353	6432782
HT224	No	No	No		*E. salmonophloia*	450	512349	6432784
HT225	No	No	No		*E. salmonophloia*	500	512346	6432769
HT226	No	No	No		*E. wandoo*	320	512544	6432954
HT227	No	No	No		*E. wandoo*	300	512538	6432954
HT228	No	No	No		*E. wandoo*	350	512532	6432965
HT229	No	No	No		*E. wandoo*	300	512525	6432959
HT230	Yes	No	No	Hollow at 10 m. Tree cracked.	*E. wandoo*	420	512525	6432960
HT231	No	No	No		*E. wandoo*	380	512503	6432987
HT232	No	No	No		*E. wandoo*	300	512538	6433003
HT233	No	No	No		*E. wandoo*	400	512538	6433003
HT234	Yes	Yes	No	Hollow at 7 m.	*E. wandoo*	400	512586	6433008
HT235	No	No	No		*E. wandoo*	400	512608	6433026
HT236	No	No	No		*E. wandoo*	400	512621	6432971
HT237	No	No	No		*E. wandoo*	500	512624	6432939
HT238	No	No	No		*E. wandoo*	400	512599	6432945
HT239	No	No	No		*E. wandoo*	300	511807	6433667
HT240	No	No	No		*E. wandoo*	450	511813	6433655
HT241	No	No	No		*E. wandoo*	400	511849	6433644
HT242	No	No	No		*E. wandoo*	300	511874	6433638
HT243	No	No	No		*E. wandoo*	300	511864	6433629
HT244	No	No	No		*E. wandoo*	300	511867	6433619

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT245	No	No	No		*E. wandoo*	300	511867	6433613
HT246	No	No	No		*E. wandoo*	400	511859	6433581
HT247	No	No	No		*E. wandoo*	300	511854	6433598
HT248	Yes	Yes	Yes	Hollow at 6 m. Hollow worn and chewed around entrance.	*E. wandoo*	350	511847	6433613
HT249	No	No	No		*E. wandoo*	300	511822	6433629
HT250	No	No	No		*E. wandoo*	400	511816	6433629
HT251	Yes	Yes	No	Hollow at 5 m.	*E. wandoo*	500	511803	6433623
HT252	No	No	No		*E. wandoo*	300	511801	6433589
HT253	No	No	No		*E. wandoo*	300	511799	6433585
HT254	No	No	No		*E. wandoo*	300	511759	6433585
HT255	No	No	No		*E. wandoo*	300	511754	6433589
HT256	No	No	No		*E. wandoo*	300	511744	6433615
HT257	No	No	No		*E. wandoo*	300	511769	6433654
HT258	No	No	No		*E. wandoo*	300	511771	6433656
HT259	No	No	No		*E. wandoo*	320	511791	6433690
HT260	No	No	No		*E. wandoo*	320	511801	6433698
HT261	No	No	No		*E. wandoo*	400	511806	6433700
HT262	No	No	No		*E. wandoo*	300	511810	6433693
HT263	No	No	No		*E. wandoo*	420	511851	6433676
HT264	No	No	No		*E. wandoo*	300	511846	6433671
HT265	No	No	No		*E. wandoo*	400	511792	6433720
HT266	No	No	No		*E. wandoo*	300	511787	6433724
HT267	No	No	No		*E. wandoo*	400	511785	6433728
HT268	No	No	No		*E. wandoo*	300	511743	6433696
HT269	No	No	No		*E. wandoo*	360	511028	6433710
HT270	No	No	No		*E. wandoo*	420	511025	6433698
HT271	No	No	No		*E. wandoo*	400	511035	6433687
HT272	No	No	No		*E. wandoo*	500	511006	6433660
HT273	No	No	No		*E. salmonophloia*	1000	510992	6433643
HT274	No	No	No		*E. wandoo*	320	510966	6433644
HT275	No	No	No		*E. salmonophloia*	500	510946	6433679
HT276	No	No	No		*E. salmonophloia*	500	510958	6433691
HT277	No	No	No		*E. salmonophloia*	800	510961	6433693
HT278	No	No	No		*E. salmonophloia*	750	510958	6433694
HT279	Yes	Yes	No	Hollow at 3 m.	*E. salmonophloia*	400	510955	6433694

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT280	No	No	No		*E. salmonophloia*	1000	510955	6433697
HT281	Yes	No	No	Hollow at 10 m. Too small.	*E. salmonophloia*	500	510944	6433697
HT282	No	No	No		*E. wandoo*	320	510921	6433670
HT283	No	No	No		*E. wandoo*	500	510932	6433650
HT284	No	No	No		*E. salmonophloia*	600	510909	6433657
HT285	No	No	No		*E. salmonophloia*	600	510900	6433665
HT286	No	No	No		*E. wandoo*	300	510889	6433660
HT287	No	No	No		*E. wandoo*	300	510889	6433663
HT288	Yes	Yes	Possible	Hollow at 4 m. Galah scarring in trunk.	*E. salmonophloia*	1000	510881	6433670
HT289	No	No	No		*E. salmonophloia*	900	510875	6433670
HT290	No	No	No		*E. salmonophloia*	500	510858	6433663
HT291	No	No	No		*E. salmonophloia*	550	510858	6433666
HT292	No	No	No		*E. wandoo*	300	510850	6433665
HT293	No	No	No		*E. wandoo*	450	510841	6433677
HT294	No	No	No		*E. wandoo*	300	510838	6433660
HT295	No	No	No		*E. wandoo*	300	510852	6433641
HT296	No	No	No		*E. salmonophloia*	350	510875	6433646
HT297	No	No	No		*E. salmonophloia*	450	510032	6433589
HT298	No	No	No		*E. salmonophloia*	1000	510034	6433588
HT299	No	No	No		*E. salmonophloia*	800	510033	6433588
HT300	No	No	No		*E. salmonophloia*	500	510027	6433580
HT301	No	No	No		*E. wandoo*	300	510021	6433568
HT302	No	No	No		*E. wandoo*	1000	510019	6433568
HT303	No	No	No		*E. salmonophloia*	800	510017	6433572
HT304	No	No	No		*E. salmonophloia*	900	510007	6433572
HT305	No	No	No		*E. salmonophloia*	600	510013	6433588
HT306	No	No	No		*E. salmonophloia*	300	510015	6433588
HT307	No	No	No		*E. salmonophloia*	350	510015	6433592
HT308	No	No	No		*E. salmonophloia*	300	510023	6433601
HT309	No	No	No		*E. salmonophloia*	350	510021	6433596
HT310	No	No	No		*E. salmonophloia*	350	510025	6433617

Tree ID	Hollows present	Hollows suitable	Evidence of breeding	Comments	Species	DBH	Easting	Northing
HT311	No	No	No		*E. salmonophloia*	320	510013	6433621
HT312	No	No	No		*E. salmonophloia*	1000	510025	6433638
HT313	No	No	No		*E. salmonophloia*	650	510021	6433642
HT314	No	No	No		*E. salmonophloia*	400	510019	6433642
HT315	No	No	No		*E. salmonophloia*	450	510009	6433648
HT316	No	No	No		*E. wandoo*	350	510011	6433652
HT317	No	No	No		*E. wandoo*	350	510002	6433637
HT318	No	No	No		*E. salmonophloia*	420	509998	6433628
HT319	No	No	No		*E. salmonophloia*	400	509998	6433616
HT320	Yes	Yes	Yes	Hollow at 8 m. Chewing around hollow entrance.	*E. salmonophloia*	500	509982	6433596
HT321	No	No	No		*E. wandoo*	450	509982	6433591
HT322	No	No	No		*E. salmonophloia*	500	509978	6433580
HT323	No	No	No		*E. wandoo*	300	509980	6433588