FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

ecoscape

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EXECUTIVE SUMMARY

The City of Wanneroo (the City) is planning to undertake the second phase of a road upgrade for a portion of Flynn Drive in Neerabup, to allow for dual carriageway development. Areas of native vegetation within the existing road reserve will be affected by these proposed works.

Ecoscape was engaged by the City in 2020 and 2021 to undertake biological surveys of two portions of Flynn Drive proposed for upgrades. The surveys were conducted to gain a detailed understanding of the environmental values of the sites, and to inform environmental impact assessments (EIA) of the areas surveyed. This 2021 EIA examines the key biological values for the Stage 2 portion of the Flynn Drive upgrade area, extending from Pinjar Road to Old Yanchep Road. The assessment evaluates the risk and predicted level of potential impacts from the proposed works in the context of the existing environment, with consideration of possible risks and mitigation opportunities. Additionally, a risk assessment of the proposed project activities against the *Environmental Protection Act 1986* (EP Act) Native Vegetation Clearing Principles was undertaken.

With regards to potential impacts to flora and vegetation:

- the most significant impacts to flora and vegetation from the proposed project works are considered to be direct impacts, resulting in the loss of flora individuals and extent of existing vegetation
- project design should avoid clearance of Banksia woodland constituting Threatened Ecological Community (TEC) vegetation as this represents a Matter of National Environmental Significance (MNES)
- impacts to flora species at the population scale are not expected to be significant
- the main factor expected to result in indirect impacts to flora and vegetation is the establishment or dispersal of exotic weeds
- clearing of flora and vegetation should be minimised and take into consideration cumulative impacts at local and regional scales
- weed control should be implemented during all stages of construction
- prompt rehabilitation is additionally recommended to maintain ecological linkages and improve quality of preserved vegetation.

With regards to potential impacts to fauna and fauna habitat:

- the most significant impacts to vertebrate fauna are predicted to be loss of critical habitat for Endangered (MNES) Black Cockatoo species
- the majority of the fauna species in the assessment area are not expected to incur significant impacts at the species level
- the Black-striped Snake, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo are likely to suffer greater impacts from proposed clearing due to restricted range or reduced extent of critical habitat, therefore, impacts to overall biodiversity of the assessment area have potential to be high
- areas of high quality Banksia woodland habitat within the assessed road reserve immediately east of Pinjar Road and north of Flynn Drive constitute critical forage habitat for Black Cockatoo species and should be preserved as a priority
- potential breeding trees for Black Cockatoos within the assessment area should be maintained
- pre-clearance surveys should be undertaken, inspecting all tree hollows and potential nesting sites, and clearing activity supervised by an authorised person
- construction should be timed outside of the Black Cockatoo and Rainbow Bee-eater nesting periods to avoid disturbance of nesting birds
- rehabilitation works should be implemented promptly post-construction and aimed at improving cover and condition of retained remnant, as well as connectivity of habitat.

Assessment against the EP Act native vegetation clearing principles indicated that clearance of vegetation would be at variance to, or partial variance to, principles (a), (b) and (d), with works unlikely to be at variance to the remaining principles.

The environmental impact assessment relating to the proposed project indicates it has potential to cause significant impacts to several MNES including Endangered Black Cockatoo foraging and breeding habitat and an Endangered TEC, as well as a State-listed Endangered TEC. Additional impacts are possible with regards to potentially occurring Priority flora species, vegetation, habitat loss and fauna mortality, however, these impacts are not predicted to be significant.

It is recommended that the proposal be referred under the EPBC Act.

ACRONYMS AND ABBREVIATIONS

Table 1: Acronyms and abbreviations

Acronyms and abbreviations	
BAM Act	Western Australian *Biosecurity and Agriculture Management Act 2007*
BC Act	Western Australian *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CR	Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
DAWE	Commonwealth Department of Agriculture, Water and Environment (2021-)
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height (1.3 m)
DEC	Western Australian Department of Environment and Conservation (2006-2013, now DBCA)
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (2007-2010, now DAWE)
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DPaW	Western Australian Department of Parks and Wildlife (2013-2017, now DBCA)
DotEE	Commonwealth Department of the Environment and Energy (2016-2020)
DPIRD	Western Australian Department of Primary Industries and Rural Development
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2010-2013, now DAWE)
DWER	Western Australian Department of Water and Environmental Regulations
EN	Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
Ecoscape	Ecoscape (Australia) Pty Ltd
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
ha	hectare/hectares
IBRA	Interim Biogeographic Regionalisation for Australia
IDE	Inflow Dependent Ecosystem (terrestrial ecosystem reliant on water in addition to rainfall)
IUCN	International Union for Conservation of Nature
km	kilometre/kilometres
m	metre/metres
MNES	Matters of National Environmental Significance
P; P1, P2, P3, P4, P5	Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
PEC	Priority Ecological Community
PF	Priority Flora
PMST	Protected Matters Search Tool (hosted by DAWE, used to search for MNES)
sp.	Species (generally referring to an unidentified taxon or when a phrase name has been applied)
spp.	Species (plural)
subsp.	Subspecies (infrataxon)
TEC	Threatened Ecological Community
T	Threatened fauna or flora species as listed by DBCA
VA	Vegetation Association
WAH	Western Australian Herbarium
WONS	Weeds of National Significance
*****	Introduced species (e.g. weed)

1 INTRODUCTION

1.1 BACKGROUND

The City of Wanneroo (the City) is a local government authority located within the Perth metropolitan area, approximately 25 km north of the CBD. The City includes a number of natural areas for which it has management responsibility.

As part of the City's forecast works, a road upgrade is proposed for Flynn Drive in Neerabup. Areas of native vegetation within the existing road reserve will be affected by these proposed works. The City engaged Ecoscape to undertake biological surveys and environmental impact assessment (EIA) of the portion of Flynn Drive between Travertine Vista and Pinjar Road in 2020. Ecoscape was again engaged by the City in 2021 to undertake biological survey and EIA for the eastern portion of Flynn Drive from Pinjar Road to Old Yanchep Road, referred to as Stage 2, to assess environmental values and potential impacts for the remainder of the proposed road upgrade area. The survey (consisting of a two-phase Detailed flora and vegetation survey incorporating an assessment for representation in the *Banksia Woodlands of the Swan Coastal Plain* Threatened Ecological Community, Basic fauna survey and Black Cockatoo habitat survey) was conducted during spring of 2021. Survey findings will support clearing permits for proposed works, inform any permit amendments due to design changes, and inform the environmental impact assessment (EIA) for proposed clearing between Pinjar Road and Old Yanchep Road.

This report forms the EIA document for Stage 2 of the intended road upgrade of Flynn Drive by the City. It examines the potential impacts of the proposed works in the context of the existing environment and key biological values for the site and discusses possible risks and mitigation opportunities.

1.2 PROJECT OBJECTIVES AND SCOPE OF WORKS

The project considered in this EIA is a portion of the second phase of planned road upgrade of Flynn Drive by the City of Wanneroo, and associated clearing of vegetation. A separate EIA was undertaken by Ecoscape during 2021 to assess the portion of Flynn Drive between Travertine Vista and Pinjar Road, with this EIA only applicable to the portion between Pinjar Road and Old Yanchep Road. Flynn Drive is an existing single carriageway road in a developing area, with proposed upgrades to the road by the City being undertaken in separate stages:

- Single Carriageway from Wanneroo Road to Travertine Vista with sections on a new alignment (completed in 2016)
- Upgrade to dual carriageway on new alignment:
  - Stage 1a – Wanneroo Road to Tranquil Drive
  - Stage 1b – Tranquil Drive to Pinjar Road
  - Stage 2 – Pinjar Road to Old Yanchep Road.

The initial Flynn Drive upgrade was completed in December of 2016, with the remaining upgrade to dual carriageway currently under planning and design. In order to undertake the remaining stages, clearing of native vegetation is required in the Flynn Drive road reserve corridor.

The EIA included the following activities:

- desktop investigation, including a review of the:
  - Department of Biodiversity, Conservation and Attractions (DBCA) fauna and flora databases

  - Ramsar wetland management principles under the *National framework and guidance for describing the ecological character of Australian Ramsar wetlands* (Department of the Environment Water Heritage and the Arts 2008)
  - various Environmental Protection Policies (EPP) subsidiary under the Western Australian *Environmental Protection Act 1994* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
  - Department of Planning, Lands and Heritage (DPLH) *Aboriginal Heritage Inquiry System* (AHIS)
  - mapped physical characteristics of the assessment area including soils, geological and hydrological features
  - relevant biological assessments conducted in the vicinity of the assessment area
  - aerial photography of the site
- evaluation within the assessment area for:
  - mapping of fauna habitat, vegetation types and condition through a combination of field survey and inspection of recent aerial photography
  - a list of all native and non-native plant and animal species recorded from opportunistic sampling
  - a record of potential Black Cockatoo habitat trees observed in the assessment area
  - a description of the vegetation types, floristic community types, vegetation condition, fauna habitat and presence of any Threatened Ecological Community (TEC) or Priority Ecological Community (PEC) occurring on the site
- an assessment of the potential impacts on flora, vegetation, terrestrial vertebrate fauna, TECs or PECs as a result of proposed clearing and review of those impacts against the ten clearing principles defined under the EP Act
- an assessment of the environmental impacts of the project that are likely to be of interest to the EPA
- an assessment of Matters of National Environmental Significance (MNES) likely to require referral of the proposal to the Commonwealth under the EPBC Act.

1.3 LEGISLATION AND GUIDELINES

The following legislation, policies and guidelines are relevant to the environmental assessment of the subject land and provide guidance on survey methodology and the development of land:

- 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)
- Western Australian *Biodiversity Conservation Regulations 2018*
- Western Australian *Biosecurity and Agriculture Management Act 2007* (BAM Act)
- Western Australian *Animal Welfare Act 2002*
- Western Australian *Planning and Development Act 2005*
- Western Australian *Planning and Development (Local Planning Schemes) Regulations 2015*
- Western Australian *Planning and Development Regulations 2009*
- Western Australian *Environmental Protection (Clearing of Native Vegetation) Regulations 2005*
- Commonwealth of Australia (2013) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*
- Department of Sustainability Environment Water Population and Communities (DSEWPaC 2011) *Survey guidelines for Australia's threatened mammals*
- DEWHA (2010) *Survey guidelines for Australia's threatened birds*

- DSEWPaC (2012) *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso,* known in this document as the Black Cockatoo Referral Guidelines
- Commonwealth of Australia (2017) *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo,* known in this document as the Revised Draft Referral Guideline
- Threatened Species Scientific Committee (TSSC 2016) *Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community.*

Key legislation and guidance documents relating to the proposed works are addressed specifically below.

1.3.1 PLANNING AND DEVELOPMENT ACT 2005

This Act was created to provide for efficient and effective land use planning within Western Australia, and to promote the sustainable use and development of land across the State. The Act was originally passed in December of 2005, with currency of the latest version commencing December 2021. The development of State, regional and local planning schemes is regulated as part of this legislation, as well as conditions for subdivision and development. The agency responsible for carrying out the Planning and Development Act, and associated planning and improvement schemes, is the Western Australian Planning Commission.

Regulations applicable to this Act include the *Planning and Development (Local Planning Schemes) Regulations 2015* and the *Planning and Development Regulations 2009*.

1.3.2 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are protected under this legislation and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable are detailed in **Table 13** in **Appendix One**; these categories align with those of the EPBC Act.

Flora and fauna species may be listed as being of special conservation interest if they satisfy at least one of the following criteria and the Minister considers that taking may result in depletion of the species:

- have a naturally low population
- have a restricted natural range
- are subject to or recovering from a significant population decline or reduction of range
- are of special interest.

Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the *Government Gazette* on 11 September 2018 (Government of Western Australia 2018).

1.3.3 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The EPBC Act is a legal framework to protect and manage Matters of National Environmental Significance (MNES) including important flora, fauna, ecological communities, and heritage areas listed under the Act. Threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species and ecological communities that have been assessed as meeting the criteria to be listed as Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild, as detailed in **Table 14** in **Appendix One**. Threatened Ecological Communities are categorised as Critically Endangered, Endangered or Vulnerable, also detailed in this table.

1.3.4 WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement, and management of the environment
- matters incidental to or connected with the above.

Part IV of the EP Act relates to environmental impact assessments, with Division 1 outlining conditions for referral and assessment of proposals. The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

Schedules 5 and 6 of the EP Act stipulate the principles for clearing of native vegetation that should be considered with regards to clearing permit applications and identify clearing activities for which a clearing permit is not required. Clearing activities exempt from permit requirement include those in accordance with industry licences and approved subdivisions.

1.3.5 TECHNICAL GUIDANCE UNDER THE ENVIRONMENTAL PROTECTION ACT 1986

The EPA has established a clear policy framework in line with objectives and principles of the EP Act which incorporates a number of procedures and guidelines for environmental impact assessment. These include the following policies and factor guidelines:

- EPA (2021a) *Statement of Environmental Principles, Factors, Aims and Objectives of EIA*
- EPA (2016a) *Environmental Factor Guideline – Flora and Vegetation*
- EPA (2016b) *Environmental Factor Guideline – Terrestrial Fauna.*

These are applied here in conjunction with the following technical guidance documents relevant to the project:

- EPA (2016c) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known herein as the Flora and Vegetation Technical Guidance
- EPA (2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*, known herein as the Fauna Technical Guidance.

1.3.6 ENVIRONMENTAL PROTECTION (CLEARING OF NATIVE VEGETATION) REGULATIONS 2004

Changes were made under Part V, Division 2 of the EP Act in 2004 relating to the protection of native vegetation, providing for establishment of the *Environmental Protection (Clearing of Native Vegetation)*

Regulations 2004. These regulations are currently administered and enforced by the Western Australian Department of Water and Environmental Regulation (DWER).

Section 5 under the Regulations contains examples of the types of activities exempt from requirement for native vegetation clearing permit. Exemptions include taking of firewood, construction of tracks and clearing of fence lines. An exemption is also provided for clearing that is required to be undertaken in accordance with a subdivision approved by the responsible authority under the *Planning and Development Act 2005*. Note that some of these exemptions do not apply where the activity is proposed to be undertaken within an 'environmentally sensitive area'. These include areas within 50 meters of protected wetlands, and areas within 50 meters of declared rare flora and areas covered by a threatened ecological community.

2 EXISTING ENVIRONMENT

2.1 LOCATION OF ASSESSMENT AREA

The assessment area is located in Neerabup within the City of Wanneroo on the Swan Coastal Plain, approximately 30 km north of Perth (**Figure 1**). The assessment area is 8.83 ha in size and forms a linear corridor of vegetation and road verge adjacent to a busy roadway. A portion of the assessment area at its western extent abuts the Mather Reserve conservation area.

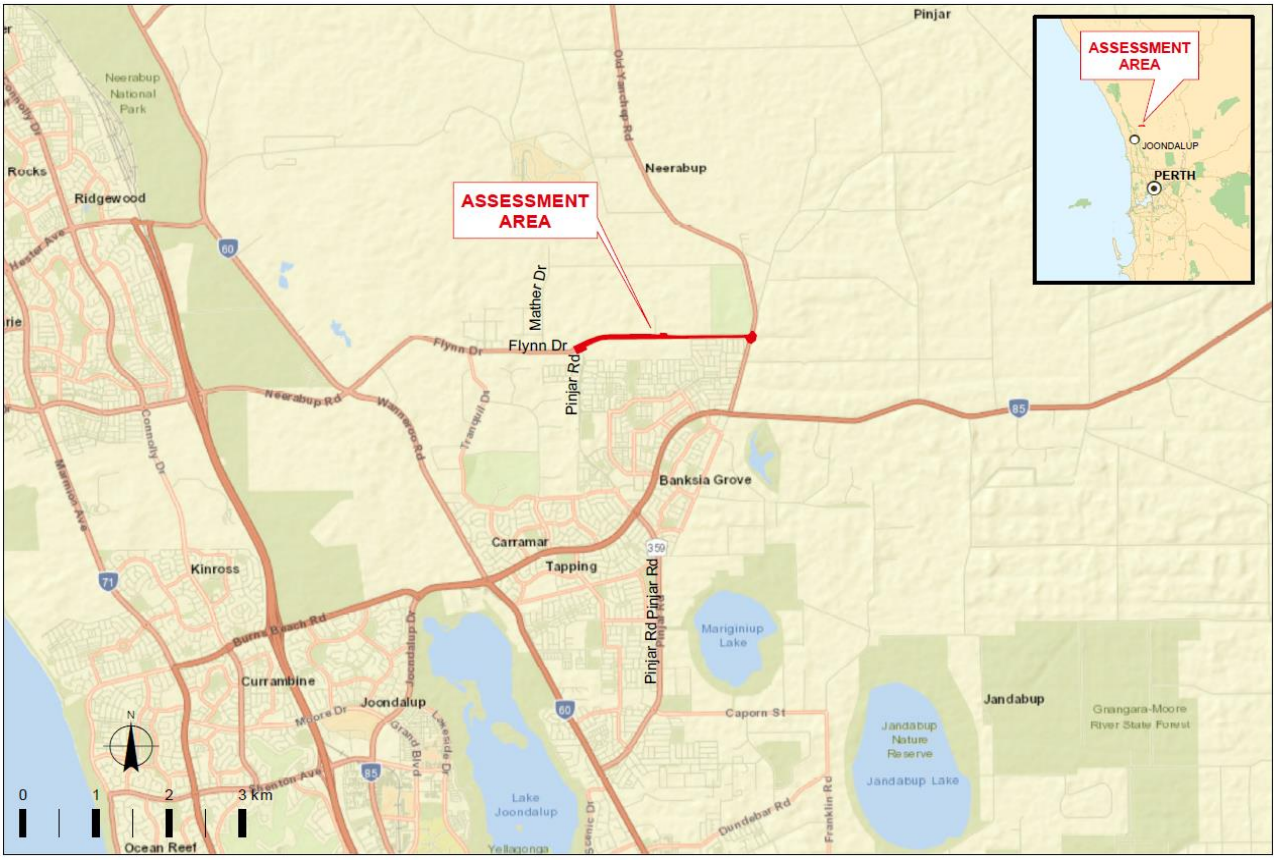

Figure 1: Assessment area location

2.2 LANDFORMS, SOILS AND GEOLOGY

Two land systems intersect the assessment area as mapped by the Department of Primary Industries and Rural Development (DPIRD 2020) soil landscape mapping. These are shown in **Table 2** and **Map 1**.

Table 2: Land systems (DPIRD 2020)

Mapping unit	Land system	Description	Extent (ha)	%
212Bs_Ja	Bassendean, Jandakot Phase	Jandakot low dunes. Slopes <10% and generally more than 5m relief. Grey sand over pale yellow sands generally underlain by humic and iron podsols; *Banksia* spp. low open woodland with a dense shrub layer	0.35	3.91
211Sp_Ky	Karrakatta Sand Yellow Phase	Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m. *Banksia* spp. woodland with scattered emergent *E. gomphocephala and E. marginata* and a dense shrub layer.	8.49	96.09

Inspection of the Perth Groundwater Map (DWER 2022) reveals the assessment area is categorised as having "No known risk" of acid sulfate soils. It should be noted, however, that land immediately to the east of the assessment area, at the intersection with Old Yanchep Road, is classed as "Low to Moderate" acid sulfate soil risk.

Geological mapping covering the assessment area is associated with the Muchea map sheet (20341) of the Department of Mines Industry Regulation and Safety (DMIRS) map series 1:50,000 Geological Series of Western Australia (2018). According to this mapping, one geological unit overlies the assessment area, as shown in **Table 3** and **Map 1**.

Table 3: Geology of the assessment area (DMIRS 2018)

Code	Description	Extent (ha)	%
S7	SAND - pale and olive-yellow medium to coarse-grained sub-angular quartz, moderately sorted, of residual origin, modified by marine inundation.	8.83	100

2.3 SURFACE WATER AND WETLANDS

The assessment area intersects the Wanneroo Coastal Lakes catchment at its western extent, with the majority of the assessment area falling within the Swan Avon (Lower Swan) catchment, in the Swan Coastal basin (DWER 2018a). The assessment area does not intersect with any wetlands or drainage lines. The nearest wetlands to the assessment area include a number of small damplands and sumplands associated with Little Coogee Flat approximately 600 m to the east, Lake Pinjar located 1.2 km to the north, and Lake Adams located 1.2 km to the south-southeast (DBCA 2019a). Hydrology of the area includes the minor river of Ellen Brook approximately 18 km to the east, and the Swan River located approximately 21 km southeast of the assessment area (DWER 2018b).

2.4 GROUNDWATER

The assessment area overlies the *Perth – Yarragadee North* aquifer within the Wanneroo groundwater area as mapped for the Water Resource Information Management System (WRIMS), which comes under the Gnangara groundwater areas allocation plan (DWER 2020a). Inspection of the *Perth Groundwater Map* (DWER 2022) indicates that for the majority of the assessment area the water table depth ranges between 27 m and 33 m below ground level, however, depth to groundwater decreases over the eastern third of the assessment area, with the water table reaching 7 m below ground level at the eastern terminus of Flynn Drive.

The Groundwater Dependent Ecosystems Atlas (Bureau of Meteorology 2021a) indicates that the assessment area is considered as a "Low" potential for terrestrial groundwater dependent ecosystems (GDEs) to occur, with an inflow dependent ecosystem (IDE) likelihood ranging from three to 10. The corresponding GDE type is medium woodland of Tuart and Jarrah.

2.5 CLIMATE

The southwest of Western Australia is generally described as having a Mediterranean-type climate of mild, wet winters and warm to hot, dry summers. The climate of the region is strongly influenced by the position of a band of high pressure known as the sub-tropical ridge. For much of the year the ridge is located to the south allowing the east or south easterly winds to prevail. During the cooler months the ridge periodically moves to the north allowing cold fronts to pass over the west coast and deliver much of the annual rainfall (Beard 1990).

According to the Köppen-Geiger climate classification, the assessment area has a temperate climate with hot, dry summers (Class Csa) (Peel, Finlayson & McMahon 2007). This classification is considered to represent a Mediterranean climate, where average summer maximum temperatures exceed 22°C; the average coldest month maximum is between 18°C and -3°C; and summer rainfall is less than one third of winter rainfall.

The closest Bureau of Meteorology (BoM) station with long term records for rainfall is Wanneroo (station no: 9105), which is located approximately 5 km from the assessment area (BoM 2021b). The mean annual rainfall is 794.9 mm with the highest rainfall occurring in the winter months from June to August.

The closest BoM station with long term records for temperature is Pearce RAAF (station no: 9053), located approximately 22 km from the assessment area. January is the hottest month with a mean maximum temperature of 33.3°C and minimum of 17.6°C. July is the coldest month with a mean maximum of 17.9°C and minimum of 8.4°C.

Figure 2 shows the long-term average rainfall and temperatures of the assessment area.

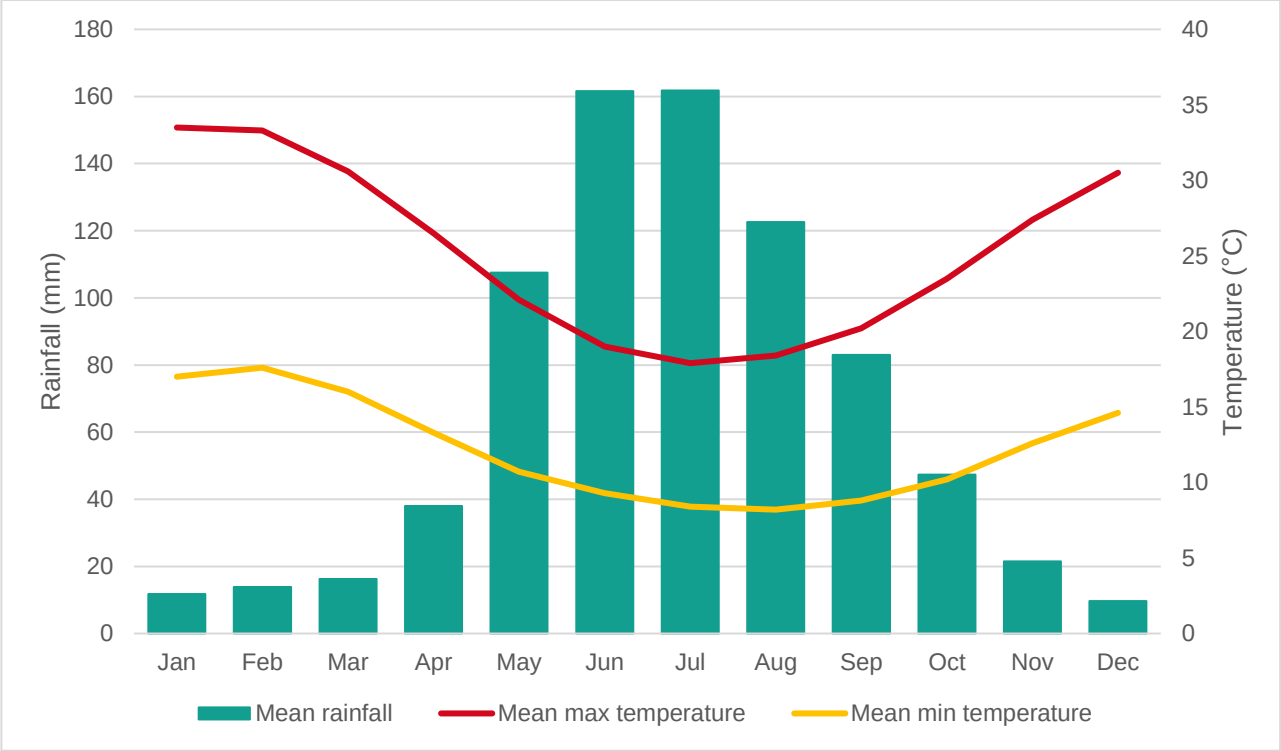

Figure 2: Rainfall and temperature data for the assessment area (BoM 2021b)

2.6 HERITAGE – ABORIGINAL AND EUROPEAN

The assessment area sits in Noongar country, within the registered native title claim for the Whadjuk People (DBCA 2007). The Aboriginal heritage site "Honey Possum Site" [Ref. 3503], registered with Department of Planning, Lands and Heritage (DPLH 2022) lies 350 m to the south of the assessment area. Additionally, Lake Neerabup, [Other Heritage Place Ref. 3396] is positioned approximately 1.8 km to the northeast, and Lake Adams [Other Heritage Place Ref.3693] approximately 1.2 km to the southeast.

The European heritage area of Pappas Swamp Precinct, recognised by the Heritage Council (Government of Western Australia 2016) as a heritage site [Ref.17952] due to lime kilns and market gardens that were active in

the area around Lake Neerabup between 1930 and 1950, lies 3 km to the west of the assessment area. Approximately 2 km to the northeast and southeast respectively are Albert Thomas House [Ref.9429], a homestead of local inter-war architecture, and Delamare House [Ref. 9493], a rare, early bush timber home.

2.7 LAND USE HISTORY

The vicinity of the assessment area has a history of horticultural and viticultural land use (DPIRD 2018). Prior activities in the area included market garden industry and sand quarrying. Areas to the west of the assessment area near Lake Neerabup were additionally used for lime kiln operation between 1930 and 1980.

2.8 BACKGROUND AND CONTEXTUAL INFORMATION ABOUT SPECIES AND COMMUNITIES AT RISK

The following provides contextual information on the conservation significant species and communities identified during biological survey as occurring, or likely to occur, within the assessment area.

2.8.1 FLORA

Conostylis bracteata – P3

A rhizomatous, tufted or shortly proliferous perennial, grass-like or herb, *Conostylis bracteata* is typically 0.2-0.45 m high. The species is found on sand, limestone and consolidated sand dunes, and bears yellow flowers between August and September. According to *FloraBase* (Western Australian Herbarium [WAH] 1998-2022) there are 17 records of this species from the Swan Coastal Plain, with a distribution between Perth and 15 km south of Lancelin, extending only 10 km inland from the coast.

Jacksonia sericea – P4

A low spreading or prostrate shrub, to 0.6 m high, with orange flowers usually occurring in December or January to February. The taxon is found typically on calcareous & sandy soils. There are currently 61 records for *Jacksonia sericea* registered with *FloraBase* (WAH 2021) from the Swan Coastal Plain between Mandurah, Armadale and Carabooda.

Poranthera moorokatta – P2

A diminutive annual herb to 0.5 cm high, with branching stems, glabrous leaves and white, pink or red flowers from September to November (Barrett 2012). This taxon is known from open spaces in *Banksia attenuata – B. menziesii* woodland on white sand, or occasionally with *Banksia littoralis* on grey sandy clay, and nine occurrence records are listed on *FloraBase* from Perth to Bindoon (WAH 2021).

2.8.2 FAUNA

Black-striped Snake (*Neelaps calonotos*) – P3

This species is now restricted to the sandy coastal strip near Perth between Mandurah and Cataby and is found in dune and sand-plains, vegetated with heaths and Eucalypt/Banksia woodlands (Wilson & Swan 2017). It feeds largely on *Lerista praepedita*, which is the smallest of the burrowing skinks within its range.

Carnaby's Cockatoo *(Calyptorhynchus latirostris) – EN; EN*

Carnaby's Cockatoo is a large species of cockatoo endemic to south-western Western Australia which has predominantly black plumage with white cheek patches and tail feather panels. The known distribution for the species runs roughly south-west of a line between Kalbarri and Esperance, extending along the south coast to

Cape Arid National Park (Commonwealth of Australia 2017), with birds foraging in proteaceous woodlands and shrublands in coastal areas from January to July, the moving inland to woodlands with suitable nesting hollows during the breeding season of late July to December (Saunders 1980). There has been an estimated 50% decline in Carnaby's Cockatoo numbers over the last 70 years, primarily due to loss of foraging habitat and nesting hollows of suitable size in breeding areas (DPaW 2013a), and the taxon is classified as Endangered under both the BC Act and EPBC Act.

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – VU; VU

Forest Red-tailed Black Cockatoo was formerly common but is now rare to uncommon and patchily distributed over a range which has become markedly reduced (DSEWPaC 2012). This taxon usually occurs in pairs or small flocks, seldom large flocks (up to 200) and has declined due to destruction of forests and woodlands and competition for nest hollows with native and exotic species, and the impact of fire.

Quenda (*Isoodon fusciventer*) – P4

Quenda are widely distributed from near the coast from Guilderton north of Perth to the east of Esperance. They also have a patchy distribution through the Jarrah and Karri forest, the Swan Coastal Plain, and inland as far as Hyden. Quenda have been recorded in swampy vegetation with dense cover up to 1 m high, often feeding in adjacent forest and woodland that is burnt on a regular basis, and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quenda will thrive in more open habitat subject to introduced predator control. On the Swan Coastal Plain, Quenda are often associated with wetlands (DEC 2012a).

Western Brush Wallaby (*Notomacropus Irma*) – P4

The Western Brush Wallaby, also called the Black-gloved Wallaby, was once common and widespread but has been subject significant reduction in abundance and range, primarily due to habitat fragmentation and clearing for agriculture (Department of Environment and Conservation [DEC] 2012b), and is now restricted to coastal regions of south-west Western Australia. Its habitat includes woodland and open forest, particularly where seasonally damp flats co-occur. This species is crepuscular, but more diurnal than most macropod species, and is known to preference feeding on **Carpobrotus edulis* (Hottentot Fig), **Cynodon dactylon* (Couch) and *Nuytsia floribunda* (Australian Christmas Tree). Breeding typically occurs from April to May, with pouch-young emerging October to November (DEC 2012b).

2.8.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

Banksia Woodlands of the Swan Coastal Plain TEC

In September 2016, the Commonwealth Minister for the Environment and Energy endorsed a new TEC for protection under the EPBC Act; the Endangered *Banksia Woodlands of the Swan Coastal Plain*, known as the Banksia Woodlands TEC (TSSC 2016).

The Banksia Woodlands TEC is dominated by Banksia in the canopy layer with scattered Eucalypts and other trees, over a species rich understorey. It occurs only on the Swan Coastal Plain between Jurien Bay and Dunsborough (including the Dandaragan Plateau), extending inland into immediately adjacent areas on the Darling and Whicher escarpments. The extent of the TEC has declined by 60% and it has been fragmented by development. The key characteristics for and threshold criteria for vegetation to be included in this TEC are detailed in **Table 21** in **Appendix One**.

Banksia attenuata woodlands over species rich dense shrublands TEC/PEC

Endorsed as endangered by the Western Australian Minister for Environment in 2001, this ecological community forms one of a suite of state-listed PECs encompassed by the *Banksia woodlands of the Swan Coastal Plain* TEC listing under the EPBC Act on 16 September 2016. The key diagnostic characteristics, condition and size thresholds in the Approved Conservation Advice should be applied to check if particular patches align with the Commonwealth *Banksia woodlands of the Swan Coastal Plain* TEC.

Occurring at the base of the Darling scarp between Chittering and Gosnells, the *Banksia attenuata woodlands over species rich dense shrublands* (Swan Coastal Plain community type 20a (Gibson *et al.* 1994)) is found on sandy soils of the Karrakatta, Bassendean, Forrestfield and Southern River soil and landform units. The community is very species rich and dominated by *Banksia attenuata* (Candlestick Banksia), often with *Eucalyptus marginata* (Jarrah). Studies of this community indicate it may be in part a groundwater dependent ecosystem. Known occurrences and suitable sandy soils with fresh superficial groundwater capable of supporting this ecological community are considered critical habitat. Description and details for inclusion in this ecological community are defined in the Interim Recovery Plan No. 359 (DPaW 2016).

2.9 CONSERVATION RESERVES

The assessment area does not intersect any formal conservation lands (i.e. National Parks, Nature Reserves and other areas vested for conservation). The Gnangara-Moore River State Forest, vested with the Conservation Commission of Western Australia, is the nearest conservation estate located immediately to the east of the assessment area on the eastern side of Old Yanchep Road. The Neerabup National Park is additionally located approximately 3.5 km west of the assessment area.

Mather Reserve, vested with the City of Wanneroo, abuts the assessment area at the northwest extent but does not intersect it. Mather Reserve (R53163) is an offset site required as part of EPBC Act approval (2007/3479) (Department of the Environment & Australian Government 2014) and managed under the City's Conservation Area Management Plan.

2.10 BUSH FOREVER

A portion of vegetation within assessment area that lies on the northern side of Flynn Drive just east of Pinjar Road forms part of the Bush Forever site #295, which also incorporates bushland in the Mather Reserve Conservation Area, and further portions of vegetation to the east of this which are adjacent to (but not intersecting with) the assessment area, positioned both north and south of Flynn Drive. A separate Bush Forever site (Site #494) is situated in the vicinity of the assessment area on the southern side of Flynn Drive between Mather Drive and Pinjar Road, however, it does not overlap or directly abut the assessment area. These sites are depicted in **Map 2**.

3 RESULTS FROM THE FLORA, VEGETATION AND FAUNA SURVEYS

Results from the biological surveys conducted for the assessment area in spring of 2021 are summarised below. A full technical report of the surveys undertaken, detailing methodology, results of the desktop study and field surveys, and analysis and discussion of findings is contained in the Flora and Vegetation and Fauna technical reports (Ecoscape 2022a, Ecoscape 2022b) attached to this EIA.

3.1 FLORA

The two-phase, Detailed flora and vegetation survey was conducted by Terri Jones (Senior Ecologist, Flora Collecting Permit FB62000191; Threatened Flora Collecting Permit TFL 8-2021) and Louisa Carlson (Ecologist, Flora Collecting Permit FB2000295) during 7-9 September and 18 October 2021.

Overall, 147 vascular flora species were recorded from within the assessment area during the field survey. The species accumulation curve, as generated using *Species Diversity and Richness IV* (Pisces Conservation Ltd 2010) software, indicated that the assessment area was adequately surveyed when taking opportunistic observations into account.

3.1.1 THREATENED AND PRIORITY FLORA

Threatened Flora

No Threatened Flora (TF) species listed under the Commonwealth EPBC Act or Western Australian BC Act were recorded during the field survey. None of the unidentified species resembled any currently listed TF.

No TF species identified by the database searches are considered likely to occur in the assessment area.

Priority Flora

No Priority Flora (PF) species under DBCA listings were recorded during the field survey. None of the unidentified species resembled any currently listed PF.

Three PF species identified by the database searches are considered to have remaining potential to occur in the assessment area:

- *Poranthera moorokatta* (P2)
- *Conostylis bracteata* (P3)
- *Jacksonia sericea* (P4).

3.1.2 SPECIES OF 'OTHER' CONSERVATION SIGNIFICANCE

No flora taxa having other significance according to the Flora and Vegetation Technical Guidance (EPA 2016c) were recorded during the field survey.

3.1.3 INTRODUCED FLORA (WEEDS)

A total of 43 introduced flora species (weeds) were recorded during the field survey, representing 29.25% of the overall flora inventory. Weed burden and diversity within the assessment area was highest along road verges and where previous clearing or disturbance had occurred, and weed taxa recorded are commonly recorded from urban bushland and road verges of the local area.

No Declared Pest species or Weeds of National Significance (WoNS; Weeds Australia & Centre for Invasive Species Solutions 2021) were observed during the survey.

3.2 VEGETATION

3.2.1 CONTEXT

Review of the relevant literature indicates that some of the largest intact areas of vegetation within the Swan Coastal Plain IBRA region overlay the Gnangara Groundwater System (GGS), over which the current assessment area is situated (Wilson *et al.* 2009). Vegetation overlying the GGS is dominated by *Banksia* woodlands with stands of *Eucalyptus* and *Allocasuarina*, over mixed understorey shrubs of Myrtaceae, Proteaceae and Fabaceae (Valentine *et al.* 2009a; Wilson *et al.* 2012). Scattered wetlands and damplands with *Melaleuca* are also present.

Banksia species are prominent canopy species within the region of the assessment area, along with Tuart, Jarrah, Marri, Coastal Blackbutt, and *Melaleuca* tree species. *Banksia* woodlands are particularly species rich, with high diversity particularly in the lower vegetation strata (understorey to 0.4 m). Species richness in the GGS area is typically next greatest in Jarrah woodland, followed by Tuart woodland and then *Melaleuca* dominated vegetation (Valentine *et al.* 2009a).

Vegetation adjacent to the assessment area consists primarily of open woodland to low woodland of *Banksia* spp. and *Allocasuarina fraseriana* with Jarrah, over *Xanthorrhoea preissii* (EcoLogical 2013; Ecoscape 2019a, Ecoscape 2022a). Areas of the *Banksia attenuata woodlands over species rich dense shrublands* TEC, consistent also with the EPBC-listed *Banksia Woodlands of the Swan Coastal Plain* TEC, were identified from previous surveys along Flynn Drive by Ecoscape (2021a) and EcoLogical (2013). *Banksia* woodland vegetation immediately to the west of the assessment area and in the adjacent Mather Reserve was assessed by Ecoscape as being in Very Good to Excellent condition (Ecoscape 2019a, Ecoscape 2021a). A number of conservation significant flora species known from the vicinity of the assessment area are locally or regionally endemic (Valentine *et al.* 2009a).

3.2.2 VEGETATION ASSOCIATIONS

Native vegetation of the assessment area is mapped (DPIRD 2019) as the vegetation associations as outlined in **Table 4.** These associations overlay the Perth IBRA sub-region.

Table 4: Vegetation Associations of the assessment area (DPIRD 2019)

VA Code	Description	% of Assessment Area
6	Medium woodland; tuart & jarrah	98.33
949	Low woodland; banksia	1.67

3.2.3 VEGETATION TYPES AND CONDITION

Vegetation Types

Based on a combination of species composition and vegetation structure, one native vegetation type was identified as occurring in the assessment area (**Table 5**), as supported by floristic analysis using PATN© software (Belbin & Collins 2006) and dendrogram alignment of floristic groups:

- **BAf** - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland.

Table 5: Vegetation types

Mapping unit	Vegetation type	Floristic quadrats	Representative photograph	Area (ha)	Extent (%)
BAf	*Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.	Q01, Q02, Q03		2.54 ha	28.74%
	Revegetation	Q04		0.26 ha	2.99%
	Cleared / Not Vegetated	R01, R02, R03, R04		6.03 ha	68.27%
	TOTAL EXTENT			**8.83 ha**	**100%**

Vegetation Condition

The condition of extant native vegetation within the assessment area ranged from Completely Degraded to Very Good-Excellent condition. Larger sections of Banksia woodland vegetation at the western end of the assessment area were predominantly in Very Good-Excellent condition, whilst narrow linear vegetated areas adjacent to the road verge and towards the eastern extent of the assessment area were predominantly in Degraded to Completely Degraded condition. Condition extents are shown in **Table 6** (scored as per criteria from **Table 18** in **Appendix One**).

Table 6: Vegetation condition (native vegetation)

Vegetation condition (EPA 2016c)	Extent (ha)	Proportion (%)
Pristine	0.00	0.00
Excellent	0.00	0.00
Very Good - Excellent	0.69	7.85
Very Good	0.17	1.97
Good	0.78	8.86
Degraded	0.31	3.55
Degraded - Completely Degraded	0.15	1.65
Completely Degraded	0.43	4.86
TOTAL (NATIVE VEGETATION)	**2.53**	**28.74**

3.2.4 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

Vegetation observed in the western portion of the assessment area was found to correspond at least in part with several TEC/PECs identified during desktop assessment, namely:

- *Banksia woodlands of the Swan Coastal Plain* (Priority 3(iii) PEC; Endangered TEC)
- *Banksia attenuata woodland over species rich dense shrublands* (Endangered TEC).

No further TECs were recorded during survey.

3.3 VERTEBRATE FAUNA

The main portion of the Basic fauna survey was conducted by Terri Jones (Senior Ecologist) and Louisa Carlsson (Ecologist) during 7-9 September 2021. A portion of the assessment area on private property which was not accessible in September (190 Flynn Drive) was assessed by Terri Jones on 18 October 2021. The survey was conducted in accordance with the requirements outlined in the Fauna Technical Guidance (EPA 2020)). The entire site was traversed on foot and all habitats were assessed for quality and capability of supporting both locally common and significant fauna species.

Overall, 22 terrestrial vertebrate fauna species (21 native and one introduced species) were recorded from the assessment area during field survey. These were comprised predominantly of birds, with evidence or observation of two native mammals (Western Grey Kangaroo and Quenda) and one reptile (Dwarf Bearded Dragon) recorded. Of the taxa recorded, three are of significance (Carnaby's Cockatoo – EN; Rainbow Bee-eater – MA; Quenda – P4).

3.3.1 FAUNA HABITAT

One fauna habitat type, Banksia Woodland, was recorded within the assessment area (as indicated on the **Map 4** series).

The Banksia Woodland habitat (2.54 ha) comprising the majority of vegetation within the assessment area will likely support bird and ground-dwelling vertebrate species, including the conservation-listed Carnaby's Cockatoo, Rainbow Bee-eater and Quenda recorded during survey. It is also suitable for the conservation-listed Black-striped Snake and Forest Red-tailed Black Cockatoo, which were not observed during survey but are considered likely to occur.

Areas of revegetation plantings or unsealed road verge were not considered to have sufficient vegetation or abiotic formation (e.g. rock piles) to provide forage resources or shelter for local fauna assemblages at this stage, and thus are not mapped as habitat.

Black Cockatoo Breeding Habitat

Three potential Black Cockatoo breeding trees were recorded, all being Jarrah (*Eucalyptus marginata*). Each tree was assessed for the potential to provide breeding habitat for the Black Cockatoo species (Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo) as per Commonwealth guidelines (DSEWPaC 2012). None of the trees showed signs of nesting activity (e.g. hollows with chew marks at entrance) at the time of the survey, however, the trunks were of suitable size (DBH >500 mm) and have a high potential to form suitable hollows in the future.

The low number of potential breeding trees, and absence of signs of use for nesting, indicates that the assessment area is likely to constitute very low value as breeding habitat.

Black Cockatoo Foraging Habitat

Based on the Revised Draft Referral Guidelines for the three Black Cockatoo species (Commonwealth of Australia 2017), the assessment area was assessed for quality of existing suitable foraging habitat. The total extent of foraging habitat within the assessment area is 2.54 ha, with the habitat quality scores as below.

- Foraging habitat quality for Carnaby's Cockatoo was assessed as having a score of **9** (out of a maximum of 21), indicating "very high quality" habitat for Carnaby's Cockatoo.

- Foraging habitat quality for Forest Red-tailed Black Cockatoo was assessed and scored as **6** (out of a maximum score of 21). According to the guidelines (Commonwealth of Australia 2017) this indicates "high quality" habitat for Forest Red-tailed Black Cockatoo.
- Foraging habitat quality was not assessed for Baudin's Cockatoo as the desktop investigation assessed this species as being unlikely to occur within the assessment area.

As the vegetation of the within the assessment area provides valuable food resources for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, it is considered 'habitat critical to survival for these species (DEC 2008; DPaW 2013a).

Black Cockatoo Roosting Habitat

A Carnaby's Cockatoo roosting site is known from approximately 250 m north of the eastern end of the assessment area, within the Wanneroo Golf Course (DBCA 2019b), however, no Black Cockatoo roosting sites (confirmed or unconfirmed) are registered within the assessment area and there is little to no roosting habitat present. Roosting behaviour was not observed during the survey period.

3.3.2 BIOREGIONAL VERTEBRATE FAUNA ASSEMBLAGE

Review of the relevant literature indicates that some of the largest intact areas of vegetated habitat within the Swan Coastal Plain IBRA region overlay the Gnangara Groundwater System (GGS) (Wilson *et al.* 2009), over which the current assessment area is situated. Remnant patches of native vegetation which are of sufficient quality and connectivity can allow for persistence of native fauna species in the local area (How & Dell 2000; Wilson *et al.* 2009). Vegetation within the GGS, particularly Banksia dominated woodlands, provides critical habitat for the endangered Carnaby's Cockatoo (Wilson *et al.* 2009).

Habitat overlying the GGS is dominated by *Banksia* woodlands with stands of *Eucalyptus* and *Allocasuarina*, over mixed understorey shrubs of Myrtaceae, Proteaceae and Fabaceae (Wilson *et al.* 2012). Scattered wetlands and damplands with *Melaleuca* are also present. This habitat is known to support a rich assemblage of ground-dwelling fauna, with a high diversity of species recorded from *Banksia* woodland, whilst Tuart woodland of the area is characterised by high abundance of reptiles but only a relatively low diversity of species *(Valentine et al.* 2009b). Richness of mammal species on the Swan Coastal Plain is reported to have declined significantly since historic records, with approximately 37% of native mammal species extant in the northern Swan Coastal Plain in 1970 compared with historic records (Valentine *et al.* 2009b). Surveys associated with recent major infrastructure works in the Neerabup area, undertaken by ERM (2009) and GHD (2014), also reported that bird and reptile species were the most commonly observed, with mammalian species (excluding bats) comprising just 12.5% and 8% of survey capture records respectively. Recent survey by Ecoscape (Ecoscape 2021c) of Banksia and Tuart woodland adjacent to the current assessment area further supports a predominance of bird species within the local fauna assemblage.

Conservation significant fauna species recorded from the Ecoscape, ERM and GHD surveys include (showing status under the BC Act; EPBC Act):

- Carnaby's Cockatoo – *Calyptorhynchus latirostris* – (EN; EN) (Ecoscape 2021b; ERM 2009; GHD 2014)
- Rainbow Bee-eater – *Merops ornatus* – (IA; MA) (GHD 2014)
- Quenda – *Isoodon fusciventer* – (P4; -) (GHD 2014)
- Western Brush Wallaby – *Macropus irma* – (P4; -) (GHD 2014)
- Carpet Python – *Morelia spilota imbricata* – (OS; -) (GHD 2014).

Fauna surveys previously conducted in the vicinity of the project provide for compilation of a regional vertebrate fauna assemblage as shown in **Table 22** in **Appendix Three.**

3.3.3 THREATENED AND PRIORITY VERTEBRATE FAUNA

Three conservation-listed fauna species were recorded during the 2021 survey:

- Carnaby's Cockatoo – *Calyptorhynchus latirostris* – (EN; EN)
- Rainbow Bee-eater – *Merops ornatus* – (IA; MA) (GHD 2014)
- Quenda – *Isoodon fusciventer* – (P4; -) (GHD 2014).

No other terrestrial vertebrate species of conservation significance were recorded during field survey. Two species not observed but considered likely to occur due to availability of suitable habitat are listed below:

- Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)* – VU; VU. Expected to occur as an irregular visitor to the assessment area.
- Black-striped Snake *(Neelaps calonotos)* – P3. Suitable habitat and resources are available to support this species within the Banksia Woodland of the assessment area, however, due to its cryptic behaviour it is difficult to observe.

3.3.4 INTRODUCED FAUNA

One introduced bird taxon was recorded during survey: Laughing Turtle Dove (**Streptopelia senegalensis*). This introduced species is commonly found in urban or semi-urban environments and, although it may compete with native granivorous birds for resources, it is not considered a significant threat to native species.

No other introduced vertebrate fauna species, or evidence thereof, were observed within the assessment area.

4 RISK ASSESSMENT

4.1 NATIVE VEGETATION CLEARING PRINCIPLES AS THEY PERTAIN TO FLORA, VEGETATION AND VERTEBRATE FAUNA

The clearing of native vegetation in Western Australia is legislated under the EP Act (section 51 C), requiring either authority of a clearing permit or exemption as applicable under the Act. Applications to clear native vegetation are assessed by DWER in line with the following clearing principles (**Table 7**) outlined in Schedule 5 of the EP Act.

Table 7: Native vegetation clearing principles as contained within the EP Act.

Principle	Description
Principle (a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.
Principle (b)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.
Principle (c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.
Principle (d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.
Principle (e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
Principle (f)	Native vegetation should not be cleared if it is growing in, or associated with, an environment associated with a watercourse or wetland.
Principle (g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
Principle (h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
Principle (i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.
Principle (j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The assessment area has been assessed against the native vegetation clearing principles to evaluate any potential impacts of Stage 2 of the proposed road upgrade works. Assessment against each of the principles is discussed below, with specification of environmental values influencing assessment.

Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

Banksia woodland vegetation overlying the Gnangara Groundwater System typically exhibits a high level of biological diversity of flora (Valentine *et al.* 2009a) and terrestrial fauna (Valentine *et al.* 2009b). This is supported by findings of the biological survey undertaken in September and October 2021, with average taxa per floristic quadrat within Banksia woodland vegetation equating to 45.7 flora species. Terrestrial fauna recorded during the survey was of similar assemblage to previous surveys in the area, with avifauna constituting

the majority of species observed. It is considered that the Banksia woodland vegetation of Very Good to Excellent condition present within the assessment area, primarily in the vicinity of Pinjar Road (between Pinjar Road and 190 Flynn Drive) and at 170 Flynn Drive, constitutes a high level of biological diversity and thus its clearance would be **at variance** to Principle (a). The areas of road verge and revegetation planting observed in the western two thirds of the assessment area is not considered of high biological diversity, therefore, its clearance is **not at variance** to this principle.

Principle (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

The vegetation in the assessment area was assessed using the Government's Black Cockatoo habitat scoring tool (Commonwealth of Australia 2017) and found to constitute very high quality foraging habitat for Carnaby's Cockatoo, and high quality habitat for Forest Red-tailed Black Cockatoo. According to the relevant recovery plans for these species (DEC 2008; DPaW 2013b), the assessment area contains habitat considered critical for the survival of these taxa. Therefore, clearing of this vegetation would be **at variance** to Principle (b).

Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

No rare flora was observed in the assessment area during the biological survey, and none is considered likely to occur. In light of this, the proposed clearing of vegetation is considered to be **not at variance** to this principle.

Principle (d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.

Banksia dominated vegetation occurring in the assessment area to the north of Flynn Drive, adjacent to Mather Conservation Reserve between Pinjar Road 190 Flynn Drive (excluding boundary margins where there is significant structural alteration due to ongoing firebreak, track and fenceline maintenance), is consistent with the TECs *Banksia woodlands of the Swan Coastal Plain* (Endangered TEC) and *Banksia attenuata woodland over species rich dense shrublands* (Endangered TEC). The removal of this portion of vegetation would be **at variance** to Principle (d).

The remaining vegetation within the assessment area does not meet the criteria for any TECs, with Banksia woodland portions failing to satisfy requirements for condition and patch size. Clearance of this remaining vegetation is **not at variance** to Principle (d).

Principle (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Of the vegetation associations (VAs) mapped as overlying the assessment area (DPIRD 2019) and shown in **Table 8**, only VA 6 (Medium woodland; Tuart & Jarrah) is under-represented in the subregion with less than 30% of its Pre-European extent remaining. This VA forms approximately 98.33% of the assessment area, and 23.72% of the pre-European extent of the VA remains in the Perth subregion. The majority (68.27%) of the assessment area is effectively devoid of native vegetation, previously cleared for road infrastructure or maintained as road verge. The remnant native vegetation of VA 6 present was found to range in condition from Completely Degraded to Very Good – Excellent, with approximately 65.9% (1.64 ha) being in Good or better condition, and 34.1% (0.85 ha) in Degraded or lesser condition. Overall, the assessment area forms a narrow linear remnant, and has been impacted by informal access, rubbish and weed incursion. It additionally provides little to no connectivity with other remnants as the linear road corridor portion has an active roadway

and limited vegetation cover, and therefore does not facilitate safe movement by ground-dwelling vertebrates. Due to the size, morphology and condition of the remnant it is not considered a significant remnant despite the under-representation of this VA regionally. The further VA overlaying the assessment area (VA 949 – Low Woodland; Banksia) has greater than 30% of its pre-European extent currently remaining in the Perth IBRA subregion, and this VA constitutes less than 2% of the assessment area. Therefore, the area of VA 949 within the assessment area is not considered to constitute significant remnant.

Table 8: Remaining extents of vegetation associations within the assessment area.

VA Code	Description	% of pre-European extent remaining in IBRA subregion	% of assessment area
6	Medium woodland; tuart & jarrah	23.72	98.33
949	Low woodland; banksia	57.28	1.67

The proposed clearing is considered to be **not at variance** to Principle (e).

Principle (f) Native vegetation should not be cleared if it is growing in, or associated with, an environment associated with a watercourse or wetland.

No vegetation associated with a watercourse or wetland occurs within the assessment area. Clearance of vegetation within the proposed assessment area is therefore **not at variance** to this principle.

Principle (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

The well-draining soils and mild gradient of the assessment area imply a low risk of rainfall-driven erosion, and any additional wind erosion during construction resulting from clearing is anticipated to be minimal due to the relatively small area of proposed clearance. The assessment area does not directly overlie any known risk area for acid sulfate soils (DWER 2017). The depth to water (from ground surface) ranges between 33 m and 7 m at its most low-lying topographical point (DWER 2022), therefore clearing (in the absence of excavation) is unlikely to intersect the water table and is unlikely to trigger surface salinisation.

For these reasons, the proposed clearing is **not at variance** to Principle (g). However, if deep excavation at the lowest point (the eastern end of Flynn Drive) is required, this principle may require revision

Principle (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

The assessment area does not directly intersect any conservation lands (i.e. National Parks, Nature Reserves and other areas vested for conservation). The Gnangara-Moore River State Forest, vested with the Conservation Commission of Western Australia, is located immediately to the east of the assessment area on the eastern side of Old Yanchep Road, and the next nearest conservation estate is Neerabup National Park approximately 3.5 km to the west of the assessment area. The proposed clearance is not predicted to have any impact on the conservation estate. Proposed clearing is therefore **not at variance** to this principle.

Principle (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

No watercourse or wetland occurs within the assessment area. Due to its sandy, porous soil the proposed clearance is unlikely to significantly increase surface run-off contributions to local wetlands or waterways. The assessment area has a depth to water (from ground surface) ranging from 33 m at the highest topographical

point to 7 m at the most low-lying topographical point (DWER 2020b). However, there is little vegetation present over the lower-lying eastern terminus of the assessment area, therefore clearing activities in themselves are expected to be superficial (shallow) and not intersect the local water table or trigger surface salinisation. The proposed clearing is **not at variance** to Principle (i).

Principle (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

No watercourse or wetland occurs within the assessment area. The proposed clearance is unlikely to significantly increase surface run-off contributions to local wetlands or waterways. Clearance for proposed works is **not at variance** to Principle (j).

Table 9: Summary of evaluated outcomes against native vegetation clearing principles

Principle	Evaluation
Principle (a)	Clearance of Banksia woodland in the vicinity of Pinjar Road and at 170 Flynn Drive would be **at variance** to this principle. Clearance of other vegetation found in the assessment area would be at **not variance** to this principle.
Principle (b)	Clearance would be **at variance** to this principle.
Principle (c)	Clearance would be **not at variance** to this principle.
Principle (d)	Clearance of Banksia woodland north of Flynn Drive between Pinjar Road and 190 Flynn Drive would be **at variance** to this principle. Clearance of other vegetation found in the assessment area would be **not at variance** to this principle.
Principle (e)	Clearance would be **not at variance** to this principle.
Principle (f)	Clearance would be **not at variance** to this principle.
Principle (g)	Clearance would be **not at variance** to this principle.
Principle (h)	Clearance would be **not at variance** to this principle.
Principle (i)	Clearance would be **not at variance** to this principle.
Principle (j)	Clearance would be **not at variance** to this principle.

4.2 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Banksia woodlands of the Swan Coastal Plain (Endangered TEC under the EPBC Act)

Vegetation observed within the assessment area was found to correspond at least in part with the *Banksia woodlands of the Swan Coastal Plain* TEC (Endangered) which constitutes a MNES. Structure and species assemblages from the **EmBaAf** vegetation unit north of Flynn Drive and east of Mather Drive (where not affected by ongoing track, firebreak and/or fence maintenance) were observed during survey to be generally consistent with criteria defined for this TEC, specifically:

- upper storey generally dominated or co-dominated by *Banksia attenuata* with emergent Jarrah and *Allocasuarina fraseriana*
- assessed to be in Very Good or Excellent condition and in excess of the minimum patch size (when taking into consideration contiguous vegetation beyond the assessment area boundary)

- containing a species-rich understorey including characteristic species *(Adenanthos cygnorum, Bossiaea eriocarpa, Conostephium pendulum, Daviesia* spp.*, Eremaea pauciflora, Hibbertia hypericoides, Jacksonia* spp.*, Kunzea glabrescens, Petrophile linearis, Phlebocarya ciliata, Philotheca spicata, Stirlingia latifolia* and *Xanthorrhoea preissii).*

As it constitutes a Commonwealth listed TEC, this area of vegetation (indicated on the **Map 3** series) represents a MNES which has potential to be impacted by proposed project works.

Carnaby's Cockatoo *(Calyptorhynchus latirostris)* – EN

This Commonwealth conservation-listed species was observed flying over the assessment area on several occasions, alighting within vegetation at one location, and actively foraging at another location. There are suitable resources within the assessment area to provide habitat for this species, including very high quality foraging habitat, although there is limited potential breeding habitat available (**Section 3.3.1**). Proposed project works have potential to impact this MNES species, primarily via direct impacts of habitat loss.

Forest Red-tailed Black Cockatoo *(Calyptorhynchus banksii naso)* – VU

The Commonwealth mapped distribution for this species (Commonwealth of Australia 2017) includes the assessment area and it has been recorded in nearby surveys (Ecoscape 2019b). Although not observed during the field survey, this species is expected to occur as an irregular visitor to the assessment area.

The Banksia Woodland habitat within the assessment area contains several potential nesting trees, along with high quality foraging habitat (**Section 3.3.1**), provided by the extents of Jarrah trees within the assessment area. The proposed project works have potential to impact this MNES species, primarily via direct impacts of habitat loss.

Rainbow Bee-eater *(Merops ornatus)* – MA

The Rainbow Bee-eater is a colourful, medium-sized bird abundant and widespread across Australia that is listed as a Marine species under the EPBC Act. The Rainbow Bee-eater occurs in a wide range of habitats (including open woodland), usually near permanent water, where it feeds on flying insects it catches in flight (DAWE 2021). It is usually seen in pairs or small flocks, breeding between August and January in loose colonies or occasionally as solitary pairs. Nests are comprised of an underground burrow chamber and entrance tunnel up to 1 m long, in sandy soils of level or gently sloping ground (Boland 2004). Nests are not re-used in subsequent seasons.

The Rainbow Bee-eater was observed moving through Banksia woodland in the central assessment area north of Flynn Drive, in the vicinity of actively worked banks of yellow sand. No nesting burrows attributable to the species were observed in the assessment area. There are limited potential nesting sites within the assessment area as most of the site is on relatively compacted substrate (road verge or previously developed land), however, there is potential for breeding to occur in uncleared Banksia Woodland in the northwest portion of the assessment area. Small numbers are likely to occur in the assessment area seasonally, and potentially during the breeding period. The proposed project works are unlikely to impact this MNES species overall, although there is potential for disturbance of underground nest chambers dependant on timing of works.

4.3 REFERRAL UNDER THE EPBC ACT

Proposed actions that are deemed likely to have a significant impact upon MNES as per Commonwealth of Australia guidelines (2013) require referral under the EPBC Act to gain approval from the Commonwealth Minister for the Environment. As part of the bilateral agreement entered into between the Commonwealth and State governments (under Part IV of the EPBC Act), impacts to MNES from certain actions relating to clearing of native vegetation can be assessed by the State EPA, essentially as proxy to the Commonwealth Minister.

Referral of the proposed project under the EPBC Act is recommended based on the following potential impacts to MNES:

- The proposed works may reduce the extent of the Endangered *Banksia woodlands of the Swan Coastal Plain* TEC
- The proposed works may require clearing of Carnaby's Cockatoo foraging habitat, constituting habitat critical to survival (DPaW 2013a), and may therefore have a significant impact on this species
- The proposed works may require clearing of Forest Red-tailed Black Cockatoo foraging habitat, constituting habitat critical to survival (DEC 2008), and may therefore have a significant impact on this species
- The proposed works may require clearing of Black Cockatoo breeding habitat (potential breeding trees for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo), constituting habitat critical to survival (DEC 2008; DPaW 2013a), and may therefore have a significant impact on these species.

5 POTENTIAL ENVIRONMENTAL IMPACTS

5.1 FLORA AND VEGETATION

5.1.1 FLORA

The flora of an area is the composition of plant species which occur there and may include species which are listed as Threatened or Priority flora due to their conservation significance. Flora may be directly impacted from proposed activities (e.g. by physical clearing of plants) or indirectly impacted (e.g. if habitat or hydrology is modified in such a way that plants or populations thereof cannot be sustained). No conservation significant flora species were observed during the survey of the assessment area, however, those that may occur are discussed below with regards to their potential impacts.

No TF species identified by the database searches are considered likely to occur in the assessment area.

Three PF species identified by the database searches are considered to have remaining potential to occur in the assessment area:

Poranthera moorokatta (P2)

This taxon occurs in open spaces of *Banksia attenuata – B. menziesii* woodland on white sand in a restricted number of locations from Perth to Bindoon and has previously been recorded from approximately 1 km from the assessment area. Suitable habitat is found in the assessment area and the small size, inconspicuous habit and annual nature of the taxon means there is potential for individuals to be missed during field survey, or not present at all times. Despite not being recorded during field assessment, this species may occur in the assessment area. There is, therefore, potential for individuals to be directly impacted by the proposed project, however, the potential for impact is predicted to be low, and at a population level it is anticipated that potential impacts will be negligible due to availability of habitat in surrounding vegetation within Mather Reserve.

Conostylis bracteata (P3)

A potentially new population of this taxon was identified in Banksia woodland adjacent the assessment area, on the northern verge of Flynn Drive opposite Mather Reserve, in 2020 (Ecoscape 2021a). Although not observed from the assessment area in 2021, availability of habitat and proximity to known records suggest individuals may still occur in Banksia woodland in the northwest portion of the assessment area, likely forming part of a single, naturally-occurring population. Individuals of this species have potential to be impacted directly via clearing, and indirectly due to edge effects and competitive weed incursion if adjacent clearing is undertaken. Potential for impact is predicted to be low. At a population level it is anticipated that potential impacts from the proposed project will be negligible due to availability of habitat in surrounding vegetation within Mather Reserve.

Jacksonia sericea (P4)

Often occurring in open areas on coastal, sandy soils from Mandurah to Two Rocks, this species may thrive following light disturbance of an area such as revegetation works. It was not observed during the current field survey, however, has been recorded recently from the vicinity in moderate numbers (Ecoscape 2021a) and as such small individuals or seedlings may have potential to be present in the assessment area particularly along firebreak or informal track edges, or be present in the seed bank. There is potential for a small number of individual plants to be directly impacted (cleared) by proposed works. No significant changes to hydrology,

weed presence or fire risk which would indirectly impact this taxon are expected. The level of direct impact is estimated to be low, with indirect impacts negligible.

5.1.2 VEGETATION

Vegetation incorporates the collective plant-life of an area described using both structural characterisation and dominant floristic species, as applied to various scales of landscape. Vegetation may be directly impacted from proposed activities (e.g. by physical clearing of vegetation) or indirectly impacted (e.g. if habitat or hydrology is modified in such a way that vegetation structure or species composition is altered in the long term).

One native vegetation unit has potential to be impacted by the proposed project works. Sections of the Banksia woodland unit (*Banksia* spp. and *Allocasuarina fraseriana* low open woodland) totalling 2.54 ha in the assessment area are predicted to have high direct impacts from clearing, with indirect impacts assessed as low based on a slightly increased risk of edge effects. It should be noted that 0.89 ha of Banksia woodland in the assessment area which constitutes TEC *(Banksia Woodlands of the Swan Coastal Plain* and *Banksia attenuata woodland over species rich dense shrublands)* represents a significant impact to these TECs (MNES) through reduction in extent of the ecological communities.

Current mapping of acid sulfate soils (DWER 2017) indicates that although risk within the assessment area is categorised as "no known risk", the land immediately adjacent to the eastern terminus is mapped as "Low to Moderate". Should works at the eastern end of Flynn Drive require excavation, it is recommended that sampling be undertaken in the vicinity to evaluate potential for presence of acid sulfate soils, the exposure of which may indirectly impact upon vegetation health.

5.1.3 EDGE EFFECTS – FLORA AND VEGETATION

The transition zone between vegetation types, particularly when representing the boundary with an anthropogenically modified or degraded area, presents a focal area for negative impacts upon vegetation through factors such as weed infiltration or exposure to less favourable conditions. Fragmented habitats are exposed to greater edge effects due to the increased perimeter-to-area ratio and, where the depth of edge effect penetration is sufficient to impact the entirety of the remnant, permanent alteration of the vegetation unit can occur.

For the assessment area, proposed works are not predicted to result in newly fragmented remnants (rather, a decrease in area of existing remnants) and vegetation adjacent to the central and eastern portions of the assessment area in particular are already impacted by degrading edge effects from informal access and weed invasion. Therefore, the increased impacts of edge effects from proposed works are predicted to be low within the assessment area. It should be noted that edge effects may indirectly impact surrounding vegetation, including Mather Reserve, if buffer areas for adjacent vegetation are removed.

5.1.4 INCREASED ACCESS

Increased access to vegetation, whether formal or informal, can result in greater weed penetration, trampling and vehicular destruction of vegetation, increased fire risk and increased dumping of rubbish and contaminant materials. The assessment area currently has a high level of informal access, and for this reason the predicted impact of proposed works from any additional access is likely to be low.

5.1.5 CLEARED AREAS

The presence of cleared areas can result in similar adverse effects to those arising from increased access, with higher risks of undesirable public usage and weed incursion. Cleared areas can additionally provide

colonisation points for new weed species due to greater sunlight exposure and catch points for wind transported seed material, and potential for erosion to develop.

Prompt control of new weed infestations and rehabilitation of cleared areas is therefore vital. Should careful minimisation and appropriate rehabilitation of cleared areas be incorporated into project design and management, predicted impacts from cleared areas are considered to be low.

5.1.6 VIABILITY AND ECOLOGICAL LINKAGE

Ecological linkages allow connectivity across a landscape, enabling movement of species and individuals, as well as the continued function of ecosystem services. Fragmented habitat results in hindrance or cessation of these processes. By maintaining ecological function and connective cover, the short- and long-term viability of remnant vegetation can be improved.

The assessment area forms a partially vegetated corridor which currently allows for limited connectivity across the immediate landscape. Excepting the western-most portion of the assessment area, the majority of vegetation present exhibits at least a moderate level of degradation and fragmentation, while the eastern third is effectively devoid of vegetation within the project boundary. As the proposed works involve a widening of road infrastructure along an existing alignment, the predicted impacts on ecological linkage are likely to be low, with some continuity of vegetation cover currently maintained on conservation lands (Bush Forever site #295) adjacent to the road upgrade alignment. However, it should be noted that recent clearing of vegetation south of the assessment area at the eastern end of Flynn Drive, which previously provided a vegetated corridor linking a Bush Forever site #295 to the Gnangara State Forest, has increased the importance of maintaining at least stepping-stone remnant or even the narrowest of corridors along the northern boundary of Flynn Drive.

5.2 VERTEBRATE FAUNA

5.2.1 BIODIVERSITY VALUE OF THE ASSESSMENT AREA

The assessment area supports a range of bird and ground-dwelling vertebrate species. This includes fauna such as the conservation significant Carnaby's Cockatoo, Quenda and Rainbow Bee-eater, all observed during field survey in 2021, as well as the Forest Red-tailed Black Cockatoo and Black-striped Snake which were assessed as having a high residual likelihood of occurrence. *Banksia* woodlands overlying the Gnangara groundwater system are known to have a particularly rich assemblage of ground-dwelling fauna (Valentine *et al.* 2009b) and form critical habitat for Carnaby's Cockatoo (Wilson *et al.* 2012).

In order to maintain the biodiversity value of the assessment area, habitat for the various species currently utilising the assessment area (or considered likely to occur in the assessment area) should be preserved as far as possible. If good quality sections of Banksia woodland habitat cannot be retained, impacts to biodiversity of the assessment area have potential to be high.

5.2.2 ECOLOGICAL FUNCTIONAL VALUE AT THE ECOSYSTEM LEVEL

The ecological functional value of an area is tied to the condition of existing habitat and vegetation, as well as ecological linkage. Good connectivity across a landscape will enable continuance of ecosystem services such as access to resources, dispersal and migration of species and individuals, pollination, nutrient cycling and regulatory services. Degradation or fragmentation of habitat or vegetation will directly reduce its ability to provide for forage and shelter needs and may lead to reduced function of supportive ecosystem processes.

Within the assessment area, habitat is effectively confined to the area north of Flynn Drive, and there is currently some fragmentation of this habitat, particularly in the central and eastern portions. Connectivity at the broader

scale is presently maintained by the presence of larger bushland remnants to the northwest, south and northeast of the assessment area and vegetated corridors linking these with smaller reserves or stepping-stone remnants to the east of the assessment area. The proposed works for the upgrade of Flynn Drive are unlikely to directly impact ecological function value at the ecosystem level but will contribute to cumulative impacts thereupon and will reduce the local ecological function to some degree. It should be noted that recent clearing of vegetation south of the assessment area at the eastern end of Flynn Drive, which previously provided a vegetated corridor linking a Bush Forever site #295 to the Gnangara State Forest, has increased the importance of maintaining at least stepping-stone remnant or even the narrowest of corridors along the northern boundary of Flynn Drive. Retention and/or qualitative improvement of vegetative corridors wherever possible will minimise both local and cumulative ecosystem level impacts, keeping predicted impacts low.

5.2.3 CONDITION OF FAUNA HABITAT

Condition of fauna habitat is loosely representative of its ecological value for the local faunal assemblage. Degradation of habitat may directly or indirectly reduce its ability to provide for forage and shelter needs of local fauna and may lead to reduced function of supportive ecosystem processes. Factors such as vegetation health and cover, diversity of forage and prey species, pest species presence, availability of nesting sites and context within surrounds are considerations when evaluating habitat condition.

Woodland habitat supportive of the faunal assemblage identified from desktop and field assessment occurs sparsely across the majority of the assessment area, with woodland at the western end adjacent to Mather Reserve representing the most valuable habitat of the assessment area. The woodland in this portion was assessed as being in Very Good – Excellent condition, and as very high quality forage habitat for Carnaby's Cockatoo. A reduction in, if not complete removal of, fauna habitat is expected, which may increase edge effects on remaining or surrounding vegetation and lead to increased degradation. In this way, impacts on the condition of fauna habitat in the assessment area are expected to be moderate to high.

If some degree of connectivity of habitat along the length of the project can be maintained, and rehabilitative efforts undertaken to improve the condition of retained habitat post development, this may help negate reduction in habitat condition and reduce the overall impact to low.

5.2.4 ECOLOGICAL LINKAGES

Ecological linkages allow connectivity across a landscape, enabling movement of species and individuals, as well as the continued function of supportive ecosystem services. Fragmentation of fauna habitat can reduce dispersal of animal offspring, increase overall fauna mortality (particularly through predation or vehicle strike when moving between remnants), reduce genetic diversity in an area and reduce the short and long-term viability of fauna populations.

The assessment area forms a partially vegetated corridor which currently allows for limited connectivity across the immediate landscape. Excepting the western-most portion of the assessment area, the majority of vegetation present exhibits at least a moderate level of degradation and fragmentation, while the eastern third is effectively devoid of vegetation within the project boundary. As the proposed works involve a widening of road infrastructure along an existing alignment, the predicted impacts on ecological linkage are likely to be low, with some continuity of vegetation cover currently maintained on conservation lands (Bush Forever site #295) adjacent to the road upgrade alignment. However, it should be noted that recent clearing of vegetation south of the assessment area at the eastern end of Flynn Drive, which previously provided a vegetated corridor

linking a Bush Forever site #295 to the Gnangara State Forest, has increased the importance of maintaining at least stepping-stone remnant or even the narrowest of corridors along the northern boundary of Flynn Drive.

5.2.5 ABUNDANCE AND DISTRIBUTION OF SIMILAR HABITAT IN THE SURROUNDING AREAS

If similar habitat to that of the assessment area is available in surrounding areas, this provides potential for the relocation of fauna displaced by habitat loss within the assessment area. Cumulative impacts of habitat loss need to be considered with respect to availability of surrounding habitat, as ongoing habitat degradation or repeated clearing in the local area will affect the overall carrying capacity of remaining habitat and may lead to increased competition for resources or density driven disease.

The area of fauna habitat within the assessment area which has potential to be impacted by the proposed works totals 2.54 ha and is small in comparison with areas of similar habitat in adjacent or nearby remnant bushland. The fauna habitat unit observed during field survey (Banksia Woodland) is well represented in the surrounds, with current connectivity allowing movement out of the assessment area. Significant areas of similar adjacent habitat include Bush Forever site #295 to the south of Flynn Drive and Mather Reserve to the northwest of the assessment area. The proposed project works are therefore likely to have a negligible direct impact with regards to availability of similar habitat in surrounding areas, however, cumulative impacts should be considered. It is understood that a proposal has been submitted to the EPA by the Borrello Family to clear 14.02 ha of Banksia woodland at Lot 902 Flynn Drive, within Bush Forever site #295 and adjacent to the assessment area (EPA 2021b). This represents a cumulative impact factor, as clearing of vegetation at Lot 902 has potential to reduce availability and connectivity of similar habitat locally, and alter ecological linkages.

5.2.6 ANIMAL DEATHS DURING THE CLEARING PROCESS AND DISPLACEMENT OF FAUNA

Clearing activities have the potential to cause direct mortality of fauna via operation of clearing machinery, or indirect mortality of fauna via displacement into unsuitable habitat or areas of high risk (e.g. areas with higher exposure to predation or into the path of vehicular traffic). Any areas to be cleared should be surveyed in the period prior to clearance to identify any active burrows or nests and clearing activities should be supervised by an appropriately trained person to identify fauna present or disturbed during the clearing process and remove them to a place of safety. Risk of fauna mortality can be minimised by conducting clearing activities in a sequential manner that advances in the direction of refuge habitat not to be cleared.

No burrows or nests were observed during the field survey of the assessment area in 2021, however, three trees of greater than 500 mm diameter (two with recognisable hollows) were recorded during assessment for Black Cockatoo habitat, and further trees of smaller diameter may contain unrecorded hollows suitable for use by other species. Additionally, some ground-dwelling vertebrates will shelter under shrubs or litter. There is a risk that proposed clearing activities in the assessment area will result in fauna mortality, however, should pre-clearance surveys and supervision of clearing operations be applied the potential impact of this is considered low.

5.2.7 REDUCTION OR LOSS OF ACTIVITY AREAS AND CLOSURE OF BURROWS

A loss of observed activity areas or existing burrows will result in increased impacts to fauna. It can cause changes in behaviour or territorial boundaries of local fauna and is an indication of greater impacts to available forage and nesting resources.

No significant activity areas were noted during the field survey of the assessment area in 2021, and no active burrows were observed. Predicted impacts specific to this factor are therefore regarded as low with respect to the assessment area.

5.2.8 EDGE EFFECTS – VERTEBRATE FAUNA

As for edge effects relating to flora and vegetation, transition zones between two or more habitat units present a focal area for negative impacts from external influences, with fragmented habitats exposed to greater edge effects. Edge effects relating to fauna include habitat alteration from exotic flora and general degradation, as well as increased presence of (or exposure to) both native and invasive predator species.

The habitat currently existing within the assessment area is already subject to a level of impact from weed burden and exotic animal presence which is not predicted to increase significantly as a result of proposed works. Perimeter-to-area ratio of available habitat remnants will likely increase to some degree for portions of the assessment area or adjacent vegetation, however, suitable invasive species control and quality rehabilitation of vegetated areas may be sufficient to offset these adverse factors and render overall increased impacts of edge effects as negligible.

5.3 OTHER FACTORS

5.3.1 SIZE AND SCALE OF THE PROPOSED DISTURBANCE

The area of vegetation which has the potential to be directly disturbed by proposed project works totals 2.80 ha. Of this, 0.26 ha represents areas of revegetation plantings not considered effective fauna habitat at present. No significant indirect impacts are predicted. This is considered a relatively small scale of disturbance in the context of surrounding areas of similar vegetation and habitat, with the associated direct impacts classified as low, although cumulative processes and connectivity should be considered in assessment of overall resultant potential impacts.

5.3.2 INTRODUCED FAUNA AND WEEDS

Introduced vertebrate pests may predate on native flora or fauna species directly, and additionally compete with native fauna species for resources such as food sources and breeding habitat (e.g. tree hollows). The most common significant feral vertebrate species include rabbits, which are destructive via grazing native vegetation and construction of warrens, and foxes and feral and roaming domestic cats, which predate directly on native wildlife and can eliminate small to medium native mammal species from discrete areas. Domestic dogs also pose a threat to native wildlife, particularly in urban areas. Presence of informal tracks and rubbish sites may attract vertebrate pests as they present possible dwelling sites and easy access into native vegetation for hunting.

The only introduced fauna observed during field assessment of the assessment area was a bird species (Laughing Turtle Dove) not considered a threat to native fauna or flora, however, rabbits, rats and domestic dogs have been recorded from adjacent vegetation in 2020 (Ecoscape 2021c) and *NatureMap* records (DBCA 2007-2021) indicate cats and foxes are known from within close proximity (<5 km). Informal access tracks and some rubbish deposits are currently present within native vegetation remnant, notably in the northwest portion of the assessment area and adjacent vegetation to the west towards Mather Drive. It is unlikely that the proposed works within the assessment area will lead to an increase in introduced fauna in the assessment area, therefore, the potential impact relating to this factor is considered negligible.

Introduced plant species (weeds) present within vegetation compete with native species for valuable resources of sunlight, nutrients, and moisture. Fast-growing and highly invasive weeds can potentially displace native plants or populations, reducing diversity and threatening local persistence of some flora taxa. Clearing which increases the perimeter-to-area ratio of native vegetation remnants can increase penetration of weed species

and overall weed burden. Creation of bare areas or increased number of formal or informal access tracks may similarly lead to greater weed penetration or colonisation of different weed species through different seed deposition avenues.

Clearing required for the proposed project works may increase the perimeter-to-area ratio of existing vegetation remnant in the assessment area to some degree and have potential to create areas of bare ground during construction, and is likely to reduce the area of buffer relating to adjacent vegetation. However, informal access tracks and points of weed penetration currently exist in the assessment area, and weed burden is currently high along previously cleared road verge, thus the increased impact of introduced flora is likely to be low if appropriate management is undertaken.

5.3.3 FIRE

Fire presents a major threat to flora and fauna as it has the capacity to cause significant loss of habitat and mortality to wildlife, as well as severely alter species composition and vegetation structure over time. Although fire events are unpredictable, environment modifications which increase fuel loads (e.g. via weed burden) or undesirable public use (such as vandalism and informal access) may lead to increased risk of fire occurrence. Based on current weed levels and public use within the assessment area, it is unlikely that the proposed works will result in an increased risk of fire and the potential impact of the works in this regard is thus considered negligible.

5.3.4 ANTHROPOGENIC ACTIVITY

Current levels of public use within the assessment area (as assessed during the 2021 field survey) are high. Areas of small-scale rubbish dumping were observed, with informal access tracks and incidental small rubbish (litter) items present throughout the assessment area. An increase in vehicular traffic through the area once the road upgrade is complete is anticipated to result in some increase in small rubbish items and littering, however, the overall potential impact from changes in anthropogenic activity is expected to be low.

5.3.5 HYDROLOGY / EROSION

Key potential hydrology impacts include changes to groundwater flow or depth to groundwater. Penetration of the groundwater table by construction activities or modified landforms can result in soil salinisation, waterlogging of vegetation and/or exposure of acid sulfate soils. Each of these outcomes can lead to death of vegetation, or structural and floristic composition changes if susceptible species are lost selectively. Clearing of deep-rooted perennial vegetation even in the absence of excavation may also lead to similar outcomes due to a resultant rise of the water table impacting low-lying areas.

Changes in surface water flow resulting from modification of landforms (e.g. gradient changes or re-surfacing) may also lead to changes in groundwater flow or surface water pooling and can additionally increase susceptibility to erosion. Erosion (the removal or deposition of material by wind, water, or other natural agent) can degrade substrate and associated vegetation and may cause chemical alteration of natural resources. Rill and sheet erosion are two common forms of erosion on sloped landforms, whereby accumulation of surface water run-off leads to formation of channels by water flow (rill erosion) or loss of broad areas of superficial topsoil (sheet erosion). Risk of erosion is increased when vegetation and leaf litter or woody debris are cleared from an area, as these features stabilise soil and act to slow movement of water across a surface, allowing it to penetrate substrate.

Wind erosion, whereby soil material is transported by wind, is also increased in the absence of vegetation. The form of erosion can be particularly problematic when bare areas are located on crests of hills, exposed flats, or hillslopes facing prevailing winds.

The level of potential hydrological or erosive impacts resulting from the proposed project works is tied to design, duration and timing of construction works, as well as promptness of post-construction rehabilitation. Considerations include:

- the linear form of the proposed project works will follow existing infrastructure alignment
- depth to groundwater exceeds 7 m in the assessment area, with the only deep-rooted vegetation to be removed positioned in areas exceeding 22 m depth to groundwater
- the scale of increase in surfaces contributing to surface water run-off is considered small to moderate, with 68.27% of the assessment area already comprised of road infrastructure or bare ground
- gradient of the assessment area is characterised as gentle
- the sandy soils of the assessment area facilitate rain penetration and are less susceptible to water erosion than clay or clay loam substrate.

Evaluation of these elements suggests that the potential impacts of the proposed project works upon hydrology and erosion risk will be negligible.

6 MANAGEMENT AND MITIGATION

6.1 DESIGN CONSIDERATION AND PREPARATION OF MANAGEMENT PLANS

For those factors where an environmental impact is considered to have potential to occur due to proposed project works, recommendations for minimisation of impact have been made in the tables below (**Table 10**, **Table 11**, and **Table 12**). These include considerations for project design, as well as suggested management actions to mitigate resultant impacts.

6.1.1 FLORA AND VEGETATION MANAGEMENT PLAN

Table 10: Flora and Vegetation Management Plan

Factor	Potential Impact (Predicted Impact Level)	Recommended Management/Mitigation
Potential occurrence of *Poranthera moorokatta* (P2)	Direct removal of individuals via clearing. (Low)	Project design should minimise clearing in known locations of the taxon should any observations be recorded subsequent to the 2021 survey.
	Indirect impacts to population. (Negligible)	Weed control and dust management should be implemented in works areas at all stages of construction. Creation of bare areas and ingress points should be avoided.
Potential occurrence of *Conostylis bracteata* (P3)	Direct removal of individuals via clearing. (Low)	Project design should minimise clearing in known locations of the taxon should any observations be recorded subsequent to the 2021 survey.
	Indirect impacts to population. (Negligible)	Weed control and dust management should be implemented in works areas at all stages of construction. Creation of bare areas and ingress points should be avoided.
Potential occurrence of *Jacksonia sericea* (P4)	Direct removal of individuals via clearing. (Low)	Project design should minimise clearing in known locations of the taxon should any observations be recorded subsequent to the 2021 survey.
	Indirect impacts to population. (Negligible)	Weed control and dust management should be implemented in works areas at all stages of construction. Creation of bare areas and ingress points should be avoided.
Vegetation	Direct removal of vegetation via clearing. (High)	Project design should minimise clearing of vegetation so far as practicable. Any cleared areas or informal access pathways not forming part of permanent infrastructure development should be promptly rehabilitated using species representative of pre-existing local vegetation units, utilising seed or plantings of local provenance.

Factor	Potential Impact (Predicted Impact Level)	Recommended Management/Mitigation
	Indirect impacts to vegetation. (Negligible – Low)	Weed control and dust management should be implemented in works areas at all stages of construction and maintained particularly in areas adjacent to Mather Reserve and Bush Forever site #295. Creation of bare areas and ingress points should be avoided. Should works at the eastern end of Flynn Drive require excavation, it is recommended that sampling be undertaken in the vicinity to evaluate potential for presence of acid sulfate soils in this location.
TECs	Significant impact to *Banksia woodlands of the Swan Coastal Plain* TEC (High)	Project design should preserve extent of the TEC within the survey area so far as possible. Weed control and dust management should be implemented in works areas at all stages of construction. Creation of bare areas and ingress points should be avoided.
Edge effects	Indirect impacts to flora and/or vegetation. (Low)	Project design should avoid fragmentation of remnant and minimise remnant perimeter-to-area ratio. Weed monitoring and management should be implemented at all stages of construction and maintained particularly in areas adjacent to Mather Reserve and Bush Forever site #295.
Increased access	Dispersal and establishment of invasive weeds. (Low)	Any informal access points to be managed for weeds and public use, and promptly rehabilitated.
	Increased undesirable anthropogenic activity. (Low)	Formal access pathways should be designed to minimise establishment of ancillary informal access.
Cleared areas	Establishment of invasive weeds. (Low)	Creation of bare areas should be avoided. Any cleared areas to be managed for weeds at all stages of construction and promptly rehabilitated.
	Increased undesirable anthropogenic activity. (Low)	Creation of bare areas should be avoided. Any cleared areas to be managed for public use and promptly rehabilitated
Viability and ecological linkage	Fragmentation of vegetation and habitat. (Negligible – Low)	Project design should avoid fragmentation of remnant and maintain vegetation corridors where possible.
Introduced flora (weeds)	Dispersal and establishment of weed species. (Low)	Weed control should be implemented in works areas pre-, during and post-construction. Creation of post-construction bare areas or ingress points should be avoided.

Factor	Potential Impact (Predicted Impact Level)	Recommended Management/Mitigation
Introduced fauna	Damage to vegetation from introduced herbivores. (Negligible)	Current control measures for invasive fauna should be at minimum maintained. Potential harbour sites for invasive fauna should be removed/rehabilitated.

6.1.2 FAUNA MANAGEMENT PLAN

Table 11: Fauna Management Plan

Factor	Potential Impact (Predicted Impact Level)	Recommended Management/Mitigation
Loss of fauna habitat	Direct removal of habitat via clearing. (High)	Project design should minimise clearance of fauna habitat so far as practicable. Project design should avoid clearance of Black Cockatoo forage habitat (critical habitat). Project design should avoid clearance of potential Black Cockatoo breeding trees (critical habitat).
	Indirect impacts to habitat condition. (Low)	Project design should avoid fragmentation of remnant and minimise remnant perimeter-to-area ratio. Creation of bare areas should be avoided. Weed management should be implemented at all stages of construction. Any cleared areas or informal access points to be managed for weeds and public use, and promptly rehabilitated.
Fauna mortality	Fauna mortality during the clearing process. (Low)	Pre-clearance surveys to be conducted (3 days - 2 weeks prior to clearing activities). Construction commencement should be timed outside of the nesting season (particularly that of the Rainbow Bee-eater and Black Cockatoo species) to avoid disturbance of nesting birds. Clearing activities to be undertaken in a sequential manner that advances in the direction of refuge habitat not to be cleared, allowing escape of fauna.
	Fauna mortality due to increased vehicular traffic. (Low)	Fauna egress points should be incorporated at regular intervals or road kerb profile reduced to minimise risk of small ground-dwelling vertebrates being incidentally confined to road corridor. Median strips and/or islands should be revegetated with low understorey plantings to provide improved connectivity of habitat and safer movement for small ground-dwelling vertebrates.

Factor	Potential Impact (Predicted Impact Level)	Recommended Management/Mitigation
Ecological linkages	Reduction in safe movement and dispersal of fauna. (Low)	Project design should avoid fragmentation of remnant vegetated habitat. Median strips and/or islands should be revegetated with low understorey plantings to provide improved connectivity of habitat and safer movement for small ground-dwelling vertebrates.
Introduced fauna	Predation or competition from introduced pest animals. (Negligible)	Current control measures for invasive fauna should be at minimum maintained. Potential harbour sites for invasive fauna should be removed/rehabilitated.

6.1.3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

Table 12: Construction Environmental Management Plan

Factor	Potential Impact	Recommended Management/Mitigation
Training /awareness	Unauthorised clearing of (or damage to) flora and vegetation.	Clear demarcation of any areas to be cleared or preserved. Environmental inductions to ensure awareness of environmental factors and identify assets. Daily pre-start to confirm intended activity areas. Supervision of clearing activities by an authorised person.
	Destruction of fauna nests/burrows.	Fauna pre-clearance surveys to be conducted (3 days – 2 weeks prior to clearing activities). Clear demarcation of any fauna sites to be preserved. Environmental inductions to ensure awareness of environmental factors and identify assets. Daily pre-start to confirm intended activity areas. Supervision of clearing activities by an authorised person.
	Fauna injury or mortality.	Clearing activities should be carried out under supervision of an appropriately trained fauna spotter/catcher. Environmental inductions to ensure awareness of environmental factors and identify assets. Daily pre-start to confirm intended activity areas. Clearing activities to be undertaken in a sequential manner that advances in the direction of refuge habitat not to be cleared, allowing escape of fauna.

Factor	Potential Impact	Recommended Management/Mitigation
Site hygiene	Dispersal of weed material.	All vehicles and equipment to be inspected for plant material prior to site access. Ensure any soil or materials used for construction purposes are free of weeds and/or seed. Weed monitoring and control to be undertaken pre-, during and post- construction.
	Transfer of *Phytophthora* species (Dieback) and other soil pathogens.	A targeted survey for signs of Dieback and soil pathogens to be undertaken prior to construction commencement to identify any risk areas. All vehicles and equipment to be inspected for soil material prior to site access. Ensure any soil or materials used for construction purposes are certified free of *Phytophthora* species. Vehicle or equipment movement to avoid identified risk areas, areas of pooled water or wet soil conditions which favour the pathogen. Monitoring for *Phytophthora* species to be undertaken at 6 month intervals to identify any new potential presence or spread of the pathogen.
Dust	Indirect impacts upon surrounding environment (e.g. smothering of flora and vegetation).	Dust suppression measures such as water application or hydromulching should be implemented at all stages of construction. Stockpiles of soil material should be kept to a minimum.
Altered hydrology	Erosion and material transfer.	Regular monitoring of erosion (or potential for erosion) to be undertaken at regular intervals throughout the construction process and problem areas managed promptly. Dust suppression measures such as water application or hydromulching should be implemented at all stages of construction. Stockpiles of soil material should be kept to a minimum. Erosion control tools such as coir logs, hydromulching or jute matting should be employed in areas of temporarily increased surface water flow to slow water movement and prevent material transport.
	Indirect impacts upon flora and vegetation (access to surface or groundwater).	Project design to allow for natural water flows and prevent excessive pooling of surface water.

7 DISCUSSION

7.1 FLORA AND VEGETATION

The most significant impacts to flora and vegetation resulting from the proposed works are considered to be direct impacts from clearing. Clearing within the project footprint is anticipated to result in the loss of flora individuals and extent of existing vegetation. Clearing should therefore be minimised so far as practicable via considerate design. In particular, project design should avoid clearance of Banksia woodland TEC vegetation as this represents a MNES and areas of this vegetation are of excellent condition. Impacts to flora species at the population scale are not expected to be significant based on the availability of suitable surrounding habitat. No conservation-listed flora species were observed during the 2021 survey of the proposed impact area, thus there is low potential for direct impacts to species of conservation significance.

There is likely to be a low or negligible level of indirect impacts to vegetation, and low indirect impacts to conservation significant flora species at the population scale. The main factor expected to result in indirect impacts to flora and vegetation is the establishment or dispersal of exotic weeds. Other indirect impacts such edge effects, invasive weed burden and impacts upon connectivity are not likely to be greatly increased from current levels, particularly given the linear form of the assessment area and current degree of fragmentation. No significant impacts upon flora and vegetation are expected from changes to hydrology, erosion, or dust creation.

In all cases, cumulative impacts are challenging to assess. Consideration should be made with regards to cumulative impacts at the local and regional scales, including a proposed development at Lot 902 Flynn Drive Neerabup which proposes clearing of up to 14.02 ha of native vegetation similar to that of the project area. In general, clearance of flora and vegetation should be minimised as far as possible.

Assessment against the native vegetation clearing principles indicated that clearance of vegetation in the assessment area would be at variance or partial variance of principles (a), (b) and (d), relating to vegetation comprising high biological diversity, significant fauna habitat or TEC. The areas of vegetation most relevant to these principles are that of Banksia woodland immediately east of Pinjar Road, on the southern side of Flynn Drive.

It is recommended that weed control be implemented prior to, and throughout, the construction process. Prompt rehabilitation of construction areas, pre-existence disturbance areas and informal access pathways with locally appropriate and provenanced stock should also be undertaken to maintain ecological linkages and improve quality of preserved vegetation.

7.2 VERTEBRATE FAUNA

The majority of the fauna species observed or considered likely to occur in the assessment area are widespread and commonly occur within available habitat in surrounding areas, and are not expected to incur significant impacts at the species level from the proposed project works.

However, several conservation taxa known from, or with potential to occur in, the assessment area such as the Black-striped Snake, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo are likely to suffer greater impacts due to restricted range or reduced extent of critical habitat. For these species in particular, and thereby the overall biodiversity of the assessment area, impacts of clearing for proposed project works have potential to be high. Areas of high-quality Banksia woodland habitat immediately east of Pinjar Road and north of Flynn

Drive specifically constitute critical forage habitat for Black Cockatoo species and should be preserved as a priority.

Breeding habitat for Black Cockatoos within the assessment area was evaluated as being of very low quality, although a small number of trees recorded from the assessment area during field survey have potential to form suitable nesting hollows in the future and these should be maintained if possible. Prior to any clearing activity all tree hollows and potential nesting sites should be inspected, and construction should be timed outside of the nesting period to avoid disturbance of nesting birds.

To offset loss of habitat for the current faunal assemblage, rehabilitation works should be aimed at both maximising available cover and resources, as well as improving condition of retained remnant. Revegetation should also be implemented with aims to maintain connectivity of vegetation across the site, and incorporate revegetation of median roadway so as to provide additional safe refuge for animals moving through the landscape as far as possible. Any rehabilitation works should be implemented promptly on (or before) construction completion.

The greatest impacts to vertebrate fauna are predicted to be as a result of the direct clearing of quality and critical habitat for Endangered Black Cockatoo species. These constitute significant impacts to a MNES taxon.

8 CONCLUSIONS

Risk assessment of the proposed project activities against the Native Vegetation Clearing Principles indicates that clearance of vegetation would be at variance, or partial variance, with principles (a), (b) and (d) under the EP Act, with works not at variance with the remaining principles.

The environmental impact assessment relating to the proposed project indicates it has potential to cause significant impacts to several MNES including Endangered Black Cockatoo foraging and breeding habitat and an Endangered TEC, as well as a State-listed Endangered TEC. Additional impacts are possible with regards to potentially occurring Priority flora species, vegetation, habitat loss and fauna mortality, however, these impacts are not predicted to be significant.

It is recommended that the proposal be referred under the EPBC Act.

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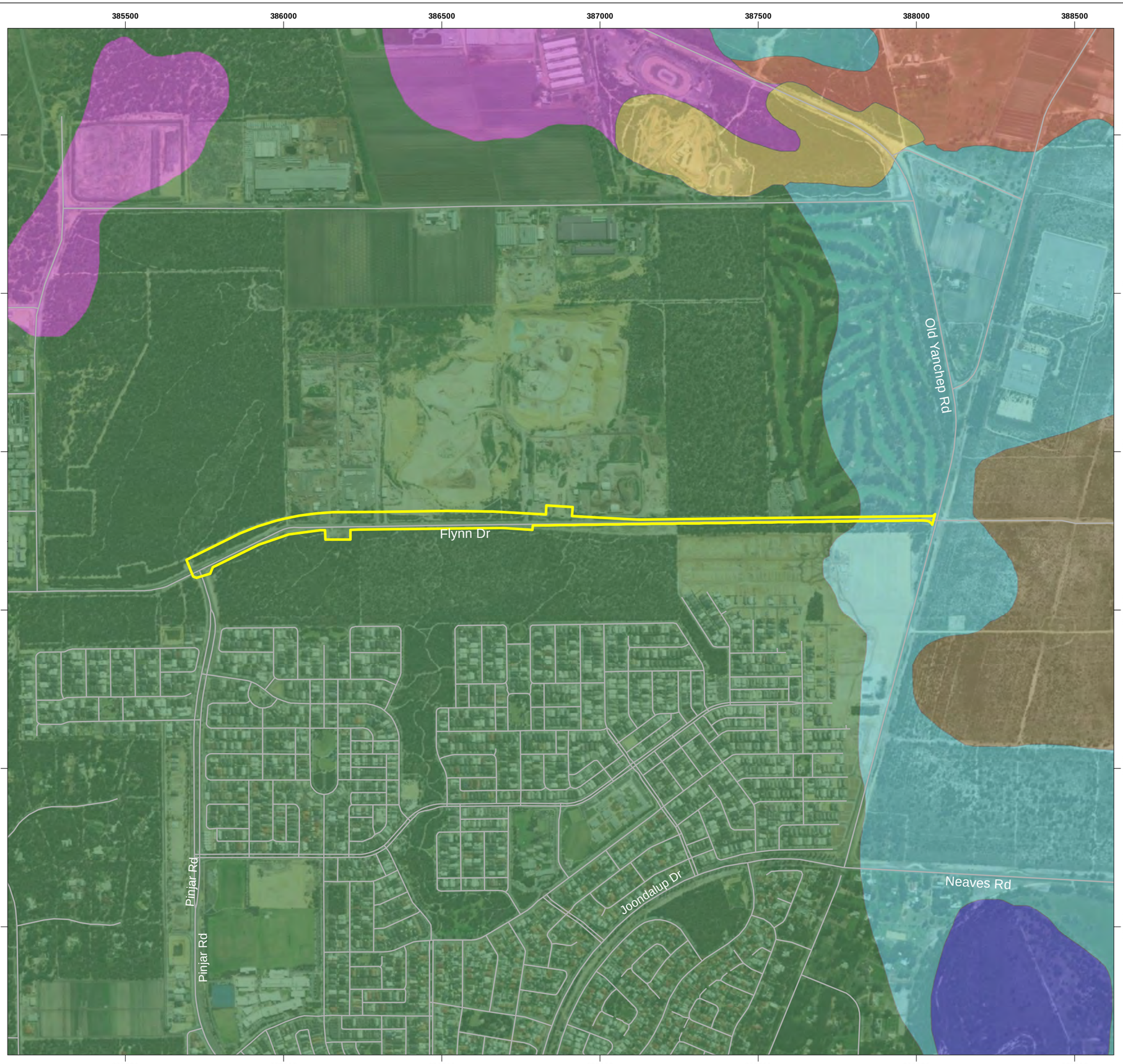
MAPS



LEGEND

- Assessment Area
- Roads

Land System

- 211Sp__Kg: Karrakatta Sand Grey Phase: Low hilly to gently undulating terrain. Iron podzols. Banksia spp woodland with E. todtiana and depauperate E. marginata; dense shrub layer.
- 211Sp__Ky: Karrakatta Sand Yellow Phase: Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m. Banksia spp. woodland with scattered emergent E. gomphocephala and E. marginata and a dense shrub layer.
- 212Bs__G: Bassendean, Gavin Phase: Flat or gently undulating landscape. Iron-humus podzols and some diatomite deposits. Banksia spp. Low open woodland with scattered emergent Eucalyptus calophylla and Melaleuca pressiana dense shrub layer.
- 212Bs__J: Bassendean, Joel Phase: Poorly drained depressions. Humus podzols. Scattered M. preissiana, E. rudis and Banksia ilicifolia with a dense shrub layer.
- 212Bs__Ja: Bassendean, Jandakot Phase: Jandakot low dunes. Slopes <10% and generally more than 5m relief. Grey sand over pale yellow sands generally underlain by humic and iron podsols; Banksia spp. low open woodland with a dense shrub layer.
- 212Bs__P: Bassendean, Pinjar Phase: Extensively flat swampy areas. Sandy surface sometimes with diatomite over organic hardpan below. E. rudis, B. littoralis and M. preissiana around the edges; sedges and reeds with scattered M. teretifolius in centre; Jacksonia furcellata.
- 212Bs__Ws: Bassendean seasonal swamps Phase: Depressions with free water in winter. Humus podzols and peat. Dense M. preissiana; M. rhaphiophylla and E. rudis around the edges with reeds and sedges in the centre.

DATASOURCES:
SOURCE DATA: SOIL LANDSCAPE MAPPING - BEST AVAILABLE (DPIRD-027)
AERIAL: ESRI BASEMAP (2019)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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SOIL LANDSCAPE MAPPING

FLYNN DRIVE (STAGE 2)
ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

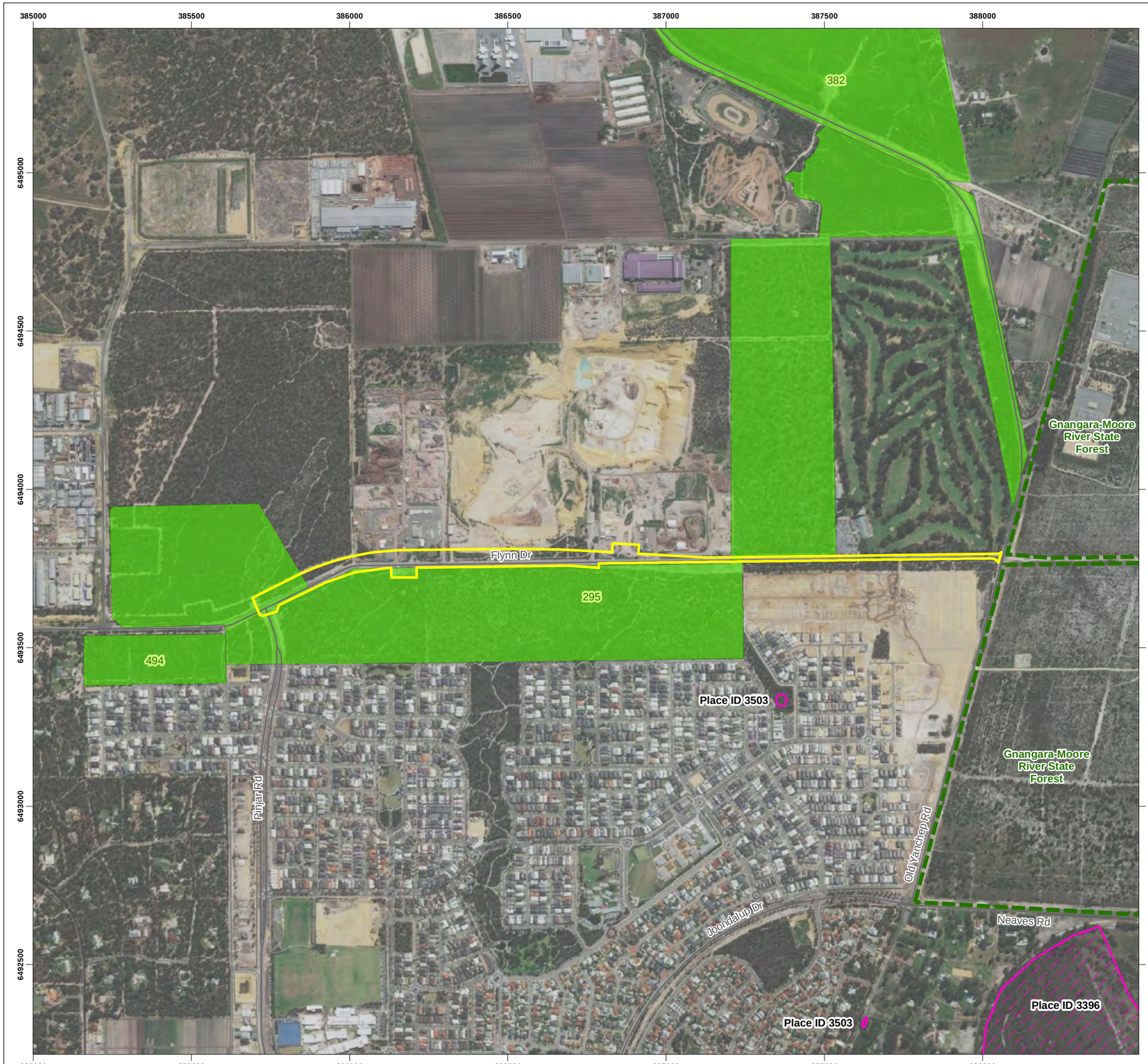
SCALE: 1:12,000 @ A3

0 0.1 0.2 0.3 0.4 0.5 km

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 1



LEGEND

- Assessment Area
- Roads
- Aboriginal Heritage Site
- Bush Forever Areas
- DBCA Legislated Lands and Waters

DATASOURCES:
SOURCE DATA: BUSH FOREVER AREAS (DPLH, 2000). ABORIGINAL HERITAGE (DPHL, 2021). HERITAGE COUNCIL WA (DPLH, 2021).
AERIAL: ESRI BASEMAP (2019)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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CONSERVATION AND HERITAGE

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:12,000 @ A3

0 0.1 0.2 0.3 0.4 0.5 km

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 2

385700 385800 385900 386000

6493800 6493700 6493600 6493500

Flynn Dr

Pinjar Rd

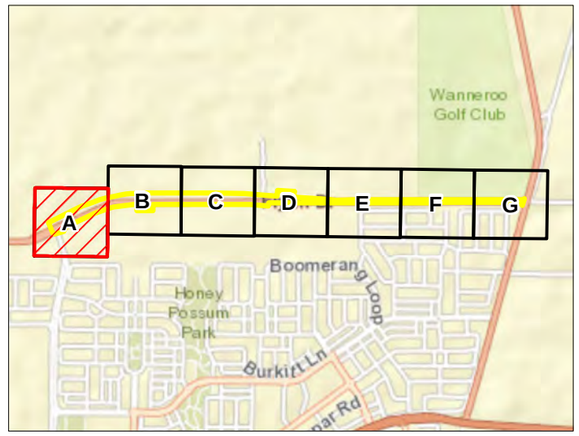
Pinjar Rd

LEGEND

- Assessment Area
- Roads
- Extent of Banksia Woodland TEC

Vegetation Unit

- **BAf** - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.
- Cleared/Not vegetated
- Revegetation



DATASOURCES :
AERIAL: NEARMAP (2021)
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

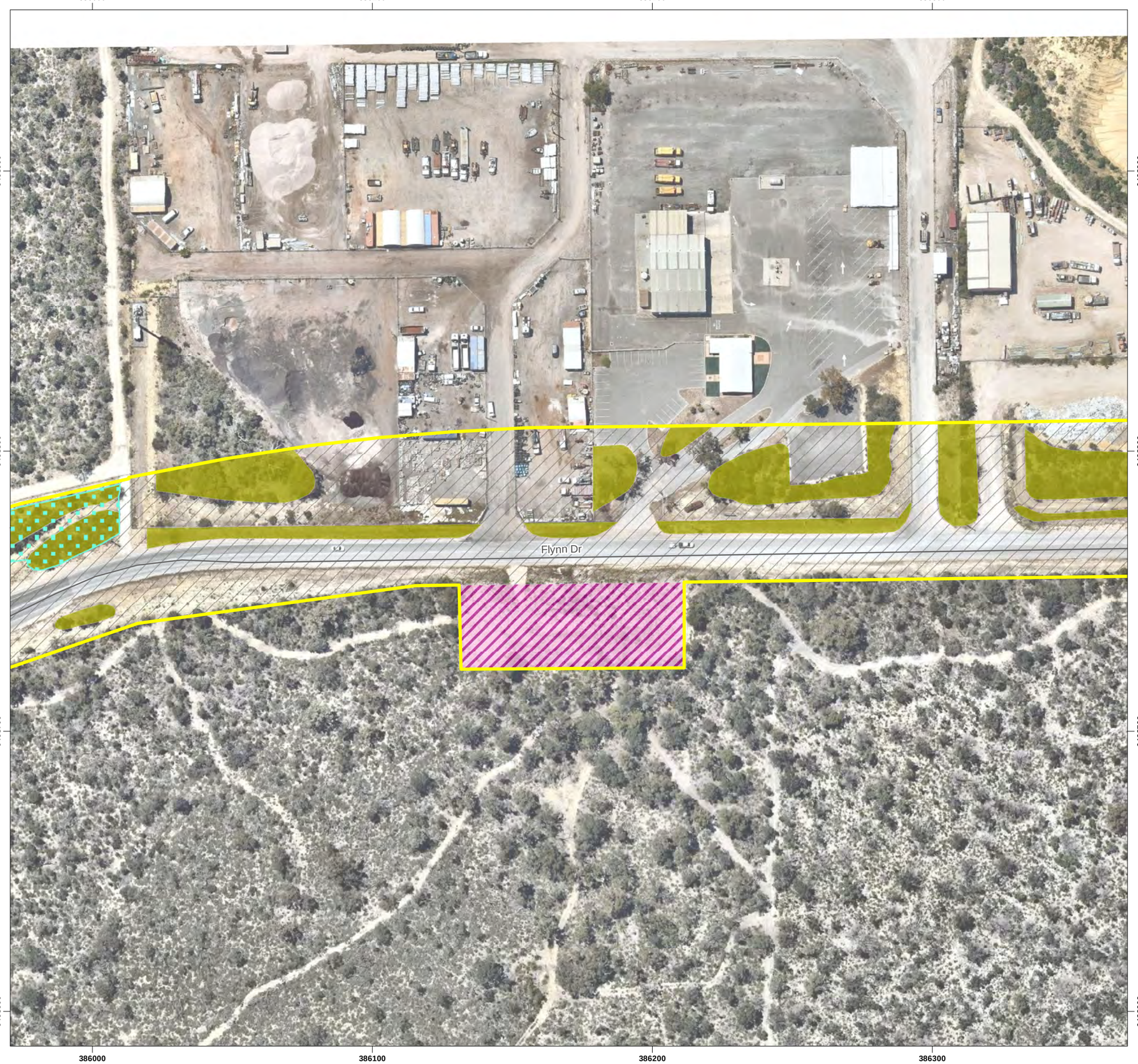
SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 3A

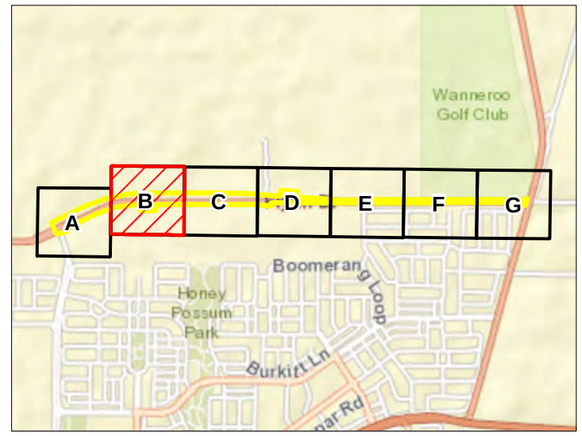


LEGEND

- Assessment Area
- Roads
- Extent of Banksia Woodland TEC

Vegetation Unit

- **BAf** - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.
- Cleared/Not vegetated
- Revegetation



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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

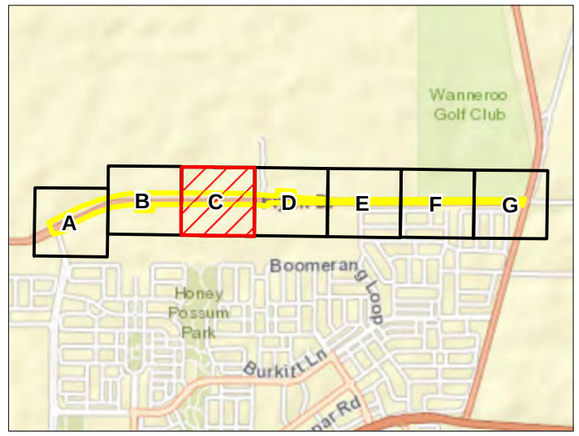
MAP 3B

LEGEND

- Assessment Area
- Roads

Vegetation Unit

- **BAf** - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.
- Cleared/Not vegetated



DATASOURCES:
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SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

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PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 3C

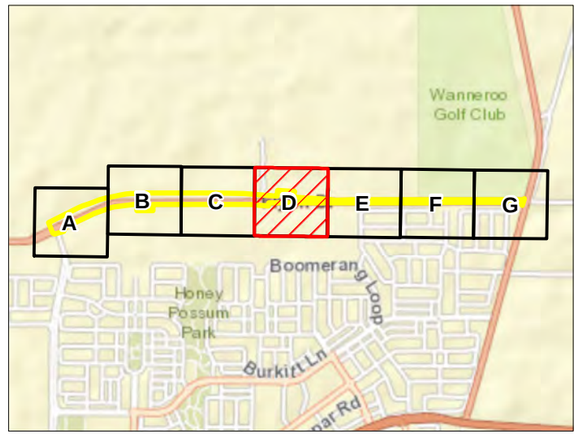
LEGEND

- Assessment Area
- Roads

Vegetation Unit

BAf - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.

Cleared/Not vegetated



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SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

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PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 3D

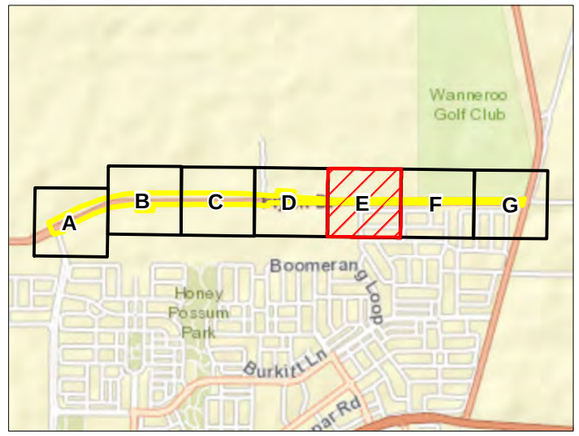
LEGEND

- Assessment Area
- Roads

Vegetation Unit

BAf - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.

Cleared/Not vegetated



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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

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DATUM: GDA 1994
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N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

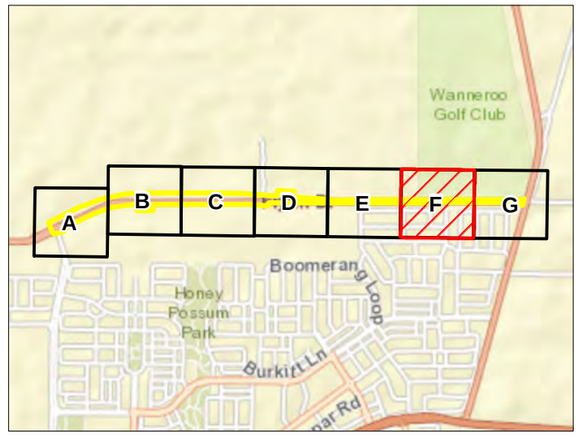
MAP 3E

LEGEND

- Assessment Area
- Roads

Vegetation Unit

- **BAf** - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.
- Cleared/Not vegetated



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SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

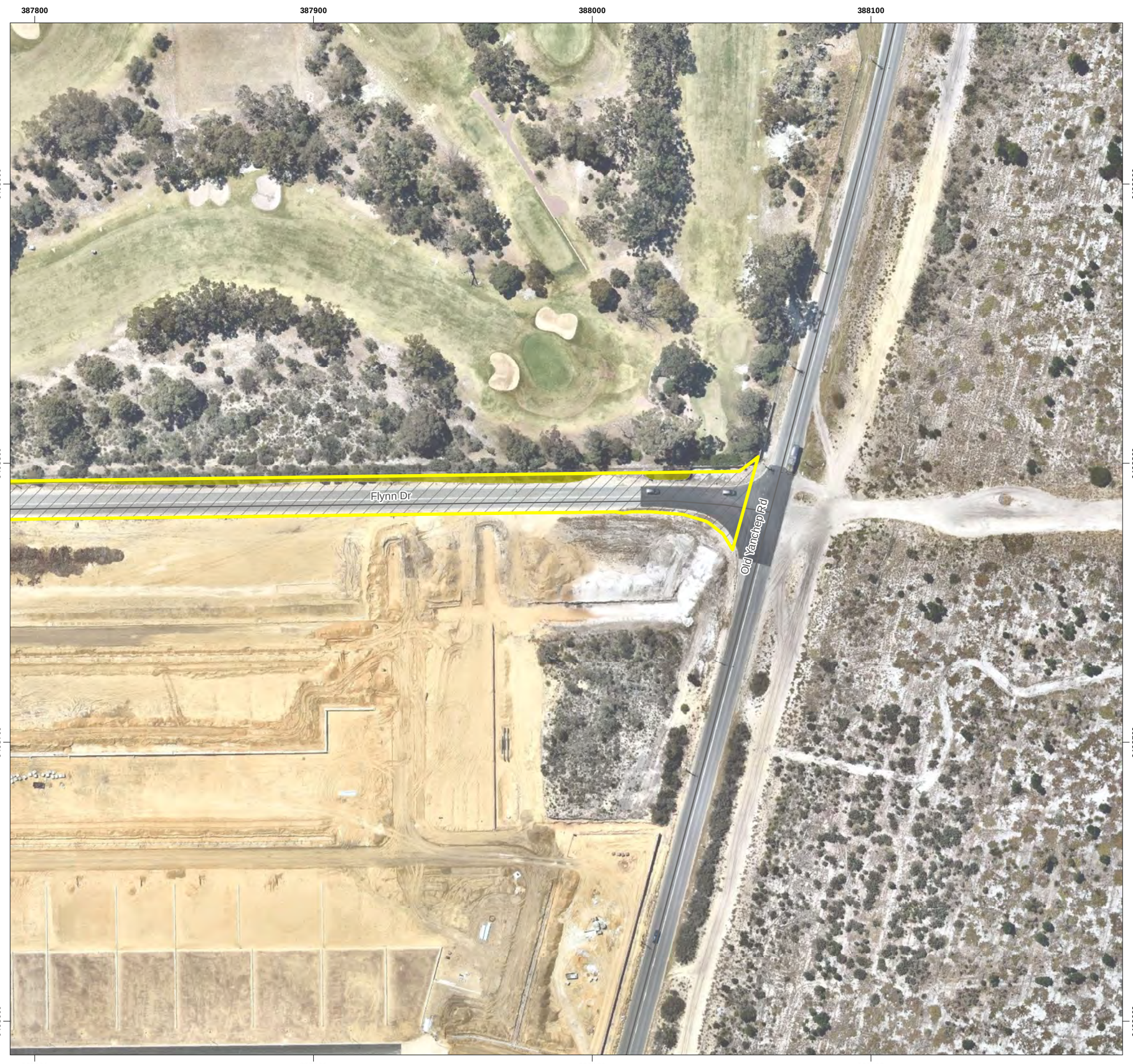
SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 3F



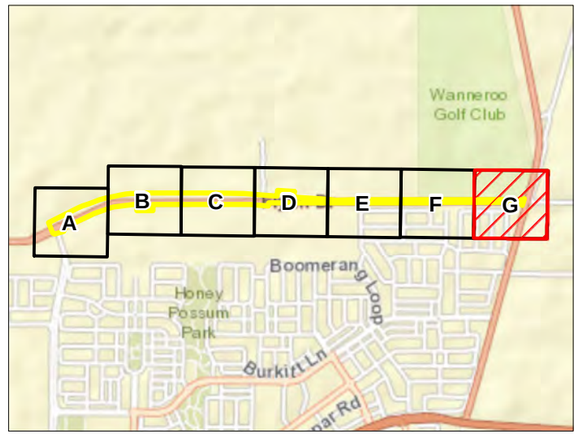
LEGEND

- Assessment Area
- Roads

Vegetation Unit

BAf - *Banksia* spp. and *Allocasuarina fraseriana* low open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Hibbertia hypericoides* and *Mesomelaena pseudostygia* low open shrubland/sedgeland.

Cleared/Not vegetated



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SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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VEGETATION UNITS AND SIGNIFICANT VEGETATION

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 3G

LEGEND

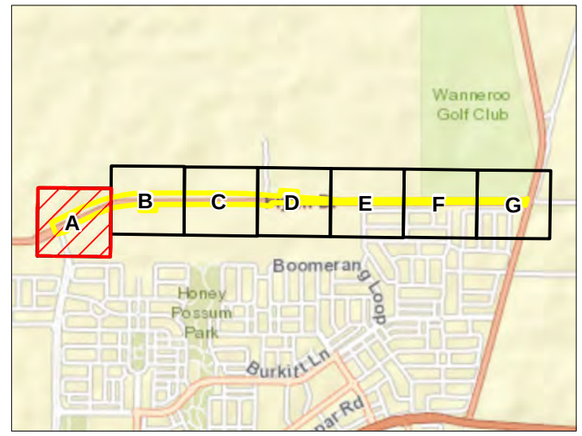
- Assessment Area
- Roads

Conservation Significant Fauna

- *Calyptorhynchus latirostris* (Endangered)
- *Isoodon fusciventer* (Priority 4)
- *Merops ornatus* (Marine Migratory Species)

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated
- Revegetation



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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 4A

386000 386100 386200 386300

6493900 6493800 6493700 6493600

2

Flynn Dr

LEGEND

- Assessment Area
- Roads

Habitat Tree

Eucalyptus marginata

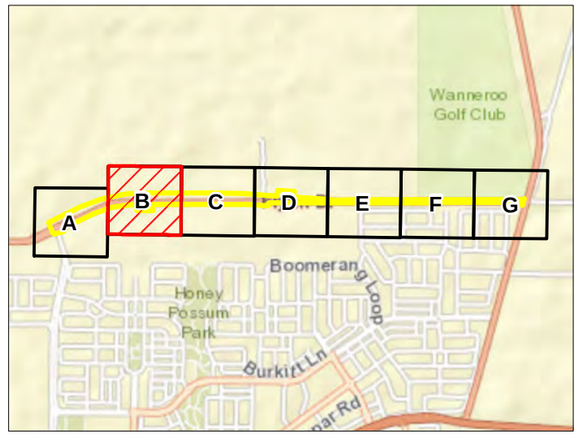
- Class 3

Conservation Significant Fauna

- *Calyptorhynchus latirostris* (Endangered)

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated
- Revegetation



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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 4B

386400 386500 386600 386700

6493900 6493800 6493700 6493600

LEGEND

- Assessment Area
- Roads

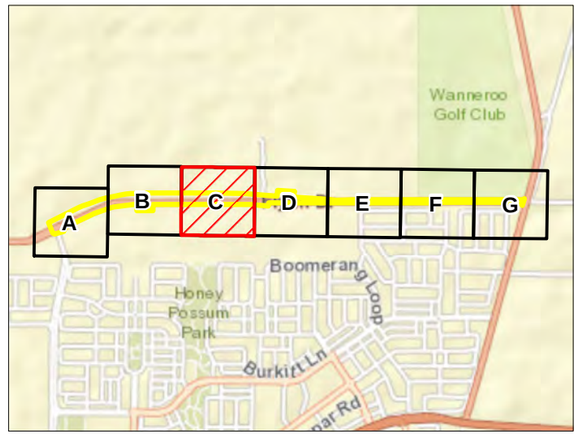
Habitat Tree

Eucalyptus marginata

- Class 4

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated



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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 4C

386700 386800 386900 387000

6493900 6493800 6493700 6493600

3

Flynn Dr

LEGEND

- Assessment Area
- Roads

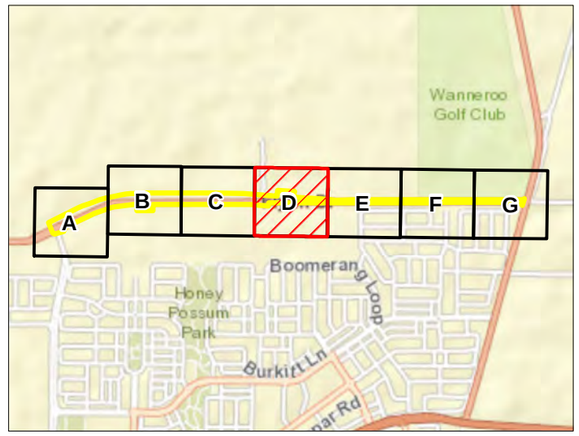
Habitat Tree

Eucalyptus marginata

- Class 5

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated



DATASOURCES:
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SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

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N

SCALE: 1:1,370 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 4D

LEGEND

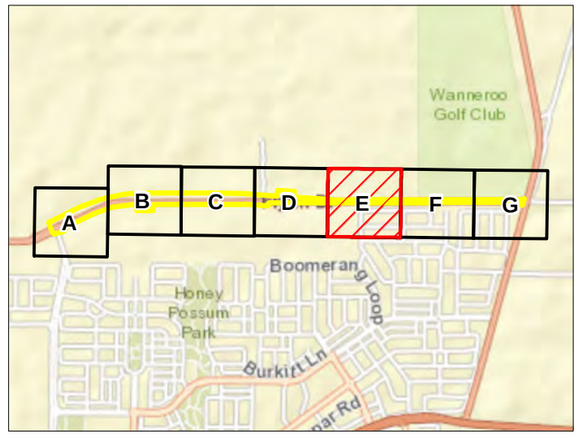
- Assessment Area
- Roads

Conservation Significant Fauna

- *Isoodon fusciventer* (Priority 4)

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated



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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

City of Wanneroo

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0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

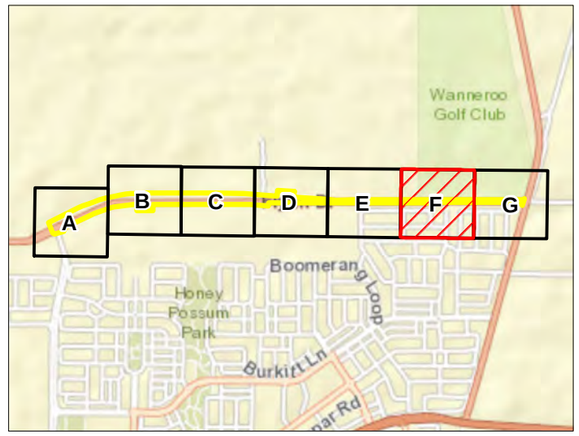
MAP 4E

LEGEND

- Assessment Area
- Roads

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated



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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

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0 10 20 30 40 50 m

PROJECT NO: 4665-21

REV	AUTHOR	APPROVED	DATE
00	NW	SB	27/01/2022

MAP 4F

387800 387900 388000 388100

6493900 6493800 6493700 6493600

Flynn Dr

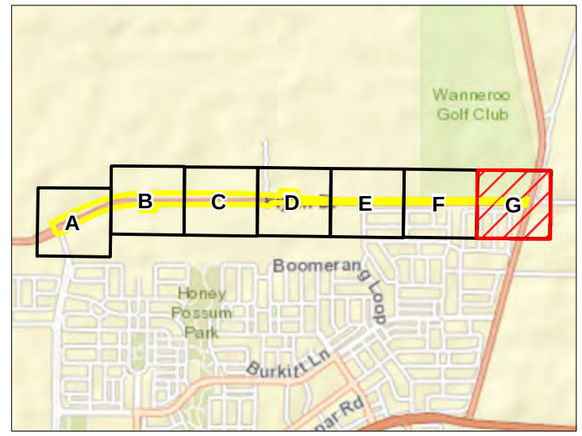
Old Yanchep Rd

LEGEND

- Assessment Area
- Roads

Habitat Unit

- Banksia Woodland
- Cleared/Not vegetated



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FAUNA HABITAT, CS FAUNA AND BC TREE LOCATIONS

FLYNN DRIVE (STAGE 2) ENVIRONMENTAL IMPACT ASSESSMENT

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MAP 4G

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 13: Conservation codes for Western Australian flora and fauna (DBCA 2019c)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
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 *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species 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 25of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Conservation Codes for Western Australian Flora and Fauna	
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**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.
2	**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.
3	**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.

Conservation Codes for Western Australian Flora and Fauna	
4	**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.
[1] The definition of flora includes algae, fungi and lichens. [2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).	

Table 14: EPBC Act categories for flora, fauna and ecological communities

Category	Threatened species	Threatened Ecological Communities
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.	n/a
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.	n/a
Critically Endangered (CE)	A native species is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria
Endangered (EN)	A native species is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.	n/a

Table 15: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

Criteria	Definition
	A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority ecological communities	
Priority One	*Poorly known ecological communities* Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	*Poorly known ecological communities* Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are

Criteria	Definition
	comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	*Poorly known ecological communities* i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or; ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
Priority Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. i. Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	*Conservation Dependent Ecological Communities* Ecological Communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table 16: NVIS structural terminology, terrestrial vegetation (NVIS Technical Working Group; DotEE 2017)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	Height Ranges (m)	Structural Formation Classes						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 17: NVIS height classes (NVIS Technical Working Group; DotEE 2017)

Height		Growth form				
Height Class	Height Range (m)	Tree, vine (M & U), palm (single-stemmed)	Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)	Tree mallee, mallee shrub	Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)	Bryophyte, lichen, seagrass, aquatic
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low

Source: (based on Walker & Hopkins 1990)

Table 18: Vegetation condition scale for the South West and Interzone Botanical Provinces (EPA 2016c)

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

Table 19: Grading system for the assessment of potential nest trees for Black Cockatoos (Bamford 2016)

Class	Description of tree and hollows/activity
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows but hollows or potential hollows are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black Cockatoos.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

Table 20: Commonwealth Black Cockatoo foraging quality scoring tool (Commonwealth of Australia 2017)

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for Forest Red-tailed Black cockatoo
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA	Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under a RFA	Jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. Does not include areas under a RFA
5 (Quality)	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts
1 (Low quality)	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants
Additions	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**
+3	Is within the Swan Coastal Plain (important foraging area).	Is within the known foraging area (see map).	Jarrah and/or marri show good recruitment (i.e. evidence of young trees).
+3	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for Forest Red-tailed Black cockatoo
+2	Primarily contains marri	Primarily contains marri	Primarily contains marri and/or jarrah
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)
+1	Is known to be a roosting site	Is known to be a roosting site	Is known to be a roosting site
Subtractions	**Context adjustor - attributes reducing functionality of foraging habitat**	**Context adjustor - attributes reducing functionality of foraging habitat**	**Context adjustor - attributes reducing functionality of foraging habitat**
-2	No clear evidence of feeding debris	No clear evidence of feeding debris	No clear evidence of feeding debris
-2	No other foraging habitat within 6 km	No other foraging habitat within 6 km	No other foraging habitat within 6 km
-1	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location
-1	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site
-1	Is > 2 km from a watering point	Is > 2 km from a watering point	Is > 2 km from a watering point
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)

APPENDIX TWO TEC ASSESSMENT CRITERIA

BANKSIA WOODLANDS TEC

The criteria outlined in the Approved Conservation Advice for the *Banksia Woodlands of the Swan Coastal Plain* TEC (TSSC 2016) was used to determine if the TEC occurs, as below.

The key characteristics for vegetation to be included in this TEC are that:

- it occurs on the Swan Coastal Plain IBRA region, including the Dandaragan Plateau and adjacent to the Jarrah Forest IBRA region on the lower parts of the Darling and Whicher escarpments
- it generally occurs on low-nutrient sandy substrates, including sandy colluvium and aeolean sands although may occur occasionally on other substrates (usually on the Bassendean and Spearwood sands)
- the structure is typically low woodland or forest with a distinct upper stratum of low trees dominated or co-dominated by one or more of four characteristic Banksia species (Banksia attenuata, B. menziesii, B. prionotes, B. ilicifolia) although emergent trees are sometimes present but cannot be the dominant stratum
- the understorey is typically a highly diverse shrub and herb layer
- it meets the thresholds in the table that follows (with vegetation type mapping extrapolated outside the assessment area to be included in the extent calculations).

Table 21: Condition categories and thresholds for inclusion in the Banksia Woodlands TEC (TSSC 2016)

Condition Threshold	Indicative Condition Measures (Typical)		Minimum Patch Size
	Native Vegetation Composition[1]	Weed Cover	
Pristine	Native plant species diversity	Native plant species diversity	No minimum
Excellent	High native plant species	High native plant species	0.5 ha / 5,000 m^2
Very Good	Moderate native plant species	Moderate native plant species	1 ha / 10,000 m^2
Good	Low native plant species	Low native plant species	2 ha / 20,000 m^2
Degraded	Very low native plant species	Very low native plant species	Not representative
Completely Degraded	Very low to no native species	Very low to no native species	Not representative

[1] Relative to expected natural range of diversity for that vegetation (e.g. Floristic Community Type; FCT), where comparative data exists.

Whilst FCTs, as defined in Gibson *et al.* (1994) can be used as a guide they do not necessarily define all vegetation that may be included in the TEC. Vegetation defined by Gibson *et al.* FCTs may be listed as TECs in Western Australia or as Priority Ecological Communities (PECs) by DBCA (combined into the EPBC-listed *Banksia Woodlands of the Swan Coastal Plain* TEC). Some Banksia woodlands on the eastern side of the Swan Coastal Plain (FCT 20 group) are not included in this TEC and have different conservation listings; these Banksia woodland types are not subject to the same thresholds as above to be considered representative of the relevant TEC or PEC.

APPENDIX THREE BIOREGIONAL VERTEBRATE FAUNAL ASSEMBLAGE

Table 22: Faunal assemblage of the area based on previous local surveys

Family	Scientific Name	Common Name	Cons Code	Naturalised	Ecoscape 2021	EcoLogical 2012	GHD 2014	NatureMap 5km 25yr
Acanthizidae	*Acanthiza apicalis*	Broad-tailed Thornbill, Inland Thornbill						x
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill					x	x
	Acanthiza inornata	Western Thornbill					x	x
	Gerygone fusca	Western Gerygone					x	x
	Sericornis frontalis	White-browed Scrubwren					x	x
	Smicrornis brevirostris	Weebill					x	x
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk						x
	Accipiter fasciatus	Brown Goshawk				x	x	x
	Accipiter fasciatus subsp. *fasciatus*	Brown Goshawk						x
	Aquila audax	Wedge-tailed Eagle					x	x
	Circus approximans	Swamp Harrier						x
	Elanus axillaris							x
	Haliastur sphenurus	Whistling Kite					x	x
	Hieraaetus morphnoides	Little Eagle						x
	Hamirostra isura	Square-tailed Kite				x		x
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar					x	x
Agamidae	*Ctenophorus adelaidensis*	Western Heath Dragon						x
	Pogona minor	Dwarf Bearded Dragon					x	x
	Pogona minor subsp. minor	Dwarf Bearded Dragon				x		x
Anatidae	*Anas gracilis*	Grey Teal						x
	Anas rhynchotis	Australasian Shoveler						x
	Anas superciliosa	Pacific Black Duck						x
	Aythya australis	Hardhead						x
	Biziura lobata	Musk Duck						x
	Chenonetta jubata	Australian Wood Duck, Wood Duck						x

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	Cygnus atratus	Black Swan						x
	Oxyura australis	Blue-billed Duck	P4					x
	Tadorna tadornoides	Australian Shelduck, Mountain Duck						x
Anhingidae	*Anhinga novaehollandiae*	Australasian Darter						x
Apodidae	*Apus pacificus*	Fork-tailed Swift, Pacific Swift	IA					x
Ardeidae	*Ardea modesta*	Great Egret, White Egret						x
	Ardea pacifica	White-necked Heron						x
	Egretta garzetta	Little Egret						x
	Egretta novaehollandiae	White-faced Heron						x
	Nycticorax caledonicus	Rufous Night Heron						x
Artamidae	*Artamus cinereus*	Black-faced Woodswallow						x
	Artamus cyanopterus	Dusky Woodswallow						x
Cacatuidae	*Cacatua pastinator*	Western Long-billed Corella						x
	Cacatua roseicapilla	Galah			x	x	x	x
	Cacatua sanguinea	Little Corella			x	x	x	x
	Cacatua sanguinea subsp. *westralensis*	Little Corella						x
	**Cacatua tenuirostris*	Eastern Long-billed Corella		*				x
	Calyptorhynchus banksii	Red-tailed Black- Cockatoo						x
	Calyptorhynchus baudinii	Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo	T					x
	Calyptorhynchus latirostris	Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo	T		x	x	x	x
	Calyptorhynchus sp. white-tailed	black cockatoo	T					x
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike				x	x	x
	Lalage tricolor	White-winged Triller					x	x
Canidae	**Canis familiaris* subsp. *familiaris*	Dog			x		x	
	**Vulpes vulpes*	Red Fox		*		x	x	x
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar				x	x	x
Casuariidae	*Dromaius novaehollandiae*	Emu					x	x

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Columbidae	**Columba livia*	Domestic Pigeon		*			x	x
	Ocyphaps lophotes	Crested Pigeon					x	x
	Phaps chalcoptera	Common Bronzewing				x	x	x
	**Streptopelia chinensis*	Spotted Turtle- Dove		*	x			x
	**Streptopelia senegalensis*	Laughing Turtle- Dove		*		x		x
Corvidae	*Corvus coronoides*	Australian Raven			x	x	x	x
	Corvus coronoides subsp. *perplexus*	Australian Raven						x
Cracticidae	*Cracticus nigrogularis*	Pied Butcherbird						x
	Cracticus tibicen	Australian Magpie			x		x	x
	Cracticus tibicen subsp. *dorsalis*	White-backed Magpie				x		x
	Cracticus torquatus	Grey Butcherbird				x	x	x
	Cracticus torquatus subsp. *torquatus*	Grey Butcherbird						x
	Strepera versicolor	Grey Currawong					x	x
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo					x	x
	Cacomantis pallidus	Pallid Cuckoo						x
	Chrysococcyx basalis	Horsfield's Bronze Cuckoo					x	x
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird						x
Diplodactylidae	*Crenadactylus ocellatus*	South-western Clawless Gecko				x		x
	Strophurus spinigerus						x	x
	Strophurus spinigerus subsp. *inornatus*							x
	Strophurus spinigerus subsp. *spinigerus*							x
Elapidae	*Brachyurophis semifasciatus*	Southern Shovel-nosed Snake					x	x
	Demansia psammophis	Yellow-faced Whipsnake				x		
	Demansia psammophis subsp. *reticulata*	Yellow-faced Whipsnake						x
	Echiopsis curta	Bardick						x
	Pseudonaja affinis	Dugite					x	x
	Pseudonaja affinis subsp. *affinis*	Dugite				x		x

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	Simoselaps bertholdi	Jan's Banded Snake					x	x
Falconidae	*Falco berigora*	Brown Falcon						x
	Falco cenchroides	Australian Kestrel, Nankeen Kestrel				x		x
	Falco longipennis	Australian Hobby					x	x
	Falco peregrinus	Peregrine Falcon	S					x
Felidae	**Felis catus*	Cat		*		x	x	x
Gekkonidae	*Christinus marmoratus*	Marbled Gecko				x	x	x
Halcyonidae	**Dacelo novaeguineae*	Laughing Kookaburra		*		x	x	x
	Todiramphus sanctus	Sacred Kingfisher					x	x
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow						x
	Hirundo neoxena	Welcome Swallow				x	x	x
	Petrochelidon nigricans	Tree Martin			x		x	x
Laridae	*Larus novaehollandiae*	Silver Gull						x
	Sterna caspia	Caspian Tern	IA					x
Leporidae	**Oryctolagus cuniculus*	Rabbit		*	x	x	x	x
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog						x
	Limnodynastes dorsalis	Western Banjo Frog				x		x
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo			x	x	x	x
	Notamacropus irma	Western Brush Wallaby	P4			x		x
Maluridae	*Malurus lamberti*	Variegated Fairy-wren						x
	Malurus splendens	Splendid Fairy-wren				x	x	x
	Malurus splendens subsp. *splendens*	Splendid Fairy-wren						x
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater						x
	Acanthorhynchus superciliosus	Western Spinebill						x
	Anthochaera carunculata	Red Wattlebird			x	x	x	x
	Anthochaera lunulata	Western Little Wattlebird				x	x	x
	Gavicalis virescens	Singing Honeyeater			x	x	x	
	Gliciphila melanops	Tawny-crowned Honeyeater						x

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	Lichenostomus leucotis	White-eared Honeyeater						x
	Lichmera indistincta	Brown Honeyeater			x	x	x	x
	Manorina flavigula	Yellow-throated Miner						x
	Melithreptus brevirostris	Brown-headed Honeyeater					x	x
	Phylidonyris niger	White-cheeked Honeyeater					x	x
	Phylidonyris novaehollandiae	New Holland Honeyeater			x	x		x
Meropidae	*Merops ornatus*	Rainbow Bee-eater				x	x	x
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat				x	x	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark				x	x	x
	Myiagra inquieta	Restless Flycatcher						x
Muridae	*Hydromys chrysogaster*	Water-rat, Rakali	P4					x
	**Mus musculus*	House Mouse		*		x	x	x
	**Rattus rattus*	Black Rat		*	x		x	x
Myobatrachidae	*Crinia insignifera*	Squelching Froglet						x
	Myobatrachus gouldii	Turtle Frog					x	x
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella					x	x
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush				x	x	x
	Colluricincla harmonica subsp. *rufiventris*	Grey Shrike-thrush						x
	Pachycephala pectoralis	Golden Whistler			x		x	
	Pachycephala rufiventris	Rufous Whistler				x	x	x
	Pachycephala rufiventris subsp. *rufiventris*	Rufous Whistler						x
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote						x
	Pardalotus striatus	Striated Pardalote				x	x	x
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican						x
Peramelidae	*Isoodon fusciventer*	Quenda, southwestern brown bandicoot	P4				x	x
Petroicidae	*Eopsaltria australis* subsp. *griseogularis*	Western Yellow Robin					x	x

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	Microeca fascinans	Jacky Winter					x	x
	Petroica boodang	Scarlet Robin				x	x	x
	Petroica goodenovii	Red-capped Robin				x		
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant						x
	Phalacrocorax sulcirostris	Little Black Cormorant						x
	Phalacrocorax varius	Pied Cormorant						x
Phalangeridae	*Trichosurus vulpecula hypoleucus*	Common Brushtail Possum					x	x
Phasianidae	*Coturnix ypsilophora*	Brown Quail					x	x
Podargidae	*Podargus strigoides*	Tawny Frogmouth				x	x	x
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe						x
	Poliocephalus poliocephalus	Hoary-headed Grebe						x
	Tachybaptus novaehollandiae	Australasian Grebe, Black-throated Grebe						x
Psittacidae	*Neophema elegans*	Elegant Parrot				x		x
	Parvipsitta porphyrocephala	Purple-crowned Lorikeet					x	
	Platycercus icterotis	Western Rosella						x
	Platycercus spurius	Red-capped Parrot					x	x
	Platycercus zonarius	Australian Ringneck, Ring-necked Parrot			x	x	x	x
	Platycercus zonarius subsp. *semitorquatus*	Twenty-eight Parrot						x
	Polytelis anthopeplus	Regent Parrot						x
	**Trichoglossus haematodus*	Rainbow Lorikeet		*		x	x	x
Pygopodidae	*Aprasia repens*	Sand-plain Worm-lizard					x	x
	Delma fraseri	Fraser's Legless Lizard						x
	Delma grayii	Gray's Legless Lizard						x
	Lialis burtonis	Burton's Legless Lizard				x	x	x
	Pletholax gracilis subsp. *gracilis*	Keeled Legless Lizard						x
	Pygopus lepidopodus	Common Scaly Foot				x		x
Pythonidae	*Morelia spilota*	Carpet Python					x	

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	Morelia spilota subsp. *imbricata*	Carpet Python				x		x
Rallidae	*Fulica atra*	Eurasian Coot						x
	Gallinula tenebrosa	Dusky Moorhen						x
	Porphyrio porphyrio	Purple Swamphen						x
	Porzana tabuensis	Spotless Crake						x
Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt						x
	Himantopus himantopus	Black-winged Stilt						x
	Recurvirostra novaehollandiae	Red-necked Avocet						x
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail				x	x	x
	Rhipidura leucophrys	Willie Wagtail			x		x	x
Scincidae	*Acritoscincus trilineatus*	Western Three-lined Skink						x
	Cryptoblepharus buchananii					x	x	x
	Ctenotus australis	Western Limestone Ctenotus					x	x
	Ctenotus fallens	West Coast Ctenotus				x	x	x
	Cyclodomorphus celatus	Western Slender Blue-tongue						x
	Hemiergis quadrilineata					x	x	x
	Lerista distinguenda						x	x
	Lerista elegans						x	x
	Lerista praepedita					x	x	x
	Menetia greyii						x	x
	Morethia lineoocellata						x	x
	Morethia obscura					x	x	x
	Tiliqua occipitalis	Western Bluetongue					x	x
	Tiliqua rugosa	Bobtail, Shingleback Lizard			x	x	x	x
	Tiliqua rugosa subsp. *aspera*							x
	Tiliqua rugosa subsp. *rugosa*				x			x
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	IA					x
Strigidae	*Ninox boobook* subsp. *Boobook*	Southern Boobook Owl				x	x	

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Sylviidae	*Acrocephalus australis*	Australian Reed Warbler						x
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna					x	x
Tarsipedidae	*Tarsipes rostratus*	Honey Possum, Noolbenger						x
Theridiidae	*Latrodectus hasselti*	Redback Spider						x
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill						x
	Plegadis falcinellus	Glossy Ibis	IA					x
	Threskiornis spinicollis	Straw-necked Ibis						x
	Threskiornis molucca	Australian White Ibis			x	x		
Typhlopidae	*Anilios australis*	Southern Blind Snake				x	x	
	Anilios pinguis	Rotund Blind Snake					x	
	Anilios waitii	Beaked Blind Snake					x	
Tytonidae	*Tyto alba*	Barn Owl					x	x
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor					x	x
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat				x	x	x
	Nyctophilus geoffroyi	Lesser Long-eared Bat					x	x
Zosteropidae	*Zosterops lateralis*	Grey-breasted White-eye, Silvereye			x	x	x	x