The Council of the City of Cockburn

Ordinary Council Meeting

Tuesday, 8 October 2024

Attachments

Item 14.1.1
Manning Park Mountain Bike Trails

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Detailed Fauna and Fauna Assemblages Survey of Manning Park – Hamilton Hill

November 2023

Prepared for the City of Cockburn by

FAUNATRACK

February 2024

Cover Photo: Carnaby's cockatoo (*Zanda latirostris*) © Ray Lloyd / FaunaTrack

Executive Summary

FaunaTrack was engaged by the City of Cockburn to undertake a Detailed Fauna and Fauna Assemblages Survey of Manning Park.

The objectives of the survey were to:

- Compile a list of all vertebrate fauna occurring or likely to occur within the study area (desktop assessment).
- Identify species of conservation significance likely to occur within the study area.
- Determine fauna habitats present within the study area.
- Report on the likelihood of occurrence of terrestrial vertebrate fauna, particularly those of conservation significance, based on location, habitats present and vegetation condition.
- Undertake a comprehensive trapping survey to detect vertebrate fauna (including those of conservation significance) occurring in the study area.
- Document any fauna recorded during trapping surveys, targeted searches or opportunistically carried out during the survey period, and
- Obtain baseline data for future monitoring programs and management actions, including the potential establishment of mountain bike trails throughout the reserve, and to detect any threats potentially impacting on species.

Surveys were undertaken from late August through to late November 2023 and consisted of the following methods:

- Comprehensive trapping survey
- Bat detection
- Bird census
- Frog census
- Motion sensor camera deployment
- Nocturnal spotlighting
- Fauna habitat assessment
- Targeted searches for vertebrate fauna, particularly those of conservation significance, including a visual assessment of Black cockatoo habitat (nesting, foraging and roosting potential), and
- Opportunistic observations

Six fauna trapping sites were established in the reserve, incorporating 1650 trapping nights, 224 motion camera nights, six bat detector nights, 14 hours of bird surveys, eight person hours of nocturnal spotlighting, two hours of frog surveys, and 26 person hours of targeted searches. This resulted in the detection of four species of amphibian, 23 species of reptile, 12 species of mammal and 69 species of bird.

The survey area however has the potential to support up to nine amphibian species, 44 species of reptile (including four of conservation significance), 22 species of mammal (including up to four of conservation significance) and 173 species of bird (including up to 28 species of conservation significance).

Of these the following species of conservation significance were detected:

- The EPBC and BC Act listed Endangered Carnaby's cockatoo (*Zanda latirostris*)
- The EPBC and BC Act listed Vulnerable Forest red-tailed black-cockatoo (*Calyptorhynchus banksia naso)*
- The EPBC Act Migratory/Marine Pied Stilt (*Himantopus himantopus leucocephalus*)
- The EPBC Act Marine listed Rainbow Bee-eater (*Merops ornatus*)
- The EPBC Act Marine listed White-bellied sea-eagle (*Haliaeetus leucogaster*)
- The Priority 4 listed Quenda (*Isoodon fusciventer*), and
- The Priority 3 listed Perth-lined Slider (*Lerista lineata*)

Additionally, a single reptile and 14 bird species of local significance were also detected:

- Western bluetounge (*Tiliqua occipitalis*)
- Australasian shoveler
- Hardhead
- Pink-eared duck
- Dusky moorhen
- Painted button-quail
- White-browed scrub-wren
- New-holland honeyeater
- White-cheeked honeyeater
- Square-tailed kite
- Brown goshawk
- Splendid fairy-wren
- Variegated fairy-wren
- Weebill, and
- Yellow-rumped thornbill

The reserve is also known to support a further six species of conservation significance:

- The EPBC and BC Act listed Endangered Baudin's cockatoo (*Zanda baudini*)
- The BC Act Specially Protected Peregrine falcon (*Falco peregrinus*)
- The Priority 4 Blue-billed duck (*Oxyura australis*)
- The EPBC Act Migratory listed Common greenshank (*Tringa nebularia*)
- The EPBC Act Marine listed Greater crested tern (*Thalasseus bergii*)

An additional 11 species of local significant birds are also known from the reserve including:

- Musk duck
- Nankeen night-heron
- Little eagle
- Collared sparrowhawk
- Whistling kite
- Western rosella
- Western wattlebird
- Inland thornbill
- Western golden whistler
- Grey shrike-thrush, and
- Dusky woodswallow

Several threats currently exist, including:

- Weed infestations
- Habitat loss and fragmentation (including dissection and degradation of habitat through track establishment)
- Fire
- Dieback
- Erosion
- Potential road mortality of some species, and
- Feral animals (particularly cats, rabbits and foxes, and hollow competitors such as bees).

In protecting, managing, enhancing and connecting existing habitats within the reserve, the following recommendations may help to guide management:

- The protection of proteaceous shrublands and heath on the limestone ridge, and the tall woodlands on the lower slopes and surrounding the lake
- Enhancement and revegetation of degraded landscapes, and creation of additional habitat corridors
- Weed management
- Designated recreational areas, including walking and/or mountain bike trails of exclusive use
- Dieback management
- Feral animal management, and
- Education and community involvement

In addition, future follow-up and targeted surveys will also be an important aspect. High species diversity was detected during the current survey, helping to understand the fauna assemblage occurring in and around the reserve. Future motion camera surveys of longer duration will help to detect and monitor Quenda populations, and may help to detect elusive species such as the Brush-tailed phascogale and/or possums, and also provide data on the presence and potentially abundance of feral predators such as feral cats and foxes, which may also provide insights into the effectiveness of management programs. Targeted surveys in late summer to early winter may also help to detect species such as the Graceful sun-moth and/or Swan Coastal Plain Sheild-backed trapdoor spider.

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1. Introduction

1.1 Site location and overview

FaunaTrack was engaged by the City of Cockburn to undertake a Detailed Fauna and Fauna Assemblages survey of Manning Park. Reserved for 'Parks and Recreation' under the City of Cockburn's Town Planning Scheme no. 3 and managed according to the Beeliar Regional Park Management Plan and the Manning Park Masterplan, the City required a Detailed Fauna and Fauna Assemblages survey to inform the development of a potential mountain bike trail, as well as practices to protect and enhance the biodiversity values of the reserve. Totalling approximately 110 hectares in size and reserved as Bush Forever Site 247 (Government of Western Australia, 2000), Manning Park is situated north of Azelia Road in Hamilton Hill, and considered part of the larger Beeliar Regional Park that encompasses Manning Lake and the limestone ridge to the west of the wetland (City of Cockburn, 2023). The current survey area covered approximately 100 hectares, which focused predominantly on the bushland area, encompassing 95 hectares, including the lake (10ha) as well as some smaller areas of surrounding parkland habitats.

The area is located within the Swan Coastal Plain 2 subregion (SWA2) of Swan Coastal Plain Bioregion, the area experiences a Mediterranean climate and rainfall range of 600-1000mm (Mitchell et. al. 2002). It is bordered in the east by the Darling Scarp and the west by the Indian Ocean and is characterised by a series of parallel dune systems from west to east, known as the Quindalup, Spearwood, and Bassendean dune systems, with the Pinjarra Plain separating the dunes from the scarp. The region (1,333,901ha in total) comprises of predominantly Tuart woodlands and/or heath on limestone, Jarrah and/or *Banksia* woodlands on dunes, Marri on colluvial and alluvial sands, as well as a series of seasonal wetlands and offshore islands (Mitchell et. al. 2002). The dominant land uses in the region consist of agriculture, horticulture and plantations, conservation and crown land reserves (including unallocated), urban and rural-residential, road infrastructure and easements, pasture improvement/grazing, as well as small areas of mining and defence (Mitchell et. al. 2002).

The study area lies within the Spearwood Dune System. The Spearwood dunes are comprised of sand dunes and plains with deep yellow and pale sands and shallower yellow to brown sands supporting woodland, open forest and closed heath. The vegetation (Cottesloe Complex – Central and South) consists of a mosaic of woodland Tuart (*Eucalyptus gomphocephala*) woodland and open forest with Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) and closed heath on the limestone outcrops.

Manning Park consists predominantly of vegetated uplands and limestone ridge supporting mixed low shrublands, scrubs and heaths, and vegetated wetlands and open water habitats supporting open forests and woodlands (Government of Australia, 2000), with the lake forming part of the western chain of Cockburn wetlands which lies in a depression between two limestone ridges, immediately to the east of the most western limestone ridge. The reserve consists of many tracks and pathways, including management/vehicle access tracks, narrower walking tracks and pathways, and many 'unsanctioned' tracks and trails snaking through the reserve, which are currently used as unofficial mountain bike trails. The reserve also contains significant heritage areas and structures remaining as part of the former Davilak House and associated ruins and also contains museum facilities showcasing this history. The wetland is also fringed by large, cleared parkland areas containing playground, picnic and ablution facilities, and supports significant stands of very large Tuarts (*Eucalyptus gomphocephala*), while degraded landscapes also occur throughout the reserve, including areas of severe localised disturbance.

Due to the location and habitats present, the reserve is known, or has the potential, to support a range of conservation significant species. These include:

- Carnaby's, Baudin's and Forest red-tailed black cockatoos
- Osprey, White-bellied sea-eagle, Fork-tailed swift, Rainbow bee-eater and Peregrine falcon
- Perth-lined slider and Black-striped snake
- Quenda and Brush-tailed phascogale, and
- Potential significant invertebrate species

As well as a range of conservation significant wetland, coastal and migratory shorebird species, and significant local fauna species (Tables 2, 3, 4 and 7).

1.2 Survey objectives

The objectives of the survey were as follows:

- Compile a list of all vertebrate fauna occurring or likely to occur within the study area (desktop assessment).
- Identify species of conservation significance likely to occur within the study area.
- Determine fauna habitats present within the study area.
- Report on the likelihood of occurrence of terrestrial vertebrate fauna, particularly those of conservation significance, based on location, habitats present and vegetation condition.
- Undertake a comprehensive trapping survey to detect vertebrate fauna (including those of conservation significance) occurring in the study area.
- Document any fauna recorded during trapping surveys, targeted searches, or opportunistically carried out during the survey period, and
- Obtain baseline data for future monitoring programs and management actions and to detect any threats potentially impacting on species, and
- Provide a discussion on potential locations for a mountain bike trail network that will not impact upon priority habitat values.

2. Methods

2.1 Database searches

Searches for fauna incorporated a 5km radius centred on the following co-ordinates:

-32.092641°/115.768056°

The following sources were consulted in the formulation of potential fauna lists:

- Atlas of Living Australia (ALA, 2023). Accessed 4th September 2023.
- Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Museum NatureMap Species Database (DBCA, 2023a). Requested 4th September 2023.
- DBCA Threatened and Priority Fauna Database (DBCA, 2023b). Requested 4th September 2023
- EPBC Act Protected Matters Search Tool (DAWE, 2023). Accessed 20th September 2023.
- BirdLife Australia's BirdData Database (BirdLife, 2023a). Accessed 18th September 2023.
- DBCA's Dandjoo Biodiversity Data Repository (DBCA, 2023c), and
- Results of previous fauna surveys conducted in the reserve(s) and/or local area.

Previous fauna survey undertaken within the reserve include:

- FVC (2021) Biological survey of Manning Park. Unpublished report to the City of Cockburn
- FaunaTrack (2018) Amphibians, reptiles, and mammals of Manning Park. Unpublished report to the City of Cockburn
- Western Wildlife (2010) Roe Highway Extension: Wetland and Migratory Bird Study, 2009-2010. Unpublished report to South Metro Connect
- WASAH (1999) Herpetofauna survey of Manning Park bushland
- BirdLife (2023b) Numerous bird surveys undertaken throughout the reserve from 1994 to 2023.

Forming part of the Desktop Assessment, these searches help to identify several species that may potentially occur or have previously been recorded within the study area. Species were then assigned to a likelihood presence category based on habitats present and distributional range. Categories were defined as follows:

- **Known:** Records previously confirmed within the reserve.
- **Likely:** Both suitable habitat present and local records exist within a radius of 5 km.
- **Possible:** Either suitable habitat present or local records exist within a radius of 5 km.
- **Unlikely:** Area contains no suitable habitat or local records, and/ or locally extinct.

These searches often comprise a large percentage of wetland, migratory or marine bird species that either infrequently visit the local coastline and/or the broader area, or are inhabitants of offshore coastal islands, near coastal or inland wetlands and are of low likelihood to use the reserve on a regular basis or even at all. Due to the presence of a moderate-sized, semi-permanent waterbody within the study area, some of these species have previously been identified in the reserve including the Blue-billed duck and Common greenshank (Birdlife, 2023a; DBCA, 2023b; see Map 2). Most species however are associated with significant coastal areas such as Woodman Point and Fremantle ports or nearby, larger waterbodies such as Bibra Lake, or large, saline lakes such as Lake Coogee, with many species unlikely to occur in or regularly frequent the study area besides a potential flyover. Brief descriptions of all conservation significant and locally significant species (including nearby wetland, coastal and/or migratory birds) that exist within 5km of the reserve have been included in Appendix 11, however many of these species have been excluded from putative species tables.

In addition, all pelagic bird species (i.e. albatross and petrels), marine mammals (i.e. whales and seals), fish (i.e. sharks) and marine reptiles (i.e. sea turtles and sea snakes) have been completely excluded from searches as these are unlikely to occur within the study area.

Subsequently, desktop assessments resulted in the identification of ten species of conservation significance that have previously been confirmed within the reserve (Maps 1 and 2), including:

- Carnaby's and Baudin's cockatoo
- Forest red-tailed black cockatoo
- Peregrine falcon
- Rainbow bee-eater
- Perth-lined slider
- Pied stilt
- Blue-billed duck
- Greater crested tern, and
- Common greenshank

While the following 14 conservation significant species are likely to occur, or known to occur close by to the study area including:

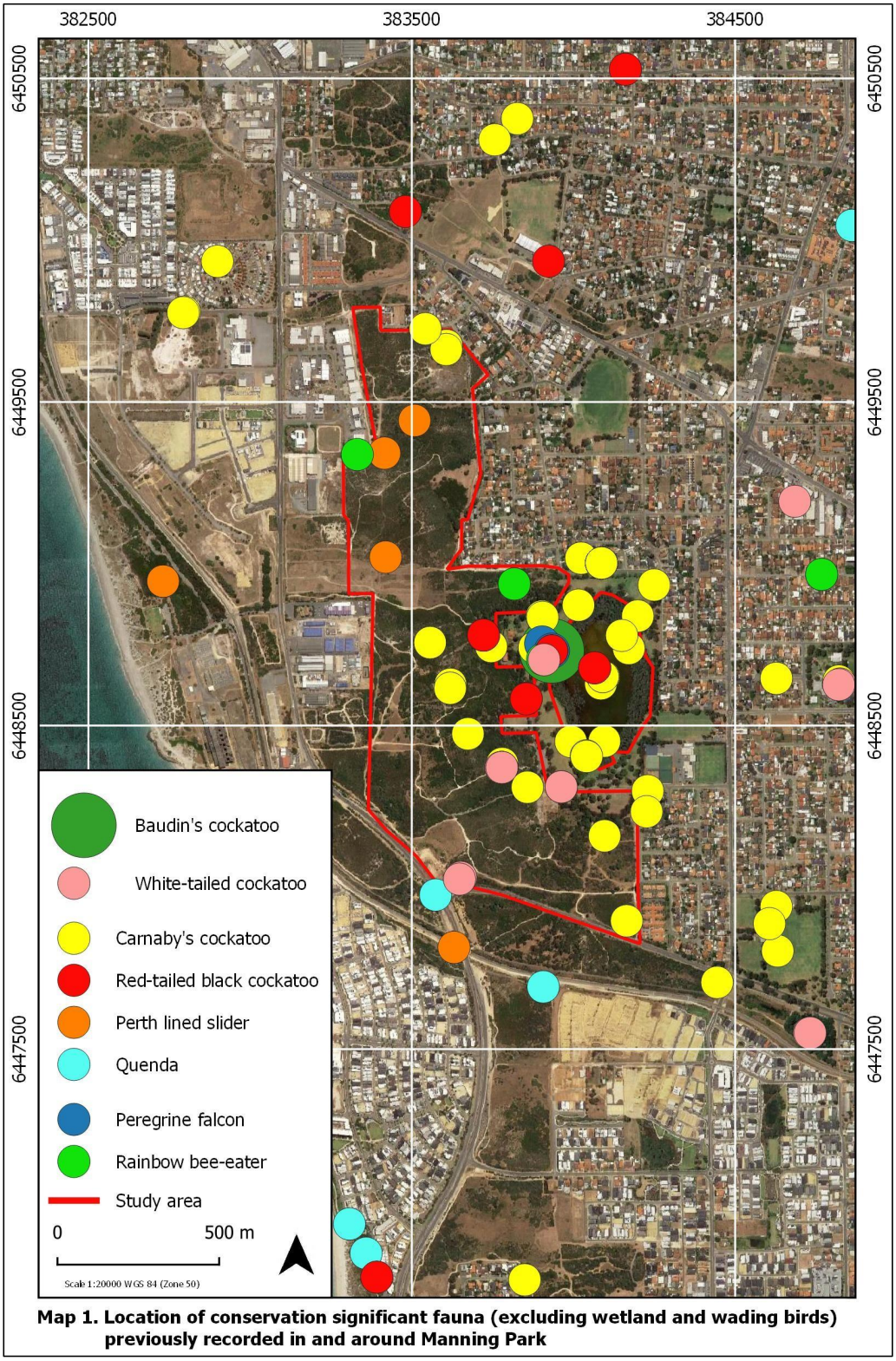
- Black-striped snake
- Quenda and Brush-tailed phascogale
- Fork-tailed swift, Osprey and White-bellied sea-eagle
- Migratory and marine bird species such as Bar-tailed godwit, Caspian tern, Common sandpiper, Red-necked avocet, Red-necked stint and Great knot, and
- Invertebrate species including the Swan Coastal Plain Shield-back trapdoor and Graceful sun-moth

Additionally, search results of the DBCA Threatened Fauna Database also identified the Fork-tailed Swift from bird surveys undertaken in the late 1970's and early 1980's from a nearby location just over 1km to the north-west of the reserve in North Coogee. These surveys also recorded a range of coastal, marine and wetland bird species from the same survey location, including:

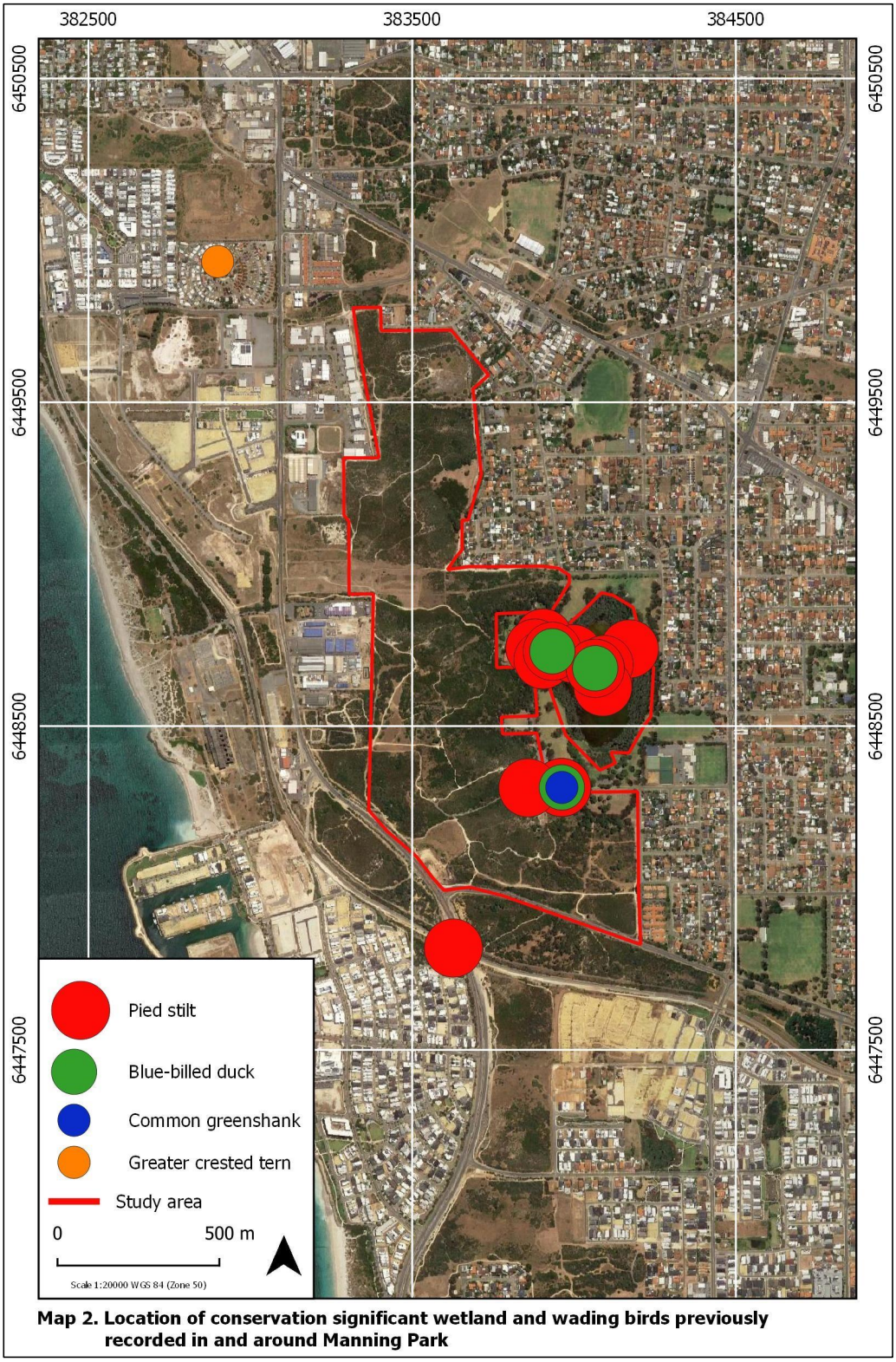
- Australasian Bittern, Blue-billed Duck, Glossy Ibis, and
- Bar-tailed Godwit, Black-tailed Godwit, Broad-billed Sandpiper, Common Greenshank, Curlew Sandpiper, Eastern Curlew, Great Knot, Greater Sand Plover, Grey Plover, Lesser Sand Plover, Long-toed Stint, Marsh Sandpiper, Oriental Pratincole, Pacific Golden Plover, Pectoral Sandpiper, Red Knot, Red-necked Stint, Roseate Tern, Ruddy Turnstone, Ruff, Sanderling, Sharp-tailed Sandpiper, Whimbrel, Wilson's Storm-petrel and Wood sandpiper.

Many of these species are known to frequent the broader area, with several known records from the coastline, ocean, offshore islands, and nearby lakes and wetlands (DBCA 2023b; Birdlife, 2023a), however due to the age of the records, the exact location of these cannot be certain, with these same records not appearing on the Birdlife Australia database search. These records however are assumed to be valid and potentially near to the reserve, which may have included brief flyovers and/or sightings offshore.

A single Quokka record also exists from approximately 1.1km northwest of the reserve, which represents a moderately certain observation of dead specimen on South Beach in 2009 (DBCA, 2023b). This may potentially be a beach-washed animal; however, the Quokka is assumed to be locally extinct in the immediate mainland area and highly unlikely to be present within the reserve and/or the local area.



Map 1. Location of conservation significant fauna (excluding wetland and wading birds) previously recorded in and around Manning Park



Map 2. Location of conservation significant wetland and wading birds previously recorded in and around Manning Park

2.2 Survey timing

Surveys were conducted over a single season (spring) during 2023, whereby the full spectrum of trapping and survey techniques were employed.

2.3 Personnel

Field surveys were undertaken by Mr Ray Lloyd and Mr Jeff Turpin. Bat call analysis and identification was undertaken by Mr Bob Bullen (Bat Call WA). This report was prepared by Ray Lloyd. Field work was carried out under the permit BA27000904 issued by the Department of Biodiversity, Conservation and Attractions, Scientific User Licence U316 (2023-2025) issued by the Department of Primary Industries and Regional Development (DPIRD) and Animals Ethics Approval Number WAEC 23-09-56 issued by the DPIRD Wildlife Animal Ethics Committee.

2.4 Site selection

Manning Park comprises of the following landscape features and vegetation communities (Government of Western Australia, 2000):

- Vegetated uplands and limestone ridge supporting *Acacia rostellifera* Closed Scrub, *Melaleuca huegelii* Shrubland, Closed Heaths with *Banksia sessilis,* and Mixed Low Shrublands
- Vegetated wetlands supporting *Melaleuca rhaphiophylla* Low Open Forest
- Scattered *Eucalyptus decipiens* Tree Mallee and *Eucalyptus gomphocephala* Open Woodland
- Open water, and
- Open parkland and cleared, degraded and/or revegetated landscapes.

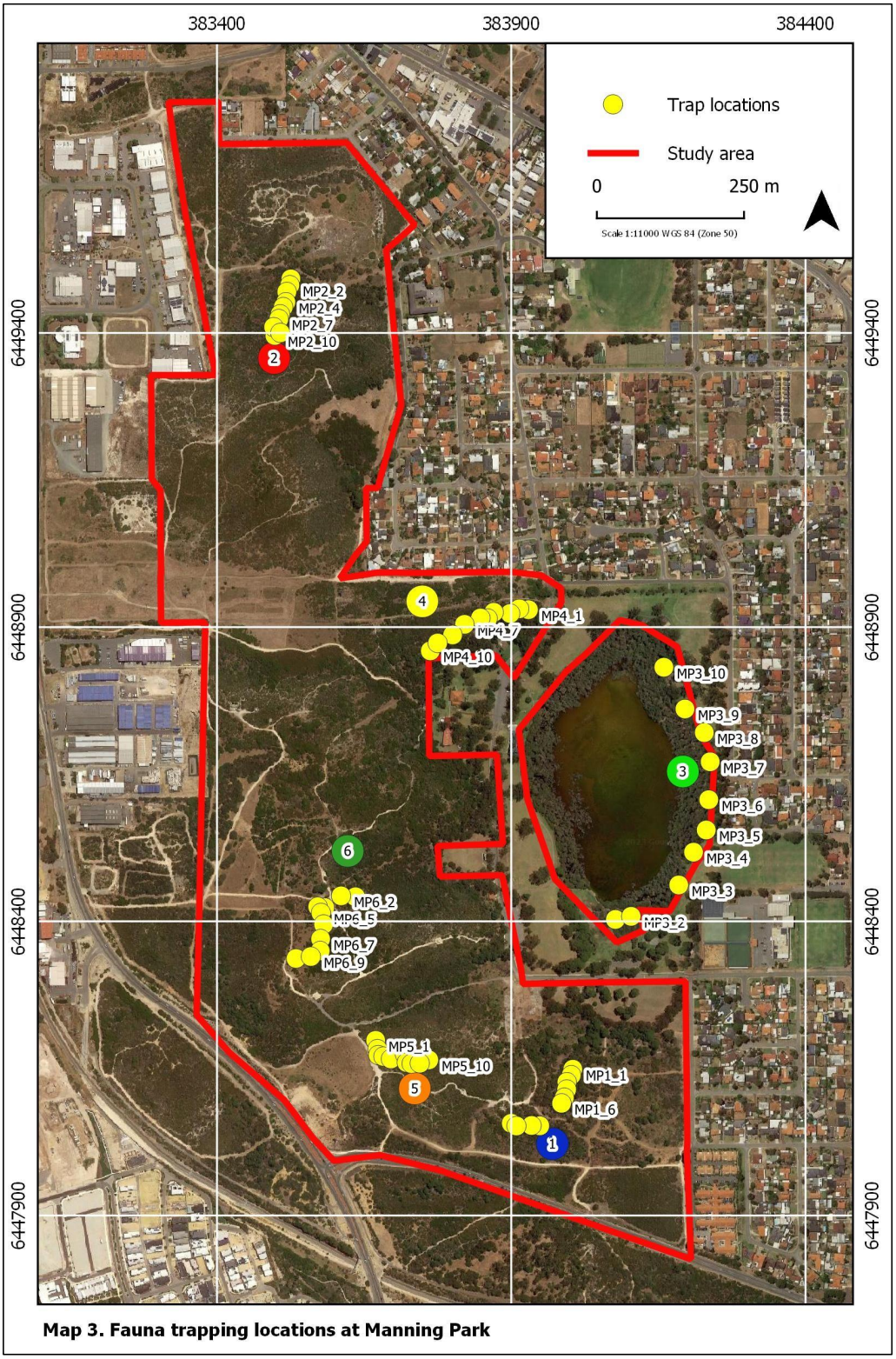
Three trapping transects were established within the reserve during 2017 fauna surveys (see FaunaTrack, 2018) and re-opened during the current survey. Sites were initially selected based on a combination of factors, including:

- Representation of vegetation associations
- Extent of 'intact' vegetation present
- Areas of conservation value or ecological sensitivity (including the likelihood of containing species of conservation significance), and
- Proximity to existing tracks to enable sites to be checked as early as possible each day.

Due to the comprehensive nature and scale of the current survey, an additional three trapping sites were established to further extend spatial and habitat coverage.

This resulted in the following six trapping sites established within the following broad fauna habitats (See Map 3);

1) Open Eucalypt (*Eucalyptus decipiens*) woodland
2) Closed heath with mixed shrubland on limestone ridge
3) *Melaleuca* woodland/wetland fringe
4) Tuart (*Eucalyptus gomphocephala*) woodland
5) Tall closed shrubland of *Acacia rostellifera* on limestone ridge, and
6) Low heath on limestone ridge



Map 3. Fauna trapping locations at Manning Park

2.5 Sampling methods for vertebrate fauna

Surveys were conducted during August/September and November 2023, whereby a variety of survey techniques were employed. This involved the following methods:

- Comprehensive trapping survey
- Bat detection
- Bird census
- Frog census
- Motion sensor camera deployment
- Nocturnal spotlighting
- Targeted searches for vertebrate fauna, particularly those of conservation significance, including a visual assessment of Black cockatoo habitat (breeding, foraging and roosting potential)
- Fauna habitat assessment, and
- Opportunistic observations

2.5.1 Trapping

Trapping for terrestrial fauna was undertaken at six sites from 16th - 24th November 2023 using conventional trapping techniques comprising a combination of twenty-litre pit-fall bucket traps, funnel traps, Elliot aluminium box traps and wire cage traps, with traps being open over seven consecutive nights, except for cage and Elliott traps, which were opened for five consecutive nights.

Five trapping sites contained a total of 10 pitfall traps, 20 funnel traps, 10 cage traps and/or large Elliott traps and 10 small Elliot box traps, with 10 individual trap lines spaced approximately 15-20m apart along a linear transect. Each trap line along the transect contained a single pitfall bucket with a 6-7m length of flywire drift fence (~30cm high) which bisected the bucket. A single funnel trap was then placed at either end of the drift fence. Each trap line also had a single small Elliot trap and a cage or large Elliot trap (trap type alternated along transect). The sixth trapping site consisted solely of a linear transect of cage and Elliott traps, whereby 10 cage traps and 10 small Elliott box traps were spaced at 50-100 metre intervals along the eastern edge of the lake. Cage and Elliot traps were baited with universal bait (peanut butter, rolled oats and sardines), which was replenished on an 'as needed' basis. All traps were checked each morning within three hours of sunrise.

In addition, we were able to determine the overall abundance of Quenda throughout the reserve by counting the number of new individuals captured during the five-day sampling period across all traps. To exclude, recaptures from this figure, we clipped a small area of fur on each trapped individual prior to release.

2.5.2 Bat detection

Bat echolocation calls were recorded using a Song Meter SM2BAT detector (Wildlife Acoustics, Concord MA, USA). Calls were recorded at each of the six trapping sites incorporating the dominant fauna habitats occurring in the reserve (Map 4) on the evenings of the 16th, 17th, 18th, 19th, 20th and 21st of November 2023. At each site units were left unattended overnight, ensuring peak activity periods were sampled.

2.5.3 Bird Census

Systematic, twenty-minute bird surveys were undertaken at each trapping site over five mornings during trap checks. Surveys were generally undertaken between 0530hrs and 0830hrs, ensuring peak bird activity was captured. Survey days and order of sites alternated, ensuring that each site had surveys undertaken at a diverse range of times. All birds recorded during systematic surveys were counted, including those observed flying overhead or in adjacent tenure. Surveys for birds were also carried out opportunistically when traversing through the study area.

2.5.4 Frog census

A casual frog census was undertaken over two consecutive nights on the 22nd and 23rd August, with surveys focusing on the lake and fringing wetland habitats. Surveys commenced approximately 30 minutes after sunset (approximately 6.45pm) and involved one person traversing the entire perimeter of the lake on foot. An hour was spent on each night inspecting the ground and low vegetation along the edge of wetland using a head-torch to pick up on the frogs distinctive dull eyeshine. Active listening for frog calls was also undertaken during this time, whereby 5 minutes was spent at several points around the lake edge that enabled access close to the water. All observations (sightings and calls) were recorded during this time.

2.5.5 Targeted searches

Targeted searches for terrestrial vertebrate fauna were undertaken on several occasions throughout the reserve, with searches undertaken on the 5th September, and 21st, 22nd, 23rd and 24th November 2023. Searches involved traversing the entire study area on foot to record sightings or evidence of fauna. This involved the raking of leaf litter and soft soil, the turning of rocks, fallen timber and rubbish, inspecting under bark, investigating hollows and burrows, and examining tracks, scats, and other traces of fauna.

2.5.6 Motion-sensor cameras

Camera trap surveys were undertaken over a 14-night period from the 17th of November to 1st December 2023, whereby sixteen motion-sensor camera units were deployed throughout the reserve. Due to the proximity of housing and open public accessibility, cameras were placed off main pathways and baited with a tuna oil-soaked cloth concealed within a small PVC cannister fixed to the ground. Each camera was attached to a steel fence post/dropper and positioned approximately 50 cm above the ground, angled downwards slightly and set to take a single photograph with a three second interval between successive photographs. Camera footage was downloaded at the end of the fortnight period.

2.5.7 Spotlighting transects

Nocturnal spotlighting surveys were undertaken over three successive nights on 21st, 22nd and 23rd of November 2023 along three pre-selected transects which optimised spatial and habitat coverage of the reserve. Each transect was traversed by two observers on foot (approximately 2-3km/hour) on a single evening between 7.15 - 8.30pm using a 30W hand-held spotlight and head-torches. Each transect covered approximately 2.5km and utilised existing tracks within the reserve and incorporated all habitats. During spotlight surveys, observations of all species detected were recorded. Species of conservation significance were marked with a handheld GPS at the point of observation.

2.5.8 Opportunistic records

Additional species opportunistically observed whilst traversing the survey area were recorded. Secondary evidence such as tracks, diggings, nests, scats and scratches were also recorded.

2.5.9 Fauna habitat assessment

Fauna habitat assessments were undertaken throughout the reserve. Factors used to assess fauna habitat quality incorporated the size of habitat, level of habitat connectivity, soil type and availability, tree hollow and other resource availability, fire history, and vegetation quality (EPA, 2020). These were further quantified using the following fauna habitat quality categories used in recent, nearby fauna surveys (i.e. PGV Env, 2021):

- **High:** No obvious disturbance, with vegetation structure, diversity, and quality like that prior to any disturbances, with a high level of habitat connectivity and is likely to contain a natural fauna assemblage.
- **Very Good:** Minimal disturbance and retaining habitat characteristics like that if it had not been disturbed, with a good level of habitat connectivity and fauna assemblages minimally affected by disturbance.
- **Good:** Some signs of disturbance, but still retaining many habitat characteristics if it had not been disturbed, with a good level of habitat connectivity, but the fauna assemblage has likely been affected by disturbances.
- **Disturbed:** Significant signs of disturbance, habitat characteristics have been modified (clearing of trees, shrubs, grazing, damage by vehicles and machinery and weed infestations) and limited habitat connectivity and fauna assemblages likely to differ from those expected in undisturbed sites.
- **Completely degraded:** Significant loss of vegetation, large weed infestations, a high number of vehicle tracks or have been completely cleared, with limited or no habitat connectivity and fauna assemblages likely to differ from those expected in undisturbed sites.

2.6 Taxonomy and nomenclature

Field identification of vertebrate species was based on the following field guides:

Birds	Simpson & Day (1999); Pizzey & Knight (1998); Morcombe & Stewart (2010)
Mammals	Menkhorst & Knight (2001); van Dyck *et al*. (2013)
Reptiles	Wilson & Swan (2021)
Amphibians	Tyler & Doughty (2009)

- In this report, nomenclature follows the Western Australian Museum's '*Checklist of the Fauna of Western Australia*'. WAM (2023).

Map 4. Motion camera and bat detector locations, and spotlight transects at Manning Park

2.7 Visual black cockatoo assessment

The study site was visually inspected for the presence or evidence of black cockatoo breeding, night roosting and/or foraging habitat. Any signs of live individuals and/or evidence of activity such as chew marks, branch clippings and chewed fruit and nuts were recorded.

2.7.1 Breeding habitat

Defined as habitat that contains known, suitable, or potential nesting trees (DAWE, 2022).

- A known nesting tree is a standing tree (dead or alive) containing a hollow where cockatoo breeding has been recorded or shows evidence of breeding (scratches, chew marks or feathers).
- Suitable nesting trees are those containing suitable hollows (>10cm wide), though have no evidence of use.
- A potential future nesting tree are those with a diameter at breast height (DBH) that may develop a hollow in the future. All trees with a diameter of 50cm or above were classed as potential future nesting trees.

Habitat trees were individually identified and incorporated the following attributes:

- Unique identification number
- Species
- Waypoint (Latitude/longitude)
- Alive or dead
- Diameter at breast height (DBH)
- Presence of hollows
- Number of hollows
- Hollow width
- Any usage, and
- Habitat category (known, suitable, potential, or foraging only)

2.7.2 Roosting habitat

Any groups of tall, native trees in or around the study site were assumed to provide potential roosting habitat for black cockatoo species and were recorded. Any signs of roosting behaviour were also noted.

2.7.3 Foraging habitat

Foraging habitat includes those habitats that typically comprise of plant species known to be consumed by black cockatoo species. These include a variety of proteaceous woodlands, shrublands and low heath, Eucalypt woodlands and a range of non-native habitats and species including pine trees and plantations, and parklands and gardens supporting species such as Cape Lilac (DAWE, 2022).

Foraging habitat was mapped for all three species, based on the presence of the following plant species known to be consumed by each species of black cockatoo, these include:

- **Baudin's cockatoo:** Woodland tree species such as Marri (*Corymbia calophylla*), proteaceous shrubs such as *Banksia* and *Hakea* spp., as well as Pine trees (*Pinus* sp.) (DAWE, 2022; Johnstone et. al. 2011).

- **Carnaby's cockatoo:** Proteaceous species such as *Banksia* and/or *Hakea* species, particularly Parrot bush (*Banksia sessilis*), and woodland tree species (many *Eucalyptus*/*Corymbia* species), particularly Tuart (*Eucalyptus gomphocephala*) and Marri and Pine trees (DAWE, 2022; Groom, 2011; Johnstone et. al. 2011).

- **Forest red-tailed black cockatoo:** Woodland tree species, particularly Jarrah (*Eucalyptus marginata*) and Marri, and Tuart, Redheart (*Eucalyptus decipiens*) and the introduced Cape Lilac (DAWE, 2022; Johnstone et. al. 2011; Johnstone et. al. 2017).

3. Results and discussion

3.1 Fauna habitats

Six broad fauna habitats were identified within the survey area (Map 5):

- Shrublands and heath
- Tall woodland
- Low open woodland
- Wetlands
- Open water, and
- Parkland

Shrublands and heath

Shrublands and heath habitats cover up to 64.3% of the study area and is predominantly centred along the limestone ridge and associated slopes, with much of the area containing skeletal sandy soils and extensive limestone exposure. Shrublands within the study site include low heaths dominated by *Melaleuca huegelii* on skeletal soils and limestone exposure in the higher parts of the landscape, with areas of taller heath/shrubland on the slopes and lower ridges supporting extensive *Banksia sessilis* shrublands, and dense thickets of tall shrubland with extensive leaf-litter dominated by *Acacia rostellifera* in areas containing deeper soils. Parts of this habitat, particularly on the slower slopes contain large infestations of the introduced Coastal tea-tree (*Leptospermum laevigatum*), with many isolated patches spread throughout higher parts of the limestone ridge. This habitat is of very high significance, as it provides an important food source for Carnaby's and Baudin's cockatoo (proteaceous shrublands), while the dense, low shrublands also provide a dense cover of low vegetation important for species such as Quenda and a range of small bushland birds, as well as sandy soils and extensive leaf litter, a habitat requirement for species such as the Perth lined slider.

Tall woodland

Tall woodland habitats cover up to 4.9% of the study area and predominantly occur in the vegetated uplands surrounding the wetland, with isolated stands occurring in the northeast of the reserve. These habitats are dominated by large Tuarts (*Eucalyptus gomphocephala*) over an open, mixed shrubland on shallow brown, loamy sands with areas of limestone exposure. This habitat is of high significance within the reserve, as it offers potential nesting and roosting habitat and extensive foraging resources for Carnaby's cockatoo and Forest red-tailed black cockatoo.

Low open woodland

Low open woodlands cover up to 4.7% of the study area. This habitat is poorly represented in the study area, where it predominantly occurs in the southern portion of the reserve, with several isolated pockets in the north and west. This habitat is dominated by Redheart (*Eucalyptus decipiens*) over mixed shrubland, with much of this habitat experiencing disturbances within the understorey layer, particularly from historical clearing and weed infestations (weedy grasses). A small area in the southeast also appears to have suffered from dieback, with much of the larger, mature trees all dying or dead. These areas are generally on the lower slopes and flats below the limestone ridge, with deeper, yellow sands and some limestone exposure.

Wetland

Wetland habitats cover approximately 6% of the study area. This habitat only occurs around the perimeter of the lake, between the open water habitats and extensive parkland. The vegetation is dominated by large Swamp paperbarks (*Melaleuca rhaphiophylla*) over dense low sedges and exposed areas on peaty sands which experience seasonal inundation. This habitat fringes most of the lake and provides important habitat and cover for a range of species including reptiles such as the King skink and a range of wetland bird species. The area also contains several large, hollow-bearing Tuarts along the outer edge, proving nesting potential, roosting habitat, and foraging resources for Carnaby's cockatoo and Forest red-tailed black cockatoo.

Open water

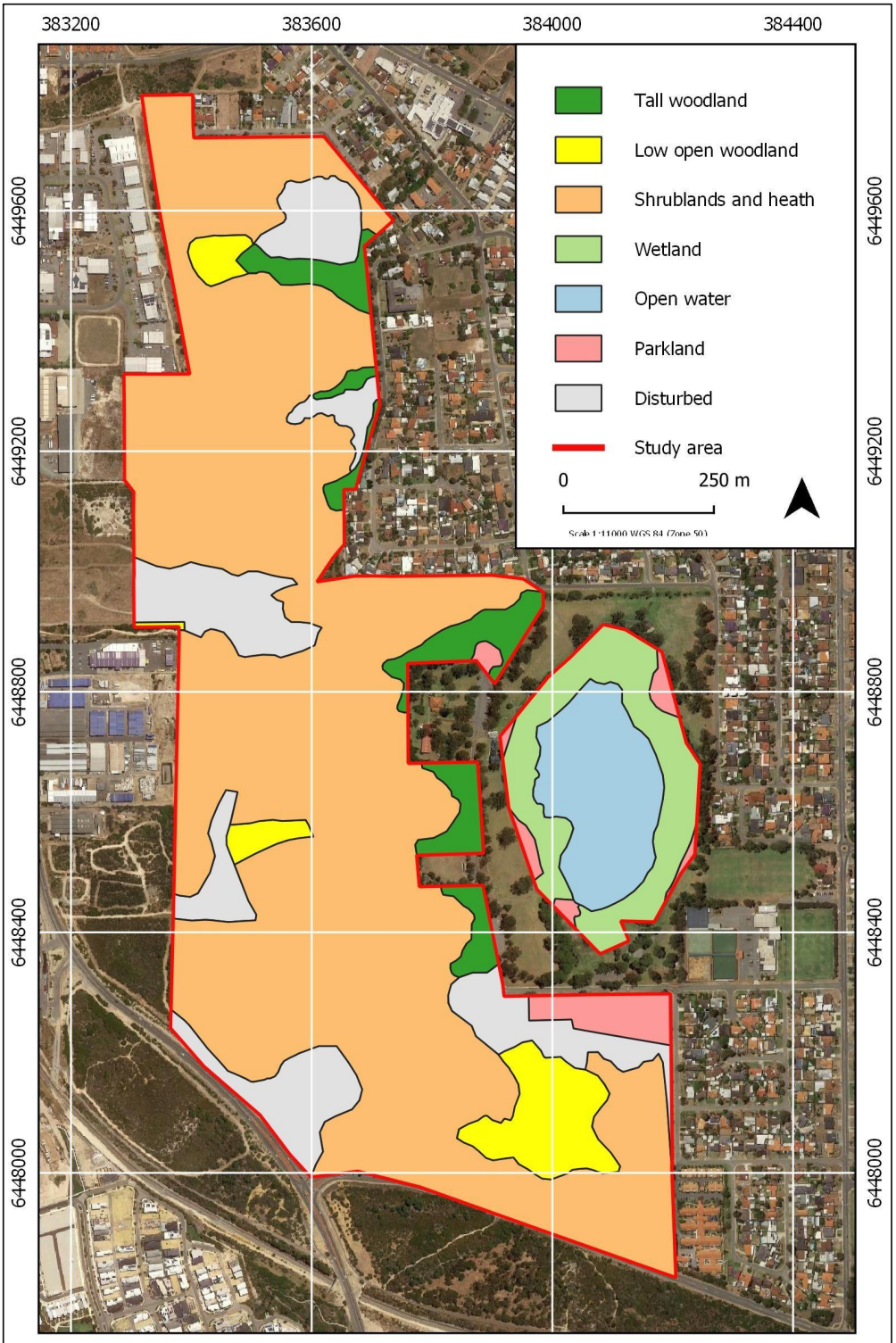
Comprising solely of Manning Lake, this habitat covers approximately 5.7% of the study area. This habitat is predominantly a moderate-sized, ephemeral to semi-permanent freshwater lake. Open water habitats are of varying depths, with much of the lake drying out in the late summer and autumn, exposing large areas of shoreline/mudflat habitats, with little to no vegetation or cover, while some deeper pools of water persist all year round. These areas, particularly the exposed mudflats and fringing vegetation are extremely important for a range of waterbirds, including a large variety of waterbirds and a range of conservation significant and migratory waders and shorebirds.

Parkland

Cleared, open parkland habitats only cover 2.3% of the area surveyed in the current study. However, a significant portion of the uplands immediately surrounding the wetland vegetation made up of predominantly manicured lawn grass and scattered large trees (mostly Tuart). This area is also of high importance, as the large trees that are scattered throughout the parkland area provide foraging and roosting habitat for a range of bird species, particularly Carnaby's and Forest red-tailed black cockatoos.

In addition, large areas of completely cleared and/or altered habitats also occur throughout the study area. These areas have generally been completely altered and no longer support any remaining native vegetation, of which are now predominantly bare soil or weedy grasslands. These areas cover the remaining 12.1% of the study area.

Figure 1. Manning Park fauna habitats: (a) Shrublands and heath; (b) Tall woodland; (c) Low, open woodland; (d) Wetland; (e) Open water; (f) Parkland.



Map 5. Major fauna habitats identified at Manning Park

3.2 Fauna habitat condition

A total of sixty-five fauna habitat assessments were undertaken throughout the study area. These assessments aimed to quantify the habitat quality throughout the reserve, with raw data presented in Appendix 10.

Fauna habitat condition varied throughout the site from very good through to completely degraded. Essentially all habitats within the study area have experienced some level of disturbance or degradation through historical land uses, the establishment of tracks, weedy grass infestations and feral species, subsequently no habitat was regarded as high-quality/pristine, however the central core of the reserve and areas higher in the landscape presented a much higher level of habitat quality and connectivity.

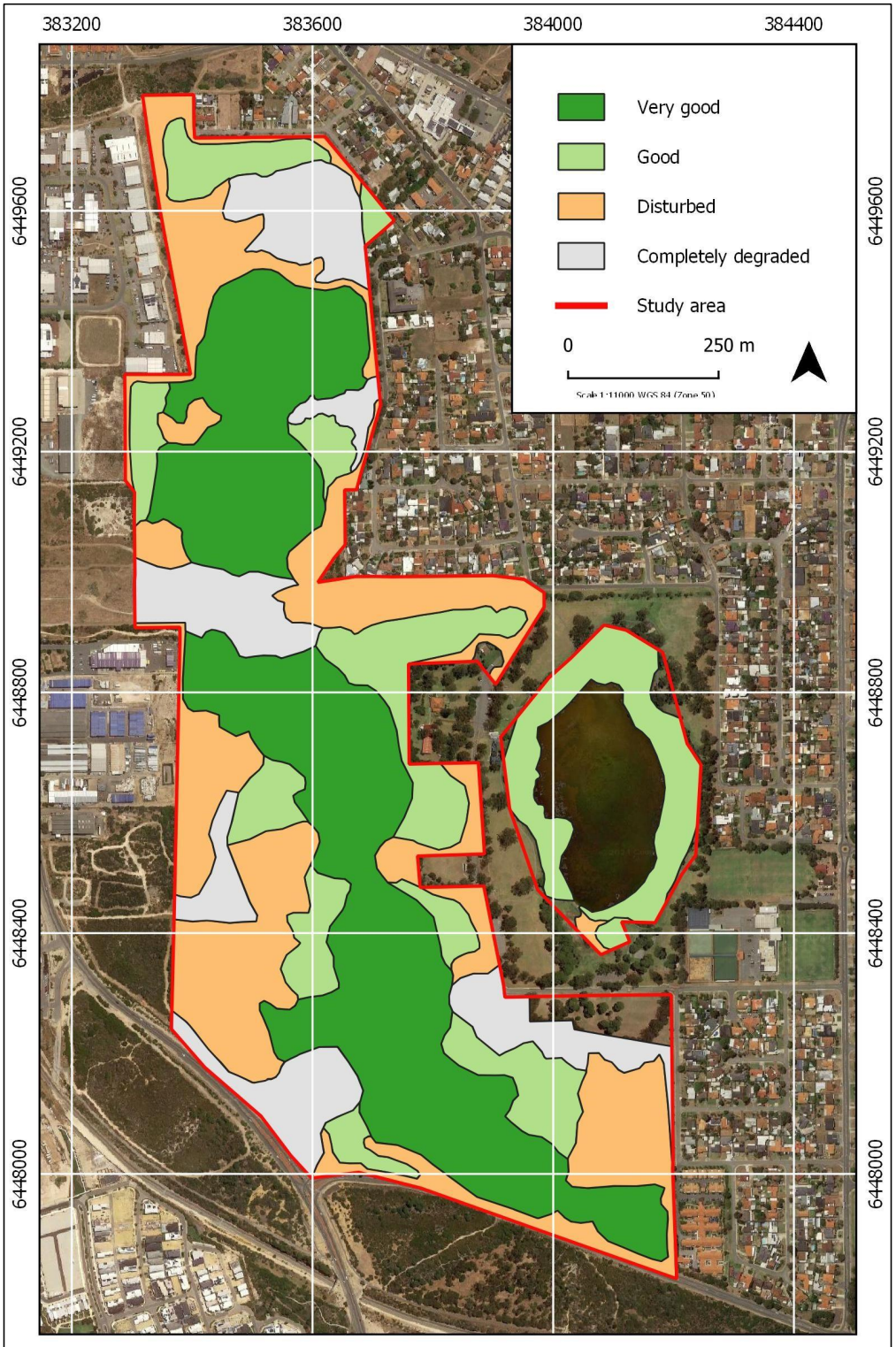
Habitats considered of 'Very Good' condition covered approximately 32.8% of the study area and mainly incorporated the 'Shrubland and Heath' habitats which occur throughout much of the reserve (Map 6; Figure 2a). These habitats generally have a high level of limestone exposure, skeletal soils and a very dense, in some instances almost impenetrable shrub layer and a high flora diversity, including herbs. These areas also contain extensive feeding grounds for black cockatoos, primarily Carnaby's and to a lesser extent Baudin's, of which the proteaceous shrubland, particularly Parrot bush (*Banksia sessilis*) forms a dominant feature of the upper shrub layer. These areas also present as having less tracks and pathways, and less cleared areas/exposed soil, erosion and weedy grass infestations and possess important habitat characteristics such as extensive leaf litter and woody debris.

Habitat considered of 'Good' condition covered approximately 20.1% of the study area (Map 6; Figure 2b). These areas were mostly on the lower slopes and closer to the edge of the reserve or in proximity to more disturbed/degraded areas, however, most form a continuous habitat corridor into the higher quality habitats. These areas incorporated most habitat types throughout the reserve, particularly the woodland and wetland habitats which have experienced a higher level of weedy grass invasion and some cleared/exposed soil, as well as some erosion on the slopes. These areas however are of high importance, as almost all the large, hollow-bearing trees occur in these areas, providing potential nesting opportunities for black cockatoo species and feeding grounds for Carnaby's and Forest red-tailed black cockatoos. The areas of 'Good' habitat throughout the limestone ridge habitat also possess substantial coverage of *Banksia sessilis*.

Disturbed areas covered approximately 25.3% of the study area (Map 6; Figure 2c). These areas are concentrated in the extreme northern and south-western parts of the reserve, particularly where large historical disturbances exist. A dominant feature of these habitats are the extensive infestations of the introduced Coastal tea-tree *(Leptospermum laevigatum*), which dominates the shrub/upper canopy layer. However, much of this habitat still comprise several elements of higher quality habitats, in particular scattered or isolated thickets of *Banksia sessilis*, extensive leaf litter patches and a dense, often impenetrable shrub layer, which offers adequate habitat for significant species such as Quenda, Perth-lined slider and locally significant bush birds such as the Splendid fairy-wren or White-browed scrub-wren, as well as connectivity to adjacent areas of higher quality habitat. These areas also often comprise of patchy cleared landscapes, scattered rubbish and feral animals, in particular rabbits.

Completely degraded areas cover approximately 13.4% of the study area (Map 6; Figure 2d). These areas are generally devoid of most of the original vegetation. Some isolated shrubs may be scattered around, but most areas contained extensive weedy grass infestations and exposed soils. Most of the highly degraded areas are associated with current and historical clearings such as old quarry sites in the north of the reserve, the powerline corridor through the central north of the reserve, parts of the south-west and also in the vicinity of the Davilak homestead ruins. These areas contain a high level of soil exposure, woody and grassy weeds, rubbish and numerous tracks and pathways.

The remaining 8.4% incorporates open water and parkland habitats.



Map 6. Fauna habitat condition at Manning Park

Figure 2. Manning Park fauna habitat condition: (a) Shrubland/heath in 'Very Good' condition, with little disturbance such as tracks and paths, and/or fragmentation and with low level weedy grass infestation, and overall providing high habitat value with dense, low vegetation cover and habitat connectivity, and extensive foraging resources (i.e. *Banksia sessilis*); (b) Shrubland/heath in 'Good' condition, with some weedy grass infestations, tracks and paths nearby, and low level woody weed encroachment, though still providing ample cover and foraging resources; (c) 'Disturbed' shrublands, with historical clearing/thinning, and extensive woody weed infestations, though some foraging resources persist; (d) 'Completely Degraded' habitats with high level disturbance such as clearing, weed infestation and fragmentation, with very little to no cover and/or foraging resources.

3.3 Black cockatoo habitat

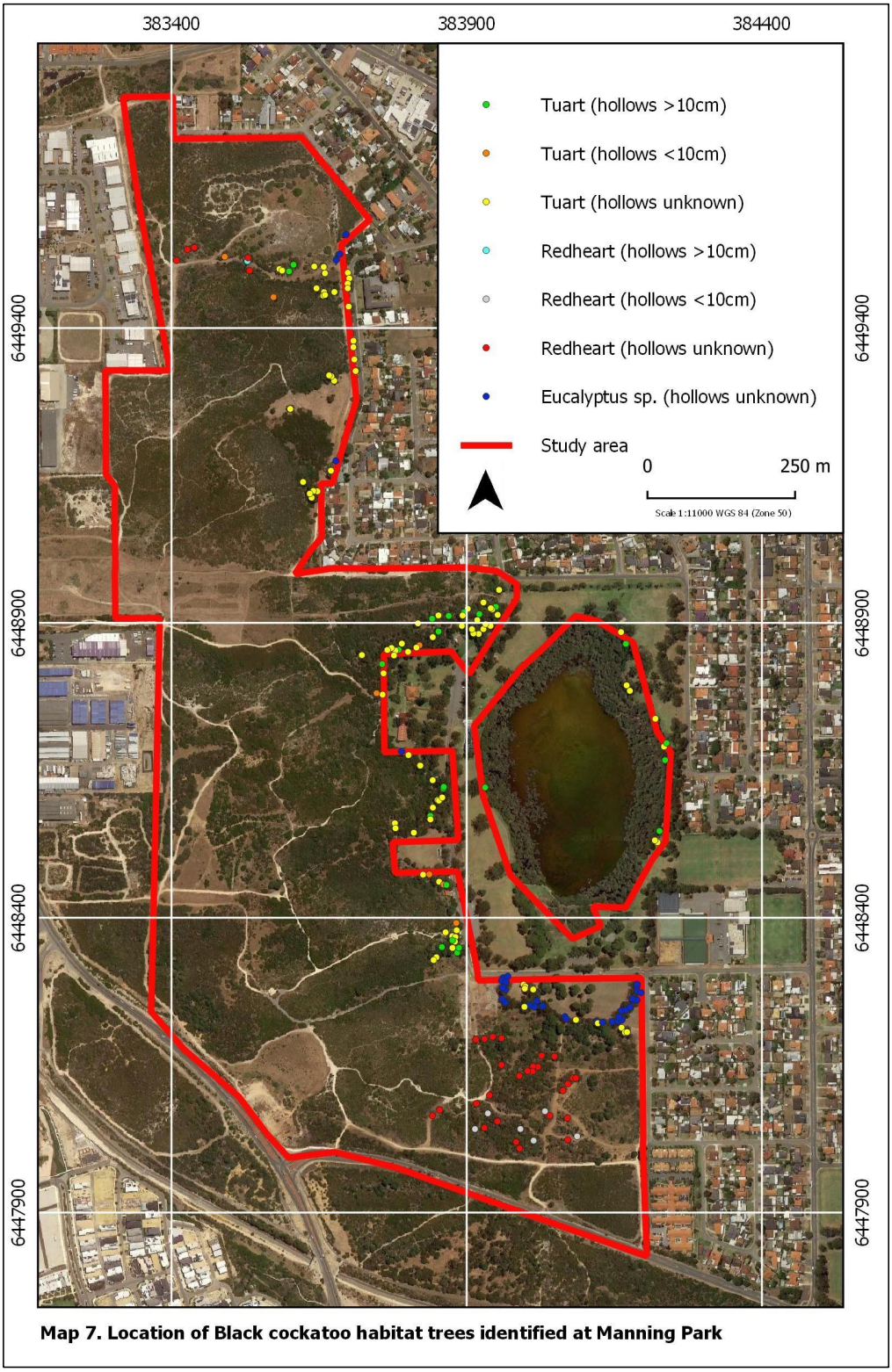
3.3.1 Breeding habitat

Two hundred and one potential habitat trees were located within the study area, which included both suitable and future potential nesting trees (Appendix 9). Habitat trees identified within the study area were mainly Tuart (*Eucalyptus gomphocephala*; 127 trees) and Redheart (*Eucalyptus decipiens*; 39 trees), while further 35 individuals of unknown large *Eucalyptus* species were also identified as potential breeding habitat.

Thirty-six of the trees identified in the study area contained visible hollows, with twenty-four of these supporting hollows of greater than 10cm wide which are considered suitable breeding habitat for black cockatoo species (i.e. Figure 3b). Of these however, 11 hollows were currently occupied by bees and a further hollow was being used by galahs. It is also of note that not all hollows or potential hollows are visible from the ground and there are many large trees present within the study area that may also contain hollows, potentially of suitability for black cockatoo species.

No known breeding hollows are present within the reserve and is unlikely that any White-tailed cockatoos will use the reserve for breeding, with the species rarely using the southern Perth metropolitan area of the Swan Coastal Plain as breeding locations (Johnstone et. al. 2011). However, an observation was made of seven Carnaby's cockatoos at tree #76 on the 24 November 2023. Two of the birds (male and female) were observed inspecting tree hollows present in the tree (see Figures 8a & 8e; Appendix 9). The birds however were chased off by Galahs and further investigation or monitoring of these hollows may be necessary. No known breeding hollows were observed within the reserve of the Forest red-tailed black cockatoo, however, unlike the white-tailed species, red-tailed black cockatoos have been known to breed on the Swan Coastal Plain (including within the City of Cockburn), with known breeding locations in the vicinity of Murdoch University and possibly Perry Lakes (Johnstone et. al. 2017) and Bibra Lake (Birdlife, 2023a). An observation was also made on the 5th September 2023 of two birds inspecting a large hollow in a smooth-barked Eucalypt in the parkland habitats of the reserve (see Figure 8f), however no further observations were made during the course of the survey and further investigation or monitoring of these hollows, and many others, may be necessary as opportunistic breeding of Forest red-tailed black-cockatoos is a possibility within the reserve.

Figure 3. (a) Tuart woodlands, including many large, hollow-bearing individuals (b) provide potential breeding habitat for Black cockatoos.



Map 7. Location of Black cockatoo habitat trees identified at Manning Park

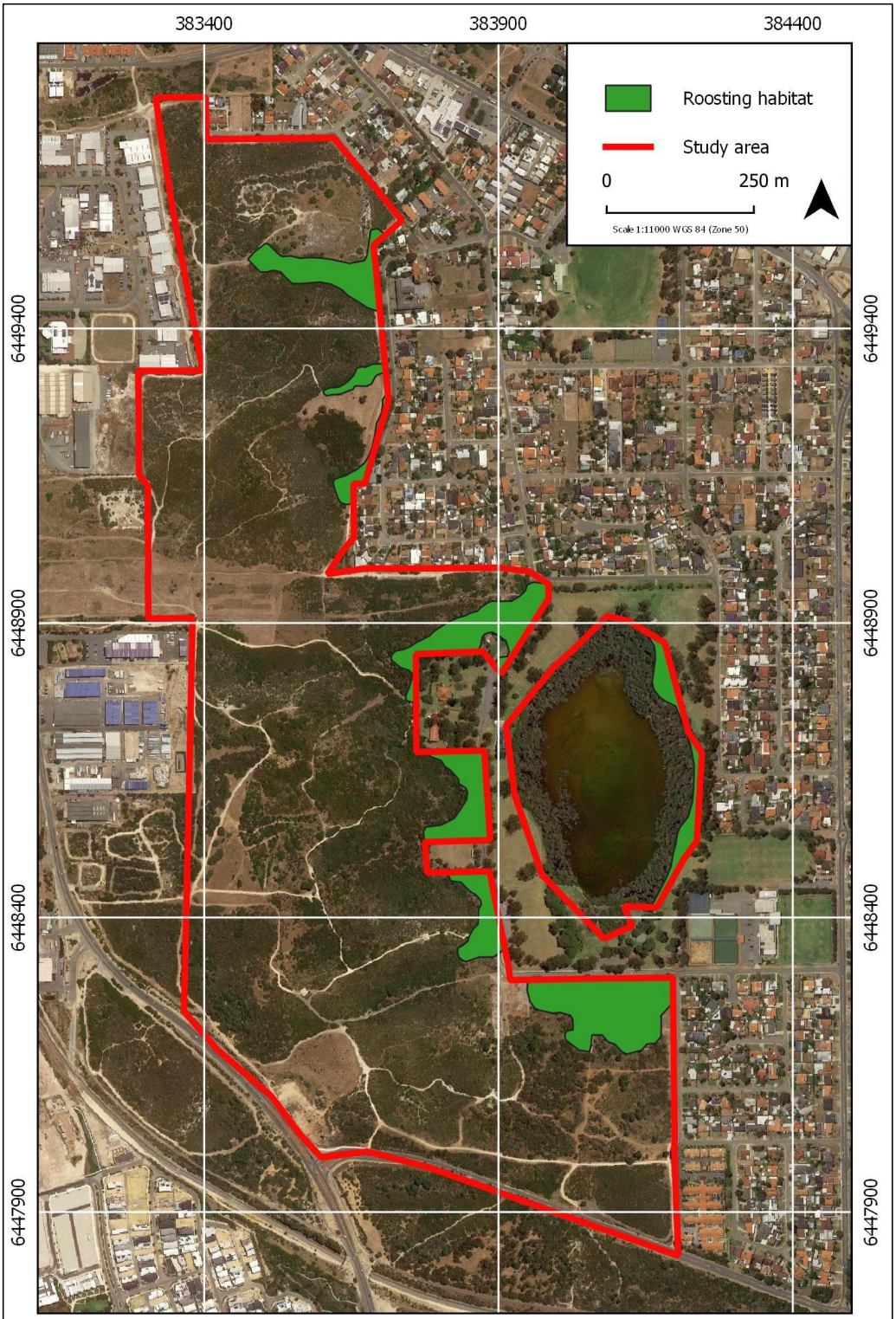
3.3.2 Roosting habitat

Up to 7.85 hectares of habitat was identified within the study area which would be classed as potential suitable for night roosting of black-cockatoo species. Much of this area (6.34 ha) occurs in the Tuart woodlands near the lake in the central-east and southeast of the reserve, while smaller areas (total 1.51ha) are patchily distributed in the north and northeast of the reserve. Large areas of potential roosting also occur throughout the parkland areas of the reserve which was not included as part of this study.

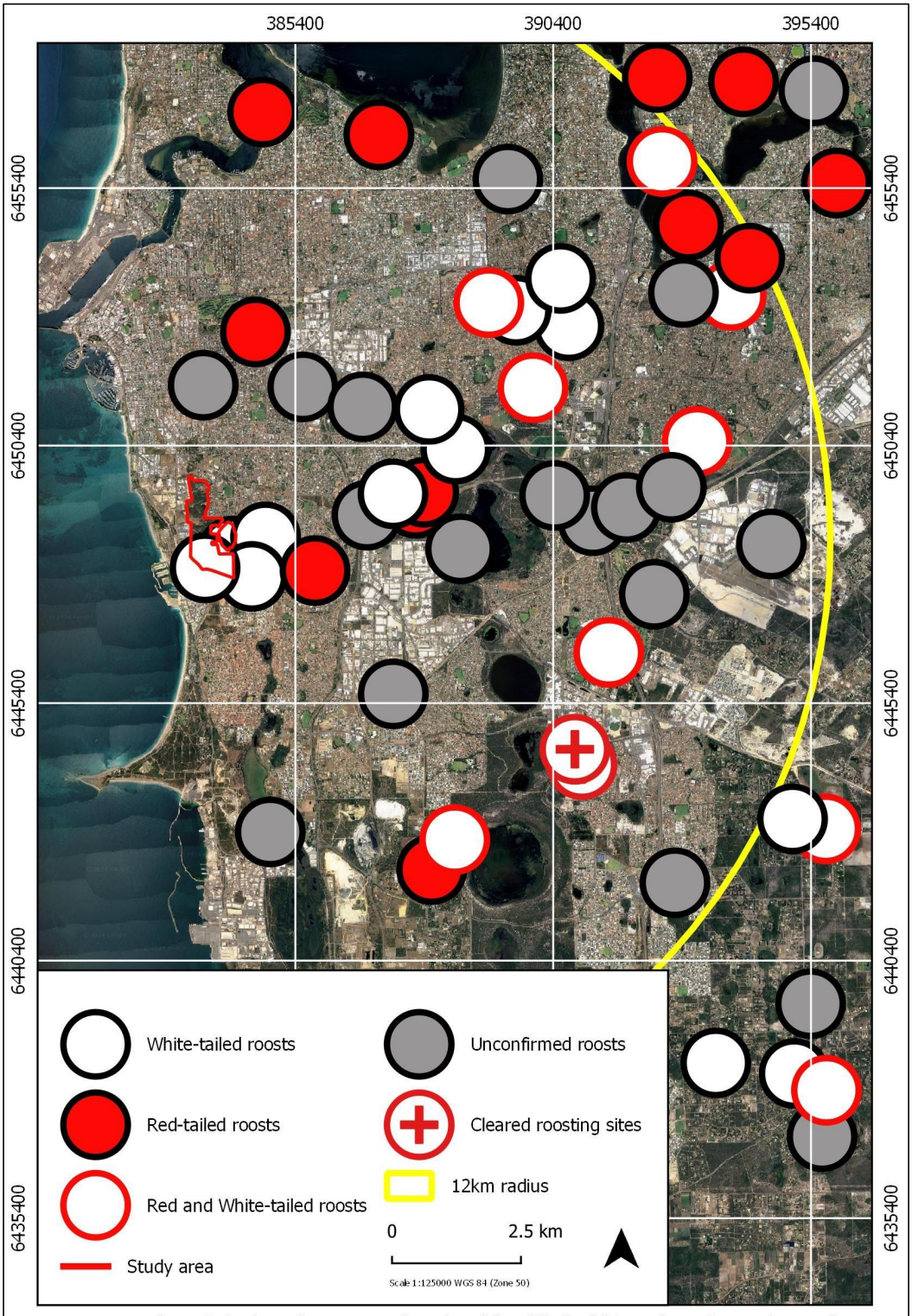
Two confirmed White-tailed black cockatoo roosts currently occur within Manning Park. While a further two confirmed roosts also occur within 1km of the reserve. A further 13 known roosts occur within 12km of the reserve and a further 16 unconfirmed roosts occur within 12km of the reserve (Birdlife, 2023a).

No Forest-red-tailed black cockatoo roosts are currently known from the reserve, however one confirmed roost is known within 2km of the reserve, while a further 15 known roosts occur within 12km of the reserve, and a further 16 unconfirmed roosts occur within 12km of the reserve (Birdlife, 2023a).

Figure 4. (a) Tuart woodlands, as well as tall trees situated within, and surrounding parkland habitat (b) provide possible roosting opportunities for Black cockatoos.



Map 8. Location of Black cockatoo roosting habitat identified at Manning Park



Map 9. Location of Black cockatoo roosting sites identified within 12km of Manning Park

3.3.3 Foraging habitat

The study area supports suitable foraging habitat for all three Black-cockatoo species. Up to 67.3 hectares of Baudin's cockatoo foraging habitat is present within the study area, which is predominantly shrubland/limestone ridge habitats containing proteaceous shrubs, particularly Parrot-bush (*Banksia sessilis)*, a high value food source for the species. No Marri trees were identified within the study area, and as such, the woodland areas are considered of lower foraging importance for the species. However, some large Pine trees (*Pinus* sp.) are scattered throughout the parkland and disturbed habitats to the south of the lake, which are of potential high value for the species. Previous surveys of the reserve, incorporating a large area of the parkland environments recorded two Marri trees in the reserve (see FVC, 2021). These however may not contribute a large resource to Baudin's cockatoo, though may be of supplementary feeding importance if and/or when Baudin's cockatoo forage within the reserve. Few confirmed records of Baudin's cockatoo are known from the reserve and the surrounding area (DBCA, 2023b).

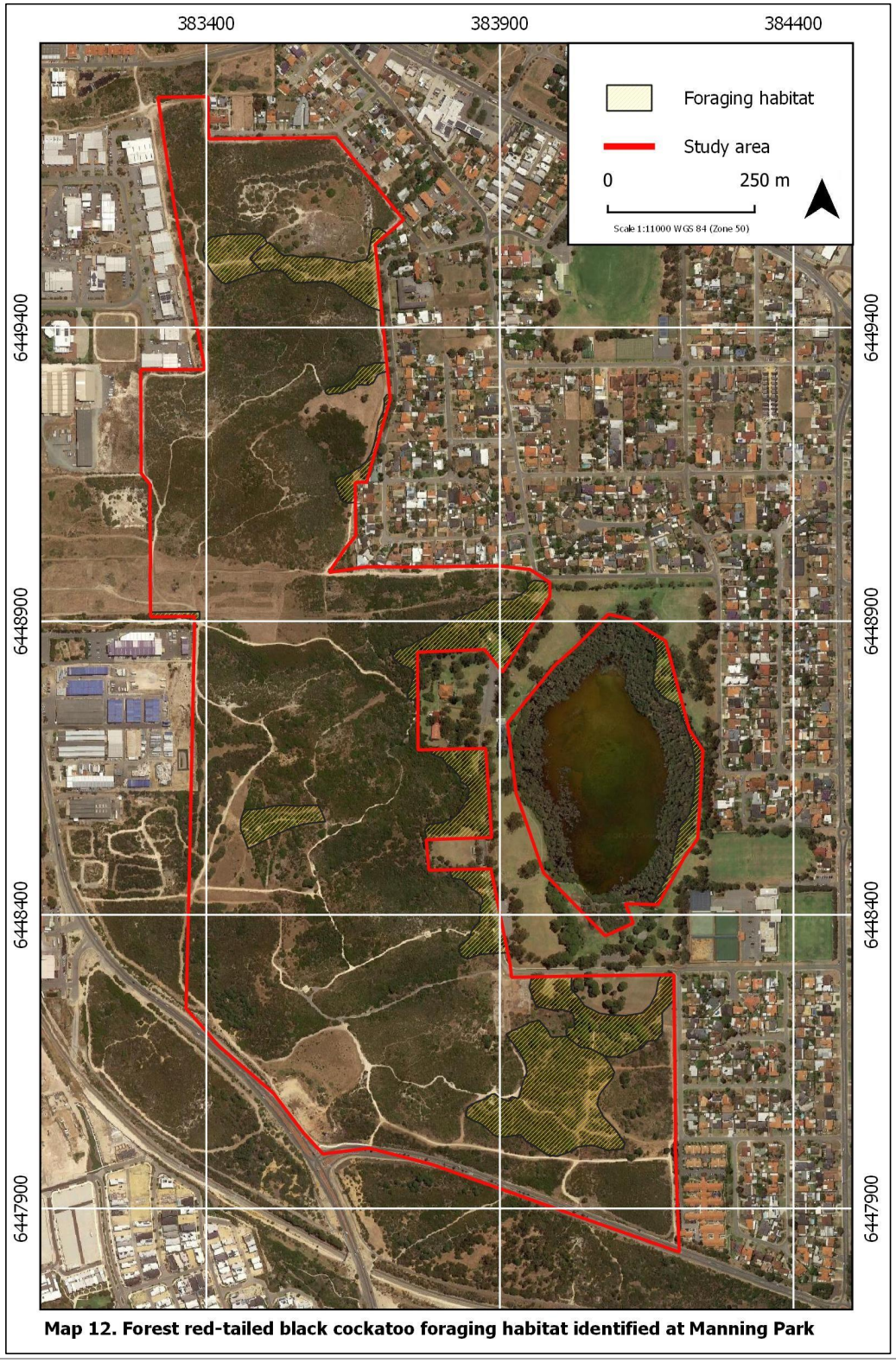
Up to 77.4 hectares of Carnaby's cockatoo foraging habitat is present within the study area, which is predominantly the shrubland/limestone ridge habitats containing proteaceous shrubs, particularly *Banksia sessilis*, a very high value food resource for the species. A significant part of the woodland and parkland habitats are also included as foraging habitat, as these areas contain extensive areas of Tuart woodland and isolated large Pine trees (*Pinus* sp.) which are also a high value food resource for the species. The *Melaleuca* woodland/wetland habitats surrounding the lake has not been highlighted as a major foraging resource for the species. However, several Carnaby's cockatoos were observed feeding in the woodlands surrounding the lake, with most feeding activity observed in from isolated Eucalypts, an observation was also made of what appeared as opportunistic feeding of *Melaleuca* seeds. There are no records in the literature of Carnaby's cockatoo feeding on *Melaleuca rhaphiophylla,* and this behaviour may have been secondary to the feeding on the Eucalypts feeding and further investigation is warranted. Several additional observations were made of Carnaby's cockatoos feeding or flying over the reserve in both shrubland and woodland habitats, as well as several observations of foraging signs (chewed *Banksia* spikes, *Callitris* nuts and pinecones), in the woodland, shrubland and parkland habitats.

Up to 12.2 hectares of Forest red-tailed black cockatoo foraging habitat was identified within the study area, which is predominantly the woodland habitats supporting Tuart and Redheart, which are considered a high value food resource, in particular Tuart. All observations of Forest red-tailed black cockatoos were made in the woodland and parkland areas, with several observations of animals feeding on Tuart nuts as well as an observation of feeding on a Cape Lilac tree just outside of the study area on Quarry Road.

Several other records of Carnaby's/White-tailed cockatoo species and Forest red-tailed black cockatoo occur within and close by the reserve and within 5km of the study area (DBCA, 2023b). Many large areas of foraging resources also exist within 20 kilometres of the reserve, including the extensive *Banksia*/Eucalypt woodlands of Jandakot Regional Park and *Banksia*/Eucalypt woodlands, and the Tuart woodlands occurring throughout the Beeliar Regional Park.

Map 10. Baudin's cockatoo foraging habitat identified at Manning Park

Map 11. Carnaby's cockatoo foraging habitat identified at Manning Park



Map 12. Forest red-tailed black cockatoo foraging habitat identified at Manning Park

Figure 5. (a) Extensive foraging resources (i.e. *Banksia sessilis*) for Carnaby's and Baudin's cockatoo throughout the proteaceous shrublands and heath; (b) Isolated Pines (*Pinus* sp.) located within parkland and some disturbed sites, provides important foraging resources for Carnaby's and Baudin's cockatoo; (c) *Eucalyptus decipiens* with some *Callitris preissii* in the low woodland habitats provide important foraging resources for Carnaby's and Forest red-tailed black cockatoo; (d) Tall Eucalypt woodlands in the vegetated uplands surrounding the wetland provide important foraging resources for Carnaby's and Forest red-tailed black cockatoo.

3.4 Vertebrate fauna assemblage

The overall trapping period incorporated 1650 trapping nights, 224 motion camera nights, six bat detector nights, 14 hours of bird surveys, eight person hours of nocturnal spotlighting, two hours of frog surveys, and 26 person hours of targeted searches (Table 1). This resulted in 903 individual fauna detections including the detection of four species of amphibian, 23 species of reptile, 12 species of mammal (including six introduced species) and 69 species of bird (including four introduced species) (Tables 2, 3, 4 and 7).

This brings the total species known from Manning Park to:

- Amphibians: Five species
- Reptiles: 23 species
- Mammals: 13 species
- Birds: 109 species

The survey area however has the potential to support up to nine amphibian species, 44 species of reptile (including four of conservation significance), 22 species of mammal (including up to four of conservation significance) and 173 species of bird (including up to 28 species of conservation significance) (Tables 2, 3, 4 and 7).

Surveys yielded five bird species, a single mammal species and a single reptile species of conservation significance:

- The EPBC listed Endangered Carnaby's cockatoo (*Zanda latirostris*)
- The EPBC listed Vulnerable Forest red-tailed black cockatoo (*Calyptorhynchus banksia naso)*
- The EPBC Migratory/Marine Pied Stilt (*Himantopus himantopus leucocephalus*)
- The EPBC Marine listed Rainbow Bee-eater (*Merops ornatus*)
- The EPBC Marine listed White-bellied sea-eagle (*Haliaeetus leucogaster*)
- The Priority 4 listed Quenda (*Isoodon fusciventer*), and
- The Priority 3 listed Perth-lined Slider (*Lerista lineata*)

Additionally, a single reptile and 14 bird species of local significance were also detected:

- Western bluetounge (*Tiliqua occipitalis*)
- Australasian shoveler
- Hardhead
- Pink-eared duck
- Dusky moorhen
- Painted button-quail
- White-browed scrub-wren
- New-holland honeyeater
- White-cheeked honeyeater
- Square-tailed kite
- Brown goshawk
- Splendid fairy-wren
- Variegated fairy-wren
- Weebill, and
- Yellow-rumped thornbill

The reserve is also known to support a further five species of conservation significance:

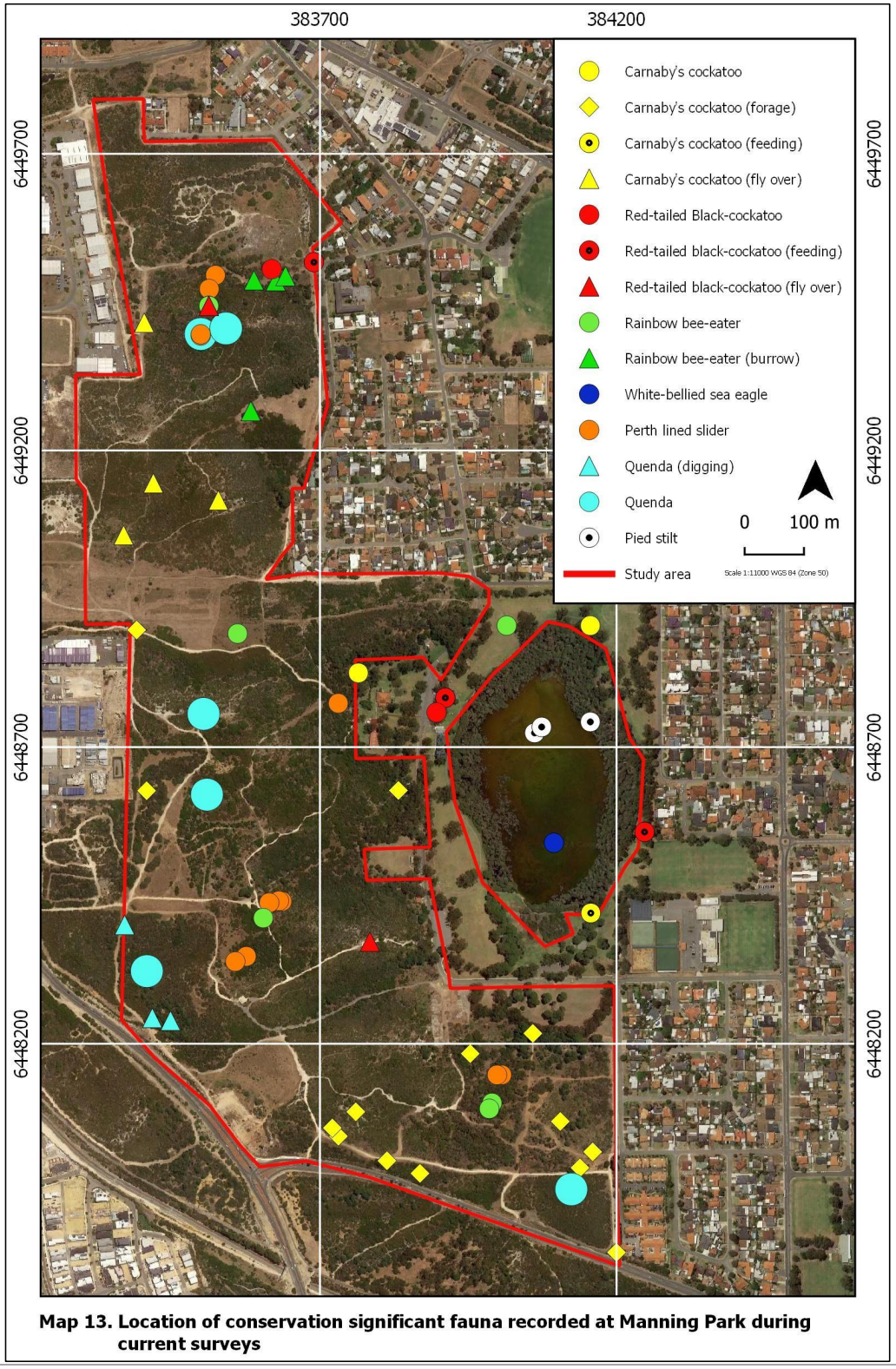
- The EPBC listed Endangered Baudin's cockatoo (*Zanda baudini*)
- The BC Act Specially Protected Peregrine falcon (*Falco peregrinus*)
- The Priority 4 Blue-billed duck (*Oxyura australis*)
- The EPBC Migratory listed Common greenshank
- The EPBC Marine listed Greater crested tern

An additional 11 species of local significant birds are also known from the reserve including:

- Musk duck
- Nankeen night-heron
- Little eagle
- Collared sparrowhawk
- Whistling kite
- Western rosella
- Western wattlebird
- Inland thornbill
- Western golden whistler
- Grey shrike-thrush, and
- Dusky woodswallow

Table 1. Number of trap-nights of each trap type across all trapping transects.

Site	Date opened	Date closed	Trap nights			
			Pitfalls	Funnels	Cages/Elliott (Large)	Elliott (Small)
1	16-Nov-23	23-Nov-23	70	140	50	50
2	16-Nov-23	23-Nov-23	70	140	50	50
3	16-Nov-23	23-Nov-23	0	0	50	50
4	16-Nov-23	23-Nov-23	70	140	50	50
5	17-Nov-23	24-Nov-23	70	140	50	50
6	17-Nov-23	24-Nov-23	70	140	50	50
Total trap-nights			350	700	300	300



Map 13. Location of conservation significant fauna recorded at Manning Park during current surveys

3.4.1 Amphibians

Up to nine species of amphibian have the potential to occur within Manning Park (Table 2). Of these, four species were recorded during the current survey: the Motorbike frog (*Litoria moorei*), Slender tree frog (*Litoria adelaidensis*), Moaning frog (*Heleioporus eyrei*), and Banjo frog (*Limnodynastes dorsalis*) (Table 2). All four species have previously been recorded in the reserve (FaunaTrack, 2018; WASAH, 1999), while the Squelching froglet (*Crinia insignifera*) has also been recorded on previous surveys of the reserve (WASAH, 1999), bringing the total number of species known to occur in the reserve to five (55.5% of predicted species).

All five species appeared to be confined to the wetland and open water habitats, with all sightings made from within and around this area, mostly during targeted frog surveys. No amphibians were captured in traps or detected during spotlighting or targeted searches in the vegetated uplands and limestone ridge habitats. However, previous fauna surveys had captured the Moaning frog and Banjo frog at all habitats within the reserve, including the limestone ridge (FaunaTrack, 2018; WASAH, 1999).

No other species of amphibians have been recorded within 2km of the reserve, however the Clicking froglet (*Crinia glauerti*), the Turtle Frog (*Myobatrachus gouldii*) and the locally significant Quacking froglet (*Crinia georgiana*) are known from approximately 5km of the reserve at North and Bibra Lakes within eastern Beeliar lake chain (ALA, 2023; DBCA, 2023c; FaunaTrack, 2022; Cornwall, 2004). While the Crawling toadlet (*Pseudophryne guentheri*) is known from Yangebup Lake (DBCA, 2023c). Most of these species are primarily associated with waterbodies and swamps on the Swan Coastal Plain, and although relatively common throughout the eastern Beeliar lake chain and neighbouring bushland areas, Manning Park contains an isolated, relatively small wetland and is separated from other large wetland systems by drier landscapes and a significant limestone ridge, as a result, these amphibians are unlikely to occur in the reserve. The Turtle frog however can be a difficult species to detect, particularly during the drier times of year, with their tendency to only emerge during heavy rainfall events, which were not encountered during the survey period. This species however mainly occurs in sandplains supporting Banksia/Eucalypt woodlands, a habitat not well represented within Manning Park, and is unlikely to occur in the reserve.

Table 2. Amphibians expected to occur, known to occur and/or recorded during the current survey at Manning Park

Species		Status	Likelihood	Recorded current survey	
				Trap	Opp
Pelodryadidae (Tree Frogs)					
Slender Tree Frog	*Litoria adelaidensis*		Known		+
Motorbike Frog	*Litoria moorei*		Known		+
Limnodynastidae (Large Ground Frogs)					
Moaning Frog	*Heleioporus eyrei*		Known		+
Banjo Frog	*Limnodynastes dorsalis*		Known		+
Myobatrachidae (Small Ground Frogs)					
Quacking Frog	*Crinia georgiana*	L	Possible		
Clicking Froglet	*Crinia glauerti*		Possible		
Squelching Froglet	*Crinia insignifera*		Known		
Turtle Frog	*Myobatrachus gouldii*		Possible		
Guenther's Toadlet	*Pseudophryne guentheri*		Possible		
Species expected	**9**				
Species recorded during 2023	**4**				

L = Locally significant due to a reduced distribution and/or population on the Swan Coastal Plain (Government of WA 2000),

3.4.2 Reptiles

Twenty-two (52%) of a potential 44 reptile species were recorded during the current survey, bringing the number of species known to occur in the reserve to 23 (55% of predicted species; see Table 3). This figure also includes three species that had not been recorded in the reserve previously, which include the Marbled gecko (*Christinus marmoratus*), South-west four-toed Lerista (*Lerista distinguenda*) and West coast pale-flecked Morethia (*Morethia lineoocellata*). These three species however are known from several locations near to the reserve (DBCA, 2023c). The only species detected previously in the reserve that was not detected during the current surveys was the Bynoe's gecko (*Heteronotia binoei*) (see FaunaTrack, 2018), however the natural distribution of this species in the area is unknown and most likely transported to the area (Bush et. al. 2010).

Skinks (12 species) were the most abundant and speciose group detected during the current survey. While three species of legless lizard and three species of snake were also recorded, along with two gecko species, and a single species of dragon lizard and a freshwater turtle. This also included the conservation significant Priority 3 Perth-lined slider (*Lerista lineata*), and the locally significant Western bluetongue (*Tiliqua occipitalis*) (see Table 3).

The limestone ridge habitats supporting shrublands appeared to support the highest reptile diversity, with 16 species recorded across the combination of sites 2(10), 5(11) and 6(11). This habitat also appeared to support four species that were not detected in other habitats. These include: Southern spiny-tailed gecko (*Strophurus spinigerus*), Western bearded dragon (*Pogona minor*), Gray's Delma (*Delma grayii*), Burton's snake-lizard (*Lialis burtonis*), Limestone Ctenotus (*Ctenotus australis*) and Black-striped snake (*Neelaps bimaculatus*). While the wetland habitats only appeared to support three species (Oblong turtle, King skink and Dugite), with many Oblong turtle (*Chelodina oblonga*) nests recorded in and around the perimeter of the wetland and extending into parkland habitats. The King skink (*Egernia kingii*) was only recorded within the *Melaleuca* forest surrounding the lake, while the Dugite (*Pseudonaja affinis*) was observed opportunistically crossing the walking path during targeted surveys, as well as throughout the remainder of the reserve. No pitfall or funnel traps were installed in the wetland habitat, so reptile captures were low and targeted searches failed to detect any additional species. The Tuart woodlands were moderately diverse, with 11 species detected here, three of which were not detected in other habitats: Marbled Gecko, South-west four-toed Lerista and West coast pale-flecked Morethia. While the woodland habitats supporting *Eucalyptus decipiens* recorded nine reptile species, with a combination of species regularly detected at all other habitats (excluding the wetland), including Sandplain worm-lizard (*Aprasia repens)*, West coast Ctenotus (*Ctenotus fallens)*, Two-toed mulch-skink (*Hemiergis quadrilineata)*, Dwarf skink (*Menetia greyii)* and Bobtail (*Tiliqua rugosa*).

The Perth lined slider was the only reptile species of conservation significance recorded during the current survey, detected on 10 separate occasions in limestone ridge habitats including the heathy shrublands of Site 2 and *Acacia* dominated shrublands of Site 6. Several detections were also made in the Redheart (*Eucalyptus decipiens*) woodland at Site 1, while a single individual was unearthed from beneath *Acacia* litter during targeted searches. The Perth-lined slider has previously been detected from the reserve (FaunaTrack 2018; WASAH, 1999), with all previous records located within the limestone ridge habitats (DBCA, 2023b; FaunaTrack, 2018). The Perth lined slider is largely restricted to the Swan Coastal Plain, from East Fremantle in the north (including Rottnest and Garden Islands) to Mandurah in the south, where it is found on coastal dunes supporting heath and shrublands, and *Banksia* and/or Eucalypt woodlands with pale sand on coastal plains, where it shelters in the loose upper soil, leaf litter and under logs. Its core range is centred around the highly disturbed southern Perth metropolitan areas, however much of its habitat has been destroyed through urbanisation and it is now restricted to remnant bushland areas and suburban gardens, where it is subject to a range of threats including weeds, fires, introduced predators and further habitat clearing and fragmentation (Maryan et. al. 2015). The high-quality shrublands and extensive ground litter occurring throughout much of the limestone ridge habitats in Manning Park are an important habitat and distributional stronghold for this species, particularly as Manning Park represents the a large part of the northerly distribution for the species along the coastline.

Few other species of conservation significance have the potential to occur within the reserve. Species such the Black-striped snake (*Neelaps calonotos*) may occur in the reserve. The Black-striped snake is confined to the Swan Coastal Plain from Dongara in the north to Mandurah in the south, where it is an inhabitant of coastal dunes and sandplains supporting *Banksia*/Eucalypt woodlands and heath. It is a fossorial species, sheltering in leaf litter and soil at the base of trees and shrubs, where it feeds exclusively on lizards, particularly *Lerista* and *Aprasia* (Bush et. al. 2010). It is generally more common north of Perth, particularly large bushland areas north of Alkimos, with records south of Perth uncommon to scarce, with most occurring from the larger inland reserves such as Jandakot Airport or coastal heath between Peron and Mandurah (He, 2021). Much of its distribution in the greater Perth metropolitan area has, and continues to be threatened by habitat loss through increased urban developments, and as such, this species is becoming increasingly restricted to these larger bushland remnants and becoming harder to find. A nearby record exists from Woodman Point (DBCA, 2023b) approximately 4km south of the study area, however this record is from 1965 and bushland in the local area was most likely much more connected and it is thought that *N. calonotos* populations may not persist in bushland areas of less than 1000 hectares (see How & Shine 1999; Bamford & Wilcox 2005).

In addition, the Western carpet python (*Morelia spilota imbricata*) is known to persist in large bushland remnants supporting woodlands and coastal limestone, however, most recent records are also from north of the Swan River (Bush et. al. 2010). Records further south are scarce, with no known recent records nearby to the reserve. While the Jewelled Ctenotus (*Ctenotus gemmula*) may also be absent from the reserve. This species is primarily an inhabitant of *Banksia* woodland with low vegetation (Bush *et. al.* 2010), a habitat generally absent from the reserve. There are no nearby records and recent records are generally scarce, most also being north of the Swan River as much of its former range south of the river has been cleared for developments (Bush *et al.* 2010).

Other notable reptile records from reserve included the locally significant Western bluetongue (*Tiliqua occipitalis*) and the potentially, locally restricted King Skink (*Egernia kingii*) and habitat restricted South-west four-toed Lerista (*Lerista distinguenda*).

The Western bluetongue was detected on several occasions in the limestone ridge habitats on cameras FA2 and FC9. The reserve represents the near southern distributional limit of for this species, which is reliant on large, undisturbed bushland areas, particularly with low, dense vegetation (Bush *et. al.* 2010). The Western bluetongue has previously been detected in the reserve on several occasions (ALA, 2023; WASAH, 1999) and is also known from adjoining bushland areas including CY O'Connor Reserve to the west and bushland areas to the south (pers. obs.) This species most likely persists due to the size and condition of bushland in the reserve and proximity to nearby bushland, creating a semi-connected habitat corridor through to the Woodman Point area and further to the south-east into Beeliar Regional Park.

The South-west four-toed Lerista is predominantly restricted to the Darling Range, however scattered populations occur along the Swan Coastal Plain, where it generally prefers woodlands on harder soils (Bush et. al. 2007). This species was only detected in the harder soils and rocky substrates of the Tuart woodlands within the reserve. Other nearby records include CY O'Connor Reserve (DBCA, 2023c) and Booyeembara Park in Fremantle (ALA, 2023), which also support harder, rocky substrates with Eucalypts. This habitat is not well represented within Manning Park or the local area, with remaining woodlands becoming degraded or isolated.

A population of the King skink inhabiting remnant vegetation around the lake is of interest. Although not of conservation significance, this represents a significant locality, as there are few known populations in the area, most separated by large expanses of urban development. The nearest known records are approximately 3.5km to the south at Lake Coogee (pers. obs.) and further to the north along the Swan/Canning Rivers (Bush et. al. 2010). However, unconfirmed records exist 5km to the east at North Lake (see Cornwall 2004), otherwise there seems to be no apparent records from the eastern Beeliar wetland chain. King skinks inhabit rocky outcrops and coastal heath or shrublands, often in association with limestone outcropping, where they shelter in rock crevices and tree hollows (Wilson & Swan, 2021). Being a large skink (up to 40 cm total length), they are extremely susceptible to predation by feral predators and domestic animals, particularly cats, with observations of up to four King skinks found in the stomach of a single feral cat (see Maryan et al 2017). No detections were made in the limestone ridge habitats, with all records from the wetland habitats. The area around the lake inhabited by the King skink contains large, hollow bearing trees (*Melaleuca* and *Eucalyptus* spp.), with a dense understorey providing ample shelter and foraging habitat. The area between the lake and the surrounding bushland is predominantly open parkland, with few areas of suitable cover, possibly restricting movements of the lizard into nearby bushland areas. The highly disturbed and fragmented coastal plain has no doubt affected the local distribution of this lizard, with fragmentation and clearing leaving lizards exposed to predation.

Figure 6. (a) The conservation significant (Priority 3) Perth-lined Slider (*Lerista lineata*) was captured on several occasions in limestone ridge habitats and low open woodland; (b) The habitat restricted Southwest four-toed Lerista (*Lerista distinguenda*) was only detected in Tall (Tuart) woodland habitats; (c) The locally significant Western bluetongue (*Tiliqua occipitalis*) was detected on several occasions on motion cameras; (d) The uncommon, and locally restricted King skink (*Egernia kingii*) was commonly detected in wetland habitats surrounding the lake.

Table 3. Reptiles expected to occur, known to occur and/or recorded during the current survey at Manning Park.

Species		Status	Likelihood	Trapping site						Targeted / opp
				1	2	3	4	5	6	
Cheluidae (Freshwater turtles)										
Oblong Turtle	*Chelodina oblonga*		Known			x				+
Agamidae (Dragon Lizards)										
Dwarf Bearded Dragon	*Pogona minor*		Known					1		+
Western Heath Dragon	*Ctenophorus adelaidensis*		Unlikely							
Diplodactylidae (Gondwanan Geckos)										
Southern Spiny-tailed Gecko	*Strophurus spinigerus*		Known		3			2	1	+
Gekkonidae (Cosmopolitan Geckos)										
Marbled Gecko	*Christinus marmoratus*		Likely				1			
Bynoe's Gecko	*Heteronotia binoei*		Known							
Pygopodidae (Legless Lizards)										
Sandplain Worm Lizard	*Aprasia repens*		Known	3	1		1	1		
Fraser's Legless Lizard	*Delma fraseri*		Likely							
Gray's Legless Lizard	*Delma grayii*		Known		1					
Burton's Snake Lizard	*Lialis burtonis*		Known		5			3	2	
Keeled Legless Lizard	*Pletholax gracilis*	L	Likely							
Common Scaly-foot	*Pygopus lepidopodus*		Likely							
Scincidae (Skinks)										
Southwest Cool Skink	*Acritoscincus trilineatus*	L	Likely							
Fence Skink	*Cryptoblepharus buchananii*		Known	2			3		1	+
Limestone Ctenotus	*Ctenotus australis*		Known		1				1	
West Coast Ctenotus	*Ctenotus fallens*		Known	11			4	14	4	+
Jewelled Ctenotus	*Ctenotus gemmula*	P3	Unlikely							
King Skink	*Egernia kingii*		Known			11				+
South-west Crevice Skink	*Egernia napoleonis*	L	Possible							
Two-toed Mulch Skink	*Hemiergis quadrilineata*		Known	9	3		4	1	4	+
South-west four-toed Lerista	*Lerista distinguenda*		Likely				22			
West-coast four-toed Lerista	*Lerista elegans*		Likely							
Perth Lined Slider	*Lerista lineata*	P3	Known	1	4				6	+
Line-spotted Lerista	*Lerista lineopunctata*		Possible							
Worm Lerista	*Lerista praepedita*	L	Possible							
Western Swamp Skink	*Lissolepis luctuosa*	L	Possible							
Dwarf Skink	*Menetia greyii*		Known	21	4		3		3	+
West Coast Morethia	*Morethia lineoocellata*		Likely				3			
Obscure Skink	*Morethia obscura*		Known				10		1	+
Western Blue-tongued Lizard	*Tiliqua occipitalis*	L	Known							+
Bobtail	*Tiliqua rugosa*		Known	10	6		9		5	+
Varanidae (Goannas)										
Gould's Goanna	*Varanus gouldii*		Possible							
Rosenberg's Goanna	*Varanus rosenbergi*	L	Unlikely							
Pythonidae (Pythons)										
Western Carpet Python	*Morelia spilota imbricata*	S	Possible							
Typhlopidae (Blind Snakes)										
Southern Blind Snake	*Anilios australis*		Known	1				5		
Elapidae (Front-fanged Land Snakes)										
Narrow-banded Shovel-nosed Snake	*Brachyurophis fasciolatus*		Unlikely							
Southern Shovel-nosed Snake	*Brachyurophis semifasciatus*		Possible							
Yellow-faced Whipsnake	*Demansia reticulata*	L	Possible							
Black-naped Snake	*Neelaps bimaculatus*		Known		2				1	
Black-striped Snake	*Neelaps calonotos*	P3	Possible							
Tiger Snake	*Notechis scutatus*		Likely							
Gould's Hooded Snake	*Suta gouldii*		Possible							
Dugite	*Pseudonaja affinis*		Known	3		x	1	1		+

Species		Status	Likelihood	Trapping site						Targeted / opp
				1	2	3	4	5	6	
Jan's Banded Snake	*Simoselaps bertholdi*		Likely							
Species expected	**44**	**Total species**		9	10	3	11	8	11	
Species recorded during 2023	**23**									

S = Specially Protected (BC Act)

P3 = Priority 3 (DBCA)

L = Locally significant due to a reduced distribution and/or population on the Swan Coastal Plain (Government of WA 2000)

3.4.3 Mammals

Twelve species of mammal were recorded during the current survey (Tables 4 and 6). Of these however, six are introduced and further five are insectivorous micro-bats. Subsequently, the Quenda (*Isoodon fusciventer*) was the only species of native, terrestrial mammal detected, and the only mammal of conservation significance detected during the current survey. Apart from anecdotal reports that Quenda inhabit Manning Park, this also formally includes Quenda in the species list for the reserve, as up until now, no official records were known from the reserve on public databases. The nearest confirmed records were from two animals just to the south and south-west of the reserve along Spearwood and Cockburn roads (DBCA, 2023b), which suggests that Quenda do occur in the reserve.

However, with this known, only a single Quenda was captured during the survey, despite 300 trapping nights across all trap locations. Several motion cameras did however detect Quenda, with further detections made across five motion cameras (FA7, FB7, FC2, FC3, and FD3). Several Quenda diggings were also recorded during targeted surveys.

All Quenda detections were from limestone ridge habitats, which generally consisted of a shrublands and heath with a dense, low shrub cover, a habitat requirement for the species. In addition, most Quenda were detected on the western side of the limestone ridge, as well as isolated detections in the north and south of the reserve. Quenda are generally known to inhabit a range of forest, woodlands and wetlands, providing there is sufficient low vegetation and habitat connectivity (Paull, 2008), however, no detections were made in the remaining habitats, including the well-vegetated wetland habitats. Quenda, were also recorded in dense thickets of the introduced tea-tree (*Leptospermum laevigatum*). The tea-tree is a established weed, that dominates the vegetation in the south-western part of the reserve, this also occurs in scattered localities throughout the reserve where it grows in disturbed sites and outcompetes local vegetation due to it dense, sprawling canopy and dense leaf-litter mats. As much of the south-western part of the reserve is disturbed to degraded, this habitat may currently play a role as a habitat corridor. The western and southern parts of the reserve are also the closest proximity to neighbouring bushland areas, such as those associated with the Fremantle rail corridor and further south of rail line towards Coogee. Although separated by major roads including Cockburn and Spearwood Roads, and the rail line, this part of the reserve may act as an important area, facilitating movement of Quenda within the reserve and to neighbouring bushland areas. The entire eastern edge of the reserve, including the wetland, is either isolated from adjacent bushland areas or adjoins residential development. These areas may not act as suitable areas for the Quenda to occur, or at least regularly frequent. Further surveys along the eastern edge of the reserve may help to further confirm Quenda presence/absence.

Few other mammal species of conservation significance are expected to occur within the reserve. A single Quokka record exists from approximately 1.1km northwest of the reserve, which represents a moderately certain observation of dead specimen on South Beach in 2009 (DBCA, 2023b). This may potentially be a beach-washed animal; however, the Quokka is assumed to be locally extinct in the immediate mainland area and highly unlikely to be present within the reserve or the local area.

The Specially Protected Brush-tailed phascogale (*Phascogale tapoatafa*) is a possibility to occur in the reserve, with known historical records from nearby, including a recent sighting 3.5km away on Rockingham Road in Lake Coogee in 2022 (DBCA, 2023b). The Brush-tailed phascogale is extremely rare in the greater Perth metropolitan area, with the only other nearby record being from the 1970's in Harry Waring Nature Reserve (DBCA, 2023b). Phascogales are typically associated with open forest containing sparse groundcover (Soderquist & Rhind, 2008), in particular the Tuart forests further south and Jarrah forests of the Darling Range. Suitable habitat occurs within the reserve of potential to support Brush-tailed phascogales, however overall suitable habitat is small and isolated, and it is unlikely that the species occurs or persists in the reserve. Further surveys, particular motion camera surveys of longer duration may help to confirm its presence.

The Priority 4 listed Western false pipistrelle (*Falsistrellus mackenziei*) may occasionally use the reserve. Although primarily an inhabitant of Eucalypt forests and woodlands of the lower south-west, it also occurs in *Banksia* woodlands on the Swan Coastal Plain, and favours tree hollows as roost sites (Churchill, 1998). Due to significant large trees and tree hollows within the reserve, there is potential for the species to roost in or nearby the reserve, or possibly forage within and around the reserve. Few records are known from Swan Coastal Plain around Perth, with only one nearby record from Thomson's Lake Nature Reserve (DBCA, 2023b), with the species being rarely detected. Otherwise, micro-bat diversity was relatively high, with five of a possible eight species being detected (Tables 4 and 5). All six sites (habitats) recorded the Gould's wattled bat (*Chalinolobus gouldii*), with this species being extremely adaptable, found in almost all habitats including urban areas (Churchill, 1998). The White-striped mastiff bat (*Austronomus australis*) was found at all sites except the wetland (Site 3). This species forages in a wide variety of habitats, however it tends to forage at much higher altitudes than other species, often 50m or more above the ground (Churchill, 1998). The dense canopy cover in the wetland habitats may have prevented the ultrasonic recorder from detecting this species. The wetland however, was the only location where the Lesser long-eared bat (*Nyctophilus geoffroyi*) was detected, with this species preferring to fly much lower, usually 6-10m from the ground, but often 1-4m in open areas (Churchill, 1998). Additionally, the Southern forest bat (*Vespadelus regulus*) was only detected at Site 4 and 6 and Western free-tail bat (*Ozimops kitcheneri*) also at site 6. These two species are often associated with tall forests habitats (Churchill, 1998), with both sites 4 and 6 within or near tall forest/woodland habitats. Although none of the confirmed species are of conservation significance, most insectivorous bats on the Swan Coastal Plain in the greater Perth metropolitan area are often regarded as locally significant (i.e. GHD, 2019), and the detection of a high diversity of species highlights the conservation significance of the reserve.

The locally significant Honey possum (*Tarsipes rostratus*) and Common brushtail possum (*Trichosurus vulpecula*) may occur in the reserve. Honey possums in particular rely on diverse, long-unburnt *Banksia* woodlands which provide a food source (nectar and pollen) all year round, which the reserve provides (*Banksia sessilis* and other proteaceous shrubs on the limestone ridge), however, the species is becoming increasingly scarce on the Swan Coastal Plain around Perth, mainly due to the reduction and degradation of *Banksia* woodland by increased urban development, fire and dieback (Bradshaw, 2014) and there are only a handful of records known from the broader area (i.e. Harry Waring Marsupial Reserve; DBCA, 2023b). The isolation of the reserve may limit their occurrence and further survey work is required to help determine their presence in the reserve. No detections were made of the Brushtail possum during the current surveys, however possums are also becoming increasingly scarce on the Swan Coastal Plain, mainly due to habitat fragmentation through increased urban development, fire and also predation by feral and domestic predators and road mortality. Few records are known from nearby, with almost all records associated with areas along the eastern Beeliar lake chain. Possums are reliant on large, hollow bearing trees, which are well represented within the reserve, with several trees containing large hollows suitable for possums (Appendix 9). Possums however may be susceptible to predation by feral predators and possibly domestic dogs, or succumbing to road deaths due to the close proximity to major roads, and isolation from any nearby suitable habitat.

Six introduced mammal species were recorded during the current survey, however this included observations of Domestic dogs on motion cameras. Subsequently, five species of introduced feral species were detected. The House mouse (*Mus musculus*) was detected at all trapping sites and on six of the 16 motion cameras. However, only a single capture was made at the woodland site 4 and the *Acacia* shrublands of site 6. The Black rat (*Rattus rattus*) was infrequently captured at trapping sites 2, 3, 4 and 6, however it was readily detected on 10 of the 16 motion cameras. While up to four individual Cats (*Felis catus*; feral/stray) were detected on motion cameras FA6 and FB2 in the far north of the reserve. Two additional cat sightings were also made in the north of the reserve during targeted surveys. Only a single detection was made of the Red fox (*Vulpes vulpes*), with an animal detected on camera FC8 in the northeastern side of the lake. Most Rabbit (*Oryctolagus cuniculus*) detections were made in the degraded habitats in the south-west of the reserve, with motion cameras FA2, FB7 and FD3 all detecting rabbits, while several diggings, scat piles (buckheaps), warrens and live individuals were also observed in the south-west of the reserve.

Table 4. Mammals expected to occur, known to occur and/or recorded during the current survey at Manning Park

Species		Status	Likelihood	Trapping site						Targeted / opp
				1	2	3	4	5	6	
Tachyglossidae (Echidnas)										
Echidna	*Tachyglossus aculeatus*		Unlikely							
Peramelidae (Bandicoots)										
Quenda	*Isoodon fusciventer*	P4	Likely		1					+
Dasyuridae (Carnivorous marsupials)										
Brush-tailed Phascogale	*Phascogale tapoatafa*	S	Possible							
Macropodidae (Kangaroos & Wallabies)										
Western Grey Kangaroo	*Macropus fuliginosus*		Unlikely							
Quokka	*Setonix brachyurus*	VU	Unlikely							
Phalangeridae (Brushtail Possums)										
Brush-tailed Possum	*Trichosurus vulpecula*	L	Possible							
Tarsipedidae (Honey Possum)										
Honey Possum	*Tarsipes rostratus*	L	Likely							
Molossidae (Free-tail Bats)										
White-striped Mastiff Bat	*Austronomus australis*		Known							+
Western Free-tail Bat	*Ozimops kitcheneri*		Likely							+
Vespertilionidae (Vespertilionid Bats)										
Southern Forest Bat	*Vespadelus regulus*		Likely							+
Gould's Wattled Bat	*Chalinolobus gouldii*		Known							+
Chocolate Wattled Bat	*Chalinolobus morio*		Possible							
Western False Pipistrelle	*Falsistrellus mackenziei*	P4	Possible							
Lesser Long-eared Bat	*Nyctophilus geoffroyi*		Known							+
Greater Long-eared Bat	*Nyctophilus major*		Possible							
Muridae (Rate and Mice)										
House Mouse	*Mus musculus*	*	Known	8	7	9	1	8	1	+
Brown Rat	*Rattus norvegicus*	*	Likely							
Black Rat	*Rattus rattus*	*	Known		1	4	1		1	+
Leporidae (Rabbit)										
European Rabbit	*Oryctolagus cuniculus*	*	Likely							+
Canidae (Fox and Dog)										
Domestic Dog	*Canis lupus familiaris*	*	Likely							+
European Red Fox	*Vulpes vulpes*	*	Known							+
Felidae (Cats)										
Cat	*Felis catus*	*	Likely							+
Species expected	**22**	**Total species**		1	2	1	1	1	1	
Species recorded during 2023	**12**									

VU = Vulnerable (EPBC and/or BC Act)

S = Specially protected (BC Act)

P4 = Priority 4 (DBCA)

L = Locally significant due to a reduced distribution and/or population on the swan coastal plain (Government of WA 2000), or at extreme limit of distribution

*** = Introduced species**

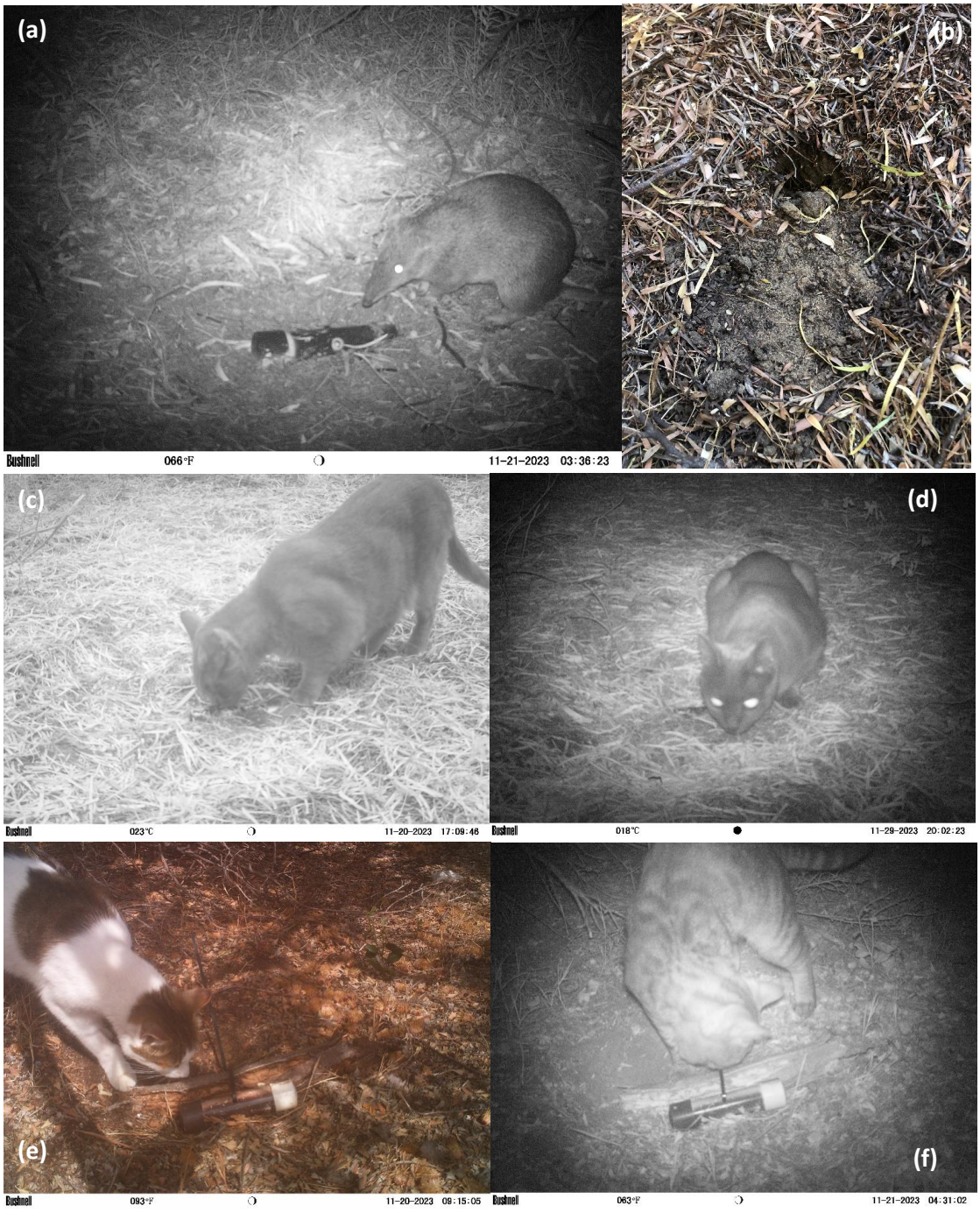


Figure 7. (a) The conservation significant (Priority 4) Quenda (*Isoodon fusciventer*) was readily detected on motion cameras on the limestone ridge, but rarely captured in traps; (b) Quenda diggings were also detected in the southwest of the reserve; (c-f) Four, uncollared Cats (*Felis catus*) detected on motion cameras; (g) The Red fox (*Vulpes vulpes*) was detected twice from motion cameras; (h) Rabbits (*Oryctolagus cuniculus*) were detected from cameras, scats and burrows, particularly in the southwest of the reserve.

Table 5. Results of bat call recording analysis outlining the date, site and species detected at each site at Manning Park

Date	Site	Species
16-Nov-23	4	*Austronomus australis* *Chalinolobus gouldii* *Vespadelus regulus*
17-Nov-23	1	*Austronomus australis* *Chalinolobus gouldii*
18-Nov-23	2	*Austronomus australis* *Chalinolobus gouldii*
19-Nov-23	5	*Austronomus australis* *Chalinolobus gouldii*
20-Nov-23	6	*Austronomus australis* *Chalinolobus gouldii* *Ozimops kitcheneri* *Vespadelus regulus*
21-Nov-23	3	*Chalinolobus gouldii* *Nyctophilus geoffroyi*

Table 6. Motion camera number and species detected on each camera (represented by an '+') at each camera location at Manning Park.

Species/Camera	FA1	FA2	FA6	FA7	FA10	FB1	FB2	FB3	FB7	FC2	FC3	FC6	FC8	FC9	FD3	FD6
Quenda				+					+	+	+				+	
Black Rat		+			+	+	+	+	+			+	+		+	+
Cat			+				+									
King Skink																
Fox									+				+			
House mouse	+				+					+	+			+		+
Buff-banded rail	+															
Bobtail		+		+	+	+	+	+	+		+	+			+	+
Spotted dove		+														
Rabbit		+							+						+	
Raven		+														
Western bluetongue		+												+		
Painted button-quail					+											
Domestic dog						+										
Scrub-wren							+									
Laughing dove								+								
Magpie																+

3.4.4 Birds

Sixty-nine species of bird were recorded during the current survey, which is 40% of a predicted 173 of potential species to occur in the reserve, or 63% of a total 109 bird species that have previously been recorded in the reserve (Table 7). Of the total potential species, up to 28 species of conservation significant bird species are known or have the potential to occur. However, only five species of conservation significance were detected during the current survey (Table 7): The EPBC and BC Act listed Endangered Carnaby's cockatoo (*Zanda latirostris*), EPBC and BC Act listed Vulnerable Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*), and EPBC Act listed Marine Pied stilt (*Himantopus himantopus leucocephalus)*, Rainbow bee-eater (*Merops ornatus*) and White-bellied sea-eagle (*Haliaeetus leucogaster*).

The greatest bird diversity was in and around the wetland habitats of Site 3, with 45 species detected. This included 26 species that were not detected elsewhere in the reserve. All these species however, excluding the Magpie-lark, are predominantly wetland/and or coastal waterway species (i.e. ducks, grebes and cormorants), and besides the occasional flyover, are not generally seen away from wetland or coastal marine habitats. The wooded habitats of sites 1 and 4 yielded over 20 species of birds, with these sites (including site 3) recording a larger percentage of woodland and/or open parkland species such as the Galah, Little corella, Australian ringneck, Tawny Frogmouth, Southern Boobook, Striated pardalote, Mistletoebird, Australian Magpie and Yellow-rumped thornbill. Site 2 also recorded a selection of woodland species, however these were almost always associated with the wooded habitats on the lower limestone slopes. In particular, the Rainbow bee-eaters at this site were associated with the sandy track at the base of the hill, where several active nests were also detected. This was also the only detection made of the Spotted pardalote, which also nests on the ground in similar habitats to the Rainbow bee-eater (sandy banks and open areas on the edge of tracks). Sites 2, 5 and 6 generally included lower species diversity, though mainly recorded species associated with low, dense vegetation and included several species not detected in other habitats including White-cheeked honeyeater, Painted-button quail and Variegated fairy-wren. These habitats were also where the only observations of the Black-shouldered kite and Square-tailed kite were made, with these species possibly surveying the more open canopy structure of these areas.

Carnaby's cockatoo was detected across all habitats within the reserve, confirmed on 21 separate occasions during the current survey. Observations included live birds observed within and flying over the reserve, and also foraging signs left by birds. An observation included nine birds feeding on Eucalypts and *Melaleuca* fringing the south-east of the lake (Figure 8b), while an additional observation was made of seven birds gathered in the large Tuart adjacent to parkland habitats, which included two birds were observed prospecting hollows in the tree, before they were all disturbed by galahs (Figure 8a). Observations also included flocks of up to 20 individuals flying over the reserve and a further 14 separate foraging signs (*Banksia* spikes, pinecones and *Callitris* nuts) detected within the reserve. Carnaby's cockatoo's have previously been, and are regularly, recorded in Manning Park and the reserve is of high importance for the species, containing suitable foraging habitat (Proteaceous shrubland, *Eucalypt* woodlands and scattered pine trees), and known or potential roosting habitat and breeding habitat. Carnaby's cockatoo is endemic to the south-west of Western Australia. They typically breed in the wheatbelt region of Western Australia, where nesting primarily occurs in smooth-barked Eucalypts but are also known to nest in Tuart, Jarrah, Marri and Flooded Gums. They then move westwards onto the Swan Coastal Plain after breeding (late-spring to mid-winter) into near coastal *Banksia* woodlands and pine plantations, including the southern Perth metropolitan area, with large flocks often seen. Important food sources include *Banksia attenuata, B. menziesii*, *B. grandis, B.ilicifolia, B. sessilis, B. prionotes,* Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*). The species however has suffered a substantial decline in the last 50 years, particularly through clearing and fragmentation of habitat, with the loss of breeding hollows, increase of hollow competitors (i.e. galahs & bees), and vehicle strikes contributing a large part. On the Swan Coastal Plain Carnaby's cockatoo have changed their migration and foraging patterns in response to ongoing habitat destruction and discovery of new food sources, with locations of roosting sites and foraging areas often changing from year to year. Carnaby's cockatoo has started breeding

further south and west, including parts of the Darling Range and Swan Coastal Plain, however breeding records on the coastal plain are generally south of Baldivis (Johnstone et al 2011).

The Forest red-tailed black cockatoo was predominantly detected in the eastern and northern parts of the reserve, mainly in habitats containing large Eucalypt species, where in was confirmed on seven separate occasions during the current survey. Observations included live birds observed within and flying over the reserve, and also foraging signs left by birds. Observations also included flocks of between 3-12 birds observed feeding on Tuart nuts on three occasions, as well as three instances of small flocks of 4-6 birds flying over the reserve. Two individuals were also observed prospecting tree hollows in a large, smooth-barked Eucalypt in parkland habitats and another three observed feeding in a large Cape Lilac tree on Quarry Road adjacent to the reserve. Forest red-tailed black cockatoo's have previously, and are regularly recorded in Manning Park, including similar observations on the Quarry Road Cape Lilac (see Johnstone et. al. 2017), with the reserve being of high importance for the species, containing suitable foraging habitat (*Eucalypt* woodlands), as well as potential roosting and breeding habitat. The Forest red-tailed black cockatoo is endemic to the south-west corner of Western Australia where it is distributed from Gingin in the north, to as far east as Brookton and south-east as Green Range, and throughout much of the remaining south-west. Although once common, it is now patchily distributed through this region and is regarded as rare on the Swan Coastal Plain, however recent changes in foraging ecology in the northern Darling Range has seen the species slowly expand out onto the sandplains to the south of Perth, which has been attributed to their discovery of the introduced Cape Lilac. This change in foraging ecology has since seen the establishment of roosting sites on the coastal plain, as well as a small number of breeding locations (Johnstone et. al. 2017). On the coastal plain it feeds a variety of plant seeds including Jarrah and Marri, Tuart or She-oak and Cape Lilac and will roost in any tall trees, but prefers Jarrah, Marri or Tuart, and breeding has been recorded in November to December (Johnstone et. al. 2011).

The Rainbow Bee-eater (*Merops ornatus*) which was observed on several occasions throughout reserve, with both live individuals and active nests detected. Live birds were mainly observed in open parkland and woodland habitats, particularly in the north of the reserve, but also around the lake and the powerline track. The Rainbow bee-eater has previously been recorded in the reserve (Birdlife, 2023a) and is most likely a regular summer visitor/breeder in the reserve. Ranging from scarce to common throughout much of Western Australia, Rainbow bee-eaters inhabit lightly wooded landscapes with open sandy country, often near water. It can occur as either a resident, a breeding visitor or winter visitor to Western Australia, where it moves to the southwest during spring to breed, whereby nests are created in burrows, dug into sandy ground, often open areas including sandy banks and edges of roads and tracks (Johnstone & Storr, 1998). Nesting sites were generally observed in the open, disturbed areas, in particular the sandy, track edges in the north of the reserve.

The White-bellied sea-eagle was only recorded on a single occasion, with a brief observation of a young individual flying over the lake. The White-bellied sea-eagle is generally rare to uncommon in the area, where it is a casual visitor to rivers and near coastal wetlands on the west coast (Johnstone & Storr, 1998). Previously unrecorded in the reserve, nearby records exist from nearby Lake Coogee, Woodman Point and the eastern Beeliar wetland chain (Birdlife, 2023a), where it mainly feeds on fish and nestling seabirds, and has been known to take King skinks (Johnstone & Storr, 1998), which are present in large numbers around the lake.

Other species of conservation significance known to occur in the reserve, though not detected during the current survey include: Blue-billed duck (*Oxyura australis*) (6 sightings) (Birdlife, 2023a, 2023b; DBCA, 2023b), Peregrine falcon (1 sighting) (Birdlife, 2023a, 2023b), Baudin's cockatoo (1 sighting) (Birdlife, 2023a, 2023b), and Common greenshank (2 sightings) (Birdlife, 2023a, 2023b; DBCA, 2023b). Manning Lake may be an important habitat for the Blue-billed duck, as the species is an inhabitant of large permanent, open wetlands and densely vegetated lakes, particularly those with significant aquatic vegetation and fringing reeds and bullrush for nesting in which they rely on in the breeding season (November-March). Waterbodies also need to be large enough (>140 metres in size) to allow birds to enter and exit

(Cull et. al. 2021). As the lake does dry up significantly during the summer months, the lake may only be suitable during the wetter times of the year.

In addition, many other migratory, wading and wetland species are known from nearby lakes, wetlands and the coastline (see Appendix 11) and may use the reserve on occasion. Many of these species however are mainly associated with tidal mudflats, and rarely found far from the coast or inland freshwater wetlands (Geering et. al. 2007). Some of these species may only utilise Manning Lake when the water levels are low and there are large areas of shallow water and exposed mudflats. The water level in Manning Lake during the current survey was high, with very little exposed areas in and around the lake. In particularly, much of the shoreline and fringing swamp habitats were inundated. Besides occasional detections of Pied stilts, there was no sign of wading birds. Previous surveys have observed up to 87 Pied stilts on the lake in January when the lake was mostly dry (Western Wildlife, 2010). An extensive wetland and migratory shorebird survey was undertaken in 2010, which included Manning Lake and involved surveys on a monthly basis for a 12-month period (see Western Wildlife, 2010). Of the 32 wetland bird species known to occur in the reserve, 20 were detected during these surveys. Bird species and densities fluctuated throughout the year dependent on the level of water in the lake, however species diversity and abundance were generally low, suggesting that the lake is unlikely to support significant numbers of waterbird, with known conservation significant species such as the Common greenshank unlikely to regularly visit the lake (Western Wildlife, 2010). Additional surveys also suggest that the Common greenshank is an infrequent occurrence at the lake (Birdlife, 2023b), and although the species is associated with coastal, freshwater wetlands (Geering et. al. 2007), this species is more readily encountered in larger wetland systems such as Lake Coogee and the eastern Beeliar wetland chain (Birdlife, 2023a).

Baudin's Cockatoo is also unlikely to regularly use the reserve. Baudin's cockatoo is endemic to the south-west of Western Australia. It is primarily a resident of the deep south-west where it inhabits eucalypt forests, particularly Jarrah-Marri woodlands and Karri forests and forages widely throughout this habitat, with a preference for proteaceous trees and shrubs, particularly *Banksia* spp. The species breeds during September to December in the deep south-west, where they prefer large, vertical tree hollows, and migrate northwards in the autumn where it moves to the central and northern Darling Range and the adjacent far east of the Swan Coastal Plain (Johnstone et al 2011). Only a single record occurs from Manning Park (Birdlife, 2023) and this species is not likely to use the reserve on a regular basis.

The Peregrine falcon was only recently recorded from the reserve in May 2023 (Birdlife, 2023b), which represents the only record for the reserve. This species is considered rare to scarce on the Swan Coastal Plain, however they are often associated with wooded watercourses and lakes, where they feed almost exclusively on birds (Johnstone & Storr, 1998), with the reserve providing ample habitat and food sources and the species may use the reserve more frequently than observations suggest.

The Fork-tailed swift may also occasionally use the reserve. A migratory species that breeds in Asia, it generally arrives in Australia in winter, where it is a regarded as a relatively common visitor. In Australia, the species begins to arrive in the Kimberley in late September, the Pilbara in November and the southwest by mid-December. It is considered uncommon to moderately common and the west coasts, but rare to scarce in the southwest. They respond to broad-scale weather pattern changes and are attracted to thunderstorms. They rarely come to ground, living almost exclusively in the air where they feed on aerial insects (Johnstone & Storr 1998). Few records are known locally, with the closest being from North Coogee, Woodman Point, and North and Bibra Lakes (Birdlife, 2023a; DBCA, 2023b), with the species rarely detected in the region.

Fourteen additional bird species were also recorded which are considered of local conservation significance (see Government of Western Australia, 2000). These include many waterbirds such as Pink-eared duck, Hardhead, Australasian shoveler and Dusky moorhen, as well as a range of specialised bush birds, including Painted button-quail, Square-tailed kite, Brown goshawk, Splendid fairy-wren, Variegated fairy-wren, New-holland honeyeater, White-cheeked honeyeater, Weebill, White-browed Scrub-wren, and Yellow-rumped Thornbill. An additional 11 locally significant bird species have also previously been detected within the reserve that were not detected during the current survey, these include: Musk duck, Nankeen night-heron, Little eagle, Collared sparrowhawk, Whistling kite, Western rosella, Western wattlebird, Inland thornbill, Western golden whistler, Grey shrike-thrush, and Dusky woodswallow. Many of these species have decreased in abundance since European settlement, with many species declining due to land clearing, with many now absent from large parts of the Swan Coastal Plain, with most of these only surviving due to the persistence of some urban remnants (Government of Western Australia, 2000), and the confirmation of these birds at the reserve show a good level of habitat quality and/or connectivity. Of particular note is the presence of the Variegated fairy-wren. This species is uncommon on the Swan Coastal Plain to the south of Perth, where this represents its southern distributional limit where it doesn't generally occur more than 2km from the coast, and closely associated with *Acacia rostellifera* thickets (Johnstone & Storr, 2004), a habitat well represented on the limestone ridge and may be an important stronghold for this species in the local area.

Figure 8. (a) Carnaby's cockatoo observed prospecting tree hollows in a large Tuart during the current survey; (b) Carnaby's cockatoo observed feeding on Swamp paperbark seeds around the wetland; (c) Recent foraging evidence on *Callitris preissii* by Carnaby's cockatoo; (d) Recent foraging evidence on Tuart by Forest red-tailed black cockatoos; (e) Large Tuart in which Carnaby's cockatoo were observed prospecting; (f) Large smooth-barked Eucalypt where Forest red-tailed black-cockatoos were observed prospecting; (g) The locally significant Painted Button-quail (*Turnix varius*) was only detected via motion camera in the dense, heathy shrublands of the limestone ridge.

Table 7. Birds expected to occur, known to occur and/or recorded during the current survey at Manning Park.

Species		Status	Likelihood	Trapping site						Opp
				1	2	3	4	5	6	
Anatidae (ducks & swans)										
Blue-billed Duck	*Oxyura australis*	P4	Known							
Pink-eared Duck	*Malacorhynchus membranaceus*	L	Known			+				
Black Swan	*Cygnus atratus*		Known			+				+
Radjah Shelduck	*Radjah radjah*		Possible							
Australian Shelduck	*Tadorna tadornoides*		Known			+				+
Hardhead	*Aythya australis*	L	Known			+				
Australasian Shoveler	*Spatula rhynchotis*	L	Known			+				
Pacific Black Duck	*Anas superciliosa*		Known			+				+
Mallard hybrid	*Anas sp.*	*	Known							
Grey Teal	*Anas gracilis*		Known			+				+
Chestnut Teal	*Anas castanea*		Possible							
Freckled Duck	*Stictonetta naevosa*	L	Possible							
Musk Duck	*Biziura lobata*	L	Known							
Australian Wood Duck	*Chenonetta jubata*		Known							
Domestic Duck	*Anas platyrhynchos domesticus*	*	Known							
Muscovy Duck	*Cairina moschata*	*	Known							
Domestic Goose	*Anser anser*	*	Known							
Phasianidae (true quails)										
Brown Quail	*Coturnix ypsilophora*		Known							
Stubble Quail	*Coturnix pectoralis*		Possible							
Podicipedidae (grebes)										
Australasian Grebe	*Tachybaptus novaehollandiae*		Known			+				
Hoary-headed Grebe	*Poliocephalus poliocephalus*		Known			+				
Great Crested Grebe	*Podiceps cristatus*		Likely							
Columbidae (pigeons & doves)										
Rock Dove	*Columba livia*	*	Known							
Spotted Dove	*Streptopelia chinensis*	*	Known		+	+	+	+	+	+
Laughing Dove	*Streptopelia senegalensis*	*	Known	+		+				+
Common Bronzewing	*Phaps chalcoptera*	L	Likely							
Crested Pigeon	*Ocyphaps lophotes*		Known	+		+				+
Cuculidae (cuckoos)										
Horsfield's Bronze-Cuckoo	*Chalcites basalis*		Known							
Shining Bronze-Cuckoo	*Chalcites lucidus*		Known							
Fan-tailed Cuckoo	*Cacomantis flabelliformis*		Known							
Pallid Cuckoo	*Cacomantis pallidus*		Likely							
Podargidae (frogmouths)										
Tawny Frogmouth	*Podargus strigoides*		Known		+					+
Apododae (swifts & swiftlets)										
Fork-tailed Swift	*Apus pacificus*	MI	Possible							
Rallidae (crakes & rails)										
Buff-banded Rail	*Hypotaenidia philippensis*		Known			+				+
Australian Spotted Crake	*Porzana fluminea*		Known							
Spotless Crake	*Zapornia tabuensis*		Possible							
Australian Swamphen	*Porphyrio porphyrio*		Known			+				+
Dusky Moorhen	*Gallinula tenebrosa*	L	Known			+				+
Black-tailed Native-hen	*Tribonyx ventralis*		Possible							
Eurasian Coot	*Fulica atra*		Known			+				
Haematopodidae (osyercatchers)										

Species		Status	Likelihood	Trapping site 1	2	3	4	5	6	Opp
Australian Pied Oystercatcher	*Haematopus longirostris*		Possible							
Recurvirostridae (stilts & avocets)										
Banded Stilt	*Cladorhynchus leucocephalus*		Known							
Red-necked Avocet	*Recurvirostra novaehollandiae*	MA	Likely							
Pied Stilt	*Himantopus h. leucocephalus*	MA	Known			+				
Charadriidae (plovers & dotterels)										
Grey Plover	*Pluvialis squatarola*	MI/MA	Possible							
Pacific Golden Plover	*Pluvialis fulva*	MI/MA	Unlikely							
Red-capped Plover	*Charadrius ruficapillus*		Possible							
Black-fronted Dotterel	*Elseyornis melanops*		Known							
Banded Lapwing	*Vanellus tricolor*		Unlikely							
Red-kneed Dotterel	*Erythrogonys cinctus*	L	Possible							
Scolopacidae (sandpipers & stints)										
Bar-tailed Godwit	*Limosa lapponica*	MI/MA	Possible							
Great Knot	*Calidris tenuirostris*	CE	Possible							
Red Knot	*Calidris canutus*	EN	Unlikely							
Sharp-tailed Sandpiper	*Calidris acuminata*	MI/MA	Unlikely							
Curlew Sandpiper	*Calidris ferruginea*	CE	Possible							
Red-necked Stint	*Calidris ruficollis*	MI/MA	Possible							
Sanderling	*Calidris alba*	MI/MA	Unlikely							
Common Sandpiper	*Actitis hypoleucos*	MI/MA	Possible							
Grey-tailed Tattler	*Tringa brevipes*	MI/MA/P4	Unlikely							
Common Greenshank	*Tringa nebularia*	MI/MA	Known							
Marsh Sandpiper	*Tringa stagnatilis*	MI/MA	Possible							
Turnicidae (button-quails)										
Painted Button-quail	*Turnix varius*	L	Known							+
Laridae (gulls & terns)										
Silver Gull	*Chroicocephalus novaehollandiae*		Known			+				+
Fairy Tern	*Sternula nereis*		Possible							
Caspian Tern	*Hydroprogne caspia*	MI/MA	Possible							
Whiskered Tern	*Chlidonias hybrida*		Possible							
Greater Crested Tern	*Thalasseus bergii*	MI	Known							
Pelicanidae (pelican)										
Australian Pelican	*Pelecanus conspicillatus*		Known			+				
Ardeidae (bittern, egrets & herons)										
Nankeen Night-Heron	*Nycticorax caledonicus*	L	Known							
White-Necked Heron	*Ardea pacifica*		Known							
Eastern Great Egret	*Ardea modesta*		Known			+				+
White-faced Heron	*Egretta novaehollandiae*		Known			+				+
Little Egret	*Egretta garzetta*		Known							
Threskiornithidae (ibis & spoonbills)										
Australian White Ibis	*Threskiornis moluccus*		Known			+		fo		
Straw-necked Ibis	*Threskiornis spinicollis*		Known			+				
Yellow-billed Spoonbill	*Platalea flavipes*		Known			+				
Glossy Ibis	*Plegadis falcinellus*	MI	Possible							
Phalacrocoracidae (cormorants)										
Little Pied Cormorant	*Microcarbo melanoleucos*		Known							
Great Cormorant	*Phalacrocorax carbo*		Known							
Little Black Cormorant	*Phalacrocorax sulcirostris*		Known			+				
Great Pied Cormorant	*Phalacrocorax varius*		Known			+				

Species		Status	Likelihood	Trapping site 1	2	3	4	5	6	Opp
Australasian Darter	*Anhinga novaehollandiae*		Known			+				
Accipitridae (eagles, harriers & kites)										
Osprey	*Pandion haliaetus*	MI/MA	Likely							
Black-shouldered Kite	*Elanus axillaris*		Known					+		
Square-tailed Kite	*Lophoictinia isura*	L	Possible							+
Wedge-tailed Eagle	*Aquila audax*	L	Possible							
Little Eagle	*Hieraaetus morphnoides*	L	Known							
Swamp Harrier	*Circus approximans*		Known							
Brown Goshawk	*Accipiter fasciatus*	L	Known	+		+	+	+		+
Collared Sparrowhawk	*Accipiter cirrocephalus*	L	Known							
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	MA/MI	Possible			+				
Whistling Kite	*Haliastur sphenurus*	L	Known							
Tytonidae (barn owls)										
Barn Owl	*Tyto alba*		Likely							
Masked Owl (SW)	*Tyto n. novaehollandie*		Possible							
Strigidae (hawk owls)										
Australian Boobook	*Ninox boobook*		Likely							+
Barking Owl (SW)	*Ninox c. connivens*	P2	Unlikely							
Meropidae (bee-eaters)										
Rainbow Bee-eater	*Merops ornatus*	MA	Known	+	+	+				+
Halcyonidae (kingfishers)										
Sacred Kingfisher	*Todiramphus sanctus*		Known							
Laughing Kookaburra	*Dacelo novaeguineae*	*	Known				+			+
Falconidae (falcons)										
Nankeen Kestrel	*Falco cenchroides*		Known							+
Eurasian Hobby	*Falco subbuteo*	*	Possible							
Australian Hobby	*Falco longipennis*		Known							
Brown Falcon	*Falco berigora*	L	Likely							
Peregrine Falcon	*Falco peregrinus*	S	Known							
Cacatuidae (cockatoos & corellas)										
Forest Red-tailed Black-Cockatoo	*Calyptorhynchus banksii naso*	VU	Known		+					+
Baudin's Cockatoo	*Zanda baudini*	EN	Known							
Carnaby's Cockatoo	*Zanda latirostris*	EN	Known			+				+
Galah	*Eolophus roseicapilla*		Known	+		+	+			+
Western Corella	*Cacatua pastinator*		Known							
Little Corella	*Cacatua sanguinea*		Known	+		+	+			+
Long-billed Corella	*Cacatua tenuirostris*		Known							
Psittacidae (parrots)										
Regent Parrot	*Polytelis anthopeplus*		Possible							
Red-capped Parrot	*Purpureicephalus spurius*		Known			+	+			+
Western Rosella	*Platycercus icterotis*	L	Known							
Australian Ringneck	*Barnardius zonarius*		Known	+		+				+
Elegant Parrot	*Neophema elegans*		Likely							
Rock Parrot	*Neophema petrophila*	L	Possible							
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*		Possible							
Rainbow Lorikeet	*Trichoglossus moluccanus*	*	Known	+	+	+	+	+	+	+
Maluridae (fairy-wrens)										
Splendid Fairy-wren	*Malurus splendens*	L	Known	+	+			+		+
Variegated Fairy-wren	*Malurus lamberti*	L	Known					+	+	+
Meliphagidae (honeyeaters)										

Species		Status	Likelihood	Trapping site 1	2	3	4	5	6	Opp
Brown Honeyeater	*Lichmera indistincta*		Known	+	+		+			+
New Holland Honeyeater	*Phylidonyris novaehollandiae*	L	Known		+		+			
White-cheeked Honeyeater	*Phylidonyris niger*	L	Known		+					+
Brown-headed Honeyeater	*Melithreptus brevirostris*		Unlikely							
White-naped Honeyeater	*Melithreptus lunatus*	L	Possible							
Tawny-crowned Honeyeater	*Glyciphila melanops*	L	Possible							
Western Spinebill	*Acanthorhynchus superciliosus*		Possible							
White-fronted Chat	*Epthianura albifrons*		Likely							
Spiny-cheeked Honeyeater	*Acanthaegenys rufogularis*		Unlikely							
Western Wattlebird	*Anthochaera lunulata*	L	Known							
Red Wattlebird	*Anthochaera carunculata*		Known	+		+	+		+	+
Yellow-throated Minor	*Manorina flavigula*	L	Unlikely							
Yellow-plumed Honeyeater	*Ptilotula ornata*		Unlikely							
Singing Honeyeater	*Gavicalis virescens*		Known	+	+		+	+	+	+
Pardalotidae (pardalotes & thornbills)										
Spotted Pardalote	*Pardalotus punctatus*		Known		+					
Striated Pardalote	*Pardalotus striatus*		Known			+	+			+
Western Gerygone	*Gerygone fusca*		Known	+	+		+		+	+
Weebill	*Smicrornis brevirostris*	L	Known	+	+		+			+
White-browed Scrub-wren	*Sericornis frontalis*	L	Known	+	+		+	+	+	+
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	L	Known	+	+					
Inland Thornbill	*Acanthiza apicalis*	L	Known							
Western Thornbill	*Acanthiza inornata*	L	Possible							
Varied Sittella	*Daphoenositta chrysoptera*	L	Possible							
Campephagidae (cuckoo-shrikes)										
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		Known	+	+		+			+
White-winged Triller	*Lalage tricolor*		Possible							
Pachycephalidae (whistlers)										
Rufous Whistler	*Pachycephala rufiventris*		Known	+	+	+			+	
Golden Whistler	*Pachycephala pectoralis*	L	Known							
Grey Shrike-thrush	*Colluricincla harmonica*	L	Known							
Artamidae (woodswallows & magpies)										
Grey Currawong	*Strepera versicolor*	L	Unlikely							
Australian Magpie	*Gymnorhina tibicen*		Known	+		+	+			+
Pied Butcherbird	*Cracticus nigrogularis*		Possible							
Grey Butcherbird	*Cracticus torquatus*		Known			+	+			
Dusky Woodswallow	*Artamus cyanopterus*	L	Known							
Corvidae (ravens & crows)										
Little Crow	*Corvus bennetti*		Unlikely							
Australian Raven	*Corvus coronoides*		Known	+	+	+	+	+	+	+
Dicruidae (fantails & flycatchers)										
Magpie-lark	*Grallina cyanoleuca*		Known			+				+
Restless Flycatcher	*Myiagra inquieta*		Unlikely							
Willie Wagtail	*Rhipidura leucophrys*		Known	+	+	+				+
Grey Fantail	*Rhipidura fuliginosa*		Known	+	+		+			
Petroicidae (robins)										
Scarlet Robin	*Petroica multicolor*	L	Possible							
Red-capped Robin	*Petroica goodenovii*		Known							
Hooded Robin	*Melanodryas cucullata*		Unlikely							
Jacky Winter	*Microeca fascinans*		Unlikely							

Species		Status	Likelihood	Trapping site 1	2	3	4	5	6	Opp
Mistletoebird	*Dicaeum hirundinaceum*		Known	+		+	+			
Passeridae (mannikins)										
Chestnut-breasted Mannikin	*Lonchura castaneothorax*	*	Unlikely							
Motacillidae (pipits)										
Australasian Pipit	*Anthus novaeseelandiae*		Likely							
Sylviidae (old world warblers)										
Little Grassbird	*Poodytes gramineus*		Possible							
Australian Reed-Warbler	*Acrocephalus australis*		Known							
Hirundinidae (swallows & martins)										
Fairy Martin	*Petrochelidon ariel*		Possible							
Tree Martin	*Petrochelidon nigricans*		Known			+		+	+	
Welcome Swallow	*Hirundo neoxena*		Known							+
Zosteropidae (white-eyes)										
Silvereye	*Zosterops lateralis*		Known	+	+		+	+	+	
Species expected	**173**			24	21	46	22	12	11	
Species recorded during 2023	**69**									

+ = Species recorded during the 2023 survey *** = Introduced species**
CE = Critically Endangered (EPBC and/or BC Act) **fo = flyover only**
EN = Endangered (EPBC and/or BC Act)
VU = Vulnerable (EPBC and/or BC Act)
MI = Migratory species (EPBC and/or BC Act)
MA = Marine species (EPBC Act)
S = Specially Protected (BC Act)
P2 = Priority 2 (DBCA)
P4 = Priority 4 (DBCA)
L = Locally significant due to a reduced distribution and/or population on the Swan Coastal Plain (Government of WA 2000)

3.4.5 Invertebrates

Two conservation significant invertebrate species have the potential to occur within the reserve, the Priority 3 Swan Coastal Plain Shied-backed trapdoor spider (*Idiosoma sigillatum*) and the Priority 3 Graceful sun-moth (*Synemon gratiosa*), however no detections of either species were made during the survey period.

The Swan Coastal Plain Shied-backed trapdoor spider is widely distribution along the Swan Coastal Plain, where it is known to occur from Dalyellup in the south to at least Ledge Point in the north and across to the foothills of the Darling Escarpment. It is also known from Rottnest and Garden Islands. Once widespread throughout the Perth region, it is now restricted to remnant bushland areas, where it inhabits *Banksia* woodlands and heath on sandy soils. It is now locally extinct throughout much of its former range due to land clearing (Rix et al 2018). Recent records (2019) exist within 5km of the reserve including Spearwood and Beeliar (DBCA, 2023b) and this species may occur on in the reserve. Only a single trapdoor spider was detected during the survey, a Brush-footed trapdoor spider of the Genus *Idiomata*, which was captured in the limestone outcropping at Site 6 (Figure 9a). Searching for burrows during the wetter parts of the years within suitable habitat is the most effective way of surveying for Shield-back trapdoor spiders, and pit-traps placed around vegetation in suitable habitats during May-July may be used to catch wandering males, when activity is known to peak in May corresponding to the first winter rains (Rix et. al. 2018). Further surveys during late autumn to winter may help to determine the presence of the Swan Coastal Plain Shied-backed trapdoor spider within the reserve.

The Graceful sun-moth is widely distributed along the Swan Coastal Plain from Nambung National Park in the north through to Mandurah in the south. It strictly associated two habitat types: Coastal heathland on Quindalup dunes, where is occurs on sand dunes supporting the host plant *Lomandra maritima*, and *Banksia* woodlands on Spearwood and Bassendean dunes which support the host plant *Lomandra hermaphrodita*. Adults breed once and only during February to April, with a very short flight time of one to two weeks and may only fly in suitable weather conditions. Sites in limestone may have both *Lomandra hermaphrodita* and *L. maritima* present and can often comprise the dominant understorey herb in these habitats (Bishop et. al. 2010). The reserve has the potential to support populations of the Graceful sun-moth, with several known localities within 5km of the reserve including *Banksia* woodland at Sir Frederick Sampson Park and Forrest Road in Bibra Lake (DBCA, 2023b). The host plant *Lomandra maritima* has been recorded from the reserve, with plants known to occur in the tall shrublands supporting *Acacia rostellifera* (FVC, 2021; see Figure 9b). The percent coverage of *Lomandra maritima* in this habitat was only 5% (see FVC, 2021), and may not be extensive enough to support populations of the Golden sun-moth, however, future surveys mapping the entire distribution and density of *Lomandra maritima* within the reserve and targeted surveys searching for live moths during February to April may help to determine the presence of the Graceful sun-moth within the reserve.

Figure 9. (a) A Brush-footed trapdoor spider (*Idiomata* sp.) detected at Site 2 on the limestone ridge; b) Shrubland on the limestone ridge containing *Lomandra maritima*, and potentially the Graceful sun-moth.

4. Conclusions & management recommendations

Manning Park supports (or has the potential to support) a very good fauna assemblage. Although the current survey was limited to a single season, a relatively high vertebrate fauna assemblage was detected, with high reptile diversity, as well as a large diversity of frog, bird, and microbat species. Few fauna surveys have been undertaken in Manning Park, however of those surveys, particularly the long history of bird surveys undertaken by Birdlife Australia, they highlight what species are generally detectable or most commonly occur within the reserve and is helping to understand the fauna assemblage occurring within Manning Park. Several species detected rely on key habitat characteristics such as diverse micro-habitats, key food sources and habitat connectivity. The species present within the study area are most likely a direct result of the remaining intact, remnant vegetation, particularly the extensive and high-quality proteaceous shrublands on the limestone ridge, as well as the lake and wetlands habitats and the surrounding woodlands. These areas are particularly importance for a range of species detected within the reserve including black cockatoos, Perth-lined slider and Quenda.

The study area contains extensive foraging habitats for all three species of black cockatoo. Particularly the limestone ridge habitats which contain large expanses of Parrot bush (*Banksia sessilis*), which is of high importance for both Carnaby's and Baudin's cockatoo, as well as other proteaceous shrubs such as *Hakea* sp. The significant areas of woodland on the lower slopes and vegetated uplands surrounding the lake also provide important foraging resources for Carnaby's and Forest red-tailed black cockatoos. These areas also contain many large, hollow-bearing trees, which provide potential breeding habitat for Carnaby's and Forest red-tailed black cockatoos, as well as potential habitat for arboreal mammal species such as the specially protected Brush-tailed phascogale. The limestone ridge habitats also provide extensive, low shrublands, sandy soils and leaf litter beds which provide critical habitat for the Perth lined slider and potentially Black-striped snake. While the dense shrublands and continuity of this habitat throughout the reserve also provides suitable habitat and movement corridors for Quenda. These areas also provide critical habitat for a range of locally significant bird and reptile species such as the Variegated fairy-wren, Painted button-quail and Western bluetongue.

The lake and fringing wetland habitats provide suitable foraging habitat for a range of conservation significant species including the Peregrine falcon, White-bellied sea-eagle, Pied stilt, Common greenshank, Blue-billed duck and a range of locally significant wetland bird species. While the *Melaleuca* forest surrounding the lake also supports a significant population of the King skink, which may be of local significance. The woodland surrounding the lake also provide ample perching and feeding locations for Rainbow-bee-eaters, as well as the nearby open sandy areas of the upland vegetation, which provide suitable nesting locations and is known to breed in the reserve.

In addition, due to the presence of *Lomandra maritima* along parts of the limestone ridge, the Graceful sun-moth may occur in the study area, while the Swan Coastal Plain Sield-back trapdoor spider may occur in the sandier heath habitats.

These habitats however need to be carefully managed to ensure these species persist and continue to inhabit the reserve in sufficient numbers. Due to the location of the reserve (isolated and enclosed by major roads, residential and industrial developments) and current and past land use (i.e. agriculture and recreation), several threats currently exist, including:

- Weed infestations
- Habitat loss and fragmentation (including dissection and degradation of habitat through track establishment)
- Fire
- Dieback
- Erosion
- Potential road mortality of some species, and
- Feral animals (particularly cats and hollow competitors such as bees).

In protecting, managing and enhancing existing habitats within the reserve, the following recommendations may help to guide management:

- The continued protection of intact vegetation is crucial, particularly the proteaceous shrublands and heath on the limestone ridge, and the tall woodlands on the lower slopes and surrounding the lake. These areas are of high conservation value, providing important foraging and roosting habitat for all three species of Black cockatoo, and cover for species such as Quenda, Perth lined slider and a range of specialised bush birds.
- Enhancement and revegetation of degraded landscapes, as well as the creation of additional habitat corridors. For example, connecting the lake to surrounding bushland, or looking at ways to connect the Manning Park bushland to surrounding bushland (i.e. road underpasses/habitat strips), as well as further enhancing the bushland corridors along the eastern edge of the reserve.
- Weed management, in particular woody weed infestations such as coastal tea tree. This however will need to be carefully managed, as tea tree thickets currently provide important habitat for species such as Quenda and locally significant bush birds. Removal of this cover may result in negative implications for the species relying on this habitat.
- Restricting recreational use to certain areas. For example, restriction of access to high quality habitats and conserve these areas as high priority conservation areas, whereby access tracks are limited. Activities that require regular or repeated access (i.e. bike riding and/or walking tracks) can be concentrated in areas of lower ecological value (i.e. lower slopes and/or disturbed areas) or reduced to a subset of fewer tracks (i.e. the Davilak trail).
- Dieback management. This is particularly crucial due to the nature of the reserve landscape and land use. Increased recreational activities throughout the reserve, particularly during the wetter months has higher potential for dieback spread. Restricted access to high quality habitats could also help mitigate the spread of dieback to these areas.
- Feral animal management is also crucial, particularly cats which pose serious threats to Quenda, and an assortment of birds and reptiles, as well as managing nest hollow competitors such as feral honeybees.
- Implement plans and promote education with the local community and landholders of the awareness of and need to manage fauna, particularly those of conservation significance and feral animals, as well the spread of weeds and diseases.

Future follow-up surveys will be an important aspect in further understanding the fauna assemblage of the reserve. A survey of this level often only gathers partial information on the fauna occurring in the reserve. It generally takes several trapping seasons and/or extensive trapping periods to detect a large percentage of the species occurring within a defined area (How and Dell 2000). Surveys incorporating the drier summer periods when the lake is dry may help to detect additional species of migratory shorebirds or may encounter more individuals of some species (i.e. large feeding flocks of Carnaby's cockatoo over the summer period). While targeted surveys in late summer to early winter may help to detect species such as the Graceful sun-moth and/or Swan Coastal Plain Sheild-backed trapdoor spider. Motion camera surveys of longer duration and at different times of the year may also help in the potential detection of arboreal mammals such as the Brush-tailed phascogale or Brush-tailed possum, while also collecting information of feral predator distribution and abundance, which may help to inform management programs.

5. Discussion of potential mountain bike trails

A large proportion of the Manning Park bushland is currently dissected by a range of tracks and pathways. These include management vehicle access tracks, infrastructure access tracks such as power and communications lines, and walking paths, as well as many 'unsanctioned' paths and tracks currently used by mountain bike riders visiting the park. Many of these however form a complex network of trails that may inadvertently create a range of impacts, particularly along the limestone ridge habitats. Much of this area supports significant limestone exposure and skeletal soils, which is very fragile, and once degraded may be very hard to rehabilitate. Owing to the naturally steep topography of the landscape, and the low, heathy vegetation it supports, these areas are highly susceptible to erosion, weed incursions and disease infestations such as dieback, and the increasing degradation of these areas, particularly the increased exposure of densely vegetated areas may create improved access for feral predators such as cats and foxes to roam.

These areas currently offer a range of sanctioned walking tracks, however, most of which are primarily made for low impact walking and jogging, with many formally developed with base material, erosion control (i.e. stairs) and hand-railing, such as walking tracks leading to lookout areas (i.e. the Davilak trail). The establishment and regular use of mountain bike trails in these areas may have some significant impacts on both the natural environment and the current use of the existing tracks, in particular:

- Potential and/or increased negative bike-rider/pedestrian interaction.
- Potential and/or increased bike-rider/wildlife interaction (i.e. tracks deaths to Bobtails, Western bluetongue lizards, etc).
- Change in behaviour of wildlife where continued disturbance may prevent some species from using an area. For example, regular traffic on sandy tracks may destroy Rainbow bee-eater nests or deter them from nesting, or species such as Carnaby's or Forest red-tailed black cockatoos may avoid certain feeding areas.
- Development of, or increased erosion.
- Dieback introduction and spread,
- Weed introduction and spread, and
- Improved feral predator access.

To combat some of these potential issues, it seems feasible to establish a network of mountain trails that have minimal impacts relating to the above potential concerns, these include:

- Establishing a trail network throughout areas that already contain a high level of degradation or where any future rehabilitation may be difficult.
- Focus on areas that have considerably less foot traffic (i.e. away from lookouts, etc).
- Avoid areas that contain critical habitat trees or extensive feeding grounds for black cockatoo species.
- Prioritise areas of lower habitat sensitivity and connectivity, and
- Establish in areas that provides direct or straightforward access to the site without having to traverse larger parts of the reserve.

Several potential areas currently exist which may help to mitigate some of the impacts a mountain trail network may have on the larger part of Manning Park. The following options may be of consideration:

Option 1: Old Quarry/North location (see Map 14)

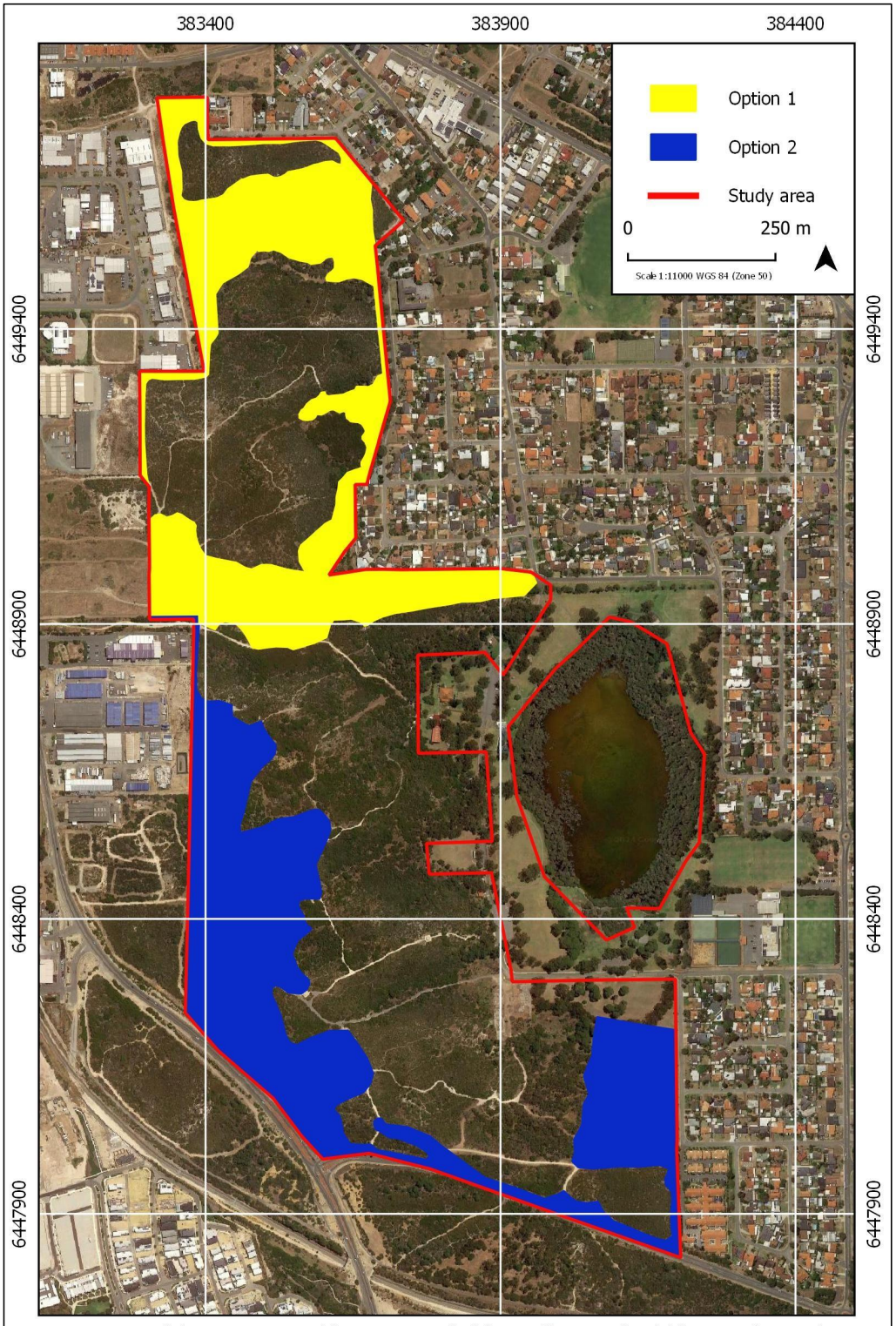
A suitable site to establish a mountain bike trail network could be the area to the north of the reserve bounded by Whitton Street, Nunn Street and the access track running westwards from Quarry Road. This area has undergone significant degradation and has a network of well used, interconnected tracks currently used by mountain bike riders. The area also has the least adjacent habitat continuity of the reserve, with several roads (including Rockingham Road), residential housing and open, grassy paddocks separating the reserve from the bushland of Clontarf Hill, with any habitat north of this area minimal to absent. This area was also the only location stray/feral cats were detected during the current surveys. The area encompasses almost 3.5 hectares of completely degraded habitats and a further 3.5 hectares of disturbed habitats, mainly surrounding the already degraded landscapes and the reserve perimeter. If more area was required to establish a track network of a larger size, extensions to this area could either incorporate the disturbed areas along Quarry Road (or along Quarry Road itself), or alternatively the western boundary track to the south and throughout the powerline corridor. In this instance, up to 8 hectares of currently highly degraded or disturbed habitat could be added to a trail network and all associated mountain bike activities could be restricted to areas from the powerline track northwards. Restricting mountain bike trails to a particular section may help to minimise impacts over a greater area and incorporating current degraded areas and areas lower in the landscape may also have minimal disturbance to the current environment. This may also considerably limit any potential negative interactions with walking tracks associated with the lookout areas to the south and tracks nearby to existing public open space and car parking facilities, while also avoiding higher quality habitats containing extensive feeding resources for Black cockatoo species (see Map 15). Additionally, there may be potential to create car-parking/access facilities to the north of the reserve in the degraded areas along Bellion Drive. This will enable direct access to the trail network without the need to traverse through other areas of the reserve or to add additional congestion/further development of car parking facilities currently available within the reserve.

Option 2: Southwest location (see Map 14)

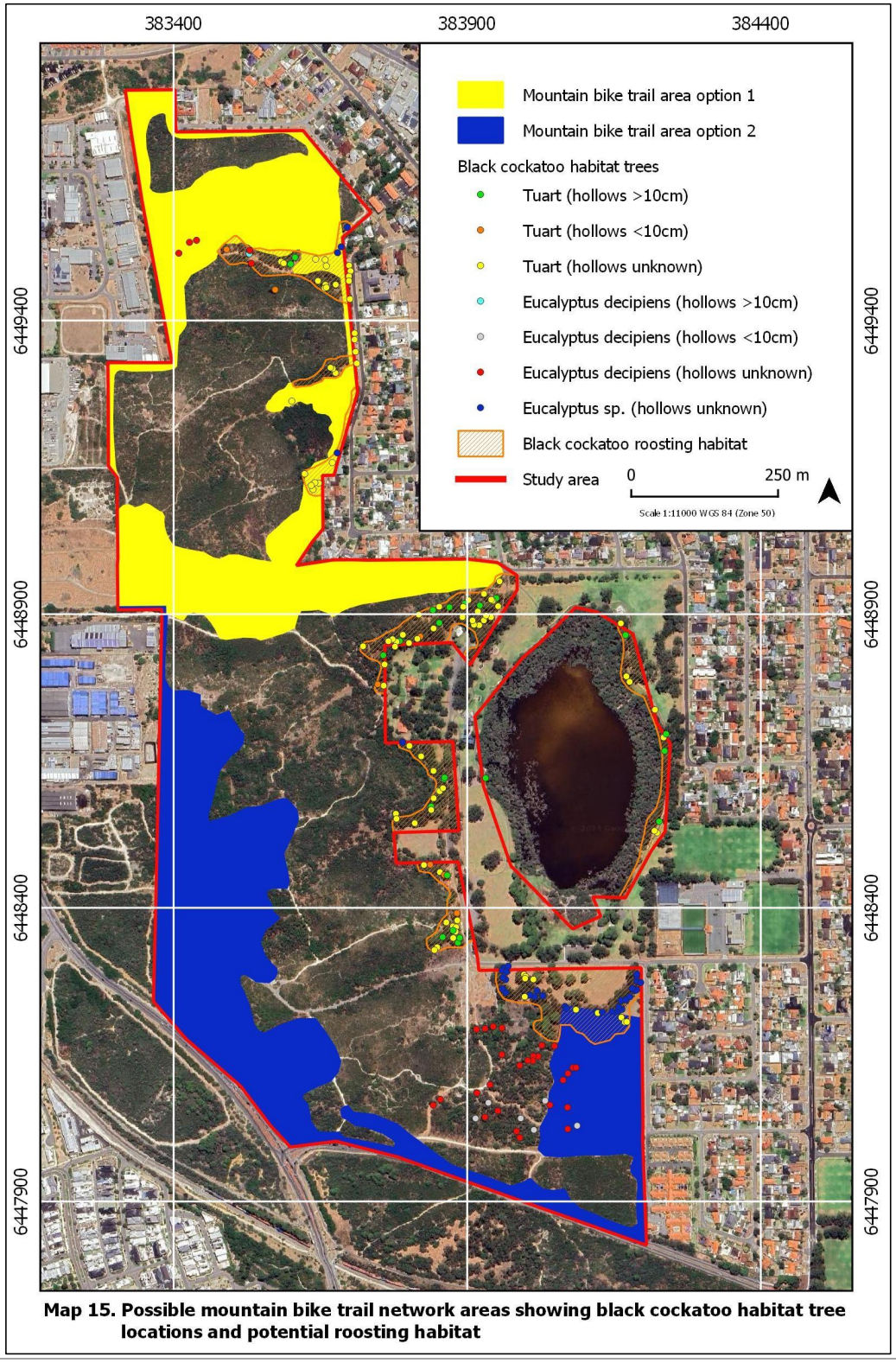
The area on the lower slopes to the west of the limestone ridge in the southwest of the reserve could potentially provide an alternative location. This area has undergone significant degradation, with extensive woody weed infestations, large cleared areas and possibly the main area of the reserve containing a significant rabbit problem. This area would incorporate an area of up to 12 hectares of highly degraded and disturbed habitats from near the intersection of Cockburn and Spearwood Roads to near the adjacent industrial area approximately 800 metres to the north. Potential access to the site may be possible from Cockburn Road with the addition of carparking facilities or alternatively access may be possible from the Azelia Road carparking area, with a designated access trail beginning in the degraded areas to the east of the Davilak homestead ruins and following the boundary tracks where the trail network may begin near the junction of Cockburn and Spearwood Roads. This would potentially provide an additional trail network area of up to 5 hectares and would incorporate existing degraded and disturbed landscapes. This area however is in much closer proximity to larger bushland areas where current habitat connectivity is high and future habitat connectivity is much more achievable. This area also appears to support a significant Quenda population (see Map 16). Although much of the area is degraded and infested with woody weeds, this creates substantial habitat for Quenda, which should be considered when and if designing a mountain bike trail (or any future management actions) in this area.

Option 3: Alternative location

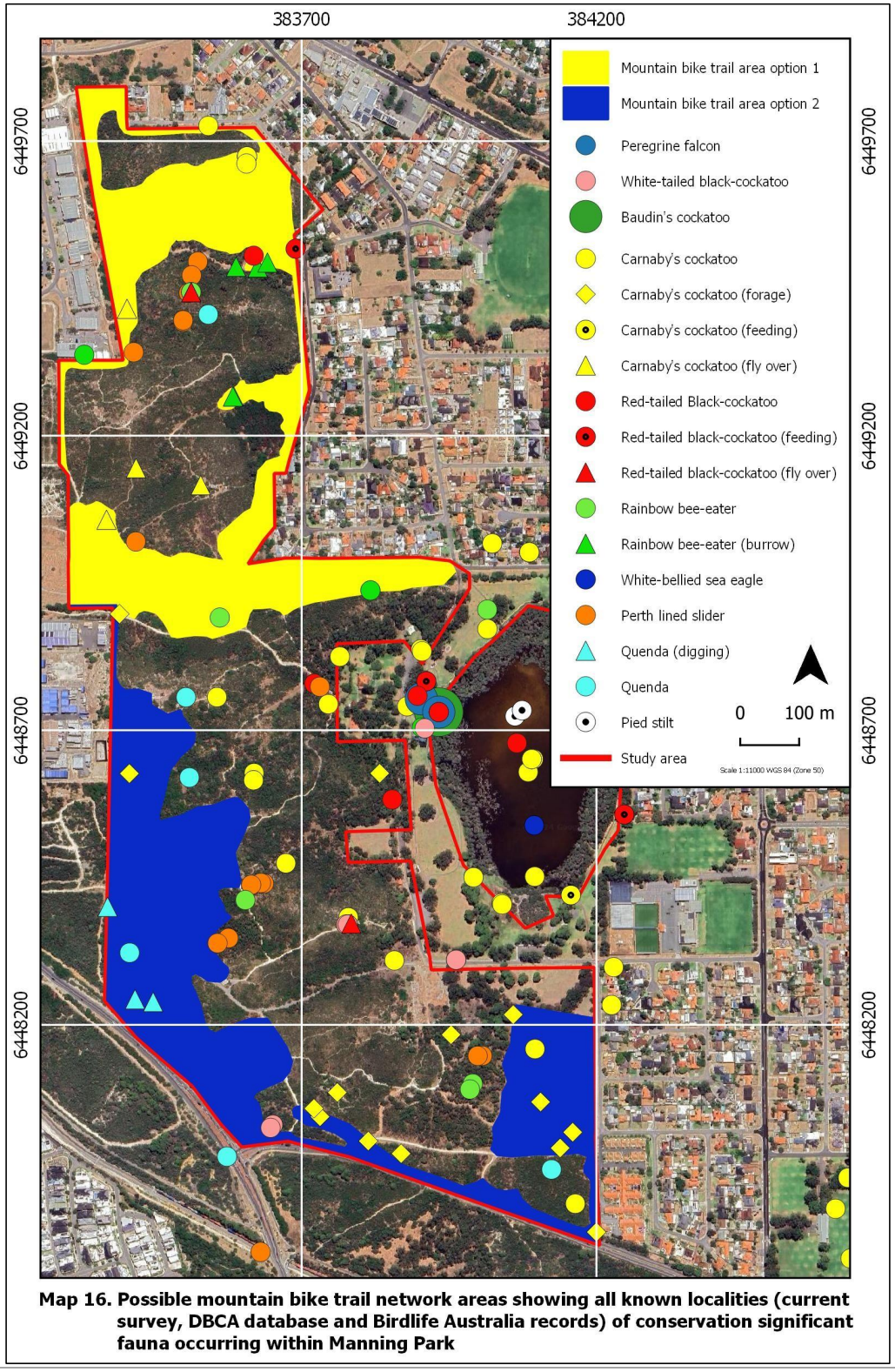
An alternative location to Manning Park may also be a consideration. A nearby, potentially suitable location may include the area allocated for the proposed Coogee Golf Complex to the south of Manning Park. This area has suffered extensive degradation and habitat fragmentation, with only small, isolated areas of fauna habitat remaining (Regen4 et. al. 2018, 2013). A trail network here could utilise existing degraded landscapes, while protecting remaining bushland areas. The area currently supports a small car parking facility, which could be extended into existing degraded landscapes if required. Additionally, any proposed impact of mountain bike trail development could be offset by rehabilitating degraded areas of Manning Park and establishing and enhancing bushland corridors in areas surrounding Manning Park, including looking at ways to connect Manning Park to CY O'Connor Reserve to the west and linking up to bushland in the south, as well as looking at ways to connect Manning Lake to neighbouring bushland.



Map 14. Possible areas to consider a mountain bike trail network within Manning Park



Map 15. Possible mountain bike trail network areas showing black cockatoo habitat tree locations and potential roosting habitat



Map 16. Possible mountain bike trail network areas showing all known localities (current survey, DBCA database and Birdlife Australia records) of conservation significant fauna occurring within Manning Park

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APPENDIX 1. Fauna trapping sites and motion camera locations at Manning Park

Faunal Habitat Description	Image
Site 1 Low open woodland of Redheart (*Eucalyptus decipiens*) over mixed shrubland, and grassy (weedy grasses) understorey.	
Site 2 Shrubland/heath on the limestone ridge and slope containing *Melaleuca huegelii* and *Banksia sessilis* on skeletal soils and limestone exposure	

Faunal Habitat Description	Image
Site 3 Wetland dominated by large Swamp paperbarks (*Melaleuca rhaphiophylla*) over dense low sedges and exposed areas on peaty-sands, and isolated Tuarts	
Site 4 Vegetated uplands with large Tuarts (*Eucalyptus gomphocephala*) over an open, mixed shrubland on shallow brown, loamy sands with areas of limestone exposure.	

Faunal Habitat Description	Image
Site 5 Low shrubland/heath on the limestone ridge and slope containing *Melaleuca huegelii* on skeletal soils and limestone exposure	
Site 6 Tall shrublands on the western slopes of *Acacia rostellifera*, with weedy grasses and extensive leaf litter on deeper sandy soils and minimal limestone exposure	

Faunal Habitat Description	Image
FA1 Wetland	
FA2 Tall (*Acacia rostellifera*) shrubland (Site 6)	

Faunal Habitat Description	Image
FA6 Shrublands/heath on limestone ridge	
FA7 Shrublands/heath on limestone ridge	

Faunal Habitat Description	Image
FA10 Low heath on limestone ridge (Site 5)	
FB1 Low open woodland	

Faunal Habitat Description	Image
FB2 Tall (*Acacia rostellifera*) shrubland	
FB3 Tall woodland (Site 4)	

Faunal Habitat Description	Image
FB7 Tall (*Acacia rostellifera*) shrubland	
FC2 Shrublands/heath on limestone ridge	

Faunal Habitat Description	Image
FC3 Shrublands/heath on limestone ridge (Site 2)	
FC6 Tall woodland	

Faunal Habitat Description	Image
FC8 Wetland (Site 3)	
FC9 Shrublands/heath on limestone ridge	

Faunal Habitat Description	Image
FD3 Tall (*Acacia rostellifera*) shrubland	
FD6 Low open woodland (Site 1)	

APPENDIX 2: Individual trapping site locations at Manning Park

Site/trap Number	Latitude	Longitude	Date Opened	Date Closed	Site Visits
MP1_1	-32.097	115.7707	16-Nov-23	23-Nov-23	12
MP1_2	-32.0971	115.7707	16-Nov-23	23-Nov-23	12
MP1_3	-32.0972	115.7706	16-Nov-23	23-Nov-23	12
MP1_4	-32.0973	115.7706	16-Nov-23	23-Nov-23	12
MP1_5	-32.0975	115.7705	16-Nov-23	23-Nov-23	12
MP1_6	-32.0975	115.7705	16-Nov-23	23-Nov-23	12
MP1_7	-32.0979	115.7701	16-Nov-23	23-Nov-23	12
MP1_8	-32.0979	115.7699	16-Nov-23	23-Nov-23	12
MP1_9	-32.0979	115.7697	16-Nov-23	23-Nov-23	12
MP1_10	-32.0978	115.7696	16-Nov-23	23-Nov-23	12
MP2_1	-32.0849	115.7658	16-Nov-23	23-Nov-23	12
MP2_2	-32.085	115.7658	16-Nov-23	23-Nov-23	12
MP2_3	-32.0851	115.7657	16-Nov-23	23-Nov-23	12
MP2_4	-32.0852	115.7657	16-Nov-23	23-Nov-23	12
MP2_5	-32.0853	115.7656	16-Nov-23	23-Nov-23	12
MP2_6	-32.0854	115.7656	16-Nov-23	23-Nov-23	12
MP2_7	-32.0855	115.7656	16-Nov-23	23-Nov-23	12
MP2_8	-32.0856	115.7655	16-Nov-23	23-Nov-23	12
MP2_9	-32.0857	115.7656	16-Nov-23	23-Nov-23	12
MP2_10	-32.0857	115.7655	16-Nov-23	23-Nov-23	12
MP3_1	-32.0947	115.7715	19-Nov-23	24-Nov-23	12
MP3_2	-32.0947	115.7718	19-Nov-23	24-Nov-23	12
MP3_3	-32.0942	115.7726	19-Nov-23	24-Nov-23	12
MP3_4	-32.0937	115.7729	19-Nov-23	24-Nov-23	12
MP3_5	-32.0934	115.7732	19-Nov-23	24-Nov-23	12
MP3_6	-32.0929	115.7732	19-Nov-23	24-Nov-23	12
MP3_7	-32.0923	115.7732	19-Nov-23	24-Nov-23	12
MP3_8	-32.0919	115.7731	19-Nov-23	24-Nov-23	12
MP3_9	-32.0915	115.7728	19-Nov-23	24-Nov-23	12
MP3_10	-32.0909	115.7724	19-Nov-23	24-Nov-23	12
MP4_1	-32.09	115.77	16-Nov-23	23-Nov-23	12
MP4_2	-32.09	115.7698	16-Nov-23	23-Nov-23	12
MP4_3	-32.09	115.7697	16-Nov-23	23-Nov-23	12
MP4_4	-32.09	115.7694	16-Nov-23	23-Nov-23	12
MP4_5	-32.0901	115.7693	16-Nov-23	23-Nov-23	12
MP4_6	-32.0901	115.7691	16-Nov-23	23-Nov-23	12
MP4_7	-32.0902	115.7688	16-Nov-23	23-Nov-23	12
MP4_8	-32.0903	115.7686	16-Nov-23	23-Nov-23	12
MP4_9	-32.0905	115.7684	16-Nov-23	23-Nov-23	12
MP4_10	-32.0906	115.7682	16-Nov-23	23-Nov-23	12

Site/trap Number	Latitude	Longitude	Date Opened	Date Closed	Site Visits
MP5_1	-32.0966	115.7672	17-Nov-23	24-Nov-23	12
MP5_2	-32.0967	115.7672	17-Nov-23	24-Nov-23	12
MP5_3	-32.0968	115.7672	17-Nov-23	24-Nov-23	12
MP5_4	-32.0968	115.7673	17-Nov-23	24-Nov-23	12
MP5_5	-32.0968	115.7674	17-Nov-23	24-Nov-23	12
MP5_6	-32.0968	115.7677	17-Nov-23	24-Nov-23	12
MP5_7	-32.0969	115.7677	17-Nov-23	24-Nov-23	12
MP5_8	-32.0969	115.7678	17-Nov-23	24-Nov-23	12
MP5_9	-32.0969	115.7679	17-Nov-23	24-Nov-23	12
MP5_10	-32.0969	115.7681	17-Nov-23	24-Nov-23	12
MP6_1	-32.0943	115.7668	17-Nov-23	24-Nov-23	12
MP6_2	-32.0943	115.7666	17-Nov-23	24-Nov-23	12
MP6_3	-32.0945	115.7663	17-Nov-23	24-Nov-23	12
MP6_4	-32.0945	115.7661	17-Nov-23	24-Nov-23	12
MP6_5	-32.0946	115.7662	17-Nov-23	24-Nov-23	12
MP6_6	-32.0948	115.7662	17-Nov-23	24-Nov-23	12
MP6_7	-32.095	115.7662	17-Nov-23	24-Nov-23	12
MP6_8	-32.0952	115.7662	17-Nov-23	24-Nov-23	12
MP6_9	-32.0953	115.766	17-Nov-23	24-Nov-23	12
MP6_10	-32.0953	115.7657	17-Nov-23	24-Nov-23	12

APPENDIX 3. Date and location of motion cameras deployed at Manning Park

Camera Number	Site Number	Latitude	Longitude	Date Deployed	Date Retrieved
FA1	-	-32.0947	115.7718	17/11/2023	1/12/2023
FA2	MP6	-32.0953	115.7662	17/11/2023	1/12/2023
FA6	-	-32.083	115.7648	17/11/2023	1/12/2023
FA7	-	-32.0988	115.7719	17/11/2023	1/12/2023
FA10	MP5	-32.0971	115.7678	17/11/2023	1/12/2023
FB1	-	-32.0844	115.7645	17/11/2023	1/12/2023
FB2	-	-32.0871	115.767	17/11/2023	1/12/2023
FB3	MP4	-32.0904	115.7687	17/11/2023	1/12/2023
FB7	-	-32.0954	115.7644	17/11/2023	1/12/2023
FC2	-	-32.0915	115.7655	17/11/2023	1/12/2023
FC3	MP2	-32.0856	115.7659	17/11/2023	1/12/2023
FC6	-	-32.0933	115.7684	17/11/2023	1/12/2023
FC8	MP3	-32.0907	115.7723	17/11/2023	1/12/2023
FC9	-	-32.0877	115.7639	17/11/2023	1/12/2023
FD3	-	-32.0927	115.7655	17/11/2023	1/12/2023
FD6	MP1	-32.0976	115.7707	17/11/2023	1/12/2023

APPENDIX 4: Bat detector locations at Manning Park

Bat Detector ID	Site Number	Latitude	Longitude	Date Deployed	Date Retrieved
BAT_MP1	1	-32.0975	115.7708	17/11/2023	18/11/2023
BAT_MP2	2	-32.0856	115.7664	18/11/2023	19/11/2023
BAT_MP3	3	-32.0915	115.7725	21/11/2023	22/11/2023
BAT_MP4	4	-32.0901	115.7693	16/11/2023	17/11/2023
BAT_MP5	5	-32.0969	115.7674	19/11/2023	20/11/2023
BAT_MP6	6	-32.0952	115.7662	20/11/2023	21/11/2023

APPENDIX 5. All fauna detected during trapping surveys of Manning Park

Date	Taxon Name	Capture number	Site number	Lat	Long	Method
17/11/2023	*Mus musculus*	1	1	-32.097851	115.769951	Bucket
17/11/2023	*Ctenotus fallens*	1	1	-32.097851	115.769951	Bucket
17/11/2023	*Lerista lineata*	1	1	-32.097034	115.770721	Bucket
17/11/2023	*Menetia greyii*	1	1	-32.097034	115.770721	Bucket
17/11/2023	*Menetia greyii*	1	1	-32.097107	115.770683	Bucket
17/11/2023	*Australian magpie*	1	1	-32.097843	115.7696	Cage
17/11/2023	*Ctenotus fallens*	1	1	-32.097107	115.770683	Funnel
17/11/2023	*Ctenotus fallens*	1	1	-32.097424	115.770576	Funnel
17/11/2023	*Hemiergis quadrilineata*	1	1	-32.097332	115.770607	Funnel
17/11/2023	*Tiliqua rugosa*	1	1	-32.097233	115.770668	Large Elliott
17/11/2023	*Menetia greyii*	2	1	-32.097527	115.770538	Bucket
17/11/2023	*Tiliqua rugosa*	1	1	-32.0979	115.770103	Large Elliott
17/11/2023	*Anilios australis*	1	2	-32.085461	115.765579	Bucket
17/11/2023	*Hemiergis quadrilineata*	1	2	-32.085674	115.76561	Funnel
17/11/2023	*Menetia greyii*	1	2	-32.085304	115.765656	Bucket
17/11/2023	*Lialis burtonis*	1	2	-32.085461	115.765579	Funnel
17/11/2023	*Cryptoblepharus buchananii*	1	4	-32.089985	115.769676	Bucket
17/11/2023	*Morethia lineoocellata*	1	4	-32.090092	115.769272	Bucket
17/11/2023	*Morethia lineoocellata*	1	4	-32.090569	115.768211	Funnel
18/11/2023	*Ctenotus fallens*	1	1	-32.097874	115.769676	Bucket
18/11/2023	*Tiliqua rugosa*	1	1	-32.097294	115.770592	Cage
18/11/2023	*Ctenotus fallens*	1	1	-32.097034	115.770737	Funnel
18/11/2023	*Ctenotus fallens*	1	1	-32.097294	115.770592	Funnel
18/11/2023	*Menetia greyii*	1	1	-32.097034	115.770737	Funnel
18/11/2023	*Tiliqua rugosa*	1	1	-32.097427	115.770576	Large Elliott
18/11/2023	*Mus musculus*	1	1	-32.097897	115.769676	Small Elliott
18/11/2023	*Mus musculus*	1	1	-32.097816	115.769531	Small Elliott
18/11/2023	*Mus musculus*	1	1	-32.0979	115.770088	Small Elliott
18/11/2023	*Menetia greyii*	1	2	-32.084946	115.765755	Bucket
18/11/2023	*Lialis burtonis*	1	2	-32.085304	115.765694	Funnel
18/11/2023	*Lialis burtonis*	1	2	-32.085415	115.765594	Funnel
18/11/2023	*Strophurus spinigerus*	1	2	-32.08551	115.765579	Funnel
18/11/2023	*Tiliqua rugosa*	1	2	-32.08551	115.765579	Large Elliott
18/11/2023	*Mus musculus*	1	2	-32.085304	115.765694	Small Elliott
18/11/2023	*Mus musculus*	1	2	-32.085594	115.765495	Small Elliott
18/11/2023	*Mus musculus*	1	2	-32.085674	115.765579	Small Elliott
18/11/2023	*Tiliqua rugosa*	1	2	-32.085049	115.765694	Small Elliott
18/11/2023	*Egernia kingii*	1	3	-32.09293	115.773209	Cage
18/11/2023	*Egernia kingii*	1	3	-32.090866	115.772415	Cage
18/11/2023	*Egernia kingii*	1	3	-32.092323	115.773262	Cage
18/11/2023	*Mus musculus*	1	3	-32.094215	115.772591	Small Elliott
18/11/2023	*Mus musculus*	1	3	-32.091541	115.772789	Small Elliott
18/11/2023	*Lerista distinguenda*	1	4	-32.089977	115.769905	Bucket
18/11/2023	*Rattus rattus*	1	4	-32.090084	115.769257	Cage
18/11/2023	*Tiliqua rugosa*	1	4	-32.09	115.769646	Cage
18/11/2023	*Tiliqua rugosa*	1	4	-32.089985	115.769371	Cage
18/11/2023	*Ctenotus fallens*	1	4	-32.090054	115.769112	Funnel
18/11/2023	*Ctenotus fallens*	1	4	-32.090172	115.768867	Funnel
18/11/2023	*Hemiergis quadrilineata*	1	4	-32.090366	115.768669	Funnel
18/11/2023	*Morethia obscura*	1	4	-32.089958	115.769806	Funnel
18/11/2023	*Mus musculus*	1	4	-32.090084	115.769257	Small Elliott
18/11/2023	*Anilios australis*	1	5	-32.09679	115.767265	Bucket

Date	Taxon Name	Capture number	Site number	Lat	Long	Method
18/11/2023	*Ctenotus fallens*	1	5	-32.096882	115.767708	Funnel
18/11/2023	*Ctenotus fallens*	4	5	-32.096779	115.767204	Funnel
18/11/2023	*Ctenotus fallens*	1	5	-32.096565	115.767159	Funnel
18/11/2023	*Lialis burtonis*	1	5	-32.096912	115.767952	Funnel
18/11/2023	*Strophurus spinigerus*	1	5	-32.096565	115.767159	Funnel
18/11/2023	*Menetia greyii*	1	6	-32.094334	115.7668	Bucket
18/11/2023	*Morethia obscura*	1	6	-32.094749	115.766243	Funnel
19/11/2023	*Cryptoblepharus buchananii*	1	1	-32.097332	115.770607	Bucket
19/11/2023	*Hemiergis quadrilineata*	1	1	-32.097145	115.770706	Bucket
19/11/2023	*Lerista lineata*	1	1	-32.097034	115.770638	Bucket
19/11/2023	*Menetia greyii*	1	1	-32.097034	115.770638	Bucket
19/11/2023	*Menetia greyii*	1	1	-32.097462	115.770554	Bucket
19/11/2023	*Tiliqua rugosa*	1	1	-32.097145	115.770706	Cage
19/11/2023	*Ctenotus fallens*	1	1	-32.097816	115.769516	Funnel
19/11/2023	*Menetia greyii*	1	1	-32.097034	115.770638	Funnel
19/11/2023	*Menetia greyii*	1	1	-32.097145	115.770706	Funnel
19/11/2023	*Mus musculus*	1	1	-32.097462	115.770554	Small Elliott
19/11/2023	*Mus musculus*	1	1	-32.097904	115.770119	Small Elliott
19/11/2023	*Ctenotus australis*	1	2	-32.084824	115.76577	Bucket
19/11/2023	*Delma grayii*	1	2	-32.0854	115.765594	Bucket
19/11/2023	*Hemiergis quadrilineata*	1	2	-32.085606	115.76548	Bucket
19/11/2023	*Lerista lineata*	1	2	-32.084824	115.76577	Bucket
19/11/2023	*Menetia greyii*	1	2	-32.085491	115.765556	Bucket
19/11/2023	*Tiliqua rugosa*	1	2	-32.085606	115.76548	Cage
19/11/2023	*Isoodon fusciventer*	1	2	-32.085716	115.765495	Large Elliott
19/11/2023	*Tiliqua rugosa*	1	2	-32.085491	115.765556	Large Elliott
19/11/2023	*Rattus rattus*	1	3	-32.094215	115.772606	Cage
19/11/2023	*Egernia kingii*	1	3	-32.090885	115.77243	Cage
19/11/2023	*Mus musculus*	1	3	-32.094215	115.772606	Small Elliott
19/11/2023	*Mus musculus*	1	3	-32.09333	115.773163	Small Elliott
19/11/2023	*Mus musculus*	1	3	-32.085308	115.765671	Small Elliott
19/11/2023	*Rattus rattus*	1	3	-32.08567	115.765579	Small Elliott
19/11/2023	*Hemiergis quadrilineata*	1	4	-32.090553	115.768181	Bucket
19/11/2023	*Lerista distinguenda*	1	4	-32.089931	115.769875	Bucket
19/11/2023	*Lerista distinguenda*	1	4	-32.089977	115.769386	Bucket
19/11/2023	*Lerista distinguenda*	1	4	-32.090153	115.768845	Bucket
19/11/2023	*Morethia lineoocellata*	1	4	-32.089977	115.769806	Bucket
19/11/2023	*Egernia kingii*	1	4	-32.092873	115.773209	Cage
19/11/2023	*Tiliqua rugosa*	1	4	-32.089977	115.769386	Cage
19/11/2023	*Ctenotus fallens*	1	4	-32.090069	115.769073	Funnel
19/11/2023	*Ctenotus fallens*	2	5	-32.096775	115.76722	Bucket
19/11/2023	*Ctenotus fallens*	2	5	-32.096798	115.767303	Funnel
19/11/2023	*Mus musculus*	1	5	-32.096939	115.767807	Small Elliott
19/11/2023	*Mus musculus*	1	5	-32.094341	115.766571	Small Elliott
19/11/2023	*Hemiergis quadrilineata*	1	6	-32.094357	115.76683	Bucket
19/11/2023	*Lerista lineata*	1	6	-32.095188	115.766182	Bucket
19/11/2023	*Lerista lineata*	1	6	-32.094357	115.76683	Bucket
19/11/2023	*Tiliqua rugosa*	1	6	-32.09499	115.766212	Bucket
19/11/2023	*Rattus rattus*	1	6	-32.094532	115.766258	Cage
19/11/2023	*Ctenotus fallens*	1	6	-32.094498	115.766159	Funnel
19/11/2023	*Ctenotus fallens*	1	6	-32.094357	115.766602	Funnel
20/11/2023	*Hemiergis quadrilineata*	1	1	-32.097126	115.770668	Bucket
20/11/2023	*Hemiergis quadrilineata*	1	1	-32.097355	115.770576	Bucket

Date	Taxon Name	Capture number	Site number	Lat	Long	Method
20/11/2023	*Menetia greyii*	1	1	-32.097008	115.770706	Bucket
20/11/2023	*Menetia greyii*	1	1	-32.097126	115.770668	Bucket
20/11/2023	*Menetia greyii*	1	1	-32.097359	115.770576	Bucket
20/11/2023	*Tiliqua rugosa*	1	1	-32.097359	115.770576	Cage
20/11/2023	*Ctenotus fallens*	1	1	-32.097126	115.770668	Funnel
20/11/2023	*Ctenotus fallens*	1	1	-32.097855	115.769562	Funnel
20/11/2023	*Pseudonaja affinis*	1	1	-32.097855	115.769562	Funnel
20/11/2023	*Tiliqua rugosa*	1	1	-32.097431	115.770592	Large Elliott
20/11/2023	*Lerista lineata*	1	2	-32.085033	115.765656	Bucket
20/11/2023	*Neelaps bimaculatus*	1	2	-32.085033	115.765656	Bucket
20/11/2023	*Lialis burtonis*	1	2	-32.085411	115.76561	Funnel
20/11/2023	*Mus musculus*	1	2	-32.085022	115.765671	Small Elliott
20/11/2023	*Mus musculus*	1	2	-32.085316	115.76564	Small Elliott
20/11/2023	*Egernia kingii*	1	3	-32.093376	115.773109	Cage
20/11/2023	*Egernia kingii*	1	3	-32.092937	115.773178	Cage
20/11/2023	*Rattus rattus*	1	3	-32.091858	115.773079	Funnel
20/11/2023	*Mus musculus*	1	3	-32.090885	115.772446	Small Elliott
20/11/2023	*Mus musculus*	1	3	-32.094711	115.771759	Small Elliott
20/11/2023	*Mus musculus*	1	3	-32.094742	115.77153	Small Elliott
20/11/2023	*Lerista distinguenda*	1	4	-32.089966	115.76976	Bucket
20/11/2023	*Lerista distinguenda*	1	4	-32.089985	115.769432	Bucket
20/11/2023	*Menetia greyii*	1	4	-32.090206	115.768883	Bucket
20/11/2023	*Tiliqua rugosa*	1	4	-32.090149	115.769272	Cage
20/11/2023	*Tiliqua rugosa*	1	4	-32.090473	115.768379	Cage
20/11/2023	*Ctenotus fallens*	1	4	-32.090099	115.769089	Funnel
20/11/2023	*Morethia obscura*	1	4	-32.089985	115.769432	Funnel
20/11/2023	*Morethia obscura*	1	4	-32.090149	115.769272	Funnel
20/11/2023	*Anilios australis*	1	5	-32.096767	115.767204	Bucket
20/11/2023	*Strophurus spinigerus*	1	5	-32.096691	115.767189	Bucket
20/11/2023	*Ctenotus fallens*	1	5	-32.096767	115.767204	Funnel
20/11/2023	*Pseudonaja affinis*	1	5	-32.096569	115.767159	Funnel
20/11/2023	*Mus musculus*	1	5	-32.096569	115.767159	Large Elliott
20/11/2023	*Silvereye*	5	5	-32.09677	115.767682	Sighting
20/11/2023	*Singing honeyeater*	1	5	-32.09677	115.767682	Sighting
20/11/2023	*Mus musculus*	1	5	-32.096878	115.767708	Small Elliott
20/11/2023	*Mus musculus*	1	5	-32.09676	115.767708	Small Elliott
20/11/2023	*Mus musculus*	1	5	-32.096569	115.767159	Small Elliott
20/11/2023	*Tiliqua rugosa*	1	6	-32.095009	115.766212	Bucket
20/11/2023	*Tiliqua rugosa*	1	6	-32.094501	115.766228	Cage
20/11/2023	*Ctenotus fallens*	1	6	-32.095188	115.766197	Funnel
20/11/2023	*Tiliqua rugosa*	1	6	-32.094357	115.7668	Small Elliott
21/11/2023	*Mus musculus*	1	1	-32.097107	115.770683	Bucket
21/11/2023	*Aprasia repens*	1	1	-32.097908	115.76992	Bucket
21/11/2023	*Menetia greyii*	1	1	-32.097107	115.770683	Bucket
21/11/2023	*Menetia greyii*	1	1	-32.097332	115.770607	Bucket
21/11/2023	*Menetia greyii*	1	1	-32.097427	115.770538	Bucket
21/11/2023	*Menetia greyii*	1	1	-32.097591	115.770477	Bucket
21/11/2023	*Menetia greyii*	1	1	-32.097908	115.76992	Bucket
21/11/2023	*Menetia greyii*	1	1	-32.097874	115.769577	Bucket
21/11/2023	*Hemiergis quadrilineata*	1	1	-32.09705	115.770721	Funnel
21/11/2023	*Hemiergis quadrilineata*	1	1	-32.097881	115.769936	Funnel
21/11/2023	*Tiliqua rugosa*	1	1	-32.097427	115.770538	Large Elliott
21/11/2023	*Tiliqua rugosa*	1	1	-32.097897	115.770119	Large Elliott

Date	Taxon Name	Capture number	Site number	Lat	Long	Method
21/11/2023	*Mus musculus*	1	1	-32.097324	115.770653	Small Elliott
21/11/2023	*Lialis burtonis*	1	2	-32.085464	115.765556	Bucket
21/11/2023	*Neelaps bimaculatus*	1	2	-32.084846	115.76577	Bucket
21/11/2023	*Tiliqua rugosa*	2	2	-32.084908	115.7658	Cage
21/11/2023	*Tiliqua rugosa*	1	2	-32.085659	115.76561	Cage
21/11/2023	*Hemiergis quadrilineata*	1	2	-32.084969	115.765739	Funnel
21/11/2023	*Mus musculus*	1	2	-32.085728	115.765495	Small Elliott
21/11/2023	*Rattus rattus*	1	3	-32.093731	115.772919	Cage
21/11/2023	*Rattus rattus*	1	3	-32.093372	115.773109	Cage
21/11/2023	*Egernia kingii*	1	3	-32.092979	115.773209	Cage
21/11/2023	*Egernia kingii*	1	3	-32.090919	115.772415	Cage
21/11/2023	*Mus musculus*	1	3	-32.094841	115.7715	Small Elliott
21/11/2023	*Christinus marmoratus*	1	4	-32.089981	115.76963	Bucket
21/11/2023	*Lerista distinguenda*	3	4	-32.089985	115.769844	Bucket
21/11/2023	*Menetia greyii*	1	4	-32.090034	115.769257	Bucket
21/11/2023	*Tiliqua rugosa*	1	4	-32.090034	115.769257	Cage
21/11/2023	*Hemiergis quadrilineata*	1	4	-32.089981	115.76963	Funnel
21/11/2023	*Hemiergis quadrilineata*	1	4	-32.090431	115.768356	Funnel
21/11/2023	*Lialis burtonis*	1	4	-32.089985	115.769844	Funnel
21/11/2023	*Morethia obscura*	1	4	-32.090034	115.769257	Funnel
21/11/2023	*Morethia obscura*	1	4	-32.090412	115.768379	Funnel
21/11/2023	*Morethia obscura*	1	4	-32.090557	115.768181	Funnel
21/11/2023	*Aprasia repens*	1	5	-32.096657	115.767204	Bucket
21/11/2023	*Hemiergis quadrilineata*	1	5	-32.096752	115.767235	Bucket
21/11/2023	*Pogona minor*	1	5	-32.096794	115.767349	Bucket
21/11/2023	*Ctenotus fallens*	1	5	-32.096794	115.767448	Funnel
21/11/2023	*Ctenotus fallens*	1	5	-32.096752	115.767235	Funnel
21/11/2023	*Strophurus spinigerus*	1	5	-32.096794	115.767349	Funnel
21/11/2023	*Mus musculus*	1	5	-32.096931	115.767921	Small Elliott
21/11/2023	*Mus musculus*	1	5	-32.096874	115.767723	Small Elliott
21/11/2023	*Ctenotus australis*	1	6	-32.095272	115.765968	Bucket
21/11/2023	*Lialis burtonis*	1	6	-32.094345	115.766777	Bucket
21/11/2023	*Menetia greyii*	1	6	-32.095161	115.766197	Bucket
21/11/2023	*Menetia greyii*	1	6	-32.094322	115.766647	Bucket
21/11/2023	*Tiliqua rugosa*	1	6	-32.094566	115.766197	Cage
21/11/2023	*Ctenotus fallens*	1	6	-32.094978	115.766212	Funnel
21/11/2023	*Neelaps bimaculatus*	1	6	-32.095161	115.766197	Funnel
21/11/2023	*Mus musculus*	1	6	-32.095257	115.765709	Small Elliott
22/11/2023	*Aprasia repens*	1	1	-32.09742	115.770554	Bucket
22/11/2023	*Aprasia repens*	1	1	-32.097805	115.769577	Bucket
22/11/2023	*Ctenotus fallens*	1	1	-32.097546	115.770508	Bucket
22/11/2023	*Hemiergis quadrilineata*	1	1	-32.097202	115.770592	Bucket
22/11/2023	*Hemiergis quadrilineata*	1	1	-32.097912	115.770088	Bucket
22/11/2023	*Menetia greyii*	1	1	-32.097214	115.770607	Bucket
22/11/2023	*Menetia greyii*	1	1	-32.097878	115.770088	Bucket
22/11/2023	*Ctenotus fallens*	1	1	-32.097103	115.770638	Funnel
22/11/2023	*Hemiergis quadrilineata*	1	1	-32.096996	115.770737	Funnel
22/11/2023	*Menetia greyii*	1	1	-32.096996	115.770737	Funnel
22/11/2023	*Tiliqua rugosa*	1	1	-32.097881	115.769661	Funnel
22/11/2023	*Lerista lineata*	1	2	-32.08572	115.765495	Bucket
22/11/2023	*Menetia greyii*	1	2	-32.08559	115.76548	Bucket
22/11/2023	*Strophurus spinigerus*	2	2	-32.085003	115.765755	Funnel
22/11/2023	*Egernia kingii*	1	3	-32.092991	115.773209	Cage

Date	Taxon Name	Capture number	Site number	Lat	Long	Method
22/11/2023	*Egernia kingii*	1	3	-32.09153	115.772789	Cage
22/11/2023	*Mus musculus*	1	3	-32.094742	115.771515	Small Elliott
22/11/2023	*Lerista distinguenda*	1	4	-32.089962	115.769386	Bucket
22/11/2023	*Lerista distinguenda*	4	4	-32.090359	115.768654	Bucket
22/11/2023	*Lerista distinguenda*	4	4	-32.090435	115.768425	Bucket
22/11/2023	*Lerista distinguenda*	1	4	-32.090576	115.768166	Bucket
22/11/2023	*Lialis burtonis*	1	4	-32.089954	115.76973	Bucket
22/11/2023	*Menetia greyii*	1	4	-32.089962	115.769386	Bucket
22/11/2023	*Morethia obscura*	1	4	-32.089962	115.769386	Bucket
22/11/2023	*Morethia obscura*	1	4	-32.09008	115.769302	Bucket
22/11/2023	*Morethia obscura*	1	4	-32.090576	115.768166	Bucket
22/11/2023	*Tiliqua rugosa*	1	4	-32.09008	115.769302	Bucket
22/11/2023	*Aprasia repens*	1	4	-32.090176	115.768867	Funnel
22/11/2023	*Tiliqua rugosa*	1	4	-32.089962	115.769386	Funnel
22/11/2023	*Ctenotus fallens*	1	5	-32.095268	115.765984	Bucket
22/11/2023	*Lialis burtonis*	1	5	-32.096783	115.76722	Bucket
22/11/2023	*Lialis burtonis*	1	5	-32.095203	115.766212	Funnel
22/11/2023	*Cryptoblepharus buchananii*	2	6	-32.09499	115.766212	Bucket
22/11/2023	*Lerista lineata*	2	6	-32.094349	115.766777	Bucket
22/11/2023	*Lialis burtonis*	1	6	-32.094517	115.766243	Bucket
23/11/2023	*Ctenotus fallens*	1	1	-32.090137	115.769058	Funnel
23/11/2023	*Pseudonaja affinis*	1	1	-32.091393	115.765999	Large Elliott
23/11/2023	*Tiliqua rugosa*	1	1	-32.091412	115.768082	Large Elliott
23/11/2023	*Aprasia repens*	1	2	-32.085396	115.765594	Bucket
23/11/2023	*Cryptoblepharus buchananii*	1	4	-32.090343	115.768669	Bucket
23/11/2023	*Lerista distinguenda*	1	4	-32.089973	115.76963	Bucket
23/11/2023	*Lerista distinguenda*	1	4	-32.090084	115.769218	Bucket
23/11/2023	*Lerista distinguenda*	1	4	-32.090111	115.769127	Bucket
23/11/2023	*Morethia obscura*	1	4	-32.089973	115.76963	Funnel
23/11/2023	*Morethia obscura*	1	4	-32.090099	115.769157	Funnel
23/11/2023	*Strophurus spinigerus*	1	5	-32.096748	115.767189	Bucket
23/11/2023	*Lialis burtonis*	1	6	-32.094597	115.766212	Bucket
23/11/2023	*Strophurus spinigerus*	1	6	-32.09528	115.765724	Funnel
24/11/2023	*Aprasia repens*	1	5	-32.096657	115.767204	Bucket
24/11/2023	*Hemiergis quadrilineata*	1	6	-32.094505	115.766243	Bucket
24/11/2023	*Lerista lineata*	1	6	-32.094376	115.766602	Bucket
24/11/2023	*Hemiergis quadrilineata*	1	6	-32.094482	115.766159	Funnel
24/11/2023	*Hemiergis quadrilineata*	1	6	-32.095287	115.765724	Funnel
24/11/2023	*Lerista lineata*	1	6	-32.095264	115.765984	Funnel

APPENDIX 6. All birds detected during systematic bird surveys at trapping sites at Manning Park

Date	Common Name	Observed number	Site number	Lat	Long	Method
17/11/2023	Australian magpie	4	1	-32.09746	115.770543	Sighting
17/11/2023	Australian raven	2	1	-32.09746	115.770543	Sighting
17/11/2023	Australian ringneck	1	1	-32.09746	115.770543	Sighting
17/11/2023	Brown honeyeater	2	1	-32.09746	115.770543	Sighting
17/11/2023	Galah	2	1	-32.09746	115.770543	Sighting
17/11/2023	Grey fantail	1	1	-32.09746	115.770543	Sighting
17/11/2023	Mistletoebird	1	1	-32.09746	115.770543	Sighting
17/11/2023	Rainbow bee-eater	1	1	-32.09746	115.770543	Sighting
17/11/2023	Rainbow lorikeet	2	1	-32.09746	115.770543	Sighting
17/11/2023	Red wattlebird	3	1	-32.09746	115.770543	Sighting
17/11/2023	Rufous whistler	1	1	-32.09746	115.770543	Sighting
17/11/2023	Silvereye	3	1	-32.09746	115.770543	Sighting
17/11/2023	Singing honeyeater	1	1	-32.09746	115.770543	Sighting
17/11/2023	Splendid fairy-wren	4	1	-32.09746	115.770543	Sighting
17/11/2023	Tawny frogmouth	4	1	-32.09746	115.770543	Sighting
17/11/2023	Weebill	2	1	-32.09746	115.770543	Sighting
17/11/2023	Western gerygone	3	1	-32.09746	115.770543	Sighting
17/11/2023	Willie wagtail	1	1	-32.09746	115.770543	Sighting
17/11/2023	Yellow-rumped thornbill	3	1	-32.09746	115.770543	Sighting
17/11/2023	Australian raven	3	2	-32.08529	115.765645	Sighting
17/11/2023	Grey fantail	1	2	-32.08529	115.765645	Sighting
17/11/2023	Laughing kookaburra	1	2	-32.08529	115.765645	Sighting
17/11/2023	Rainbow bee-eater	2	2	-32.08529	115.765645	Sighting
17/11/2023	Rufous whistler	2	2	-32.08529	115.765645	Sighting
17/11/2023	Silvereye	2	2	-32.08529	115.765645	Sighting
17/11/2023	Singing honeyeater	2	2	-32.08529	115.765645	Sighting
17/11/2023	Weebill	2	2	-32.08529	115.765645	Sighting
17/11/2023	Western gerygone	1	2	-32.08529	115.765645	Sighting
17/11/2023	Black-faced cuckoo-shrike	1	4	-32.0901	115.769262	Sighting
17/11/2023	Brown goshawk	1	4	-32.0901	115.769262	Sighting
17/11/2023	Brown honeyeater	3	4	-32.0901	115.769262	Sighting
17/11/2023	Galah	2	4	-32.0901	115.769262	Sighting
17/11/2023	Grey butcherbird	1	4	-32.0901	115.769262	Sighting
17/11/2023	Laughing kookaburra	2	4	-32.0901	115.769262	Sighting
17/11/2023	Little corella	3	4	-32.0901	115.769262	Sighting
17/11/2023	Mistletoebird	1	4	-32.0901	115.769262	Sighting
17/11/2023	Rainbow lorikeet	4	4	-32.0901	115.769262	Sighting
17/11/2023	Red wattlebird	4	4	-32.0901	115.769262	Sighting
17/11/2023	Silvereye	3	4	-32.0901	115.769262	Sighting
17/11/2023	Singing honeyeater	2	4	-32.0901	115.769262	Sighting
17/11/2023	Spotted dove	1	4	-32.0901	115.769262	Sighting
17/11/2023	Weebill	3	4	-32.0901	115.769262	Sighting
17/11/2023	Western gerygone	2	4	-32.0901	115.769262	Sighting
18/11/2023	Australian magpie	4	1	-32.097547	115.770492	Sighting
18/11/2023	Australian raven	2	1	-32.097547	115.770492	Sighting
18/11/2023	Brown goshawk	1	1	-32.097547	115.770492	Sighting
18/11/2023	Brown honeyeater	5	1	-32.097547	115.770492	Sighting
18/11/2023	Crested pigeon	2	1	-32.097547	115.770492	Sighting
18/11/2023	Grey fantail	1	1	-32.097547	115.770492	Sighting
18/11/2023	Mistletoebird	1	1	-32.097547	115.770492	Sighting
18/11/2023	Rainbow lorikeet	6	1	-32.097547	115.770492	Sighting
18/11/2023	Red wattlebird	1	1	-32.097547	115.770492	Sighting

Date	Common Name	Observed number	Site number	Lat	Long	Method
18/11/2023	Rufous whistler	1	1	-32.097547	115.770492	Sighting
18/11/2023	Silvereye	2	1	-32.097547	115.770492	Sighting
18/11/2023	Singing honeyeater	1	1	-32.097547	115.770492	Sighting
18/11/2023	Weebill	4	1	-32.097547	115.770492	Sighting
18/11/2023	Willie wagtail	1	1	-32.097547	115.770492	Sighting
18/11/2023	Australasian grebe	2	3	-32.0943	115.771122	Sighting
18/11/2023	Australasian shoveler	2	3	-32.0943	115.771122	Sighting
18/11/2023	Australian magpie	4	3	-32.091682	115.772377	Sighting
18/11/2023	Australian pelican	3	3	-32.0943	115.771122	Sighting
18/11/2023	Australian shelduck	2	3	-32.0943	115.771122	Sighting
18/11/2023	Australian white ibis	3	3	-32.0943	115.771122	Sighting
18/11/2023	Black swan	4	3	-32.0943	115.771122	Sighting
18/11/2023	Buff-banded rail	1	3	-32.0943	115.771122	Sighting
18/11/2023	Dusky moorhen	2	3	-32.0943	115.771122	Sighting
18/11/2023	Eurasian coot	30	3	-32.0943	115.771122	Sighting
18/11/2023	Galah	5	3	-32.091682	115.772377	Sighting
18/11/2023	Grey butcherbird	2	3	-32.091682	115.772377	Sighting
18/11/2023	Grey teal	20	3	-32.0943	115.771122	Sighting
18/11/2023	Hoary-headed grebe	1	3	-32.0943	115.771122	Sighting
18/11/2023	Little black cormorant	2	3	-32.0943	115.771122	Sighting
18/11/2023	Little corella	6	3	-32.091682	115.772377	Sighting
18/11/2023	Pacific black duck	4	3	-32.0943	115.771122	Sighting
18/11/2023	Pink-eared duck	5	3	-32.0943	115.771122	Sighting
18/11/2023	Purple swamphen	1	3	-32.0943	115.771122	Sighting
18/11/2023	Rainbow lorikeet	8	3	-32.091682	115.772377	Sighting
18/11/2023	Silver gull	3	3	-32.0943	115.771122	Sighting
18/11/2023	White-faced heron	2	3	-32.0943	115.771122	Sighting
18/11/2023	Willie wagtail	2	3	-32.091682	115.772377	Sighting
18/11/2023	Yellow-billed spoonbill	3	3	-32.0943	115.771122	Sighting
18/11/2023	Australian raven	5	4	-32.0901	115.769262	Sighting
18/11/2023	Brown honeyeater	2	4	-32.0901	115.769262	Sighting
18/11/2023	Galah	2	4	-32.0901	115.769262	Sighting
18/11/2023	Little corella	2	4	-32.0901	115.769262	Sighting
18/11/2023	New-holland honeyeater	2	4	-32.0901	115.769262	Sighting
18/11/2023	Rainbow lorikeet	7	4	-32.0901	115.769262	Sighting
18/11/2023	Red wattlebird	6	4	-32.0901	115.769262	Sighting
18/11/2023	Red-capped parrot	2	4	-32.0901	115.769262	Sighting
18/11/2023	Rufous whistler	1	4	-32.0901	115.769262	Sighting
18/11/2023	Silvereye	2	4	-32.0901	115.769262	Sighting
18/11/2023	Spotted dove	1	4	-32.0901	115.769262	Sighting
18/11/2023	Striated pardalote	1	4	-32.0901	115.769262	Sighting
18/11/2023	Weebill	4	4	-32.0901	115.769262	Sighting
18/11/2023	Western gerygone	2	4	-32.0901	115.769262	Sighting
19/11/2023	Australian magpie	1	1	-32.097547	115.770492	Sighting
19/11/2023	Australian raven	4	1	-32.097547	115.770492	Sighting
19/11/2023	Black-faced cuckoo-shrike	1	1	-32.097547	115.770492	Sighting
19/11/2023	Galah	3	1	-32.097547	115.770492	Sighting
19/11/2023	Little corella	1	1	-32.097547	115.770492	Sighting
19/11/2023	Rainbow lorikeet	4	1	-32.097547	115.770492	Sighting
19/11/2023	Red wattlebird	3	1	-32.097547	115.770492	Sighting
19/11/2023	Silvereye	6	1	-32.097547	115.770492	Sighting
19/11/2023	Singing honeyeater	1	1	-32.097547	115.770492	Sighting
19/11/2023	Splendid fairy-wren	4	1	-32.097547	115.770492	Sighting

Date	Common Name	Observed number	Site number	Lat	Long	Method
19/11/2023	Weebill	4	1	-32.097547	115.770492	Sighting
19/11/2023	Western gerygone	4	1	-32.097547	115.770492	Sighting
19/11/2023	Australian raven	3	2	-32.08529	115.765645	Sighting
19/11/2023	Black-faced cuckoo-shrike	1	2	-32.08529	115.765645	Sighting
19/11/2023	Grey fantail	1	2	-32.08529	115.765645	Sighting
19/11/2023	New-holland honeyeater	3	2	-32.08529	115.765645	Sighting
19/11/2023	Rainbow bee-eater	2	2	-32.08529	115.765645	Sighting
19/11/2023	Rainbow lorikeet	3	2	-32.08529	115.765645	Sighting
19/11/2023	Red-tailed Black-cockatoo	4	2	-32.08529	115.765645	Sighting
19/11/2023	Rufous whistler	1	2	-32.08529	115.765645	Sighting
19/11/2023	Silvereye	6	2	-32.08529	115.765645	Sighting
19/11/2023	Splendid fairy-wren	2	2	-32.08529	115.765645	Sighting
19/11/2023	Spotted dove	2	2	-32.08529	115.765645	Sighting
19/11/2023	Spotted pardalote	2	2	-32.08529	115.765645	Sighting
19/11/2023	Tawny frogmouth	4	2	-32.08529	115.765645	Sighting
19/11/2023	Western gerygone	1	2	-32.08529	115.765645	Sighting
19/11/2023	White-browed scrubwren	2	2	-32.08529	115.765645	Sighting
19/11/2023	white-cheeked honeyeater	2	2	-32.08529	115.765645	Sighting
19/11/2023	Willie wagtail	1	2	-32.08529	115.765645	Sighting
19/11/2023	Singing honeyeater	1	5	-32.09677	115.767682	Sighting
19/11/2023	Variegated fairy-wren	3	5	-32.09677	115.767682	Sighting
19/11/2023	White-browed scrubwren	1	5	-32.09677	115.767682	Sighting
19/11/2023	Silvereye	3	6	-32.094762	115.766243	Sighting
19/11/2023	White-browed scrubwren	2	6	-32.094762	115.766243	Sighting
20/11/2023	Australian raven	2	2	-32.08529	115.765645	Sighting
20/11/2023	Brown honeyeater	2	2	-32.08529	115.765645	Sighting
20/11/2023	New-holland honeyeater	2	2	-32.08529	115.765645	Sighting
20/11/2023	Rainbow bee-eater	2	2	-32.08529	115.765645	Sighting
20/11/2023	Rainbow lorikeet	4	2	-32.08529	115.765645	Sighting
20/11/2023	Red-tailed Black-cockatoo	2	2	-32.08529	115.765645	Sighting
20/11/2023	Rufous whistler	2	2	-32.08529	115.765645	Sighting
20/11/2023	Silvereye	6	2	-32.08529	115.765645	Sighting
20/11/2023	Singing honeyeater	1	2	-32.08529	115.765645	Sighting
20/11/2023	Western gerygone	2	2	-32.08529	115.765645	Sighting
20/11/2023	White-browed scrubwren	2	2	-32.08529	115.765645	Sighting
20/11/2023	white-cheeked honeyeater	1	2	-32.08529	115.765645	Sighting
20/11/2023	Yellow-rumped thornbill	2	2	-32.08529	115.765645	Sighting
20/11/2023	Australian white ibis	2	3	-32.0943	115.771122	Sighting
20/11/2023	Black swan	3	3	-32.0943	115.771122	Sighting
20/11/2023	Crested pigeon	2	3	-32.091682	115.772377	Sighting
20/11/2023	Eurasian coot	20	3	-32.0943	115.771122	Sighting
20/11/2023	Great egret	2	3	-32.0943	115.771122	Sighting
20/11/2023	Grey teal	20	3	-32.0943	115.771122	Sighting
20/11/2023	Laughing dove	2	3	-32.091682	115.772377	Sighting
20/11/2023	Little corella	6	3	-32.091682	115.772377	Sighting
20/11/2023	Pacific black duck	8	3	-32.0943	115.771122	Sighting
20/11/2023	Pink-eared duck	3	3	-32.0943	115.771122	Sighting
20/11/2023	Red wattlebird	8	3	-32.091682	115.772377	Sighting
20/11/2023	Willie wagtail	1	3	-32.091682	115.772377	Sighting
20/11/2023	Australian magpie	2	4	-32.0901	115.769262	Sighting
20/11/2023	Galah	2	4	-32.0901	115.769262	Sighting
20/11/2023	Grey fantail	1	4	-32.0901	115.769262	Sighting
20/11/2023	Laughing kookaburra	1	4	-32.0901	115.769262	Sighting

Date	Common Name	Observed number	Site number	Lat	Long	Method
20/11/2023	Rainbow lorikeet	2	4	-32.0901	115.769262	Sighting
20/11/2023	Red wattlebird	4	4	-32.0901	115.769262	Sighting
20/11/2023	Rufous whistler	1	4	-32.0901	115.769262	Sighting
20/11/2023	Silvereye	9	4	-32.0901	115.769262	Sighting
20/11/2023	Singing honeyeater	3	4	-32.0901	115.769262	Sighting
20/11/2023	Spotted dove	2	4	-32.0901	115.769262	Sighting
20/11/2023	Striated pardalote	1	4	-32.0901	115.769262	Sighting
20/11/2023	Weebill	2	4	-32.0901	115.769262	Sighting
20/11/2023	Western gerygone	4	4	-32.0901	115.769262	Sighting
20/11/2023	White-browed scrubwren	1	4	-32.0901	115.769262	Sighting
20/11/2023	Silvereye	5	5	-32.09677	115.767682	Sighting
20/11/2023	Singing honeyeater	1	5	-32.09677	115.767682	Sighting
20/11/2023	Australian raven	2	6	-32.094762	115.766243	Sighting
20/11/2023	Rufous whistler	2	6	-32.094762	115.766243	Sighting
20/11/2023	Silvereye	4	6	-32.094762	115.766243	Sighting
20/11/2023	Singing honeyeater	1	6	-32.094762	115.766243	Sighting
20/11/2023	Variegated fairy-wren	3	6	-32.094762	115.766243	Sighting
20/11/2023	Western gerygone	3	6	-32.094762	115.766243	Sighting
20/11/2023	White-browed scrubwren	3	6	-32.094762	115.766243	Sighting
21/11/2023	Australian magpie	3	1	-32.097547	115.770492	Sighting
21/11/2023	Australian raven	1	1	-32.097547	115.770492	Sighting
21/11/2023	Black-faced cuckoo-shrike	1	1	-32.097547	115.770492	Sighting
21/11/2023	Brown honeyeater	3	1	-32.097547	115.770492	Sighting
21/11/2023	Grey fantail	1	1	-32.097547	115.770492	Sighting
21/11/2023	Laughing dove	1	1	-32.097547	115.770492	Sighting
21/11/2023	Rainbow bee-eater	1	1	-32.097547	115.770492	Sighting
21/11/2023	Rainbow lorikeet	2	1	-32.097547	115.770492	Sighting
21/11/2023	Red wattlebird	4	1	-32.097547	115.770492	Sighting
21/11/2023	Rufous whistler	1	1	-32.097547	115.770492	Sighting
21/11/2023	Silvereye	6	1	-32.097547	115.770492	Sighting
21/11/2023	Singing honeyeater	2	1	-32.097547	115.770492	Sighting
21/11/2023	Splendid fairy-wren	3	1	-32.097547	115.770492	Sighting
21/11/2023	Weebill	5	1	-32.097547	115.770492	Sighting
21/11/2023	Western gerygone	2	1	-32.097547	115.770492	Sighting
21/11/2023	Australasian shoveler	2	3	-32.0943	115.771122	Sighting
21/11/2023	Australian pelican	3	3	-32.0943	115.771122	Sighting
21/11/2023	Australian ringneck	2	3	-32.091682	115.772377	Sighting
21/11/2023	Australian shelduck	2	3	-32.0943	115.771122	Sighting
21/11/2023	Australian white ibis	4	3	-32.0943	115.771122	Sighting
21/11/2023	Brown goshawk	1	3	-32.091682	115.772377	Sighting
21/11/2023	Buff-banded rail	1	3	-32.0943	115.771122	Sighting
21/11/2023	Carnaby's cockatoo	2	3	-32.090217	115.772396	Sighting
21/11/2023	Crested pigeon	1	3	-32.0943	115.771122	Sighting
21/11/2023	Dusky moorhen	1	3	-32.0943	115.771122	Sighting
21/11/2023	Eurasian coot	50	3	-32.0943	115.771122	Sighting
21/11/2023	Galah	2	3	-32.091682	115.772377	Sighting
21/11/2023	Great egret	2	3	-32.0943	115.771122	Sighting
21/11/2023	Grey teal	9	3	-32.0943	115.771122	Sighting
21/11/2023	Hoary-headed grebe	1	3	-32.0943	115.771122	Sighting
21/11/2023	Laughing kookaburra	1	3	-32.091682	115.772377	Sighting
21/11/2023	Little black cormorant	2	3	-32.0943	115.771122	Sighting
21/11/2023	Little corella	4	3	-32.091682	115.772377	Sighting
21/11/2023	Magpie-lark	2	3	-32.091682	115.772377	Sighting

Date	Common Name	Observed number	Site number	Lat	Long	Method
21/11/2023	Mistletoebird	1	3	-32.091682	115.772377	Sighting
21/11/2023	Pacific black duck	7	3	-32.0943	115.771122	Sighting
21/11/2023	Pink-eared duck	8	3	-32.0943	115.771122	Sighting
21/11/2023	Purple swamphen	3	3	-32.0943	115.771122	Sighting
21/11/2023	Red-capped parrot	2	3	-32.091682	115.772377	Sighting
21/11/2023	Silver gull	5	3	-32.0943	115.771122	Sighting
21/11/2023	White-faced heron	1	3	-32.0943	115.771122	Sighting
21/11/2023	Willie wagtail	2	3	-32.091682	115.772377	Sighting
21/11/2023	Yellow-billed spoonbill	3	3	-32.0943	115.771122	Sighting
21/11/2023	Australian magpie	2	4	-32.0901	115.769262	Sighting
21/11/2023	Australian raven	3	4	-32.0901	115.769262	Sighting
21/11/2023	Brown honeyeater	5	4	-32.0901	115.769262	Sighting
21/11/2023	Galah	2	4	-32.0901	115.769262	Sighting
21/11/2023	Grey butcherbird	1	4	-32.0901	115.769262	Sighting
21/11/2023	Grey fantail	1	4	-32.0901	115.769262	Sighting
21/11/2023	Little corella	4	4	-32.0901	115.769262	Sighting
21/11/2023	New-holland honeyeater	2	4	-32.0901	115.769262	Sighting
21/11/2023	Rainbow lorikeet	7	4	-32.0901	115.769262	Sighting
21/11/2023	Red wattlebird	4	4	-32.0901	115.769262	Sighting
21/11/2023	Rufous whistler	1	4	-32.0901	115.769262	Sighting
21/11/2023	Silvereye	3	4	-32.0901	115.769262	Sighting
21/11/2023	Singing honeyeater	2	4	-32.0901	115.769262	Sighting
21/11/2023	Striated pardalote	2	4	-32.0901	115.769262	Sighting
21/11/2023	Weebill	2	4	-32.0901	115.769262	Sighting
21/11/2023	Western gerygone	2	4	-32.0901	115.769262	Sighting
21/11/2023	Black-shouldered Kite	1	5	-32.09677	115.767682	Sighting
21/11/2023	Brown goshawk	3	5	-32.09677	115.767682	Sighting
21/11/2023	Silvereye	6	5	-32.09677	115.767682	Sighting
21/11/2023	Splendid fairy-wren	4	5	-32.09677	115.767682	Sighting
21/11/2023	White-browed scrubwren	1	5	-32.09677	115.767682	Sighting
21/11/2023	Australian raven	2	6	-32.094762	115.766243	Sighting
21/11/2023	Rainbow lorikeet	2	6	-32.094762	115.766243	Sighting
21/11/2023	Red wattlebird	2	6	-32.094762	115.766243	Sighting
21/11/2023	Rufous whistler	1	6	-32.094762	115.766243	Sighting
21/11/2023	Silvereye	5	6	-32.094762	115.766243	Sighting
21/11/2023	Singing honeyeater	1	6	-32.094762	115.766243	Sighting
21/11/2023	Tree martin	2	6	-32.094762	115.766243	Sighting
21/11/2023	Western gerygone	1	6	-32.094762	115.766243	Sighting
21/11/2023	White-browed scrubwren	3	6	-32.094762	115.766243	Sighting
22/11/2023	Australian magpie	1	1	-32.097547	115.770492	Sighting
22/11/2023	Australian raven	1	1	-32.097547	115.770492	Sighting
22/11/2023	Brown honeyeater	2	1	-32.097547	115.770492	Sighting
22/11/2023	Grey fantail	1	1	-32.097547	115.770492	Sighting
22/11/2023	Mistletoebird	1	1	-32.097547	115.770492	Sighting
22/11/2023	Rainbow lorikeet	2	1	-32.097547	115.770492	Sighting
22/11/2023	Red wattlebird	2	1	-32.097547	115.770492	Sighting
22/11/2023	Silvereye	4	1	-32.097547	115.770492	Sighting
22/11/2023	Weebill	2	1	-32.097547	115.770492	Sighting
22/11/2023	Western gerygone	2	1	-32.097547	115.770492	Sighting
22/11/2023	White-browed scrubwren	1	1	-32.097547	115.770492	Sighting
22/11/2023	Willie wagtail	1	1	-32.097547	115.770492	Sighting
22/11/2023	Yellow-rumped thornbill	2	1	-32.097547	115.770492	Sighting
22/11/2023	Brown honeyeater	3	2	-32.08529	115.765645	Sighting

Date	Common Name	Observed number	Site number	Lat	Long	Method
22/11/2023	Grey fantail	1	2	-32.08529	115.765645	Sighting
22/11/2023	Rainbow bee-eater	2	2	-32.08529	115.765645	Sighting
22/11/2023	Rainbow lorikeet	2	2	-32.08529	115.765645	Sighting
22/11/2023	Rufous whistler	1	2	-32.08529	115.765645	Sighting
22/11/2023	Silvereye	5	2	-32.08529	115.765645	Sighting
22/11/2023	Singing honeyeater	1	2	-32.08529	115.765645	Sighting
22/11/2023	Western gerygone	1	2	-32.08529	115.765645	Sighting
22/11/2023	White-browed scrubwren	1	2	-32.08529	115.765645	Sighting
22/11/2023	Australasian shoveler	3	3	-32.0943	115.771122	Sighting
22/11/2023	Australian magpie	4	3	-32.091682	115.772377	Sighting
22/11/2023	Australian raven	3	3	-32.091682	115.772377	Sighting
22/11/2023	Australian shelduck	3	3	-32.0943	115.771122	Sighting
22/11/2023	Crested pigeon	2	3	-32.091682	115.772377	Sighting
22/11/2023	Eurasian coot	50	3	-32.0943	115.771122	Sighting
22/11/2023	Galah	5	3	-32.091682	115.772377	Sighting
22/11/2023	Great egret	2	3	-32.0943	115.771122	Sighting
22/11/2023	Grey teal	30	3	-32.0943	115.771122	Sighting
22/11/2023	Hoary-headed grebe	1	3	-32.0943	115.771122	Sighting
22/11/2023	Little black cormorant	2	3	-32.0943	115.771122	Sighting
22/11/2023	Little corella	3	3	-32.091682	115.772377	Sighting
22/11/2023	Pacific black duck	30	3	-32.0943	115.771122	Sighting
22/11/2023	Pied stilt	1	3	-32.09184	115.771378	Sighting
22/11/2023	Pink-eared duck	5	3	-32.0943	115.771122	Sighting
22/11/2023	Silver gull	20	3	-32.0943	115.771122	Sighting
22/11/2023	Straw-necked Ibis	1	3	-32.0943	115.771122	Sighting
22/11/2023	Tree martin	2	3	-32.091682	115.772377	Sighting
22/11/2023	White-faced heron	1	3	-32.0943	115.771122	Sighting
22/11/2023	Willie wagtail	2	3	-32.091682	115.772377	Sighting
22/11/2023	Yellow-billed spoonbill	5	3	-32.0943	115.771122	Sighting
22/11/2023	Australian magpie	4	4	-32.0901	115.769262	Sighting
22/11/2023	Australian raven	3	4	-32.0901	115.769262	Sighting
22/11/2023	Black-faced cuckoo-shrike	1	4	-32.0901	115.769262	Sighting
22/11/2023	Brown goshawk	1	4	-32.0901	115.769262	Sighting
22/11/2023	Brown honeyeater	3	4	-32.0901	115.769262	Sighting
22/11/2023	Galah	4	4	-32.0901	115.769262	Sighting
22/11/2023	Grey butcherbird	1	4	-32.0901	115.769262	Sighting
22/11/2023	Little corella	2	4	-32.0901	115.769262	Sighting
22/11/2023	New-holland honeyeater	2	4	-32.0901	115.769262	Sighting
22/11/2023	Rainbow lorikeet	6	4	-32.0901	115.769262	Sighting
22/11/2023	Red wattlebird	5	4	-32.0901	115.769262	Sighting
22/11/2023	Rufous whistler	2	4	-32.0901	115.769262	Sighting
22/11/2023	Silvereye	9	4	-32.0901	115.769262	Sighting
22/11/2023	Singing honeyeater	2	4	-32.0901	115.769262	Sighting
22/11/2023	Weebill	2	4	-32.0901	115.769262	Sighting
22/11/2023	Western gerygone	3	4	-32.0901	115.769262	Sighting
22/11/2023	White-browed scrubwren	1	4	-32.0901	115.769262	Sighting
23/11/2023	Mistletoebird	1	2	-32.08529	115.765645	Sighting
23/11/2023	Rainbow bee-eater	2	2	-32.08529	115.765645	Sighting
23/11/2023	Rufous whistler	1	2	-32.08529	115.765645	Sighting
23/11/2023	Silvereye	3	2	-32.08529	115.765645	Sighting
23/11/2023	Singing honeyeater	1	2	-32.08529	115.765645	Sighting
23/11/2023	Western gerygone	2	2	-32.08529	115.765645	Sighting
23/11/2023	Australian magpie	4	3	-32.091682	115.772377	Sighting

Date	Common Name	Observed number	Site number	Lat	Long	Method
23/11/2023	Australian raven	5	3	-32.091682	115.772377	Sighting
23/11/2023	Eurasian coot	30	3	-32.0943	115.771122	Sighting
23/11/2023	Grey teal	20	3	-32.0943	115.771122	Sighting
23/11/2023	Little black cormorant	1	3	-32.0943	115.771122	Sighting
23/11/2023	Pacific black duck	20	3	-32.0943	115.771122	Sighting
23/11/2023	Pied stilt	2	3	-32.091751	115.771506	Sighting
23/11/2023	Pink-eared duck	5	3	-32.0943	115.771122	Sighting
23/11/2023	Rainbow bee-eater	2	3	-32.090203	115.770902	Sighting
23/11/2023	Red wattlebird	5	3	-32.091682	115.772377	Sighting
23/11/2023	White-faced heron	1	3	-32.0943	115.771122	Sighting
23/11/2023	Willie wagtail	1	3	-32.091682	115.772377	Sighting
23/11/2023	Australian raven	2	5	-32.09677	115.767682	Sighting
23/11/2023	Australian white ibis	1	5	-32.09677	115.767682	Sighting
23/11/2023	Rainbow lorikeet	3	5	-32.09677	115.767682	Sighting
23/11/2023	Silvereye	4	5	-32.09677	115.767682	Sighting
23/11/2023	Spotted dove	1	5	-32.09677	115.767682	Sighting
23/11/2023	Variegated fairy-wren	5	5	-32.09677	115.767682	Sighting
23/11/2023	White-browed scrubwren	3	5	-32.09677	115.767682	Sighting
23/11/2023	Rufous whistler	3	6	-32.094762	115.766243	Sighting
23/11/2023	Silvereye	6	6	-32.094762	115.766243	Sighting
23/11/2023	Singing honeyeater	2	6	-32.094762	115.766243	Sighting
23/11/2023	Spotted dove	1	6	-32.094762	115.766243	Sighting
23/11/2023	White-browed scrubwren	2	6	-32.094762	115.766243	Sighting

APPENDIX 7. All fauna detected during targeted, spotlighting, motion camera and bat detector surveys at Manning Park

Date	Species	Observed number	Site number	Lat	Long	Method
22/08/2023	*Limnodynastes dorsalis*	5		-32.09375	115.772612	Sighting
22/08/2023	*Limnodynastes dorsalis*	1		-32.091698	115.772383	Sighting
22/08/2023	*Limnodynastes dorsalis*	1		-32.090167	115.772088	Sighting
22/08/2023	*Limnodynastes dorsalis*			-32.091443	115.770158	Sighting
22/08/2023	*Limnodynastes dorsalis*	1		-32.093358	115.770397	Sighting
22/08/2023	*Limnodynastes dorsalis*	1		-32.094252	115.770747	Sighting
22/08/2023	*Litoria adelaidensis*	1		-32.09375	115.772612	Sighting
22/08/2023	*Litoria adelaidensis*	1		-32.091698	115.772383	Sighting
22/08/2023	*Litoria adelaidensis*	1		-32.090167	115.772088	Sighting
22/08/2023	*Litoria adelaidensis*			-32.091443	115.770158	Sighting
22/08/2023	*Litoria adelaidensis*	1		-32.093358	115.770397	Sighting
22/08/2023	*Litoria moorei*			-32.091443	115.770158	Sighting
22/08/2023	*Litoria moorei*	1		-32.094252	115.770747	Sighting
23/08/2023	*Limnodynastes dorsalis*	5		-32.09375	115.772612	Sighting
23/08/2023	*Limnodynastes dorsalis*	2		-32.091698	115.772383	Sighting
23/08/2023	*Limnodynastes dorsalis*	4		-32.090167	115.772088	Sighting
23/08/2023	*Limnodynastes dorsalis*	2		-32.091443	115.770158	Sighting
23/08/2023	*Limnodynastes dorsalis*	2		-32.093358	115.770397	Sighting
23/08/2023	*Limnodynastes dorsalis*	2		-32.094252	115.770747	Sighting
23/08/2023	*Litoria adelaidensis*	2		-32.09375	115.772612	Sighting
23/08/2023	*Litoria adelaidensis*	3		-32.091698	115.772383	Sighting
23/08/2023	*Litoria adelaidensis*	2		-32.090167	115.772088	Sighting
23/08/2023	*Litoria adelaidensis*	5		-32.091443	115.770158	Sighting
23/08/2023	*Litoria adelaidensis*	2		-32.093358	115.770397	Sighting
23/08/2023	*Litoria adelaidensis*	1		-32.094252	115.770747	Sighting
23/08/2023	*Litoria moorei*	1		-32.09375	115.772612	Sighting
23/08/2023	*Litoria moorei*	2		-32.091698	115.772383	Sighting
23/08/2023	*Litoria moorei*	3		-32.091443	115.770158	Sighting
5/09/2023	Red-tailed Black-cockatoo	5		-32.09129	115.769791	Forage
5/09/2023	Red-tailed Black-cockatoo	1		-32.091511	115.76963	Hollow
5/09/2023	Australian kestrel	1				Sighting
5/09/2023	Australian magpie	1				Sighting
5/09/2023	Australian raven	1				Sighting
5/09/2023	Australian ringneck	1				Sighting
5/09/2023	Australian shelduck	1				Sighting
5/09/2023	Black swan	1				Sighting
5/09/2023	Black-faced cuckoo-shrike	1				Sighting
5/09/2023	Brown honeyeater	1				Sighting
5/09/2023	Carnaby's cockatoo	10		-32.087975	115.764618	Sighting
5/09/2023	Carnaby's cockatoo	8		-32.08876	115.764076	Sighting
5/09/2023	Crested pigeon	1				Sighting
5/09/2023	Dusky moorhen	1				Sighting
5/09/2023	Galah	1				Sighting
5/09/2023	Grey teal	1				Sighting
5/09/2023	Hardhead	1				Sighting
5/09/2023	Laughing kookaburra	1				Sighting
5/09/2023	Little corella	1				Sighting
5/09/2023	Magpie-lark	1				Sighting
5/09/2023	Pacific black duck	1				Sighting
5/09/2023	Purple swamphen	1				Sighting
5/09/2023	Rainbow lorikeet	1				Sighting

Date	Species	Observed number	Site number	Lat	Long	Method
5/09/2023	Red wattlebird	1				Sighting
5/09/2023	Red-tailed Black-cockatoo	12		-32.084743	115.766777	Sighting
5/09/2023	Silver gull	1				Sighting
5/09/2023	Singing honeyeater	1				Sighting
5/09/2023	Splendid fairy-wren	1		-32.084568	115.765335	Sighting
5/09/2023	Striated pardalote	1				Sighting
5/09/2023	Weebill	1				Sighting
5/09/2023	Welcome swallow	1				Sighting
5/09/2023	Western gerygone	1		-32.096764	115.770523	Sighting
5/09/2023	white-cheeked honeyeater	1		-32.089138	115.765854	Sighting
5/09/2023	white-cheeked honeyeater	1		-32.086231	115.766228	Sighting
5/09/2023	white-cheeked honeyeater	1		-32.085438	115.766373	Sighting
5/09/2023	white-cheeked honeyeater	1		-32.086376	115.764275	Sighting
5/09/2023	White-faced heron	1				Sighting
5/09/2023	Willie wagtail	1				Sighting
5/09/2023	*Pogona minor*	1		-32.086239	115.766212	Sighting
16/11/2023	*Cryptoblepharus buchananii*	1	1	-32.097569	115.770462	Sighting
16/11/2023	*Pseudonaja affinis*	1	1	-32.097412	115.770554	Sighting
16/11/2023	*Lerista lineata*	1	2	-32.085739	115.765495	Sighting
16/11/2023	*Cryptoblepharus buchananii*	1	4	-32.090065	115.769173	Sighting
16/11/2023	*Austronomus australis*			-32.090095	115.769297	Bat Detector
16/11/2023	*Chalinolobus gouldii*			-32.090095	115.769297	Bat Detector
16/11/2023	*Vespadelus regulus*			-32.090095	115.769297	Bat Detector
16/11/2023	Rainbow bee-eater	1		-32.084908	115.766457	Burrow
16/11/2023	Rainbow bee-eater	1		-32.084923	115.766846	Burrow
17/11/2023	*Austronomus australis*			-32.097452	115.770775	Bat Detector
17/11/2023	*Chalinolobus gouldii*			-32.097452	115.770775	Bat Detector
17/11/2023	*Rainbow bee-eater*	1		-32.08485	115.767021	Burrow
17/11/2023	*Hemiergis quadrilineata*	1		-32.085674	115.76561	Funnel
17/11/2023	Red-tailed Black-cockatoo	3		-32.084644	115.767532	Sighting
17/11/2023	White-browed scrubwren	1		-32.09354	115.766472	Sighting
17/11/2023	White-faced heron	1		-32.096279	115.766571	Sighting
18/11/2023	*Austronomus australis*			-32.08559	115.766382	Bat Detector
18/11/2023	*Chalinolobus gouldii*			-32.08559	115.766382	Bat Detector
18/11/2023	Oryctolagus cuniculus	1		-32.095291	115.764359	Burrow
18/11/2023	Brown goshawk	2		-32.094376	115.766129	Sighting
18/11/2023	Brown goshawk	1		-32.084679	115.765312	Sighting
19/11/2023	*Austronomus australis*			-32.096897	115.7674	Bat Detector
19/11/2023	*Chalinolobus gouldii*			-32.096897	115.7674	Bat Detector
19/11/2023	Carnaby's cockatoo	9		-32.094589	115.772346	Sighting
20/11/2023	*Austronomus australis*			-32.095158	115.766162	Bat Detector
20/11/2023	*Chalinolobus gouldii*			-32.095158	115.766162	Bat Detector
20/11/2023	*Ozimops kitcheneri*			-32.095158	115.766162	Bat Detector
20/11/2023	*Vespadelus regulus*			-32.095158	115.766162	Bat Detector
21/11/2023	*Chalinolobus gouldii*			-32.091512	115.772518	Bat Detector
21/11/2023	*Nyctophilus geoffroyi*			-32.091512	115.772518	Bat Detector
21/11/2023	*Chelodina oblonga*	1		-32.094711	115.771484	Nest
21/11/2023	*Chelodina oblonga*	1		-32.094646	115.77137	Nest
21/11/2023	*Chelodina oblonga*	1		-32.094799	115.772415	Nest
21/11/2023	*Chelodina oblonga*	1		-32.09322	115.773209	Nest
21/11/2023	*Chelodina oblonga*	1		-32.091595	115.772964	Nest
21/11/2023	*Chelodina oblonga*	1		-32.09306	115.773354	Nest
21/11/2023	*Chelodina oblonga*	1		-32.093254	115.773506	Nest

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21/11/2023	*Chelodina oblonga*	1		-32.093479	115.773521	Nest
21/11/2023	*Chelodina oblonga*	1		-32.093491	115.773369	Nest
21/11/2023	*Chelodina oblonga*	1		-32.09425	115.772919	Nest
21/11/2023	*Chelodina oblonga*	1		-32.094376	115.772881	Nest
21/11/2023	*Chelodina oblonga*	1		-32.095219	115.772232	Nest
21/11/2023	*Chelodina oblonga*	1		-32.089912	115.770393	Nest
21/11/2023	Carnaby's cockatoo	1		-32.096409	115.771286	Forage
21/11/2023	Carnaby's cockatoo	1		-32.097752	115.771759	Forage
21/11/2023	Carnaby's cockatoo	1		-32.098221	115.772331	Forage
21/11/2023	Carnaby's cockatoo	1		-32.098461	115.772102	Forage
21/11/2023	Carnaby's cockatoo	1		-32.099754	115.772736	Forage
21/11/2023	Carnaby's cockatoo	1		-32.098518	115.769241	Forage
21/11/2023	Carnaby's cockatoo	1		-32.09832	115.768654	Forage
21/11/2023	Carnaby's cockatoo	1		-32.096706	115.770164	Forage
21/11/2023	Oryctolagus cuniculus	1		-32.09539	115.765541	Scat
21/11/2023	Brown goshawk	1		-32.094551	115.771729	Sighting
21/11/2023	Great egret	1		-32.093723	115.77256	Sighting
21/11/2023	Red-tailed Black-cockatoo	6		-32.094986	115.768394	Sighting
21/11/2023	Red-tailed Black-cockatoo	1		-32.093365	115.773323	Sighting
21/11/2023	Splendid fairy-wren	1		-32.096333	115.766701	Sighting
21/11/2023	White-browed scrubwren	1		-32.09832	115.768555	Sighting
21/11/2023	*Cryptoblepharus buchananii*	1		-32.096981	115.771973	Sighting
21/11/2023	*Cryptoblepharus buchananii*	1		-32.090744	115.772575	Sighting
21/11/2023	*Ctenotus fallens*	1		-32.096981	115.771973	Sighting
21/11/2023	*Ctenotus fallens*	1		-32.097595	115.771873	Sighting
21/11/2023	*Hemiergis quadrilineata*	1		-32.0965	115.7714	Sighting
21/11/2023	*Pseudonaja affinis*	1		-32.094135	115.772705	Sighting
21/11/2023	*Tiliqua rugosa*	1		-32.098515	115.772118	Sighting
21/11/2023	*Heleioporus eyrei*	1		-32.090775	115.772591	Spotlighting
21/11/2023	*Limnodynastes dorsalis*	1		-32.091015	115.770554	Spotlighting
21/11/2023	*Litoria moorei*	1		-32.091064	115.770462	Spotlighting
21/11/2023	*Litoria moorei*	1		-32.090652	115.771065	Spotlighting
21/11/2023	*Litoria moorei*	2		-32.090164	115.772285	Spotlighting
21/11/2023	*Litoria moorei*	1		-32.090511	115.772575	Spotlighting
21/11/2023	*Litoria moorei*	1		-32.090694	115.772545	Spotlighting
21/11/2023	*Litoria moorei*	1		-32.092777	115.773323	Spotlighting
21/11/2023	*Litoria moorei*	1		-32.094303	115.772606	Spotlighting
21/11/2023	Australian boobook	1		-32.095535	115.770523	Spotlighting
21/11/2023	Galah	1		-32.092754	115.769951	Spotlighting
21/11/2023	*Strophurus spinigerus*	1		-32.098549	115.770233	Spotlighting
22/11/2023	*Isoodon fusciventer*	1		-32.094688	115.764015	Digging
22/11/2023	*Isoodon fusciventer*	1		-32.096108	115.7644895	Digging
22/11/2023	*Isoodon fusciventer*	1		-32.0961517	115.7648147	Digging
22/11/2023	Carnaby's cockatoo	1		-32.097939	115.767792	Forage
22/11/2023	Carnaby's cockatoo	1		-32.0978119	115.7676843	Forage
22/11/2023	Carnaby's cockatoo	1		-32.0975714	115.768107	Forage
22/11/2023	Carnaby's cockatoo	1		-32.0926913	115.768934	Forage
22/11/2023	*Chelodina oblonga*	1		-32.093533	115.769257	Nest
22/11/2023	*Oryctolagus cuniculus*	1		-32.095058	115.764114	Scat
22/11/2023	*Oryctolagus cuniculus*	1		-32.095753	115.765556	Scat
22/11/2023	Variegated fairy-wren	1		-32.09269	115.767937	Sighting
22/11/2023	Variegated fairy-wren	1		-32.094303	115.766701	Sighting
22/11/2023	Variegated fairy-wren	1		-32.0927152	115.7678767	Sighting

Date	Species	Observed number	Site number	Lat	Long	Method
22/11/2023	*Menetia greyii*	1		-32.09269	115.767937	Sighting
22/11/2023	*Strophurus spinigerus*	1		-32.096191	115.766342	Sighting
22/11/2023	*Strophurus spinigerus*	1		-32.094868	115.765656	Sighting
22/11/2023	*Strophurus spinigerus*	1		-32.094795	115.765671	Sighting
22/11/2023	Australian boobook	1		-32.094925	115.769463	Spotlighting
22/11/2023	Australian boobook	1		-32.090389	115.766144	Spotlighting
22/11/2023	Oryctolagus cuniculus	2		-32.095684	115.765656	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.09449	115.764175	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.093418	115.76458	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.092567	115.765167	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.090553	115.7658	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.092281	115.767677	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.093662	115.766327	Spotlighting
22/11/2023	*Strophurus spinigerus*	1		-32.094997	115.768845	Spotlighting
23/11/2023	*Oryctolagus cuniculus*	1		-32.092415	115.764938	Digging
23/11/2023	Carnaby's cockatoo	1		-32.092651	115.764435	Forage
23/11/2023	*Chelodina oblonga*	1		-32.091114	115.770195	Nest
23/11/2023	*Chelodina oblonga*	1		-32.090225	115.771271	Nest
23/11/2023	*Chelodina oblonga*	1		-32.09026	115.772446	Nest
23/11/2023	*Chelodina oblonga*	1		-32.09449	115.771194	Nest
23/11/2023	*Chelodina oblonga*	1		-32.094707	115.770912	Nest
23/11/2023	*Chelodina oblonga*	1		-32.093925	115.770164	Nest
23/11/2023	*Chelodina oblonga*	1		-32.093189	115.769844	Nest
23/11/2023	*Chelodina oblonga*	1		-32.092766	115.769821	Nest
23/11/2023	*Chelodina oblonga*	1		-32.092667	115.769547	Nest
23/11/2023	*Chelodina oblonga*	1		-32.092396	115.769485	Nest
23/11/2023	*Chelodina oblonga*	1		-32.092041	115.769447	Nest
23/11/2023	Rainbow bee-eater	1		-32.0902776	115.7660921	Sighting
23/11/2023	Splendid fairy-wren	1		-32.0913952	115.7678467	Sighting
23/11/2023	*Felis catus*	1		-32.084763	115.767548	Sighting
23/11/2023	*Morethia obscura*	1		-32.092579	115.764618	Sighting
23/11/2023	Tawny frogmouth	1		-32.084633	115.765167	Spotlighting
23/11/2023	Tawny frogmouth	1		-32.087482	115.767418	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.08939	115.766182	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.08852	115.763527	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.086414	115.763542	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.085659	115.767532	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.089485	115.768021	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.089539	115.768311	Spotlighting
23/11/2023	*Strophurus spinigerus*	1		-32.089478	115.768784	Spotlighting
24/11/2023	Rainbow bee-eater	1		-32.086895	115.766388	Burrow
24/11/2023	Rainbow bee-eater	1		-32.0868957	115.7663728	Burrow
24/11/2023	*Chelodina oblonga*	1		-32.091492	115.768799	Nest
24/11/2023	*Chelodina oblonga*	1		-32.091377	115.769012	Nest
24/11/2023	*Chelodina oblonga*	1		-32.091171	115.769257	Nest
24/11/2023	*Oryctolagus cuniculus*	1		-32.084045	115.7659	Scat
24/11/2023	Brown goshawk	1		-32.091919	115.769691	Sighting
24/11/2023	Brown goshawk	1		-32.0875038	115.7651811	Sighting
24/11/2023	Carnaby's cockatoo	7		-32.090897	115.768242	Sighting
24/11/2023	Carnaby's cockatoo	2		-32.085533	115.764488	Sighting
24/11/2023	Carnaby's cockatoo	20		-32.0882467	115.7657772	Sighting
24/11/2023	Crested pigeon	1		-32.0862999	115.7675315	Sighting
24/11/2023	Dusky moorhen	1		-32.092476	115.76992	Sighting

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24/11/2023	Red-capped parrot	1		-32.093758	115.772591	Sighting
24/11/2023	Splendid fairy-wren	1		-32.0844711	115.7642556	Sighting
24/11/2023	Variegated fairy-wren	1		-32.0846532	115.7664644	Sighting
24/11/2023	Western gerygone	1		-32.084827	115.766357	Sighting
24/11/2023	Western gerygone	1		-32.084827	115.766357	Sighting
24/11/2023	White-bellied sea-eagle	1		-32.093514	115.771701	Sighting
24/11/2023	White-browed scrubwren	1		-32.088459	115.765312	Sighting
24/11/2023	White-browed scrubwren	1		-32.086979	115.766144	Sighting
24/11/2023	White-browed scrubwren	1		-32.090584	115.766701	Sighting
24/11/2023	white-cheeked honeyeater	1		-32.089531	115.768394	Sighting
24/11/2023	*Felis catus*	1		-32.085491	115.767532	Sighting
24/11/2023	*Cryptoblepharus buchananii*	1		-32.088181	115.767006	Sighting
24/11/2023	*Lerista lineata*	1		-32.091355	115.767877	Sighting
24/11/2023	*Morethia obscura*	1		-32.083366	115.766144	Sighting
24/11/2023	*Pseudonaja affinis*	1		-32.090221	115.766533	Sighting
24/11/2023	*Pseudonaja affinis*	1		-32.086737	115.764899	Sighting
30/11/2023	Buff-banded rail		FA1	-32.094747	115.771775	Motion camera
30/11/2023	*Mus musculus*		FA1	-32.094747	115.771775	Motion camera
30/11/2023	Painted button-quail		FA10	-32.097062	115.767775	Motion camera
30/11/2023	*Mus musculus*		FA10	-32.097062	115.767775	Motion camera
30/11/2023	*Rattus rattus*		FA10	-32.097062	115.767775	Motion camera
30/11/2023	*Tiliqua rugosa*		FA10	-32.097062	115.767775	Motion camera
30/11/2023	Australian raven		FA2	-32.095348	115.766205	Motion camera
30/11/2023	Spotted dove		FA2	-32.095348	115.766205	Motion camera
30/11/2023	*Oryctolagus cuniculus*		FA2	-32.095348	115.766205	Motion camera
30/11/2023	*Rattus rattus*		FA2	-32.095348	115.766205	Motion camera
30/11/2023	*Tiliqua occipitalis*		FA2	-32.095348	115.766205	Motion camera
30/11/2023	*Tiliqua rugosa*		FA2	-32.095348	115.766205	Motion camera
30/11/2023	*Felis catus*		FA6	-32.082982	115.764837	Motion camera
30/11/2023	*Isoodon fusciventer*		FA7	-32.098787	115.771942	Motion camera
30/11/2023	*Tiliqua rugosa*		FA7	-32.098787	115.771942	Motion camera
30/11/2023	*Canis lupus familiaris*		FB1	-32.084433	115.764495	Motion camera
30/11/2023	*Mus musculus*		FB1	-32.084433	115.764495	Motion camera
30/11/2023	*Rattus rattus*		FB1	-32.084433	115.764495	Motion camera
30/11/2023	White-browed scrubwren		FB2	-32.087087	115.766958	Motion camera
30/11/2023	*Felis catus*		FB2	-32.087087	115.766958	Motion camera
30/11/2023	*Rattus rattus*		FB2	-32.087087	115.766958	Motion camera
30/11/2023	*Tiliqua rugosa*		FB2	-32.087087	115.766958	Motion camera
30/11/2023	Laughing dove		FB3	-32.090415	115.768675	Motion camera
30/11/2023	*Rattus rattus*		FB3	-32.090415	115.768675	Motion camera
30/11/2023	*Tiliqua rugosa*		FB3	-32.090415	115.768675	Motion camera
30/11/2023	*Isoodon fusciventer*		FB7	-32.095395	115.764402	Motion camera
30/11/2023	*Oryctolagus cuniculus*		FB7	-32.095395	115.764402	Motion camera
30/11/2023	*Rattus rattus*		FB7	-32.095395	115.764402	Motion camera
30/11/2023	*Tiliqua rugosa*		FB7	-32.095395	115.764402	Motion camera
30/11/2023	*Isoodon fusciventer*		FC2	-32.091493	115.765468	Motion camera
30/11/2023	*Mus musculus*		FC2	-32.091493	115.765468	Motion camera
30/11/2023	*Isoodon fusciventer*		FC3	-32.085635	115.765948	Motion camera
30/11/2023	*Mus musculus*		FC3	-32.085635	115.765948	Motion camera
30/11/2023	*Tiliqua rugosa*		FC3	-32.085635	115.765948	Motion camera
30/11/2023	*Rattus rattus*		FC6	-32.093258	115.76836	Motion camera
30/11/2023	*Tiliqua rugosa*		FC6	-32.093258	115.76836	Motion camera
30/11/2023	*Rattus rattus*		FC8	-32.090743	115.772268	Motion camera

Date	Species	Observed number	Site number	Lat	Long	Method
30/11/2023	*Vulpes vulpes*		FC8	-32.090743	115.772268	Motion camera
30/11/2023	*Mus musculus*		FC9	-32.087735	115.763912	Motion camera
30/11/2023	*Tiliqua occipitalis*		FC9	-32.087735	115.763912	Motion camera
30/11/2023	*Isoodon fusciventer*		FD3	-32.092722	115.765512	Motion camera
30/11/2023	*Oryctolagus cuniculus*		FD3	-32.092722	115.765512	Motion camera
30/11/2023	*Rattus rattus*		FD3	-32.092722	115.765512	Motion camera
30/11/2023	*Tiliqua rugosa*		FD3	-32.092722	115.765512	Motion camera
30/11/2023	Australian magpie		FD6	-32.097613	115.770728	Motion camera
30/11/2023	*Mus musculus*		FD6	-32.097613	115.770728	Motion camera
30/11/2023	*Rattus rattus*		FD6	-32.097613	115.770728	Motion camera
30/11/2023	*Tiliqua rugosa*		FD6	-32.097613	115.770728	Motion camera
1/12/2023	*Oryctolagus cuniculus*	1		-32.093159	115.764763	Burrow
1/12/2023	Carnaby's cockatoo	1		-32.090206	115.76429	Forage
18/12/2023	*Chelodina oblonga*	1		-32.09288	115.769157	Nest
19/12/2023	Square-tailed kite	1		-32.094841	115.766617	Sighting

APPENDIX 8: Raw capture data from the single Quenda captured at Manning Park during current surveys.

Date	Trap	Species	Trap #	Age	Sex	Weight (g)	Re-trap (Y/N)	Comments
19/11/2023	Elliott B	*Isoodon fusciventer*	9	Subadult	female	550	N	Clean pouch

APPENDIX 9: Location and description of tree hollows occupied by feral bees identified at Manning Park during the current survey.

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Comments
4	Redheart	-32.084663	115.765822	Alive	59	1-5	10-15	Bees in 2 hollows and vertical crevice
11	Tuart	-32.084727	115.76665	Alive	100	1-5	10-15	
62	Tuart	-32.090167	115.769065	Alive	>100	1-5	10-15	
63	Tuart	-32.090365	115.769177	Alive	95	1-5	15-20	
90	Tuart	-32.092767	115.769233	Alive	80	1-5	10-30	
91	Tuart	-32.092742	115.76924	Alive	130	1-5	10-15	
110	Tuart	-32.095193	115.769173	Alive	74	1-5	10	
115	Tuart	-32.095207	115.76948	Alive	140	1-5	20-30	
191	Tuart	-32.093455	115.773103	Alive	80	1-5	5-15	Bees in most hollows
192	Tuart	-32.092372	115.773218	Alive	110	1-5	10	
194	Tuart	-32.092112	115.773248	Alive	120	5-10	15-20	

APPENDIX 10. Species, location and measurements of potential habitat trees identified at Manning Park during the current survey.

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
0	*Eucalyptus decipiens*	-32.084642	115.764552	Alive	68				Potential	
1	*Eucalyptus decipiens*	-32.084477	115.764748	Alive	54				Potential	Two trunks (54 & 32cm)
2	*Eucalyptus decipiens*	-32.084447	115.764875	Alive	60				Potential	
3	Tuart (*Eucalyptus gomphocephala*)	-32.084593	115.765417	Alive	88	1-5	1-5		Potential	
4	*Eucalyptus decipiens*	-32.084663	115.765822	Alive	59	1-5	10-15	bees	Suitable	2 hollows/large vertical crevice
5	*Eucalyptus decipiens*	-32.084613	115.765835	Alive	70				Potential	
6	*Eucalyptus decipiens*	-32.08481	115.76586	Alive	60				Potential	
7	Tuart (*Eucalyptus gomphocephala*)	-32.08479	115.766397	Alive	59				Potential	
8	Tuart (*Eucalyptus gomphocephala*)	-32.084815	115.766443	Alive	80				Potential	Two trunks (80 & 61cm)
9	Tuart (*Eucalyptus gomphocephala*)	-32.084828	115.766568	Alive	70	1-5	10-20		Suitable	Two trunks (70 & 55cm)
10	Tuart (*Eucalyptus gomphocephala*)	-32.08522	115.766285	Alive	70	1-5	2-3		Potential	
11	Tuart (*Eucalyptus gomphocephala*)	-32.084727	115.76665	Alive	100	1-5	10-15	bees	Suitable	Two trunks (100 & 95cm)
12	Tuart (*Eucalyptus gomphocephala*)	-32.084758	115.767022	Alive	64				Potential	
13	Tuart (*Eucalyptus gomphocephala*)	-32.084767	115.767192	Alive	50				Potential	Two trunks (50 & 38cm)
14	Tuart (*Eucalyptus gomphocephala*)	-32.084863	115.767213	Alive	58				Potential	
15	Unknown	-32.084662	115.767418	Alive	50				Potential	Red-flowering gum
16	Unknown	-32.084572	115.767483	Alive	60				Potential	Red-flowering gum
17	Unknown	-32.084273	115.767598	Alive	50				Potential	White-gum
18	Tuart (*Eucalyptus gomphocephala*)	-32.085092	115.767058	Alive	50				Potential	
19	Tuart (*Eucalyptus gomphocephala*)	-32.085152	115.767192	Alive	60				Potential	
20	Tuart (*Eucalyptus gomphocephala*)	-32.085205	115.767178	Alive	50				Potential	Two trunks (50 & 41cm)
21	Tuart (*Eucalyptus gomphocephala*)	-32.085195	115.76721	Alive	51				Potential	
22	Tuart (*Eucalyptus gomphocephala*)	-32.085152	115.767378	Alive	82	?			Potential	
23	Tuart (*Eucalyptus gomphocephala*)	-32.08486	115.767623	Alive	51				Potential	
24	Tuart (*Eucalyptus gomphocephala*)	-32.084947	115.767648	Alive	63				Potential	
25	Tuart (*Eucalyptus gomphocephala*)	-32.085027	115.767618	Alive	75				Potential	
26	Tuart (*Eucalyptus gomphocephala*)	-32.085098	115.767618	Alive	69				Potential	
27	Tuart (*Eucalyptus gomphocephala*)	-32.085377	115.767632	Alive	60				Potential	
28	Tuart (*Eucalyptus gomphocephala*)	-32.085902	115.76771	Alive	50				Potential	
29	Tuart (*Eucalyptus gomphocephala*)	-32.086	115.767707	Alive	54				Potential	

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
30	Tuart (*Eucalyptus gomphocephala*)	-32.086187	115.767723	Alive	57				Potential	
31	Tuart (*Eucalyptus gomphocephala*)	-32.086365	115.767743	Alive	58				Potential	
32	Unknown	-32.087737	115.76737	Alive	700	?			Potential	White-gum
33	Tuart (*Eucalyptus gomphocephala*)	-32.087885	115.76728	Alive	110	?			Potential	Three trunks (110, 62 & 60cm)
34	Tuart (*Eucalyptus gomphocephala*)	-32.088198	115.767032	Alive	80				Potential	Four trunks (80, 60, 40 & 30cm)
35	Tuart (*Eucalyptus gomphocephala*)	-32.088295	115.766927	Alive	72	?			Potential	
36	Tuart (*Eucalyptus gomphocephala*)	-32.088192	115.76696	Alive	90	?			Potential	
37	Tuart (*Eucalyptus gomphocephala*)	-32.088233	115.766895	Alive	85	?			Potential	
38	Tuart (*Eucalyptus gomphocephala*)	-32.088053	115.766777	Alive	91	?			Potential	
39	Tuart (*Eucalyptus gomphocephala*)	-32.086933	115.766562	Alive	50				Potential	Three trunks (50, 46 & 39cm)
40	Tuart (*Eucalyptus gomphocephala*)	-32.08651	115.767357	Alive	50				Potential	
41	Tuart (*Eucalyptus gomphocephala*)	-32.086442	115.767308	Alive	70				Potential	
42	Tuart (*Eucalyptus gomphocephala*)	-32.086427	115.767267	Alive	55				Potential	Two trunks (55 & 37cm)
43	Tuart (*Eucalyptus gomphocephala*)	-32.090408	115.769898	Alive	115	?			Potential	
44	Tuart (*Eucalyptus gomphocephala*)	-32.0904	115.769803	Alive	74				Potential	
45	Tuart (*Eucalyptus gomphocephala*)	-32.090335	115.769778	Alive	81	?			Potential	
46	Tuart (*Eucalyptus gomphocephala*)	-32.090335	115.769983	Alive	90	?			Potential	
47	Tuart (*Eucalyptus gomphocephala*)	-32.090287	115.770112	Alive	77				Potential	
48	Tuart (*Eucalyptus gomphocephala*)	-32.09012	115.770242	Alive	110	?			Potential	
49	Tuart (*Eucalyptus gomphocephala*)	-32.089738	115.770273	Alive	64				Potential	Three trunks (64, 63 & 56cm)
50	Tuart (*Eucalyptus gomphocephala*)	-32.089997	115.770212	Alive	60	1	10-15	?	Suitable	Chew marks
51	Tuart (*Eucalyptus gomphocephala*)	-32.090035	115.770145	Alive	59				Potential	
52	Tuart (*Eucalyptus gomphocephala*)	-32.090018	115.77012	Alive	64	?			Potential	
53	Tuart (*Eucalyptus gomphocephala*)	-32.089928	115.76999	Alive	55	?			Potential	Two trunks (55 & 37cm)
54	Tuart (*Eucalyptus gomphocephala*)	-32.090105	115.769913	Alive	90	1	10-15	?	Suitable	
55	Tuart (*Eucalyptus gomphocephala*)	-32.090262	115.770023	Alive	64				Potential	
56	Tuart (*Eucalyptus gomphocephala*)	-32.090197	115.769875	Alive	105	?			Potential	
57	Tuart (*Eucalyptus gomphocephala*)	-32.090022	115.769707	Alive	60				Potential	
58	Tuart (*Eucalyptus gomphocephala*)	-32.090075	115.769642	Alive	50	1	10	?	Suitable	
59	Tuart (*Eucalyptus gomphocephala*)	-32.090123	115.769612	Alive	50				Potential	
60	Tuart (*Eucalyptus gomphocephala*)	-32.090127	115.769363	Alive	110	1-5	10-30	?	Suitable	
61	Tuart (*Eucalyptus gomphocephala*)	-32.090118	115.76918	Alive	74	?			Potential	

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
62	Tuart (*Eucalyptus gomphocephala*)	-32.090167	115.769065	Alive	>100	1-5	10-15	bees	Suitable	
63	Tuart (*Eucalyptus gomphocephala*)	-32.090365	115.769177	Alive	95	1-5	15-20	bees	Suitable	
64	Tuart (*Eucalyptus gomphocephala*)	-32.09045	115.769073	Alive	100	1	5-10	?	Potential	Chew marks
65	Tuart (*Eucalyptus gomphocephala*)	-32.090235	115.76881	Alive	57				Potential	
66	Tuart (*Eucalyptus gomphocephala*)	-32.090572	115.768832	Alive	95	5-10	3-5	?	Potential	
67	Tuart (*Eucalyptus gomphocephala*)	-32.090607	115.768778	Alive	59				Potential	
68	Tuart (*Eucalyptus gomphocephala*)	-32.09067	115.768627	Alive	52				Potential	
69	Tuart (*Eucalyptus gomphocephala*)	-32.090543	115.768517	Alive	88	?			Potential	
70	Tuart (*Eucalyptus gomphocephala*)	-32.090638	115.768458	Alive	100	1-5	10-20	?	Suitable	
71	Tuart (*Eucalyptus gomphocephala*)	-32.090648	115.768402	Dead	56	?			Potential	Narrow vertical cracks and crevices
72	Tuart (*Eucalyptus gomphocephala*)	-32.090723	115.768373	Alive	57				Potential	
73	Tuart (*Eucalyptus gomphocephala*)	-32.090623	115.768313	Alive	63	?			Potential	
74	Tuart (*Eucalyptus gomphocephala*)	-32.090608	115.76833	Alive	72	?			Potential	
75	Tuart (*Eucalyptus gomphocephala*)	-32.090638	115.768255	Alive	74	?			Potential	
76	Tuart (*Eucalyptus gomphocephala*)	-32.090853	115.76816	Alive	100	1-5	10-15	Carnaby's prospecting	Suitable	Three trunks (100, 60 & 34cm). Possible 30cm wide hollow in trunk
77	Tuart (*Eucalyptus gomphocephala*)	-32.090712	115.767797	Alive	110	?			Potential	Two trunks (110 & 80cm)
78	Tuart (*Eucalyptus gomphocephala*)	-32.090995	115.768182	Alive	>150	?			Potential	
79	Tuart (*Eucalyptus gomphocephala*)	-32.09132	115.76816	Alive	64				Potential	
80	Tuart (*Eucalyptus gomphocephala*)	-32.091298	115.768053	Alive	68	1-5	5-10	?	Potential	Four trunks (68, 66, 62 & 38cm)
81	Tuart (*Eucalyptus gomphocephala*)	-32.090282	115.769597	Alive	100	?			Potential	Two trunks (100 & 68cm)
82	Unknown	-32.092192	115.768488	Alive	58				Potential	White-gum
83	Tuart (*Eucalyptus gomphocephala*)	-32.09225	115.768613	Alive	52				Potential	Two trunks (52 & 40cm)
84	Tuart (*Eucalyptus gomphocephala*)	-32.092408	115.768812	Alive	50				Potential	
85	Tuart (*Eucalyptus gomphocephala*)	-32.092413	115.768823	Alive	60				Potential	Two trunks (60 & 48cm)
86	Tuart (*Eucalyptus gomphocephala*)	-32.092638	115.769042	Alive	67				Potential	
87	Tuart (*Eucalyptus gomphocephala*)	-32.092943	115.769127	Alive	66	?			Potential	
88	Tuart (*Eucalyptus gomphocephala*)	-32.092952	115.76915	Alive	61	?			Potential	Two trunks (61 & 52cm)
89	Tuart (*Eucalyptus gomphocephala*)	-32.092905	115.76921	Alive	70	?			Potential	
90	Tuart (*Eucalyptus gomphocephala*)	-32.092767	115.769233	Alive	80	1-5	10-30	bees	Suitable	Two trunks (80 & 71cm). Several 10cm hollows, 1 x large 10x30cm vertical hollow

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
91	Tuart (*Eucalyptus gomphocephala*)	-32.092742	115.76924	Alive	130	1-5	10-15	bees	Suitable	Two trunks (130 & 90cm)
92	Tuart (*Eucalyptus gomphocephala*)	-32.093058	115.76904	Alive	66	?			Potential	
93	Tuart (*Eucalyptus gomphocephala*)	-32.093183	115.768993	Alive	82	1-5	10-15			
94	Tuart (*Eucalyptus gomphocephala*)	-32.093237	115.768993	Alive	81	?			Potential	Two trunks (81 & 44cm)
95	Tuart (*Eucalyptus gomphocephala*)	-32.093438	115.768693	Alive	55				Potential	
96	Tuart (*Eucalyptus gomphocephala*)	-32.09329	115.768355	Alive	60				Potential	Horizontal trunk
97	Tuart (*Eucalyptus gomphocephala*)	-32.093367	115.768365	Alive	94	?			Potential	Three trunks (94, 44 & 37cm)
98	Tuart (*Eucalyptus gomphocephala*)	-32.094082	115.76885	Alive	89				Potential	
99	Tuart (*Eucalyptus gomphocephala*)	-32.094078	115.768963	Alive	100	1	10		Potential	Low down in trunk
100	Tuart (*Eucalyptus gomphocephala*)	-32.094193	115.769137	Alive	50				Potential	
101	Tuart (*Eucalyptus gomphocephala*)	-32.094237	115.769217	Alive	59	1-5	<5cm	?	Potential	
102	Tuart (*Eucalyptus gomphocephala*)	-32.094243	115.769268	Alive	88	1	10	?	Potential	
103	Tuart (*Eucalyptus gomphocephala*)	-32.094827	115.769437	Alive	55	1	10		Potential	2m high
104	Tuart (*Eucalyptus gomphocephala*)	-32.094938	115.769442	Alive	106	?			Potential	
105	Tuart (*Eucalyptus gomphocephala*)	-32.094968	115.769243	Alive	85	?			Potential	
106	Tuart (*Eucalyptus gomphocephala*)	-32.095028	115.769363	Alive	78	?			Potential	
107	Tuart (*Eucalyptus gomphocephala*)	-32.095042	115.769418	Alive	70	?			Potential	Large dead trunk with narrow vertical cracks
108	Tuart (*Eucalyptus gomphocephala*)	-32.095112	115.769408	Alive	61	?			Potential	
109	Tuart (*Eucalyptus gomphocephala*)	-32.095092	115.769363	Alive	75	1-5	10-15	?	Suitable	Chew marks
110	Tuart (*Eucalyptus gomphocephala*)	-32.095193	115.769173	Alive	74	1-5	10	bees	Potential	Two trunks (74 & 62cm)
111	Tuart (*Eucalyptus gomphocephala*)	-32.095348	115.769073	Alive	50				Potential	
112	Tuart (*Eucalyptus gomphocephala*)	-32.09539	115.769022	Alive	58				Potential	
113	Tuart (*Eucalyptus gomphocephala*)	-32.095208	115.769363	Alive	72	?			Potential	
114	Tuart (*Eucalyptus gomphocephala*)	-32.095282	115.769448	Alive	51	1-5	10	?	Potential	Mostly dead. Large dead trunk with several large hollows and cracks
115	Tuart (*Eucalyptus gomphocephala*)	-32.095207	115.76948	Alive	140	1-5	20-30	bees	Suitable	Two trunks (140 & 60cm)
116	*Eucalyptus decipiens*	-32.096613	115.769765	Alive	52				Potential	
117	*Eucalyptus decipiens*	-32.096605	115.76992	Alive	50				Potential	
118	*Eucalyptus decipiens*	-32.096575	115.770068	Alive	50				Potential	Three trunks (50, 48 & 40cm)
119	*Eucalyptus decipiens*	-32.096598	115.770225	Alive	70				Potential	
120	*Eucalyptus decipiens*	-32.097467	115.769998	Alive	58				Potential	

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
121	*Eucalyptus decipiens*	-32.097593	115.76976	Alive	50				Potential	
122	*Eucalyptus decipiens*	-32.097685	115.7691	Alive	52				Potential	
123	*Eucalyptus decipiens*	-32.097773	115.768968	Alive	50				Potential	
124	*Eucalyptus decipiens*	-32.097983	115.76973	Alive	54	1	2		Potential	1.5m from ground
125	*Eucalyptus decipiens*	-32.097965	115.7699	Alive	50				Potential	
126	*Eucalyptus decipiens*	-32.097745	115.769965	Alive	50	1-5	1-3		Potential	
127	*Eucalyptus decipiens*	-32.09787	115.770135	Alive	62				Potential	
128	*Eucalyptus decipiens*	-32.09799	115.770545	Alive	56	1	10		Potential	
129	*Eucalyptus decipiens*	-32.098188	115.770467	Alive	67	?			Potential	Two trunks (67 & 63cm)
130	*Eucalyptus decipiens*	-32.098287	115.770525	Alive	68	?			Potential	
131	*Eucalyptus decipiens*	-32.09817	115.77078	Alive	65	2	2-10	?	Potential	
132	*Eucalyptus decipiens*	-32.097723	115.77099	Alive	72	1-5	3-10	?	Potential	10cm hollow with chew marks
133	*Eucalyptus decipiens*	-32.09779	115.771075	Alive	80	?			Potential	
134	*Eucalyptus decipiens*	-32.098162	115.771393	Dead	50	?			Potential	Two trunks (50 & 36cm)
135	*Eucalyptus decipiens*	-32.098113	115.771562	Alive	50	1	5		Potential	In dead trunk
136	*Eucalyptus decipiens*	-32.09783	115.771392	Alive	70	?			Potential	
137	*Eucalyptus decipiens*	-32.09741	115.771317	Alive	68	?			Potential	
138	*Eucalyptus decipiens*	-32.097308	115.771407	Alive	59	?			Potential	
139	*Eucalyptus decipiens*	-32.09722	115.771497	Alive	70	?			Potential	
140	*Eucalyptus decipiens*	-32.09722	115.771553	Alive	60	?			Potential	
141	*Eucalyptus decipiens*	-32.096885	115.77117	Alive	72	?			Potential	
142	*Eucalyptus decipiens*	-32.096872	115.770942	Alive	55	?			Potential	
143	*Eucalyptus decipiens*	-32.097042	115.770873	Alive	50	?			Potential	
144	*Eucalyptus decipiens*	-32.097035	115.770785	Alive	50	?			Potential	
145	*Eucalyptus decipiens*	-32.09711	115.770775	Alive	50	?			Potential	
146	*Eucalyptus decipiens*	-32.097103	115.770683	Alive	51	?			Potential	
147	*Eucalyptus decipiens*	-32.097178	115.770538	Alive	50	?			Potential	
148	*Eucalyptus decipiens*	-32.097007	115.770218	Alive	72	?			Potential	
149	Unknown	-32.096278	115.771367	Alive	59	0			Potential	White-gum
150	Unknown	-32.096313	115.771393	Alive	51				Potential	
151	Tuart (*Eucalyptus gomphocephala*)	-32.09633	115.771565	Alive	73				Potential	
152	Unknown	-32.09636	115.771933	Alive	51				Potential	

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
153	Tuart (*Eucalyptus gomphocephala*)	-32.096385	115.771958	Alive	69				Potential	
154	Unknown	-32.096373	115.77204	Alive	71				Potential	
155	Unknown	-32.096365	115.772215	Alive	62				Potential	
156	Tuart (*Eucalyptus gomphocephala*)	-32.096458	115.772382	Alive	52				Potential	
157	Tuart (*Eucalyptus gomphocephala*)	-32.09653	115.772443	Alive	64				Potential	
158	Tuart (*Eucalyptus gomphocephala*)	-32.096527	115.77248	Alive	56				Potential	
159	Unknown	-32.096358	115.772323	Alive	59				Potential	White-gum
160	Unknown	-32.096335	115.772393	Alive	78				Potential	
161	Unknown	-32.096297	115.772335	Alive	53				Potential	
162	Unknown	-32.096198	115.77238	Alive	50				Potential	White-gum
163	Unknown	-32.096187	115.772467	Alive	54				Potential	
164	Unknown	-32.096142	115.772538	Alive	80				Potential	White-gum
165	Unknown	-32.096048	115.772625	Alive	88				Potential	
166	Unknown	-32.096038	115.772663	Alive	69				Potential	White-gum
167	Unknown	-32.096015	115.772583	Alive	58				Potential	
168	Unknown	-32.095903	115.772672	Alive	56				Potential	
169	Unknown	-32.095925	115.772738	Alive	70				Potential	
170	Unknown	-32.095825	115.772665	Alive	69				Potential	White-gum
171	Unknown	-32.095795	115.77267	Alive	52				Potential	
172	Unknown	-32.096125	115.770823	Alive	78				Potential	White-gum
173	Unknown	-32.096112	115.77097	Alive	50				Potential	White-gum
174	Unknown	-32.096032	115.770865	Alive	60				Potential	Partly dead
175	Unknown	-32.096098	115.770733	Alive	53				Potential	White-gum
176	Tuart (*Eucalyptus gomphocephala*)	-32.096122	115.770642	Alive	130	?			Potential	Two trunks (130 & 52cm)
177	Unknown	-32.096053	115.7703	Alive	77				Potential	
178	Unknown	-32.095997	115.770243	Alive	59				Potential	
179	Unknown	-32.095855	115.770302	Alive	69				Potential	White-gum
180	Unknown	-32.095825	115.770253	Alive	78				Potential	White-gum
181	Unknown	-32.095673	115.77027	Alive	68				Potential	
182	Unknown	-32.095715	115.77024	Alive	52				Potential	
183	Unknown	-32.095737	115.77032	Alive	50				Potential	
184	Unknown	-32.09565	115.77035	Alive	68				Potential	

#	Species	Lat	Long	Dead/ Alive	DBH (cm)	# Hollows	Hollow Width (cm)	Evidence of use	Breeding suitability	Comments
185	Tuart (*Eucalyptus gomphocephala*)	-32.095782	115.770633	Alive	54				Potential	
186	Tuart (*Eucalyptus gomphocephala*)	-32.095812	115.770663	Alive	56				Potential	Two trunks (56 & 45cm)
187	Tuart (*Eucalyptus gomphocephala*)	-32.095843	115.770653	Alive	50				Potential	Two trunks (50 & 32cm)
188	Tuart (*Eucalyptus gomphocephala*)	-32.095858	115.770803	Alive	58				Potential	
189	Tuart (*Eucalyptus gomphocephala*)	-32.093628	115.773065	Alive	71				Potential	
190	Tuart (*Eucalyptus gomphocephala*)	-32.093597	115.773018	Alive	57				Potential	
191	Tuart (*Eucalyptus gomphocephala*)	-32.093455	115.773103	Alive	80	1-5	5-15	bees	Suitable	Three large, hollow bearing trees in close proximity. Bees in most hollows
192	Tuart (*Eucalyptus gomphocephala*)	-32.092372	115.773218	Alive	110	1-5	10	bees	Suitable	Two trunks (110 & 51cm)
193	Tuart (*Eucalyptus gomphocephala*)	-32.092165	115.773202	Alive	50	?			Potential	
194	Tuart (*Eucalyptus gomphocephala*)	-32.092112	115.773248	Alive	120	5-10	15-20	bees	Suitable	
195	Tuart (*Eucalyptus gomphocephala*)	-32.091737	115.773052	Alive	75				Potential	
196	Tuart (*Eucalyptus gomphocephala*)	-32.091305	115.7726	Alive	86	?			Potential	
197	Tuart (*Eucalyptus gomphocephala*)	-32.09122	115.772543	Alive	88	?			Potential	
198	Tuart (*Eucalyptus gomphocephala*)	-32.090585	115.772538	Alive	67	1-5	10-20		Suitable	Chew marks
199	Tuart (*Eucalyptus gomphocephala*)	-32.090405	115.772453	Alive	55				Potential	
200	Tuart (*Eucalyptus gomphocephala*)	-32.092758	115.769982	Alive	113	10-15	5-15	galah	Suitable	Possibly a larger hollow in tree fork?

APPENDIX 11: Habitat and disturbance characteristics identified during fauna habitat assessment of the study area.

#	Location		Habitat	Landform	Aspect	Slope	Soil	Soil availability	Rocks		Leaf litter	Woody debris	Veg structure	Hollows		Disturbances	Condition
	Lat	Long							Type	Size				Present	>10cm		
1	-32.096474	115.764824	Shrubland	Hillslope	South	Low	Sand	Many large patches	Limestone	Large rocks	Evenly spread	Many small patches	Shrub >1m; Shrub <1m;			F, C, W, T	Disturbed
2	-32.096214	115.766212	Shrubland	Hillcrest/upper slope	SW	Moderate	Loamy sand	Many small patches	Limestone	Boulders	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Herb; Grass;				Very Good
3	-32.094746	115.76535	Shrubland	Hillslope	West	Low	Sand	Evenly spread			Evenly spread	Many small patches	Shrub >1m;			F	Good
4	-32.094265	115.76712	Cleared	Hillslope	West	Moderate	Loamy sand	Few large patches	Limestone	Boulders	Scarce	Few small patches	Grass;			C, T	Completely degraded
5	-32.097858	115.768227	Shrubland	Hillslope	East	Moderate	Loamy sand	Few small patches			Many small patches	Many small patches	Shrub >1m; Shrub <1m; Herb; Grass;			W, T	Good
6	-32.092793	115.768456	Shrubland	Hillslope	NE	Moderate	Loamy sand	Few small patches	Limestone	Boulders	Many large patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			W	Very Good
7	-32.09325	115.766846	Shrubland	Hillcrest/upper slope	SW	Moderate	Loamy sand	Few small patches	Limestone	Boulders	Evenly spread	Many small patches	Shrub >1m; Shrub <1m;			C, T	Very Good
8	-32.094307	115.767105	Shrubland	Hillslope	NE	Moderate	Loamy sand	Few small patches	Limestone	Boulders	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			W	Very Good
9	-32.093872	115.768036	Shrubland	Hillslope	East	Low	Loamy sand	Evenly spread			Evenly Spread	Few large patches	Shrub >1m; Grass;			W	Disturbed
10	-32.091328	115.766098	Shrubland	Hillcrest/upper slope	NE	Moderate	Loamy sand	Few small patches	Limestone	Boulders	Many small patches	Many small patches	Shrub >1m; Shrub <1m; Grass;			W, T	Very Good
11	-32.092529	115.764633	Shrubland	Hillslope	West	Low	Sand	Few large patches			Many large patches	Many large patches	Shrub >1m;			F, C, W, T	Disturbed
12	-32.091099	115.764488	Shrubland	Hillslope	North	Moderate	Loamy sand	Many small patches	Limestone	Boulders	Many small patches	Many small patches	Shrub >1m; Shrub <1m; Herb; Grass;			F, W, T	Very Good
13	-32.088818	115.765694	Shrubland	Hillslope	South	Low	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Many small patches	Shrub >1m;			W, T	Good
14	-32.088509	115.763756	Shrubland	Hillslope	West	Moderate	Loamy sand	Few small patches	Limestone	Large rocks	Few small patches	Few small patches	Shrub >1m;			W, T	Good
15	-32.087379	115.764549	Shrubland	Hillcrest/upper slope	East	Steep	Loamy sand	Few small patches	Limestone	Large rocks	Few small patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			C, W, T	Very Good
16	-32.086857	115.763901	Shrubland	Hillcrest/upper slope	NW	Steep	Loamy sand	Few small patches	Limestone	Large rocks	Few small patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			C, E, T	Disturbed
17	-32.084812	115.766289	Tall woodland	Foot slope	NE	Low	Loamy sand	Few small patches			Evenly spread	Few large patches	Tree > 5m; Herb;	Y	Y	C, W, E, T	Disturbed
18	-32.088184	115.767021	Tall woodland	Foot slope	NE	Low	Loamy sand	Few small patches			Evenly spread	Few large patches	Tree > 5m; Herb;	Y	Y	C, W, E, T	Disturbed
19	-32.093628	115.770294	Wetland	Wetland	Flat	Flat	Clay/sand	Few small patches			Few large patches	Many large patches	Tree > 5m; Tree 2 to 5m; Grass;	Y	Y	F, C, W, T	Good
20	-32.094315	115.771126	Open water	Wetland	Flat	Flat		Scarce			Scarce	Scarce	Tree 2 to 5m; Grass;	Y	Y	F, C, W, T	Disturbed
21	-32.09552	115.764015	Wetland	Wetland	Flat	Flat	Clay/sand	Few large patches			Many small patches	Many large patches	Tree 2 to 5m; Herb; Grass;			F, C, W, T	Good
22	-32.091312	115.77256	Wetland	Wetland	Flat	Flat	Clay/sand	Few small patches			Many large patches	Many large patches	Tree > 5m; Tree 2 to 5m; Grass;	Y	Y	F, C, W, T	Good
23	-32.090446	115.772247	Wetland	Wetland	Flat	Flat	Clay/sand	Few large patches			Many large patches	Many large patches	Tree > 5m; Tree 2 to 5m; Grass;	Y	Y	F, C, W, T	Good
24	-32.097996	115.772346	Shrubland	Low hills and slopes	NE	Moderate	Sand	Many small patches	Limestone	Large rocks	Few small patches	Scarce	Shrub >1m; Shrub <1m; Grass;			C, W	Disturbed
25	-32.097633	115.770462	Low woodland	Plain	North	Flat	Sand	Evenly spread			Evenly spread	Few large patches	Tree > 5m; Shrub <1m; Herb; Grass;	Y	Y	W, T	Good
26	-32.098713	115.771957	Shrubland	Hillslope	East	Low	Sand	Evenly spread			Evenly spread	Few small patches	Shrub >1m; Grass;			W	Very Good
27	-32.098751	115.770393	Shrubland	Hillslope	East	Moderate	Sand	Evenly spread	Limestone	Large rocks	Evenly spread	Many small patches	Shrub >1m; Shrub <1m; Grass;			W	Good
28	-32.098133	115.767662	Shrubland	Hillslope	South	Moderate	Sand	Evenly spread	Limestone	Large rocks	Evenly spread	Few large patches	Shrub >1m; Grass;			W, T	Good
29	-32.096874	115.767403	Shrubland	Hillcrest/upper slope	NE	Steep	Sand	Few small patches	Limestone	Large rocks	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Herb; Grass;			W, T	Very Good

#	Location		Habitat	Landform	Aspect	Slope	Soil	Soil availability	Rocks		Leaf litter	Woody debris	Veg structure	Hollows		Disturbances	Condition
	Lat	Long							Type	Size				Present	>10cm		
30	-32.095776	115.766991	Shrubland	Hillcrest/upper slope	SE	Steep	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Herb; Grass;			W, T	Very Good
31	-32.094822	115.766243	Shrubland	Hillslope	West	Moderate	Loamy sand	Few small patches			Evenly spread	Many large patches	Shrub >1m; Grass;			F, W, T	Good
32	-32.095345	115.765312	Shrubland	Hillslope	West	Moderate	Sand	Few large patches	Limestone	Large rocks	Many large patches	Few large patches	Shrub >1m; Grass;			F, W, T	Disturbed
33	-32.095406	115.764435	Shrubland	Hillslope	West	Low	Loamy sand	Few small patches	Limestone	Large rocks	Evenly spread	Many large patches	Shrub >1m;			F, W, T	Disturbed
34	-32.094318	115.764244	Cleared	Hillslope	West	Low	Sand	Scarce			Scarce	Scarce	Grass;			F, W, T	Completely degraded
35	-32.093498	115.765656	Shrubland	Hillslope	West	Low	Sand	Few small patches			Many large patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			F, W, T	Disturbed
36	-32.092617	115.76548	Shrubland	Hillslope	West	Low	Sand	Few small patches			Evenly spread	Few large patches	Shrub >1m; Grass;			F, W, T	Good
37	-32.091473	115.765526	Shrubland	Hillcrest/upper slope	North	Low	Loamy sand	Many small patches	Limestone	Large rocks	Many large patches	Many small patches	Shrub >1m; Shrub <1m; Grass;			F, W, T, I	Good
38	-32.09013	115.763702	Low woodland	Hillslope	NW	Low	Loamy sand	Scarce			Many large patches	Many small patches	Tree > 5m; Tree 2 to 5m; Shrub <1m; Grass;			C, W, T	Good
39	-32.089581	115.764893	Cleared	Hillslope	SW	Low	Loamy sand	Scarce			Scarce	Scarce	Shrub >1m; Grass;			C, W, T	Completely degraded
40	-32.089561	115.766068	Shrubland	Hillslope	South	Low	Loamy sand	Few small patches	Limestone	Large rocks	Many large patches	Many small patches	Shrub >1m; Grass;			C, W, T	Disturbed
41	-32.088799	115.766586	Shrubland	Hillslope	East	Steep	Sand	Many small patches	Limestone	Large rocks	Many large patches	Many large patches	Shrub >1m; Grass;			W, R	Disturbed
42	-32.08709	115.767021	Shrubland	Hillslope	East	Low	Sand	Scarce			Evenly spread	Many large patches	Shrub >1m;			W	Very Good
43	-32.08559	115.765495	Shrubland	Hillcrest/upper slope	North	Moderate	Loamy sand	Few small patches	Limestone	Large rocks	Many large patches	Many small patches	Shrub >1m; Herb; Grass;			W, T	Very Good
44	-32.087727	115.763901	Shrubland	Hillslope	SW	Moderate	Sand	Scarce	Limestone	Large rocks	Evenly spread	Few small patches	Shrub >1m; Grass;	Y	N	W, T	Very Good
45	-32.084366	115.764603	Low woodland	Hillslope	South	Moderate	Sand	Few small patches	Limestone	Small rocks	Evenly spread	Few large patches	Tree > 5m; Shrub >1m; Grass;	Y	N	W, T	Disturbed
46	-32.083076	115.764908	Shrubland	Hillcrest/upper slope	North	Moderate	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			C, W	Disturbed
47	-32.083839	115.766182	Cleared	Hillcrest/upper slope	NE	Flat	Sand	Many large patches	Limestone	Large rocks	Few large patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			F, C, W, E, T	Completely degraded
48	-32.083683	115.767532	Shrubland	Hillcrest/upper slope	East	Steep	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			W, T	Disturbed
49	-32.093246	115.773048	Wetland	Wetland	Flat	Flat	Clay/sand	Scarce			Few large patches	Many large patches	Tree > 5m; Tree 2 to 5m; Grass;	Y	*	W, T	Good
50	-32.095966	115.772018	Parkland	Hillslope	North	Low	Loamy sand	Scarce			Scarce	Scarce	Tree > 5m; Grass;			C, W	Completely degraded
51	-32.096989	115.771713	Shrubland	Hillslope	East	Low	Loamy sand	Many small patches	Limestone	Large rocks	Few large patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			C, W, T	Disturbed
52	-32.096432	115.770508	Cleared	Hillslope	North	Low	Sand	Evenly spread			Few large patches	Many large patches	Tree > 5m; Shrub >1m; Shrub <1m;			C, W, T	Disturbed
53	-32.095783	115.768242	Shrubland	Hillslope	East	Moderate	Loamy sand	Few small patches			Evenly spread	Many small patches	Shrub >1m; Grass;			W, T	Very Good
54	-32.096718	115.768929	Shrubland	Hillslope	East	Steep	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Scarce	Shrub >1m; Shrub <1m; Herb; Grass;			W, T	Very Good
55	-32.095207	115.769417	Tall woodland	Hillslope	East	Moderate	Loamy sand	Few small patches	Limestone	Boulders	Evenly spread	Many small patches	Tree > 5m; Shrub <1m;	Y	Y	C, W, T, R	Disturbed
56	-32.093338	115.768486	Tall woodland	Hillslope	SE	Moderate	Loamy sand	Few small patches			Evenly spread	Few small patches	Tree > 5m; Shrub >1m; Grass;	Y	Y	W, T	Good
57	-32.090115	115.769806	Tall woodland	Hillcrest/upper slope	South	Steep	Loamy sand	Few small patches	Limestone	Large rocks	Evenly spread	Many small patches	Tree > 5m; Shrub >1m; Shrub <1m;	Y	Y	W, T	Good
58	-32.090137	115.76857	Shrubland	Hillslope	SE	Moderate	Sand	Few small patches	Limestone	Large rocks	Many large patches	Many small patches	Shrub >1m; Shrub <1m; Grass;			W, T	Good
59	-32.091125	115.767952	Shrubland	Hillslope	East	Moderate	Sand	Few small patches			Evenly spread	Few large patches	Shrub >1m; Grass;			W, T	Good

#	Location		Habitat	Landform	Aspect	Slope	Soil	Soil availability	Rocks		Leaf litter	Woody debris	Veg structure	Hollows		Disturbances	Condition
	Lat	Long							Type	Size				Present	>10cm		
60	-32.08601	115.766701	Shrubland	Hillcrest/upper slope	NE	Low	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Few small patches	Shrub >1m; Shrub <1m;			W, T	Very Good
61	-32.087917	115.76548	Shrubland	Hillcrest/upper slope	North	Moderate	Loamy sand	Many small patches	Limestone	Small rocks	Many small patches	Many small patches	Shrub >1m;			W, T	Very Good
62	-32.089931	115.76725	Shrubland	Hillslope	East	Low	Loamy sand	Many small patches	Limestone	Small rocks	Many large patches	Few small patches	Shrub >1m; Grass;			C, W	Good
63	-32.092346	115.766846	Shrubland	Hillcrest/upper slope	SE	Moderate	Loamy sand	Many small patches			Many small patches	Many small patches	Shrub >1m; Grass;			W, T	Very Good
64	-32.090893	115.766113	Shrubland	Hillslope	North	Moderate	Loamy sand	Many small patches	Limestone	Large rocks	Many small patches	Many small patches	Shrub >1m; Grass;			W	Very Good
65	-32.086449	115.765869	Shrubland	Hillcrest/upper slope	NE	Moderate	Loamy sand	Few small patches	Limestone	Large rocks	Many small patches	Few small patches	Shrub >1m; Shrub <1m; Grass;			W, T	Very Good

F = Feral animals, C = Cleared areas, W = Weed infestations, E = Erosion, T = Tracks and paths, R = Revegetated

APPENDIX 12: Conservation significant fauna (including locally significant fauna) known to occur within 5km of Manning Park (excluding marine species)

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
Curlew Sandpiper *Calidris ferruginea*	Critically Endangered Migratory/Marine	Critically Endangered	Intertidal mudflats in sheltered coastal areas (Geering et al 2007)	Few. Woodman Pt. Lake Coogee. Nth Coogee
Great Knot *Calidris tenuirostris*	Critically Endangered Migratory/Marine	Critically Endangered	Sandy or muddy estuaries and coasts with broad intertidal mudflats (Geering et al 2007)	Few. Coogee & Nth Coogee. Lake Coogee
Eastern Curlew *Numenius madagascariensis*	Critically Endangered Migratory/Marine	Critically Endangered	Estuaries, beaches, mangrove swamps and salt-marsh, particularly on exposed seagrass beds or mudflats (Geering et. al. 2007)	Few. Woodman Pt. Nth Coogee
Red Knot *Calidris canutus*	Endangered Migratory/Marine	Endangered	Intertidal mud and sandflats, estuaries, bays and inlets (Geering et al 2007)	Few. Woodman Pt. Nth Coogee
Lesser Sand Plover *Charadrius mongolus*	Endangered Migratory/Marine	Endangered	Mudflats, sandy beaches and intertidal mudflats, rarely found inland (Geering et al 2007)	Few. Woodman Pt. Nth Coogee
Baudin's Cockatoo *Zanda baudini*	Endangered	Endangered	Woodlands and forest (Karri, Marri, Jarrah, Wandoo, Bullich & Tuart). Uncommon on SCP, though may breed in the south. Roosts near water, particularly riparian habitats. Feeds on Marri, proteaceous shrubs as well as non-native species (pines) also insects and their larvae (DAEE, 2022).	Known. Few nearby
Carnaby's Cockatoo *Zanda latirostris*	Endangered	Endangered	Common along the SCP. Can forage all year round. Breeds in tree hollows, generally tuart, jarrah & marri but rarely on SCP. Roosts near water, particularly riparian habitats. Forages on proteaceous woodlands and heath, riparian vegetation and some introduced species (pines) (DAEE, 2022)	Known. Many nearby
Greater Sand Plover *Charadrius leschenaultii*	Vulnerable Migratory/Marine	Endangered	Sandy beaches and exposed, intertidal sand and mudflats (Geering et al 2007)	Few. Woodman Pt. Nth Coogee
Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*	Vulnerable	Vulnerable	Woodlands of Darling Range. Becoming more common on the SCP. May breed where suitable large, suitable tree species occur (i.e. hollow-bearing Marri, Jarrah & Tuart). Will roost in any tall trees, prefers Jarrah, Marri, Blackbutt or Tuart. Feeds on Jarrah & Marri, Tuart or She-oak and also Cape Lilac. (Johnstone et al 2011)	Known. Many nearby
Grey-tailed Tattler *Tringa brevipes*	Migratory/Marine	Migratory Priority 4	Occurs in a variety of sheltered costal habitats, usually reefs and rock platforms or intertidal mudflats (Geering et al 2007)	Many. Woodman Pt
Common Sandpiper *Actitis hypoleucos*	Migratory/Marine	Migratory	Mangrove inlets and muddy edges and rocky shores of coastal or inland wetlands (Geering et al 2007)	Several. Woodman Pt. Lake Coogee
Fork-tailed Swift *Apus pacificus*	Migratory/Marine	Migratory	Non-breeding visitor to Australia, but rare in Western Australia. Almost entirely restricted to flying, mainly in open spaces though will occasionally fly over forests and cities (Pizzey & Knight 1998)	Few. Woodman Pt. Nth Coogee
Ruddy Turnstone *Arenaria interpres*	Migratory/Marine	Migratory	Rocky coastlines, coral and sand islands and sometimes intertidal mudflats (Geering et al 2007)	Several. Woodman Pt. to Fremantle
Sharp-tailed Sandpiper *Calidris acuminata*	Migratory/Marine	Migratory	Muddy edges of shallow, non-tidal (generally inland) fresh or brackish wetlands (Geering et al 2007)	Few. Woodman Pt. Nth Coogee
Sanderling *Calidris alba*	Migratory/Marine	Migratory	Open sandy beaches exposed to surf (Geering et al 2007)	Few. Woodman Pt. Nth Coogee. Lake Coogee

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
Pectoral Sandpiper *Calidris melanotos*	Migratory/Marine	Migratory	Solitary, preferring shallow, freshwater to brackish wetlands (Geering et al 2007)	One. Nth Coogee
Red-necked Stint *Calidris ruficollis*	Migratory/Marine	Migratory	Estuarine mudflats but also occurs in a wide range of fresh and saltwater habitats in coastal and inland areas (Geering et al 2007)	Several. Woodman Pt. Lake Coogee. Nth Coogee
Long-toed Stint *Calidris subminuta*	Migratory/Marine	Migratory	Muddy or vegetated edges of freshwater or brackish wetlands (Geering et al 2007)	One. Woodman Point
Bar-tailed Godwit *Limosa lapponica*	Migratory/Marine	Migratory	Found in flocks mainly in coastal areas with intertidal mudflats rarely far from the coast (Geering et. al. 2007)	Few. Woodman Pt. Lake Coogee. Nth Coogee
Black-tailed Godwit *Limosa limosa*	Migratory/Marine	Migratory	Freshwater and muddy coastal habitats. Fresh and brackish wetlands and intertidal mudflats (Geering et. al. 2007)	Inland. Nth Lake/Thomsons Lake
Whimbrel *Numenius phaeopus*	Migratory/Marine	Migratory	Open coastal and estuarine mudflats, particularly with mangroves (Geering et al 2007)	Few. Woodman Point. Nth Coogee
Bridled Tern *Onychoprion anaethetus*	Migratory/Marine	Migratory	A breeding visitor, usually found close to breeding colonies on small rocky islands and cliffs on large rocky islands (Johnstone & Storr 1998)	Few. Woodman Point
Osprey *Pandion haliaetus*	Migratory/Marine	Migratory	Common in sheltered seas on west coasts, islands and lower courses of rivers (Johnstone & Storr 1998)	Several. Woodman Pt. Nth Coogee. Coogee Beach. Lake Coogee
Ruff *Philomachus pugnax*	Migratory/Marine	Migratory	A variety of coastal and inland wetlands (Geering et al 2007)	One. Nth Coogee
Pacific Golden Plover *Pluvialis fulva*	Migratory/Marine	Migratory	Estuaries, intertidal mud and sand flats, costal salt marshes, rocky shores and also open, short grassy areas such as paddocks (Geering et al 2007)	One. Nth Coogee
Grey Plover *Pluvialis squatarola*	Migratory/Marine	Migratory	Predominantly coastal, occurring in small flocks on intertidal mud and sand flats in estuaries and bays (Geering et al 2007).	Several. Woodman Pt. Nth Coogee
Roseate Tern *Sterna dougallii*	Migratory/Marine	Migratory	Scarce to uncommon, occurring along the coast close to land, particularly on islands (Johnstone & Storr 1998)	Few. Woodman Pt. Nth Coogee
Little Tern *Sternula albifrons*	Migratory/Marine	Migratory	Sheltered seas, estuaries and mangrove creeks (Johnstone & Storr 1998)	One. Woodman Point
Wood Sandpiper *Tringa glareola*	Migratory/Marine	Migratory	Favours well-vegetated, shallow freshwater wetlands and rarely on intertidal mudflats (Geering et al 2007)	One. Nth Coogee
Common Greenshank *Tringa nebularia*	Migratory/Marine	Migratory	Occurs in a wide variety of coastal and inland, fresh or saltwater wetlands including intertidal mudflats (Geering et al 2007)	Known. Many nearby incl.

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
				Woodman Pt. Lake Coogee
Marsh Sandpiper *Tringa stagnatilis*	Migratory/Marine	Migratory	A variety of brackish and freshwater wetlands, avoiding open beaches (Geering et al 2007)	Few. Lake Coogee. Nth Coogee
Caspian Tern *Hydroprogne caspia*	Migratory/Marine		Uncommon to moderately common where it occurs mainly in sheltered sites such as estuaries and tidal creeks, rarely in fresh waters (Johnstone & Storr 1998)	Several. Woodman Pt. Lake Coogee
Pin-tailed Snipe *Galinago stenura*	Migratory	Migratory	Freshwater wetlands including swamps, soaks, floodwaters and sewerage ponds (Geering et al 2007)	Few. Frederick Baldwin Park
Greater Crested Tern *Sterna bergii*	Migratory	Migratory	Common in most coast and island habitats (Johnstone & Storr 1998)	Known. Many nearby incl. Woodman Pt. Nth Coogee
White-bellied Sea-eagle *Haliaeetus leucogaster*	Marine	Migratory	A rare to uncommon, but casual visitor to rivers and near coastal wetlands on the west coast (Johnstone & Storr 1998)	Known. Few nearby. Woodman Pt. Lake Coogee
Hooded Plover *Thinornis cucullatus*	Marine	Priority 4	Occurs on Sandy beaches, but predominantly on salt-lakes in the south-west of Australia (Geering et al 2007)	Few. Woodman Point
Red-capped plover *Charadrius ruficapillus*	Marine		Occurs in a wide variety of coastal habitats and in bare, open areas of inland wetlands (Geering et al 2007)	Several. Lake Coogee
Pied Stilt *Himantopus himantopus leucocephalus*	Marine		Open coastal and inland fresh and saltwater wetlands and intertidal mudflats (Geering et al 2007)	Known. Many nearby incl. Lake Coogee, eastern Beeliar wetlands
Pacific Gull *Larus pacificus*	Marine		Scarce to common, occurring along the west coast and around islands, towns and saltworks (Johnstone & Storr 1998)	Few. Woodman Point
Rainbow Bee-eater *Merops ornatus*	Marine		Open forests, woodlands and shrublands (Pizzey & Knight 1998)	Known. Many nearby
Red-necked avocet *Recurvirostra novaehollandiae*	Marine		Freshwater, brackish or saline wetlands, intertidal mudflats or sheltered bays (Geering et al 2007)	Few. Woodman Pt. Lake Coogee
Peregrine Falcon *Falco peregrinus*		Specially protected	Scarce on the SCP. Inhabits tall forest and woodland, and cliffs along the coast, breeding on rock ledges, granite outcrops and quarries (Johnstone & Storr 1998)	Known. Several nearby
Glossy Ibis *Plegadis falcinellus*		Migratory	A non-breeding visitor, on well-watered plains, shallows and flats of and surrounding freshwater lakes and swamps, river pools and flooded samphire and sewerage ponds (Johnstone & Storr 1998)	Eastern Beeliar wetlands
Common Tern *Sterna hirundo*		Migratory	Sheltered seas and estuaries (Johnstone & Storr 1998)	One. Woodman Point
Barking Owl (SW) *Ninox connivens connivens*		Priority 3	Dense vegetation, particularly forest, thickets and waterside Melaleuca (Johnstone & Storr 1998). Declining SW (Johnstone & Storr 1998). Thought to be locally extinct on SCP (Government of WA, 2000)	Few. Coogee

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
Australian Masked Owl (SW) *Tyto novaehollandiae novaehollandiae*		Priority 3	Forests and woodlands. Locally common in the deep south-west but generally uncommon (Johnstone & Storr 1998)	Few. Munster & Henderson
Blue-billed Duck *Oxyura australis*		Priority 4	Well-vegetated freshwater swamps, large dams and lakes (Pizzey & Knight 1998)	Known. Several nearby. Lake Coogee. Eastern Beeliar wetlands
Western Ringtail Possum *Pseudocheirus occidentalis*	Critically Endangered	Critically Endangered	Coastal areas south of Bunbury in woodlands and forest dominated by Peppermints (*Agonis flexuosa*), including some inland areas of Jarrah, Marri & Wandoo forest (De Tores, 2008a)	Locally extinct
Chuditch *Dasyurus geoffroii*	Vulnerable	Vulnerable	Dry woodlands, sclerophyll forests, heath and mallee shrublands (Serena & Soderquist, 2008)	None nearby
Quokka *Setonix brachyurus*	Vulnerable	Vulnerable	Formerly occurring throughout much of the SW, now largely confined to Rottnest Island and a few mainland localities, it is thought to be locally extinct from much of the SCP (De Tores, 2008b)	Locally extinct
Western False Pipistrelle *Falsistrellus mackenziei*		Priority 4	Mainly occurs in the Karri, Jarrah and Tuart forests of higher rainfall areas of the southwest, but known to inhabit Banksia woodlands on the Swan Coastal Plain (Churchill, 1998)	Few. Harry Waring/Thomson Lake
Water Rat *Hydromys chrysogaster*		Priority 4	Dense vegetation associated with swamps, lakes and waterways (Government of Australia 2000)	Few. Harry Waring/Thomson Lake
Quenda *Isoodon fusciventer*		Priority 4	Forest, woodland, shrubland, heath, wetland habitats on sandy soils and dense low vegetation (Paull, 2008)	Known. Several nearby
Tammar Wallaby *Notomacropus eugenii derbianus*		Priority 4	Coastal scrub, heath, dry sclerophyll forest and dense low thickets in mallee and woodland (Hinds, 2008)	Locally extinct
Carpet Python *Morelia spilota imbricata*		Specially protected	Uncommon, only persisting in large bushland remnants particularly woodlands and coastal limestone (Bush et al 2010)	None nearby
Perth-lined Slider *Lerista lineata*		Priority 3	Occurs in coastal dunes and sandplains supporting Banksia/Eucalypt woodland and heath south of the Swan River where it shelters in leaf litter and soil at the base of shrubs. Much of its habitat has been cleared for developments but can be locally common in small remnants and suburban gardens (Bush et. al. 2010)	Known. Several nearby
Black-striped Snake *Neelaps calonotos*		Priority 3	Occurs in coastal dunes and sandplains supporting Banksia/Eucalypt woodlands and heath throughout the swan coastal plain where it shelters in leaf litter and soil at the base of trees and shrubs (Bush et al 2010).	Few. Woodman Point
Inland Thornbill *Acanthiza apicalis*		Locally significant	Coastal scrubs and heath (Pizzey & Knight, 1998)	Known
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*		Locally significant	Open grassy areas (Pizzey & Knight, 1998)	Known
Western Thornbill *Acanthiza inornata*		Locally significant	Open woodland and coastal scrub (Pizzey & Knight, 1998)	Few. Woodman Pt. Lake Coogee
Hardhead *Aythya australis*		Locally significant	Fresh and brackish waters including farm dams (Johnstone & Storr 1998)	Known
Musk Duck *Biziura lobata*		Locally significant	Well-vegetated freshwater bodies but mainly in brackish and salt waters (Johnstone & Storr 1998)	Known

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
Grey Shrike-thrush *Colluricincla harmonica*		Locally significant	Forests, woodlands riparian forest and coastal scrub (Pizzey & Knight, 1998)	Known
Dusky Moorhen *Gallinula tenebrosa*		Locally significant	Well-vegetated wetlands, parks and artificial lakes and lawns (Pizzey & Knight, 1998)	Known
Yellow-plumed Honeyeater *Lichenostomas ornatus*		Locally significant	Coastal forests (Pizzey & Knight, 1998)	Few. Lake Coogee
Pink-eared Duck *Malacorhynchus membranaceus*		Locally significant	Well-watered areas, preferring large fresh or salt waterbodies (Johnstone & Storr 1998)	Known
Variegated Fairy-wren *Malurus lamberti*		Locally significant	Associated with shrublands particularly in dune and coastal vegetation (Pizzey & Knight, 1998)	Known
Splendid Fairy-wren *Malurus splendens*		Locally significant	Dense undergrowth in margins of forests, woodlands and watercourses (Pizzey & Knight, 1998)	Known
Hooded Robin *Melanodryas cucullata*		Locally significant	Banksia dominated coastal scrub and drier woodlands (Pizzey & Knight, 1998)	One near Coogee
Rock Parrot *Neophema petrophila*		Locally significant	Near coastal limestone, coastal dunes and scrub (Pizzey & Knight, 1998)	Few. Coogee, Woodman Pt.
Western Golden Whistler *Pachycephala fuliginosa*		Locally significant	Forests, woodlands riparian forest and coastal scrub (Pizzey & Knight, 1998)	Known
Scarlet Robin *Petroica multicolor*		Locally significant	Open woodlands (Pizzey & Knight, 1998)	Few. Coogee, Woodman Pt.
Common Bronzewing *Phaps chalcoptera*		Locally significant	Forests, woodlands and a range of shrublands, thickets and heaths (Pizzey & Knight, 1998)	Few. Woodman Pt. Lake Coogee
Brush Bronzewing *Phaps elegans*		Locally significant	Woodlands, forests and heaths supporting a dense, scrubby understorey (Pizzey & Knight, 1998)	Few. Eastern Beeliar lakes
White-browed Scrubwren *Sericornis frontalis*		Locally significant	Dense undergrowth in forests, woodlands and shrublands (Pizzey & Knight, 1998)	Known
Weebill *Smicrornis brevirostris*		Locally significant	Dry woodland and Acacia thickets (Pizzey & Knight, 1998)	Known
Australasian Shoveler *Spatula rhynchotis*		Locally significant	Large, deep bodies of water, particularly wooded freshwater lakes and also fresh and brackish swamps (Johnstone & Storr 1998)	Known
Collared Sparrowhawk *Accipiter cirrocephalus*		Locally significant	Forages in and around forests, woodlands and suburban gardens (Pizzey & Knight, 1998)	Known
Brown Goshawk *Accipiter fasciatus*		Locally significant	Forages in and around forests, woodlands and suburban parkland and gardens (Pizzey & Knight, 1998)	Known
Western Wattlebird *Anthochaera lunulata*		Locally significant	Banksia/Eucalypt woodland associations and heathland communities (Pizzey & Knight, 1998)	Known
Wedge-tailed Eagle *Aquila audax*		Locally significant	Forages in a range of open and forested habitats, occasionally over lakes, beaches and towns (Pizzey & Knight, 1998)	Few. Lake Coogee
Black-faced Woodswallow *Artamus cinereus*		Locally significant	Open country, as well as open woodlands, lake margins and wetlands (Pizzey & Knight, 1998)	Several. Woodman Pt.

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
Dusky Woodswallow *Artamus cyanopterus*		Locally significant	Open forests and woodlands, and coastal scrub (Pizzey & Knight, 1998)	Known
Brown Falcon *Falco berigora*		Locally significant	Forages in open woodlands, farmlands, roadsides and coastal dunes (Pizzey & Knight, 1998)	Several nearby
Whistling Kite *Haliastur sphenurus*		Locally significant	Open forests, usually near water and near coastal environments (Pizzey & Knight, 1998)	Known
Little Eagle *Hieraaetus morphnoides*		Locally significant	Forages in open habitats, watercourses and lakes (Pizzey & Knight, 1998)	Known
Square-tailed Kite *Lophoictinia isura*		Locally significant	Forages over woodlands, heathlands and forests (Pizzey & Knight, 1998)	Known
White-naped Honeyeater *Melithreptus lunatus*		Locally significant	Forests and woodlands (Pizzey & Knight, 1998)	Few. Woodman Pt.
Nankeen Night Heron *Nycticorax caledonicus*		Locally significant	River margins and wetlands (Pizzey & Knight, 1998)	Known
White-cheeked Honeyeater *Phylidonyris niger*		Locally significant	Coastal thickets and sandplain heaths (Pizzey & Knight, 1998)	Known
New-holland Honeyeater *Phylidonyris novaehollandiae*		Locally significant	Forests and woodlands with a scrubby understorey, coastal scrubs and heaths (Pizzey & Knight, 1998)	Known
Western Rosella *Platycercus icterotis*		Locally significant	Open forest and woodlands including nearby open parks, gardens and open areas (Pizzey & Knight, 1998)	Known
Painted Button-quail *Turnix varius*		Locally significant	Open woodlands and shrublands with a dense understorey and ground debris (Pizzey & Knight, 1998)	Known
Quacking Frog *Crinia georgiana*		Locally significant	Clay-based ephemeral swamps (Bush et. al. 2010)	None nearby. Eastern Beeliar wetlands
Western Grey Kangaroo *Macropus fuliginosus*		Locally significant	Woodland, shrublands, open areas. Requires habitat connectivity and large bushland remnants (Government of WA, 2000)	Few. Eastern Beeliar wetlands
Echidna *Tachyglossus aculeatus*		Locally significant	No particular habitat requirements, however have thought to be lost from the SCP (Government of WA, 2000)	Locally extinct
Honey Possum *Tarsipes rostratus*		Locally significant	Diverse, long-unburnt Banksia woodlands which provide a food source (nectar and pollen) all year round. Scarce on the Swan Coastal Plain around Perth (Bradshaw 2014)	Few. Harry Waring
Keeled Legless Lizard *Pletholax gracilis*		Locally significant	Heath, Banksia/Eucalypt woodlands with low, dense vegetation (Bush et. al. 2010)	Few. Henderson
Western three-lined skink *Acritoscincus trilineatus*		Locally significant	Dense vegetation on lake margins & ephemeral swamps (Bush et. al. 2010)	Few. Lake Coogee
Western Blue-tongue Lizard *Tiliqua occiptalis*		Locally significant	Large, undisturbed habitats. Sandplains and dunes with Bankia/Eucalypt woodland (Bush et. al. 2010)	Known
Southern Heath Monitor *Varanus rosenbergi*		Locally significant	Large, undisturbed bushland. Scarce in Perth region (Bush et. al. 2010)	Few. Nth Lake

Species	EPBC Act Status	BC Act/DBCA Status	Habitat/Ecology	Nearby records
Yellow-faced whipsnake *Demansia reticulata*		Locally significant	Large bushland areas. Scarce in the Perth region (Bush et. al. 2010)	Few. Eastern Beeliar wetlands

Australian Government
Department of Climate Change, Energy, the Environment and Water

Approved Conservation Advice for Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion

In effect under the *Environment Protection and Biodiversity Conservation Act 1999* from 15 November 2023.

This document combines the Approved Conservation Advice and listing assessment for this nationally threatened ecological community. It provides a foundation for conservation action and further management planning.

Honeymyrtle shrubland on limestone ridges of Swan Coastal Plain Bioregion © DCCEEW

The Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion ecological community occurs on Noongar Boodja (Noongar Country) of the Gnaala Karla Booja, Whadjuk and Yued Noongar regions. It occurs on Country (the traditional lands) of the Noongar peoples, including the Pinjarup, Wajuk/Whadjuk/Wadjuk and Yuat/Yued groups. We acknowledge their culture and continuing link to this ecological community and the Country it inhabits.

Conservation Status

The Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion ecological community is listed in the Critically Endangered category of the threatened ecological

communities list under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (the EPBC Act) effective from 15 November 2023.

This ecological community was assessed by the Threatened Species Scientific Committee to be eligible for listing as Critically Endangered under Criterion 2. The Committee's assessment is at Section 6.

The main factor that makes this threatened ecological community eligible for listing in the Critically Endangered category is the very restricted nature of its distribution coupled with a range of major threats, such as: clearing for mining, housing and road building; fire regimes that cause declines in biodiversity; weed invasion; and other urbanisation impacts and climate change.

Ecological communities can also be listed as threatened under state and territory legislation. At the time of drafting this Conservation Advice, this ecological community corresponds to the Critically Endangered WA Threatened Ecological Community '*Melaleuca huegelii – M. systena* shrublands of limestone ridges (floristic community type 26a as originally described in Gibson et al. 1994)' that is on the WA environmentally sensitive area list. It is also on the list of Threatened Ecological Communities, under the WA *Biodiversity Conservation Act 2016* (GoWA 2021, 2023).

Recovery Plan Decision

The Minister decided, in line with the Committee's recommendation, that a recovery plan is not required at this time. The Committee's recommendation is at Section 6.3.

Approved Conservation Advice for Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion

About this document

This document describes this ecological community and where it can be found (Section 1). It outlines information to help identify this ecological community (Section 2). It also briefly describes some aspects of this ecological community's cultural significance (Section 3).

In line with the requirements of section 266B of the EPBC Act, this document sets out the grounds on which this ecological community is eligible to be listed as threatened (Section 6). It outlines the main factors that cause this ecological community to be eligible for listing (Section 4 Threats). It also provides information about what can be done to stop its decline and support its recovery (Section 5).

CONTENTS

FIGURES

1 Ecological community name and description

1.1 Name

The name of this ecological community is Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion (also referred to as 'Honeymyrtle shrubland', or as the/this ecological community). The name refers to key dominant species, vegetation structure and the geographic area where it occurs.

This ecological community was originally placed on the 2021 Finalised Priority Assessment List as the 'Honeymyrtle shrublands on limestone ridges of the Swan Coastal Plain', following its nomination by the Threatened Species Scientific Committee (the Committee).

1.2 Description of Honeymyrtle shrubland and the area it inhabits

The EPBC Act defines an ecological community as an assemblage of native species that inhabits a particular area in nature. This section describes the assemblage of flora and fauna species that comprise the ecological community and the areas of habitat that represent the typical range of its natural state. Because of past loss or degradation, not all of what is left of this ecological community is in a completely natural state. More information to help identify Honeymyrtle shrubland is in Section 2.

The Honeymyrtle shrubland, described in this Conservation Advice, is the assemblage of plants, animals and other organisms associated with a type of warm temperate shrubland or heath, dominated by *Melaleuca huegelii* (chenille honeymyrtle), *M. systena* (coastal honeymyrtle), and/or *Banksia sessilis* (parrot bush).

It occurs only in southwest Western Australia (WA). It is known from a small number of locations in the Swan Coastal Plain IBRA[1] Bioregion (SWA). It is a shrub-dominated ecological community, with sclerophyll shrubs forming thickets or heaths, above a typically diverse ground layer of herbs, including sedges, Restionaceae and occasional grasses. Honeymyrtle shrubland only occurs on the slopes and tops of limestone ridges on the Swan Coastal Plain. Its plants provide food for a variety of nectar-, seed- and fruit-eating birds, and browsing for mammals. The associated rocky and sandy substrates provide ample reptile basking sites, and the shrub layer gives them cover.

1.2.1 Area in nature inhabited by this ecological community

The following is current as at August 2023.

Honeymyrtle shrubland occurs in the Perth subregion (SWA02) of the Swan Coastal Plain IBRA Bioregion. Known occurrences occur from near Guilderton in the north, to near Lake Clifton/ Preston Beach in the south — between the Moore River and the Harvey River Diversion (Gibson et al. 1994; Luu & English 2005; WA DBCA 2022). There are some occurrences in Neerabup and Yanchep national parks.

[1] IBRA refers to the Interim Biogeographic Regionalisation of Australia version 7 (CoA 2012). The Swan Coastal Plain IBRA Bioregion (SWA) is comprised of the Dandaragan Plateau (SWA01) and the Perth (SWA02) subregions. Honeymyrtle shrubland is known to occur in the Perth Subregion.

Honeymyrtle shrubland occurs in the South West Land Division of WA, in the Swan Coastal and in the Perth Hills DBCA[2] districts of the Swan administrative DBCA Region. It is known to occur in the following Local Government areas (LGAs).

- City of Cockburn
- City of Joondalup
- City of Kwinana
- City of Wanneroo
- Shire of Gingin
- Shire of Waroona.

There are known occurrences of Honeymyrtle shrubland are in the following Natural Resource Management (NRM) regions.

- Peel-Harvey
- Northern Agricultural
- Swan[3].

Honeymyrtle shrubland is known to occur 3–103 m above sea level (ASL)[4]. Its occurrences are highly restricted. It is only known to occur on shallow skeletal soils, on the ridge slopes and tops of limestone ridges (and outcrops) associated with Tamala Limestone (Keighery et al. 2003; WA DoW 2017). It is known to occur on the Cottesloe and Karrakatta soil units, mainly within the Spearwood dune system (Schoknecht et al. 2004; WA DoW 2017; WA DPIRD 2018; WA DBCA 2022). For further details, see Appendix B – Landscape and soils.

The Swan Coastal Plain has a warm Mediterranean climate, with dry summers typically of five to six months duration. The whole coast is under the influence of west to south-westerly winds during winter, but experiences strong diurnal wind patterns in summer. Table 1 provides climate statistics for weather monitoring sites across the range of the Honeymyrtle shrubland ecological community.

[2] DBCA: WA Department of Biodiversity, Conservation and Attractions (regions and districts).
[3] The Perth NRM Region was redefined (2016-17) and renamed the Swan NRM Region.
[4] Using mapped occurrence data and Gallant et al. (2011).

Table 1 Climate statistics across the range of the Honeymyrtle shrubland ecological community

Site information			Temperature			Rainfall			
Site name	**Site #[1]**	**Elev. (m)[2]**	**Years T[3] (-2023)**	**T Max (°C)[4]**	**T Min (°C)[5]**	**Years R[6] (-2023)**	**Mean (mm)[7]**	**Median (mm)[8]**	**Mean days of rain...[9]**
Gingin Aero	009178	73	27	25.7	11.1	27/26	639	612	74
Perth Metro	009225	25	30	24.8	12.9	30/31	733	739	81
Jandakot Aero	009172	30	33	24.6	11.6	49	813	806	83
Mandurah	009977	3	22	23.3	14.8	22	617	642	80
Wokalup	009642	30	38*	23.1	11.5	69–71	926	956	88
Bunbury	009965	5	28	23.2	11.1	28	735	754	84

Notes
[1] The Site number is hyperlinked to the Bureau of Meteorology (BoM) website's Climate statistics for Australian locations. The statistical terms have hyperlinks to their definitions on the BoM website.
[2] Elevation (m above sea level (ASL)).
[3] Years of available data on which the temperature statistics are based, to 10/10/2023 (*Only to the year 2000).
[4] Mean maximum temperature (°C) – The average daily maximum air temperature, as an annual statistic, calculated over all the years of record.
[5] Mean minimum temperature (°C) – The long-term average daily minimum air temperature observed over the year.
[6] Years of available data on which the rainfall statistics are based, to 10/10/2023.
[7] Mean rainfall (mm) – The arithmetically averaged total amount of precipitation recorded per year.
[8] Median (decile 5) rainfall (mm) – The midpoint of the ordered yearly precipitation totals . The median is usually the preferred measure of 'typical' rainfall from the meteorological point of view. This is because of the high variability of rainfall (one extreme rainfall event will affect the median less than it will the arithmetic mean).
[9] Mean number of days of rain ≥ 1 mm – Mean (average) number of days per year with at least 1 mm of precipitation.

Source: BoM (2023).

1.2.2 Description of the assemblage

1.2.2.1 ECOSYSTEM TYPE AND VEGETATION STRUCTURE

This ecological community forms a shrub-dominated ecosystem, with sclerophyll shrubs typically forming thickets or heaths. There are typically long intervals between successive fires, usually resulting, over time, in a mossy ground cover with numerous herbs in the understorey.

Under the International Union for Conservation of Nature (IUCN) Global Ecosystem Typology 2.1 (Keith et al. 2022), the Honeymyrtle shrubland are part of the T3.2 Seasonally dry temperate heaths and shrublands, an Ecosystem Functional Group within the Shrublands and shrubby woodlands biome.

1.2.2.2 FLORA

1.2.2.2.1 Shrub species

Honeymyrtle shrubland is dominated by *Melaleuca huegelii* (chenille honeymyrtle), *M. systena* (coastal honeymyrtle) and/or *Banksia sessilis* (parrot bush); commonly over *Acacia lasiocarpa* (pajang), *Grevillea preissii* (spider net grevillea) and *Spyridium globulosum* (basket bush).

Other common shrubs include: *Acacia rostellifera* (summer-scented wattle), *Banksia dallanneyi*[5] (couch honeypot), *Gompholobium tomentosum* (hairy yellow pea), *Hardenbergia comptoniana* (native wisteria), *Hibbertia hypericoides* (yellow buttercups), *Leucopogon parviflorus*

[5] Previously identified as *Banksia nivea* (syn. *Dryandra nivea*) now *B. dallanneyi* (syn. *D. lindleyana*).

(coast beard-heath) and *Templetonia retusa* (cockies tongues). *Xanthorrhoea preissii* (balga) may be present (Gibson et al. 1994).

Some endemic, to near endemic, shrubs are part of this ecological community. These include: *Melaleuca* sp. Wanneroo (G.J. Keighery 16705)[6] (Endangered in WA and nationally), which is only known from the northern sites near Yanchep; and *Hakea oligoneura*, which is almost entirely confined to southern sites (Yalgorup); and *Eucalyptus argutifolia* (Yanchep mallee, Vulnerable nationally and in WA), which has disjunct populations in the north and south (G Keighery 2023. pers comm 14 June). Other WA species of conservation significance (Priority Flora in WA), known to be part of Honeymyrtle shrubland, include *Hibbertia spicata* subsp. *leptotheca*[7] and *Sarcozona bicarinata*.

The honeymyrtle shrubland typically has high species richness. The mean species richness for quadrats surveyed by Gibson et al. (1994) was 50 species per 100 m^2 (0.01 ha e.g. 10 x 10 m). A list of shrub species that are characteristic of, or frequently occur in Honeymyrtle shrubland, is in Appendix A – Species lists.

1.2.2.2.2 Herbaceous ground layer species

The ground layer typically has numerous herbs, including orchids and lilies, and may develop a mossy ground cover (Gibson et al. 1994; Keighery et al. 2003; WA DBCA 2022). Typical species include: *Crassula colorata* (dense stonecrop), *Daucus glochidiatus* (Australian carrot), *Desmocladus flexuosus*, *Eriochilus dilatatus* (white bunny orchid), *Millotia tenuifolia* (soft millotia), *Phyllangium paradoxum* (wiry mitrewort), *Thysanotus manglesianus* (fringed lily), *T. patersonii* (fringed lily) and *Trachymene pilosa* (native parsnip). Other, common ground layer species include: *Hydrocotyle hispidula* (fire pennywort), *Opercularia vaginata* (dog weed), *Parietaria debilis* (pellitory), *Pterostylis pyramidalis* (snail orchid) and *Wurmbea monantha* (a lily).

WA threatened endemic species include *Haloragis luminosa* (Priority 1 – lantern sea-berry[8]) and *Stylidium maritimum* (Priority 3 – a trigger plant).

Honeymyrtle shrubland typically includes the grass *Austrostipa flavescens* (coast spear-grass); and commonly includes *Rytidosperma occidentale* (a wallaby grass) and *A. compressa* (compact needlegrass), which is most obvious following fire.

A fuller list of ground layer species that are characteristic of, or frequently occur in the Honeymyrtle shrubland ecological community is in Appendix A – Species lists.

1.2.2.3 FAUNA

The most common shrubs of this ecological community, such as *Melaleuca*, *Banksia* and *Grevillea* species, produce large flowers that provide food for many animals, including for nectar-feeding birds, insects and mammals — e.g. *Tarsipes rostratus* (honey possum). Other specific plant species provide food for particular animals — e.g. *Parietaria judaica* (pellitory) providing for *Danaus plexippus* (monarch butterfly). Butterflies and birds of prey (including whistling kites)

[6] Not common to all occurrences, but it is common to sites in the Neerabup area.
[7] Recently reclassified in WA as *Hibbertia leptotheca* (JR Wheeler) KR Thiele – https://florabase.dbca.wa.gov.au/search/advanced?id=49637 and Thiele (2019).
[8] Only known from the northern sites near Yanchep (Wege & Orchard 2020; G Keighery 2023. pers comm 14 June).

may be more commonly seen around the limestone ridge environments, perhaps because of the ridges' prominence in the landscape and the associated thermals.

Honeyeaters of varying sizes and bill shapes are part of Honeymyrtle shrubland. They use their relatively long, thin bills to harvest nectar. They incidentally collect and transfer pollen between plants (a critical ecological function). Some specialise in harvesting nectar from particular plant species; whilst others are more generalist in their foraging behaviour. Large honeyeaters include *Anthochaera* spp. (wattlebirds). Medium-sized honeyeaters include *Lichmera indistincta* (brown honeyeater), *Manorina flavigula* (yellow-throated miner) and *Phylidonyris niger* (white-cheeked honeyeater). Numerous other smaller honeyeaters that may be present, include *Acanthorhynchus superciliosus* (western spinebill), *Gavicalis virescens* (singing honeyeater) and *Gliciphila melanops* (tawny-crowned honeyeater) (ALA 2022).

The characteristic shrubs, herbs and grasses of Honeymyrtle shrubland also provide food for a variety of seed-eating and fruit-eating birds (as well as cover). For example, outside of the breeding season, the nationally Endangered *Zanda baudinii* (Baudin's cockatoo) and *Zanda latirostris* (Carnaby's cockatoo) may migrate out of eucalypt forests and woodlands in search of *Banksia* seeds, or of moth larvae inhabiting inflorescence spikes. Other parrots, such as *Barnardius zonarius* (Australian ringneck), *Cacatua sanguinea* (little corella), *Eolophus roseicapilla* (galah) and *Platycercus icterotis* (western rosella), may be attracted by the variety of forage available in the shrub and ground layers of this ecological community (ALA 2022).

Many smaller, insectivorous bird species are part of this ecological community. These include *Acanthiza* spp. (thornbills), *Artamus* spp. (woodswallows), *Eopsaltria* and *Petroica* species (robins), *Hirundo neoxena* (welcome swallow), *Malurus* and *Sericornis* species (wrens), *Merops ornatus* (rainbow bee-eater), *Pachycephala* spp. (whistlers) and *Zosterops lateralis* (silvereye) (ALA 2022).

The prominent limestone ridgetops that support Honeymyrtle shrubland provide ideal perching locations and lookouts for birds of prey that hunt across the ridges and surrounding lower-lying terrain. The nexus between these elevated landforms, coastal habitats, more arid inland habitats, and nearby lakes and riverine habitats, provides suitable conditions for a wide variety of predatory and opportunistic birds – such as *Accipiter, Haliaeetus*, *Haliastur*, *Hieraaetus* and *Pandion* species (hawks and eagles), *Circus approximans* (Australasian harrier), *Corvus* spp. (corvids), *Cracticus torquatus* (grey butcherbird), *Dacelo novaeguineae* (laughing kookaburra, introduced to WA), *Elanus axillaris* (black-shouldered kite) and *Falco* spp. (falcons). At night, *Podargus strigoides* (tawny frogmouth) may be seen perching and hunting for invertebrates, reptiles and small mammals (ALA 2022).

The Swan Coastal Plain is exceptional in its reptile species richness (How & Dell 2000). The sunbathed rocky and sandy substrates associated with Honeymyrtle shrubland provide ample basking sites for a rich diversity of reptiles; and the shrub layer provides cover from predatory birds. The dense vegetation protects namma/gnamma, which are used as a water source by reptiles and other fauna, that also rely on the rough karst and deep voids for shelter. Even the bare limestone areas and bare sand are important native reptile habitats. Numerous skink species, such as *Hemiergis quadrilineata* (two-toed earless skink), *Lerista* spp. (sliders) and *Menetia greyii* (common dwarf skink), inhabit the leaf litter — and hunt for small invertebrates. Medium-sized skinks, such as *Ctenotus* spp. and *Pogona minor minor* (western bearded dragon), prey on larger invertebrates*. Anilios* spp. (blind snakes) and *Aprasia* and *Delma* spp. (legless lizards) hunt on the ground for other small reptiles and invertebrates. The largest skinks of the ecological community*, Tiliqua rugosa* (shingleback) and *Egernia kingii* (King's skink), forage

widely on palatable vegetation, fruits and invertebrates. Smaller venomous snakes of the ecological community include *Brachyurophis semifasciatus* (southern shovel-nosed snake) and *Suta gouldii* (Gould's hooded snake*). Christinus marmoratus* (spectacular marbled gecko) and *Diplodactylus polyophthalmus* (spotted sandplain gecko) hunt for invertebrates at night amongst the vegetation, or on the ground (ALA 2022).

Native marsupials play a key role in trophic interactions, pollination, seed dispersal, decomposition, mineral nutrient cycling and fuel load reduction in this ecological community. The most common native mammals in bushland remnants that include Honeymyrtle shrubland are species that are able to adapt to human habitation, such as *Macropus fuliginosus* (western grey kangaroo). Although the shrubs may be too thick to penetrate easily in many areas, herbaceous plants can provide browsing for kangaroos that may visit the limestone ridgetops in search of food or shade. The WA Priority 4 species *Isoodon fusciventer* (quenda) is the only medium-sized ground-dwelling native mammal that survives around the broader Perth metropolitan region where Honeymyrtle shrubland occurs (Ramalho et al. 2018). Quenda are subject to ongoing habitat loss, roadkill, and predation by foxes and cats (Davis et al. 2008), so the vegetation of the Honeymyrtle shrubland provides important dense shelter. *Rattus fuscipes* (bush rat) and *Trichosurus vulpecula* (common brushtail possum) are also part of Honeymyrtle shrubland and are found at some locations.

Invertebrates have important roles such as pollination, herbivory and distribution of seeds, as well as being food for a range of fauna. There is limited information on the invertebrate components of Honeymyrtle shrubland. However, *Stigmodera roei* (Roe's jewel beetle) may be common, especially if *Hibbertia hypericoides* is present in large numbers. *Synemon gratiosa* (graceful sun-moth) may also be present, with their preferred locations being limestone ridges with *Lomandra maritima* (coast mat rush) growing on them — on which the larvae feed (one of two *Lomandra* species that are key to the moth's survival).

A more comprehensive list of fauna species that are part of the Honeymyrtle shrubland ecological community, including threatened fauna, are in Appendix A – Species lists.

1.2.3 Key ecological processes

This section is not comprehensive, but ecological responses to fire are outlined below. Honeymyrtle shrubland has a range of fire responses, from resprouting — to avoidance (e.g. annuals, winter-active geophytes). The AusTraits database has flora species fire response details (R Core Team 2022). However, the resprouting success of plants depends on the level of damage they sustain during a fire (or accumulate over multiple fires), which in turn is influenced by fire severity and frequency, and by plant characteristics (DAWE 2022). An August 2023 assessment of one site (Shire View Hill), which experienced a fire in May 2019, showed no evidence of resprouting of *Melaleuca huegelii* or *M. systena* — but did show evidence of extensive recruitment from seed, with plants all of a similar age structure. The lack of resprouting was probably due to the intensity of the 2019 fire; and the combination of intense fire and skeletal soils is likely to affect the capacity of these plants to resprout (G Keighery 2023. pers comm 14 June).

Variability in vegetation structure and cover is likely in fire-affected sites for several years post-fire. This includes completely top-killed, or partially killed, herbaceous species and shrubs that may regenerate.

2 Identifying areas of this ecological community

Section 1.2 describes the Honeymyrtle shrubland species assemblage and the particular area in nature it inhabits. This section (along with Appendix A – Species lists) provides additional information to help identify Honeymyrtle shrubland. It includes Section 2.1, which outlines Its Key diagnostic characteristics that distinguish it from other ecological communities. The Honeymyrtle shrubland ecological community intergrades with, or may be similar to, other vegetation types and ecological communities (see Section 2.2.4).

2.1 Key diagnostic characteristics

These key diagnostic characteristics are designed to help identify patches of Honeymyrtle shrubland irrespective of the season. Assemblages of species that do not meet these key diagnostics are not part of the nationally listed ecological community; unless they are recovering areas of the ecological community, which are included. Honeymyrtle shrubland is the assemblage of native species (as described in Section 1.2 and cited sources) that meets the following key diagnostic characteristics.

- It occurs in the Perth subregion of the Swan Coastal Plain IBRA[9] Bioregion in WA.
- It occurs on shallow to skeletal soils, on the ridge slopes and tops of limestone ridges and outcrops associated with Tamala Limestone[10].
- It occurs as shrubland, heath, or thickets; and it has less than 10% canopy cover of *Eucalyptus* species or other tall trees[11].
- The shrub layer is dominated[12] by *Melaleuca huegelii* (chenille honeymyrtle), and/or *M. systena* (coastal honeymyrtle), and/or *Banksia sessilis* (parrot bush) — commonly over *Acacia lasiocarpa* (pajang), *Grevillea preissii* (spider net grevillea) and *Spyridium globulosum* (basket bush).
- The ground layer is typically rich with numerous herbs (including grasses) and smaller shrubs and may develop a mossy ground cover.
- The structure and diversity of Honeymyrtle shrubland may be altered by recent disturbances (e.g. fire may damage or remove above-ground cover and stems) and cause a shift to a regenerative state. Under these circumstances the loss is likely to be a temporary phenomenon if natural regeneration is not disrupted. Recovering/ regenerating areas are still included in the nationally protected ecological community. See Section 2.2.2 *Survey requirements*.

[9] Interim Biogeographic Regionalisation of Australia version 7 (CoA 2012).
[10] Skeletal soils contain little or no organic content. They are typically shallow and may consist merely of weathered rock (Britannica 2023).
Deeper soils occur on the lower slopes, or in pockets, on which *Eucalyptus gomphocephala*, *E. foecunda* and/or *E. petrensis* woodland or mallee may develop over a dense heath (this is not the nationally defined Honeymyrtle shrubland ecological community).
[11] Adjacent woodland is not included in this ecological community but can act as a very effective buffer zone. Where they border, the boundary of the Honeymyrtle shrubland ecological community is defined as areas where there is less than 10% projective foliage cover of tree species.
[12] Dominated means that one or more of the three named shrub species are the most abundant shrubs in the shrub layer (e.g. either by crown cover, or by stem numbers).

2.2 Additional information to assist in identifying Honeymyrtle shrubland

Also consider the following information when using the key diagnostic characteristics to assess whether this ecological community is present.

2.2.1 Identifying a patch

A patch is a discrete and mostly continuous area of the ecological community, as defined by the key diagnostic characteristics, but it can include small-scale variations, gaps and disturbances. The minimum patch size is 0.01 ha (100 m^2, e.g. 10 x 10 m). The smallest area of an existing patch with known boundaries, at the time this advice was drafted, is 0.04 ha (see Section 2.3.1 Minimum patch size). Where a larger area has been mapped or classified as a different vegetation type (e.g. by state vegetation mapping), localised areas of this ecological community (≥ 0.01 ha in size) may still be present within the larger area.

It is also important to consider whether, and how far, a patch of Honeymyrtle shrubland continues beyond the boundary of a particular area surveyed, or beyond the site for a particular proposed development, project, or change of use/activity (i.e. it is important to assess and consider the patch as a whole).

2.2.1.1 BREAKS IN A PATCH

When it comes to defining a patch of this ecological community, allowances are made for 'breaks' of up to 30 m between areas that meet the key diagnostic characteristics. These breaks may be because of drainage lines, tracks, paths, roads, gaps made by exposed areas of soil, or leaf litter, or areas of localised variation in vegetation that do not meet the Key diagnostic characteristics. For example, a single patch could include two areas of Honeymyrtle shrubland on different sides of a track. Small breaks like this do not significantly alter the overall functionality of the Honeymyrtle shrubland ecological community. Drainage lines, gaps made by exposed areas of soil, or leaf litter and areas of localised variation in vegetation, should all be included in the calculation of the size of the patch. Tracks, paths, roads or other artificial surfaces or buildings should be excluded from the calculation of patch size and condition.

Where there is a break in this ecological community of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers, or a different type of vegetation) then the gap indicates that separate patches are present.

2.2.1.2 VARIATION WITHIN A PATCH

Patches of Honeymyrtle shrubland may contain areas that vary in structural or biological characteristics. For example, one part of a patch may have been more recently burnt and therefore be at a different stage of regeneration. Variation, in cover, condition or composition of vegetation across a patch is not evidence of multiple patches, as long as the patch as a whole meets the Key diagnostic characteristics using appropriate survey methodology (see Section 2.2.2).

2.2.1.3 BUFFER ZONE

A buffer zone is intended to help protect and manage areas of this ecological community. A buffer zone is a contiguous area adjacent to a patch of the ecological community. It is important for protecting the patch's integrity because the risk of damage to an ecological community is usually greater when actions (outside the patch) occur near-by. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone acts as a barrier to direct disturbance. Native vegetation that surrounds or adjoins a patch of this ecological community is an ideal buffer — such as Floristic Community Type (FCT) 26b 'Woodlands and mallees on limestone' and FCT 24 'Northern Spearwood shrublands and woodlands' — both of which may co-occur with, intergrade with, or occur near to Honeymyrtle shrubland (see also Section 2.2.4).

Because the buffer is outside the patch, it is not part of the ecological community. So it is not formally protected as a Matter of National Environmental Significance (MNES). Where the buffer on a particular property is subject to existing land uses, such as grazing or spraying, these can continue (because of the 'continuing use' exemptions in the EPBC Act). However, practical application of a buffer zone is strongly recommended. For instance, it is recommended that care be exercised in the buffer zone — to minimise the risk of any significant adverse impacts extending into the patch of Honeymyrtle shrubland. Note that if the activity in the buffer zone is not a continuing use and it is likely to have a significant impact on the ecological community, then it will require EPBC Act approval.

The recommended minimum buffer zone for Honeymyrtle shrubland is at least 200 m from the outer edge of a patch if the zone is native vegetation, or 100 m for other adjacent areas. The appropriate size depends on the nature of the buffer and local context (e.g. slope) (based on Luu & English (2005)). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value.

2.2.1.4 REVEGETATION AND REGROWTH

Restored (including reconstructed) areas and regrowth, are part of this nationally defined ecological community, as long as they meet the Key diagnostic characteristics.

2.2.2 Survey requirements

Patches of Honeymyrtle shrubland can vary markedly in shape, size, condition and features. Representative on-ground surveys should assess the extent of a patch. Publications related to field surveys (such as Keighery (1994), Casson et al. (2009), NCST (2009) and WA EPA (2016a)) provide guidance. More detailed locally relevant guidelines are in Gibson et al. (1994) and WA DBCA (2021a).

Begin by reviewing maps and aerial imagery of the site and surrounding landscape context. Also review available information on management history and features (such as flora and fauna species likely to be present). Where possible, walk around the site to determine the patch boundary. Also record other native vegetation near the patch (up to at least 200 m away), because it may provide important landscape connections and will be the buffer zone. Walk through the site to observe and make a note of the vegetation structure and floristics (including understorey cover and diversity), landscape qualities, areas of vegetation recruitment and likely habitat features.

The size, number and spatial distribution of plots or transects must be adequate to assess the patch. Sampling should be based on an area of at least 10 x 10 m, or an equivalently sized shape (i.e. 100 m^2 = 0.01 ha) (Gibson et al. 1994; Keighery 1994). However, larger and more variable areas of vegetation will need more samples or quadrats to assess a site accurately.

Record the survey date(s) and the survey effort (i.e. the number of person hours spent per plot/transect and in total), along with the surveyor's level of expertise and any limitations at the time of survey. Include a detailed enough map to locate surveyed areas/sampling points. It is also important to note climatic conditions and what kind of disturbance, if any, may have happened in the patch and when. Surveys should note areas that are either in significantly higher or lower condition, as well as any gaps in cover.

Identifying Honeymyrtle shrubland and its condition is possible at most times of the year[13]. However, do consider the how season, rainfall and disturbance history may affect a survey/ assessment of key diagnostic characteristics and condition. For example, flowering may be necessary to identify shrub or herb species, and active growth will indicate population sizes of annual weeds (during spring and early summer).

Immediately after disturbance (such as a fire), one or more vegetation layers or groups of species (e.g. obligate seeders) may not be evident for quite some time. Ideally, do surveys in more than one season, to maximise the chance of detecting all the species that are present, particularly threatened species. In years of low rainfall, be aware that many species may not be detected. In these situations, it is preferable to carry out surveys over more than one year.

After severe disturbance (e.g. fire), or severe drought, the presence of Honeymyrtle shrubland is indicated by any information available on the pre-disturbance state, as well as evidence present at the site. Evidence of the pre-disturbance state may include, for example, earlier surveys or vegetation mapping, photographs or literature, plus the correct substrate, landscape position and proximity (e.g. within 200 m) to native vegetation that meets the key diagnostic characteristics of Honeymyrtle shrubland.

Surveys should be delayed until there has been opportunity for regeneration (ideally at least 2 years after the disturbance event (natural or human-induced), and at least 2 months after adequate rainfall to initiate some recovery). During this recovery period, all patches 0.01 ha or larger that were previously identified, or likely to have been identified, as Honeymyrtle shrubland, are considered to be part of the nationally protected ecological community.

2.2.3 Mapping and vegetation classifications

In WA the nationally defined Honeymyrtle shrubland ecological community is typically identified and mapped as:

- *Melaleuca huegelii – M. systena* shrublands of limestone ridges (floristic community type 26a as originally described in Gibson et al. 1994).

This also referred to as FCT26a, or SCP26a [Swan Coastal Plain Community type 26a[14]].

[13] The best time to identify this ecological community is often when *Melaleuca huegelii* is flowering, because the white flower mass is very obvious.
[14] Slight variations may be used. For example, '*Melaleuca huegelii – Melaleuca systena* shrublands of limestone ridges (Swan Coastal Plain Community type 26a - Gibson et al. 1994)' in Luu & English (2005).

Known occurrences of FCT26a (which corresponds to the Honeymyrtle shrubland ecological community) are primarily associated with the following vegetation complexes, described and mapped on the Swan Coastal Plain (WA DPaW 2016; WA DBCA 2020).

- Cottesloe Complex–Central and South
- Cottesloe Complex–North.

However, occurrences may also be found in the Herdsman Complex, Karrakatta Complex–Central and South and the Karrakatta Complex–North (see WA DPaW (2017)).

The WA 'state-listed' Swan Coastal Plain floristic community type (FCT) 26a was mapped by Gibson et al. (1994), Weston & Gibson (1997) and Keighery et al. (2012). Additional locations for WA FCT26a in Spearwood and Hamilton Hill may not have yet been mapped (as of August 2023).

Mapping units should be considered indicative of, rather than definitive as to, whether the nationally listed ecological community is or is not present in an area. There may be areas (within the geographic distribution of Honeymyrtle shrubland) that whilst identified as a different mapping or vegetation unit, meet the Key diagnostic characteristics of Honeymyrtle shrubland. This includes intergrading areas. Mapped units can be inaccurate or ambiguous — and their definition can change over time. For these reasons, thorough and appropriate on-ground surveys (considering all relevant parts of this Approved Conservation Advice) are the way to determine whether this nationally defined ecological community is present at a particular site (see Section 2.2.2).

2.2.4 Intergrading and closely allied vegetation communities.

The nationally defined Honeymyrtle shrubland ecological community most closely corresponds to one of the two subgroups of a broader WA Swan Coastal Plain floristic community type — FCT 26 (that is restricted to the large limestone ridges north of Perth and in the Yalgorup area; on Spearwood Sands, on Tamala Limestone).

FCT 26 has two distinct subgroups (FCT 26a and FCT 26b), which are related to the degree of soil development. The nationally defined Honeymyrtle shrubland ecological community (which best corresponds to FCT/Subgroup 26a) occurs on skeletal soils, on the ridge slopes and ridge tops. The other (FCT/Subgroup 26b 'Woodlands and mallees on limestone'), is found on the lower slopes, or in pockets, where deeper soil is able to develop. Type 26b is mostly restricted to the Cottesloe unit (Gibson et al. 1994). Areas mapped as FCT 26b do not usually correspond to the nationally defined ecological community.

FCT 26b comprises *Eucalyptus gomphocephala*, *E. foecunda* and/or *E. petrensis* woodland or mallee, over a dense heath. Occasionally an overstorey is absent. In the understorey *Caladenia flava*, *Hibbertia hypericoides*, *Lagenophora huegelii*, *Mesomelaena pseudostygia*, *Schoenus clandestinus* and *Sowerbaea laxiflora* are common (Gibson et al. 1994).

Species richness was similar in both of the FCT 26 subgroups (with a mean species richness of 50.2 and 52.7 respectively), as was a high mean weed frequency (8.0 and 8.4 species/plot) (Gibson et al. 1994).

As well as differentiating FCT/Subgroup 26b, Gibson et al. (1994) describes the differences between the nationally defined Honeymyrtle shrubland ecological community (Subgroup 26a) and other closely allied vegetation communities.

- FCT 27 'Species poor mallees and shrublands on limestone'.
  This is largely restricted to the Yalgorup area; and is either shrubland or mallee heath, variously dominated by *Eucalyptus decipiens*, *E. foecunda*, *Melaleuca systena* or *Hakea prostrata* (without *Melaleuca huegelii*).
- FCT 24 'Northern Spearwood shrublands and woodlands'.
  FCT 24 consists of heaths, or heaths with scattered *Eucalyptus gomphocephala*, occurring on deeper soils north from Woodmans Point. It grades into FCT 26b where the heath element is richer (WA DBCA 2022).

Honeymyrtle shrubland (FCT 26a) is also closely related to FCT 25 'Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands', which encompasses woodlands south of Woodmans Point (Gibson et al. 1994).

Because Honeymyrtle shrubland intergrades with other WA FCTs, it is possible that small patches of the threatened ecological community are present within broader areas mapped as these FCTs, if the Key diagnostic characteristics are met. This emphasises the importance of thorough on-ground surveys.

2.2.5 Relevant listed ecological communities

The Honeymyrtle shrubland ecological community corresponds closely to (and includes all of) the Critically Endangered WA Threatened Ecological Community '*Melaleuca huegelii – M. systena* shrublands of limestone ridges ((floristic community type 26a as originally described in Gibson et al. 1994)' that is on the Western Australian environmentally sensitive area list, and on the list of Threatened Ecological Communities under the WA *Biodiversity Conservation Act 2016* (as Item 25, under Division 1 – gazetted on 26 May 2023) (GoWA 2021, 2023).

2.3 Condition and minimum patch size

Landuse and disturbance history will influence the 'state' in which a patch of Honeymyrtle shrubland is expressed, as well as its condition. Because less than 200 ha of Honeymyrtle shrubland remains, all areas of this ecological community are critical to its survival, regardless of their condition. Because of this, minimum condition thresholds are not proposed as a cut-off for protection of Honeymyrtle shrubland under national environment law (the EPBC Act, at time of this advice).

All patches of Honeymyrtle shrubland are protected as a Matter of National Environmental Significance (MNES) under national environment law, regardless of their condition, as long as they:

- meet the Key diagnostic characteristics AND
- are at least 0.01 ha in size (100 m2 e.g. 10 x 10 m).

Recent disturbance by fire is likely to result in a patch of Honeymyrtle shrubland being in a temporary regenerative state. This may include severely reduced vegetation cover, simplified vegetation structure, varying abundance of seedlings, and/or resprouting shrubs that have been partially or completely top-killed. Surveys should be undertaken when regeneration is sufficiently advanced to identify species with confidence.

2.3.1 Minimum patch size

The minimum patch size is 0.01 ha (100 m^2). The smallest patch with a mapped boundary (as of August 2023) is 0.04 ha in size.

Note:

- even the smallest patches that retain the key diagnostic characteristics of this ecological community need protecting
- mature shrubs are important for the range of habitats and resources they provide to other species in this ecological community and across the broader region
- large intact patches are relatively uncommon in this landscape
- larger size and/or connectivity to other native vegetation areas are typically beneficial
- The extreme paucity of Honeymyrtle shrubland means there are no suitable offsets.

Other indicators of conservation value, to consider when protecting, managing and restoring Honeymyrtle shrubland, are detailed in Section 2.5 Surrounding environment and landscape context considerations when protecting, managing and restoring Honeymyrtle shrubland.

2.4 Habitat critical to the survival of this ecological community

Because of its very restricted distribution, the areas (including habitat) most critical to the survival of Honeymyrtle shrubland include the following:

- all areas that are at least 0.01 ha in size (100 m2, e.g. 10 x 10 m), and that meet the key diagnostic characteristics of this ecological community
- areas of native vegetation, within 200 m of this ecological community — these areas buffer and/or link patches (e.g. to provide habitat for pollinators, and other functional components of Honeymyrtle shrubland, and to allow them to move or be transported between occurrences)[15].

Other key areas for conservation and restoration of Honeymyrtle shrubland are:

- areas that formerly contained Honeymyrtle shrubland and have the correct soils and other abiotic requirements (because these areas can potentially be restored)
- areas that could otherwise provide potential habitat for natural range extension; for example because of climate change (based on Luu & English (2005)).

No significant occurrences of Honeymyrtle shrubland have been identified on Commonwealth land at this time.

2.5 Surrounding environment and landscape context considerations when protecting, managing and restoring Honeymyrtle shrubland

For natural resource management activities or actions that may have 'significant impacts' and/or require approval under national environment law (the EPBC Act at time of this advice), it

[15] All dense vegetation contiguous with, or closely adjacent to, patches of the Honeymyrtle shrubland ecological community has high ecological importance. This is because it plays a part in conserving this ecological community; and because it is critical habitat for fauna (including pollinators) not able to cross large gaps (C Tauss 2023. pers comm 15 June).

is important to consider the entire landscape context and environment surrounding patches of Honeymyrtle shrubland. The surrounding vegetation and other landscape considerations will influence the survival of Honeymyrtle shrubland as a whole. Other considerations could include symptoms of dieback, the presence of weeds and feral animals, road reserves, faunal habitat, and evidence of recruitment of key native plant species following disturbance.

Honeymyrtle shrubland often occurs in association with other native vegetation types. Patches of Honeymyrtle shrubland that are connected to other native vegetation have a better chance of survival and restoration success, in part because they are buffered from disturbance by the surrounding native vegetation (see more information on buffer zones, in sections 2.2.1.3 & 5.4.1.4). Areas of mosaic native vegetation also provide a wider range of habitats that benefit flora and fauna diversity. In addition, patches of other native vegetation, and small patches of Honeymyrtle shrubland, are important as linkages between larger remnants of this ecological community. They act as 'stepping stones' for biodiversity across the landscape. Connectivity should be considered when planning restoration works (e.g. native plantings).

3 Cultural and community significance

Traditional Owners and Custodians have ongoing connections, rights and responsibilities over land where Honeymyrtle shrubland occurs. Listing an ecological community as threatened under national environmental law does not change land ownership. Nor does it affect Native Title rights, nor traditional access and use of Country; for example, collecting bushfood and medicine. Current lawful use (including under Native Title) is supported through protection and recovery of Honeymyrtle shrubland.

WA DBCA (2022) notes that this ecological community occurs in the following Native Title areas.

- Gnaala Karla Booja Indigenous Land Use Agreement
- Whadjuk People Indigenous Land Use Agreement
- Yued Indigenous Land Use Agreement.

Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion occurs on Noongar Boodja (Noongar Country), including the Gnaala Karla Booja, Whadjuk and Yued Noongar regions. It occurs on Country (the traditional lands) of the Noongar peoples, including the Pinjarup, Wajuk/Whadjuk/Wadjuk and Yuat/Yued Noongar groups.

The significance of the area where Honeymyrtle shrubland is found, in particular the flora and fauna, spiritual and other cultural values are diverse and varied for the First Nations peoples that live in the vicinity and care for Country. This includes Noongar mythology, memories, ceremony, traditions, daily life and the calendar of seasons (hunting, fishing and gathering) that link the contemporary Noongar community to Honeymyrtle shrubland and landscape over a long timeline. In some cases, knowledge of cultural significance may only be held by First Nations groups and individuals who are its custodians, and they have the right to decide how it is shared and used.

In general, "limestone country" or Booyeembara, is known for its cultural significance, including through the story of Waugul (a mythical, great serpent of the Noongar cosmology), the creator/ bestower of country, life and fresh water, family/ kinship and knowledge/law (Collard et al. 2004, Collard 2007, McDonald et al. 2005, Moodjar Consultancy 2016). Unpublished information provided to the Committee also note important song-line areas, which may also be associated with the Waugul. In addition, there are namma/gnamma holes (places that hold

water for drinking; believed to be created by dreamtime spirits that went underground at some point in time) on limestone ridges associated with occurrences of Honeymyrtle shrubland. Yanchep National Park Management Plan (WA DEC 2012) objectives are to protect the Aboriginal heritage of the park and encourage greater understanding and appreciation of its values. Interpretive programs, including historical walks, and activities involving traditional use of the area, are undertaken in the park (WA DBCA 2022).

Most of the plants of this ecological community are likely to have cultural significance. For instance, key dominant species such as *Banksia sessilis* (parrot bush) and *Melaleuca huegelii* (chenille honeymyrtle), and other species, are known as "bush tucker" and "bush medicine" plants. The leaves of chenille honeymyrtle are likely to be used to treat the symptoms of head colds and influenza and may also have ceremonial significance. Both of these, and other similar species, provide a rich source of summer nectar and are used to make refreshing drinks (Hansen & Horsfall 2016). Like other eucalypts, the Yanchep mallee is another useful medicine plant, and could also be used to make bedding. The vegetation of Honeymyrtle shrubland provides habitat for unusually rich assemblages of native fauna, which have cultural significance, i.e. snakes, lizards and frogs, as well as kangaroo, wallabies, and ducks.

Information about registered sites is held at the time of this advice by the WA Department of Planning, Lands and Heritage, on the Aboriginal Heritage Sites Register. This includes sites in the vicinity of patches of this ecological community. In particular, occupation sites in the Yanchep and Neerabup National Parks, which may also have mythological, ritual and ceremonial significance — particularly in the northern distribution of the ecological community.

4 Threats

The most significant threat to Honeymyrtle shrubland is extensive past and potential future clearing for mining (mainly limestone extraction), housing and road/rail corridor building. Fire regimes that cause declines in biodiversity (particularly too frequent fire), and interactions with weed invasion are also major threats. Climate change (increasing temperatures and declining rainfall) also intensifies a number of threats (e.g. droughts and fire). A drying climate will lead to hotter fires, which may have a much greater effect because of the shallow soils of this ecological community (G Keighery 2023. pers comm 14 June).

With many occurrences surrounded by highly urbanised areas, altered fire regimes, impacts from recreational uses, weed incursions and illegal rubbish dumping all generally increase. These factors can all lead to degradation of Honeymyrtle shrubland by increasing weed invasion, alteration of structure or species composition, or loss of component taxa (Luu & English 2005; WA DEC & CCWA 2010). Grazing by livestock and rabbits is also a problem.

4.1 Threat table

Table 2 outlines the key threats facing Honeymyrtle shrubland, which represent the *main factors that cause it to be eligible for listing* as required by section 266B (2) (a) (ii) of the EPBC Act. This information supports the assessment against the criteria at Section 6. Although presented as a list, in reality these threats often interact, rather than act independently.

Table 2 Summary of threats facing Honeymyrtle shrubland

Threat factor	Threat Status*	Threat impacts
Clearing for urban, rural, infrastructure and industrial development, and for agricultural activities	*Timing*: ongoing *Severity*: extreme *Scope*: majority	The primary source of past loss of Honeymyrtle shrubland was extensive vegetation clearing (Luu & English 2005). Land use changes that have occurred in the areas that once contained Honeymyrtle shrubland are essentially permanent and irreversible. Impacts on remnants are ongoing and often compounded by other factors, including those associated with fragmentation. Because this ecological community occurs on the tops of ridges, localised clearing for construction of infrastructure is a threat (Luu & English 2005). A proposed highway (Primary Regional Road), the Fremantle to Rockingham Access Corridor (FRAC), is mapped along the western (tallest) part of the Manning Park ridge (Metropolitan Regional Planning Scheme). The FRAC alignment includes areas of this ecological community (C Tauss 2023. pers comm 15 June). Accelerating urbanisation is the main driver of clearing and fragmentation on the Swan Coastal Plain, although agricultural clearing was significant in the past, since settlement in 1829. A population increase of almost 70% is predicted for the region between 2015 and 2050, reaching an estimated 3.5 million (Weller 2009; Ramalho et al. 2014; GoWA 2015a, 2018). (See also the threat of clearing for mining/ extraction of limestone).
Clearing for mining/ extraction of limestone	*Timing*: ongoing *Severity*: extreme *Scope*: minority	Tamala Limestone is a source of road-making material, industrial lime used mainly for cement, builders' lime and building blocks. The Cottesloe soil unit associated with Honeymyrtle shrubland is the main source of limestone for road making and building (WA DCE 1980; Luu & English 2005). Clearing for limestone extraction was a significant source of loss of this ecological community in the past (Luu & English 2005). Mineral exploration and extraction leases exist over some areas containing this ecological community (Luu & English 2005). Mining and quarrying has occurred on the Swan Coastal Plain since the 19th century. Impacts include direct clearing of areas to be mined, damage to soils, fragmentation, and the introduction and spread of dieback and weeds; as well as indirect impacts, such as temporary or long-term changes to hydrology. Even though there have not been any known clearances of Honeymyrtle shrubland for limestone extraction in recent years, demand for basic raw materials such as limestone and rock for construction and infrastructure development will increase in the future to support population growth. Plants that are obligate calcicoles (only grow in calcium-rich soils) are unlikely to regenerate once the limestone is removed from the substrate. In addition, regeneration techniques such as returning topsoil and controlling weeds, were poorly developed when much of this ecological community's substrate was mined. So regeneration is unlikely to have returned such areas to anything approaching their original state.

Threat factor	Threat Status*	Threat impacts
Climate change (increasing temperatures, declining rainfall, rainfall timing)	*Timing*: ongoing *Severity*: major *Scope*: whole	Climate change is affecting southwest WA at a rapid rate, with the number of days per year above 40°C increasing since the 1990s and trends projected to continue. Rainfall has been declining in the region since the 1970s. The decline is associated with decreases in both the frequency of daily precipitation and in wet-day totals (Bates et al. 2010). Mean annual temperatures rose approximately 1°C over the past century and mean annual rainfall declined by 15% in southwestern Australia (mid–1970s–2010) (Steffen & Hughes 2013). Rainfall decline is projected to continue, with early winter rain declining by as much as 45% by 2090 (Hope et al. 2015; CSIRO & BoM undated). The long-term reduction in rainfall is also strongly reflected in declining groundwater levels (Petrone et al. 2010). Correspondingly, time spent in drought is expected to increase, while fire weather is also expected to increase (Hope et al. 2015; CSIRO & BoM undated). Drought frequency, duration and intensity are all projected to increase in this region (Ukkola et al. 2020). There is strong evidence that these changes are caused by anthropogenic climate warming, resulting in a southern shift of the Southern Annular Mode, which brings rain-bearing fronts from the Indian Ocean to the WA coast (Steffen & Hughes 2013). Climate change is likely to have direct ecological effects (e.g. from drought); and it interacts with other factors, such as fire regimes. In the long term, climate change is likely to change the character of Honeymyrtle shrubland by altering resource availability and the competitive relationships between species. Declines in rainfall directly affect plants on the Swan Coastal Plain, and changes hydrology (Longman & Keighery 2002). More frequent drought may also make Honeymyrtle shrubland susceptible to other disturbances. Greater fire frequency and intensity due to changed climatic conditions is likely to affect the ability of plants to recover and recruit, as well as impacting faunal populations. Also, some species are particularly susceptible to extreme heat, and an increase in the number (and maximum temperature) of very hot days is likely to result in their increased death or decline. Declining rainfall also reduces resilience to changing fire regimes, through processes such as interval squeeze (Enright et al. 2015). A drying climate will lead to hotter fires, which may have a much greater effect because of the shallow soils of this ecological community (G Keighery 2023. pers comm 14 June).

Fire regimes that cause declines in biodiversity	*Timing*: ongoing *Severity*: extreme *Scope*: majority	Many Australian plant species have strategies to persist under certain fire regimes; and they will recover, given time, suitable conditions and low exposure to threats. Persistent knowledge gaps, about species' fire response and their post-fire population persistence, threaten the effective long-term management of Australian vegetation in an increasingly pyric world (Gallagher et al. 2021). Fires are a major influence on vegetation composition in a Mediterranean climate, such as that in south west WA. Ecosystems are usually fire responsive and may require a particular fire regime to assist regeneration (Abbott & Burrows 2003; Keeley et al. 2012). 'Fire regimes that cause declines in biodiversity' is listed as a key threatening process under the EPBC Act (DAWE 2022). There are several mechanisms by which fire regimes can threaten this ecological community (Keith 2012; DAWE 2022). These include fire frequency, fire season, and fire effects on biotic interactions and abiotic processes. *High fire frequency* Fire history records indicate that some sites have been burnt at high fire frequency (Table 4). Luu & English (2005) note that high fire frequency may be a major threat to this ecological community. High frequency fires are likely to lead to declines in obligate seeders, although the threshold of sensitivity is likely to be longer in dry years and prevent juvenile re-sprouters attaining fire-tolerance. Interval squeeze (see Enright et al. 2015), driven by both increasing fire frequency and slower developmental rates, is likely threatening the persistence of some species and their community interactions. High fire frequency can increase fauna mortality and reduce habitat complexity, by reducing key structural features such as hollows and nesting sites. Animals may also have insufficient resources, or time, to reach maturity and replace populations. *High severity fire* Increased fire severity may have negative effects on germination and may increase mortality rates of plants and animals. *Interactions between fire and other threats* Interactions between fire and other threats are increasingly likely, as climate change increases the frequency and severity of fire weather. Fire and drought are likely to interact by priming conditions for more severe fires, as happened in 2019–20 (Nolan et al. 2020). Climate change is likely to compound changes to fire regimes (Hope et al. 2015) and changes to vegetation — such as increases in density, extent and potentially the diversity of annual and highly flammable grass weeds. Other threats that may interact with fire include disease and herbivory. In both cases the added pressure of these threats, before or after fire, may reduce a species' capacity to recover from the fire impacts, or make them more susceptible to these threats (DAWE 2022). Post–fire grazing (e.g. by rabbits) is detrimental to Honeymyrtle shrubland. In recent decades, there is evidence of weed invasion and possibly of increased rabbit numbers, due to high fire frequency. Large fires have recently impacted Honeymyrtle shrubland at Yanchep (WA DBCA 2022). The large area burned also creates risks associated with subsequent fires, which may occur before some plant and animal species reach maturity. Burning, without effective pest control may expose regenerating seedlings to herbivory from rabbits (or native fauna), which may negatively impact groundcover (Lambert & Lambert 2015a; Strauch 2015) and lead to a subsequent increase in predation by feral or native predators on native fauna. Arson reduces the predictability of fire regimes. Because of its small area, increasing proximity to urban areas, and its dependence on

Threat factor	Threat Status*	Threat impacts
		appropriate fire regimes, the risk of damage to Honeymyrtle shrubland, by unplanned or mismanaged fire is elevated, especially in a changing climate (e.g. with increased drought and lightning strikes). A number of patches of Honeymyrtle shrubland are close to urban areas, or appear to have been historically viewed as buffers for plantations, and so they have been burnt relatively frequently in recent years (WA DBCA 2022).
Invasive plant species	*Timing*: ongoing *Severity*: major *Scope*: unknown	Many areas of Honeymyrtle shrubland are close to, or surrounded by, increasingly urbanised areas. These act as weed sources, increasing the likelihood of weed invasion following disturbance. At some sites, highly impactful weeds such as bridal creeper are present. These can cause significant problems if not controlled. Disturbances such as fires and grazing can predispose areas to weed invasion if weed propagules are present. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They may also exacerbate grazing pressure and increase the fire hazard by increasing easy-ignition high fuel loads. Gibson et al. (1994) recorded an average of eight weed species per plot (Luu & English 2005). Introduced species include *Aira caryophyllea*, *Lysimachia arvensis*, *Dischisma arenarium*, *Heliophila pusilla*, *Hypochaeris glabra*, *Sonchus oleraceus, Asparagus asparagoides* (bridal creeper) and *Vulpia myuros* (Gibson et al. 1994). Although using herbicide to control weeds is common practice, including after a fire, it can be detrimental to biodiversity — because it not only kills weeds — it also kills macroinvertebrates and other native flora and fauna.
Localised disturbance due to urbanisation	*Timing*: ongoing *Severity*: major *Scope*: majority	In general, increased human populations near natural areas increases the impacts and pressure on them. Problems include approved and informal trails and tracks for bikes, walking and for four-wheel drive vehicles; weed invasion; increased fire frequency and intensity (including through arson); rubbish dumping; mowing or 'tidying up' native areas; and firewood and rock collection; as well as impacts from busy roads nearby (Del Marco et al. 2004; CCoWA 2010). There have been several recent developments or proposals for approved mountain bike trails that threaten Honeymyrtle shrubland, including in Bold Park and in the City of Cockburn in the south. As well as directly destroying vegetation and fragmenting remaining remnants, tracks also encourage entry and spread of weeds (Luu & English 2005) and other invasive species. With an increasing human population and traffic, vehicle strikes are likely to kill native animals crossing roads and tracks. Increasing urbanisation increases the density of roaming domestic pets (notably cats, which continuously replenish feral cat populations). These often displace, or prey on, native fauna (CCoWA 2010; DoE 2015a). Using poisons to control an increase in introduced rodents from surrounding urban areas could kill birds of prey and reptiles — both are important faunal components of Honeymyrtle shrubland (Lettoof et al. 2020; Lohr, 2018). Occurrences of Honeymyrtle shrubland in National Parks and State Forest, where visitation is high, have increased impacts from recreational users from trampling, rubbish and track creation. One occurrence has also been used as an unofficial rubbish tip. Domestic rubbish, in particular garden waste, introduces weed seeds into the bushland and increases fire hazard (Luu & English 2005).

Threat factor	Threat Status*	Threat impacts
Overgrazing and trampling by herbivores	*Timing*: ongoing *Severity*: minor *Scope*: minority	Grazing impacts the establishment of young plants, limiting natural recruitment (Luu & English 2005). Historically, areas near Honeymyrtle shrubland were grazed by livestock (since the 1800s); and horses and kangaroos are still present. Livestock grazing causes alterations to species composition by the selective grazing of edible species, the introduction of weeds and nutrients (e.g. via droppings), and trampling and general disturbance. High numbers of rabbits have invaded a number of occurrences, selectively grazing more palatable species, and damaging vegetation with their high densities of warrens. High kangaroo numbers in the landscape can also be a threat, impacting native vegetation by grazing, trampling and breaking foliage when moving through an area, although the impacts on this ecological community are likely to be minor.
Erosion	*Timing*: ongoing *Severity*: unknown *Scope*: unknown	Honeymyrtle shrubland inhabits limestone ridges that are not subject to major aeolian or hydrological forces. However, erosion of the substrate by wind and water (e.g. heavy rain) may occur following removal of vegetation by grazing, clearing, mining, or fire — especially on lighter soils. These problems may be exacerbated by climate change causing more extreme weather events.
Diseases and pathogens	*Timing*: future *Severity*: unknown *Scope*: unknown	While there have been negligible impacts to date (and Honeymyrtle shrubland is very well drained, occurs on limestone, and has few species susceptible to dieback), potential infection by myrtle rust (*Austropuccinia psidii*) and honey fungus (*Armillaria* spp.) are probably the greatest disease threats (G Keighery 2023. pers comm 14 June). While Polyphagous Shot-hole Borer has not been recorded in any of the Honeymyrtle shrubland species, some native species (including two *Melaleuca* species), have been found to be susceptible. A metropolitan quarantine area is currently in place, which forbids the transport of plants with woody stems greater than 2 cm across the boundary without a permit (see https://www.agric.wa.gov.au/borer).
Notes ***Timing*** – the threat occurs in the **past** (and unlikely to return), is **ongoing** (present/continuing), is likely to occur/return in the **future,** or timing is **unknown** ***Severity*** – the threat causes or has the potential to cause impacts that are **extreme** (leading to loss or transformation of affected patches/occurrences), **major** (leading to degradation of affected patches/occurrences), **minor** (impacting some components of affected patches/occurrences), **negligible** or **unknown** ***Scope*** – the threat is affecting the **whole** (>90%), a **majority** (>50%), a **minority** (<50%), a **negligible** amount, or **unknown** amount of this ecological community		

4.1.1 Key threatening processes

The EPBC Act provides for the identification and listing of key threatening processes (KTPs). A process is defined as a key threatening process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

The following are EPBC-listed KTPs (as of August 2023), which may be relevant to Honeymyrtle shrubland, or to specific plants and animals that comprise it.

- Land clearance
- Fire regimes that cause declines in biodiversity
- Novel biota and their impact on biodiversity
- Competition and land degradation by rabbits
- Predation by feral cats
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.

Any approved threat abatement plans or advice, associated with these KTPs, provide information to help landowners manage the threats and reduce their impacts on biodiversity. These can be found at http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl.

5 Conservation of Honeymyrtle shrubland

5.1 Primary conservation objective

To prevent the extinction or collapse of Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion ecological community in the immediate future and promote recovery of its biodiversity and function through protecting it from significant impacts as a matter of national environmental significance under national environmental law, and by implementing management, recovery and other actions in Section 5.4. This includes retaining and protecting all remaining patches and natural buffer zones from key identified threats and restoring them to a better condition.

5.2 Existing protection and management plans

5.2.1 Existing protections

At the time of this Conservation Advice, Honeymyrtle shrubland corresponds to the Critically Endangered WA Threatened Ecological Community *'Melaleuca huegelii – M. systena* shrublands of limestone ridges (floristic community type 26a as originally described in Gibson et al. 1994)' that is on the Western Australian environmentally sensitive area list and on the list of Threatened Ecological Communities (TECs), under the WA *Biodiversity Conservation Act 2016* (GoWA 2021, 2023). In WA, TECs are considered when evaluating the impact of a proposed development.

An estimated 17% of Honeymyrtle shrubland is in protected areas (CAPAD 2020), in:

- Yanchep National Park - 34 ha (17%)
- Neerabup National Park <1 ha (<1%).

These National Parks provide partial protection against some of the threats facing the Honeymyrtle shrubland. According to WA DBCA (2022) 58 ha of Honeymyrtle shrubland is in Nature Reserves; and 105 ha is in State Forest (most of which is proposed as potential national park, nature reserve or conservation park); another 28 ha is on lands under the care, control and management of other authorities (mainly Local Government Authorities).

Honeymyrtle shrubland is not known to occur in any World Heritage, National Heritage or Ramsar areas. It does, however, occur adjacent to the Peel-Yalgorup System Ramsar wetland (WA DCLM 2003; Peel-Harvey Catchment Council 2019).

5.2.2 Existing management plans

The following list is not comprehensive. It is intended to help identify where some other information relevant to the management of this ecological community and its broader landscape may be found.

- Luu R & English V (2005) Melaleuca huegelii – Melaleuca systena *shrublands of limestone ridges (Swan Coastal Plain Community type 26a – Gibson et al. 1994) 2004-2009 Interim Recovery Plan No. 193*. WA Department of Environment and Conservation]. Perth.
- WA DEC [Department of Environment and Conservation] (2012) *Parks and reserves of Yanchep and Neerabup management plan 76*.

WA DBCA (2022) states that the WA DEC (2012) management plan encompasses the management of a series of occurrences. Excerpts from the plan include:

"Tuart trees associated with threatened ecological communities, particularly those that support or with the potential to support aquatic root mat communities, and trees within the *Melaleuca huegelii–Melaleuca systena* shrublands on limestone ridges are of particular importance for monitoring and protection" and "Securing formal conservation tenure (for example, national park) for the Ridges area and Reserve 25253 will improve protection of *Melaleuca huegelii–Melaleuca systena* shrublands on limestone ridges".

The Swan Region Threatened Flora and Communities Recovery Team coordinates recovery actions for Honeymyrtle shrubland and other TECs and threatened flora in the region (WA DBCA 2022).

5.3 Principles and standards for conservation

To undertake priority actions to meet the conservation objective, the overarching principle is to maintain existing occurrences of this ecological community. Most species may not be easy to recover in practice, if lost from a site.

This principle is highlighted in the *National Standards for the Practice of Ecological Restoration in Australia* (Standards Reference Group SERA 2021).

> ***"Ecological restoration is not a substitute for sustainably managing and protecting ecosystems in the first instance.***
>
> *The promise of restoration cannot be invoked as a justification for destroying or damaging existing ecosystems because functional natural ecosystems are not transportable or easily rebuilt once damaged and the success of ecological restoration cannot be assured."*
>
> *Standards Reference Group SERA (2021) – Appendix 2.*

This principle discourages 'offsets', for example where intact remnants are removed with an undertaking to set aside and/or restore other, lower quality, sites. The destruction of intact sites represents a net loss of the functional ecological community because it is unlikely that all the species and ecological functions of the intact site can be replicated elsewhere. Retention provides the greatest guarantee of a nature positive outcome. It is more cost-effective and less risky to retain an intact occurrence than to allow degradation or loss and then attempt to restore it or establish an occurrence in another area to replace it.

Where restoration is to be undertaken, it should be planned and implemented with reference to Standards Reference Group SERA (2021). These Standards guide how ecological restoration actions should be undertaken. They are available online from the Standards Reference Group Society for Ecological Restoration Australasia (SERA). They outline the principles that convey the main ecological, biological, technical, social and ethical underpinnings of ecological restoration practice.

5.4 Priority conservation and research actions

Priority actions are recommended to abate threats to and support the recovery of this ecological community. They are designed to provide guidance for the following.

- planning, management and restoration of this ecological community by landholders, NRM and community groups, Traditional owners/custodians and other land managers
- conditions of approval for relevant controlled actions under national environment law (the EPBC Act)
- prioritising activities in applications for Australian Government funding programs.

Detailed advice on actions may be available in specific plans, such as management plans for weeds, fire or certain parks or regions. The most relevant at the time this Conservation Advice was developed are listed in Section 5.2.

This Conservation Advice identifies priority conservation actions under the following key approaches.

- PROTECT this ecological community to prevent further losses
- RESTORE this ecological community by active abatement of threats, appropriate management, restoration and other conservation initiatives
- COMMUNICATE, ENGAGE WITH AND SUPPORT people to increase understanding of the value and function of this ecological community and encourage their efforts in its protection and recovery
- RESEARCH AND MONITORING to improve our understanding of this ecological community and the best methods to aid its management and recovery.

These approaches overlap in practice; and they form part of an iterative approach to management that includes research, planning, management, monitoring and review.

The actions below do not necessarily encompass all actions in detail that may benefit this ecological community. They highlight general but key actions required to at least maintain survival of this ecological community at the time of preparing this Conservation Advice.

5.4.1 PROTECT this ecological community

The key priority is to prevent further loss and damage.

5.4.1.1 PLAN FOR PROTECTION

- Protect this ecological community as an essential action during the early stages of zoning and development planning decisions, including in strategic planning documents at state, regional and local levels.
- Liaise with local councils and state authorities to minimise cumulative impacts on this ecological community as part of broader strategic planning, and/or during large projects (e.g. including future mining (mainly limestone extraction), housing and road building, and fire and weed management).
- Undertake activities to mitigate future climate change and so reduce the impacts of climate stress (mainly fire and drought).

5.4.1.2 CONSERVE REMAINING PATCHES

There should be no further clearance of, or deliberate damage to, patches of this ecological community. This is because its extent has been greatly reduced and its ecological integrity substantially reduced; and it is also because it is now very restricted in occurrences and area, with only a few patches remaining.

- Prevent further clearance or destruction of patches of this ecological community (i.e. retain and protect all patches because losses cannot be offset).
- Prevent construction of new trails and rehabilitate existing informal trails that go through this ecological community (e.g. for mountain biking, four-wheel drives or walking). If any trails are formalised/proposed, they should be designed to fully protect this ecological community, without any negative impacts.
- Protect from direct damage, and do not exacerbate other threats (e.g. from feral pests, weeds, disease, rubbish, arson, light pollution and domestic pets).
- Maintain the extent and condition of patches; and maintain existing landscape scale connections between areas of native vegetation (of both this ecological community and of other vegetation types).
- Retain other native vegetation, near patches of this ecological community, particularly where they are important for connectivity and diversity of habitat, or where they act as buffer zones between this ecological community and any threats or development zones.
- Include (and acquire) more patches, along with suitable buffer areas, in formal conservation reserves.
- Include this ecological community as a key target in Nature Repair Market mechanisms, and/or provide through funding incentives for conservation covenants.
    - Consider other remnants for less formal conservation tenures, preferably ones affording long-term protection. This includes investigating formal conservation arrangements, management agreements and covenants to protect patches on private land.
    - Acquisition and other conservation incentives might be prioritised for patches that:
        - are large and intact
        - are in pristine condition
        - have very high species diversity, with mature shrubs and provide a range of habitats
        - provide connectivity to other good quality native vegetation areas.
- Where this ecological community is regenerating, support its regeneration to full maturity. For example, provide fencing to minimise damage risk if appropriate, and ensure fire response and management plans are aligned with regeneration needs.

5.4.1.3 MANAGE ACTIONS TO MINIMISE IMPACTS

Minimise the risk of impacts to Honeymyrtle shrubland (even indirectly, from actions outside but near patches of Honeymyrtle shrubland). For example, avoid building fire-sensitive infrastructure (such as powerlines or telecommunications infrastructure) in, or immediately adjacent to, patches of Honeymyrtle shrubland.

Apply the mitigation hierarchy to avoid, then mitigate potential impacts on Honeymyrtle shrubland from development or other actions. The priority is to avoid deleterious changes to, or

further clearance and fragmentation of, Honeymyrtle shrubland. However, offsetting is not suitable for Honeymyrtle shrubland, hence any loss or damage must be avoided. It is also important to avoid changes to ecological processes and damage to landscape function, particularly by preventing loss of nearby native vegetation.

5.4.1.4 APPLY BUFFER ZONES

- Protect and apply appropriate buffer zones (particularly adjacent areas of other native vegetation) around patches of this ecological community to minimise impacts arising 'off-site'. A buffer zone is a contiguous area adjacent to a patch that is important to protect the integrity of this ecological community. The risk of indirect damage is usually greater where actions occur close to a patch. Buffer zones can minimise this risk, by absorbing and reducing impacts. They can also make land managers aware that Honeymyrtle shrubland is nearby and to be extra careful. For instance, buffer zones help protect the root zone of outermost plants and other members of this ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion, polluted water runoff and other damage. The best buffer zones are typically areas of native vegetation. Fire breaks and other built asset protection zones do not typically provide a suitable buffer and should be additional to the vegetated buffer.
- The recommended minimum buffer zone for Honeymyrtle shrubland is at least 200 m from the outer edge of a patch if the zone is native vegetation or 100 m for other adjacent areas. The appropriate size depends on the nature of the buffer and local context (e.g. slope) (based on Luu & English (2005)). Apply larger buffer zones to protect patches from broader landscape threats.

5.4.1.5 PREVENT THE INTRODUCTION AND SPREAD OF EXOTIC SPECIES AND DISEASES

- Maintain national and state quarantine and biosecurity arrangements to exclude new invasive species, pathogens and diseases.
- When conducting activities in or around Honeymyrtle shrubland, practice good biosecurity hygiene to avoid spreading weeds or pathogens such as *Armillaria* spp. (honey fungus). In particular, maintain soil and plant hygiene when undertaking any work such as fire management, plantings, and weeding is critical. Limit visitor access to paths and install hygiene stations where necessary.
- Encourage local landholders/managers to engage in weed identification and intervention, and to implement prevention measures using current best management practices. Encourage landholders/managers to identify weed threats early by monitoring invasion pathways.
- Engage with local government and state departments to minimise impacts to the flora and fauna of this ecological community from weed spraying activities when managing roadsides in or adjacent to this ecological community.
- Use an integrated weed management approach to control transformer weeds species. Where appropriate use a staged approach and use methods that reduce off-target damage. Weed control should target all problematic species. Schedule regular follow-up work to maintain effective weed management.

- Do not sell known or potential invasive species and do not plant them in gardens, developments or landscaping near this ecological community. In particularly, avoid known transformer weeds and bird-dispersed species. Review planting schedules, to ensure that potential weeds, or other inappropriate plant species (e.g. native plants likely to contaminate the local gene pool) are not included.
- Prevent dumping garden waste in bushland, especially in or near patches of this ecological community.
- Control runoff during nearby construction activities to prevent weeds and pathogens getting into this ecological community.
- Avoid spreading weeds or pathogens, when conducting activities in or around this ecological community, by practicing good biosecurity hygiene. Refer to DoE (2015).
- Minimise unnecessary soil disturbance that may facilitate weed establishment.
- If new invasive species incursions occur, detect and control them early, because small infestations are easier to eradicate.
- Limit or prevent access of grazing animals to patches of this ecological community (e.g. construct fences). Exotic species seeds (e.g. from cattle fodder, or from other areas) can be spread in their manure and by adhering to their coats. Provide advice and support to landholders/managers to assist with this.
- Prevent further incursions of feral animals into this ecological community; and contain pets in nearby residential areas.
- Monitor for *Armillaria* spp. and other plant pathogens, to minimise the risk of new infestations in areas not yet infested. Manage early, for local containment or eradication.

5.4.2 RESTORE and MANAGE this ecological community

This key approach includes priorities to restore (aiming for SERA Five Star restoration as a key aspiration) and maintain Honeymyrtle shrubland by active threat abatement, and appropriate management, restoration and other conservation initiatives. Act to increase the remaining extent, condition, and landscape scale connectivity of this ecological community (particularly connectivity with other surrounding native vegetation types). Conservation management of the broader landscape (including areas formerly containing Honeymyrtle shrubland and nearby native vegetation), also supports the survival and functioning of Honeymyrtle shrubland.

- Engage and liaise with landholders/managers, NRM/catchment and community groups, Traditional Owners/Custodians and governments to support, undertake and promote programs that ameliorate impacts such as those from mining and development.
- Identify and prioritise managing other specific threats and undertake appropriate on-ground site management strategies where necessary.
- Undertake strategic weed management in conjunction with appropriate fire management, to facilitate and promote natural regeneration where propagules are likely to be present.

5.4.2.1 FIRE MANAGEMENT

Rapid urban development has given rise to an extensive urban-rural interface. This presents both fire managers and policy makers with substantial challenges on the issues of urban planning, bushfire response and bushfire risk management. This situation is exacerbated by a

landscape located within an internationally recognised biodiversity hotspot, with highly specific environmental needs, a diverse geomorphology and sites of cultural significance to the Noongar people. This has produced a complex fire-management environment, where multiple objectives compete for limited resources (Fontaine 2022).

- Avoid physical damage to Honeymyrtle shrubland during and after fire operations.
- Liaise with local fire management authorities and agencies, and engage their support to manage fire in this ecological community. Ensure that they avoid damaging this ecological community (e.g. by creating and using suitable maps and by installing field markers).
- Manage fires, so that prevailing fire regimes support rather than degrade this ecological community (e.g. so that fires do not disrupt this ecological community's component species' life cycles).
- Do not burn Honeymyrtle shrubland for conservation purposes, except under circumstances where research indicates that there are conservation benefits to burning (see 5.4.4.2 Options for management).
- Limit prescribed burning, to minimise the impacts of out-of-season fires, fire-drought impacts (particularly from spring burns); and also to reduce the risk of interval squeeze for flora and fauna.
- Manage the fire-weed cycle by controlling invasive weed species before and after any fire events. However, use herbicide carefully when controlling weeds after a fire because it can be detrimental to biodiversity. It not only kills weeds — it can also kill native flora, macroinvertebrates and other fauna of the ecological community.
- Limit the impacts of post-fire herbivory and predation, by controlling feral pests (rabbits, foxes, cats) for at least two years after a fire.
- Avoid using fire-retardant chemicals on, or near Honeymyrtle shrubland.

5.4.3 COMMUNICATE, engage with and support

This key approach includes priorities to promote awareness of Honeymyrtle shrubland and to encourage people and groups to contribute to its recovery. It includes communicating, engaging with and supporting the public and key stakeholders — to increase people's and groups' understanding of the value and function of this ecological community; and also to assist their efforts in its protection and recovery. Key people/groups to communicate with include landholders, land managers, land use planners, researchers, First Nations communities of the Swan Coastal Plain and other community members.

5.4.3.1 RAISE AWARENESS

Raise awareness by distributing relevant publications, erecting interpretive signs at strategic locations, through school programs and by establishing demonstration sites for Honeymyrtle shrubland.

- Communicate with and educate landholders/managers, relevant agencies, groups and the public about Honeymyrtle shrubland. Emphasise its value, significance and its key threats (such as mining and urban development). Also, emphasise the importance of its protection and restoration, and the importance of appropriate management actions.
- Encourage the activities of, and seek support from local restoration groups, Indigenous Australians, state-based conservation organisations and appropriate national groups.

- With permission, include culturally appropriate information on Traditional knowledge and values in education and awareness programs, and in publications and signage.
- Encourage landholders/managers to talk with local NRM organisations and other knowledgeable groups, to promote cooperation to protect and restore patches of this ecological community.
- Undertake effective community engagement and education to highlight the importance of minimising disturbance, pollution and littering (e.g. during recreational activities).
- Inform landholders/managers about incentives, such as conservation agreements, stewardship projects, funding and government NRM programs that support them to look after Honeymyrtle shrubland on private land.

5.4.3.2 GATHER AND PROVIDE INFORMATION

- Develop education programs, information products and signage to help the public recognise the presence and importance of Honeymyrtle shrubland; and help them understand their responsibilities under state and local regulations, and under the EPBC Act.
- Install signs to discourage damaging activities in Honeymyrtle shrubland — such as dumping garden waste and other rubbish, creating paths and tracks (e.g. for walking and mountain biking); and discourage off-road vehicles.
- Install significant vegetation markers along roads to designate areas of Honeymyrtle shrubland, to help protect it (e.g. to prevent inappropriate road side maintenance).
- Promote knowledge about local weeds and what garden plants to avoid planting. Recommend local native species for revegetation and landscaping, or safe alternatives for garden plants. Discourage nurseries and DIY stores from selling invasive species.

5.4.3.3 COORDINATE EFFORTS

- Encourage local participation in restoration and 'landcare' efforts (e.g. through local conservation groups, creating 'friends of' groups, field days and planting projects).
- Engage with landholders and utilise peer-to-peer learning with other landholders.
- Liaise with local fire management authorities and agencies. Engage their support in appropriate fire management for Honeymyrtle shrubland. Ensure land managers are given information about how to manage fire risks, to conserve this and other threatened ecological communities and species.
- Develop coordinated incentive projects to encourage conservation and stewardship of Honeymyrtle shrubland on private land. Link projects with other programs and activities, especially those managed by regional NRM/catchment groups.
- Support opportunities for Traditional Owners/Custodians, or other Indigenous community members, to manage this ecological community.
- Promote awareness and protection of Honeymyrtle shrubland with relevant agencies and industries. For example, with the following.
    - State and local government planning authorities — to ensure that planning protects remnants, with due regard to principles for long-term conservation.
    - Land owners and developers — to minimise threats associated with land conversion and development.

- Local councils and state authorities — to ensure that infrastructure or development works (particularly those involving substrate or vegetation disturbance) do not adversely impact Honeymyrtle shrubland. This includes avoiding the introduction or spread of invasive species.

5.4.4 RESEARCH AND MONITORING

This key approach includes priorities for research into this ecological community, and monitoring, to improve understanding of this ecological community and the best methods to aid its recovery through restoration and protection. Relevant and well-targeted research and other information gathering activities are important to inform the protection and management of this ecological community.

- Actively promote research and development in restoration science and technology to enable communities to protect and restore the biota of this ecological community.
- Improve understanding of Traditional ecological knowledge. Identify and support culturally appropriate mechanisms to share knowledge, to protect and restore Honeymyrtle shrubland.
- Investigate the responses of key plants and animals to alternative fire regimes. Consider the effects on reproduction and survival.
- Investigate potential impacts of climate change and its interaction with fire regimes on the current diversity, distribution and future habitat suitability of important component species of this ecological community.
- Investigate the impact of climate change on flowering phenology and plant/animal interactions (e.g. pollination networks).

5.4.4.1 MAPPING

- Collate, update and validate additional vegetation mapping information and associated data for Honeymyrtle shrubland and identify gaps in knowledge.
- Map and regularly report the extent, severity and temporal parameters of all fires across the range of Honeymyrtle shrubland and surrounding fire-dependent and/or fire sensitive vegetation, to support fire management decisions.
- Monitor and report on changes in the extent and condition of Honeymyrtle shrubland across its range.
    - Support targeted field surveys and interpretation of other data, such as aerial photographs and satellite images. Update current extent, condition, threats, function, and the presence of, and use by, regionally significant or threatened species. Ground-truth to fill data and knowledge gaps, including knowledge of this ecological community's different 'states' and recovery from different disturbances.
    - Support and enhance existing programs to model the pre-1750 extent across the entire range of this ecological community to inform restoration.
    - Identify the most intact, high conservation value remnants and gain a better understanding of variation across this ecological community.
    - Undertake new surveys and collate existing information on populations of fauna characteristic of Honeymyrtle shrubland, across its range.

5.4.4.2 OPTIONS FOR MANAGEMENT

- Investigate key ecological interactions, such as the role of fauna in pollination, seed dispersal and nutrient cycling.
- Conduct research into the role of fire in this ecological community, including understanding the following.
    - The current fire frequency status in each management area, by comparing time since fire across this ecological community.
    - The ecological consequences of fire-exclusion, including identifying critical thresholds in important processes.
- Improve understanding of habitat requirements of resident and transient fauna.
- Conduct research into appropriate and integrated methods to manage pests and invasive species that affect Honeymyrtle shrubland.
- Assess the vulnerability of Honeymyrtle shrubland to climate change and investigate ways to improve resilience through other threat abatement and management actions.
- Improve understanding of how fire regimes affect life history processes and population dynamics of component flora and fauna, including indirect effects through interactions with threats posed by periodic droughts, invasive species and other pressures.
- Use improved knowledge of fire ecology to investigate the efficacy of alternative fire management strategies for conservation of Honeymyrtle shrubland under different land tenures and land uses.
- Conduct research to develop effective landscape-scale restoration techniques for Honeymyrtle shrubland, including by incorporating Traditional ecological knowledge.
- Investigate interactions between disturbance types, such as fire and invasion by weeds and feral animals, to determine how to implement an integrated approach to threat management.
- Investigate the most cost-effective options for restoring landscape function. These include:
    - re-vegetation/ assisted regeneration of priority areas
    - buffering, connecting and protecting existing remnants.
- Add the northern Ridges to Yanchep National Park, as described in the Management Plan. These ridges have been known to be significant for a long time (G Keighery 2023. pers comm 14 June).

5.4.4.3 MONITORING

Plan monitoring before starting to manage or restore Honeymyrtle shrubland; and consider what data are required to address research questions. Adequately resource monitoring — especially when using a novel approach. Monitor during and after management action (and preferably before).

- Monitor for new pest animal, invasive species and pathogen incursions (e.g. myrtle rust, honey fungus). Continual reappraisal is needed of the evolving potential arrival pathways, and measures for prevention and early detection.
- Monitor changes in the condition, composition, structure and function of Honeymyrtle shrubland, including its response to various management actions. Use this information to better understand Honeymyrtle shrubland and inform future management recommendations.

6 Listing assessment

This assessment outlines the *grounds on which the community is eligible to be listed* as required by section 266B (2) (a) (i) of the EPBC Act.

6.1 Assessment process

6.1.1 Reason for assessment

This assessment follows prioritisation of a nomination from the Committee.

6.2 Eligibility for listing

An ecological community is eligible for listing under section 182 of the *Environmental Protection and Biodiversity Conservation Act 1999* (the EPBC Act) if it meets the prescribed criteria outlined in section 7.02 of the EPBC Regulations 2000. This assessment uses the criteria set out in the EPBC Regulations and in the Committee's TSSC (2017) Guidelines for nominating and assessing the eligibility for listing of threatened ecological communities, as in force at the time of the assessment.

Information on listing eligibility under the International Union for Conservation of Nature (IUCN) Red List for Ecosystems criteria (Bland et al. 2017) is included for information only.

6.2.1 Criterion 1 – decline in geographic distribution

Eligible under Criterion 1 for listing as **Vulnerable,** based on an estimated substantial decline in geographic distribution of 55 – 60% relative to the longer-term**.**

	Category		
	Critically Endangered	Endangered	**Vulnerable**
Its decline in geographic distribution is:	very severe	severe	**substantial**
decline relative to the longer-term/1750 timeframe	*≥90%*	*≥70%*	***≥50%***
decline relative to the past 50 years	*≥80%*	*≥50%*	*≥30%*

Source: TSSC (2017).

Evidence

WA DEC & CCWA (2010) states that much of the Spearwood Dune System in the metropolitan area has been cleared for urban development. Large limestone ridges associated with the system are of conservation significance (Weston & Gibson 1997). However, most of these ridges in the metropolitan area have been lost to, or are threatened by, urban development and mining pressures.

Ninety records of occurrences of this ecological community are included in the WA DBCA TEC database (as of October 2023). Six of these occurrences have been destroyed, and three require further survey. So, there were 81 occurrences with mapped boundaries in the WA TEC database, with a total area of 199 ha mapped (as at 8/4/2019).

Detailed mapping of the pre-European extent of Honeymyrtle shrubland is not available, but estimates of decline can be made, as outlined below.

The extant ecological community is restricted to the limestone ridge slopes and ridge tops of the Spearwood system of the Perth Coastal Zone (Schoknecht et al. 2004; WA DPIRD 2018), typically on Karrakatta shallow soils and Spearwood S2b Phase map units.

Broader vegetation complexes (defined by Heddle et al. (1980)) have been mapped on the Swan Coastal Plain for pre-European extent, and for remnant and regrowth vegetation at five yearly intervals since 2000 (WA DPaW 2016; WA DBCA 2020). A pre-European and a 2005-06 extent were calculated by Kinloch et al. (2009) for vegetation complexes on the Swan Coastal Plain.

Known occurrences of Honeymyrtle shrubland are primarily associated with the Cottesloe Complex–Central and South (61% decline in extent – e.g. grazed/cleared), and with the Cottesloe Complex–North (42% decline). This ecological community may also occur on the Herdsman Complex (74% decline), Karrakatta Complex–Central and South (74% decline) and on the Karrakatta Complex–North (56% decline). Overall, these five vegetation complexes have declined from an estimated 193,000 ha to 78,000 ha — a decline of 60% across the Swan Coastal Plain Bioregion since settlement. The Committee assumed that Honeymyrtle shrubland declined at a similar rate to these complexes, of which it is a part.

WA DBCA (2022) estimated the figure in a similar way, but used fewer soil and landform units. It states that this ecological community occurs on the Cottesloe and Karrakatta soil and landform units (vegetation complexes), mainly within the Spearwood System. The occurrences are within the Cottesloe–Central and South, Cottesloe–North, and the Karrakatta–North soil and landform units. The pre-1750 and current extent of these soil and landform units are outlined in Table 3.

Table 3 Historical and current extent of soil and landform units (vegetation complexes) on the Swan Coastal Plain with which Honeymyrtle shrubland is associated

Soil and landform unit	Pre-European extent (ha)	Current extent (ha)	Decline (%)
Cottesloe–Central & South	45,300	14,568	68
Cottesloe–North	43,474	25,165	42
Karrakatta–North	44,273	19,976	55
Total	**133,047**	**59,710**	**55**

Source: adapted from GoWA (2019), in WA DBCA (2022).

These WA DBCA (2022) data suggest a figure for the likely decline of the Honeymyrtle shrubland ecological community. As calculated in Table 3, the extent to which it has declined is estimated as 42–68%; with a best estimate of total decline as 55%. The timing of the clearing is not known, so it was conservatively inferred to be since 1750 (WA DBCA 2022).

WA DBCA (2022) goes on to say that this ecological community has been targeted for limestone quarrying — so historical losses are likely to be greater than the losses through general land clearing of the associated soil and landform units.

Conclusion

The two figures of 55–60% represent a **substantial** decline in geographic distribution relative to the longer-term. The Committee's assessment is that Honeymyrtle shrubland meets the relevant elements of Criterion 1 to make it eligible for listing as **Vulnerable**.

This decline in geographic distribution since 1750 also represents a likely Vulnerable status, under Criterion A3 of the IUCN Red List of Ecosystems.

6.2.2 Criterion 2 – limited geographic distribution coupled with demonstrable threat

Eligible under Criterion 2 for listing as **Critically Endangered.**

Its geographic distribution is:		**very restricted**	restricted	limited
Extent of occurrence (EOO)		*< 100 km2 = <10,000 ha*	*<1,000 km2 = <100,000 ha*	*<10,000 km2 = <1,000,000 ha*
Area of occupancy (AOO)		***< 10 km2 = <1,000 ha***	*<100 km2 = <10,000 ha*	*<1,000 km2 = <100,000 ha*
Average patch size		***< 0.1 km2 = <10 ha***	*< 1 km2 = <100 ha*	–
AND the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in:				
the immediate future	*10 years or **3 generations** (up to a maximum of 60 years)*	**Critically Endangered**	Endangered	Vulnerable
the near future	*20 years or 5 generations (up to a maximum of 100 years)*	Endangered	Endangered	Vulnerable
the medium term future	*50 years or 10 generations (up to a maximum of 100 years)*	Vulnerable	Vulnerable	Vulnerable

Source: TSSC (2017).

Evidence

The geographic distribution was estimated, based on 81 mapped known occurrences of the comparable WA floristic community type, SCP26a on limestone ridges, as described by Gibson et al. (1994) (as supplied by WA DBCA (2022)).

The estimated extent of occurrence (EOO) is 192,000 ha (1920 km^2), this is considered **limited**. The estimated area of occupancy (AOO) is less than 200 ha (2 km^2), this is considered **very restricted**. The estimated median patch size, based on 81 known occurrences is 1.3 ha; and 96% of patches are less than 10 ha in size. This is also considered **very restricted**. Honeymyrtle shrubland occurs on the naturally fragmented habitat of isolated massive limestone ridges. Ongoing clearing of Honeymyrtle shrubland and other surrounding native vegetation has increased fragmentation (WA DBCA 2022).

The most significant threat to Honeymyrtle shrubland is ongoing clearing for mining (mainly limestone extraction), housing and road building. There is a history of clearing, and a further risk that clearing will reduce the distribution of this ecological community, through mineral leases and proposed housing developments (WA DBCA 2022).

Too frequent fire is also a major threat (Luu & English 2005). A significant proportion of Honeymyrtle shrubland (10–20%) occurs in areas burnt in the 2019–20 bushfires, exacerbating other threats and impacts. Climate change (increasing temperatures and declining rainfall) also intensifies a number of threats (e.g. droughts and fire). A drying climate will lead to hotter fires, which may have a much greater effect than currently assumed, because of the shallow soils of this ecological community (G Keighery 2023. pers comm 14 June).

With many occurrences surrounded by highly urbanised areas, altered fire regimes, impacts from recreational uses and incidence of illegal rubbish dumping are increased. These factors can all lead to degradation of Honeymyrtle shrubland through incursions by invasive species, the alteration of vegetation structure and species composition, or the loss of component flora and fauna (Luu & English 2005; WA DEC & CCWA 2010). Grazing (by livestock, rabbits and kangaroos) is also a problem (Luu & English 2005).

WA DBCA (2022) summarises the expected effects of threats to this ecological community in the future, as follows.

1) Clearing this ecological community and adjacent vegetation causes direct and indirect loss — and it exacerbates weed invasion. Nearby urban and peri-urban areas can act as weed sources and can increase fire frequency.

2) Recreational use — where visitation is high, impacts from trampling, rubbish and track creation are likely to increase; and dumping garden waste introduces weed seeds.

3) Grazing causes alterations to the species composition — by fauna selective grazing edible species, the introduction of weeds and nutrients, and trampling and general disturbance.

4) Fire — there is evidence of weed invasion and possibly of increased rabbit numbers, because of increased fire frequency.

Conclusion

Honeymyrtle shrubland faces ongoing threats — including a combination of clearing, fire regimes that cause biodiversity decline, climate change, introduced species, recreational use and other impacts from urbanisation. It is very susceptible to the cumulative impact of these threats because of its very restricted area of occupancy and because it mostly occurs in small patches.

Honeymyrtle shrubland has a **very restricted** geographic distribution; and the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in the **immediate future** (within 3 generations of the predominant shrub layer species of the ecological community; estimated to be 45–90 years). The Committee's assessment is that Honeymyrtle shrubland meets the relevant elements of Criterion 2 to make it eligible for listing as **Critically Endangered**.

6.2.3 Criterion 3 – decline of functionally important species

Insufficient data to determine eligibility under Criterion 3.

	Category		
	Critically Endangered	**Endangered**	**Vulnerable**
For a population of a native species that is likely to play a major role in the community, there is a:	very severe decline	severe decline	substantial decline
Estimated decline over the last 10 years or three generations (up to a maximum of 60 years), whichever is longer	*80%*	*50%*	*20%*
to the extent that restoration of the community is not likely to be possible in:	the immediate future	the near future	the medium-term future
timeframe	*10 years or 3 generations (up to a maximum of 60 years)*	*20 years or 5 generations (up to a maximum of 100 years)*	*50 years or 10 generations (up to a maximum of 100 years)*

Source: TSSC (2017).

Evidence

There has been significant loss the of the flora and fauna species that support the functioning of Honeymyrtle shrubland across the broader Swan Coastal Plain. However, there are limited data on population occurrence trends in the ecological community for the characteristic shrub species, or groups of fauna (such as pollinating birds, or digging/ scratching ground mammals and birds) that undertake key functional roles. Their roles include habitat provision, nutrient cycling, seed dispersal and/or burial, and pollination. Insufficient data are available to support specific analyses against Criterion 3 and its indicative thresholds.

Conclusion
The Committee's assessment is that there is unlikely to be sufficient information to determine the eligibility of this ecological community for listing in any category under Criterion 3.

6.2.4 Criterion 4 – reduction in community integrity

Eligible under Criterion 4 for listing as **Vulnerable**.

	Category		
	Critically Endangered	Endangered	**Vulnerable**
The reduction in its integrity across most of its geographic distribution is:	very severe	severe	**substantial**
as indicated by degradation of the community or its habitat, or disruption of important community processes**, that is:**	very severe	severe	**substantial**
such that restoration is unlikely (even with positive human intervention) within	*the immediate future (10 years or 3 generations up to a maximum of 60 years)*	***the near future (20 years or 5 generations up to a maximum of 100 years)***	***the medium-term future (50 years or 10 generations up to a maximum of 100 years)***

Source: TSSC (2017).

Evidence
The Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion has undergone substantial changes in structure and function as result of the threats outlined in Section 4. This ecological community has experienced a **substantial** reduction in integrity across most of its extent primarily because of the following.

6.2.4.1 REDUCTION IN INTEGRITY DUE TO FRAGMENTATION AND CHANGES TO THE SURROUNDING LANDSCAPE
Honeymyrtle shrubland occurs on the naturally fragmented habitat of isolated massive limestone ridges. The wider landscape has been changed and fragmented by clearing for mining, housing and road building — of both the ecological community itself and surrounding vegetation (WA DBCA 2022). The estimated median patch size is 1.3 ha; and 96% of patches are less than 10 ha in size.

Fragmentation and degradation of native vegetation affect the integrity of remaining patches of Honeymyrtle shrubland in many ways. For example, fragmentation increases the vulnerability of patches to a range of threats due to increased perimeter to area ratio. This increases the influence and negative impacts of surrounding land uses and disturbances. When developments remove or severely fragment native vegetation (and replace or surround it by modified landscapes), the loss of habitat and wildlife corridors can alter the abundance of species that depend on these features, and reduce their ability to disperse (Davis et al. 2008; Davis et al. 2013). Although populations of flora and fauna may persist, or be relatively stable in the short-term, their ability to escape from or recolonise remnants after a disturbance (e.g. fire) can be hindered by fragmentation. For example, when they are unable to successfully disperse across landscapes that are increasingly modified and unsuitable.

The extensive and rapid urban sprawl, particularly around the Perth Metropolitan region and the Swan Coastal Plain (SCP), has had large impacts on native vegetation and species through habitat loss, disturbances that allow non-native species to be introduced and establish, the spread of plant diseases, and alteration of natural hydrological and disturbance regimes (Stenhouse 2004; Fisher et al. 2009a; Ramalho et al. 2014). Integrity is more likely to be affected in smaller more isolated remnants. Although, integrity can still be affected in larger, less

fragmented patches of Honeymyrtle shrubland, because they are also subject to threats (e.g. altered fire regimes and climate change).

Few studies document the direct impacts of fragmentation on this ecological community. However, native plant species richness in isolated patches of nearby woodland on the Swan Coastal Plain, was found to generally decrease with time since isolation, particularly in smaller remnants (Ramalho et al. 2014). This was associated with altered soil properties. Also, Ecoscape's (2013) study (to identify areas of this ecological community in Kwinana) indicated that other areas could have previously been analogous to this ecological community if their condition were better.

For birds, Davis et al. (2013) showed that the amount of native or other vegetation in the immediate surroundings (within 2 km) was the most important factor for determining occurrences of bushland birds in the Perth region. Occurrences of these species declined as the landscape changed from variegated to fragmented to relictual, according to the percentage of vegetation cover remaining.

An analysis of reptile assemblages in urban bushland remnants on the SCP showed that larger areas of urban bushland retained larger assemblages of reptiles for all groups, except skinks (How unpublished). The assemblages in smaller patches of woodland differed due to the loss of some original species from the assemblages. This indicates fragmentation into smaller, presumably more degraded patches also limits faunal species richness.

6.2.4.2 Reduction in integrity due to Grazing and trampling

A number of patches have been historically grazed. There is also evidence that domesticated animals and high numbers of kangaroos are currently having an impact. Grazing is likely to have caused alterations to the species composition by the selective grazing of edible species, the introduction of weeds and nutrients, and by trampling and general disturbance. High numbers of rabbits have also invaded a number of patches, selectively grazing more palatable species, and have caused damage to vegetation with high densities of warrens (WA DBCA 2022).

6.2.4.3 Reduction in integrity due to altered fire regimes

There is evidence of weed invasion and possibly of increased rabbit numbers as a result of more frequent burning in recent decades. Large fires have recently impacted occurrences at Yanchep (WA DBCA 2022). Table 4 summarises aspects of the fire history of Honeymyrtle shrubland.

Table 4 Summarised aspects of the fire history of Honeymyrtle shrubland (1957–2022)

Statistic	Value
Average % (area) burnt per year	8
Median % (area) burnt per year	5
Average fire return interval by occurrence (years)	20

Source: WA DBCA (2022b).

Count of fire events (1957–2022)	Number of occurrences
1 to 5	55 (63%)
6 to 10	30 (34%)
11 to 15	1 (1%)
16 to 20	1 (1%)
Total	87

Quadrats were established on this ecological community at Yalgorup in 1993 (and re-scored in 2007 and then after the very hot fires of 2016). They showed that on the shallow soils, for several plant species such as *Grevillea preissii* and *Hakea prostrata* (that normally re-sprout from

lignotubers), the whole plant was killed; and that very poor regeneration occurred in the dry years following. This was also true for several re-seeders such as *Trymalium ledifolium*, *Acacia truncata*, and *Hakea trifurcata*. It appears that severe fires may kill the exposed rootstocks of normally re-sprouting plants on these shallow soils (similar issues were found on the Ironstone shrublands and adjacent Calcareous silts). The dense moss layer often found on these hills is also lost, and very slow to re-establish (G Keighery 2023. pers comm 14 June). Cryptogams (such as mosses, liverworts, and lichens) are known to be fire sensitive and have no particular fire-adapted survival strategies; they rely on airborne spores or propagules to disperse to new habitats (Mistry 1998, in Kantvilas et al. 2015; Wills et al. 2018).

An estimated 10 - 20% of the known occurrences of Honeymyrtle shrubland were within the 2019/2020 fire extent. Fire severity analysis indicated around half of these areas had high to very high severity (WA DPIE 2020).

6.2.4.4 REDUCTION IN INTEGRITY DUE TO RECREATIONAL USE / MAINTENANCE ACTIVITIES

Several patches of Honeymyrtle shrubland occur in National Parks and State Forest, where visitation is high and the impact from recreational users from trampling, rubbish and track creation is increased. One patch, on unvested land, is also used as an unofficial rubbish tip. Apart from being visually unappealing and damaging vegetation, rubbish and in particular garden waste, introduces weed seeds into the bushland and increases the fire hazard (WA DBCA 2022).

Both authorised an unauthorised mountain bike trails have also adversely impacted Honeymyrtle shrubland. The limestone ridges, on which Honeymyrtle shrubland occurs, are a prime target for mountain biking because of their elevation. For example Manning Park in the City of Cockburn has substantial impacts attributed to mountain bike trails. Rehabilitation of informal trails is seen as a benefit to be gained by formalizing and expanding the current unsanctioned mountain bike trail network. However professionally built trails, to provide the most challenging trails for the riders (and surfaces that will be durable over time) in limestone karst environments, increase fragmentation, reinforce degradation processes, increase the totally degraded area and decrease biodiversity.

6.2.4.5 REDUCTION IN INTEGRITY DUE TO CLIMATE CHANGE

Climate change is having direct ecological effects (e.g. from drought); and it interacts with other factors such as fire regimes. Declines in rainfall directly affect plants, and changes hydrology (Longman & Keighery 2002). For example, through slower growth to maturity, reduced fecundity and increased mortality during extended droughts (Keith et al. 2014). Greater fire frequency and intensity due to changed climatic conditions appears to be affecting the ability of plants to recover and recruit, as well as impacting on faunal populations. A drying climate will lead to hotter fires, which may have a much greater effect than currently assumed because of the shallow soils of this ecological community (G Keighery 2023. pers comm 14 June).

The length of time that Honeymyrtle shrubland takes to successfully regenerate/ fully recover, from the various types of ongoing disturbance that it is subject to, is not known. Synergies between threats, particularly those exacerbated by climate change, are adversely affecting recovery.

Conclusion
WA DBCA (2022) stated that none of the remaining vegetation of this ecological community[16] was in 'Pristine' condition. Although 85% was in 'Excellent' condition, patches had still sustained disturbance affecting individual species, and/or were affected by weeds. The remaining 15% had its vegetation structure altered (with obvious signs of disturbance), had substantially reduced native plant species diversity, and aggressive weeds were present.

The combination of threat impacts has adversely affected the structure and species assemblage of Honeymyrtle shrubland across its range. This represents a **substantial** reduction in integrity across most of its geographic distribution, as indicated by a **substantial** degradation of this ecological community and its habitat. It seems unlikely that Honeymyrtle shrubland will be restored in the **medium-term or near-term future**. The Committee's assessment is that Honeymyrtle shrubland meets the relevant elements of Criterion 4 to make it eligible for listing as **Vulnerable**.

6.2.5 Criterion 5 – rate of continuing detrimental change

Insufficient data to determine eligibility under Criterion 5

	Category		
	Critically Endangered	**Endangered**	**Vulnerable**
Its rate of continuing detrimental change is: as indicated by:	very severe	severe	substantial
(a) rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is: OR	very severe	severe	serious
(b) intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	very severe	severe	serious
an observed, estimated, inferred or suspected detrimental change over the immediate past, or projected for the immediate future (10 years or 3 generations, up to a maximum of 60 years), of at least:	*80%*	*50%*	*30%*

Source: TSSC (2017).

Evidence
Consistent measurements to provide quantitative estimates of rates of continuing detrimental change (of extent or degradation) over a time series, have not been obtained to be able to address this criterion. However, change in extent from pre-1750 estimates is addressed under Criterion 1, and reduction in community integrity is addressed under Criterion 4.

Conclusion
The Committee's assessment is that there is unlikely to be sufficient information to determine the eligibility of Honeymyrtle shrubland for listing in any category under Criterion 5.

[16] Based on the 73 patches of this ecological community whose condition was known — 90% of the then known occurrences.

6.2.6 Criterion 6 – quantitative analysis showing probability of extinction

Insufficient data to determine eligibility under Criterion 6.

	Category		
	Critically Endangered	**Endangered**	**Vulnerable**
A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution, is:	at least 50% in the immediate future	at least 20% in the near future	at least 10% in the medium-term future
Timeframes	*10 years or 3 generations (up to a maximum of 60 years)*	*20 years or 5 generations (up to a maximum of 100 years)*	*50 years or 10 generations (up to a maximum of 100 years)*

Source: TSSC (2017).

Conclusion
Quantitative analysis of the probability of extinction or extreme degradation over all its geographic distribution has not been undertaken. The Committee considers that there is unlikely to be sufficient information to determine the eligibility of Honeymyrtle shrubland for listing in any category under this criterion.

6.3 Listing and Recovery Plan Recommendations

6.3.1 TSSC Recommendations

The Threatened Species Scientific Committee recommends:

(i) that the list referred to in section 181 of the EPBC Act be amended by **including** Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion in the list in the Critically Endangered category; and

(ii) that there not be a recovery plan for this ecological community at this time.

a. An Approved Conservation Advice is an effective, efficient and responsive document to guide the implementation of priority management actions, mitigate key threats and support the recovery for this ecological community.

b. An Approved Conservation Advice would support this ecological community's recovery by identifying priority actions, stakeholders for engagement, and the survey and research priorities to facilitate a better understanding of key threats as well as biological and ecological knowledge gaps.

c. The threats facing the entity, and the recovery actions needed can effectively be guided via an approved Conservation Advice.

Appendix A – Species lists

This appendix lists the assemblage of native species that characterises Honeymyrtle shrubland throughout its range at the time of listing — particularly characteristic and frequently occurring vascular plants at Table 5 and macroscopic animals at Table 6. Honeymyrtle shrubland includes fungi, cryptogamic plants and other species; however, they are relatively poorly documented.

The species on the list may be abundant, rare, or not necessarily present in any given patch of Honeymyrtle shrubland. Other native species, not listed here, may also be present. The total list of species that may be found in Honeymyrtle shrubland is larger than those listed here.

Species presence and relative abundance varies naturally across the range of this ecological community — based on factors such as historical biogeography, soil properties (e.g. moisture, chemical composition, texture, depth and drainage), topography, hydrology and climate. They also change over time — for example, in response to disturbance (by fire or grazing), or to the climate and weather (e.g. seasons, floods, drought and extreme heat). The species recorded at a particular site can also be affected by sampling scale, season, effort and expertise. In general, the number of species recorded is likely to increase with the size of the site.

Scientific names used in this appendix are nationally accepted names as per the Atlas of Living Australia (ALA 2022, 2023), as at the time of writing.

A1 Flora

Table 5 Characteristic, frequently occurring, or threatened/endemic flora

Scientific name	Common name/s	Fire response[1]	EPBC status[2]	State status[3]
Shrub species				
Acacia lasiocarpa	panjang	Fire killed	–	–
Acacia rostellifera	summer-scented wattle, skunk tree		–	–
Banksia dallanneyi (syn. *Dryandra lindleyana*)	couch honeypot	Resprouts	–	–
Banksia sessilis (syn. *Dryandra sessilis*)	parrot bush	Fire-killed	–	–
Eucalyptus argutifolia	Yanchep mallee		Vulnerable	Vulnerable
Gompholobium tomentosum	hairy yellow pea	Fire-killed	–	–
Grevillea preissii	spider net grevillea	Resprouts	–	–
Hardenbergia comptoniana	native wisteria	Resprouts	–	–
Hakea oligoneura (syn. *Hakea* sp. Yalgorup, *Hakea undulata* limestone variant)			–	Priority 2
Hibbertia hypericoides	yellow buttercups	Resprouts	–	–
Hibbertia spicata	glossy-leaved coastal guinea flower		–	–
Leucopogon parviflorus	coast beard-heath	Resprouts	–	–
Melaleuca huegelii	chenille honeymyrtle	Resprouts	–	–
Melaleuca systena (syn. *M. acerosa*)	coast honeymyrtle, Yowarl (Noongar)	Resprouts	–	–
Sarcozona bicarinata	ridged noon-flower	Fire killed	–	Priority 3
Spyridium globulosum (syn. Trymalium albicans)	basket bush	Fire killed	–	–
Templetonia retusa	cockies tongues	Resprouts	–	–

Scientific name	Common name/s	Fire response[1]	EPBC status[2]	State status[3]
Herb and orchid and sedge/graminoid species				
Crassula colorata	dense stonecrop	Fire-killed. Annual[4]	–	–
Daucus glochidiatus	Australian carrot		–	–
Desmocladus flexuosus (syn. *Loxocarya flexuosa*)	–	Resprouts	–	–
Eriochilus dilatatus	white bunny orchid	Resprouts	–	–
Haloragis luminosa	lantern sea-berry	Fire killed	–	Priority 1
Hydrocotyle hispidula	a pennywort	Annual[4]	–	–
Lomandra maritima	coast mat rush		–	–
Millotia tenuifolia	soft millotia	Annual[4]	–	–
Opercularia vaginata	dog weed	Fire-killed	–	–
Parietaria debilis	(small-flower/ native) pellitory	Fire-killed	–	–
Parietaria judaica	spreading pellitory, pellitory of the wall, asthma weed		–	–
Phyllangium paradoxum (syn. *Mitrasacme paradoxa*)	wiry mitrewort	Fire-killed. Annual[4]	–	–
Pterostylis pyramidalis	snail orchid	Resprouts	–	–
Stylidium maritimum	a trigger plant		–	Priority 3
Thysanotus manglesianus	fringed lily	Resprouts	–	–
Thysanotus patersonii	fringed lily	Resprouts	–	–
Trachymene pilosa	native parsnip	Fire-killed. Annual[4]	–	–
Xanthorrhoea preissii	balga	Resprouts	–	–
Wurmbea monantha	–	Resprouts	–	–
Grass species				
Austrostipa compressa	compact needlegrass	Fire-killed. Annual[4]	–	–
Austrostipa flavescens	coast spear-grass		–	–
Rytidosperma occidentale (syn. *Austrodanthonia /Danthonia occidentalis*)	a wallaby grass		–	–

Notes [1] Known plant fire responses, derived from the R package 'AusTraits, for R version 4.2.1 (R Core Team 2022). The AusTraits database is described in Falster et al. (2021).
[2] EPBC status refers to species listed under the EPBC Act when this document was prepared (DCCEEW 2023).
[3] State status refers to species listed under the State Act when this document was prepared (WA DBCA 2023).
[4] Annuals may be killed by fire, if it occurs in winter or spring when they are alive and growing; at other times, when fire is most likely to occur, they persist as seeds — protected from fire by burial in the soil seedbank (B Miller 2023. pers comm 9 October).

Sources: Gibson et al. (1994); WA Herbarium (1998–); ALA (2022, 2023); G Keighery 2023. pers comm 14 June; DCCEEW (2023).

A2 Fauna

Table 6 Fauna recorded in the Honeymyrtle shrubland ecological community

Scientific name	Common name/s	EPBC Status[1]	State status[2]
Mammals			
Isoodon fusciventer	southern brown bandicoot, quenda, Kwenda (Noongar)		Priority 4
Macropus fuliginosus	western grey kangaroo, Yonga (Noongar)	–	–
Rattus fuscipes	bush rat	–	–
Tarsipes rostratus	honey possum, Noolbenger (Noongar)	–	–
Trichosurus vulpecula	common brushtail possum	–	–

Scientific name	Common name/s	EPBC Status[1]	State status[2]
Birds			
Acanthiza apicalis	inland thornbill	–	–
Acanthiza chrysorrhoa	yellow-tail	–	–
Acanthiza inornata	western thornbill	–	–
Acanthorhynchus superciliosus	western spinebill	–	–
Accipiter cirrocephalus	collared sparrowhawk	–	–
Accipiter fasciatus	grey-headed goshawk	–	–
Anthochaera carunculata	red wattlebird	–	–
Anthochaera lunulata	western wattlebird	–	–
Anthus novaeseelandiae	Australasian pipit	–	–
Aquila audax	wedge-tailed eagle	–	–
Ardea pacifica	white-necked heron	–	–
Artamus cinereus	black-faced woodswallow	–	–
Artamus cyanopterus	dusky woodswallow	–	–
Barnardius zonarius	Australian ringneck	–	–
Cacatua sanguinea	little corella	–	–
Cacomantis flabelliformis	fan-tailed cuckoo	–	–
Chalcites basalis	horsfield's bronze-cuckoo	–	–
Chalcites lucidus	shining bronze-cuckoo	–	–
Chenonetta jubata	maned duck, Australian wood duck	–	–
Cheramoeca leucosterna	white-backed swallow	–	–
Circus approximans	Australasian harrier	–	–
Colluricincla harmonica	grey shrike-thrush	–	–
Coracina novaehollandiae	black-faced cuckoo-shrike	–	–
Corvus bennetti	little crow	–	–
Corvus coronoides	Australian raven	–	–
Cracticus torquatus	grey butcherbird	–	–
Dacelo novaeguineae[3]	kookaburra	–	–
Daphoenositta chrysoptera	varied sittella	–	–
Egretta novaehollandiae	matuka, white-faced heron	–	–
Elanus axillaris	black-shouldered kite	–	–
Eolophus roseicapilla	galah	–	–
Eopsaltria griseogularis	western yellow robin	–	–
Eurostopodus argus	spotted nightjar	–	–
Falco berigora	brown falcon	–	–
Falco cenchroides	wala, nankeen kestrel	–	–
Falco longipennis	Australian hobby	–	–
Gavicalis virescens	singing honeyeater	–	–
Gerygone fusca	fuscous warbler	–	–
Gliciphila melanops	tawny-crowned honeyeater	–	–
Grallina cyanoleuca	magpie-lark	–	–
Gymnorhina tibicen	Australian magpie	–	–
Haliaeetus leucogaster	white-bellied sea-eagle	–	–

Scientific name	Common name/s	EPBC Status[1]	State status[2]
Haliastur sphenurus	whistling eagle-hawk	–	–
Heteroscenes pallidus	pallid cuckoo	–	–
Hieraaetus morphnoides	little eagle	–	–
Hirundo neoxena	welcome swallow	–	–
Lichmera indistincta	brown honeyeater	–	–
Malurus leucopterus	white-winged fairy-wren	–	–
Malurus splendens	splendid fairy-wren	–	–
Manorina flavigula	yellow-throated miner	–	–
Melanodryas cucullata	hooded robin	–	–
Merops ornatus	rainbow bee-eater	Marine	–
Ninox novaeseelandiae	southern boobook	–	–
Ocyphaps lophotes	crested pigeon	–	–
Oreoica gutturalis	crested bellbird	–	–
Pachycephala pectoralis	Australian golden whistler	–	–
Pachycephala rufiventris	rufous whistler	–	–
Pandion haliaetus	osprey	–	–
Pardalotus punctatus	spotted pardalote	–	–
Pardalotus striatus	striated pardalote	–	–
Petrochelidon nigricans	tree martin	–	–
Petroica boodang	scarlet robin	–	–
Phaps chalcoptera	common bronzewing	–	–
Phylidonyris niger	white-cheeked honeyeater	–	–
Phylidonyris novaehollandiae	New Holland honeyeater	–	–
Platycercus icterotis	western rosella	–	–
Podargus strigoides	tawny frogmouth	–	–
Purpureicephalus spurius	red-capped parrot	–	–
Rhipidura albiscapa	grey fantail	–	–
Rhipidura leucophrys	willie wagtail	–	–
Sericornis frontalis	white-fronted scrubwren	–	–
Smicrornis brevirostris	brown weebill	–	–
Trichoglossus haematodus	rainbow lorikeet	–	–
Tyto javanica	eastern barn owl	–	–
Vanellus tricolor	banded lapwing	–	–
Zanda baudinii (Syn. *Calyptorhynchus baudinii*)	Baudin's (black-)cockatoo, long-billed black-cockatoo	Endangered	Endangered
Zanda latirostris (Syn. *Calyptorhynchus latirostris*)	Carnaby's (black) cockatoo, short-billed black-cockatoo	Endangered	Endangered
Zosterops lateralis	silvereye	Marine	–
Reptiles and Amphibians			
Anilios australis	southern blind snake	–	–
Aprasia repens	southwestern sandplain worm lizard	–	–
Brachyurophis semifasciatus	southern shovel-nosed snake	–	–
Christinus marmoratus	marbled gecko	–	–
Ctenotus australis	western limestone ctenotus	–	–

Scientific name	Common name/s	EPBC Status[1]	State status[2]
Delma grayii	side-barred delma	–	–
Diplodactylus polyophthalmus	spotted sandplain gecko	–	–
Egernia kingii	King's skink	–	–
Hemiergis quadrilineata	two-toed earless skink	–	–
Lerista distinguenda	dwarf four-toed slider	–	–
Lerista praepedita	blunt-tailed west-coast slider	–	–
Limnodynastes dorsalis	western banjo frog, pobblebonk	–	–
Menetia greyii	common dwarf skink	–	–
Myobatrachus gouldii	turtle frog	–	–
Pogona minor minor	western bearded dragon	–	–
Suta gouldii	Gould's hooded snake	–	–
Tiliqua rugosa	boggi, shingle-back, bobtail, stumpy-tail	–	–
Invertebrates			
Amblyomma triguttatum	kangaroo tick	–	–
Austracantha minax	jewel/ Christmas spider	–	–
Danaus plexippus	monarch butterfly	–	–
Heterotermes platycephalus	drywood heterotermes termite	–	–
Hylaeus alcyoneus	banksia bee	–	–
Jassopsaltria rufifacies	hairy maggot blow fly	–	–
Lioponera brevis	(an ant)	–	–
Lioponera clarki	(an ant)	–	–
Megachile clypeata	(a bee)	–	–
Megachile preissi	(a bee)	–	–
Mixocyclops mortoni	(a copepod)	–	–
Neolucia agricola	fringed heath-blue butterfly	–	–
Stigmodera roei	Roe's jewel beetle	–	–
Synemon gratiosa	graceful sun-moth	–	–
Triplectides niveipennis	(a caddisfly)	–	–
Vanessa kershawi	Australian painted lady	–	–
Perthia acutitelson	(an amphipod)	–	–

Notes
[1] EPBC status refers to species listed under the EPBC Act when this document was prepared (DCCEEW 2023).
[2] State status refers to species listed under the State Act when this document was prepared (WA DBCA 2023).
[3] Introduced species.

Sources: ALA (2022) — All spatially-valid records, where the number of records for each species was more than one, were extracted; G Keighery 2023. pers comm 14 June; ALA (2023); DCCEEW (2023).

Appendix B – Landscape and soils

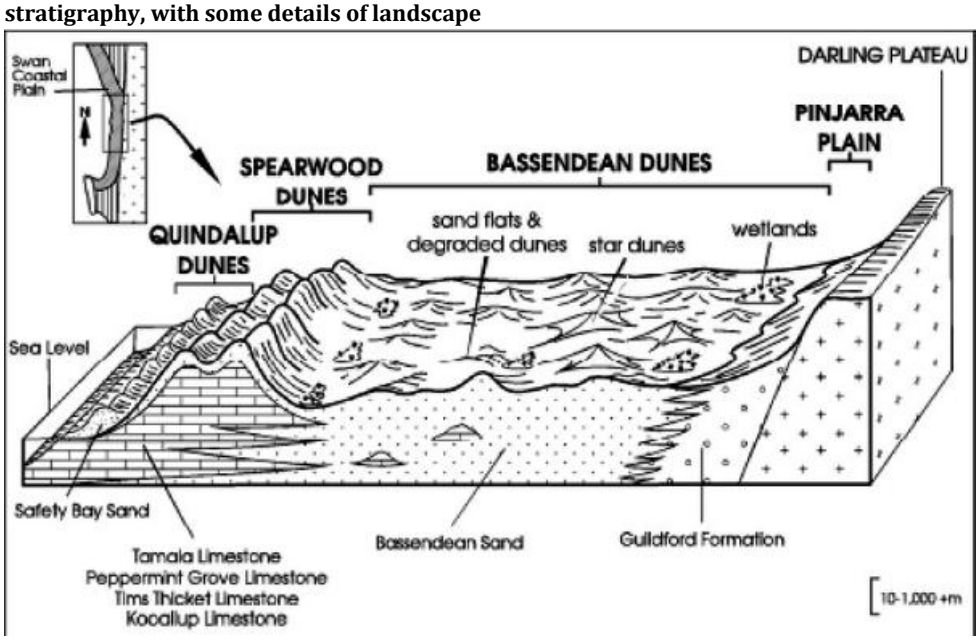
Gibson et al. (1994) describes the Swan Coastal Plain (SCP) as a narrow belt of aeolian, alluvial and colluvial deposits, generally of Holocene or Pleistocene age, on which is found the city of Perth and most of the population of Western Australia (WA). It extends from Dunsborough north to Jurien. Over most of its length the SCP is less than 30 km wide. It is bounded on the west by the Indian Ocean and to the east by the faulted Yilgarn block (McArthur & Bettenay 1960).

The Swan Coastal Plain, Perth subregion (SWA02), has three coastal dune systems, each older as you go inland from the coast (McArthur & Bettenay 1974; McArthur 2004).

- The Quindalup System (Holocene[17]; it is the youngest and most westerly dune system fringing the coastline).
- The Spearwood System (middle to late Pleistocene).
- The Bassendean System (late Pliocene to early Pleistocene).

Figure 1 illustrates the relative position of these dune systems on the SCP and the occurrence of limestone beneath them. Table 7 summarises the geomorphological units associated with each dune system. Figure 2 and Figure 3 show their relative position and surface geology.

Figure 1 Illustration of the geomorphic units of the Swan Coastal Plain and their stratigraphy, with some details of landscape



Source: after Semeniuk & Glassford (1989), in Semeniuk & Semeniuk (2004).

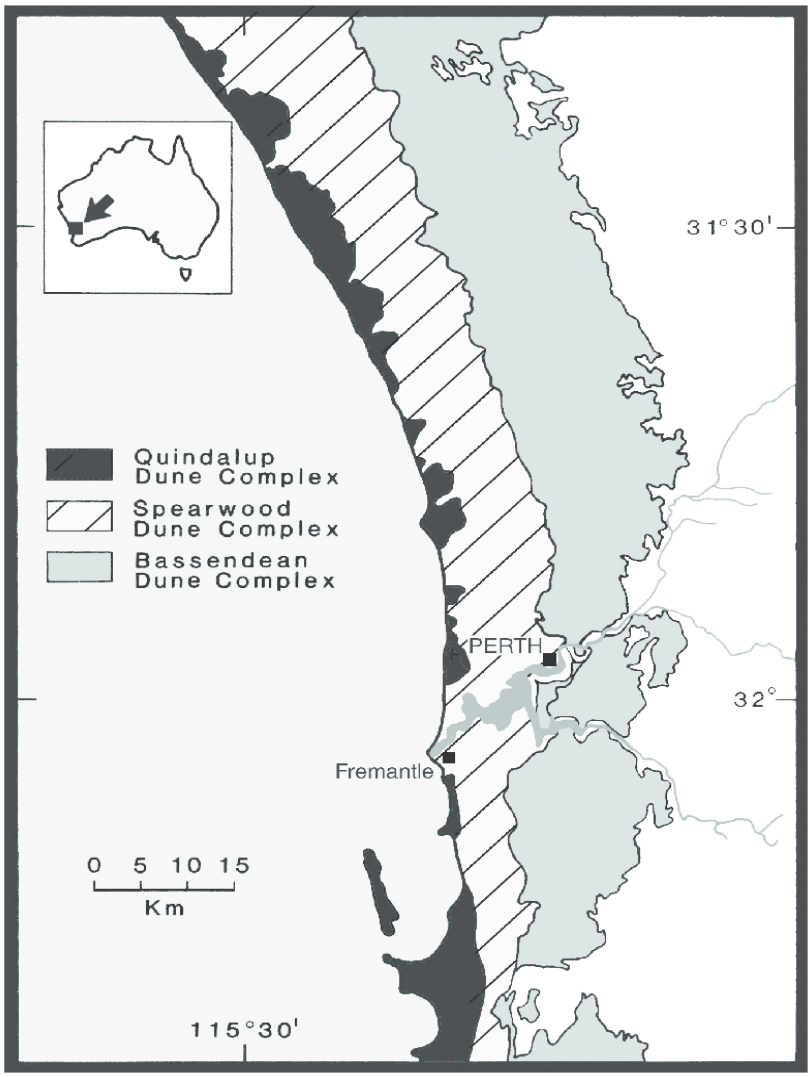
[17] Australian Museum (2023) gives summary details of the latest version of the geological time scale.

Table 7 Selected geomorphological classifications of the lower Swan Coastal Plain

Major geomorphological systems	More details geomorphological units
Quindalup Dunes (Holocene)	Quindalup unit
Spearwood Dunes (middle to late Pleistocene)	Cottesloe unit Karrakatta unit Herdsman unit
Bassendean Dunes (late Pliocene to early Pleistocene)	Bassendean unit Southern River unit Caladenia unit Yoongarillup unit Herdsman unit

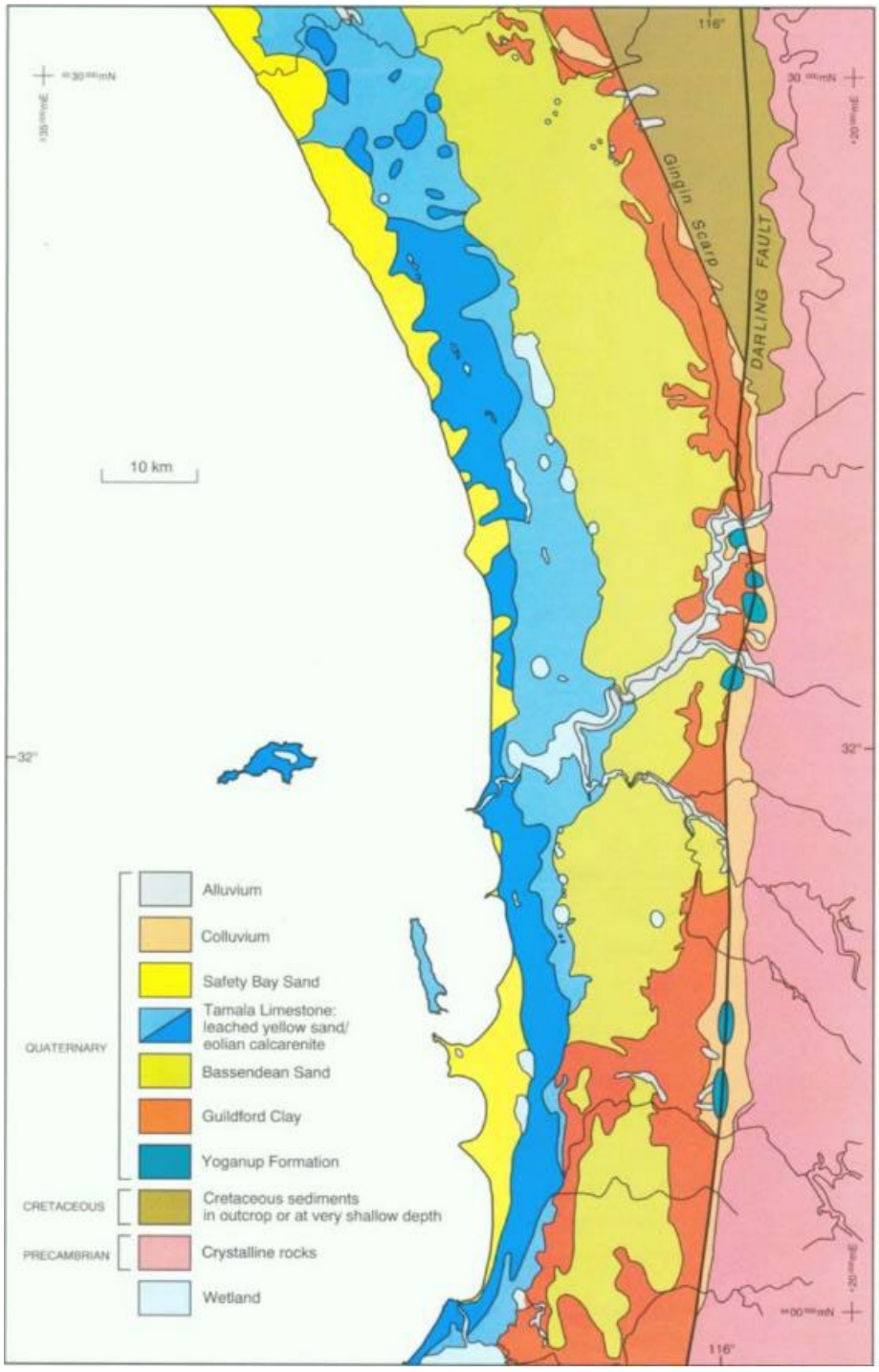
Source: adapted from Gibson et al. (1994), based on McArthur & Bettany (1960) and Churchward & McArthur (1980).

Figure 2 Illustration of the three dune complex systems of the Swan Coastal Plain (covering most of the distribution of the Honeymyrtle shrubland ecological community)



Source: Oliver et al. (2003).

Figure 3 Illustration of the surface geology on the Swan Coastal Plain (covering most of the distribution of the Honeymyrtle shrubland ecological community)



Source: Davidson (1995).

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FLORA AND VEGETATION ASSESSMENT OF MANNING PARK RESERVE

CITY OF COCKBURN

MAY 2024

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EXECUTIVE SUMMARY

Focused Vision Consulting Pty Ltd (FVC) was commissioned by the City of Cockburn (the City) to undertake a flora and vegetation assessment of Manning Park Reserve.

The scope of work required a detailed flora and vegetation survey and targeted survey for Threatened and Priority Flora and ecological communities within Manning Park Reserve (the study area). The assessments were completed as per the Environmental Protection Authority (EPA) Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a), and in accordance with an established method utilised by the City for annual reserve assessments, which includes using the Local Government Natural Area Initial Assessment (NAIA) forms to produce a NAIA report. Field assessment data collection focused on the key components of a floristic survey: flora inventory, vegetation/floristic community mapping, vegetation condition mapping, weed mapping, targeted Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) assessment.

The flora and vegetation assessment (desktop assessment and field assessment) was completed during spring (October - November) 2023 by experienced personnel.

The key findings, conclusions and recommendations arising from the flora and vegetation assessment within the study area are as follows:

- The timing of the field assessment (October - November) was considered optimal for the identification of flowering flora or annual and ephemeral species.
- No Threatened flora were recorded within the study area.
- Two Priority flora, *Pimelea calcicola* (Priority 3), and *Dodanoaea hackettiana* (Priority 4) were recorded within vegetation units ArSgS Sand MhTrS.
- Two of the recorded weed species, Bridal Creeper (**Asparagous asparagoides*) and Common Lantana (**Lantana camara*) are listed as a Declared Pest (DP) plant under the *Biosecurity and Agricultural Management Act 2007* (BAM Act) (DPIRD 2017a) and as a Weeds of National Significance (WoNS) (CISS 2021); however, as it is listed under the "Exempt' category, landholders are under no obligation to control infestations.
- None of the recorded flora species are exhibiting an extension beyond their currently documented range and no flora species were undescribed.
- A total of six intact vegetation communities AcBsS, ArSgS, EdSgW, EgSgW, MhTrS, and MrGtW were recorded and mapped for the study area.
- The vegetation condition within the study area was found to range from 'Completely Degraded' to 'Excellent', with the majority (29.43%) in 'Good' condition.
- The desktop assessment identified three Threatened Ecological Communities (TECs) and/or Priority Ecological Communities (PECs) and or their buffers that occur within the study area, but did not report that Floristic Community Type (FCT) *SCP 24 Northern Spearwood shrublands and woodlands* (a PEC) occurs within the study area.
- One vegetation unit, EgSgW, was found to meet key diagnostic criteria, and therefore be representative of the Commonwealth-Listed ecological community, Tuart woodlands and forests TEC. Three patches of Tuart woodlands and forests were confirmed to be part of the nationally protected ecological community, as they meet minimum condition and biotic thresholds.
- One vegetation unit MhTrS was found to meet diagnostic criteria, and therefore be representative of the Commonwealth-listed ecological community, Honeymyrtle shrubland TEC. Six patches of Honeymyrtle shrubland were mapped and all of these were confirmed to be part of the nationally protected ecological community as they meet the minimum condition threshold.

- One vegetation unit, MhTrS was considered representative of SCP 26a, which is a State-listed TEC.
- Portions of one vegetation unit, EgSgW that are in 'Good' or better condition are considered representative of the State-listed Priority 3 PEC, SCP 24 – Northern Spearwood Shrublands.
- Vegetation representing one or more of the three TECs and two PECs was determined to occur across 53.94 ha (50.15%) of the study area, comprised of:
    - Tuart Woodlands and Forests TEC (Commonwealth-listed), covering 27.75 ha (25.78%) across vegetation unit EgSgW, and 'Parkland', 'Revegetation' and 'Other Uses' areas
    - Honeymyrtle Shrublands TEC (Commonwealth-listed), covering 23.25 ha (21.60%) across vegetation unit MhTrS
    - SCP 26a TEC (State-listed), covering 19.72 ha (18.32%) across 'Good' or better condition areas of vegetation unit MhTrS
    - Tuart Woodlands and Forest PEC (State-listed), covering 12.07 ha (11.21%) across areas eligible as the Tuart Woodlands and Forest TEC (Commonwealth-listed), associated with vegetation unit EgSgW where vegetation occurs as a native assemblage.
    - SCP 24 PEC (State-listed), covering 5.44 ha (5.05%) across 'Good' or better condition areas of vegetation unit EdSgW.
- All areas of vegetation supporting Priority flora, representative of TECs or PECs, and in 'Very Good' or better condition are considered areas of significant floristic value.

The following recommendations are suggested in relation to the development or enhancement of recreational facilities in Manning Park Reserve:

- Where possible, avoid any clearing of native vegetation
- Avoid clearing any 'Areas of Significant Floristic Value'
- Develop an environmental management plan to manage the impacts of recreational use of the park.

1 INTRODUCTION

1.1 BACKGROUND

Focused Vision Consulting Pty Ltd (FVC) was commissioned by the City of Cockburn (the City) to undertake a detailed flora and vegetation survey and targeted survey for Threatened and Priority Flora and ecological communities within Manning Park Reserve. These assessments will contribute to a full evaluation of the biodiversity and environmental values in Manning Park Reserve, in order to inform potential development plans for a mountain bike trail, as well as management practices to protect and enhance the biodiversity of the Reserve.

1.2 LOCATION

Manning Park Reserve (the study area) is situated within Hamilton Hill, approximately 16 km south-west of the Perth central business district (CBD) and 1 km from the coast. Nestled against Cockburn Road and Azelia Road, the study area is part of the larger Beeliar Regional Park that encompasses Manning Lake and the limestone ridge to the west of the wetland. The study area encompasses 107.63 hectares (ha) (**Figure 1**).

1.3 SCOPE OF WORK

The scope of work required for the flora and vegetation assessment was to undertake a desktop assessment and a detailed flora and vegetation field survey, plus a targeted field survey for Threatened and Priority Flora and ecological communities in the study area. The assessments were completed as per the Environmental Protection Authority (EPA) (2016a) Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* and in accordance with an established method utilised by the City for reserve assessments, which includes using the Local Government Natural Area Initial Assessment (NAIA) forms to produce a NAIA report. Field assessment data collection focused on the key components of a floristic survey: flora inventory, vegetation/floristic community mapping, vegetation condition mapping, weed mapping, and a targeted Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) assessment.

Figure 1 - Study Area

2 LEGISLATIVE CONTEXT

Flora and vegetation assessments are required to be conducted in accordance with the following legislation:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act)*
- Western Australian *Environmental Protection Act 1986 (EP Act)*
- Western Australian *Biodiversity Conservation Act 2016 (BC Act).*

The assessments complied with requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2008) *Guidance Statement No. 33: Environmental Guidance for Planning and Development*
- EPA (2016a) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*
- EPA (2016b) *Environmental Factor Guideline – Flora and Vegetation*.

2.1 THREATENED AND PRIORITY FLORA

Under the Commonwealth EPBC Act, actions that have, or are likely to have, a significant impact on a Matter of National Environmental Significance (MNES) require approval from the Federal Minster for the Environment, as administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW 2022).

At a Commonwealth level, flora species at risk of extinction are recognised as Threatened (T) and are categorised according to the EPBC Act, as summarised in **Table 1**.

In Western Australia, the State BC Act provides a statutory basis for the listing of Threatened species. The Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a Priority (P) flora list, for species of conservation concern. The DBCA assigns conservation status to endemic plant species that are geographically restricted to few known populations or threatened by local processes. Although Priority listed flora are not awarded any statutory protection, allocating conservation status to these species assists in conserving populations and protecting species from potential threats (DBCA 2020a). Priority flora are given consideration in environmental impact assessments (EIAs) and in the assessment of clearing permit applications, in accordance with the ten clearing principles (DER 2019).

Threatened and Priority flora are an important focus of surveys conducted to inform the EIA process, and their definitions are presented in **Table 2**.

Any flora species listed under Commonwealth and State legislation as being of conservation significance, and any DBCA listed Priority flora species, is broadly considered to be a significant species. This incorporates species that are endangered, vulnerable and rare or covered by international conventions. A flora Species may also be considered significant within a study area based on being (EPA 2016a):

- a new or unusual species (or subspecies, variety or hybrid)
- locally endemic or associated with a restricted habitat type
- representative of the range of a species (particularly, at the extremes of range recently discovered range extensions, or isolated outliers of the main range)
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Table 1 – Categories of Commonwealth (EPBC Act) Listed Threatened Flora Species

Conservation Code	Category
EX	**Extinct** Species where "there is no reasonable doubt that the last member of the species has died" (section 179(1) of the EPBC Act).
EW	**Extinct in the Wild** Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 179(2) of the EPBC Act).
CR	**Critically Endangered** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria" (section 179(3) of the EPBC Act).
EN	**Endangered** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria" (section 179(4) of the EPBC Act).
VU	**Vulnerable** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria" (section 179(5) of the EPBC Act).

Table 2 – Definitions of State (BC Act) Threatened Species and DBCA listed Priority Species

Conservation Code	Category
T	**Threatened Species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the BC Act.
P1	**Priority 1 – Poorly Known Species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	**Priority 2 – Poorly Known Species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	**Priority 3 – Poorly Known Species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	**Priority 4 – Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

2.2 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat, which are subject to processes that threaten to destroy or significantly modify the assemblage across its range (DEC 2007).

The Commonwealth Environment Minister may list an ecological community as a TEC in one of the following categories; Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). The categories and the criteria for defining TECs have been described by English and Blyth (1997). A publicly available database, listing TECs within Western Australia (WA) is maintained by DBCA.

TECs in WA are protected under the State BC Act and some are also protected under the Commonwealth EPBC Act. The TECs on the Commonwealth register are also listed on the DCCEEW website, and in the Protected Matters Database (DCCEEW 2023a; b).

Department of Biodiversity, Conservation and Attractions listed Priority Ecological Communities (PECs) are ecological communities considered of potential conservation significance (and are potentially TECs). They do not currently meet survey criteria or are not adequately defined, are rare but not threatened, or have been recently removed from the TEC list or require regular monitoring (DEC 2013).

Commonwealth and State listed TECs and DBCA listed PECs are required to be taken into consideration during environmental impact assessments (EPA 2016b).

2.3 VEGETATION CLEARING, EXTENT AND STATUS

Clearing of native vegetation is regulated in WA under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Any clearing of native vegetation is an offence, unless carried out under a clearing permit or if the clearing is for an exempt purpose (DER 2015). A clearing permit may be applied for under Part V of the EP Act. Applications to clear native vegetation must be assessed against the '10 Clearing Principles' as outlined in the regulations (DER 2014).

Where clearing of native vegetation is proposed to occur, there are several key criteria applied to the assessment of clearing permit applications, in the interests of biodiversity conservation (DER 2014).

The objective of the EPA in relation to flora and vegetation is 'to protect flora and vegetation so that biological diversity and ecological integrity are maintained' (EPA 2016a). This objective is documented in the EPA Factor Guideli–e - Flora and Vegetation (EPA 2016b). The EPA considers it is important that ecological communities are maintained above the threshold level of 30% of the original pre-clearing extent of the community in unconstrained areas and 10% within 'constrained' areas (EPA 2008).

2.4 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas (ESAs) are areas that require special protection due to aspects such as landscape, fauna or historical value and are generally considered to be areas of high conservation value. ESAs are declared in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, which was gazetted on 8 April 2005 (State of Western Australia 2005).

There are several types of ESAs relating to flora and vegetation, declared under Part V of the EP Act, which include:

- a defined wetland and the area within 50 m of that wetland
- the area covered by vegetation within 50 m of rare (Threatened) flora, to the extent where the vegetation is continuous with the vegetation in which the rare (Threatened) flora is located
- the area covered by a TEC.

2.5 VEGETATION OF SIGNIFICANCE OR POTENTIAL SIGNIFICANCE

Alongside and in addition to significance according to statutory and DBCA listings, vegetation may be considered significant at a National, State, regional or local level. Whilst not applicable to any legislation or statutory protection, the significance, or potential significance of vegetation is an important consideration in the environmental impact assessment process. The assessment of vegetation of significance (or potential significance) highlights vegetation units that should be considered further as part of project-specific impact assessment, impact avoidance and further survey, where appropriate.

2.5.1 Nationally Significant Vegetation

Vegetation communities may be of National significance where they support the following Commonwealth-listed MNES:

- populations of Threatened (EPBC listed) species
- TECs listed as nationally (EPBC) significant
- RAMSAR Wetlands of International Importance (DCCEEW 2023c).

2.5.2 State Significant Vegetation

Vegetation communities may be of State significance where they:

- support State-listed Threatened flora, fauna and TECs afforded protection under the BC Act
- occur within the State-managed conservation estate (areas protected under the *Conservation and Land Management Act 1984*) or areas that have been formally recommended by DBCA for inclusion in the State conservation estate (EPA 2008).

2.5.3 Regionally Significant Vegetation

Vegetation communities may be of regional significance where they:

- support populations of Priority Flora or ecological communities (EPA 2016b; Government of Western Australia 2000a)
- are formally protected or recognised as Environmentally Sensitive Areas (ESAs), or under planning schemes for conservation, such as Bush Forever (EPA 2008; WALGA 2004)
- support conservation category wetlands including associated vegetation (Government of Western Australia 1997, 2000b)
- maintain important ecological processes (EPA 2016b)
- contain flora species exhibiting range extensions or undescribed species (EPA 2016b)
- have a restricted regional distribution (EPA 2016b)
- are represented by less than 30% of their pre-European extent (Commonwealth of Australia 2001).

2.5.4 Locally Significant Vegetation

Vegetation communities may be locally significant where they:

- occur as small, isolated communities (Government of Western Australia 2000b; WALGA 2004), and/or are locally restricted to only one or a few locations (WALGA 2004)
- have a limited local extent (proportion) and/or distribution (EPA 2016b).

2.6 INTRODUCED FLORA

A total of 1,1,348 introduced (weed) species have been recognised to occur within Western Australia by Florabase's 2023 Flora Statistics (Western Australian Herbarium (WAH) 1998-). Weeds are plants that are not indigenous to an area and have been introduced either directly or indirectly through human activity. They establish in natural ecosystems and adversely modify natural processes, have the potential to dominate and simplify the ecosystems and thus decrease habitat value provided for native fauna. Weeds pose a threat to many native flora species due to their ability to rapidly grow and out-compete for available water, space, sunlight, and nutrients (EPA 2007).

2.6.1 Weeds of National Significance

Under the National Weed Strategy, there are currently 32 weed species listed as Weeds of National Significance (WoNS) (CISS 2023). Each weed listed was considered for inclusion based on the following criteria:

- invasive tendencies
- impacts
- potential for spread
- socioeconomic and environmental values.

2.6.2 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests (DPs), including pest plants, under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) (CISS 2021). Under the BAM Act, DPs are listed under one of the following categories:

- **C1 (exclusion)**, that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- **C2 (eradication)**, that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- **C3 (management)**, that applies to established pests where it is not feasible or desirable to manage them to limit their damage.

3 EXISTING ENVIRONMENT

3.1 CLIMATE

The study area occurs on the Swan Coastal Plain, which has a warm Mediterranean climate, characterised by hot, dry summers and cool to mild wet winters (Mitchell *et al.* 2002). The Bureau of Meteorology (BoM) Jandakot Aero weather station (Site 009172) is the closest to the study area, operating since 1972. Average annual long-term rainfall recorded at the station is 813 mm. Annual mean maximum temperatures range from 18.1°C in winter to 31.6°C in summer (BoM 2024). In 2023, monthly rainfall from July to October was lower compared to the long-term average for those months (**Figure 2**).

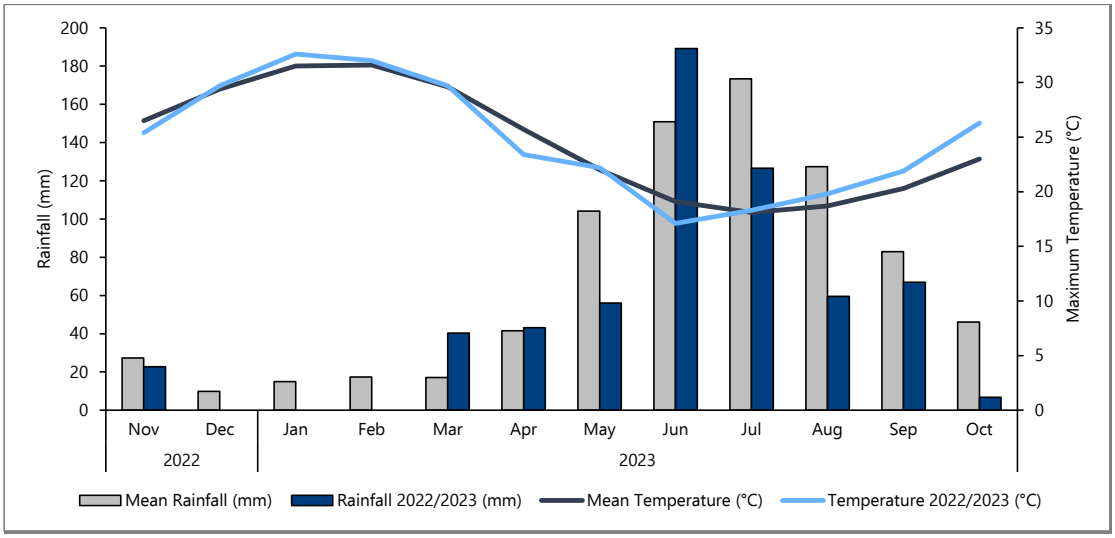

Figure 2 - Climate Data for Jandakot Aero (Site 009172) (BoM 2024)

3.2 IBRA REGION

There are 89 recognised Interim Biogeographic Regionalisation for Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (DCCEEW 2021). The study area lies within the Swan Coastal Plain (SWA) IBRA region and, at a finer scale, within the Perth subregion (SWA2) (Mitchell *et al.* 2002).

The Swan Coastal Plain bioregion is a low lying coastal plain, mainly covered with Banksia and Tuart woodlands on sandy soils. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone, as well as heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials (Mitchell *et al.* 2002).

3.3 SOILS

The Swan Coastal Plain supports five major geomorphological systems (landforms) that lie parallel to the coast. From west to east these are; Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward and McArthur 1980; Gibson *et al.* 1994). The study area is situated on the Spearwood and Pinjarra Systems (Government of Western Australia 2000b).

The Spearwood System is categorised as sand dunes and plains with yellow deep sands, pale deep sands and yellow/brown shallow sands. The Pinjarra System is categorised as Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils. Variable vegetation includes jarrah, marri, wandoo, paperbark, sheoaks and flooded gum (Government of Western Australia 2000b) (**Figure 3**).

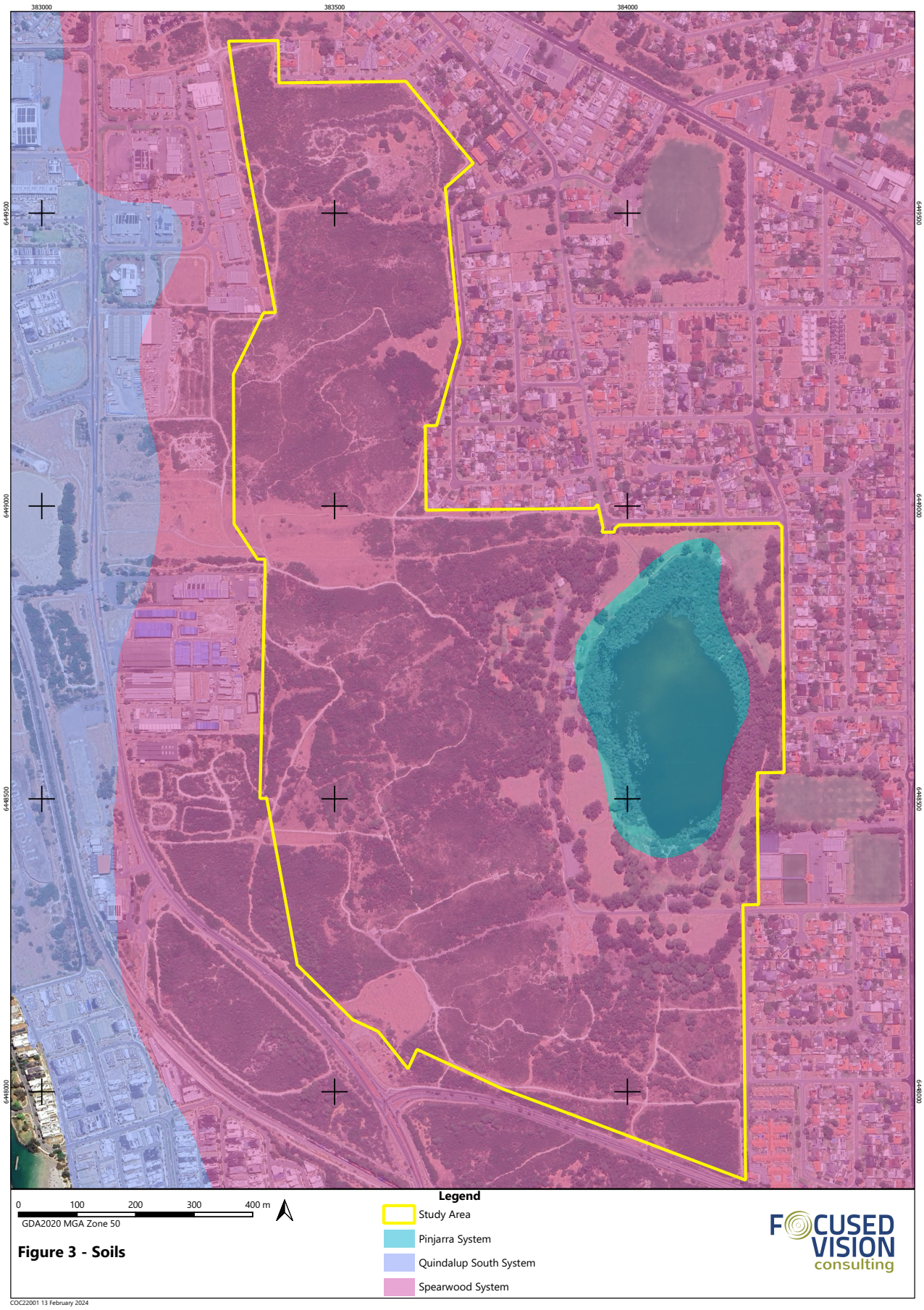

Figure 3 - Soils

3.4 VEGETATION

The following key criteria are applied to vegetation clearing from a biodiversity perspective, which justifies the current retention targets as introduced in **Section 2.3** (EPA 2008):

- The threshold level below which species loss appears to accelerate exponentially within an ecosystem level, is regarded as being at a level of 30% (of the pre-European, i.e. pre-1750 retention of the vegetation type).
- A level of 10% of the original extent of a vegetation community is regarded as being a level representing Endangered status.
- Clearing which would increase the threat level to a vegetation community should be avoided.

The study area is considered to be a constrained area, as it is within an urban context; therefore, retention of remnant vegetation above a threshold of 10% of the pre-European extent applies.

3.4.1 Pre-European Vegetation

Vegetation of the Swan Coastal Plain has been broadly mapped by Beard (1990), and later re-assessed by Shepherd *et al.* (2002) into vegetation associations. This mapping depicted the native vegetation as it was presumed to be at the time of European settlement and is referred to as pre-European vegetation mapping. One vegetation association, 998, occurs within the study area. This vegetation association only occurs on the Swan Coastal Plain. It is described as medium tuart woodland (Beard 1990). The remaining extents of Beard vegetation association 998 on the Swan Coastal Plain and in the City of Cockburn are presented in **Table 3** and spatially in **Figure 4**.

The remaining extent of Beard vegetation association 998 exceeds 10% of its pre-European extent in the State (Western Australia), IBRA Region (Swan Coastal Plain), IBRA Sub-Region (Perth), and Local Government Area (City of Cockburn) contexts (**Table 3**).

Table 3 - Pre-European Vegetation of the Study Area (DPIRD 2023)

Veg. Association No.	Veg. System Association	Broad Vegetation Description	Extent Context	Pre–European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent Protected (IUCN I –IV)
998	Spearwood	Medium woodland; tuart	Western Australia	51,015.33	18,492.63	36.25	13.26
			Swan Coastal Plain	50,867.50	18,492.32	36.35	13.30
			Perth IBRA Sub-Region	50,867.50	18,492.32	36.35	13.30
			City of Cockburn	4,464.34	845.02	18.92	6.50

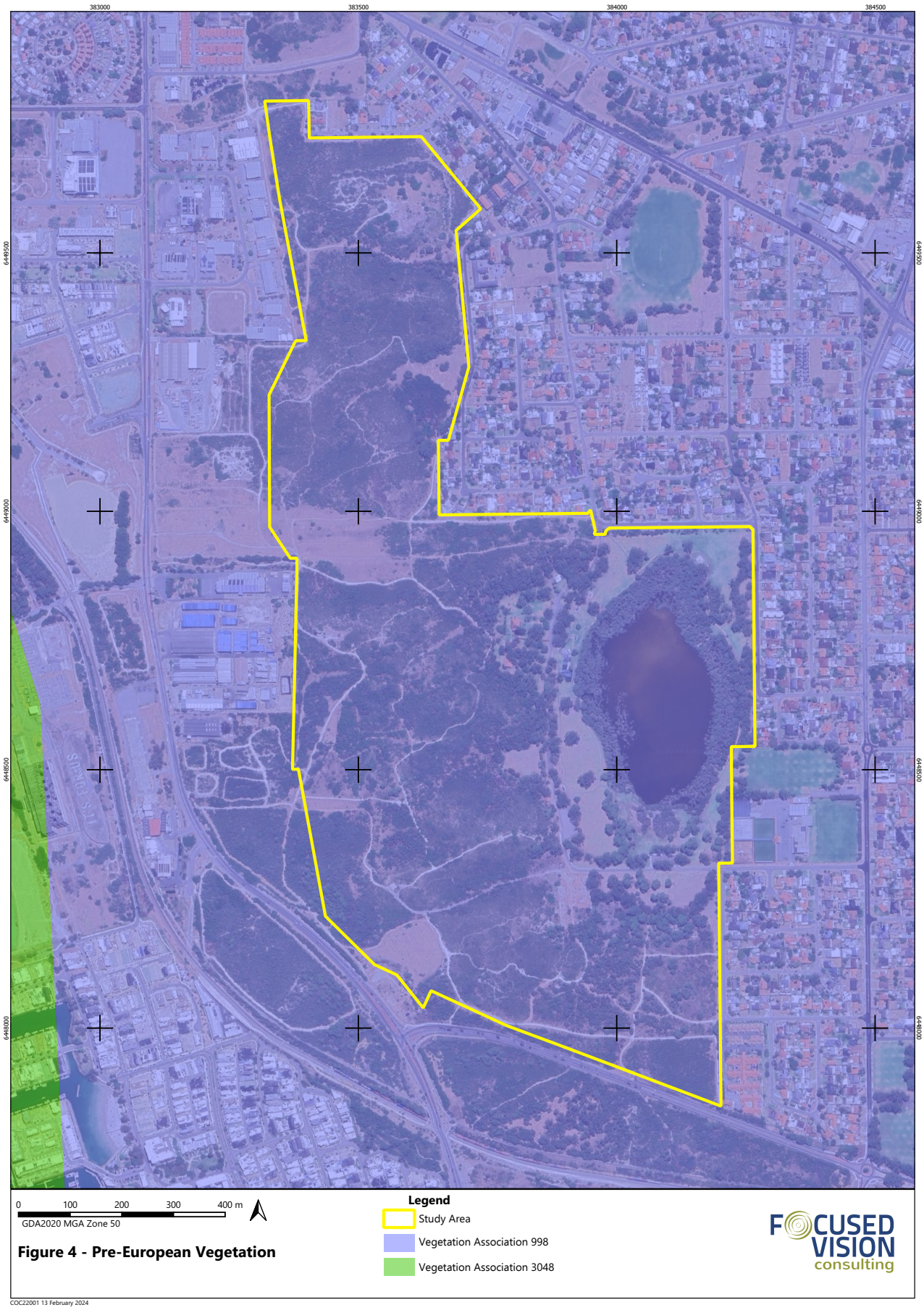

Figure 4 - Pre-European Vegetation

3.4.2 Vegetation Complexes

Vegetation of the Swan Coastal Plain has also been characterised by Heddle *et al.* (1980) based on vegetation complexes in association with landforms and underlying geology. The study area is situated on vegetation complex, the *Cottesloe complex – central and south.* This complex is described as a mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest *of Eucalyptus gomphocepha–a - Eucalyptus marginata* (Jarra–) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops (Heddle *et al.* 1980; Government of Western Australia 2019). The remaining extent of this complex on the Swan Coastal Plain and in the City of Cockburn are presented in **Table 4** and spatially in **Figure 5**. The remaining extent of the *Cottesloe complex – central and south* is greater than 10% of its pre-European extent on the Swan Coastal Plain and within the City of Cockburn (**Table 4**).

Table 4 - Remaining Extent of the Vegetation Complex in the Study Area (DBCA 2018)

Location	Vegetation Complex	Pre–European Extent (ha)	Current Extent (ha)	% Remaining
Swan Coastal Plain	Cottesloe Complex – central and south	45,299.61	14,567.87	32.16
City of Cockburn	Cottesloe Complex – central and south	4,990.60	961.70	19.27

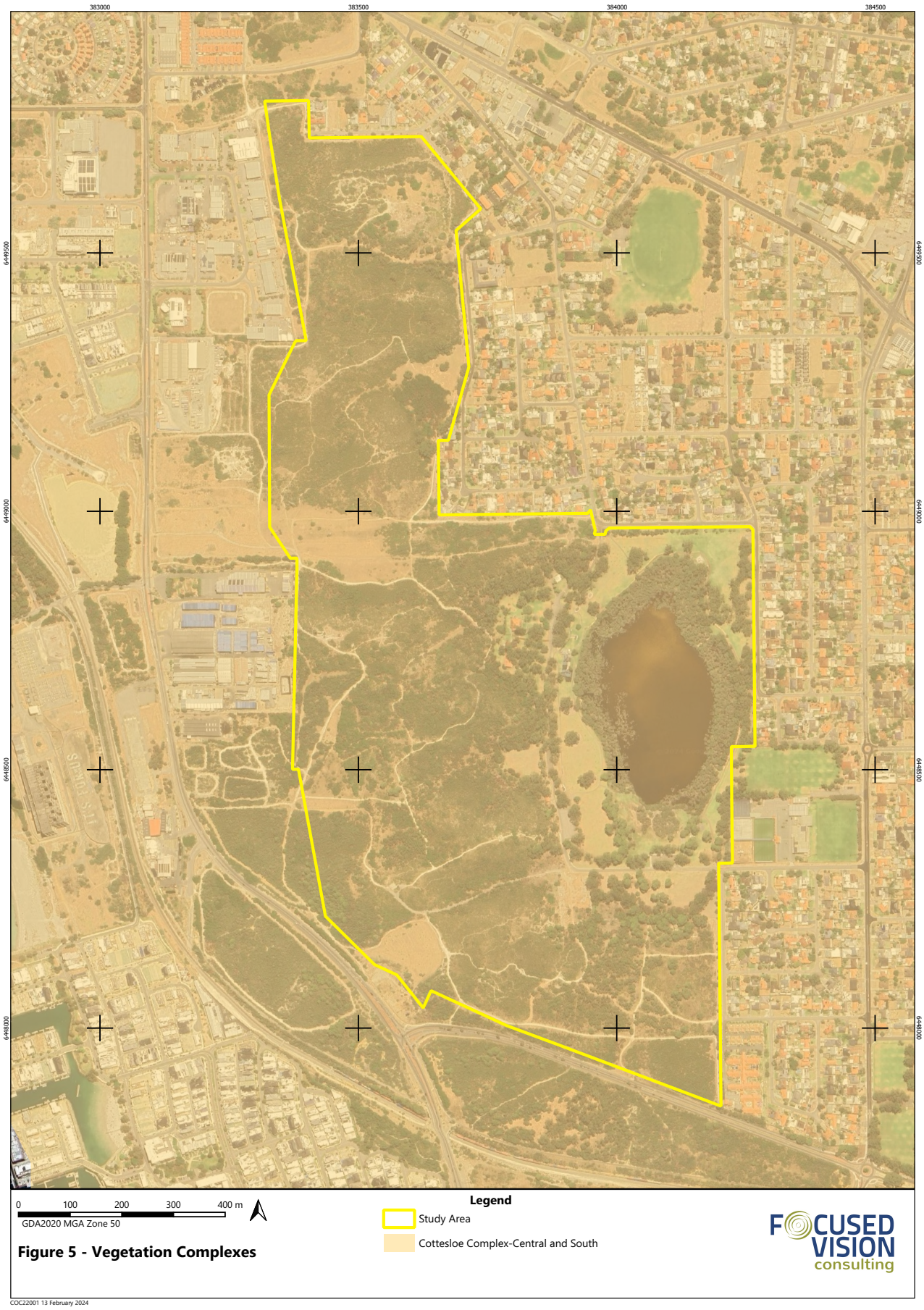

Figure 5 - Vegetation Complexes

3.5 WETLANDS

The Geomorphic Wetlands of the Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain. Wetland management categories are based on their ecological, hydrological, and geomorphological significance, and the degree of disturbance that has occurred. The three Wetland Management Categories defined by the DBCA (DBCA 2017b) on the Swan Coastal Plain can be summarised as follows:

- Conservation Category (CC) – wetlands that support a high level of ecological attributes and functions (generally having intact vegetation and natural hydrological processes), or that have a reasonable level of functionality and are representative of wetland types that are rare or poorly protected.
- Resource Enhancement (RE) – wetlands that have been modified (degraded) but still support substantial ecological attributes (wetland dependant vegetation covering more than 10%) and functions (hydrological properties that support wetland dependent vegetation and associated fauna) and have some potential to be restored to CC quality. Typically, such wetlands still support some elements of the original native vegetation, and hydrological function.
- Multiple Use (MU) – wetlands that are assessed as possessing few remaining ecological attributes and functions. While such wetlands can still play an important role in regional or landscape ecosystem management, including water management, they are considered to have low intrinsic ecological value. Typically, they have very little or no native vegetation remaining (less than 10%).

Interrogation of the Geomorphic Wetlands Swan Coastal Plain dataset identified three wetlands that occur within the study area, as summarised in **Table 5** and spatially presented in **Figure 6**.

Table 5 – Geomorphic Wetlands of the Swan Coastal Plain within the Study Area (DBCA 2019)

Unique Field Identifier	Wetland Name	Wetland Classification	Wetland Evaluation
6216	Manning Lake	Basin	Conservation
6217	Manning Lake	Basin	Multiple Use
6218	Manning Lake	Basin	Multiple Use

Ramsar wetlands are listed under the Ramsar Convention as wetlands considered to be of international importance. These internationally important (Ramsar) wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity (DCCEEW 2023c). No Ramsar wetlands are located within the study area (DBCA 2017a).

3.6 RESERVES, CONSERVATION AREAS AND ENVIRONMENTALLY SENSITIVE AREAS

Under the *State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region*, 51,200 ha of regionally significant bushland areas are protected in 287 Bush Forever Sites in Western Australia (State of Western Australia 2010). One Bush Forever site, site 287 (Manning Lake and Adjacent Bushland, Hamilton Hill/Spearwood), occurs within the study area and is also classified as an ESA (State of Western Australia 2005) (**Figure 6**).

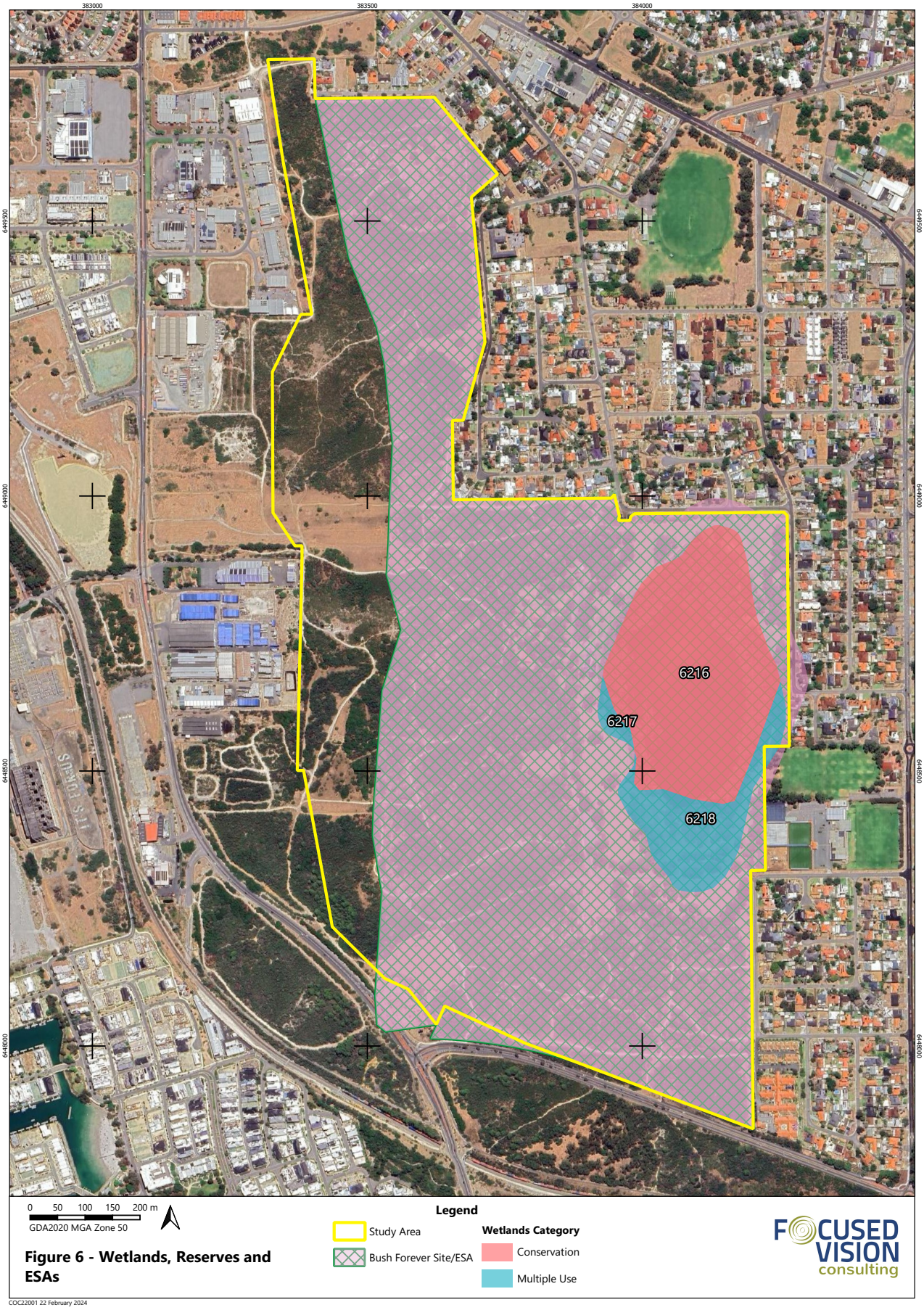

Figure 6 - Wetlands, Reserves and ESAs

4 METHODOLOGY

4.1 DESKTOP ASSESSMENT

4.1.1 Literature Review

Previous survey reports within the study area were reviewed as part of the desktop assessment. These surveys are listed below, and their results have been summarised in **Section 4.1.1**:

- FVC (2021) *Biological Survey of Manning Park*
- Eco Logical Australia (ELA) (2018) *Vegetation Condition, Floristic Community Mapping and Weed Mapping in the City of Cockburn*.

4.1.2 Database Searches

A desktop assessment was undertaken for Threatened and Priority flora and Threatened and Priority Ecological Communities potentially occurring within the study area. The desktop assessment refers to NatureMap (**Appendix A**), DBCA Threatened and Priority flora (DBCA ref: 61-1023FL) and ecological communities databases (DBCA ref: 35-1023EC) and the Commonwealth Protected Matters Search Tool (PMST) for MNES (DCCEEW 2023b) (**Appendix B**). All database searches were performed for the study area, plus a 10 km buffer (desktop assessment area).

Prior to the field assessment, the occurrence of potential vegetation was assessed in reference to regional vegetation data, aerial imagery, and results from the Threatened and Priority Database (TPFL) and the Western Australian Herbarium (WAH) database provided by the Species and Communities Branch within DBCA.

The likelihood of occurrence of flora and vegetation of conservation significance was evaluated based on four criteria: the presence of suitable habitat within the study area, age of previous records, proximity of previous records to the study area, and the current condition of the study area (**Table 6**).

Based on this assessment, each species was given a likelihood of occurrence category of 'likely to occur', 'may occur' or 'unlikely to occur'. Where recent records and suitable habitat is provided for a species within or near the study area, these species were given a category of 'likely to occur'. Whilst species occurring a greater distance from the study area with limited suitable habitat, or for very old records, a category of 'unlikely to occur' or 'may occur' was applied, depending on record relevance (proximity and habitat suitability). The likelihood of occurrence assessment was then repeated following the field assessment, based on the field observations made, focused on habitat provided and the condition of those habitats.

Table 6 – Likelihood of Occurrence Criteria

Criteria	Explanation
Suitable habitat	The likelihood of suitable habitat being present within the study area was based on known habitat information gathered from Florabase (WAH 1998-) and literature sourced from the Species Profile and Threats Database (SPRAT) (DCCEEW 2023a) (e.g., recovery plans, conservation advice).
Age of previous records	The age of previous records for significant species resulting from the desktop assessment was evaluated to determine how likely the species was to still occur in the study area (i.e., habitat of species recorded decades ago may no longer occur or a species may be locally extinct).
Proximity of previous records	The proximity of previous significant flora and vegetation results in relation to the study area contributed to the likelihood of occurrence results, with those previously recorded close by considered more likely to occur within the study area. It is noted that species identified from the PMST have not necessarily been recorded within proximity to the study area and may have resulted due to habitat possibly occurring within the area.
Current condition of study area	Highly modified and degraded environments usually represent a lower likelihood of the occurrence of significant flora, whilst intact remnants are known to harbour significant species and communities that may have otherwise been cleared or impacted throughout their range.

4.2 FIELD ASSESSMENT

A targeted and detailed flora and vegetation survey were undertaken by Botanist/Ecologists, Taryn Brebner, Megan Gray and Olga Nazarova, and Graduate Ecologists, Sarah Beckwith and Aishwarya Gujarathi, from 31 October to 2 November 2023.

The field assessment was recorded and reported in accordance with:

- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a)
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*
- *Methods for survey and identification of the Western Australian ecological communities* (DBCA 2023b)
- *Approved Conservation Advice for Honeymyrtle shrublands on limestone ridges of the Swan Coastal Plain Bioregion* (DCCEEW 2023d)
- *Approved Conservation Advice (incorporating listing advice) for the Tuart* Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community* (DEE 2019a).

Field data collection (via spatial mapping on the basis of aerial imagery, and collection of quadrat-based data and observations made during site traverses) focused on the key components of the study; flora inventory, vegetation/floristic community mapping, vegetation condition mapping, weed mapping, targeted TEC/PEC assessment. These are described in more detail in the following sections.

4.2.1 Vegetation and Floristic Community Mapping

Identification and mapping of vegetation and floristic communities in the study area was achieved via a combination of the collection of quadrat-based data for each floristic community present, spatial mapping of floristic community extents observed during site traverses walked by field personnel, and extrapolation of spatial mapping in reference to aerial imagery.

The likely extent and variation in floristic communities across the study area was reviewed during the desktop assessment, initially by consulting data from the ELA (2018) and the FVC (2021) studies, and also by examining current, high-resolution aerial imagery. Draft boundaries of differing floristic communities were mapped as part of the desktop assessment, that helped plan the locations of quadrats for the sampling of floristic communities.

The Technical Guidance (2016a) recommends at least three quadrats for each intact remnant floristic community. However, the methodology adopted by the City uses data from one quadrat per floristic community. Therefore, since the vegetation of the study area has been previously well-defined, one to two additional quadrats (to the six quadrats and one relevé that was sampled during the 2020 survey) were installed and sampled by FVC in 2023 for each floristic community present, in order to confirm the floristic composition of the vegetation of the study area.

Thirteen quadrats were installed and recorded where native vegetation was found to be in 'Good' or better condition, in accordance with the Technical Guidance (EPA 2016a), and five relevés were sampled where vegetation is in 'Degraded' or poorer condition (**Figure 7**). Relevés are a low intensity survey technique for gathering information for flora and vegetation reconnaissance surveys, or as part of detailed surveys, in areas of vegetation that are not in 'Good' or better condition. Developed areas (e.g. grassed/recreation) were not characterised by quadrats or relevés, and aquatic vegetation was not documented or mapped.

Sampled quadrats were demarcated with a peg (galvanised fence-dropper) at the north-west corner and geographic co-ordinates were recorded using GPS. During sampling, quadrats were marked by measuring tapes. Quadrat dimensions were 10 m x 10 m in accordance with the Technical Guidance (EPA 2016a) and in alignment with the Gibson *et al.* (1994) study. Where a relevé was sampled, an area equivalent to a quadrat (100 m^2) was assessed; however, relevés were not bounded by measuring tapes while sampled.

The following information was recorded from each sampled quadrat or relevé:

- GPS location (GDA 94) of north-west corner (quadrat)
- observer
- date
- location/site/reserve
- representative photograph (from north-west corner)
- soil type and colour
- topography
- degradation/disturbances (e.g. weed invasion, fire)
- vegetation condition, assessed against the currently accepted scale; an adaptation of the Keighery (1994) condition scale
- flora inventory, including average height and projected foliage cover of the dominant species of each stratum.

Observations and opportunistic data collection were also carried out continuously while traversing between quadrats, within and throughout the reserve, to enable spatial mapping of each floristic community. Field navigation was achieved using the GPS of each electronic device (tablet) carried by each of the field personnel. Track logs recorded by field personnel are presented in **Figure 8**.

In addition, particular focus was also paid where known or suspected TECs or PECs occur, with the appropriate sections of the NAIA forms (Part B) that address TECs populated for these locations.

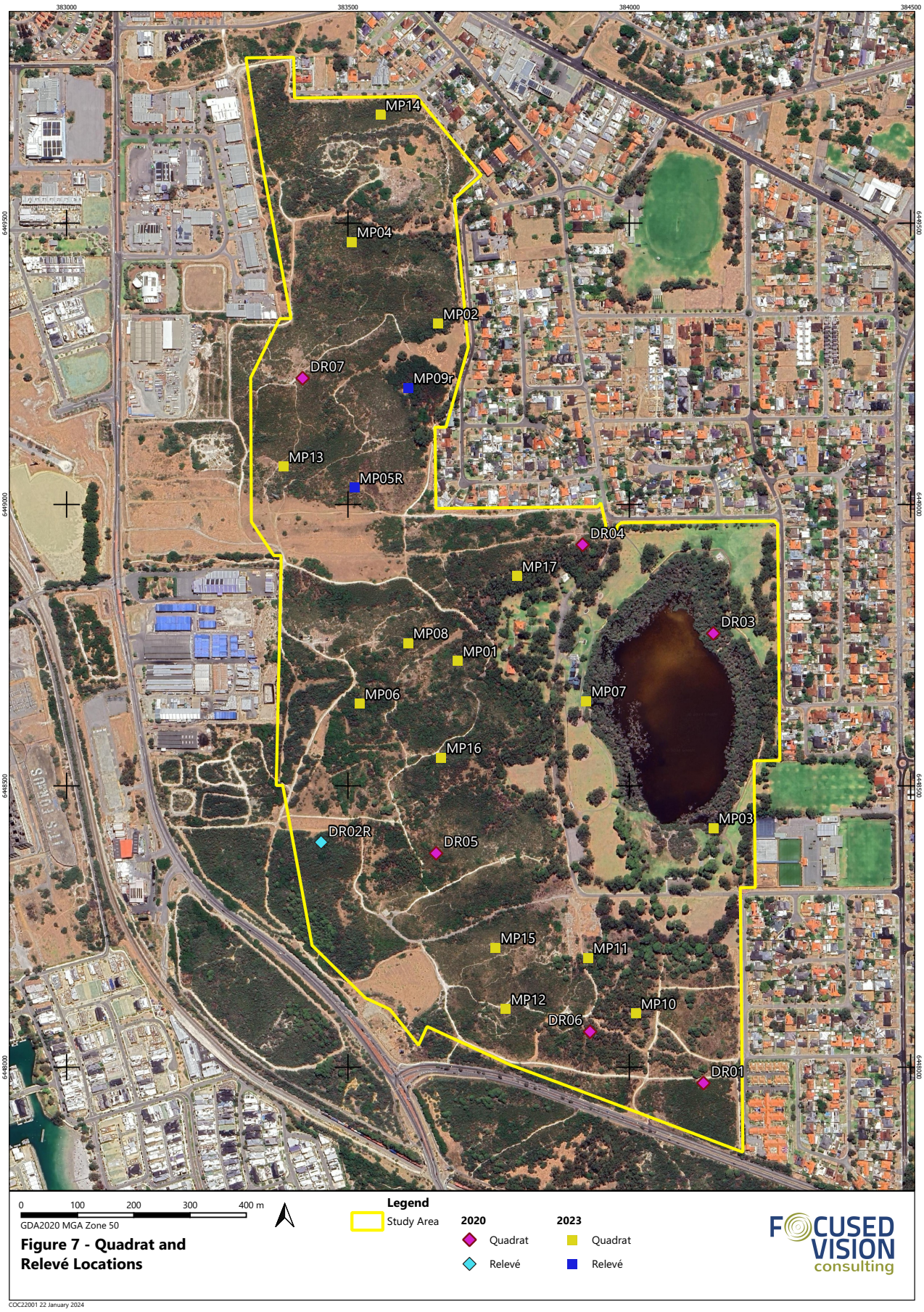

Figure 7 - Quadrat and Relevé Locations

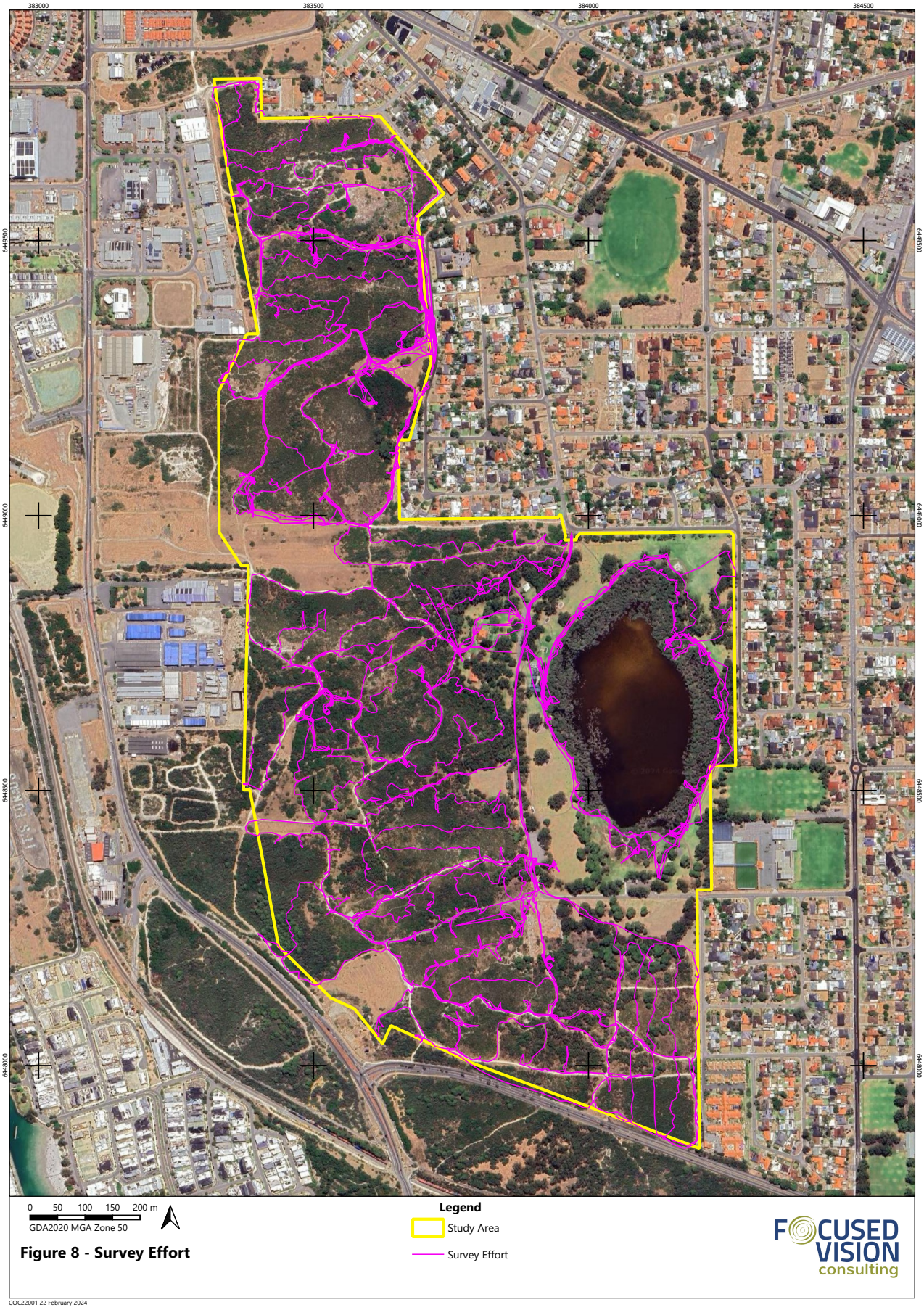

Figure 8 - Survey Effort

4.2.2 Vegetation Condition Mapping

Vegetation condition mapping was carried out within the study area in accordance with the currently accepted scale of EPA's Technical Guidance (2016a), which is an adaptation of the Keighery (1994) scale.

Field personnel traversed the study area at a suitable intensity, typically a grid of traverses spaced approximately 40 m apart, along which individual vegetation condition observations were made. Whilst traversing the study area, vegetation condition ratings were scored in accordance with the Keighery (1994) scale and entered spatially (mapped) into tablets using Mappt™ software. Condition rating applied were based on the ratio of weeds to natives, the types (aggressiveness) of the weeds present, intactness of vegetation structure, degree and type of disturbances and other relevant observations.

4.2.3 Weed Mapping

In order to map weeds within the study area, field personnel traversed the study area along transects of 40 m and collected individual weed observations at suitable intervals. Weed were recorded based on densities and species, as per density categories and species lists provided by the City (**Tables 7** and **8**). Weed occurrences were mapped as point and/or polygons. Following data processing, recorded weed data was able to be mapped for each density category, and also categorising weed species in categories of 'Woody', 'Bulbous', 'Grass', 'Aquatic' and 'Other' (**Table 8**). Weed species which were not listed to be mapped were recorded as present when observed, to ensure a detailed flora inventory is provided (**Appendix C**).

Table 7 – Weed Density Categories

Weed Density Categories (%)	Value
< 5%,	1
6 –30%,	2
31- 60%,	3
>61%	4

Table 8 – Weed Species Type and Mapping Method

Weed Type	Scientific Name	Common Name		Mapping Method
P = Point Mapping D = Density Mapping				
Grass Weeds	*Ammophila arenaria*	Marram Grass		P and D
	Cenchrus sp.	Buffel Grass, Burr Grass		P and D
	Cortaderia selloana	Pampas Grass		P
	Hyparrhenia hirta	Tambookie Grass		P
	Ehrharta villosa	Pyp Grass		D
	Eragrostis curvula	African Lovegrass		D
	Ehrharta calycina	Perennial Veldt Grass		D
	Pennisetum setaceum	Fountain Grass		P and D
	Thinopyrum distichum	Sea Wheat		D
	Cenchrus clandestinus	Kikuyu	Rhizomatous grass	D – map as a single entity
	Cynodon dactylon	Couch		
	Stenotraphum secundatum	Buffalo		
Woody Weeds	*Acacia longifolia*	Sydney Golden Wattle		P
	Ficus carica	Edible Fig		P
	Gaudium laevigatum	Victorian Tea Tree		P
	Melaleuca nesophila	Mindiyed		P

Weed Type	Scientific Name	Common Name	Mapping Method
P = Point Mapping D = Density Mapping			
	Melia azedarach	Cape Lilac	P
	Olea europea	Olive	P
	Schinus terebinthifolia	Japanese Pepper	P
	Solanum linnaeanum	Apple of Sodom	P
Bulbous Weeds	*Asphodelus fistulosus*	Onion Weed	P and D
	Chasmanthe floribunda	African Cornflag	P and D
	Ferraria crispa	Black Flag	P and D
	Freesia hybrid	Freesia	P and D
	Gladiolus caryophyllaceus	Gladiolus	P and D
	Lachenalia reflexa, Lachenalia sp.	Yellow Soldiers, Soldiers	P and D
	Moraea flaccida	One-Leaf Cape Tulip	P and D
	Trachyandra divaricata	Dune Onion Weed	P and D
	Watson26tilized26eraera	Watsonia	P and D
	Zantedeschia aethiopica	Arum Lily	P and D
Other Weeds	*Anredera cordifolia*	Potato Creeper, Madeira Vine	P
	Asparagus asparagoides	Bridal Creeper	P and D
	Cakile maritima	Sea Rocket	D
	Carpobrotus edulis	Pigface	D
	Chrysanthemoides monilifera	Boneseed	P and D
	Cirsium vulgare	Spearthistle	P and D
	Echium plantagineum	Paterson's Curse	D
	Emex australis	Doublegee	P
	Euphorbia paralias	Sea Spurge	D
	Euphorbia terracina	Geraldton Carnation	D
	Foeniculum vulgare	Fennel	P
	Fumaria bastardii/capreolata/muralis	Fumitory	D – map as a single entity
	Gomphocarpus fruticosus	Narrow Leaf Cotton Bush	P
	Lupinus cosentinii	Sandplain Lupin	P and D
	Lycium ferocissimum	African Boxthorn	P and D
	Juncus acutus	Spiny Rush	P and D
	Pelargonium capitatum	Rose Pelargonium	D
	Opuntia stricta	Prickly Pear	P
	Persicaria maculosa	Redshank	D
	Raphanus raphanistrum	Wild Raddish	D
	Retama raetam	White Broom	P
	Ricinus communis	Castor Oil	P
	Rubus discolor	Blackberry	P
	Tetragonia decumbens	Sea Spinach	D
	Tribulus terrestris	Caltrop	D
	Typha orientalis #	Bulrush	D
	Vicia sativa	Vetch	P and D
Aquatic Weeds	*Bacopa monnieri*	Bacopa	P and D
	Eichhornia crassipes	Water hyacinth	P
	Hydrocotyle bonariensis	Large Leaf Pennywort	P
	Limnobium laevigatum	Amazon Frogbit	P and D

4.2.4 Threatened and Priority Ecological Communities

Where known or suspected areas of TECs or PECs were considered likely to occur, particularly the Tuart Woodlands and Forests of the Swan Coastal Plain TEC (Tuart woodlands and forests TEC) and the Honeymyrtle shrubland on Limestone ridges of the Swan Coastal Plain TEC (Honeymyrtle shrubland TEC), adequate data was collected in order to diagnose the community based on appropriate Conservation Advice (DEE 2019a; DCCEEW 2023d).

4.2.5 Threatened and Priority Flora

The study area was traversed on foot to search for Threatened and Priority flora potentially supported by the study area. If any conservation-significant flora were observed, location were recorded using a GPS-enabled device. Habitat preferences for Threatened and Priority flora species were determined during the desktop assessment, to enable targeted searching in the field.

4.2.6 Flora Inventory

The flora and vegetation data collected from the combination of quadrats relevés, traverses and continuous opportunistic observations contributed to the flora inventory for the survey, including weeds (**Appendix C**).

4.3 DATA PROCESSING/ANALYSIS AND REPORTING

Although field botanists/ecologists are able to identify most flora whilst in the field, to ensure accuracy of identifications, some specimens required collection for later identification. Flora specimens collected and dried were done so in accordance with WA Herbarium protocols (DBCA 2020b, 2021).

Identifications were undertaken by FVC botanists, Olga Nazarova and Taryn Brebner, with independent botanist, Margaret Collins, confirming the collected specimen of the Priority species, *Pimelea calcicole* (P3). Flora taxonomy and nomenclature followed current protocols of the WAH (1998-). The combined Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets used for floristic analysis were updated with current species nomenclature, and are current at the time of this report.

Field data from quadrats were recorded electronically, entered directly into tablet devices. Boundaries of floristic communities, as well as other important observations, were recorded spatially in the field using the Mappt™ program. Since field data collection included the use of electronic equipment and customised data collection forms, field data was uploaded and filed following the return from the field assessments.

All quadrat data was analysed with singletons and annuals included, for comparison with Gibson *et al.* (1994) and Keighery *et al.* (2012) data (as per previous advice from Val English, DBCA). Data analysis was in accordance with the *Methods for survey and identification of the Western Australian threatened ecological communities* (DBCA 2023b) to determine floristic community types on the southern Swan Coastal Plain. This methodology analysed data utilising PATN™ software (Belbin and Collins 2006), via multivariate cluster analysis of species presence/absence, in order to group sites of floristically similar composition within the study area. Flexible unweighted pair group mean average (UPGMA) fusion was used to generate the site classification (beta = -0.1) and to group the quadrats data into clusters based on species similarities. Following this, floristic analysis of quadrats in comparison to reference datasets by Gibson *et al.* (1994) and Keighery *et al.* (2012) were carried out, in order to assign relevant Floristic Community Types (FCTs). Floristic analysis via single site insertion (SSI) (into the Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets) was carried out for all quadrats and relevés within the study area.

Dissimilarities between recorded quadrat data and that of the quadrat data from the Gibson *et al.* (1994) and Keighery *et al.* (2012) dataset were analysed to produce an association matrix. In such matrices, results range from 0 to 1, where 0 would indicate that the quadrats are identical (have zero dissimilarity) (Belbin and Collins 2006) and 1 indicating no shared species (Hao *et al.* 2019). The closer the value to 0, the greater the similarity. A dissimilarity index value of greater than 0.6 is considered high (Maguire *et al.* 2016) and tends to indicate little similarity.

An inferred FCT was assigned to each quadrat based on the results of clustering in the dendrogram and position in the association matrix (dissimilarity value). Conclusions from the dendrogram were based on 'nearest neighbour' in the resulting clusters. Where appropriate, they were also further critically analysed by determining similarities to the Gibson *et al.* (1994) and Keighery *et al.* (2012) sites based on some or all of the following characteristics: key dominant flora species, vegetation structure, habitat, geographical location, soils/landforms, vegetation complexes and site hydrological status. The collective results of the FCT analysis concluded with settling on an inferred FCT for each quadrat, with justifications provided.

Floristic communities were named in accordance with the City's requested format: acronyms for 'Genus name' + 'species name' + 'vegetation structure code', which also follows the protocols of the National Vegetation Information System (NVIS) Structural Vegetation Classifications, (NVIS Technical Working Group 2017) (**Appendix D**).

Using QGIS, a map of the floristic communities and vegetation condition was confirmed based on the field mapping and field results from previous assessments, refined as appropriate, in reference to aerial imagery, and presented in the report.

The weed mapping data collected from systematic field traverses was used to prepare points and polygon mapping of the weed densities for each weed type across the study area, in accordance with the colours specified for each density category as per the City's established methodology. Maps were produced for each of the weed types (woody, bulbous, grass aquatic and other), plus the total combined weed cover across the study area. The total weed occurrence and density shapefiles and maps for the study area were created in QGIS by creating a union/intersect between each of the species' spatial records.

Data collected from locations of known or suspected TECs were also analysed against the diagnostic criteria as listed in the appropriate Conservation Advice (DEE 2019a; DCCEEW 2023d) which further supports any conclusions made regarding the presence and extent of these TECs.

The Assessment A section of the NAIA forms was completed for delivery with the report, with the Assessment B section also completed where Threatened flora or TECs are represented. The 'Recommendations for Management' section, focused on actions relevant to vegetation condition and weeds, was also completed.

Field botanists/ecologists prepared the draft report following the completion of field surveys, data processing and mapping. Experienced ecologists from the FVC team have undertaken technical reviews of the completed draft report, before submission to the City. The report format and layout is based on a combination of previous Vegetation Condition and Weed Mapping reports prepared for the City and standard flora and vegetation assessment reports prepared in accordance with the Technical Guidance (EPA 2016a).

4.4 LIMITATIONS

The current biological survey was assessed against limitations imposed by many variables as outlined in the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) (**Table 9**).

Table 9 – Potential Survey Limitations and Constraints

Aspect	Constraint?	Commentary
Availability of regional data, previously available information	No	The ELA (2018) and FVC (2021) reports provided previous spatial data, literature, and other information specifically relevant to Manning Park Reserve. Results of the DBCA database search for Threatened and Priority flora within the desktop assessment area returned few records, which is likely due to the highly developed nature of the local region, and interrogation of NatureMap and the PMST assisted in the development of a list of Threatened and Priority flora potentially occurring within the study area.
Scope (detail)	No	The detailed flora and vegetation assessment was carried out in accordance with the EPA (2016a). Thirteen quadrats were sampled within areas of vegetation considered to be in 'Good' condition or better and five relevés in 'Degraded' (more disturbed) vegetation. This data supplemented previous information collected by ELA (2018) and FVC (2021) and such a level of survey detail was adequate for the assessment of floristic values as per the scope.
Competency/ Experience of personnel	No	All personnel undertaking the relevant study and reporting aspects are experienced ecologists/botanists, with specialist skills in their respective fields. All personnel who led the field flora and vegetation survey have a NAIA skill level of 5b or 6b, with assisting (Graduate) personnel's skills levels being 4b (see **Appendix H**).
Survey effort/detail/ intensity	No	Similarly, as per the 'Scope (detail)' aspect above, the detailed flora and vegetation assessment was adequate to determine floristic values of the study area, which is set amongst a largely developed, built-up environment. Thirteen quadrats were established in vegetation considered to be in 'Good' or better condition, and five relevé were recorded in areas of 'Degraded' remnant vegetation. The level of degradation in some sections (and therefore poorer vegetation condition) of the study area determined that sampling of quadrats was not required.
Seasonal timing and climatic conditions	No	The flora and vegetation field assessment was conducted during spring, which is the optimal season for flora and vegetation surveys on the Swan Coastal Plain, as per the Technical Guidance (EPA 2016a).
Access	No	Most of the study area was easily accessible on foot, other than small areas of dense foliage. Extrapolation of biological values therein were able to be made.
Mapping reliability	No	The mapping was prepared at a scale based on ground-truthed areas, with limited extrapolation given the good accessibility to most of the study area and the high-intensity of survey effort on the ground, required for the weed mapping task. Therefore, mapping reliability is considered high.
Disturbances	No	A large proportion of the study area has been subject to a moderate to high degree of disturbance and is bounded by commercial and urban areas. This degradation did not impede the definition of biological values present within the areas of better-quality vegetation present.
Survey completeness	No	Previous biological assessments have been conducted within the study area, with ELA (2018) and FVC (2021) the focus of the literature review and their results providing a basis for the results reported herein. Data and other information for the region is also readily available. Most areas, except dense shrubbery, were easily accessible, with existing tracks able to 29tilizedsed, enabling the survey to be completed in thorough detail.

5 RESULTS

5.1 DESKTOP REVIEW

5.1.1 Literature Review

A summary of findings of the literature review of the two previous surveys undertaken as part of the desktop assessment to identify flora and vegetation values previously recorded in the study area, is provided in **Table 10**.

Table 10 – Summary of Results of Previous Surveys Within Study Area

Reference	Survey Methodology	Key Results
Biological Survey of Manning Park (FVC 2021)	Detailed Flora and Vegetation Assessment, November 2020 Six quadrats, 1 relevé	• 77 flora taxa, 62 genera, 31 families • 23 weed species • No Threatened flora • Two Priority flora species *Pimelea calcicola* (P3), and *Dodonaea hackettiana* (P4) • One DP and WoNS species, Bridal creeper (**Asparagus asparagoides*) • No range extensions or undescribed flora • Six vegetation units • Vegetation condition ranged from 'Completely Degraded' to 'Very Good' • Commonwealth-listed TEC Tuart woodlands and forests present within the site represented by three patches • One floristic community (EfOF) representative of PEC SCP 24 • One floristic community (MhTrAtOH) representative of TEC SCP 26a
Vegetation Condition, Floristic Community Mapping and Weed Mapping in the City of Cockburn (ELA 2018)	Detailed Flora and Vegetation Assessment, October 2017 Six quadrats	• 49 weed species • Six floristic communities • Vegetation Condition ranged from 'Completely Degraded' to 'Very Good' • No significant taxa or communities were recorded • One DP and WoNS species, Bridal creeper (**Asparagus asparagoides*)

5.1.2 Threatened and Priority Flora

The desktop assessment identified thirty-eight Threatened and Priority flora species that have the potential to occur within the study area (**Table 11**). Of these, 14 are Commonwealth-listed and/or State-listed Threatened flora, with two Priority 1, one Priority 2, twelve Priority 3, and nine Priority 4 species. Of these, it was determined that two species, *Dodonaea hackettiana* and *Pimelea calcicola,* are known to occur in the study area as they have been recorded previously in 2020 (FVC 2021) (**Figure 9**). For the remaining species, it was determined three are likely to occur, 11 may occur and 22 are considered unlikely to occur.

Table 11 –Threatened and Priority Flora with the Potential to occur within the Study Area

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence in the Study Area	Source
Grevillea thelemanniana	Critically Endangered	Critically Endangered	Spreading, lignotuberous shrub growing between 0.3 to 1.5 m high. Produces red to pink flowers from May to November.	Sand, sandy clay soils. Winter-wet low-lying flats.	May occur – Closest occurrence recorded 7.2 km north of the study area, however, the geology of preferred habitat differs from the study area. Suitable habitat may to occur within the study area.	NatureMap, DBCA, PMST
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Critically Endangered	Critically Endangered	Dense, clumped shrub growing from 0.3 to 0.6 m high and 0.4-0.8 m wide. Produces yellow flowers on erect spikes 0.07-0.24 m long from September to October.	Grey clayey, sand soil with lateritic pebbles. Near winter-wet flats, low woodlands with weedy grasses.	Unlikely to occur – one record occurs 13 km north-east of the study area, where the pre-European vegetation differs from the study area. Suitable habitat is unlikely to occur within the study area.	PMST
Caladenia huegelii	Endangered	Critically Endangered	Tuberous, perennial herb growing from 0.25 to 0.6 m high with a single pale green, hairy leaf. Produces 1 to 2 (rarely 3) distinctive flowers with red and green to cream parts from September to October.	Grey, white, or brown sand, clay loam soils. Margins of swamps, low depressions, and flats. Mixed jarrah and Banksia woodlands.	Unlikely to occur – Closest occurrence recorded 6 km south-east of the study area, on a different geology than that of the study area. Suitable habitat is unlikely to occur within the study area.	PMST
Drakaea elastica	Endangered	Critically Endangered	Tuberous, perennial herb growing from 0.1 to 0.3 m high with a single bright green, glossy, prostrate heart to shaped leaf. Produces distinctive flower with red and green to yellow parts from October to November.	Bare patches of white or grey sandy soils. Low-lying situations adjoining winter-wet swamps.	Unlikely to occur – Closest occurrence recorded 14 km south-east of the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA, PMST
Diuris purdiei	Endangered	Endangered	Tuberous, perennial orchid growing from 0.15 to 0.45 m high. Produces distinct flattened yellow flowers with brown blotches on their underside from September to October.	Grey-black sand, sandy clay moist soils. Winter-wet swamps.	Unlikely to occur – Closest occurrence recorded 15 km east of the study area. Suitable habitat is unlikely to occur within the study area.	PMST
Thelymitra stellata	Endangered	Endangered	Tuberous perennial herb growing to 0.25 m high with a single lily-like leaf to 0.9 m long. Produces up to 6 golden-brown or yellow with orange striped flowers from September to November.	Sandy loam soils with lateritic gravel. Ridges, slopes and gullies in wandoo and jarrah woodland.	Unlikely to occur – one record occurs 13 km north-east of the study area, the pre-European vegetation differs from the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA, PMST
Macarthuria keigheryi	Endangered	Endangered	Small, erect shrub growing to 0.4 m high with bright yellow to green stems. Leaves mainly at the base of stems and on young growth. Produces flowers with white and	Open patches of white or grey sandy soil. Winter wet depressions, jarrah, and banksia woodlands.	Unlikely to occur – Closest occurrence recorded 16 km north-east of the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence in the Study Area	Source
			green parts from September to December and February to March.			
Banksia mimica	Endangered	Vulnerable	Prostrate, lignotuberous shrub growing from 0.15 to 0.4 m high with leaves growing to 0.4 m long. Produces yellow to brown flowers from December to February.	White or grey sand, sandy loam soils over laterite. Slopes and flats.	Unlikely to occur – Closest occurrence recorded 22.5 km east of the study area. Laterite geology is not known to occur within the survey area and therefore suitable habitat is unlikely to occur within the survey area.	DBCA
Diuris drummondii	Vulnerable	Endangered	Tuberous, perennial tall orchid growing from 0.5 to 1 m high. Produces 3 to 8 pale yellow flowers from November to January.	Brown sandy clay, moist peat soils. Low lying depressions, swamps.	Unlikely to occur – Closest occurrence recorded 7.2 km south-east of the study area, on a different geology than that of the study area. Suitable is unlikely to occur within the study area.	NatureMap, DBCA
Drakaea micrantha	Vulnerable	Endangered	Tuberous, perennial herb growing from 0.15 to 0.3 m high with a single silvery to grey, prostrate heart to shaped leaf. Produces distinct flower with red and yellow parts from September to October.	Bare patches of white-grey sandy soils. Winter wet swamps, disturbed areas.	Unlikely to occur – Closest occurrence recorded 14 km south-east of the study area. Suitable habitat is unlikely to occur within the study area.	PMST
Conospermum undulatum	Vulnerable	Vulnerable	Erect, compact shrub growing from 1.5 to 2 m high with distinctive fibrous, longitudinally fissured stems and hairless, wavy leaves to 0.12 m long. Produces white flowers held above the leaves from May to October.	Grey or yellow-orange clayey sand soils. Flats and slopes often over laterite and occasionally in slightly swampy areas.	Unlikely to occur – Closest occurrence recorded 20 km east of the study area. Suitable habitat is unlikely to occur within the study area.	PMST
Diuris micrantha	Vulnerable	Vulnerable	Tuberous, perennial orchid growing from 0.3 to 0.6 m high with a basal tuft of narrow, linear leaves. Produces up to 7 yellow flowers with red to brown markings from August to October.	Brown/black sandy clay-loam and clayey soils. Winter-wet depressions and swamps, in shallow water.	Unlikely to occur – Closest occurrence recorded 17 km south-east of the study area. Suitable habitat is unlikely to occur within the study area.	PMST
Eleocharis keigheryi	Vulnerable	Vulnerable	Tufted, clumping grass like sedge growing from 0.2 to 0.4 m high and 0.4 m wide with smooth, erect stems and leaves reduced to straw coloured sheaths. Produces pale green flowers in a narrow, cylindrical flower spike from August to November (December in favourable conditions).	Clay, sandy loam soils. Emergent in freshwater creeks, claypans and wetlands.	Unlikely to occur – Closest occurrence recorded 20 km south-east of the study area. Suitable habitat is unlikely to occur within the study area.	PMST

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence in the Study Area	Source
Thelymitra variegata	-	Critically Endangered	Tuberous, perennial herb growing from 0.1 to 0.35 m high. Produces conspicuous purple-red flowers with dark purple blotches and yellow parts from June to September.	Sandy clay or sandy soils. Associated with laterite.	Unlikely to occur – one record occurs more than 20 km north-east of the study area, the pre-European vegetation differs from the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)	-	Priority 1	Spinescent shrub growing between 0.4 to 1.5 m high. Produces yellow flowers in globular heads from May or August.	Grey or black sand over clay soils. Swampy areas, winter wet lowlands.	May occ–r - The closest occurrence recorded 4.7 km east of the study area on different geology than that of the study area. Suitable habitat may occur within the study area in association with Manning Lake.	DBCA
Hydrocotyle striata	-	Priority 1	Annual herb growing from 0.1 to 0.3 m high. Produces cream flowers from December (likely longer period).	Sandy peaty soil. Winter wet drainage lines and depressions.	May occur – Closest occurrence recorded 9.7 km north-east of the study area and is the most southern record of the species. Suitable habitat may occur in association with Manning Lake.	NatureMap, DBCA
Bossiaea modesta	-	Priority 2	Slender, trailing, and twining shrub. Produces flowers with yellow and red parts from October to December.	Clayey loam, loamy soils. Riparian areas.	Unlikely to occur – Closest occurrence recorded 20 km south of the study area. The species has not been recorded on the Swan Coastal Plain and therefore, suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Angianthus micropodioides	-	Priority 3	Erect or decumbent annual herb growing from 0.05 to 0.15 m high. Produces yellow to white flowers from November to February.	Sandy, clay, loam soils. River edges, saline depressions and claypans.	Unlikely to occur – One occurrence recorded 6.5 km north-east of the study area found on a different geology than the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Austrostipa mundula	-	Priority 3	Erect, fine perennial grass growing to 0.6 m high with mostly basal leaves. Produces brown flowers in a linear or elliptic panicle 5 to 12 cm long from September to November.	Grey sandy soil with limestone. Dune slopes, coastal cliffs, plains.	May occur – Two occurrence recorded, one 6 km north and 9 km south of the study area on a similar soil system as that of the study area. Suitable limestone and sandy soil habitat may occur within the survey area.	NatureMap, DBCA
Beyeria cinerea subsp. *cinerea*	-	Priority 3	Low spreading shrubs to 0.3 m, narrow lime green leaves with pale underside and tuberculate fruits.	Limestone ridges, slopes and hilltops, sand over limestone.	May occur – Closest occurrence recorded 20 km south of the study area. The study area is within the species known	NatureMap, DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence in the Study Area	Source
					distribution and suitable limestone slopes may occur within the study area.	
Cyathochaeta teretifolia	-	Priority 3	Rhizomatous, clumped, perennial sedge growing to 2 m high and 1.0 m wide. Produces brown-straw flowers from September to January.	Grey sand, sandy clay soil. Lowlands, swamps, creek edges and drainage lines.	Unlikely to occur – Closest occurrence recorded 10 km south-east of the study area, on a different geology than that of the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Dampiera triloba	-	Priority 3	Erect perennial, herb or shrub growing to 0.5 m high. Produces blue flowers from August to December.	Dark brown/black peaty, dry grey loamy soils. Wetlands, swamps, slopes, and flats.	Unlikely to occur – Closest occurrence recorded 6 km south-east of the study area, on a different geology than that of the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Hibbertia leptotheca	-	Priority 3	Small shrub growing from 0.3 to 0.5 m high. Produces yellow flowers from August to October.	Coastal and near coastal sites on sand with limestone. Limestone ridges (Tamala limestone), outcrops, slopes, and dunes.	Likely occur – Closest occurrence recorded 4 km north-west of the study area on the same soil system present within the study area. The study area is a near coastal site and occurs on the Tamala Limestone geology unit. Suitable limestone habitat is likely to occur.	NatureMap, DBCA
Jacksonia gracillima	-	Priority 3	Prostrate, spreading or scrambling spindly shrub growing from 0.5 to 1 m high and 1 m wide. Produces flowers with yellow, red, and orange parts from October and November.	Sand and loam soils. Wetlands, winter wet flats, slopes, and flats.	Unlikely to occur – Closest occurrence recorded 6 km east of the study area, however, the geology and soil system differs from the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Phlebocarya pilosissima subsp. *pilosissima*	-	Priority 3	Compactly tufted, rhizomatous perennial grass-like shrub growing from 0.15-0.4 m high. Produces cream-white flowers from August to October.	White or grey sandy soil, sometimes with lateritic gravel. Slopes.	May occur – Closest occurrence recorded 7.5 km east of the study area on geology that differs from the study area. Suitable habitat may occur within the study area.	DBCA
Pimelea calcicola	-	Priority 3	Erect to spreading shrub growing from 0.2 to 1 m high. Produces white flowers with some pink from September to November.	Brown sandy loam, white-grey sandy soil associated with limestone. Coastal limestone ridges.	Known to occur – One DBCA record within the study area. FCV also recorded six individuals within the study area (FVC 2020).	NatureMap, DBCA, (FVC 2020)
Stylidium maritimum	-	Priority 3	Caespitose perennial, herb 0.3 to 0.7 m with white/purple flowers between September to November.	Sand over limestone on dune slopes and flats. Coastal heath	May occur – Closest occurrence recorded 4.5 km north of the study area, general preferred habitat is present in study area,	NatureMap, DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence in the Study Area	Source
				and shrubland, open Banksia woodland.	however, the geology differs from the study area.	
Stylidium paludicola	-	Priority 3	Reed-like perennial herb growing from 0.35 to 1 m high. Produces pink flowers from October to December.	Peaty sand over clay soils. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Unlikely to occur – four occurrences recorded within 10 km of the study area, the closest being 7 km north-east of the study area. All four occurrences were recorded on geology that differs from the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Styphelia filifolia	-	Priority 3	Shrub to 0.3 m high with green asymmetric fruit. Produces white flowers in February and April.	Sandplain and mid-slopes with yellow or grey sand. Banksia woodland.	Unlikely to occur – although one record occurs 7 km east of the study area, the pre-European vegetation differs from the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Calothamnus graniticus subsp. *leptophyllus*	-	Priority 4	Erect, multi-stemmed shrub growing to 2 m high. Produces red flowers from June to November.	Grey/brown sand, loam, clay, lateritic soils. Granite outcrops, hillsides, slopes, and flats.	Unlikely to occur – Closest occurrence recorded 8 km north of the study area, however, the geology differs from the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA
Dodonaea hackettiana	-	Priority 4	Erect shrub or tree growing from 1 to 5 m high. Produces yellow flowers with green and red parts mainly between July to October.	Sandy soils, associated with limestone outcropping. Limestone ridges, slopes, and dunes.	Known to occur – Closest other documented occurrence 2 km east of the study area on a similar soil system and vegetation as that of the study area. Known to be locally abundant.	NatureMap, DBCA, (FVC 2020)
Eucalyptus foecunda subsp. *foecunda*	-	Priority 4	Erect mallee form shrub growing to 4 m high with rough, flaky blackish bark.	Brown sandy soil. Limestone	Likely to occur – Closest occurrence recorded 2.5 km north-west of the study area, suitable geology occurs within the study area. Suitable habitat is likely to occur within the study area.	NatureMap, DBCA
Grevillea olivacea	-	Priority 4	Erect, non to lignotuberous shrub, 1 to 4.5 m high. Flowers red/red to pink, June to September.	White or grey sand. Coastal dunes, limestone rocks.	May occur – Closest occurrence recorded 4 km south-west of the study area, however, suitable geology likely occurs within the study area, this species records are mainly from revegetation planting.	NatureMap
Hydrocotyle lemnoides	-	Priority 4	Aquatic, floating annual herb. Produces purple flowers from August to October.	Permanent water in swamps.	May occur – Closest occurrence recorded 8.6 km north-east of the study area.	NatureMap, DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description	Preferred Habitat	Likelihood of Occurrence in the Study Area	Source
					Suitable permanent water is likely to occur within the study area.	
Jacksonia sericea	-	Priority 4	Low spreading shrub growing to 0.6 m high. Produces flowers with yellow and red and orange parts usually from December to February.	Grey to white, yellow or brown sandy loam soils, often associated with limestone. Limestone ridges, slopes, and flats.	Likely to occur – Closest occurrence recorded 4.3 km north-east of the study area on a similar soil system and vegetation as that of the study area. Locally common.	PMST
Microtis quadrata	-	Priority 4	Erect herb growing to 0.4 m high. Produces cream-white flowers from October to December.	Sand, clay, loam soils. Winter wet flats, near wetlands, drainage lines, slopes.	May occur – Closest occurrence recorded 6 km south-east of the study area, however, the geology differs from the study area. Suitable habitat may occur in association with Manning Lake.	NatureMap, DBCA
Stylidium longitubum	-	Priority 4	Erect annual (ephemeral) herb growing from 0.05 to 0.12 m high. Produces pink flowers with white markings from October to December.	Sandy clay, clay soils. Seasonal wetlands.	May occur – Closest occurrence recorded 6.5 km south-east of the study area, however, the geology differs from the study area. Suitable habitat may occur in association with Manning Lake.	PMST
	-	Priority 4	Slender, erect, multi-stemmed perennial herb to 0.6 m high. Produces orange-yellow flowers from October to February.	Grey-white sand, peaty sand over clay soils. Winter wet flats, shallow depressions, dry flats, and slopes.	Unlikely to occur – one record occurs more than 13 km east of the study area, and the pre-European vegetation differs from that of the study area. Suitable habitat is unlikely to occur within the study area.	NatureMap, DBCA

Figure 9 - DBCA Threatened and Priority Flora

5.1.3 Threatened and Priority Ecological Communities

A review of DBCA's TEC and PEC database and the PMST report (DCCEEW 2023b) found that ten Threatened and/or Priority Ecological Communities or their buffers occur within the desktop assessment area (**Table 12**). Of these, three TECs and/or PECs and their buffers intersect, or are known to occur within the study area (**Figure 10**), these being; Tuart Woodlands and Forest, SCP 26a and SCP 24. Previous surveys (FVC 2021) identified these three TECs and PECs to occur within the study area.

Since the previous surveys were conducted, the '*Honeymyrtle shrubland on limestone ridges of the SCP*' TEC was listed as a Critically Endangered TEC under the EBPC Act in November 2023 (DCCEEW 2023e; d). The SCP 26a community corresponds to the '*Honeymyrtle shrubland on limestone ridges of the SCP*' (DCCEEW 2023d; State of Western Australia 2023). Based on known geology and previously defined vegetation units, at the time of the desktop assessment this TEC was also considered likely to occur within the study area.

Table 12 – Threatened and Priority Ecological Communities Potentially Occurring within the Desktop Assessment Area

Abbreviated Identifier	Community Name	EPBC Cons. Status	WA Cons. Status
Tuart Woodlands and Forests	Tuart (*Eucalyptus gomphocephala*) Woodlands and Forest of the Swan Coastal Plain Ecological Community	Critically Endangered	Priority 3
Honeymyrtle shrubland on limestone ridges of the SCP	Honey myrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion (corresponds to SCP26a).	Critically Endangered	-
Banksia WL SCP	Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Priority 3
SCP22	*Banksia ilicifolia* woodlands	Endangered	Priority 3
^ *Empodisma* peatlands of southwestern Australia	*Empodisma* peatlands of southwestern Australia	Endangered	-
Coastal Saltmarsh	Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Priority 3
SCP26a	*Melaleuca huegelii – M. systena* shrublands of limestone ridges (floristic community type 26 a as originally described in (Gibson *et al.* 1994)) (corresponds to Honeymyrtle shrubland on limestone ridges of the SCP)	-	Critically Endangered
SCP30a	*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands of the Swan Coastal Plain (floristic community type 30a as originally described in (Gibson *et al.* 1994)	-	Critically Endangered
Wooded waterbird wetlands	Wooded wetlands which support colonial waterbird nesting areas	-	Priority 2
SCP24	Northern Spearwood shrublands and woodlands	-	Priority 3

^Denotes ecological community/ies identified by PMST only, therefore not depicted in **Figure 10**

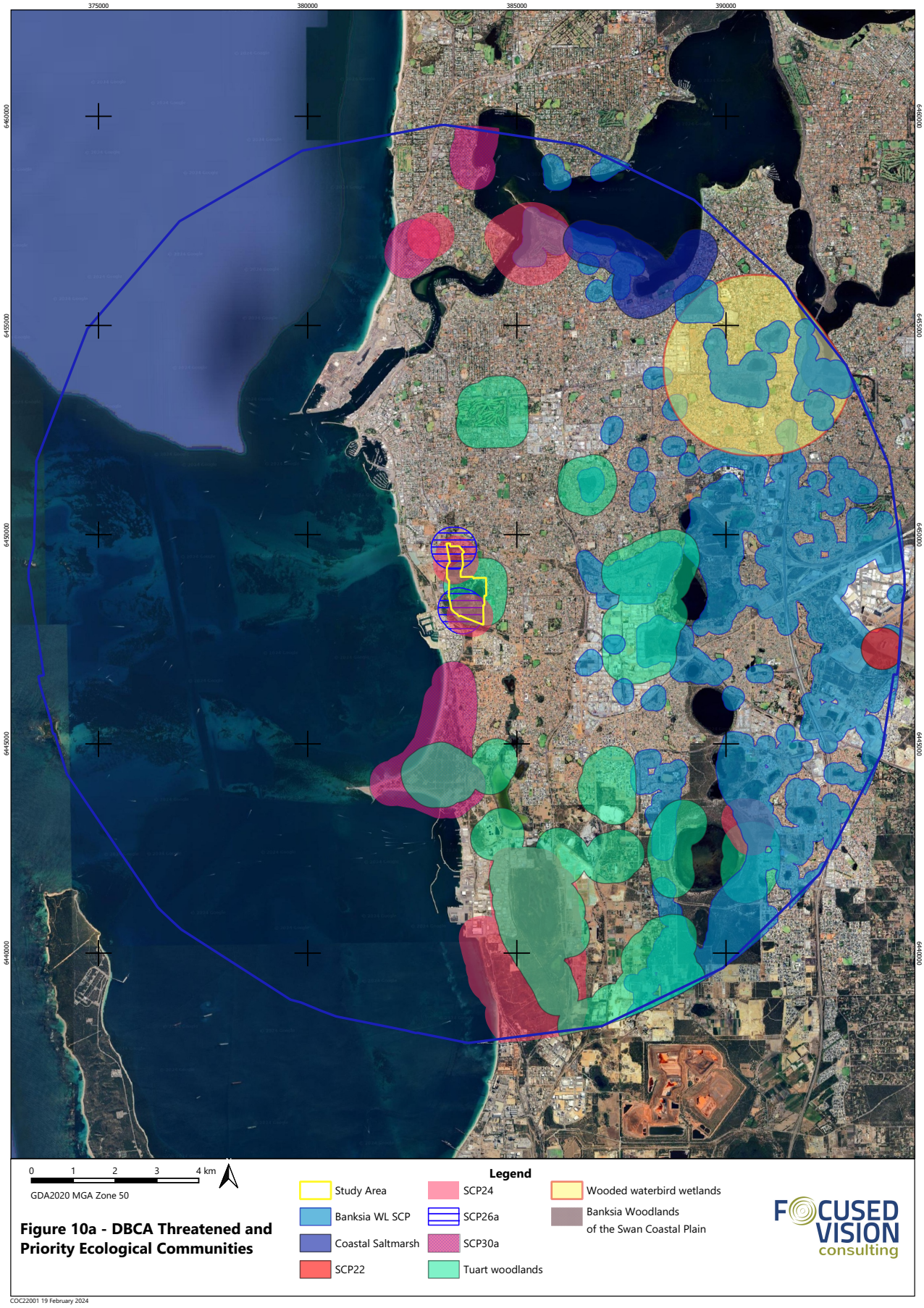

Figure 10a - DBCA Threatened and Priority Ecological Communities

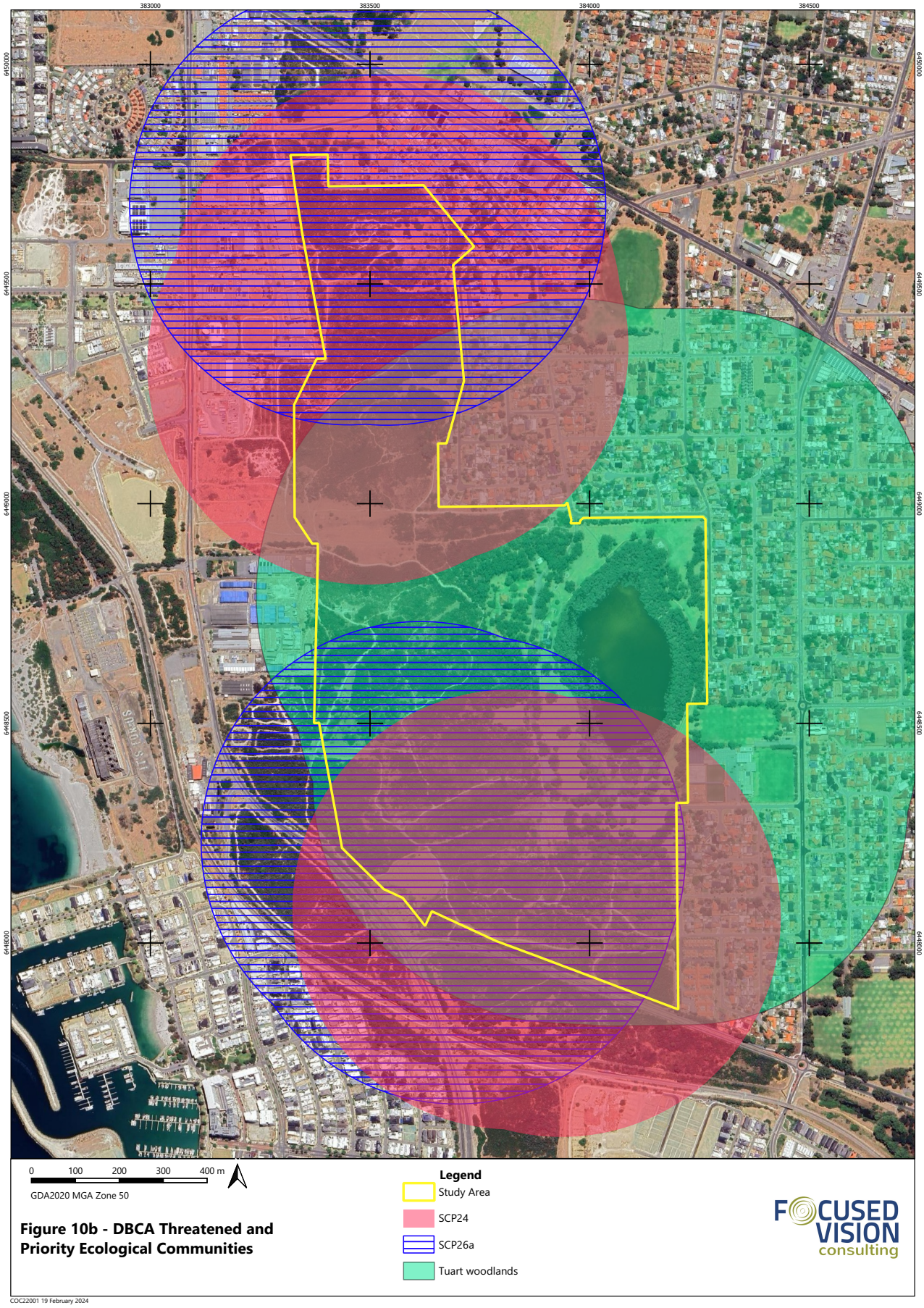

Figure 10b - DBCA Threatened and Priority Ecological Communities

5.2 FIELD ASSESSMENT

5.2.1 Flora

A total of 156 flora species, from 118 genera and 56 families were recorded during the field survey. The dominant families were found to be Poaceae (Grass family – 21 taxa), Fabaceae (Pea family – 18 taxa) and Myrtaceae (12 taxa). The total includes 80 (51.28%) native species and 76 (48.72%) introduced (weed) species. The full list of vascular flora within each vegetation unit recorded is presented in **Appendix E** and individual quadrat data is presented in **Appendix F**.

No species listed as Threatened under the EPBC Act or BC Act were recorded during the survey. A total of 61 individuals of the Priority 3 species, *Pimelea calcicola*, were recorded within the study area during the 2020 (16 individuals) and 2023 (45 individuals) field assessments (**Figure 11**). This species was recorded within floristic communities MhTrS, ArSgS and AcBsS.

One individual of the Priority 4 species, *Dodonaea hackettiana*, was opportunistically recorded in 2020 in the north of the study area (**Figure 11**), within floristic community MhTrS. *Dodonaea hackettiana* has been historically incorporated into the City's revegetation programs; however, in this location, it is possible it could be occurring naturally.

One of the 37 recorded introduced (weed) species, **Asparagus asparagoides* is listed as a Weed of National Significance (WoNS) and is also listed as a Declared Pest (s22(2)) plant under the BAM Act, and was recorded within the study area supporting vegetation units: AcBsS, ArSgS , EdSgW , EgSgW and MhTrS (CISS 2021; DPIRD 2022) (**Figure 13**).

None of the recorded, naturally occurring flora are exhibiting an extension beyond their currently documented range, in accordance with records of the Western Australian Herbarium (WAH 1998-), and no undescribed flora were recorded.

The results of the assessment of targeted weed species mapping in relation to locations and densities is discussed in more detail in **Section 4.2.2**.

Figure 11 - Recorded Priority Flora Locations

5.2.2 Weed Mapping

Of the 61 flora recorded within the study area, 36 are weeds, recorded across the five weed categories. The total weed coverage across the study area is presented in **Figure 12**. Two species listed as both WoNS and DP plants under the BAM Act were recorded, **Asparagus asparagoides* and **Lantana camara* (**Figure 13**).

Spatial presentation of each weed category are as follows:

- Bulbous Weed Density and Locations (**Figure 14**)
- Grass Weeds Density and Locations (**Figure 15** series)
- Aquatic Weeds Density and Locations (**Figure 16**)
- Woody Weed Density and Locations (**Figure 17** series)
- Other Weeds Density and Locations (**Figure 18** series).

The most commonly recorded species were 'Other' and 'Woody' weeds, with **Euphorbia terracina, *Pelargonium capitatum, *Asparagus asparagoides, *Gaudium laevigatum* (syn. **Leptospermum laevigatum*) and **Schinus terebinthifolia* recorded throughout the survey area.

Weed species encountered that were not on the target list, were still recorded to ensure a detailed flora inventory, a total of 39 weed species were recorded in addition to those recorded for weed mapping.

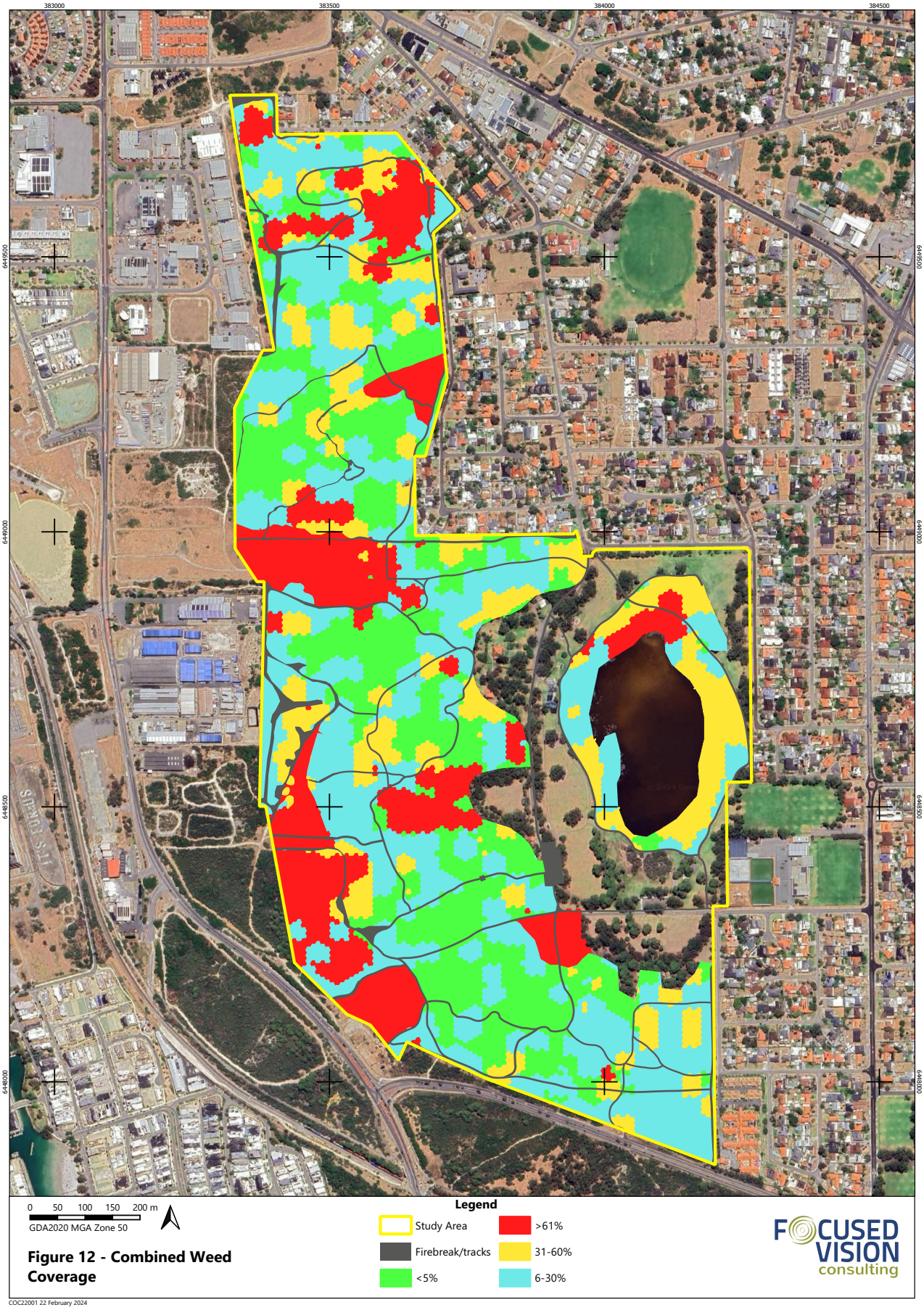

Figure 12 - Combined Weed Coverage

Figure 13 - Declared Pest Plants and Weeds of National Significance

Figure 14 - Bulbous Weed Density and Locations

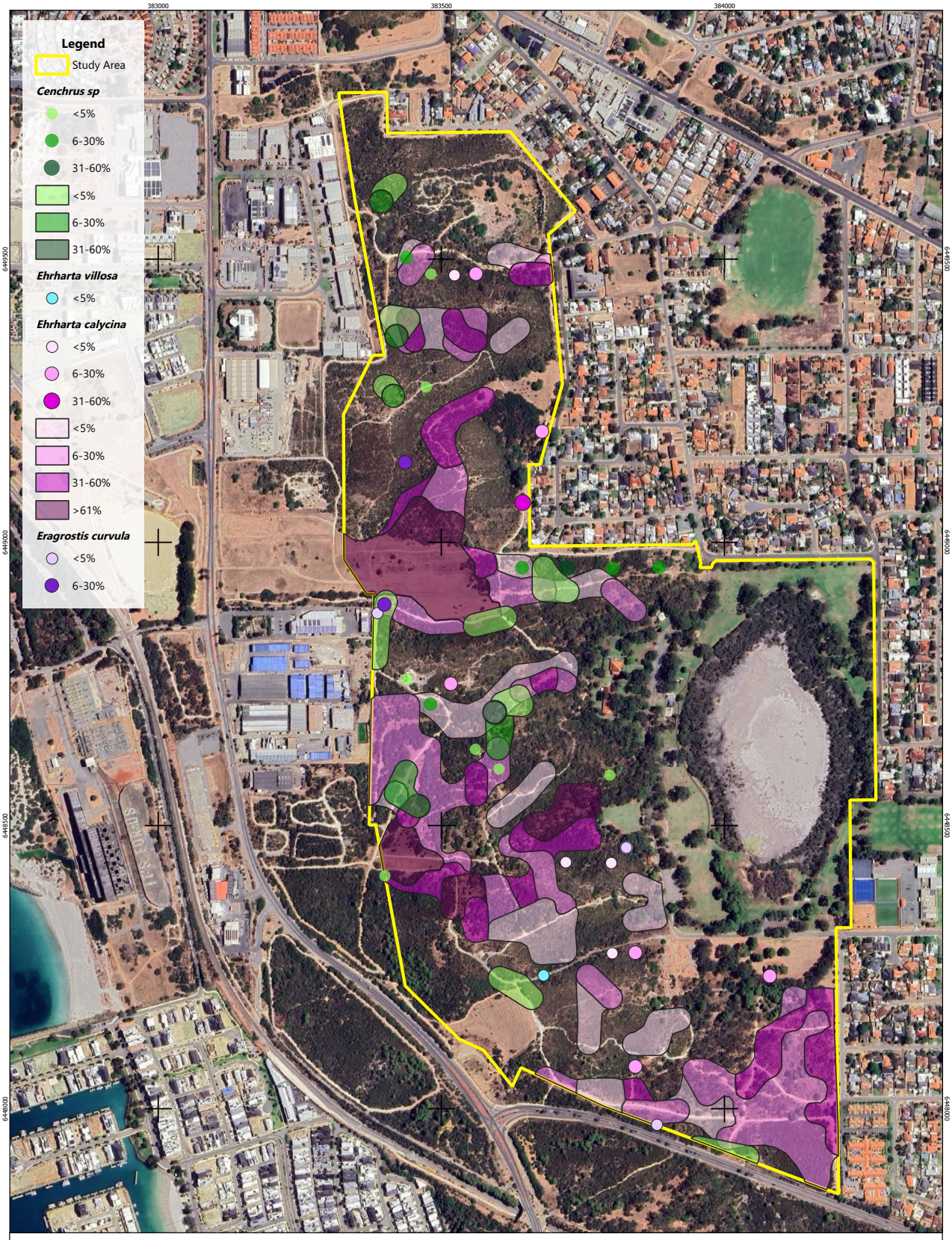

Figure 15a - Grass Weeds Density and Locations

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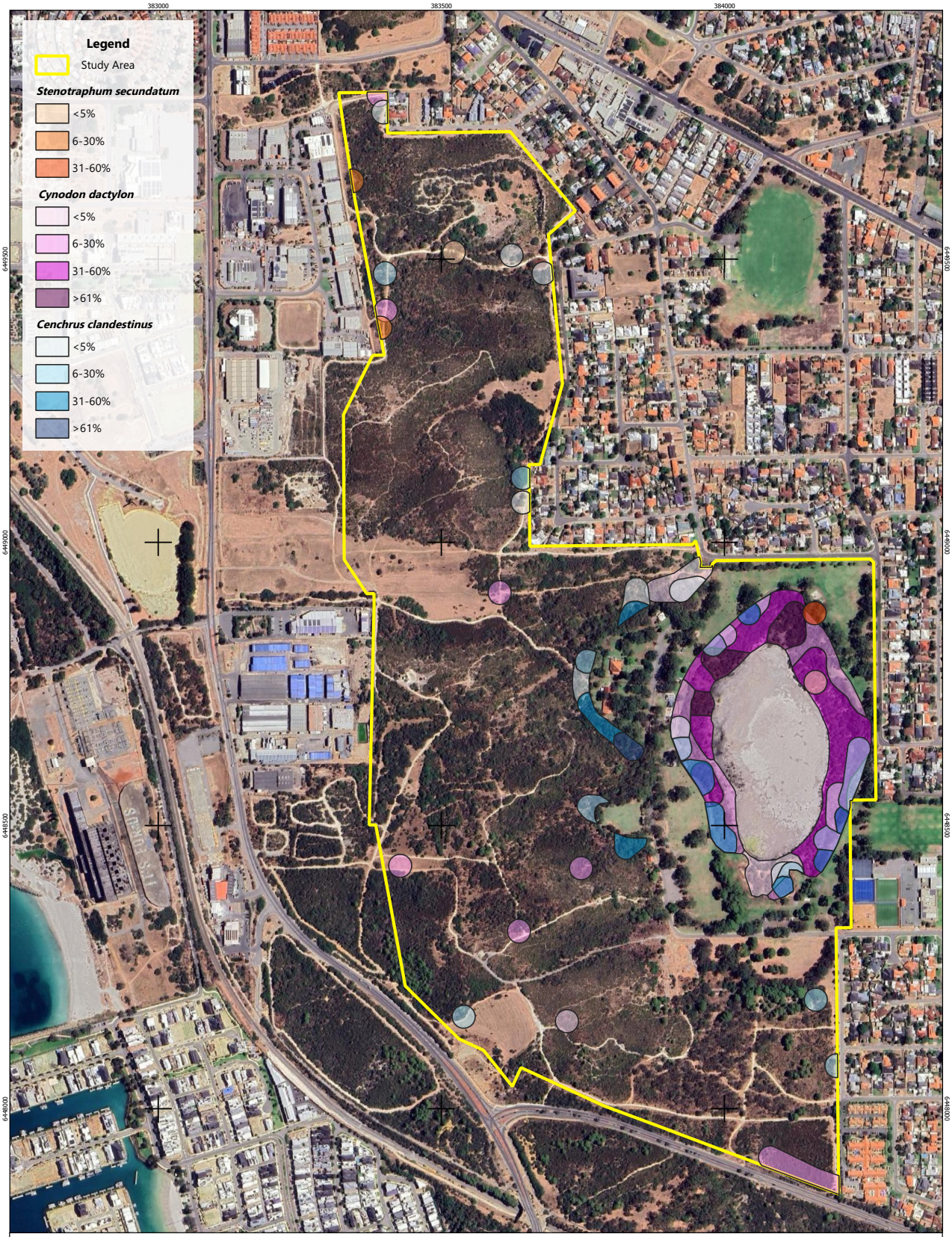


Figure 15b - Grass Weeds Density and Locations

Figure 16 - Aquatic Weeds Density

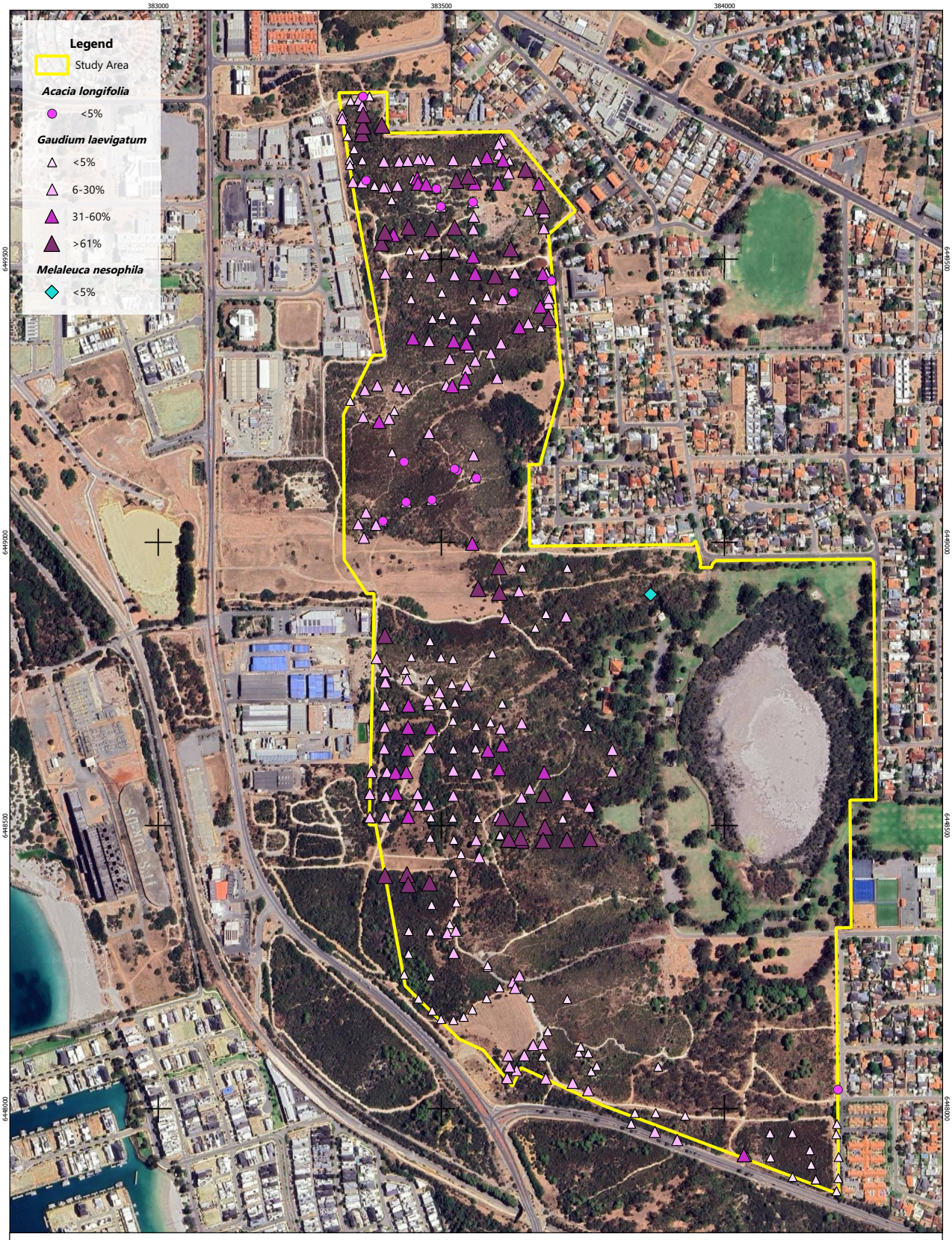


Figure 17a - Woody Weed Density and Locations

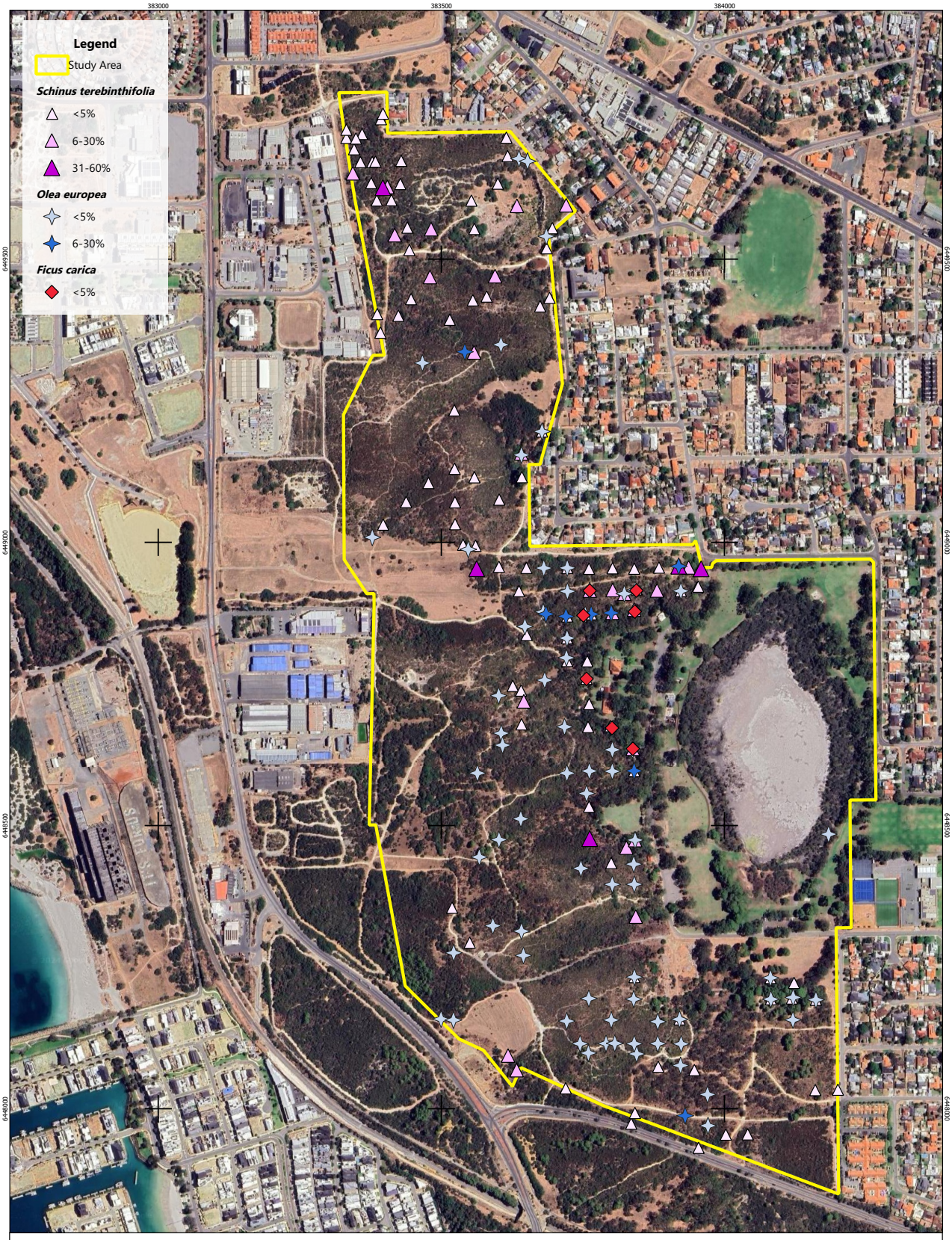


Figure 17b - Woody Weed Density and Locations

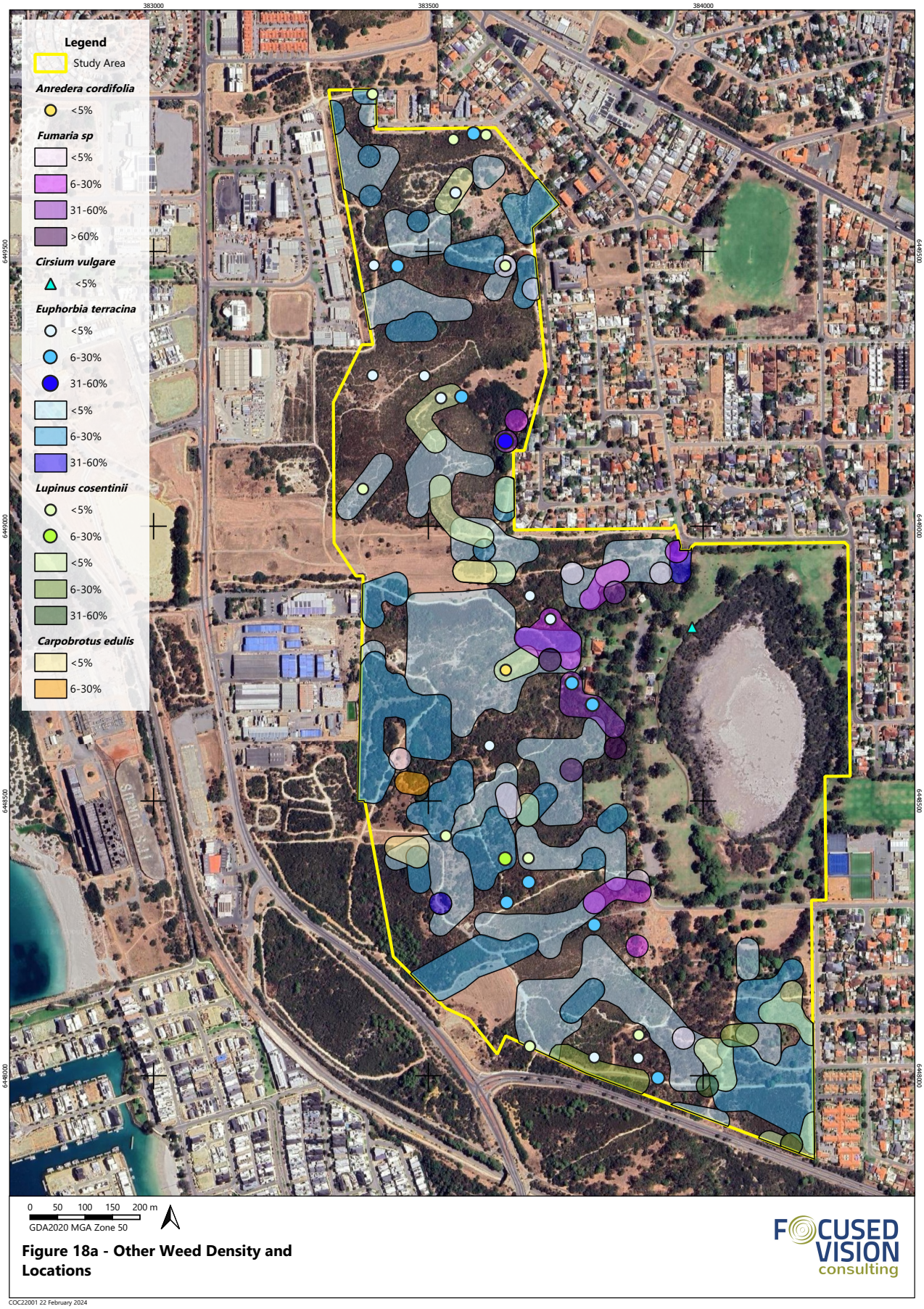


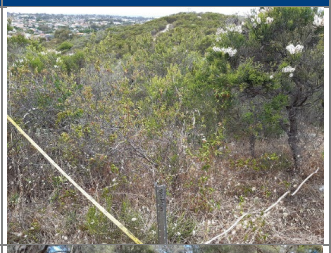
Figure 18a - Other Weed Density and Locations

5.2.3 Vegetation Units

Six vegetation units (AcBsS, ArSgS, EdSgW, EgSgW, MhTrS and MrGtW) were defined and mapped across the study area, based on data collected in both the 2023 and 2020 FVC surveys. A summary of the units if presented in **Table 13**, and their spatial extent is presented in **Figure 19**. Nearly a quarter of the study area is occupied by the *Melaleuca huegelii* shrubland (MhTrS) unit, accounting for 23.30% (25.08 ha) of the total study area. The modified areas, including parkland, revegetated, cleared, firebreaks, and tracks, account for 33.28% (35.82 ha) of the study area.

Table 13 – Summary of Recorded Vegetation Units within the Study Area

Vegetation Unit Code	Vegetation Type and Description	Representative Photo	Quadrat or Relevé	Area (ha)	Area (%)
AcBsS	***Acacia cyclops* shrubland** *Acacia cyclops* and *Banksia sessilis* tall shrubland over **Euphorbia terracina* and **Pelargonium capitatum* isolated herbs and **Ehrharta calycina* isolated grasses		DR01 MP05r	11.71	10.88
ArSgS	***Acacia rostellifera* shrubland** *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs		DR02r DR05 MP06 MP08 MP09r MP12	17.01	15.80
EdSgW	***Eucalyptus decipiens* woodland** *Eucalyptus decipiens* low woodland over *Spyridium globulosum* and *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* and *Tricoryne elatior* low sparse shrubland over **Ehrharta calycina* sparse grassland over *Mesomelaena pseudostygia* sparse sedgeland		DR06 MP10 MP11r	6.18	5.74
EgSgW	***Eucalyptus gomphocephala* woodland** *Eucalyptus gomphocephala* open woodland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over **Euphorbia terracina* isolated herbs		DR04 MP02 MP17	6.56	6.10

Vegetation Unit Code	Vegetation Type and Description	Representative Photo	Quadrat or Relevé	Area (ha)	Area (%)
MhTrS	***Melaleuca huegelii* shrubland** *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland		DR07 MP01 MP04 MP13r MP14 MP15 MP16	25.08	23.30
MrGtW	***Melaleuca rhaphiophylla* woodland** *Melaleuca rhaphiophylla* woodland over *Gahnia trifida* and *Juncus kraussii* sedgeland over *Cynodon dactylon* grassland		DR03 MP03 MP07r	5.27	4.90
Open Water				5.31	4.93
Other Uses (includes cleared, firebreak/tracks, paths)				13.69	12.72
Parkland				14.16	13.16
Revegetated				2.66	2.47
			TOTAL	**107.63**	**100**

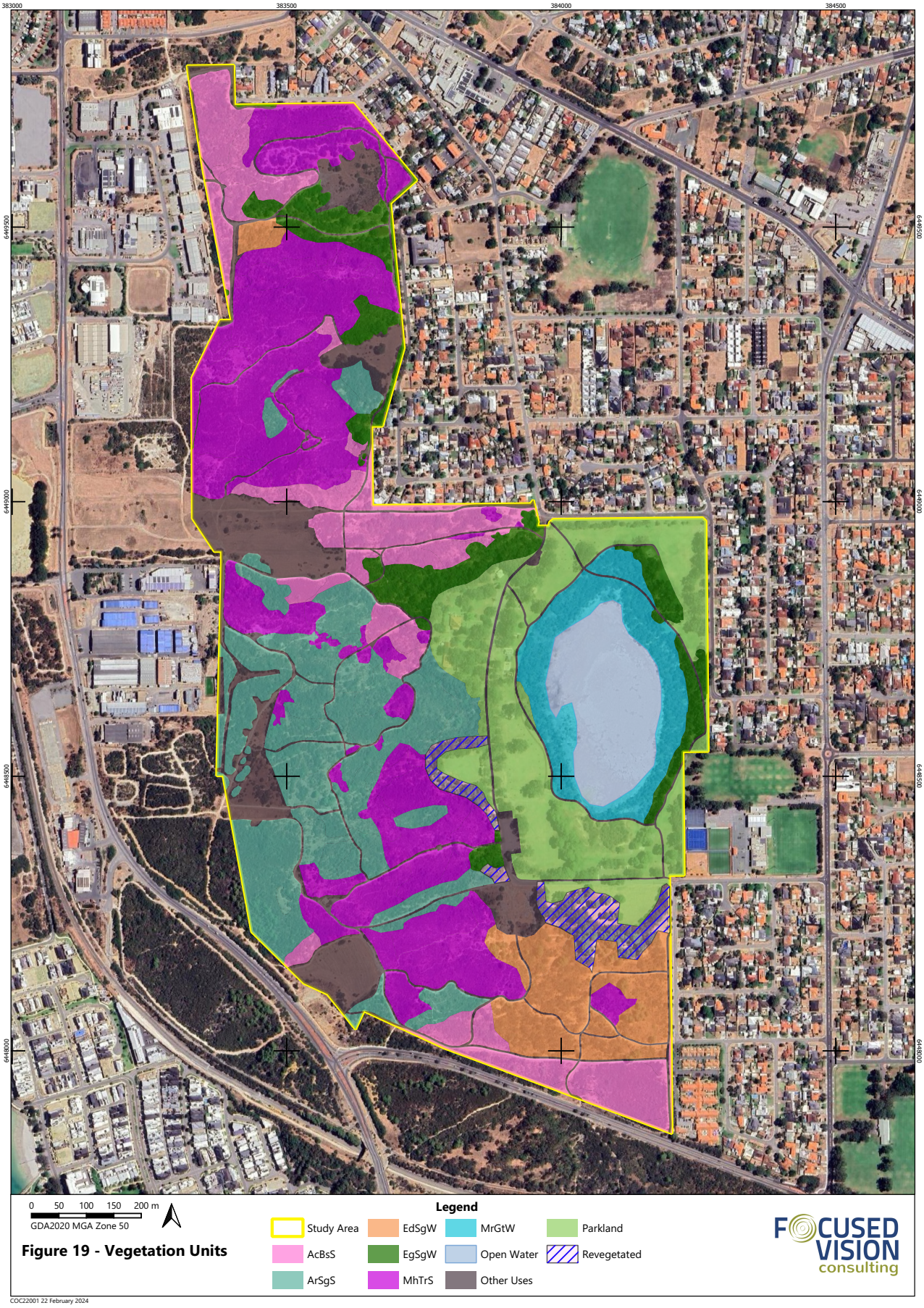


Figure 19 - Vegetation Units

5.2.3.1 *Floristic Community Types*

Analysis of the full suite of quadrats and relevés sampled in the study area was conducted against the Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets, utilising multivariate cluster analysis of species presence/absence in PATN™. This was conducted in order to assign the FCT that is most likely to be represented within each quadrat and relevé. Batch analysis and excerpts of SSI dendrograms are presented in **Appendix G** and the results, including dissimilarity indices, are summarised in **Table 14**.

Based on the floristic analysis results (**Table 14**), the vegetation units described and mapped for the survey best align to the following FCTs:

- AcBsS (*Acacia cyclops* shrubland) analysis was inconclusive
- ArSgS (*Acacia rostellifera* shrubland) is considered most comparable to FCT S11
- EdSgW (*Eucalyptus decipiens* woodland) is considered most comparable to FCT 24, a State-listed Priority 3 PEC
- EgSgW (*Eucalyptus gomphocephala* woodland) is considered most comparable to FCT S11, which corresponds to a State-Listed Critically Endangered TEC
- MhTrS (*Melaleuca huegelii* shrubland) is considered most comparable to FCT 26a, a State-listed Critically Endangered TEC
- MrGtW (*Melaleuca rhaphiophylla* woodland) is considered most comparable to FCT S17.

Table 14 – Summary of PATN™ Analysis Results

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
AcBsS	DR01	bold12 (24) BOLD-4 (24) MHENRY-2 (30a2)	0.7297 0.7600 0.7619	25/ S15/ 24	Inconclusive	The resulting dissimilarity values are notably high, suggesting a poor fit of the quadrat species with the Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets. Lowest dissimilarity to FCT 24, defined as 'Northern Spearwood shrublands and woodlands' and has been described as heaths with *Banksia attenuata* and *Banksia menziesii* with scattered *Eucalyptus gomphocephala with heathlands including Dryandra* (*Banksia*) *sessilis*, *Calothamnus quadrifidus* and *Schoenus grandiflorus* (DCCEEW 2016). The resulting dendrogram indicates some affinity to FCT 25 and S15, however is not considered representative of either due to the lack of characteristic species and the typical FCT distribution. The quadrat contains species (*Acacia cyclops, Banksia sessilis, Ehrharta calycina, Euphorbia terracina, Pelargonium capitatum, Petrorhagia dubia, Urospermum picroides* and *Hypochaeris glabra*) common with FCT 24 (DEE 2019a; DCCEEW 2023d). However, due to the lack of characteristic species such as scattered *Eucalyptus gomphocephala, Banksia attenuata* and *Banksia menziesii* it is not considered representative of FCT 24.
	MP05r	MI22 (S13) Bold17 (S15) TR03 (S13)	0.7778 0.8125 0.8125	20b/ S14	-	Degraded. Not considered representative of any FCT.
ArSgS	DR02r	TR06 (S11) bold10 (29b) bold17 (S15)	0.8333 0.8571 0.8571	20b	S11	This site is Degraded, and the resulting dissimilarity values are notably high, suggesting a poor fit of the quadrat species with the Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets. Lowest dissimilarity to FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. The quadrat contains *Acacia rostellifera* and **Ehrharta longiflora* common to FCT S11 (DEE 2019a; DCCEEW 2023d).
	DR05	TRIG-5 (24) BOLD-4 (24) NEER-9 (24)	0.5281 0.5904 0.596	24/ 26b	S11	Lowest dissimilarity to FCT 24, defined as 'Northern Spearwood shrublands and woodlands'. This could be attributed to the high complexity of species within this quadrat. Nearest neighbour in the dendrogram is also FCT 24. However, species composition of the quadrat is not a match for FCT 24. The presence of the dominant *Acacia rostellifera* and *Melaleuca systena* along with other species (*Acanthocarpus preissii, Lysiandra calycina, Spyridium globulosum, Templetonia retusa* and more) commonly found in FCT S11, suggests that this quadrat is more closely aligned with this community. FCT S11 is defined as *'Northern* Acacia rostellifera – Melaleuca acerosa (syn. Melaleuca systena) *shrublands*'. (DEE 2019a; DCCEEW 2023d).

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
ArSgS (cont.)	MP06	m4601 (S11)	0.6410	S11/ 30a2	S11	Lowest dissimilarity to FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. The resulting dendrogram indicates affinity to FCT S11. The quadrat contains *Acacia rostellifera*, *Melaleuca systena* and other species common to FCT S11 (DEE 2019a; DCCEEW 2023d).
		TRIG-1 (29b)	0.7000			
		SW10 (S11)	0.7222			
	MP08	tokyu07 (29b)	0.5357	29b/ S11/ 30a2	S11	Lowest dissimilarity value and showed the greatest affinity in the dendrogram to FCT 29b, defined as 'Acacia shrubland on taller dunes'. However, based on the next nearest neighbour in the dendrogram, structure and dominant species, it was concluded that the quadrat is most similar to S11 which is defined as 'Northern *Acacia rostellifera-Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. The quadrat contains *Acacia rostellifera*, *Melaleuca systena* and other species common to FCT S11 (Gibson *et al.* 1994)
		Bold06 (30a2)	0.5745			
		BURN-1 (29a)	0.6232			
	MP09r	m4601 (S11)	0.6250	30a2/ 24	S11	Due to the degraded condition, data was recorded utilising a relevé. The high number of weeds may affect the analysis results. Lowest dissimilarity to FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. Nearest neighbour in the dendrogram in FCT 30a2 is described as *Callitris preissii* and/or *Melaleuca lanceolata* forest and woodlands. Neither *Callitris preissii* or *Melaleuca lanceolata* were recorded and therefore, the quadrat is not representative of FCT 30a2. The quadrat contains *Acacia rostellifera* and species (**Asparagus asparagoides, *Ehrharta longiflora, *Euphorbia terracina* and **Fumaria capreolata*) common to FCT S11 (DEE 2019a; DCCEEW 2023d).
		WOODP-1 (30a2)	0.7241			
		TR06 (S11)	0.7692			
	MP12	SW10 (S11)	0.6667	S11/ 30a2	S11	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. FCT 30a2 is described as *Callitris preissii* and/or *Melaleuca lanceolata* forest and woodlands. Neither, *Callitris preissii* or *Melaleuca lanceolata* were recorded and therefore' the quadrat is not representative of FCT 30a2. The quadrat contains *Acacia rostellifera*, *Melaleuca systena* and other species common to FCT S11 (DEE 2019a; DCCEEW 2023d).
		WHILL-2 (29b)	0.6667			
		MI05 (S11)	0.6744			
EdSgW	DR06	TRIG-5 (24)	0.5904	S15/ 25	24	Lowest dissimilarity to FCT 24, defined as 'Northern Spearwood shrublands and woodlands'. The quadrat contains typical (**Lysimachia arvensis, *Briza maxima,* and *Desmocladus flexuosus*) and common (*Dianella revoluta, Hardenbergia comptoniana, Melaleuca systena* and *Xanthorrhoea preissii*) species for FCT 24 (DEE 2019a; DCCEEW 2023d). FCT S15 is the nearest neighbour within the dendrogram, however, is described by Keighery *et al.* (2012) as a weed group and the key dominant species recorded within the quadrat (*Eucalyptus decipiens, Acacia rostellifera* and *Spyridium globulosum*) are not present within S15.
		xbeer01 (24)	0.6119			
		bold07 (24)	0.6452			

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
EdSgW (cont.)	MP10	TRIG-5 (24)	0.4865	24/ 29b	24	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT 24, defined as 'Northern Spearwood shrublands and woodlands'. The quadrat contains species typical of (**Briza maxima,* and *Desmocladus flexuosus*) and common to (*Austrostipa flavescens, Dianella revoluta, Hardenbergia comptoniana, Lomandra maritima* and *Xanthorrhoea preissii*) FCT 24 (DEE 2019a; DCCEEW 2023d).
		Hepb02 (26b)	0.6203			
		star01 (24)	0.6216			
	MP11r	WOODP-1 (30a2)	0.7241	29a/ 19a/ S13	-	Due to the degraded condition, data was recorded utilising a relevé. The resulting dissimilarity values are notably high, suggesting a poor fit with the quadrats of Gibson *et al.* (1994) and Keighery *et al.* (2012) datasets. Not considered representative of any FCT.
		TR05 (S13)	0.7273			
		MHENRY-1 (30a2)	0.7576			
EgSgW	DR04	trigg08 (S15)	0.7143	S11/ S15	S11	The resulting dissimilarity values are notably high, suggesting a poor fit with the Gibson *et al.* (1994)and Keighery *et al.* (2012) datasets. Lowest dissimilarity to FCT S15; 'Weed group. Not allied with any supergroup'. FCT 17 has next lowest dissimilarity value, defined as '*Melaleuca rhaphiophylla – Gahnia trifida* seasonal wetlands'. However, the quadrat does not contain any *Melaleuca* species or sedges (Gibson *et al.* 1994). High dissimilarity values attributed to the high presence of weeds within the quadrat. The SSI dendrogram indicates affinities to FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. All dominant quadrat species, and most in the quadrat are shared with FCT 11.
		Bold17 (S15)	0.7778			
		cool 04 (17)	0.7838			
	MP02	m4601 (S11)	0.641	S11/ 30a2/ 24	S11	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. All dominant quadrat species, *Eucalyptus gomphocephala, Spyridium globulosum* and most of present in the quadrat are shared with FCT 11 (DEE 2019a; DCCEEW 2023d).
		Tokyu07 (29b)	0.6735			
		GARD04 (30a2)	0.6842			
	MP17	m4601 (S11)	0.6098	30a2/ S11	S11	Lowest dissimilarity to and some affinity in the dendrogram with FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. All dominant quadrat species, **Asparagus asparagoides, Eucalyptus gomphocephala, *Euphorbia terracina, Templetonia retusa, Spyridium globulosum,* and most present in the quadrat are shared with FCT 11 (DEE 2019a; DCCEEW 2023d).
		MHENRY-1 (30a2)	0.6667			
		bold06 (30a2)	0.6842			

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
MhTrS	DR07	NEER-10 (24)	0.6500	24/ 30a2/ S11	26a	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT 24, defined as 'Northern Spearwood shrublands and woodlands'. This FCT forms part of the Commonwealth listed Banksia Woodlands of the Swan Coastal Plain TEC. However, quadrat DR07 lacks the key characteristic Banksia tree species of this TEC, so is not representative of FCT 24. FCT 30a2 is described as *Callitris preissii* and/or *Melaleuca lanceolata* forest and woodlands. Neither *Callitris preissii* or *Melaleuca lanceolata* were recorded, and therefore, it is not representative of FCT 30a2. Floristic community type 26b 'Woodlands and mallees on limestone; and FCT 24 (the FCT that floristics most strongly indicate is represented) both co-occur with, or intergrade with the Honeymyrtle shrubland (DEE 2019a; DCCEEW 2023d). Quadrat DR07 contains species typical of the Honeymyrtle shrubland, occurs on limestone ridges, and has been diagnosed as the Commonwealth TEC using the relevant criteria, so is therefore inferred to be representative of FCT 26a.
		BOLD-4 (24)	0.6571			
		SW08 (S11)	0.6610			
	MP01	BOLD-4 (24)	0.5833	24/ 27	26a	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT 24, defined as 'Northern Spearwood shrublands and woodlands'. This FCT forms part of the Commonwealth listed Banksia Woodlands of the Swan Coastal Plain TEC. However, quadrat MP01 lacks the key characteristic Banksia tree species of this TEC, so is not representative of FCT 24. FCT 30a2 is described as *Callitris preissii* and/or *Melaleuca lanceolata* forest and woodlands. Neither *Callitris preissii* or *Melaleuca lanceolata* were recorded, and therefore, it is not representative of FCT 30a2. Floristic community type 26b 'Woodlands and mallees on limestone; and FCT 24 (the FCT that floristics most strongly indicate is represented) both co-occur with, or intergrade with the Honeymyrtle shrubland (DEE 2019a; DCCEEW 2023d). Quadrat DR07 contains species typical of the Honeymyrtle shrubland, occurs on limestone ridges, and has been diagnosed as the Commonwealth TEC using the relevant criteria, so is therefore inferred to be representative of FCT 26a.
		Bold05 (S11)	0.6000			
		CHIDPT-1 (24)	0.6232			
	MP04	BOLD-4 (24)	0.6000	24/ 30a2	26a	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT 24, defined as 'Northern Spearwood shrublands and woodlands'.
		MI04 (S11)	0.6000			
		TRIG-5 (24)	0.6053			
	MP13r	m4601 (S11)	0.5789	S11/ 30a2/ 24	26a	Due to the Degraded nature data was recorded utilising a relevé. Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT S11, defined as 'Northern *Acacia rostellifera – Melaleuca acerosa* (syn. *Melaleuca systena*) shrublands'. However, the dominant quadrat
		TR03 (S13)	0.6500			

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
MhTrS (cont.)		buck01 (24)	0.6522			species, *Melaleuca huegelii* does not occur in FCT S11, nor the next most similar, FCT S13 (Gibson *et al.* 1994). FCT 24 is the third most similar in species composition, defined as 'Northern Spearwood shrublands and woodlands'. This FCT contains most of the quadrat species (*Acacia cyclops, Banksia sessilis, Clematis linearifolia, Dianella revoluta* and more) as well as *Melaleuca huegelii,* however the quadrat did not record *Eucalyptus gomphocephala* and occurs on limestone outcropping rather than deeper soil typical of FCT 24. FCT 24 co-occurs with, or intergrades with the Honeymyrtle shrubland (DEE 2019a; DCCEEW 2023d). Relevé MP13r contains species typical of the Honeymyrtle shrubland, occurs on limestone ridges, and has been diagnosed as the Commonwealth TEC using the relevant criteria, so is therefore inferred to be representative of FCT 26a.
	MP14	bold22 (27) BOLD-4 (24) PEPGRV-1 (30a2)	0.6889 0.6897 0.6957	27/ 24/ 30a2	26a	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT 27, defined as 'Species poor mallees and shrublands on Limestone". However, this community is more common over 15 km north and south of the study area. FCT 24 has the next lowest dissimilarity value and some affinity in the dendrogram, defined as 'Northern Spearwood shrublands and woodlands', however the quadrat did not record *Eucalyptus gomphocephala* and occurs on limestone outcropping rather than deeper soil typical of FCT 24. . FCT 30a2 is described as *Callitris preissii* and/or *Melaleuca lanceolata* forest and woodlands. Neither *Callitris preissii* or *Melaleuca lanceolata* were recorded in the quadrat, and therefore, it is not representative of FCT 30a2. FCT 24 (the FCT that floristics most strongly indicate is represented) co-occurs with, or intergrades with the Honeymyrtle shrubland (DEE 2019a; DCCEEW 2023d). Quadrat MP14 contains species typical of the Honeymyrtle shrubland, occurs on limestone ridges, and has been diagnosed as the Commonwealth TEC using the relevant criteria, so is therefore inferred to be representative of FCT 26a.
	MP15	BU04 (29a) CHIDPT-1 (24)	0.6596 0.6721	27/ 29a/ 30a2/	26a	Lowest dissimilarity to FCT 29a, defined as 'Coastal shrubland on shallow sand' containing typical species such as *Acanthocarpus preissii, Rhagodia baccata* and *Spyridium globulosum* (Gibson et al (1994). None of these typical species were recorded within quadrat MP15. The

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
MhTrS (cont.)		BOLD-4 (24)	0.6765	24		presence of dominant *Melaleuca huegelii* and *Templetonia retusa* aligns better with FCT 24 with the next lowest dissimilarity. FCT 24 is defined as 'Northern Spearwood shrublands and woodlands', its typical species (*Briza maxima* and *Desmocladus flexuosus*) and common species (*Austrostipa flavescens, Dianella revoluta* and *Lysiandra calycina*) were present within the quadrat (DEE 2019a; DCCEEW 2023d). However, due to the lack of characteristic Banksia tree species, quadrat MP15 would not be representative of this FCT. Nearest neighbour in the dendrogram is FCT 27, defined as 'Species poor mallees and shrublands on Limestone' and is considered a closely allied vegetation community to FCT 26a. However, FCT 27 is largely restricted to the Yalgorup area and is either shrubland or mallee heath, variously dominated by Eucalyptus decipiens, Eucalyptus foecunda, Melaleuca systena or Hakea prostrata (without Melaleuca huegelii (DCCEEW 2023d). Quadrat MP15 contains species typical of the Honeymyrtle shrubland, occurs on limestone ridges, and has been diagnosed as the Commonwealth TEC using the relevant criteria, so is therefore inferred to be representative of FCT 26a.
	MP16	CHIDPT-1 (24)	0.7193	24/ 30a2	26a	The resulting dissimilarity values are notably high, suggesting a poor fit with the Gibson *et al.*(1994) and Keighery *et al.* (2012) datasets. Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT 24, defined as 'Northern Spearwood shrublands and woodlands'. This FCT forms part of the Commonwealth listed Banksia Woodlands of the Swan Coastal Plain TEC. However, quadrat MP16 lacks the key characteristic Banksia tree species of this TEC, so is not representative of FCT 24. FCT 30a2 is described as *Callitris preissii* and/or *Melaleuca lanceolata* forest and woodlands. Neither *Callitris preissii* nor *Melaleuca lanceolata* were recorded, and therefore, quadrat MP16 is not representative of FCT 30a2. Quadrat MP16 contains species typical of the Honeymyrtle shrubland, occurs on limestone ridges, and has been diagnosed as the Commonwealth TEC using the relevant criteria, so is therefore inferred to be representative of FCT 26a.
		PEPGRV-2 (30a2)	0.7200			
		cool 08 (24)	0.7288			
MrGtW	DR03	MTB-5 (17)	0.5385	S07/ 17/16	17	Lowest dissimilarity to and some affinity in the dendrogram with FCT 17, defined as '*Melaleuca rhaphiophylla – Gahnia trifida* seasonal wetlands'. The quadrat species are shared with FCT 17, including the presence of *Melaleuca rhaphiophylla* and *Gahnia trifida* (Gibson *et al.* 1994). FCT S07 is described as 'Northern woodlands to forest over tall sedgelands alongside permanent wetlands'. Due to the lack of *Eucalyptus rudis* it is not considered representative of FCT S07.
		Alfr02 (S07)	0.5455			
		bold21 (S07)	0.5714			

Vegetation Unit	Quadrat/ Relevé	Most Similar Gibson/ Keighery Quadrats (FCT)	Dissimilarity Value	Nearest on Dendrogram	Inferred FCT	Reasoning
MrGtW (cont.)	MP03	cool 04 (17)	0.4857	17	17	Lowest dissimilarity to FCT 17, defined as '*Melaleuca rhaphiophylla – Gahnia trifida* seasonal wetlands'. The quadrat species are shared with FCT 17, including the presence of *Melaleuca rhaphiophylla* and *Gahnia trifida* (Gibson *et al.* 1994). The resulting dendrogram indicates affinity to FCT 17.
		Possum2 (16)	0.5897			
		alfr02 (S07)	0.6129			
	MP07r	alfr02 (S07)	0.6154	S07/ 16/ 17	17	Lowest dissimilarity to and nearest neighbour in the dendrogram is FCT S07, defined as 'Northern woodlands to forests over tall sedgelands alongside permanent wetlands', likely due to the presence weeds (*Atriplex prostrata* and *Symphyotrichum subulatum*) shared by the quadrat and FCT S07. The next lowest dissimilarity is to FCT 17, defined as '*Melaleuca rhaphiophylla – Gahnia trifida* seasonal wetlands'. Characteristic species of FCT 17 , including *Melaleuca rhaphiophylla* and *Gahnia trifida,* occur within the quadrat (Gibson *et al.* 1994). The resulting dendrogram also indicates affinity to FCT 17.
		Possum2 (16)	0.7059			
		cool 01 (17)	0.7143			

5.2.4 Vegetation Condition

Based on a combination of FVC (2021) vegetation condition mapping, supplemented with results from FVC field observations in November 2023, vegetation condition mapping was carried out. The results of this determined that of the remnant vegetation within the study area (71.81 ha), majority is in 'Good' condition (44.1%), followed by 31.57% in 'Very Good' condition. Overall, the vegetation has been determined to range from 'Completely Degraded' to 'Excellent' condition.

Only 1.55% of remnant vegetation is considered to be 'Completely Degraded', as cleared areas such as parkland, tracks and infrastructure are excluded from this mapping. Areas of better-quality vegetation, ranging from 'Good' to 'Excellent', comprise 76.42% of remnant vegetation, and are mostly concentrated within the central corridor.

The study area also includes parkland, open water, revegetation areas, firebreaks, paths and clearings, which collectively occupy 35.82 ha (33.28%) of the total study area. The areas of the varying vegetation condition are summarised in **Table 15** and the spatial extent of this is presented in **Figure 21**.

Comparison of vegetation condition mapping from ELA (2018) and FVC (2021) to current mapping (**Figure 20**), show similar proportions, with 'Completely Degraded' and 'Very Good' condition vegetation decreasing and 'Good' condition vegetation increasing between 2018 and 2023 (**Figure 20**). No areas of 'Excellent' condition vegetation have previously been recorded.

Table 15 – Summary of Vegetation Condition in the Study Area

Vegetation Condition Rating		Area (ha)	% of Study Area	% of Bushland Area
Excellent		0.54	0.50	0.75
Very Good		22.67	21.06	31.57
Good		31.67	29.43	44.1
Degraded		15.82	14.7	22.03
Completely Degraded		1.11	1.03	1.55
Remaining areas	Other Uses (Includes cleared, firebreaks/tracks, other uses)	13.69	12.72	-
	Open Water	5.31	4.93	-
	Parkland	14.16	13.16	-
	Revegetation	**2.66**	**2.47**	**-**
TOTAL		**107.63**	**100**	**100**

^remaining area consist of firebreaks/tracks, open water, cleared, parkland and revegetation

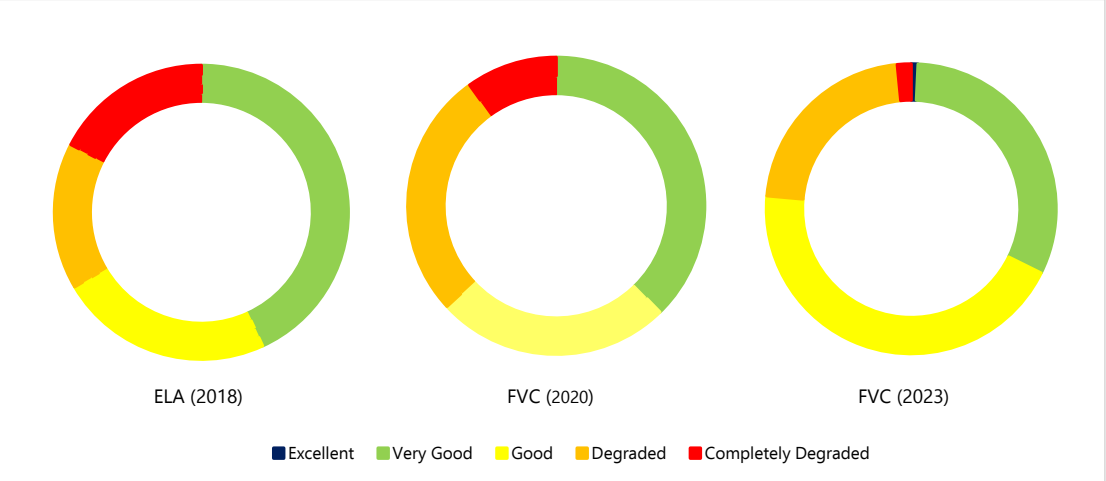


Figure 20 – Vegetation Condition Comparison

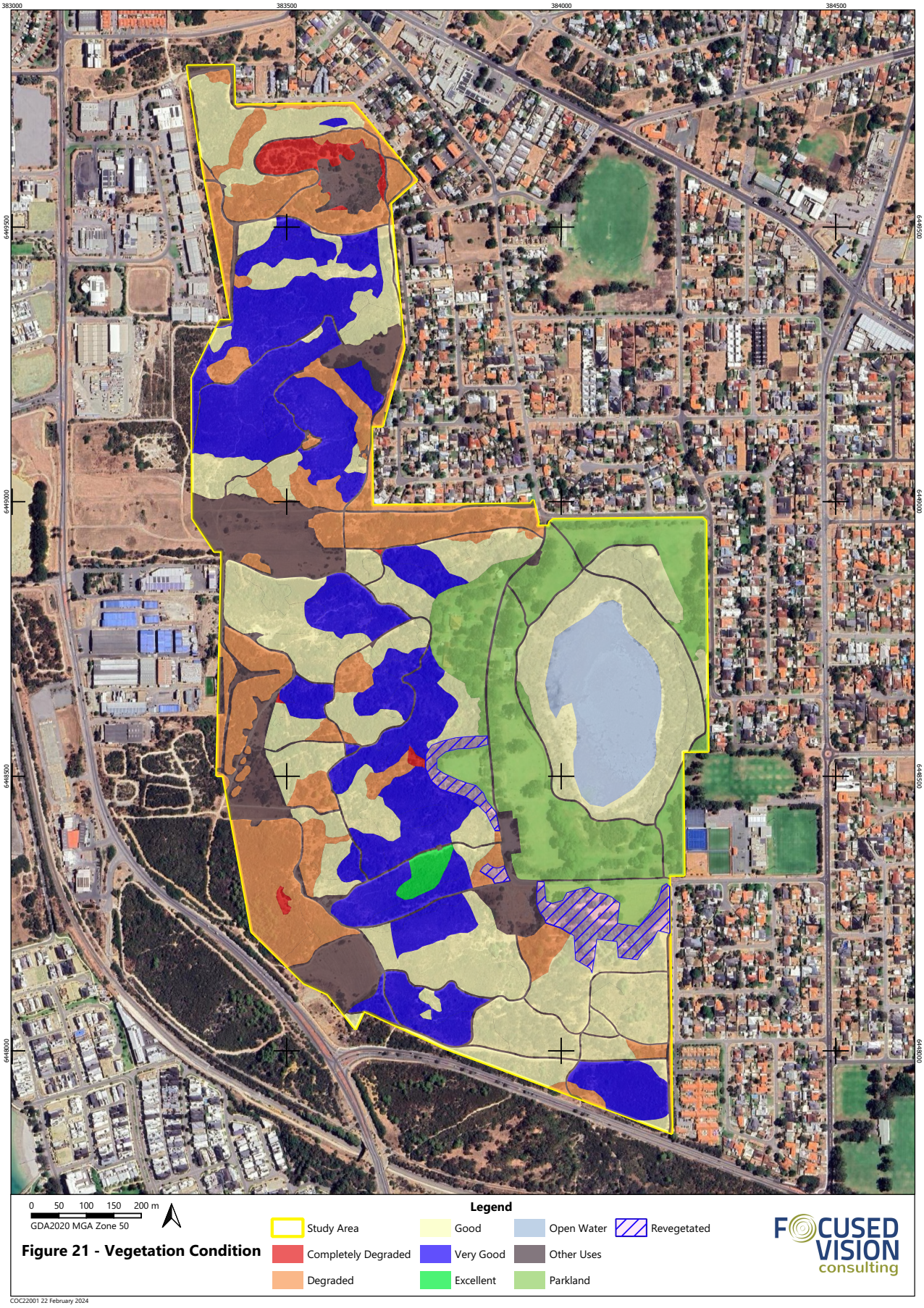


Figure 21 - Vegetation Condition

5.2.5 Threatened and Priority Ecological Communities

The desktop assessment identified nine TECs and/or PECs that are known to occur within the desktop study area (study area plus a 10 km buffer). Of these, known occurrences of the following three ecological communities and/or their buffer intersect the study area, and the presence of all three was confirmed during the previous FVC (2020) survey:

- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forest of the Swan Coastal Plain Ecological Community (EPBC Act: Critically Endangered; WA Conservation status: Priority 3)
- SCP 26a *Melaleuca huegelii – M. systena* shrublands of limestone ridges (FCT 26a) a State-listed Critically Endangered TEC
- SCP 24 Northern Spearwood shrublands and woodlands (FCT24) a State-listed Priority 3 PEC.

Additionally, since the previous survey, the *Honeymyrtle shrubland on limestone ridges of the SCP ecological community* (Honeymyrtle shrubland TEC) (EBPC Act: Critically Endangered) has been listed (after the database inquiry for the desktop assessment was lodged) as a TEC of Commonwealth significance. The previously recorded SCP 26a corresponds with this TEC (DCCEEW 2023d).

Each of these TECs and PECs and their presence and extent in the study area, based on relevant Conservation Advice and available information, are discussed in the following sections.

5.2.5.1 *Tuart Woodlands and Forests TEC*

The primary defining feature of the Tuart woodlands and forests TEC is the presence of *Eucalyptus gomphocephala* (Tuart) in the uppermost canopy (DEE 2019a). The ecological community intergrades and/or interacts with other ecological communities of the Swan Coastal Plain (DEE 2019a). The Tuart woodlands and forests TEC may be comprised of a number of different FCTs, which may include separately listed significant ecological communities, including FCTs S11 and SCP 24, that resulted from PATN^{TM} analysis (DEE 2019a). However, Tuart trees must be present to be representative of the TEC, and Tuart trees are not necessarily represented within all representations of the respective FCTs.

The Conservation Advice (DEE 2019a) states that the Tuart woodlands and forests TEC is primarily found in sandy, well-drained soils, though it can also occur in protected swales, saline and freshwater wetlands, riverbanks, and limestone slopes.

Tuart Woodlands and Forests TEC Characterisation

Since the presence of Tuart trees in the uppermost canopy is the key defining feature of the Tuart woodlands and forests TEC), areas supporting Tuarts (*Eucalyptus gomphocephala*) were assessed using a checklist developed from the Conservation Advice (DEE 2019a). The checklist includes the key characteristics of the TEC, including botanical region, soil and landform types and required or typical species (**Table 16**). The analysis results concluded that where Tuart trees occur (EgSgW, Parkland, Revegetation and Other Uses) vegetation is characteristic of the Tuart woodlands and forests TEC. This applied to all areas supporting Tuart trees except one instance where only a single Tuart is present, on the western boundary of the study area. The key characters of the TEC require that there are at least two Tuart trees separated by no more than 60 m, which creates a patch (**Table 16**).

Table 16 – Tuart Woodlands and Forests TEC Characterisation

Key Character	
a)	Swan Coastal Plain or Jarrah Forest location
b)	Mainly in the Spearwood and Quindalup dune systems, as well as the Bassendean dunes and Pinjarra Plain, along riverbanks and in wetlands. Extends beneath the Darling and Whicher escarpments, on a plateau east of the Swan Coastal Plain.
c)	Contains a minimum of two *Eucalyptus gomphocephala* (Tuart) situated within 60 m of each tree's canopy
d)	Mainly as woodland, though may be a closed forest, open forest, woodland, open woodland, closed mallee forest, open mallee forest, mallee woodland and open mallee woodland
e)	The dominant canopy species is tuart: *Eucalyptus gomphocephala*. Although other tree species might present, they are not as abundant as tuart
f)	With (although can be without) other trees including *Agonis flexuosa, Banksia grandis, Banksia attenuata, Eucalyptus marginata* or less commonly *Corymbia calophylla*

Tuart Woodlands and Forests Extent

The possible extent of the Tuart woodlands and forests TEC within the study area was, in accordance with the Conservation Advice (DEE 2019a), determined to be all areas containing a continuous Tuart canopy (incorporating a 30 m buffer around each of the canopies). These areas of Tuart canopy, plus the 30 m buffer, as per the Conservation Advice (DEE 2019a) are presented in **Figure 22**.

Tuart Woodlands and Forests Patches

The Tuart woodlands and forests patches within the study area have been mapped in accordance with the methodologies and requirements described in the approved Conservation Advice (DEE 2019a). The key criteria for an area to be considered for inclusion in a patch are the presence of Tuarts in the upper canopy and no more than 60 m distance between the canopy of two trees (which allows for a 30 m buffer around each canopy). Even in the absence of understorey (i.e. in parkland), Tuart trees can form a patch characteristic of the TEC. The patch mapping resulted in three Tuart woodlands and forests TEC patches, as presented in **Figure 22**.

In the context of regional patches, there are no areas supporting Tuart trees adjacent to the study area that would extend the patches within the study area into the local region.

Tuart Woodlands and Forests TEC Condition

Within the study area, the condition of the vegetation characteristic of the Tuart woodlands and forests TEC ranges from 'Completely Degraded' to 'Very Good', in accordance with the Keighery (1994) condition scale. Most of the remnant vegetation supporting Tuart trees in the study area is in 'Degraded' and 'Good' condition, with areas considered 'Other Uses', 'Revegetation', 'Parkland' considered 'Completely Degraded'. The implication of this condition rating and meeting condition thresholds is discussed further below.

Tuart Woodlands and Forests TEC Patch and Condition Thresholds

The Conservation Advice (DEE 2019a) specifies condition thresholds for patches to be considered eligible as part of the nationally protected ecological community. The following criteria apply:

- Patches <0.5 ha – NOT part of the nationally protected ecological community
- Patches at least 0.5 ha to <5 ha – patches in this range are presumed to be part of the nationally protected ecological community unless they do not meet the minimum condition
- Patches ≥5 ha – that meet the key diagnostic characteristics are part of the nationally protected ecological community.

This analysis has determined that all three of the mapped patches of Tuart woodland are eligible for inclusion as part of the nationally protected ecological community, covering an area of 28.50 ha, of which 27.75 ha occurs within the study area (**Table 17**).

Table 17 –Analysis of Tuart Woodlands and Forests Patches Against Condition and Biotic Thresholds

Patch Number	Area (ha)	Relevant Conservation Advice Patch Size Range	FVC Conservative Average Condition	Corresponding Conservation Advice Condition	Relevant Biotic Thresholds of the Conservation Advice Met in that Patch (DEE 2019a)	Eligible as TEC?
1	4.77	≥2 ha to <5 ha	Degraded - Good	(Moderate - High)	Plays an important landscape role, has a habitat role and shows regeneration	Yes
2	1.11	≥0.5 ha to <2 ha	Good	(Moderate - High)	Plays an important landscape role, has a habitat role and shows regeneration	Yes
3	22.62	>5 ha	Degraded	(Moderate - High)	N/A (minimum patch size met)	Yes

Tuart Woodlands and Forests PEC

Areas of defined Tuart Woodlands and Forests TEC are eligible as the Priority 3 ecological community, provided that the vegetation is a naturally occurring assemblage, as defined by the BC Act. A total of 12.07 ha of areas eligible as the Tuart Woodlands TEC occur as a naturally occurring assemblages and hence 12.07 ha of the study area (11.21%) is considered representative of the Tuart Woodlands and Forests PEC (**Figure 22**).

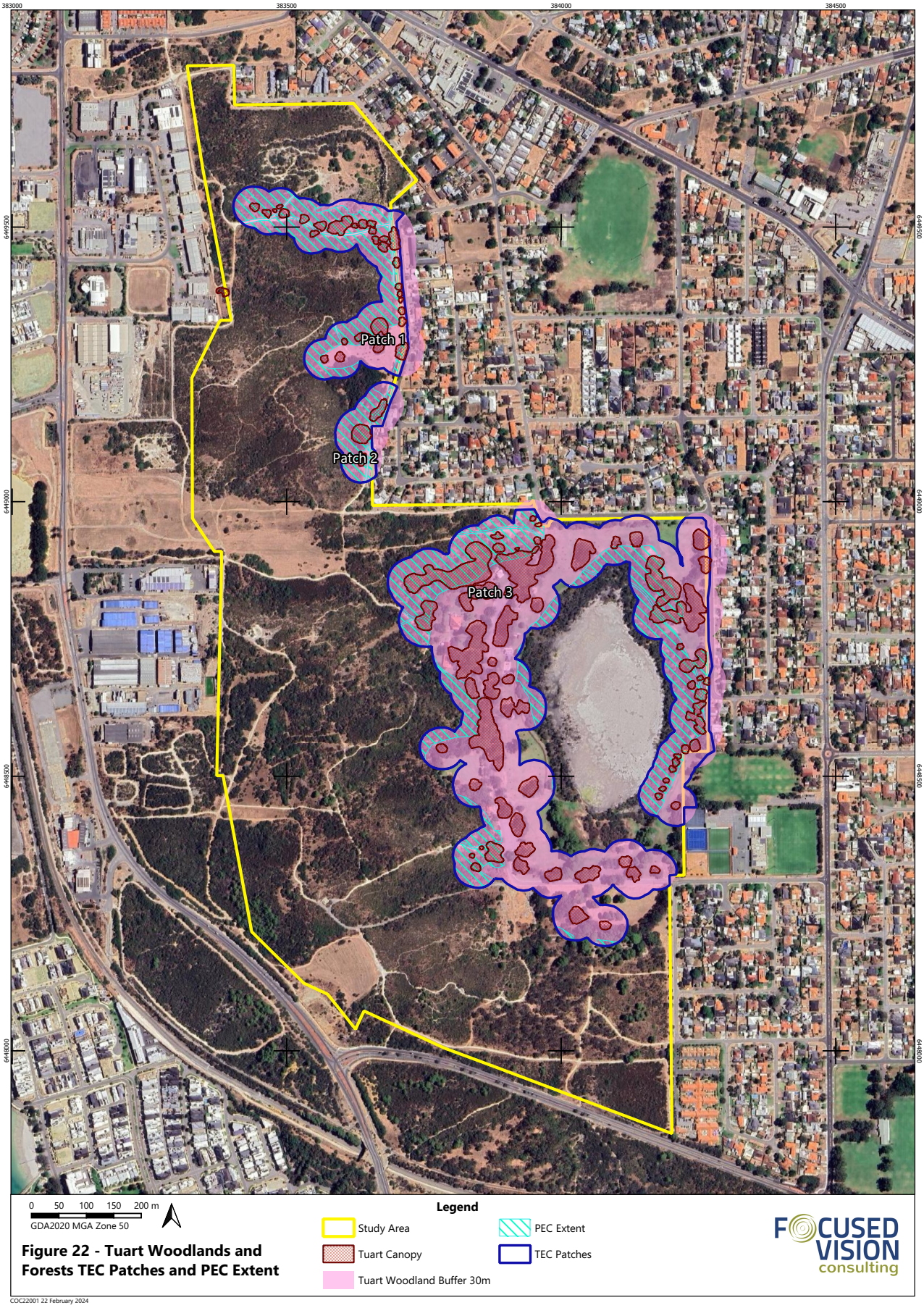


Figure 22 - Tuart Woodlands and Forests TEC Patches and PEC Extent

5.2.5.2 *Honeymyrtle shrubland on limestone ridges of the SCP TEC*

The Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion TEC (Honeymyrtle shrubland TEC) is listed in the Critically Endangered category of the Threatened Ecological Communities list under the EPBC Act (DCCEEW 2023d; e).

This ecological community is confined to the slopes and hilltops of limestone ridges of the Swan Coastal Plain (DCCEEW 2023d). It represents an assemblage of plants, animals, and other organisms found in warm temperate shrubland or heath habitats, predominantly dominated by species such as *Melaleuca huegelii, Melaleuca systena*, and/or *Banksia sessilis* commonly over by *Grevillea preissii*, *Spyridium globulosum*, *Acacia lasiocarpa*, and herby understory (DBCA 2023a; DCCEEW 2023d).

Honeymyrtle Shrubland TEC Characterisation, Extent and Patch Eligibility

In order to ascertain the equivalence of the defined vegetation units with the Honeymyrtle shrubland TEC, the sampled quadrats and relevés supporting *Melaleuca huegelii*, *Melalecua systena* and/or *Banksia sessilis* were assessed using a checklist developed from the Conservation Advice (DCCEEW 2023d). The checklist includes the key characteristics of the TEC, including botanical region, soil and landform types and required or typical species.

All quadrats within vegetation unit MhTrS meet the key diagnostic criteria, whilst quadrats/relevés within different vegetation units, did not (**Table 18**). The analysis results concluded that vegetation unit MhTrS exhibits characteristics typical of the Honeymyrtle shrubland TEC (DCCEEW 2023d).

Table 18 – Honeymyrtle Shrubland TEC Characterisation

Vegetation Unit		AcBsS		ArSgS					EdSgW		EgSg	MhTrS						
Quadrat/ Relevé		DR01	MP05r	DR02r	DR05	MP06	MP08	MP12	DR06	MP10	MP02	DR07	MP01	MP04	MP13r	MP14	MP15	MP16
Key Character (see Key)	a)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	b)	-	-	-	-	+	+	+	-	-	+	+	+	+	+	+	+	+
	c)	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+
	d)	+	+	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+
	e)	-	-	-	+	-	-	-	+	-	-	+	+	+	-	-	+	+
Confirmed		No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Key

a) Perth subregion (SWA02) of the Swan Coastal Plain IBRA7 Bioregion in Western Australia
b) Mainly on the ridge slopes and tops of limestone ridges and outcrops associated with Tamala Limestone
c) Mainly as shrubland, heath, or as thickets; and has less than 10% tree canopy cover
d) The dominant shrub layer species are: *Melaleuca huegelii*, *M. systena*, and/or *Banksia sessilis*. Commonly over *Acacia lasiocarpa, Grevillea preissii* and *Spyridium globulosum*
e) The ground layer is typically abundant with herbs, and may have a mossy ground cover

In accordance with the approved Conservation Advice, there is no minimum vegetation condition threshold for the Honeymyrtle shrubland TEC, and minimum patch size is 0.01 ha (DCCEEW 2023d). Therefore, also in accordance with the approved Conservation Advice (DCCEEW 2023d), the confirmed extent of the Honeymyrtle shrubland TEC within the study area was determined to be all areas meeting the key diagnostic criteria (**Table 18**). Where breaks of tracks and exposed areas of soils occur the patch extent was altered, separate patches are defined by breaks up to 30 m. A total of six patches, occur within the study area, ranging from 0.12 ha to 10.34 ha. In conclusion, all areas of the floristic community/vegetation unit MhTrS and representative of the Honeymyrtle shrubland TEC, are eligible for inclusion as the nationally protected TEC, covering an area of 23.25 ha (21.60%) in the study area (**Figure 23**).

5.2.5.3 *SCP26a Melaleuca huegelii – M. systena shrublands of limestone ridges TEC*

The *'Melaleuca huegelii – M. systena* shrublands of limestone ridges TEC (floristic community type 26a as originally described in (Gibson *et al.* 1994)*'* (SCP 26a) is considered to correspond to the Honeymyrtle shrublands TEC (DCCEEW 2023d; DBCA 2023c). This vegetation unit ranges from 'Completely Degraded' to 'Excellent' in the study area. Where vegetation was considered to be in 'Degraded' or poorer condition, including minor tracks and cleared areas (DCCEEW 2023d), it is not considered to be representative FCT 26a (since floristic analysis relies on vegetation being in approximately 'Good or better condition), and therefore, such degraded vegetation is not representative of the State-listed TEC. Areas considered representative of the SCP 26a TEC occupy 19.72 ha (18.32%) of the study area (**Figure 23**).

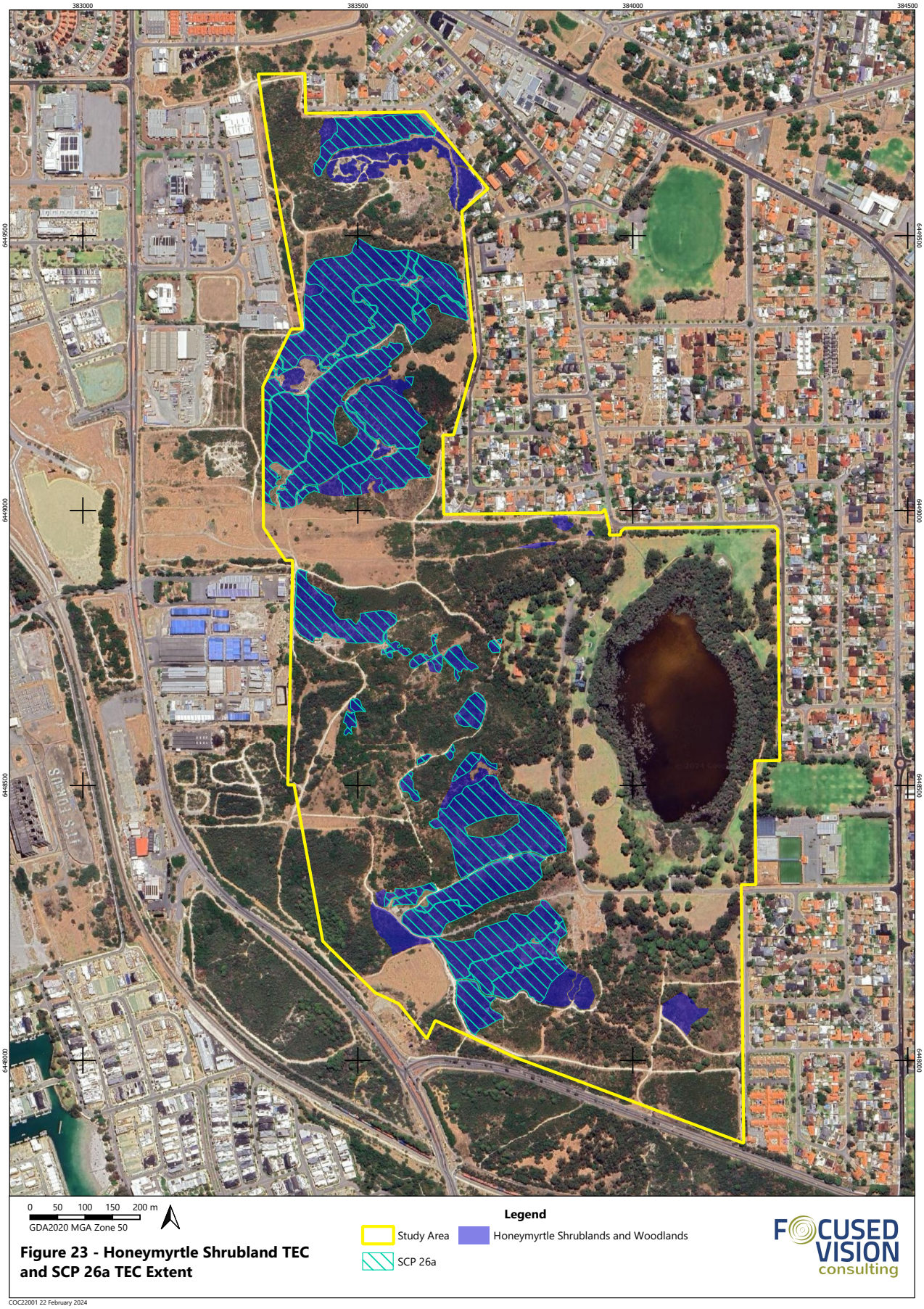


Figure 23 - Honeymyrtle Shrubland TEC and SCP 26a TEC Extent

5.2.5.4 *SCP24 Northern Spearwood Shrublands and Woodlands (FCT 24) PEC*

The Northern Spearwood shrublands and woodlands PEC (SCP 24) is defined as heaths with *Banksia attenuata* and *Banksia menziesii* with scattered *Eucalyptus gomphocephala* occurring on deeper soils occurring from Rockingham to Alkimos. This FCT is associated Tuart woodlands and forests TEC and the Banksia Woodlands TEC, providing key species are present. The heathlands in this group typically include *Banksia sessilis*, *Calothamnus quadrifidus* and *Schoenus grandiflorus* (DCCEEW 2016). Other species typical for this community are *Lepidosperma angustatum*, *Desmocladus flexuosus, Melaleuca systena, Xanthorrhoea preissii, Phyllanthus calycinus, Dianella revoluta, Conostylis aculeata* and *Lomandra maritima* (Gibson *et al.* 1994).

Floristic analysis against the Gibson *et al.* (1994) and Keighery *et al.* (2012) dataset indicates that vegetation unit EdSgW has the greatest affinity to FCT 24, supporting vegetation structure and composition similar to this FCT (**Table 14**). This vegetation unit ranges from 'Degraded' to 'Very Good'. Where vegetation was considered to be in 'Degraded' or poorer condition, it is not considered to be representative FCT 24, and therefore, not considered representative of the SCP 24 PEC. A total of 5.44 ha (5.05%) study area and is considered to represent the 'Northern Spearwood shrublands and woodlands' PEC (SCP 24) (**Figure 24**).

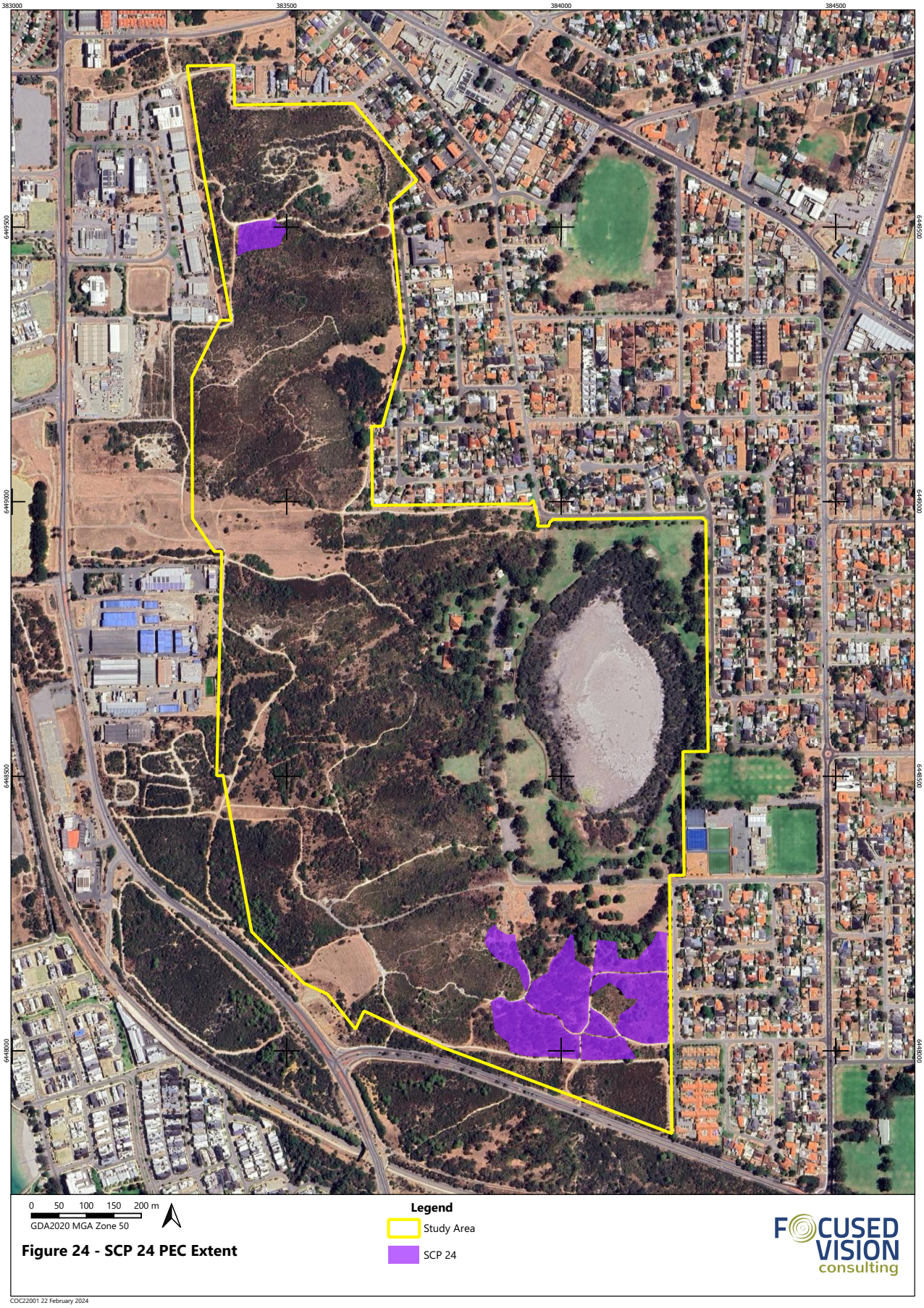


Figure 24 - SCP 24 PEC Extent

6 DISCUSSION

6.1 FLORA

A total of 156 flora species, from 118 genera and 56 families were recorded during the field survey. The study area supports a high proportion (48.72%) of introduced weeds species, which can be attributed to the disturbed state of some parts of the study area and its close proximity to cleared, recreational areas, infrastructure such as roads, residential, commercial, and industrial properties, and other land uses that necessitated the removal of vegetation and habitat.

Reassessment of the likelihood of occurrence of Threatened and Priority flora post-field survey confirmed that no Threatened flora are deemed possible or likely to occur naturally in the study area. However, three Priority flora are considered likely to occur, and two were recorded within the study area. This determination was based on field observations, indicating the absence of suitable habitat within the study area. Vegetation within the study area was traversed on foot, where possible. Given the level of survey intensity, the habitats provided, and the condition of the study area, further targeted surveys to detect additional significant flora species are not considered to be necessary. However, further surveys would better ascertain the population numbers and extents of the Priority recorded, discussed further below.

The survey confirmed the presence of two Priority flora species, identified during the desktop assessment. A total of 61 individuals of the Priority 3 species, *Pimelea calcicola* (found within vegetation units ArSgS, AcBsS and MhTrS), and one individual of the Priority 4 species, *Dodonaea hackettiana* (found in vegetation unit MhTrS), were recorded within the study area during the 2020 and 2023 FVC field assessments. It is likely that further surveys would record additional *Pimelea calcicola* individuals within the survey area. The single *Dodonaea hackettiana* plant recorded is likely to have been planted, as it is a commonly planted species within the City and therefore no others may occur. However, this species is also known to be locally abundant in natural and planted populations.

None of the recorded flora were found to be occurring outside their known range, as determined by known distributions from WA Herbarium records. None of the recorded flora are undescribed (not formally described and published in a scientific journal) taxa. Nineteen taxa were not able to be identified to species level and one was not able to be identified to genus level. None of these 19 taxa are considered likely to represent Threatened or Priority flora.

Out of the 38 introduced species recorded within the study area, two DP plants are listed under the BAM Act and are also classed as WoNS (**Asparagus asparagoides*, commonly known as Bridal Creeper and, **Lantana camara* commonly called Common Lantana), Bridal Creeper was found across the majority of the study area, whereas Common Lantana was found in three isolated areas within the middle of the study area, plus one individual in the north. Bridal Creeper is a highly invasive weed which spreads along roadsides, town allotments and invades dry coastal vegetation and undisturbed bushland as its seeds are spread by birds (DPRID 2017). Common Lantana is a highly invasive weed spreading along rivers and near wetlands, usually spread by birds, all parts of the plant are considered poisonous and is toxic to livestock (DPRID 2017). Any proposed activities in the study area should ensure no degradation of the surrounding environment as a result of further proliferation of Bridal Creeper or other weed species.

6.2 VEGETATION

6.2.1 Vegetation Units

Six vegetation units (AcBsS, ArSgS, EdSgW, EgSgW, MhTrS and MrGtW) were identified across the study area based on data collected in the 2023 and 2020 FVC surveys from a total of 18 quadrats and six relevés. These units constitute 66.72% (71.81 ha) of the study area, with the remaining area comprising open water (4.93% or 5.31 ha) and modified land (28.35% or 30.51 ha).

Of the six vegetation units, one, MrGtW, is associated with water availability, only occurring in association with a conservation category wetland, Manning Lake. The evidence for this conclusion is the dominant presence of the riparian species, *Melaleuca rhaphiophylla* (White *et al.* 2021).

6.2.2 Vegetation Condition

The condition of the vegetation within the study area ranges from 'Excellent' to 'Completely Degraded', with the majority found to be in 'Good' and 'Very Good' condition.

A large proportion of weeds were recorded, a reflection of the disturbed nature of the study area. This is evident as the study area is within or in proximity to cleared or disturbed areas including roads, residential, commercial and industrial properties. In addition, within the study area, there are numerous cleared recreational areas and access paths throughout Manning Park Reserve and adjacent areas, which are a source of existing and ongoing degradation in the forms of weed invasion, erosion and further clearing through expansion of the unrationalised path and trail network.

Areas that have been subject to disturbance and historic clearing support vegetation of poorer quality, which is evident along tracks and areas that have been extensively modified. Areas of higher-quality vegetation were predominantly observed in the central part of the study area, primarily within the vegetation unit MhTrW, which mainly ranges from 'Excellent' to 'Good' condition.

6.2.3 Vegetation Representation

EPA's Position Statement No. 2 lists a series of objectives which relate to biodiversity (EPA 2000). One of them is to protect at least 30% of the original extent of vegetation complexes in unconstrained areas and 10% in constrained areas (i.e. urban regions). All documented (Beard 1990) remaining vegetation extents in the study area are above the minimum 10% threshold level and therefore meet the EPA objective of retention for the purposes of biodiversity conservation.

6.2.4 Threatened and Priority Ecological Communities

Just over half of the study area (54.78 ha, 50.90%) was considered to represent one or more of the three TECs and two PECs identified, with TECs covering a total of 49.50 ha (45.99%) and PECs covering a total of 17.34 ha (16.11%) of the study area (**Figure 25**).

Among the six vegetation units, two, EdEgW and MhTrS, are characteristic of the SCP24 PEC and SCP26a TEC, respectively, based on FCT analysis. Additionally, the Tuart Woodlands and Forests TEC and Honeymyrtle shrubland TEC were identified to occur based on approved conservation advice. (**Table 19**).

Vegetation unit, MhTrS, features a dominant shrub layer characteristic of the Commonwealth-listed, Critically Endangered, Honeymyrtle shrubland TEC. Evaluation of this vegetation unit against the key diagnostic criteria outlined in the Conservation Advice concluded that it meets the condition thresholds to be eligible for inclusion as the nationally protected TEC.

Vegetation unit, EgSgW (and other areas of isolated Tuart trees), contains a canopy characteristic of the Commonwealth-listed, Critically Endangered, Tuart Woodlands and Forests TEC. Assessment of this vegetation

unit against key diagnostic criteria as per the Conservation Advice (DEE 2016) determined that there are three patches occupying a total area of 27.75 ha in the study area that are eligible for inclusion as the nationally protected TEC.

Table 19 – Threatened and Priority Ecological Communities Recorded in the Study Area

Abbreviated Identifier	EPBC Cons. Status	WA Cons. Status	Representative Vegetation	Area (ha)	Area (%)	% of Bushland Area
Tuart Woodlands and Forests	Critically Endangered		EgSgW, Parkland, Revegetation, Other Uses	27.75	25.78	38.64
Honeymyrtle shrubland	Critically Endangered	-	MhTrS	23.25	21.60	32.38
SCP26a	-	Critically Endangered	MhTrS (in 'Good' or better condition)	19.72	18.32	27.46
			Sub-Total TECs	**49.50**	**45.99**	**68.93**
Tuart Woodlands and Forests	-	Priority 3	EgSgW (in 'Good' or better condition)	12.07	11.21	16.81
SCP24	-	Priority 3	EdSgW (in 'Good' or better condition)	5.44	5.05	7.58
			Sub-Total TOTAL PECs	**17.34**	**16.11**	**24.15**
			TOTAL ALL TECs and PECs*	**54.78**	**50.90**	**76.28**

^Extent of Tuart Woodland and Forest TEC overlap with other TECs and PECs

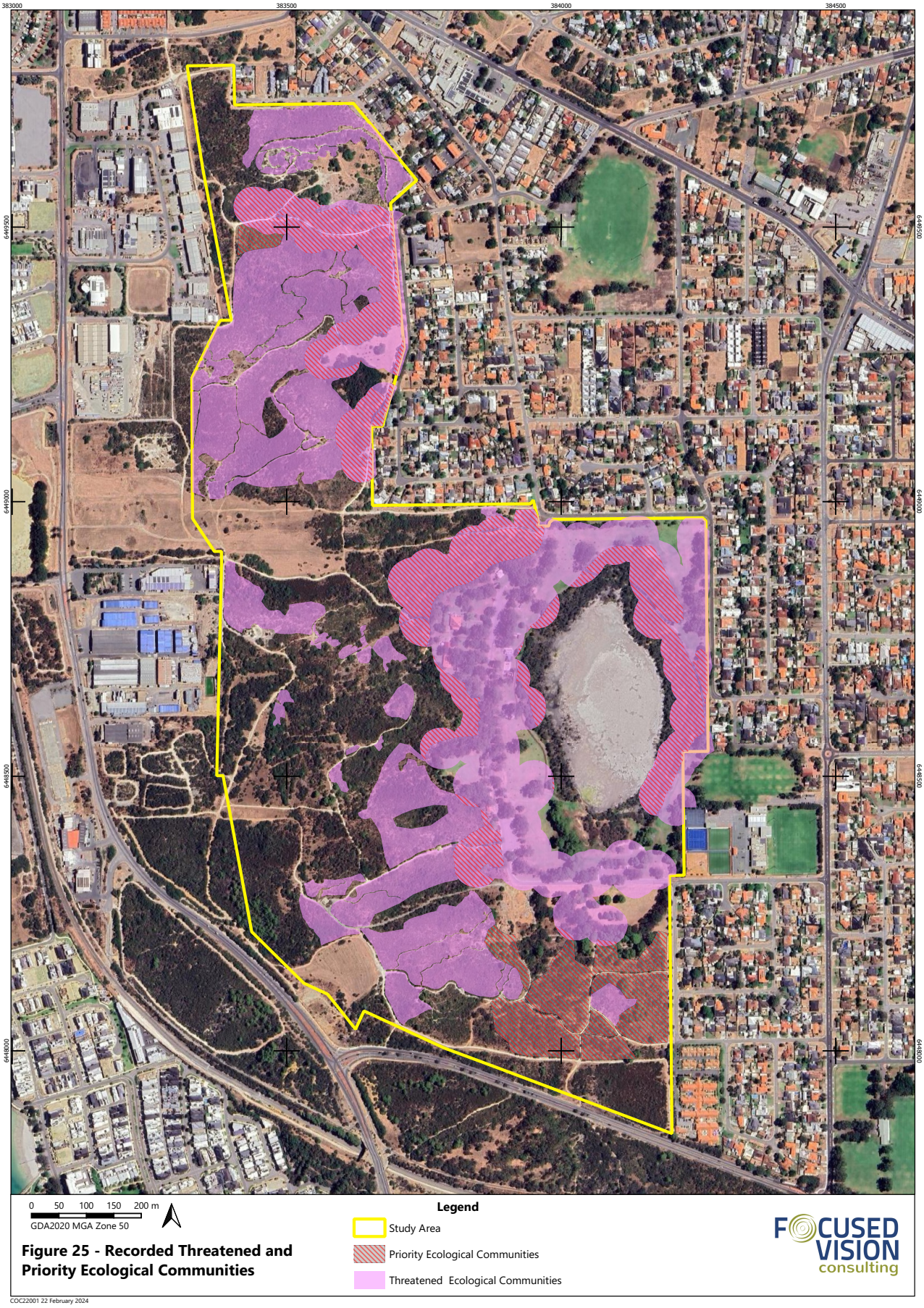


Figure 25 - Recorded Threatened and Priority Ecological Communities

6.3 VEGETATION OF SIGNIFICANCE

6.3.1 Nationally Significant Vegetation

The National significance of the vegetation units was assessed based on presence of:

- Populations of Threatened (EPBC listed) species
- TECs listed as nationally (EPBC) significant
- Ramsar Wetlands of International Importance (DCCEEW 2023c).

6.3.1.1 *Threatened Flora*

No EPBC-listed Threatened flora were recorded in the field assessment; therefore, none of the recorded vegetation units are of significance due to this factor.

6.3.1.2 *Threatened Ecological Communities*

Two EPBC listed TECs were recorded within the study area, the Tuart Woodlands and Forests TEC and the Honeymyrtle shrublands TEC. Vegetation units EgSgW and MhTrS are associated with these TECs and therefore may be considered to be of national significance.

6.3.1.3 *Ramsar Wetlands*

No Ramsar wetlands occur within the study area and therefore, none of the recorded vegetation units are of significance due to this factor.

6.3.2 State Significant Vegetation

The State significance of the vegetation units was assessed based on presence of:

- State-listed Threatened flora or TECs
- land within (or areas recommended by DBCA for inclusion) the State-managed conservation estate.

6.3.2.1 *Threatened Flora*

No State-listed Threatened flora were recorded within the study area, nor are any likely to occur, and therefore, none of the recorded vegetation units are of significance due to this factor.

6.3.2.2 *Threatened Ecological Communities*

One State listed TEC is considered to occur within the study area, SCP 26a. This TEC is considered to be represented by vegetation unit MhTrS which therefore may be of significance due to this factor.

6.3.2.3 *Conservation Estate*

No DBCA Conservation Reserves or Estates occur within the study area. Therefore, none of the defined vegetation units are significant due to this factor.

6.3.3 Regionally Significant Vegetation

The regional significance of the vegetation units was assessed based on:

- the presence of populations of Priority flora or ecological communities
- the presence of ESAs or areas relevant to a conservation scheme
- the presence of conservation category wetlands
- their role in maintaining important ecological processes
- the presence of flora species exhibiting range extensions or undescribed species
- having a restricted regional distribution
- being represented by less than 10% of the pre-European extent.

6.3.3.1 *Priority Flora*

Two Priority flora species, *Pimelea calcicola* (P3) and *Dodonaea hackettiana* (P4), were recorded within the study area in vegetation units AcBsS, ArSgS and MhTrS, which therefore, may considered to be of regional significance.

6.3.3.2 *Priority Ecological Communities*

Two PECs were recorded within the study area, Tuart Woodlands and Forests PEC and FCT 24. Vegetation units EgSgW and EdSgW are considered representative of these PECs and therefore may be considered to be of regional significance.

6.3.3.3 *ESAs or Conservation Areas*

The study area intersects with the buffer of one ESA and supports a Bush Forever Site, *Site 247 – Manning Lake and Adjacent Bushland, Hamilton Hill/Spearwood*. Therefore, all recorded vegetation units, AcBsS, ArSgS, EdSgW, EgSgW, MhTrS and MrGtW may considered to be of regional significance.

6.3.3.4 *Conservation Category Wetlands*

One Conservation Category Wetland, Manning Lake, occurs within the study area intersecting with remnant vegetation units EgSgW and MrGtW. Therefore, these vegetation units may considered to be of regional significance.

6.3.3.5 *Role in Maintaining Important Ecological Processes*

One of the recorded vegetation units, MrGtW, is associated with Manning Lake, which would rely on this vegetation to maintain important ecological processes associated with the wetland's function. Therefore, vegetation units MrGtW may be considered to be of regional significance.

6.3.3.6 *Range Extending and Undescribed Flora*

Of the recorded flora, none are considered to be exhibiting an extension beyond their currently documented range of occurrence, in accordance with records of the WAH (WAH 1998-), nor are any undescribed flora, and therefore, none of the recorded vegetation units are of significance due to this factor .

6.3.3.7 *Restricted Regional Representation and Distribution*

The one vegetation association defined by Shepherd *et al.* (2002) and the two complexes defined by Heddle *et al.* (1980) that are supported by the study area are all well-represented and distributed regionally (**Section 3.4**), and therefore, none of the recorded vegetation units are of significance due to this factor.

6.3.3.8 *Extent Remaining*

The one vegetation association defined by Shepherd *et al.* (2002) and the two complexes defined by Heddle *et al.* (1980) that are supported by the study area are all currently represented by more than 10% of their pre-European extent (**Section 3.4**), and therefore, none of the recorded vegetation units are of significance due to this factor.

6.3.4 Locally Significant Vegetation

The local significance of the vegetation units was assessed based on:

- the presence of small, isolated communities
- the local extent (proportion) and/or distribution.

6.3.4.1 *Small, Isolated Communities*

Although some occurrences of some of the mapped vegetation units occur as small, isolated occurrences, they are all also represented in larger extents, and therefore, none are considered to be of local significance due to this factor.

6.3.4.2 *Limited Extent and Distribution*

One of the recorded vegetation units, MrGtW, is considered to be limited in its local distribution, restricted to the fringes of Manning Lake, and therefore, may be considered to be of local significance.

6.3.5 Summary of Vegetation Significance

The significant vegetation units of the study area, along with the aspects determining their significance, are summarised in **Table 20**. The level of significance for each vegetation unit is broadly summarised in **Table 21**.

Table 20 –Summary of Level of Potential Significance

Scale	Significance Aspect	Vegetation Units
National Significance	Populations of Threatened (EPBC listed) species	-
	Presence of EPBC listed TECs	EgSgW, MhTrS
	Presence of Ramsar wetlands	-
State Significance	Presence of State-listed Threatened flora	-
	Presence of State-listed TECs	MhTrS
	Land within in the Conservation Estate	-
Regional Significance	Presence of Priority flora	AcBsS, ArSgS, MhTrS
	Presence of PECs	EdSgW, EgSgW
	Presence of ESAs or areas relevant to a conservation scheme	AcBsS, ArSgS, EdSgW, EgSgW, MhTrS, MrGtW
	Presence of conservation category wetlands	EgSgW, MrGtW
	Role in maintaining important ecological processed	MrGtW
	Presence of flora species exhibiting a range extension	-
	Presence of undescribed flora	-
	Having a restricted regional representation and distribution	-
	Represented by less than 10% of the pre-European extent	-
Local Significance	Small, isolated communities	-
	Having a limited local extent and distribution	MrGtW

Table 21 – Summary of the Potential Significance of Vegetation Units

Vegetation Unit	Overall Significance – Factor of Significance	Area (ha)	Survey Area (%)
AcBsS	Regional Significance - Presence of Priority flora Regional Significance - Presence of ESAs or areas relevant to a conservation scheme	11.71	10.88
ArSgS	Regional Significance - Presence of Priority flora Regional Significance - Presence of ESAs or areas relevant to a conservation scheme	17.01	15.80
EdSgW	Regional Significance - Presence of PECs Regional Significance - Presence of ESAs or areas relevant to a conservation scheme	6.18	5.74
EgSgW	National Significance - Presence of EPBC listed TECs Regional Significance - Presence of PECs Regional Significance - Presence of ESAs or areas relevant to a conservation scheme Regional Significance - Presence of conservation category wetlands	6.56	6.10
MhTrS	National Significance - Presence of EPBC listed TEC State Significance – Presence of State-Listed TEC Regional Significance - Presence of Priority flora Regional Significance - Presence of ESAs or areas relevant to a conservation scheme	25.08	23.30
MrGtW	Regional Significance - Presence of conservation category wetlands Regional Significance - Role in maintaining important ecological processes Local Significance – Having limited local extent or distribution	5.27	4.90

6.3.6 Areas of Significant Floristic Value

Further to the areas of vegetation of significance listed above, vegetation supporting Priority flora, representative of TECs or PECs, and in 'Very Good' or better condition are considered areas of significant floristic value. These combined areas are presented in **Figure 26**.

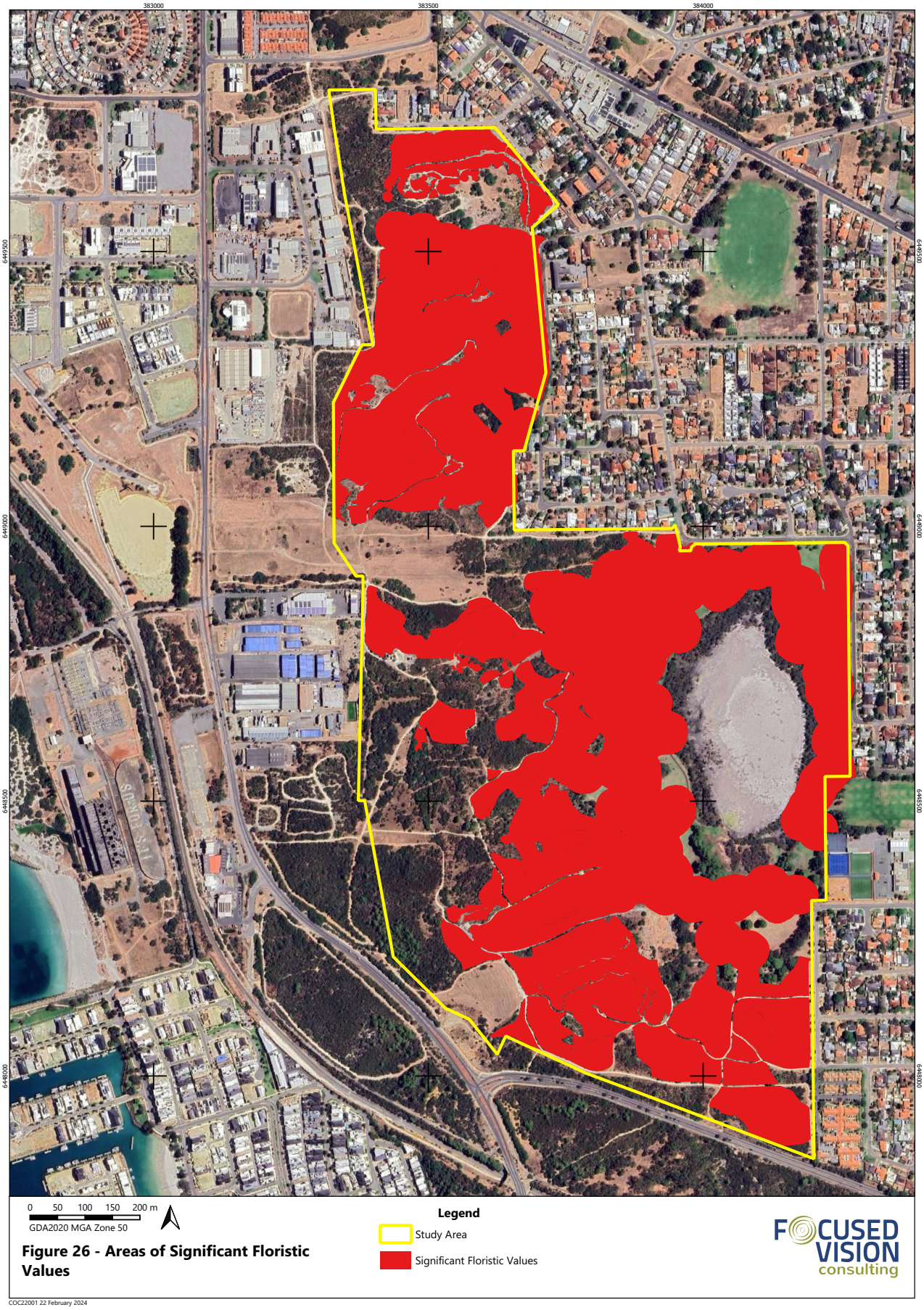


Figure 26 - Areas of Significant Floristic Values

7 CONCLUSIONS

The key findings, conclusions and recommendations arising from the flora and vegetation assessment within the study area are as follows:

- The timing of the field assessment (October - November) was considered optimal for the identification of flowering flora or annual and ephemeral species.
- No Threatened flora were recorded within the study area.
- Two Priority flora, *Pimelea calcicola* (Priority 3), and *Dodanoaea hackettiana* (Priority 4) were recorded within vegetation units ArSgS and MhTrS.
- Two of the recorded weed species, Bridal Creeper (**Asparagus asparagoides*) and Common Lantana (**Lantana camara*) are listed as a Declared Pest (DP) plant under the *Biosecurity and Agricultural Management* (BAM) Act (DPIRD 2017a) and as a WoNS (CISS 2021); however, as it is listed under the "Exempt' category, landholders are under no obligation to control infestations.
- None of the recorded flora species are exhibiting an extension beyond their currently documented range and no flora species were undescribed.
- A total of six intact vegetation communities AcBsS, ArSgS, EdSgW, EgSgW, MhTrS, and MrGtW were recorded and mapped for the study area.
- The vegetation condition within the study area was found to range from 'Completely Degraded' to 'Excellent', with the majority (29.43%) in 'Good' condition.
- The percentage of Bushland Area within the study area was 66.72% (71.81 ha)
- The desktop assessment identified three TECs and/or PECs and or their buffers that occur within the study area, but did not report that FCT *SCP 24 Northern Spearwood shrublands and woodlands* (a PEC) occurs within the study area.
- One vegetation unit, EgSgW, was found to meet key diagnostic criteria, and therefore be representative of the Commonwealth-Listed ecological community, Tuart woodlands and forests TEC. Three patches of Tuart woodlands and forests were confirmed to be part of the nationally protected ecological community, as they meet minimum condition and biotic thresholds.
- One vegetation unit, MhTrS, was found to meet diagnostic criteria, and therefore be representative of the Commonwealth-listed ecological community, Honeymyrtle shrubland TEC. Six patches of Honeymyrtle shrubland were mapped and all of these were confirmed to be part of the nationally protected ecological community as they meet the minimum condition threshold.
- One vegetation unit, MhTrS was considered representative of SCP 26a, which is a State-listed TEC.
- Portions of one vegetation unit, EdSgW that are in 'Good' or better condition are considered representative of the State-listed Priority 3 PEC, SCP 24 – Northern Spearwood Shrublands.
- Vegetation representing three TECs and two PECs was determined to occur across 53.94 ha (50.12%) of the study area, comprised of:
    - Tuart Woodlands and Forests TEC (Commonwealth-listed), covering 27.75 ha across vegetation unit EgSgW, and 'Parkland', 'Revegetation' and 'Other Uses' areas
    - Honeymyrtle Shrublands TEC (Commonwealth-listed), covering 23.25 ha across vegetation unit MhTrS
    - SCP 26a TEC (State-listed), covering 19.72 ha across 'Good' or better condition areas of vegetation unit MhTrS
    - Tuart Woodlands and Forest PEC (State-listed), covering 12.07 ha across areas eligible as the Tuart Woodlands and Forest TEC, associated with vegetation unit EgSgW where vegetation occurs as a native assemblage.

    - SCP 24 PEC (State-listed), covering 5.44 ha across 'Good' or better condition areas of vegetation unit EdSgW.
- All areas of vegetation supporting Priority flora, representative of TECs or PECs, and in 'Very Good' or better condition are considered areas of significant floristic value.

The following recommendations are suggested in relation to the development or enhancement of recreational facilities in Manning Park Reserve:

- Where possible, avoid any clearing of native vegetation
- Avoid clearing any 'Areas of Significant Floristic Value'
- Develop an environmental management plan to manage the impacts of recreational use of the park.

8 LIST OF PARTICIPANTS

The personnel who contributed to the project are summarised in **Table 22**.

Table 22 – Project Team

Name	Qualification	Years of Relevant Experience	Role
Kellie Bauer–Simpson Principal Ecologist	B.Sc. Biological Science	25	Project manager, study planning, report technical and authorization review
Linda Hosking Administration		20	Editorial support
Dr. Margaret Collins Botanist/Taxonomist	Ph.D. Botany M.Sc. Biotechnology and Molecular Biology B.Sc. Organic Chemistry and Microbiology (Hons.)	26	Flora identifications
Will Bauer–Simpson Technician	Cert. IV (Health and Safety)	14	Field safety and logistics planning, GIS mapping, spatial analysis, spatial data management
Dr Kristen Bleby Senior Ecologist	BSc. (Hons) Natural Resource Management PhD (Ecology)	11	Report technical review
Taryn Brebner Botanist/Ecologist (FB62000156)	BSc. (Conservation Biology)	7	Field survey, report writing
Megan Gray Botanist/Ecologist (FB62000334)	BSc. (Environmental Biology)	4	Field survey, spatial data management, GIS mapping, technical support, technical review
Olga Nazarova Botanist/Ecologist	BSc (Botany and Genetics)	4	Flora identification, report writing, floristic analysis, data management
Vaida Seikyte GIS Technician	B.Sc. Geography	2	GIS mapping, spatial analysis, spatial data management
Sarah Beckwith Graduate Botanist/Ecologist (FB62000535)	BSc. (Conservation Biology)	1	Field survey, report support
Aishwarya Gujarathi Botanist/Ecologist (FB62000581)	BSc. (Botany) MSc. Environmental Science	2	Field survey, report support

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APPENDIX A - DBCA NATURE MAP SEARCH REPORT

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Grevillea thelemanniana*	Critically endangered
Plantae	DICOT	*Acacia lasiocarpa* var. bracteolata long peduncle variant (G.J. Keighery 5026)	Priority 1
Plantae	DICOT	*Hydrocotyle striata*	Priority 1
Plantae	DICOT	*Bossiaea modesta*	Priority 2
Plantae	DICOT	*Angianthus micropodioides*	Priority 3
Plantae	DICOT	*Beyeria cinerea* subsp. *cinerea*	Priority 3
Plantae	DICOT	*Dampiera triloba*	Priority 3
Plantae	DICOT	*Jacksonia gracillima*	Priority 3
Plantae	DICOT	*Pimelea calcicola*	Priority 3
Plantae	DICOT	*Stylidium maritimum*	Priority 3
Plantae	DICOT	*Stylidium paludicola*	Priority 3
Plantae	DICOT	*Styphelia filifolia*	Priority 3
Plantae	DICOT	*Calothamnus graniticus* subsp. *leptophyllus*	Priority 4
Plantae	DICOT	*Dodonaea hackettiana*	Priority 4
Plantae	DICOT	*Grevillea olivacea*	Priority 4
Plantae	DICOT	*Hydrocotyle lemnoides*	Priority 4
Plantae	DICOT	*Jacksonia sericea*	Priority 4
Plantae	DICOT	*Stylidium longitubum*	Priority 4
Plantae	DICOT	?*Astroloma pallidum*	-
Plantae	DICOT	?*Dampiera linearis*	-
Plantae	DICOT	?*Lactuca serriola*	-
Plantae	DICOT	?*Solanum nigrum*	-
Plantae	DICOT	?*Wahlenbergia capensis*	-
Plantae	DICOT	*Acacia applanata*	-
Plantae	DICOT	*Acacia cochlearis*	-
Plantae	DICOT	*Acacia cyclops*	-
Plantae	DICOT	*Acacia divergens*	-
Plantae	DICOT	*Acacia huegelii*	-
Plantae	DICOT	*Acacia iteaphylla*	-
Plantae	DICOT	*Acacia lasiocarpa*	-
Plantae	DICOT	*Acacia lasiocarpa* var. *lasiocarpa*	-
Plantae	DICOT	*Acacia longifolia*	-
Plantae	DICOT	*Acacia longifolia* subsp. *longifolia*	-
Plantae	DICOT	*Acacia microbotrya*	-
Plantae	DICOT	*Acacia pulchella*	-
Plantae	DICOT	*Acacia pulchella* var. *glaberrima*	-
Plantae	DICOT	*Acacia pulchella* var. *glaberrima* x *pulchella* var. *pulchella*	-
Plantae	DICOT	*Acacia pulchella* var. *pulchella*	-
Plantae	DICOT	*Acacia rostellifera*	-
Plantae	DICOT	*Acacia saligna*	-
Plantae	DICOT	*Acacia saligna* subsp. *saligna*	-
Plantae	DICOT	*Acacia* sp.	-
Plantae	DICOT	*Acacia stenoptera*	-
Plantae	DICOT	*Acacia truncata*	-
Plantae	DICOT	*Acacia willdenowiana*	-
Plantae	DICOT	*Acacia xanthina*	-
Plantae	DICOT	*Acrotriche cordata*	-
Plantae	DICOT	*Adenanthos cygnorum* subsp. *cygnorum*	-
Plantae	DICOT	*Adenanthos obovatus*	-
Plantae	DICOT	*Adriana quadripartita*	-
Plantae	DICOT	*Ageratina adenophora*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Agonis flexuosa*	-
Plantae	DICOT	*Agonis flexuosa* var. *flexuosa*	-
Plantae	DICOT	*Ailanthus altissima*	-
Plantae	DICOT	*Aizoon pubescens*	-
Plantae	DICOT	*Allocasuarina fraseriana*	-
Plantae	DICOT	*Allocasuarina humilis*	-
Plantae	DICOT	*Alternanthera denticulata*	-
Plantae	DICOT	*Alternanthera nodiflora*	-
Plantae	DICOT	*Alyogyne huegelii*	-
Plantae	DICOT	*Alyogyne huegelii* var. *huegelii*	-
Plantae	DICOT	*Alyxia buxifolia*	-
Plantae	DICOT	*Amaranthus albus*	-
Plantae	DICOT	*Amaranthus blitum*	-
Plantae	DICOT	*Amaranthus caudatus*	-
Plantae	DICOT	*Amaranthus lividus*	-
Plantae	DICOT	*Amaranthus powellii*	-
Plantae	DICOT	*Amaranthus* sp.	-
Plantae	DICOT	*Amaranthus viridis*	-
Plantae	DICOT	*Anagallis arvensis*	-
Plantae	DICOT	*Anchusa capensis*	-
Plantae	DICOT	*Anredera cordifolia*	-
Plantae	DICOT	*Anthotium junciforme*	-
Plantae	DICOT	*Aotus cordifolia*	-
Plantae	DICOT	*Aotus gracillima*	-
Plantae	DICOT	*Aotus procumbens*	-
Plantae	DICOT	*Apium annuum*	-
Plantae	DICOT	*Apium prostratum*	-
Plantae	DICOT	*Apium prostratum* subsp. *prostratum* var. *prostratum*	-
Plantae	DICOT	*Arctotheca calendula*	-
Plantae	DICOT	*Arctotheca calendula* x *populifolia*	-
Plantae	DICOT	*Arctotheca populifolia*	-
Plantae	DICOT	*Arenaria leptoclados*	-
Plantae	DICOT	*Argemone ochroleuca* subsp. *ochroleuca*	-
Plantae	DICOT	*Argyranthemum frutescens*	-
Plantae	DICOT	*Argyranthemum frutescens* subsp. *foeniculaceum*	-
Plantae	DICOT	*Asclepias curassavica*	-
Plantae	DICOT	*Astartea* aff. *fascicularis*	-
Plantae	DICOT	*Astartea scoparia*	-
Plantae	DICOT	*Asteridea pulverulenta*	-
Plantae	DICOT	*Astroloma microcalyx*	-
Plantae	DICOT	*Astroloma pallidum*	-
Plantae	DICOT	*Astroloma xerophyllum*	-
Plantae	DICOT	*Atriplex cinerea*	-
Plantae	DICOT	*Atriplex hypoleuca*	-
Plantae	DICOT	*Atriplex isatidea*	-
Plantae	DICOT	*Atriplex prostrata*	-
Plantae	DICOT	*Babingtonia camphorosmae*	-
Plantae	DICOT	*Bacopa monnieri*	-
Plantae	DICOT	*Banksia attenuata*	-
Plantae	DICOT	*Banksia dallanneyi* subsp. *dallanneyi* var. *dallanneyi*	-
Plantae	DICOT	*Banksia grandis*	-
Plantae	DICOT	*Banksia ilicifolia*	-
Plantae	DICOT	*Banksia littoralis*	-
Plantae	DICOT	*Banksia menziesii*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Banksia sessilis* var. *cygnorum*	-
Plantae	DICOT	*Bartsia trixago*	-
Plantae	DICOT	*Beaufortia elegans*	-
Plantae	DICOT	*Bellardia trixago*	-
Plantae	DICOT	*Bellardia viscosa*	-
Plantae	DICOT	*Beyeria viscosa*	-
Plantae	DICOT	*Bidens pilosa*	-
Plantae	DICOT	*Billardiera fraseri*	-
Plantae	DICOT	*Boronia alata*	-
Plantae	DICOT	*Boronia crenulata*	-
Plantae	DICOT	*Boronia crenulata* subsp. *viminea*	-
Plantae	DICOT	*Boronia dichotoma*	-
Plantae	DICOT	*Boronia fastigiata*	-
Plantae	DICOT	*Boronia ramosa*	-
Plantae	DICOT	*Bossiaea eriocarpa*	-
Plantae	DICOT	*Brachyloma preissii*	-
Plantae	DICOT	*Brachyscome bellidioides*	-
Plantae	DICOT	*Brachyscome iberidifolia*	-
Plantae	DICOT	*Brachyscome pusilla*	-
Plantae	DICOT	*Brassica tournefortii*	-
Plantae	DICOT	*Brassica* x *napus*	-
Plantae	DICOT	*Buglossoides arvensis*	-
Plantae	DICOT	*Cakile maritima*	-
Plantae	DICOT	*Calandrinia brevipedata*	-
Plantae	DICOT	*Calandrinia calyptrata*	-
Plantae	DICOT	*Calandrinia corrigioloides*	-
Plantae	DICOT	*Calandrinia liniflora*	-
Plantae	DICOT	*Calceolaria tripartita*	-
Plantae	DICOT	*Callitriche brutia* subsp. *brutia*	-
Plantae	DICOT	*Calothamnus lateralis*	-
Plantae	DICOT	*Calothamnus quadrifidus*	-
Plantae	DICOT	*Calothamnus quadrifidus* subsp. *angustifolius*	-
Plantae	DICOT	*Calothamnus quadrifidus* subsp. *quadrifidus*	-
Plantae	DICOT	*Calothamnus sanguineus*	-
Plantae	DICOT	*Calothamnus validus*	-
Plantae	DICOT	*Calytrix angulata*	-
Plantae	DICOT	*Calytrix flavescens*	-
Plantae	DICOT	*Calytrix flavescens* x *fraseri*	-
Plantae	DICOT	*Calytrix fraseri*	-
Plantae	DICOT	*Capsella bursa-pastoris*	-
Plantae	DICOT	*Cardamine occulta*	-
Plantae	DICOT	*Cardiospermum grandiflorum*	-
Plantae	DICOT	*Carduus pycnocephalus*	-
Plantae	DICOT	*Carpobrotus aequilaterus*	-
Plantae	DICOT	*Carpobrotus edulis*	-
Plantae	DICOT	*Carpobrotus* sp.	-
Plantae	DICOT	*Carthamus lanatus*	-
Plantae	DICOT	*Cassytha flava*	-
Plantae	DICOT	*Cassytha racemosa*	-
Plantae	DICOT	*Casuarina cunninghamiana*	-
Plantae	DICOT	*Casuarina equisetifolia*	-
Plantae	DICOT	*Casuarina glauca*	-
Plantae	DICOT	*Casuarina obesa*	-
Plantae	DICOT	*Centaurea calcitrapa*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Centaurea melitensis*	-
Plantae	DICOT	*Centaurium erythraea*	-
Plantae	DICOT	*Centaurium tenuiflorum*	-
Plantae	DICOT	*Centella asiatica*	-
Plantae	DICOT	*Centranthus macrosiphon*	-
Plantae	DICOT	*Cerastium glomeratum*	-
Plantae	DICOT	*Chamaecytisus palmensis*	-
Plantae	DICOT	*Chamelaucium uncinatum*	-
Plantae	DICOT	*Chenopodium album*	-
Plantae	DICOT	*Chenopodium glaucum*	-
Plantae	DICOT	*Chenopodium macrospermum*	-
Plantae	DICOT	*Chenopodium murale*	-
Plantae	DICOT	*Chondrilla juncea*	-
Plantae	DICOT	*Chorizema cordatum*	-
Plantae	DICOT	*Chrysanthemoides monilifera* subsp. *monilifera*	-
Plantae	DICOT	*Cinnamomum camphora*	-
Plantae	DICOT	*Cirsium arvense* var. *arvense*	-
Plantae	DICOT	*Cirsium vulgare*	-
Plantae	DICOT	*Clematis linearifolia*	-
Plantae	DICOT	*Clematis pubescens*	-
Plantae	DICOT	*Comesperma calymega*	-
Plantae	DICOT	*Comesperma ciliatum*	-
Plantae	DICOT	*Comesperma confertum*	-
Plantae	DICOT	*Comesperma flavum*	-
Plantae	DICOT	*Comesperma integerrimum*	-
Plantae	DICOT	*Comesperma virgatum*	-
Plantae	DICOT	*Conospermum triplinervium*	-
Plantae	DICOT	*Conostephium pendulum*	-
Plantae	DICOT	*Conostephium preissii*	-
Plantae	DICOT	*Convolvulus arvensis*	-
Plantae	DICOT	*Convolvulus sabatius* subsp. *mauritanicus*	-
Plantae	DICOT	*Conyza albida*	-
Plantae	DICOT	*Conyza bonariensis*	-
Plantae	DICOT	*Conyza canadensis*	-
Plantae	DICOT	*Conyza* sp.	-
Plantae	DICOT	*Conyza sumatrensis*	-
Plantae	DICOT	*Corrigiola litoralis*	-
Plantae	DICOT	*Corymbia calophylla*	-
Plantae	DICOT	*Cotoneaster pannosus*	-
Plantae	DICOT	*Cotula coronopifolia*	-
Plantae	DICOT	*Cotula cotuloides*	-
Plantae	DICOT	*Cotula turbinata*	-
Plantae	DICOT	*Crassula colorata*	-
Plantae	DICOT	*Crassula colorata* var. *colorata*	-
Plantae	DICOT	*Crassula exserta*	-
Plantae	DICOT	*Crassula glomerata*	-
Plantae	DICOT	*Crassula natans*	-
Plantae	DICOT	*Crassula pedicellosa*	-
Plantae	DICOT	*Crassula* sp.	-
Plantae	DICOT	*Crepis foetida*	-
Plantae	DICOT	*Cristonia biloba* subsp. *biloba*	-
Plantae	DICOT	*Croninia kingiana*	-
Plantae	DICOT	*Cryptandra mutila*	-
Plantae	DICOT	*Cuscuta epithymum*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Cymbalaria muralis* subsp. *muralis*	-
Plantae	DICOT	*Dampiera linearis*	-
Plantae	DICOT	*Dampiera pedunculata*	-
Plantae	DICOT	*Datura metel*	-
Plantae	DICOT	*Daucus glochidiatus*	-
Plantae	DICOT	*Daviesia decurrens* subsp. *decurrens*	-
Plantae	DICOT	*Daviesia divaricata*	-
Plantae	DICOT	*Daviesia divaricata* subsp. *divaricata*	-
Plantae	DICOT	*Daviesia nudiflora* subsp. *nudiflora*	-
Plantae	DICOT	*Daviesia physodes*	-
Plantae	DICOT	*Daviesia triflora*	-
Plantae	DICOT	*Diplolaena dampieri*	-
Plantae	DICOT	*Diplopeltis huegelii* subsp. *huegelii*	-
Plantae	DICOT	*Diplotaxis muralis*	-
Plantae	DICOT	*Diplotaxis tenuifolia*	-
Plantae	DICOT	*Dischisma arenarium*	-
Plantae	DICOT	*Dischisma capitatum*	-
Plantae	DICOT	*Dittrichia graveolens*	-
Plantae	DICOT	*Dodonaea aptera*	-
Plantae	DICOT	*Drosera drummondii*	-
Plantae	DICOT	*Drosera erythrorhiza*	-
Plantae	DICOT	*Drosera erythrorhiza* subsp. *erythrorhiza*	-
Plantae	DICOT	*Drosera gigantea*	-
Plantae	DICOT	*Drosera glanduligera*	-
Plantae	DICOT	*Drosera macrantha*	-
Plantae	DICOT	*Drosera menziesii*	-
Plantae	DICOT	*Drosera paleacea* subsp. *paleacea*	-
Plantae	DICOT	*Drosera pallida*	-
Plantae	DICOT	*Drosera porrecta*	-
Plantae	DICOT	*Drosera* sp.	-
Plantae	DICOT	*Drosera* sp. "climbing"	-
Plantae	DICOT	*Drosera* sp. indet.	-
Plantae	DICOT	*Drosera stolonifera*	-
Plantae	DICOT	*Drosera subhirtella*	-
Plantae	DICOT	*Drosera zonaria*	-
Plantae	DICOT	*Dryandra nivea*	-
Plantae	DICOT	*Dryandra sessilis*	-
Plantae	DICOT	*Dryandra sessilis* var. *sessilis*	-
Plantae	DICOT	*Dysphania ambrosioides*	-
Plantae	DICOT	*Dysphania multifida*	-
Plantae	DICOT	*Epilobium ciliatum*	-
Plantae	DICOT	*Epilobium hirtigerum*	-
Plantae	DICOT	*Eremaea asterocarpa*	-
Plantae	DICOT	*Eremaea asterocarpa* subsp. *asterocarpa*	-
Plantae	DICOT	*Eremaea pauciflora*	-
Plantae	DICOT	*Eremaea pauciflora* var. *pauciflora*	-
Plantae	DICOT	*Eremophila glabra*	-
Plantae	DICOT	*Eremophila glabra* subsp. *albicans*	-
Plantae	DICOT	*Erigeron karvinskianus*	-
Plantae	DICOT	*Eriostemon spicatus*	-
Plantae	DICOT	*Erodium botrys*	-
Plantae	DICOT	*Erodium cicutarium*	-
Plantae	DICOT	*Erodium moschatum*	-
Plantae	DICOT	*Eryngium pinnatifidum*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Eryngium pinnatifidum* subsp. *pinnatifidum*	-
Plantae	DICOT	*Eucalyptus botryoides*	-
Plantae	DICOT	*Eucalyptus camaldulensis* subsp. *camaldulensis*	-
Plantae	DICOT	*Eucalyptus camaldulensis* subsp. *obtusa*	-
Plantae	DICOT	*Eucalyptus decipiens*	-
Plantae	DICOT	*Eucalyptus erythrocorys*	-
Plantae	DICOT	*Eucalyptus foecunda*	-
Plantae	DICOT	*Eucalyptus gomphocephala*	-
Plantae	DICOT	*Eucalyptus marginata*	-
Plantae	DICOT	*Eucalyptus marginata* subsp. *marginata*	-
Plantae	DICOT	*Eucalyptus patens*	-
Plantae	DICOT	*Eucalyptus petrensis*	-
Plantae	DICOT	*Eucalyptus rudis*	-
Plantae	DICOT	*Eucalyptus rudis* subsp. *rudis*	-
Plantae	DICOT	*Eucalyptus todtiana*	-
Plantae	DICOT	*Eucalyptus utilis*	-
Plantae	DICOT	*Euchilopsis linearis*	-
Plantae	DICOT	*Euphorbia arborea*	-
Plantae	DICOT	*Euphorbia helioscopia*	-
Plantae	DICOT	*Euphorbia maculata*	-
Plantae	DICOT	*Euphorbia paralias*	-
Plantae	DICOT	*Euphorbia peplus*	-
Plantae	DICOT	*Euphorbia prostrata*	-
Plantae	DICOT	*Euphorbia terracina*	-
Plantae	DICOT	*Eutaxia virgata*	-
Plantae	DICOT	*Exocarpos sparteus*	-
Plantae	DICOT	*Ficus carica*	-
Plantae	DICOT	*Foeniculum vulgare*	-
Plantae	DICOT	*Frankenia pauciflora*	-
Plantae	DICOT	*Fumaria bastardii*	-
Plantae	DICOT	*Fumaria capreolata*	-
Plantae	DICOT	*Fumaria muralis* subsp. *muralis*	-
Plantae	DICOT	*Galinsoga parviflora*	-
Plantae	DICOT	*Galium aparine*	-
Plantae	DICOT	*Galium murale*	-
Plantae	DICOT	*Gastrolobium capitatum*	-
Plantae	DICOT	*Gastrolobium ebracteolatum*	-
Plantae	DICOT	*Gastrolobium linearifolium*	-
Plantae	DICOT	*Gastrolobium nervosum*	-
Plantae	DICOT	*Gazania linearis*	-
Plantae	DICOT	*Geranium molle*	-
Plantae	DICOT	*Glebionis coronaria*	-
Plantae	DICOT	*Gnaphalium* sp. indet.	-
Plantae	DICOT	*Gnephosis angianthoides*	-
Plantae	DICOT	*Gomphocarpus fruticosus*	-
Plantae	DICOT	*Gompholobium aristatum*	-
Plantae	DICOT	*Gompholobium confertum*	-
Plantae	DICOT	*Gompholobium tomentosum*	-
Plantae	DICOT	*Gonocarpus pithyoides*	-
Plantae	DICOT	*Goodenia pulchella* subsp. Coastal Plain A (M. Hislop 634)	-
Plantae	DICOT	*Goodenia scapigera*	-
Plantae	DICOT	*Goodenia* sp.	-
Plantae	DICOT	*Grammatotheca bergiana* var. *bergiana*	-
Plantae	DICOT	*Gratiola pubescens*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Grevillea crithmifolia*	-
Plantae	DICOT	*Grevillea preissii* subsp. *preissii*	-
Plantae	DICOT	*Grevillea thelemanniana* subsp. *preissii*	-
Plantae	DICOT	*Grevillea vestita*	-
Plantae	DICOT	*Grevillea vestita* subsp. *vestita*	-
Plantae	DICOT	*Gyrostemon ramulosus*	-
Plantae	DICOT	*Hakea amplexicaulis*	-
Plantae	DICOT	*Hakea myrtoides*	-
Plantae	DICOT	*Hakea prostrata*	-
Plantae	DICOT	*Hakea varia*	-
Plantae	DICOT	*Hardenbergia comptoniana*	-
Plantae	DICOT	*Helianthus annuus*	-
Plantae	DICOT	*Helianthus tuberosus*	-
Plantae	DICOT	*Heliophila pusilla*	-
Plantae	DICOT	*Hemiandra linearis*	-
Plantae	DICOT	*Hemiandra pungens*	-
Plantae	DICOT	*Hemiandra pungens* var. *glabra*	-
Plantae	DICOT	*Hemiandra* sp.	-
Plantae	DICOT	*Hemigenia incana*	-
Plantae	DICOT	*Hemigenia sericea*	-
Plantae	DICOT	*Hibbertia amplexicaulis*	-
Plantae	DICOT	*Hibbertia commutata*	-
Plantae	DICOT	*Hibbertia cuneiformis*	-
Plantae	DICOT	*Hibbertia huegelii*	-
Plantae	DICOT	*Hibbertia huegelii complex*	-
Plantae	DICOT	*Hibbertia hypericoides*	-
Plantae	DICOT	*Hibbertia hypericoides* subsp. *hypericoides*	-
Plantae	DICOT	*Hibbertia racemosa*	-
Plantae	DICOT	*Hibbertia spicata* subsp. *leptotheca*	-
Plantae	DICOT	*Hibbertia stellaris*	-
Plantae	DICOT	*Hibbertia striata*	-
Plantae	DICOT	*Hibbertia subvaginata*	-
Plantae	DICOT	*Hibiscus diversifolius* subsp. *diversifolius*	-
Plantae	DICOT	*Homalanthus novo-guineensis*	-
Plantae	DICOT	*Homalosciadium homalocarpum*	-
Plantae	DICOT	*Hornungia procumbens*	-
Plantae	DICOT	*Hovea pungens*	-
Plantae	DICOT	*Hovea trisperma*	-
Plantae	DICOT	*Hovea trisperma* var. *trisperma*	-
Plantae	DICOT	*Hyalosperma cotula*	-
Plantae	DICOT	*Hybanthus calycinus*	-
Plantae	DICOT	*Hydrocotyle hispidula*	-
Plantae	DICOT	*Hydrocotyle ranunculoides*	-
Plantae	DICOT	*Hydrocotyle scutellifera*	-
Plantae	DICOT	*Hypocalymma angustifolium*	-
Plantae	DICOT	*Hypocalymma angustifolium* subsp. Swan Coastal Plain (G.J. Keighery 16777)	-
Plantae	DICOT	*Hypocalymma robustum*	-
Plantae	DICOT	*Hypochaeris glabra*	-
Plantae	DICOT	*Hypochaeris radicata*	-
Plantae	DICOT	*Ipomoea cairica*	-
Plantae	DICOT	*Ipomoea indica*	-
Plantae	DICOT	*Isotropis cuneifolia*	-
Plantae	DICOT	*Isotropis cuneifolia* subsp. *cuneifolia*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Ixiolaena viscosa*	-
Plantae	DICOT	*Jacksonia furcellata*	-
Plantae	DICOT	*Jacksonia sternbergiana*	-
Plantae	DICOT	*Kennedia coccinea*	-
Plantae	DICOT	*Kennedia prostrata*	-
Plantae	DICOT	*Kunzea glabrescens*	-
Plantae	DICOT	*Lactuca saligna*	-
Plantae	DICOT	*Lactuca serriola*	-
Plantae	DICOT	*Lagenifera huegelii*	-
Plantae	DICOT	*Lagenophora huegelii*	-
Plantae	DICOT	*Lagunaria patersonia*	-
Plantae	DICOT	*Lantana camara*	-
Plantae	DICOT	*Lasiopetalum glabratum*	-
Plantae	DICOT	*Latrobea tenella*	-
Plantae	DICOT	*Lawrencia spicata*	-
Plantae	DICOT	*Lechenaultia expansa*	-
Plantae	DICOT	*Lechenaultia floribunda*	-
Plantae	DICOT	*Lechenaultia linarioides*	-
Plantae	DICOT	*Leonotis leonurus*	-
Plantae	DICOT	*Leontodon rhagadioloides*	-
Plantae	DICOT	*Leontodon saxatilis*	-
Plantae	DICOT	*Lepidium didymum*	-
Plantae	DICOT	*Lepidium rotundum*	-
Plantae	DICOT	*Leptomeria cunninghamii*	-
Plantae	DICOT	*Leptomeria empetriformis*	-
Plantae	DICOT	*Leptomeria pauciflora*	-
Plantae	DICOT	*Leptomeria preissiana*	-
Plantae	DICOT	*Leptospermum erubescens*	-
Plantae	DICOT	*Leptospermum laevigatum*	-
Plantae	DICOT	*Leucophyta brownii*	-
Plantae	DICOT	*Leucopogon conostephioides*	-
Plantae	DICOT	*Leucopogon oxycedrus*	-
Plantae	DICOT	*Leucopogon parviflorus*	-
Plantae	DICOT	*Leucopogon polymorphus*	-
Plantae	DICOT	*Leucopogon propinquus*	-
Plantae	DICOT	*Leucopogon racemulosus*	-
Plantae	DICOT	*Leucopogon tenuis*	-
Plantae	DICOT	*Levenhookia pusilla*	-
Plantae	DICOT	*Levenhookia pusilla/stipitata*	-
Plantae	DICOT	*Levenhookia stipitata*	-
Plantae	DICOT	*Limonium sinuatum*	-
Plantae	DICOT	*Linaria maroccana*	-
Plantae	DICOT	*Linum marginale*	-
Plantae	DICOT	*Liparophyllum violifolium*	-
Plantae	DICOT	*Lobelia alata*	-
Plantae	DICOT	*Lobelia anceps*	-
Plantae	DICOT	*Lobelia gibbosa*	-
Plantae	DICOT	*Lobelia tenuior*	-
Plantae	DICOT	*Lobularia maritima*	-
Plantae	DICOT	*Logania vaginalis*	-
Plantae	DICOT	*Lophostemon* sp.	-
Plantae	DICOT	*Lotus angustissimus*	-
Plantae	DICOT	*Lotus subbiflorus*	-
Plantae	DICOT	*Lotus uliginosus*	-

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Plantae	DICOT	*Lupinus angustifolius*	-
Plantae	DICOT	*Lupinus cosentinii*	-
Plantae	DICOT	*Lupinus luteus*	-
Plantae	DICOT	*Lycium ferocissimum*	-
Plantae	DICOT	*Lycopersicon esculentum*	-
Plantae	DICOT	*Lysimachia arvensis*	-
Plantae	DICOT	*Lysinema elegans*	-
Plantae	DICOT	*Lysinema pentapetalum*	-
Plantae	DICOT	*Macarthuria apetala*	-
Plantae	DICOT	*Macarthuria australis*	-
Plantae	DICOT	*Malva arborea*	-
Plantae	DICOT	*Malva parviflora*	-
Plantae	DICOT	*Malva pseudolavatera*	-
Plantae	DICOT	*Marrubium vulgare*	-
Plantae	DICOT	*Matthiola incana*	-
Plantae	DICOT	*Medicago littoralis*	-
Plantae	DICOT	*Medicago polymorpha*	-
Plantae	DICOT	*Medicago sativa*	-
Plantae	DICOT	*Meionectes brownii*	-
Plantae	DICOT	*Melaleuca acerosa*	-
Plantae	DICOT	*Melaleuca armillaris* subsp. *armillaris*	-
Plantae	DICOT	*Melaleuca cuticularis*	-
Plantae	DICOT	*Melaleuca huegelii*	-
Plantae	DICOT	*Melaleuca huegelii* subsp. *huegelii*	-
Plantae	DICOT	*Melaleuca incana* subsp. *incana*	-
Plantae	DICOT	*Melaleuca lanceolata*	-
Plantae	DICOT	*Melaleuca lateritia*	-
Plantae	DICOT	*Melaleuca lateritia* x *teretifolia*	-
Plantae	DICOT	*Melaleuca linariifolia*	-
Plantae	DICOT	*Melaleuca nervosa*	-
Plantae	DICOT	*Melaleuca pauciflora*	-
Plantae	DICOT	*Melaleuca preissiana*	-
Plantae	DICOT	*Melaleuca rhaphiophylla*	-
Plantae	DICOT	*Melaleuca seriata*	-
Plantae	DICOT	*Melaleuca systena*	-
Plantae	DICOT	*Melaleuca teretifolia*	-
Plantae	DICOT	*Melaleuca thymoides*	-
Plantae	DICOT	*Melaleuca viminea*	-
Plantae	DICOT	*Melaleuca viminea subsp. viminea*	-
Plantae	DICOT	*Melilotus indicus*	-
Plantae	DICOT	*Mentha spicata*	-
Plantae	DICOT	*Mesembryanthemum crystallinum*	-
Plantae	DICOT	*Millotia tenuifolia*	-
Plantae	DICOT	*Minuartia hybrida*	-
Plantae	DICOT	*Mirabilis jalapa*	-
Plantae	DICOT	*Monoculus monstrosus*	-
Plantae	DICOT	*Monopsis debilis* var. *depressa*	-
Plantae	DICOT	*Monotaxis grandiflora* var. *grandiflora*	-
Plantae	DICOT	*Monotaxis occidentalis*	-
Plantae	DICOT	*Muehlenbeckia adpressa*	-
Plantae	DICOT	*Myoporum insulare*	-
Plantae	DICOT	*Myriocephalus occidentalis*	-
Plantae	DICOT	*Myriophyllum crispatum*	-
Plantae	DICOT	*Myriophyllum salsugineum*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Myriophyllum tillaeoides*	-
Plantae	DICOT	*Nemcia capitata*	-
Plantae	DICOT	*Nemcia reticulata*	-
Plantae	DICOT	*Nicotiana glauca*	-
Plantae	DICOT	*Nitraria billardierei*	-
Plantae	DICOT	*Nuytsia floribunda*	-
Plantae	DICOT	*Oenothera drummondii*	-
Plantae	DICOT	*Oenothera drummondii* subsp. *drummondii*	-
Plantae	DICOT	*Oenothera glazioviana*	-
Plantae	DICOT	*Oenothera indecora* subsp. *bonariensis*	-
Plantae	DICOT	*Oenothera jamesii*	-
Plantae	DICOT	*Oenothera laciniata*	-
Plantae	DICOT	*Oenothera mollissima*	-
Plantae	DICOT	*Oenothera speciosa*	-
Plantae	DICOT	*Oenothera stricta*	-
Plantae	DICOT	*Oenothera stricta* subsp. *stricta*	-
Plantae	DICOT	*Olea europaea*	-
Plantae	DICOT	*Olearia axillaris*	-
Plantae	DICOT	*Olearia rudis*	-
Plantae	DICOT	*Olearia* sp. Kennedy Range (G. Byrne 66)	-
Plantae	DICOT	*Opercularia hispidula*	-
Plantae	DICOT	*Opercularia vaginata*	-
Plantae	DICOT	*Ornduffia albiflora*	-
Plantae	DICOT	*Ornithopus compressus*	-
Plantae	DICOT	*Orobanche minor*	-
Plantae	DICOT	*Osteospermum ecklonis*	-
Plantae	DICOT	*Oxalis corniculata*	-
Plantae	DICOT	*Oxalis debilis* var. *corymbosa*	-
Plantae	DICOT	*Oxalis pes-caprae*	-
Plantae	DICOT	*Parentucellia latifolia*	-
Plantae	DICOT	*Parentucellia viscosa*	-
Plantae	DICOT	*Parietaria debilis*	-
Plantae	DICOT	*Parietaria judaica*	-
Plantae	DICOT	*Parthenocissus quinquefolia*	-
Plantae	DICOT	*Pelargonium capitatum*	-
Plantae	DICOT	*Pelargonium havlasae*	-
Plantae	DICOT	*Pelargonium littorale*	-
Plantae	DICOT	*Pelargonium* x *domesticum*	-
Plantae	DICOT	*Pericalymma ellipticum*	-
Plantae	DICOT	*Pericalymma ellipticum* var. *ellipticum*	-
Plantae	DICOT	*Persicaria decipiens*	-
Plantae	DICOT	*Persicaria hydropiper*	-
Plantae	DICOT	*Persicaria maculosa*	-
Plantae	DICOT	*Persicaria* sp.	-
Plantae	DICOT	*Persoonia saccata*	-
Plantae	DICOT	*Petrophile axillaris*	-
Plantae	DICOT	*Petrophile linearis*	-
Plantae	DICOT	*Petrophile serruriae*	-
Plantae	DICOT	*Petrorhagia dubia*	-
Plantae	DICOT	*Petrorhagia velutina*	-
Plantae	DICOT	*Petunia* x *atkinsiana*	-
Plantae	DICOT	*Philotheca spicata*	-
Plantae	DICOT	*Phyllanthus calycinus*	-
Plantae	DICOT	*Phyllota gracilis*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Physalis philadelphica*	-
Plantae	DICOT	*Phytolacca octandra*	-
Plantae	DICOT	*Pimelea ferruginea*	-
Plantae	DICOT	*Pimelea imbricata* var. *piligera*	-
Plantae	DICOT	*Pimelea leucantha*	-
Plantae	DICOT	*Pimelea rosea* subsp. *rosea*	-
Plantae	DICOT	*Pimelea suaveolens* subsp. *suaveolens*	-
Plantae	DICOT	*Pimelea sulphurea*	-
Plantae	DICOT	*Pithocarpa cordata*	-
Plantae	DICOT	*Pithocarpa pulchella*	-
Plantae	DICOT	*Pithocarpa pulchella* var. *melanostigma* / *pulchella* var. *pulchella*	-
Plantae	DICOT	*Pithocarpa pulchella* var. *pulchella*	-
Plantae	DICOT	*Pittosporum phylliraeoides*	-
Plantae	DICOT	*Plantago coronopus* subsp. *commutata*	-
Plantae	DICOT	*Plantago major*	-
Plantae	DICOT	*Plantago* sp. indet.	-
Plantae	DICOT	*Platysace compressa*	-
Plantae	DICOT	*Platysace filiformis*	-
Plantae	DICOT	*Platytheca galioides*	-
Plantae	DICOT	*Podolepis gracilis*	-
Plantae	DICOT	*Podolepis nutans*	-
Plantae	DICOT	*Podotheca angustifolia*	-
Plantae	DICOT	*Podotheca chrysantha*	-
Plantae	DICOT	*Podotheca gnaphalioides*	-
Plantae	DICOT	*Podotheca* sp.	-
Plantae	DICOT	*Polycarpon tetraphyllum*	-
Plantae	DICOT	*Polygala myrtifolia*	-
Plantae	DICOT	*Polygonum aviculare*	-
Plantae	DICOT	*Poranthera drummondii*	-
Plantae	DICOT	*Poranthera microphylla*	-
Plantae	DICOT	*Poranthera microphylla/moorokatta*	-
Plantae	DICOT	*Pseudognaphalium luteoalbum*	-
Plantae	DICOT	*Pseudognaphalium luteo-album*	-
Plantae	DICOT	*Ptilotus drummondii*	-
Plantae	DICOT	*Ptilotus drummondii* var. *drummondii*	-
Plantae	DICOT	*Ptilotus eremita*	-
Plantae	DICOT	*Ptilotus manglesii*	-
Plantae	DICOT	*Ptilotus polystachyus*	-
Plantae	DICOT	*Ptilotus sericostachyus* subsp. *sericostachyus*	-
Plantae	DICOT	*Ptilotus stirlingii* subsp. *stirlingii*	-
Plantae	DICOT	*Pultenaea ochreata*	-
Plantae	DICOT	*Pultenaea reticulata*	-
Plantae	DICOT	*Quinetia urvillei*	-
Plantae	DICOT	*Ranunculus colonorum*	-
Plantae	DICOT	*Ranunculus sp.*	-
Plantae	DICOT	*Ranunculus trilobus*	-
Plantae	DICOT	*Raphanus raphanistrum*	-
Plantae	DICOT	*Rapistrum rugosum*	-
Plantae	DICOT	*Regelia ciliata*	-
Plantae	DICOT	*Regelia inops*	-
Plantae	DICOT	*Reseda luteola*	-
Plantae	DICOT	*Retama raetam*	-
Plantae	DICOT	*Rhagodia baccata*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Rhagodia baccata* subsp. *baccata*	-
Plantae	DICOT	*Rhagodia baccata* subsp. *dioica*	-
Plantae	DICOT	*Rhagodia radiata*	-
Plantae	DICOT	*Rhamnus alaternus*	-
Plantae	DICOT	*Rhodanthe corymbosa*	-
Plantae	DICOT	*Ricinocarpos undulatus*	-
Plantae	DICOT	*Ricinus communis*	-
Plantae	DICOT	*Roepera similis*	-
Plantae	DICOT	*Rorippa nasturtium-aquaticum*	-
Plantae	DICOT	*Rumex acetosella*	-
Plantae	DICOT	*Rumex crispus*	-
Plantae	DICOT	*Rumex pulcher*	-
Plantae	DICOT	*Rumex pulcher* subsp. *pulcher*	-
Plantae	DICOT	*Sagina apetala*	-
Plantae	DICOT	*Sagina maritima*	-
Plantae	DICOT	*Salicornia quinqueflora*	-
Plantae	DICOT	*Salicornia quinqueflora* subsp. *quinqueflora*	-
Plantae	DICOT	*Salvia verbenaca*	-
Plantae	DICOT	*Samolus junceus*	-
Plantae	DICOT	*Samolus repens*	-
Plantae	DICOT	*Samolus repens var. paucifolius*	-
Plantae	DICOT	*Samolus repens var. repens*	-
Plantae	DICOT	*Santalum acuminatum*	-
Plantae	DICOT	*Sarcocornia quinqueflora*	-
Plantae	DICOT	*Scabiosa atropurpurea*	-
Plantae	DICOT	*Scaevola anchusifolia*	-
Plantae	DICOT	*Scaevola canescens*	-
Plantae	DICOT	*Scaevola crassifolia*	-
Plantae	DICOT	*Scaevola nitida*	-
Plantae	DICOT	*Scaevola repens* var. *repens*	-
Plantae	DICOT	*Scaevola thesioides* subsp. *thesioides*	-
Plantae	DICOT	*Schinus terebinthifolia*	-
Plantae	DICOT	*Scholtzia involucrata*	-
Plantae	DICOT	*Senecio condylus*	-
Plantae	DICOT	*Senecio diaschides*	-
Plantae	DICOT	*Senecio glossanthus* x *lautus*	-
Plantae	DICOT	*Senecio lautus subsp. maritimus*	-
Plantae	DICOT	*Senecio multicaulis* subsp. *multicaulis*	-
Plantae	DICOT	*Senecio pinnatifolius*	-
Plantae	DICOT	*Senecio pinnatifolius* var. *latilobus*	-
Plantae	DICOT	*Senecio vulgaris*	-
Plantae	DICOT	*Silene armeria*	-
Plantae	DICOT	*Silene gallica*	-
Plantae	DICOT	*Silene gallica* var. *gallica*	-
Plantae	DICOT	*Silene nocturna*	-
Plantae	DICOT	*Siloxerus humifusus*	-
Plantae	DICOT	*Sisymbrium irio*	-
Plantae	DICOT	*Sisymbrium orientale*	-
Plantae	DICOT	*Solanum americanum*	-
Plantae	DICOT	*Solanum linnaeanum*	-
Plantae	DICOT	*Solanum lycopersicum*	-
Plantae	DICOT	*Solanum nigrum*	-
Plantae	DICOT	*Solanum oldfieldii*	-
Plantae	DICOT	*Solanum simile*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Solanum symonii*	-
Plantae	DICOT	*Solidago chilensis*	-
Plantae	DICOT	*Soliva sessilis*	-
Plantae	DICOT	*Sonchus asper*	-
Plantae	DICOT	*Sonchus hydrophilus*	-
Plantae	DICOT	*Sonchus oleraceus*	-
Plantae	DICOT	*Spergularia marina*	-
Plantae	DICOT	*Sphaerolobium linophyllum*	-
Plantae	DICOT	*Sphaerolobium medium*	-
Plantae	DICOT	*Sphaerolobium vimineum*	-
Plantae	DICOT	*Spyridium globulosum*	-
Plantae	DICOT	*Stachys arvensis*	-
Plantae	DICOT	*Stackhousia huegelii*	-
Plantae	DICOT	*Stackhousia* sp.	-
Plantae	DICOT	*Stellaria media*	-
Plantae	DICOT	*Stellaria pallida*	-
Plantae	DICOT	*Stenopetalum gracile*	-
Plantae	DICOT	*Stirlingia latifolia*	-
Plantae	DICOT	*Stylidium androsaceum*	-
Plantae	DICOT	*Stylidium araeophyllum*	-
Plantae	DICOT	*Stylidium araeophyllum/neurophyllum*	-
Plantae	DICOT	*Stylidium brunonianum*	-
Plantae	DICOT	*Stylidium bulbiferum*	-
Plantae	DICOT	*Stylidium guttatum*	-
Plantae	DICOT	*Stylidium neurophyllum*	-
Plantae	DICOT	*Stylidium piliferum*	-
Plantae	DICOT	*Stylidium preissii*	-
Plantae	DICOT	*Stylidium repens*	-
Plantae	DICOT	*Stylidium scariosum*	-
Plantae	DICOT	*Stylidium schoenoides*	-
Plantae	DICOT	*Stylidium* sp.	-
Plantae	DICOT	*Suaeda australis*	-
Plantae	DICOT	*Symphyotrichum squamatum*	-
Plantae	DICOT	*Synaphea acutiloba*	-
Plantae	DICOT	*Synaphea gracillima*	-
Plantae	DICOT	*Synaphea spinulosa*	-
Plantae	DICOT	*Synaphea spinulosa* subsp. *spinulosa*	-
Plantae	DICOT	*Taraxacum khatoonae*	-
Plantae	DICOT	*Taraxacum* sp.	-
Plantae	DICOT	*Tecticornia halocnemoides*	-
Plantae	DICOT	*Tecticornia indica* subsp. *bidens*	-
Plantae	DICOT	*Tecticornia pergranulata* subsp. *pergranulata*	-
Plantae	DICOT	*Templetonia retusa*	-
Plantae	DICOT	*Tersonia cyathiflora*	-
Plantae	DICOT	*Tetragonia decumbens*	-
Plantae	DICOT	*Tetragonia tetragonoides*	-
Plantae	DICOT	*Tetratheca hirsuta* subsp. *viminea*	-
Plantae	DICOT	*Thomasia cognata*	-
Plantae	DICOT	*Thomasia triphylla*	-
Plantae	DICOT	*Threlkeldia diffusa*	-
Plantae	DICOT	*Trachymene coerulea* subsp. *coerulea*	-
Plantae	DICOT	*Trachymene pilosa*	-
Plantae	DICOT	*Tribulus terrestris*	-
Plantae	DICOT	*Trifolium ?campestre*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	DICOT	*Trifolium ? campestre/dubium*	-
Plantae	DICOT	*Trifolium angustifolium*	-
Plantae	DICOT	*Trifolium angustifolium* var. *angustifolium*	-
Plantae	DICOT	*Trifolium arvense* var. *arvense*	-
Plantae	DICOT	*Trifolium campestre*	-
Plantae	DICOT	*Trifolium campestre var. campestre*	-
Plantae	DICOT	*Trifolium campestre/dubium*	-
Plantae	DICOT	*Trifolium cernuum*	-
Plantae	DICOT	*Trifolium dubium*	-
Plantae	DICOT	*Trifolium fragiferum* var. *fragiferum*	-
Plantae	DICOT	*Trifolium hirtum*	-
Plantae	DICOT	*Trifolium resupinatum* var. *resupinatum*	-
Plantae	DICOT	*Trifolium scabrum*	-
Plantae	DICOT	*Trifolium* sp.	-
Plantae	DICOT	*Trifolium* sp. indet.	-
Plantae	DICOT	*Trifolium suffocatum*	-
Plantae	DICOT	*Trifolium tomentosum*	-
Plantae	DICOT	*Trifolium tomentosum var. tomentosum*	-
Plantae	DICOT	*Tripterococcus* sp. (A.S. George 14234)	-
Plantae	DICOT	*Tropaeolum majus*	-
Plantae	DICOT	*Trymalium albicans*	-
Plantae	DICOT	*Trymalium ledifolium* var. *ledifolium*	-
Plantae	DICOT	*Urospermum picroides*	-
Plantae	DICOT	*Ursinia anthemoides*	-
Plantae	DICOT	*Ursinia anthemoides* subsp. *anthemoides*	-
Plantae	DICOT	*Urtica urens*	-
Plantae	DICOT	*Utricularia multifida*	-
Plantae	DICOT	*Vellereophyton dealbatum*	-
Plantae	DICOT	*Veronica arvensis*	-
Plantae	DICOT	*Verticordia drummondii*	-
Plantae	DICOT	*Vicia benghalensis*	-
Plantae	DICOT	*Vicia hirsuta*	-
Plantae	DICOT	*Vicia sativa*	-
Plantae	DICOT	*Vicia sativa* subsp. *nigra*	-
Plantae	DICOT	*Villarsia* sp. indet.	-
Plantae	DICOT	*Viminaria juncea*	-
Plantae	DICOT	*Wahlenbergia ? capensis*	-
Plantae	DICOT	*Wahlenbergia capensis*	-
Plantae	DICOT	*Wahlenbergia preissii*	-
Plantae	DICOT	*Wahlenbergia* sp.	-
Plantae	DICOT	*Waitzia citrina*	-
Plantae	DICOT	*Waitzia nitida*	-
Plantae	DICOT	*Waitzia suaveolens*	-
Plantae	DICOT	*Wilsonia backhousei*	-
Plantae	DICOT	*Wilsonia humilis*	-
Plantae	DICOT	*Xanthium spinosum*	-
Plantae	DICOT	*Xanthosia huegelii*	-
Plantae	DICOT	*Xanthosia* sp. indet.	-
Plantae	DICOT	*Xylomelum occidentale*	-
Plantae	FERN	*Ophioglossum gramineum*	-
Plantae	FERN	*Phylloglossum drummondii*	-
Plantae	FERN	*Pteridium esculentum* subsp. *esculentum*	-
Plantae	FERN	*Selaginella gracillima*	-
Plantae	FERN	*Callitris preissii*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	FERN	*Macrozamia fraseri*	-
Plantae	FERN	*Macrozamia riedlei*	-
Plantae	GYMNO	*Pinus halepensis*	-
Plantae	GYMNO	*Pinus radiata*	-
Plantae	GYMNO	?*Asparagus asparagoides*	-
Plantae	GYMNO	?*Austrostipa compressa*	-
Plantae	GYMNO	?*Chamaescilla corymbosa*	-
Plantae	MONOCOT	*Caladenia huegelii*	Critically endangered
Plantae	MONOCOT	*Drakaea elastica*	Critically endangered
Plantae	MONOCOT	*Thelymitra variegata*	Critically endangered
Plantae	MONOCOT	*Diuris drummondii*	Endangered
Plantae	MONOCOT	*Austrostipa mundula*	Priority 3
Plantae	MONOCOT	*Cyathochaeta teretifolia*	Priority 3
Plantae	MONOCOT	*Phlebocarya pilosissima* subsp. *pilosissima*	Priority 3
Plantae	MONOCOT	*Microtis quadrata*	Priority 4
Plantae	MONOCOT	?*Asparagus asparagoides*	-
Plantae	MONOCOT	?*Austrostipa compressa*	-
Plantae	MONOCOT	?*Chamaescilla corymbosa*	-
Plantae	MONOCOT	?*Ehrharta calycina*	-
Plantae	MONOCOT	?*Microlaena stipoides*	-
Plantae	MONOCOT	?*Phlebocarya ciliata*	-
Plantae	MONOCOT	?*Pterostylis sanguinea*	-
Plantae	MONOCOT	?*Romulea rosea*	-
Plantae	MONOCOT	?*Rytidosperma occidentalis*	-
Plantae	MONOCOT	?*Sowerbaea laxiflora*	-
Plantae	MONOCOT	*Acanthocarpus preissii*	-
Plantae	MONOCOT	*Agave americana*	-
Plantae	MONOCOT	*Aira caryophyllea*	-
Plantae	MONOCOT	*Aira caryophyllea/cupaniana group*	-
Plantae	MONOCOT	*Aira/Pentameris* sp.	-
Plantae	MONOCOT	*Allium triquetrum*	-
Plantae	MONOCOT	*Althenia preissii*	-
Plantae	MONOCOT	*Amphibolis antarctica*	-
Plantae	MONOCOT	*Amphibolis griffithii*	-
Plantae	MONOCOT	*Amphibolis* sp.	-
Plantae	MONOCOT	*Amphipogon laguroides*	-
Plantae	MONOCOT	*Amphipogon laguroides* subsp. *laguroides*	-
Plantae	MONOCOT	*Amphipogon turbinatus*	-
Plantae	MONOCOT	*Anigozanthos humilis*	-
Plantae	MONOCOT	*Anigozanthos humilis* subsp. *humilis*	-
Plantae	MONOCOT	*Anigozanthos humilis* x *manglesii*	-
Plantae	MONOCOT	*Anigozanthos manglesii*	-
Plantae	MONOCOT	*Anigozanthos manglesii* subsp. *manglesii*	-
Plantae	MONOCOT	*Anigozanthos* sp.	-
Plantae	MONOCOT	*Arnocrinum preissii*	-
Plantae	MONOCOT	*Asparagus aethiopicus*	-
Plantae	MONOCOT	*Asparagus asparagoides*	-
Plantae	MONOCOT	*Asparagus plumosus*	-
Plantae	MONOCOT	*Asphodelus fistulosus*	-
Plantae	MONOCOT	*Austrostipa* ?*compressa*	-
Plantae	MONOCOT	*Austrostipa compressa*	-
Plantae	MONOCOT	*Austrostipa flavescens*	-
Plantae	MONOCOT	*Austrostipa hemipogon*	-
Plantae	MONOCOT	*Austrostipa nitida*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Austrostipa semibarbata*	-
Plantae	MONOCOT	*Austrostipa* sp.	-
Plantae	MONOCOT	*Austrostipa* sp. Marchagee (B.R. Maslin 1407)	-
Plantae	MONOCOT	*Austrostipa variabilis*	-
Plantae	MONOCOT	*Avellinia michelii*	-
Plantae	MONOCOT	*Avena barbata*	-
Plantae	MONOCOT	*Avena fatua*	-
Plantae	MONOCOT	*Baumea articulata*	-
Plantae	MONOCOT	*Baumea juncea*	-
Plantae	MONOCOT	*Baumea laxa*	-
Plantae	MONOCOT	*Baumea preissii*	-
Plantae	MONOCOT	*Baumea vaginalis*	-
Plantae	MONOCOT	*Bolboschoenus caldwellii*	-
Plantae	MONOCOT	*Brachypodium distachyon*	-
Plantae	MONOCOT	*Briza maxima*	-
Plantae	MONOCOT	*Briza minor*	-
Plantae	MONOCOT	*Bromus arenarius*	-
Plantae	MONOCOT	*Bromus diandrus*	-
Plantae	MONOCOT	*Bromus hordeaceus*	-
Plantae	MONOCOT	*Bromus* sp.	-
Plantae	MONOCOT	*Burchardia bairdiae*	-
Plantae	MONOCOT	*Burchardia congesta*	-
Plantae	MONOCOT	*Burchardia umbellata*	-
Plantae	MONOCOT	*Caesia micrantha*	-
Plantae	MONOCOT	*Caesia occidentalis*	-
Plantae	MONOCOT	*Caladenia ? arenicola*	-
Plantae	MONOCOT	*Caladenia ? discoidea*	-
Plantae	MONOCOT	*Caladenia ? flava*	-
Plantae	MONOCOT	*Caladenia arenicola*	-
Plantae	MONOCOT	*Caladenia arenicola* x *huegelii*	-
Plantae	MONOCOT	*Caladenia discoidea*	-
Plantae	MONOCOT	*Caladenia flava*	-
Plantae	MONOCOT	*Caladenia flava* subsp. *flava*	-
Plantae	MONOCOT	*Caladenia footeana*	-
Plantae	MONOCOT	*Caladenia georgei*	-
Plantae	MONOCOT	*Caladenia latifolia*	-
Plantae	MONOCOT	*Caladenia longicauda* subsp. *calcigena*	-
Plantae	MONOCOT	*Caladenia marginata*	-
Plantae	MONOCOT	*Caladenia nana* subsp. *nana*	-
Plantae	MONOCOT	*Caladenia nobilis*	-
Plantae	MONOCOT	*Caladenia occidentalis*	-
Plantae	MONOCOT	*Caladenia paludosa*	-
Plantae	MONOCOT	*Caladenia* sp.	-
Plantae	MONOCOT	*Caladenia* sp. indet.	-
Plantae	MONOCOT	*Caladenia vulgata*	-
Plantae	MONOCOT	*Calectasia narragara*	-
Plantae	MONOCOT	*Cartonema philydroides*	-
Plantae	MONOCOT	*Catapodium rigida*	-
Plantae	MONOCOT	*Catapodium rigidum*	-
Plantae	MONOCOT	*Cenchrus americanus*	-
Plantae	MONOCOT	*Cenchrus clandestinus*	-
Plantae	MONOCOT	*Cenchrus echinatus*	-
Plantae	MONOCOT	*Cenchrus longisetus*	-
Plantae	MONOCOT	*Cenchrus purpureus*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Cenchrus setaceus*	-
Plantae	MONOCOT	*Centrolepis drummondiana*	-
Plantae	MONOCOT	*Chaetanthus aristatus*	-
Plantae	MONOCOT	*Chamaescilla corymbosa*	-
Plantae	MONOCOT	*Chamaescilla corymbosa* var. *corymbosa*	-
Plantae	MONOCOT	*Chasmanthe floribunda*	-
Plantae	MONOCOT	*Chordifex sinuosus*	-
Plantae	MONOCOT	*Commelina benghalensis*	-
Plantae	MONOCOT	*Conostylis aculeata*	-
Plantae	MONOCOT	*Conostylis aculeata* subsp. *aculeata*	-
Plantae	MONOCOT	*Conostylis aculeata* subsp. *cygnorum*	-
Plantae	MONOCOT	*Conostylis aurea*	-
Plantae	MONOCOT	*Conostylis candicans*	-
Plantae	MONOCOT	*Conostylis candicans* subsp. *calcicola*	-
Plantae	MONOCOT	*Conostylis candicans* subsp. *candicans*	-
Plantae	MONOCOT	*Conostylis juncea*	-
Plantae	MONOCOT	*Conostylis serrulata*	-
Plantae	MONOCOT	*Conostylis setigera*	-
Plantae	MONOCOT	*Conostylis setigera* subsp. *setigera*	-
Plantae	MONOCOT	*Conostylis setosa*	-
Plantae	MONOCOT	*Conostylis sp.*	-
Plantae	MONOCOT	*Cortaderia selloana* subsp. *selloana*	-
Plantae	MONOCOT	*Corynotheca micrantha* var. *micrantha*	-
Plantae	MONOCOT	*Cryptostylis ovata*	-
Plantae	MONOCOT	*Cyanicula sericea*	-
Plantae	MONOCOT	*Cycnogeton huegelii*	-
Plantae	MONOCOT	*Cynodon dactylon*	-
Plantae	MONOCOT	*Cyperus congestus*	-
Plantae	MONOCOT	*Cyperus eragrostis*	-
Plantae	MONOCOT	*Cyperus gymnocaulos*	-
Plantae	MONOCOT	*Cyperus involucratus*	-
Plantae	MONOCOT	*Cyperus laevigatus*	-
Plantae	MONOCOT	*Cyperus polystachyos*	-
Plantae	MONOCOT	*Cyperus tenuiflorus*	-
Plantae	MONOCOT	*Cyrtostylis huegelii*	-
Plantae	MONOCOT	*Danthonia occidentalis*	-
Plantae	MONOCOT	*Dasypogon bromeliifolius*	-
Plantae	MONOCOT	*Desmocladus asper*	-
Plantae	MONOCOT	*Desmocladus fasciculatus*	-
Plantae	MONOCOT	*Desmocladus flexuosus*	-
Plantae	MONOCOT	*Deyeuxia quadriseta*	-
Plantae	MONOCOT	*Dianella revoluta*	-
Plantae	MONOCOT	*Dianella revoluta* var. *divaricata*	-
Plantae	MONOCOT	*Dichopogon capillipes*	-
Plantae	MONOCOT	*Dielsia stenostachya*	-
Plantae	MONOCOT	*Digitaria violascens*	-
Plantae	MONOCOT	*Disa bracteata*	-
Plantae	MONOCOT	*Diuris ? magnifica*	-
Plantae	MONOCOT	*Diuris corymbosa*	-
Plantae	MONOCOT	*Diuris corymbosa/magnifica*	-
Plantae	MONOCOT	*Diuris laxiflora*	-
Plantae	MONOCOT	*Diuris magnifica*	-
Plantae	MONOCOT	*Echinochloa crus-galli*	-
Plantae	MONOCOT	*Echinochloa crus-pavonis*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Ehrharta brevifolia*	-
Plantae	MONOCOT	*Ehrharta calycina*	-
Plantae	MONOCOT	*Ehrharta longiflora*	-
Plantae	MONOCOT	*Ehrharta villosa*	-
Plantae	MONOCOT	*Eleusine indica*	-
Plantae	MONOCOT	*Elythranthera brunonis*	-
Plantae	MONOCOT	*Elythranthera emarginata*	-
Plantae	MONOCOT	*Elythranthera* sp. indet.	-
Plantae	MONOCOT	*Epiblema grandiflorum*	-
Plantae	MONOCOT	*Eragrostis curvula*	-
Plantae	MONOCOT	*Eriochilus dilatatus*	-
Plantae	MONOCOT	*Eriochilus dilatatus* subsp. *multiflorus*	-
Plantae	MONOCOT	*Eriochilus helonomos*	-
Plantae	MONOCOT	*Eriochilus scaber* subsp. *scaber*	-
Plantae	MONOCOT	*Ferraria crispa*	-
Plantae	MONOCOT	*Ficinia nodosa*	-
Plantae	MONOCOT	*Fimbristylis velata*	-
Plantae	MONOCOT	*Freesia* aff. *leichtlinii*	-
Plantae	MONOCOT	*Freesia alba* x *leichtlinii*	-
Plantae	MONOCOT	*Freesia* x sp.	-
Plantae	MONOCOT	*Furcraea selloa*	-
Plantae	MONOCOT	*Gahnia trifida*	-
Plantae	MONOCOT	*Gladiolus caryophyllaceus*	-
Plantae	MONOCOT	*Haemodorum paniculatum*	-
Plantae	MONOCOT	*Haemodorum sp.*	-
Plantae	MONOCOT	*Haemodorum spicatum*	-
Plantae	MONOCOT	*Halodule uninervis*	-
Plantae	MONOCOT	*Halophila ovalis*	-
Plantae	MONOCOT	*Hensmania turbinata*	-
Plantae	MONOCOT	*Holcus lanatus*	-
Plantae	MONOCOT	*Homeria flaccida*	-
Plantae	MONOCOT	*Hordeum leporinum*	-
Plantae	MONOCOT	*Hypolaena exsulca*	-
Plantae	MONOCOT	*Isolepis cernua*	-
Plantae	MONOCOT	*Isolepis cernua* var. *setiformis*	-
Plantae	MONOCOT	*Isolepis marginata*	-
Plantae	MONOCOT	*Isolepis nodosa*	-
Plantae	MONOCOT	*Isolepis producta*	-
Plantae	MONOCOT	*Isolepis prolifera*	-
Plantae	MONOCOT	*Isolepis* sp.	-
Plantae	MONOCOT	*Juncus acutus* subsp. *acutus*	-
Plantae	MONOCOT	*Juncus acutus* subsp. *acutus* x *kraussii* subsp. *australiensis*	-
Plantae	MONOCOT	*Juncus bufonius*	-
Plantae	MONOCOT	*Juncus kraussii* subsp. *australiensis*	-
Plantae	MONOCOT	*Juncus microcephalus*	-
Plantae	MONOCOT	*Juncus pallidus*	-
Plantae	MONOCOT	*Lachenalia aloides*	-
Plantae	MONOCOT	*Lachenalia reflexa*	-
Plantae	MONOCOT	*Lachnagrostis filiformis*	-
Plantae	MONOCOT	*Lagurus ovatus*	-
Plantae	MONOCOT	*Laxmannia ramosa* subsp. *ramosa*	-
Plantae	MONOCOT	*Laxmannia squarrosa*	-
Plantae	MONOCOT	*Lemna disperma*	-
Plantae	MONOCOT	*Lepidosperma angustatum*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Lepidosperma gladiatum*	-
Plantae	MONOCOT	*Lepidosperma longitudinale*	-
Plantae	MONOCOT	*Lepidosperma oldhamii*	-
Plantae	MONOCOT	*Lepidosperma pubisquameum*	-
Plantae	MONOCOT	*Lepidosperma scabrum*	-
Plantae	MONOCOT	*Lepidosperma* sp.	-
Plantae	MONOCOT	*Lepidosperma* sp. (coastal terete varient) (BJK&NG 231)	-
Plantae	MONOCOT	*Lepidosperma* sp. Brixton Street broad inflorescence	-
Plantae	MONOCOT	*Lepidosperma* sp. Brixton Street narrow inflorescence	-
Plantae	MONOCOT	*Lepidosperma* sp. Darling Scarp	-
Plantae	MONOCOT	*Lepidosperma* sp. inland scabrum	-
Plantae	MONOCOT	*Lepidosperma* sp. Margaret River (B.J. Lepschi 1841)	-
Plantae	MONOCOT	*Lepidosperma squamatum*	-
Plantae	MONOCOT	*Lepidosperma squamatum* s.l.	-
Plantae	MONOCOT	*Leporella fimbriata*	-
Plantae	MONOCOT	*Leptocarpus coangustatus*	-
Plantae	MONOCOT	*Leptocarpus decipiens*	-
Plantae	MONOCOT	*Leptocarpus scariosus*	-
Plantae	MONOCOT	*Leptocarpus tephrinus*	-
Plantae	MONOCOT	*Leptoceras menziesii*	-
Plantae	MONOCOT	*Lepyrodia muirii*	-
Plantae	MONOCOT	*Lolium perenne*	-
Plantae	MONOCOT	*Lolium perenne* x *rigidum*	-
Plantae	MONOCOT	*Lolium rigidum*	-
Plantae	MONOCOT	*Lomandra ? caespitosa*	-
Plantae	MONOCOT	*Lomandra ? nigricans*	-
Plantae	MONOCOT	*Lomandra ? preissii*	-
Plantae	MONOCOT	*Lomandra ? suaveolens*	-
Plantae	MONOCOT	*Lomandra caespitosa*	-
Plantae	MONOCOT	*Lomandra hermaphrodita*	-
Plantae	MONOCOT	*Lomandra maritima*	-
Plantae	MONOCOT	*Lomandra micrantha* subsp. *micrantha*	-
Plantae	MONOCOT	*Lomandra nigricans*	-
Plantae	MONOCOT	*Lomandra preissii*	-
Plantae	MONOCOT	*Lomandra* sp.	-
Plantae	MONOCOT	*Lomandra suaveolens*	-
Plantae	MONOCOT	*Loxocarya flexuosa*	-
Plantae	MONOCOT	*Luzula meridionalis*	-
Plantae	MONOCOT	*Lyginia barbata*	-
Plantae	MONOCOT	*Lyginia barbata/imberbis*	-
Plantae	MONOCOT	*Lyginia imberbis*	-
Plantae	MONOCOT	*Lyginia* sp.	-
Plantae	MONOCOT	*Lyperanthus nigricans*	-
Plantae	MONOCOT	*Melinis repens*	-
Plantae	MONOCOT	*Mesomelaena pseudostygia*	-
Plantae	MONOCOT	*Microlaena stipoides*	-
Plantae	MONOCOT	*Microtis arenaria*	-
Plantae	MONOCOT	*Microtis brownii*	-
Plantae	MONOCOT	*Microtis cupularis*	-
Plantae	MONOCOT	*Microtis media*	-
Plantae	MONOCOT	*Microtis media* subsp. *media*	-
Plantae	MONOCOT	*Monadenia bracteata*	-
Plantae	MONOCOT	*Musa acuminata*	-
Plantae	MONOCOT	*Myrsiphyllum asparagoides*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Narcissus papyraceus* x *tazetta*	-
Plantae	MONOCOT	*Neurachne alopecuroidea*	-
Plantae	MONOCOT	*Ornithogalum arabicum*	-
Plantae	MONOCOT	*Orthrosanthus laxus* var. *laxus*	-
Plantae	MONOCOT	*Ottelia ovalifolia*	-
Plantae	MONOCOT	*Pancratium maritimum*	-
Plantae	MONOCOT	*Panicum miliaceum*	-
Plantae	MONOCOT	*Parapholis incurva*	-
Plantae	MONOCOT	*Paspalum dilatatum*	-
Plantae	MONOCOT	*Paspalum distichum*	-
Plantae	MONOCOT	*Paspalum urvillei*	-
Plantae	MONOCOT	*Paspalum vaginatum*	-
Plantae	MONOCOT	*Patersonia occidentalis*	-
Plantae	MONOCOT	*Patersonia occidentalis* (swamp form)	-
Plantae	MONOCOT	*Patersonia occidentalis* var. *angustifolia*	-
Plantae	MONOCOT	*Patersonia occidentalis* var. *occidentalis*	-
Plantae	MONOCOT	*Pauridia occidentalis* var. *occidentalis*	-
Plantae	MONOCOT	*Pauridia occidentalis* var. *quadriloba*	-
Plantae	MONOCOT	*Phalaris arundinacea* var. *arundinacea*	-
Plantae	MONOCOT	*Pheladenia deformis*	-
Plantae	MONOCOT	*Phlebocarya ciliata*	-
Plantae	MONOCOT	*Phlebocarya filifolia*	-
Plantae	MONOCOT	*Phoenix canariensis*	-
Plantae	MONOCOT	*Poa annua*	-
Plantae	MONOCOT	*Poa drummondiana*	-
Plantae	MONOCOT	*Poa porphyroclados*	-
Plantae	MONOCOT	*Poa pratensis*	-
Plantae	MONOCOT	*Poa* sp. indet.	-
Plantae	MONOCOT	*Poaceae* sp.	-
Plantae	MONOCOT	*Polypogon monspeliensis*	-
Plantae	MONOCOT	*Posidonia coriacea*	-
Plantae	MONOCOT	*Posidonia sinuosa*	-
Plantae	MONOCOT	*Posidonia* sp.	-
Plantae	MONOCOT	*Prasophyllum drummondii*	-
Plantae	MONOCOT	*Prasophyllum drummondii* x *regium*	-
Plantae	MONOCOT	*Prasophyllum fimbria*	-
Plantae	MONOCOT	*Prasophyllum gibbosum*	-
Plantae	MONOCOT	*Prasophyllum macrostachyum*	-
Plantae	MONOCOT	*Prasophyllum plumiforme*	-
Plantae	MONOCOT	*Prasophyllum regium*	-
Plantae	MONOCOT	*Prasophyllum* sp. indet.	-
Plantae	MONOCOT	*Pterostylis ?sanguinea*	-
Plantae	MONOCOT	*Pterostylis* aff. *nana*	-
Plantae	MONOCOT	*Pterostylis* aff. *nana* ?short sepal	-
Plantae	MONOCOT	*Pterostylis aspera*	-
Plantae	MONOCOT	*Pterostylis atrosanguinea*	-
Plantae	MONOCOT	*Pterostylis ectypha*	-
Plantae	MONOCOT	*Pterostylis nana* "short sepal"	-
Plantae	MONOCOT	*Pterostylis recurva*	-
Plantae	MONOCOT	*Pterostylis sanguinea*	-
Plantae	MONOCOT	*Pterostylis* sp.	-
Plantae	MONOCOT	*Pterostylis* sp. crinkled leaf (G.J. Keighery 13426)	-
Plantae	MONOCOT	*Pterostylis vittata*	-
Plantae	MONOCOT	*Pyrorchis nigricans*	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Romulea rosea*	-
Plantae	MONOCOT	*Romulea rosea* var. *australis*	-
Plantae	MONOCOT	*Romulea rosea* var. *communis*	-
Plantae	MONOCOT	*Rostraria cristata*	-
Plantae	MONOCOT	*Ruppia polycarpa*	-
Plantae	MONOCOT	*Ruppia* sp.	-
Plantae	MONOCOT	*Rytidosperma caespitosum*	-
Plantae	MONOCOT	*Rytidosperma occidentale*	-
Plantae	MONOCOT	*Schoenus* aff. *laevigatus*	-
Plantae	MONOCOT	*Schoenus brevisetis*	-
Plantae	MONOCOT	*Schoenus caespititius*	-
Plantae	MONOCOT	*Schoenus clandestinus*	-
Plantae	MONOCOT	*Schoenus curvifolius*	-
Plantae	MONOCOT	*Schoenus efoliatus*	-
Plantae	MONOCOT	*Schoenus grandiflorus*	-
Plantae	MONOCOT	*Schoenus lanatus*	-
Plantae	MONOCOT	*Schoenus rodwayanus*	-
Plantae	MONOCOT	*Schoenus subfascicularis*	-
Plantae	MONOCOT	*Secale cereale*	-
Plantae	MONOCOT	*Sisyrinchium rosulatum*	-
Plantae	MONOCOT	*Sorghum bicolor*	-
Plantae	MONOCOT	*Sorghum halepense*	-
Plantae	MONOCOT	*Sowerbaea laxiflora*	-
Plantae	MONOCOT	*Sparaxis pillansii*	-
Plantae	MONOCOT	*Spinifex hirsutus*	-
Plantae	MONOCOT	*Spinifex longifolius*	-
Plantae	MONOCOT	*Spinifex* x *alterniflorus*	-
Plantae	MONOCOT	*Sporobolus africanus*	-
Plantae	MONOCOT	*Sporobolus virginicus*	-
Plantae	MONOCOT	*Stenotaphrum secundatum*	-
Plantae	MONOCOT	*Stipa compressa*	-
Plantae	MONOCOT	*Stipa elegantissima*	-
Plantae	MONOCOT	*Stipa flavescens*	-
Plantae	MONOCOT	*Stipa* sp.	-
Plantae	MONOCOT	*Stipa* sp. indet.	-
Plantae	MONOCOT	*Stuckenia pectinata*	-
Plantae	MONOCOT	*Stypandra glauca*	-
Plantae	MONOCOT	*Syringodium isoetifolium*	-
Plantae	MONOCOT	*Tetraria octandra*	-
Plantae	MONOCOT	*Thalassodendron pachyrhizum*	-
Plantae	MONOCOT	*Thelymitra campanulata*	-
Plantae	MONOCOT	*Thelymitra flexuosa* x *vulgaris*	-
Plantae	MONOCOT	*Thelymitra graminea*	-
Plantae	MONOCOT	*Thelymitra mucida*	-
Plantae	MONOCOT	*Thelymitra tigrina*	-
Plantae	MONOCOT	*Thysanotus* ? *manglesianus/patersonii complex*	-
Plantae	MONOCOT	*Thysanotus* ? *thyrsoideus*	-
Plantae	MONOCOT	*Thysanotus arbuscula*	-
Plantae	MONOCOT	*Thysanotus arenarius*	-
Plantae	MONOCOT	*Thysanotus manglesianus*	-
Plantae	MONOCOT	*Thysanotus manglesianus/patersonii complex*	-
Plantae	MONOCOT	*Thysanotus multiflorus*	-
Plantae	MONOCOT	*Thysanotus patersonii*	-
Plantae	MONOCOT	*Thysanotus* sp.	-

KINGDOM	CLASS	TAXON	WA Cons Code
Plantae	MONOCOT	*Thysanotus* sp. indet.	-
Plantae	MONOCOT	*Thysanotus* sp. *manglesianus/patersonii group*	-
Plantae	MONOCOT	*Thysanotus sparteus*	-
Plantae	MONOCOT	*Thysanotus thyrsoideus*	-
Plantae	MONOCOT	*Thysanotus triandrus*	-
Plantae	MONOCOT	*Trachyandra divaricata*	-
Plantae	MONOCOT	*Tradescantia fluminensis*	-
Plantae	MONOCOT	*Tribonanthes violacea*	-
Plantae	MONOCOT	*Tricoryne elatior*	-
Plantae	MONOCOT	*Tricoryne tenella*	-
Plantae	MONOCOT	*Triglochin mucronata*	-
Plantae	MONOCOT	*Triglochin sp.*	-
Plantae	MONOCOT	*Triglochin striata*	-
Plantae	MONOCOT	*Typha domingensis*	-
Plantae	MONOCOT	*Typha orientalis*	-
Plantae	MONOCOT	*Urochilus sanguineus*	-
Plantae	MONOCOT	*Vulpia bromoides*	-
Plantae	MONOCOT	*Vulpia myuros*	-
Plantae	MONOCOT	*Vulpia myuros forma megalura*	-
Plantae	MONOCOT	*Vulpia myuros forma myuros*	-
Plantae	MONOCOT	*Vulpia* sp.	-
Plantae	MONOCOT	*Watsonia meriana*	-
Plantae	MONOCOT	*Watsonia meriana* var. *bulbillifera*	-
Plantae	MONOCOT	*Xanthorrhoea brunonis*	-

APPENDIX B - EPBC PROTECTED MATTERS SEARCH REPORT

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 19-Oct-2023

Summary

Matters of National Environment Significance

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

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	59
Listed Migratory Species:	73

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	107
Commonwealth Heritage Places:	2
Listed Marine Species:	107
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	18
Regional Forest Agreements:	None
Nationally Important Wetlands:	4
EPBC Act Referrals:	76
Key Ecological Features (Marine):	None
Biologically Important Areas:	12
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties			[Resource Information]
Name	State	Legal Status	Buffer Status
Australian Convict Sites (Fremantle Prison)	WA	Declared property	In buffer area only

National Heritage Places			[Resource Information]
Name	State	Legal Status	Buffer Status
Historic			
Fremantle Prison (former)	WA	Listed place	In buffer area only

Wetlands of International Importance (Ramsar Wetlands)		[Resource Information]
Ramsar Site Name	Proximity	Buffer Status
Forrestdale and thomsons lakes	Within Ramsar site	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area	In feature area
Empodisma peatlands of southwestern Australia	Endangered	Community may occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anous tenuirostris melanops			
Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area	In buffer area only
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In feature area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Zanda latirostris listed as Calyptorhynchus latirostris			
Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area	In feature area
FISH			
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only
INSECT			
Hesperocolletes douglasi			
Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
MAMMAL			
Balaenoptera musculus			
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
Dasyurus geoffroii			
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat likely to occur within area	In feature area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area	In feature area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat may occur within area	In buffer area only
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area	In feature area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area	In feature area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area	In feature area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Drakaea micrantha			
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eleocharis keigheryi			
Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Macarthuria keigheryi			
Keighery's Macarthuria [64930]	Endangered	Species or species habitat may occur within area	In buffer area only
Synaphea sp. Fairbridge Farm (D.Papenfus 696)			
Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area	In buffer area only
Thelymitra stellata			
Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area	In buffer area only
REPTILE			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Natator depressus			
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
SHARK			
Carcharias taurus (west coast population)			
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pristis pristis			
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Rhincodon typus			
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini			
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area	In buffer area only

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus			
Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea			
Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Ardenna pacifica			
Wedge-tailed Shearwater [84292]		Breeding known to occur within area	In buffer area only
Diomedea amsterdamensis			
Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area	In feature area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Marine Species			
Balaenoptera edeni			
Bryde's Whale [35]		Species or species habitat may occur within area	In buffer area only
Balaenoptera musculus			
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
Caperea marginata			
Pygmy Right Whale [39]		Species or species habitat may occur within area	In buffer area only
Carcharhinus longimanus			
Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area	In feature area
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area	In buffer area only
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat known to occur within area	In buffer area only
Mobula alfredi as Manta alfredi			
Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat may occur within area	In buffer area only
Mobula birostris as Manta birostris			
Giant Manta Ray [90034]		Species or species habitat may occur within area	In buffer area only
Natator depressus			
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Orcinus orca			
Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Pristis pristis			
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Rhincodon typus			
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area	In buffer area only
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area	In buffer area only
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area	In buffer area only
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area	In buffer area only
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area	In feature area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area	In buffer area only
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area	In buffer area only
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

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

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - ARTILLERY BARRACKS - FREMANTLE [50155]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Defence - EAST FREMANTLE SMALL CRAFT BASE [50118]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50149]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50148]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50146]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50147]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50152]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50151]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50154]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50150]	WA	In buffer area only
Defence - LEEUWIN BARRACKS - EAST FREMANTLE [50153]	WA	In buffer area only
Defence - PRESTON POINT TRAINING DEPOT [50174]	WA	In buffer area only
Defence - PRESTON POINT TRAINING DEPOT [50172]	WA	In buffer area only
Defence - PRESTON POINT TRAINING DEPOT [50173]	WA	In buffer area only
Unknown		
Commonwealth Land - [51115]	WA	In buffer area only
Commonwealth Land - [50779]	WA	In buffer area only
Commonwealth Land - [51438]	WA	In buffer area only
Commonwealth Land - [50755]	WA	In buffer area only
Commonwealth Land - [50754]	WA	In buffer area only
Commonwealth Land - [50756]	WA	In buffer area only
Commonwealth Land - [50751]	WA	In buffer area only
Commonwealth Land - [50750]	WA	In buffer area only
Commonwealth Land - [51148]	WA	In buffer area only
Commonwealth Land - [50671]	WA	In feature area
Commonwealth Land - [50647]	WA	In buffer area only
Commonwealth Land - [50670]	WA	In buffer area only
Commonwealth Land - [51150]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [50677]	WA	In buffer area only
Commonwealth Land - [51151]	WA	In buffer area only
Commonwealth Land - [50676]	WA	In buffer area only
Commonwealth Land - [51494]	WA	In buffer area only
Commonwealth Land - [51149]	WA	In buffer area only
Commonwealth Land - [50672]	WA	In buffer area only
Commonwealth Land - [50673]	WA	In buffer area only
Commonwealth Land - [51116]	WA	In buffer area only
Commonwealth Land - [51153]	WA	In buffer area only
Commonwealth Land - [51498]	WA	In buffer area only
Commonwealth Land - [51152]	WA	In buffer area only
Commonwealth Land - [50729]	WA	In buffer area only
Commonwealth Land - [50725]	WA	In buffer area only
Commonwealth Land - [51147]	WA	In buffer area only
Commonwealth Land - [50664]	WA	In buffer area only
Commonwealth Land - [50665]	WA	In buffer area only
Commonwealth Land - [50721]	WA	In buffer area only
Commonwealth Land - [50669]	WA	In buffer area only
Commonwealth Land - [50722]	WA	In buffer area only
Commonwealth Land - [50785]	WA	In buffer area only
Commonwealth Land - [50745]	WA	In buffer area only
Commonwealth Land - [50742]	WA	In buffer area only
Commonwealth Land - [50741]	WA	In buffer area only
Commonwealth Land - [50749]	WA	In buffer area only
Commonwealth Land - [50743]	WA	In buffer area only
Commonwealth Land - [50740]	WA	In buffer area only
Commonwealth Land - [51146]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [50788]	WA	In buffer area only
Commonwealth Land - [50789]	WA	In buffer area only
Commonwealth Land - [51143]	WA	In buffer area only
Commonwealth Land - [50782]	WA	In buffer area only
Commonwealth Land - [50781]	WA	In buffer area only
Commonwealth Land - [50786]	WA	In buffer area only
Commonwealth Land - [51122]	WA	In buffer area only
Commonwealth Land - [50787]	WA	In buffer area only
Commonwealth Land - [51421]	WA	In buffer area only
Commonwealth Land - [51125]	WA	In buffer area only
Commonwealth Land - [50666]	WA	In buffer area only
Commonwealth Land - [50663]	WA	In buffer area only
Commonwealth Land - [50517]	WA	In buffer area only
Commonwealth Land - [50516]	WA	In buffer area only
Commonwealth Land - [50762]	WA	In buffer area only
Commonwealth Land - [50763]	WA	In buffer area only
Commonwealth Land - [50690]	WA	In buffer area only
Commonwealth Land - [50734]	WA	In buffer area only
Commonwealth Land - [50733]	WA	In buffer area only
Commonwealth Land - [50683]	WA	In buffer area only
Commonwealth Land - [51981]	WA	In buffer area only
Commonwealth Land - [50686]	WA	In buffer area only
Commonwealth Land - [50687]	WA	In buffer area only
Commonwealth Land - [51128]	WA	In buffer area only
Commonwealth Land - [51126]	WA	In buffer area only
Commonwealth Land - [51900]	WA	In buffer area only
Commonwealth Land - [51901]	WA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [50685]	WA	In buffer area only
Commonwealth Land - [50684]	WA	In buffer area only
Commonwealth Land - [51895]	WA	In buffer area only
Commonwealth Land - [50730]	WA	In buffer area only
Commonwealth Land - [50731]	WA	In buffer area only
Commonwealth Land - [50732]	WA	In buffer area only
Commonwealth Land - [50790]	WA	In buffer area only
Commonwealth Land - [51899]	WA	In buffer area only
Commonwealth Land - [50795]	WA	In buffer area only
Commonwealth Land - [51894]	WA	In buffer area only
Commonwealth Land - [50735]	WA	In buffer area only
Commonwealth Land - [51413]	WA	In buffer area only
Commonwealth Land - [51415]	WA	In buffer area only
Commonwealth Land - [51412]	WA	In buffer area only
Commonwealth Land - [51417]	WA	In buffer area only
Commonwealth Land - [51414]	WA	In buffer area only
Commonwealth Land - [50736]	WA	In buffer area only
Commonwealth Land - [51416]	WA	In buffer area only
Commonwealth Land - [50688]	WA	In buffer area only
Commonwealth Land - [50710]	WA	In buffer area only
Commonwealth Land - [51144]	WA	In buffer area only
Commonwealth Land - [50707]	WA	In buffer area only
Commonwealth Land - [50784]	WA	In buffer area only
Commonwealth Land - [50780]	WA	In buffer area only
Commonwealth Land - [50708]	WA	In buffer area only
Commonwealth Land - [50761]	WA	In buffer area only

Commonwealth Heritage Places [Resource Information]

Name	State	Status	Buffer Status
Historic			
Artillery Barracks	WA	Listed place	In buffer area only
Claremont Post Office	WA	Listed place	In buffer area only

Listed Marine Species [Resource Information]			
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Ardenna pacifica as Puffinus pacificus Wedge-tailed Shearwater [84292]		Breeding known to occur within area	In buffer area only
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In buffer area only
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area overfly marine area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area	In buffer area only
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In buffer area only
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area	In buffer area only
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area	In feature area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Species or species habitat may occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area	In buffer area only
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Breeding known to occur within area	In feature area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area	In feature area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area overfly marine area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Onychoprion anaethetus as Sterna anaethetus Bridled Tern [82845]		Breeding known to occur within area	In feature area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area	In buffer area only
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area	In feature area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area	In buffer area only
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Sternula nereis as Sterna nereis Fairy Tern [82949]		Breeding known to occur within area	In buffer area only
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In feature area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area	In feature area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area	In buffer area only
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area overfly marine area	In buffer area only
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area overfly marine area	In buffer area only
Fish			
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area	In feature area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Arctocephalus forsteri			
Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat likely to occur within area	In feature area
Reptile			
Aipysurus pooleorum			
Shark Bay Seasnake [66061]		Species or species habitat may occur within area	In buffer area only
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Disteira kingii			
Spectacled Seasnake [1123]		Species or species habitat may occur within area	In feature area
Natator depressus			
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Pelamis platurus			
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area	In buffer area only

Whales and Other Cetaceans		[Resource Information]	
Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In buffer area only
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area	In buffer area only
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In buffer area only
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Alfred Cove	Nature Reserve	WA	In buffer area only
Canning River	Management Area	WA	In buffer area only
Carnac Island	Nature Reserve	WA	In buffer area only
Cottesloe Reef	Fish Habitat Protection Area	WA	In buffer area only
Harry Waring Marsupial Reserve	Nature Reserve	WA	In buffer area only
Keanes Point Reserve	5(1)(g) Reserve	WA	In buffer area only
Swan Estuary - Alfred Cove	Marine Park	WA	In buffer area only
Swan River	Management Area	WA	In buffer area only
Thomsons Lake	Nature Reserve	WA	In buffer area only
Unnamed WA39584	Conservation Park	WA	In buffer area only
Unnamed WA39752	Conservation Park	WA	In buffer area only
Unnamed WA42469	Nature Reserve	WA	In buffer area only
Unnamed WA44414	5(1)(g) Reserve	WA	In buffer area only
Unnamed WA48291	Conservation Park	WA	In buffer area only
Unnamed WA49220	Conservation Park	WA	In buffer area only
Unnamed WA49561	Conservation Park	WA	In buffer area only
Unnamed WA53313	Conservation Park	WA	In buffer area only
Unnamed WA53632	Conservation Park	WA	In buffer area only

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Booragoon Swamp	WA	In buffer area only
Gibbs Road Swamp System	WA	In buffer area only
Swan-Canning Estuary	WA	In buffer area only
Thomsons Lake	WA	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
119 Hammond Road Residential Development	2023/09541		Completed	In buffer area only
Beale Park Redevelopment	2022/09297		Assessment	In feature area
Cockburn Surf Park	2022/09267		Completed	In buffer area only
Fremantle District Police Complex Project	2022/09345		Completed	In buffer area only
Jandakot Airport Expansion, Commercial Development and Clearing of Vegetation	2009/4796		Referral Decision	In buffer area only
Jandakot Horse Agistment	2022/09280		Assessment	In buffer area only
Kwinana Alumina Refinery ? Future Residue Storage Area	2023/09454		Referral Decision	In buffer area only
Land clearing for limestone quarry	2023/09558		Referral Decision	In buffer area only
Residential Development, Wattleup Road, Hammond Park, WA	2021/8933		Post-Approval	In buffer area only
Controlled action				
Alcoa Bauxite Residue Storage Area Extension	2011/5878	Controlled Action	Further Information Request	In buffer area only
Construction of Fiona Stanley Hospital	2008/3970	Controlled Action	Post-Approval	In buffer area only
Development of Kwinana Quay port facility	2008/4387	Controlled Action	Completed	In buffer area only
Extension of Beeliar Drive between the junction of Mayor and Fawcett Roads an...	2003/1029	Controlled Action	Completed	In buffer area only
Hammond Park Secondary School development, WA	2016/7741	Controlled Action	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Latitude 32-industrial development of various lots, Ashley and Sayer Roads, Hope Valley, WA	2016/7695	Controlled Action	Post-Approval	In buffer area only
Lots 13, 14 & 18 Barfield Rd & Lots 48-51 Rowley Rd, Hammond Park	2012/6524	Controlled Action	Post-Approval	In buffer area only
Roe Highway extension, Kwinana Freeway to Stock Road, WA	2009/5031	Controlled Action	Post-Approval	In buffer area only
Roe Hwy Extension	2003/972	Controlled Action	Post-Approval	In buffer area only
Shark Hazard Mitigation Drum Line Program, WA	2014/7174	Controlled Action	Completed	In buffer area only
Shenton Park Subdivision	2004/1479	Controlled Action	Completed	In buffer area only
Thornlie-Cockburn Link Project, WA	2018/8188	Controlled Action	Post-Approval	In buffer area only
Vegetation clearing (Cwlth land), Jandakot Airport, Cockburn, WA	2013/7032	Controlled Action	Post-Approval	In buffer area only
Warders Hotel, Block 1 Warders Cottages, Fremantle, WA	2018/8144	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
'Looping 10' gas transmission pipeline from Kwinana to Hopelands	2005/2212	Not Controlled Action	Completed	In buffer area only
Armadale Road Duplication - Tapper to Anstey Road	2017/7972	Not Controlled Action	Completed	In buffer area only
Armadale Road to North Lake Road Bridge development, Jandakot, WA	2018/8284	Not Controlled Action	Completed	In buffer area only
Bibra Lake Aboriginal Cultural Centre Development	2020/8642	Not Controlled Action	Completed	In buffer area only
Calleya Residential Development, Banjup, WA	2016/7708	Not Controlled Action	Completed	In buffer area only
Clearing and development of 220 and 234 Wattleup Rd, Wattleup, WA	2016/7738	Not Controlled Action	Completed	In buffer area only
Clearing of Native Vegetation, Hammond Park, WA	2011/6041	Not Controlled Action	Completed	In buffer area only
Construction and operation of an 8 turbine wind farm at Rous Head Harbour, Frema	2003/933	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Construction of Hammond Road Primary School, Hammond Park, WA	2012/6619	Not Controlled Action	Completed	In buffer area only
Development of Lots 100-101 Sayer Road, Hope Valley, WA	2019/8399	Not Controlled Action	Completed	In buffer area only
Disposal of residential properties, Fremantle, WA	2019/8593	Not Controlled Action	Completed	In buffer area only
Eradication of the European House Borer, Perth metropolitan area, WA	2009/5027	Not Controlled Action	Completed	In buffer area only
Expansion of berthing facilities at Kwinana Bulk Terminal	2006/2509	Not Controlled Action	Completed	In buffer area only
Expansion of existing Ammonium Nitrate Production Facility	2005/1941	Not Controlled Action	Completed	In buffer area only
Frankland Parks Oval project, Hammond Park, WA	2018/8369	Not Controlled Action	Completed	In buffer area only
Fremantle Ports Inner Harbour Capital Dredging Proposal	2005/2477	Not Controlled Action	Completed	In feature area
Gas-fired Power Station	2005/2213	Not Controlled Action	Completed	In buffer area only
Hammond West Urban Development, Hammond Park, WA	2017/7917	Not Controlled Action	Completed	In buffer area only
High Street Upgrade, Fremantle, WA	2018/8315	Not Controlled Action	Completed	In buffer area only
Hope Valley-Wattleup Redevelopment Project	2020/8644	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Industrial development 105 Sayer Road, Hope Valley, WA	2014/7261	Not Controlled Action	Completed	In buffer area only
Industrial Development Lot 64 Ashley Road, Hope Valley, WA	2014/7238	Not Controlled Action	Completed	In buffer area only
Jandakot Road Widening, Solomon Road to Berrigan Drive, Jandakot, WA	2020/8728	Not Controlled Action	Completed	In buffer area only
Kwinana Fwy southbound widening Roe Hwy to Armadale Rd and construction of farrington Rd off-ramp	2013/7062	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Kwinana Gas-Fired Power Station	2005/2101	Not Controlled Action	Completed	In buffer area only
Latitude 32 industrial development 6A, Cockburn, WA	2018/8193	Not Controlled Action	Completed	In buffer area only
Lot 170 Hope Valley Road, Hope Valley	2020/8830	Not Controlled Action	Completed	In buffer area only
Lots 12, 13 and 18 Hammond Road, Lot 80 Beeliar Drive and Lot 500 Hird Road	2012/6576	Not Controlled Action	Completed	In buffer area only
Murdoch University Sports Precinct, Melville, WA	2016/7823	Not Controlled Action	Completed	In buffer area only
Perth Seawater Desalination Project: Thomsons Lake to Kogolup Pipeline	2005/1971	Not Controlled Action	Completed	In buffer area only
Redevelopment of Purvis Street school site, Hamilton Hill, WA	2018/8255	Not Controlled Action	Completed	In buffer area only
Residential Development, Lot 12 Lyon Road, Aubin Grove, WA	2013/6852	Not Controlled Action	Completed	In buffer area only
Residential development, Lot 33 Barfield Road, Hammond Park, WA	2015/7548	Not Controlled Action	Completed	In buffer area only
Residential development, Lot 74 Wattleup Road, Hammond Park, WA	2018/8273	Not Controlled Action	Completed	In buffer area only
Residential development, Lots 124 and 125, Wattleup Road, Hammond Park, WA	2015/7519	Not Controlled Action	Completed	In buffer area only
Residential Development Lot 4225 North Lake Road, Kardinya, WA	2015/7505	Not Controlled Action	Completed	In buffer area only
Residential Development of Lots 76 and 107 Wattleup Road, Hamond Park	2020/8865	Not Controlled Action	Completed	In buffer area only
Residential development on part of Lot 2 Fanstone Avenue, Beeliar, WA	2016/7726	Not Controlled Action	Completed	In buffer area only
Roe Highway - Karel Avenue to Hope Road Bridge Project	2005/2061	Not Controlled Action	Completed	In buffer area only
South Metropolitan Crop Research Hub, Murdoch WA	2018/8201	Not Controlled Action	Completed	In buffer area only
Stages 2-5 of primary school and assoc facilities development, Hammond Park, WA	2015/7407	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Urban development, Lot 109 Wattleup Road, Hammond Park, WA	2015/7425	Not Controlled Action	Completed	In buffer area only
Urban development of Lot 107 Wattleup Road, Hammond Park, WA	2017/7890	Not Controlled Action	Completed	In buffer area only
Warders' Cottages Block 2 'W2'	2022/9148	Not Controlled Action	Completed	In buffer area only
Warders' Cottages W2 minor works, Fremantle, WA	2018/8185	Not Controlled Action	Completed	In buffer area only
Wentworth West residential development, Bartram Road, Success, WA	2014/7245	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
City of Cockburn Sporting Facilties	2005/2139	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Extension of Spearwood Ave, from Barrington Rd to Miguel Rd	2009/5140	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
South West Metropolitan Railway Project	2003/1175	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
Rezoning of Crown Reserve 39181 to facilitate future residential development	2005/2096	Referral Decision	Completed	In buffer area only

Biologically Important Areas			
Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna carneipes Flesh-footed Shearwater [82404]	Aggregation	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging (in high numbers)	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Eudyptula minor			
Little Penguin [1085]	Foraging (provisioning young)	Known to occur	In feature area
Hydroprogne caspia			
Caspian Tern [808]	Foraging (provisioning young)	Known to occur	In feature area
Larus pacificus			
Pacific Gull [811]	Foraging (in high numbers)	Former Range	In feature area
Onychoprion anaethetus			
Bridled Tern [82845]	Foraging (in high numbers)	Known to occur	In feature area
Puffinus assimilis tunneyi			
Little Shearwater [59363]	Foraging (in high numbers)	Known to occur	In feature area
Sterna dougallii			
Roseate Tern [817]	Foraging	Known to occur	In feature area
Sternula nereis			
Fairy Tern [82949]	Foraging (in high numbers)	Known to occur	In feature area
Seals			
Neophoca cinerea			
Australian Sea Lion [22]	Foraging (male)	Likely to occur	In feature area
Whales			
Balaenoptera musculus brevicauda			
Pygmy Blue Whale [81317]	Distribution	Known to occur	In buffer area only
Megaptera novaeangliae			
Humpback Whale [38]	Migration (north and south)	Known to occur	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

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

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

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

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

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APPENDIX C – FLORA INVENTORY

*denotes weed (introduced) flora species

Family	Species
Aizoaceae	**Carpobrotus edulis*
Anacardiaceae	**Schinus terebinthifolia*
Apiaceae	*Daucus glochidiatus*
Apiaceae	**Foeniculum vulgare*
Apocynaceae	**Asclepias tuberosa*
Arecaceae	**Pheonix dactylifera*
Arecaceae	**Washingtonia filifera*
Asparagaceae	*Acanthocarpus preissii*
Asparagaceae	**Agave* sp.
Asparagaceae	**Asparagus asparagoides*
Asparagaceae	*Dichopogon capillipes*
Asparagaceae	*Lomandra maritima*
Asparagaceae	*Thysanotus arenarius*
Asparagaceae	**Yucca* sp.
Asphodelaceae	**Asphodelus fistulosus*
Asphodelaceae	**Trachyandra divaricata*
Asteraceae	**Gazania* sp.
Asteraceae	**Hypochaeris glabra*
Asteraceae	**Lactuca serriola*
Asteraceae	*Olearia axillaris*
Asteraceae	**Reichardia tingitana*
Asteraceae	**Sonchus oleraceus*
Asteraceae	**Symphyotrichum squamatum*
Asteraceae	**Urospermum picroides*
Asteraceae	**Ursinia anthemoides*
Basellaceae	**Anredera cordifolia*
Brassicaceae	**Raphanus raphanistrum*
Caprifoliaceae	**Centranthus macrosiphon*
Caprifoliaceae	**Sixalix atropurpurea*
Caryophyllaceae	**Petrorhagia dubia*
Casuarinaceae	*Allocasuarina humilis*
Chenopodiaceae	**Atriplex prostrata*
Chenopodiaceae	**Chenopodium macrospermum*
Chenopodiaceae	*Rhagodia baccata*
Chenopodiaceae	*Rhagodia baccata* subsp. *dioica*
Cyperaceae	*Gahnia trifida*
Cyperaceae	*Lepidosperma oldhamii*
Cyperaceae	*Lepidosperma* sp.
Cyperaceae	*Lepidosperma squamatum*
Cyperaceae	*Machaerina juncea*
Cyperaceae	*Mesomelaena pseudostygia*
Cyperaceae	*Mesomelaena* sp.
Cyperaceae	*Morelotia octandra*
Dilleniaceae	*Hibbertia hypericoides*
Droseraceae	*Drosera* sp.
Ericaceae	*Conostephium pendulum*
Ericaceae	*Leucopogon ?australis*
Ericaceae	*Leucopogon parviflorus*
Ericaceae	*Leucopogon* sp.
Euphorbiaceae	**Euphorbia terracina*
Euphorbiaceae	**Ricinus communis*
Fabaceae	*Acacia cyclops*

Family	Species
Fabaceae	**Acacia iteaphylla*
Fabaceae	**Acacia longifolia*
Fabaceae	*Acacia pulchella*
Fabaceae	*Acacia rostellifera*
Fabaceae	*Acacia saligna*
Fabaceae	*Acacia truncata*
Fabaceae	*Bossiaea eriocarpa*
Fabaceae	Fabaceae sp.
Fabaceae	*Gompholobium tomentosum*
Fabaceae	*Hardenbergia comptoniana*
Fabaceae	**Lupinus cosentinii*
Fabaceae	**Lupinus* sp.
Fabaceae	**Retama raetam*
Fabaceae	*Templetonia retusa*
Fabaceae	**Trifolium campestre*
Fabaceae	**Trifolium* sp.
Fabaceae	**Vicia sativa*
Geraniaceae	**Pelargonium capitatum*
Goodeniaceae	*Lechenaultia linarioides*
Goodeniaceae	*Scaevola thesioides* subsp. *thesioides*
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*
Hemerocallidaceae	*Dianella revoluta*
Hemerocallidaceae	*Tricoryne elatior*
Iridaceae	**Ferraria crispa*
Iridaceae	**Freesia alba x leichtlinii*
Iridaceae	**Gladiolus caryophyllaceus*
Iridaceae	**Romulea rosea*
Iridaceae	**Watsonia meriana*
Juncaceae	*Juncus kraussii*
Juncaceae	*Juncus pallidus*
Lamiaceae	**Lavandula* sp.
Lauraceae	*Cassytha racemosa*
Lauraceae	*Cassytha* sp.
Lycium	**Lycium ferocissimum*
Malvaceae	*Thomasia triphylla*
Moraceae	**Ficus carica*
Myrtaceae	*Calothamnus quadrifidus*
Myrtaceae	**Chamelaucium uncinatum*
Myrtaceae	*Eucalyptus decipiens*
Myrtaceae	*Eucalyptus gomphocephala*
Myrtaceae	*Eucalyptus rudis subsp. Rudis*
Myrtaceae	**Gaudium laevigatum*
Myrtaceae	*Melaleuca huegelii*
Myrtaceae	**Melaleuca nesophila*
Myrtaceae	*Melaleuca rhaphiophylla*
Myrtaceae	*Melaleuca* sp.
Myrtaceae	*Melaleuca systena*
Myrtaceae	*Melaleuca teretifolia*
Oleaceae	**Olea europaea*
Onagraceae	**Oenothera drummondii*
Orchidaceae	*Microtis media*
Oxalidaceae	**Oxalis pes-caprae*
Papaveraceae	**Fumaria capreolata*
Papaveraceae	**Fumaria* sp.
Phyllanthaceae	*Lysiandra calycina*
Pinaceae	**Pinus pinaster*

Family	Species
Plantaginaceae	**Bacopa monnieri*
Poaceae	*Amphipogon turbinatus*
Poaceae	**Arundo donax*
Poaceae	*Austrostipa elegantissima*
Poaceae	*Austrostipa flavescens*
Poaceae	*Austrostipa nitida*
Poaceae	*Austrostipa* sp.
Poaceae	**Avena barbata*
Poaceae	**Briza maxima*
Poaceae	**Bromus diandrus*
Poaceae	**Cenchrus clandestinus*
Poaceae	**Cenchrus* sp.
Poaceae	**Cenchrus setaceus*
Poaceae	**Cynodon dactylon*
Poaceae	**Ehrharta calycina*
Poaceae	**Ehrharta longiflora*
Poaceae	**Ehrharta villosa*
Poaceae	**Eragrostis curvula*
Poaceae	**Lagurus ovatus*
Poaceae	**Lolium perenne*
Poaceae	**Stenotaphrum secundatum*
Poaceae	**Vulpia myuros*
Polygalaceae	*Comesperma confertum*
Polygalaceae	*Comesperma integerrimum*
Polygalaceae	**Polygala myrtifolia*
Primulaceae	**Lysimachia arvensis*
Proteaceae	*Banksia dallanneyi*
Proteaceae	*Banksia sessilis*
Proteaceae	*Conospermum canaliculatum*
Proteaceae	*Grevillea preissii*
Ranunculaceae	*Clematis linearifolia*
Restionaceae	*Desmocladus flexuosus*
Rhamnaceae	*Spyridium globulosum*
Rhamnaceae	*Trymalium ledifolium*
Rhamnaceae	*Trymalium ledifolium* var. *ledifolium*
Rhamnaceae	*Trymalium odoratissimum*
Rhamnaceae	*Trymalium* sp.
Rubiaceae	*Opercularia hispidula*
Rubiaceae	*Opercularia vaginata*
Santalaceae	*Santalum acuminatum*
Sapindaceae	*Dodonaea hackettiana* (P4)
Scrophulariaceae	*Eremophila glabra*
Thymelaeaceae	*Pimelea calcicola* (P3)
Verbenaceae	**Lantana camara*
Violaceae	*Pigea ?calycina*
Xanthorrhoeaceae	*Xanthorrhoea preissii*

APPENDIX D - STRUCTURAL VEGETATION CLASSIFICATIONS (MUIR, 1977)

Life Form/Height Class	Canopy Cover			
	Dense 70-100%	**Mid-dense 30-70%**	**Sparse 10-30%**	**Very sparse 2-10%**
Trees >30m **Trees 15-30m** **Trees 5-15m** **Trees <5m**	Dense tall forest Dense forest Dense low forest A Dense low forest B	Tall forest Forest Low forest A Low forest B	Tall woodland Woodland Low woodland A Low woodland B	Open tall woodland Open woodland Open low woodland A Open low woodland B
Mallee Tree Form **Mallee Shrub form**	Dense tree mallee Dense shrub mallee	Tree mallee Shrub mallee	Open tree mallee Open shrub mallee	Very open tree mallee Very open shrub mallee
Shrubs >2m **Shrubs 1.5-2m** **Shrubs 1-1.5m** **Shrubs 0.5-1m** **Shrubs <0.5m**	Dense thicket Dense heath A Dense heath B Dense low heath C Dense low heath D	Thicket Heath A Heath B Low heath C Low heath D	Scrub Low scrub A Low scrub B Dwarf scrub C Dwarf scrub D	Open scrub Open low scrub A Open low scrub B Open dwarf scrub C Open dwarf scrub D
Mat plants **Hummock grass** **Bunch grass >0.5m** **Bunch grass <0.5m** **Herbaceous spp.**	Dense mat plants Dense hummock grass Dense tall grass Dense low grass Dense herbs	Mat plants Mid-dense hummock grass Tall grass Low grass Herbs	Open mat plants Hummock grass Open tall grass Open low grass Open herbs	Very open mat plants Open hummock grass Very open tall grass Very open low grass Very open herbs
Sedges >0.5m **Sedges <0.5m**	Dense tall sedges Dense low sedges	Tall sedges Low sedges	Open tall sedges Open low sedges	Very open tall sedges Very open low sedges
Ferns **Mosses, Liverwort**	Dense ferns Dense mosses	Ferns Mosses	Open ferns Open mosses	Very open ferns Very open mosses

APPENDIX E – FLORA SPECIES BY VEGETATION UNIT

*denotes weed (introduced) flora species

Family	Species	AcBsS	ArSgS	EdSgW	EgSgW	MhTr	MhTrS
Aizoaceae	**Carpobrotus edulis*		+				
Anacardiaceae	**Schinus terebinthifolia*	+	+	+	+	+	+
Apiaceae	*Daucus glochidiatus*						
Apiaceae	**Foeniculum vulgare*	+	+	+	+	+	+
Apocynaceae	**Asclepias tuberosa*	+					
Arecaceae	**Pheonix dactylifera*	+	+		+		
Arecaceae	**Washingtonia filifera*				+		
Asparagaceae	*Acanthocarpus preissii*		+				+
Asparagaceae	**Agave* sp.	+		+		+	+
Asparagaceae	**Asparagus asparagoides*	+	+	+	+	+	+
Asparagaceae	*Dichopogon capillipes*				+		
Asparagaceae	*Lomandra maritima*		+	+			+
Asparagaceae	*Thysanotus arenarius*		+				
Asparagaceae	**Yucca* sp.				+		
Asphodelaceae	**Asphodelus fistulosus*	+	+	+	+	+	+
Asphodelaceae	**Trachyandra divaricata*		+				
Asteraceae	**Gazania* sp.	+					+
Asteraceae	**Hypochaeris glabra*	+					+
Asteraceae	**Lactuca serriola*			+			
Asteraceae	*Olearia axillaris*		+				+
Asteraceae	**Reichardia tingitana*						+
Asteraceae	**Sonchus oleraceus*		+	+	+		+
Asteraceae	**Symphyotrichum squamatum*						
Asteraceae	**Urospermum picroides*	+	+	+	+		+
Asteraceae	**Ursinia anthemoides*		+	+			
Basellaceae	**Anredera cordifolia*						+
Brassicaceae	**Raphanus raphanistrum*	+	+	+		+	+
Caprifoliaceae	**Centranthus macrosiphon*		+				
Caprifoliaceae	**Sixalix atropurpurea*				+		+
Caryophyllaceae	**Petrorhagia dubia*	+	+	+			+
Casuarinaceae	*Allocasuarina humilis*		+				
Chenopodiaceae	**Atriplex prostrata*						
Chenopodiaceae	**Chenopodium macrospermum*						
Chenopodiaceae	*Rhagodia baccata*		+		+		
Chenopodiaceae	*Rhagodia baccata* subsp. *dioica*						
Cyperaceae	*Gahnia trifida*						+
Cyperaceae	*Lepidosperma oldhamii*		+	+			+
Cyperaceae	*Lepidosperma* sp.						
Cyperaceae	*Lepidosperma squamatum*		+	+			
Cyperaceae	*Machaerina juncea*						
Cyperaceae	*Mesomelaena pseudostygia*		+	+			
Cyperaceae	*Mesomelaena* sp.		+				
Cyperaceae	*Morelotia octandra*			+			
Dilleniaceae	*Hibbertia hypericoides*		+	+			+
Droseraceae	*Drosera* sp.						+
Ericaceae	*Conostephium pendulum*		+				
Ericaceae	*Leucopogon ?australis*				+		+
Ericaceae	*Leucopogon parviflorus*		+				+
Ericaceae	*Leucopogon* sp.						+
Euphorbiaceae	**Euphorbia terracina*	+	+	+	+	+	+
Euphorbiaceae	**Ricinus communis*	+			+		+
Fabaceae	*Acacia cyclops*	+					+

Family	Species	AcBsS	ArSgS	EdSgW	EgSgW	MhTr	MhTrS
Fabaceae	**Acacia iteaphylla*	+			+		+
Fabaceae	**Acacia longifolia*	+			+	+	+
Fabaceae	*Acacia pulchella*			+			
Fabaceae	*Acacia rostellifera*		+	+			+
Fabaceae	*Acacia saligna*						+
Fabaceae	*Acacia truncata*						+
Fabaceae	*Bossiaea eriocarpa*		+				
Fabaceae	Fabaceae sp.		+				
Fabaceae	*Gompholobium tomentosum*		+	+			+
Fabaceae	*Hardenbergia comptoniana*		+	+	+		+
Fabaceae	**Lupinus cosentinii*	+	+	+	+	+	+
Fabaceae	**Lupinus* sp.	+					
Fabaceae	**Retama raetam*	+		+	+		+
Fabaceae	*Templetonia retusa*		+		+		+
Fabaceae	**Trifolium campestre*		+	+			
Fabaceae	**Trifolium* sp.			+			
Fabaceae	**Vicia sativa*		+		+	+	+
Geraniaceae	**Pelargonium capitatum*	+	+	+	+	+	+
Goodeniaceae	*Lechenaultia linarioides*			+			
Goodeniaceae	*Scaevola thesioides* subsp. *thesioides*						+
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*						+
Hemerocallidaceae	*Dianella revoluta*		+	+			+
Hemerocallidaceae	*Tricoryne elatior*		+	+			+
Iridaceae	**Ferraria crispa*		+		+		+
Iridaceae	**Freesia alba x leichtlinii*	+	+	+	+	+	+
Iridaceae	**Gladiolus caryophyllaceus*		+	+	+	+	+
Iridaceae	**Romulea rosea*			+	+		+
Iridaceae	**Watsonia meriana*	+	+	+	+	+	+
Juncaceae	*Juncus kraussii*						
Juncaceae	*Juncus pallidus*						
Lamiaceae	**Lavandula* sp.						+
Lauraceae	*Cassytha racemosa*		+				+
Lauraceae	*Cassytha* sp.		+				
Lycium	**Lycium ferocissimum*		+				+
Malvaceae	*Thomasia triphylla*						+
Moraceae	**Ficus carica*	+	+		+		+
Myrtaceae	*Calothamnus quadrifidus*			+			
Myrtaceae	**Chamelaucium uncinatum*			+	+		
Myrtaceae	*Eucalyptus decipiens*			+			
Myrtaceae	*Eucalyptus gomphocephala*				+		
Myrtaceae	*Eucalyptus rudis subsp. Rudis*						
Myrtaceae	**Gaudium laevigatum*	+	+	+	+	+	+
Myrtaceae	*Melaleuca huegelii*		+	+	+		+
Myrtaceae	**Melaleuca nesophila*				+		
Myrtaceae	*Melaleuca rhaphiophylla*						
Myrtaceae	*Melaleuca* sp.		+				
Myrtaceae	*Melaleuca systena*		+	+			+
Myrtaceae	*Melaleuca teretifolia*						
Oleaceae	**Olea europaea*	+	+	+	+	+	+
Onagraceae	**Oenothera drummondii*	+					
Orchidaceae	*Microtis media*			+			
Oxalidaceae	**Oxalis pes-caprae*				+		
Papaveraceae	**Fumaria capreolata*		+		+		
Papaveraceae	**Fumaria* sp.	+	+		+		+
Phyllanthaceae	*Lysiandra calycina*		+				+
Pinaceae	**Pinus pinaster*	+	+	+			+

Family	Species	AcBsS	ArSgS	EdSgW	EgSgW	MhTr	MhTrS
Plantaginaceae	**Bacopa monnieri*						
Poaceae	*Amphipogon turbinatus*			+			
Poaceae	**Arundo donax*	+					
Poaceae	*Austrostipa elegantissima*		+				
Poaceae	*Austrostipa flavescens*		+	+	+		+
Poaceae	*Austrostipa nitida*		+	+			
Poaceae	*Austrostipa* sp.				+		+
Poaceae	**Avena barbata*	+	+	+	+		+
Poaceae	**Briza maxima*		+	+			+
Poaceae	**Bromus diandrus*		+				+
Poaceae	**Cenchrus clandestinus*	+	+		+	+	+
Poaceae	**Cenchrus* sp.	+	+	+		+	+
Poaceae	**Cenchrus setaceus*	+	+				+
Poaceae	**Cynodon dactylon*	+	+		+		+
Poaceae	**Ehrharta calycina*	+	+	+	+	+	+
Poaceae	**Ehrharta longiflora*		+	+	+		+
Poaceae	**Ehrharta villosa*		+				
Poaceae	**Eragrostis curvula*					+	+
Poaceae	**Lagurus ovatus*		+		+		+
Poaceae	**Lolium perenne*		+				+
Poaceae	**Stenotaphrum secundatum*	+			+		
Poaceae	**Vulpia myuros*			+			
Polygalaceae	*Comesperma confertum*			+			
Polygalaceae	*Comesperma integerrimum*		+				
Polygalaceae	**Polygala myrtifolia*	+				+	
Primulaceae	**Lysimachia arvensis*		+	+			+
Proteaceae	*Banksia dallanneyi*		+	+			+
Proteaceae	*Banksia sessilis*	+	+		+		+
Proteaceae	*Conospermum canaliculatum*						+
Proteaceae	*Grevillea preissii*		+	+			+
Ranunculaceae	*Clematis linearifolia*		+	+	+		+
Restionaceae	*Desmocladus flexuosus*		+	+			+
Rhamnaceae	*Spyridium globulosum*	+	+	+	+		+
Rhamnaceae	*Trymalium ledifolium*						+
Rhamnaceae	*Trymalium ledifolium* var. *ledifolium*						+
Rhamnaceae	*Trymalium odoratissimum*						+
Rhamnaceae	*Trymalium* sp.						+
Rubiaceae	*Opercularia hispidula*		+				+
Rubiaceae	*Opercularia vaginata*		+				+
Santalaceae	*Santalum acuminatum*						+
Sapindaceae	*Dodonaea hackettiana* (P4)						+
Scrophulariaceae	*Eremophila glabra*		+				
Thymelaeaceae	*Pimelea calcicola* (P3)	+	+				+
Verbenaceae	**Lantana camara*	+	+				+
Violaceae	*Pigea ?calycina*						+
Xanthorrhoeaceae	*Xanthorrhoea preissii*		+	+	+		

APPENDIX F – VEGETATION QUADRAT DATA

Site DR01

Date	17/11/2020
Botanist	Daniel Roberts and Adrian Barrett
Quadrat Size	10 x 10 m
NW Corner Coordinates	384131mE 6447970mN
Vegetation Unit	**AcBsS** - *Acacia cyclops* and *Banksia sessilis* tall shrubland over **Euphorbia terracina* and **Pelargonium capitatum* isolated herbs and **Ehrharta calycina* isolated grasses
Slope	Flat
Landform	Upper Slope
Soil Colour	Brown Orange
Soil Type	Sand
Litter	35%
Bare Ground	10%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (cm)	% Cover
Banksia sessilis	2.5	75.0
*Ehrharta calycina	0.7	75.0
*Euphorbia terracina	0.5	5.0
Acacia cyclops		+
*Hypochaeris glabra		+
*Pelargonium capitatum		+
*Petrorhagia dubia		+
*Urospermum picroides		+

Site DR02r

Date	17/11/2020
Botanist	Daniel Roberts and Adrian Barrett
Quadrat Size	Relevè
NW Corner Coordinates	383451mE 6448398mN
Vegetation Unit	**ArSgS** - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Gentle
Landform	Mid Slope
Soil Colour	Brown Orange
Soil Type	Sand
Litter	65%
Bare Ground	15%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	weeds

Species	Height (m)	% Cover
Acacia rostellifera	4.0	5.0
**Gaudium laevigatum*	3.0	85.0
Banksia sessilis		+
**Ehrharta calycina*		+

Site DR03

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	384142 mE 6448772 mN
Vegetation Unit	**MrGtW** - *Melaleuca rhaphiophylla* woodland over *Gahnia trifida* and *Juncus kraussii* sedgeland over *Cynodon dactylon* grassland
Slope	Gentle
Landform	Wetland
Soil Colour	Dark brown black
Soil Type	Peat loam
Litter	20%
Bare Ground	2%
Fire Age	>10 Years
Vegetation Condition	Good-Very Good
Disturbances/Impacts	Litter, weeds

Species	Height (m)	% Cover
Melaleuca rhaphiophylla	6.0	20.0
Gahnia trifida	1.0	25.0
Juncus kraussii	1.0	2.0
**Cynodon dactylon*	0.2	1.0
**Chenopodium macrospermum*		+
Comesperma integerrimum		+
Lepidosperma sp.		+

Site DR04

Date	19/11/2020
Botanist	Daniel Roberts and Adrian Barrett
Quadrat Size	10 x 10 m
NW Corner Coordinates	383916mE 6448927mN
Vegetation Unit	**EgSgW** - *Eucalyptus decipiens* open woodland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Gentle
Landform	Mid Slope
Soil Colour	Brown
Soil Type	Sandy Loam
Litter	60%
Bare Ground	5%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Eucalyptus gomphocephala	30	50.0
Templetonia retusa	2.5	20.0
**Euphorbia terracina*	0.5	3.0
**Asparagus asparagoides*		+
**Asphodelus fistulosus*		+
Austrostipa sp.		+
**Avena barbata*		+
Clematis linearifolia		+
Dichopogon capillipes		+
**Ehrharta calycina*		+
Hardenbergia comptoniana		+
**Romulea rosea*		+
**Schinus terebinthifolia*		+
Xanthorrhoea preissii		+

Site DR05

Date	19/11/2020
Botanist	Daniel Roberts and Adrian Barrett
Quadrat Size	10 x 10 m
NW Corner Coordinates	383656mE 6448379mN
Vegetation Unit	**ArSgS** - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Gentle
Landform	Uppre Slope
Soil Colour	Brown
Soil Type	Sandy Loam
Litter	25%
Bare Ground	5%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Acacia rostellifera	2.7	20.0
Templetonia retusa	1.5	12.0
Xanthorrhoea preissii	1.5	8.0
Spyridium globulosum	1.5	5.0
Hibbertia hypericoides	0.7	35.0
Lomandra maritima	0.5	5.0
Desmocladus flexuosus	0.4	5.0
Acanthocarpus preissii		+
Allocasuarina humilis		+
**Asparagus asparagoides*		+
Austrostipa nitida		+
**Avena barbata*		+
Banksia dallanneyi		+
Bossiaea eriocarpa		+
**Briza maxima*		+
Cassytha sp.		+
Clematis linearifolia		+
Conostephium pendulum		+
Dianella revoluta		+
**Ehrharta calycina*		+
**Euphorbia terracina*		+
**Gladiolus caryophyllaceus*		+
Gompholobium tomentosum		+
Grevillea preissii		+
**Lagurus ovatus*		+
Lepidosperma squamatum		+
Lysimachia arvensis		+
Melaleuca systena		+
Mesomelaena pseudostygia		+
Mesomelaena sp.		+
Opercularia vaginata		+
**Petrorhagia dubia*		+
Phyllanthus calycinus		+
Pimelea calcicola (P3)		+
Thysanotus arenarius		+
Tricoryne elatior		+
**Trifolium campestre*		+
**Urospermum picroides*		+
**Ursinia anthemoides*		+

Site DR06

Date	19/11/2020
Botanist	Daniel Roberts and Adrian Barrett
Quadrat Size	10 x 10 m
NW Corner Coordinates	383929mE 6448062mN
Vegetation Unit	**EdSgW** - *Eucalyptus decipiens* low woodland over *Spyridium globulosum* and *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* and *Tricoryne elatior* low sparse shrubland over **Ehrharta calycina* sparse grassland over *Mesomelaena pseudostygia* sparse sedgeland
Slope	Flat
Landform	Valley Floor
Soil Colour	Light Brown
Soil Type	Sand
Litter	15%
Bare Ground	25%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Eucalyptus decipiens	8.0	30.0
Acacia rostellifera	7.0	10.0
Xanthorrhoea preissii	1.8	20.0
Spyridium globulosum	1.8	10.0
**Ehrharta calycina*	1.2	2.0
**Avena barbata*	1.0	3.0
Hibbertia hypericoides	0.6	13.0
**Briza maxima*	0.6	3.0
Mesomelaena pseudostygia	0.6	3.0
Tricoryne elatior	0.6	3.0
**Asparagus asparagoides*		+
Austrostipa nitida		+
Banksia dallanneyi		+
Calothamnus quadrifidus		+
Clematis linearifolia		+
Comesperma confertum		+
Desmocladus flexuosus		+
Dianella revoluta		+
**Euphorbia terracina*		+
Freesia alba x leichtlinii		+
**Gladiolus caryophyllaceus*		+
Hardenbergia comptoniana		+
Lepidosperma squamatum		+
Lysimachia arvensis		+
Melaleuca systena		+
Microtis media		+
**Pelargonium capitatum*		+
**Petrorhagia dubia*		+
**Romulea rosea*		+
Morelotia octandra		+
**Trifolium campestre*		+
**Urospermum picroides*		+
**Ursinia anthemoides*		+
**Vulpia myuros*		+

Site DR07

Date	17/11/2020
Botanist	Kellie Bauer-Simpson and Lisa Chappell
Quadrat Size	10 x 10 m
NW Corner Coordinates	383418mE 6449221mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Steep
Landform	Upper Slope
Soil Colour	Brown
Soil Type	Loam sand
Litter	25%
Bare Ground	5%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Weeds

Species	Height (cm)	% Cover
Banksia sessilis	1.8	30.0
Melaleuca huegelii	1.5	15.0
Templetonia retusa	1.2	6.0
Thomasia triphylla	1.2	4.0
**Lagurus ovatus*	0.5	4.0
**Ehrharta longiflora*	0.4	5.0
Acacia truncata		+
Acanthocarpus preissii		+
**Asparagus asparagoides*		+
Austrostipa sp.		+
Banksia dallanneyi		+
**Briza maxima*		+
Conospermum canaliculatum		+
Dianella revoluta		+
**Euphorbia terracina*		+
**Hypochaeris glabra*		+
Lysimachia arvensis		+
Melaleuca systena		+
Olearia axillaris		+
**Pelargonium capitatum*		+
Pimelea calcicola (P3)		+
**Romulea rosea*		+
**Sonchus oleraceus*		+
Tricoryne elatior		+
Trymalium ledifolium		+
Trymalium ledifolium var. *ledifolium*		+
Trymalium odoratissimum subsp. *odoratissimum*		+
Trymalium sp.		+

Site MP01

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383693 mE 6448720 mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Moderate
Landform	Ridge
Soil Colour	Light brown
Soil Type	Loam sand
Litter	55%
Bare Ground	22%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Melaleuca huegelii	1.5	2.0
Templetonia retusa	1.5	25.0
Melaleuca systena	1.5	1.0
Banksia dallanneyi	0.5	2.0
Lepidosperma oldhamii	0.5	10.0
Acacia saligna		+
Acanthocarpus preissii		+
**Asparagus asparagoides*		+
Banksia dallanneyi		+
Banksia sessilis		+
**Briza maxima*		+
Desmocladus flexuosus		+
Dianella revoluta		+
**Euphorbia terracina*		+
Gompholobium tomentosum		+
Hardenbergia comptoniana		+
**Lagurus ovatus*		+
**Lavandula* sp.		+
Lepidosperma oldhamii		+
Leucopogon sp.		+
Lomandra maritima		+
**Lysimachia arvensis*		+
Melaleuca systena		+
**Olea europaea*		+
Opercularia vaginata		+
**Petrorhagia dubia*		+
Pimelea calcicola (P3)		+
**Reichardia tingitana*		+
Spyridium globulosum		+
Trymalium ledifolium var. *ledifolium*		+
**Urospermum picroides*		+

Site MP02

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383659 mE 6449320 mN
Vegetation Unit	**EgSgW** - *Eucalyptus decipiens* open woodland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Moderate
Landform	Mid Slope
Soil Colour	Brown
Soil Type	Sandy loam
Litter	70%
Bare Ground	0.1%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Eucalyptus gomphocephala	10.0	3.0
**Gaudium laevigatum*	4.0	2.0
Spyridium globulosum	4.0	40.0
**Schinus terebinthifolia*	1.5	1.0
**Asparagus asparagoides*		+
Banksia sessilis		+
Clematis linearifolia		+
**Ehrharta longiflora*		+
**Euphorbia terracina*		+
Hardenbergia comptoniana		+
Leucopogon ? australis		+
Melaleuca huegelii		+
Rhagodia baccata		+
**Urospermum picroides*		+
**Watsonia* sp.		+

Site MP03

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	384149 mE 6448423 mN
Vegetation Unit	**MrGtW** - *Melaleuca rhaphiophylla* woodland over *Gahnia trifida* and *Juncus kraussii* sedgeland over *Cynodon dactylon* grassland
Slope	Moderate
Landform	Wetland
Soil Colour	Dark brown black
Soil Type	Peat loam
Litter	3%
Bare Ground	8%
Fire Age	5-10 Years
Vegetation Condition	Good-Very Good
Disturbances/Impacts	Weeds, litter

Species	Height (m)	% Cover
Melaleuca rhaphiophylla	6.0	5.0
Melaleuca teretifolia	1.5	2.0
Juncus pallidus	1.0	0.5
Machaerina juncea	1.0	1.0
**Cynodon dactylon*	0.5	85.0
Eucalyptus gomphocephala		+
Eucalyptus rudis subsp. *rudis*		+
Gahnia trifida		+
Rhagodia baccata		+
Rhagodia baccata subsp. *dioica*		+

Site MP04

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383506 mE 6449465 mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Gentle
Landform	Mid Slope
Soil Colour	Brown
Soil Type	Sandy loam
Litter	55%
Bare Ground	1%
Fire Age	>10 Years
Vegetation Condition	Poor-Good
Disturbances/Impacts	Weeds and litter

Species	Height (m)	% Cover
Banksia sessilis	2.5	5.0
Melaleuca huegelii	2.5	2.0
Spyridium globulosum	2.5	2.0
Grevillea preissii	1	1.0
Melaleuca systena	1	1.0
Desmocladus flexuosus	0.5	10
**Freesia alba* x *leichtlinii*	0.5	1.0
Tricoryne elatior	0.5	1.0
Acacia rostellifera		+
**Asparagus asparagoides*		+
Austrostipa flavescens		+
**Avena barbata*		+
**Briza maxima*		+
Clematis linearifolia		+
Conostylis candicans subsp. *calcicola*		+
Dianella revoluta		+
**Ehrharta calycina*		+
**Gaudium laevigatum*		+
Gompholobium tomentosum		+
Lepidosperma oldhamii		+
Lomandra maritima		+
Lysiandra calycina		+
**Pelargonium capitatum*		+
Pigea ?calycina		+
Santalum acuminatum		+
Scaevola thesioides subsp. *thesioides*		+
Spyridium globulosum		+
Templetonia retusa		+
**Urospermum picroides*		+

Site MP05r

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	Relevé
NW Corner Coordinates	383510 mE 6449028 mN
Vegetation Unit	**AcBsS** - *Acacia cyclops* and *Banksia sessilis* tall shrubland over **Euphorbia terracina* and **Pelargonium capitatum* isolated herbs and **Ehrharta calycina* isolated grasses
Slope	Gentle
Landform	Mid Slope
Soil Colour	Brown grey
Soil Type	Loam sand
Litter	55%
Bare Ground	0.1%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Weeds, loss of structure

Species	Height (m)	% Cover
Acacia cyclops	3.0	1.0
Banksia sessilis	3.0	25.0
**Schinus terebinthifolia*	2.5	1.0
**Avena barbata*	0.5	25.0
**Ehrharta calycina*	0.5	30.0
**Euphorbia terracina*		+
**Lupinus* sp.		+
**Pelargonium capitatum*		+
**Schinus terebinthifolia*		+
Spyridium globulosum		+

Site MP06

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383520 mE 6448644 mN
Vegetation Unit	**ArSgS** - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Gentle
Landform	Mid Slope
Soil Colour	Light brown yellow
Soil Type	Loam sand
Litter	80%
Bare Ground	2%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Acacia rostellifera	4.0	4.0
Banksia sessilis	1.5	3.0
**Gaudium laevigatum*	1.5	2.0
**Ehrharta longiflora*	0.3	1.0
**Asparagus asparagoides*		+
Austrostipa flavescens		+
Clematis linearifolia		+
Dianella revoluta		+
**Euphorbia terracina*		+
Lepidosperma oldhamii		+
Leucopogon parviflorus		+
Melaleuca systena		+
**Pelargonium capitatum*		+
**Urospermum picroides*		+

Site MP07r

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	Relevé
NW Corner Coordinates	383922 mE 6448649 mN
Vegetation Unit	**MrGtW** - *Melaleuca rhaphiophylla* woodland over *Gahnia trifida* and *Juncus kraussii* sedgeland over *Cynodon dactylon* grassland
Slope	Gentle
Landform	Wetland
Soil Colour	Dark brown black
Soil Type	Peat loam
Litter	12%
Bare Ground	4%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	High water level (50% gc) weeds

Species	Height (m)	% Cover
Melaleuca rhaphiophylla	6.0	20.0
Gahnia trifida	1.0	1.0
Juncus kraussii	1.0	0.5
**Cynodon dactylon*	0.3	35.0
**Atriplex prostrata*		+
Daucus glochidiatus		+
**Symphyotrichum squamatum*		+

Site MP08

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383605 mE 6448752 mN
Vegetation Unit	**ArSgS** - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Moderate
Landform	Upper Slope
Soil Colour	Light brown yellow
Soil Type	Sand
Litter	45%
Bare Ground	10%
Fire Age	5-10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Acacia rostellifera	4	5.0
Banksia sessilis	1.5	3.0
Spyridium globulosum	1.5	3.0
Templetonia retusa	1.5	1.0
**Euphorbia terracina*	0.2	1.0
Clematis linearifolia	Climber	2.0
Acanthocarpus preissii		+
**Asparagus asparagoides*		+
**Bromus diandrus*		+
Dianella revoluta		+
**Ehrharta longiflora*		+
Eremophila glabra		+
**Euphorbia terracina*		+
Hardenbergia comptoniana		+
**Lagurus ovatus*		+
Leucopogon parviflorus		+
**Lolium perenne*		+
Lomandra maritima		+
Melaleuca huegelii		+
Melaleuca systena		+
Rhagodia baccata		+
**Schinus terebinthifolia*		+
**Sonchus oleraceus*		+
Templetonia retusa		+
Tricoryne elatior		+
**Urospermum picroides*		+

Site MP09r

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	Relevé
NW Corner Coordinates	383606 mE 6449205 mN
Vegetation Unit	**ArSgS** - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Moderate
Landform	Lower Slope
Soil Colour	Dark brown
Soil Type	Sandy loam
Litter	85%
Bare Ground	2%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Weeds, loss of structure

Species	Height (m)	% Cover
Acacia rostellifera	4	60.0
Melaleuca sp.	2	1.0
**Ehrharta longiflora*	0.3	3.0
**Fumaria capreolata*	0.2	1.0
**Asparagus asparagoides*		+
**Euphorbia terracina*		+

Site MP10

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	384010 mE 6448094 mN
Vegetation Unit	**EdSgW** - *Eucalyptus decipiens* low woodland over *Spyridium globulosum* and *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* and *Tricoryne elatior* low sparse shrubland over **Ehrharta calycina* sparse grassland over *Mesomelaena pseudostygia* sparse sedgeland
Slope	Gentle
Landform	Lower Slope
Soil Colour	Light brown orange
Soil Type	Sand
Litter	62%
Bare Ground	18%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Eucalyptus decipiens	6.0	4.0
Xanthorrhoea preissii	1.5	3.0
**Ehrharta calycina*	1.0	5.0
Mesomelaena pseudostygia	1.0	2.0
Acacia pulchella		+
Amphipogon turbinatus		+
Austrostipa flavescens		+
Banksia dallanneyi		+
**Briza maxima*		+
Clematis linearifolia		+
Desmocladus flexuosus		+
Dianella revoluta		+
**Gladiolus caryophyllaceus*		+
Gompholobium tomentosum		+
Grevillea preissii		+
Hardenbergia comptoniana		+
Hibbertia hypericoides		+
Lechenaultia linarioides		+
Lepidosperma oldhamii		+
Lomandra maritima		+
Melaleuca huegelii		+
Melaleuca systena		+
**Pelargonium capitatum*		+
Spyridium globulosum		+
Tricoryne elatior		+
**Ursinia anthemoides*		+

Site MP11r

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	Relevé
NW Corner Coordinates	383926 mE 6448192 mN
Vegetation Unit	**EdSgW** - *Eucalyptus decipiens* low woodland over *Spyridium globulosum* and *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* and *Tricoryne elatior* low sparse shrubland over **Ehrharta calycina* sparse grassland over *Mesomelaena pseudostygia* sparse sedgeland
Slope	Moderate
Landform	Upper Slope
Soil Colour	Dark brown
Soil Type	Loam sand
Litter	65%
Bare Ground	15%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Weeds, tracks nearby, loss of structure

Species	Height (m)	% Cover
Eucalyptus decipiens	5.0	25.0
**Schinus terebinthifolia*	2.0	25.0
Spyridium globulosum	1.5	1.0
**Ehrharta longiflora*	0.3	25.0
**Lactuca serriola*	0.3	1
**Avena barbata*		+
**Sonchus oleraceus*		+

Site MP12

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383779 mE 6448102 mN
Vegetation Unit	**ArSgS** - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Steep
Landform	Upper Slope
Soil Colour	Brown
Soil Type	Sandy loam
Litter	62%
Bare Ground	1%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Weeds, tracks nearby

Species	Height (m)	% Cover
Acacia rostellifera	2.5	2.0
Spyridium globulosum	1.5	2.0
Templetonia retusa	1.5	2.0
Olearia axillaris	1.0	1.0
Opercularia hispidula	0.3	2.0
Acanthocarpus preissii		+
Austrostipa elegantissima		+
**Avena barbata*		+
Cassytha racemosa		+
Comesperma integerrimum		+
Dianella revoluta		+
Fabaceae sp.		+
**Gaudium laevigatum*		+
**Lagurus ovatus*		+
Lepidosperma oldhamii		+
Leucopogon parviflorus		+
Melaleuca systena		+
Olearia axillaris		+
Opercularia hispidula		+
Templetonia retusa		+
**Urospermum picroides*		+

Site MP13r

Date	31/10/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	Relevé
NW Corner Coordinates	383385 mE 6449065 mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Steep
Landform	Upper Slope
Soil Colour	Brown grey
Soil Type	Sandy loam
Litter	20%
Bare Ground	0.1%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Banksia sessilis	1.5	5.0
Melaleuca huegelii	1.5	25.0
Acacia cyclops		+
**Asparagus asparagoides*		+
Austrostipa flavescens		+
**Bromus diandrus*		+
Clematis linearifolia		+
Dianella revoluta		+
**Euphorbia terracina*		+
Hardenbergia comptoniana		+
**Lagurus ovatus*		+
Leucopogon ? australis		+
**Lolium perenne*		+
**Pelargonium capitatum*		+
**Sixalix atropurpurea*		+
**Vicia sativa*		+

Site MP14

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383556 mE 6449691 mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Moderate
Landform	Mid Slope
Soil Colour	Light brown
Soil Type	Loam sand
Litter	45%
Bare Ground	30%
Fire Age	5-10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
**Gaudium laevigatum*	4.0	0.5
Melaleuca huegelii	2.0	25.0
Spyridium globulosum	1.5	5.0
Templetonia retusa	1.3	20.0
**Freesia alba* x *leichtlinii*	0.2	1.0
Acacia truncata		+
Austrostipa flavescens		+
Banksia sessilis		+
Dianella revoluta		+
Grevillea preissii		+
**Lagurus ovatus*		+
Lepidosperma oldhamii		+
Melaleuca systena		+
**Petrorhagia dubia*		+
**Retama raetam*		+

Site MP15

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383761 mE 6448210 mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Moderate
Landform	Mid Slope
Soil Colour	Light brown
Soil Type	Sandy loam
Litter	30%
Bare Ground	1%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Tracks, weeds

Species	Height (m)	% Cover
Melaleuca huegelii	1.5	4.0
Templetonia retusa	1.5	15.0
Desmocladus flexuosus	0.2	3.0
Cassytha racemosa	Climber	2.0
Acacia truncata		+
**Asparagus asparagoides*		+
Austrostipa flavescens		+
**Avena barbata*		+
**Briza maxima*		+
Desmocladus flexuosus		+
Dianella revoluta		+
Gompholobium tomentosum		+
Grevillea preissii		+
Hibbertia hypericoides		+
Lepidosperma oldhamii		+
Lysiandra calycina		+
Olearia axillaris		+
Opercularia hispidula		+
Pimelea calcicola (P3)		+
Trymalium ledifolium var. *ledifolium*		+
**Urospermum picroides*		+

Site MP16

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383664 mE 6448548 mN
Vegetation Unit	**MhTrS** - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland
Slope	Steep
Landform	Upper Slope
Soil Colour	Light brown
Soil Type	Sandy loam
Litter	58%
Bare Ground	5%
Fire Age	>10 Years
Vegetation Condition	Very Good
Disturbances/Impacts	Weeds

Species	Height (m)	% Cover
Acacia rostellifera	3.0	2.0
**Gaudium laevigatum*	3.0	5.0
Melaleuca huegelii	1.5	2.0
Spyridium globulosum	1.5	2.0
Templetonia retusa	1.5	5.0
Lepidosperma oldhamii	0.3	5.0
**Asparagus asparagoides*		+
Austrostipa flavescens		+
**Avena barbata*		+
Banksia sessilis		+
Dianella revoluta		+
Drosera sp.		+
**Euphorbia terracina*		+
Gahnia trifida		+
**Lagurus ovatus*		+
Leucopogon parviflorus		+
Lysiandra calycina		+
Tricoryne elatior		+
**Urospermum picroides*		+

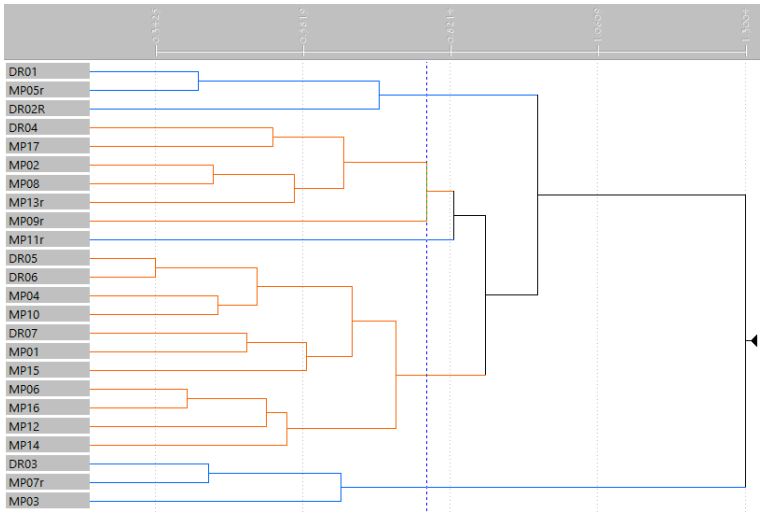
Site MP17

Date	01/11/2023
Botanist	Sarah Beckwith and Taryn Brebner
Quadrat Size	10 x 10 m
NW Corner Coordinates	383799 mE 6448871 mN
Vegetation Unit	**EgSgW** - *Eucalyptus decipiens* open woodland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over **Euphorbia terracina* isolated herbs
Slope	Moderate
Landform	Lower Slope
Soil Colour	Dark brown
Soil Type	Sandy loam
Litter	80%
Bare Ground	2%
Fire Age	>10 Years
Vegetation Condition	Good
Disturbances/Impacts	Weeds, some loss of structure

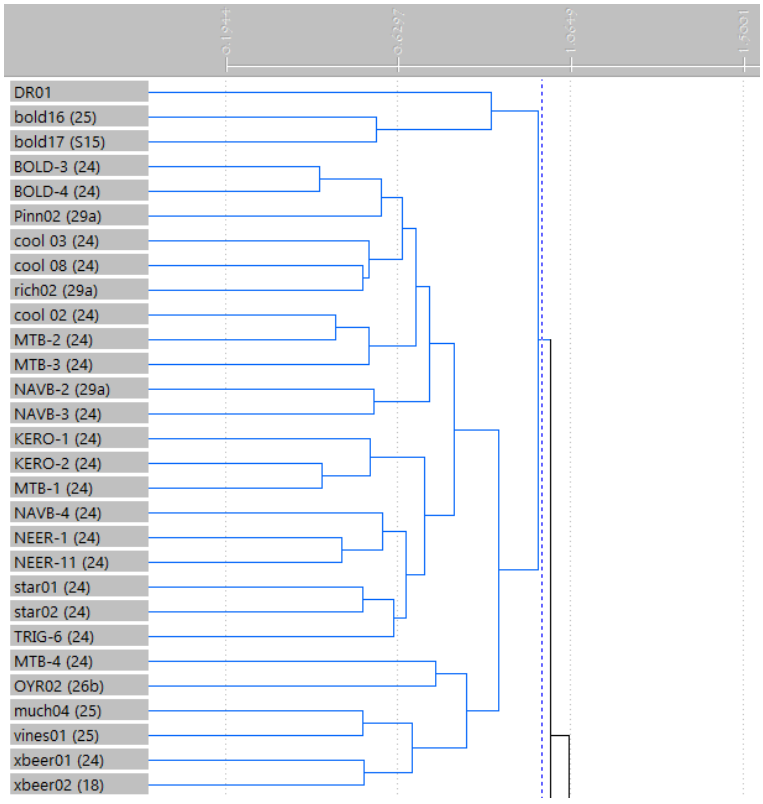
Species	Height (m)	% Cover
Eucalyptus gomphocephala	10.0	30.0
Spyridium globulosum	1.5	1.0
Templetonia retusa	1.5	0.5
**Asparagus asparagoides*	0.5	1.0
**Ehrharta longiflora*	0.5	2.0
**Euphorbia terracina*	0.5	0.5
**Fumaria capreolata*	0.5	1
Austrostipa flavescens		+
**Avena barbata*		+
**Cenchrus clandestinus*		+
Hardenbergia comptoniana		+
**Lagurus ovatus*		+
**Oxalis pes-caprae*		+
**Schinus terebinthifolia*		+
**Sixalix atropurpurea*		+
**Sonchus oleraceus*		+

APPENDIX G – FLORISTIC ANALYSIS DENDROGRAM

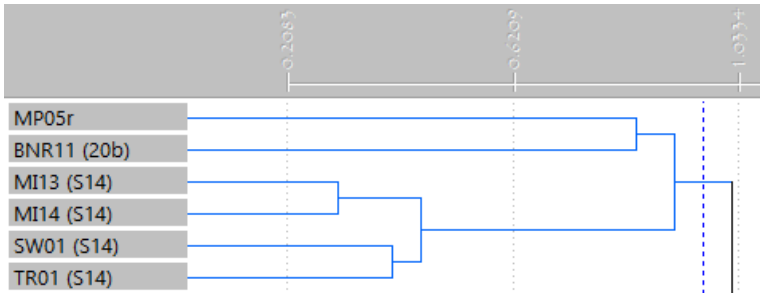
Dendrogram 1 – Batch Analysis Manning Park Quadrats



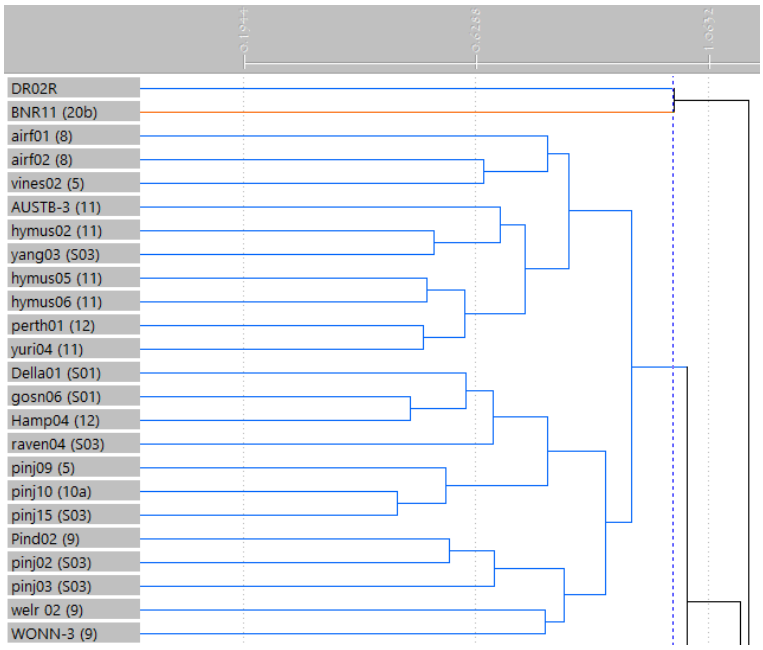
Dendrogram 2 – AcBs SSI DR01 (Excerpt)



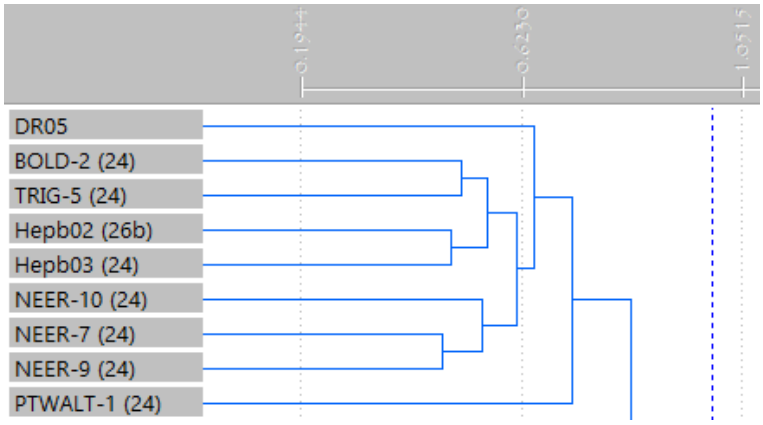
Dendrogram 3 – AcBs SSI MP05r (Excerpt)



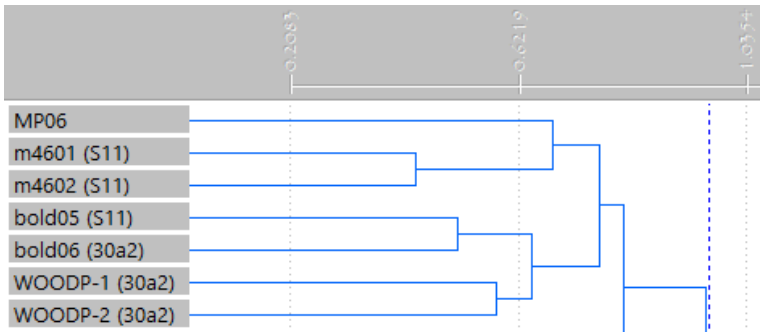
Dendrogram 4 – ArSg DR02R (Excerpt)



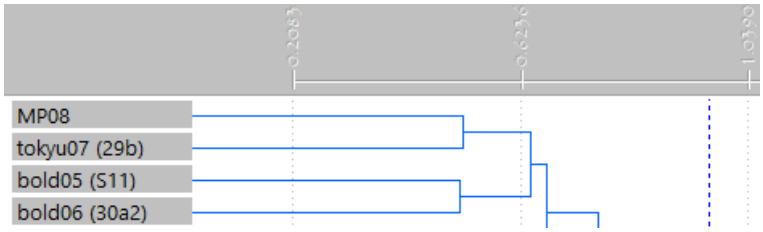
Dendrogram 5 – ArSg SSI DR05 (Excerpt)



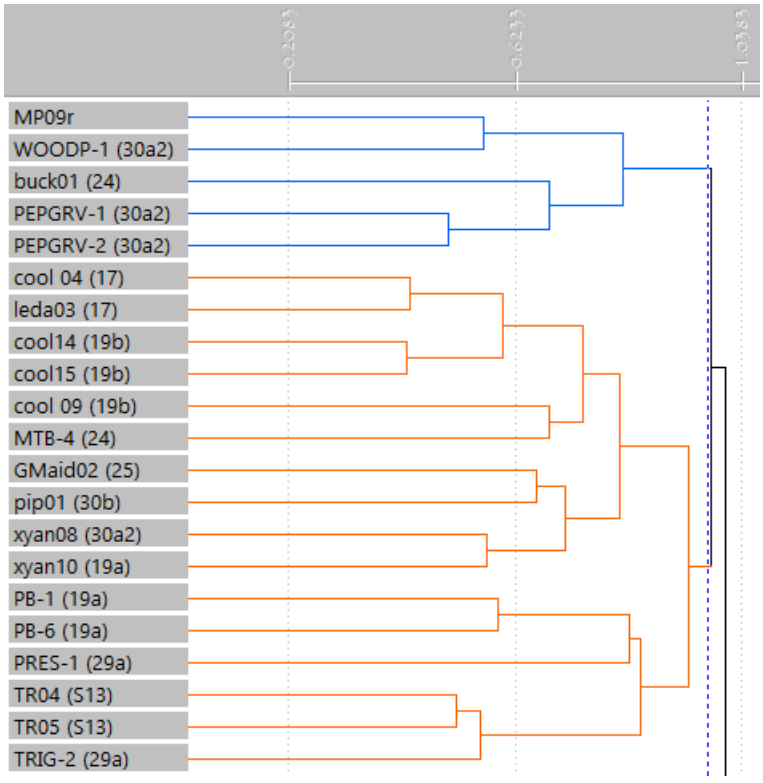
Dendrogram 6 – ArSg SSI MP06 (Excerpt)



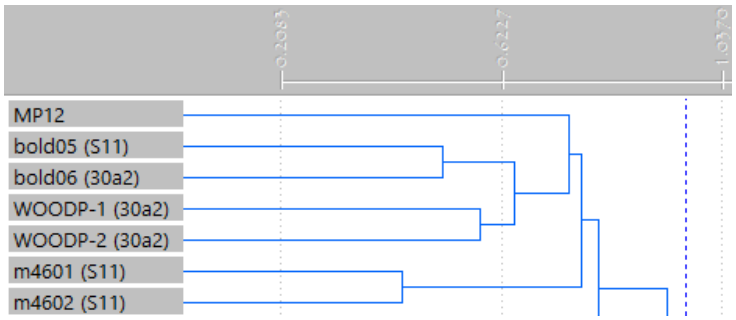
Dendrogram 7 – ArSg SSI MP08 (Excerpt)



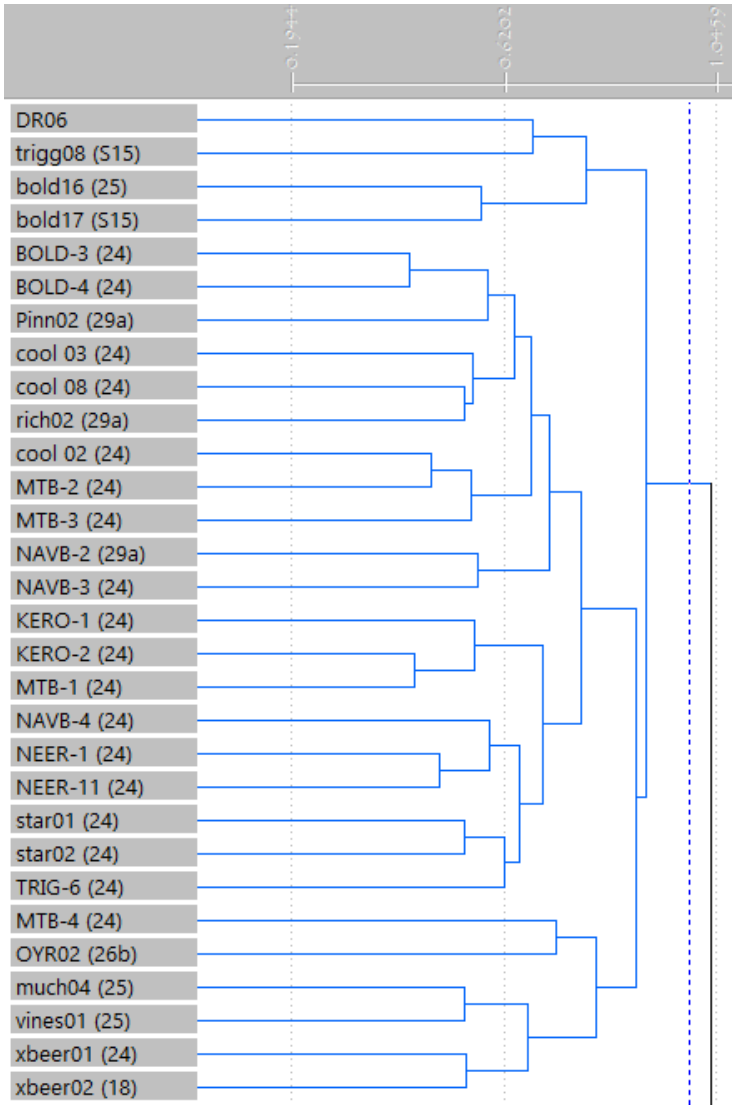
Dendrogram 8 – ArSg SSI MP09r (Excerpt)



Dendrogram 9– ArSg SSI MP12 (Excerpt)

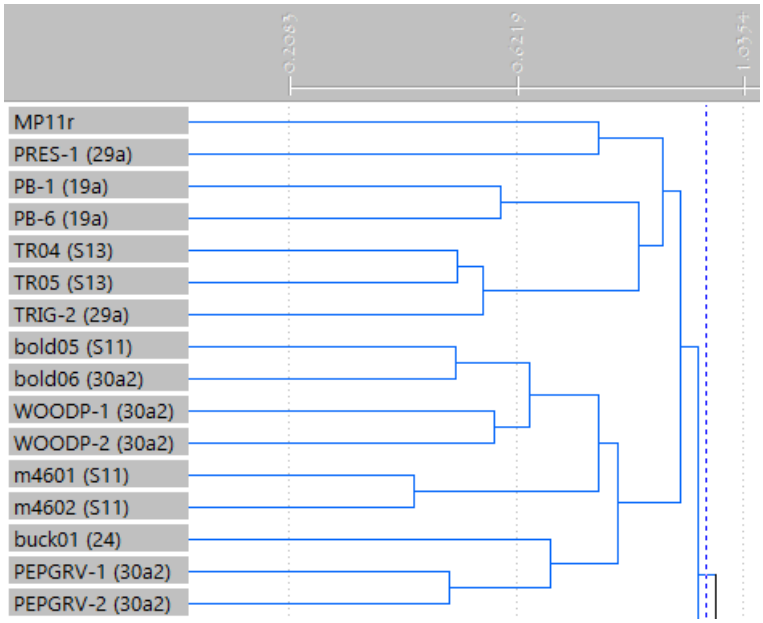


Dendrogram 10 – EdSg SSI DR06 (Excerpt)

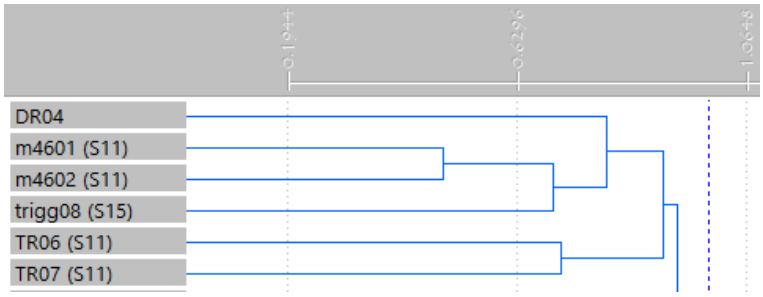


Dendrogram 11 – EdSg SSI MP10 (Excerpt)

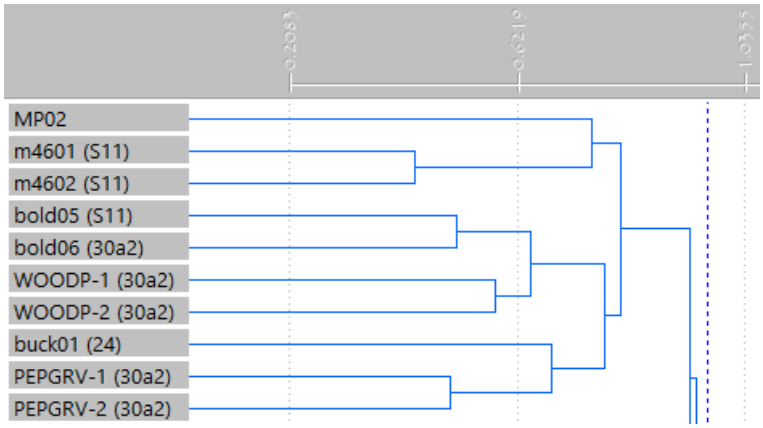
Dendrogram 12 – EdSg SSI MP11r (Excerpt)



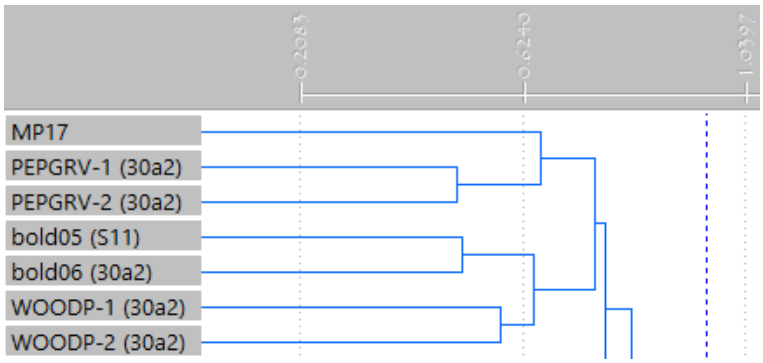
Dendrogram 13 – EgSg SSI DR04 (Excerpt)



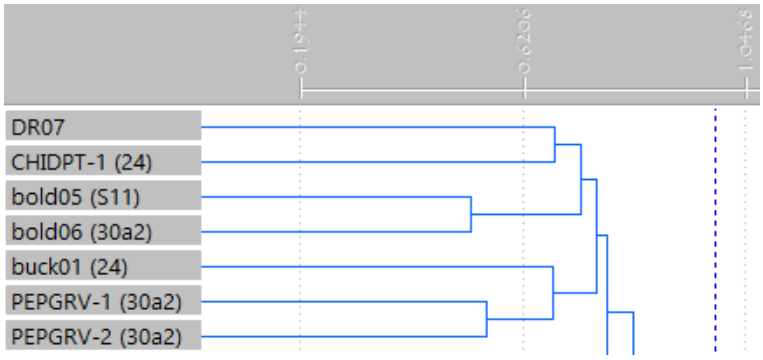
Dendrogram 14 – EgSg SSI MP02 (Excerpt)



Dendrogram 15 – EgSg SSI MP17 (Excerpt)

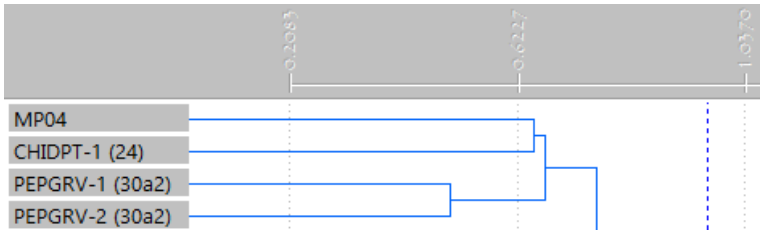


Dendrogram 16 – MhTr SSI DR07 (Excerpt)

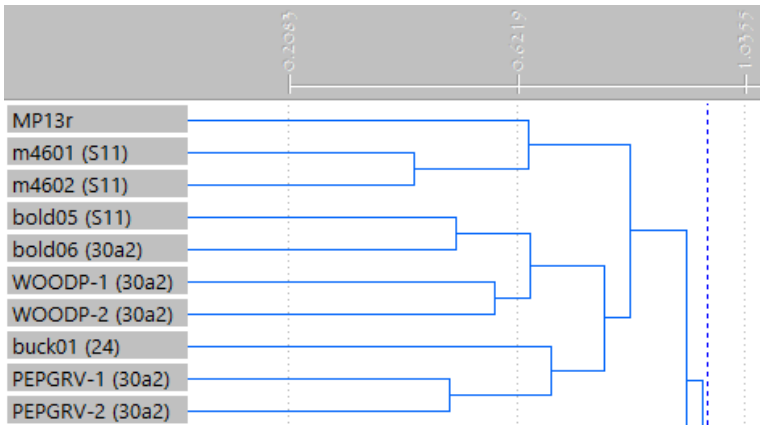


Dendrogram 17 – MhTr SSI MP01 (Excerpt)

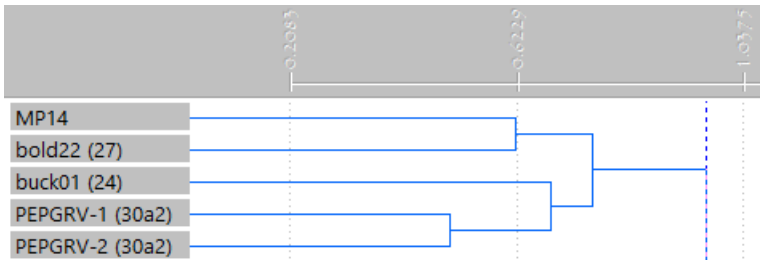
Dendrogram 18 – MhTr SSI MP04 (Excerpt)



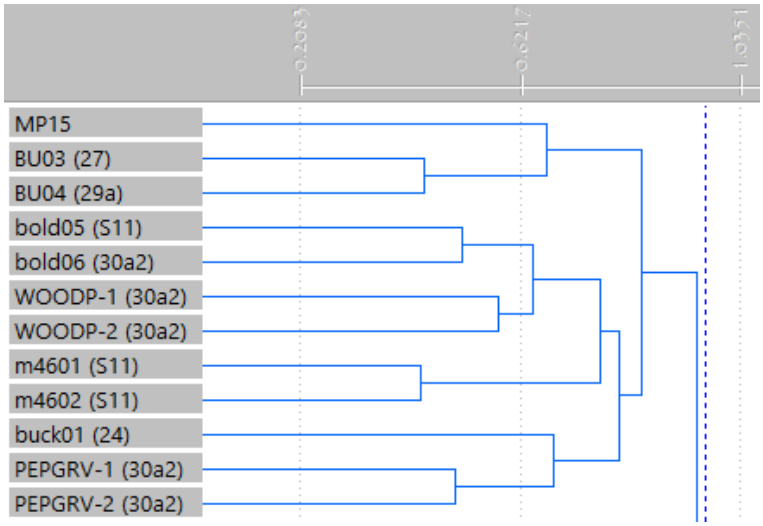
Dendrogram 19 – MhTr SSI MP13r (Excerpt)



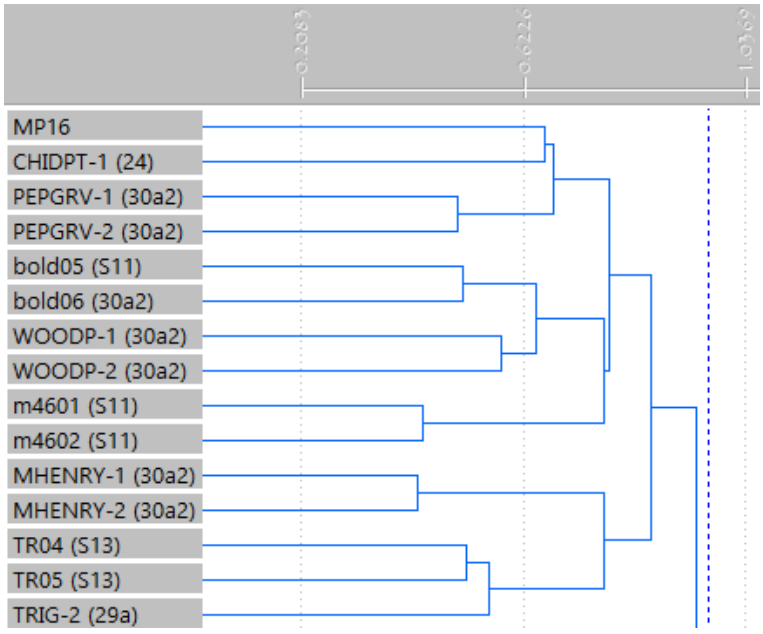
Dendrogram 20 – MhTr SSI MP14 (Excerpt)



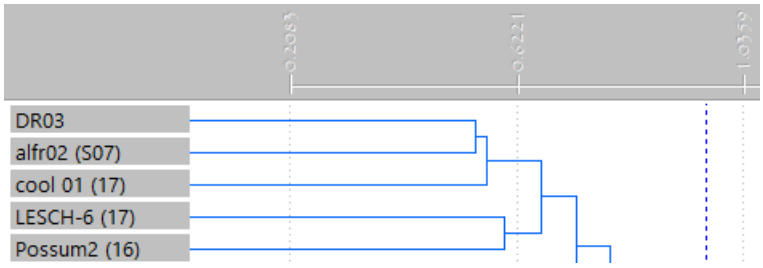
Dendrogram 21 – MhTr SSI MP15 (Excerpt)



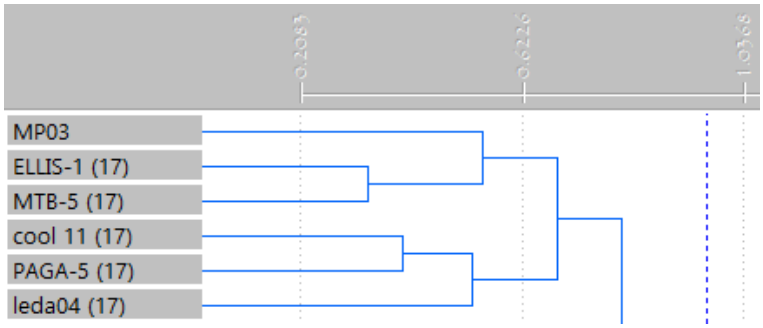
Dendrogram 22 – MhTr SSI MP16 (Excerpt)



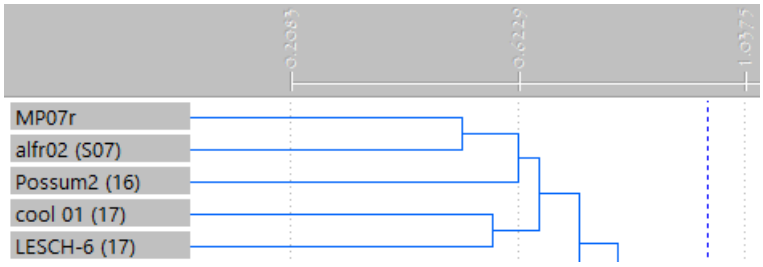
Dendrogram 23 – MtGt SSI DR03 (Excerpt)



Dendrogram 24 – MtGt SSI MP03 (Excerpt)



Dendrogram 25 – MtGt SSI MP07r (Excerpt)



APPENDIX H – NAIA FORMS

Natural Area Initial Desktop Assessment

Date of assessment 23/02/2024 Native Vegetation Unique ID No.

Name of area Manning Park Database Site No.

Other names used Part submission Area 336, part Bellier Regional Park

Location (address/street name incl. suburb, nearest street corner, Local Government)

Azelia Road, Spearwood/Hamilton Hill, City of Cockburn

Street Directory: Year, Page and Grid Ref. (Street Smart/ Gregorys/ UBD)

Prepare the following maps and label with the name of the area.

Map 1: Location of

Photocopy of street directory showing location of site

Map 2: Reference Sites/Plots and Linkage for

A GIS print-out of general area showing vegetation complexes, potential reference sites and plots, mapped wetlands and their management category, areas of any previously recorded Declared Rare Flora, Specially Protected Fauna, Priority Flora or Fauna or Threatened Ecological Communities plus location of Draft Regional and, if available, Local Ecological Linkages. If no Local Ecological Linkages have been determined for the Local Government area, use this map to mark potential local ecological linkages to other natural areas.

Map 3: Aerial photograph of

Date of photography Scale

GIS print-out of aerial photography (with topography, if available) at a scale that ensures site covers most of an A4 page. Easy-to-use scales are 1:2000 (1 cm = 20 m), 1:3000 (1 cm = 30 m), 1:4000 (1 cm = 40 m) or 1:5000 (1 cm = 50 m). For large sites, spread over several A4 pages at one of these scales if necessary.

Area (ha) 107.63 Perimeter (m) 5606.67

Perimeter (m) to area (m^2) ratio 0.005 Priority for Further Investigation

Lot/Location/Reserve Number/s Bushforever Site number 247

Ownership (Local Government Reserve / Other Govt (Agency?) / Private)

Local Government Reserve

Land Manager City of Cockburn

Vesting Purpose Parks and Recreation

MRS Reservation or Zoning Parks and Recreation

TPS Reservation or Zoning Parks and Recreation

Protection Status (circle) none / conservation covenant / conservation zone / conservation vesting purpose / Bush Forever & Parks and Recreation in the MRS / protected CALM land

Current Status/Use of land Conservation

Long term plans?

Initial Desktop Assessment Name of area: Manning Park

Recognised International/ National? State? Regional Conservation Value (yes/no)

Specify:

Entered in the Interim List of the Register of the National Estate: Subject to protection under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, EPP Lake

Part of a Draft Regional Ecological Linkage Specify (links which areas?): Recognised regional ecological linkage (Linkage 76), protected under State policy, North-South (yes/no)

Mapped Vegetation Complex/es: Cottesloe complex-central and south (yes/no)

Mapped Soil Type/s (if mapping available): Spearwood system - Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/ brown shallow sands (CC/RE/MU) (yes/no)

Mapped wetland/s: (yes/no) Environmental Protection Policy (EPP) Lake:

Wetland Management Category:

Is it a mapped floodplain area?

Potential Reference Sites and Plots (e.g. Bush Forever Sites; CALM Reserves, see Map 2). For Bush Forever Sites note floristic community type/s (FCTs) and whether FCTs actual or inferred.

Bush Forever site 247. Manning Lake and Adjacent Bushland, Hamilton Hill/Spearwood Inferred FCTs:

SCP 17 - *Melaleuca rhaphiophylla - Gahnia trifida* seasonal wetlands SCP24 - Northern Spearwood shrublands and woodlands

SCP26a - *Melaleuca huegleii - Melaleuca* systena shrulands on limestone ridges SCP16 - Highly saline seasonal wetlands

SCP 30a - The Rottnest Island Pine and Tea Tree TEC

SCP30c - Woodlands and Shrublands on Holcene Dunes

Existing biological information for area or for potential Reference Sites (reports/ surveys/ species lists)

NAIA assessment 2008

NAIA assessment 2018 (Ecological Australia)

NAIA assessment 2020 (Focused Vision Consulting

Conservation Management Plan (yes/no) Current or Review needed? Review needed

Title/Author/Year Beelier Regional Park Final Management Plan 2006

Part of a Local Ecological Linkage yes/no

(if these have not already been determined by Local Government mark potential linkages on Map 2)

Time since isolation from other natural areas <5 years (5 - 20 years) >20 years
(consult local community, historical aerial photography)

Initial Desktop Assessment Name of area: Manning Park

Does it contain any mapped Threatened Ecological Communities (see Map 2)? yes/no
Specify: Tuart woodlands and forests TEC, and Honeymyrtle on Limestone Ridges TEC

Does it contain any mapped Declared Rare Flora (see Map 2) or is it a known location for any Specially Protected Fauna or significant habitat for these fauna? yes/no

Specify: Habitat provided for Threatened Black-cockatoos

Does it contain any mapped Priority (see Map 2) or other significant **flora** (e.g. see Table 13, Bush Forever, Vol. 2, p. 51) or is it a known location for any Priority or other significant **fauna** (e.g. see Tables 14 and 15, Bush Forever, Vol. 2, pp. 59-63) or significant habitat for these fauna? yes/no

Specify Records of Carnaby Black-cockatoo, Perth Slider, Lined Skink, Blue-billed duck within study area

Riparian streamline vegetation expected yes/no
Estuarine fringing vegetation expected yes/no
Coastal vegetation expected (foredunes or secondary dunes) yes/no
Fire History (consult with FESA/Volunteer Fire Brigades, local community, historical aerial photography)
Last fire approx 15years

Known to be of particular value to the local community for conservation yes/no
Active Friends/Environmental Group yes/no
Name of group and contact details Cockburn Wetlands Friends Group
Friends of Manning Park

Surrounding land uses with potential for community interest and possibly assistance with management
☒ educational facility yes/no
☒ residential development yes/no
☒ other (specify) yes/no

Indigenous or European Cultural or Historical Heritage Value yes/no

Notes Place No.533 Manning Estate, Hamilton Hill, Azelia Ley Homestead, Manning Park and Tuart Trees, Manning Lake

Natural Area Initial Field Assessment A

Date of assessment 23/02/2024 Native Vegetation Unique ID No. _____

Name of area Manning Park Reserve Database Site No. _____

Location (address/street name) Azelia Road, Spearwood/Hamilton Hill, City of Cockburn

Assessor	Taryn Brebner	*Skill Level 6b
Recorder	Taryn Brebner	Skill Level 6b
Recorder	Sarah Beckwith	Skill Level 6b
Recorder	Megan Gray	Skill Level 6b
Recorder	Olga Nazarova	Skill Level 6b

**Important Note: Skill level 4 or above is required by the assessor to complete this template (see Appendix 1).*

Photographs

Indicate film roll no. and photograph no., location and direction of each photo on Map 4 during the field assessment. e.g. R1/P4 **o** (Roll 1/Photo 4 looking **o**)

Photographer's Name _____

GPS used: (yes)/no GPS datum: GDA 2020 _____

Descriptor and Location No. (eg. BMX jump GPS 1)	Latitude (S) or Northing	Longitude (E) or Easting
Study Area central Point	383811	6448623

Prepare the following map during the field assessment and label with the name of the area.

Map 4 (transparent overlay on aerial photograph, Map 3): Uplands/Wetlands, Structural Plant Communities, Vegetation Condition, Spot Weed Occurrences, Areas of Disturbance and Management Infrastructure of _____

Uplands, Wetlands And Structural Plant Communities – Description And Mapping

On Map 4 divide the site into upland versus wetland areas and then into broad sections based on structural plant communities. Allocate a number to each community and describe each community using a representative sample point. Note the vegetation condition of each sample point as well as drawing a vegetation condition map for the whole site.

Describe each community using page 5 of these templates OR if preferred the templates of Keighery(1994) (see Appendix 3). If using the Keighery templates, describe each community on Recording Sheets 1 & 2 and list common native species present on Recording Sheet 3. Note that Appendix 3 contains minor modifications to the Keighery (1994) templates to include the additional information required on page 5.

Each structural plant community is described by noting the dominant species in each growth form layer of the community (see Appendix 2). Collect specimens for identification if necessary provided you have a licence from CALM and land owner permission. Carefully label all specimens. DO NOT collect species suspected of being DECLARED RARE FLORA instead take a good photo and accurately note location. Do not collect whole plants unless they are very small species and do not collect at all if only a few are present, take a good photo as an alternative

Initial Field Assessment A Name of area Manning Park

Structural Plant Community No. 1 Indicate location of sample point described on Map 4. **Latitude and Longitude**
GPS used: (yes) no GPS datum: 2020 E: 383693 N: 6448720
Landform and Soils
SLOPE: flat/ gentle/ (steep) ASPECT: N/ NE/ (E)/ SE/ S/ SW/ W/ NW OR n/a
SURFACE SOIL: Colour: Light Brown Texture: sand/ (loamy sand)/ sandy loam/ loam/ clay/ gravel EXPOSED ROCK (type and % of surface):
SUB-SURFACE SOIL: Colour: Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel
UNDERLYING ROCK (type and depth if known):
DRAINAGE: (well) moderate/ poor WET: all year/ winter and spring only OR (n/a)
CURRENT WATER DEPTH: cm
LITTER (% cover & depth): 55 BARE GROUND (% cover) 22
Topographic Position Circle position of point described on a transect diagram of site below.

(**Upland**) **or Wetland?** (circle one)

Growth Form Layer	**Dominant species** for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	**Crown Cover (Keighery 1994)** 2-10% / 10-30% / 30-70% / over 70%	**Height & Crown Cover (NVIS)** Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m			
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m			
Shrubs 1-2 m	*Melaleuca huegleii, Templetonia retusa, Melaleuca systena*	20-30%	1.5, 28%
Shrubs under 1 m	*Banksia dallanneyii,*	0-2%	0.5 2
Herbs			
Sedges/ Rushes	*Lepidosperma oldhamii*	10-30%	0.5, 10
Grasses			
Other (e.g. climbers)			

Common Native Species Note species observed.

Refer to Appendix G in COC22001 report

Icon Flora Species (Note if present)

Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)
Very Good

Description Of Structural Plant Community No. (see Appendix 2)

MhTrS - *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland.

Icon Community (tick if an icon community)

Community Type1

Initial Field Assessment A Name of area Manning Park

Structural Plant Community No. 2 Indicate location of sample point described on Map
4. **Latitude and Longitude**
GPS used: yes/no GPS datum: 2020 E: 383659 N: 6449320
Landform and Soils
SLOPE: flat/ gentle/ steep ASPECT: N/ NE/ E/ SE/ S/ SW/ W/ NW OR n/a
SURFACE SOIL: Colour: Brown Texture: sand/ loamy sand/ sandy loam/ loam/ clay/
gravel EXPOSED ROCK (type and % of surface):
SUB-SURFACE SOIL: Colour: Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel
UNDERLYING ROCK (type and depth if known):
DRAINAGE: well/ moderate/ poor WET: all year/ winter and spring only OR n/a
CURRENT WATER DEPTH: cm
LITTER (% cover & depth): 70 BARE GROUND (% cover) 0.1
Topographic Position Circle position of point described on a transect diagram of site below.

Upland or Wetland? (circle one)

Growth Form Layer	**Dominant species** for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	**Crown Cover (Keighery 1994)** 2-10% / 10-30% / 30-70% / over 70%	**Height & Crown Cover (NVIS)** Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m	*Eucalyptus gomphocephala*	2-10%	10, 3%
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m	*Spyridium globulosum, *Gaudium laevigatum*	30-70%	4, 42%
Shrubs 1-2 m			
Shrubs under 1 m	**Schinus terebinthifolia*	0-2%	1.5, 1%
Herbs			
Sedges/ Rushes			
Grasses			
Other (e.g. climbers)			

Common Native Species Note species observed.

Refer to Appendix G in COC22001 report

Icon Flora Species (Note if present)

Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)
Good

Description Of Structural Plant Community No. (see Appendix 2)

EgSgW - *Eucalyptus decipiens* open woodland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over **Euphorbia terracina* isolated herbs.

Icon Community (tick if an icon community)

Community Type 2

Initial Field Assessment A Name of area Manning Park

Structural Plant Community No. 3 Indicate location of sample point described on Map
4. **Latitude and Longitude**
GPS used: (yes)/no GPS datum: 7850 E: 384149 N: 6448423
Landform and Soils
SLOPE: flat/ gentle/ (steep) ASPECT: N/ NE/ E/ SE/ S/ SW/ (W)/ NW OR n/a
SURFACE SOIL: Colour: Dark Brown Black Texture: sand/ loamy sand/ sandy loam/ (loam)/ clay/
gravel EXPOSED ROCK (type and % of surface):
SUB-SURFACE SOIL: Colour: Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel
UNDERLYING ROCK (type and depth if known):
DRAINAGE: well/ moderate/ (poor) WET: (all year)/ winter and spring only OR n/a
CURRENT WATER DEPTH: cm
LITTER (% cover & depth): 3 BARE GROUND (% cover) 8
Topographic Position Circle position of point described on a transect diagram of site below.

Upland or Wetland? (circle one)

Growth Form Layer	**Dominant species** for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	**Crown Cover (Keighery 1994)** 2-10% / 10-30% / 30-70% / over 70%	**Height & Crown Cover (NVIS)** Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m			
Trees under 10 m	*Melaleuca rhaphiophylla*	2-10%	6, 5%
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m			
Shrubs 1-2 m			
Shrubs under 1 m			
Herbs			
Sedges/ Rushes	*Machaerina juncea* and *Juncus pallidus*	0-2%	1, 1.5%
Grasses	**Cynodon dactylon*	>70%	0.5, 85%
Other (e.g. climbers)			

Common Native Species Note species observed.

Refer to Appendix G in COC22001 report

Icon Flora Species (Note if present)

Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)
Good-Very Good

Description Of Structural Plant Community No. (see Appendix 2)

MtGtW - *Melaleuca rhaphiophylla* woodland over *Gahnia trifida* and *Juncus kraussii* sedgeland over **Cynodon dactylon* grassland

Icon Community (tick if an icon community)

Community Type 3

Initial Field Assessment A Name of area Manning Park

Structural Plant Community No. 4 Indicate location of sample point described on Map 4. **Latitude and Longitude**
GPS used: (yes)/no GPS datum: 2020 E: 383520 N: 6448644
Landform and Soils
SLOPE: flat/ (gentle)/ steep ASPECT: N/ NE/ E/ SE/ S/ SW/ (W)/ NW OR n/a
SURFACE SOIL: Colour: Light Brown/yellow Texture: sand/ (loamy sand)/ sandy loam/ loam/ clay/ gravel EXPOSED ROCK (type and % of surface):
SUB-SURFACE SOIL: Colour: Light Brown/yellow Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel
UNDERLYING ROCK (type and depth if known):
DRAINAGE: well/ (moderate)/ poor WET: all year/ winter and spring only OR (n/a)
CURRENT WATER DEPTH: cm
LITTER (% cover & depth): 80 BARE GROUND (% cover) 2
Topographic Position Circle position of point described on a transect diagram of site below.

(**Upland or Wetland?** (circle one)

Growth Form Layer	**Dominant species** for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	**Crown Cover (Keighery 1994)** 2-10% / 10-30% / 30-70% / over 70%	**Height & Crown Cover (NVIS)** Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m			
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m	*Acacia rostellifera*	2-10%	4, 4%
Shrubs 1-2 m	*Banksia sessilis, *Gaudium laevigatum*	2-10%	1.5, 5%
Shrubs under 1 m			
Herbs			
Sedges/ Rushes			
Grasses	*Ehrharta longiflora*	0-2%	0.3, 1%
Other (e.g. climbers)			

Common Native Species Note species observed.

Refer to Appendix G in COC22001 report

Icon Flora Species (Note if present)

Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)
Good

Description Of Structural Plant Community No. (see Appendix 2)

ArSgS - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over *Euphorbia terracina* isolated herbs

Icon Community (tick if an icon community)

Community Type 4

Initial Field Assessment A Name of area Manning Park

Structural Plant Community No. 5 Indicate location of sample point described on Map
4. **Latitude and Longitude**
GPS used: yes/no GPS datum: 7850 E: 383605 N: 6448752
Landform and Soils
SLOPE: flat/ gentle/ steep ASPECT: N/ NE/ E/ SE/ S/ SW/ W/ NW OR n/a
SURFACE SOIL: Colour: Light Brown/yellow Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel EXPOSED ROCK (type and % of surface):
SUB-SURFACE SOIL: Colour: Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel
UNDERLYING ROCK (type and depth if known):
DRAINAGE: well/ moderate/ poor WET: all year/ winter and spring only OR n/a
CURRENT WATER DEPTH: cm
LITTER (% cover & depth): 45 BARE GROUND (% cover) 10
Topographic Position Circle position of point described on a transect diagram of site below.

Upland or Wetland? (circle one)

Growth Form Layer	**Dominant species** for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	**Crown Cover (Keighery 1994)** 2-10% / 10-30% / 30-70% / over 70%	**Height & Crown Cover (NVIS)** Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m			
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m	*Acacia rostellifera*	2-10%	4, 5%
Shrubs 1-2 m	*Banksia sessilis, Spyridium globulosum, Templetonia retusa*	2-10%	1.5, 7%
Shrubs under 1 m			
Herbs	**Euphorbia terracina, Clematis linearifolia*	2-10%	0.2, 3%
Sedges/ Rushes			
Grasses			
Other (e.g. climbers)			

Common Native Species Note species observed.

Refer to Appendix G in COC22001 report

Icon Flora Species (Note if present)

Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)
Good

Description Of Structural Plant Community No. (see Appendix 2)

ArSgS - *Acacia rostellifera* tall open shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Lomandra maritima* low sparse shrubland over **Euphorbia terracina* isolated herbs

Icon Community (tick if an icon community)

Community Type 5

Initial Field Assessment A Name of area Manning Park

Structural Plant Community No. 6 Indicate location of sample point described on Map 4. **Latitude and Longitude**
GPS used: (yes)/no GPS datum: 7850 E: 383510 N: 6449028
Landform and Soils
SLOPE: flat/ (gentle)/ steep ASPECT: N/ NE/ E/ (SE)/ S/ SW/ W/ NW OR n/a
SURFACE SOIL: Colour: Brown/grey Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel EXPOSED ROCK (type and % of surface):
SUB-SURFACE SOIL: Colour: Texture: sand/ (loamy sand)/ sandy loam/ loam/ clay/ gravel
UNDERLYING ROCK (type and depth if known):
DRAINAGE: well/ (moderate)/ poor WET: all year/ winter and spring only OR (n/a)
CURRENT WATER DEPTH: cm
LITTER (% cover & depth): 55 BARE GROUND (% cover) 0.1
Topographic Position Circle position of point described on a transect diagram of site below.

(**Upland**) **or Wetland?** (circle one)

Growth Form Layer	**Dominant species** for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	**Crown Cover (Keighery 1994)** 2-10% / 10-30% / 30-70% / over 70%	**Height & Crown Cover (NVIS)** Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m			
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m	*Acacia cyclops, Banksia sessilis, *Schinus terebinthifolia*	10-30%	2.5-3, 27%
Shrubs 1-2 m			
Shrubs under 1 m			
Herbs			
Sedges/ Rushes			
Grasses	*Avena barbata, *Ehrharta calycina*	30-70%	0.5, 55%
Other (e.g. climbers)			

Common Native Species Note species observed.

Refer to Appendix G in COC22001 report

Icon Flora Species (Note if present)

Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)
Degraded

Description Of Structural Plant Community No. (see Appendix 2)

AcBsS - *Acacia cyclops* and *Banksia sessilis* tall shrubland over **Euphorbia terracina* and **Pelargonium capitatum* isolated herbs and **Ehrharta calycina* isolated grasses

Icon Community (tick if an icon community)

Community Type 6

Initial Field Assessment A Name of area: Manning Park

Weed Species Note species observed, especially the occurrence of species in better condition areas, even if they only occur in small numbers or in small patches at present. Note the distribution of each species across the site, e.g. throughout the site, spot occurrences or disturbed areas only (edges/tracks/cleared areas). Mark spot occurrences and easily mapped distributions on Map 4. If a species is widespread, note whether it is restricted to specific plant communities or wetland areas.

Weed Species	**Distribution** e.g. throughout the site, spot occurrences or disturbed areas only (edges/tracks/cleared areas)
**Acacia iteaphylla*	Spot occurrences
**Acacia longifolia*	Spot occurrences
**Agave* sp.	Spot occurrences
**Anredera cordifolia*	Spot occurrences
**Arundo donax*	Spot occurrences
**Asclepias tuberosa*	Spot occurrences
**Asparagus asparagoides*	Throughout site
**Asphodelus fistulosus*	Spot occurrences
**Atriplex prostrata*	Spot occurrences
**Avena barbata*	Spot occurrences
**Bacopa monnieri*	Spot occurrences
**Briza maxima*	Spot occurrences
**Bromus diandrus*	Spot occurrences
**Carpobrotus edulis*	Spot occurrences
**Cenchrus clandestinus*	Spot occurrences
**Cenchrus* sp.	Disturbed areas
**Cenchrus setaceus*	Spot occurrences
**Centranthus macrosiphon*	Spot occurrences
**Chamelaucium uncinatum*	Spot occurrences
**Chenopodium macrospermum*	Spot occurrences
**Cynodon dactylon*	Throughout site
**Ehrharta calycina*	Spot occurrences
**Ehrharta longiflora*	Spot occurrences
**Ehrharta villosa*	Spot occurrences
**Eragrostis curvula*	Spot occurrences
**Euphorbia terracina*	Throughout site
**Ferraria crispa*	Spot occurrences
**Ficus carica*	Spot occurrences
**Foeniculum vulgare*	Spot occurrences
**Freesia alba x leichtlinii*	Spot occurrences
**Fumaria capreolata*	Spot occurrences
**Fumaria* sp.	Spot occurrences
**Gaudium laevigatum*	Throughout site
**Gazania* sp.	Spot occurrences
**Gladiolus caryophyllaceus*	Spot occurrences
**Hypochaeris glabra*	Spot occurrences
**Lactuca serriola*	Spot occurrences

**Lagurus ovatus*	Spot occurrences
**Lantana camara*	Spot occurrences
**Lavandula* sp.	Spot occurrences
**Lolium perenne*	Spot occurrences
**Lupinus cosentinii*	Spot occurrences
**Lupinus* sp.	Spot occurrences
**Lycium ferocissimum*	Spot occurrences
**Lysimachia arvensis*	Spot occurrences
**Melaleuca nesophila*	Spot occurrences
**Oenothera drummondii*	Spot occurrences
**Olea europaea*	Spot occurrences
**Oxalis pes-caprae*	Spot occurrences
**Pelargonium capitatum*	Spot occurrences
**Petrorhagia dubia*	Spot occurrences
**Pheonix dactylifera*	Spot occurrences
**Pinus pinaster*	Spot occurrences
**Polygala myrtifolia*	Spot occurrences
**Raphanus raphanistrum*	Spot occurrences
**Reichardia tingitana*	Spot occurrences
**Retama raetam*	Spot occurrences
**Ricinus communis*	Spot occurrences
**Romulea rosea*	Spot occurrences
**Schinus terebinthifolia*	Spot occurrences
**Sixalix atropurpurea*	Spot occurrences
**Sonchus oleraceus*	Spot occurrences
**Stenotaphrum secundatum*	Spot occurrences
**Symphyotrichum squamatum*	Spot occurrences
**Trachyandra divaricata*	Spot occurrences
**Trifolium campestre*	Spot occurrences
**Trifolium* sp.	Spot occurrences
**Urospermum picroides*	Spot occurrences
**Ursinia anthemoides*	Spot occurrences
**Vicia sativa*	Spot occurrences
**Vulpia myuros*	Spot occurrences
**Washingtonia filifera*	Spot occurrences
**Watsonia meriana*	Spot occurrences
**Yucca* sp.	Spot occurrences
**Oxalis pes-caprae*	Spot occurrences
**Pelargonium capitatum*	Throughout site
**Petrorhagia dubia*	Spot occurrences
**Pheonix dactylifera*	Spot occurrences
**Pinus pinaster*	Spot occurrences
**Polygala myrtifolia*	Spot occurrences
**Raphanus raphanistrum*	Spot occurrences
**Reichardia tingitana*	Spot occurrences
**Retama raetam*	Spot occurrences
**Ricinus communis*	Spot occurrences

**Romulea rosea*	Spot occurrences
**Schinus terebinthifolia*	Spot occurrences
**Sixalix atropurpurea*	Spot occurrences
**Sonchus oleraceus*	Spot occurrences
**Stenotaphrum secundatum*	Spot occurrences
**Symphyotrichum squamatum*	Spot occurrences
**Trachyandra divaricata*	Spot occurrences
**Trifolium campestre*	Spot occurrences
**Trifolium* sp.	Spot occurrences
**Urospermum picroides*	Spot occurrences
**Ursinia anthemoides*	Spot occurrences
**Vicia sativa*	Spot occurrences
**Vulpia myuros*	Spot occurrences
**Washingtonia filifera*	Spot occurrences
**Watsonia meriana*	Spot occurrences
**Yucca* sp.	Spot occurrences
**Vulpia myuros*	Spot occurrences
**Washingtonia filifera*	Spot occurrences
**Watsonia meriana*	Spot occurrences

Feral Fauna Note species observed or evidence for presence of species (scats, tracks or traces).

	✓	**Comments**
Evidence of Foxes (burrows, wildlife kills)		
Evidence of Rabbits (burrows, dung piles, grazing)		
Evidence of Dogs (droppings, scratchings)		
Evidence of Cats (wildlife kills)		
European Honey Bees (hives in tree hollows)		
Evidence of Horses/ Cattle/ Sheep (foot prints, droppings)		
Evidence of Pigs (soil disturbance)		
Rainbow Lorikeets		
Other		

Initial Field Assessment A Name of area: Manning Park

Native Fauna and Fungi. Note species observed or evidence of presence for fauna species. Indicate icon species.

Species	**Comments:** Observed directly, evidence of presence (scats, tracks and traces) or likely habitat?
	No fauna species of conservation significance directly observed

Native Fauna and Fungi Habitat

Habitat	✓	Comments
Areas of trees (with or without understory)	✓	Mature trees in remnant vegetation and in parkland areas providing important habitat for black cockatoos
Areas of dense understory vegetation		
Tree hollows in old mature trees		
Dead branches as perches for hunting/ look outs		
Dead vegetation for fungi/invertebrate habitat (leaf litter, branches/logs)		
Large fallen logs on the ground		
Granite or other natural rocky outcrops	✓	Limestone outcropping
Moss beds for fungi habitat		
Wetlands or waterways	✓	Infested with weedy grasses from neighboring parklands

Vegetation Health

Note dead or dying trees, shrubs, herbs and so on. Note the species concerned and the pattern of deaths/changes in the vegetation. *Phytophthora* Root Rot moves in fronts and along drainage lines therefore noting patterns helps to determine whether *Phytophthora* spp. are present. Appendix 5 defines and provides the website address for a list of common indicator species that are affected by *Phytophthora* spp. Do not automatically assume dead or dying plants means that *Phytophthora* is present.

	✓	Comments
Numerous tree stumps (not from logging)		
Dead or dying species		
Obvious reduction of tree canopies (e.g. staghorns)		
Heavy leaf/stem damage by insects (e.g. lerps, stem borers)		
Diseases/pests suspected		
Drought/lowering of groundwater table suspected		
Flooding/rise in groundwater table suspected		

Initial Field Assessment A Name of area: Manning Park

Miscellaneous Disturbance Factors and Threatening Processes

Determine the range and extent of disturbance factors and threatening processes occurring at the site. If appropriate, mark on Map 4 and photograph as required. If site is large it may be beneficial to divide into sections and evaluate each separately.

Factor/Process	✓	Comments
Evidence of salinisation (e.g. scalding, seeps)		
Erosion (e.g. gullies, bank collapse)	✓	Erosion on and adjacent to tracks and quarries
Wetland eutrophication (e.g. algal blooms)		
Stormwater drains/sumps		
Service corridors (e.g. Water Corp, Telstra, Western Power, Alinta Gas)		
Mining/extraction	✓	Historic Limestone quarries
Evidence of past logging (e.g. selective removal of large trees)		
Previous clearing (may be partially cleared areas or evidence of previous clearing and regrowth over much of site)	✓	Recreation parkland areas cleared
Overgrazing (e.g. rabbits, stock, goats; over-population by kangaroos)		
Firewood collection (e.g. recent chainsaw/axe cuts, sawdust piles)		
Dope plants/ production equipment		
Soil movement (dumping or removal)		Historic limestone quarries
Rubbish dumping (note type, e.g. construction, garden waste, weed source?)	✓	General rubbish
Proliferation of tracks (fire breaks, walk trails)	✓	Walking and Cycling tracks, firebreaks
Off road vehicle use (4WD / trail bikes/ BMX/ mountain bikes)	✓	Mountain bike tracks
Cubby construction		
Vandalism (damage to plants)		
"Enrichment Planting" (revegetation with species not found in that local plant community, are these becoming weeds?)		
Impacts of High Fire Frequency and/or Intensity		
• Reduced range of tree ages		
• Fire scars high up (due to a hot burn)		
• Major trunk damage		
• Trees suckering from trunk and branches		
• Amount of leaf litter reduced		
• Large fallen logs nearly burnt away		
• Evidence of arson (burnt grass tree skirts, matches, cigarette lighters, exploded spray cans)		
Time since last fire (estimate)		<2 yrs/ < 5 yrs/ <10 yrs/ <20 yrs / >20 yrs (circle one)
Other disturbance factors or threatening processes		

Initial Field Assessment A Name of area Manning Park

Vegetation Condition Map

For initial assessment, the overall vegetation condition of the site can be determined after familiarising yourself with the site. On Map 4, divide the site into broad sections based on condition, draw the boundaries of each section and record their condition. Using the map, estimate the % area each section occupies of the total site and note in the relevant boxes below using the Keighery (1994) condition scale(see Appendix 4). For example, 'Very Good: Section 1, 75% of site.' 'Degraded: Section 2, 25% of site.' For most sites there will be very degraded areas along tracks, for example, where rubbish has been dumped. If not extensive, these can be referred to by adding a statement such as 'areas of severe localised disturbance' in the comments.

Vegetation Condition Scales Indicate % area each section occupies of the total site (ensure adds up to 100%).

Keighery (1994)	Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded
% area		0.75	31.57	44.1	22.03	1.55

Comments Areas of Open Water, Parkland, Revegetation and areas for Other Use (including cleared, firebreaks/tracks and other use) have been excluded from percentage area of vegetation condition.

Existing Management Infrastructure

Describe type in box below and mark location on Map 4, photograph if required.

	✓	Comments
Fencing	✓	Cyclone, Mesh
Fence condition	✓	Mostly in good condition, some holes been cut
Gates		
Paths	✓	Sand or limestone
Path condition	✓	Mostly good, some paths eroded
Path fencing		
Path fence condition		
Fire access tracks	✓	
Signs	✓	Reserve signs
Previous works	✓	Revegetation, weed control

Social Significance Values

	✓	Comments
Evidence of Community/ Passive recreation/ Education interest	✓	BBQ and picnic areas around lake. Lookout spots, Exercise on Manning Stairs
Landscape amenity (e.g. area screens/ buffers conflicting land uses)	✓	Lawn present in parkland areas
Scenic features (e.g. high point in landscape)	✓	Lookouts present
Indigenous/ European Heritage (Cultural or Historical)	✓	Limestone Quarry
Other		

Initial Field Assessment A Name of area Manning Park

Surrounding Land Uses (mark on Map 4)

	Comments
Surrounding Land Uses (note type/s and indicate likely impacts/benefits e.g. source of rubbish; weed seeds blowing into site; potential for community interest and perhaps volunteers to assist management)	Light industrial to the west Housing surrounding to the north, south and east

Recommendations for Management List potential management actions (for example, assessment for the presence of *Phytophthora* species by an accredited assessor; fencing; signage to identify as a conservation area; rubbish removal; detailed weed survey and mapping; fire response and management planning; detailed flora/fauna/fungi surveys).
Trail audit – map, name tracks, rehabilitate where possible
Weed control
Domestic ducks in wetland, public feeding them
Continue revegetation and consider opportunities to reintroduce *E. gomphocephala* in the vegetation community to restore Tuart woodlands and forests TEC
Other specific actions to promote the conservation, recovery and management of the occurrences of the Tuart woodlands and forests TEC include: o Avoiding further clearing, fragmentation or detrimental modification of any of the TEC vegetation o Protection of mature trees o Establishing and maintaining suitable buffers o Retaining vegetation connectivity between patches of the TEC other local vegetation o Rehabilitation o Prevention of impacts to native vegetation, native fauna, hydrology, or soil structure o Planning prescribed burning only when coupled with appropriate weed management o Protection from feral animals o Hygiene management o Community and stakeholder communication
Other specific actions to promote the conservation, recovery and management of the occurrences of the Honeymyrtle shrubland on Limestone ridges: o Avoiding further clearing, fragmentation or detrimental modification of any of the TEC vegetation o Establishing and maintaining suitable buffers o Retaining vegetation connectivity between patches of the TEC other local vegetation o Rehabilitation o Prevention of impacts to native vegetation, native fauna, hydrology, or soil structure o Planning prescribed burning only when coupled with appropriate weed management o Protection from feral animals o Hygiene management o Community and stakeholder communication o Formalise main tracks, rehab non-formal tracks

Initial Field Assessment A Name of area: Manning Park

Confirmation of GIS Mapped Boundaries

Prepare the following map if recommending changes to native vegetation (A) or wetland (B) mapping and label with the name of the area.

Map 5: (overlay on aerial photo): Recommended GIS Boundary Changes for

When recommending changes, forward a completed copy of all 4 Initial Natural Area Assessment templates to the Perth Biodiversity Project, WALGA, 15 Altona St, West Perth 6005 for distribution to relevant custodian of database.

GIS dataset		Changes recommended (yes/no) Outline the rationale for each change against the relevant category (A, B or C). Prepare Map 5 if recommending changes to A or B only. Draw boundaries that correspond to your field assessment and assign accordingly to 'A' and/or 'B'.
A	**Mapped Native Vegetation** (DPI/Dept of Agriculture 2001)	Yes / No
	Rationale:	
B	**Mapped Wetland/s and Management Category** CC, RE or MU (DoE current update)	Yes / No / NA For changes to the mapping of wetlands on the Swan Coastal Plain complete and attach the current Department of the Environment guidelines for evaluating wetlands in this bioregion.
	Rationale:	
C	**Mapped Vegetation Complex/es** (Heddle, Loneragan and Havel 1980 or Mattiske & Havel 1998)	Yes / No More likely to be
	Rationale: (do not map)	

Natural Area Initial Field Assessment B –

Significant Species and Communities

General Information

Date of assessment 23 / 02 / 2023 Native Vegetation Unique ID No. _____

Name of area Manning Park, Reserve Database Site No. _____

Location (address/street name) Azelia Road, Spearwood/Hamiliton Hill, City of Cockburn

Assessor Taryn Brebner *Skill Level 6b

Recorder Taryn Brebner Skill Level 6b

Recorder Sarah Beckwith Skill Level 6b

Recorder Megan Gray Skill Level 6b

Recorder Olga Nazarova Skill Level 6b

**Important Note: Skill level 5 or above is required by the assessor to survey natural areas for significant species. Skill Level 6 is required to survey for threatened ecological communities (see Appendix 1).*

NO significant species or communities recorded through Field Assessment B If searches for significant flora, significant fauna and Threatened Ecological Communities by an appropriately skilled assessor have **NOT** recorded any significant species or communities on this site during this assessment, tick the box and continue no further.	✓

Partial Assessment ONLY In situations where significant species or communities have been recorded during Field Assessment A but a comprehensive Field Assessment B has **NOT** yet taken place, transfer the relevant information to these forms for databasing purposes and tick this box.	✓

Initial Field Assessment B Name of area Manning Park

Photographs
Indicate film roll no. and photograph no., location and direction of each photo on Map 4 during the field assessment. e.g. R1/P4 **o** (Roll 1/Photo 4 looking**o**)
Photographer's Name Olga Nazarova

Latitude And Longitude (for various locations noted during assessment, compulsory)
GPS used: yes/no GPS datum: GDA 2020

Descriptor and Location No. (eg. Species A GPS 1)	Reading/calculation (mark location number on Map 6) Latitude (S) or Northing	Longitude (E) or Easting
Pimelea calcicola	6448330	383760
Pimelea calcicola	6448309	383681
Pimelea calcicola	6448327	383709
Pimelea calcicola	6448321	383708
Pimelea calcicola	6448286	383667
Pimelea calcicola	6448115	383791
Pimelea calcicola	6449598	383424
Pimelea calcicola	6448116	383792
Pimelea calcicola	6448110	383771
Pimelea calcicola	6448110	383771
Pimelea calcicola	6448261	383610
Pimelea calcicola	6448240	383584
Pimelea calcicola	6448264	383584
Pimelea calcicola	6448313	383708
Pimelea calcicola	6448325	383707
Pimelea calcicola	6448320	383704
Pimelea calcicola	6449641	383443
Pimelea calcicola	6449639	383455
Pimelea calcicola	6448308	383669
Pimelea calcicola	6448313	383708
Pimelea calcicola	6448325	383707
Pimelea calcicola	6448313	383715
Dodonaea hackettiana	6449692	383514

Prepare the following map during the field assessment and label with the name of the area. Consult Map 4 prepared for Natural Area Initial Field Assessment A for the structural plant communities and vegetation condition mapping, update on Map 6 if necessary.

Map 6 (overlay on aerial photograph): Location of Threatened Ecological Communities, significant native flora or fauna or suitable habitat for these fauna of

Threatened Ecological Communities (TECs) (see Appendix 6)
List the Threatened Ecological Communities present or believed to be present on the site and the reasons why. For those TECs based on floristic community types, map the boundary of each TEC by cross referencing with the structural plant communities mapped during the Natural Area Initial Field Assessment A (Map 4). **During spring**, describe a standard 10 x 10 m quadrat and compile a species list for each structural plant community representing a TEC (see **page 15**, Threatened Ecological Communities – Description and Mapping).

Tuart woodlands and forests TEC (Critically Endangered) **EgOF**

Eucalyptus gomphocephala open forest over **Leptospermum laevigatum*, *Spyridium globulosum* and *Banksia sessilis* var. *sessilis* tall open scrub over **Ehrharta calycina* and **Briza maxima* very open grassland. Meets the following TEC characteristics
-Swan Coastal Plain bioregion -Soils and landform either Spearwood or Quindalup dune systems, occasionally occurring on Bassendean dunes and Pinjarra plains -Contains a minimum of two *Eucalyptus gomphocephala* (Tuart) situated within 60 m of each tree's canopies -Occurs as woodland but can occur as forest, open forest, open woodland and various mallee forms -Other tree species include: *Agonis flexuosa*, *Banksia grandis*, *Banksia attenuata*, *Eucalyptus marginata*, less commonly *Corymbia calophylla*, *Banksia menziesii*, *Banksia prionotes*. -Understorey is structurally variable. Common species include: *Hardenbergia comptoniana*, *Daucus glochidiatus* and *Trachymene pilosa* (although can be without)
Honeymyrtle shrubland on limestone ridges TEC (Critically Endangered) **MhTrS** *Melaleuca huegelii* and *Melaleuca systena* sparse shrubland over *Spyridium globulosum* and *Templetonia retusa* sparse shrubland over *Desmocladus flexuosus* and *Lepidosperma oldhamii* sparse sedgeland. Meets the following TEC characteristics
-Perth subregion (SWA02) of the Swan Coastal Plain Bioregion -Mainly on the ridge slopes and tops of limestone ridges and outcrops associated with Tamala limestone -Mainly as shrubland, heath, or as a thicket and has less than 10% tree canopy -Dominant shrub layer species are: *Melaleuca huegelii, Melaleuca systena*, and *Banksia sessilis* over *Acacia lasiocarpa*, *Grevillea preissii,* and *Spyridium globulosum.*

Initial Field Assessment B Name of area Manning Park

Significant Native Flora (see Appendix 6) Note presence of Declared Rare, Priority or other significant flora. Note location of species on Map 6. Indicate which structural plant communities they occur in (refer to Map 4 of the Natural Area Initial Field Assessment A).	
Species and Significance	**Comments eg. Structural Plant Community, Population Size**
Pimelea calcicola	DR05 (ArTOS)
Pimelea calcicola	DR07 (MhTrAtOH)
Dodonaea hackettiana	Recorded in the North of the study area
Pimelea calcicola	MP01 (MhTrS)
Pimelea calcicola	Mp15 (MhTrS)
Pimelea calcicola	Opportunistically (MhTrS)
Pimelea calcicola	Opportunistically ArGs
Pimelea calcicola	Opportunitically (AcBsS)

Significant Native Fauna (see Appendix 6) Note presence or evidence for presence of Specially Protected, Priority or other significant fauna. Note location of species/evidence on Map 6. Indicate which structural plant communities they occur in or utilise.	
Species and Significance	**Comments: Observed Directly, Evidence of Presence or Likely Habitat?**

Initial Field Assessment B Name of area Manning Park

Photocopy this page and complete for **each** Structural Plant Community identified as a TEC OR if preferred use Recording Sheets 1 & 2 of Keighery (1994) (see Appendix 3) to describe each community. Note that Appendix 3 contains minor modifications to the Keighery (1994) templates to include the additional information required below.

Threatened Ecological Communities – Description and Mapping

For TECs based on floristic community types, description and mapping needs to be undertaken during spring to provide the definitive floristic information needed to confirm the presence of a TEC. On Map 6, draw the boundary of each Threatened Ecological Community present and label with the TEC to which it belongs. These boundaries should be based on the structural plant communities identified on Map 4 of the Natural Area Initial Field Assessment A template. Allocate a number to each structural plant community representing a TEC and describe each below using a permanently located and representative 10 x 10 m quadrat. Note the vegetation condition of each quadrat. Compile a list of the plant species present within each quadrat.

Structural Plant Community No. 1 Indicate location of sample point described on Map 6.

Latitude and Longitude

GPS used: (yes)/no GPS datum: 2020 E.: 383693 N.: 6448720

Landform and Soils

SLOPE: flat/ gentle/ (steep) ASPECT: N/ NE/ (E)/ SE/ S/ SW/ W/ NW OR n/a

SURFACE SOIL: Colour: Light Brown Texture: sand/ (loamy sand)/ sandy loam/ loam/ clay/ gravel

EXPOSED ROCK (type and % of surface):

SUB-SURFACE SOIL: Colour: Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel

UNDERLYING ROCK (type and depth if known):

DRAINAGE: (well)/ moderate/ poor WET: all year/ winter and spring only OR (n/a)

CURRENT WATER DEPTH: cm

LITTER (% cover & depth): 55 BARE GROUND (% cover) 22

Topographic Position Circle position of point described on a transect diagram of site below.

(**Upland or Wetland?** (circle one)

Growth Form Layer	Dominant species for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	Crown Cover (Keighery 1994) 2-10% / 10-30% / 30-70% / over 70%	Height & Crown Cover (NVIS) Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m			
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m			
Shrubs 1-2 m	*Melaleuca huegleii, Templetonia retusa, Melaleuca systena*	20-30%	1.5, 28%
Shrubs under 1 m	*Banksia dallanneyii,*	0-2%	0.5 2
Herbs			
Sedges/ Rushes	*Lepidosperma oldhamii*	10-30%	0.5, 10
Grasses			
Other (e.g. climbers)			

Initial Field Assessment B Name of area Manning Park

Photocopy this page and complete for each Structural Plant Community identified as a TEC OR if preferred use Recording Sheet 3 of Keighery (1994) (see Appendix 3) to list species for each community. Note that Appendix 3 contains minor modifications to the Keighery (1994) templates to include the additional information required below.

Plant Species Note native and weed species observed within a standard 10 x 10 m quadrat.		
Trees / Mallees	**Herbs**	
	**Asparagus asparagoides*	
	Desmocladus flexuosus	
	Dianella revoluta	
	**Euphorbia terracina*	
	Hardenbergia comptoniana	
Shrubs	**Lysimachia arvensis*	
Melaleuca huegelii	*Opercularia vaginata*	
Templetonia retusa	**Petrorhagia dubia*	
Melaleuca systena	*Trymalium ledifolium* var. *ledifolium*	
Banksia dallanneyi	**Urospermum picroides*	
Acacia saligna		
Acanthocarpus preissii		
Banksia sessilis		
Gompholobium tomentosum		
**Lavandula* sp.		**Sedges / Rushes**
Leucopogon sp.		*Lepidosperma oldhamii*
**Olea europaea*		*Lomandra maritima*
Pimelea calcicola (P3)		
**Reichardia tingitana*		
Spyridium globulosum		
		Grasses
		**Briza maxima*
		**Lagurus ovatus*
Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)		
Description Of Structural Plant Community No. 2 (see Appendix 2)		MhTrS

Initial Field Assessment B Name of area Manning Park

Photocopy this page and complete for **each** Structural Plant Community identified as a TEC OR if preferred use Recording Sheets 1 & 2 of Keighery (1994) (see Appendix 3) to describe each community. Note that Appendix 3 contains minor modifications to the Keighery (1994) templates to include the additional information required below.

Threatened Ecological Communities – Description and Mapping

For TECs based on floristic community types, description and mapping needs to be undertaken during spring to provide the definitive floristic information needed to confirm the presence of a TEC. On Map 6, draw the boundary of each Threatened Ecological Community present and label with the TEC to which it belongs. These boundaries should be based on the structural plant communities identified on Map 4 of the Natural Area Initial Field Assessment A template. Allocate a number to each structural plant community representing a TEC and describe each below using a permanently located and representative 10 x 10 m quadrat. Note the vegetation condition of each quadrat. Compile a list of the plant species present within each quadrat.

Structural Plant Community No. 2 Indicate location of sample point described on Map 6.

Latitude and Longitude

GPS used: (yes)/no GPS datum: 2020 E: 383659 N: 6449320

Landform and Soils

SLOPE: flat/ gentle/(steep) ASPECT: N/ NE/ (E)/ SE/ S/ SW/ W/ NW OR n/a

SURFACE SOIL: Colour: _____ Texture: sand/(loamy sand)/ sandy loam/ loam/ clay/ gravel

EXPOSED ROCK (type and % of surface): _____

SUB-SURFACE SOIL: Colour: _____ Texture: sand/ loamy sand/ sandy loam/ loam/ clay/ gravel

UNDERLYING ROCK (type and depth if known): _____

DRAINAGE:(well)/ moderate/ poor WET: all year/ winter and spring only OR (n/a)

CURRENT WATER DEPTH: _____ cm

LITTER (% cover & depth): _____ BARE GROUND (% cover) _____

Topographic Position Circle position of point described on a transect diagram of site below.

Upland or Wetland? (circle one)

Growth Form Layer	Dominant species for each growth form layer list all dominant species, in their order of dominance, up to a maximum of 3*. (* if more than 3 species are obviously dominant record as many as appropriate to describe the layer)	Crown Cover (Keighery 1994) 2-10% / 10-30% / 30-70% / over 70%	Height & Crown Cover (NVIS) Record max. height of layer & % crown cover to nearest 5%
Trees over 30 m			
Trees 10–30 m	*Eucalyptus gomphocephala*	2-10%	10, 3%
Trees under 10 m			
Mallees over 8 m			
Mallees under 8 m			
Shrubs over 2 m	*Spyridium globulosum, *Gaudium laevigatum*	30-70%	4, 42%
Shrubs 1-2 m			
Shrubs under 1 m	**Schinus terebinthifolia*	0-2%	1.5, 1%
Herbs			
Sedges/ Rushes			
Grasses			
Other (e.g. climbers)			

Initial Field Assessment B Name of area: Manning Park

Photocopy this page and complete for each Structural Plant Community identified as a TEC OR if preferred use Recording Sheet 3 of Keighery (1994) (see Appendix 3) to list species for each community. Note that Appendix 3 contains minor modifications to the Keighery (1994) templates to include the additional information required below.

Plant Species Note native and weed species observed within a standard 10 x 10 m quadrat.		
Trees / Mallees	**Herbs**	
Eucalyptus gomphocephala	**Asparagus asparagoides*	
	Clematis linearifolia	
	**Euphorbia terracina*	
	Hardenbergia comptoniana	
	**Urospermum picroides*	
Shrubs		
**Gaudium laevigatum*		
Spyridium globulosum		
**Schinus terebinthifolia*		
Banksia sessilis		
Leucopogon ?australis		
Melaleuca huegelii		
Rhagodia baccata		
		Sedges / Rushes
		**Watsonia* sp.
		Grasses
		**Ehrharta longiflora*
Vegetation Condition (Give reasoning and note scale used) (see Appendix 4)		
Description Of Structural Plant Community No. _____ (see Appendix 2)		

Natural Area Initial Assessment Summary

Database Site Number _____ Name of area Manning Park

ECOLOGICAL CRITERIA	
1. Representation	
1a. Regional Representation	
i) recognised International, National, State or Regional conservation value but not already protected Specify:	yes/(no)
ii) of an ecological community with only 1500 ha or 30% or less (whichever is the greater) remaining in IBRA subregion Specify: Honeymrtle shrubland on limestone ridges TEC (MhTr)	(yes)/no
iii) large (greater than 20 ha), viable natural areas in good or better condition of an ecological community with more than 30% remaining within the IBRA subregion	yes/(no)
iv) of an ecological community with only 1500 ha or 15% or less (whichever is the greater) protected for conservation in the Jarrah Forest IBRA subregion Specify:	yes/(no)
v) of an ecological community with only 400 ha or 10% or less (whichever is the greater) protected for conservation in the Bush Forever Study Area Specify:	yes/(no)
1b. Local Representation	
i) of an ecological community with 10% or less remaining of its pre-European extent within the Local Government Area Specify:	yes/(no)
ii) of an ecological community with 30% or less remaining of its pre-European extent within the Local Government Area Specify: Veg association 998, only has 18.92% remaining in cockburn	(yes)/no
iii) large (greater than 10 ha), viable natural areas in good or better condition of an ecological community with more than 30% remaining within the Local Government Area	(yes)/no
2. Diversity	
i) natural area in good or better condition that contains both upland and wetland structural plant communities	(yes)/no
3. Rarity	
i) of an ecological community with only 1500 ha or 10% or less (whichever is the greater) remaining in the IBRA subregion Specify: Honeymrtle shrubland on limestone ridges TEC (MhTr)	(yes)/no
ii) of an ecological community with only 400 ha or 10% or less (whichever is the greater) remaining in the Bush Forever Study Area Specify: Honeymrtle shrubland on limestone ridges TEC (MhTr)	(yes)/no
iii) contains a Threatened Ecological Community Specify: Tuart Woodland and Forests TEC and Honeymyrtle shrubland on Limestone ridges TEC	(yes)/no
iv) contains Declared Rare Flora, Specially Protected Fauna or significant habitat for these fauna Specify: Black Cocoatoo Habitat	(yes)/no
v) contains Priority or other significant flora or fauna or significant habitat for these fauna Specify: Pimelea cacicola and Dodanaea hackattiana	(yes)/no
4. Maintaining Ecological Processes or Natural Systems - Connectivity	
i) natural areas acting as stepping stones in a Regionally Significant Ecological Linkage	(yes)/no
ii) natural areas acting as stepping stones in a locally significant ecological linkage	(yes)/no
5. Protection of Wetland, Streamline and Estuarine Fringing Vegetation and Coastal Vegetation	
i) Conservation or Resource Enhancement category wetland plus buffer	(yes)/no
ii) EPP Wetland plus buffer	(yes)/no
iii) riparian vegetation plus buffer	(yes)/no
iv) floodplain area plus buffer	yes/(no)
v) estuarine fringing vegetation plus buffer	yes/(no)
vi) coastal vegetation on foredunes and secondary dunes	(yes)/no

Perth Biodiversity Project (P B P) Natural Area Initial Assessment Templates. **.35 of 36.**

Initial Assessment Summary Name of area Manning Park

VIABILITY ESTIMATE		
Viability Factor	**Category**	**Score**
Size	Greater than 20 ha	5
	Greater than 10 ha less than 20 ha	4
	Greater than 4 ha less than 10 ha	3
	Greater than 1 ha less than 4 ha	2
	Less than 1 ha	1
Shape	Circle, square or squat rectangle	3.5
	Oval, rectangle or symmetrical triangle	3
	Irregular shape with few indentations	2.5
	Irregular shape with many indentations	2
	Long thin shape with large proportion of area greater than 50 m wide	1.5
	Long thin shape with large proportion of area less than 50 m wide	1
Perimeter to area ratio	Less than 0.01	4
	Greater than 0.01 less than 0.02	3
	Greater than 0.02 less than 0.04	2
	Greater than 0.04	1
Vegetation condition NB: based on Keighery (1994) condition scale	Pristine 10 x 0 % = 0	
	Excellent 8 x 0.75 % = 0.06	
	Very Good 6 x 31.57 % = 1.89	
	Good 4 x 44.1 % = 1.76	
	Degraded 2 x 22.03 % = 0.44	
	Completely Degraded 0 x 1.55 % = 0	
	Total calculated score =	4.15
Connectivity	**A.** Forms part of a Regional Ecological Linkage and is contiguous with a protected natural area greater than 4ha	5
	B. Not part of a Regional Ecological Linkage but contiguous with a protected natural area greater than 4ha	4.5
	C. Forms part of a Regional Ecological Linkage and is within 500 m of more than 4 protected natural areas having an area greater than 4 ha	4
	D. Not part of a Regional Ecological Linkage but within 500 m of more than 4 protected natural areas having an area greater than 4 ha	3.5
	E. Forms part of a Regional Ecological Linkage and is within 500 m of 3 or 4 protected natural areas having an area greater than 4 ha	3
	F. Not part of a Regional Ecological Linkage but within 500 m of 3 or 4 protected natural areas having an area greater than 4 ha	2.5
	G. Forms part of a Regional Ecological Linkage and is within 500 m of 2 protected natural areas having an area greater than 4 ha	2
	H. Not part of a Regional Ecological Linkage but within 500 m of 2 protected natural areas having an area greater than 4 ha	1.5
	I. Forms part of a Regional Ecological Linkage and is within 500 m of 1 protected natural area having an area greater than 4 ha	1
	J. Not part of a Regional Ecological Linkage but within 500 m of 1 protected natural area having an area greater than 4 ha	0.5
	K. Forms part of a Regional Ecological Linkage but is not within 500 m of any protected natural areas having an area greater than 4 ha	0.25
TOTAL SCORE (Viability Estimate)		20.65

9.1.1 Manning Park - Cost of Closing and Rehabilitating Unsanctioned Trails (2022/MINUTE NO 0001)

Council Decision
That Council:

(1) NOTES the officer's report; and

(2) ALLOCATES $50,000 for consideration in the draft 2023-24 Budget to identify and map, through aerial imagery and ground truthing all trails, both formal and informal, in the upland area of the Manning Park Reserve.

Background

The City of Cockburn is responsible for the management of Manning Park.

There are a variety of people using the trails in the upland area of the Park.

The upland area is described as area 30 in the Beeliar Regional Park Management Plan.

Trail users include walkers, trail runners, orienteers and mountain bikers.

Numerous unsanctioned trails have been created by mountain bikers in the upland area without authorisation from the City.

Left unmanaged, the continued creation of unsanctioned trails will increase the risk of weed invasion, erosion and vegetation degradation.

A Community Engagement Group (CEG) was established to work through some of the issues, including those relating to the Manning Park Mountain Bike Concept Plan.

Advice from the CEG was used to inform a Council Report which was presented to Council at the 12 May Ordinary Council Meeting.

The resulting recommendation from the Council meeting was that Council:

(1) Defers any decision regarding trails in the Manning Park upland area (Area 30 – as described in the Beeliar Regional Park Management Plan), until such time as the Expenditure Review Committee (ERC) have been provided, for consideration and recommendation to Council, a report detailing costs and presumptive timings for:
   (i) A full evaluation of the biodiversity and environmental values of the area
   (ii) An Aboriginal Heritage Assessment
   (iii) A European Heritage Assessment
   (iv) Creation of a derailed specific Management Plan for Area 30
   (v) Commencing a structured process regarding trails development following the DBCA Trails Development Process – Eight Staged Planning Process.

(2) Forms a Community Advisory Group for the area once the Management Plan is completed, to guide and inform the Management Plan and future management of Manning Park.

(3) Requests said report to be presented, at the latest, to the September 2022 meeting of the Expenditure Review Committee (ERC).

As per the Council recommendation, a report was presented to the 21 September 2022 ERC.

The ERC report provided cost estimates and an implementation timeline for the activities listed in the Council recommendation.
As a result of the report the ERC recommendation was that Council:

(1) NOTES the officer's report

(2) ALLOCATES funds from the FY23/24 Municipal Budget for a combined Flora and Fauna Survey, and for a detailed Aboriginal and European Assessment

(3) ADOPTS and ENDORSES the Department of Biodiversity, Conservation and Attraction's 8 Step Plan as a framework for investigating formalised trails in Manning Park

(4) REQUESTS a report to the November 2022 Expenditure Review Committee which provides an indication of the likely interim costs to protect and maintain Manning Park.

Council, at the 13 October 2022 Ordinary Council Meeting subsequently resolved to adopt the Committee's recommendation.

This report has been prepared to address Recommendation (4) above, which has been interpreted as: to identify costs to close and rehabilitate trails currently used by mountain bikers.

Submission

N/A

Report

The protection and maintenance of the Manning Park upland area from unsanctioned trail development and use would be addressed through two phases of project delivery:

Phase 1 Trail Identification, Closure and Site Remediation

Phase 2 Ongoing Compliance Enforcement and Public Education Messaging

Phase 1 – Trail Identification, Closure and Site Remediation

To estimate the cost of protecting and maintaining Manning Park, the spatial extent of all unsanctioned trails needs to be determined.

This is likely to be a challenging exercise due to the long history of unauthorised trails being established in the reserve over many decades.

Some of these unsanctioned trails have become so well used, by both mountain bikers and other park users, that they now appear as formal tracks.

As some of these well-established trails now form an important part of the movement network for Manning Park, the City would need to consider the implications that closing these trails would have on the broader community.

Despite being unsanctioned, these trails provide an important function and further analysis and consultation would be required to determine the level of impact of closing some trails.

As further investigation is required, Phase 1 has been broken down into smaller steps to help get a better understanding of the overall cost of trail closure and remediation. These steps are outlined below:

1. Undertake a Trails Audit to determine the location, length and average width of all trails (both formal and informal) with the upland area of the reserve. **To be undertaken by a consultant.**
2. Categorise each of the trails according to condition (good/medium/poor). **To be undertaken by a consultant.**
3. Categorise each of the identified trails according to level of usage (low/ medium/high). It is envisaged that this would be determined through smartphone applications like Strava and through onsite observations. **To be undertaken by a consultant.**
4. Categorise each of the identified trails according to the predominant type of usage (predominantly walking/predominantly biking/other). **To be undertaken by a consultant.**
5. Categorise each of the identified trails according to underlying gradient and the potential to cause environmental harm (unlikely/likely/environmental harm observed

onsite). Note: erosion and vegetation degradation are exacerbated on steep terrain. **To be undertaken by a consultant.**

6. Prepare a Trail Categorisation and Mapping Report to display the information obtained through the implementation of Steps 1-5. **To be undertaken by a consultant.**

7. Consult with the existing Manning Park Trails Community Engagement Group to select trails for closure based on a review of the Trial Categorisation and Mapping Report with the aim of developing a Trail Closure Plan. **To be independently facilitated.**

8. Advertise the Trail Closure Plan to the City of Cockburn community. **To be undertaken by the City.**

9. Make adjustments to the Trail Closure Plan based on community input. **To be undertaken by the City.**

10. Install signage in the reserve to advise of impending trail closures. **To be undertaken by the City.**

11. Close off and revegetate all selected trails. **To be undertaken by the City.**

12. Maintain the revegetation areas with watering and weed control over the standard five-year establishment period. **To be undertaken by the City.**

Costs for Step 1 to Step 6
Indicative quotes were sought from two (2) specialist trail design consultants to undertake Step 1 to Step 6 (inclusive).

One consultancy quoted $50,000 to perform the works and the second consultancy declined the quotation request.

Steps 1 to 6 could be implemented in the 2023-2024 financial year should funding be made available.

Costs for Step 7
The cost of implementing Step 7 is estimated to be $15,000.

This estimate is based on the costs expended in 2021 for appointing a facilitator and hiring venues to consult with the CEG on issues associated with the Manning Park Mountain Bike Trail Concept Plan.

Step 7 could be implemented in the 2023-2024 financial year should funding be made available.

Costs for Steps 8 and 9
The community consultation required to perform Step 8 and Step 9 requires no additional budget allocation.

It is anticipated that roughly ten (10) hours of officer time would be required to complete these tasks.

Step 8 and Step 9 could be implemented in the 2023-2024 financial year.

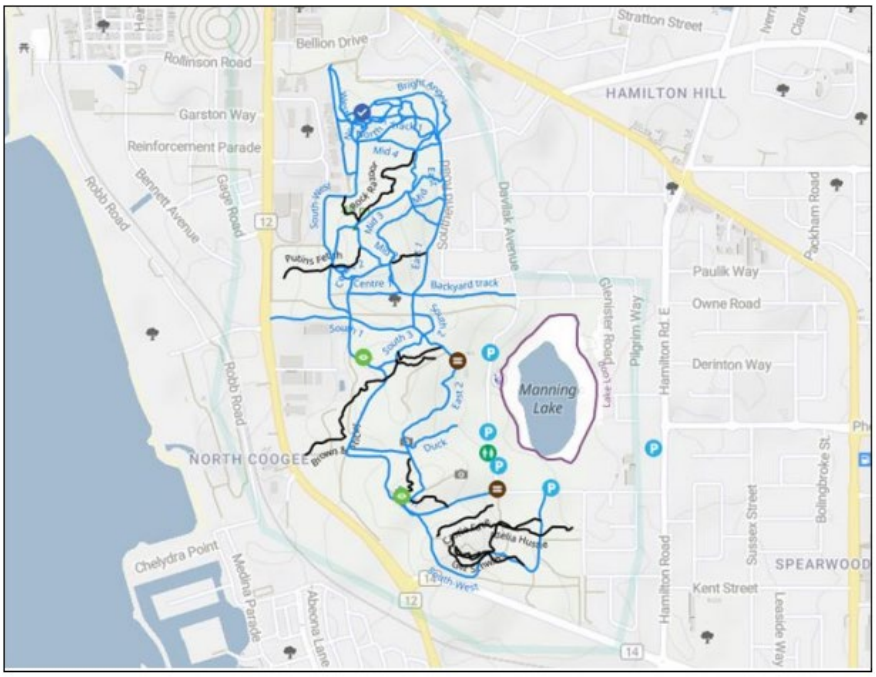
Costs for Steps 10, 11 and 12

It is very difficult to estimate the cost of executing Steps 10, 11 and 12 as the actual extent of trails requiring closure, revegetation and maintenance would be dependent on the outcomes and recommendations of the assessment of trails outlined above.

The cost estimates provided for Steps 10, 11 and 12 have been provided using the limited information available at this time and should therefore be viewed as indicative only.

Figure 1, below, depicts the extent of trails used by mountain bikers in Manning Park, with over 17km of trails being used. However, some of these may also be used by other trail users.

The number of trails to that would actually be closed down would be identified in the Trails Closure Plan. Steps 10, 11 and 12 will be calculated based on the assumption that 10km of trails would be closed and there are 10 trails, each 1km in length.



Stats

Avg Trail Rating:	★★★½☆
Trails (view details):	58
Total Distance:	17 km
Total Descent:	662 m
Total Vertical:	48 m
Highest Trailhead:	49 m
Reports:	32
Photos:	12
Ridden Counter:	3,714

Figure 1: Trails used by Mountain Bikers in Manning Park.

Source: http://www.trailforks.com/region/manning-park-1486544341

To implement Step 10, temporary signage would be deployed at the beginning and at the end of each trail for a two-week period.

This would require the print and design of 20 corflute signs, for which the current market rate is for $10 per sign.

These signs would then be deployed using the City's existing supply of star pickets. The cost of implementing Stage 10 has therefore been estimated at $200.

Step 10 could be implemented in the 2024-2025 financial year should funding be made available.

Trail closure would then be initiated by installing two metres of temporary fencing at each end of the 10trails to prevent access.

The City currently purchases temporary fencing at a rate of $15 per linear metre.

Using this price, the overall cost of temporary fencing has been estimated to be $600 (10 trails x 2 entrances x 2m per entrance x $15 per metre = $600).

The overall area of the closed trail network is estimated to be 1.5 hectares (10 trails x 1,000m x 1.5m = 1.5 hectares).

The cost of revegetating 1.5 hectares of native vegetation has been estimated by using the City's Natural Area Management Strategy (NAMS) as a basis for cost per area.

The most recent review of the NAMS in 2017 indicated that $90,300 was required to revegetate one hectare of good condition vegetation.

To account for substantial inflation since 2017, a price rise of 30% has been applied.

As a result, the cost per hectare for revegetation is estimated to be $117,390. Therefore the overall cost of revegetation is estimated to be $176,085.

Step 11 (trail closure and revegetation) could be implemented in the 2024-2025 financial year should funding be made available.

Following the initial planting, maintenance of the revegetation areas will be undertaken in accordance with the costings provided by the NAMS and the 30% inflation multiplier.

These costs include weed control, infill planting and watering and are outlined in Table 1, below.

Revegetation Maintenance Costs per Hectare				
Task	Year 2	Year 3	Year 4	Year 5
Weed control – grass	$780	$650	$390	$390
Weed control – broad-leaved / bulbous	$1,430	$650	$390	$390
Woody weed removal	$2,860	$1,300	$650	$260
Infill tubestock	$7,800	$1,300	$0	$0
Infill – greenstock	$19,500	$3,900	$0	$0
Maintenance and watering	$25,350	$5,070	$0	$0
TOTAL	**$57,720**	**$11,570**	**$1,430**	**$1,040**

The overall cost of revegetation maintenance in the four (4) years following initial planting is therefore estimated to be $107,640. ($57,720 + $11,570 + $1,430 + $1,040) x1.5 = $107,640).

Step 12 (revegetation maintenance) could be implemented between 2026 and 2029 should funding be made available.

Overall cost of Phase 1: Trail Identification, Closure and Site Remediation.

- Preparation of the Trail Categorisation and Mapping Report: $50,000
- Consultation with the CEG: $15,000
- Signage: $200
- Temporary Fencing: $600
- Revegetation: $176,085
- Revegetation maintenance: $107,640
- Phase 1 Total: $349,525

Phase 2: Ongoing Compliance Enforcement and Public Education Messaging.

There are two options available.

Mountain bikes can be banned completely from Manning Park or mountain bikes permitted with an ongoing surveillance program to ensure no new tracks are created and rehabilitated trails not reopened.

For the purposes of this report, the latter option has been chosen.

As soon as the unsanctioned trails are closed off, the City would need to maintain an active presence at the reserve.

Given that Manning Park is 117 hectares in size and that there are multiple points of entry, permanent surveillance of the entire reserve is not possible.

The most effective means of surveillance would be to install mobile CCTV at selected points and conduct regular Ranger patrols of the upland area.

Mounted CCTV cameras could be purchased at an estimated cost of $10,000 each with four (4) being deployed at any one time.

Ranger patrols could be accommodated in the current budgets.

The mounted security cameras could be deployed in the 2024-2025 financial year if funding were to be made available.

Even with an active security presence, enforcing breaches of compliance will be challenging and seldom successful.

Identifying people on CCTV footage is difficult and Local Government officers are not authorised to make arrests.

It is therefore anticipated that investing in surveillance will only serve to reduce instances of unauthorised trail construction, rather than to rule them out altogether.

This means that closing off and rehabilitating trails will likely be an ongoing exercise as it is anticipated that new unsanctioned trails will continue to be developed into the future.

Educating the public on the environmental and social impacts of creating unauthorised trails would need to be undertaken to complement the onsite security initiatives.

This could be achieved by conducting community workshops and mailing flyers to local residents on a periodic basis.

These engagement initiatives are estimated to cost roughly $20,000 per annum.

Overall cost of Phase 2: Ongoing Compliance Enforcement and Public Education Messaging

- Installation of mounted CCTV cameras: $40,000
- Community Education Initiatives: $20,000
- Phase 2 Total: $60,000.

Estimated Cost of Protecting and Maintaining Manning Park

The cumulative cost of implementing Phase 1 and Phase 2 is $409,525 Both phases could be commenced in 2023-2024 if sufficient funds were to be provided.

Strategic Plans/Policy Implications

Environmental Responsibility
A leader in environmental management that enhances and sustainably manages our local natural areas and resources.
• Protection and enhancement of our natural areas, bushland, parks and open spaces.
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Community, Lifestyle & Security
A vibrant healthy, safe, inclusive and connected community.
• A safe and healthy community that is socially connected.

Listening & Leading
A community focused, sustainable, accountable and progressive organisation.
• High quality and effective community engagement and customer service experiences.

Budget/Financial Implications

The cost of protecting and maintaining Manning Park by closing down unsanctioned trails is estimated to be $409,525.

To commence this option $65,000 would need to be allocated in the 2023/2024 budget, with the remainder of the funding to be provided in subsequent years.

Further funding of $344,525 would need to be made available spread across the next 4 years for trail closure, rehabilitation, and ongoing surveillance.

Legal Implications

N/A

Community Consultation

The Trail Closure Plan would need to be advertised for community consultation in 2023-2024.

Education initiatives would be undertaken on an ongoing basis following trail closure.

Risk Management Implications

There is a risk that significant investment into protecting and maintaining Manning Park would only result in a reduction to the number of unsanctioned trails being developed rather than eliminating all trail construction.

There is a risk that an increased security presence will detract from the amenity of Manning Park.

There is a risk that further delay in making a decision on trails development at Manning Park will result in ongoing degradation of the area, continued community angst and further staff time commitments.

Advice to Proponent(s)/Submitters

N/A

Implications of Section 3.18(3) *Local Government Act 1995*

Nil

9.1 (2022/MINUTE NO 0001) Manning Park Costings

Council Decision
That Council:

(1) NOTES the officer's report;

(2) ALLOCATES funds from the FY23/24 Municipal Budget for a combined flora and fauna survey, and for a detailed Aboriginal and European Heritage Assessment;

(3) ADOPTS and ENDORSES the Department of Biodiversity, Conservation and Attractions' 8 Step Plan as a framework for investigating formalised trails in Manning Park; and

(4) REQUESTS a report to the November 2022 Expenditure Review Committee which provides an indication of the likely interim costs to protect and maintain Manning Park.

Background

There are a variety of trail users in the upland area of Manning Park.

The area is described as area 30 in the Beeliar Regional Park Management Plan.

Users include walkers, trail runners, orienteers, and mountain bikers.

Some unsanctioned trails have been created by mountain bikers.

A Community Engagement Group (CEG) was established to work through some of the issues, including those relating to the Manning Park Mountain Bike Concept Plan.

Advice from the CEG was used to inform a Council Report which was presented to Council at the 12 May 2022 Ordinary Council Meeting.

The officer recommendation was:

That Council:

(1) receives the report;

(2) excludes mountain bikes from Manning Park, with the exception of designated cycle paths, effective from 1 March 2023;

(3) refers the assessment of required works and associated budget impacts to the Expenditure Review Committee (ERC) for consideration and recommendation to Council; and

(4) authorises the City to close and remove all unauthorised bike trails from Manning Park.

The resulting recommendation from the Council meeting was:

That Council:

(1) Defers any decision regarding trails in the Manning Park upland area (Area 30) of Manning Park, as described in the Beeliar Regional Park Management Plan, until such time as the Expenditure Review Committee (ERC) have been provided, for consideration and recommendation to Council, a report detailing costs and presumptive timings for:
- A full evaluation of the biodiversity and environmental values of the area
- An Aboriginal heritage assessment
- A European Heritage Assessment
- Creation of a detailed specific Management Plan for Area 30
- Commencing a structured process regarding trails development following the DBCA Trails Development Process – Eight Staged Planning Process.

(2) Forms a Community Advisory Group for the area once the Management Plan is completed, to guide and inform the Management Plan and future management of Manning Park;

(3) Requests said report to be presented, at the latest, to the September 2022 meeting of the ERC.

Submission

N/A

Report

As per the Council recommendation, quotes and indicative timings were sought for the following in relation to the Manning Park upland area:

- A full evaluation of the biodiversity and environmental values of the area
- An Aboriginal heritage assessment
- A European Heritage Assessment
- Creation of a detailed specific management plan for Area 30
- Commencing a structured process regarding trails development following the DBCA Trails Development Process – Eight Staged Planning Process.

Full evaluation of the biodiversity and environmental values of the upland area of Manning Park

A full evaluation of the biodiversity and environmental values of Manning Park upland will require both a detailed flora and a detailed fauna survey as outlined in the Environmental Protection Authority Technical Guidance notes.

Surveys will include a targeted Black Cockatoo habitat assessment and targeted surveys for fauna of conservation significance.

These surveys would be required as part of the DBCA Trails Development Guidelines.

Quotes were sought from four (4) consultants to undertake individual flora and fauna surveys and combined surveys. Only two consultants offer combined flora or fauna surveys.

All prices below exclude GST:
- Prices submitted for a detailed flora survey ranged from $22,550 to $32,240
- Prices submitted for a detailed fauna survey ranged from $13,411 to $100,000
- Prices for the combined flora and fauna survey ranged from $35,961 to $71,650.

Based on the prices submitted and, allowing for future price increases, it is estimated that $80,000 would be required to fund a detailed biodiversity and environmental assessment of the subject area.

Given that consultants generally only hold prices for a specified period, requests for quotes may need to be re-issued.

The full details of the requirements for detailed flora and fauna surveys can be found in the EPA Technical Guidance documentation (refer Attachments 1 and 2).

Timing of Flora and Fauna Surveys

Detailed flora surveys are undertaken in spring with a second supplementary survey generally after autumn rains.

Detailed fauna surveys are undertaken at various times of the year depending on the fauna groups being surveyed.

Flora and fauna surveys could commence in spring 2023 if funding is made available.

Aboriginal and European Heritage Assessment

Quotes were sought from four (4) consultants to undertake a comprehensive Aboriginal and European Heritage Study for the subject area which includes the following key elements:
- Appropriate Aboriginal research and engagement to understand the Aboriginal heritage significance of the area
- Appropriate early European research, to understand the extent of early European history and heritage significance of the area.

These studies would also be required as part of the DBCA Trails Development Guidelines.

Only two of the four consultants approached submitted prices.

One consultant that was approached required payment to prepare a quote and, given no funds have yet been allocated to this project, no price was provided by that consultant.

Prices submitted to undertake a comprehensive Aboriginal and European Heritage Assessment of Manning Park Upland ranged from $60,426 to $78,146.

Based on the prices submitted and allowing for future price increases, it is estimated that $80,000 would be required to undertake comprehensive Aboriginal and European Heritage Assessment of the subject area.

Given that consultants generally only hold prices for a specified period, requests for quotes may need to be re-issued.

The scope for the request for quote that was sent to consultants can be found in Attachment 2.

Timing of Heritage Assessments

Heritage assessments could commence as soon as funding was confirmed although it would be dependent upon the availability of suitably qualified consultants.

Detailed Management Plan for Manning Park Upland (Area 30)

Quotes were sought from three (3) consultants to develop a detailed management plan for the upland area of Manning Park, identified as Area 30 in the Beeliar Regional Park Management Plan.

Consultants were informed that development of the plan would need to consider protection and enhancement of the biodiversity and environmental values of the area and potentially the management and maintenance of trails.

The Management Plan would guide the ongoing use and management of the upland area of Manning Park over the next ten years.

Prices submitted to prepare a Management Plan ranged from $14,560 to $60,100.

Based on the prices submitted, and allowing for future price increases, it is estimated that $60,000 would be required to develop a detailed management plan.

Timing for development of a Management Plan

Generally, the consultant charged with developing a Management Plan will use existing information within surveys and seek expert advice from other consultants who have expert knowledge in certain fields.

For example, if mountain bike trails were to be established in Manning Park, the consultant charged with developing the Management Plan would seek expert advice from trails designers and construction contractors in terms of requirements for ongoing management and maintenance.

The preparation of a detailed Management Plan for Manning Park Upland Area could commence as soon as funding is available however, it would be prudent to prepare the Plan once there is a decision in terms of trails development and once the other surveys and assessments have been completed.

It is recommended that development of the Management Plan commence in 24/25.

A community advisory group would be formed to help guide and inform the management plan and future management of Manning Park

Given that consultants generally only hold prices for a specified period, requests for quotes will need to be re-issued.
Details of the quote request can be found in Attachment 3.

DBCA Trails Development Process

The surveys, assessments, and development of a Management Plan, as detailed above, are integral components the DBCA Eight Stage Trail Development Process.

The development process is quite comprehensive and involves detailed consultation, establishment of a steering group, further studies of opportunities and constraints, field work, concept and detailed design and construction.

A summary of the process can be found in Table 1 below.

Without any in principle agreement for trail development by Council and an indication of where trails may be constructed or their length, the costs to commence and complete the trail development process are difficult to quantify.

It is recommended that initially, if the development of trails is supported in principle by Council, that $50,000 is made available to commence the process.

Timing for commencement of the DBCA trails development process

Trails development using the DBCA Trails Development Guidelines could commence once funds are made available and a decision has been made in relation to any trail development.

Stage	Outcome
1. Trail Proposal	A trail development proposal is either supported in principle by the land manager/owner, or not supported (due to environmental, social, cultural, or other constraints). The purpose of a proposal could be to identify potential suitable areas for consideration.
2. Framework	A project outline developed by the steering group (stakeholders), including project objectives, project management model, stakeholders, roles, target market, requirements, execution, and ongoing management model.
3. Site	Assessment broad-scale study of the area and identification of opportunities, constraints, and characteristics such as soil types, vegetation etc.
4. Concept Planning	Field identification of opportunities and conceptual trail plan, including broad trail corridors and infrastructure requirements.
5. Corridor	Evaluation detailed assessment of trail corridors for use in determining the final trail alignment.
6. Detailed Design	Detailed trail design and alignments physically flagged in the field. Includes detail on the trail classifications, technical trail features (TTFs), construction methods and specifications.
7. Construction	Trail constructed in line with the Detailed Design.
8. Management	Management plan implemented detailing maintenance and monitoring requirements

Table 1. Summary of the DBCA Trails Development Process

Future Trail Development Estimates

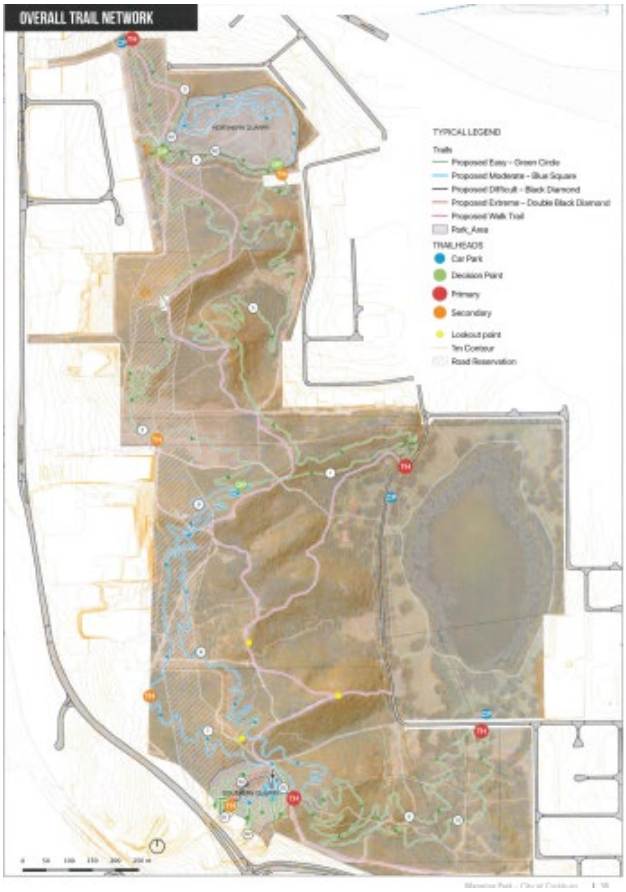
The total cost to develop a trails network in the upland area is difficult to quantify at this time without any indication of where trails might be established.

If we take a scenario where both the northern and southern quarries are to be activated and a loop trail constructed only in the road reservation linking the two quarry sites, using the DBCA trails development process, then we can get an indicative cost from the original Manning Park Mountain Bike Concept Plan.

Some of this expenditure could be supported from grant funding opportunities.

These cost estimates are indicative only and do not include any associated infrastructure costs such as car parking or trail head information.

Future Trail Development Estimate taken from original Manning Bike Mountain Bike Concept Plan	
Northern Quarry (Trails N1, N2, T3 & T4)	$156,764
Southern Quarry (Trails S1-S5)	$255,410
Loop Trail in road reservation (Trails T2, T7 & T8)	$191,151
Total Cost	**$603,325**



Strategic Plans/Policy Implications

Environmental Responsibility
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Community, Lifestyle & Security
A vibrant healthy, safe, inclusive, and connected community.
• Accessible and inclusive community, recreation and cultural services and facilities that enrich our community.

Listening & Leading
A community focused, sustainable, accountable, and progressive organisation.
• High quality and effective community engagement and customer service experiences.

Budget/Financial Implications

To undertake the necessary detailed flora and fauna surveys, Aboriginal and European Heritage surveys for the upland area of Manning Park, including the existing road reservation it would require $220,000 to be allocated in the 2023/24 budget.

To allow the commencement of the DBCA Trails Development Process for the upland area of Manning Park, a further $50,000 would need to be allocated in the 2023/24 budget.

To undertake for the development of a detailed management plan for the upland area of Manning Park it would require $60,000 to be allocated in the 2024/25 budget.

Funding would be provided from the City's municipal budget and an operational account would need to be created to progress the studies.

Legal Implications

N/A

Community Consultation

N/A

Risk Management Implications

There is a risk that if there is no funding made available to undertake the relevant studies and assessments that there will be further delay in relation to a decision on trails development at Manning Park, potentially resulting in further degradation of the area, continued community angst and further staff time commitments.

Advice to Proponent(s)/Submitters

N/A

Implications of Section 3.18(3) *Local Government Act 1995*

Nil